

# Stormwater Master Plan for the Town of Pownal, Vermont

## FINAL REPORT

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## 1.0 Introduction

In 2022, Fitzgerald Environmental Associates (FEA) and SLR International Consulting (SLR) were contracted by the Vermont Department of Environmental Conservation (VTDEC) to develop a Stormwater Master Plan (SWMP) for the Town of Pownal. This final SWMP report for the Town of Pownal represents significant efforts and collaborations over the last several years between the Town, FEA, SLR, VTDEC, and other partners, including private landowners and business owners, interested in mitigating stormwater and improving water quality.

### 1.1 Stormwater Master Planning

Stormwater runoff is caused by precipitation, both in the form of rain or melting snow/ice, that is not infiltrated into the ground, absorbed by wetlands, or otherwise intercepted by plants. Human alteration of our landscapes in the form of impervious surfaces (i.e., pavement, rooftops, etc.) and compaction of soils disrupts natural hydrology and causes increased stormwater runoff. Increased stormwater runoff leads to higher magnitude flood flows, greater erosive power in stream channels, and increased delivery of sediment, nutrients, and other pollutants to waterways. Increased stormwater runoff is directly linked to the quality of water in our streams, rivers, ponds, and lakes that we depend on for drinking water, healthy fisheries, and recreation.

Stormwater Master Plans (SWMPs) can address stormwater problem areas either by mitigating impacts before they create problems or by avoiding the creation of issues at vulnerable sites. Prevention is cheaper than restoration, and SWMPs aim to address stormwater problem areas primarily through prevention. If we are to avoid the high cost of restoring degraded surface waters, we must better manage stormwater runoff before those waters become impaired. SWMPs are developed with public involvement and comment and should be as comprehensive as possible in listing all known problem areas within the Town. SWMPs are based on a prioritized list of stormwater projects. This strategic approach is more likely to produce long term water quality resiliency than a reactionary approach that addresses problems as they arise. Historically, almost all Vermont municipalities have responded to stormwater runoff or drainage problems the latter way, often during an emergency or after a structural failure has occurred. SWMPs contain important information and recommendations about preserving natural features and functions of watersheds and provide lists of evaluated alternatives such as using traditional pipe (gray) infrastructure versus green stormwater infrastructure.



## 1.2 Project Goals and Objectives

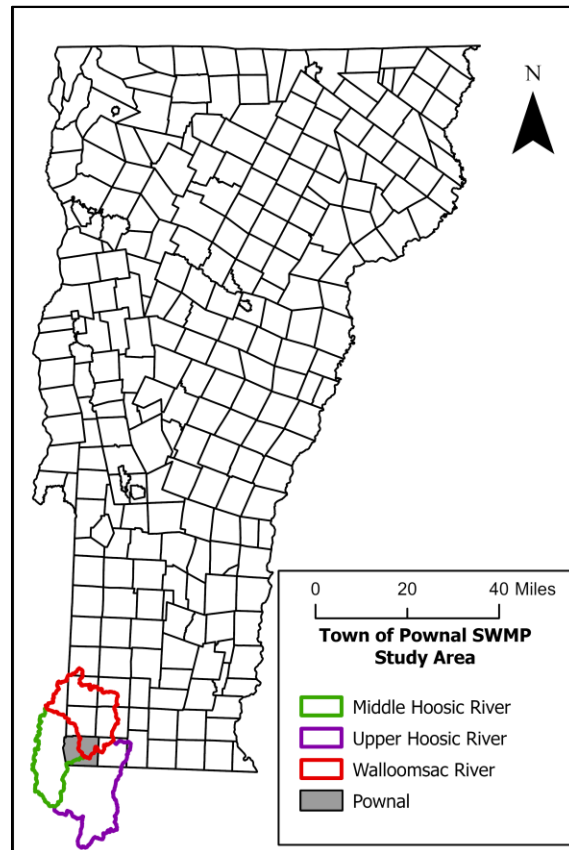
The purpose of this planning effort is to better manage stormwater runoff to reduce sediment and nutrient pollution to the Hoosic River and Walloomsac River watersheds, improve flood resiliency, and reduce the Town's maintenance burden at chronic problem areas. The primary objectives of this SWMP are to:

- Identify opportunities to incorporate stormwater treatment and/or outfall stabilization at the outfalls of existing closed stormwater conveyance systems.
- Identify opportunities to incorporate green stormwater infrastructure within the Village Centers.
- Identify opportunities to improve stormwater management in areas with active erosion and/or poor conveyances.

Project prioritization followed the Unified Scoring Metrics developed by VTDEC (2023) and Non-Unified Scoring Metrics (**Section 4.4**). Conceptual design plans (30% and 10% designs) were prepared for 5 high-priority projects. Phosphorus loading and removal estimates were provided for each project to assist the Town with project implementation prioritization for meeting water quality goals.

## 2.0 Study Area Description

Pownal is a 46.7 square mile town located in Bennington County. It includes the villages of Pownal, North Pownal, and Pownal Center. As of the 2020 census, Pownal has a total population of 3,258 people (U.S. Census Bureau, 2020). The Town's area is primarily forested and is 7.1% developed and 9.6% agriculture (Table 1). Pownal is bordered by 3 Vermont towns (Bennington, Woodford, and Stamford). Most of the roads in Pownal are municipal and private, with 7.6% of the Town's road length on US Highways (Table 2). The Town lies within the Upper Hoosic River, Middle Hoosic River, and Walloomsac River watersheds (Figure 1).



**Figure 1:** Town of Pownal and Associated Watershed Location Map





**Table 1:** Land cover in Pownal (Dewitz and U.S Geological Survey 2021)

| Landcover/Landuse Type | Percent of Town Area |
|------------------------|----------------------|
| Agriculture            | 9.6%                 |
| Barren                 | 0.3%                 |
| Developed              | 7.1%                 |
| Forest                 | 76.5%                |
| Grassland/Herbaceous   | 1.1%                 |
| Open Water             | 0.4%                 |
| Shrub/Scrub            | 0.5%                 |
| Wetland                | 4.5%                 |

**Table 2:** Road length by AOT Class in Pownal (Enhanced 911 Board, 2022)

| AOT Class | Description             | Length (miles) | Percent of Town Road Length<br>(excluding discontinued) |
|-----------|-------------------------|----------------|---------------------------------------------------------|
| 1         | Class 1 Town Highway    | -              | -                                                       |
| 2         | Class 2 Town Highway    | 11.8           | 11.6%                                                   |
| 3         | Class 3 Town Highway    | 50.8           | 49.6%                                                   |
| 4         | Class 4 Town Highway    | 9.43           | 9.2%                                                    |
| 5         | State Forest Highway    | -              | -                                                       |
| 6         | National Forest Highway | -              | -                                                       |
| 7         | Legal Trail             | 0.1            | 0.1%                                                    |
| 8 & 9     | Private Road            | 17.3           | 16.9%                                                   |
| 30        | Vermont State Highway   | 4.63           | 4.5%                                                    |
| 40        | US Highway              | 7.73           | 7.6%                                                    |
| Other     | -                       | 0.53           | 0.5%                                                    |
| 96        | Discontinued Road       | 1.02           | -                                                       |



Soil mapping for the Town shows that soil hydrogroups are variable, with a higher area of poorly drained (D-type) and somewhat poorly drained (C-type) soils than well drained (A-type) and somewhat well drained (B-type) soils (**Table 3**).

**Table 3:** Summary of town-wide soil drainage (VCGI, 2022).

| Soil Hydrogroup | Area (acres) | Percent of Town Area |
|-----------------|--------------|----------------------|
| A               | 5,731        | 19.1%                |
| B               | 5,848        | 19.4%                |
| C               | 10,802       | 35.9%                |
| D               | 7,475        | 24.9%                |
| Water           | 224          | 0.7%                 |

### 3.0 Stormwater Management Planning Library

#### 3.1 Mapping Data

##### VTDEC Municipal Roads Program

A Road Erosion Inventory (REI) for the Town of Pownal was conducted by the Bennington County Regional Commission (BCRC) in 2018. The REI was developed for municipalities to fulfill requirements of the VTDEC Municipal Roads General Permit (MRGP). In this inventory, roads are divided into 100-meter (328 ft) segments with unique identification numbers. The segments deemed hydrologically connected to surface waters (rivers, lakes, wetlands, etc.) are assessed in the field and given a road erosion score. This score is determined from characteristics of the roadway and of the stormwater drainage features associated with it (crown, berm, ditch, conveyance stability, culverts, etc). Each segment is classified as “Fully Meets”, “Partially Meets”, or “Does Not Meet”, to reflect the current level of conformance with the MRGP standards. Of the 577 hydrologically connected segments inventoried in Pownal, 76 (13.2%) did not meet MRGP standards and 157 (27.2%) partially met MRGP standards ([link](#)). Roads in the Town with segments that did not meet or partially met MRGP standards included Boyd Hill Road and Shearer Hill Road, among others. The MRGP specifies a timeline for bringing all road segments up to standards. High priority segments identified in the REI are potentially important opportunities to reduce erosion and sediment loading to receiving waters.

##### Light Detection and Ranging (LiDAR)

LiDAR returns for Pownal were collected in a series of flights conducted during 2017 as part of the VT LiDAR Initiative. These data meet the National Digital Elevation Program Quality Level 2 specifications for accuracy satisfactory for generation of a 0.7-meter Digital Elevation Model (DEM) and 1-foot contours. Derivations of LiDAR data, such as Digital Elevation Models (DEMs), terrain models, and contours are useful tools for stormwater feature identification and site design. The 0.7-meter DEM can assist in culvert watershed delineation and the design of stormwater management projects. Terrain models can assist in remote identification of erosion features, such as stormwater gullies.

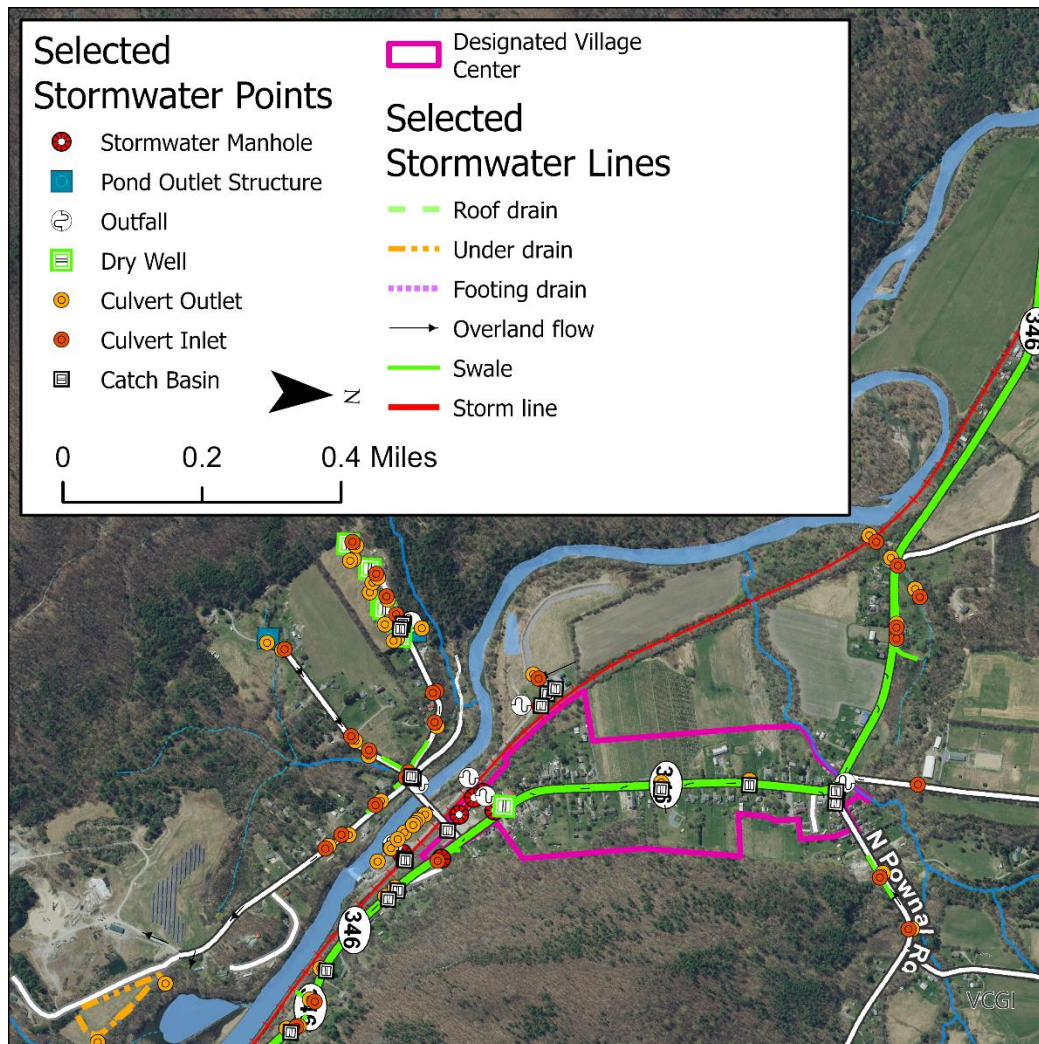


### Municipal Bridge and Culvert Data

Culvert and bridge data collected by the BCRC for town roads in Pownal are available online (<https://vtculverts.org/>). The dataset includes the structure dimensions and overall conditions but does not include the presence/absence of erosion. While most culverts were rated as good or fair, a few were rated as poor (11%) or critical (7%). The culvert data were reviewed to refine the selection of non-stream culverts focused on during field surveys.

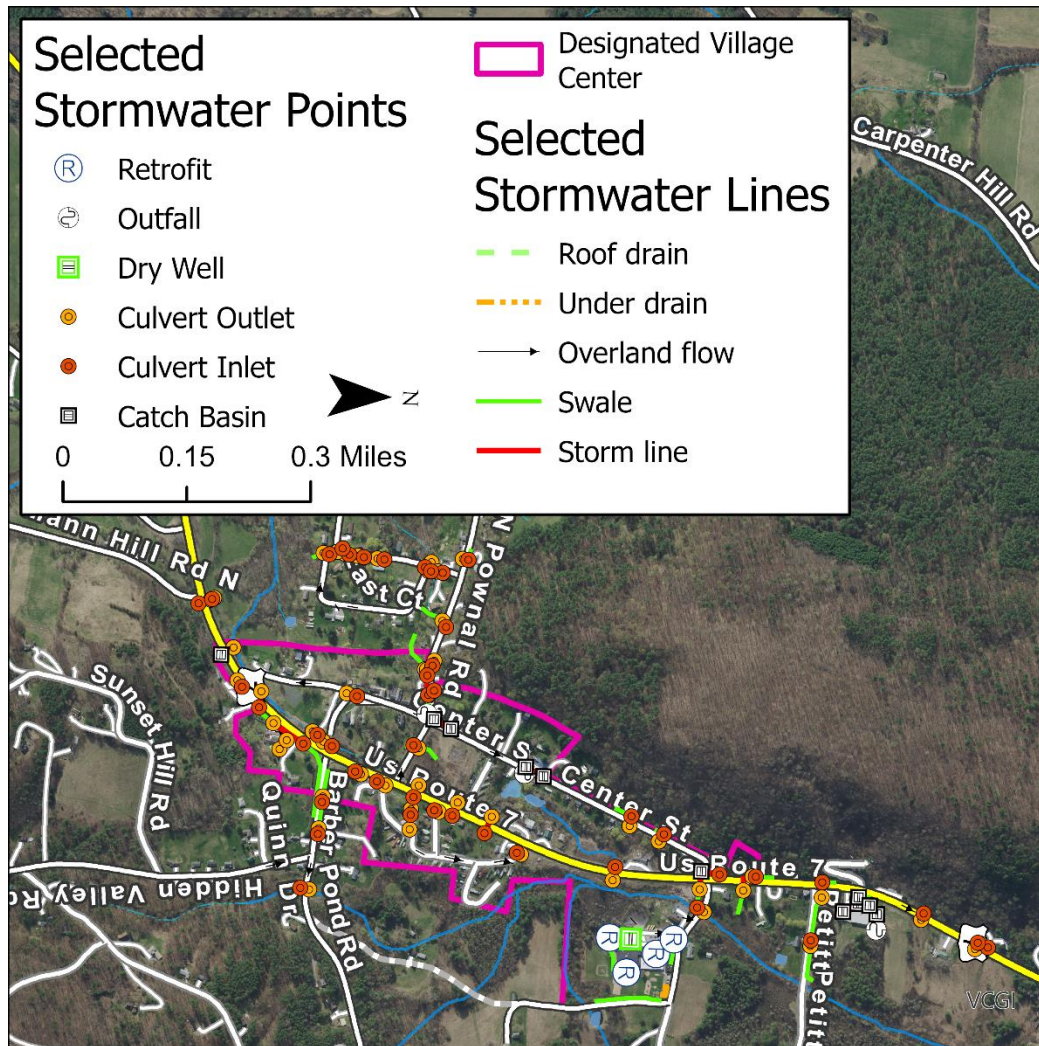
### Town of Pownal Stormwater Infrastructure Mapping Project

This dataset was produced by the Vermont Agency of Natural Resources (VTANR) in November 2018. The Stormwater Mapping Project documents the connectivity of stormwater infrastructure on private and public land within the Town of Pownal. The data show the paths of stormwater from different areas of impervious surface (**Figure 2**). The associated report identifies three high priority sites for improvement. Eight potential retrofit projects were identified in this study.



**Figure 2:** North Pownal Stormwater Infrastructure Map





**Figure 3: Pownal Center Stormwater Infrastructure Map**





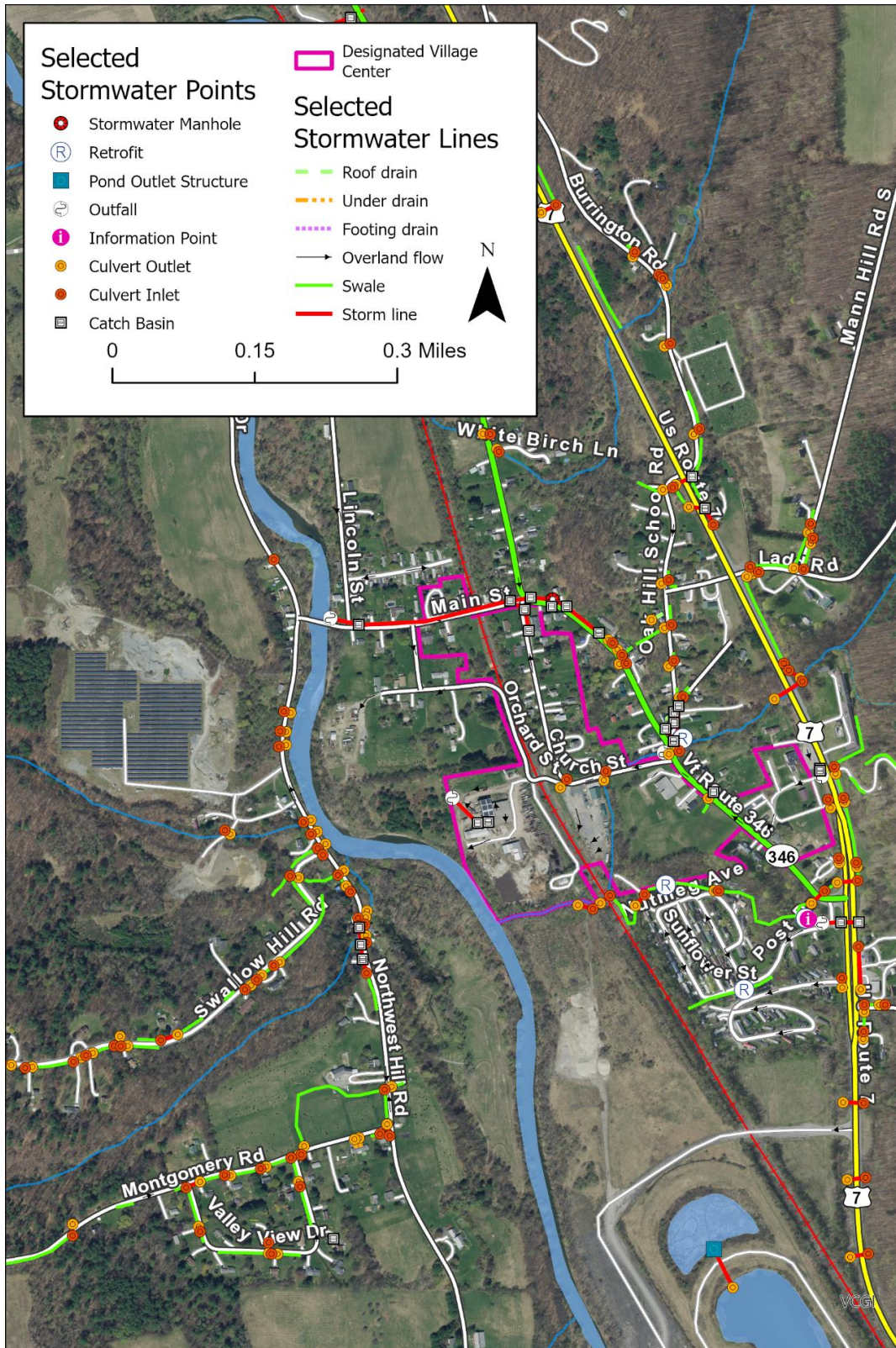


Figure 4: Pownal Village Stormwater Infrastructure Map



### Natural Resources Conservation Service (NRCS) Soils Survey

The NRCS soils survey dataset is valuable for stormwater master planning ([websoilsurvey.sc.egov.usda.gov](https://websoilsurvey.sc.egov.usda.gov)). As part of our initial scoping, we screened for problem areas based on the NRCS hydrologic soil groupings (HSG). The HSGs indicate the infiltration potential of the native soil type, which is useful for identifying areas of excessive runoff potential (e.g., HSG D-type) or good infiltration (e.g., HSG A-type) where stormwater infiltration practices should be explored.

### Flood Hazard Mapping

The FEMA DFIRM flood hazard dataset categorizes areas based on flooding potential. This dataset can inform planning based on areas where high flow volumes will occur during major storm events. This dataset can also be used to inform BMP designs and locations. BMPs proposed for locations upgradient of areas that are at high risk of flooding may have the potential to reduce downstream flooding and erosion issues. Prioritization of sites was informed by flood hazard potentials to mitigate flood damage within the Village centers.

### River Corridor Mapping

River corridor maps were produced by the Vermont Agency of Natural Resources. These data display both the river channel and the active corridor through which a river can be expected to meander over time. This mapping can inform stormwater mitigation efforts by indicating where rivers and streams might flow during flood events. This dataset also identifies areas where the river channel has been altered or confined. These problem areas are often prone to erosion and flooding.

## **3.2 Watershed Planning**

### Basin 1- Batten Kill, Hoosic, and Walloomsac Tactical Basin Plan

The Tactical Basin Plan for Basin 1 was produced by the Vermont Agency of Natural Resources Water Investment Division in 2021. Basin 1 includes, the Batten Kill, the Hoosic River, and the Walloomsac River. Roughly 82% of the basin is forested with 5.9% agriculture, 5.8% developed, and 4.5% wetland. Within the Tactical Basin, Pownal is in the Hoosic and Walloomsac River watersheds. Near Pownal, these watersheds are most heavily impacted by temperature, metals, PCB, and sediment. Potential projects mentioned in the Tactical Basin Plan of relevance to Pownal include supporting the implementation of agricultural best management practices, addressing erosion and runoff sources causing sediment and chloride pollution, initiating riparian buffer planting and protection projects, and conducting studies on potential class I candidate wetlands.



### Basin 10 IDDE Report

The Illicit Discharge Detection and Elimination (IDDE) report for Basins 1 and 12 was produced by Stone Environmental for VTDEC in June 2020. The study investigated discharges in 12 towns. Researchers collected water samples at outfalls and junctions in stormwater systems and tested them for chemical and biological pollutants. Based on surveys in July 2019, the study identified one location in Pownal with a suspected illicit discharge. Any sites where stormwater and wastewater may be comingling are high priorities for the SWMP.

### Hoosic River Watershed Updated Water Quality and Aquatic Habitat Assessment

This report on water quality in the Hoosic River watershed was produced in December 2014 by VTANR and VTDEC. The study included monitoring for biological contaminants as well as physical condition monitoring and identification of hazardous waste sites and old landfills. The most common stressors in Pownal were hazardous waste sites. The biological health of the river for macroinvertebrates in Pownal was generally good to very good.

### Hoosic River Phase 2 Geomorphic Assessment

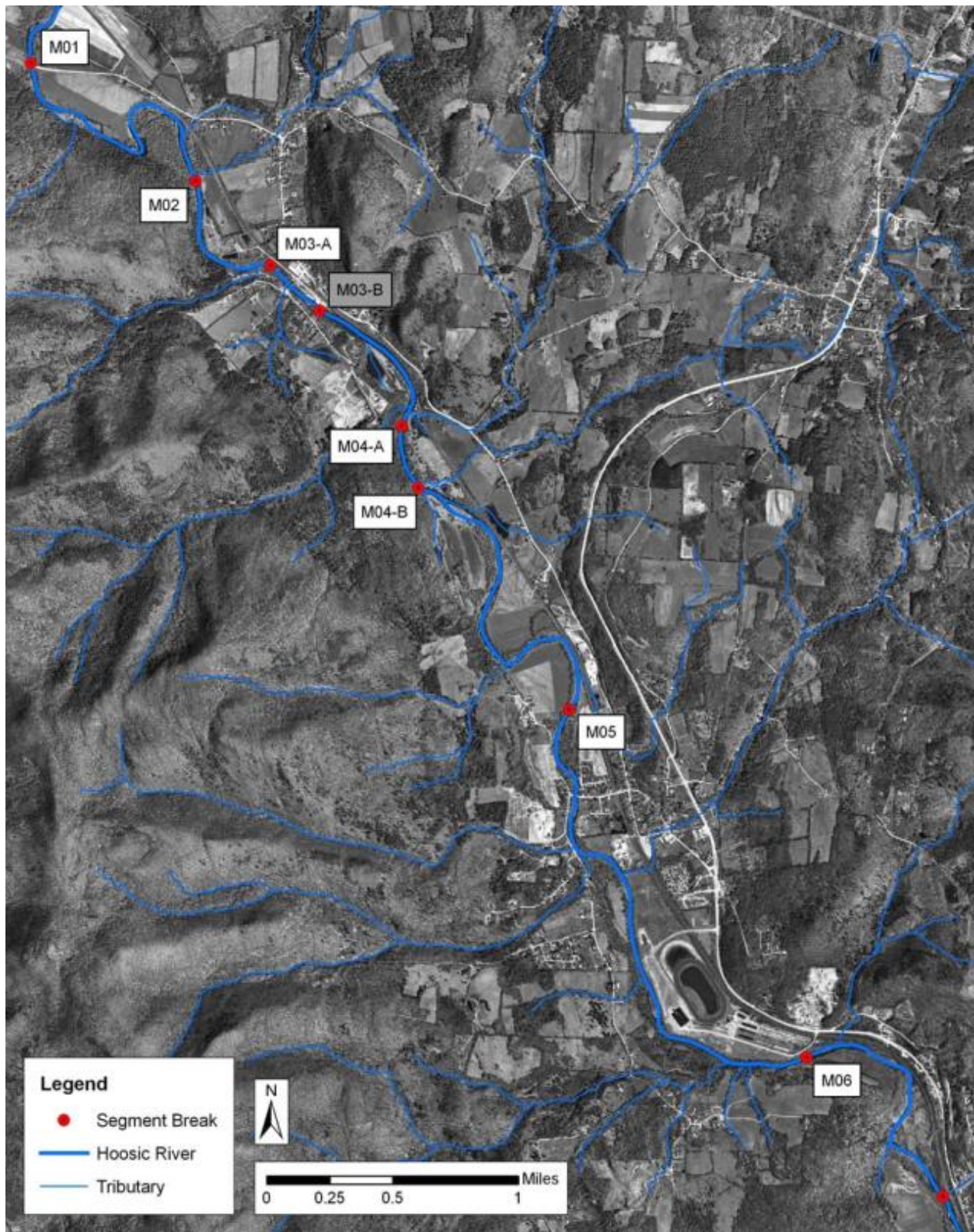
The report detailing the Phase 2 Stream Geomorphic Assessment of the Hoosic River was completed by Gomez and Sullivan Engineers in May 2009. Major problems in these reaches included human-caused channel and valley constriction. Channel straightening, berming, and stream bank armoring have all brought the Hoosic River channel away from its natural geomorphology and caused increased risk of damage and erosion during high flow events. Habitat conditions in these reaches were generally good. General information about each reach is summarized in **Table 4**. The locations of these reaches are shown in **Figure 5**.

**Table 4:** Summary of Phase 2 Reaches in Pownal

| Stream       | Reach | Existing Stream Type | Habitat Condition | Geomorphic Condition |
|--------------|-------|----------------------|-------------------|----------------------|
| Hoosic River | M01   | B                    | Good              | Fair                 |
|              | M02   | F                    | Good              | Fair                 |
|              | M03-A | B                    | Good              | Fair                 |
|              | M03-B | -                    | -                 | -                    |
|              | M04-A | C                    | Good              | Poor                 |
|              | M04-B | C                    | Good              | Fair                 |
|              | M05   | C                    | Good              | Fair                 |
|              | M06   | F                    | Good              | Fair                 |







**Figure 5:** Map of Phase 2 Reaches in Pownal (Gomez and Sullivan 2009)



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### 3.3 Town Planning and Permitting

#### Town of Pownal Town Plan

The Town of Pownal Town Plan was developed by the Pownal Planning Commission and adopted by the Town in 2019. Goals of the plan include, “identify[ing], protect[ing], and preserv[ing] natural and historic features of the Vermont landscape,” and , “encourag[ing] land development that avoids or minimizes impacts to physical constituents of the land”. The Town is susceptible to flooding and FEMA flood hazard helped to inform project selection to address flood risk and minimize damage.

#### Town of Pownal, Vermont Land Use Bylaw

This document was adopted by the Town of Pownal in 2021. It contains provisions to promote the development of the Town in a way that minimizes potential damages from future flood events and minimizes water quality impacts. It limits development in river corridors and wetlands. These guidelines will inform site selection for the SWMP. Development of BMPs in safer areas will be prioritized over those in flood-prone areas.

### 3.4 Data Gaps

The data sources and information describing stormwater and watershed management in the Town of Pownal are thorough and primarily up to date. Since the stormwater infrastructure mapping was completed in 2018 and no discrepancies in drainage mapping were identified over the course of our field work.

## 4.0 Stormwater Problem Areas

One of the primary objectives of this SWMP is to "develop a comprehensive list of stormwater problems" within the Town of Pownal. FEA staff made several field visits to the project area and hosted meetings with the Town to identify existing problem areas, evaluate and prioritize sites, and recommend potential solutions.

### 4.1 Identification of Problem Areas

The initial round of problem area identification began with the identification of stormwater related projects using a desktop exercise scanning the watershed with aerial imagery, NRCS soils data, Town stormwater infrastructure mapping, contour data, and road erosion inventory results in GIS. Potential project areas were identified and mapped for review during site visits. A total of 21 stormwater problem areas were identified and assessed in the field (see map in Appendix A and table in Appendix B). We grouped the problem areas into four project categories described below.

- **Green Stormwater Infrastructure (GSI) Installation/Retrofit (14)** – Opportunity to reduce sediment and nutrient loads through the installation of a new stormwater best management practice (BMP). Also includes sites where nutrient and sediment reductions could be improved through the retrofit of existing stormwater BMPs .
- **Road Erosion Mitigation (4)** – Areas of high sediment and nutrient loading due to road, embankment, and ditch erosion.
- **Gully Stabilization (2)** – Areas of severe erosion from concentrated stormwater runoff.



- **Other (1)** – Areas that do not fall into one of the project categories described above. The project in this category is a stream bank stabilization.

#### 4.2 Evaluation and Prioritization of Problem Areas

Sixteen (16) projects are described in the Unified Prioritization Project Table (Appendix B) where projects are prioritized based on the potential for each project to improve water quality and reduce environmental impact, project feasibility, and co-benefits. Estimated project cost and the phosphorus removal efficiency (\$/lb of P) were included. We followed the methods described in the “Unified Scoring Prioritization for Stormwater Master Plans” document developed by VTDEC (2023). These methods include a total of 19 criteria divided into 3 categories. The final score is expressed as a percentage of the maximum score (50 points). The final project scores ranged from 36% to 68% points. Additional information about the unified prioritization methods can be found in **Table 5** and **Section 4.3**.

The 5 projects that could not be assigned a BMP treatment volume were prioritized using Non-Unified Scoring Prioritization methods. These projects were assigned several numerical scoring metrics that are weighted to assist in prioritizing each project based on water quality benefits, project feasibility, maintenance requirements, costs, and any additional benefits. The maximum possible score is 30 and the individual site scores ranged from 12 to 19. Additional information about the non-unified prioritization methods can be found in **Section 4.4**.

#### 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 project prioritization table (Appendix B).

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

- **Subwatershed Mapping** – The contributing drainage area to each problem area was mapped based on field observations and 1-foot contours derived from the 0.7-meter 2017 LiDAR elevation surface.
- **Aerial Photography** – We used the 0.6 m imagery collected in 2021 to review the site land cover characteristics (i.e., forest, grass, impervious).
- **Impervious Surfaces Data** – We used the 2016 statewide high-resolution impervious surfaces data layer developed by the UVM Spatial Analysis Lab.
- **Stormwater Infrastructure** – We used the Stormwater Infrastructure Mapping Project data collected in 2018 with detailed mapping of stormwater infrastructure throughout the Town.
- **NRCS Soils** – We used the VT 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 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.

#### 4.3 Unified Matrix Evaluation and Prioritization of Problem Areas

The 16 projects described in the Unified Prioritization Project Table (Appendix B) were prioritized using the methods described in **Table 5**. Methods for determining project costs are described on page 15. Estimated project cost and the phosphorus removal efficiency (\$/lb of P) were included. We followed the Unified Scoring Prioritization for Stormwater Master Plans document developed by VTDEC, with an adjustment to the phosphorus loading and phosphorus reduction criteria (VTDEC, 2018). This 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. **It is important to note that the phosphorus loading estimates for the unified scoring system have only been developed for the Lake Champlain Basin.** VTANR has not yet released a timeline for developing nutrient loading calculations for the Connecticut River Basin and Hudson River Basin. Phosphorus loading rates are highly variable between lake segments. We selected the loading rates for the “Winooski River” lake segment for the Town of Pownal, as these rates are roughly in the median range for phosphorus loading from pervious and impervious surfaces.





**Table 5:** Unified prioritization scoring for Stormwater Master Plans, developed by VTDEC (2023).

| Criteria                                                                                  | Proposed Weight                                                                                                                                                                                                                                                   | Max points |
|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| <b>Water Quality/Environmental impact</b>                                                 |                                                                                                                                                                                                                                                                   |            |
| 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 <a href="#">STP Calculator</a> )                     | 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 |                                                                                                                                                                                                                                                                   |            |
| <b>Total Water Quality Score (out of 21, or 15 if road project)</b>                       |                                                                                                                                                                                                                                                                   |            |
| <b>Feasibility Criteria</b>                                                               |                                                                                                                                                                                                                                                                   |            |
| 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          |
| <b>Total Feasibility Score (out of 20)</b>                                                |                                                                                                                                                                                                                                                                   |            |
| <b>Other considerations/Co-benefits (0=doesn't address concern, 1=addresses concern)</b>  |                                                                                                                                                                                                                                                                   |            |
| 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          |
| <b>Total Co-benefits Score (out of 9)</b>                                                 |                                                                                                                                                                                                                                                                   |            |
| <b>Overall Score (out of 50 or 44)</b>                                                    |                                                                                                                                                                                                                                                                   |            |



### 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<sup>3</sup> 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<sup>3</sup> and 0.037 kg (P)/ft<sup>3</sup> (VTDEC 2020).

### BMP Unit Costs and Adjustment Factors

BMP unit costs (**Table 6**) and adjustment factors (**Table 7**) 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 compiled by FEA and other consultants. The unit cost estimates include a 28% total inflation adjustment for 2017-2023 based on the Consumer Price Indicator Inflation Calculator. 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 7**) and level of permitting and engineering required (**Table 8**) are also shown below.



**Table 6: BMP Unit Costs (\$)**

| <b>BMP Type</b>               | <b>Cost/ft<sup>3</sup> Treatment Volume</b> |
|-------------------------------|---------------------------------------------|
| Constructed Wetland           | \$11.26                                     |
| Dry Pond                      | \$5.77                                      |
| Grass Conveyance Swale        | \$5.13                                      |
| Rain Garden (no underdrain)   | \$19.83                                     |
| Rain Garden (with underdrain) | \$19.83                                     |
| Subsurface Infiltration       | \$8.02                                      |
| Surface Infiltration          | \$8.00                                      |
| Wet Pond                      | \$8.72                                      |
| Swirl Separator (small)       | Lump Sum: \$20,000                          |
| Swirl Separator (medium)      | Lump Sum: \$40,000                          |
| Swirl Separator (large)       | Lump Sum: \$60,000                          |

**Table 7: Site Type Cost Adjustment**

| <b>Site Type</b>                    | <b>Cost Multiplier</b> |
|-------------------------------------|------------------------|
| Existing BMP retrofit               | 0.25                   |
| Complicated retrofit                | 0.75                   |
| New BMP in undeveloped area         | 1.00                   |
| New BMP in partially developed area | 1.50                   |
| New BMP in developed area           | 2.00                   |

**Table 8: Permitting and Engineer (P&E) Cost Adjustment**

| <b>Level of P&amp;E Required</b> | <b>Cost Multiplier</b> |
|----------------------------------|------------------------|
| None                             | 1.00                   |
| Low                              | 1.20                   |
| Moderate                         | 1.25                   |
| High                             | 1.35                   |



#### 4.4 Non-Unified Evaluation and Prioritization of Problem Areas

The 5 projects that could not be assigned a BMP treatment volume described in the Non-Unified Prioritization Project Table (Appendix B) were prioritized using the methods described below.

- **Water Quality Benefits (15 points total)**
  - **Nutrient Reduction Effectiveness (4 points)** – Degree of nutrient removal potential with project implementation, this accounts for both the existing nutrient loads and the removal efficiency and capacity of the proposed treatment. Nutrient loading was quantified based on the watershed size, the land cover types, and percent impervious surfaces. The effectiveness was based on the treatment efficacy of the potential mitigation options appropriate for the space and location of the treatment area.
    - 0 points – No nutrient source and/or no increased treatment
    - 1 point – Minor nutrient source and/or minor increase in treatment
    - 2 points – Moderate nutrient source with some increase in treatment
    - 3 points – Moderate nutrient source with significant increase in treatment
    - 4 points – Major nutrient source with significant increase in treatment
  - **Sediment Reduction Effectiveness (4 points)** – Degree of sediment removal potential with project implementation, this accounts for both the existing sediment loads and the removal efficiency and capacity of the proposed treatment. Sediment loading was quantified based on the watershed size, the land cover types, and percent impervious surfaces, and the effectiveness was based on the treatment efficacy of the potential mitigation options appropriate for the space and location of the treatment area.
    - 0 points – No sediment source and/or no increased treatment
    - 1 point – Minor sediment source and/or minor increase in treatment
    - 2 points – Moderate sediment source with some increase in treatment
    - 3 points – Moderate sediment source with significant increase in treatment
    - 4 points – Major sediment source with significant increase in treatment
  - **Drainage Area (1 point)** – Approximate drainage area to site is greater than 2 acres
  - **Impervious Drainage (3 points)** – Approximate area of impervious surfaces draining to the site.
    - 0 points – Area of impervious surfaces is less than 0.25 acres
    - 1 point – Area of impervious surfaces is 0.25-0.5 acres
    - 2 points – Area of impervious surfaces is 0.5-1.0 acres
    - 3 points – Area of impervious surfaces is >1.0 acres
  - **Connectivity to Surface Waters (3 points)**
    - 0 points – All stormwater infiltrates on site
    - 1 point – Stormwater receives some treatment before reaching receiving waters
    - 2 points – Stormwater drains into drainage infrastructure that directly outlets to receiving waters (assumes no erosion or additional pollutant loading to discharge point)
    - 3 points – Stormwater drains directly into receiving waters (typically stormwater draining directly into a large wetland is assigned 2 points)





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



#### 4.5 Conceptual Designs

FEA hosted a meeting with the Town and VTDEC in April 2024 to discuss project prioritization and selection of 5 projects for conceptual design development. Five (5) projects were selected at this meeting for concept designs. FEA and SLR developed four 30% conceptual designs and one 10% conceptual design along with preliminary cost estimates. 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 (not included in 10% designs)

The projects selected for conceptual design were:

1. **Project POW-05 – Intersection of VT Route 246 and Oak Hill School Road (10%)**

**Problems Identified:** Untreated runoff from a steep section of Oak Hill School Road flows directly into the stream.

**Proposed Best Management Practice(s):** Infiltration Basin with pre-treatment sediment forebay.

**Estimated Cost Effectiveness:** \$25,000-\$35,000/kg P/year

2. **Project POW-09 –Barber Pond Boat Launch (30%)**

**Problems Identified:** The eroding gravel boat launch drains directly into Barber Pond.

**Proposed Best Management Practice(s):** Lakeshore Buffer Plantings and Vegetated Settling Area.

**Estimated Cost Effectiveness:** \$200,000-\$250,000/kg P/year

3. **Project POW-10/POW-12 – Town Municipal Complex (30%)**

**Problems Identified:** A large amount of impervious area (Municipal buildings, driveways, parking lots, and skate park) drains into two separate storm drainage systems discharging to a forested area west of Center Street (POW-12) and a narrow wetland along US Route 7 (POW-10). There is also erosion leading into the stormwater infrastructure in front of the town hall. The outlet from the uphill culvert is buried with new rock.

**Proposed Best Management Practice(s):** Construct grassed swales to collect runoff from the rooftop areas, gravel parking lot, and the skate park, discharging to pre-treatment forebays and a gravel wetland (POW-10). Runoff from the Municipal buildings and driveways will be collected in the existing storm drainage system discharging to a new pre-treatment forebay and infiltration basin located at the outfall west of Center Street (POW-12).

**Estimated Cost Effectiveness:** POW-10: \$150,000-\$200,000/kg P/year, POW-12: \$70,000-\$80,000/kg P/year



#### 4. Project POW-17 – Snake Hill Road (30%)

**Problems Identified:** A cross culvert outlets onto a very steep slope that has a history of erosion and mass failure.

**Proposed Best Management Practice(s):** Install a pre-treatment forebay at the cross-culvert inlet and install a vegetated infiltration basin at the culvert outlet. The basin will have an overflow spillway designed to discharge sheet flow down the steep embankment to the stream.

**Estimated Cost Effectiveness:** \$130,000-\$150,000/kg P/year

#### 5. Project POW-18 – Intersection of Dean Road and Snake Hill Road (30%)

**Problems Identified:** An eroding ditch and gravel roads drain into stormwater infrastructure that flows directly into the river.

**Proposed Best Management Practice(s):** Two (2) Infiltration Basins

**Estimated Cost Effectiveness:** \$20,000-\$40,000/kg P/year

### 5.0 Next Steps

This Stormwater Master Plan represents an extensive effort to identify, describe, and evaluate stormwater issues affecting water quality and localized flooding in the Town of Pownal. For each project recommendation, we provided a preliminary cost estimate and nutrient/sediment treatment estimates to town representatives to assist with planning and prioritizing project implementation. The problem area descriptions for town roads (e.g., roadside ditches) will aid the Town Highway Department in proactively stabilizing and maintaining these features to avoid future stormwater problems, and to come into compliance with the VTANR Municipal Roads General Permit.

We recommend that the Town work with VTDEC and other partners to secure funding for the high priority projects described in Appendices B and C. Landowner outreach should be completed for all projects that are not on Town land or right-of-way. The BMP installation/retrofit opportunities identified in the Unified Prioritization Matrix represent a potential phosphorus load reduction of approximately 36 lb/year. Based on our review and preliminary designs and our experience with previous SWMP efforts, we feel that the projects listed in Appendix C should be considered for further development and implementation.



## 6.0 References

- Clean Water Initiative Program, Watershed Management Division, Vermont Department of Environmental Conservation, November, 2018. Town of Pownal Stormwater Infrastructure Mapping Project
- Dewitz, J., and U.S. Geological Survey, 2021. National Land Cover Database (NLCD) Products (ver. 2.0, June 2021)
- Environmental Protection Agency (EPA), 2016. Methodology for developing cost estimates for Opti-Tool.
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- Fitzgerald Environmental Associates (FEA) and Milone and MacBroom (MMI). 2017. Road Erosion Site Prioritization and Remediation Project Summary. Memo prepared for the Chittenden County Regional Planning Commission. Dated December 27, 2017.
- Gomez and Sullivan Engineers, May, 2009. Hoosic River Phase 2 Stream Geomorphic Assessment.
- Pownal Planning Commission, April, 2019. Town of Pownal Town Plan.
- Town of Pownal, August, 2021. Land Use Bylaw Including Zoning and Subdivision Regulation.
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- Water Investment Division, Vermont Agency of Natural Resources, November, 2021. Basin 1- Batten Kill, Hoosic, and Walloomsac Tactical Basin Plan.
- Watershed Consulting Associates, LLC. 2018. Stormwater Master Plan for the Town of Berlin, Vermont. Prepared for the Central Vermont Regional Planning Commission. Final Report, January 17, 2018.
- Watershed Management Division, Vermont Agency of Natural Resources, December, 2014. Hoosic River Watershed Updated Water Quality and Aquatic Habitat Assessment.

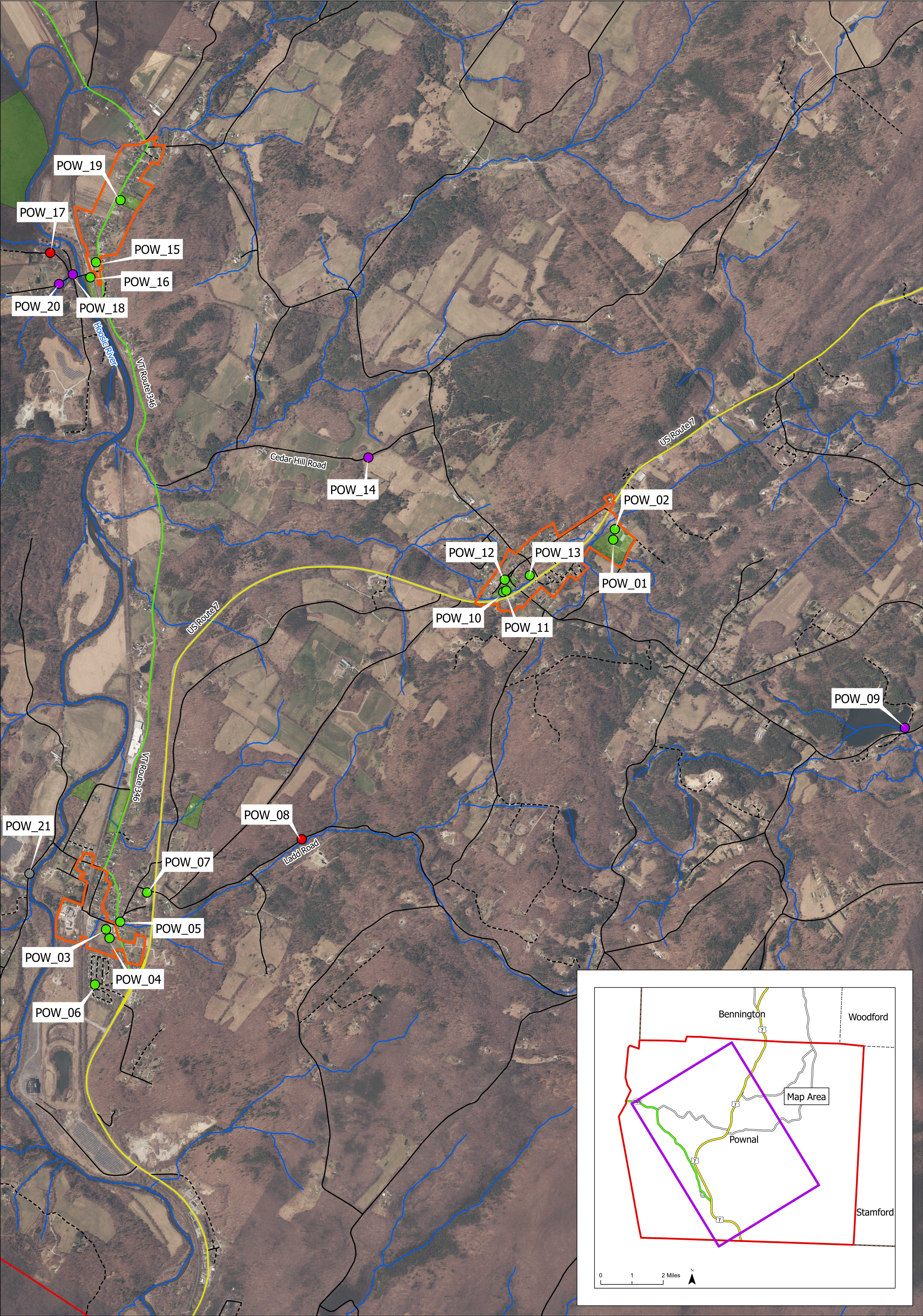




## **APPENDIX A**

### **Project Location Map (24"x36")**







# **Appendix B**

## **Project Prioritization Summary Tables**

### **Unified and Non-Unified**

### **(11"x17"& 8.5"x 11")**



Stormwater Master Plan - Town of Pownal  
Unified Prioritization Project Table  
March 28, 2024

| Project ID | Project Type | Location                                                          | Description                                                                                                                                        | Preliminary Recommendations                                                                                                                                                                                                                                                                           | Total Acreage | Impervious Acreage | % Impervious | P Load (lb/yr) | WQv (cf) | BMP Type                    | BMP Volume (cf) | BMP P Reduction (lb/yr) | Erosion P Reduction (lb/yr) | Total P Reduction (lb/yr) | Gully Mitigation | Landowner | Project/ Permitting Complexity | Infrastructure Conflicts | Total Cost | Project Efficiency \$/lb | Ease of O&M | Co-Benefits Sum | Total Score | Possible | Final Score % |
|------------|--------------|-------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|--------------|----------------|----------|-----------------------------|-----------------|-------------------------|-----------------------------|---------------------------|------------------|-----------|--------------------------------|--------------------------|------------|--------------------------|-------------|-----------------|-------------|----------|---------------|
| POW_18     | Road Erosion | Intersection of Dean Road and Snake Hill Road                     | An eroding ditch and gravel roads drain into stormwater infrastructure that flows directly into the river.                                         | Stabilize the roadways and ditches with stone. Direct stormwater into the green space with an existing catch basin to infiltrate in a small basin.                                                                                                                                                    | 34.14         | 1.41               | 4%           | 15.53          | 10,803   | Infiltration Basin          | 1,900           | 10.03                   | 2.00                        | 12.03                     | 0                | 2         | 1                              | 1                        | \$ 35,800  | \$ 2,976                 | 2           | 2               | 34          | 50       | 68%           |
| POW_12     | GSI          | Center Street - Town Municipal Complex Front of Town Hall         | There is erosion leading into the stormwater infrastructure in front of the town hall. The outlet from the uphill culvert is buried with new rock. | Install small bioretention features on either side of the driveway entrance to the town hall. Stabilize the existing erosion with stone. Sediment traps are another option for this site.                                                                                                             | 0.33          | 0.23               | 70%          | 0.62           | 811      | Bioretention (infiltrating) | 240             | 0.46                    | 5.00                        | 5.46                      | 0                | 3         | 2                              | 1                        | \$ 13,900  | \$ 2,547                 | 1           | 2               | 32          | 50       | 64%           |
| POW_05     | GSI          | Intersection of VT Route 346 and Oak Hill School Road - Empty Lot | Untreated runoff from a steep section of Oak Hill School Road flows directly into the stream.                                                      | Install a treatment feature in the empty lot and divert existing stormwater infrastructure into it. Stabilize the road surface and ditches where necessary.                                                                                                                                           | 3.54          | 0.53               | 15%          | 2.84           | 2,362    | Infiltration Basin          | 2,370           | 2.68                    | 0.37                        | 3.05                      | 0                | 0         | 2                              | 1                        | \$ 37,100  | \$ 12,148                | 2           | 2               | 31          | 50       | 62%           |
| POW_09     | Road Erosion | Pine Ridge Road - Barber Pond Boat Launch                         | The eroding gravel boat launch drains into the pond.                                                                                               | Stabilize and regrade the gravel. There is not space for a large treatment feature, but a small bioretention feature could be installed.                                                                                                                                                              | 0.21          | 0.15               | 74%          | 0.40           | 540      | Infiltration Basin          | 1,100           | 0.40                    | 0.52                        | 0.91                      | 0                | 0         | 2                              | 1                        | \$ 15,600  | \$ 17,068                | 2           | 4               | 30          | 50       | 60%           |
| POW_03     | GSI          | VT Route 346 and Church Street - Pownal Municipal Building        | There is a large open green space on municipal property, downhill of a municipally-owned building.                                                 | Install a treatment feature in the lawn area, add swales as necessary to divert parking lot and building runoff to treatment.                                                                                                                                                                         | 0.79          | 0.56               | 70%          | 1.50           | 1,962    | Infiltration Basin          | 1,970           | 1.45                    | 0.00                        | 1.45                      | 0                | 3         | 2                              | 1                        | \$ 31,400  | \$ 21,625                | 2           | 2               | 29          | 50       | 58%           |
| POW_10     | GSI          | Center Street - Town Municipal Complex Skate Park                 | The skate park drains into a thin wetland along VT Route 7.                                                                                        | Install a swale along the eastern edge of the skate park to infiltrate and direct water. There is space for a basin, but the horseshoe court would have to be removed.                                                                                                                                | 0.33          | 0.25               | 74%          | 0.66           | 861      | Dry Swale (infiltrating)    | 860             | 0.64                    | 0.00                        | 0.64                      | 0                | 3         | 2                              | 1                        | \$ 6,400   | \$ 10,031                | 2           | 2               | 29          | 50       | 58%           |
| POW_04     | GSI          | VT Route 346 - US Post Office                                     | The paved parking lot and building drain untreated runoff downhill through unused green space.                                                     | Install an infiltration practice in the empty green space downhill of the building. This project could be combined with Project POW_03.                                                                                                                                                               | 0.55          | 0.27               | 49%          | 0.81           | 972      | Infiltration Basin          | 980             | 0.79                    | 0.00                        | 0.79                      | 0                | 3         | 2                              | 1                        | \$ 16,100  | \$ 20,328                | 2           | 2               | 28          | 50       | 56%           |
| POW_06     | GSI          | Post Drive - Pownal Estates Community                             | Untreated roof runoff drains onto an eroding section of the gravel road. The water flows untreated into the river.                                 | Retrofit the existing swale to infiltrate stormwater. There is space for an infiltration feature to the south of the community, on the far side of the berm.                                                                                                                                          | 4.98          | 2.14               | 43%          | 6.71           | 7,910    | Dry Swale (infiltrating)    | 2,950           | 4.97                    | 0.30                        | 5.27                      | 0                | 0         | 0                              | 1                        | \$ 20,300  | \$ 3,853                 | 2           | 1               | 28          | 50       | 56%           |
| POW_01     | GSI          | School House Road - Elementary School                             | There is unused green space next to the building and parking area. There is an existing dry well in the center.                                    | There is space for an infiltration basin to treat roof and driveway runoff. The existing dry well could be retrofitted and the grade of the lawn area could be adjusted to add storage capacity to the feature.                                                                                       | 0.79          | 0.61               | 77%          | 1.58           | 2,146    | Infiltration Basin          | 2,150           | 1.43                    | 0.00                        | 1.43                      | 0                | 3         | 2                              | 0                        | \$ 36,000  | \$ 25,175                | 2           | 2               | 27          | 50       | 54%           |
| POW_19     | GSI          | VT Route 346 - Pownal Baseball Field                              | An eroding gravel driveway drains into a catch basin.                                                                                              | Install a small rain garden or infiltration basin around the catch basin in the green island at the entry to the park. Install swales to divert water to a feature in another location on the property if this location is undesirable.                                                               | 0.20          | 0.14               | 72%          | 0.37           | 503      | Infiltration Basin          | 510             | 0.35                    | 0.04                        | 0.39                      | 0                | 3         | 2                              | 1                        | \$ 10,300  | \$ 26,478                | 2           | 3               | 27          | 50       | 54%           |
| POW_16     | GSI          | Dean Road - Small Park along the Hoosic River                     | The gravel road next to the park and along the river is eroding.                                                                                   | Direct portion(s) of runoff to rain garden(s). The project could be sized to fit the desired space. Swales could be installed and the road could be regraded to treat as much or as little stormwater as desired.                                                                                     | 0.18          | 0.05               | 28%          | 0.18           | 198      | Bioretention (infiltrating) | 200             | 0.18                    | 0.19                        | 0.36                      | 0                | 3         | 2                              | 1                        | \$ 8,000   | \$ 22,161                | 1           | 3               | 26          | 50       | 52%           |
| POW_13     | GSI          | North Pownal Road - Fire Station                                  | An existing wet pond receives very little water from the parking lot and building.                                                                 | Install swales around the parking area so that a larger drainage area feeds into the existing wet ponds or install a larger infiltration feature in the green space to replace the existing wet ponds. Direct all runoff from the parking lot and the building to the new feature.                    | 0.30          | 0.23               | 78%          | 0.59           | 820      | Infiltration Basin          | 820             | 0.59                    | 0.00                        | 0.59                      | 0                | 3         | 2                              | 1                        | \$ 16,800  | \$ 28,283                | 2           | 2               | 25          | 50       | 50%           |
| POW_02     | GSI          | School House Road - Elementary School                             | A large portion of the paved parking area drains to a low point along the west side.                                                               | Install a swale along western side of the parking lot. This swale could be used to divert water to another feature on site or to infiltrate. A narrow infiltration basin could also be installed in this space.                                                                                       | 0.54          | 0.43               | 79%          | 1.12           | 1,493    | Dry Swale (w/ underdrain)   | 1,500           | 0.57                    | 0.00                        | 0.57                      | 0                | 3         | 2                              | 0                        | \$ 14,500  | \$ 25,350                | 2           | 2               | 24          | 50       | 48%           |
| POW_15     | GSI          | VT Route 346 and Dean Road - Pownal Highway Department Warehouse  | A large eroding gravel parking lot drains into existing stormwater infrastructure.                                                                 | Regrade the parking lot and install swales to direct water to awetland in the green space at the northern side of the parking lot and building. The building is an old tannery, so soil tests may be necessary before considering infiltration practices.                                             | 0.76          | 0.63               | 83%          | 1.61           | 2,202    | Gravel Wetland              | 2,210           | 0.97                    | 1.00                        | 1.97                      | 0                | 2         | 0                              | 0                        | \$ 67,200  | \$ 34,164                | 0           | 1               | 20          | 50       | 40%           |
| POW_11     | GSI          | Center Street - Town Municipal Complex Behind Town Hall           | A large drainage area including the gravel parking lot, the building, and much of the paved parking lot drains to a small settling pond.           | Install a sediment trap at the outlet from the roof drain and parking lot. Replace the existing settling pond with a larger gravel wetland. There is potential to increase the drainage area by adding swales along the south side of the parking lot and along the southeast side of the skate park. | 0.71          | 0.40               | 56%          | 1.14           | 1,436    | Gravel Wetland              | 1,440           | 0.66                    | 0.00                        | 0.66                      | 0                | 3         | 2                              | 1                        | \$ 26,400  | \$ 40,000                | 0           | 3               | 19          | 50       | 38%           |
| POW_07     | GSI          | Ladd Road - Rescue Squad Building                                 | Untreated building and parking lot runoff flows into a culvert and is directed down an eroding gravel road.                                        | Use a part of the green parking lot island to treat runoff from the parking lot and building before it enters the culvert.                                                                                                                                                                            | 0.25          | 0.20               | 79%          | 0.51           | 696      | Bioretention (infiltrating) | 730             | 0.51                    | 0.00                        | 0.51                      | 0                | 3         | 2                              | 1                        | \$ 27,100  | \$ 53,557                | 1           | 1               | 18          | 50       | 36%           |



Stormwater Master Plan - Town of Pownal  
Non-Unified Prioritization Project Table  
March 28, 2024

| Additional<br>Benefits Codes | CPA                  | SF                | E           | IC                       | SW                                            | BMP                               | HV              | TH                        | PF                  | L                                     |
|------------------------------|----------------------|-------------------|-------------|--------------------------|-----------------------------------------------|-----------------------------------|-----------------|---------------------------|---------------------|---------------------------------------|
|                              | Chronic Problem Area | Seasonal Flooding | Educational | Infrastructure Conflicts | Drains to Connected Stormwater Infrastructure | Improves Existing BMP Performance | High Visibility | Reduces Thermal Pollution | Peak Flow Reduction | Enhance Lakeshore Natural Communities |

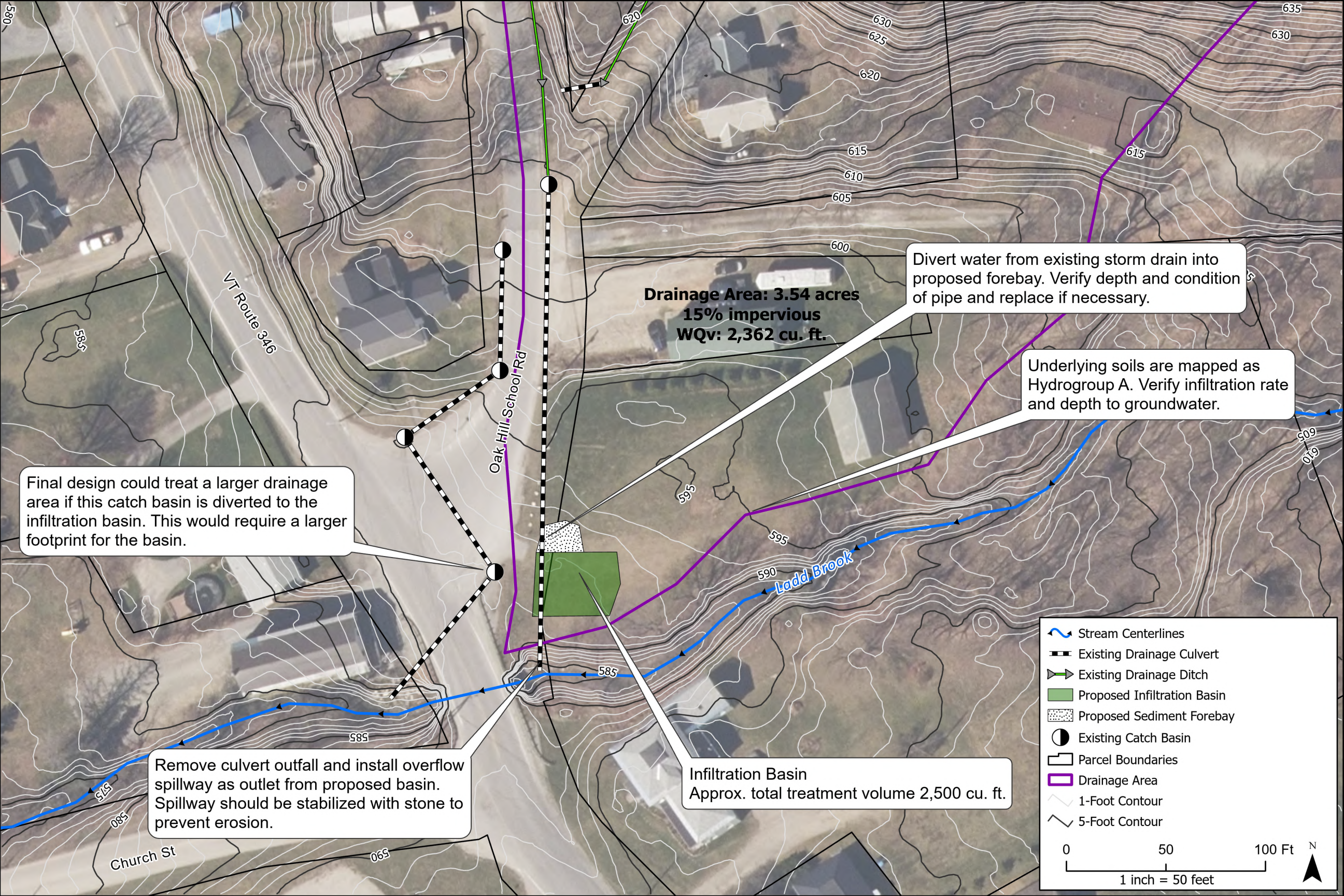
| Water Quality Benefits |              |                                                         |                                                                                                            |                                                                                                                                                              |                    |                    |               |                     |                                |                   |                  |                           |                     |                           |             |  |
|------------------------|--------------|---------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--------------------|---------------|---------------------|--------------------------------|-------------------|------------------|---------------------------|---------------------|---------------------------|-------------|--|
| Project ID             | Project Type | Location                                                | Description                                                                                                | Preliminary Recommendations                                                                                                                                  | Nutrient Reduction | Sediment Reduction | Drainage Area | Impervious Drainage | Connectivity to Surface Waters | Landowner Support | O&M Requirements | Cost and Constructability | Additional Benefits | Additional Benefits Score | Total Score |  |
| POW_17                 | Gully        | Snake Hill Road                                         | A cross culvert outlets onto a very steep slope that has a history of erosion and mass failure.            | Add a splash pool/sediment trap at the culvert outlet. Stabilize the flow path and ditch leading into the culvert with stone.                                | 3                  | 3                  | 0             | 0                   | 2                              | 1                 | 2                | 6                         | CPA, IC             | 2                         | 19          |  |
| POW_20                 | Road Erosion | Furlong Road                                            | The road is falling away into the river. Multiple gullies have formed down the embankment.                 | Stabilize the gullies with stone. Install toe armor in the channel and on the slope, armor stable flow paths for the water that causes the existing gullies. | 4                  | 4                  | 0             | 0                   | 3                              | 1                 | 2                | 2                         | CPA, IC             | 2                         | 18          |  |
| POW_08                 | Gully        | Ladd Road                                               | An eroding ditch crosses through a culvert into a forming gully.                                           | Line the ditch with stone and add checkdams to slow the water down. Stabilize the outfall and gully with a splash pad and stone.                             | 2                  | 2                  | 1             | 0                   | 3                              | 0                 | 2                | 6                         |                     | 0                         | 16          |  |
| POW_14                 | Road Erosion | Cedar Hill Road                                         | Roughly 400 feet of eroding ditch drains to one old eroding culvert.                                       | Stabilize the ditch with stone and install checkdams. Replace the existing culvert and add a new culvert 200 feet uphill to reduce the stormwater.           | 3                  | 3                  | 0             | 1                   | 2                              | 1                 | 0                | 4                         | CPA, IC             | 2                         | 16          |  |
| POW_21                 | Other        | Intersection of Northwest Hill Road and a Private Drive | The road is being undermined by the river. The telephone poles and guard rails are falling down the slope. | Stabilize the bank with stone. Bioengineering on the bank could be a good option here.                                                                       | 1                  | 1                  | 0             | 0                   | 3                              | 1                 | 2                | 3                         | IC                  | 1                         | 12          |  |



## **APPENDIX C**

Conceptual Designs  
**(11"x17")**







Fitzgerald  
Environmental  
Associates, LLC

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Colchester, VT 05446  
Telephone: 802.876.7778  
[www.fitzgeraldenvironmental.com](http://www.fitzgeraldenvironmental.com)

Notes:

- Conceptual design based on FEA field visit in 2024

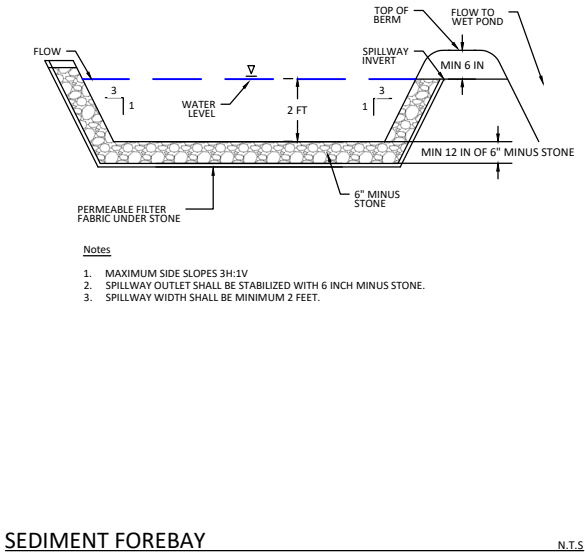
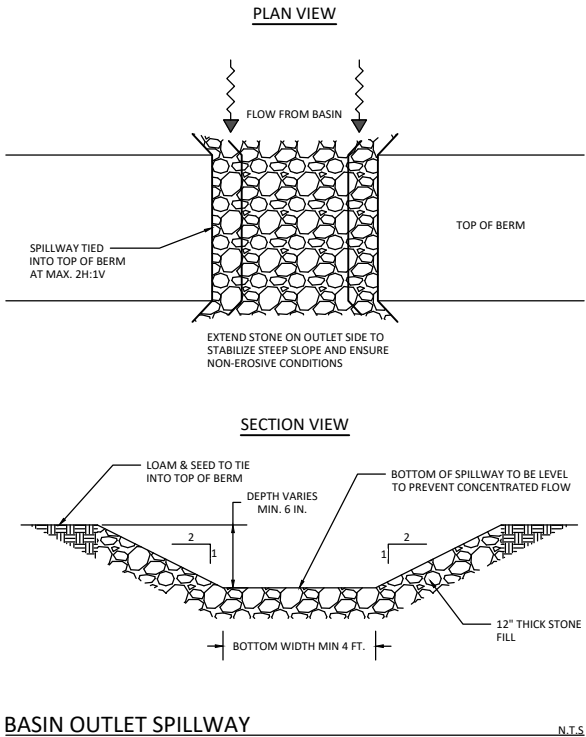
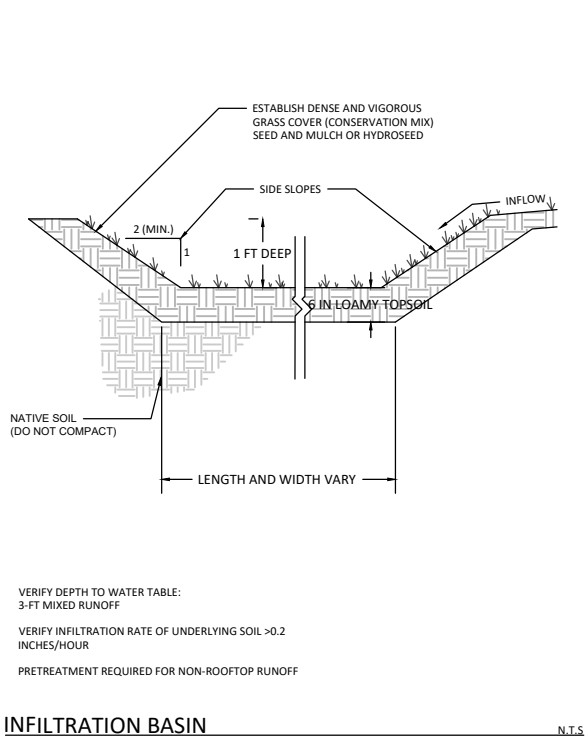
**Project POW-05** Conceptual Design  
Stormwater Master Plan

Oak Hill School Rd  
Pownal, VT

|                  |         |
|------------------|---------|
| FCP              | JHB     |
| MAP BY           | CHECKED |
| 1 inch = 50 feet |         |
| SCALE            |         |
| April 30, 2025   |         |
| DATE             |         |
| <b>SHEET 1</b>   |         |
| SHEET NO.        |         |



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#### INSTALLATION NOTES

- THE VERMONT STORMWATER MANAGEMENT MANUAL IS A GOOD EDUCATIONAL RESOURCE TO ACCOMPANY THIS PROJECT. ALTERNATIVES TO THE DETAILS PRESCRIBED IN THIS PLAN ARE AVAILABLE IN THAT MANUAL.
- MINIMIZE DISTURBANCE TO EXISTING VEGETATION DURING INSTALLATION.
- PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.

#### OPERATION OF MAINTENANCE NOTES

- MAINTENANCE OF THE INFILTRATION BASIN IS VERY SIMILAR TO PLANTED LANDSCAPED BEDS. REPLACEMENT OF SOME MULCH MAY BE REQUIRED IN THE SPRING. OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETIC.
- DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
- THE ACCUMULATION OF SEDIMENT WITHIN THE INFILTRATION BASIN SHOULD BE MONITORED. REMOVE SEDIMENT AFTER APPROXIMATELY 3 INCHES OF SEDIMENT HAS ACCUMULATED OR RAKE AWAY WHEN IT DOES NOT DRAIN WITHIN 1 DAY.
- ANNUALLY INSPECT TO MAKE SURE NO INVASIVE SPECIES ARE PRESENT.
- INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW, AS NEEDED REDISTRIBUTE MATERIAL TO REMOVE CONCENTRATED FLOW PATHS.

#### DESIGN NOTES FOR FINAL DESIGN

- TEST INFILTRATION RATE, SHOULD BE AT LEAST 0.2 INCHES PER HOUR.
- INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO PROVIDE 24 INCHES OF USDA SAND TO LOAMY SAND AS NOTED IN THE VERMONT STORMWATER TREATMENT STANDARDS.

\*NOTES ADAPTED FROM SLR CONCEPT DESIGNS



Fitzgerald  
Environmental  
Associates, LLC

164 Main Street, Suite 2  
Colchester, VT 05446  
Telephone: 802.876.7778

[www.fitzgeraldenvironmental.com](http://www.fitzgeraldenvironmental.com)

Notes:

### Project POW-05 Conceptual Design

Stormwater Master Plan

Oak Hill School Rd

Pownal, VT

NOT FOR CONSTRUCTION

FCP  
DRAWN

JHB  
CHECKED

N.T.S.  
SCALE

2025-02-27  
DATE

SHEET 2  
SHEET NO.



**Existing Features**

- Drainage Area
- Existing Culvert Inlet
- Existing Culvert Outlet
- Existing Storm Line
- Guard Rail
- Parking Lot
- Road
- VT Hydrography
- Parcel Boundaries (VCGI)
- 1-ft Contours (LiDAR Derived)
- 10-ft Contours (LiDAR Derived)

**Proposed Features**

- Proposed Settling Basin
- Proposed Level Spreader
- Buffer Plantings

N

0

25

Feet

SLR

1 S MAIN ST

WATERBURY, VT 05676

802.882.8335

Concept Design - POW\_09

Stormwater Master Plan - Town of Pownal

Fitzgerald Environmental Associates, LLC

Pine Ridge Drive

Pownal, Vermont

1 INCH = 25 FEET

SCALE

2/19/2025

DATE

14294.00009

PROJECT NO.

SHEET 1

Drainage Area: 0.10 acres  
100% Impervious  
WQv: 350 cu. ft.

25 ft, 16 ft, 8 ft, 15 ft

STONE BERM

VEGETATED SETTLING AREA (APPROX. 350 CU. FT.)

REGRADE PARKING AREA TO DRAIN TO SETTLING AREA

Buffer Plantings

Buffer Plantings

Pine Ridge Drive

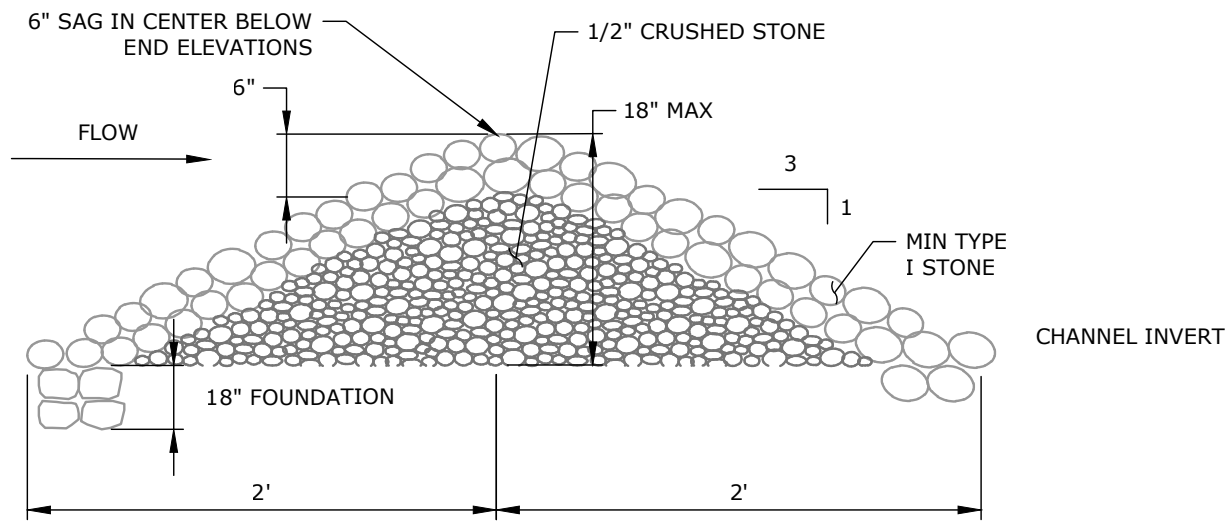
Barber Pond Road

DATE SAVED: 2/18/2025

MXD: Y:\14294.00009\POWNA\ARCGIS PRO\POWNA SWMP\POWNA SWMP.APRX

COPYRIGHT SLR CONSULTING - 2025





NOT TO SCALE

NOT TO SCALE

1. THE VERMONT STORMWATER MANAGEMENT MANUAL IS A GOOD EDUCATIONAL RESOURCE TO ACCOMPANY THIS PROJECT. ALTERNATIVES TO THE DETAILS PRESCRIBED IN THIS PLAN ARE AVAILABLE IN THAT MANUAL.
2. PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.
3. INSTALL STONE OUTLET SO OVERFLOW RUNOFF CAN BE CONVEYED AS NON-EROSIVE SHEET FLOW THROUGH THE BUFFER PLANTINGS BEFORE ENTERING THE POND.

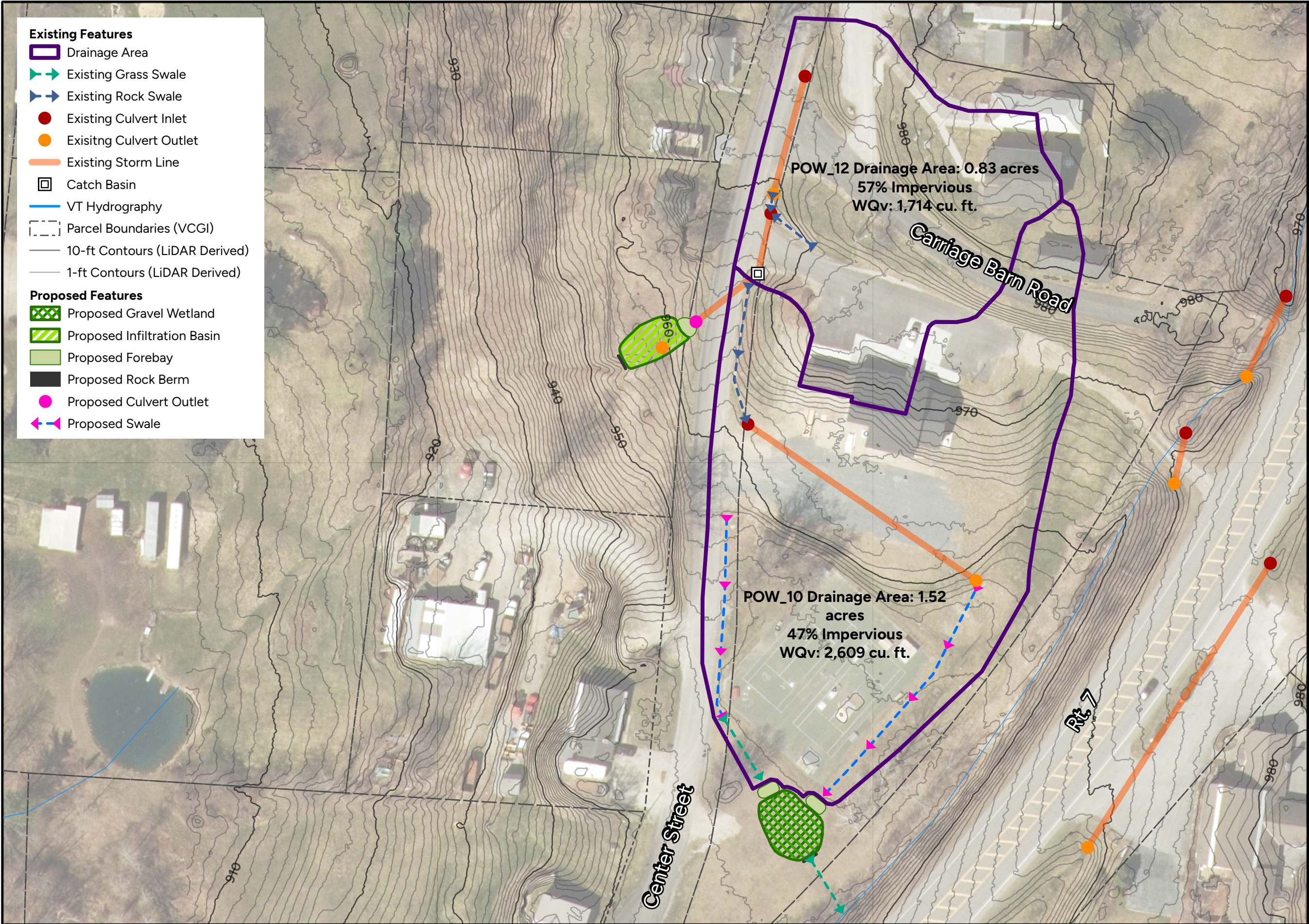
1. MAINTENANCE OF THE INFILTRATION BASIN IS VERY SIMILAR TO PLANTED LANDSCAPED BEDS. REPLACEMENT OF SOME MULCH MAY BE REQUIRED IN THE SPRING. OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETICALLY PLEASING.
2. DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
3. THE ACCUMULATION OF SEDIMENT WITHIN THE INFILTRATION BASIN SHOULD BE MONITORED. REMOVE SEDIMENT AFTER APPROXIMATELY 3 INCHES OF SEDIMENT HAS ACCUMULATED OR RAKE AWAY WHEN DOES NOT DRAIN WITHIN 1 DAY.
4. ANNUALLY INSPECT MAKE SURE NO INVASIVE SPECIES ARE PRESENT.
5. INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW OVER STONE BERM, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

1. TEST INFILTRATION RATE, SHOULD BE AT LEAST 0.2 INCHES PER HOUR.
2. INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO PROVIDE 24 INCHES OF USDA SAND TO LOAMY SAND AS NOTED IN THE VERMONT STORMWATER TREATMENT STANDARDS.

| Item                        | Quantity | Unit | Unit Price | Cost      |
|-----------------------------|----------|------|------------|-----------|
| Mobilization/Demobilization | 1        | LS   | \$ 5,000   | \$ 5,000  |
| Common Excavation           | 15       | CY   | \$ 25      | \$ 375    |
| Trucking                    | 15       | CY   | \$ 20      | \$ 300    |
| Site Grading                | 1        | LS   | \$ 1,000   | \$ 1,000  |
| Parking Area Stone          | 4        | CY   | \$ 50      | \$ 200    |
| Stone Berm                  | 6        | CY   | \$ 65      | \$ 390    |
| Wood Chip Mulch             | 4        | CY   | \$ 70      | \$ 280    |
| Topsoil                     | 35       | CY   | \$ 65      | \$ 2,275  |
| Plantings                   | 1        | LS   | \$ 4,000   | \$ 4,000  |
| Final Design & Permitting   |          |      |            | \$ 8,000  |
| Construction Oversight      |          |      |            | \$ 3,000  |
| Subtotal                    |          |      |            | \$ 24,820 |
| Contingency (20%)           |          |      |            | \$ 4,960  |

**Total \$ 29,780**





Existing Features

- Drainage Area
- Existing Grass Swale
- Existing Rock Swale
- Existing Culvert Inlet
- Existing Culvert Outlet
- Existing Storm Line
- Catch Basin
- VT Hydrography
- Parcel Boundaries (VCGI)
- 10-ft Contours (LiDAR Derived)
- 1-ft Contours (LiDAR Derived)

Proposed Features

- Proposed Gravel Wetland
- Proposed Infiltration Basin
- Proposed Forebay
- Proposed Rock Berm
- Proposed Culvert Outlet
- Proposed Swale



1 S MAIN ST  
WATERBURY, VT 05676  
802.882.8335

Drainage Area - POW\_12 and POW\_10

Stormwater Master Plan - Town of Pownal  
Fitzgerald Environmental Associates, LLC

Center Street  
Pownal, Vermont

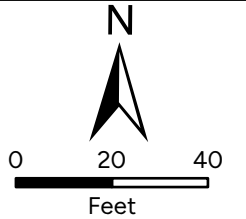
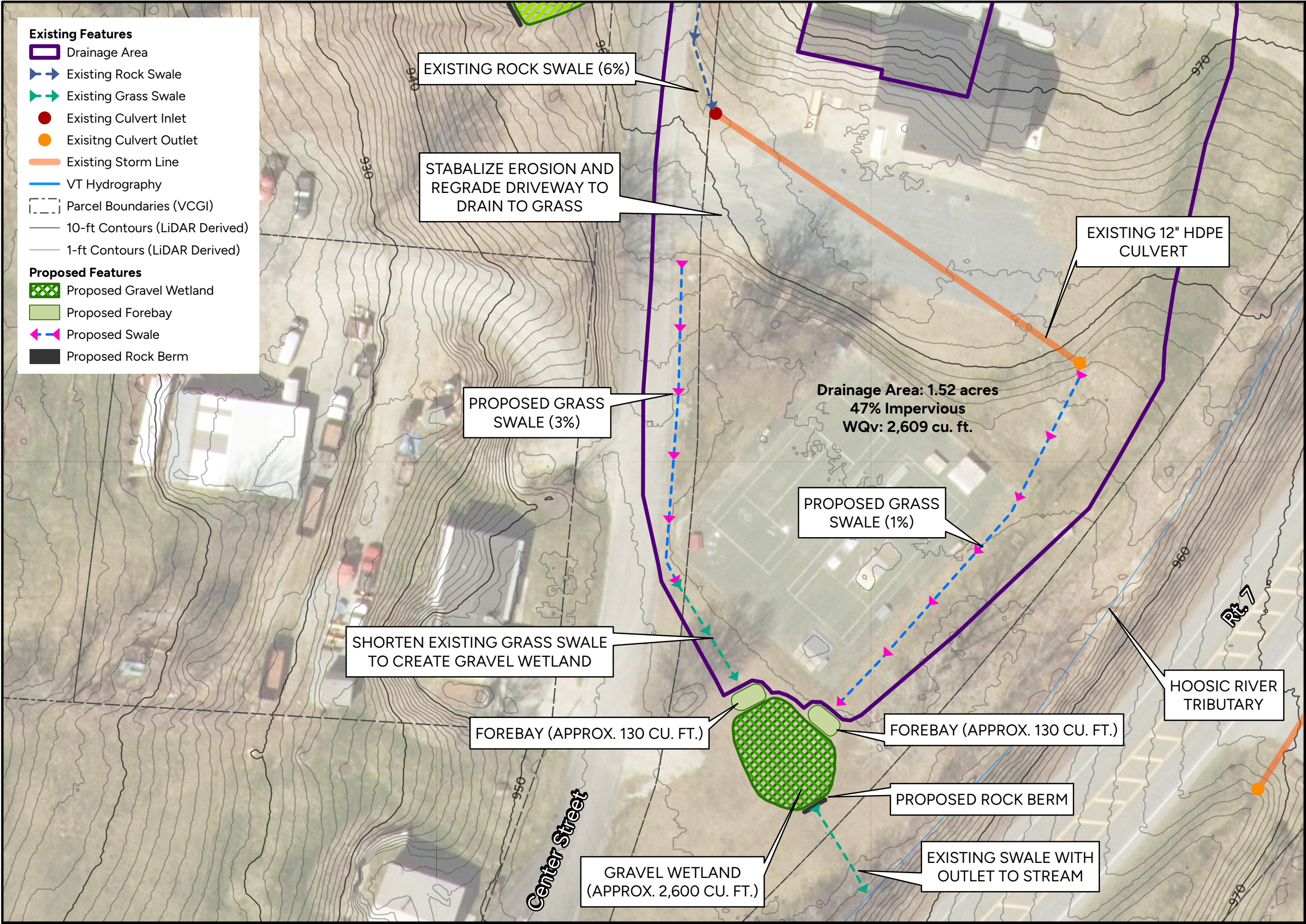
1 INCH = 25 FEET  
SCALE

4/30/2025  
DATE

14294.00009  
PROJECT NO.

SHEET 1





1 S MAIN ST  
WATERBURY, VT 05676  
802.882.8335

## Concept Design - POW\_10

Stormwater Master Plan - Town of Pownal

Fitzgerald Environmental Associates, LLC

Center Street  
Pownal, Vermont

1 INCH = 40 FEET  
SCALE

1/30/2025  
DATE

14294.00009  
PROJECT NO.

# SHEET 2



Existing Features

 Drainage Area

 Existing Rock Swale

 Existing Culvert Inlet

 Existing Culvert Outlet

 Existing Storm Line

 Catch Basin

 VT Hydrography

 Parcel Boundaries (VCGI)

 10-ft Contours (LiDAR Derived)

 1-ft Contours (LiDAR Derived)

Proposed Features

 Proposed Culvert Outlet

 Proposed Infiltration Basin

 Proposed Rock Berm

 Proposed Forebay

  
0 25  
Feet

  
1 S MAIN ST  
WATERBURY, VT 05676  
802.882.8335

Concept Design - POW\_12

Stormwater Master Plan - Town of Pownal

Fitzgerald Environmental Associates, LLC

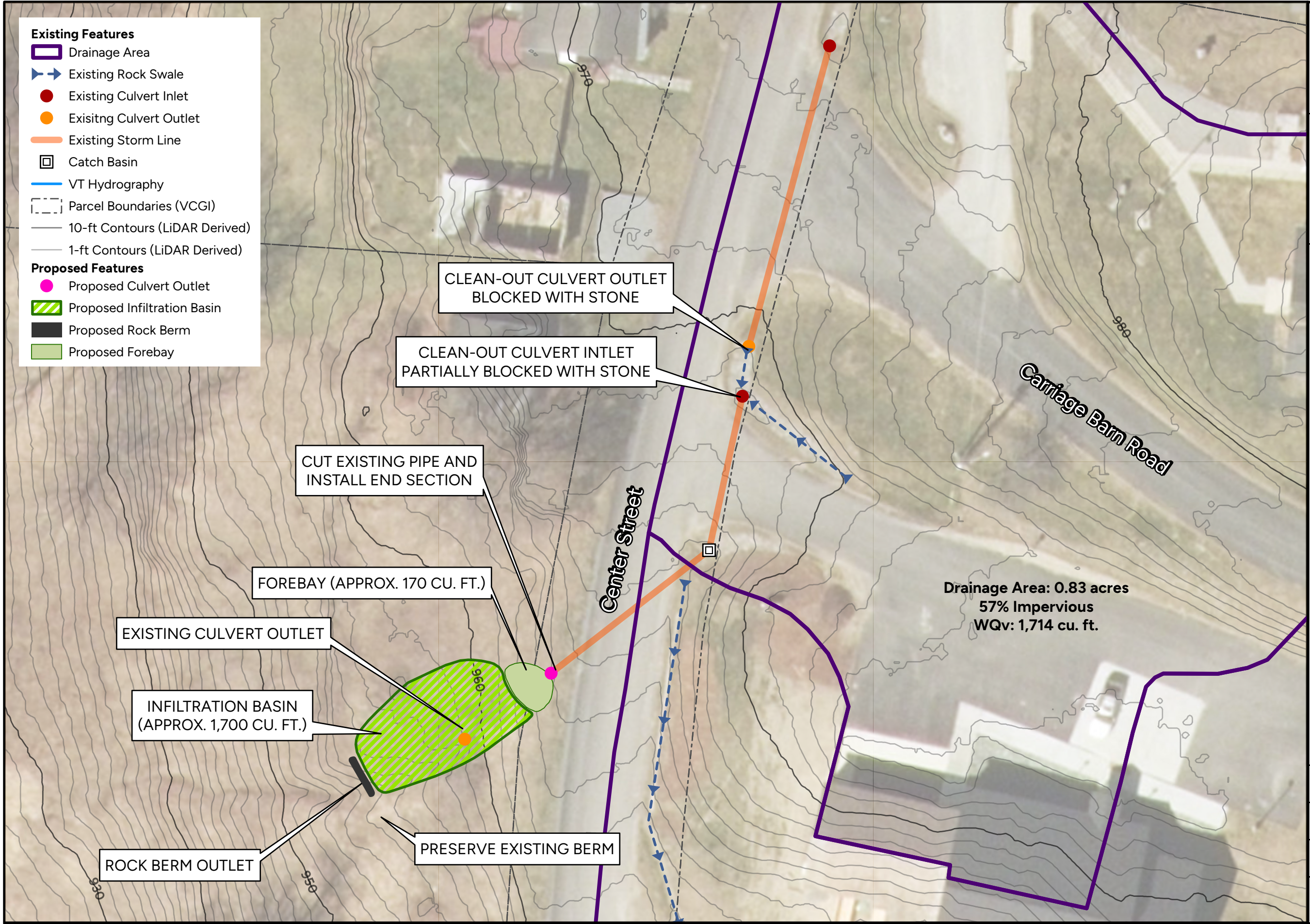
Center Street  
Pownal, Vermont

1 INCH = 25 FEET  
SCALE

1/30/2025  
DATE

14294.00009  
PROJECT NO.

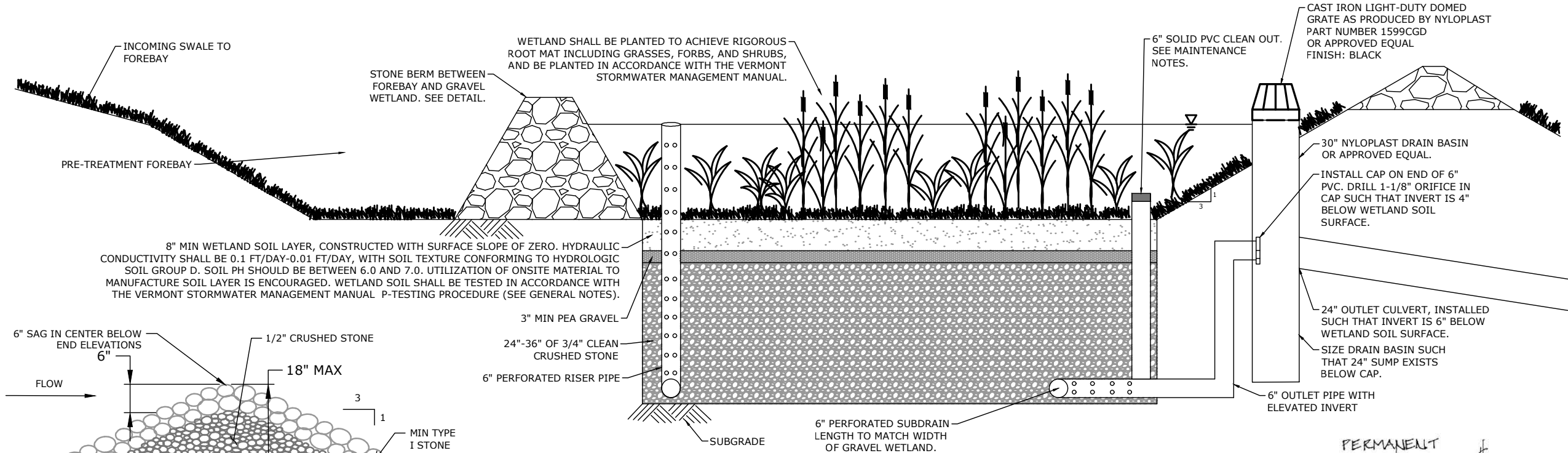
SHEET 3





Drawing: C:\AUTOSAVE\WORK\BUSH\_11732\POWNA\DETAILS.DWG Layout: T:\BROW\_10.GRAVELWETLAND

Plotted by: JALING On this date: Wed, 2025 April 30 - 10:53am



## GRAVEL WETLAND SECTION VIEW

NOT TO SCALE

### INSTALLATION NOTES:

- THE VERMONT STORMWATER MANAGEMENT MANUAL IS A GOOD EDUCATIONAL RESOURCE TO ACCOMPANY THIS PROJECT. ALTERNATIVES TO THE DETAILS PRESCRIBED IN THIS PLAN ARE AVAILABLE IN THAT MANUAL.
- PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.

### OPERATION AND MAINTENANCE NOTES:

- OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETICALLY PLEASING.
- DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
- THE ACCUMULATION OF SEDIMENT WITHIN THE WETLAND SHOULD BE MONITORED. REMOVE SEDIMENT AFTER APPROXIMATELY 3 INCHES OF SEDIMENT HAS ACCUMULATED OR RAKE AWAY WHEN DOES NOT DRAIN WITHIN 1 DAY.
- ANNUALLY INSPECT MAKE SURE NO INVASIVE SPECIES ARE PRESENT.
- INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW OVER STONE BERM, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

### P TESTING REQUIREMENT TO BE USED FOR THE UPPER MEDIA LAYER OF BIORETENTION SYSTEMS:

FINAL MIXES MUST HAVE A PHOSPHORUS SATURATION RATIO (PSR) LESS THAN OR EQUAL TO 0.10. PSR IS TO BE DETERMINED USING THE FOLLOWING PROTOCOL:

- SAMPLES ARE TO BE AIR DRIED AND SIEVED THROUGH 2 MM PRIOR TO TESTING
- AIR-DRY, SIEVED SOIL SAMPLES ARE TO THEN BE EXTRACTED WITH THE MEHLICH-3 SOLUTION (0.2 M CH<sub>3</sub>COOH + 0.25 M NH<sub>4</sub>NO<sub>3</sub> + 0.015 M NH<sub>4</sub>F + 0.013 M HNO<sub>3</sub> + 0.001 M EDTA) BY SHAKING A SOIL-SOLUTION SUSPENSION FOR 5 MINUTES AT A 1:10 (SOIL MASS:SOLUTION) RATIO, FOLLOWED BY FILTERING TO REMOVE PARTICLES ABOVE 2μm IN SIZE (0.45 μm PRE SIZE IS ALSO ACCEPTABLE).
- EXTRACTS FROM THE MEHLICH-3 PROCEDURE ARE TO BE ANALYZED FOR P, FE, AND AL BY ICP-OES.
- THE PHOSPHORUS SATURATION RATIO (PSR) IS THEN CALCULATED AS FOLLOWS:  
EQUATION 1:

$$PSR = \frac{\left(\frac{PM_3}{31}\right)}{\left(\frac{FEM_3}{56}\right) + \left(\frac{ALM_3}{27}\right)}$$

WHERE,

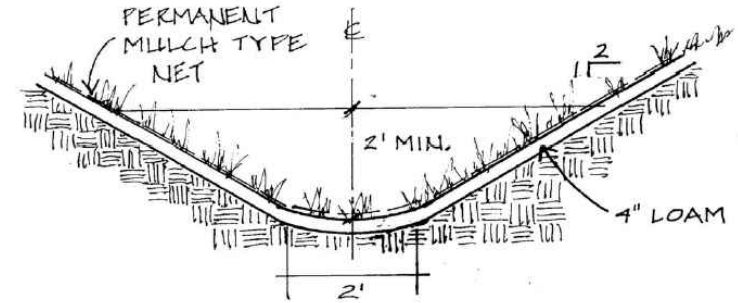
PM<sub>3</sub> = MEHLICH-3 P IN MG P PER KG DRY SOIL

FEM<sub>3</sub> = MEHLICH-3 FE IN MG FE PER KG DRY SOIL

ALM<sub>3</sub> = MEHLICH-3 AL IN MG AL PER KG DRY SOIL

MEHLICH-3 EXTRACTATIONS MUST BE USED FOLLOWING THE ABOVE PROTOCOL. OTHER SOIL TEST EXTRACTATIONS, INCLUDING MODIFIED MORGAN TESTS, OXALATE EXTRACTATIONS, WATER EXTRACTATIONS, OR EXTRACTATIONS USED TO QUANTIFY TOTAL ELEMENTS, ARE NOT ACCEPTABLE. IN CASES WHERE INGREDIENT MIXING HAS NOT YET OCCURRED, INGREDIENTS CAN BE MIXED AT THE INTENDED VOLUMETRIC PROPORTIONS IN A SMALL BATCH (AT LEAST 1 QUART IN VOLUME) FOR TESTING PURPOSES. IF THIS SMALL BATCH TESTING APPROACH IS TAKEN, THE FINAL MATERIAL TO BE USED DURING INSTALLATION MUST BE RE-TESTED TO CONFIRM ACCEPTABLE PSR.

ALL RESULTS TO BE SUBMITTED TO PROJECT ENGINEER FOR REVIEW AND APPROVAL.

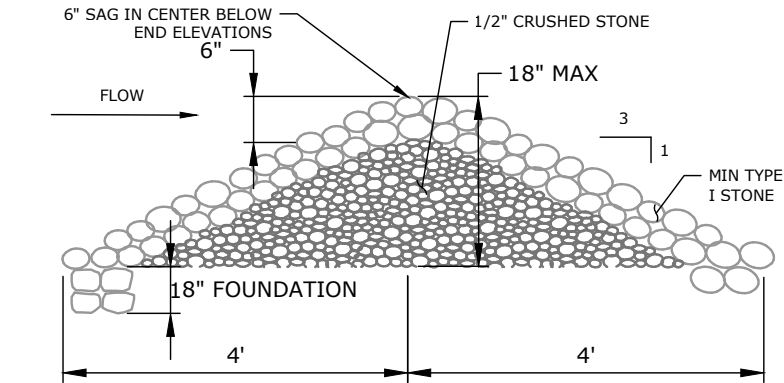


## GRASS SWALE

NOT TO SCALE

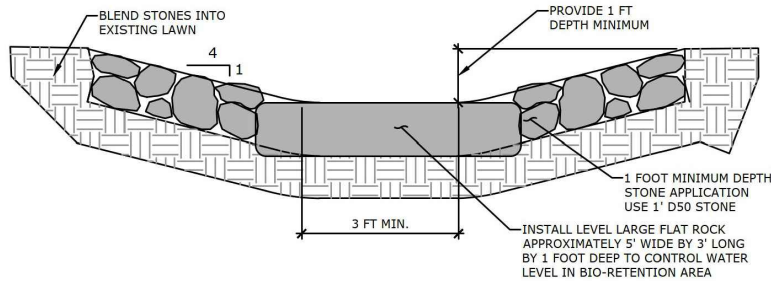
### Preliminary Cost Opinion

| Item                                                   | Quantity | Unit | Unit Price | Cost      |
|--------------------------------------------------------|----------|------|------------|-----------|
| Mobilization/Demobilization                            | 1        | LS   | \$ 5,000   | \$ 5,000  |
| Common Excavation                                      | 400      | CY   | \$ 25      | \$ 10,000 |
| Trucking                                               | 400      | CY   | \$ 20      | \$ 8,000  |
| New Grass Swale                                        | 330      | LF   | \$ 9       | \$ 2,970  |
| PrecastReinforced Concrete Mahole with Cast Iron Cover | 1        | EA   | \$ 7,000   | \$ 7,000  |
| Stone Fill                                             | 170      | CY   | \$ 50      | \$ 8,500  |
| Gravel                                                 | 15       | CY   | \$ 30      | \$ 450    |
| Wetland Soils                                          | 50       | CY   | \$ 50      | \$ 2,500  |
| Underdrain Pipe, 6"                                    | 60       | LF   | \$ 25      | \$ 1,500  |
| Straw Mulch                                            | 0.25     | TON  | \$ 1,200   | \$ 300    |
| Rolled Erosion Control Product                         | 150      | SY   | \$ 5       | \$ 750    |
| Stone Berm                                             | 8        | CY   | \$ 65      | \$ 520    |
| Plantings                                              | 1        | LS   | \$ 6,000   | \$ 6,000  |
| Final Design & Permitting                              |          |      | \$ 15,000  | \$ 15,000 |
| Construction Oversight                                 |          |      | \$ 10,000  | \$ 10,000 |
| Subtotal                                               |          |      | \$ 78,490  | \$ 78,490 |
| Contingency (20%)                                      |          |      | \$ 15,700  | \$ 15,700 |
| Total                                                  |          |      | \$ 94,190  | \$ 94,190 |



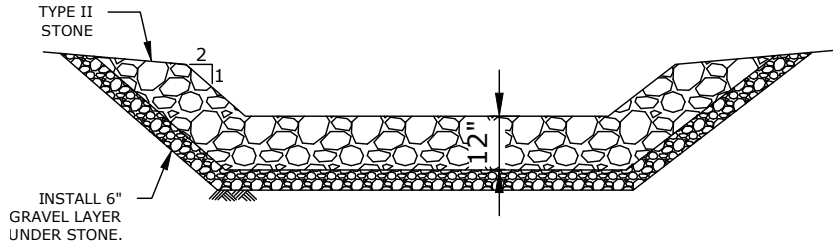
## STONE BERM

NOT TO SCALE



## STONE OUTLET

NOT TO SCALE



## EMERGENCY SPILLWAY

NOT TO SCALE

**SLR**

1 SOUTH MAIN STREET  
WATERBURY, VT 05676  
802.852.1233  
SLRCONSULTING.COM

REVISIONS

CONCEPT DESIGN

DETAILS - POW\_10  
STORMWATER MASTER PLAN - TOWN OF POWNA  
POWNA, VERMONT

JAG JAG JCL  
DESIGNED DRAWN CHECKED

NOT TO SCALE

APRIL 30, 2025

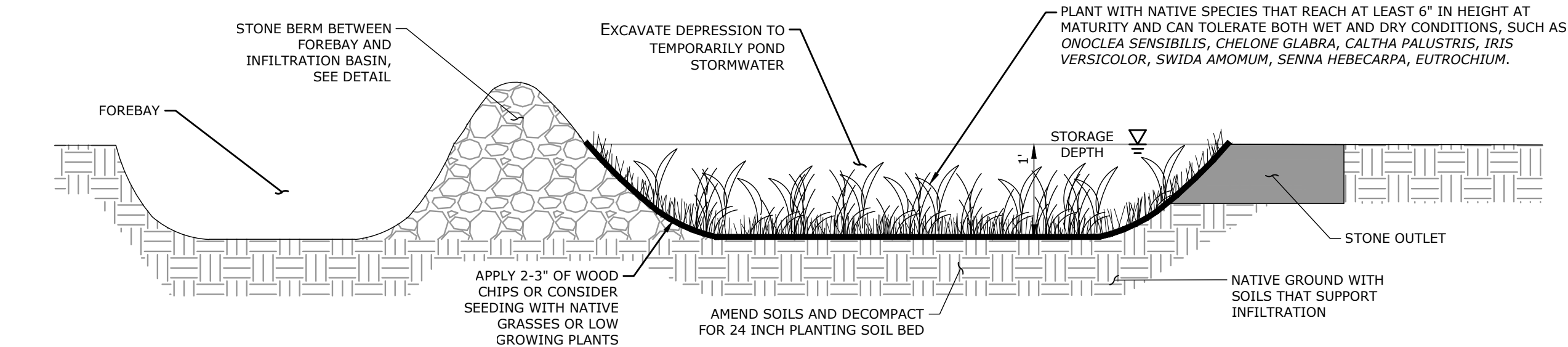
14294.00009

DET-1

SHEET NO.

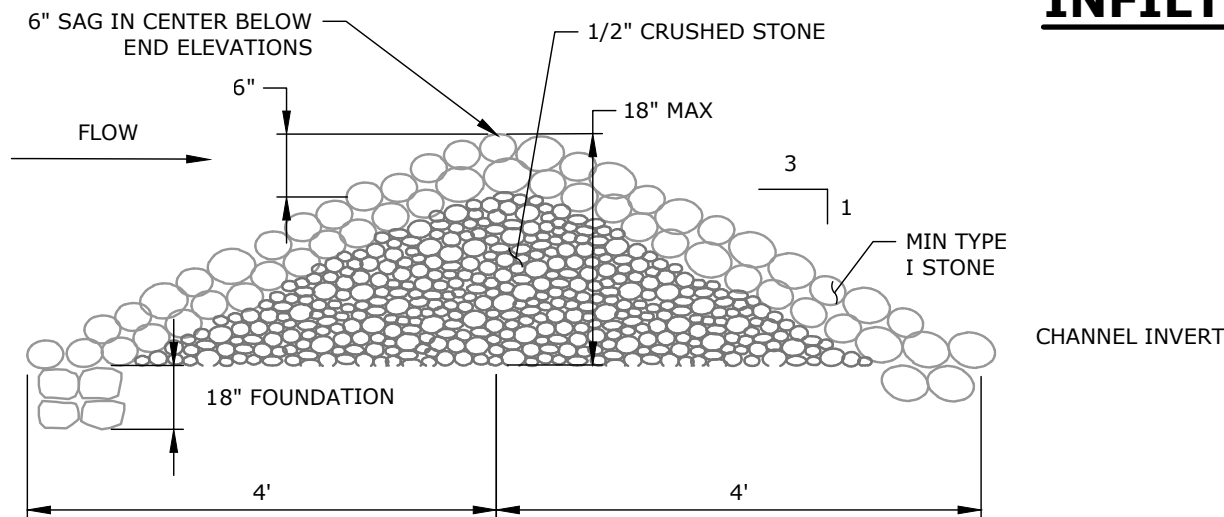


Drawing: C:\AUTOSAVE\WORK\BUSH\_11732\POW\N\DETAILS.DWG Layout: Twp-Pow\_12 - INFILTRATION



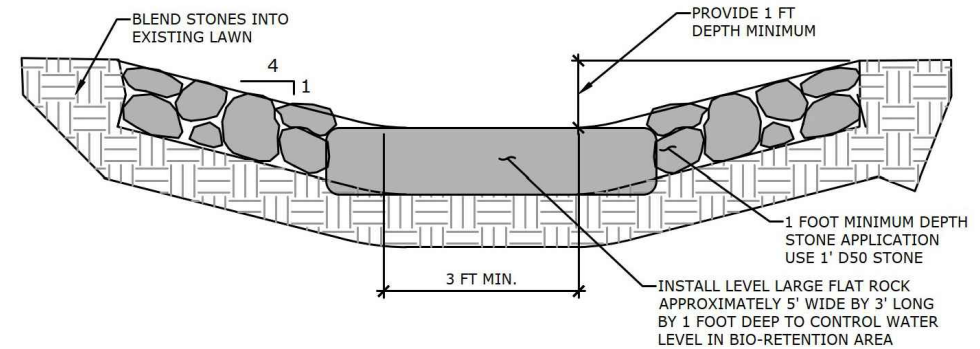
## INFILTRATION BASIN

NOT TO SCALE



## STONE BERM

NOT TO SCALE



## Preliminary Cost Opinion

| Item                        | Quantity | Unit | Unit Price        | Cost             |
|-----------------------------|----------|------|-------------------|------------------|
| Mobilization/Demobilization | 1        | LS   | \$ 5,000          | \$ 5,000         |
| Common Excavation           | 150      | CY   | \$ 25             | \$ 3,750         |
| Trucking                    | 150      | CY   | \$ 20             | \$ 3,000         |
| Clean Swale                 | 1        | LS   | \$ 500            | \$ 500           |
| Cut Existing Culvert        | 1        | LS   | \$ 2,000          | \$ 2,000         |
| Stone Berm                  | 3        | CY   | \$ 65             | \$ 195           |
| Wood Chip Mulch             | 6        | CY   | \$ 70             | \$ 420           |
| Topsoil                     | 12       | CY   | \$ 65             | \$ 780           |
| Plantings                   | 1        | LS   | \$ 2,000          | \$ 2,000         |
| Final Design & Permitting   |          |      |                   | \$ 10,000        |
| Construction Oversight      |          |      |                   | \$ 10,000        |
|                             |          |      | Subtotal          | \$ 37,645        |
|                             |          |      | Contingency (20%) | \$ 7,530         |
|                             |          |      | <b>Total</b>      | <b>\$ 45,175</b> |

### INSTALLATION NOTES:

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- PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.
- INSTALL STONE OUTLET TO DIRECT OVERFLOW TO GRASS SWALE.

### OPERATION AND MAINTENANCE NOTES:

- MAINTENANCE OF THE INFILTRATION BASIN IS VERY SIMILAR TO PLANTED LANDSCAPED BEDS. REPLACEMENT OF SOME MULCH MAY BE REQUIRED IN THE SPRING. OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETICALLY PLEASING.
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- ANNUALLY INSPECT MAKE SURE NO INVASIVE SPECIES ARE PRESENT.
- INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW OVER STONE BERM, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

### DESIGN NOTES FOR FINAL DESIGN:

- TEST INFILTRATION RATE, SHOULD BE AT LEAST 0.2 INCHES PER HOUR.
- INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO PROVIDE 24 INCHES OF USDA SAND TO LOAMY SAND AS NOTED IN THE VERMONT STORMWATER TREATMENT STANDARDS.



1 SOUTH MAIN STREET  
SUITE 200  
BURLINGTON, VT 05401  
802.255.1234  
SLRCONSULTING.COM

REVISIONS

CONCEPT DESIGN

DETAILS - POW\_12

STORMWATER MASTER PLAN - TOWN OF POWNAL

POWNAI, VERMONT

JAG DESIGNED JAG DRAWN JCL CHECKED

NOT TO SCALE

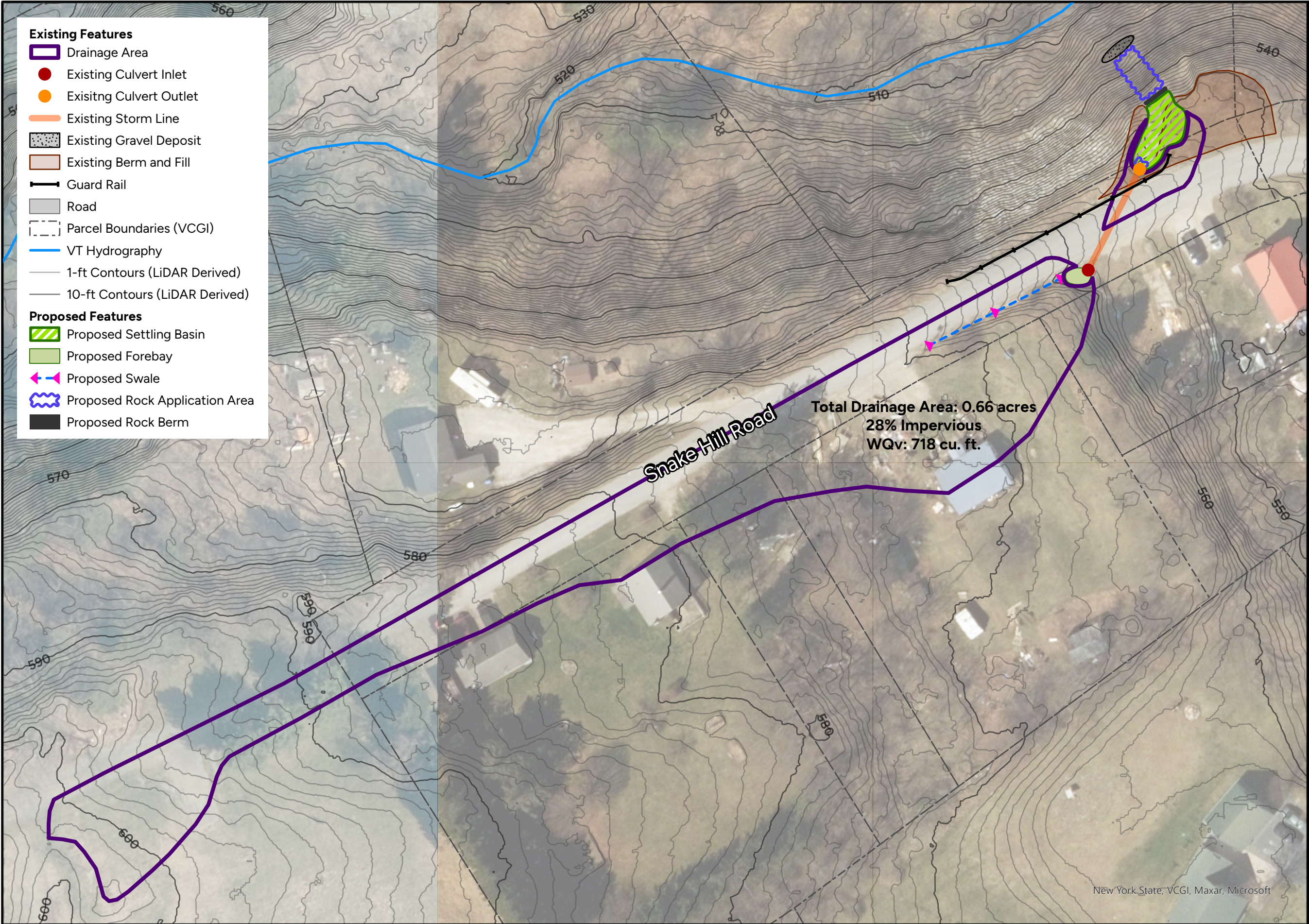
DATE: FEBRUARY 19, 2025

PROJECT NO. 14294.00009

SHEET NO. DET-2

Plotted by: JKLING On this date: Wed, 2025 April 30 - 11:00am



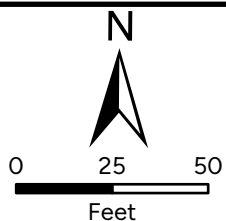


**Existing Features**

- Drainage Area
- Existing Culvert Inlet
- Existing Culvert Outlet
- Existing Storm Line
- Existing Gravel Deposit
- Existing Berm and Fill
- Guard Rail
- Road
- Parcel Boundaries (VCGI)
- VT Hydrography
- 1-ft Contours (LiDAR Derived)
- 10-ft Contours (LiDAR Derived)

**Proposed Features**

- Proposed Settling Basin
- Proposed Forebay
- Proposed Swale
- Proposed Rock Application Area
- Proposed Rock Berm



1 S MAIN ST  
WATERBURY, VT 05676  
802.882.8335

**Drainage Area - POW\_17**

Stormwater Master Plan - Town of Pownal  
Fitzgerald Environmental Associates, LLC  
Snake Hill Road  
Pownal, Vermont

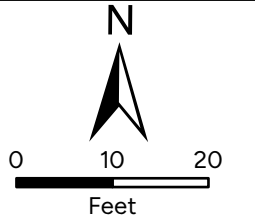
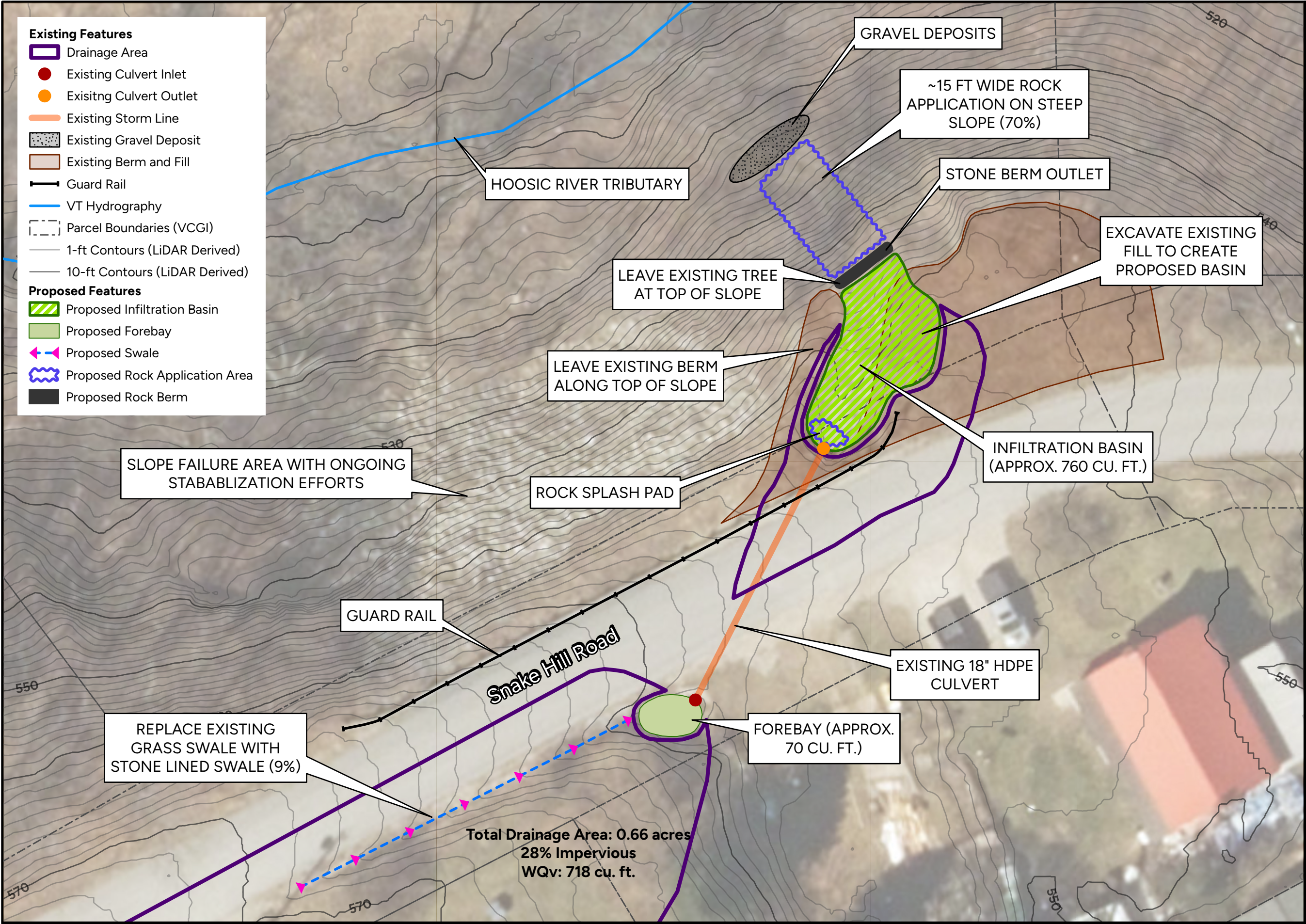
1 INCH = 50 FEET  
SCALE

1/30/2025  
DATE

14294.00009  
PROJECT NO.

**SHEET 1**





1 S MAIN ST  
WATERBURY, VT 05676  
802.882.8335

## Concept Design - POW\_17

Stormwater Master Plan - Town of Pownal  
Fitzgerald Environmental Associates, LLC

Snake Hill Road  
Pownal, Vermont

1 INCH = 20 FEET  
SCALE

4/30/2025  
DATE

14294.00009  
PROJECT NO.

# SHEET 2

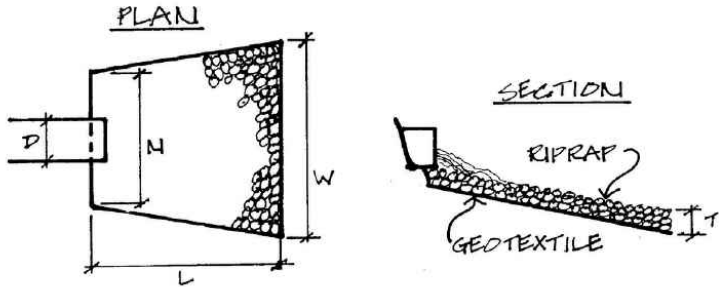


Drawing: C:\AUTOSAVE\WORK\BUSH\_11732\POW\DETAILS.DWG Layout: T66P0W\_17\_INFILTRATION

Plotted by: JALING On this date: Wed, 2025 April 30 - 11:37am

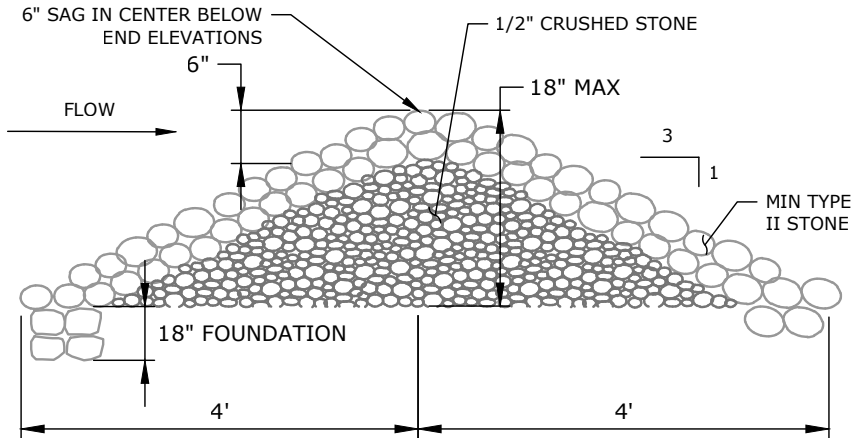
| Rock Apron Specifications |             |         |         |         |         |
|---------------------------|-------------|---------|---------|---------|---------|
| Culvert Diameter (D)      | Riprap Size | T (in.) | N (ft.) | W (ft.) | L (ft.) |
| 18 inches                 | (3-12 inch) | 18      | 4.5     | 14.5    | 10.0    |
| 24 inches                 | (3-12 inch) | 18      | 6.0     | 20.0    | 14.0    |

D= diameter of culvert  
T= depth of stone in apron  
N= width of apron near culvert  
W= width at downhill end of apron  
L= length of apron



### ROCK SPLASH PAD

NOT TO SCALE



### STONE BERM

NOT TO SCALE

#### INSTALLATION NOTES:

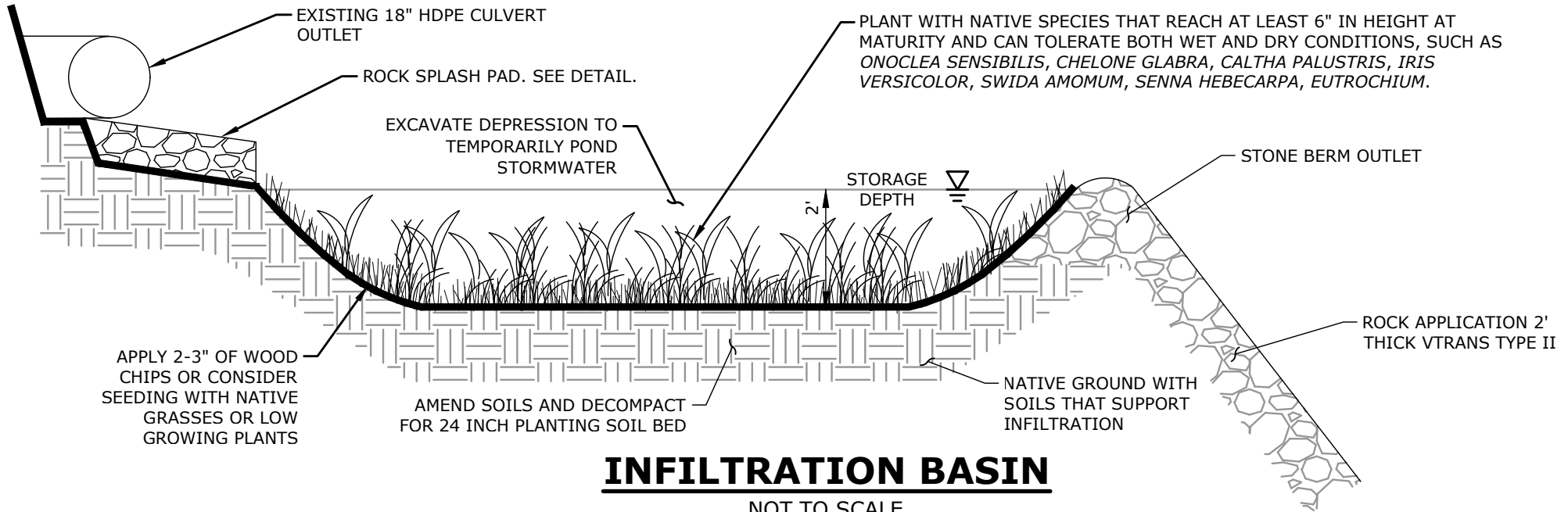
- THE VERMONT STORMWATER MANAGEMENT MANUAL IS A GOOD EDUCATIONAL RESOURCE TO ACCOMPANY THIS PROJECT. ALTERNATIVES TO THE DETAILS PRESCRIBED IN THIS PLAN ARE AVAILABLE IN THAT MANUAL.
- PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.
- INSTALL STONE OUTLET TO DIRECT OVERFLOW TO GRASS SWALE.

#### OPERATION AND MAINTENANCE NOTES:

- MAINTENANCE OF THE INFILTRATION BASIN IS VERY SIMILAR TO PLANTED LANDSCAPED BEDS. REPLACEMENT OF SOME MULCH MAY BE REQUIRED IN THE SPRING. OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETICALLY PLEASING.
- DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
- THE ACCUMULATION OF SEDIMENT WITHIN THE INFILTRATION BASIN SHOULD BE MONITORED. REMOVE SEDIMENT AFTER APPROXIMATELY 3 INCHES OF SEDIMENT HAS ACCUMULATED OR RAKE AWAY WHEN DOES NOT DRAIN WITHIN 1 DAY.
- ANNUALLY INSPECT MAKE SURE NO INVASIVE SPECIES ARE PRESENT.
- INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW OVER STONE BERM, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

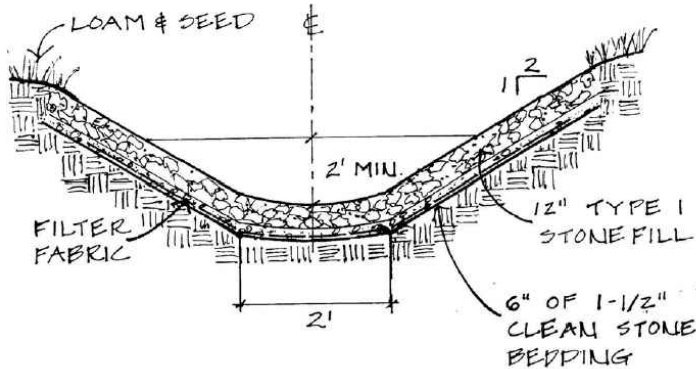
#### DESIGN NOTES FOR FINAL DESIGN:

- TEST INFILTRATION RATE, SHOULD BE AT LEAST 0.2 INCHES PER HOUR.
- INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO PROVIDE 24 INCHES OF USDA SAND TO LOAMY SAND AS NOTED IN THE VERMONT STORMWATER TREATMENT STANDARDS.



### INFILTRATION BASIN

NOT TO SCALE



### STONE LINED SWALE

NOT TO SCALE

### Preliminary Cost Opinion

| Item                        | Quantity | Unit | Unit Price | Cost      |
|-----------------------------|----------|------|------------|-----------|
| Mobilization/Demobilization | 1        | LS   | \$ 5,000   | \$ 5,000  |
| Common Excavation           | 130      | CY   | \$ 25      | \$ 3,250  |
| Trucking                    | 130      | CY   | \$ 20      | \$ 2,600  |
| Regrade Swale               | 80       | LF   | \$ 10      | \$ 800    |
| Line Swale with Stone       | 80       | LF   | \$ 35      | \$ 2,800  |
| Rock Application            | 35       | CY   | \$ 65      | \$ 2,275  |
| Stone Berm                  | 3        | CY   | \$ 65      | \$ 195    |
| Wood Chip Mulch             | 5        | CY   | \$ 70      | \$ 350    |
| Topsoil                     | 8        | CY   | \$ 65      | \$ 520    |
| Seed                        | 1        | LS   | \$ 1,000   | \$ 1,000  |
| Final Design & Permitting   |          |      |            | \$ 10,000 |
| Construction Oversight      |          |      |            | \$ 5,000  |

Subtotal \$ 33,790  
Contingency (20%) \$ 6,760

Total \$ 40,550

**SLR**

1 SOUTH MAIN STREET  
SUITE 200  
BURLINGTON, VT 05401  
802.255.1234  
SLRCONSULTING.COM

REVISIONS

CONCEPT DESIGN

DETAILS - POW\_17

STORMWATER MASTER PLAN - TOWN OF POWNAL

POWNA, VERMONT

JAG DESIGNED JAG DRAWN JCL CHECKED

NOT TO SCALE

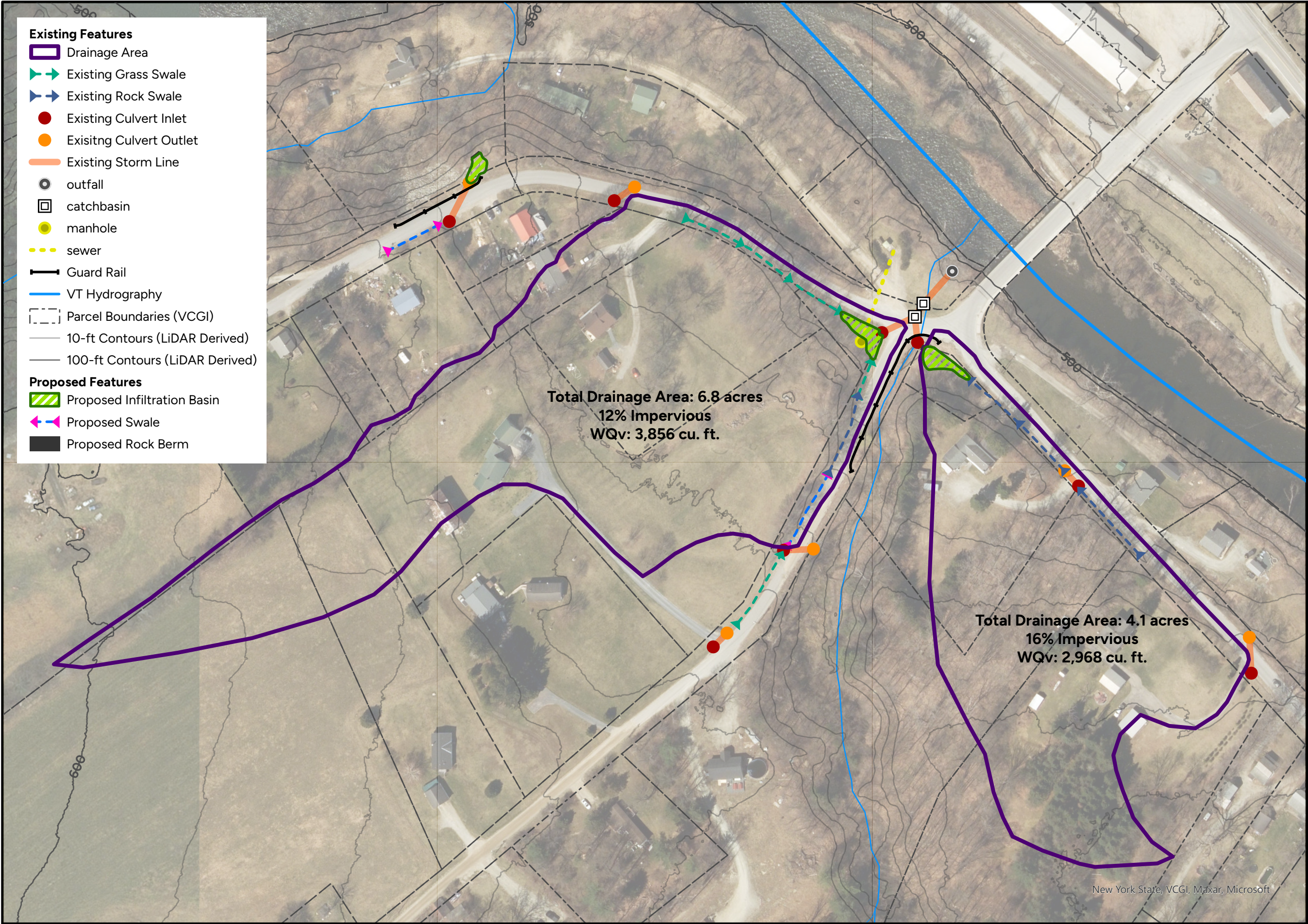
DATE: APRIL 30, 2025

PROJECT NO. 14294.00009

**DET-1**

SHEET NO.





**Existing Features**

- Drainage Area
- Existing Grass Swale
- Existing Rock Swale
- Existing Culvert Inlet
- Existing Culvert Outlet
- Existing Storm Line
- outfall
- catchbasin
- manhole
- sewer
- Guard Rail
- VT Hydrography
- Parcel Boundaries (VCGI)
- 10-ft Contours (LiDAR Derived)
- 100-ft Contours (LiDAR Derived)

**Proposed Features**

- Proposed Infiltration Basin
- Proposed Swale
- Proposed Rock Berm

N

0

100

200

Feet

1 S MAIN ST

WATERBURY, VT 05676

802.882.8335

Drainage Area - POW\_18

Stormwater Master Plan - Town of Pownal

Fitzgerald Environmental Associates, LLC

Dean Road

Pownal, Vermont

1 INCH = 130 FEET

SCALE

2/19/2025

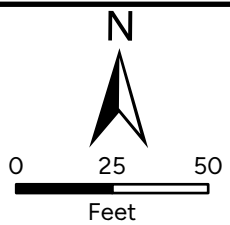
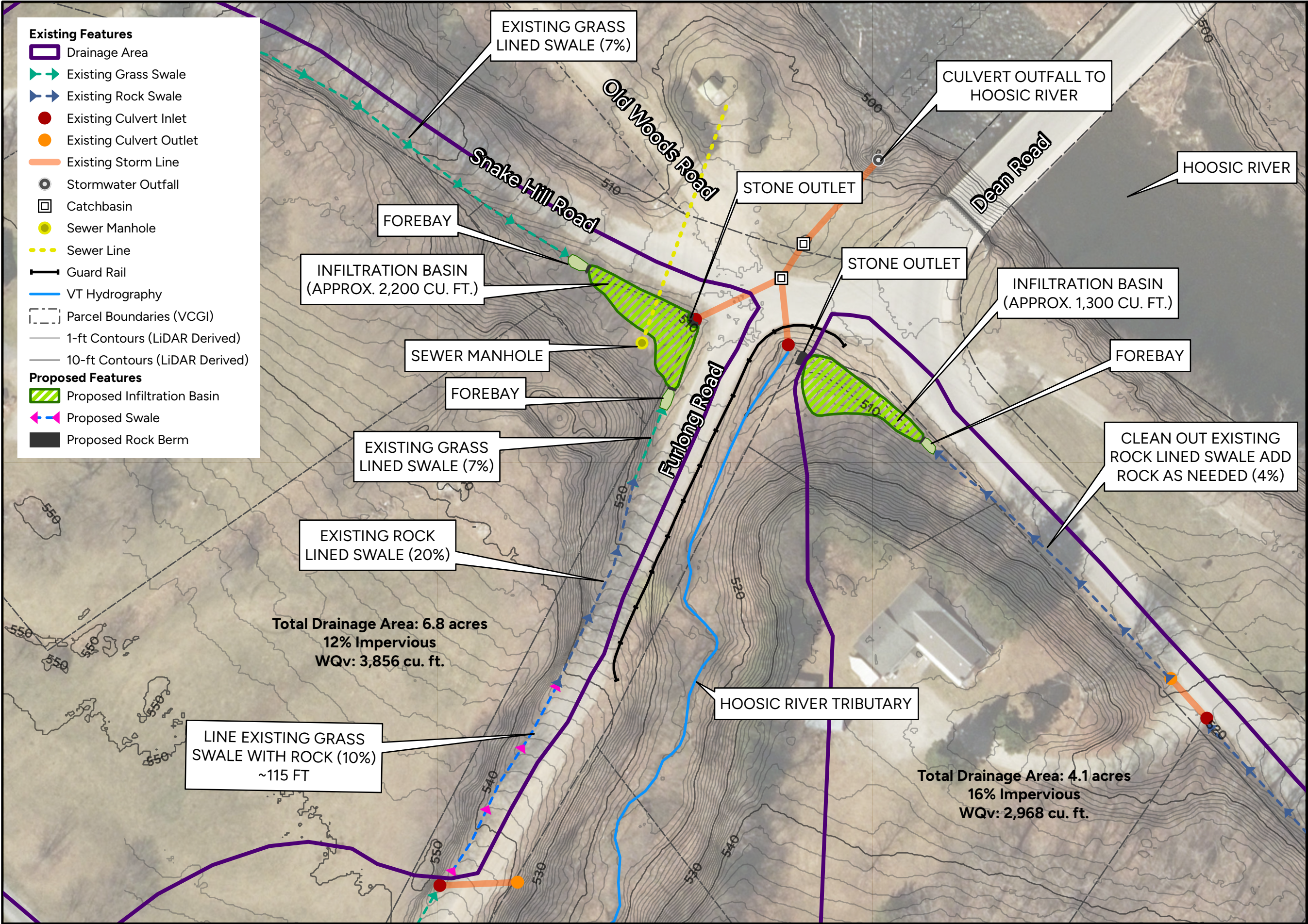
DATE

14294.00009

PROJECT NO.

SHEET 1





**SLR**

1 S MAIN ST  
WATERBURY, VT 05676  
802.882.8335

Concept Design - POW\_18

Stormwater Master Plan - Town of Pownal  
Fitzgerald Environmental Associates, LLC

Dean Road  
Pownal, Vermont

1 INCH = 50 FEET  
SCALE

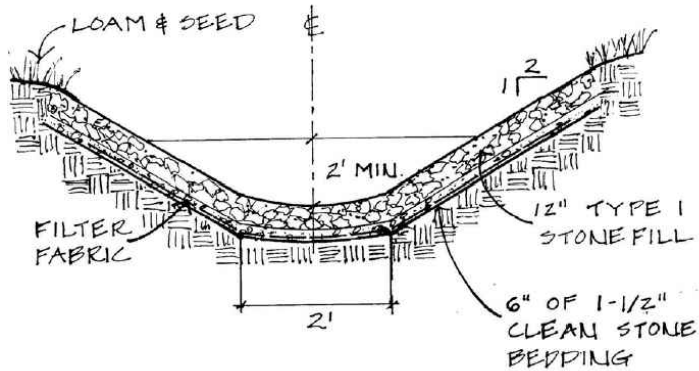
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14294.00009  
PROJECT NO.

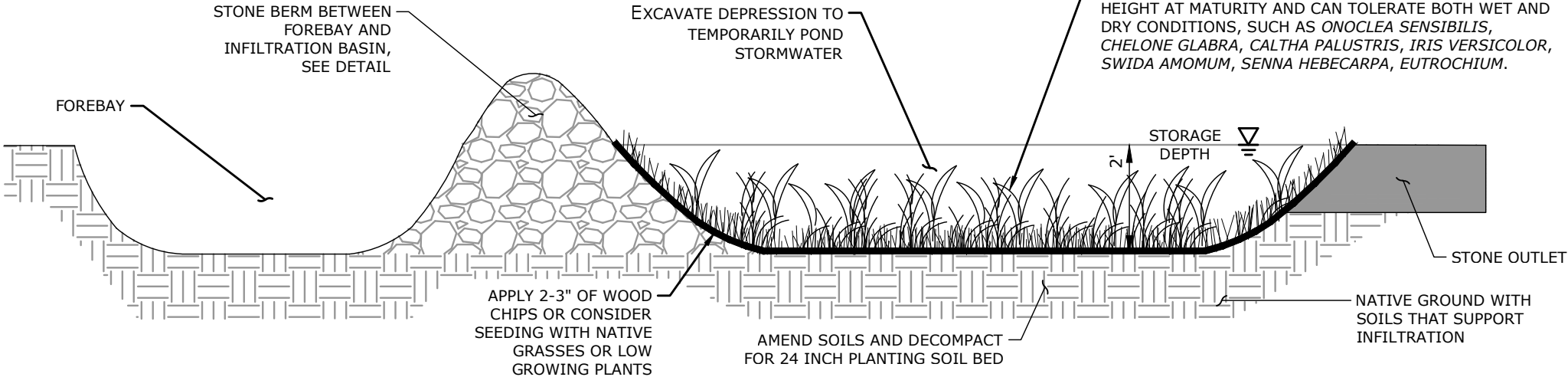
**SHEET 2**



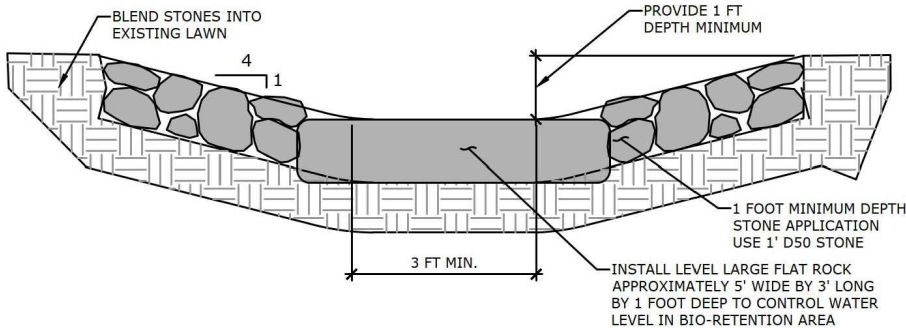
Drawing: C:\AUTOSAVE\WORK\BUSH\_11732\POWNAI\DETAILS.DWG Layout: Taborow\_18\_INFILTRATION



**STONE LINED SWALE**  
NOT TO SCALE



**INFILTRATION BASIN**  
NOT TO SCALE



**STONE OUTLET**  
NOT TO SCALE

**INSTALLATION NOTES:**

1. THE VERMONT STORMWATER MANAGEMENT MANUAL IS A GOOD EDUCATIONAL RESOURCE TO ACCOMPANY THIS PROJECT. ALTERNATIVES TO THE DETAILS PRESCRIBED IN THIS PLAN ARE AVAILABLE IN THAT MANUAL.
2. PLANTING DENSITIES ARE RECOMMENDED TO BE ONE PERENNIAL EVERY 2.5 FEET ON CENTER OR ONE SHRUB EVERY 5 FEET ON CENTER.
3. INSTALL STONE OUTLET TO DIRECT OVERFLOW TO GRASS SWALE.

**OPERATION AND MAINTENANCE NOTES:**

1. MAINTENANCE OF THE INFILTRATION BASIN IS VERY SIMILAR TO PLANTED LANDSCAPED BEDS. REPLACEMENT OF SOME MULCH MAY BE REQUIRED IN THE SPRING. OCCASIONAL WEEDING WILL BE REQUIRED TO MAINTAIN THE SELECTED PLANTS AESTHETICALLY PLEASING.
2. DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
3. THE ACCUMULATION OF SEDIMENT WITHIN THE INFILTRATION BASIN SHOULD BE MONITORED. REMOVE SEDIMENT AFTER APPROXIMATELY 3 INCHES OF SEDIMENT HAS ACCUMULATED OR RAKE AWAY WHEN DOES NOT DRAIN WITHIN 1 DAY.
4. ANNUALLY INSPECT MAKE SURE NO INVASIVE SPECIES ARE PRESENT.
5. INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW OVER STONE BERM, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

**DESIGN NOTES FOR FINAL DESIGN:**

1. TEST INFILTRATION RATE, SHOULD BE AT LEAST 0.2 INCHES PER HOUR.
2. INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO PROVIDE 24 INCHES OF USDA SAND TO LOAMY SAND AS NOTED IN THE VERMONT STORMWATER TREATMENT STANDARDS.

**Preliminary Cost Opinion**

| Item                        | Quantity | Unit | Unit Price | Cost      |
|-----------------------------|----------|------|------------|-----------|
| Mobilization/Demobilization | 1        | LS   | \$ 5,000   | \$ 5,000  |
| Common Excavation           | 450      | CY   | \$ 25      | \$ 11,250 |
| Trucking                    | 450      | CY   | \$ 20      | \$ 9,000  |
| Regrade Swale               | 500      | LF   | \$ 10      | \$ 5,000  |
| Line Swale with Stone       | 300      | LF   | \$ 35      | \$ 10,500 |
| Stone Outlet                | 1        | LS   | \$ 1,000   | \$ 1,000  |
| Wood Chip Mulch             | 25       | CY   | \$ 70      | \$ 1,750  |
| Topsoil                     | 35       | CY   | \$ 65      | \$ 2,275  |
| Seed                        | 1        | LS   | \$ 2,000   | \$ 2,000  |
| Final Design & Permitting   |          |      |            | \$ 10,000 |
| Construction Oversight      |          |      |            | \$ 5,000  |
| Subtotal                    |          |      | \$ 62,775  |           |
| Contingency (20%)           |          |      | \$ 12,560  |           |
| Total                       |          |      | \$ 75,335  |           |

Plotted by: JALING On this date: Wed, 2025 April 30 - 12:16pm



1 SOUTH MAIN STREET  
WATERBURY, VT 05676  
802.852.8333  
SLRCONSULTING.COM

REVISIONS

CONCEPT DESIGN

STORMWATER MASTER PLAN - TOWN OF POWNAI

DETAILS - POW\_18

JAG DESIGNED JAG DRAWN JCL CHECKED

NOT TO SCALE

APRIL 30, 2025

14294.00009

DET-1

SHEET NO.

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