# Stormwater Master Plan
# Poultney River Watershed
# Featuring Projects in Benson, Fair Haven, Middletown Springs, Poultney, and West Haven, Vermont

**March 15, 2022**

Flooding in Poultney, VT
April 15, 2019


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## 1.0 Introduction

The Poultney River Watershed makes up the northern half of the Vermont South Lake Watershed draining to South Lake B of Lake Champlain. The towns in the headwaters of the Poultney River include Tinmouth, Middletown Springs, and Poultney, while the lower elevation towns closer to Lake Champlain include Fair Haven, Benson, and West Haven (Figure 1). Similar to the rest of the South Lake Watershed, the Poultney River Watershed has experienced repeated, severe flooding over the past ten years. Tropical Storm Irene damaged many roads and significantly altered morphology of headwater tributaries in the area. Notable floods on July 3, 2016, July 1, 2017, January 20, 2019, and April 15, 2019, each had severe road erosion, flooding, and water quality consequences in the Poultney River Watershed, with damage in some parts of the watershed, specifically areas in Poultney and Castleton, rivaling that during Tropical Storm Irene. The Castleton River watershed, while a subwatershed within the larger Poultney River watershed was not included in this study (please refer to the Castleton River Headwaters Stormwater Master Plan and the Lake Bomoseen SWMP for projects identified in the Castleton River Watershed).

Water quality concerns in the Poultney River Watershed tend to follow along the traditional sectors, with streambank erosion in the steep, forested headwaters, runoff from agricultural land uses in the hills and valleys, and stormwater from developed lands and roads throughout. Pressures include significant development along local inland lakes, but relatively slow growth of the small towns in the watershed. Local mapping efforts performed by Rutland RPC show that approximately 17 percent of municipal roads, many unpaved, do not meet State Standards under the Municipal Roads General Permit. Local water quality data repeatedly measures high concentrations of sediment and *E. coli* bacteria during runoff events throughout the watershed.

While there are not as many conserved agricultural lands in the Poultney Watershed as there are in the neighboring Mettowee Watershed, a private entity is purchasing large tracts of forested lands in Poultney and Middletown Springs to create mountain bike and hiking trails, essentially conserving that land from all but very low-level development. In 2019 the Poultney Mettowee Natural Resources Conservation District (PMNRCD) received grant funding from the Vermont Agency of Natural Resources (VTANR) Ecosystem Restoration Program to carry out stormwater master planning and efforts in the Poultney River watershed. PMNRCD hired Fitzgerald Environmental Associates (FEA) in the fall of 2019 to assist with the development of the Stormwater Master Plan (SWMP) for the watershed. The SWMP follows the VTANR SWMP guidelines and was developed over the course of 2020 and 2021 through extensive field work, interaction with multiple stakeholders within the study area to prioritize projects, and follow-up analysis and design work.

### 1.1 Stormwater Master Planning

Stormwater runoff is generated any time rain or melting snow/ice runs off the land; stormwater runoff typically increases when the land use has been altered from its natural state. Typically, hardened surfaces such as rooftops and roads are the primary sources of stormwater runoff, however in a rural setting it is important to consider hayfields, pasture, and other developed or agricultural areas that may increase and concentrate runoff. Increased stormwater runoff leads to higher magnitude flood flows and greater erosive power in stream channels, increased delivery of sediment, nutrients, and other pollutants to waterways, and increased flooding conflicts with improved properties downstream. The network of roads, ditches, and culverts that are found in steep, rural settings are important for conveying stormwater and protecting infrastructure. However, these systems concentrate runoff, reduce infiltration, and may lead to areas of erosion and sediment generation. Increased stormwater runoff is directly linked to the quality of water in the streams, rivers, ponds, and lakes that we depend on for drinking water, healthy fisheries, and recreation.

The stormwater master planning process is used to identify current stormwater inputs to surface waters. The relative impact from each of these inputs is calculated and the ranked projects can then be prioritized with feedback from local stakeholders who are familiar with both the storm-related problems and the capacity and resources available to assist in their mitigation. The Wells Brook / Lake St Catherine Stormwater Master Plan was developed with public involvement and comment and is as comprehensive as possible in listing all known problems. The plan is based on a prioritized list of projects and a strategic approach and is potentially more likely to succeed than a reactionary approach that addresses problems as they arise.

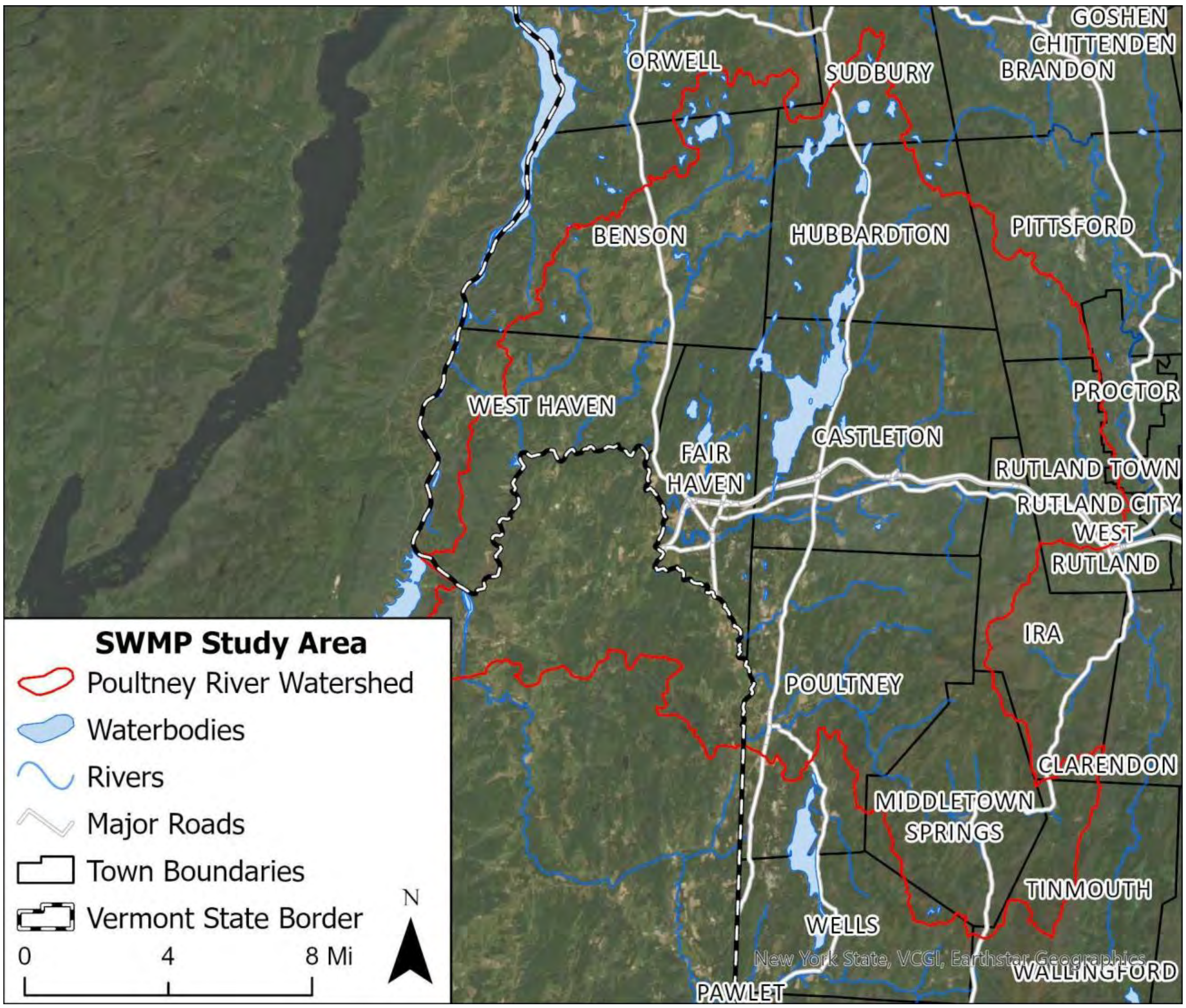


**Figure 1:** Stormwater master plan study area

### 1.2 Project Goals

The goal of this project was to evaluate approximately 167,680 acres (262 mi^2 (streamstats 2022, measured from the Bay St Bridge) within the Poultney River Watershed (a subwatershed within the South Lake (Poultney and Mettawee) USGS HUC8) with a specific focus on the 112,302 acres within the Poultney River Watershed, but excluding the Castleton River Watershed (55,378 acres; FEA/PMNRCD, 2016 and 2018) to identify sources of increased stormwater runoff and associated sediments and nutrients (Figure 1). Phosphorus reducing projects are of particular importance given the water quality concerns within the South Lake watershed. The work involved identifying sources of stormwater, prioritizing sources based on Vermont's Unified Stormwater Prioritization Matrix developed by VTDEC 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 (see maps in Appendix C).

Specific project tasks and deliverables included: 1) identify, evaluate, and prioritize stormwater problem areas throughout the watershed; 2) develop one-page project summary sheets (including BMP concepts) for the top 20 project areas; 3) develop conceptual designs (30% level of completion) for ten (10) high priority project areas; and 4) produce a final report summarizing the assessment and design work.

## 2.0 Study Area Description

The Poultney River Watershed drains approximately 262 square miles of land (measured from the Bay St Bridge) in Tinmouth, Poultney, Middletown Springs, Fair Haven, West Haven, and Benson. The Poultney River headwaters are steep with narrow, hydrologically-connected gravel roads and driveways. Gullying, erosion, and poor drainage on the gravel roads and stream crossings with steep, eroded outfalls are common in the headwaters. The towns in this area recognize and are working to address these concerns and ideally this plan will assist with facilitation of funds to improve road drainage in the headwaters.

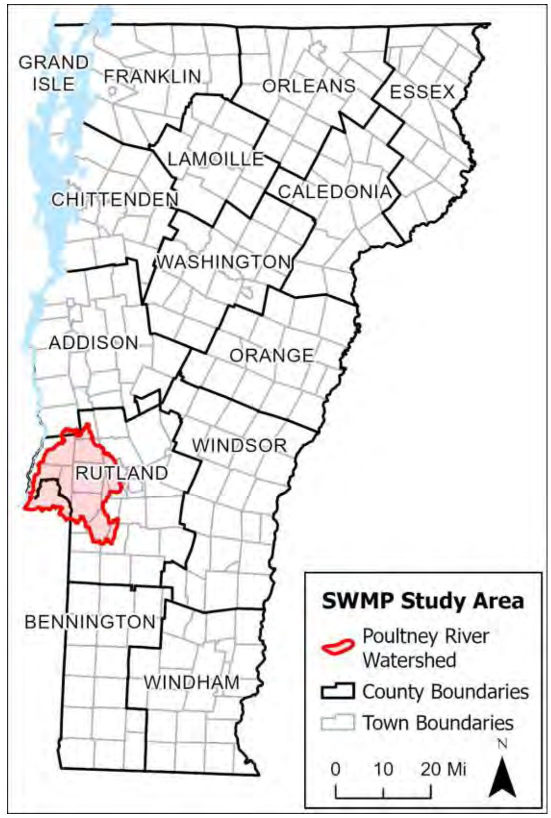


**Figure 2:** Poultney River SWMP study area location map.

The Poultney River watershed is located largely within the Taconic Mountains and the Champlain Valley. The highest elevation in the Poultney River watershed is over 2,800 feet at the peak of Tinmouth Mountain. The lowest elevation in the watershed is approximately 95 feet at the confluence with the Poultney River with South Lake Champlain in West Haven.

The Poultney River Watershed contains significant sections of the Taconic Mountain Range in Tinmouth, Middletown Springs, Hubbardton, and Sudbury. It also contains sections of the Champlain Valley including relic fragments of the historic Clayplain Forest in Poultney, Fair Haven, West Haven, and Benson. The Clayplain forest features a rich diversity of masting tree species including beech, hickories, oaks, ash, and pine in the former lake bottom soils of the Champlain Valley. Inland lakes in the watershed include Burr Pond in Sudbury, Lake Hortonia, Lake Beebe, and Echo Lake in Hubbardton, Lake Bomoseen and Glenn Lake in Castleton, and Sunrise, Sunset, and Perch Lakes in Benson (several lakes, including Hortonia and Glenn Lake are technically located in more than one town). Lake Bomoseen is the largest inland lake in Vermont, at approximately 2360 acres (FEA/PMNRCD, 2016).

Land cover data based on imagery from 2016 National Land Cover Database (Yang et al., 2018) are summarized in Table 1. Development is concentrated along the Route 30 corridor and shores of Lake Bomoseen. The largest town is Poultney with 3,270 residents while Fair Haven is the second most populated at 2,573 residents. According to US Census Data, the populations of both towns have been in decline for at least the past 15 years. The remainder the watershed is predominantly rural with a mixture of forest and agricultural areas. The agricultural land is mainly pasture and hay rather than row crops. A long history of slate quarrying occurred along the western side of the watershed. High quality slate veins run north-south through Poultney and Fair Haven with slate still extracted in several of the larger quarries.

| Land Cover Type | Poultney River Watershed |
|---|---|
| Agriculture | 15.6% |
| Barren Land | 0.4% |
| Developed | 5.7% |
| Forest | 66.6% |
| Grassland/Herbaceuous | 1.7% |
| Shrub/Scrub | 0.3% |
| Water | 2.7% |
| Wetlands | 6.9% |
| Total Area ($mi^2$) | 277.3 |

**Table 1**: Land cover data for the Poultney River Watershed.

## 3.0 Stormwater Management Planning Library

Project partners began the SWMP efforts by gathering and reviewing information and documentation related to stormwater runoff and watershed management within the Poultney River 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 – 2003 - 2021
  - Culvert Assessment and AOP modeling – 2012
  - Lay Monitoring Data – 1970s – Present
  - Poultney River Phase 2 Geomorphic Assessment – 2006
- **Town and Regional Plans**
  - Benson Town Plan – 2017
    - Reducing impervious surfaces and designing yards with more stormwater infiltration will contribute to better water quality (p. 42).
  - Castleton Town Plan – 2018
    - A policy encouraging the use of green stormwater practices and recommending stormwater mitigation projects …, should be included in the town plan (intro pages).
  - Fair Haven Town Plan – 2015
  - Ira Town Plan – 2020
    - Identify and protect all wetlands which provide significant functions and values … to achieve no net loss of wetlands and their functions (p 30).
  - Hubbardton Town Plan – 2016
    - Objective: Hold a workshop on the Clean Water Initiative and GSI with RRPC and PMNRCD by 2020
  - Middletown Springs Town Plan – 2017

    - It is important that water flowing into Lake Champlain (from the Poultney River) not exceed nutrient levels necessary to meet the phosphorus goal for South Lake B, as cited in the Vermont Water Quality Standards (WQS) (p. 18-19).
  - Poultney Town Plan – 2015
    - Future land use maps include the following districts: Village, Agriculture and Rural Residential, Lakeshore, Industrial, and Northeast Conservation and Wildlife Habitat (p 12-17).
  - Tinmouth Town Plan – 2020
    - Tinmouth serves as the headwaters for a series of streams and rivers that serve two watersheds (p. 14).
  - West Haven Town Plan – 2019
    - The town does not have specific river corridor bylaws, but fortunately the town's river corridors mostly coincide with the FEMA special flood hazard areas, giving the river corridors some level of regulation. Additionally, this fact imparts that by adopting the state's river corridor bylaws, the town will not be subjecting additional lands to regulation, but will instead be subjecting the FEMA flood hazard areas to additional regulation (p. 10).
  - Rutland County Regional Plan – 2018
  - Vermont Hazard Mitigation Plan, Rutland Region – 2011
- **State Data and Plans**
  - Hydrologically Connected Roads and Road Erosion Inventory data
  - VTDEC Vermont Lake Champlain Phosphorus TMDL Phase 1 – 2016
  - VTDEC South Lake Champlain Tactical Basin Plan – 2014/2017
  - VTDEC Draft State of Vermont Proposal for a Clean Lake Champlain – 2013
  - VTDEC Hydrologically Collected Road Segment Data
  - Light Detection and Ranging (LiDAR) Topography Data - 2015
- **Other Datasets**
  - Vermont Water Quality Standards – most current version
  - USGS gage 0428450 Mettawee River near Middle Granville, NY
  - USGS gage 04280000 Poultney River below Fair Haven, VT

## 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 several tours of the project area and had meetings with representatives from the towns of Benson, Fair Haven, Middletown Springs, Poultney, and West Haven to identify and/or discuss existing problem areas, evaluate and prioritize sites, and recommend potential solutions.

## 4.1 Identification of Stormwater 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. FEA and PMNRCD identified 51 stormwater problem areas, which were visited and assessed in the field (see maps in Appendix C and table in Appendix D). Problem areas were identified in each of the above towns with twelve (12) sites in Benson, sixteen (16) in Fair Haven (including 2 in the Lake Bomoseen watershed), ten (10) sites in Poultney, eight (8) sites in Middletown Springs, and five (5) sites in West Haven. We grouped the problem areas into three (3) project categories described below.

- **Green Stormwater Infrastructure 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 Improvements –** 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.
- **Gully Stabilization –** Areas of severe erosion from concentrated stormwater runoff.

## 4.2 Evaluation and Prioritization of Stormwater Problem Areas

### *4.2.1 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 0.15 m imagery collected for Rutland County in 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 between 2013 and 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 2013 to locate outfalls and other drainage features as well as determine drainage areas and flow paths of stormwater features in Poultney.
- **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.

#### *4.2.2 Evaluation and Prioritization of Stormwater Problem Areas*

The 49 projects described in the master project table (Appendix D) were prioritized based on the potential for each project to improve water quality, reduce environmental impact, project feasibility, and co-benefits. Estimated project cost and the phosphorus removal efficiency ($/lb of P) were included. We followed the Unified and Non-Unified Scoring Prioritization for Stormwater Master Plans document developed by VTDEC (VTDEC, 2018). The Unified Prioritization method includes a total of 19 criteria divided into 3 categories. The final score is expressed as a percent of the total score, with slightly different criteria applied to road drainage projects. Total scores were out of a maximum of 50 points (Table 2). Two scoring categories are not applicable to road erosion/road drainage projects, which had a maximum score of 44 points. The projects in the Unified Prioritization Project Table ranged from 14 to 31 points.

**Figure 3:** Project FHV-06 had the highest total score (31 out of 50) in the Unified Prioritization. The project is located on the north side of the Fair Haven. In fall of 2021 FEA and the Town performed test pits to verify soil suitability for a large underground infiltration practice.

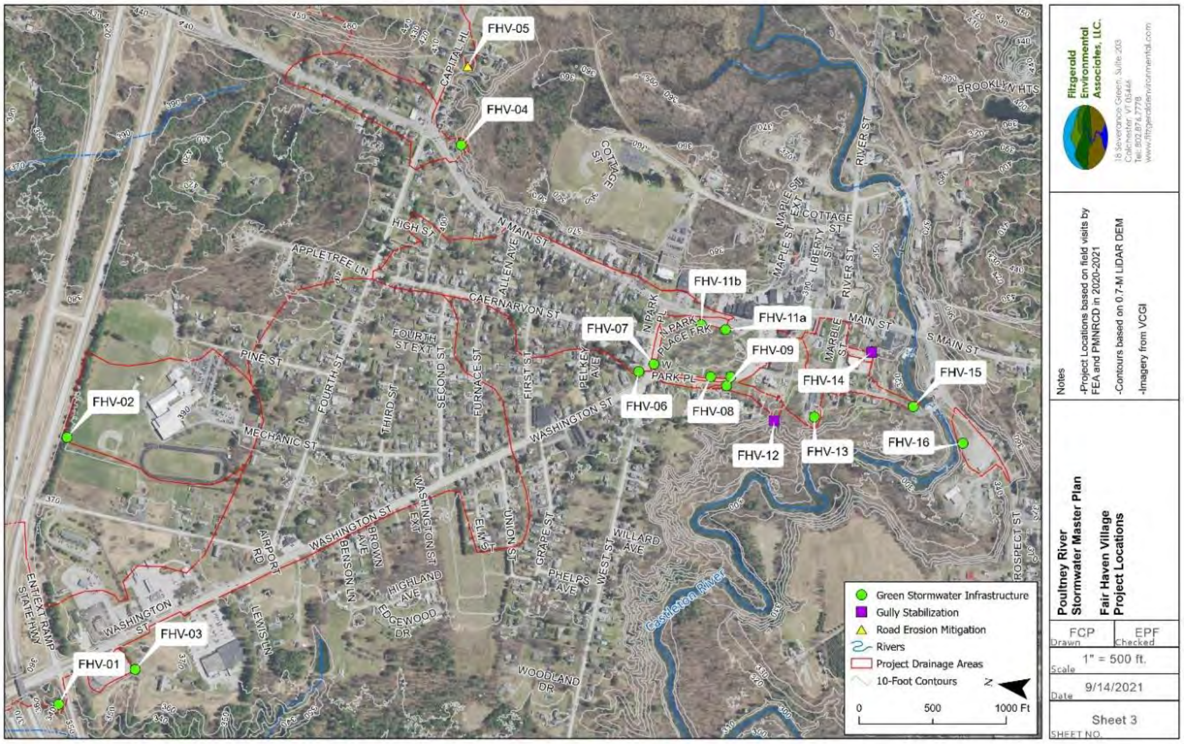


**Figure 4**: Fair Haven Problem Area map – FEA created location maps showing stormwater problem areas for each town in the assessment area.

**Figure 5:** Rural roads can contribute gravel and nutrients to nearby streams. River Road in Poultney after a large spring storm (2019).

**Table 2:** Unified scoring prioritization for stormwater master plans, developed by VTANR (VTDEC, 2018).

| Criteria | Proposed Weight | Max points |
|---|---|---|
| **Water Quality/Environmental impact** | | |
| Sediment reduction (using STP calculator for sediment) (not yet developed) | 0-4 (natural groupings within the range of sediment reductions for proposed projects for a specific plan. 0=very low reduction, 4= very high sediment reduction) | 4 |
| Phosphorus/nutrient reduction (using STP Calculator) | 0-4 (natural groupings within the range of phosphorus reductions for proposed projects for a specific plan. 0=very low p reduction, 4= very high P reduction) | 4 |
| Impervious area managed | 1-4 (natural groupings within the range of impervious surface managed for proposed projects for a specific plan. More impervious treated gets more points) | 4 |
| Percent of Water Quality & Channel Protection Volume treated* | 0-3 (0= no WQ treated, 1= ½ WQV treated, 2=meeting WQV, 3=meets WQV and CPV). Do not apply to road projects. | 3 |
| Percent of Recharge criteria met * | 0-3 (0 = no infiltration, 1 =infiltrates less than recharge volume, 2= meets full recharge, 3= exceeds recharge 1.5 times or more) Do not apply to road projects. | 3 |
| Streambank or other gully erosion mitigation | 0-2 (calculate volume= Length x avg. width x avg. depth, use natural groupings to divide volume into 3 categories) | 2 |
| Green infrastructure opportunity | 0-1 (0=no, 1=yes) | 1 |
| * WQV, CPV and Recharge criteria as outlined in 2017 Vermont Stormwater Management Manual | | |
| **Total Water Quality Score (out of 21, or 15 if road project)** | | |
| **Feasibility Criteria** | | |
| Public land or Private Landowner support | 0-3 (3=public land, 2=willing private land owner, 0=unwilling or unknown willingness of private landowner) | 3 |
| Project and Permitting complexity (number of permits required) | 0-2 (2= simple permitting, 0= complex permitting-potential denial) | 2 |
| Infrastructure conflicts | 1 (Y= 0, N=1) | 1 |
| Total Estimated Project Cost) | Enter engineering estimate+ construction estimate (no points) | |
| Project efficiency ($/lbs. of P removed) | 1-12 (Use natural grouping of $/lbs. removed) | 12 |
| Ease of O&M and ease of access for O&M | 0-2 (based on municipal input on what is easiest to maintain, 0=high maintenance, 2=easy maintenance) | 2 |
| **Total Feasibility Score (out of 20)** | | |
| **Other considerations/Co-benefits** (0=doesn't address concern, 1=addresses concern) | | |
| Educational benefits and or Recreational benefits | 1 | 1 |
| Natural habitat creation/protection | 1 | 1 |
| Infrastructure improvement (culvert replacement) | 1 | 1 |
| Outfall erosion control | 1 | 1 |
| Connected to receiving water | 3=all runoff infiltrates on site, 2= runoff receives some treatment before reaching receiving water. 1=runoff drains via infrastructure directly to receiving water with no erosion or additional pollutant loading, 0 =runoff drains directly to receiving water | 3 |
| Flood mitigation (known problem) | 1 | 1 |
| Existing local concerns | 1 | 1 |
| **Total Co-benefits Score (out of 9)** | | |
| **Overall Score (out of 50 or 44)** | | |

Phosphorus Loads from Sediment

Land cover-based phosphorus loading estimates account for generalized assumptions of sediment mobilization; however, we believe that phosphorus loading from active erosion areas may be underestimated for some of the stormwater problem areas. Other project types such as stream bank restoration or gully stabilization do not fit into the VTDEC Unified Scoring framework. We followed the VTDEC Standard Operating Procedure (SOP) for tracking and accounting of phosphorus associated with the Municipal Roads General Permit (MRGP) to estimate phosphorus loading and reduction associated with road improvements and erosion stabilization (VTDEC 2020).

For estimating the overall phosphorus loading and phosphorus reduction associated with excess sediment mobilization and stabilization, we used methods and loading rates established for the stabilization of roadside gully erosion in the VTDEC SOP. We estimate annual soil loss (in cubic feet) based on our best professional estimate of the age and volume of erosion features. We apply a 43.38 kg/$ft^3$ sediment bulk density to volume of erosion and 0.000396 kg (P)/ kg sediment (TSS), the equivalent of an annual loading rate of 0.017 kg (P)/$ft^3$ and 0.037 kg (P)/$ft^3$ (VTDEC 2020).

BMP Unit Costs and Adjustment Factors

BMP unit costs (2016 $) and adjustment factors were derived from research completed by the Charles River Watershed Association and the Center for Watershed Protection (EPA, 2016), as well as updates based on actual construction costs in Vermont (Table 3). Unit construction costs for road drainage projects were based on the estimates provided in the Road Erosion Site Prioritization and Remediation Project Summary (Fitzgerald Environmental Associates and Milone and MacBroom, Inc., 2017). Additional multipliers for site type (Table 4) and level of permitting and engineering required (Table 5) are also shown below.

**Table 3:** BMP Unit Costs ($)

| BMP Type | Cost/$ft^3$ Treatment Volume |
|---|---|
| Constructed Wetland | 9.49 |
| Dry Pond | 4.87 |
| Grass Conveyance Swale | 4.32 |
| Rain Garden (no underdrain) | 16.72 |
| Rain Garden (with underdrain) | 16.72 |
| Subsurface Infiltration | 6.76 |
| Surface Infiltration | 6.75 |
| Wet Pond | 7.35 |

**Table 4:** Site Type Cost Adjustment

| Site Type | Cost Multiplier |
|---|---|
| Existing BMP retrofit | 0.25 |
| New BMP in undeveloped area | 1.00 |
| New BMP in partially developed area | 1.50 |
| New BMP in developed area | 2.00 |

**Table 5:** Permitting and Engineer (P&E) Cost Adjustment

| Level of P&E Required | Cost Multiplier |
|---|---|
| None | 1.00 |
| Low | 1.20 |
| Moderate | 1.25 |
| High | 1.35 |

### 4.3 Project Prioritization and Conceptual Designs

The Poultney River SWMP partners reviewed and commented on the list of preliminary projects during various meetings and email correspondences. From the list of 51 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, ten (10) projects were chosen for conceptual design development (30% design).

**30% Concept Designs**

Ten (10) of the highest priority projects were selected to include in 30% concept designs (Appendix G). Concept designs include:

- A site plan with contours, existing stormwater infrastructure, and proposed design elements
- Where relevant, hydrologic and hydraulic modeling data of the contributing drainage area and proposed BMP sizing and design specifications
- Typical details for proposed practices
- A preliminary cost opinion

The projects chosen for 30% conceptual design were:

1. **Project BN-11: Benson Village School** – Rainfall from the parking lot, school roof, and pathways will drain to existing swales to receive pretreatment, then utilize existing underground pipe and outlet, draining to a 45x30-foot rain garden installed discretely to the southeast of the school building.

2. **BN-12: Root Pond Road –** Install a variety of practices including stone-lined ditches, check dams, stabilized turnouts, and road grading to bring high priority road segments into compliance.
3. **FHV-04: North Main Street, Fair Haven –** Install pretreatment forebay and restore the existing (possibly former stormwater) pond to continue/renew treatment of 10.54 acres of downtown (north of the Dollar Store) land area.
4. **FHV-06: Fair Haven Village Green (across from Town Hall)** – Install a pretreatment swirl separator and underground infiltration chambers to treat 25.37 acres (nearly 10 impervious) of downtown Fair Haven. The overflow will pipe to the existing stormdrain system. This project will treat 33 lbs/year of phosphorus at estimated $9540 per pound (about half the estimated $46,000 per kilogram estimated for stormwater projects in the Act 76 formula costs for stormwater projects).
5. **FHV-10: Fair Haven Village Green (western edge) –** Small project with swales and check dams will treat drainage from the road and parking areas adjacent to the back of the Fair Haven Village Green minimizing outflow to the existing stormwater system. Re-grading the road may bring additional benefits.
6. **FHV-11: Fair Haven Village Green (southeast corner) –** Removal of curb sections and installation of a rain garden will allow movement of stormwater from Main St into a proposed infiltration swale and catch basin. This project will need to be coordinated with new EV charging stations.
7. **MS-03: Middletown Springs Town Property –** Road grading and swale installation will divert water into a forebay and infiltration basin, with overflow exiting the basin via a new culvert into a swale which ties into an existing catch basin. This practice will treat 2.19 ac (0.54 impervious).
8. **PY-06: St Raphael's Catholic Church –** Install grassed swale, level spreader, and infiltration basin to capture and infiltrate runoff from a large gravel parking lot.
9. **PY-07: Poultney Town Garage –** A berm will be installed to direct drainage from the high school and Poultney Town Garage into a proposed wet pond and will improve flow to the Poultney River via a newly stabilized outflow. This project will treat 12.20 acres and 5.63 acres of impervious surfaces.
10. **RR-05: River Road in West Haven -** Install a wide variety of practices including improve road crown, raise road grade, remove grader berm on the lower shoulder, edge of road stabilization/maintenance, new stone-lined ditches, new grass-lined ditch, side slope excavation for ditch, and improvements to existing ditch stone and grass to bring high priority road segments into compliance. Install sediment trap and stone armor and bedding, type V rock stacked, upgrade cross culvert, new conveyance culvert, new driveway culvert.

**Figure 5:** Road drainage to the Poultney Town Garage (PY-07).

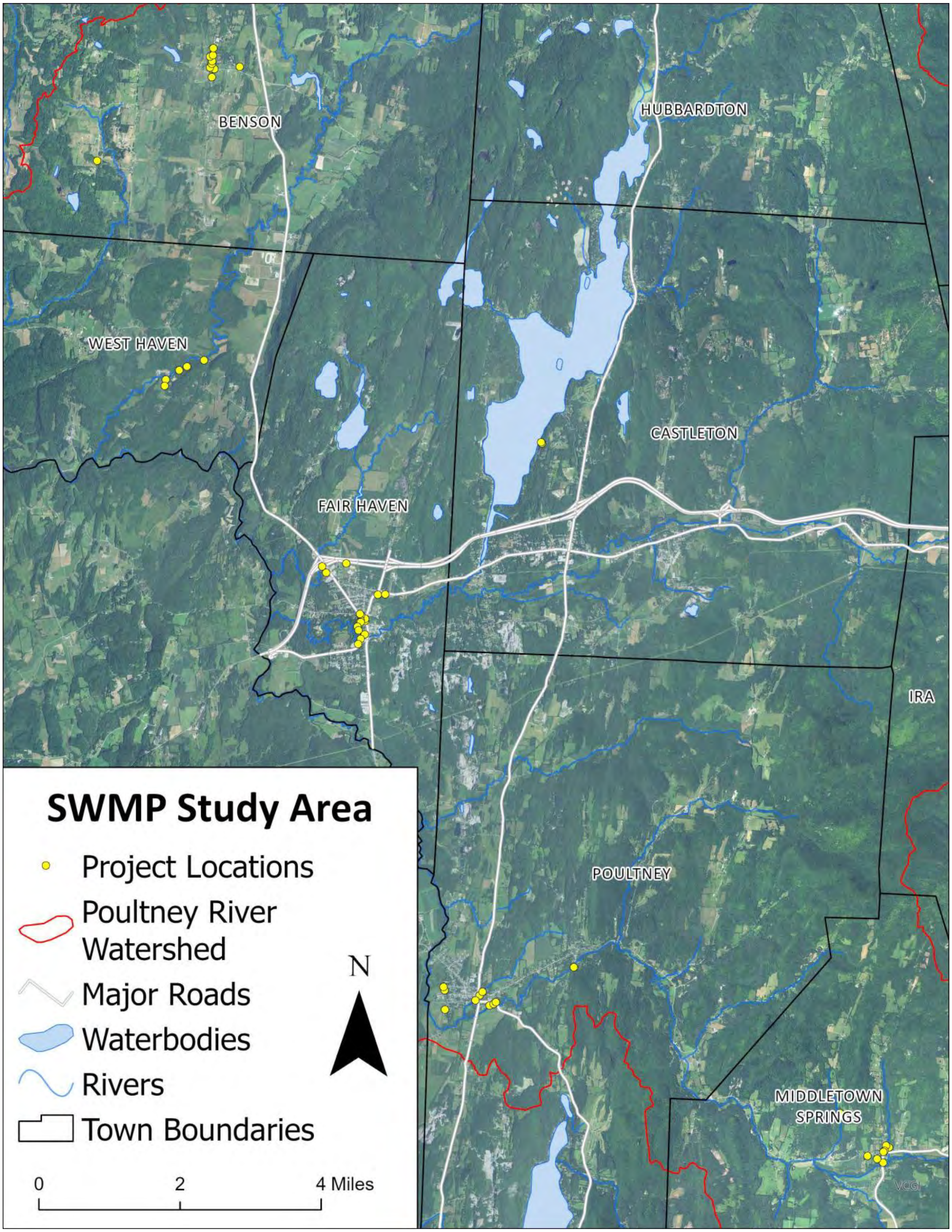


**Figure 6:** Map of 51 identified project locations.

## 5.0 Next Steps

This Stormwater Master Plan represents an extensive effort to identify, describe, and evaluate stormwater problem areas affecting the Poultney River watershed. For each project recommendation, we provided a preliminary cost estimate and a site rating to aid the local partners including PMNRCD, Lake Associations, 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 VTANR Municipal Roads General Permit.

Project partners, FEA and PMNRCD, recommend that PMNRCD continues to work with the Towns, Lake Associations, and other local partners to secure funding through the South Lake Clean Water Service Provider (CWSP) for the high priority projects described in Appendices D, E, F, and G. The CWSP (facilitated by the Rutland Regional Planning Commission in consultation with PMNRCD) and the related advisory council, the South Lake Basin Water Quality Council, will work to promote efficient implementation of high-quality phosphorus reduction projects in the South Lake watershed. Based on the level of scoping and design work already completed to date, overall project prioritization, and past stakeholder input, we recommend that the following projects are prioritized for further work in the near term.

- Benson Village School, BN-11 (30% design complete, school unsure of ability to deal with project installation).
- Root Pond Road, BN-12 (30% design complete)
- Fair Haven North Main Street Drainage, FHV-04 (30% design complete)
- Fair Haven Town Green, FHV-06 (30% design, town of Fair Haven to assist, scheduled for 2023)
- Fair Haven Town Green, FHV-10 (30% design complete)
- Fair Haven Town Green, FHV-11 (30% design complete)
- Middletown Springs Town Property, MS-03 (30% design complete, Dot Reed infiltration area, town on board to assist)
- San Raphael's Church, PY-06 (30% design complete)
- Poultney Town Garage, PY-07 (30% design, Town of Poultney to assist, scheduled for 2023)
- River Road, West Haven, RR-05 (30% design complete)

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. Stormwater best management 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, which eventually drain to Lake Champlain.

## 6.0 References

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VTANR (Vermont Agency of Natural Resources), 2013, Draft State of Vermont Proposal for a Clean Lake Champlain. VT Department of Environmental Conservation and Vermont Agency of Agriculture, Food, and Markets. 30pp. http://dec.vermont.gov/sites/dec/files/wsm/erp/Champlain/docs/2013-11-20_DRAFT_Proposal_for_a_Clean_Lake_Champlain.pdf

VTANR, 2016, Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan, prepared by VAAFM and VTANR, draft published August 2016, pp. 173, http://dec.vermont.gov/sites/dec/files/wsm/erp/docs/2016%20Draft%20Phase%201%20Implementation%20Plan.pdf

VTANR, 2005, Poultney Mettowee Basin Plan. Accessed in October 2015 at: http://www.watershedmanagement.vt.gov/planning/docs/pl_basin2.final-plan.3-07.pdf

VTANR, 2014, South Lake Champlain Tactical Basin Plan, Watershed Management Division, http://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/mapp_b02-04tbp.pdf

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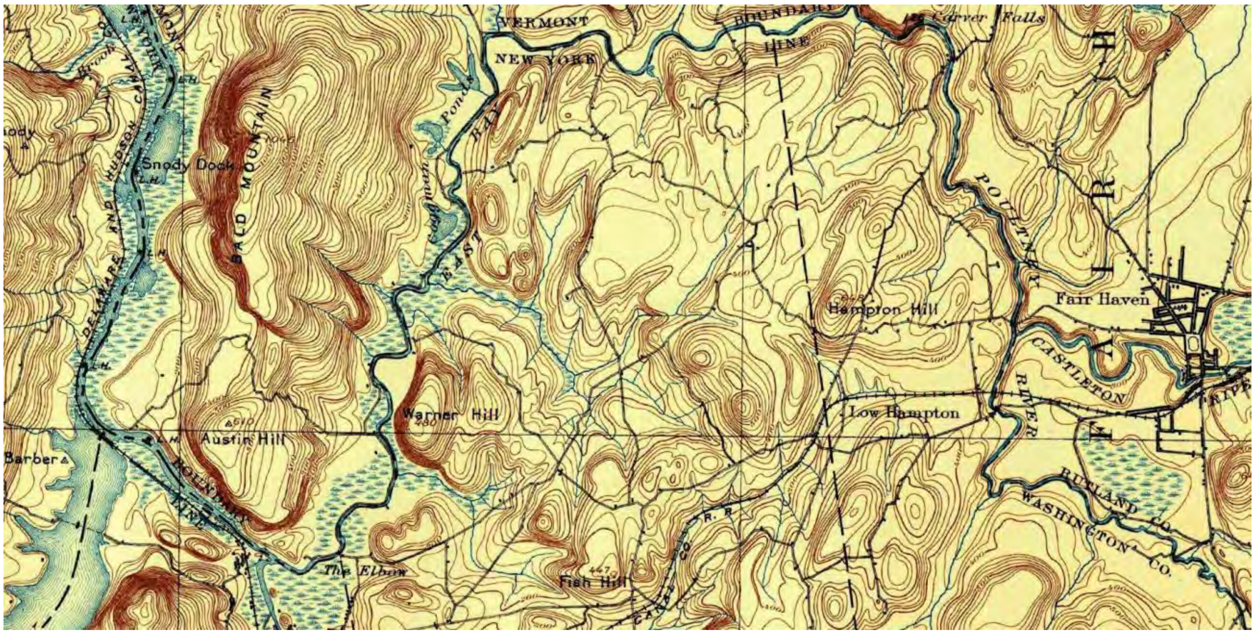
# APPENDIX A

Stormwater Management
Planning Library
**(**8.5**"x11")**

# Poultney River Watershed Data and Report Bibliography

POULTNEY METTOWEE NRCD (PMNRCD)
FITZGERALD ENVIRONMENTAL ASSOCIATES (FEA)

September 9, 2020, Initial Version
Updated March 14, 2022, Final Version




*Poultney River confluence with the Castleton River and South Lake B north of Whitehall*

## AVAILABLE LOCAL DATASETS

**PMNRCD, 2015-2021, Water Quality Monitoring Reports and raw data (May - September biweekly data with some storm data), LaRosa Laboratory Partnership Program with DEC**

PMNRCD collects and analyzes water quality data in the Poultney (and Mettowee) Watershed(s). The District began collecting water samples on the Poultney River at eight locations in 2003 and at six locations along the Castleton river in 2006. In 2015, new sites were added around Lake Bomoseen (see Table 1 below) to support the Lake Bomoseen Stormwater Master Plan, as well as on North Bretton Brook in the Castleton Headwaters. In addition to the Lake Bomoseen sites, PMNRCD also added two additional sites along the Hubbardton River in 2016. In 2018, additional sites included stormwater sites on a N Bretton Brook tributary, a series of sites within the Coggman Creek watershed, and sites on Lewis Creek a small tributary to the Poultney River. Reports from 2003-2019 are available upon request, with 2018 and 2019 including many additional sample locations added in the Poultney River watershed.

**PMNRCD, 2016-2017, South Lake Champlain Trust, South Lake Water Quality Monitoring**
Water quality data for five locations at the mouth of the Mettowee River, Poultney River, Barge Canal, and two locations in the South Lake near Whitehall.

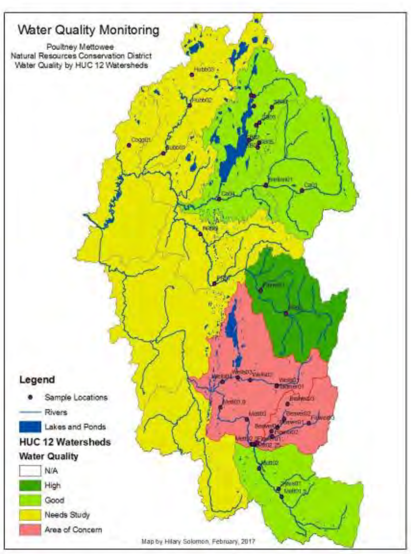
**RRPC, 2005, Castleton River Phase 1 Geomorphic Assessment, Rutland County, Vermont, SGA dataset**
Sucker Brook phase 1 data sheets can be appended to the back as an appendix. The scores are listed in the report section below. The data sheets are available and can be attached and/or emailed upon request.

**Field, John, 2004, Hubbardton River and Poultney River PH1 SGA**, w some PH2 data

**Godfrey, Lisa, 2006, Poultney River SGA Phase 2**, all reaches assessed

**Solomon, Hilary, 2007, Phase 1 Stream Geomorphic Assessment Conducted on Select Poultney River Tributaries and Phase 2 on Select Reaches of Vail Brook and North Brook, PMNRCD, pp 29 plus appendices (52 pp)**.

**SMRC, 2011, Poultney and Mettowee Watershed Culvert Assessment, at the request of TNC, funds from VDFW and USFWS**
The majority of culverts in the Lake Bomoseen watershed were assessed through this study. The assessment information includes the size, width, and length of the culvert. The data includes its condition, perch height at the downstream end (if any), scour pool depth, and other information. Each culvert was then scored for aquatic organism passage (AOP score) and geomorphic compatibility (GC score). The Nature Conservancy recently completed a modeling exercise ranking the culverts for replacement based on fish passage and other criteria.




**TNC, 2015, AOP model applied to 2010 Culvert Assessment Data**.
This data was recently received by PMNRCD and we are currently examining the Tier 1-5 datasets.
A map showing the results TNC model applied to the original culvert data will be used in the SWMP study.

**DEC, multiple years, Lake Bomoseen Lay Monitoring Data**
Many years of this dataset exist, and this information may be useful. It is from limited locations in the lake.

**DEC, multiple years, Lake Scorecards** for lakes located in the Poultney River Watershed.

**PMNRCD, 2016, SLCT Methodology**: Watersheds assigned a water quality value related to WQM data.

## GIS DATA—STATEWIDE

All statewide GIS data were downloaded from the Vermont Open Geodata Portal. Data and metadata are maintained by PMNRCD and the Project Team will check for updates throughout the study period.

- **LiDAR Data**—LiDAR data for Rutland County were collected in 2013. Derivatives of the LiDAR dataset include a 0.7-meter gridded digital elevation model, a topographic hillshade, and gridded slope raster.
- **Surficial Geology**
- **High Erosion Potential Roads**
- **Streams**
- **Wetlands**
- **State Waters of Concern**
- **HUC 8/12 Watershed Boundaries**
- **NRCS Soils**

**USGS gage 04280000 Poultney River Below Fair Haven, VT:**
**http://www.waterdata.usgs.gov/usa/nwis.**
This US Geologic Survey gage record is maintained by the USGS New Hampshire Water Science Center. The gage has been in operation since 1929.

**USGS, Streamstats, State Applications, Vermont Interactive Map:**
**https://streamstats.usgs.gov/ss/**
This web application can be used to measure a subwatershed size based from any point on a mapped stream. Also provided are flow predictions for various return intervals.

**Road Erosion Inventories (REI) and Outlet Assessments**
Road erosion inventories have been completed for most towns in the area to evaluate their compliance with Municipal Roads General Permit (MRGP) standards. FEA downloaded REI data for Benson, Fair Haven, Middletown Springs, Poultney, Poultney Village, and West Haven. Outlet assessment data were available for Benson, Middletown Springs, Poultney Village, and Poultney.

*Benson*
Approximately 25% of hydrologically connected road segments in Fair Haven are paved. Approximately 50% of segments meet the MRGP standards. Two hundred six (206) segments did not meet or partially met the standards. None of the stormwater infrastructure outlets assessed in Benson had erosion present.

*Fair Haven*
Approximately 75% of hydrologically connected road segments in Fair Haven are paved. Almost all segments meet the MRGP standards. Only 12 segments did not meet or partially met the standards.

*Middletown Springs*
Less than 20% of hydrologically connected road segments in Fair Haven are paved. Over 70% of segments meet the MRGP standards. Seventy-two (72) segments did not meet or partially met the standards. Three (3) of the stormwater infrastructure outlets assessed in Middletown Springs exhibited rill erosion.

*Poultney*
Approximately 30% of hydrologically connected road segments in Poultney are paved. Over 80% of segments meet the MRGP standards. One hundred (100) segments did not meet or partially met the standards. One (1) of the stormwater infrastructure outlets assessed in Poultney exhibited rill erosion.

*Poultney Village*
All hydrologically connected Poultney Village roads were paved, and all hydrologically connected segments met the MRGP standards. The stormwater infrastructure outlet assessed in Poultney Village did not have any erosion present.

*West Haven*
Approximately 25% of hydrologically connected road segments in West Haven are paved. Approximately 50% of segments meet the MRGP standards. One hundred sixty-four (164) segments did not meet or partially met the standards.

**Stream Geomorphic Assessment (SGA) Data**
Phase II SGA data are available for most of the Poultney River, Castleton River, and Hubbardton Rivers as well as tributaries to these rivers. GIS data from the SGA Feature Indexing Tool (FIT) are available for most of these waterways. The FIT data include documented stormwater inputs and other areas of encroachment that may affect water quality. Phase I and II assessments were conducted between 2005 and 2007 by Rutland RPC (Castleton River, Poultney Tribs), South Mountain Research and Consulting (Castleton River, Field Geology Services (Poultney – Hubbardton River), and Poultney/Mettowee NRCD (Poultney River, Vail Brook).

**Stormwater reports and infrastructure mapping**
Available for Poultney/Green Mtn College, Fair Haven, Benson, Castleton University/Castleton, and Middletown Springs.

## Available Reports for Areas within the Poultney Watershed

**PMNRCD and FEA, 2016, Stormwater Master Plan: Lake Bomoseen, Castleton and Hubbardton, Vermont, 42 pages plus appendices**

**PMNRCD and FEA, 2018, Stormwater Master Plan: Castleton Headwaters, Castleton, Ira, West Rutland, and Pittsford, Vermont, 18 pages plus appendices**

**PMNRCD, 2015, Water Quality Monitoring Report (also 2006-2008, 2010, 2011, 2016-2019)**
Water Quality Reports by PMNRCD during the dates listed above include data from the Castleton River and/or its tributaries. The Castleton River has moderate to low levels of phosphorus, while the Hubbardton River contains comparatively higher concentrations during most monitoring events. All the locations monitored appear to contain high concentrations of phosphorus during storm events (storm event monitoring occurs 1-3 times per monitoring season).

Five sites along the Castleton River were originally sampled in 2006. The Castleton River was targeted, because the District and our partners were implementing a floodplain restoration along one of the major tributaries to the Castleton River, Gully Brook. There was also active channel movement of the Castleton River, with two avulsions in 2007, one through a horse pasture owned by a large stable and one through an annually cropped field These five sites were sampled in 2006, 2007, and 2008.

The SWMP with subwatershed-specific monitoring and data analysis, focuses attention on the Castleton River. It begins in a rich marsh and flows through agricultural and residential lands, constrained by roads and rail beds. It flows through both Castleton and Fair Haven and is the receiving waters of Lake Bomoseen. In 2007, it was the subject of a controversial dam assessment and removal study that was eventually tabled due to lack of interest in Fair Haven.

Sites along the castleton River CA01-CA05 were sampled from 2006-2009. To better understand the nutrient and bacteria flow in the Castleton River, but with deference to the limited sample capacity, the District began only collecting samples at the uppermost site, CA01, downstream of a wetland and draining several discrete agricultural areas, and the site downstream of Castleton Village, CA05. The District also chose to monitor North Breton Brook, a large headwater tributary to the Castleton River, which originally had received a geomorphic assessment in 2006.

| Site Name | River | Lat/Long | Description | Significance? |
|---|---|---|---|---|
| **CA01** | Castleton | 43.60944<br>-73.11484 | At the downstream end of the wetland along the Birdseye Ski Area access road. | Monitor the wetlands nutrient levels; farms in vicinity and upstream |
| **CA02** | Castleton | | Downstream of the Traverse project/Savage property at the road crossing on rte 4 | Downstream of a large restoration project at Traverse Farm |
| **CA03** | Castleton | | At the drinking water wells along old route 4 | Important site for Castleton Town |
| **CA04** | Castleton | | At the route 30 crossing | Agricultural area and upstream of the Castleton WWTP |
| **CA05** | Castleton | 43.5998<br>-73.2329 | Blissville Road crossing | Downstream of Castleton WWTP |
| **Bretton01** | North Breton Brook | 43.627858<br>-73.159384 | Ford to agricultural field on Monument Hill Road, north of the Route 4 Bypass | Evaluate the sediment and nutrient flow from the North Breton watershed to Castleton |
| **Eaton01** | Trib to N Breton Bk | | At Eaton Hill Rd crossing | Evaluate sediment from road and agricultural operations in the brook |

In 2006 The District had only measured one location on the Hubbardton River and samples were collected at the Main Road crossing in West Haven on three sample dates. In 2015, the District added two additional sites on the Hubbardton River, Hubb02, downstream of the Mill Pond, and Hubb03 near the headwaters along Route 144 in the Hortonia region.

| Site Name | River | Lat/Long | Description | Significance? |
|---|---|---|---|---|
| **Hubb01** | Hubbardton | 43.64693<br>-73.31209 | Hubbardton River at Main Road and River Road | Downstream Hubbardton measurement; previously measured |
| **Hubb02** | Hubbardton | 43.696743<br>-73.275901 | Hubbardton River downstream of the Mill Pond | Mid-Hubbardton measurement |

| | | | | |
|---|---|---|---|---|
| **Hubb3** | Hubbardton | 43.736230<br>-73.243413 | Hubbardton River at Route 144 | Upstream Hubbardton measurement |
| **Coggman01** | Coggman Creek | 43.6547<br>-73.36218 | Coggman Creek at Burr Road crossing | Accessible Coggman Creek measurement |

The Lake Bomoseen Sucker Brook sample sites were added in 2015, due to the Stormwater Master Planning work completed in the watershed. Several sites were added at the end of the 2016 sampling season to seek out potential information leading to inputs of high concentrations of TP to Lake Bomoseen. These sites include LB01 at the golf club, LB02 at Hart Towers Road, LB03 at Indian Point, LB04 at Point of Pines, LB05 at the small tributary on Coon Hill Road, LB06 at Bomoseen State Park, and LB07 upstream of Love's Marsh.

| Site Name | River | Lat/Long | Description | Significance? |
|---|---|---|---|---|
| **LB01** | Lake Bomoseen | 43.64406<br>-73.20018 | Downstream of the lily pond at golf course | Input to Lake Bomoseen |
| **LB02** | Lake Bomoseen | 43.63324<br>-73.20780 | Small stream, draining to back bay | Input to Lake bomoseen |
| **LB03** | Lake Bomoseen | 43.61459<br>-73.22525 | Small wetland E-type stream at Indian Bay | Input to Lake Bomoseen |
| **LB04** | Lake Bomoseen | 43.62224<br>-73.23370 | Forested buffer upstream of Point of Pines Rd | Input to Lake Bomoseen |
| **LB05** | Lake Bomoseen | 43.63881<br>-73.23473 | Forested area downstream of small pond | Input to Lake Bomoseen |
| **LB06** | Lake Bomoseen | 43.65747<br>-73.22964 | Drainage from Glenn Lake, old slate | Input to Lake Bomoseen |
| **LB07** | Lake Bomoseen | 43.67817<br>-73.20670 | Forested area, some implementation of forestry practices | Input to Lake Bomoseen |
| **LBSB01** | Sucker Brook | 43.66165<br>-73.18977 | Sucker Brook at the Route 30 crossing/Crystal Beach access | Assessment; no previous info, but sediment source |
| **LBSB02** | Sucker Brook Trib | 43.661764<br>-73.170993 | Sucker Brook at Barker Hill Road | Assessment; no previous info, but sediment source |
| **LBSB03** | Sucker Brook | 43.679876<br>-73.175183 | Sucker Brook at Gill Hill Road | Assessment; no previous info, but sediment source |
| **LBSB04** | Sucker Brook | 43.693213<br>-73.164747 | Sucker Brook at Howland Road Crossing | Assessment; no previous info, but sediment source |
| **LBSB05** | Sucker Brook | 43.653812<br>-73.177549 | Sucker Brook at North Road, past Barker Hill | Assessment; no previous info, but sediment source |
| **DHTrib** | Trib | 43.69641<br>-73.18413 | Trib to Lake Bomoseen at Dikeman Hill Rd and Route 30 | Assessment; no previous info |
| **Giddings01** | Giddings Bk | 43.70711<br>-73.18454 | Trib to Lake Bomoseen at Monument Hill and Rte 30 | Assessment; no previous info, animal pasture |
| **Giddings02** | Unnamed Trib near Giddings | 43.69656<br>-73.18413 | Trib to Lake Bomoseen at private road (branch of the above creek) | Assessment; no previous info, downstream of wetland |

The District has sample sites directly on the Poultney River beginning in 2002 with PR01, 03, 04, and 07. Additional Poultney River sites were added in 2004. All sites were sampled up until 2008, with PR03 and PR07 being sampled until 2011.

| Site Name | River | Lat/Long | Description | Significance? |
|---|---|---|---|---|
| **PR01** | Poultney River | | Daisy Hollow Rd at old bridge | upstream site |

| | | | | |
|---|---|---|---|---|
| **PR02** | Poultney River | | Buxton Hollow Rd upstr of Vail Bk | upstream of ag lands |
| **PR03** | Poultney River | 43.48361<br>-73.13444 | Poultney River at Orchard Rd | downstream of ag lands |
| **PR04** | Poultney River | | Poultney River at Morse Hollow Tributary confluence (from Rte 140) | Gravelly confluence enters PR |
| **PR05** | Poultney River | | Poultney River upstream swimming hole at Rte 140 bridge/Seamans garage | Swimming hole, monitored for E coli and TP |
| **PR06** | Poultney River | | Poultney River at Horse Heavan swimming hole | Swimming hole monitored for E coli and TP |
| **PR07** | Poultney River | 43.5122<br>-73.2369 | Poultney River at Rail Trail | Eroded area and in Town of Poultney |
| **PR08** | Poultney River | 43.56368<br>-7325800 | Poultney River at Greene Rd. | Agricultural area in the silty NY/VT shared valley south of Fair Haven |
| **PR99** | Poultney River | 43.623885<br>-73.352210 | Poultney River in ag area, Ag fields and dirt road on one side, forested to the south | Located near mouth of Poultney River to Lake Champlain |

**RRPC, 2005, Phase 1 Geomorphic Assessment, Castleton River, Rutland County, Vermont**

Table 1. Stream and Watershed Provisional Impact Rankings. Sensitivity and impact scores are from the DMS, data accessed February 29, 2016 and September 9, 2020. The phase 1 data was updated by SMRC after field verification during the phase 2 assessment (SMRC, 2007, p. 13)

| Reach ID | Stream Name | Total Impact | Reach Condition | Sensitivity |
|---|---|---|---|---|
| T02.01 | Castleton River | 11 | Fair / Good | High |
| T02.02 | Castleton River | 9 / 12 | Fair / Good | High |
| T02.03 | Castleton River | 14 / 16 | Fair / Good | V. low |
| T02.04 | Castleton River | 9 / 11 | Fair/ Good | High |
| T02.05 | Castleton River | 10 / 15 | Reference / Good | High |
| T02.05-S1.01 | Lake Bomoseen | 13 / 15 | Fair | High |
| T02.05-S1.02-S1.01 | Sucker Brook | 11 / 14 | Fair | High |
| T02.05-S1.02-S1.02 | Sucker Brook | 10 / 9 | Good / Reference | High |
| T02.05-S1.02-S1.03 | Sucker Brook | 3 / 5 | Reference | Moderate |
| T02.05-S1.02-S1.04 | Sucker Brook | 1 /3 | Reference | High |
| T02.05-S1.02-S1.05 | Sucker Brook | 5 / 8 | Good / Reference | High |
| T02.05-S1.02-S1.06 | Sucker Brook | 9 / 8 | Good / Reference | Moderate |
| T02.05-S1.02-S2.01 | Giddings Brook | 8 / 12 | Good | High |
| T02.05-S1.02-S2.02 | Giddings Brook | 5 / 5 | Reference | Moderate |
| T02.05-S1.02-S2.03 | Giddings Brook | 9 / 9 | Good / Reference | High |
| T02.05-S1.02-S2.04 | Giddings Brook | 6 / 8 | Good / Reference | High |
| T02.05-S1.02-S2.05 | Giddings Brook | 6 / 7 | Good | High |
| T02.08-S1.01 | Pond Hill Brook | 27 | Poor/Fair | High |
| T02.08-S1.02 | Pond Hill Brook | 27 | Poor/Poor | High |
| T02.08-S1.03 | Pond Hill Brook | 6 | Reference/Reference | Very Low |
| T02.08-S1.04 | Pond Hill Brook | 12 | Fair/Fair | High |

| | | | | |
|---|---|---|---|---|
| T02.08-S1.05 | Pond Hill Brook | 13 | Good/Good | Very Low |
| T02.09-S1.01 | North Bretton Brook | 20 | Fair/Fair | High |
| T02.09-S1.02 | North Bretton Brook | 14 | Fair/Fair | High |
| T02.09-S1.03 | North Bretton Brook | 10 | Good/Good | High |
| T02.09-S1.04 | North Bretton Brook | 11 | Fair/Good | High |
| T02.09-S1.05 | North Bretton Brook | 6 | Reference/Reference | High |
| T02.11-S1.01 | Gully Brook | 16 | Fair/Fair | High |
| T02.11-S1.02 | Gully Brook | 13 | Good/Good | Moderate |
| T02.11-S1.03 | Gully Brook | 4 | Reference/Reference | Very Low |
| T02.11-S1.04 | Gully Brook | 7 | Reference/Reference | Very Low |

The highest contributing factors to the impact scores were historic corridor land use and inadequate riparian buffer widths. The Castleton River downstream of Lake Bomoseen has experienced high levels of channelization and channel management. The streams are highly sensitive to land use changes on the landscape. **The impact scores seem high, for such good reach conditions*?

**SMRC, 2007, Phase 2 Geomorphic Assessment, Castleton River and Tributaries, Rutland County, Vermont** (includes North Bretton Brook, Pond Hill Brook, Gully Brook, and the Castleton Main Stem). This report focused in part on the dams located in the lower four reaches of the Castleton River and the potential for their removal. The Town of Fair Haven was not receptive to a dam removal project, though safety issues, flood resiliency, and fish passage would all be improved with removal of the dams.

The phase 2 assessment was completed on North Bretton Brook, Pond Hill Brook, Gully Brook, and the Castleton Main Stem. Many projects were identified during the assessment including three on the Castleton Main Stem, five on Gully Brook, and nine project opportunities on Pond Hill Brook. These projects include improved buffers, removing dams, and minimizing conflicts with transportation infrastructure. Maps in Appendix A depict the potential project types and locations.

Pond Hill Brook, in particular showed a number of interesting features, from waterfalls and hemlock gorges in the headwaters to its meandering course through Castleton University. SMRC identified potential projects ranging from livestock exclusion and wetlands augmentation in the headwaters to removal of a railroad berm and unused rail road trestle abutments that no longer hold a bridge deck, but greatly constrict the width of the brook. Two small and one large dam exist on the section of brook just upstream from Hadeka Stone, the entrance to Hadeka is via an undersized culvert, and the confluence of the brook with the Castleton River is through a perched culvert (section T02.08-s1, p. 77).

Gully Brook is the site of a successful berm removal and floodplain reconnection project, though the reach upstream of the project has departed from a D-type stream to an F-type degraded stream.

**State of VT, 2017, Water Quality Standards VT Code R 12 004 052, Natural Resources Board, Water Resources Panel, Montpelier, VT, 108 pp.**

The water quality standards for bacteria, chemical, and physical tests conducted in Flower Brook and its tributaries prior to 2014 were 77 MPN *E. coli* bacteria per single grab sample (most probable number of colonies per 100 ml of water), and 235 colonies after 2014. Total phosphorus standards range from 9-27 ug depending on the stream location (slope) and function (A1, A2, B1, B2) (p. 27) and 10 NTU turbidity for coldwater streams.

**State of VT, 2014, Water Quality Standards, October 30, 2014, Environmental Rule Chapter 29, http://www.watershedmanagement.vt.gov/rulemaking/docs/wrprules/wsmd_wqs2014.pdf**
The current water quality standards for bacteria, chemical, and physical tests conducted in Flower Brook and its tributaries are 235 MPN *E. coli* bacteria per single grab sample (most probable number of colonies per 100 ml of water), 27 *u*g/l total phosphorus, and 10 NTU turbidity.

**USGS gage 0428450 Mettawee River near Middle Granville, NY:**
**http://www.waterdata.usgs.gov/usa/nwis.**
This US Geologic Survey gage is used to determine approximate stream flow conditions for all water quality monitoring samples collected by the District. This gage is currently funded through NY DEC and LCBP.

**USGS, Streamstats, State Applications, Vermont Interactive Map:**
**http://streamstatsags.cr.usgs.gov/vt_ss/default.aspx?stabbr=vt&dt=1420856108418**
This web application can be used to measure a subwatershed size based from any point on a mapped stream. Also provided are flow predictions for various return intervals.

**Van Hoesen, 2011, Phosphorus Critical Source Areas in the Poultney and Mettowee Watersheds.**
This work, which focused on agricultural lands and combined soil slope and erodibility data, presence/absence of riparian buffers, and presence of annual crop lands, was completed in 2011 and predicts high phosphorus sources areas. The NRCS is currently completing an updated version of critical source area (CSA) mapping.

**VT ANR. 2013. Draft State of Vermont Proposal for a Clean Lake Champlain. VT Department of Environmental Conservation and Vermont Agency of Agriculture, Food, and Markets. 30pp. http://www.watershedmanagement.vt.gov/erp/champlain/docs/2013-11_20_DRAFT_Proposal_for_a_Clean_Lake_Champlain.pdf**
Lists potential implementation scenarios to decrease phosphorus levels in Lake Champlain.

**VTANR, 2005, Poultney-Mettowee Basin Plan,**
**http://www.vtwaterquality.org/planning/docs/pl_pmplan.pdf**
This plan lists data and implementation projects specific to the Poultney and Mettowee watersheds.

**VTANR, 2014, South Lake Champlain Tactical Basin Plan, Watershed Management Division,**
**http://www.watershedmanagement.vt.gov/mapp/docs/mapp_b02-04tbp.pdf**
Updated version of the 2005 Basin Plan, the TBP lists projects specific to the Flower Brook watershed, including the Stormwater Master Planning and IDDE studies currently underway. Also recommends additional assessment of the headwater tributaries in Flower Brook and conservation of reach M05T03.02, the confluence of Flower and Beaver Brooks.

**VTANR, 2014, Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan, prepared by VAAFM and VTrans, published May 29, 2014, pp. 181 including appendices,**

**http://www.watershedmanagement.vt.gov/erp/champlain/docs/Phase1-LakeChamplainTMDLImplementationPlan-Presentation.pdf**
Updated and more comprehensive (from the 2013 version) implementation plan for the Lake Champlain watershed. Strategies generally recommended for the Flower Brook watershed.

2008, 2010, 2012, VT DEC Water Quality Division, published every 2 years, *State of Vermont 2008 303(d) List of Waters*: *Part A – Impaired Surface Waters in Need of TMDL*

2014, VT DEC Water Quality Division, published every 2 years, *State of Vermont 2008 303(d) List of Waters*: *Part B – Impaired Surface Waters with a TMDL*

## Regional and Town Planning Documents

### Rutland County Regional Plan

**RRPC, 2018, Rutland Regional Plan, Rutland Regional Planning Commission, pp. 279, http://publicservice.vermont.gov/sites/dps/files/documents/Pubs_Plans_Reports/Act_174/RRPC/Rutland%20Regional%20Plan%20Adopted%20June%2019_%202018.pdf**

**RRPC, 2011 update, Rutland Region, Vermont, Hazard Mitigation Plan, Rutland Regional Planning Commission, valid through February 8, 2017, pp. 166.**

The Rutland Region Hazard Mitigation Plan shows broad support for stormwater planning and flood mitigation as seen in section 3.2, Rutland Region Hazard Mitigation Goals:

The Rutland Region identifies the following goals for completion of mitigation planning and implementation of strategies. In addition to reducing the loss of life and property, the plan describes encouraging planning; adoption of existing mitigation resources such as River Corridor Plans and Fluvial Erosion Hazard Maps; recognition of the connections between land use, stormwater road construction and land development design and maintenance, and the effects from storms and floods, and ensuring that mitigation features are compatible with streams and other surface waters.

**Section 2.3 RUTLAND REGION HAZARD INVENTORY – NATURAL HAZARDS**
What follows in this section is a detailed analysis of the natural hazards in the Rutland Region based upon available historical data. The only hazard related to stormwater is Floods and Fluvial Erosion, defined as the overflowing of rivers, streams, drains and lakes due to excessive rain, rapid snow melt or ice as well as overflow of banks caused by sudden high water flow due to breaching of dams (both human-made and natural dams caused by beavers or debris build-up).

> Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. *Development has increased the potential for flooding because rainfall that used to soak into the ground or take several days to reach a river or a*

*stream via a natural drainage basin now quickly runs off streets, parking lots and rooftops and through human-made channels and pipes*.

Flood prone areas due to natural events are found throughout Rutland Region as nearly every lake, river and stream has a floodplain. The type of development that exists within the floodplain will determine the extent of damage that flooding will cause. Of all types of natural hazards experienced in Vermont, flash flooding has historically resulted in the greatest magnitude of damage suffered by private property and public infrastructure. There is little reason to expect this to change within the near future. Over the last fifty years, flood recovery has cost Vermonters an average of $14 million a year. During the period of 1995-1998 alone, flood losses in Vermont totaled nearly $57 million. The State of Vermont reports that since 1989, $1,242,757 has been spent to repair the publicly-owned infrastructure (Public Assistance) in Rutland Region due to damage that has occurred during Presidential Declared Disasters.

Flood events in the Rutland Region are generally of two types – winter flooding associated with warm spells and snowmelt, and summer flooding associated with heavy rainstorms. The State of Vermont Hazard Mitigation Plan (State HMP) separates flooding events into three types: rain or snow melt, flash flooding, and urban flooding (2007, 43). The State HMP notes that urban flooding usually occurs when drainage systems are overwhelmed (45). These categorizations may be appropriate for the Rutland Region, given the concentrated urban development in Rutland City and the recent flooding events associated with drainage system failure, which closed much of the downtown (June 2008).

Winter flood events from December through April often include snowmelt, rain and the occasional ice jam. Rivers rise rapidly in these situations as the snow-covered, frozen ground is unable to absorb excess runoff. Acknowledging these characteristics of these winter flood events, it makes sense that April is the month of the most reported flood events in the county.

In Rutland Region, there is a history of flooding along many of the major waterways. The other rivers that flood are faster moving and more likely to cause extensive infrastructure damage. These include the Poultney River, Castleton River, Cold River, Neshobe River, Mill River, and Tenney and Moon Brooks. On occasion, Lake Champlain, along the borders of West Haven and Benson, has also been known to flood. Each town annex contains a Hazards Analysis Map which includes floodplain information.

These **Natural Resource Actions** and policies support Hazard Mitigation (p. 70):

• Work with the Poultney-Mettowee and Otter Creek Natural Resource Conservation Districts, River Corridor Management Program to better address issues of nuisance species, watershed protection, and riparian buffers, and to prioritize these initiatives.
• Work with local officials to promote partnerships between the Region’s largest land tract holders

*Water Quality*
• Assist towns to complete source water assessments.
• Assist towns in identifying floodplains and enrolling in National Flood Insurance Program.

• Work with the Vermont Agency of Natural Resources and individual communities to establish greater enforcement of floodplain regulations and floodway determinations.
• Work with communities to promote better design strategies such as Low-Impact Development (LID) and cluster development, which would lessen the impact of combined impervious surfaces therefore decreasing runoff.
• Assist communities to install regulations addressing setbacks, buffers, and other tools that protect shoreline and/or riparian areas from floodplain encroachment and fluvial erosion hazards.

## Benson Town Plan, adopted Dec 4, 2017, pp. 78

Benson is a small, rural town with a history of agricultural landuse and from roughly 1790 - 1850 was a trading hub connected to other communities via Lake Champlain and the Champlain Canal. From the introduction of the Benson Town Plan: Benson was chartered in 1780 and by 1790 the village was a prospering market center. The Town was supported in part by traffic and trade that traveled on the Whitehall to Vergennes Stage Road (Stage Road) and the road to the lake and Benson Landing (Lake Road) (pp 6-7).

The importance of Benson Landing increased after the completion of the Champlain Canal connected Benson to urban markets. In the early nineteenth century, Benson was home to many profitable sheep farms, though the advent of the 'Fair Haven Turnpike' (Rte 202A), which passes by the village, the lowering of Australian wool tariffs, and completion of the D&H Rail Line all affected local agricultural operation, changing first from sheep to dairy and later to the fewer diversified farms that we see today (from info on p 7).

Several of the top town goals (p. 10) are highly compatible with the stormwater project identification and planning work of the SWMP including:

- Preserve the Town's rural character.
- Protect the Town's natural resources and environment.
- Protect and improve water quality.

The Benson Town Plan has a Natural Resources section (pp. 40-48), which briefly touches on climate, agriculture, forestry, watersheds, surface water, threats to water quality, wetlands, flood resilience, open spaces, forest fragmentation, and a few other related geological topics. The Natural Resources section opens with a description of the former expanses of clayplain forest that the Nature Conservancy worked to replant and a description of the planting programs active in the area before the Nature Conservancy South Lake office in West Haven shut down. *While this section is well-written and accurate, the following sections are brief with no useful goals or strategies to preserve the open lands and species diversity mentioned in the section intro*. Examples of those sections are seen below (slightly edited here).

P. 42: The emphasis of our land use regulations and Town Plan in maintaining the Benson landscape is our primary method of ensuring a continuing agricultural and forestry industry in Benson.

Water Resources

Lakes, ponds, streams and wetlands have been mapped and there has been renewed interest in their importance since they support a great diversity of plants and wildlife and provide recreation and other opportunities. The various waterway flood plains are critical areas that also need attention.

Surface Waters

Benson is home to many lakes, ponds, rivers and streams. Ultimately these all flow into Lake Champlain. The Hubbardton River grows from a small stream to a good-sized river in Benson, and passes many fragments of Clayplain Forest. In the very northern part of Benson most streams flow into the East Creek watershed. Lake Champlain is the western border of Benson and of Vermont. The quality of Lake Champlain is affected by many Towns, both in Vermont and New York.

Threats to Water Quality

By educating farmers and the public about the threats to water quality, they can be encouraged to create buffer strips between areas that are plowed, grazed and treated with pesticides and/or herbicides. Buffer strips will slow the speed of the water running off the agricultural areas and filter contaminants before the water reaches waterways. ***Reducing impervious surfaces and designing yards for more stormwater infiltration will also contribute to better water quality***.

Benson's wastewater treatment facility flows into a stream, which has been listed as impaired for E-Coli by the Agency of Natural Resources. The stream eventually flows into the Hubbardton River. Upgrades have been made to remedy the situation but efforts should continue to ensure that the Town's facility is not responsible for the degradation of the stream.

The effects on water quality in Lake Champlain come from many sources. It is important to consider how lake pollution may be affecting not only the water supply of Benson's households on its shore, but also the possible effects on the health of Town residents who use the lake and who eat fish from the lake. The water quality issues may even affect expansion of tourism attractions in Benson, as the waterfront area could be developed into a vibrant social and community gathering place (*goal?*).

Wetlands

Some functions and values that wetlands provide include surface and ground water quality maintenance, flood water storage, fish and wildlife habitat, erosion control, threatened and endangered species habitat, open space and aesthetics, recreation, and education. The preservation of Benson's wetlands is vital to water quality and a healthy ecosystem.

Water Resource Protection

*Significant surface waters are specifically identified in the Land Use section and protected in a separate Land Use District*. The major stream, the Hubbardton River, is likewise protected in the Land Use Regulations. From the Benson Unified Bylaws p. 3: *All structures… must be set back at least 75 feet from the top of the bank of the Hubbardton River and the mean water level of Doughty Pond, Parsons Mill Pond, Mud Pond, Bullhead Pond, and Root Pond*. This is farther than the other lakes and Lake Champmlain, for which the bylaws require a 25-foot setback. According to the town plan (and verified in the bylaws), (Benson) relies on State regulations for protection of other resources such as wetlands, ground water and small streams. Farther stated, *The Town has no outstanding wetlands, streams or aquifers, and our surface water(s) by their very nature of clean, unpolluted recreational bodies of water are outstanding (*which might not be technically accurate*).*

All structures, except those that must by their nature (i.e. bridges, docks, etc.) be located closer, must be set back at least 75 feet from the top of the bank of the Hubbardton River and the mean water level of Doughty Pond, Parsons Mill Pond, Mud Pond, Bullhead Pond, and Root Pond
As mentioned above, additional, similar sections exist for flood resilience, forest fragmentation, wildlife habitat, and open spaces. Pages 48-49 include a list of 'goals, policies, and programs', which includes some statements and recognition of local work accomplished, but do not outline specific tasks for the town to take in preserving or improving the resources listed in this section. The following may be referred to in conjunction with stormwater mitigation, though there is not specific mention of it:

- Encourage the protection of the quality of ground water and water of our lakes, natural ponds, streams and rivers to protect drinking water, swimming, recreation, wildlife habitat, and fish consumption.
- Encourage landowners to create buffer zones between waterways and agricultural and silvicultural land.
- Limit development along waterways, lakes and ponds.
- Protect wetlands from degradation.

With exception of the one line highlighted above, there is no mention of stormwater mitigation in this town plan. Benson has no conservation commission.

Finally, the landuse and growth section outlines the existing conditions and promotes growth in a way consistent with the current land uses. A set of maps provided by the Rutland RPC indicate flood plains, soils, topography, wetlands, critical wildlife habitat, conservation areas, the designated village center, the sewer district, and a future land use map. The plan notes that the future land use map shows the intended land uses, which are consistent with the designated zoning districts, indicating that zoning exists to review development for consistency with land use goals of the town. Zoning related to future stormwater projects and/or mitigation includes adoption of bridge and culvert standards, a zoning and subdivision bylaw, and floodplain regulations.

P. 68: The Planning Commission will periodically review and update the existing land use regulations and ordinances as appropriate to accomplish the goals of this Plan. It is hoped that this effort will protect water quality, limit the loss of agricultural land, protect natural areas, protect forests and forestry, and encourage development in a way that preserves the Town's rural character and natural beauty. For this reason, five land use districts have been established, with differing objectives in each. It is not the goal to prevent development, but to direct development such that the unique social, environmental and historical characteristics of Benson are preserved.

Three land use districts have been identified by the Town of Benson (p. 69) and include Agriculture and Rural Residential, Village District, and Lake Shore District. The Lake Shore District in particular calls for a 500 foot buffer along all lakes in the town 'to protect water quality, while balancing the desire for development with the need for protecting public access, the shoreline and wildlife habitat and used to protect the lakes'. This district is the one where stormwater mitigation might be an important focus to protect the lakes from pollution, sediment, and nutrients.

The plan ends with several beautiful maps showing several large conserved areas, a high percentage of prime and statewide ag soils (map 1), many wetlands to the west of the Village, a significant and wide river corridor mapped along the Hubbardton River, relative lack of steep lands (map 2), and roughly ½ the town is mapped as high quality forest blocks (map 3). The town plan does not refer to any specific zoning language except that noted above. It would be good to cross reference this document with existing zoning for the town and reference where to find this zoning.

## Castleton Town Plan, Adopted July 9, 2018

The Castleton Town Plan has well-written and thorough Land Use and Natural Resources Sections, describing Lake Bomoseen, the surrounding wetlands, and the steep surrounding mountain areas in detail. Within the Land Use section, the Castleton Town plan lists Water Source Protection and Flood Hazard as Land Use Districts.

The Castleton Town Plan lists as a goal: Provide for development that fits the character of existing development, functions in an efficient and coordinated fashion, and supports the vitality of the community. The supporting rationale includes: Proposed land use patterns are intended to accommodate future growth in harmony with the natural capabilities of the land and the ability of the town to adequately provide municipal services. Castleton's scenic and natural resources are among the town's primary assets. Future land use and development should proceed in such a way that these assets are protected and enhanced while establishing a built environment that is both functional and aesthetically pleasing.

Within Policy 1, Maintain Sound Land Use Policy…, adopt regulations for ridgeline development, shoreland, groundwater recharge areas and other identified natural areas to carefully regulate development in these areas, and generally restrict development on slopes in excess of 25% in grade. Through Policy 3, Maintain and Protect the Quality and Character of Historic Settlement Patterns, there is mention of continuing to require a site plan for all non-residential development. *This process could be extended to include review of all new impervious areas to encourage stormwater treatment onsite*.

Policy 4, is to "preserve agriculture, scenic resources, and open space". Program areas include economic incentives to encourage preservation of scenic resources and open space, inclusion of greenbelts and common land areas in subdivision design, and use of cluster subdivision techniques. *A similar policy encouraging the use of green stormwater practices and recommending stormwater mitigation projects for existing infrastructure contributing to flooding and pollution issues in Castleton, should be included in the Town Plan.*

Comments based on the NATURAL RESOURCES SECTION, p. 25-36.

**Climate and Topography**- The Natural Resources section of the Castleton Town Plan includes background information about climate and topography that underlines the need for comprehensive plans to manage stormwater. Castleton receives 38-42 inches of rain annually and around 60 inches of snow (p. 25). This amount of precipitation leads to runoff, especially during periods of winter and spring thaws and thunderstorms. Additionally, Castleton is located entirely within the Taconic Range, characterized by rugged mountains and irregular topography (p. 25), further emphasizing the need for comprehensive stormwater planning.

**Agriculture and Forest Resources-** Castleton's forested upland hills and mountains remain undeveloped due to their inaccessibility by town roads and the limiting influence of steep slopes and shallow soils. There are also several extensive land areas in Castleton that are owned by the state (2287.5 acres in total). Lands under the jurisdiction of the State include Love's Marsh and Blueberry Hill Wildlife Management Areas that are managed by the Fish and Game Department. Bomoseen State Park, located in West Castleton, fronts, in part, on the lake and is under the management of the Department of Forest and Parks. The Town of Castleton owns a town forest (96 acres), a short segment of shoreline in the Crystal Beach area (5.9 acres), and a small parcel adjoining the Crystal Beach area to the north (5.9 acres) (p. 25-26).

**Watersheds, Surface Waters and Wetlands**- The Castleton River and its tributaries drain the majority of the town, including Gully Brook, North Breton Brook, Pond Hill Brook and Lake Bomoseen. Significant bodies of water in Castleton include the 2,360 acre Lake Bomoseen, 202 acre Glen Lake, 42 acre Pine Pond, 62 acre Love's Marsh, and the town's largest flowing water body, the Castleton River (p. 26). Love's Marsh, located on the northwestern shore of Lake Bomoseen, is the most extensive wetland wholly contained within the town. Maintained by the Fish and Game Department as a wildlife management area other highly productive wetlands in Castleton include: the northeastern end of Lake Bomoseen, Pine Pond Marsh, and Lilly Pond (p. 27).

**Flood Hazard Areas and Floodplain Management-** Flood hazard areas are identified on the Castleton Natural Resources Map 1 and in more detail within the Digital Flood Insurance Rate Map (DFIRM) for Castleton, updated in 2008 by FEMA and the State of Vermont.

Most communities in Vermont rely solely on the minimum standards of the NFIP to protect their communities from flood hazards, but all should recognize that floodplain management based solely on NFIP minimum regulations allows for development in floodplains that will reduce the floodplain's ability to convey and store water. NFIP minimum standards also do not preserve other natural and beneficial functions of the floodplain, such as water quality maintenance and protection, groundwater recharge and discharge, and biologic resources and functions. Communities should consider adopting flood hazard area regulations that are more stringent than the minimum requirements for participation in the NFIP. Communities that adopt more stringent regulations are eligible to receive insurance premium discounts for their residents through participation in the Community Rating System.

The flood resiliency map indicates the number of structures in our flood prone areas. You will note the total number is 63, which indicates a low possibility of major flooding impacting structures in the town as a whole, with only 2 structures in the area with the highest chance of flooding (p. 27-28).

**Fluvial Erosion Hazard Mitigation and River Corridor Protection**

Municipal adoption of a Fluvial Erosion Hazard overlay district is one of the best avoidance strategies for fluvial erosion hazard mitigation. An overlay district is an additional zoning requirement placed on a specific geographic area (in this case the FEH zone) without changing the underlying zoning. The degree of protection afforded by an FEH overlay district depends on the exact wording, but could include limits on structures, land use activities, or even vegetation. Limiting development within an overlay district based on the boundaries of an FEH map has two major functions. First, it will prevent development in hazardous areas, reducing costly flood losses. Second, it will prevent river corridor encroachment, which would increase overall fluvial erosion hazards and even impede a river's natural tendency to adjust toward a more stable condition.

The Vermont Agency of Natural Resources has sponsored a Stream Geomorphic Assessment (SGA) of the Castleton River. The data indicates that these streams have been highly modified in the past to make room for human investments such as roads and houses. These modifications have led to unstable stream systems resulting in increased flooding and erosion hazards and compromised habitat for aquatic species. For more information on Flood Hazard Areas and Fluvial Erosion Hazards see the Castleton Annex of the Rutland Region All Hazards Mitigation Plan.

**Stormwater**

Phosphorus and other pollutants in stormwater runoff are addressed to some extent for new developments in Vermont that require state stormwater discharge permits or state land use (Act 250) permits. Erosion control and stormwater management requirements are generally included as conditions in these permits and these practices help limit new sources of phosphorus loading caused by land development. However, these permits are required primarily for large projects, and many small developments may have a significant cumulative effect on urbanization and phosphorus loading. Towns can implement their own LID(Low Impact Development) site design standards and encourage GSI(Green Stormwater Infrastructure) measures, such as rain gardens and bioswales, on private and public properties.

Simple erosion control measures are possible for one or two family dwellings and accessory uses. These can include setbacks and buffers along surface waters, wetlands, and property lines so that no soil or water move into these areas. They can also include the use of stone check dams, silt fence, stormwater diversion ditches, designated areas of infiltration, seeding, and mulching. The following erosion control policies and requirements should apply to all development activity, including single family and double family residential development with accessory uses. Site visits from local regulatory individuals should be conducted to ensure compliance with these measures during construction, and to take appropriate enforcement steps if necessary.

Adequate erosion control is required on projects that go through the Act 250 development review process. However, most development is regulated not through Act 250 but through local zoning. At the municipal level, simple erosion control measures should be required for one or two family dwellings and accessory uses through the permit application process. The applicant should provide the following information on the applicable municipal permit application:

- The locations of any surface waters and wetlands.
- How the structure and any disturbed soil will remain at least 50 feet from these features.
- Where the limits of disturbance will be and how the applicant is minimizing the area of disturbance.
- Where silt fence or stone check dams will be installed.
- Where any roof and driveway runoff will go to infiltrate once the house or structure is complete (p. 28-29).

**Impervious Surface Minimization and Site Design**

This section provides a rationale for minimization of impervious surfaces and many suggestions for how to do so, such as: encouraging use of open vegetated channels for stormwater runoff, creating urban or suburban zoning regulations for narrower streets, shorter or shared driveways, smaller parking spaces, and reduced setback distances from roads, and encouraging alternative modes of transit (mass transit, bike paths, commuter parking) to reduce the need for new roads and parking.

**Water Quality Threats in Lake Bomoseen**

**Development and Recreational Use**- This section mentions building setbacks, vegetative buffer strips, and properly designed and installed septic for enlarged or year-round septic systems. *No mention is made of the sedimentation from local roads and streamflow entering the lake. Stormwater inputs of sediment, nutrients, and other pollutants do pose significant water quality threats to Lake Bomoseen*.

**Riparian Buffers**- This section mentions characteristics of effective buffers for phosphorus removal and cites the Vermont League of Cities and Towns' model riparian buffer ordinance, *but does not specifically recommend that Castleton adopt such an ordinance* (p.32-33).

**NATURAL RESOURCES GOALS, POLICIES, AND PROGRAMS**
**Agriculture and Forestry**
**Goal**
Protect Castleton's farm and forest resources for future generations to enjoy.
**Rationale**
Clean air and water, as well as intact forests and working farms are essential to the health and quality of life of all living things that inhabit a community.
*Might add: Farms and Forest lands, especially those with healthy soils, decrease stormwater inputs to streams and can help protect against future flooding.*

**Policy 1**
Maintain and improve the quality of important soils, such as agriculture and forestry soils, when considering the future development of the town.
**Programs**
- Discourage development in areas of important agricultural and forest soils.
- Preserve farm and forest lands and maintain the working landscape through conservation, agricultural easements, and land acquisition.
- Promote the use of acceptable soil erosion control measures in development of slopes in excess of 8%.
- In zoning bylaws, adopt a Fluvial Erosion Hazard Overlay District (as explained on p 29) and/or River Corridor protections to ensure that development in hazard areas is reasonably safe and accomplished in a manner that is consistent with public wellbeing, does not impair stream equilibrium, flood plain services, or the stream corridor.
- Require Low Impact Development (LID) for new development site design and promote Green Stormwater Infrastructure (GSI) measures for stormwater management (as explained on p 30).
- Update subdivision regulations to minimize the creation of new impervious surfaces (as explained on p 31).

**Water Resources**
**Goal**- Protect and retain the quality of Castleton's surface water, groundwater and wetlands resources and enhance opportunities for access, recreation, education and natural beauty in these areas.
**Policy 1-** Prohibit any development that will degrade water quality in Castleton.
**Programs**

- Establish and enforce setback and vegetative buffer requirements in Castleton zoning regulations for development along lakes, rivers, streams and wetlands; using state recommendations listed on page 33.
- Enforce all provisions of Castleton's shoreland zoning requirements.
- Reduce erosion and siltation of shorelines and stream banks by requiring proper stabilizing measures for new construction under Castleton's site plan review.
- Require on site storm water management measures be implemented on all new construction sites under Castleton's site plan review.

**Policy 2-** Protect lakes, ponds, rivers, streams and wetlands from pollutants.
**Programs**

- Discourage application of lawn fertilizers and pesticides along lakeshores and streambeds.
- Establish and enforce setback and vegetative buffer requirements in Castleton zoning regulations for development along lakes, rivers, and streams.
- Keep abreast of the results of the Department of Environmental Conservation's biological assessment program and Poultney Mettowee NRCD's phosphorus and bacteria monitoring in the Castleton Watershed.
- Seek funding for measures recommended by the ongoing stormwater master planning work funded by the Department of Environmental Conservation and conducted by the Poultney Mettowee NRCD in Lake Bomoseen and the Castleton River Headwaters.
- Keep abreast of the results of the Department of Environmental Conservation's water quality monitoring program in the Castleton River.
- Support the efforts of the Poultney-Mettowee watershed Partnership to educate the public about threats to surface water resources, best management practices to reduce human impact, and to work proactively to remediate and restore impaired, eroded or polluted surface water resources.

**Flood Hazard Areas**
**Goal**
Control development within areas subject to periodic flooding
**Policy 1**
Continue to review development in Flood Hazard Areas for compliance to the Castleton Flood Hazard Area Regulations.

**Fragile, Unique Habitats and Open Space and Scenic Resources**
**Goal**
Protect fragile, unique habitats and open space and scenic resources from the adverse effects and encroachments of development.
**Policy 3**
Support the conservation of large tracts of forest areas and open space so as to maintain critical wildlife habitat, ample corridors to accommodate seasonal migration patterns, and a scenic balance between the built and natural landscape.

*The plan is missing a stormwater goals, policies, and programs section, which might be well-placed after the Flood Hazard Areas goals section. A stormwater goals section, might mention that the large, undeveloped tracts (mentioned in Policy 3) also protect against stormwater and flooding…*

## Fair Haven Town Plan, dated November 19, 2015, 44 pages

Fair Haven's town plan opens with a remarkable and very interesting historical description of the town founding and history of the buildings and people central to the early days of town life. The town's history, like many in the area, dates back to pre-revolutionary war days and it's early activities were focused on local resources including the falls along the river in town and the introduction of slate quarrying. The introduction, like most of the rest of the plan, does not highlight the natural resources of the area or mention stormwater mitigation.

Fair Haven's Town Plan includes one page of Natural Resources information (p. 15), with an interesting description and defense of the rattlesnake colony located in Fair Haven and only the following under the section titled 'water':

> *Water Quality - Protecting the quality of water servicing the town, including both groundwater and surface waters, is an important part of the Town Plan. Water quality is protected in numerous ways including: 1) regulation of on-site sewage systems 2) Surface water setback requirements 3) Floodplain regulations 4) Vegetated buffer requirements 5) Erosion control measures on steep slopes*

The wetlands section does not actually mention any wetlands, but the Poultney and Castleton Rivers and Inmann Pond, the town's drinking water reservoir.

Flood Resilience Section (p.25)

The following goals are listed in the Flood Resilience section: 1) To make certain that the Town of Fair Haven is able to recover from flooding quickly and in a way that improves flood resilience. 2) To see that development in the Town of Fair Haven occurs in a manner that does not worsen flooding. 3) To make sure that the citizens, property and economy, the quality of life of the townspeople of Fair Haven, and the town's natural resources are protected by using sound planning practices to address flood risks.
Action Items:

- Complete the EPA and State of Vermont flood resiliency checklists.
- Invite the State to ground truth the town's river corridor maps.
- Adopt River Corridor Protection language into the Town's Flood Hazard Regulations.

The Land Use and Future Land Use does not contain descriptions of or actions to protect natural resources in the town. The following is found in a notes page about the 2015 update: 'It is the belief of the town that this Plan is compatible with those of its neighbors, sharing many of the same values for water quality protection and concentrated development (of) industries.'

The Natural Resource Maps 1 and 2 (p. 42 and 43) show large tracts of conserved lands in the northern portion of the town and high levels of prime ag soils (great for infiltrating stormwater) in the southern part of the town. Additionally, the maps show large tracts of undeveloped flood prone areas in the Mud Brook watershed. These areas likely have great unrealized potential to absorb floodwaters, as it is mentioned many times in the town plan that Fair Haven does not suffer from flooding during historic flood events.

## Town of Ira, Adopted April 21, 2020

Ira has limited watershed. In contrast to some neighboring communities, there are no lakes, and there are very few ponds or other bodies of standing water such as marshes or bogs. Ira Brook, which flows north through the southern half of Town, and the Castleton River located in North Ira, are the two rivers in Town and account for the majority of wetlands indicated on the Town's land use map. The topography in Ira is such that the mountainous and mostly 9 wooded areas in the outlying areas of Town serve to channel precipitation, in the form of runoff, to the lower lying and settled regions in Town which are dependent upon such water for residential uses (p. 8-9).

Though not listed as a potential sink for stormwater, p. 25 lists other benefits of the forested landscape and has a nice mention of forest fragmentation, explaining the process and some of the results.

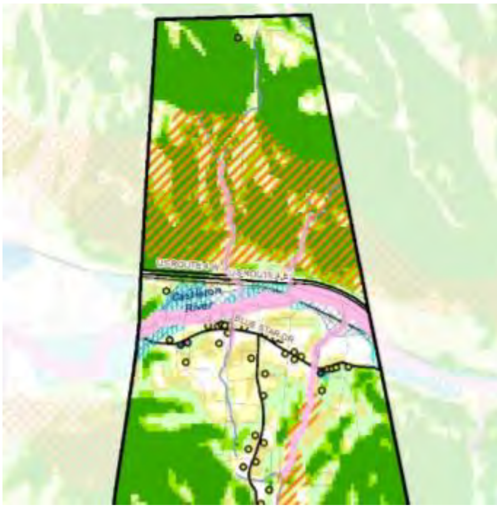
Again, while stormwater management is not listed in the ‘rivers’ section, p. 28 mentions the function of wetlands for storing stormwater. The majority of Ira's wetlands are found along the Castleton River in the northern part of Town and on the Ira Brook.

**Natural Resources Goals and Objectives** (p. 30-31)
Goal: Protect and preserve the natural features in Ira, particularly the areas of high elevation, and promote land uses appropriate to the natural character of the land.

- Encourage development that will minimize runoff in vulnerable areas.
- Further identify and map areas of particular scenic and ecological importance to the community and the environment.
- Continue to support the road crew in employing gravel road maintenance techniques that prevent soil erosion and road surface deterioration.

Goal: Maintain and enhance the quality of ground water resources and their resource protection areas from adverse development.

- Identify and protect all wetlands which provide significant functions and values in such a manner as to achieve no net loss of such wetlands and their functions.
- Significant wetlands and other critical natural communities should be protected from development by encouraging the maintenance of an undisturbed buffer strip of naturally vegetated upland at least 50 feet in width around the edge and by preventing runoff and direct discharge into wetlands.



Beginning on page 31 is a Flood Resiliency Chapter. Often the methods used to reduce flood vulnerabilities in towns are similar to the methods used to address stormwater issues and have many overall water quality benefits. For example the maps listed on page 33, FEMA inundation and Vermont DEC River Corridor maps are important in both stormwater and flood-related planning. Page 52 of the Ira Town Plan shows Map 1 of the Natural Resources Maps, which delineates the floodplain along the Castleton River. (Castleton River section of Ira shown at left).

Within the Flood Resiliency Section of the Ira Town Plan, several sections contain relevant information to this study: History of Flooding, Flood Hazard Area Regulations, Flood Hazard Mapping and Assessment, and Goals and Objectives.

Within History of Flooding, the recent flood dates are recorded, including 1996, 2000, 2011, 2013, 2017 and 2019 in which lands in Ira were Federally declared disaster areas due to extensive flood damages. Also noted are the steep back roads, which sustain repeated damages from storms including loss of gravel and culverts. Solutions for both flood hazards and stormwater management include planting stream buffers, stabilizing stream banks, removing berms, removing structures, and restoring incision areas (p. 34).

Community Outreach and Planning includes important information on stormwater reduction elements, such as the importance of riparian buffers, wetlands, and upland forests, though these features are not recognized in the plan as minimizing stormwater. Impervious surfaces are noted as increasing the amount and velocity of stormwater runoff.

**Flood Resilience Goals and Objectives** (p. 35)
Goal:
The citizens, property and economy, and the quality of the Town's natural resources are protected by: sound planning practices to address flood risks; development in the Town that does not interfere with natural river functions and will not worsen flooding; and other measures that increase the Town's flood resilience.

Action Items:

- Assess feasibility of adoption of river corridor bylaws.
- Work with the RRPC and the state floodplain manager to establish and sustain a flood hazard area education and outreach effort to support flood damage mitigation and better insure community residents and property for future flood damage.

The Transportation section contains important information for stormwater planning under Bridges and Culverts and Municipal Roads General Permit. Ira has a total of 98 culverts, all of which were inventoried in 2017. Of the 98 total culverts, 23 culverts are listed as poor, critical, or urgent condition and should be scheduled for replacement and/or upgrade in accordance with the VTrans Town Road and Bridge Standards (p. 42).

The Municipal Roads General Permit (MRGP) is intended to achieve significant reductions in stormwater related erosion from municipal roads, both paved and unpaved. In order to comply with the MRGP, towns implement a customized, multi-year plan to stabilize their road drainage system. Ira, with the help of the RRPC, has conducted a road erosion inventory to identify problematic road segments, develop mitigation strategies, and target potential sources of funding. The RRPC created a Road Stormwater Management Plan to assist the Town with planning road segment upgrades under the MRGP. Currently, the Town has one very high, four high, and several moderate and low priority road segments that need to be upgraded to MRGP standards.

The plan lists both “Develop a Capital Improvement Plan to identify, prioritize, and fund transportation related projects” and “Continue to comply with the Municipal Roads General Permit” as goals, with action plans being:

- Utilize vtculverts.org to plan culvert upgrades and maintain an up-to-date culvert inventory.
- Apply for state and federal grants to assist with project funding including funding to support replacement of aged equipment.
- Utilize the MRGP Implementation Table Portal and the Road Stormwater Management Plan to plan upgrades to road segments that do not meet the standard.
- Apply for state funding from the Better Roads Program, Grants In Aid, and other VTrans stormwater funding sources to improve roads and stormwater infrastructure.

The Future Land Use section suggests minimal development along Ira brook, with setbacks to be encouraged for any development. It also suggests encouraging riparian landowners to pursue bank stabilization projects. The section also suggests limiting development in the Highland Conservation District (p. 46-47).

## Hubbardton Town Plan, Adopted October 24, 2016.

The town of Hubbardton is characterized by rural residential scattered development with concentration of seasonal dwellings around lakes and ponds (p. 1). Located in the Taconic Mountains, Hubbardton has varying topography, including many lakes, ponds, and streams. Due to the many steep hills, valleys, marshes and wetlands, agriculture is limited.

**NATURAL RESOURCES (p. 15-19)**

The natural resources section lists as a single, broad goal: “Protection of water, open space, and ridgelines” (p19). While there is no mention of the impact of stormwater on these resources, the plan does list as objectives:

- Workshops and forums on the Clean Water Initiative and Green Stormwater Initiative with Rutland Regional Planning Commission and Poultney Mettowee Natural Resources Conservation District by 2020
- Adopt a River Corridor Bylaw
- Invite PMNRCD to present to the Planning Commission information from the Lake Bomoseen Stormwater Master Plan by 2021
- Adopt a Stormwater and Erosion Control Bylaw by 2023

**Agricultural and Forest Lands** (p. 15)

There are no working farms left in the community and a relatively small portion of the land is considered prime for agricultural purposes. However, high quality agricultural soils and high-quality forest soils are scattered throughout the town. High quality forest soils are not limited to any particular landform. It is important to note that many soils classified as having high potential for agricultural production may also have high potential forestry and may overlap.

**Water Resources: Watersheds** (p. 16)
Most of Hubbardton is located in watersheds feeding the Poultney and Hubbardton Rivers, with a small corner flowing into Otter Creek and Little Otter Creek. All of these watersheds drain into Lake Champlain, making the entire town a component of the much larger Lake Champlain Basin.

**Water Resources: Surface Water** (p.16)
Surface water resources are abundant in Hubbardton and provide ecological habitat, recreational opportunities and visual beauty. There are nine lakes and ponds qualifying as public waters (over 20 acres in size) as well as several more ponds below the threshold for public waters. Hubbardton has two water bodies in its boundaries that are potential candidates for reclassification and increased protection: Giddings Brook for reclassification as a B(1) water, and High Pond for an A(1) or Outstanding Resource Water designation. Residents on several lakes have formed lake associations to manage issues including water quality.

**Water Resources: Wetlands** (p. 16)
Wetlands are land areas that are saturated with water at least part of the year and include marshes, swamps, sloughs, fens, mud flats and bogs. Wetlands provide important wildlife habitat, but also provide other benefits such as storing storm water runoff, purifying surface and groundwater supplies, recharging aquifers, controlling erosion, as well as providing areas for recreation.

Hubbardton has 1,057 acres of Class Two wetlands, as identified by the National Wetlands Inventory or 5.8% of the town's land area. Per the VT Wetlands Act, a 50-foot buffer zone protects all Class Two wetlands.

The section detailing sources of surface water pollution (p.17) lists road salt as a pollutant, but general roadway sediment and road erosion are not listed.

**Surface and groundwater protection measures:**
- Regulating on-site sewerage systems
- Surface water setback requirements
- Floodplain regulations
- Vegetated buffer strips
- Erosion control measures on slopes
- Protection of wetlands
- Back-road maintenance

*Green stormwater infrastructure should be added to this list.*

**Flood Hazard Areas and River Corridors**
The town adopted Flood Hazard Regulations in 2008, which regulate and protect the Special Flood Hazard Area (the 100 year floodplain, as mapped by FEMA). The town is looking to adopt River Corridor

protections as well, which would protect river banks from erosion and development. Hubbardton's topography and pattern of settlement are such that the town sees minimal damage from flooding, even in large scale flooding events like TS Irene. However, the town is still acting proactively by updating zoning to protect stream banks from erosion and development, and by updating their local hazard mitigation plan with flooding and erosion mitigation actions.

Flood hazard areas are identified within the Digital Flood Insurance Rate Map (DFIRM) for Hubbardton updated in 2008 by FEMA and the State of Vermont.

**Water Resources: Riparian Buffers** (p. 17-18)
This section defines and details the benefits of riparian buffers. It also states the legal standing towns have to adopt setback and buffer requirements and lists ways these requirements might be implemented, but does not expressly say Hubbardton plans to do so.

**Scenic Roads, Waterways, and Views** (p. 18-19)
Siting of future development should always consider the potential impact on the aesthetic qualities of the community and preserve the undisturbed integrity, wherever possible, of Hubbardton's scenic and open spaces. Any development that impacts the pristine and unbroken viewscape of the ridgelines is discouraged. (*This will protect against increased runoff and flooding*).

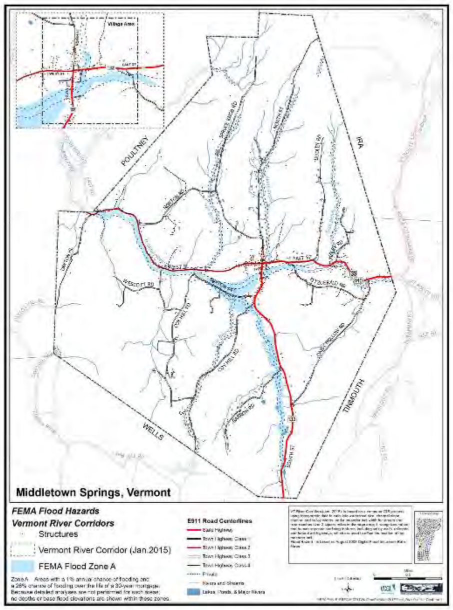
Many brooks and the Hubbardton River, which once were a source of industry for Hubbardton, flow in and through the town. These all are connected to the ponds and lakes.

**TRANSPORTATION** (p. 30-31)

**Private Roads**
There are numerous private roads in Hubbardton, usually used to access the seasonal homes surrounding the lakes. These roads are gradually becoming inadequate for more frequent and winter traffic demands. As has been the case in other parts of Vermont, converting these to town roads in the future (if requested) may become a problem due to inadequate dimensions and/or maintenance costs to the community. Highways and private roads in town are depicted on the Hubbardton Community Map on page 22.

**Bridges**
Bridges and culverts are challenging to maintain and expensive to replace. Thus, they are a major focus of transportation and management. Hubbardton has 16 bridges in its highway network and approximately 373 culverts. Some of the town's bridges are severely lacking in adequate maintenance due to a lack of necessary funding.

## Middletown Springs Town Plan, Adopted March 7, 2017, 64 pages




Middletown Springs formed in 1784 when citizens from Ira, Poultney, Wells, and Tinmouth petitioned the Vermont legislature to create a town bounded by the ridges that prevented them from attending meeting and worship services in the original towns.

Middletown Springs town plan highlights in the Past section (of Past, Present, and Future), the importance of the Poultney River and its tributaries. Talking about the floods of 1811 in the introduction creates a great reminder of the importance of maintaining, improving, and protecting flood zones. The town's plan states in the Future section that a general goal is the protection of the environment, which is a recurring theme throughout the plan.

**Overview** (p.8)

"Because the Town lacks a formal zoning ordinance, future development can legally occur in most locations without formal Town review." This could lead to development in wetlands, ridgelines, and steep slopes potentially compromising roads, culverts and bridges built to meet current flooding standards. Risking past, present and future general goals (p.4) and Overall Land Use Goals (p.9) which preserve maintaining rural appearance, protect the environment, and ensure agriculture and forestry operations downhill/downstream of the developments are not compromised with increased levels of stormwater runoff.

**D. Natural Areas and Resources** (p.15-20)

Ecological Features (p.15)

Protecting the diversity of species and ecosystems, important ecosystem functions are maintained such as pollination, carbon storage, flood and erosion control, and maintenance of soil, water, and air quality.

Local and State Significant Natural Communities (p.16-17)

High quality wetland natural communities including floodplain forests and a seepage swamp forest have also been identified in Middletown Springs. These areas are considered locally-significant based on the important functions and values they provide and potentially state-significant based on natural community characteristics. It is likely that further survey efforts will identify additional examples of locally- or state-significant natural communities in Town.

Lowland Conservation Areas (p.18)

The surface waters and wetlands found in Middletown Springs are associated primarily with the upper reaches of the Poultney River and its tributaries. The entire town, with the exception of a small amount of land in the southwest and northeast corners, falls within the upper Poultney River watershed.

Wetlands (p.18)

All wetlands on the Vermont Significant Wetlands Inventory (VSWI) are subject to Vermont Wetland Rules. In addition, wetlands that have significant function and value, even if they do not appear on the VSWI map are under the regulatory jurisdiction of the Vermont Wetlands Rules. The wetlands map completed during the Wildlife Habitat Inventory by the PMNRCD in 2011, includes some wetland areas not included on the VSWI as well as a wetland function and value assessment of all mapped wetlands. Since small forested wetlands, vernal pools, seepage wetlands on slopes, and temporarily flooded wetlands are difficult to detect remotely, wetland mapping is an ongoing process.

Surface Waters and Riparian Zones (p.18-19)

Middletown Springs recognizes the need to protect and improve water quality through the practice of Accepted Agricultural Practices (AAPs) and Best Management Practices (BMPs). In order to balance the need for water quality improvement with the need to sustain a healthy, economically-viable agricultural and forestry industry. In addition, it is important that water flowing into Lake Champlain not exceed the nutrient levels necessary to meet the phosphorus goal for South Lake B, as cited in the Vermont Water Quality Standards.

Goals (p.19)

- Maintain large areas of contiguous, unfragmented forest with natural streams, wetlands, cliffs, and ridge tops to ensure habitat for all naturally-occurring species and to maintain viable natural communities.
- Maintain riparian and upland habitat corridors to connect large areas of contiguous forest and allow unhindered movement of animal populations between the Green Mountains and the Adirondacks.
- Protect streams, wetlands, vegetated riparian areas, and floodplains to ensure high surface and groundwater quality and minimize flood danger.

Strategies (19-20)

- Encourage protection and/or planting of riparian buffers and protection of viable flood plains. Promote the use of state and local river corridor easements, where appropriate.
- Support continued efforts to protect wetlands, especially state and locally-significant wetlands through site visits and landowner outreach.
- Manage the use of herbicides and road salt to protect water resources from pollution or destruction.
- Support efforts to assist landowners in obtaining information, grants, and assistance for such projects as bank stabilization, best agricultural practices, sustainable logging practices, sustainable energy sources, road construction, recreational use, protection of state-significant natural communities, forested wetlands, vernal pools and conservation easements.
- Ensure that state and federal regulations to protect soil and water resources are followed in development, road building and maintenance, agriculture, and logging activities.
- Maintain existing Flood Plain Regulations to protect property and adopt the state-recommended River Corridor Overlay to protect sensitive areas along rivers and streams from new development.

- Support efforts such as The Vernal Pool Mapping Project (VPMP) (www.vtecostudies.org/VPMP/background.html) to encourage citizens to report the location of vernal pools and to field-verify pools that have been mapped remotely.
- Continue current efforts to control invasive species on public lands and work with landowners to control invasive species on private lands.

**Private Roads** (p.26)

If new roads are poorly designed, they can have a negative impact on the natural resources and scenic beauty of the Town. Soil erosion, disturbance of wetlands and wildlife habitat, and infringement on ridgelines or viewsheds are some of the potential impacts of poorly designed roads.

**Flood Resilience** (p.29-33)

Lands Which Helps Prevent Flooding (p.29)
Riparian buffers, wetlands, and upland forested hillsides are important features in town that naturally filter and store stormwater and help to prevent flooding

Mapping Flood Hazard Areas & NFIP Participation (p.30-31)
Middletown Springs received a flood hazard boundary map in the late 1970s and joined the National Flood Insurance Program (NFIP) in 1985. Currently there are 29 structures in the high hazard zone (Zone A) that do not have flood insurance. Development in the river corridor and stream channel management over time has decreased channel stability. While these management practices may create the illusion of stability, these engineered channels, when tested by a high flow such as a flood, cannot be maintained. Stream Geomorphic Assessments and River Corridor Plans have been completed for most streams in Middletown Springs, including the Poultney River and many of its tributaries. These studies identify areas subject to normal channel erosion processes and help towns and landowners avoid loss of floodplain functions. The assessments also collect data on the long-term function of stream crossing structures, such as bridges and culverts, and predict the potential for future flood-related failures at these sites.

History of Flooding in Middletown Springs (p.31)
Repeated flooding has occurred at the Mineral Springs Park, located in the Poultney River floodplain. Roughly twenty-nine buildings stand in floodplains in town and are potentially subject to flooding, though flooding events in Middletown Springs are relatively rare. During Tropical Storm Irene (8/28/2011) North Brook flooded Burdock Avenue and the homes along that road were evacuated. A tributary to North Brook washed out several hundred feet of North Street, cutting off access to a number of homes. The work to replace the damaged, undersized culvert cost approximately $250,000, underscoring the need for ongoing planning and budgeting to replace potentially vulnerable culverts found on town roads.

Land Use Bylaws (including Flood Hazard Regulations) (p.31)
Middletown Springs does not currently have Land Use Bylaws. Under its current flood hazard regulations, Middletown Springs does not qualify for favorable (17.5%) state reimbursement rates after disasters as established in the Emergency Relief and Assistance Fund (ERAF) rules.

Development in Flood Hazard Areas (p.31-32)

As of 2015, 29 structures are within a special flood hazard area (SFHA) located in the 1% annual chance flood hazard area.

Goals (p.32)

- To recover from flooding quickly and in a manner that recognizes and addresses past vulnerabilities and improves long-term flood resilience.
- To encourage development in town in a manner that does not increase vulnerabilities from flooding in Middletown Springs or in towns located downstream of Middletown Springs (e.g. Poultney).
- To understand and protect natural river functions in Middletown Springs.

Strategies:
1. Explore Implementation of Select Land Use Bylaws
2. Encourage Green Stormwater Infrastructure techniques to implement on-site stormwater practices to increase infiltration and decrease runoff to the Poultney River and its tributaries.
3. Explore Funding Sources for stormwater management projects, including examining the steps that must be taken to qualify for increased reimbursement levels from the Vermont Emergency Relief and Assistance Fund.
4. Consider Regional Watershed Stormwater Management and coordinate with Tinmouth and Poultney on regional stormwater management planning and implementation projects. To protect the residents and lands in Middletown Springs and Poultney, new connections to the existing storm drain system in Middletown Springs should be discouraged in favor of on-site stormwater treatment.

## Pittsford Town Plan, Adopted February 7, 2018

From the introduction: The Town Plan should be used in a variety of ways. First and foremost, the Town Plan should be a basis for community programs and decision-making. For example, it should influence the town's budget and capital expenditures, community development efforts and natural resource protection initiatives (p. 4). That said, the town does not have many actionable items related to conservation and preservation of water quality, managing stormwater, etc, within their town plan.

**Physical Characteristics** (p. 10-11)

The town of Pittsford lies between the Taconic Mountains to the west and the Green Mountains to the east. Otter Creek, which winds its way between Florence and Pittsford, is the second largest watershed in the State of Vermont, which flows into Lake Champlain. Florence and Pittsford are located within the Vermont Valley Biophysical Region. Furnace Brook also flows southwesterly through the town and has provided a source of power in the past.

East of Otter Creek, Pittsford is located in an area of favorable slopes and soils. This holds true except for lands along East Creek, which runs from the Chittenden reservoir through east Pittsford in a flood plain that was a 300-acre lake until a 1947 flood destroyed the dam. Cox Mountain, Blueberry Hill, Biddie Knob, Bald Peak and lands above 800 feet all present limitations to extensive development due to their steep slope and poor soils. The most prevalent problems are unfavorable permeability, shallow depth to bedrock and an excessive amount of stone. These higher elevations retain rainfall providing for water supplies while supporting woodlands and marshes necessary for wildlife. Industrial development here should be prohibited and other development here should be severely limited to low impact residential and agricultural use so as not to disturb the delicate nature of these areas.

**Land Use** (p. 14)

Several acres of forested land also exist in the town in the form of preserves or other lands unavailable for development. These properties include:

- 1,787 acres owned by the Nature Conservancy
- A 109-acre portion of the Proctor Town Forest
- A 360-acre parcel owned by the Vermont Department of Fish and Wildlife
- 55 acres owned by the Historical Society
- 14 acres in a town forest and a 48-acre town recreational area
- 43 acres owned by the school district.

These properties comprise a natural resource, which this plan endorses as worthy of retention in their natural state.

**Land Use Districts and Overlays** (p. 15)
The following land use areas reflect the town's future plans for management of growth while considering environmental constraints such as flood plains, wetlands and steep slopes found throughout the community. Taken together, these areas provide a variety of agricultural, business, residential and recreational opportunities.
1. Village This area is mostly the former Village of Pittsford. This plan proposes to maintain the village's traditional social and physical character, while promoting commercial and small business growth within this area.
2. Designated Village Center
3. Rural
4. Industrial
5. Commercial
6. Conservation

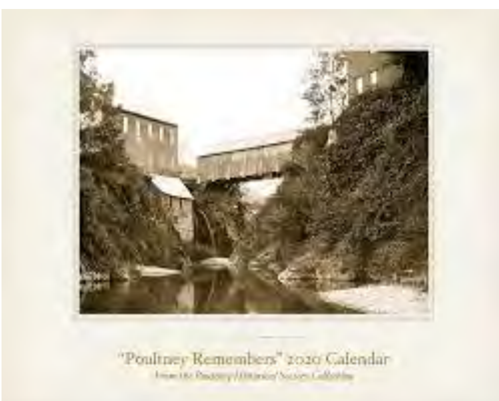
The Conservation areas are above the eight hundred (800) foot contour and are generally characterized by dense forests, steep hills with shallow or otherwise fragile soils, stream banks and elevations where development is to be limited. These lands are important sources for water supplies. They provide habitat for wildlife and offer scenic vistas of Pittsford, which are essential components of our character and the tourist industry. *Development above the eight hundred (800) foot contour should be limited to residential and agricultural uses only. Given the availability of water and on-site sewage disposal, avoidance of erosion issues and wildlife habitat; development between the eight hundred (800) foot and eleven hundred (1100) foot contours lots should be at least five acres, above the eleven hundred (1100) foot contour lots should be at least ten acres*.

It is recommended that the town consider language within our zoning regulations which will impose specific limitations on portions of the town which are sensitive to view amenity or highly sensitive to development due to erosion, or would seriously impact wildlife habitat. Industrial development in the Conservation areas would threaten the orderly development of the region, as adjacent communities have all adopted similar restrictions on areas of this elevation. Therefore, any development, even low impact, will have an effect on not only Pittsford, but also the surrounding communities. The zoning ordinance should include regulations prohibiting industrial development and limiting other low intensity development along ridgelines, prohibiting the placement of signs above the treeline, and limiting the development of telecommunications towers or other large structures. The Conservation Districts 1 and 2 consist of contiguous forested lands that are protected from the encroachment of development by our zoning regulations and the terrain.

**Pittsford actions: Land Use and Development** (p. 22)
The town will continue to support strong zoning regulations in our conservation zones to protect the integrity of forest lands.

## Poultney Town Plan, Adopted July 20, 2015

Poultney has a varied natural environment. It is bounded on the west by the Poultney River. Its land boundaries range from elevations of 500 feet or less to 2,320 feet elevation at Spruce Knob on the east boundary. Several small streams ripple through the hills to the east and flow west to the Poultney River or to Lake St. Catherine. The Bozeck Marsh Wildlife Management Area (96 acres) is located about halfway between the Village and the Lake south of Route 30. The Bird Mountain Wildlife Management Area (350 acres) is located in the northwest corner of Poultney. The Dean Nature Preserve is east of the lake and encompasses the row of prominent cliffs that extend into the Town of Wells (p. 10).




The Poultney Town plan contains many pieces of important information for stormwater planning, although much of the focus within the plan seems to be on Lake Saint Catherine with very little mention of the Poultney River. The town of Poultney is in the process of adopting a new plan, so recommendations made now could be impactful.

FUTURE LAND USE (p. 12 – 17)
Districts included in the Town Plan include the Village of Poultney, Agriculture and Rural Residential District, Lakeshore District, Industrial District, and the Northeast Conservation and Wildlife Habitat Area.

***Flood Hazard Areas –*** Flood hazard areas are designated in the Digital Flood Insurance Rate Map (DFIRM) for Poultney updated in 2008 by FEMA and the State of Vermont. The Town Future Land Use Map and Zoning Districts Map also include the Flood Hazard Areas. New development is restricted in these areas and regulated by the Poultney Unified Bylaws (Article VIII: Flood Hazard Area). It is noted in the Town Plan that the Fluvial Erosion Hazard areas have similar extents to the Flood Hazard Areas.

TRANSPORTATION (p. 40-41)
The transportation sections states the challenges of mitigating environmental effects of already existing infrastructure but does list, under Transportation Goals and Objectives, "Identify road related erosion affecting water quality." The Transportation Technical Report (p. 103-110) has an inventory of Poultney's roads.

NATURAL RESOURCES (p. 44 – 55)

In addition to the Village and Lakeshore, Poultney includes areas used for forestry, agriculture, and the slate quarrying industry. Slate is primarily mined on the west side of town, with some quarrying extending east into the Lake Saint Catherine watershed.

***Wetlands –*** The Town Plan Wetlands Goal 1 (Section 9.5) is to “Protect Class I and Class II wetlands in accord with Vermont Wetland Rules”. Programs specific to this goal include the dissemination of information and education, making wetland maps available to the public, permit assistance, promoting vegetated buffers on the lakeshore, and discouraging the use of riprap. The Town Plan also seeks to encourage the use of the Vermont Handbook for Soil Erosion, Sediment Control on Construction Sites and the Streambank Conservation Manual by the Development Review Board.

***Slopes –*** The Town Plan Slopes Goal (Section 9.8) includes programs to restrict development in areas with slopes greater than 20%, encourage hydroseeding and erosion control, and discourage riprap use. The maximum grade for roads is set at 7% for unpaved roads and 10% for paved roads.

***Water Resources –*** This section acknowledges the need for further study surrounding the Poultney river in regards to where e. coli enters and what land uses be a cause. Town Plan Water Resources Goal 1 (Section 9.13) is to “Protect and enhance the ability of Poultney’s water resources to provide wildlife habitat, travel corridors, and public recreational opportunities”. Specific programs relevant to the stormwater master planning process include:

- Plan for development that will minimize undue adverse impact on significant water resources.
- Encourage water quality best practices by property owners and contractors to protect streambanks and shorelines.
- Promote the use of adequate erosion control measures in areas of high erosion potential (e.g. steep slopes, roads and erodible soils) and high susceptibility to surface water pollution (e.g. along wetlands, streams and ponds).
- Encourage the use of practices that will help address water quality by decreasing nutrient run-off, erosion and sedimentation
- Establish reasonable, site specific stream buffers that preserve and conserve water quality, natural habitats, wildlife movement, and other processes along aesthetically, ecologically and recreationally important sections of streams.
- Incorporate into zoning regulations measures to address sediment and stormwater runoff during and after construction.
- Support the Poultney Mettowee NRCD and University of Vermont Lake Education and Action Program, which work with lake associations and area youth to implement water quality projects and develop long-term water quality education programs.
- In most cases, development should be setback a minimum distance of 50' from the shoreline of all streams and natural and man-made ponds in the Town.
- Support the Poultney Mettowee Natural Resource Conservation District monitoring of Poultney River water quality and efforts to identify methods to address concerns.

Also under Water Resources, Goal 3 states “ All development other than those uses and structures essential to the operation of agriculture, forestry, recreation and wildlife production should be restricted from flood hazard areas as designated on the Flood Insurance Rate Maps (FIRM) for Poultney, as well as taking into account information gained through the Geomorphic Assessment of the Poultney River." To achieve this goal the town plans to use the Poultney River Geomorphic assessment and Stream Corridor Plan in development decisions and to hold flood emergency preparedness and response planning.

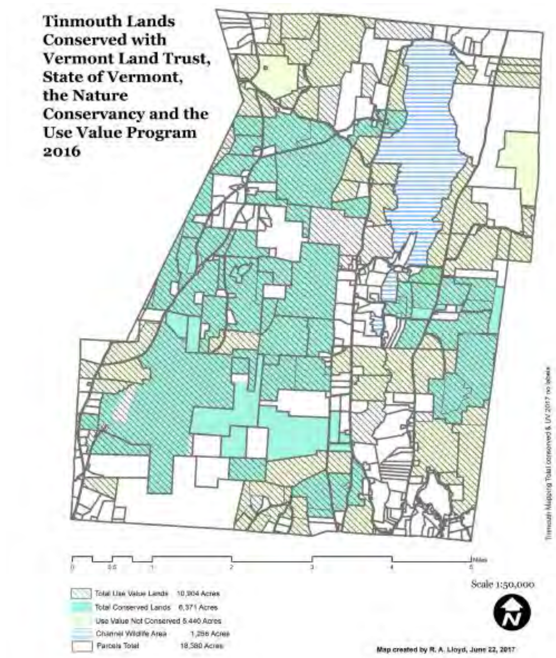
***Stormwater Runoff –*** The Vermont stormwater management rules are mentioned, including permit requirements for impervious surfaces over one acre, as a necessity to protect surface water from runoff. Subdivision regulations include requiring sedimentation basin construction for subdivisions.

## Tinmouth Town Plan, Adopted January 9, 2020, 92 pp.

The Tinmouth Town Plan has historically been very comprehensive with respect to inclusion of a variety of natural resources and their ecosystem functions, making them central to town planning. While there is too much information to include in this data library, here are several example sections related to water quality and drainage areas.
**Watersheds** (p. 14)


Surface water drains in two key directions: westward, into the Poultney-Mettowee Watershed and eastward, into the Otter Creek Watershed. Both eventually lead into Lake Champlain and the Great Lakes watershed that drains via the St Lawrence River. Five sub-watersheds direct water into these two. See watershed map at right.
1. The Tinmouth Channel flows north, becoming the Clarendon River, a major tributary of Otter
Creek.
2. The east slopes of Clark Mountain drain into the Valley of Vermont and the Otter Creek.
3. The southwest corner of Tinmouth drains westward through the Wells Brook into the Mettowee River.
4. The south end of Tinmouth Mountain drains towards Flower Brook, which flows westward and joins the Mettowee River.
5. The northwest section is drained by the headwaters of the Poultney River.

**Streams and Rivers** (p. 14)




Tinmouth serves as the headwaters for a series of streams and rivers that serve the two watersheds described above. The three largest bodies of flowing water are the Tinmouth Channel, the Poultney River, and the Wells Brook.

**Wetlands** (p. 15)
The Tinmouth Channel Wetland is one of only three Class I wetlands in the state of Vermont. Class I wetlands are considered “exceptional or irreplaceable in their contribution to Vermont’s natural heritage and are therefore so significant that they merit the highest level of protection” according to the 2002 update for Water Resources Board’s Vermont Wetland Rules. The extensive and diverse wetland habitats range from open fens to shrubby and wooded swamps and represent numerous state significant natural communities due to the limey (calcareous) bedrock. At the southern end tamarack swamps and a rare open calcareous peat landform the headwaters. The waterway eventually broadens so that the northern end is navigable by canoe. Historically this end was straightened or channelized, likely so that iron ore could be transported from Clark Mountain to early iron furnaces downstream. Early surveys showed the wetlands subdivided into hay lots for nearby farmers, though these earlier agricultural disturbances are no longer evident.

Class II wetlands, also considered “significant,” and any wetlands contiguous to mapped Class I and II wetlands are regulated as well and mapped by the State of Vermont and included in this Plan’s Natural Resource maps. Class III wetlands, although greater in number, are not protected by the Vermont Wetland Rules of 2002 because of their small size or intermittent nature but may have local significance and may be protected by other federal, state, or local regulations.

**Land Ownership** (p. 21)

As evidenced by this map and detailed in the town plan, much of the land in Tinmouth is conserved through the Use Value program and/or conservation easements.

Total conserved, and/or in Current Use Program, and in Channel 13,067, or 70.5% of total land in town.

**Open Fields and Forestry Policies** (p. 26)
• Keep active, sustainable agricultural and forestry practices a top priority for land use in Tinmouth.
• Logging operations should take place at appropriate times of year.
• Remind qualifying landowners of the current use program option.
• Retain farms and large contiguous forest blocks wherever possible.

**Open Fields and Forestry Actions**

• Review land use regulation to ensure that sustainable agriculture and forestry practices are a top priority and information is available to landowners.
• Provide information to residents about the importance of undisturbed vegetated buffers
• Identify patches of contiguous forest, those that are relatively large, in good condition (e.g., relatively unfragmented or un-developed).

**Conservation District (p. 47-48)**
Conservation areas contain lands that are very sensitive to development for a variety of reasons. They generally contain significant natural resources such as large forest blocks, high elevations, steep slopes In 2002, the town added land to this district in the areas surrounding the Tinmouth Channel and connecting the Channel to Tinmouth Mountain. The decision to add this land followed an extensive public input process and is intended to help maintain the quality and function of this unique wetland and wildlife habitat.

**Conservation District Analysis**
While the goal of maintaining larger, less disturbed land area in the town has been supported by the Conservation District, land development over the past 25 years has not always forwarded the intent of maintaining viable agricultural and forestry lands or wildlife habitats. The Planning Commission has learned that supplemental tools, in addition to minimum lots sizes, are necessary to help landowners identify and conserve sensitive areas within the Conservation District.

**Conservation District Policies**
• Conserve sensitive areas within the Conservation District while allowing for limited, low intensity development.

**Protection District**
Protection areas contain land that is unconditionally protected from development such as lands above the 2,500-foot contour, lands that are in the floodplain, and significant natural features and wetlands. These include the 1245-acre Tinmouth Channel (a Class 1 wetland), the Poultney River source wetland, Crow Hill Wetland, Ballou's Swamp, the top of Tinmouth Mountain above 2500 feet, and the narrow, steep sided Tinmouth Gulf.

**Protection District Analysis:**
Lands in the protection areas are suitable for low-impact recreational uses, such as hiking and nature trails, hunting, and other human-powered low impact recreation. Intensive motorized recreational activities, such as "four-wheeling", are not appropriate or should occur only in designated areas. The state of Vermont requires that agriculture and forestry be allowed in all zones, including the protection areas.
**Protection District Policies**
• The Town of Tinmouth shall prohibit permanent structures in the Protection District.
• Subdivision of land within the Protection District is strongly discouraged.

**Agricultural Overlay District** (p. 48)
Agriculture is an important part of the economy, image, and lifestyle of Tinmouth. The continued economic success of this activity is directly related to the availability of large amounts of undeveloped land with moderate slope and productive agricultural soils. Retaining large tracts of undeveloped land in areas identified as high resource value for agriculture is vital to ensuring the future viability of farming in

Tinmouth. Based on current land use as well as consideration of soil associations and slopes, some lands have been identified as of the greatest agricultural resource value that require protective measures. These lands were incorporated into a special "Agricultural Overlay" district in the town's zoning regulations in 2002.

**Wetlands** (p. 53)
The wetland areas within the town contain special vegetative communities. They form a distinctive and unique landscape pattern of high scenic quality.

**Wetland Policies**

- Wetland areas shall be retained in their natural state for the provision of wildlife habitats, retention areas for surface runoff, recreation, and scientific value. A naturally vegetated buffer strip of at least 100 feet in width will be maintained around all wetlands identified on the town's wetland inventory map. Direct discharges into wetlands are prohibited.
- Wetland areas shall be protected from uses which would reduce their scenic quality. Class I and II wetlands and Class III wetlands of concern to Tinmouth are mapped on the plan's Natural Resources map.
- Reminder concerning Class I and II wetlands: Information regarding actual wetland boundary and conditional use determination for individual sites can be obtained from the Department of Environmental Conservation. The current Vermont Wetland Rules should be consulted for allowed uses and zoning permit restrictions.

**Productive Woodlands**
Timber is a potential resource of commercial value. Productive growth and management are dependent upon extensive areas of connected forestland with suitable soil conditions for tree growth.

**Woodland Policies**

- Maintain large forested blocks of land within the Town of Tinmouth and between Tinmouth and neighboring communities.
- New development should take place on the edges of forest areas to avoid the interruption of connected woodland areas and loss of viable silvicultural activities.

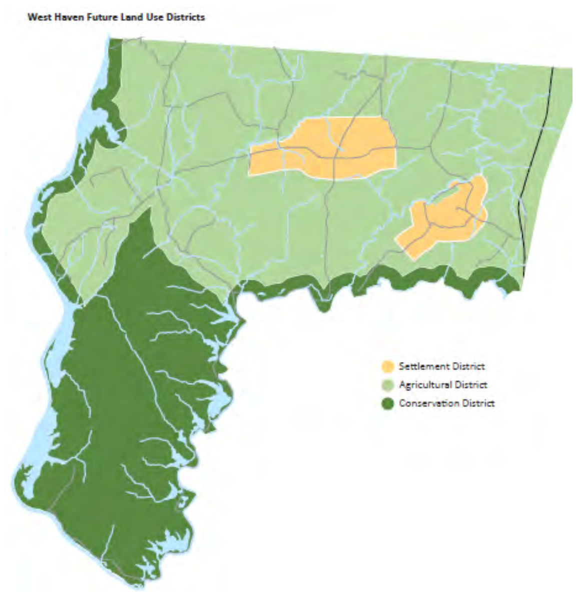
**Floodways and floodplains**
Future development in floodways or floodplains is discouraged. The potential for flood damage in these areas is high and is likely to cause expense to landowners, the town, and state and federal government.

**Floodplains Policies**
• The town shall review development in the floodplain in accordance with National Flood Insurance Program regulations and the town's flood insurance rate maps.

**Standards for New Development, Regardless of Location**
**General Development Policies** (p. 55)
• Include provisions in both the zoning and subdivision regulations which allow for review of site conditions, settlement patterns, natural features, the placement of driveways, the location of buildings, and other aspects of residential development that may impact sensitive natural areas, water quality, open spaces, the working landscape, and important views and vistas. Upon completion of the Town Plan, re-evaluate the zoning ordinance for compatibility with the Plan.

**should include a bullet about stormwater management at all new development.*

## Town of West Haven Town Plan, Adopted March 2019, 30 pp.




The Town of West Haven does not have zoning, but does have a very simple and easy to understand map of preferred Land Use Districts. Each District is the preferred area for settlement, agriculture, or conservation (40%) (p. 9).

"The town does not have specific river corridor bylaws, but fortunately, the town's river corridors mostly
coincide with the FEMA special flood hazard areas, giving the river corridors some level of regulation. Additionally, this fact imparts that by adopting the State's river corridor bylaws, the town will not be subjecting additional lands to regulation, but will instead be subjecting the FEMA flood hazard areas to additional regulation.
The town now has the opportunity to review and adopt the State's model bylaws, in an effort to add more protections to the FEMA special flood hazard area and to put in place official river corridor protections bylaws" (p. 10).

**Flood Resiliency Implementation Actions**
*Invite the Rutland RPC to host informational meetings about the State's River Corridor Protection program.*

**The Natural Environment**
Important surface water resources (lakes and ponds, rivers and streams) include the Poultney River, Lake Champlain, Coggman Pond, Billings Marsh Pond, and the Hubbardton River. Groundwater resources include the Town's aquifers, which appear to have their greatest potential along the base of the Great Ledge. Water resources also include wetlands, which are found throughout the Town.

**Physical Setting and Geology**
West Haven is located at the southernmost end of the Champlain Lowland region. The Town owes its unique shape to the Poultney River and Lake Champlain. These waterbodies played major roles in the formation of West Haven's wetlands and marshes, home to many diverse ecosystems.

**Soils**
Among a variety of soil types from steep and rocky to shallow and poorly drained, the most common soils in the Town are ones generally well suited for the cultivation of crops but have slow permeability and high water tables, making them undesirable for septic leach fields (p. 13). These soils generally occur in low lying, sediment filled areas and may not be suitable for stormwater practices.

**Forestry**
High quality forest lands are scattered throughout the Town, with the greatest concentration found in the flatter north central portion (p. 15). Many high quality forest blocks and corridors are found in West Haven and help contribute to high quality waters and a lack of stormwater runoff.

**Forest Connectivity**
Critical Habitat Connectivity areas in West Haven connect adjacent forested blocks of "stepping stone" habitat, typically blocks greater than 5,000 acres. Here, road corridors and/or fragmented forest cover separate larger forest habitat blocks. These areas are places where land use most threatens connectivity for wide ranging mammals. Landscape features that support connectivity (e.g. riparian habitat along streams and rivers, linear strips of forest cover in otherwise developed areas and hedgerows, woodlots/small forest blocks) are especially important in these areas. Accordingly, land use management will ideally not destroy and/or would restore these features.

The town of West Haven should coordinate efforts to protect its valuable natural resources with the organizations discussed in this chapter to further the goals of this plan. While much has been accomplished in West Haven, many of the rare plant and animal sites, as well as wetlands and other important habitats are not currently protected.

**Land Conservation (p. 15)**
Decisions regarding use of the land should consider the impact on these natural resources. One private landholder in West Haven, The Nature Conservancy, is working to preserve the many diverse and ecologically important plant and animal communities in the Town. Much of their landholdings can be found in the southern tip of West Haven, as well as along the Poultney River. Lands conserved by the Nature Conservancy, as well as other conservation programs are presently protecting many fragile ecosystems found along steep slopes, deer wintering habitat, and wetlands.

Much of West Haven surrounds the southern end of Lake Champlain, an area characterized by an ecologically rich landscape of undeveloped lake and river shoreline, deep emergent wetlands, calcareous cliffs, and oak-hickory woodlands. The Eastern New York / Vermont chapters of the Nature Conservancy has protected over 8,000 acres in the Southern Lake Champlain Valley including over 5 miles of Poultney River shore in New York, along with two significant holdings within West Haven. This landscape-scale project is a bi-state partnership: Eastern New York and Vermont Chapters share site-based staff and office space.

**Watersheds** (p. 16)
The eastern half of West Haven lies in the Poultney River watershed, while the western half of the Town drains directly into the Lake Champlain watershed. Much of the eastern portion of the town actually drains into the Hubbardton River, a large tributary to the Poultney River.

**Surface Water** (p. 16)
West Haven's primary water bodies – the Poultney and Hubbardton rivers – are both used for recreational and educational opportunities, as well as providing wildlife habitat and harboring archeological resources. In June 1991, the Lower Poultney River was designated as an Outstanding Resource Water (ORW) because of its exceptional natural, cultural, and scenic values. Lakes and ponds constitute the other surface water resources in West Haven. Major lakes and ponds include Lake

Champlain, Coggman Pond, and Billings Marsh Pond. These resources offer recreational opportunities as well as supporting warmwater fisheries.

*The following Discharges to the Surface Waters section is very general and the SWMP could contribute some specific examples of discharges to local surface waters.*

**Wetlands** (p.16)
The majority of West Haven's wetlands are found along the shore of Lake Champlain and East Bay; along the banks of Coggman Creek and the Hubbardton River; and in the northeast corner of Town. Horton Marsh, East Bay Marsh, Schoolhouse Marsh, Billings Marsh, and Coggman Marsh comprise the significant portion of West Haven's 1,300 acres of wetlands.

**Natural Resource Implementation Goals** (p. 20)
1. Ensure that agriculture remains a viable land use.
2. Stream conservation and water quality protection.
3. Protect West Haven's scenic resources, including scenic roads.
4. Support Nature Conservancy projects on the Hubbardton and Poultney rivers.

**Natural Resource Implementation Actions** (p. 20)
Support in efforts that are assessing the source of pollutants in the town's two stressed waterways: Coggman Pond and Billings Marsh Pond. Support in the State process of reclassifying the Ward Marsh Complex as a Class 1 Waterway. Support in local efforts of biomonitoring and/or water quality monitoring on streams that are candidates for reclassification, such as Ward Marsh. *Support the Southern Champlain Stormwater Collaborative efforts to implement stormwater outreach so that landowners are aware of stormwater Best Management Practices and to create local expertise in implementing green stormwater (GSI) practices (PM and DEC TBP are unsure what this collaborative is)*.

When the State determines the sources of nutrient levels in the waterways, the Town will ask the RRPC to develop a one-page report for town report.

Invite RRPC to present the complete results of the Lake-Watershed Stormwater Master Plan and of the LakeWise Assessment project.

Support local land trusts and conservation organizations in conserving forest blocks that are important for protecting water quality in headwater streams.

Support Volunteer community group(s) that are conducting water quality testing.

Invite the RRPC and Poultney Mettowee Natural Resources Conservation District (PMNRCD) Tree Program to plant trees in sensitive areas for erosion control, make suggestions for trees that work well in this landscape.

Town will request RRPC to develop a list of plants and trees that will be suitable for planting in the West Haven environment

## Town of West Rutland Town Plan, adopted March 28, 2016

Natural resources maps are mentioned in the Table of Contents (p. 4), but are not included in the Town Plan available online.

The natural resources plan (p 10-17) has no general write-up, but begins with several goals that have elements of addressing stormwater, including Goal 2, to protect and retain wetlands, and Goal 5, avoid additional fragmentation of larger woodland areas and other significant natural resources.

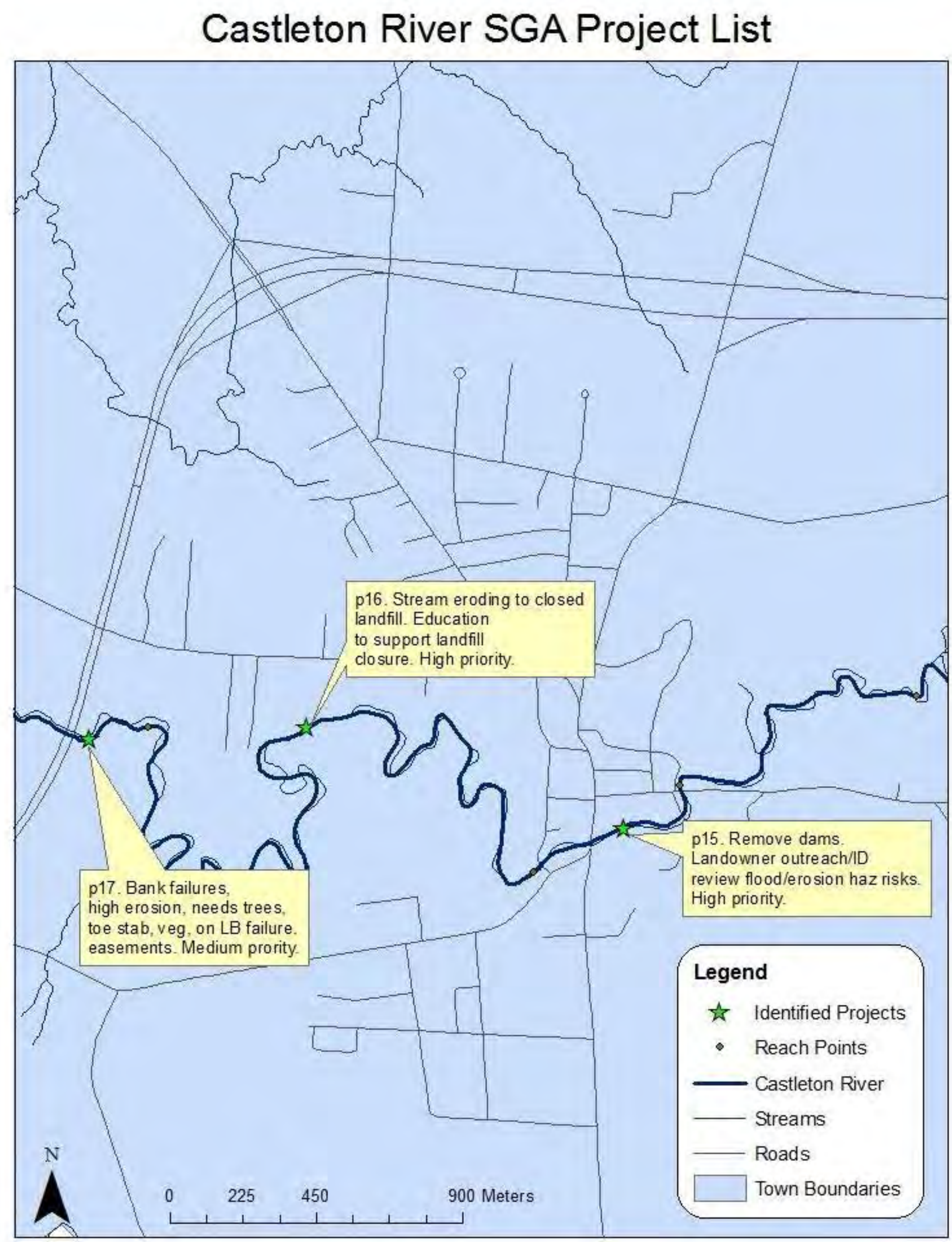
The Agriculture and Forestry section (p. 10-11) does not address stormwater except for recommendation 3, which mentions cluster development and implementing innovative technologies to reduce development impacts.

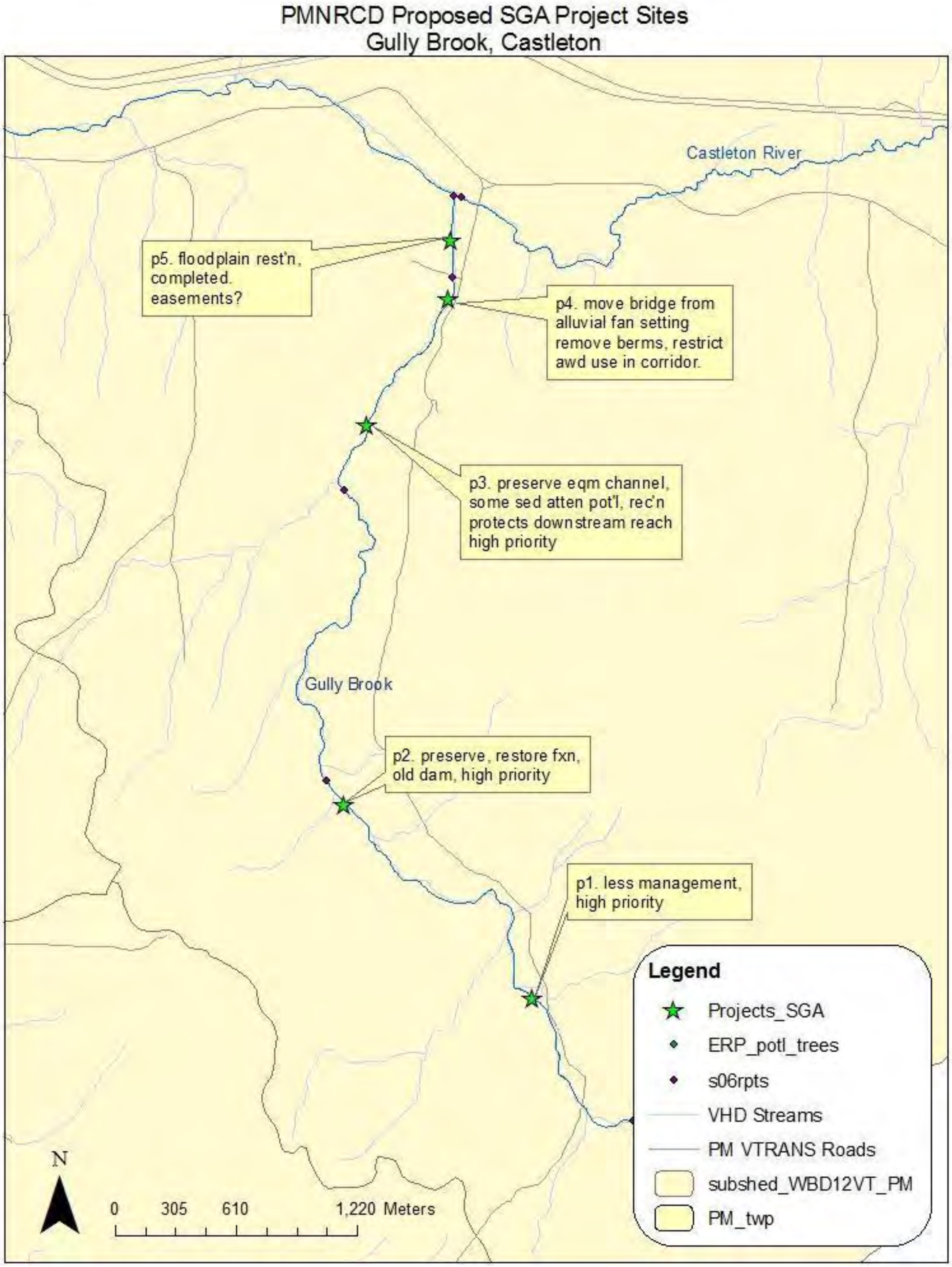
On page 11, the Water Resources section includes a wetlands subsection which mentions the importance of wetlands for storing stormwater and notes the importance of floodplains. A recommendation is made to add wetlands to the town's priority list for acquisition and land easements. The floodplain section includes recommendations to regulate development in the floodplain and update FEMA maps.
The Flood Resilience section defines river corridors and gives some detail of the negative effects of development and channel engineering in river corridors. The section also notes that a flood hazard map for West Rutland can be found at www.msc.fema.gov.

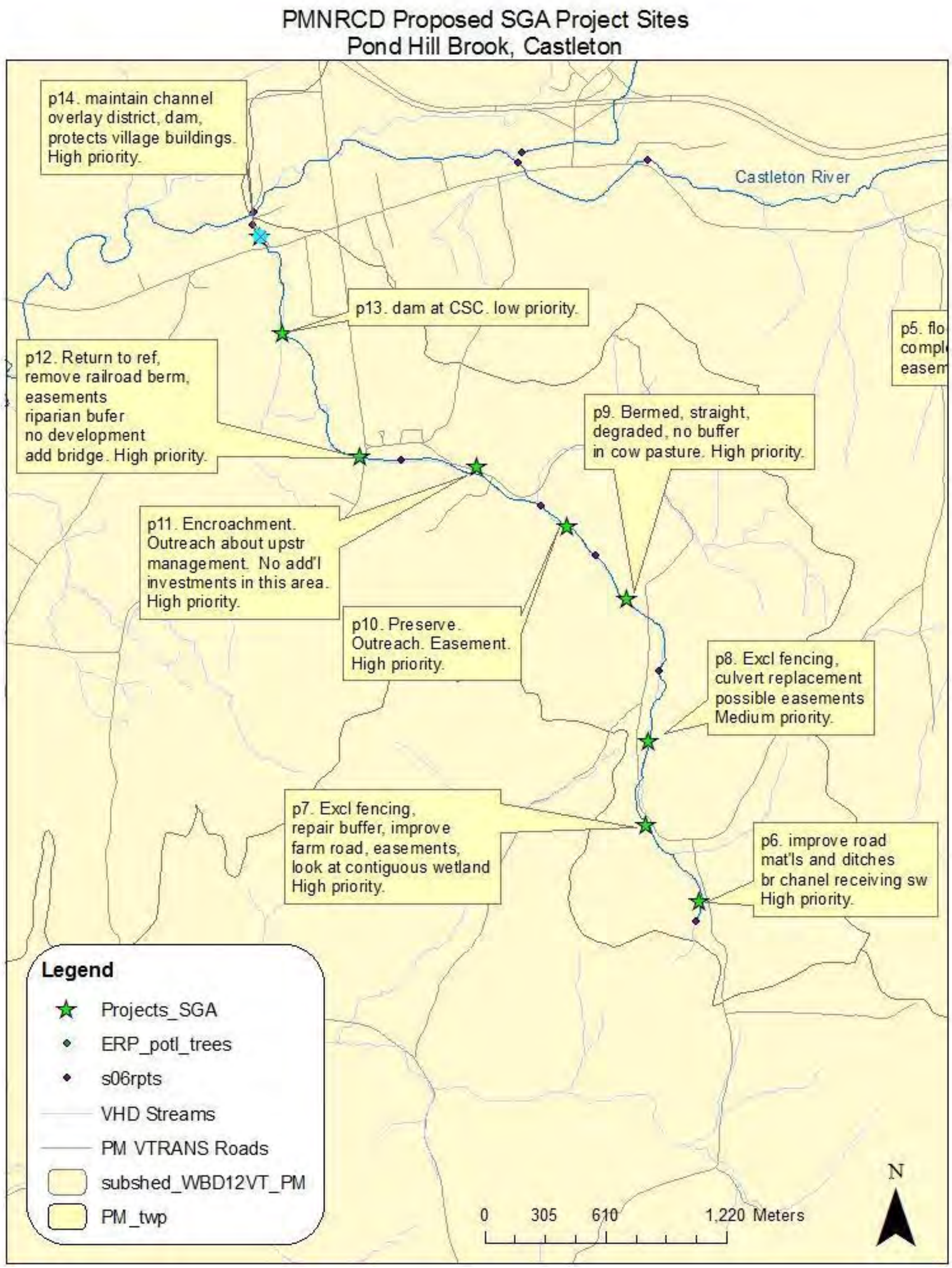
The streams section is extremely limited and should be expanded to include information about River Corridors and the many benefits of streams, including their interactions with stormwater. Recommendation 2 called for establishing visual access to water and shorelines, which could conflict with the maintenance of broad continuous buffers along lakes and streams. Recommendation 4 calls for buffers, but also discusses erosion control measures for development that is approved in the buffers, signaling a lack of resolve excluding new buildings from the floodplain area. However, in the West Rutland Land Use section, floodplains are designated as Conservation District II areas, which is the most restrictive land use area for new development.

This Town Plan has minimal information about stormwater, flood preparedness, or water quality in general. The town should look at the Stream Geomorphic Assessments completed on its streams and Corridor Plans that have been written through RRPC, PMNRCD, and RNRCD, for valuable recommendations for town plan language and planning ideas. The plan should encourage GSI, LID, and much more to help minimize water-related conflicts and pollution.

**APPENDIX A: Identified Stream Geomorphic Assessment Projects (2007)**




PMNRCD Proposed SGA Project Sites
Gully Brook, Castleton
Castleton River
p5. floodplain rest'n, completed. easements?
p4. move bridge from alluvial fan setting remove berms, restrict awd use in corridor.
p3. preserve eqm channel, some sed atten pot'l, rec'n protects downstream reach high priority
Gully Brook
p2. preserve, restore fxn, old dam, high priority
p1. less management, high priority
Legend
Projects_SGA
ERP_potl_trees
s06rpts
VHD Streams
PM VTRANS Roads
subshed_WBD12VT_PM
PM_twp
N
0
305
610
1,220 Meters


PMNRCD Proposed SGA Project Sites
Pond Hill Brook, Castleton
p14. maintain channel overlay district, dam, protects village buildings. High priority.
Castleton River
p13. dam at CSC. low priority.
p5. flo compl easem
p12. Return to ref, remove railroad berm, easements riparian bufer no development add bridge. High priority.
p9. Bermed, straight, degraded, no buffer in cow pasture. High priority.
p11. Encroachment. Outreach about upstr management. No add'l investments in this area. High priority.
p10. Preserve. Outreach. Easement. High priority.
p8. Excl fencing, culvert replacement possible easements Medium priority.
p7. Excl fencing, repair buffer, improve farm road, easements, look at contiguous wetland High priority.
p6. improve road mat'ls and ditches br chanel receiving sw High priority.
Legend
Projects_SGA
ERP_potl_trees
s06rpts
VHD Streams
PM VTRANS Roads
subshed_WBD12VT_PM
PM_twp
0 305 610 1,220 Meters
N

# APPENDIX B

**Pro**ject Drainage
Area Maps
**(**11**"x17")**



Fitzgerald Environmental Associates, LLC.
18 Severance Green, Suite 203
Colchester, VT 05446
Tel: 802.876.7778
www.fitzgeraldenvironmental.com


Notes

-Project Locations based on field visits by FEA and PMNRCD in 2020-2021

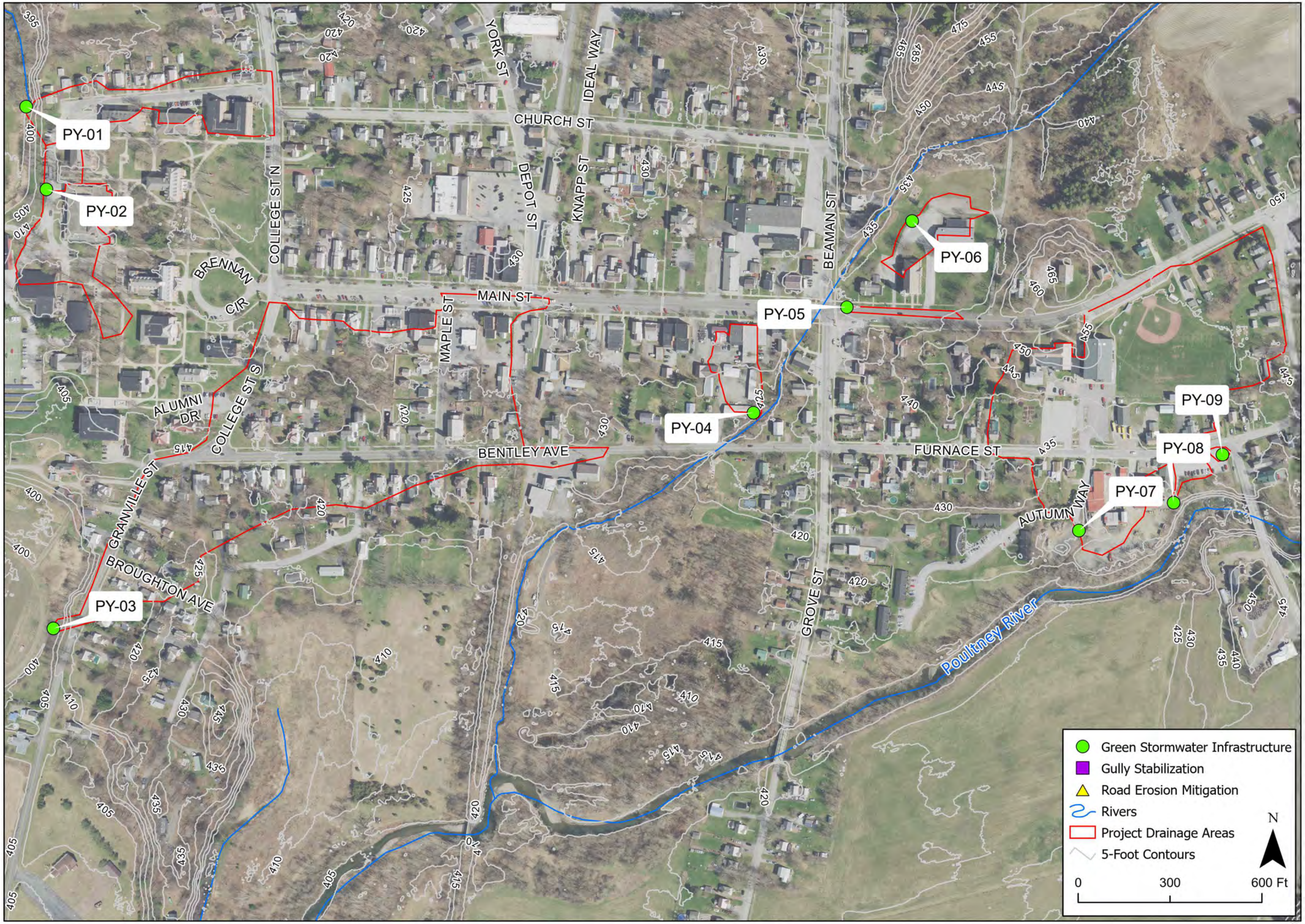
-Contours based on 0.7-M LiDAR DEM

-Imagery from VCGI

**Poultney River Stormwater Master Plan**

**Benson Village Project Locations**

| | |
|---|---|
| FCP Drawn | EPF Checked |
| Scale 1" = 300 ft. | |
| Date 9/14/2021 | |
| Sheet 1 SHEET NO. | |

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-Imagery from VCGI

**Poultney River Stormwater Master Plan**

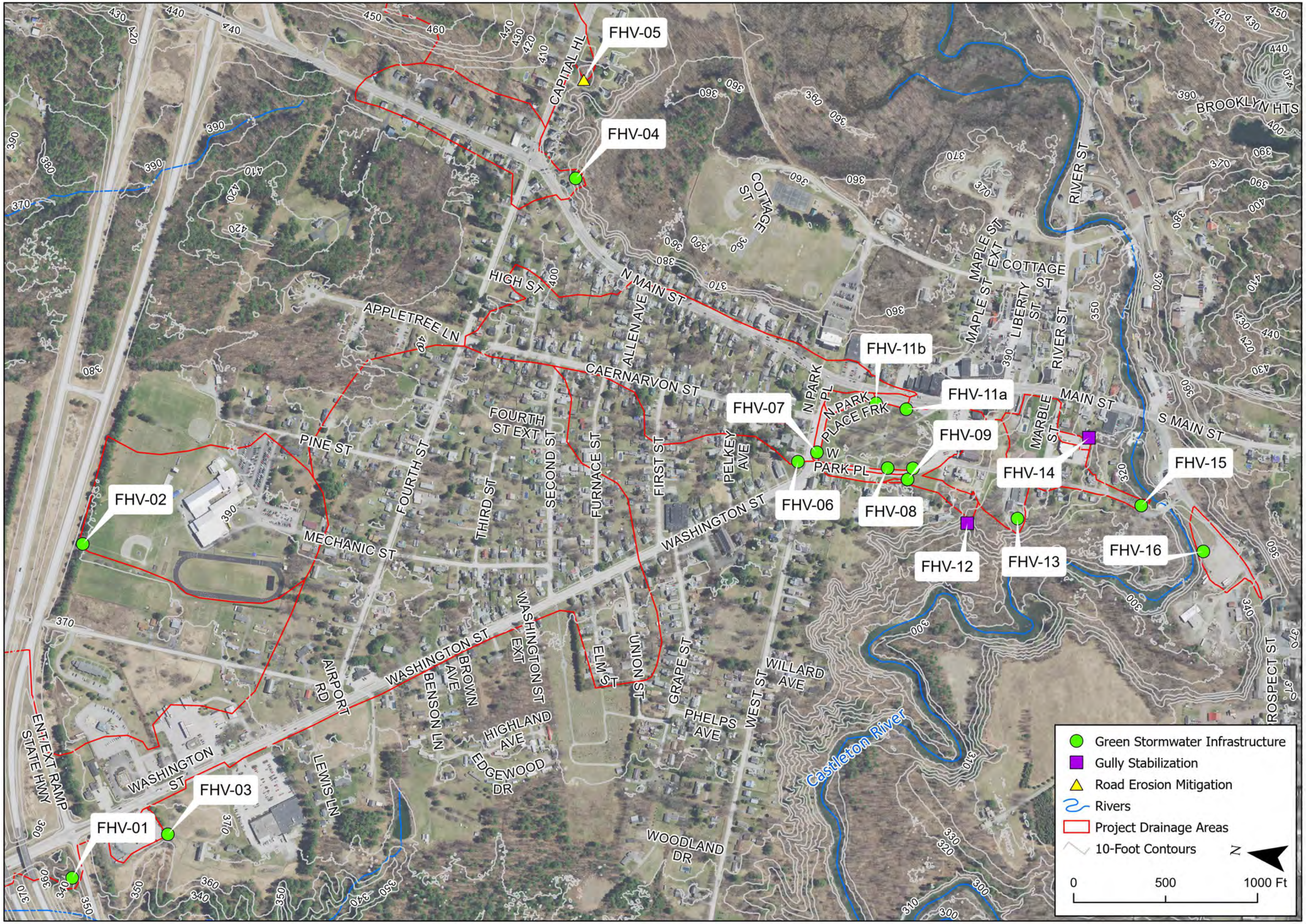
**Poultney Village Project Locations**

| FCP | EPF |
|---|---|
| Drawn | Checked |

Scale: 1" = 300 ft.

Date: 9/14/2021

SHEET NO.: Sheet 2

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Notes
-Project Locations based on field visits by FEA and PMNRCD in 2020-2021
-Contours based on 0.7-M LiDAR DEM
-Imagery from VCGI

**Poultney River Stormwater Master Plan**

**Fair Haven Village Project Locations**

| Drawn | Checked |
|---|---|
| FCP | EPF |

Scale: 1" = 500 ft.

Date: 9/14/2021

SHEET NO.: Sheet 3


**Fitzgerald Environmental Associates, LLC.**
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Notes
-Project Locations based on field visits by FEA and PMNRCD in 2020-2021
-Contours based on 0.7-M LiDAR DEM
-Imagery from VCGI

**Poultney River**
**Stormwater Master Plan**

**Middletown Springs Village**
**Project Locations**

| Drawn | Checked |
|---|---|
| FCP | EPF |

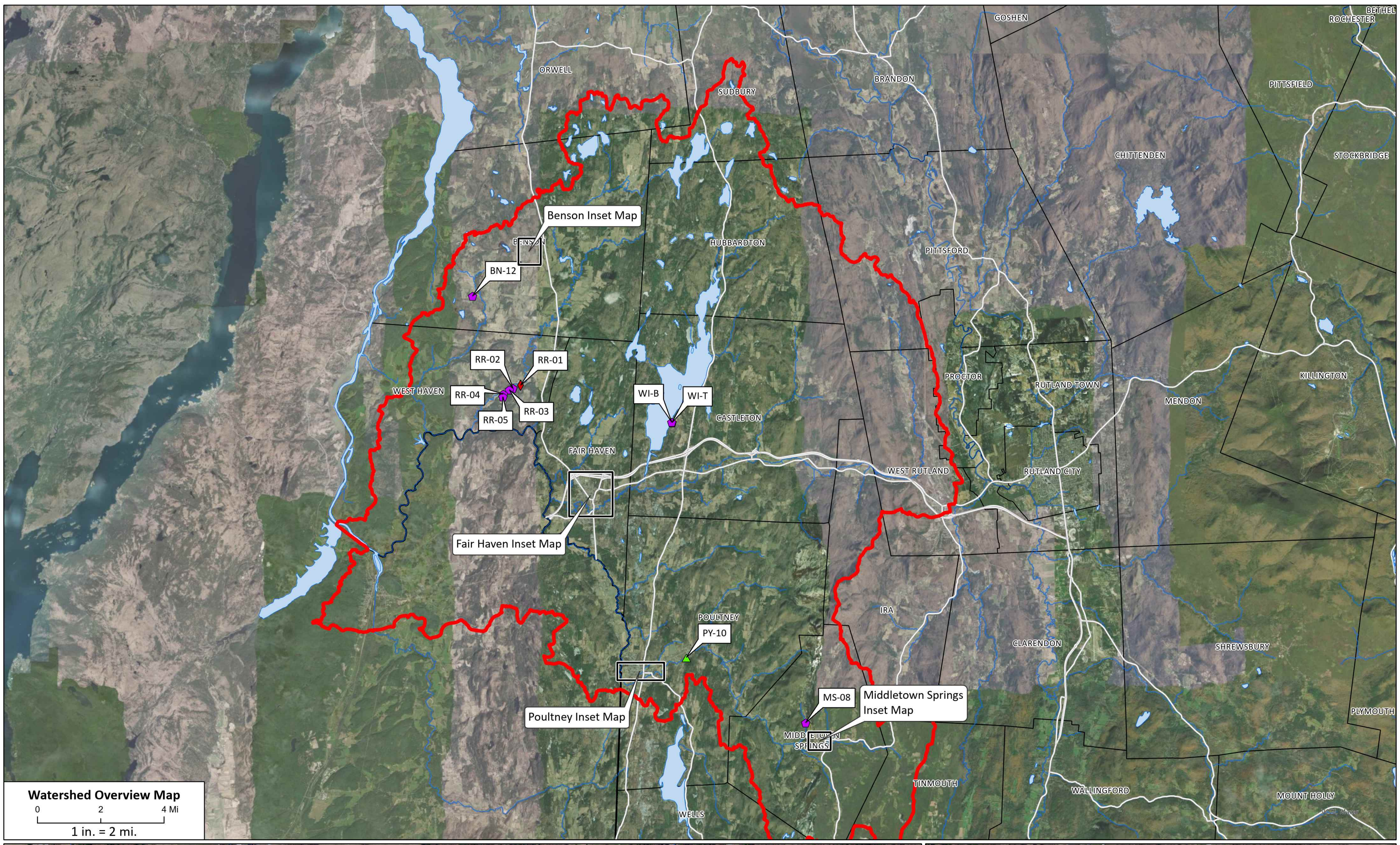
Scale: 1" = 200 ft.

Date: 9/14/2021

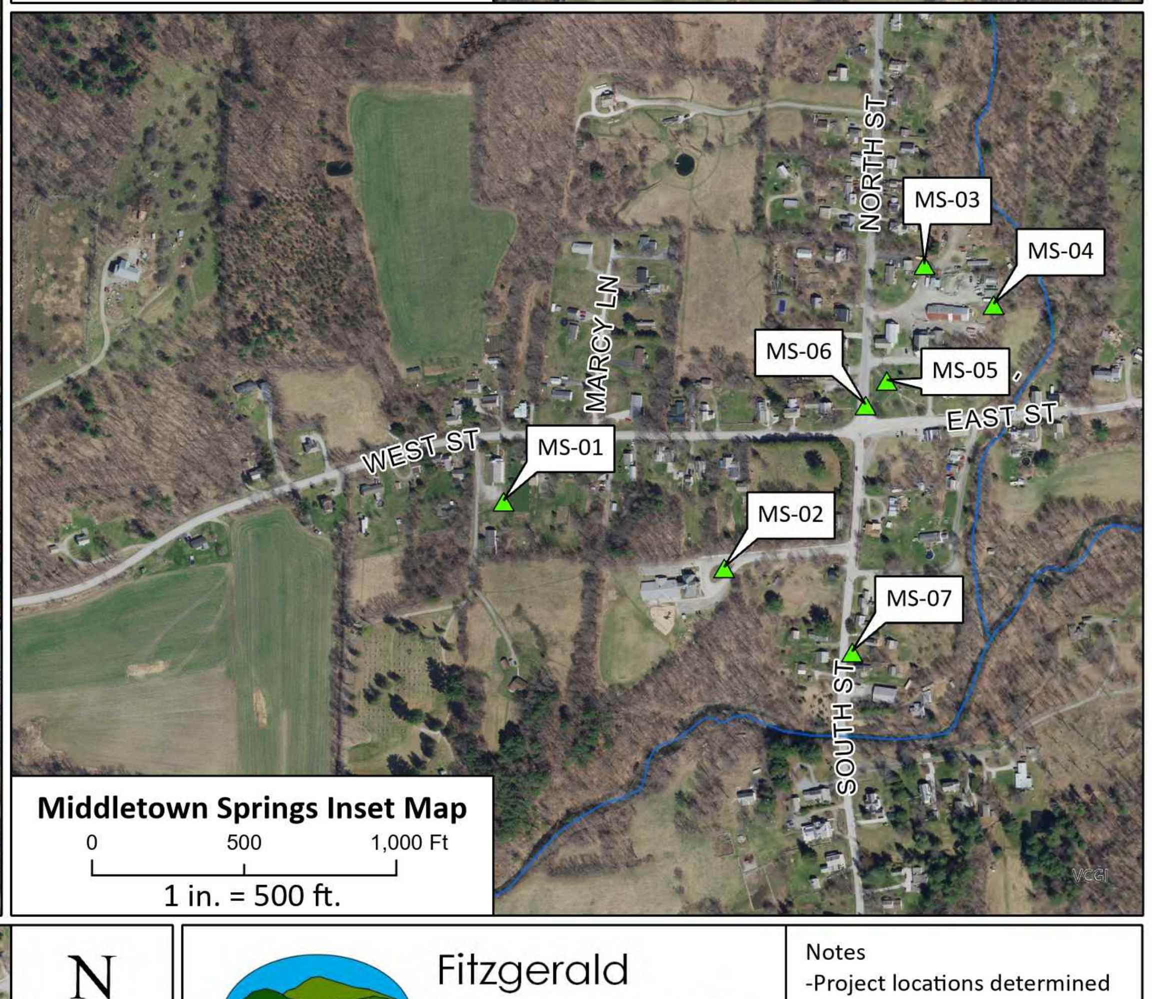
SHEET NO.: Sheet 4

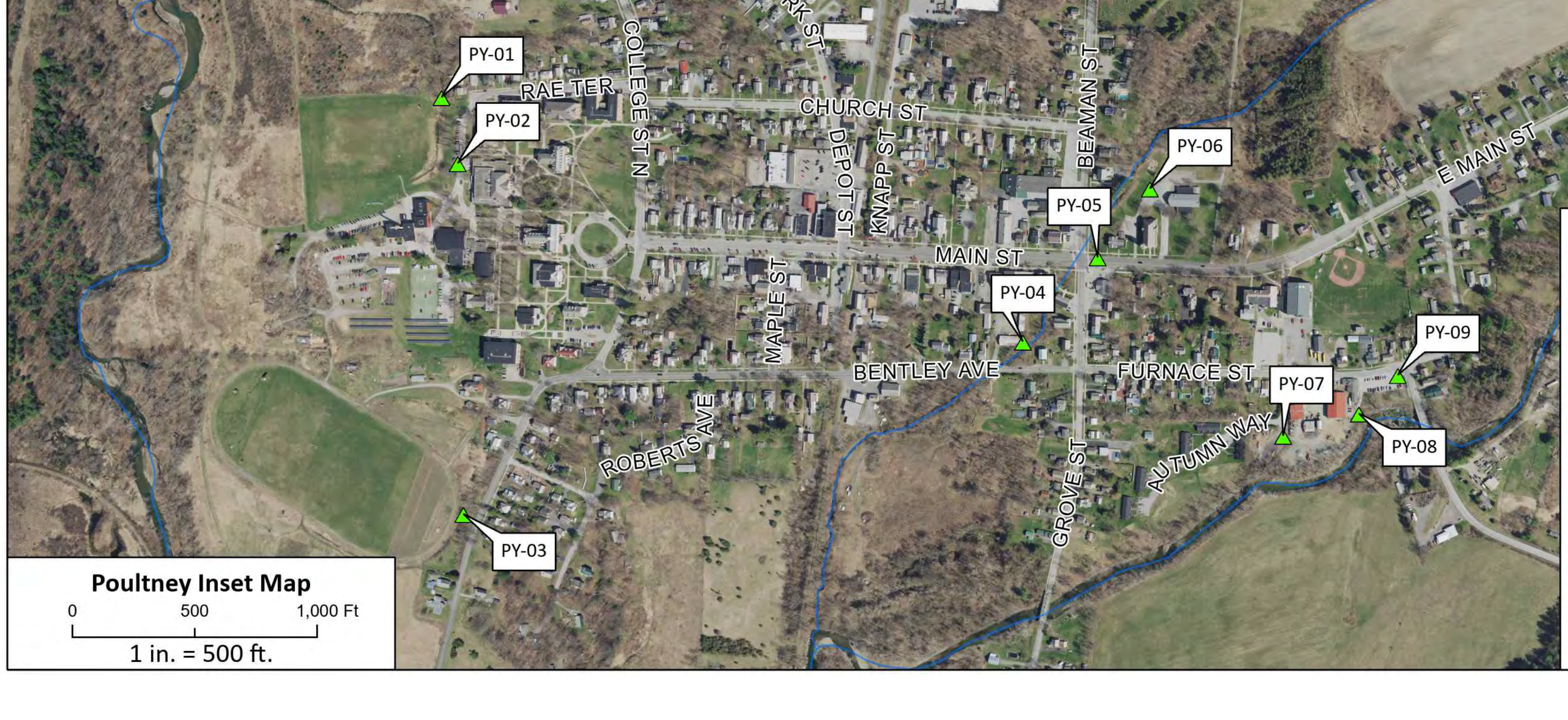
# APPENDIX C

## Project Location Map
## (24”x36”)






N

- Green Stormwater Infrastructure
- Gully Stabilization
- Road Erosion Mitigation
- Poultney River Watershed
- Waterbodies
- Rivers
- Town Boundaries
- Major Roads
- Vermont State Border

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Notes
-Project locations determined by FEA and PMNRCD staff in 2020 and 2021

NOTES

# Appendix C
# Project Location Map

Poultney River Stormwater Master Plan

| | |
|---|---|
| 19036 | PROJ. NUMBER |
| March 15, 2022 | DATE |
| EPF | REVISED |
| VARIES | SCALE |
| FCP | DRAWN |
| EPF | CHECKED |
| SHEET 1 | SHEET NO. |

# APPENDIX D

Problem Area Summary Table
and Prioritization Matrix
**(11”x17”)**

**Stormwater Master Plan - Poultney River**
**Unified Prioritization Matrix**
**March 15, 2022**

| Project ID | Project Type | Town | Location | Decription | Preliminary Recommendations | Total Acreage | Impervious Acreage | % Impervious | P Load (lb/yr) | WQv (cf) | BMP Type | BMP Volume (cf) | Total P Reduction (lb/yr) | Project/ Permitting Complexity | Total Cost | Project Efficiency $/lb | Co-Benefits Sum | Total Score | Possible | Final Score % | Overall Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BN-01** | GSI | Benson | Stage Road and Old North Lake Road | Culvert from corner of old north lake rd and stage rd daylighting and entering catchbasin through vegetated swale in private lawn. | Space for a GSI retrofit in grassy area. | 0.77 | 0.10 | 13% | 0.69 | 471 | Bioretention (w/ underdrain) | 1,644 | 0.37 | 2 | $ 41,200 | $ 109,930 | 2 | 17 | 50 | 34% | 47 |
| **BN-02** | GSI | Benson | Stage Road | Green space in front of church with vegetated swale. Drains gravel parking lot of church. | Space for small infiltration basin. | 0.33 | 0.28 | 86% | 0.76 | 985 | Infiltration Basin | 266 | 0.48 | 2 | $ 2,700 | $ 5,614 | 2 | 27 | 50 | 54% | 22 |
| **BN-03** | Road Erosion Mitigation | Benson | Apt. Complex on Stage Road | Apartment complex with steep paved and gravel driveways and parking lots. No current Stormwater infrastructure. Sediment deposition on steepest part of paved driveway under gravel lot. | Could infiltrate stormwater in one of the adjacent grassy areas. | 0.22 | 0.20 | 92% | 0.53 | 699 | Dry Swale (w/ underdrain) | 895 | 0.37 | 2 | $ 5,800 | $ 15,821 | 3 | 23 | 50 | 46% | 34 |
| **BN-04** | GSI | Benson | Stage Road | Catch basin with small wetland treating entering water. Old concrete wall right next to it. Limited space. | Install berm to pool water in wetland and treat stormwater. | 0.49 | 0.14 | 28% | 0.57 | 541 | Bioretention (w/ underdrain) | 1,601 | 0.33 | 2 | $ 40,200 | $ 121,563 | 2 | 18 | 50 | 36% | 45 |
| **BN-05** | GSI | Benson | Stage Road | Raised catch basin in private lawn draining into BN-06 swale after daylighting and going into another culvert. Lots of space but all on private land. | Install berm around existing catch basin and raise invert to pool and infiltrate water. | 0.89 | 0.17 | 19% | 0.90 | 705 | Bioretention (w/ underdrain) | 2,448 | 0.44 | 2 | $ 61,400 | $ 139,253 | 2 | 14 | 50 | 28% | 49 |
| **BN-06** | GSI | Benson | Stage Road | Densely vegetated swale draining into 24" culvert. Large overflow drainage area that accepts stormwater during high flow events. No visible erosion. | Wide grassy space for treatment, on site of old gas station, soil would need to be tested. | 10.73 | 2.44 | 23% | 11.57 | 9,919 | Gravel Wetland | 6,338 | 5.18 | 2 | $ 108,300 | $ 20,907 | 2 | 28 | 50 | 56% | 15 |
| **BN-07** | GSI | Benson | Lake Road | Catch basin at Southeast corner of Stage-Lake rd. intersection. Sediment deposition around it from gravel parking lot of VFD. Small green space with high curb next to it. | Convert curbed green space to small infiltration area. | 0.14 | 0.14 | 96% | 0.34 | 478 | Infiltration Basin | 193 | 0.32 | 2 | $ 2,000 | $ 6,201 | 2 | 26 | 50 | 52% | 26 |
| **BN-08** | GSI | Benson | Lake Road | Catchbasin draining some of Lake Rd. and a gravel parking lot at the corner of Stage rd. and Lake rd. Sediment building up around the catchbasin on the paved surface. | Divert runff into adjacent green space for infiltration. | 1.89 | 0.59 | 31% | 2.36 | 2,271 | Infiltration Basin | 337 | 0.77 | 2 | $ 3,400 | $ 4,406 | 2 | 27 | 50 | 54% | 22 |
| **BN-09** | GSI | Benson | Lake Road | Sheet/rill erosion in upper parking lot of VFD south station. Water flowing off Lake road, through parking lot and into private yard. | Retrofit with swale or berm to divert water out of lot. | 0.11 | 0.04 | 36% | 0.10 | 144 | Dry Swale (w/ underdrain) | 253 | 0.08 | 2 | $ 1,600 | $ 20,000 | 2 | 20 | 50 | 40% | 41 |
| **BN-10** | GSI | Benson | Stage Road and Lake Road | Set of three consecutive culverts separated by small ponds/wetlands. Endpoint for Benson stormwater system. Receives all stormwater collected in closed system within the town. | Expand wetland areas, add meanders, upsize culverts. | 56.80 | 9.67 | 17% | 54.94 | 41,901 | Wet pond/ Created Wetland | 500 | 1.04 | 0 | $ 17,600 | $ 16,983 | 2 | 19 | 50 | 38% | 42 |
| **BN-11** | GSI | Benson | School Street EXT. | School parking lot with three catchbasins draining into the same closed system. Drains gravel parking lot and school roof. Minor erosion at culvert outlet in back of school. | Raise catchbasins to pool water before entering system. Educational benefits to children at the school. Could also treat at the outlet. | 0.89 | 0.66 | 74% | 1.85 | 2,320 | Infiltration Basin | 1,500 | 1.57 | 2 | $ 52,800 | $ 33,732 | 5 | 27 | 50 | 54% | 22 |
| **BN-12** | Road Erosion Mitigation | Benson | Root Pond Road | Very steep gravel road segment with forest on uphill side and farm field on downhill side. Heavy erosion in downhill side ditch. Erosion extends into farm field with large sediment deposit. | Narrow ditches on either side, cross culvert. Stone line existing ditch. | 2.32 | 0.09 | 4% | 1.66 | 728 | Dry Swale (infiltrating) | - | 1.33 | 2 | $ 20,000 | $ 15,079 | 1 | 25 | 44 | 57% | 12 |
| **FHV-01** | GSI | Fair Haven | Southwest Median at exit for Route 4 | Large drainage area outlets into highway median. Little wetland is filtering some of the water now. A lot of paved area would be treated. | Make berm to enclose depression and pool water. Expensive and difficult. | 90.10 | 33.90 | 38% | 123.17 | 127,104 | Infiltration Basin | 20,000 | 25.95 | 0 | $ 283,500 | $ 10,925 | 3 | 28 | 50 | 56% | 15 |
| **FHV-02** | GSI | Fair Haven | Fair Haven Union High School Ballfield | Drains large area of school property into green space. | Definite space for a feature depending on permitting with highway. | 21.05 | 7.88 | 37% | 28.70 | 29,564 | Constructed Wetland | 5,000 | 6.68 | 1 | $ 116,300 | $ 17,410 | 3 | 24 | 50 | 48% | 32 |
| **FHV-03** | GSI | Fair Haven | Citgo Parking lot, Route 22A | Most of the citgo parking lot drains to one eroding corner. Stormwater infrastructure mapping on this property is wrong. | Could add infiltration basin. Could divert water from road if soil is good. Tons of space for a feature. | 1.04 | 1.02 | 98% | 2.65 | 3,521 | Infiltration Basin | 2,000 | 2.63 | 1 | $ 26,300 | $ 10,019 | 2 | 28 | 50 | 56% | 15 |

**Stormwater Master Plan - Poultney River**
**Unified Prioritization Matrix**
**March 15, 2022**

| Project ID | Project Type | Town | Location | Decription | Preliminary Recommendations | Total Acreage | Impervious Acreage | % Impervious | P Load (lb/yr) | WQv (cf) | BMP Type | BMP Volume (cf) | Total P Reduction (lb/yr) | Project/ Permitting Complexity | Total Cost | Project Efficiency $/lb | Co-Benefits Sum | Total Score | Possible | Final Score % | Overall Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FHV-04** | GSI | Fair Haven | North Main St | Small gully at outfall behind house. Draining into wetland. Large drainage area. Looks like there used to be a pond. | Could infiltrate or do bioretention. Build up sides of existing pond outline to recreate it. | 10.54 | 4.34 | 41% | 15.12 | 16,076 | Wet pond/ Created Wetland | 2,000 | 3.18 | 0 | $ 26,300 | $ 8,277 | 4 | 30 | 50 | 60% | 7 |
| **FHV-06** | GSI | Fair Haven | Fair Haven Municipal Building Driveway | Large drainage area comes into one underground pipe at junction next to municipal building. | Could connect a pipe to thecatch basin in front of municipal building. Tie it into underground infiltration in adjacent grassy area to treat a target volume. | 25.37 | 9.74 | 38% | 35.05 | 36,409 | Infiltration Chamber | 15,000 | 27.51 | 2 | $ 215,500 | $ 7,832 | 4 | 31 | 50 | 62% | 4 |
| **FHV-07** | GSI | Fair Haven | Fair Haven Village Green | Water pooling in road against curb at northern edge of park. Drainage area includes southern half of road from end to end of the top of the park. | Knock out 2 curb sections before catch basin in the NW corner of the park. Infiltrate water in large green space. | 0.26 | 0.25 | 99% | 0.64 | 876 | Infiltration Basin | 570 | 0.57 | 2 | $ 11,300 | $ 19,707 | 4 | 28 | 50 | 56% | 15 |
| **FHV-09** | GSI | Fair Haven | West Park Pl | Pooling water on roadside further from park, picking up gravel and draining into catch basin. | Divert into green space to infiltrate. | 0.50 | 0.31 | 62% | 0.93 | 1,090 | Infiltration Basin | 150 | 0.60 | 2 | $ 8,500 | $ 14,227 | 4 | 30 | 50 | 60% | 7 |
| **FHV-08,10** | GSI | Fair Haven | Fair Haven Village Green | Water pooling along road side. Receives water from FHV-08. | Add swale and little berm to pool water and infiltrate before catch basin. | 0.26 | 0.24 | 91% | 0.64 | 816 | Infiltration Basin | 150 | 0.03 | 2 | $ 8,500 | $ 322,953 | 3 | 17 | 50 | 34% | 47 |
| **FHV-11a,b** | GSI | Fair Haven | Fair Haven Village Green | Ponding water on Main Street. | Take out curb and bring water into infiltrating swale in park. Inexpensive and simple design. | 0.48 | 0.45 | 94% | 0.84 | 1,097 | Infiltrating Swale | 650 | 0.71 | 2 | $ 7,800 | $ 11,056 | 4 | 30 | 50 | 60% | 7 |
| **FHV-12** | Road Erosion Mitigation | Fair Haven | Behind the Adams House, Adams St | Mild erosion in flow path at old foundation. | Stabilize slope. Hard to get machinery down. Lots of loose stone to potentially work with by hand. | 7.77 | 2.37 | 31% | 9.55 | 9,153 | N/A | | 0.40 | 1 | $ 3,800 | $ 9,500 | 3 | 24 | 44 | 55% | 18 |
| **FHV-13** | GSI | Fair Haven | Fair Haven Inn Parking Lot, Adams St | Steep gravel driveway with some erosion down river bank. | Space below driveway. Could do swale, corral water in skinny BMP ( bioretention). Add berm and stabilize overflow and existing gully. | 3.52 | 1.71 | 49% | 5.56 | 6,214 | Bioretention (w/ underdrain) | 400 | 1.93 | 1 | $ 16,000 | $ 8,293 | 4 | 29 | 50 | 58% | 11 |
| **FHV-14** | Road Erosion Mitigation | Fair Haven | Fair Haven Post Office Parking Lot | Slightly plugged catch basin leading to small gully into river. Drainage area mostly paved. | Stone line gully. Some space below for treatment but steep and close to river. | 0.23 | 0.22 | 96% | 0.57 | 749 | N/A | | 0.20 | 2 | $ 3,800 | $ 19,000 | 2 | 19 | 44 | 43% | 36 |
| **FHV-15** | GSI | Fair Haven | Adams St Bridge | Paved drainage area leading into catch basin that outlets into river. | Route water around catch basin and into green space by fire hydrant, lower shoulder. Have water settle in green before turning around and back into catch basin. | 4.51 | 2.52 | 56% | 7.76 | 9,046 | Infiltration Basin | 400 | 1.27 | 1 | $ 13,600 | $ 10,690 | 3 | 25 | 50 | 50% | 29 |
| **FHV-16** | GSI | Fair Haven | Prospect St | DEC recommended retrofit site. Old parking lot in area next to river. | Could remove useless pavement or add a bioretention feature. | 1.71 | 1.36 | 80% | 3.73 | 4,767 | Bioretention (w/ underdrain) | 4,000 | 2.12 | 1 | $ 110,800 | $ 52,313 | 3 | 24 | 50 | 48% | 32 |
| **WI-B** | Road Erosion Mitigation | Bomoseen | Winnick Road and Lakeview Lane | Stormwater from the top of Winnick Road drains down the road and along undersized ditches causing erosion. | Properly regrade road to facilitate turnouts. Establish properly sized ditches. | 0.18 | 0.03 | 15% | 0.18 | 260 | N/A | N/A | 0.20 | 2 | $ 3,400 | $ 17,000 | 3 | 18 | 44 | 41% | 40 |
| **WI-T** | Road Erosion Mitigation | Bomoseen | Winnick Road | Stormwater from Winnick Road drains down along Lakeview Road causing erosion and flooding in driveways. | Evaluate options for diverting runoff into wooded areas to spread out and infiltrate. | 0.80 | 0.08 | 10% | 0.66 | 1,020 | N/A | N/A | 0.40 | 2 | $ 7,000 | $ 17,500 | 3 | 19 | 44 | 43% | 36 |
| **MS-01** | GSI | Middletown Springs | Pleasant View Rd | A large drainage area flows out of a culvert and through a grass swale behind a church. | Appears to be a low volume of runoff despite large drainage area. Treat on neighboring property? | 27.03 | 4.08 | 15% | 25.13 | 18,235 | Infiltration Basin | 2,000 | 1.50 | 2 | $ 21,000 | $ 13,999 | 5 | 26 | 50 | 52% | 26 |
| **MS-02** | GSI | Middletown Springs | School House Rd | Drainage area including school drains through green space and under driveway through a culvert. | Small rain garden at inlet to 18" HDPE to treat school building an courtyard. | 0.31 | 0.24 | 77% | 0.66 | 835 | Bioretention (w/ underdrain) | 550 | 0.66 | 2 | $ 14,200 | $ 21,515 | 4 | 27 | 50 | 54% | 22 |
| **MS-03** | GSI | Middletown Springs | Fire House Lane | There is an existing basin filled with slate next to a gravel pile and a number of gravel driveways. | Install Infiltration Basin at Bill Reed's mother's (Dot) house. Would require some reditching upslope | 2.19 | 0.54 | 25% | 2.45 | 2,161 | Infiltration Basin | 750 | 2.07 | 2 | $ 12,600 | $ 6,075 | 3 | 30 | 50 | 60% | 7 |

**Stormwater Master Plan - Poultney River**
**Unified Prioritization Matrix**
**March 15, 2022**

| Project ID | Project Type | Town | Location | Decription | Preliminary Recommendations | Total Acreage | Impervious Acreage | % Impervious | P Load (lb/yr) | WQv (cf) | BMP Type | BMP Volume (cf) | Total P Reduction (lb/yr) | Project/ Permitting Complexity | Total Cost | Project Efficiency $/lb | Co-Benefits Sum | Total Score | Possible | Final Score % | Overall Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **MS-04** | GSI | Middletown Springs | Fire House Lane | Runoff from the fire department roof, uphill storage areas, and the salt/sand pile drain to the north of the Middletown Springs Fire Department and eventually out behind the building, draining toward North Brook. | Install rudimentary sediment basin treatment system for sand and salt from sheet flow and pipe. Will salt be an issue? Where is the septic system? | 0.33 | 0.33 | 99% | 0.86 | 1,128 | Sediment Trap | 150 | 0.62 | 1 | $ 6,000 | $ 9,646 | 3 | 27 | 50 | 54% | 22 |
| **MS-05** | GSI | Middletown Springs | Park Ave Park | Park provides green space for potential stormwater treatment. | Install Swales and new Drainage infrastructure | 3.97 | 1.65 | 42% | 5.73 | 6,111 | Dry Swale | 150 | 0.46 | 2 | $ 6,800 | $ 14,628 | 4 | 26 | 50 | 52% | 26 |
| **MS-06** | GSI | Middletown Springs | Park Ave Park | Park provides green space for potential stormwater treatment. | Divert WQv from corner DI or with diversion in swale to green space on corner. Bioretention or rain garden | 0.18 | 0.10 | 54% | 0.31 | 348 | Bioretention (w/ underdrain) | 348 | 0.29 | 2 | $ 13,000 | $ 44,372 | 4 | 25 | 50 | 50% | 29 |
| **MS-07** | GSI | Middletown Springs | South Street | Empty lot adjacent to underground stormwater infrastructure. | Divert WQv or larger storm into infiltration on empty lot or underground chambers | 19.41 | 6.20 | 32% | 24.38 | 23,777 | Infiltration Basin | 500 | 2.05 | 0 | $ 27,100 | $ 13,207 | 2 | 23 | 50 | 46% | 34 |
| **MS-08** | Road Erosion Mitigation | Middletown Springs | Soruce Knob Road | A private road off of Spruce Knob Road has an undersized culvert that is deformed, has embankment erosion, and lacks AOP. | Replace culvert with a larger structure that is properly sized to the bankfull channel and provides AOP. | 748.80 | 11.81 | 2% | N/A | N/A | Stream Crossing Replacement | N/A | 2.70 | 1 | $ 100,000 | $ 37,037 | 5 | 16 | 44 | 36% | 44 |
| **PY-01** | GSI | Poultney | Rae Terrace at GMC | Very deep manhole to system draining much of college campus directly into wetland. Retrofit space exists in wetland | Create feature at base of slope to treat large volume. | 5.23 | 2.83 | 54% | 8.82 | 10,195 | Wet pond/ Created Wetland | 5,526 | 3.51 | 0 | $ 82,200 | $ 23,450 | 3 | 21 | 50 | 42% | 38 |
| **PY-02** | GSI | Poultney | Rae Terrace at GMC | Lowpoint in paved parking lots of GMC. Floods during heavy rains. Some sediment deposition in the vicinity. | Plug catchbasin and take out curb to let water into green space for infiltration instead of entering system. | 0.40 | 0.10 | 26% | 0.37 | 407 | Infiltration Basin | 191 | 0.33 | 2 | $ 1,900 | $ 5,746 | 2 | 25 | 50 | 50% | 29 |
| **PY-03** | GSI | Poultney | Granville Street and GMC Field | Very large drainage area draining into broken, undersized culvert with lots of sediment deposition and some gully erosion. Drains through very long and gradual vegetated swale | Reinforce existing swale. Seems to be treating water effectively as is. Replace/upsize culvert. | 16.91 | 7.68 | 45% | 25.68 | 28,159 | Dry Swale (infiltrating) | 500 | 0.69 | 1 | $ 17,900 | $ 26,010 | 0 | 21 | 50 | 42% | 38 |
| **PY-04** | GSI | Poultney | Lumber Yard on Main Street | Surface runoff from hardware store/lumber yard gravel parking lot. Lots of sediment deposition in small woodland buffer and adjacent lawn. Large drainage area and little space for retrofit. | Fit small infiltration feature in green space of yard. Private property. | 0.87 | 0.76 | 87% | 2.03 | 2,636 | Infiltration Basin | 886 | 1.91 | 0 | $ 15,500 | $ 8,127 | 1 | 27 | 50 | 54% | 22 |
| **PY-05** | GSI | Poultney | Main Street | Catch basin in paved intersection draining paved road. Water flowing along curb to catch basin. Green space above curb in church lawn. | Divert water into green space for infiltration before it enters catch basin. | 0.19 | 0.19 | 100% | 0.48 | 646 | Infiltration Basin | 817 | 0.39 | 2 | $ 9,900 | $ 25,541 | 2 | 21 | 50 | 42% | 38 |
| **PY-06** | GSI | Poultney | Behind Church on Main Street | Large paved and gravel church parking lot with grass swale along one side. Lots of space. Some sediment deposition on paved surfaces and sheet erosion in gravel lots. | Install/reinforce grass swale. Divert surface flow into surrounding green space. | 0.87 | 0.66 | 75% | 1.85 | 2,315 | Dry Swale (infiltrating) | 4,876 | 1.85 | 2 | $ 31,600 | $ 17,102 | 3 | 30 | 50 | 60% | 7 |
| **PY-07** | GSI | Poultney | Poultney Town Garage on Autumn Way | Town garage parking lot with swales/culverts draingin large area including school parking lot. Close to Poultney river floodplain. High area of paved and gravel. | Install retention pond or gravel wetland. | 12.20 | 5.63 | 46% | 18.70 | 20,607 | Wet pond/ Created Wetland | 18,832 | 10.72 | 0 | $ 278,300 | $ 25,967 | 5 | 29 | 50 | 58% | 11 |
| **PY-08** | GSI | Poultney | Senior Center on Furnace Street | Parking lot with paved and gravel surfaces draining into eroded channel that leads to gully into Poultney river. Lots of sediment runoff directly into the river. | Divert water into green space, add rain garden. | 0.22 | 0.18 | 81% | 0.40 | 634 | Dry Swale (infiltrating) | 1,319 | 0.60 | 0 | $ 8,500 | $ 14,242 | 2 | 28 | 50 | 56% | 15 |
| **PY-09** | GSI | Poultney | Furnace Street | Catch basin draining small area of entirely impervious, very little space. | Divert water into median green area or toward PY-08. | 0.05 | 0.05 | 95% | 0.13 | 176 | Bioretention (w/ underdrain) | 97 | 0.04 | 0 | $ 2,400 | $ 54,431 | 1 | 15 | 50 | 30% | 48 |
| **PY-10** | GSI | Poultney | Thrall Road | Runoff from River St and Thrall Rd flow onto 212 Thrall Road property causing flooding and erosion. | Install new trench drain, catch basin, and cross culvert to divert water under Thrall Road and into new BMP on East side. | 0.39 | 0.20 | 51% | 0.64 | 920 | Bioretention | 600 | 0.62 | 1 | $ 30,000 | $ 48,387 | 3 | 14 | 50 | 28% | 49 |

**Stormwater Master Plan - Poultney River**
**Unified Prioritization Matrix**
**March 15, 2022**

| Project ID | Project Type | Town | Location | Decription | Preliminary Recommendations | Total Acreage | Impervious Acreage | % Impervious | P Load (lb/yr) | WQv (cf) | BMP Type | BMP Volume (cf) | Total P Reduction (lb/yr) | Project/ Permitting Complexity | Total Cost | Project Efficiency $/lb | Co-Benefits Sum | Total Score | Possible | Final Score % | Overall Rank |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **RR-01** | Road Erosion Mitigation | West Haven | River Road | Cross culvert draining directly into Poultney river. Gravel road eroding into channel on either side of road. Culvert is perched with gully erosion below. | Stabilize gully with stone. | 14.96 | 0.38 | 3% | 10.28 | 7,737 | N/A | 4,369 | 0.20 | 0 | $ 6,300 | $ 31,500 | 3 | 16 | 44 | 36% | 44 |
| **RR-02** | Road Erosion Mitigation | West Haven | River Road | Cross culvert from steep uphill slope. Heavy gully erosion above road starting to clog culvert. Outlet onto reinforced slope with sediment depositing. | Plunge pool below or reinforcement above. | 1.29 | 0.00 | 0% | 0.82 | 268 | N/A | 3,831 | 0.66 | 0 | $ 6,300 | $ 9,604 | 3 | 28 | 44 | 64% | 3 |
| **RR-03** | Road Erosion Mitigation | West Haven | River Road | Cross culvert almost fully clogged by sediment. Large landslide just uphill depositing lots of sediment. Erosion on downhill side. | Upsize culvert and add catchment feature to slow water before entering culvert. | 0.77 | 0.22 | 28% | 0.92 | 164 | N/A | 1,057 | 0.74 | 0 | $ 6,300 | $ 8,560 | 3 | 29 | 44 | 66% | 2 |
| **RR-04** | Road Erosion Mitigation | West Haven | River Road | Culvert draining directly into Poultney river. Nearby construction replacing cross culvert and reinforcing ditch. Surface erosion on road surface and off sides. | Install turnout above to keep water off road. | 4.21 | 0.50 | 12% | 3.65 | 1,265 | N/A | 747 | 0.08 | 0 | $ 7,500 | $ 93,750 | 3 | 16 | 44 | 36% | 44 |
| **RR-05** | Road Erosion Mitigation | West Haven | River Road | Undersized, plugged cross culvert draining into gully and then into wetland. Heavy erosion in roadway with channels carved into the gravel surface. Very steep grade and very few culverts. Minimal space for changes. | Install more cross culverts and small ditches on either side. Regrade roadway. | 2.33 | 0.48 | 21% | 2.42 | 606 | N/A | 3,242 | 1.94 | 1 | $ 37,500 | $ 19,370 | 4 | 30 | 44 | 68% | 1 |

# APPENDIX E

# Project Descriptions and Photographs by Town (8.5”x11”)

Poultney River Stormwater Masterplan

Benson Sites

| Project ID | Project Type | Location | Description | BMP Recommendations | Photo |
|---|---|---|---|---|---|
| BN-01 | GSI | **Benson** Lake Road | Culvert from corner of Old North Lake Rd and Stage Rd daylighting and entering catch basin through vegetated swale in private lawn. | Space for a GSI retrofit in grassy area. |  |
| BN-02 | GSI | **Benson** Stage Road | Green space in front of church with vegetated swale. Drains gravel parking lot of church. | Space for small infiltration basin. |  |
| BN-3 | Road Erosion Mitigation | **Benson** Stage Road Apt Complex | Apartment complex with steep paved and gravel driveways and parking lots. No current Stormwater infrastructure. Sediment deposition on steepest part of paved driveway under gravel lot. | Could infiltrate stormwater in one of the adjacent grassy areas. Dry swale w/ underdrain. |  |

| | | | | | |
|---|---|---|---|---|---|
| BN-04 | GSI | **Benson** Stage Road | Catch basin with small wetland treating entering water. Old concrete wall right next to it. Limited space. Id'd by state for retrofit. | Install berm to pool water in wetland and treat stormwater. Bioretention (w/ underdrain) |   |
| BN-5 | GSI | **Benson** Lake Road | Raised catch basin in private lawn draining into BN-06 swale after daylighting and going into another culvert. Lots of space but all on private land. 806 Lake Rd downtown. | Install berm around existing catch basin and raise invert to pool and infiltrate water. Bioretention (w/ underdrain) |  |
| BN-06 | GSI | **Benson** Stage Road | Densely vegetated swale draining into 24" culvert. Large overflow drainage area that accepts stormwater during high flow events. No visible erosion. | Wide grassy space for treatment, on site of old gas station, soil would need to be tested. Gravel Wetland. |  |

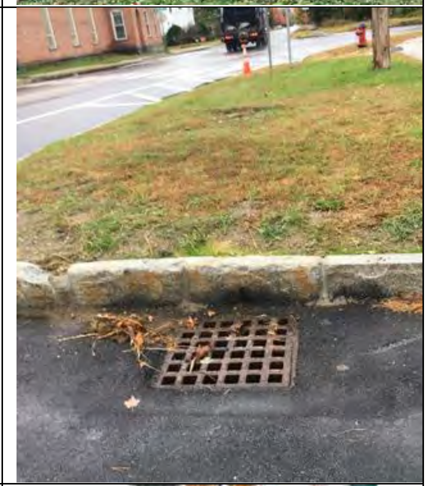
| | | | | | |
|---|---|---|---|---|---|
| BN-07 | GSI | **Benson** Lake Road | Catch basin at Southeast corner of Stage-Lake Rd. intersection. Sediment deposition around it from gravel parking lot of VFD. Small green space with high curb next to it. | Convert curbed green space to small infiltration area. Infiltration Basin |  |
| BN-08 | GSI | **Benson** Lake Rd. | Catch basin draining some of Lake Rd. and a gravel parking lot at the corner of Stage rd. and Lake rd. Sediment building up around the catch basin on the paved surface. | Areas added could be located at the curve in the driveway and in front of the church by the parking area. Infiltration Basin |  |
| BN-09 | GSI | **Benson** Stage Road | Sheet/rill erosion in upper parking lot of VFD south station. Water flowing off Lake road, through parking lot and into private yard. | Retrofit with swale or berm to divert water out of lot. Dry swale (w/ underdrain) |  |
| BN-10 | GSI | **Benson** Stage Road and Lake Road | Set of three consecutive culverts separated by small ponds/wetlands. Endpoint for Benson stormwater system. Receives all stormwater collected in closed system within the town. | Expand wetland areas, add meanders, upsize culverts. Wet pond/ Created Wetland |  |

| | | | | | |
|---|---|---|---|---|---|
| BN-11 | GSI | **Benson** School Street EXT. | School parking lot with three catch basins draining into the same closed system. Drains gravel parking lot and school roof. Minor erosion at culvert outlet in back of school. | Raise catch basins to pool water before entering system. Educational benefits to children at the school. Could also treat at the outlet. Infiltration Basin |  |

Poultney River Stormwater Masterplan

Fair Haven Sites

| Project ID | Project Type | Location | Description | BMP Recommendations | Photo |
|---|---|---|---|---|---|
| FHV-01 | GSI | **Fair Haven** Route 4 Exit | Large drainage area outlets into highway median. Little wetland is filtering some of the water now. A lot of paved area would be treated. | Make berm to enclose depression and pool water. Expensive and difficult. |  |
| FHV-02 | GSI | **Fair Haven** FHUHS | Drains large area of school property into green space. | Definite space for a feature depending on permitting with highway. |  |
| FHV-03 | GSI | **Fair Haven** Route 22A | Most of the citgo parking lot drains to one eroding corner. Stormwater infrastructure mapping on this property is wrong. | Could add infiltration basin. Could divert water from road if soil is good. Tons of space for a feature. |  |

| | | | | | |
|---|---|---|---|---|---|
| FHV-04 | GSI | **Fair Haven** North Main St | Small gully at outfall behind house. Draining into wetland. Large drainage area. Looks like there used to be a pond. | Could infiltrate or do bioretention. Build up sides of existing pond outline to recreate it. |  |
| FHV-06 | GSI | **Fair Haven** Municipal Building Driveway | Large drainage area comes into one underground pipe at junction next to municipal building. | Could connect a pipe to the catch basin in front of municipal building. Tie it into underground infiltration in adjacent grassy area to treat a target volume. |  |
| FHV-07 | GSI | **Fair Haven** Village Green | Water pooling in road against curb at northern edge of park. Drainage area includes southern half of road from end to end of the top of the park. | Knock out 2 curb sections before catch basin in the NW corner of the park. Infiltrate water in large green space. |  |

| | | | | | |
|---|---|---|---|---|---|
| FHV-09 | GSI | **Fair Haven** West Park Pl | Pooling water on roadside further from park, picking up gravel and draining into catch basin. | Divert into green space to infiltrate. |  |
| FHV-08,10 | GSI | **Fair Haven** Village Green | Water pooling along road side. Receives water from FHV-08. | Add swale and little berm to pool water and infiltrate before catch basin. |  |
| FHV-11a,b | GSI | **Fair Haven** Village Green | Ponding water on Main Street. | Take out curb and bring water into infiltrating swale in park. Inexpensive and simple design. |  |

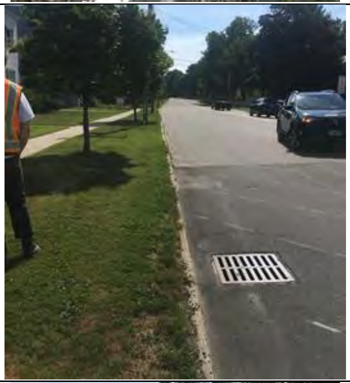
| | | | | | |
|---|---|---|---|---|---|
| FHV-12 | Road Erosion Mitigation | **Fair Haven** Adams St | Mild erosion in flow path at old foundation. | Stabilize slope. Hard to get machinery down. Lots of loose stone to potentially work with by hand. |  |
| FHV-13 | GSI | **Fair Haven** Inn Parking Lot, Adams St | Steep gravel driveway with some erosion down riverbank. | Space below driveway. Could do swale, corral water in skinny BMP (bioretention). Add berm and stabilize overflow and existing gully. |  |
| FHV-14 | Road Erosion Mitigation | **Fair Haven** Post Office Parking Lot | Slightly plugged catch basin leading to small gully into river. Drainage area mostly paved. | Stone line gully. Some space below for treatment but steep and close to river. |  |

| | | | | | |
|---|---|---|---|---|---|
| FHV-15 | GSI | **Fair Haven** Adams St Bridge | Paved drainage area leading into catch basin that outlets into river. | Route water around catch basin and into green space by fire hydrant, lower shoulder. Have water settle in green before turning around and back into catch basin. |  |
| FHV-16 | GSI | **Fair Haven** Prospect St | DEC recommended retrofit site. Old parking lot in area next to river. | Could remove useless pavement or add a bioretention feature. |  |

Poultney River Stormwater Masterplan

Poultney Sites

| Project ID | Project Type | Location | Description | BMP Recommendations | Photo |
|---|---|---|---|---|---|
| PY-01 | GSI | **Poultney** Rae Terrace at GMC | Very deep manhole to system draining much of college campus directly into wetland.<br>Retrofit space exists in wetland | Create feature at base of slope to treat large volume. |  |
| PY-02 | GSI | **Poultney** Rae Terrace at GMC | Lowpoint in paved parking lots of GMC. Floods during heavy rains. Some sediment deposition in the vicinity. | Plug catch basin and take out curb to let water into green space for infiltration instead of entering system. |  |
| PY-03 | GSI | **Poultney** Granville Street and GMC Field | Very large drainage area draining into broken, undersized culvert with lots of sediment deposition and some gully erosion. Drains through very long and gradual vegetated swale | Reinforce existing swale. Seems to be treating water effectively as is.<br>Replace/upsize culvert. |  |

| | | | | | |
|---|---|---|---|---|---|
| PY-04 | GSI | **Poultney** Main Street | Surface runoff from hardware store/lumber yard gravel parking lot. Lots of sediment deposition in small woodland buffer and adjacent lawn. Large drainage area and little space for retrofit. | Fit small infiltration feature in green space of yard. Private property. |  |
| PY-05 | GSI | **Poultney** Main Street | Catch basin in paved intersection draining paved road. Water flowing along curb to catch basin. Green space above curb in church lawn. | Divert water into green space for infiltration before it enters catch basin. |  |
| PY-06 | GSI | **Poultney** Main Street | Large paved and gravel church parking lot with grass swale along one side. Lots of space. Some sediment deposition on paved surfaces and sheet erosion in gravel lots. | Install/reinforce grass swale. Divert surface flow into surrounding green space. |  |

| | | | | | |
|---|---|---|---|---|---|
| PY-07 | GSI | **Poultney** Autumn Way | Town garage parking lot with swales/culverts draining large area including school parking lot. Close to Poultney river floodplain. High area of paved and gravel. | Install retention pond or gravel wetland. |  |
| PY-08 | GSI | **Poultney** Furnace Street | Senior Center parking lot with paved and gravel surfaces draining into eroded channel that leads to gully into Poultney river. Lots of sediment runoff directly into the river. | Divert water into green space, add rain garden. |  |
| PY-09 | GSI | **Poultney** Furnace Street | Catch basin draining small area of entirely impervious, very little space. | Divert water into median green area or toward PY-08. |  |

Poultney River Stormwater Masterplan

West Haven Sites

| Project ID | Project Type | Location | Description | BMP Recommendations | Photo |
|---|---|---|---|---|---|
| RR1 | Roadside | **West Haven** River Road | Cross culvert draining directly into river. Gravel road eroding into channel on either side of road. Culvert is perched with gully erosion below. | Stabilize gully with stone. |  |
| RR2 | Roadside | **West Haven** River Road | Cross culvert from steep uphill slope. Heavy gully erosion above road starting to clog culvert. Outlet onto reinforced slope with sediment depositing. | Plunge pool below or reinforcement above. |  |

| | | | | | |
|---|---|---|---|---|---|
| RR3 | Roadside | **West Haven** River Road | Cross culvert almost fully clogged by sediment. Large landslide just uphill depositing lots of sediment. Erosion on downhill side. | Upsize culvert and add catchment feature to slow water before entering culvert. |  |
| RR4 | Roadside | **West Haven** River Road | Culvert draining directly into river. Nearby construction replacing cross culvert and reinforcing ditch. Surface erosion on road surface and off sides. | Install turnout above to keep water off road. |  |
| RR5 | Roadside | **West Haven** River Road | Undersized, plugged cross culvert draining into gully and then into wetland. Heavy erosion in roadway with channels carved into the gravel surface. Very steep grade and very few culverts. Minimal space for changes. | Install more cross culverts and small ditches on either side. Regrade roadway. |  |

# APPENDIX F

Problem Area
Summary Sheets
**(**8.5**"x11")**

| Project: BN-02 | Problem Area Summary |
|---|---|
| **Location** | Stage Road, Benson |
| **Land Ownership** | Private |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 0.33 / 0.28 acres |
| **% Impervious** | 86% |
| **Estimated Project Cost** | $ 2,700 |
| **P Efficiency ($/lb removed)** | $ 5,614 |
| **Project Priority** | Moderate |


**Site Description:** Minor erosion in church parking lot leads into vegetated swale and then into a culvert.

**Photo 1:** Vegetated swale accepting runoff from the church parking lot.

**Photo 2:** Rill erosion in church parking lot.

**BMP Description:** Divert runoff into infiltration basin for treatment before it enters the larger stormwater system for the town. The existing vegetated swale could be adapted to infiltrate and slow down runoff.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 266 | 0.76* | 0.48 | Low | Low | Rill | Med |

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: BN-03** | **Problem Area Summary** |
|---|---|
| **Location** | Stage Road, Benson |
| **Land Ownership** | Private |
| **BMP Type** | Swale with underdrain |
| **Drainage Area/Impervious** | 0.22 / 0.20 acres |
| **% Impervious** | 92% |
| **Estimated Project Cost** | $ 5,800 |
| **P Efficiency ($/lb removed)** | $ 15,821 |
| **Project Priority** | Low |


**Site Description:** This paved driveway for an apartment complex has no stormwater infrastructure in place. Water carries sediment across the paved surfaces and runs downhill. Stormwater picks up a lot of sediment by cutting through the steep corner shown in photo 1.

**Photo 1:** Corner of driveway being eroded and mobilizing sediment.

**Photo 2:** Sediment from uphill deposited on paved driveway.

**Feasibility Comments:** This project is entirely in private property and would require landowner permission.

**BMP Description:** Install swale with underdrain to infiltrate and divert flow away from the paved surfaces. Low soil infiltration at this site must be addressed.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 895 | 0.53* | 0.37 | Med | Low | Rill | Med |

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: BN-06** | **Problem Area Summary** |
|---|---|
| **Location** | Lake Road, Benson |
| **Land Ownership** | Private |
| **BMP Type** | Gravel Wetland |
| **Drainage Area/Impervious** | 10.73 / 2.44 acres |
| **% Impervious** | 23% |
| **Estimated Project Cost** | $ 108,300 |
| **P Efficiency ($/lb removed)** | $ 20,907 |
| **Project Priority** | High |


**Site Description:** A vegetated swale drains the western half of Benson Village to this site where the water inters a catch basin that brings it to the site of BN-10.

**Photo 1:** Section of current vegetated swale.

**Photo 2:** Catch basin accepting stormwater with gravel deposition around it.

**Feasibility Comments:** Landowner permission is not guaranteed and would be necessary to make any improvements to this site. There are potentially buried gas tanks in the parking lot.

**BMP Description:** Construct a gravel wetland to treat and infiltrate the runoff from the west side of the village before it enters the larger stormwater system.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 6,338 | 11.57* | 5.18 | Low | Low | Sheet | Med |

**Other Considerations/Benefits:** Treating this site would reduce the P load going to site BE-4 and would treat a significant portion of the village's stormwater. This would be a good alternative if BE-4 cannot be improved.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

## Project: BN-07 — Problem Area Summary

| | |
|---|---|
| **Location** | Lake Road and Stage Road, Benson |
| **Land Ownership** | Town of Benson |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 0.143 / 0.138 acres |
| **% Impervious** | 96% |
| **Estimated Project Cost** | $ 2,000 |
| **P Efficiency ($/lb removed)** | $ 6,201 |
| **Project Priority** | Moderate |


**Site Description:** Gravel from the Volunteer Fire Department parking lot is running off along the road next to a curbed, vegetated island and into a catch basin.

**Photo 1:** Sediment runoff along road edge.

**Photo 2:** Catch basin accepting stormwater with gravel deposition beginning to clog it.

**Feasibility Comments:** The vegetation surrounded by a curb (shown in photos) could be adapted into an infiltration basin.

**BMP Description:** Remove curb around vegetation and direct stormwater into it for infiltration and sediment reduction.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 193 | 0.34* | 0.32 | Med | Low | Sheet | Low |

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: BN-08** | **Problem Area Summary** |
|---|---|
| **Location** | Lake Road and Stage Road, Benson |
| **Land Ownership** | Private |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 1.89 / 0.59 acres |
| **% Impervious** | 31% |
| **Estimated Project Cost** | $ 3,400 |
| **P Efficiency ($/lb removed)** | $ 4,406 |
| **Project Priority** | Low |


**Site Description:** This catch basin accepts water from the hill on Lake road and the parking lot and roof of the inn. Sediment from the gravel parking lot is moving into the catch basin along the road and through sheet erosion in the lot.

**Photo 1:** Gravel parking lot draining into catch basin.


**Photo 2:** Green space next to catch basin.

**Feasibility Comments:** This project would require landowner permission to construct a berm and infiltration basin in the green space.

**BMP Description:** Divert water into infiltration basin in the adjacent green space. Raise catch basin to reduce water input before infiltration.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 337 | 2.36* | 0.77 | Med | Low | Sheet | Med |

**Other Considerations/Benefits:** This site is in the center of the village of Benson and could serve as an educational tool for the people of Benson, drawing attention to the importance of green stormwater infrastructure.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: BN-10** | **Problem Area Summary** |
| --- | --- |
| **Location** | Stage Road, Benson |
| **Land Ownership** | Town of Benson, Private |
| **BMP Type** | Wet pond, constructed wetland |
| **Drainage Area/Impervious** | 56.80 / 9.67 acres |
| **% Impervious** | 17% |
| **Estimated Project Cost** | $ 261,100 |
| **P Efficiency ($/lb removed)** | $ 13,473 |
| **Project Priority** | Moderate |


**Site Description:** This site drains the entire village center of Benson through stormwater infrastructure. The stormwater daylights into a series of vegetated swales and wetlands separated by driveway culverts. Temporary sediment traps have been installed in the standing water.

**Photo 1:** Standing water draining from wetland into one of the culverts. White sediment trap has been placed in feature.

**Photo 2:** Perched culvert draining into eroded ditch before entering another culvert.

**Feasibility Comments:** The high cost of this project could be reduced by simply upgrading the existing treatment system to have more storage and infiltration capacity.

**BMP Description:** A series of robust wet ponds and constructed wetlands will slow down the stormwater before it enters the adjacent stream and give some of it a chance to infiltrate.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
| --- | --- | --- | --- | --- | --- | --- |
| 18,946 | 54.94* | 18.58 | Low | Low | None | Mod |

**Other Considerations/Benefits:** Since this site drains the whole village, installing a BMP here would reduce P input from many of the identified sites in the Benson Town Center.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| Project: BN-11 | Problem Area Summary |
|---|---|
| **Location** | School Street, Benson |
| **Land Ownership** | Town of Benson |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 0.91 / 0.65 acres |
| **% Impervious** | 71% |
| **Estimated Project Cost** | $ 52,800 |
| **P Efficiency ($/lb removed)** | $ 33,732 |
| **Project Priority** | Moderate |


**Site Description:** Three catch basins collect stormwater from the school parking lot and surrounding areas. This includes rooves and gravel parking lots. The water is all drained through a small outlet in the lawn behind the school (Photo 2). There is minor erosion at the outlet, but it feeds a larger gully at the end of the field.

**Photo 1:** One of the three catch basins draining the school driveway.

**Photo 2:** Minor erosion from outlet.

**BMP Description:** Raise catch basins to allow stormwater to pool and infiltrate before entering the system. The issue could also be addressed at the outlet by installing a vegetated swale to slow down and infiltrate stormwater.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 1,754 | 1.84* | 1.57 | Med | Low | Gully | Low |

**Other Considerations/Benefits:** This site is in front of the elementary school. Children, parents, and teachers would all interact with green stormwater infrastructure. The educational potential of this site is the highest among our selected sites.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: BN-12** | **Problem Area Summary** |
|---|---|
| **Location** | Root Pond Road, Benson |
| **Land Ownership** | Town of Benson |
| **BMP Type** | Stone-Lined Ditch |
| **Drainage Area/Impervious** | 2.32 / 0.09 acres |
| **% Impervious** | 4% |
| **Estimated Project Cost** | $ 20,000 |
| **P Efficiency ($/lb removed)** | $ 15,079 |
| **Project Priority** | High |


**Site Description:** Severe gully erosion along east side of Root Pond Road is depositing sediment on adjacent field. There is a wetland downhill of the site. There is limited space for improvements on both sides of the very steep road (16°).

**Photo 1:** Gully Erosion alongside road.

**Photo 2:** Trail of Sediment deposited in field.

**Feasibility Comments:** The ditches will have to be narrow to fit in the space along the road. With property owner permission, the ditches could extend past the fences that are currently in place.

**BMP Description:** A narrow stone-lined ditch along the east side of the steep part of the road.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 1,810 | 1.66* | 1.33 | High | Low | Gully | Low |

**Other Considerations/Benefits:** This site is far from the Poultney River, but drains toward a wetland. Improving the site would benefit this wetland.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: FHV-03** | **Problem Area Summary** |
|---|---|
| **Location** | Washington Street |
| **Land Ownership** | Private |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 1.04 / 1.02 acres |
| **% Impervious** | 98% |
| **Estimated Project Cost** | $ 26,300 |
| **P Efficiency ($/lb removed)** | $ 10,019 |
| **Project Priority** | High |


**Site Description:** Gas station paved parking lot drains to southwest corner. Runoff flows over gravel and into depression that leads to Mud Brook.

**Photo 1:** Gravel patch at low point of paved parking lot where all runoff flows

**Photo 2:** Vegetated depression into which runoff flows from parking lot

**BMP Description:** Install large infiltration basin between the parking lot and the depression to intercept runoff. Potential to divert more runoff from road into BMP if a large enough feature in installed.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 2,000 | 2.65* | 2.63 | Med | Med | Sheet | Med |

**Feasibility Comments:** There is excess open space at this site, however, the land is privately owned. Potential to treat a large P load with landowner approval.

**Other Considerations/Benefits:** Runoff from the gas station may contain harmful chemicals. Treating this runoff would be very beneficial for downstream waterways.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

## Project: FHV-06 — Problem Area Summary

| | |
|---|---|
| **Location** | Washington Street and North Park Place |
| **Land Ownership** | Private |
| **BMP Type** | Infiltration Chamber |
| **Drainage Area/Impervious** | 25.37 / 9.74 acres |
| **% Impervious** | 46% |
| **Estimated Project Cost** | $ 215,000 |
| **P Efficiency ($/lb removed)** | $ 7,832 |
| **Project Priority** | High |


**Site Description:** A catch basin in front of the fire department is the junction of two large stormwater systems that drain a large swath of the village center. This is across the street from the Village Green.


**Photo 1:** Green space under which BMP will fit

**Photo 2:** Catch basin to be tied into proposed BMP

**BMP Description:** Tie catch basin into underground infiltration in the empty area in the northwest corner of the Village Green. Use existing infrastructure as an overflow for excess stormwater.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 15,000 | 35.05* | 27.51 | Low | Low | None | High |

**Feasibility Comments:** This site has space for a very large feature in the village green.

**Other Considerations/Benefits:** This high-profile location could provide educational benefits.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: FHV-08/FHV-10** | **Problem Area Summary** |
|---|---|
| **Location** | West Park Place |
| **Land Ownership** | Town of Fair Haven |
| **BMP Type** | Infiltrating Swale |
| **Drainage Area/Impervious** | 0.26 / 0.24 acres |
| **% Impervious** | 91% |
| **Estimated Project Cost** | $ 8,500 |
| **P Efficiency ($/lb removed)** | $ 322,953 |
| **Project Priority** | Moderate |


**Site Description:** Stormwater pools in the grass and on the pavement along the west side of the village green. There are two culverts that do not accept all the runoff because of problems with the road grade.

**Photo 1:** Stormwater pooling along the side of the road just up gradient from FHV-08 catch basin.

**Photo 2:** FHV-10 catch basin with water pooling on road just to the south

**BMP Description:** Fix crown of road to direct all water into the green space. Dig infiltrating swale along the west side of the fence to tie into the two catch basins.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 150 | 0.64* | 0.11 | Low | Low | None | Low |

**Feasibility Comments:** Low P load at this site could warrant regrading the road to direct more runoff through proposed BMP.

**Other Considerations/Benefits:** Location in Village Green could provide educational benefits.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: FHV-11a,b** | **Problem Area Summary** |
|---|---|
| **Location** | Main Street |
| **Land Ownership** | Town of Fair Haven |
| **BMP Type** | Infiltrating Swale |
| **Drainage Area/Impervious** | 0.42 / 0.39 acres |
| **% Impervious** | 93% |
| **Estimated Project Cost** | $ 7,800 |
| **P Efficiency ($/lb removed)** | $ 11,056 |
| **Project Priority** | High |


**Site Description:** Water pools on the pavement on the east side of the Village Green. Catch basins are situated above the low point and far from the edge of the road, giving the water nowhere to go.

**Photo 1:** Water pooling against curb with existing catch basin far from curb and above low point

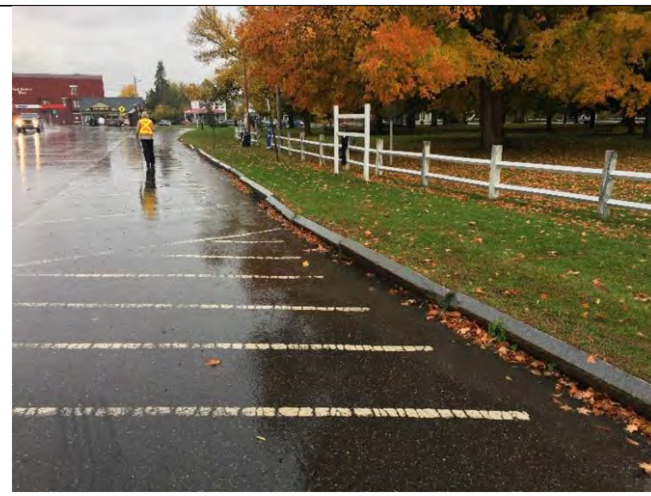


**Photo 2:** Damaged curb to be removed to allow water to flow into green space where BMP will be

**BMP Description:** Remove sections of curb in two areas to allow runoff to flow into the existing lawn. Install an infiltrating swale along the east side of the fence to direct runoff to the south.

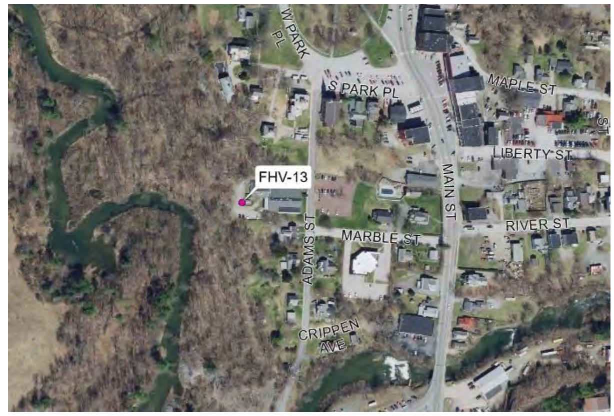
| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 650 | 1.06* | 0.84 | Low | Med | None | Low |

**Feasibility Comments:** The proposed BMP is on town property and in a section of the green that does not have any walking paths or other frequent usage.

**Other Considerations/Benefits:** The location in the Town center on the village green will provide an educational benefit to the Town of Fair Haven.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| Project: FHV-13 | Problem Area Summary |
|---|---|
| **Location** | Adams Street |
| **Land Ownership** | Private |
| **BMP Type** | Bioretention/Gully Stabilization |
| **Drainage Area/Impervious** | 3.52 / 1.71 acres |
| **% Impervious** | 49% |
| **Estimated Project Cost** | $ 16,000 |
| **P Efficiency ($/lb removed)** | $ 8,293 |
| **Project Priority** | Moderate |




**Site Description:** A large gravel driveway has a cracked culvert connected to a catch basin on Adams Street. Runoff from this culvert and surface runoff are eroding the gravel driveway and forming a gully on the slope down to the Castleton River.

**Photo 1:** Stormwater flowing over gravel out of broken culvert

**Photo 2:** Eroding gravel in driveway just uphill of low point

**BMP Description:** Install a small bioretention feature at the west side of the driveway before the slope. Stabilize the existing gully and use it as an overflow for the BMP.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 400 | 5.56* | 1.93 | High | Low | Gully | Med |

**Feasibility Comments:** Gully on slope is steep and heavily vegetated with little buffer to the river below.

**Other Considerations/Benefits:**

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| Project: MS-01 | Problem Area Summary |
|---|---|
| **Location** | Pleasant View Rd. |
| **Land Ownership** | Private |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 27.03 / 4.08 acres |
| **% Impervious** | 15% |
| **Estimated Project Cost** | $ 21,000 |
| **P Efficiency ($/lb removed)** | $ 13,999 |
| **Project Priority** | Moderate |


**Site Description:** A large drainage area flows out of a culvert and through a grass swale behind a church at the edge of town. The volume of water reaching the site may be low and/or infiltrate in the swale with underlying sandy soils. Unclear how much treatment potential exists. Need field observations during storm events.

**Photo 1:** Culvert leading into the area where the BMP will be located.

**Photo 2:** Swale to be diverted into future BMP.

**BMP Description:** Install an infiltration basin to intercept flow through the existing grass swale. Overflow can continue along existing flow path.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 2,000 | 25.13* | 1.50 | Low | Low | None | Low |

**Feasibility Comments:** While this project would be relatively easy to install, the runoff from this area doesn't seem to cause water quality problems. It drains over relatively flat ground and doesn't appear to reach a stream or other waterway.

**Other Considerations/Benefits:** Location in a high visibility area would have additional educational benefits. The site is located at a church and the school uses this area to gather after fire drills, bringing many churchgoers and parents into the vicinity of the project area on a regular basis.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: MS-02** | **Problem Area Summary** |
|---|---|
| **Location** | School House Rd. |
| **Land Ownership** | Middletown Springs Elementary School |
| **BMP Type** | Bioretention |
| **Drainage Area/Impervious** | 0.31 / 0.24 acres |
| **% Impervious** | 77% |
| **Estimated Project Cost** | $ 14,200 |
| **P Efficiency ($/lb removed)** | $ 21,515 |
| **Project Priority** | Moderate |


**Site Description:** Drainage area including school roof and parking drains through green space and under driveway through a culvert.

**Photo 1:** Culvert inlet where proposed BMP will be installed.


**Photo 2:** Middletown Springs Elementary School and drainage area of the proposed BMP.

**BMP Description:** Install infiltration basin at culvert inlet to treat runoff before it leaves the school. This area drains to a vegetated hillside, so low priority for water quality remediation, but high educational value.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 550 | 0.66* | 0.66 | Low | Low | None | Low |

**Feasibility Comments:** Site is on public property and existing grade suits itself well to installation of an infiltration basin.

**Other Considerations/Benefits:** Location at school would provide educational benefits.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| Project: MS-03 | Problem Area Summary |
|---|---|
| **Location** | Fire House Ln. |
| **Land Ownership** | Private |
| **BMP Type** | Infiltration Basin |
| **Drainage Area/Impervious** | 2.19 / 0.54 acres |
| **% Impervious** | 25% |
| **Estimated Project Cost** | $ 12,600 |
| **P Efficiency ($/lb removed)** | $ 6,075 |
| **Project Priority** | High |


**Site Description:** Town garage, equipment storage area, sand/salt pile, fire house and transfer station. There is an existing infiltration basin filled with slate next to a gravel pile and a number of gravel driveways.

**Photo 1:** Gravel driveway that drains to the basin.

**Photo 2:** Existing basin grown in with vegetation.

**BMP Description:** Retrofit the existing basin into an infiltration basin and direct additional runoff to be infiltrated.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 750 | 2.45* | 2.07 | High | Low | Sheet | Low |

**Feasibility Comments:** With a basin already in place, this should be a simple and inexpensive BMP. If a larger volume can be constructed, additional runoff could be diverted into the basin. Landowners are supportive and the Town would assist with the project, likely offering their services without pay.

**Other Considerations/Benefits:** The Town has been requesting help with this project for many years and it would be nice to support their initiative.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: MS-04** | **Problem Area Summary** |
|---|---|
| **Location** | Fire House Ln. |
| **Land Ownership** | Middletown Springs Volunteer Fire Dept. |
| **BMP Type** | Sediment Trap |
| **Drainage Area/Impervious** | 0.33 / 0.33 acres |
| **% Impervious** | 100% |
| **Estimated Project Cost** | $ 6,000 |
| **P Efficiency ($/lb removed)** | $ 9,646 |
| **Project Priority** | Moderate |


**Site Description:** Runoff from the fire department roof, uphill storage areas, and the salt/sand pile drain to the north of the Middletown Springs Fire Department and eventually out behind the building, draining toward North Brook.

**Photo 1:** Sediment buildup along the edge of the drainage area.

**Photo 2:** Gravel parking lot that contributes sediment to the proposed BMP.

**BMP Description:** Install a rudimentary sediment basin treatment system for sand and salt from sheet flow and pipe.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 150 | 0.86* | 0.62 | High | Low | Sheet | Low |

**Feasibility Comments:** There is a septic system located in the vicinity of this project. The area would need to be scoped by a septic company to locate the extent of the system.

**Other Considerations/Benefits:** Fire department would support a project that did not interfere with site utility.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: PY-01** | **Problem Area Summary** |
|---|---|
| **Location** | Rae Terrace, Poultney |
| **Land Ownership** | Private |
| **BMP Type** | Constructed Wetland |
| **Drainage Area/Impervious** | 5.23 / 2.83 acres |
| **% Impervious** | 54% |
| **Estimated Project Cost** | $ 82,200 |
| **P Efficiency ($/lb removed)** | $ 23,450 |
| **Project Priority** | Moderate |


**Site Description:** This outfall drains most of the campus of the former Green Mountain College directly into a wetland/stream. The central area of the campus has dry wells and is therefore omitted from the drainage area of this site.

**Photo 1:** Paved area in the drainage area of the site

**Photo 2:** Green space into which the outfall drains

**Feasibility Comments:** The pipe is 20+ feet underground and would be difficult to alter. Any BMP at this site should be at the outfall.

**BMP Description:** Install a constructed wetland at the outfall to infiltrate stormwater and reduce sediment runoff into the stream. The area in which the BMP would fit is at the bottom of the hill in a wooded area.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 5,526 | 8.82* | 3.51 | Low | Low | None | Med |

**Other Considerations/Benefits:** This site drains a very large impervious area. It will require a complex BMP, but effective improvements would have valuable effects on Phosphorus and sediment levels in the Poultney River.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: PY-04** | | **Problem Area Summary** |
|---|---|---|
| **Location** | Bentley Ave, Poultney | |
| **Land Ownership** | Private | |
| **BMP Type** | Infiltration Basin | |
| **Drainage Area/Impervious** | 0.87 / 0.76 acres | |
| **% Impervious** | 87% | |
| **Estimated Project Cost** | $ 15,500 | |
| **P Efficiency ($/lb removed)** | $ 8,127 | |
| **Project Priority** | Moderate | |


**Site Description:** Sediment from the Hardware Store and Lumber Yard is deposited in a large swath through a vegetated area and into a small stream

**Photo 1:** Deposited sediment from the coming from the corner of the parking lot.

**Photo 2:** Small gully forming in steeper section of the parking lot.

**Feasibility Comments:** Landowner permission is not guaranteed and would be necessary to make any improvements to this site. The BMP would be very close to the channel of the small stream

**BMP Description:** Construct an infiltration basin to trap the mobilized sediment and infiltrate runoff before stormwater enters the stream.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 886 | 2.03* | 1.91 | High | Low | Gully | Med |

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

Fitzgerald
Environmental

| Project: PY-06 | Problem Area Summary |
|---|---|
| Location | East Main Street, Poultney |
| Land Ownership | Private |
| BMP Type | Infiltrating Vegetated Swale |
| Drainage Area/Impervious | 0.87 / 0.66 acres |
| % Impervious | 75% |
| Estimated Project Cost | $ 31,600 |
| P Efficiency ($/lb removed) | $ 17,102 |
| Project Priority | Moderate |


**Site Description:** This site drains the roof and parking lots of the St. Rafael Church. Water currently flows through a minor depression in the lawn and into the stream to the northwest. There is minor sheet erosion in the gravel parking lot.

**Photo 1:** Sheet erosion in gravel portion of parking lot.

**Photo 2:** Sediment deposition along the edge of the paved section of the parking lot.

**Feasibility Comments:** Landowner permission is not guaranteed and would be necessary to make any improvements to this site.

**BMP Description:** Construct a vegetated swale to direct and infiltrate stormwater from the mostly-impervious area.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 4,876 | 1.85* | 1.85 | Med | Low | Sheet | Low |

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

**Project: PY-07** **Problem Area Summary**

| | |
|---|---|
| **Location** | Poultney Town Garage, Furnace Street |
| **Land Ownership** | Town of Poultney |
| **BMP Type** | Gravel Wetland |
| **Drainage Area/Impervious** | 12.20 / 5.63 acres |
| **% Impervious** | 46% |
| **Estimated Project Cost** | $ 278,300 |
| **P Efficiency ($/lb removed)** | $ 25,967 |
| **Project Priority** | High |


**Site Description:** Gravel piles and gravel parking lot behind the Poultney Town Garage. There is sheet erosion within the gravel parking lot. There is currently a vegetated swale through the area draining a large area including the school directly into the Poultney River.

**Photo 1:** Sheet erosion in the gravel parking lot behind the garage.

**Photo 2:** Existing Vegetated swale that drains into the Poultney River.

**Feasibility Comments:** This project would involve construction within the Poultney River Corridor. Additional permitting including a FARC permit may be required.

**BMP Description:** Install a gravel wetland in the greenspace where there is currently a vegetated swale. The BMP could extend into some of the area that is currently used for gravel storage or the parking lot.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 18,832 | 18.70* | 10.72 | Med | Low | None | Mod |

**Other Considerations/Benefits:** This site drains a wide area including 3.44 acres of impervious surfaces, and outlets directly into the river. Improving this site would be an effective way to reduce P input to the waterway.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: PY-08** | **Problem Area Summary** |
|---|---|
| **Location** | Furnace Street, Poultney |
| **Land Ownership** | Town of Poultney |
| **BMP Type** | Vegetated Swale |
| **Drainage Area/Impervious** | 0.22 / 0.18 acres |
| **% Impervious** | 81% |
| **Estimated Project Cost** | $ 8,500 |
| **P Efficiency ($/lb removed)** | $ 14,242 |
| **Project Priority** | Moderate |


**Site Description:** This site drains the paved parking lot of the senior center and a portion of the gravel parking lot below. Sediment is transported down the steep driveway. Stormwater runoff is causing gully erosion down the steep bank of the Poultney River.

**Photo 1:** Sediment runoff directly into the Poultney River channel.

**Photo 2:** Erosion in driveway at the toe of slope.

**Feasibility Comments:** This site is within the River Corridor for the Poultney River and may require additional permitting including a FARC permit.

**BMP Description:** Install a vegetated swale along upper parking lot and an infiltration feature at the corner of the gravel parking lot. If unable to install a feature close to the water, an infiltration basin at the upper parking lot would greatly reduce the amount of stormwater and sediment mobilized.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 1,319 | 0.40* | 0.40 | High | Low | Gully | Low |

**Other Considerations/Benefits:** This site is in a public place in the center of town and could draw attention to the benefits of green stormwater infrastructure.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: RR-03** | **Problem Area Summary** |
|---|---|
| **Location** | River Road, West Haven, ROW |
| **Land Ownership** | Town of West Haven |
| **BMP Type** | Culvert Replacement |
| **Drainage Area/Impervious** | 0.77 / 0.22 acres |
| **% Impervious** | 28% |
| **Estimated Project Cost** | $ 6,300 |
| **P Efficiency ($/lb removed)** | $ 8,560 |
| **Project Priority** | Moderate |


**Site Description:** Cross culvert draining gravel pit area is clogged with sediment. There is minor gully erosion at the outlet leading directly into the channel of the Poultney River.

**Photo 1:** Landslide uphill of site at old gravel pit.

**Photo 2:** Sediment build-up on right side of road completely blocking culvert inlet.

**BMP Description:** Upsize the culvert and add catchment features or stone lining to ditch above to slow down runoff and remove suspended sediment.

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 1,057 | 0.92* | 0.74 | High | Low | Rill | Mod |

**Feasibility Comments:** The ditch leading into the culvert is very thin and may need to be widened to provide space to slow the runoff down.

**Other Considerations/Benefits:** Potential to improve natural habitat in the channel, provides some treatment before reaching receiving water

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

| **Project: RR-05** | | **Problem Area Summary** |
|---|---|---|
| **Location** | River Road, West Haven, ROW |   |
| **Land Ownership** | Town of West Haven | |
| **BMP Type** | Install Stone-Lined Ditch and new culverts | |
| **Drainage Area/Impervious** | 2.33 / 0.48 acres | |
| **% Impervious** | 21% | |
| **Estimated Project Cost** | $ 37,500 | |
| **P Efficiency ($/lb removed)** | $ 19,370 | |
| **Project Priority** | High | |

**Site Description:** Heavy erosion within the ROW on a 10% slope road segment. The road is impassable for small cars and only has two 8” culverts.

**Photo 1:** Gully erosion in center of the road from water flowing directly down ROW.

**Photo 2:** Erosion from ditch overflowing into ROW.

**BMP Description:** Repair and stone line the ditch on the uphill side of the road. Replace and upsize the two existing culverts and potentially add more as needed

| BMP Volume (cf) | P Load (lbs) | P Reduction (lbs) | Sed Reduction | %WQv/CPv | Gully/Erosion | Maintenance |
|---|---|---|---|---|---|---|
| 3,242 | 2.42* | 1.94 | High | Low | Gully | Mod |

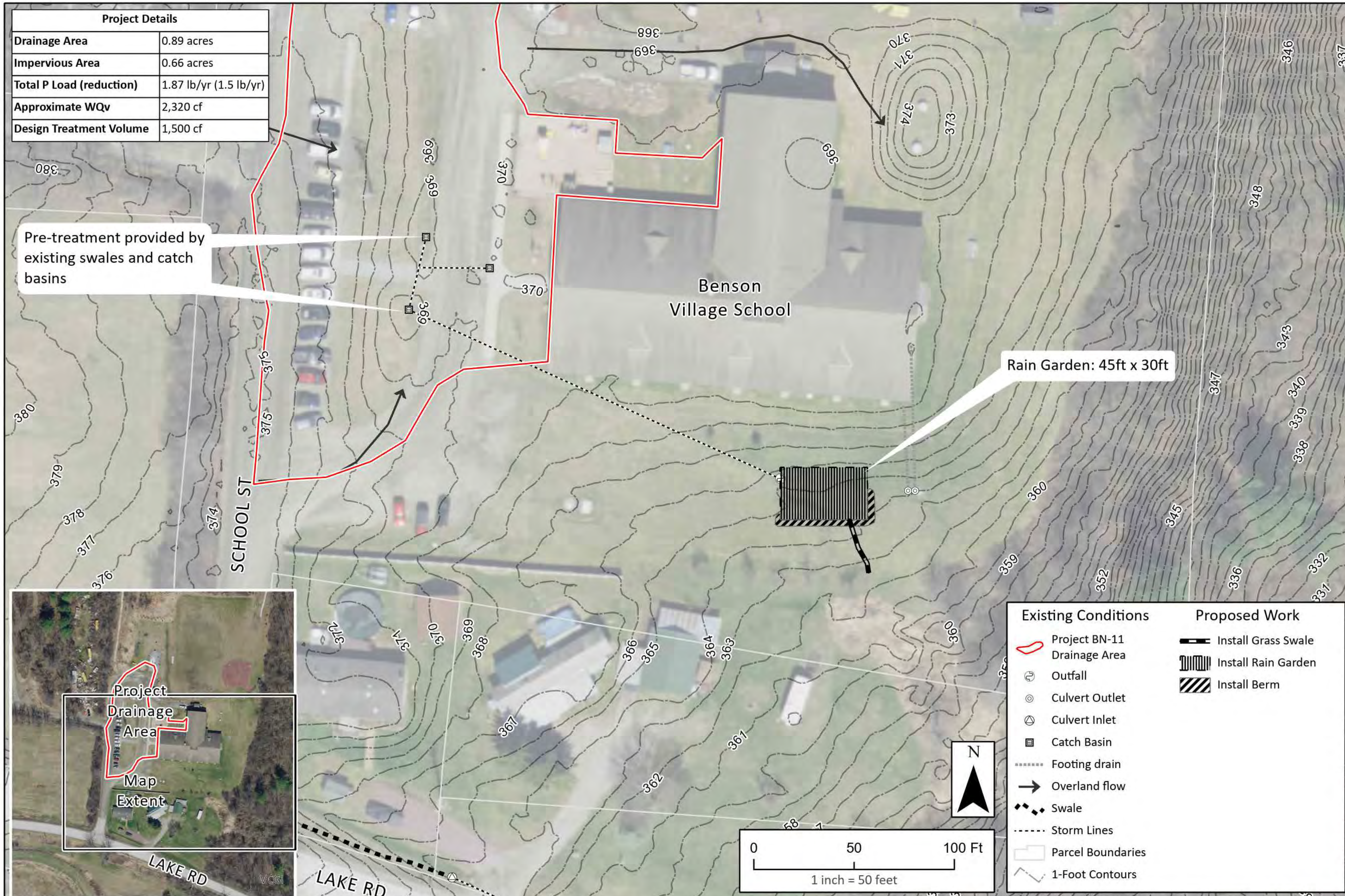
**Other Considerations/Benefits:** There is a wetland on the downhill side of the road and the segment ends next to the Poultney River Channel. Addressing the issues at this site would benefit habitats in both of these areas.

*P load (annual) is estimated from land cover values for each lake segment. Estimates include additional P loading from erosion or other sources.

# APPENDIX G

# Conceptual Designs
# (11”x17”)

| Project Details | |
|---|---|
| **Drainage Area** | 0.89 acres |
| **Impervious Area** | 0.66 acres |
| **Total P Load (reduction)** | 1.87 lb/yr (1.5 lb/yr) |
| **Approximate WQv** | 2,320 cf |
| **Design Treatment Volume** | 1,500 cf |





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Telephone: 802.876.7778
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Notes:
- VCGI Imagery from 2018.
- DEM from 2017 LiDAR (0.7 m).

# 30% Conceptual Design
## Project BN-11
## Benson Village School
## Poultney River SWMP

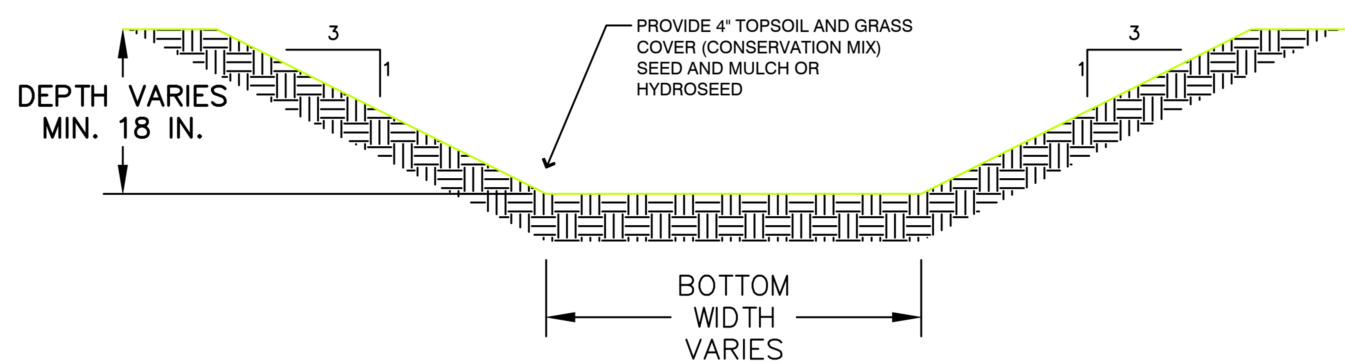
| MAP BY | CHECKED |
|---|---|
| FCP | EPF |

SCALE: 1 inch = 50 feet

DATE: January 18, 2022

SHEET NO.: SHEET 1

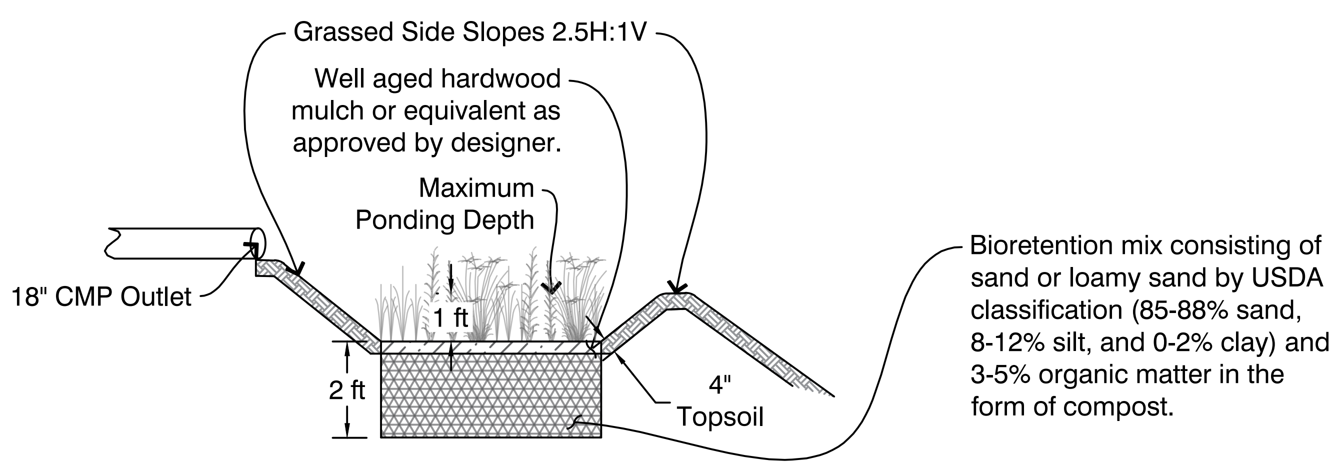
## Detail A: Grass-Lined Ditch
Not to Scale




## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 750 | $ 750 |
| Rain Garden Installation | 1,500 | CF | $ 10 | $ 15,000 |
| Final Design & Permitting | 1 | LS | $ 3,000 | $ 3,000 |
| Construction Oversight | 1 | LS | $ 1,500 | $ 1,500 |
| | | | Subtotal | $ 20,250 |
| | | | Contingency (20%) | $ 4,050 |
| | | | **Total** | **$ 24,300** |
| | | | **Estimated $/lb of P removal** | **$ 16,200** |

## Detail B: Rain Garden
Not to Scale




## Photo 1: Site of proposed Rain Garden at Existing Outlet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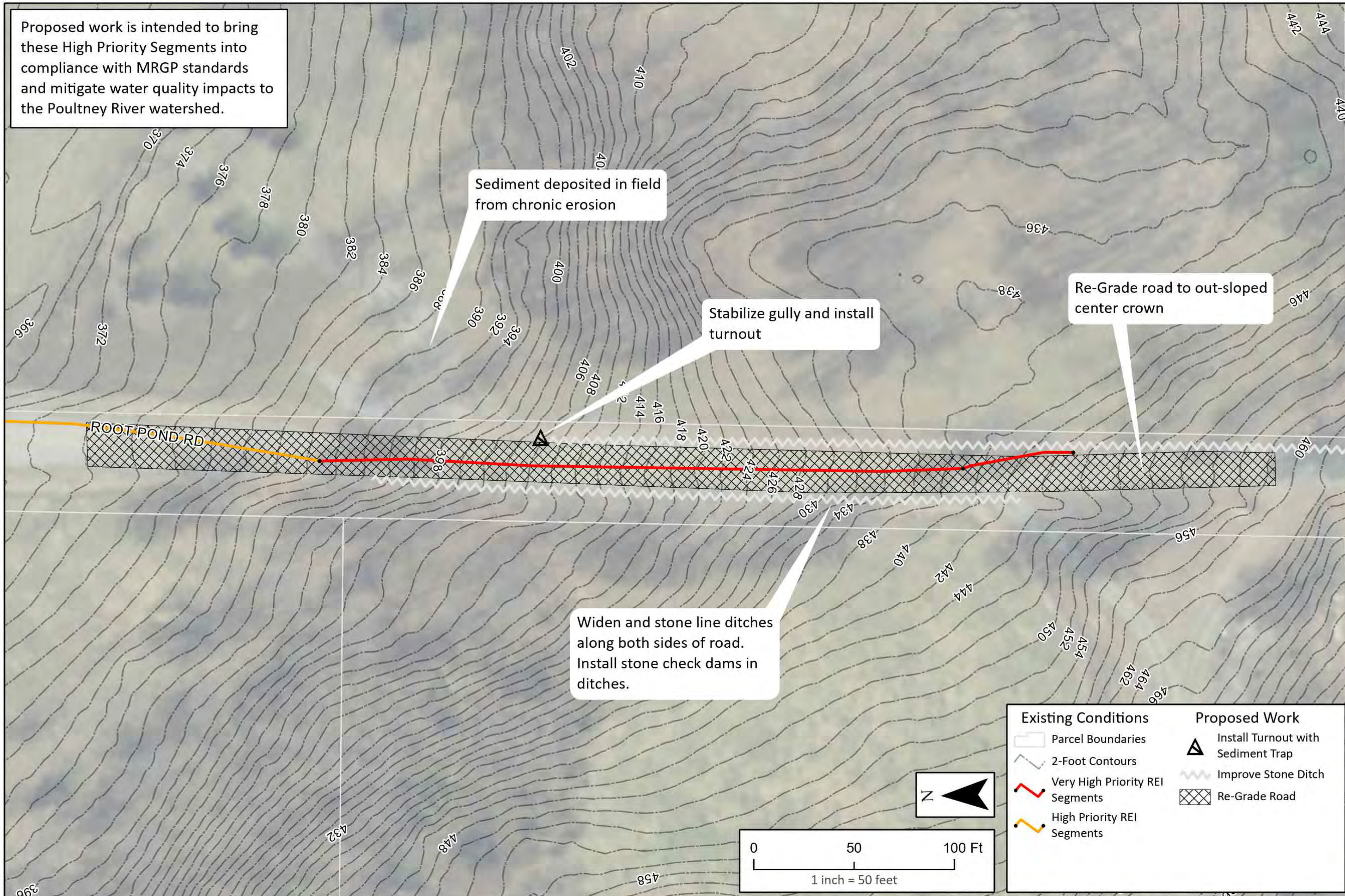
Notes:
-

30% Conceptual Design
Project BN-11
Benson Village School
Poultney River SWMP

DRAWN: FCP
CHECKED: EPF
SCALE: As Shown
DATE: January 24, 2022
SHEET NO.: SHEET 2





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# 30% Conceptual Design
## Project BN-12
## Root Pond Road, Benson
## Poultney River SWMP

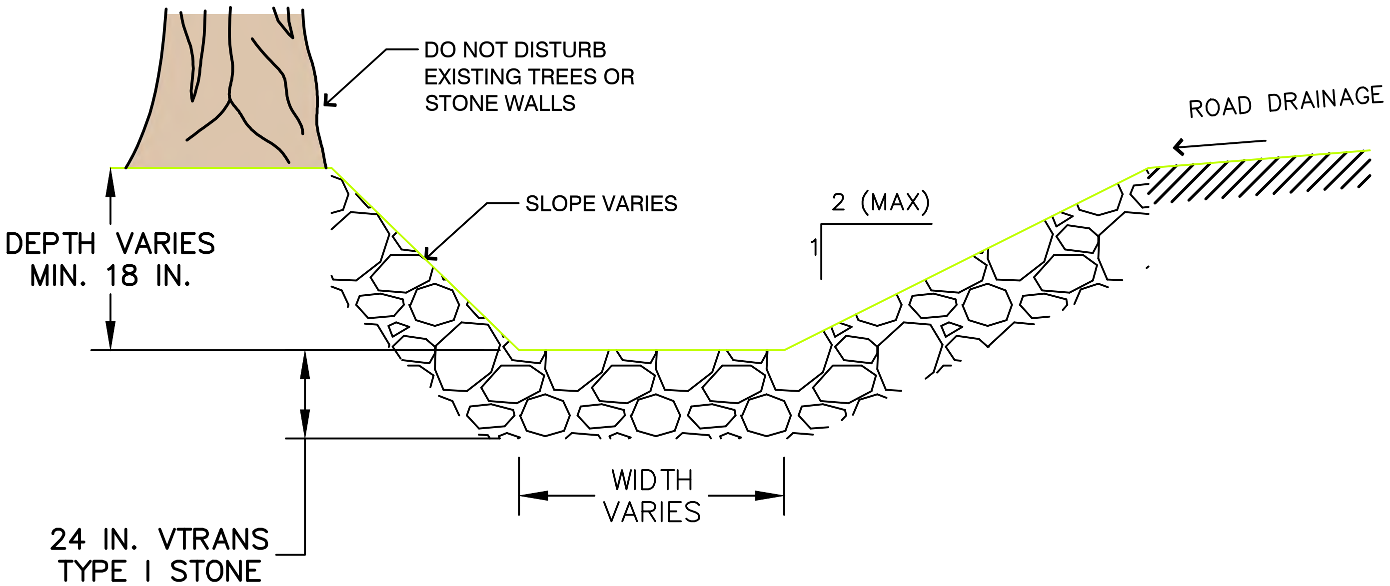
| MAP BY | CHECKED |
|---|---|
| FCP | EPF |

SCALE: 1 inch = 50 feet

DATE: January 18, 2022

SHEET NO.: SHEET 1

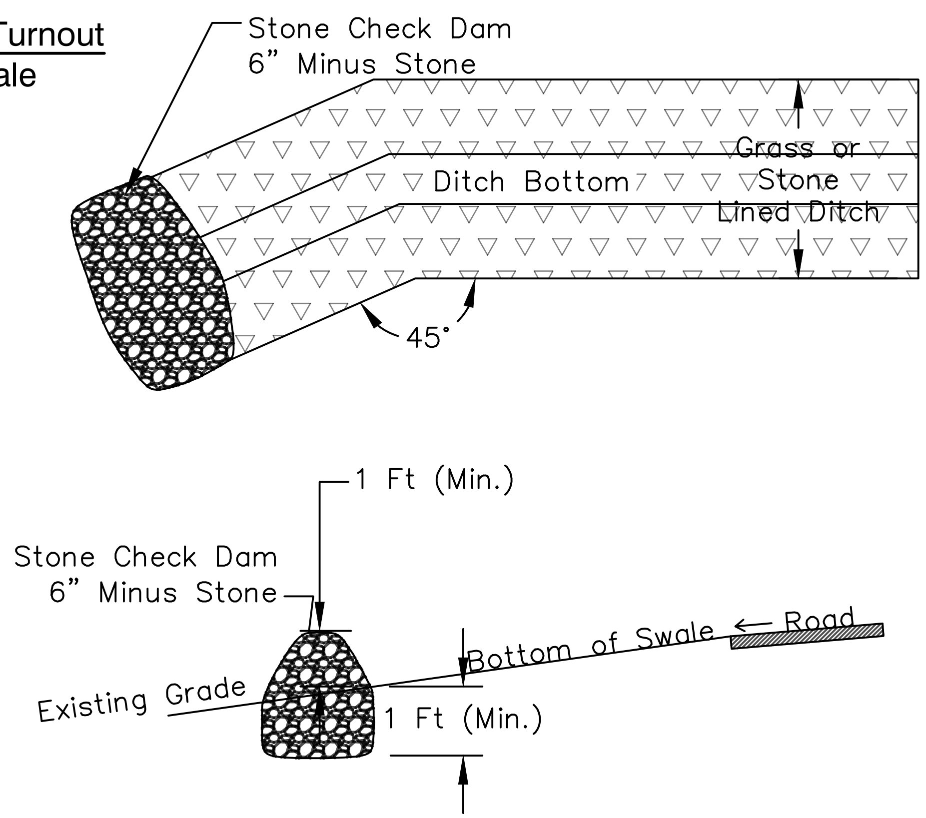
## Detail A: Stone-Lined Ditch
Not to Scale




## Preliminary Cost Opinion

| Estimated Project Costs | | | | |
|---|---|---|---|---|
| **Practice** | **Units** | **Unit Cost** | **Quantity** | **Total** |
| Improve Road Crown | Linear Foot | $ 5 | 1200 | $ 6,000 |
| Raise Road Grade | Cubic Yard | $ 40 | | $ - |
| Remove Grader Berm/Lower Shoulder | Linear Foot | $ 3 | 2400 | $ 7,200 |
| Edge of Road Stabilization/Maintenance | Linear Foot | $ 8 | | $ - |
| Side Slope Excavation for Ditch | Linear Foot | $ 10 | | $ - |
| Improve Existing Ditch (Stone) | Linear Foot | $ 20 | 750 | $ 15,000 |
| Improve Existing Ditch (Grass) | Linear Foot | $ 5 | | $ - |
| General Excavation (Cut and Haul) | Cubic Yard | $ 20 | | $ - |
| Install Sediment Trap | Each | $ 1,500 | 1 | $ 1,500 |
| Install Stone Armor (Bank/Slope) | Cubic Yard | $ 40 | 10 | $ 400 |
| Install Stone Bedding (2" minus) | Cubic Yard | $ 40 | | $ - |
| Install Type V Rock (Stacked) | Cubic Yard | $ 50 | | $ - |
| | | | **Total Cost:** | **$ 30,100** |

## Detail B: Turnout
Not to Scale




## Photo 1: View of Road with no Accessible Ditches

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Notes:
- Existing profile based on LiDAR DEM (2017) and field observations by FEA (2021).

30% Conceptual Design
Project BN-12
Root Pond Road, Benson
Poultney River SWMP

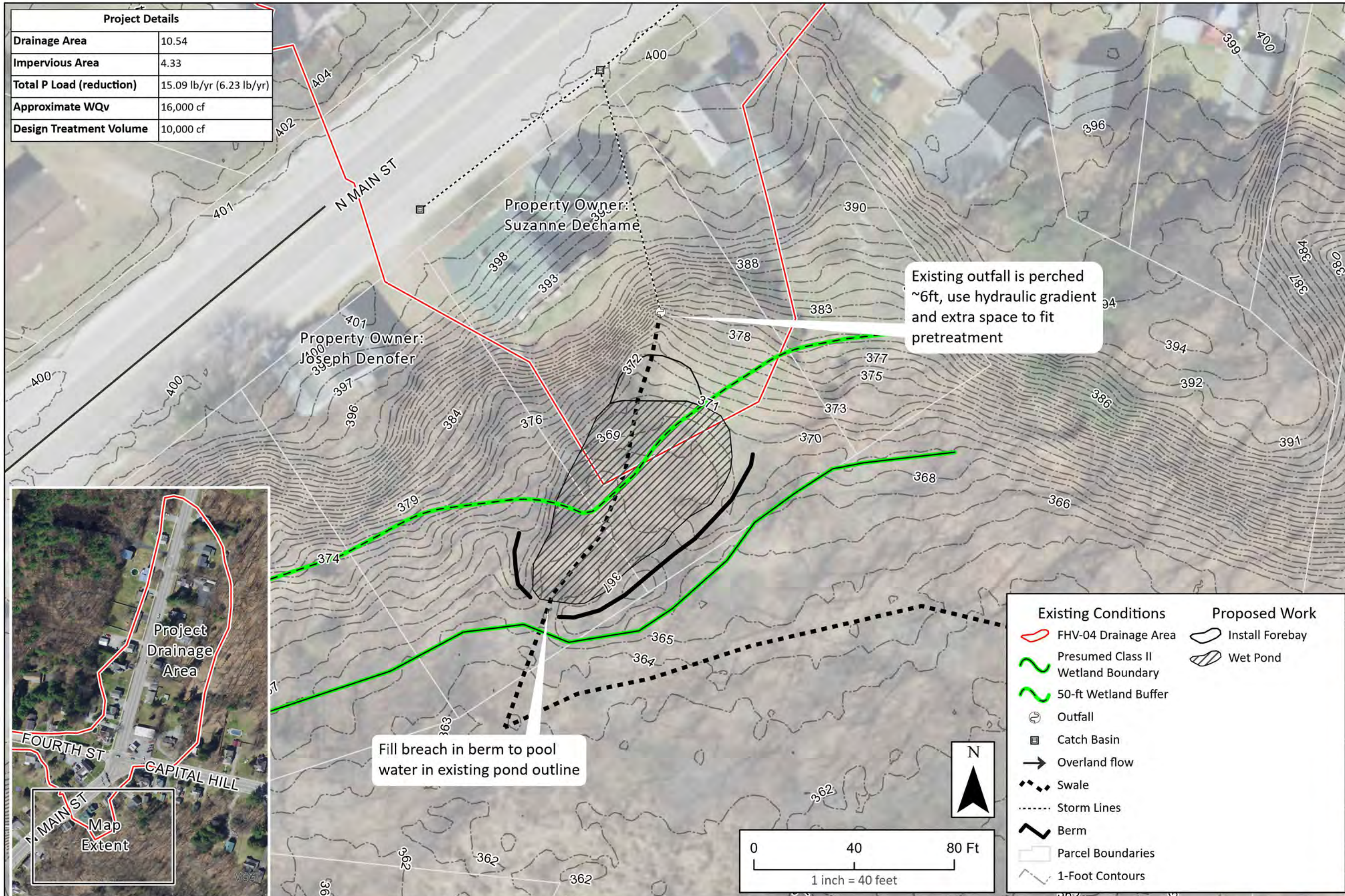
| DRAWN | CHECKED |
|---|---|
| FCP | EPF |

SCALE: As Shown

DATE: January 18, 2022

SHEET NO.: SHEET 2

| Project Details | |
|---|---|
| **Drainage Area** | 10.54 |
| **Impervious Area** | 4.33 |
| **Total P Load (reduction)** | 15.09 lb/yr (6.23 lb/yr) |
| **Approximate WQv** | 16,000 cf |
| **Design Treatment Volume** | 10,000 cf |





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Notes:
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30% Conceptual Design
Project FHV-04
North Main Street, Fair Haven
Poultney River SWMP

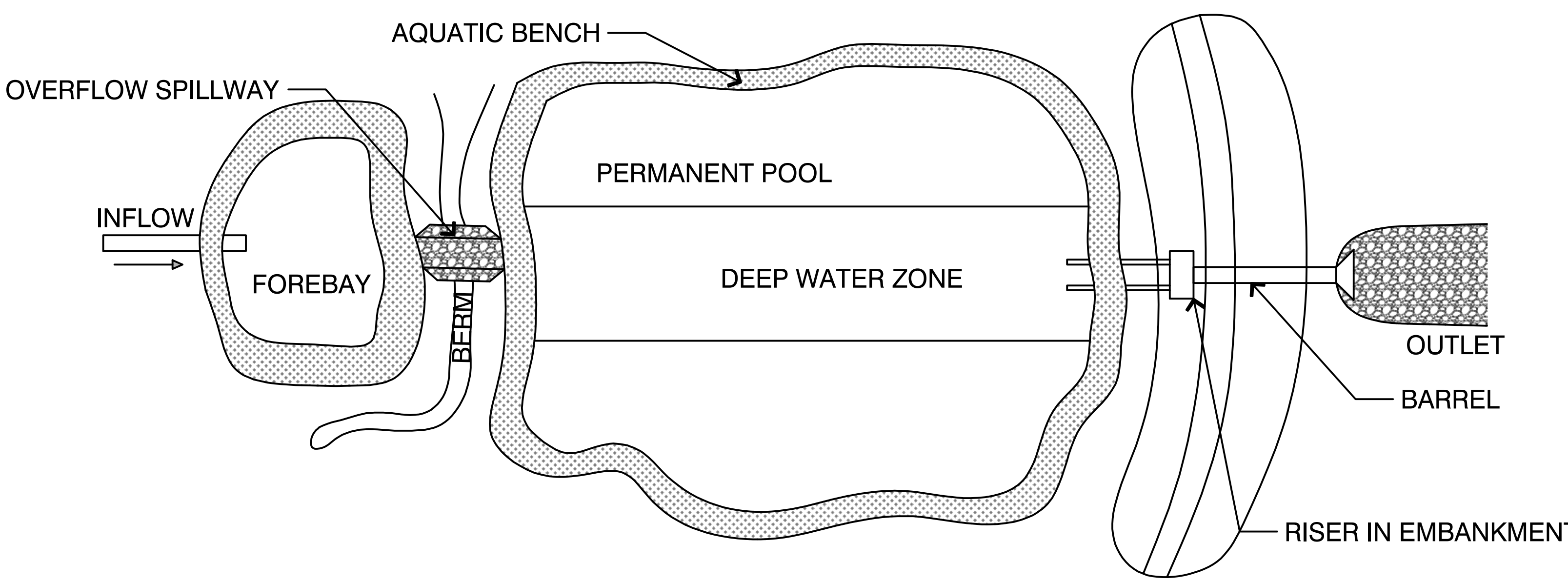
MAP BY: FCP
CHECKED: EPF
SCALE: 1 inch = 40 feet
DATE: January 25, 2022
SHEET NO.: SHEET 1

Photo 1: Break in berm to be filled in to create wet pond outline

## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 4,000 | $ 4,000 |
| Wet Pond/Forebay Retrofit Installation | 10,000 | CF | $ 8 | $ 80,000 |
| Final Design & Permitting | 1 | LS | $ 15,000 | $ 15,000 |
| Construction Oversight | 1 | LS | $ 10,000 | $ 10,000 |
| | | | Subtotal | $ 109,000 |
| | | | Contingency (20%) | $ 21,800 |
| | | | **Total** | **$ 130,800** |
| | | | **Estimated $/lb of P removal** | **$ 20,995** |

Detail A: Wet Pond Plan View
Not to Scale

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Notes:
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30% Conceptual Design
Project FHV-04
North Main Street, Fair Haven

Poultney River SWMP

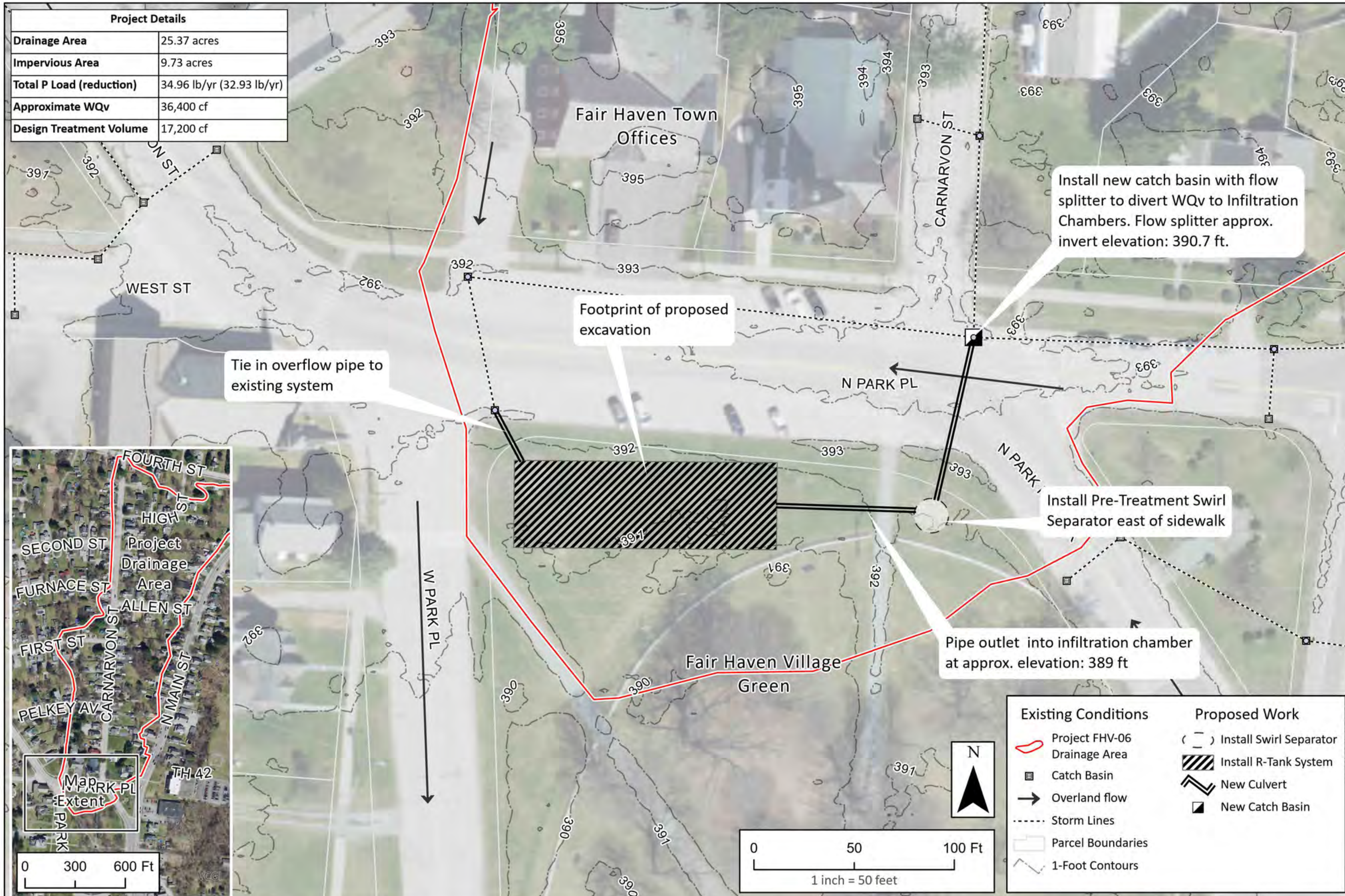
FCP (DRAWN) | EPF (CHECKED)

As Shown (SCALE)

January 24, 2022 (DATE)

SHEET 2 (SHEET NO.)

| Project Details | |
|---|---|
| Drainage Area | 25.37 acres |
| Impervious Area | 9.73 acres |
| Total P Load (reduction) | 34.96 lb/yr (32.93 lb/yr) |
| Approximate WQv | 36,400 cf |
| Design Treatment Volume | 17,200 cf |

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Notes:
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30% Conceptual Design
Project FHV-06
Fair Haven Village Green
Poultney River SWMP

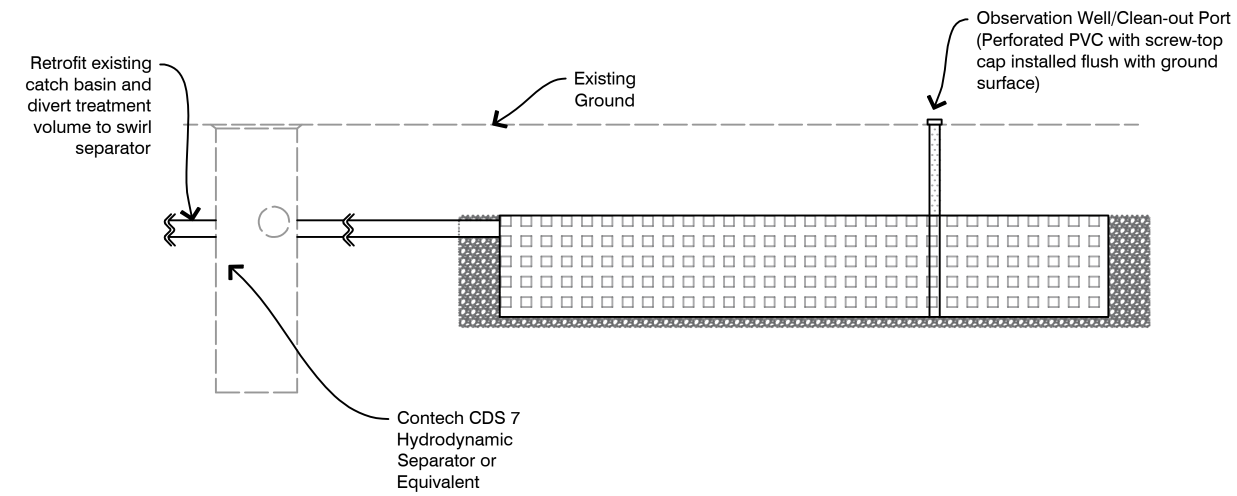
| MAP BY | CHECKED |
|---|---|
| FCP | EPF |

SCALE: 1 inch = 50 feet

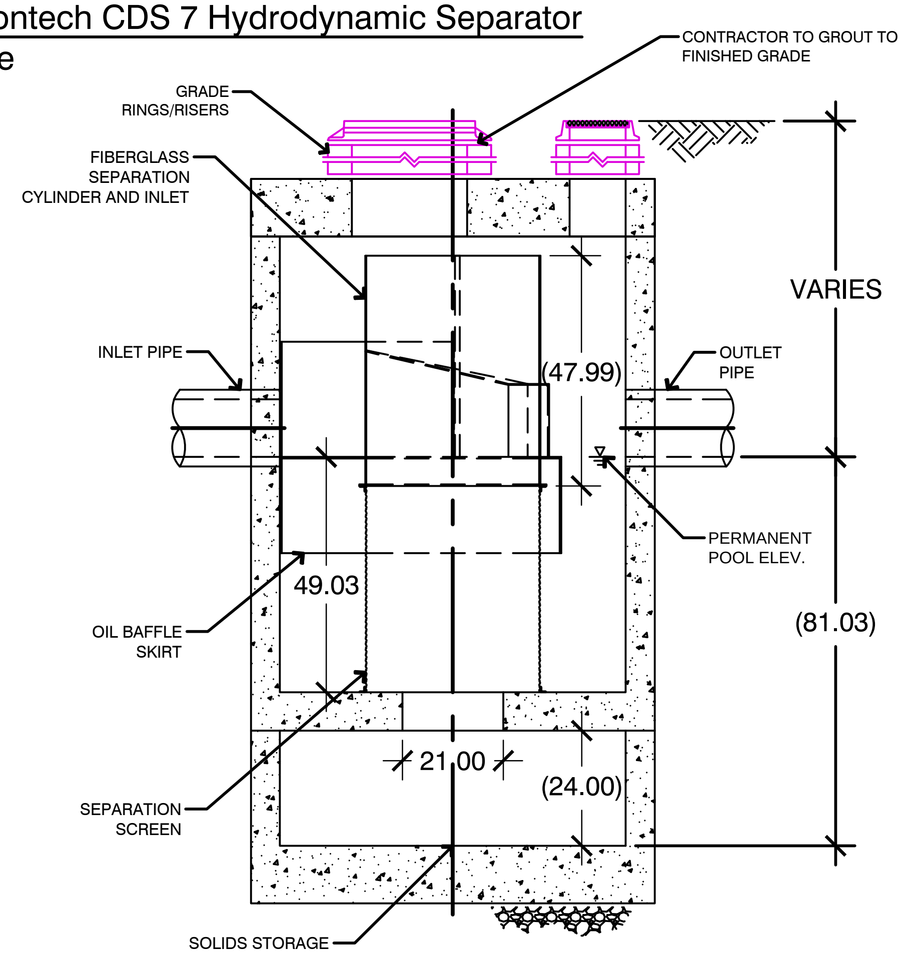
DATE: January 25, 2022

SHEET NO.: SHEET 1

## Detail A: Underground Infiltration Chamber Detail
Not to Scale




## Detail B: Contech CDS 7 Hydrodynamic Separator
Not to Scale




## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 10,000 | $ 10,000 |
| R-Tanks (Tanks, Fabric, etc.) | 1 | LS | $ 140,000 | $ 140,000 |
| CDS 7 Pre-treatment Installation | 1 | LS | $ 40,000 | $ 40,000 |
| Catch Basin Retrofit | 1 | LS | $ 3,000 | $ 3,000 |
| Stone Backfill | 360 | CY | $ 40 | $ 14,400 |
| Laborer | 12 | Days | $ 400 | $ 4,800 |
| Excavator/Loader | 8 | Days | $ 1,200 | $ 9,600 |
| Trucking | 2 | Days | $ 800 | $ 1,600 |
| Trenching | 1 | LS | $ 4,000 | $ 4,000 |
| 8" ADS Pipe | 140 | FT | $ 10 | $ 1,400 |
| Site Restoration | 1 | LS | $ 3,000 | $ 3,000 |
| Final Design | 1 | LS | $ 20,000 | $ 20,000 |
| Construction oversight | 1 | LS | $ 10,000 | $ 10,000 |
| | | | Subtotal | $ 261,800 |
| | | | Contingency (20%) | $ 52,360 |
| | | | **Total** | **$ 314,160** |
| | | | **Estimated $/lb of P removal** | **$ 9,540.24** |

## Photo 1: R-Tank Installation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Notes:

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Project FHV-06
Fair Haven Village Green
Poultney River SWMP

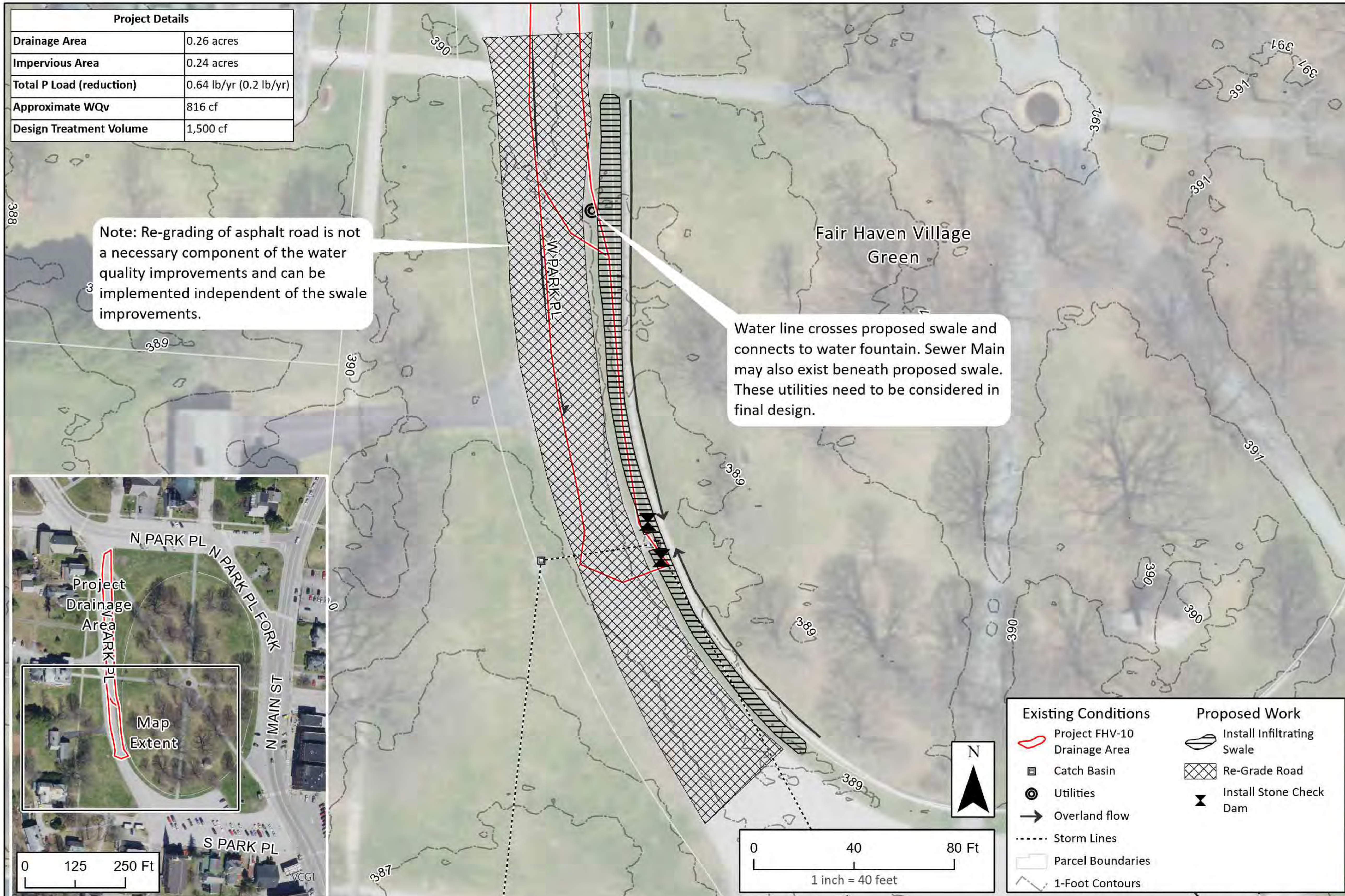
| DRAWN | CHECKED |
|---|---|
| FCP | EPF |

SCALE: As Shown

DATE: January 25, 2022

SHEET NO.: SHEET 2

| Project Details | |
|---|---|
| **Drainage Area** | 0.26 acres |
| **Impervious Area** | 0.24 acres |
| **Total P Load (reduction)** | 0.64 lb/yr (0.2 lb/yr) |
| **Approximate WQv** | 816 cf |
| **Design Treatment Volume** | 1,500 cf |





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**30% Conceptual Design**
**Project FHV-10**
**Fair Haven Village Green**

**Poultney River SWMP**

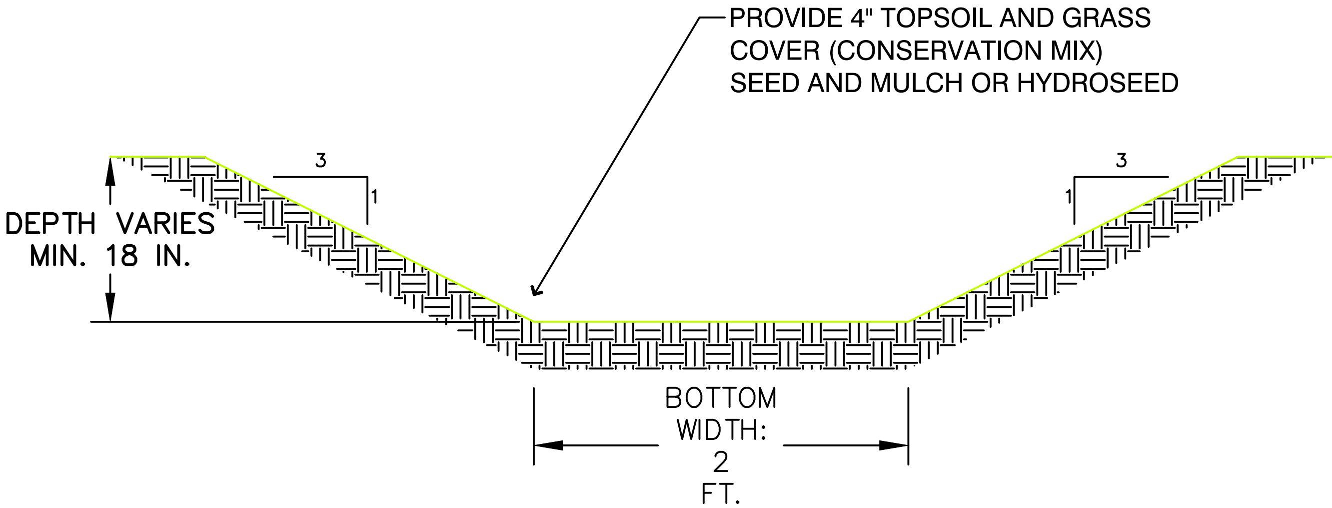
MAP BY: FCP
CHECKED: EPF

SCALE: 1 inch = 40 feet

DATE: January 24, 2022

SHEET NO.: SHEET 1

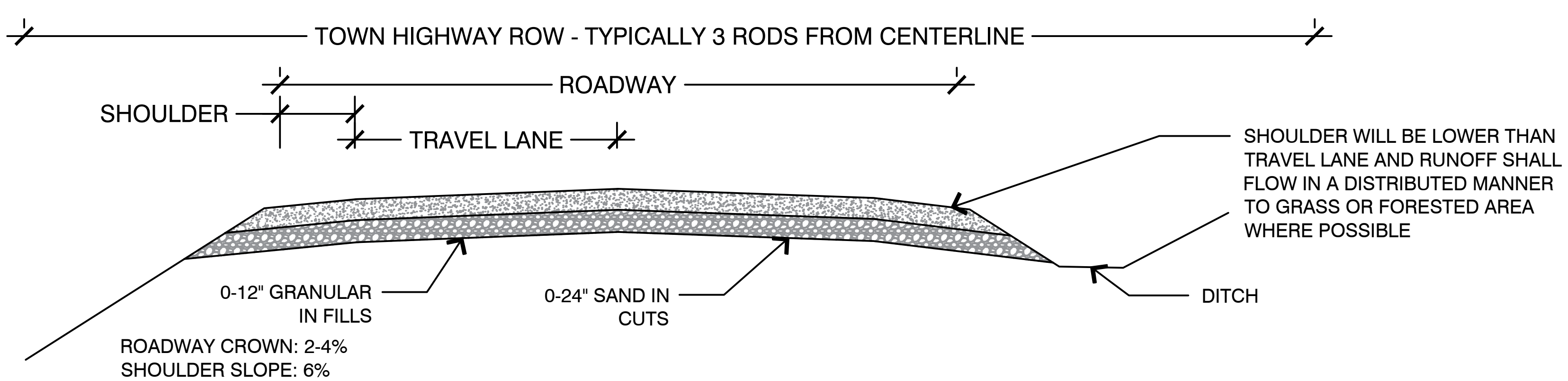
## Detail A: Infiltrating Swale
Not to Scale




## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 250 | $ 250 |
| Infiltrating Swale Installation | 300 | LF | $ 12 | $ 3,600 |
| Check Dam Installation | 2 | EA | $ 250 | $ 500 |
| Final Design & Permitting | 1 | LS | $ 500 | $ 500 |
| Construction Oversight | 1 | LS | $ 500 | $ 500 |
| | | | Subtotal | $ 5,350 |
| | | | Contingency (20%) | $ 1,070 |
| | | | **Total** | **$ 6,420** |
| | | | **Estimated $/lb of P removal** | **$ 32,100** |

## Detail B: Standard Road Crown
Not to Scale




## Photo 1: Deteriorating Catch Basin and Pooling Water in ROW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Notes:
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30% Conceptual Design
Project FHV-10
Fair Haven Village Green
Poultney River SWMP

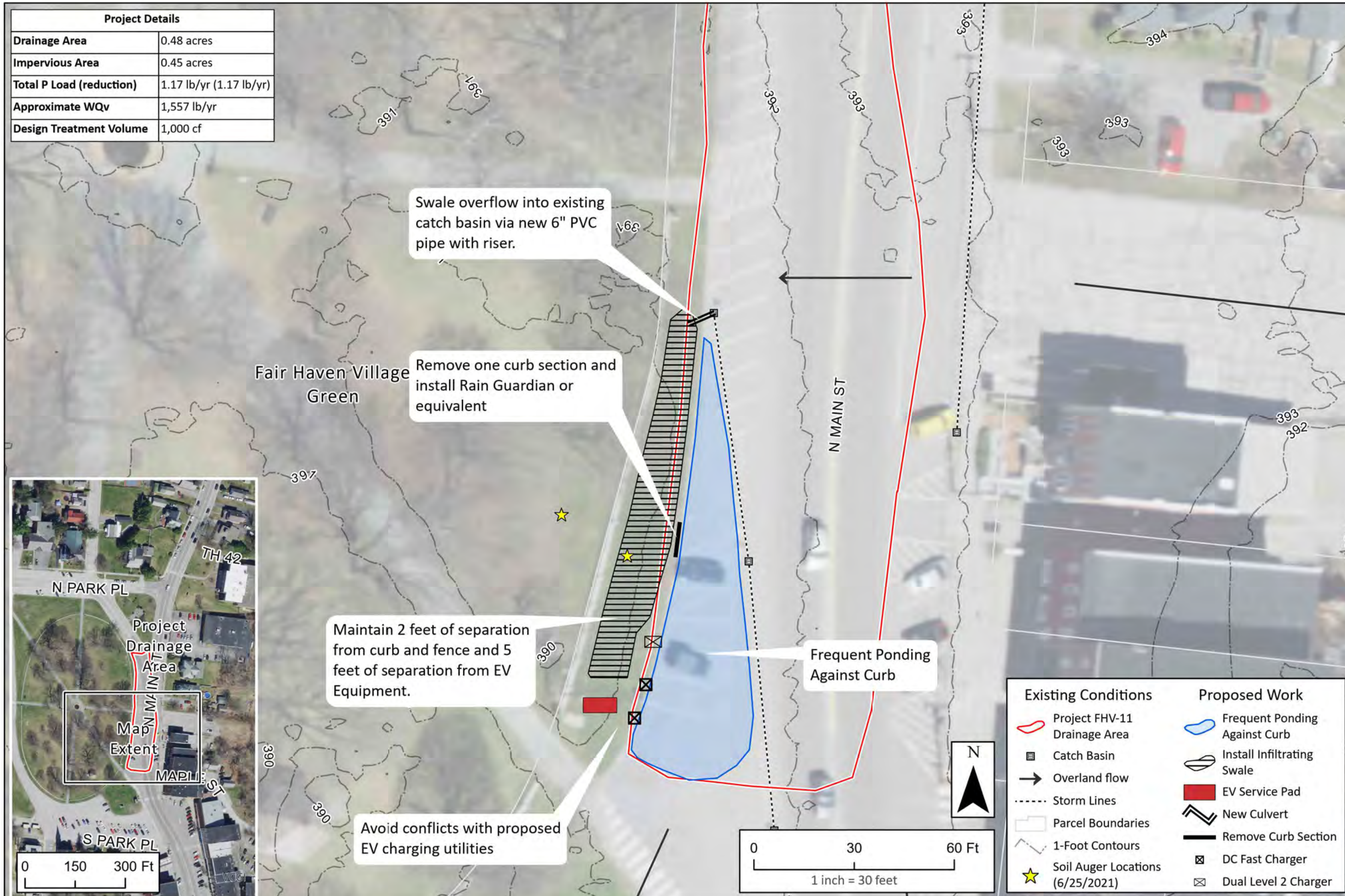
| DRAWN | CHECKED |
|---|---|
| FCP | EPF |

SCALE: As Shown

DATE: January 24, 2022

SHEET NO.: SHEET 2

| Project Details | |
|---|---|
| **Drainage Area** | 0.48 acres |
| **Impervious Area** | 0.45 acres |
| **Total P Load (reduction)** | 1.17 lb/yr (1.17 lb/yr) |
| **Approximate WQv** | 1,557 lb/yr |
| **Design Treatment Volume** | 1,000 cf |





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Notes:
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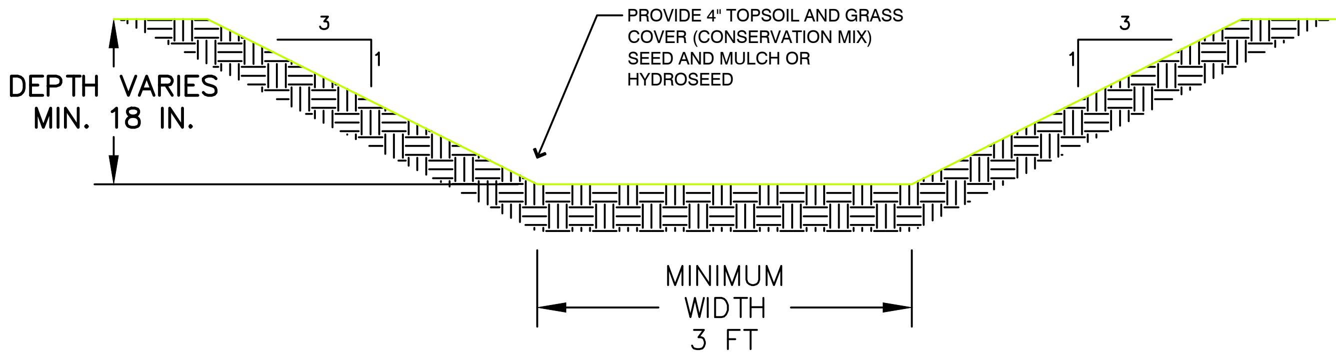
- DEM from 2017 LiDAR (0.7 m).

# 30% Conceptual Design
## Project FHV-11
## Fair Haven Village Green
## Poultney River SWMP

MAP BY: FCP
CHECKED: EPF
SCALE: 1 inch = 30 feet
DATE: January 25, 2022
SHEET NO.: SHEET 1

## Detail A: Infiltrating Swale

Not to Scale




## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 750 | $ 750 |
| Remove Curb Section | 1 | LS | $ 500 | $ 500 |
| Install Rain Guardian & Stone | 1 | LS | $ 5,000 | $ 5,000 |
| Infiltrating Swale | 1,000 | CF | $ 7 | $ 7,000 |
| Final Design & Permitting | 1 | LS | $ 3,500 | $ 3,500 |
| Construction Oversight | 1 | LS | $ 1,500 | $ 1,500 |
| | | | Subtotal | $ 18,250 |
| | | | Contingency (20%) | $ 3,650 |
| | | | **Total** | **$ 21,900** |
| | | | **Estimated $/lb of P removal** | **$ 18,718** |

Photo 1: Rain Guardian Turret to be used for pretreatment

Photo 2: Water ponding along curb where proposed feature will be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Notes:
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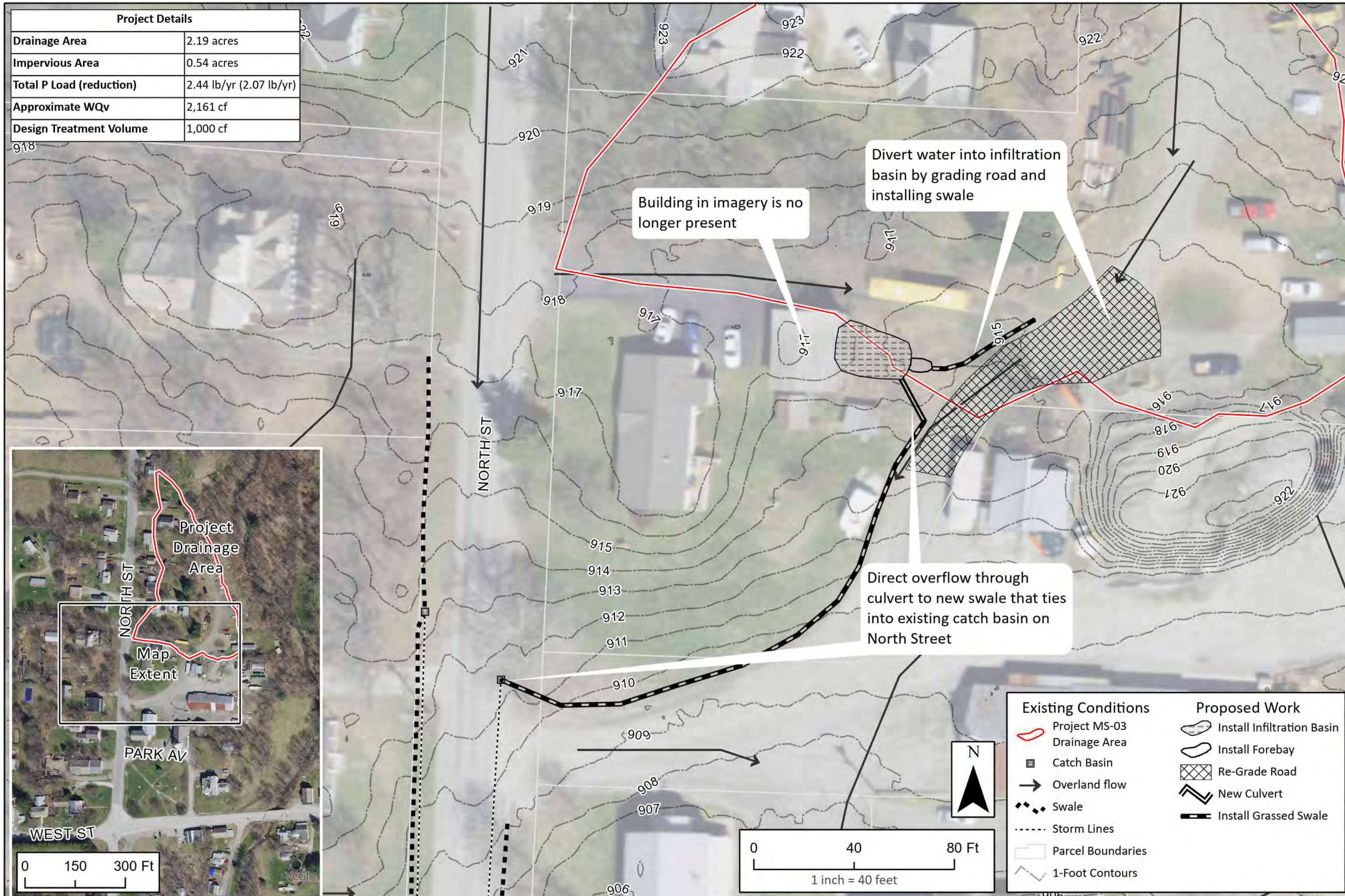
30% Conceptual Design
Project FHV-11
Fair Haven Village Green

Poultney River SWMP

DRAWN: FCP
CHECKED: EPF
SCALE: As Shown
DATE: January 24, 2022
SHEET NO.: SHEET 2

| Project Details | |
|---|---|
| **Drainage Area** | 2.19 acres |
| **Impervious Area** | 0.54 acres |
| **Total P Load (reduction)** | 2.44 lb/yr (2.07 lb/yr) |
| **Approximate WQv** | 2,161 cf |
| **Design Treatment Volume** | 1,000 cf |





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- DEM from 2017 LiDAR (0.7 m).

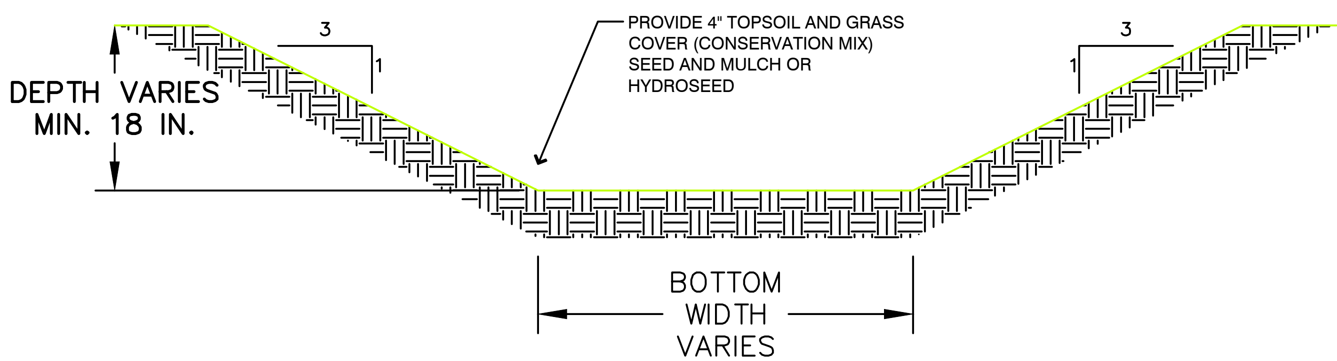
# 30% Conceptual Design
## Project MS-03
## Middletown Springs
## Poultney River SWMP

MAP BY: FCP
CHECKED: EPF
SCALE: 1 inch = 40 feet
DATE: January 18, 2022

SHEET NO.: SHEET 1

## Detail A: Grass-Lined Ditch

Not to Scale

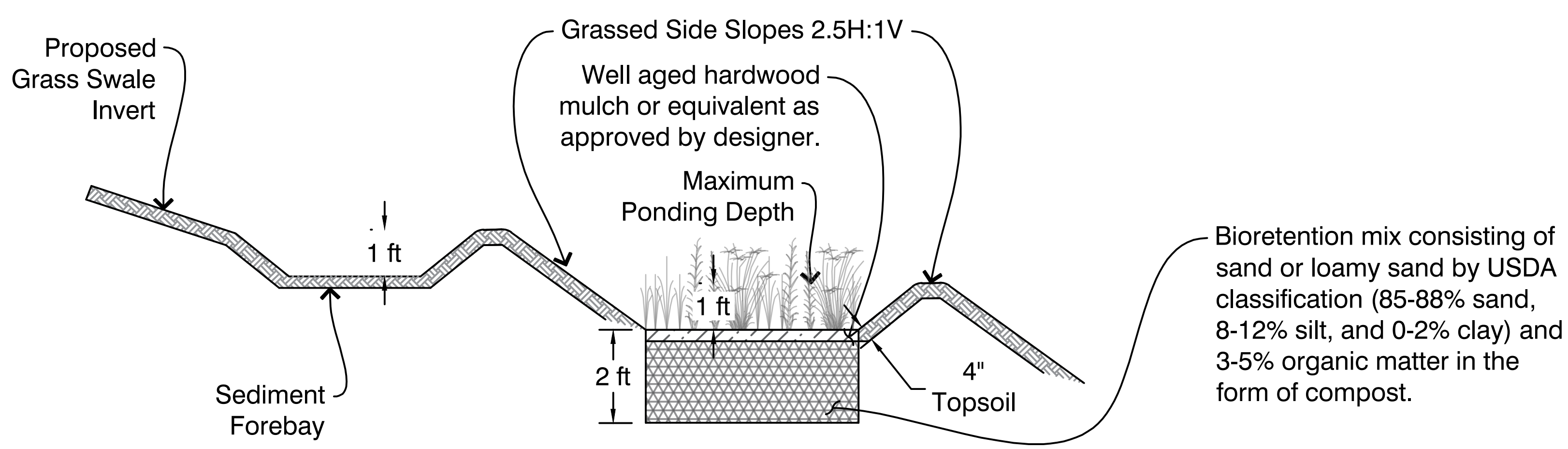



## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 750 | $ 750 |
| Regrade Road | 120 | FT | $ 10 | $ 1,200 |
| Infiltration Basin Retrofit | 1,000 | CF | $ 7 | $ 7,000 |
| Install Culvert | 1 | LS | $ 2,000 | $ 2,000 |
| Grassed Swale Installation | 275 | LF | $ 12 | $ 3,300 |
| Final Design & Permitting | 1 | LS | $ 3,500 | $ 3,500 |
| Construction Oversight | 1 | LS | $ 1,500 | $ 1,500 |
| | | | Subtotal | $ 19,250 |
| | | | Contingency (20%) | $ 3,850 |
| | | | **Total** | **$ 23,100** |
| | | | **Estimated $/lb of P removal** | **$ 11,159** |

## Detail B: Sediment Forebay and Rain Garden

Not to Scale




## Photo 1: Existing pit to be retrofitted as Infiltration Basin


Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
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Telephone: 802.876.7778
www.fitzgeraldenvironmental.com


Notes:
- Existing profile based on LiDAR DEM and field survey by FEA (2021).

30% Conceptual Design
Project MS-03
Middletown Springs
Poultney River SWMP

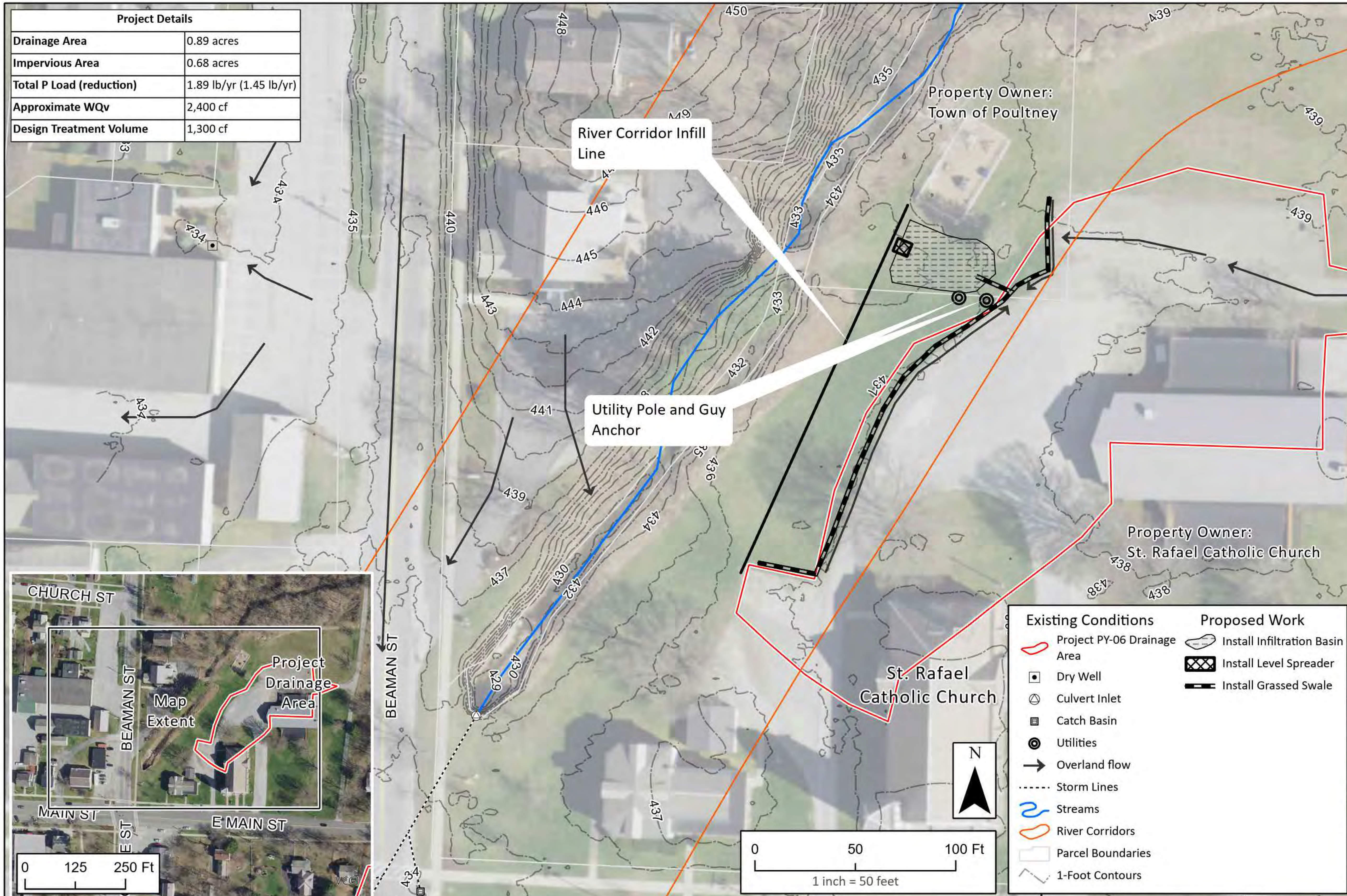
| DRAWN | CHECKED |
|---|---|
| FCP | EPF |

SCALE: As Shown

DATE: January 24, 2022

SHEET NO.: SHEET 2

| Project Details | |
|---|---|
| **Drainage Area** | 0.89 acres |
| **Impervious Area** | 0.68 acres |
| **Total P Load (reduction)** | 1.89 lb/yr (1.45 lb/yr) |
| **Approximate WQv** | 2,400 cf |
| **Design Treatment Volume** | 1,300 cf |

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Notes:
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- DEM from 2017 LiDAR (0.7 m).

30% Conceptual Design
Project PY-06
St. Raphael Catholic Church
Poultney River SWMP

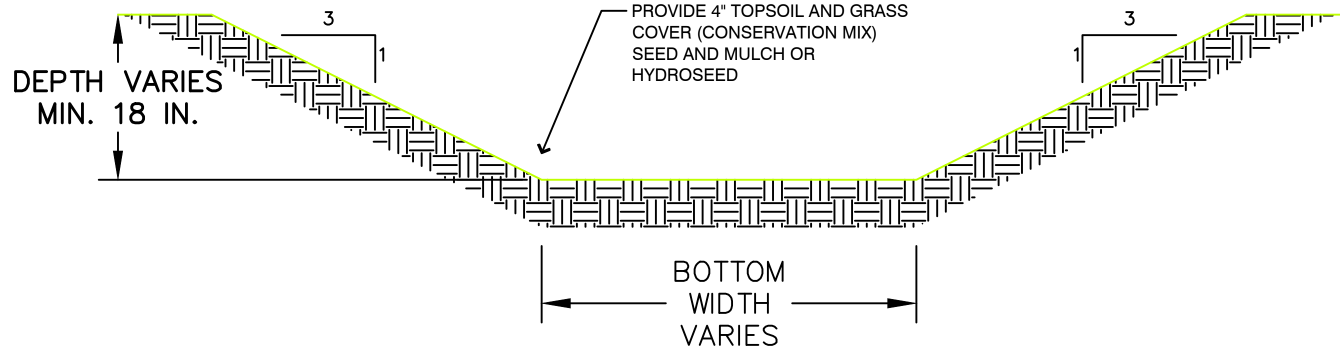
| MAP BY | CHECKED |
|---|---|
| FCP | EPF |

SCALE: 1 inch = 50 feet

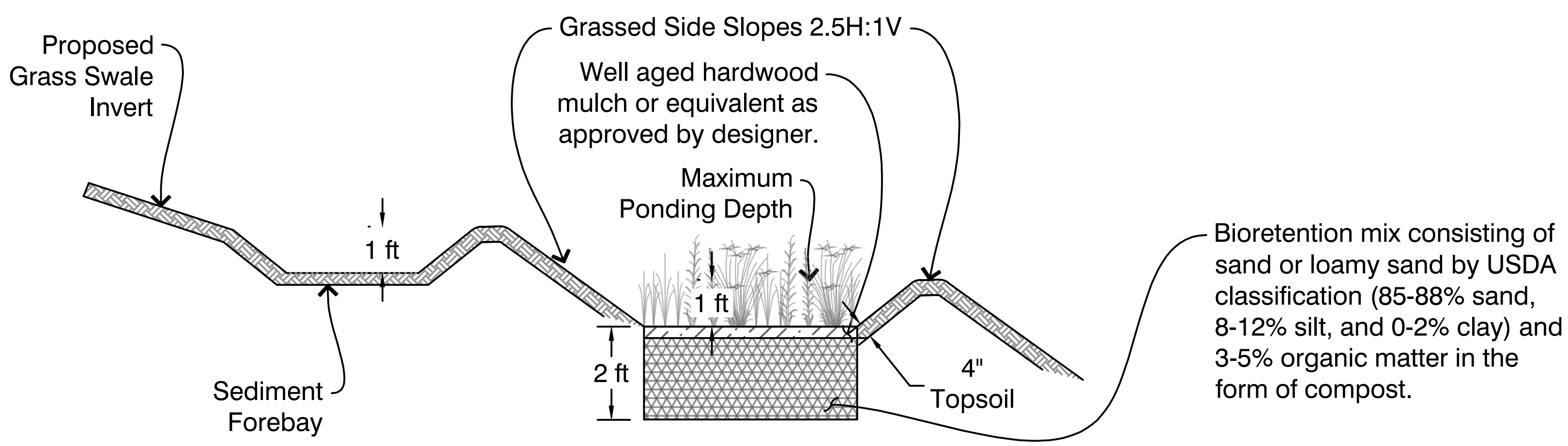
DATE: January 19, 2022

SHEET NO.: SHEET 1

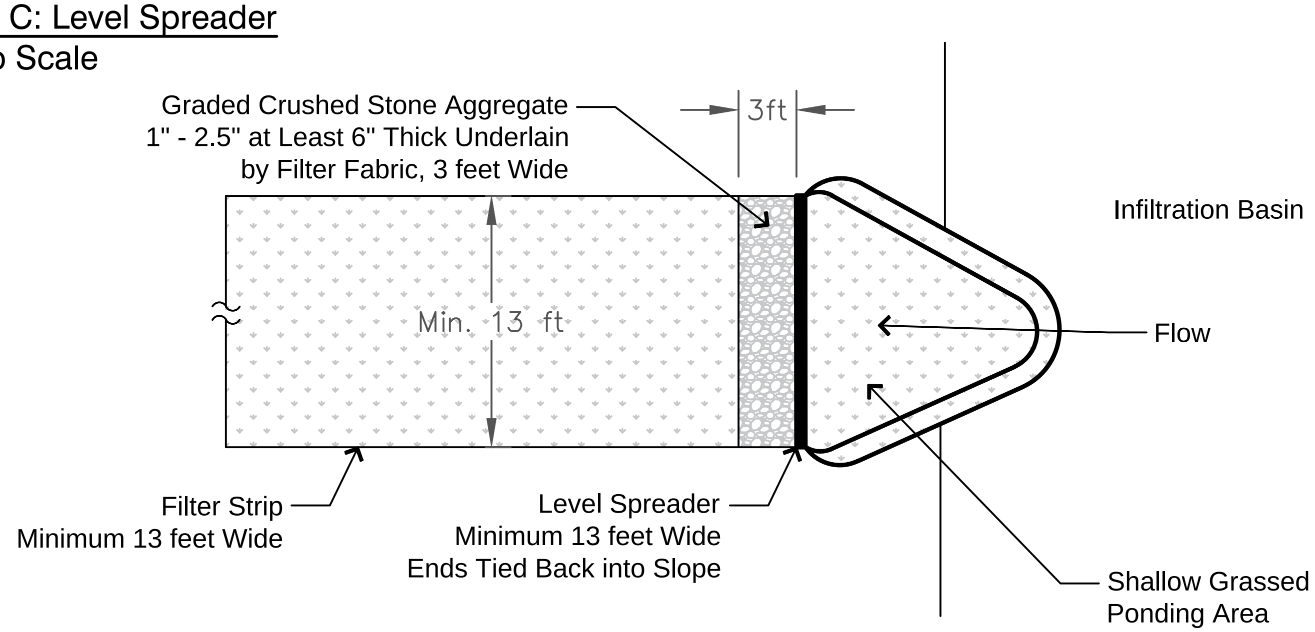
## Detail A: Grass-Lined Swale
Not to Scale




## Detail B: Sediment Forebay and Infiltration Basin
Not to Scale




## Detail C: Level Spreader
Not to Scale




## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 750 | $ 750 |
| Infiltration Basin Retrofit | 1,000 | CF | $ 7 | $ 7,000 |
| Level Spreader Installation | 1 | LS | $ 2,500 | $ 2,500 |
| Grassed Swale Installation | 275 | LF | $ 12 | $ 3,300 |
| Final Design & Permitting | 1 | LS | $ 3,500 | $ 3,500 |
| Construction Oversight | 1 | LS | $ 1,500 | $ 1,500 |
| | | | Subtotal | $ 18,550 |
| | | | Contingency (20%) | $ 3,710 |
| | | | **Total** | **$ 22,260** |
| | | | **Estimated $/lb of P removal** | **$ 15,352** |

## Photo 1: Gravel Parking Lot draining to proposed BMP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Notes:
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30% Conceptual Design
Project PY-06
St. Rafael Catholic Church
Poultney River SWMP

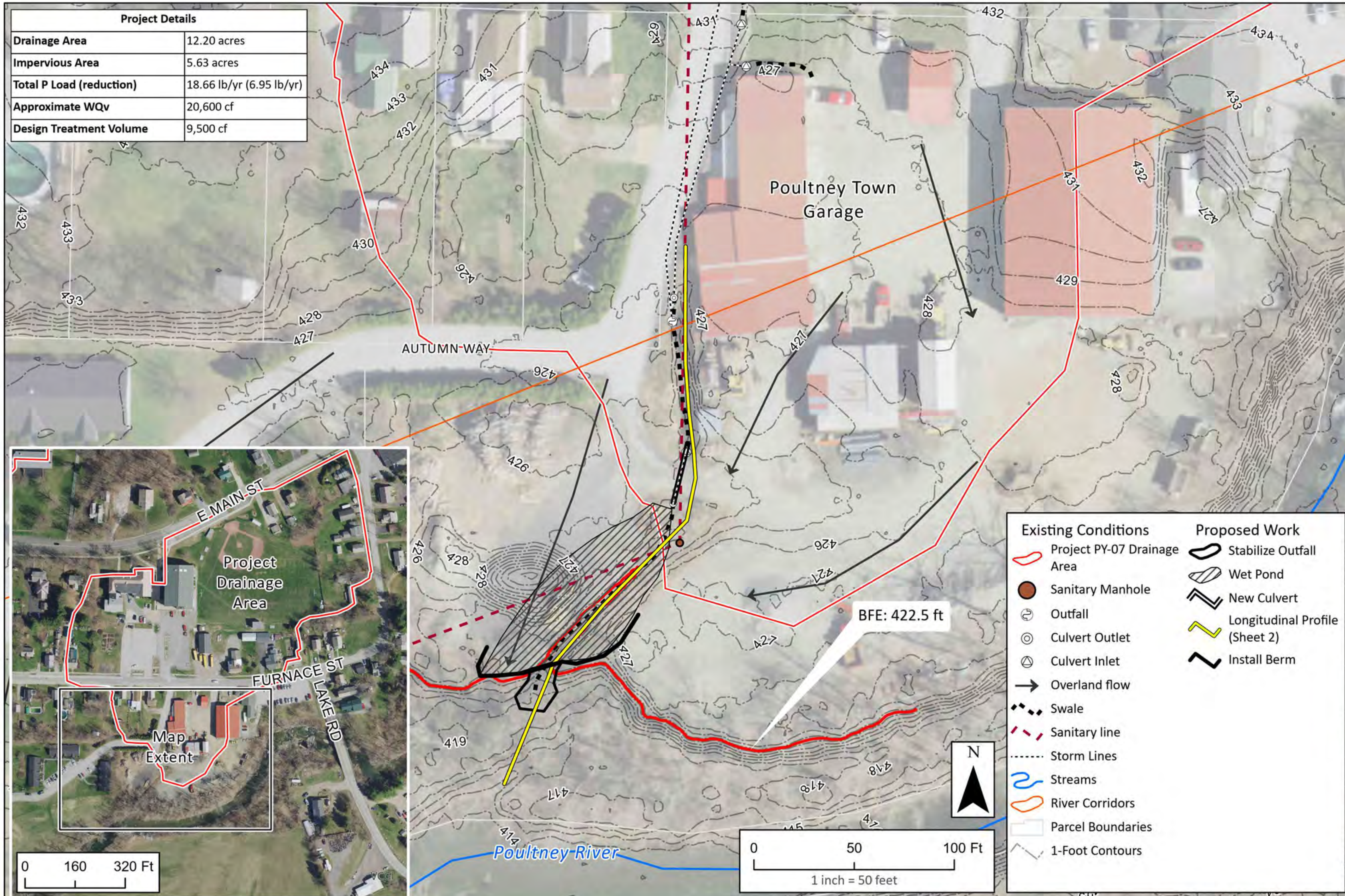
| DRAWN | CHECKED |
|---|---|
| FCP | EPF |

SCALE: As Shown

DATE: January 24, 2022

SHEET NO.: SHEET 2

| Project Details | |
|---|---|
| **Drainage Area** | 12.20 acres |
| **Impervious Area** | 5.63 acres |
| **Total P Load (reduction)** | 18.66 lb/yr (6.95 lb/yr) |
| **Approximate WQv** | 20,600 cf |
| **Design Treatment Volume** | 9,500 cf |





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Notes:
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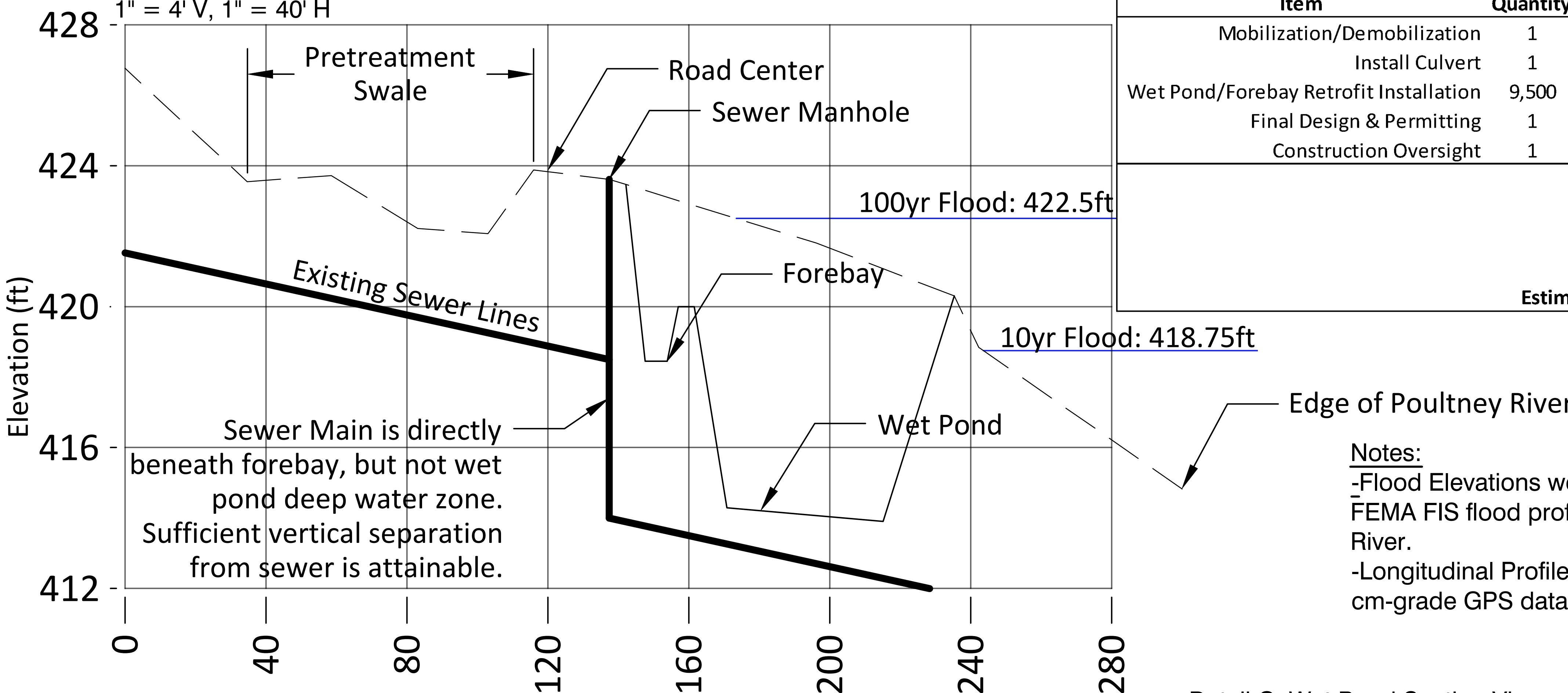
- DEM from 2017 LiDAR (0.7 m).

30% Conceptual Design
Project PY-07
Poultney Town Garage
Poultney River SWMP

MAP BY: FCP
CHECKED: EPF
SCALE: 1 inch = 50 feet
DATE: January 25, 2022
SHEET NO.: SHEET 1

## Detail A: Longitudinal Profile of Existing Conditions

1" = 4' V, 1" = 40' H



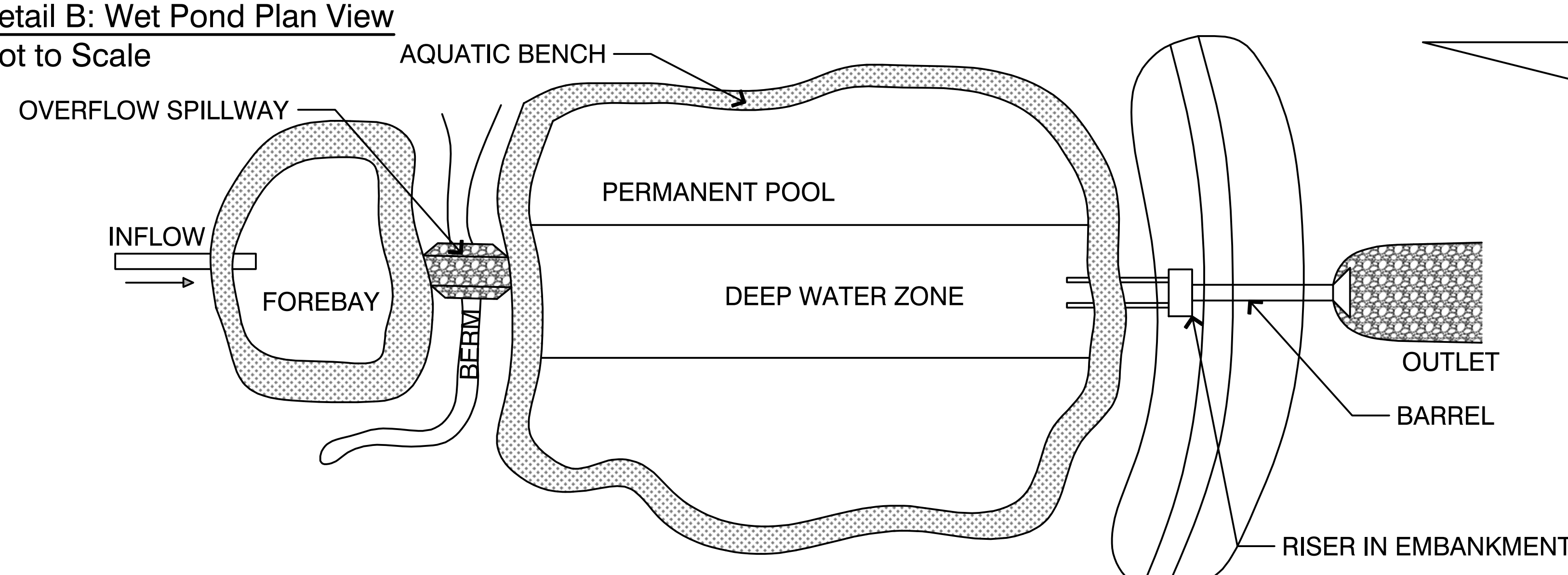

## Preliminary Cost Opinion

| Item | Quantity | Unit | Unit Price | Cost |
|---|---|---|---|---|
| Mobilization/Demobilization | 1 | LS | $ 4,000 | $ 4,000 |
| Install Culvert | 1 | LS | $ 2,000 | $ 2,000 |
| Wet Pond/Forebay Retrofit Installation | 9,500 | CF | $ 8 | $ 76,000 |
| Final Design & Permitting | 1 | LS | $ 15,000 | $ 15,000 |
| Construction Oversight | 1 | LS | $ 10,000 | $ 10,000 |
| | | | Subtotal | $ 107,000 |
| | | | Contingency (20%) | $ 21,400 |
| | | | **Total** | **$ 128,400** |
| | | | **Estimated $/lb of P removal** | **$ 18,475** |

Notes:
- Flood Elevations were determined from FEMA FIS flood profiles of the Poultney River.
- Longitudinal Profile is based on cm-grade GPS data collected by FEA.

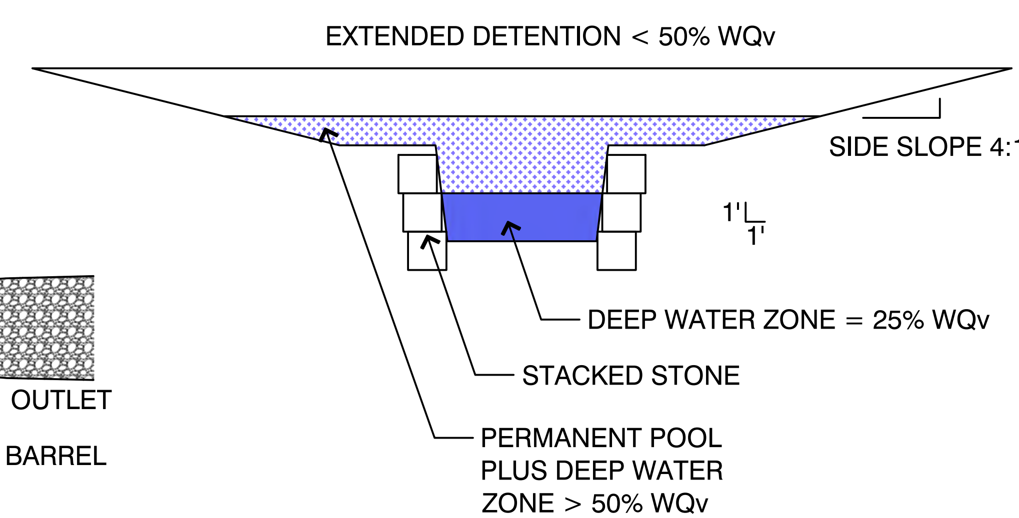
## Detail B: Wet Pond Plan View

Not to Scale




## Detail C: Wet Pond Section View

Not to Scale





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Notes:
- Existing profile based on LiDAR DEM (2017) and field observations by FEA (2021).

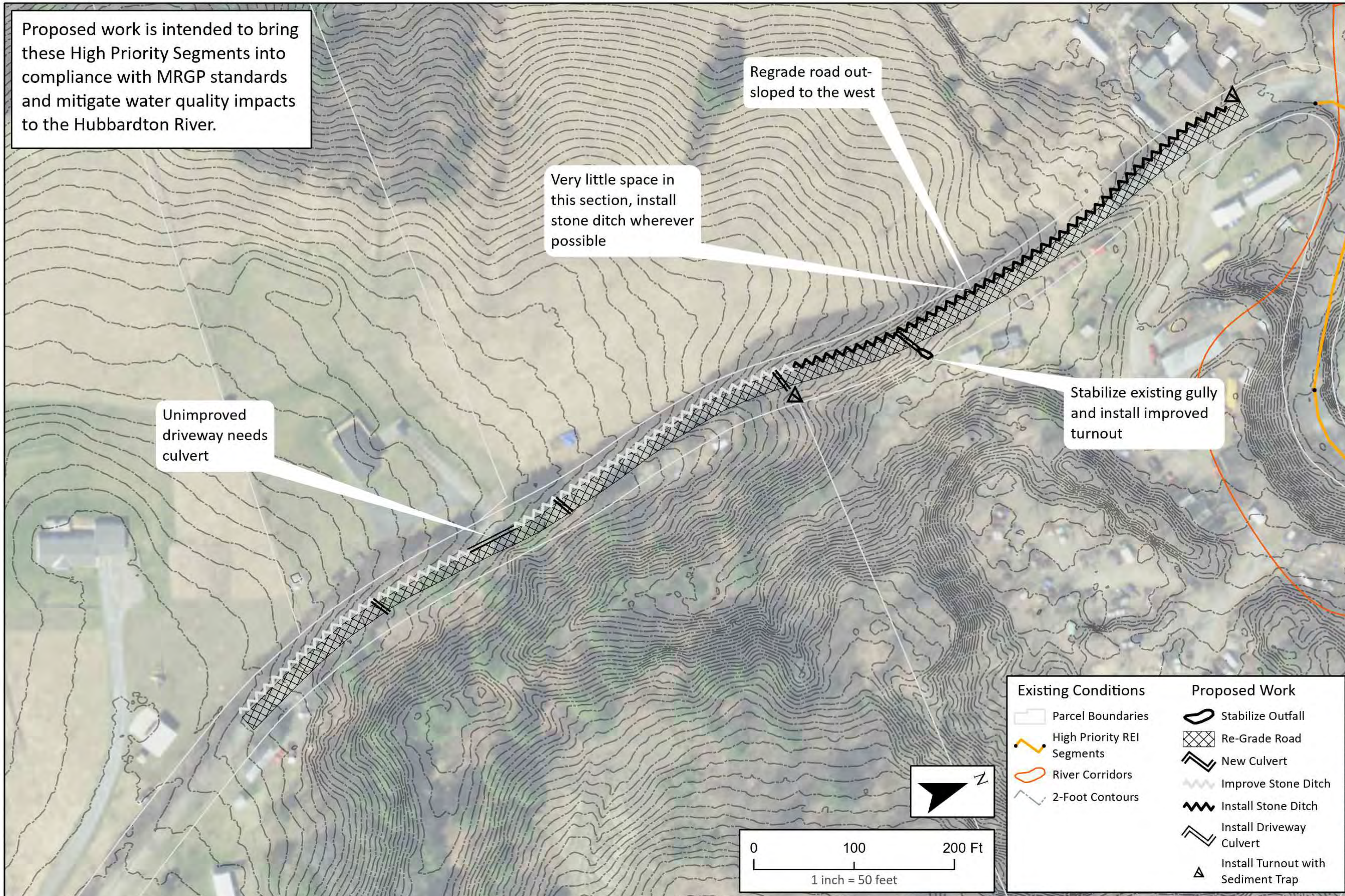
30% Conceptual Design
Project PY-07
Poultney Town Garage
Poultney River SWMP

| | |
|---|---|
| FCP (DRAWN) | EPF (CHECKED) |

As Shown (SCALE)

January 25, 2022 (DATE)

SHEET 2 (SHEET NO.)

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Notes:
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- DEM from 2017 LiDAR (0.7 m).

# 30% Conceptual Design
Project RR-05
River Road, West Haven

Poultney River SWMP

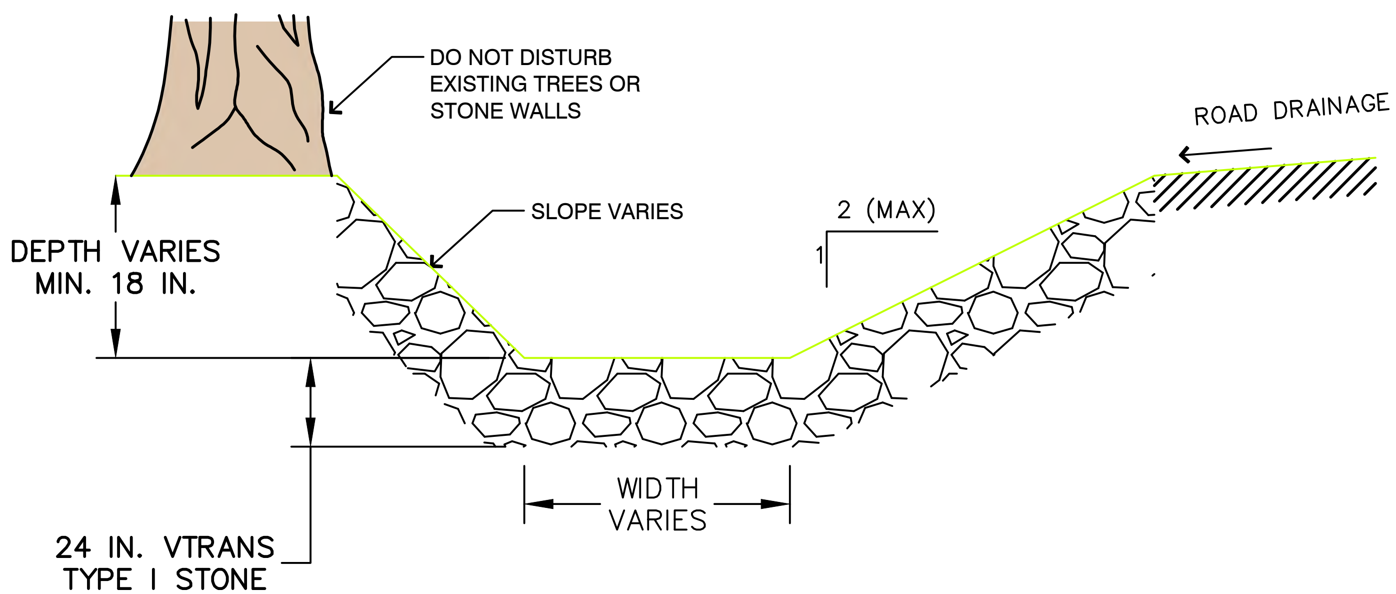
| MAP BY | CHECKED |
|---|---|
| FCP | EPF |

SCALE: 1 inch = 100 feet

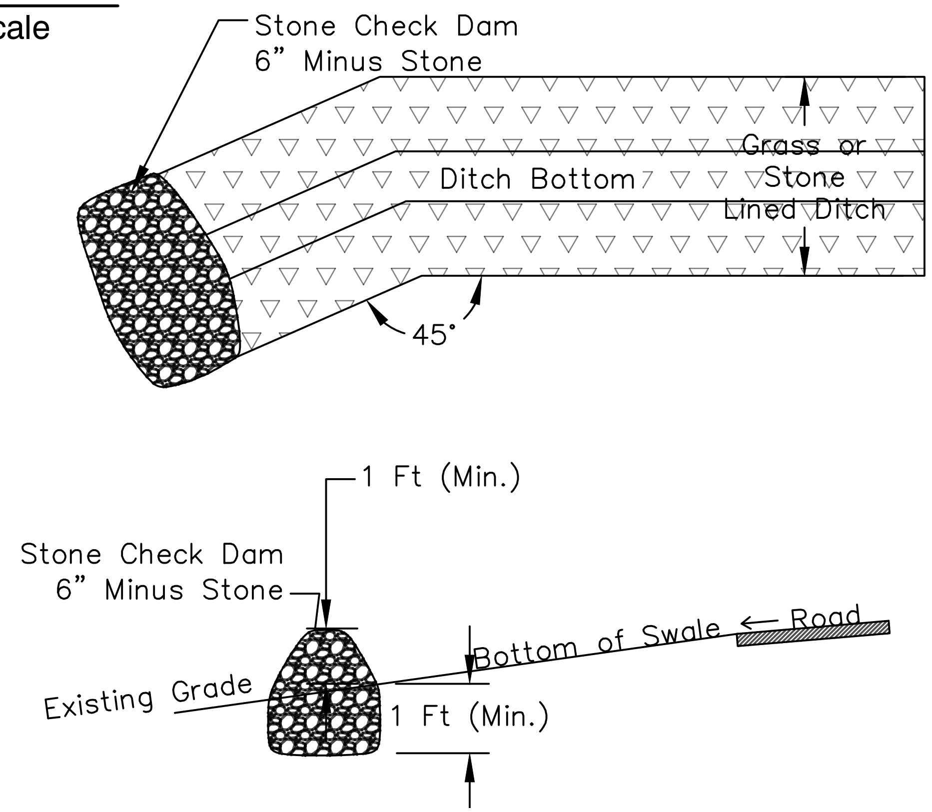
DATE: January 19, 2022

SHEET NO.: SHEET 1

## Detail A: Stone-Lined Ditch
Not to Scale




## Detail B: Turnout
Not to Scale




## Preliminary Cost Opinion

| Practice | Units | Unit Cost | Quantity | Total |
|---|---|---|---|---|
| Improve Road Crown | Linear Foot | $ 5 | 2400 | $ 12,000 |
| Raise Road Grade | Cubic Yard | $ 40 | | $ - |
| Remove Grader Berm/Lower Shoulder | Linear Foot | $ 3 | 1200 | $ 3,600 |
| Edge of Road Stabilization/Maintenance | Linear Foot | $ 8 | | $ - |
| New Stone-Lined Ditch | Linear Foot | $ 25 | 500 | $ 12,500 |
| New Grass-Lined Ditch | Linear Foot | $ 8 | | $ - |
| Side Slope Excavation for Ditch | Linear Foot | $ 10 | | $ - |
| Improve Existing Ditch (Stone) | Linear Foot | $ 20 | 600 | $ 12,000 |
| Improve Existing Ditch (Grass) | Linear Foot | $ 5 | | $ - |
| General Excavation (Cut and Haul) | Cubic Yard | $ 20 | 50 | $ 1,000 |
| Install Sediment Trap | Each | $ 1,500 | 2 | $ 3,000 |
| Install Stone Armor (Bank/Slope) | Cubic Yard | $ 40 | 10 | $ 400 |
| Install Stone Bedding (2" minus) | Cubic Yard | $ 40 | | $ - |
| Install Type V Rock (Stacked) | Cubic Yard | $ 50 | | $ - |
| New/Upgrade Cross-Culvert (18" to 24") | Each | $ 1,500 | 4 | $ 6,000 |
| New/Upgrade Conveyance Culvert | Each | $ 2,500 | | $ - |
| New/Upgrade Driveway Culvert | Each | $ 750 | 1 | $ 750 |
| | | | **Total Cost:** | **$ 51,250** |

Photo1: View of Road Section with very little space for Ditch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Notes:
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30% Conceptual Design
Project RR-05
River Road, West Haven
Poultney River SWMP

DRAWN: FCP
CHECKED: EPF
SCALE: As Shown
DATE: January 19, 2022
SHEET NO.: SHEET 2