

Stormwater Master Plan for the Town of Londonderry, Vermont

FINAL REPORT

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Appendix A: Stormwater Project Location Map (24"x36")

Appendix B: Problem Area Summary Table and Prioritization Matrix (11"x17" and 8.5"x11")

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1.0 Introduction

In 2022, Fitzgerald Environmental Associates (FEA) was contracted by the Vermont Department of Environmental Conservation (VTDEC) to develop a Stormwater Master Plan (SWMP) for the Town of Londonderry. This final SWMP report for the Town of Londonderry 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: (1) Higher magnitude flood flows and greater erosive power in stream channels; (2) Increased delivery of sediment, nutrients, and other pollutants to waterways; and (3) Increased flooding conflicts with improved properties downstream. 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. Stormwater Master Plans 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 reduce sediment and nutrient pollution to the West River watershed, 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.



- 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% 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

Londonderry is a 35.9 square mile town located in Windham County in Southern Vermont. Londonderry has two village centers. The 21-acre Village of South Londonderry spans the West River. The 19-acre Village of Londonderry also spans the West River. The Magic Mountain Ski Area is located within the Town and constitutes another developed area. As of the 2020 census, Londonderry has a total population of 1,919 people (U.S. Census Bureau, 2020). The Town’s area is primarily forested and is 7.7% developed (**Table 1**). Londonderry is bordered by 6 Vermont towns (Landgrove, Weston, Andover, Windham, Jamaica, and Winhall). Most of the roads in Londonderry are municipal and private, with 15.8% of the Town’s road length on Vermont State Roads (**Table 2**). The Town of Londonderry lies within the West River Watershed (**Figure 1**).

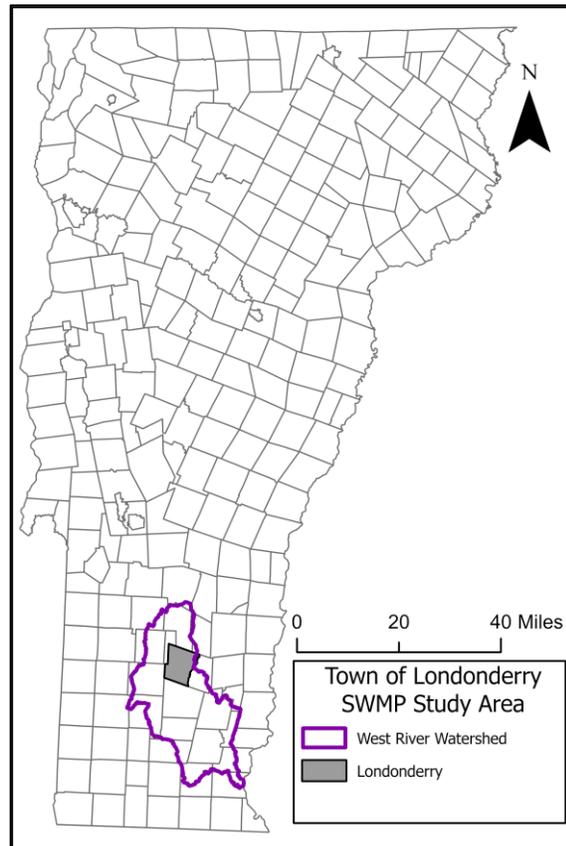


Figure 1: Town of Londonderry and Associated Watershed Location Map



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

Landcover/Landuse Type	Percent of Town Area
Agriculture	6.4%
Barren	0.2%
Developed	7.7%
Forest	79.0%
Grassland/Herbaceous	0.9%
Open Water	0.8%
Shrub/Scrub	1.5%
Wetland	3.7%

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

AOT Class	Description	Length (miles)	Percent of Town Road Length (excluding discontinued)
1	Class 1 Town Highway	-	-
2	Class 2 Town Highway	12.1	12.6%
3	Class 3 Town Highway	39.8	41.5%
4	Class 4 Town Highway	5.62	5.9%
5	State Forest Highway	-	-
6	National Forest Highway	-	-
7	Legal Trail	3.64	3.8%
8 & 9	Private Road	18.7	19.5%
30	Vermont State Highway	15.1	15.8%
40	US Highway	-	-
Other	-	1.02	1.1%
96	Discontinued Road	2.21	-



Soil mapping for the Town shows that soils are primarily mapped as D-type (moderately well drained). The majority of the other soil types present were B-type (poorly drained) and C-type (somewhat poorly drained) (**Table 3**).

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

Soil Hydrogroup	Area (acres)	Percent of Town Area
A	648	2.8%
B	7,262	31.6%
C	5,064	22.0%
D	9,765	42.4%
Water	279	1.2%

3.0 Stormwater Management Planning Library

3.1 Mapping Data

VTDEC Municipal Roads Program

A Road Erosion Inventory (REI) for the Town of Londonderry was conducted in 2019. 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 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 524 hydrologically connected segments inventoried in Londonderry, 66 (12.6%) did not meet MRGP standards and 98 (18.7%) partially met MRGP standards ([link](#)). Roads in the Town with segments that did not meet or partially met MRGP standards included Little Pond Road, Under the Mountain Road, and Spring 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 Londonderry were collected in a series of flights conducted during 2016 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 Windham Regional Commission (WRC) for Town roads in Londonderry 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 (64%) were rated as good or excellent, some were rated as poor (17.5%) or fair (16.6%). We reviewed the culvert data to refine the selection of non-stream culverts we focused on during field surveys.

Town of Londonderry and Magic Mountain Ski Area Stormwater Infrastructure Mapping Project

This dataset was produced by the Vermont Agency of Natural Resources (VTANR) in 2017. The Stormwater Mapping Project documents the connectivity of stormwater infrastructure on private and public land within the Town of Londonderry. These data show the paths of stormwater from different areas of impervious surface (**Figures 2 through 4**). The associated report identifies three high priority sites for improvement, and points to another four sites of moderate priority. Eight potential retrofit projects were identified in this study.



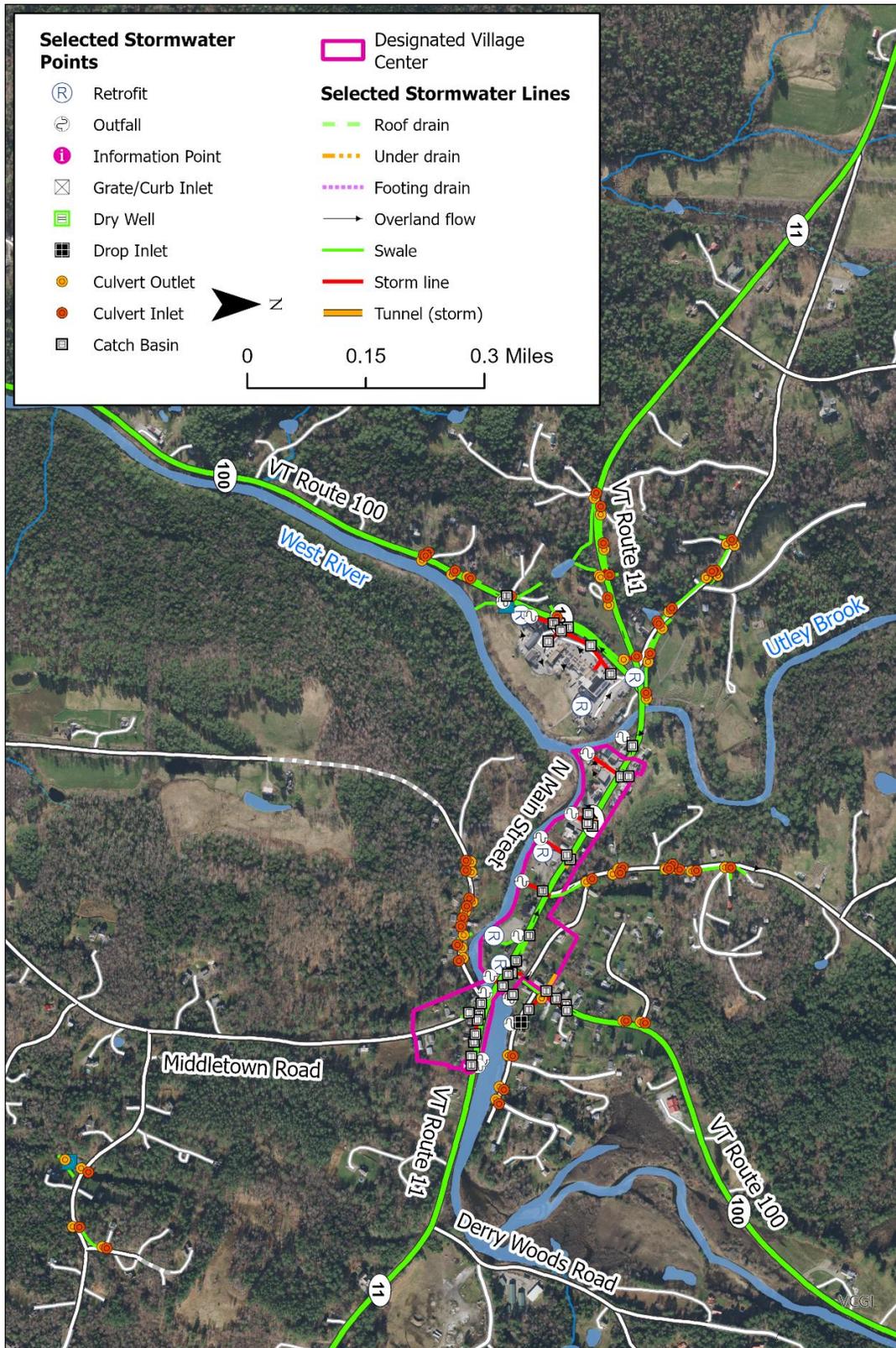


Figure 2: Village of Londonderry Stormwater Infrastructure Map



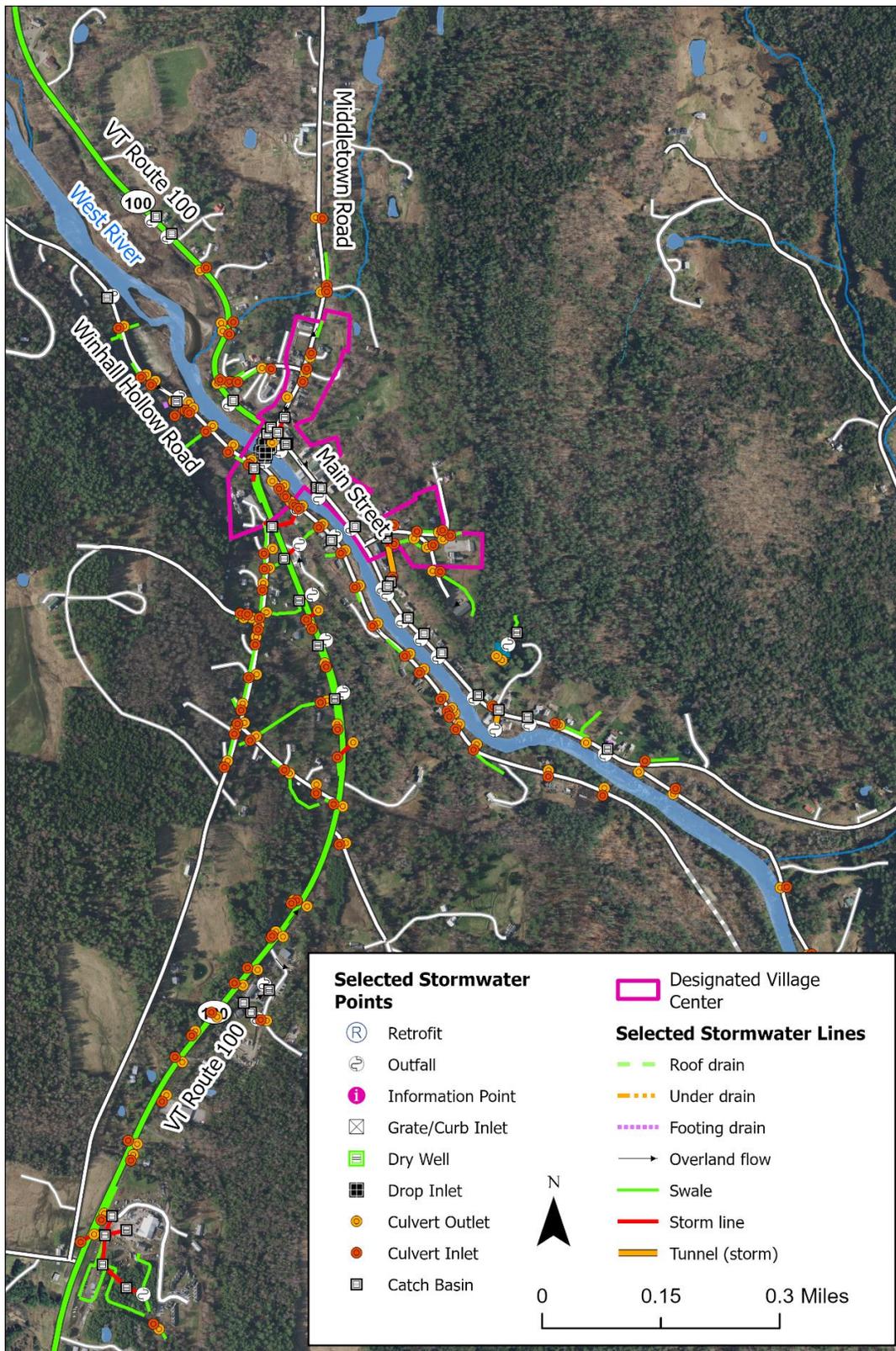


Figure 3: Village of South Londonderry Stormwater Infrastructure Map



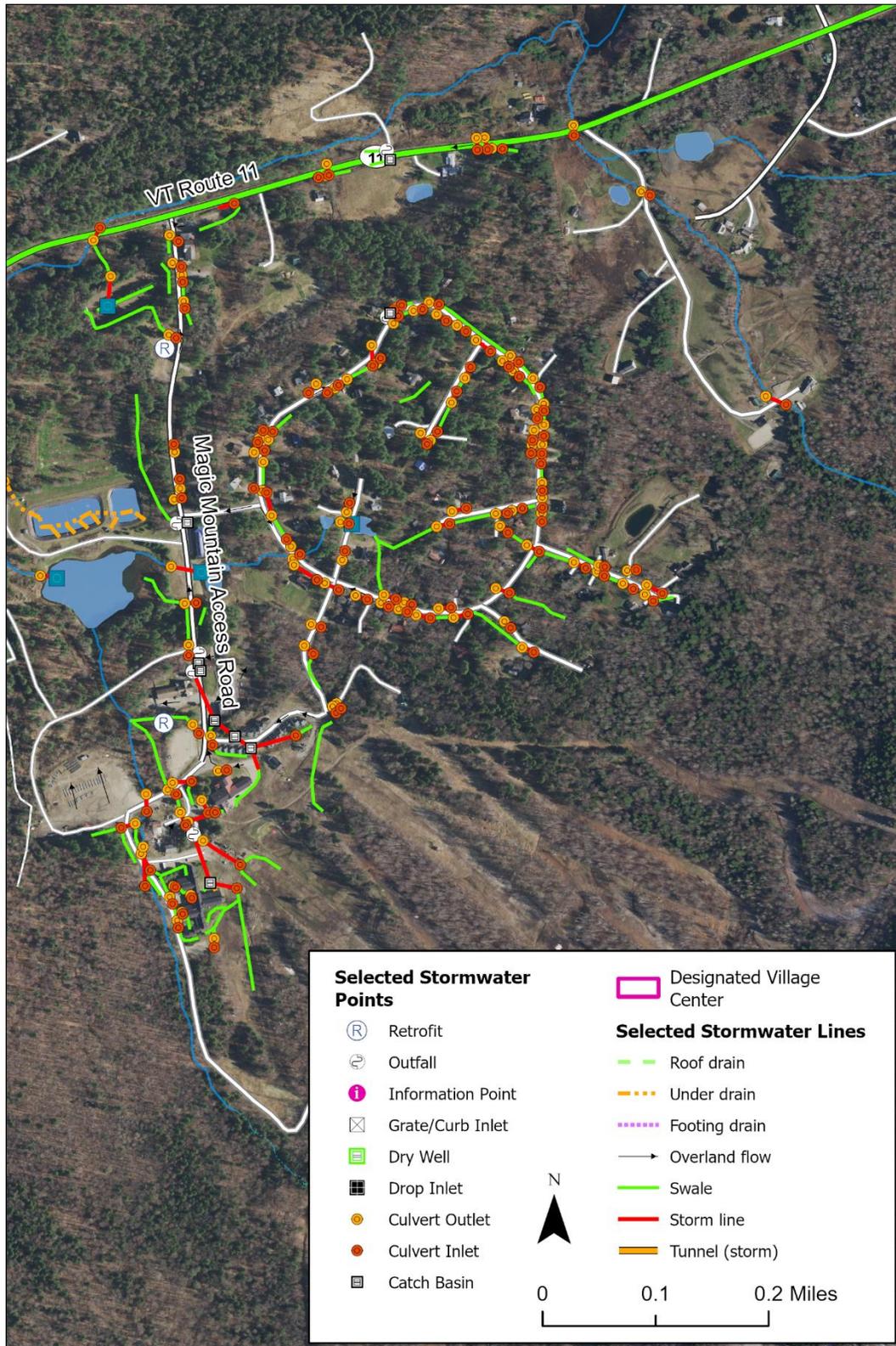


Figure 4: Magic Mountain Ski Area Stormwater Infrastructure Map



Natural Resources Conservation Service (NRCS) Soils Survey

The NRCS soils survey dataset is valuable for stormwater master planning (websoilsurvey.sc.egov.usda.gov). As part of our initial scoping, we screened 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 on 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 informs 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 11 Tactical Plan

The Tactical Basin Plan for Basin 11 was prepared by the Vermont Agency of Natural Resources in 2021. Basin 11 includes the West, Williams, Saxtons, and Lower Connecticut Rivers. This Basin plan catalogs current surface water quality conditions, stressors, and recommended actions for water quality restoration. Between the publication of the Tactical Basin Plans in 2015 and 2020, 57 watershed projects were implemented (either on-going, in progress, or completed). 84% of the basin is forested with about 6% developed and 5% agriculture. The largest watershed in the basin is the West River watershed, which drains 423 square miles of Vermont.

Within the West River watershed, Londonderry is located in the headwaters, which include the Winhall River and Utlely Brook. The Winhall River is most threatened by sediment and temperature stress. Utlely Brook is in good condition. The Tactical Basin Plan draws focus to several potential projects for the West River headwaters. Those of relevance to Londonderry include removing the Williams Dam, determining E. coli sources in the West River, and to conducting road erosion and buffer assessments to address sediment and temperature impairments in the Winhall River.



Basin 11 IDDE Report

The Illicit Discharge Detection and Elimination (IDDE) report for Basin 11 was produced by Stone Environmental for VTDEC in 2020. The study investigated discharges in 17 towns including Londonderry. Researchers collected water samples at outfalls and junctions in stormwater systems and tested them for chemical and biological pollutants. The study confirmed one illicit discharge location and identified one location with suspected illicit discharges in Londonderry. Any sites where stormwater and wastewater may be comingling are high priorities for the SWMP.

West River Watershed Water Quality/Aquatic Habitat Assessment Report

This report on water quality in the West River watershed was produced in October 2014 by VTANR and VTDEC. The study included monitoring for biological contaminants and E. coli as well as physical condition monitoring and identification of hazardous waste sites and landfills. The study identified stressors of all these types in Londonderry, the most common being hazardous waste sites. No biological community sampling was conducted in Londonderry. The two E. coli monitoring sites in Londonderry were both above standards for E. coli levels. Impaired sites from this study could make good improvement sites under the SWMP.

Phase 2 Stream Geomorphic Assessment (SGA) of the Winhall River Corridor

Bear Creek Environmental, through a contract with WRC, conducted a Phase 2 Stream Geomorphic Assessment (SGA) of selected reaches on the Winhall River mainstem and its tributaries in 2014. Major problems in these reaches included human-caused channel and valley constriction. Channel straightening, berming, and stream bank armoring have all brought the Winhall 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 fair. Some other 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 Londonderry



Stream	Reach	Existing Stream Type	Existing Confinement Type	Habitat Condition	Geomorphic Condition
Winhall River	T11.01	B	Broad	Fair	Fair
	T11.02-A	F	Semi-Confined	Fair	Fair
	T11.02-B	F	Narrowly Confined	-	-
	T11.03-A	F	Very Broad	Fair	Poor



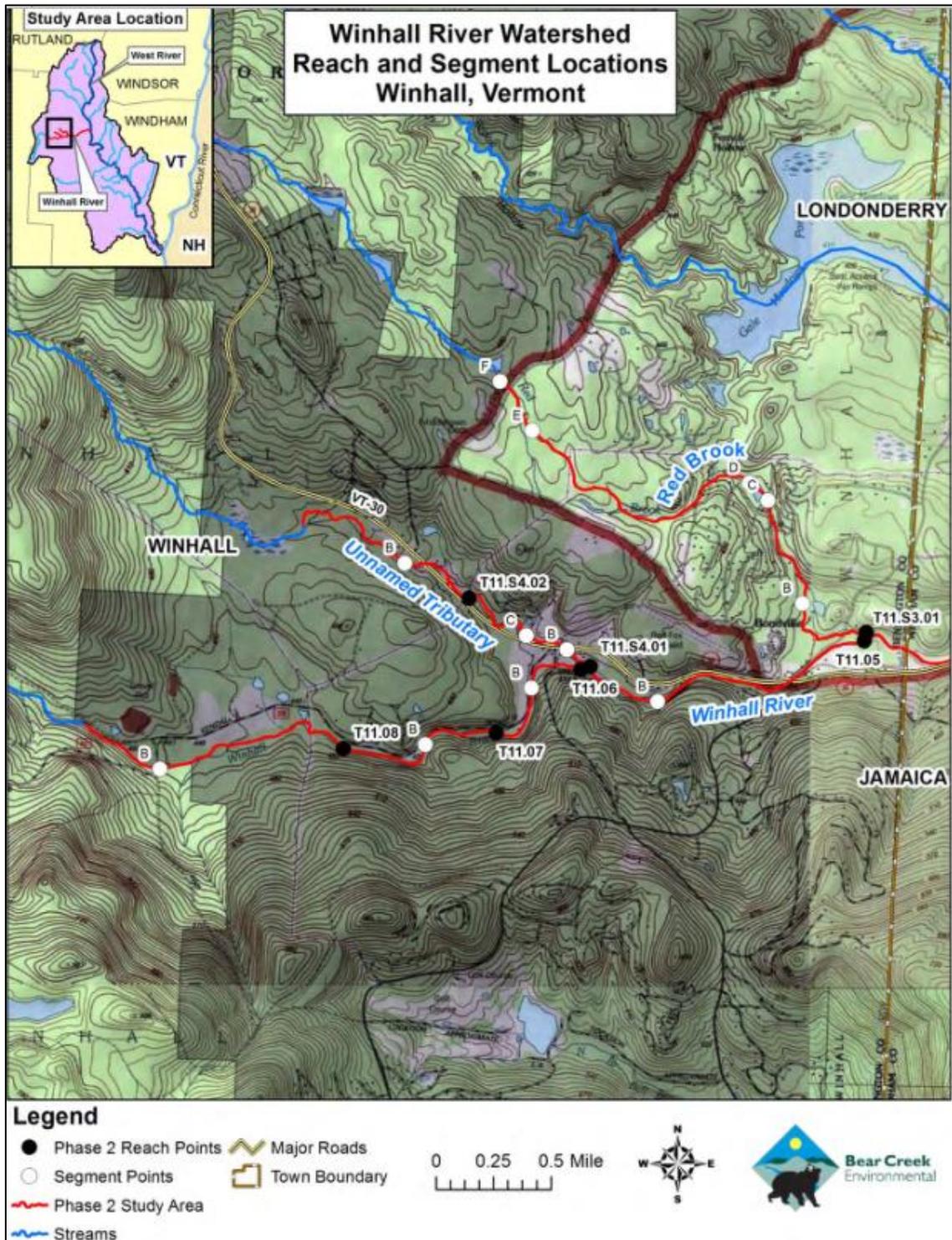


Figure 5: Map of Phase 2 Reaches in Londonderry (Bear Creek Environmental and WRC, 2014)



3.3 Town Planning and Permitting

Londonderry Town Plan

The Londonderry Town Plan was adopted by the Town in October 2017 and was developed by the Londonderry Planning Commission with assistance from WRC. This plan aims to establish “goals and objectives for responsible growth and development based upon a public commitment to preservation of natural resources, historic settlement patterns, the vitality of north and south villages, and quality of life for those who live here.” The plan emphasizes pollution from septic tanks and flood resilience. The Town has many older in-ground septic tanks that are at risk of failing and plans on providing support to landowners with failed septic systems. The town is susceptible to flooding and FEMA flood hazard mapping will be used to inform project selection to address flood risk and minimize damage.

Londonderry Local Hazard Mitigation Plan

This document was prepared by the WRC for the Town of Londonderry and adopted in 2014. The purpose of this plan is to identify natural hazards that are more likely to occur, assess their impacts on the community, and generate a list of strategies and actions to reduce the impacts. Of the hazards assessed, flooding was found to be the hazard that Londonderry is most susceptible to. High priority actions and mitigation strategies associated with flooding include buyouts of damaged structures along the West River, upgrading culverts, and considering the installation of a Village sewer system to reduce E. coli pollution resulting from flood events.

Londonderry Zoning Bylaws

This document was completed and implemented by the Town of Londonderry in 2009. It contains provisions to promote the development of the Town in a way that minimizes potential damages from future flood events and minimize 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 Londonderry are primarily thorough and up to date. The stormwater infrastructure mapping was completed in 2017, so there may have been important updates to the drainage systems in recent years. If we identify discrepancies in the drainage mapping over the course of our field work, we will summarize these changes in GIS files and bring them to the attention of VTDEC and the Town.

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 Londonderry. FEA 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 20 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 (12)** – 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 (3)** – Areas of high sediment and nutrient loading due to road, embankment, and ditch erosion.
- **Gully Stabilization (3)** – Problem areas where stormwater erosion has formed a gully, resulting in a nutrient and sediment source.
- **Stream Restoration (2)** – Problem areas where stream bank or bed erosion is a significant nutrient and sediment source.

4.2 Evaluation and Prioritization of Problem Areas

Twelve (12) GSI 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 26% to 74%. Additional information about the unified prioritization methods can be found in **Section 4.3** and **Table 5**.

The additional 7 projects described in the Non-Unified Prioritization Project Table (Appendix B) were assigned several numerical scoring metrics that were 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 20. 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 2013 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 2021 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 12 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 17. 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 Londonderry, 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
Water Quality/Environmental impact		
Sediment reduction (using STP calculator for sediment) (not yet developed)	0-4 (natural groupings within the range of sediment reductions for proposed projects for a specific plan. 0=very low reduction, 4= very high sediment reduction)	4
Phosphorus/nutrient reduction (using STP Calculator)	0-4 (natural groupings within the range of phosphorus reductions for proposed projects for a specific plan. 0=very low p reduction, 4= very high P reduction)	4
Impervious area managed	1-4 (natural groupings within the range of impervious surface managed for proposed projects for a specific plan. More impervious treated gets more points)	4
Percent of Water Quality & Channel Protection Volume treated*	0-3 (0= no WQ treated, 1= ½ WQV treated, 2=meeting WQV, 3=meets WQV and CPV). Do not apply to road projects.	3
Percent of Recharge criteria met *	0-3 (0 = no infiltration, 1 =infiltrates less than recharge volume, 2= meets full recharge, 3= exceeds recharge 1.5 times or more) Do not apply to road projects.	3
Streambank or other gully erosion mitigation	0-2 (calculate volume= Length x avg. width x avg. depth, use natural groupings to divide volume into 3 categories)	2
Green infrastructure opportunity	0-1 (0=no, 1=yes)	1
* WQV, CPV and Recharge criteria as outlined in 2017 Vermont Stormwater Management Manual		
Total Water Quality Score (out of 21, or 15 if road project)		
Feasibility Criteria		
Public land or Private Landowner support	0-3 (3=public land, 2=willing private land owner, 0=unwilling or unknown willingness of private landowner)	3
Project and Permitting complexity (number of permits required)	0-2 (2= simple permitting, 0= complex permitting-potential denial)	2
Infrastructure conflicts	1 (Y= 0, N=1)	1
Total Estimated Project Cost)	Enter engineering estimate+ construction estimate (no points)	
Project efficiency (\$/lbs. of P removed)	1-12 (Use natural grouping of \$/lbs. removed)	12
Ease of O&M and ease of access for O&M	0-2 (based on municipal input on what is easiest to maintain, 0=high maintenance, 2=easy maintenance)	2
Total Feasibility Score (out of 20)		
Other considerations/Co-benefits (0=doesn't address concern, 1=addresses concern)		
Educational benefits and or Recreational benefits	1	1
Natural habitat creation/protection	1	1
Infrastructure improvement (culvert replacement)	1	1
Outfall erosion control	1	1
Connected to receiving water	3=all runoff infiltrates on site, 2= runoff receives some treatment before reaching receiving water. 1=runoff drains via infrastructure directly to receiving water with no erosion or additional pollutant loading, 0 =runoff drains directly to receiving water	3
Flood mitigation (known problem)	1	1
Existing local concerns	1	1
Total Co-benefits Score (out of 9)		
Overall Score (out of 50 or 44)		



Phosphorus Loads from Sediment

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

For estimating the overall phosphorus loading and phosphorus reduction associated with excess sediment mobilization and stabilization, we used methods and loading rates established for the stabilization of roadside gully erosion in the VTDEC SOP. We estimate annual soil loss (in cubic feet) based on our best professional estimate of the age and volume of erosion features. We apply a 43.38 kg/ft³ 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)/ft³ and 0.037 kg (P)/ft³ (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 (\$)

BMP Type	Cost/ft ³ Treatment Volume
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

Site Type	Cost Multiplier
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

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



4.4 Non-Unified Evaluation and Prioritization of Problem Areas

The 7 additional projects 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 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 developed five 30% conceptual designs 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

The projects selected for conceptual design were:

1. **Project LON-07 – VT Route 100, Outfall behind bank parking lot (30%)**
Problems Identified: A small gully is forming from a perched outfall pipe.
Proposed Best Management Practice: Bioretention Swale
Estimated Cost Efficiency: \$10,000-\$15,000/kg P/year
2. **Project LON-10 – VT Route 100, Transfer Station (30%)**
Problems Identified: Rill erosion is forming across the driveway area into an eroding ditch. The ditch outlets into a soil dumping area where water is pooling.
Proposed Best Management Practices: Ditch stabilization, grassed pre-treatment swale and settling basin.
Estimated Cost Efficiency: \$30,000-\$40,000/kg P/year
3. **Project LON-15 – Old Town Garage Road, Town Garage Parking Area (30%)**
Problems Identified: The large building and gravel parking lot drain into swales that send water to the river.
Proposed Best Management Practices: Wet pond with pre-treatment sediment forebay
Estimated Cost Efficiency: \$35,000-\$50,000/kg P/year
4. **Project LON-16 – Pingree Park Road, Behind Ballfield (30%)**
Problems Identified: Two swales reach a steep slope and form large parallel gullies.
Proposed Best Management Practices: Infiltration Basin with grass pre-treatment swale
Estimated Cost Efficiency: \$10,000-\$15,000/kg P/year



5. **Project LON-18 – VT Route 11 (30%)**

Problems Identified: A large gravel parking lot drains directly into the West River.

Proposed Best Management Practices: Infiltration Basin with grass pre-treatment swales

Estimated Cost Efficiency: \$30,000-\$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 Londonderry. 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 and gully stabilization opportunities identified in the Unified Prioritization Matrix represent a potential phosphorus load reduction of approximately 65 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.



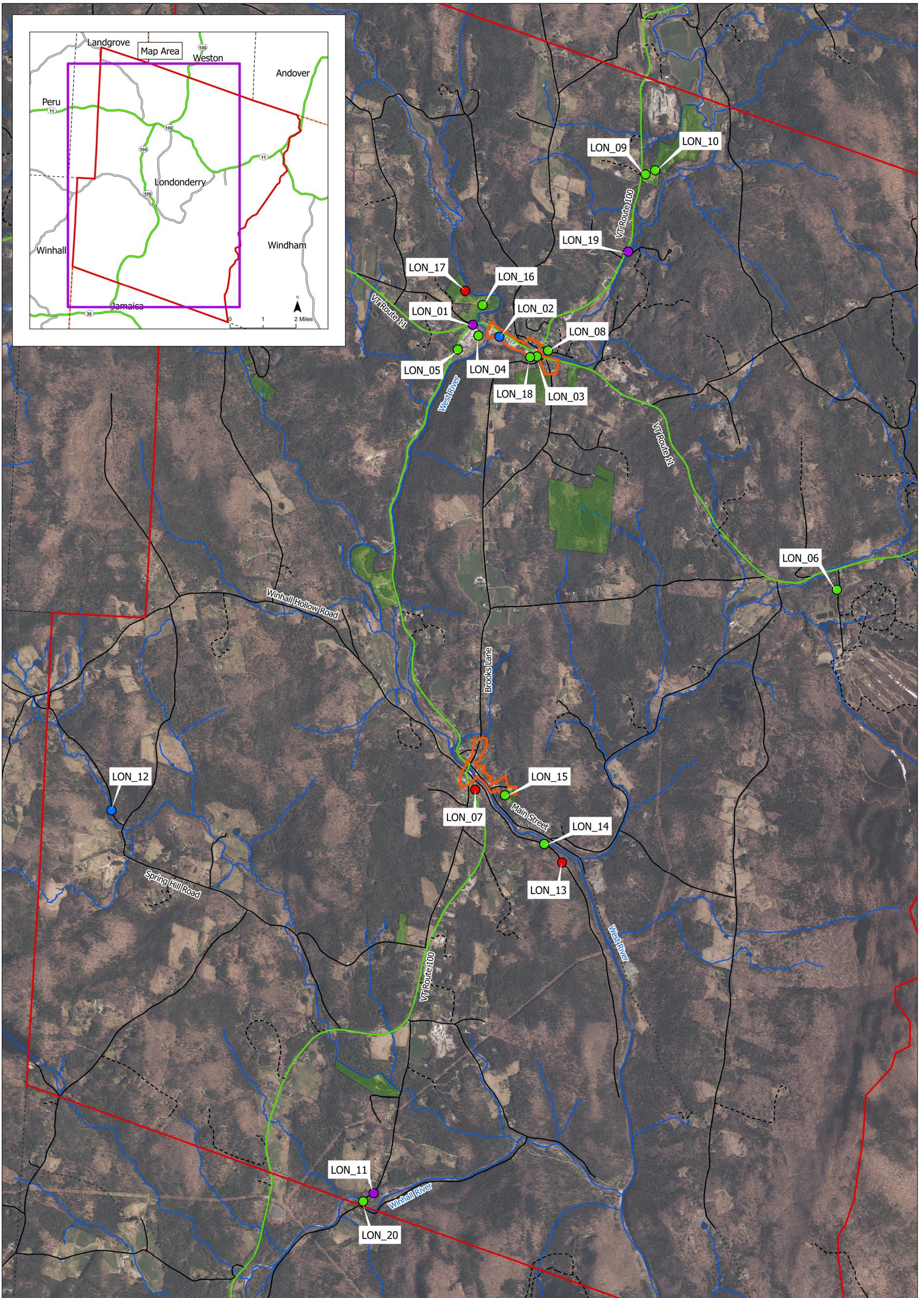
6.0 References

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- Dewitz, J., and U.S. Geological Survey, 2021. National Land Cover Database (NLCD) Products (ver. 2.0, June 2021)
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- Stone Environmental, January 2020. Detecting and Eliminating Illicit Discharges in the West-Williams-Saxtons-Lower Connecticut River Basin: Final Report
- U.S. Census Bureau, 2020. 2020 United States Census.
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- 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.
- Water Investment Division, Vermont Agency of Natural Resources, December 2021. West, Williams & Saxtons & Lower Connecticut River Basin 11 Tactical Plan.
- Watershed Management Division, Vermont Agency of Natural Resources, October 2014. West River Watershed: Updated Water Quality/Aquatic Habitat Assessment Report
- Windham Regional Commission, December 2014. Single Jurisdiction Hazard Mitigation Plan: Town of Londonderry, Vermont



APPENDIX A

Project Location Map (24"x36")




Fitzgerald Environmental Associates, LLC
 164 Main Street, Suite 2
 Colchester, VT 05446
 Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

Town of Londonderry
Stormwater Master Plan Study Area
Project Location Map

Notes:
 -Project locations and recommendations are based on field assessments conducted on 6/22/23

DRAWN: JWC
 CHECKED: JHB
 DATE: March 13, 2024

Proposed Project Type <ul style="list-style-type: none"> ● Stormwater BMP New/Retrofit ● Road Erosion Mitigation ● Gully Stabilization ● Stream Restoration 	Roads <ul style="list-style-type: none"> Town Road State Highway Private Road Legal Trail 	<ul style="list-style-type: none"> Surface Waters Londonderry Village Center Town Boundaries Municipal Parcels
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 0 1,250 2,500 US Feet
 1 inch = 1,250 feet

APPENDIX B

Project Prioritization Summary Tables
Unified and Non-Unified
(11"x17" & 8.5"x11")

Stormwater Master Plan - Town of Londonderry
 Unified Prioritization Project Table
 March 28, 2025

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 %
LON_16	GSI	Pingree Park Road - Behind Ballfield	Two swales reach a steep slope and form large parallel gullies.	Stabilize both of the gullies with stone. Redirect the swales into a basin in the unused lawn space. The white pine tree next to the culvert inlet may need to be removed. A feature here could treat most of the park's area.	8.30	0.95	11%	6.07	4,605	Infiltration Basin	4,610	5.68	37.00	42.68	2	3	0	1	\$ 79,800	\$ 1,870	2	2	37	50	74%
LON_14	GSI	West River Street	An agricultural area with farm animals drains into the road ditch and into the river.	Divert the ditch and farm runoff into a small wet pond in the green space on the farm.	3.12	0.62	20%	2.79	2,589	Wet Pond/Created Wetland	1,380	1.06	5.55	6.61	2	0	2	1	\$ 20,000	\$ 3,028	1	2	31	50	62%
LON_07	Gully	VT Route 100 - Outfall behind bank parking lot	A small gully is forming from a perched outfall pipe.	Stabilize the outfall with stone. There is space for a small BMP as well if permission is granted. The drainage area to this outfall is large.	4.66	1.36	29%	5.02	5,291	Infiltration Basin	1,100	2.57	0.74	3.31	1	0	2	1	\$ 20,800	\$ 6,276	2	2	29	50	58%
LON_15	GSI	Old Town Garage Road - Town Garage Parking Area	The large building and gravel parking lot drain to swales that send water to the river.	Capture water from both the swales at the culvert outlet. Install a large forebay for all the gravel and a wet pond or gravel wetland for treatment. This feature would take up some area that is currently gravel.	7.98	1.22	15%	6.42	5,423	Wet Pond/Created Wetland	5,680	2.88	1.85	4.73	2	3	0	1	\$ 102,900	\$ 21,746	1	2	29	50	58%
LON_10	GSI	VT Route 100 - Transfer station	Rill erosion is forming across the driveway area into an eroding ditch. The ditch outlets into a soil dumping area where water is pooling.	Stabilize the eroding ditch and direct it into an infiltration feature in the low area out of the way of town usage.	1.80	0.43	24%	1.76	1,730	Infiltration Basin	1,730	1.67	0.56	2.23	1	3	2	1	\$ 38,200	\$ 17,153	2	1	26	50	52%
LON_03	GSI	VT Route 11 - Park along the West River	An outfall from the underground stormwater infrastructure flows down the steep bank just downstream of the dam. The slope is eroding from the outfall and from overland flow.	The outfall culvert is deep underground which may limit possible treatment features. An underground sand filter or infiltration chamber in the green space could accept water from the culvert. Stabilize the bank with stone.	0.81	0.50	62%	1.39	1,777	Infiltration Chambers	1,800	1.30	2.00	3.30	2	3	0	0	\$ 59,200	\$ 17,961	0	2	25	50	50%
LON_08	GSI	Pond Street - Private lawn with catch basin	Gravel and paved roads drain into town stormwater infrastructure through a catch basin in a privately-owned lawn area. The outfall emits water directly into the West River.	Raise the catch basin inlet and pool stormwater in the surrounding lawn. The topography of the lawn forms a basin. The pipes are not deep.	15.70	3.07	20%	13.97	12,874	Infiltration Basin	7,300	11.53	0.00	11.53	0	0	0	1	\$ 118,300	\$ 10,262	2	1	25	50	50%
LON_09	GSI	VT Route 100 - Transfer station	A large gravel parking area drains untreated down a grassy hill. The hill is an old landfill.	Install a swale along the side of the parking area. Direct stormwater runoff to the low point and treat it in the grassy area with level spreader. Infiltration is not an option on the landfill.	0.85	0.85	100%	2.09	2,931	Dry Swale (Infiltrating)	2,940	2.05	0.19	2.23	0	3	2	1	\$ 40,200	\$ 18,019	2	2	25	50	50%
LON_06	GSI	Magic Mountain Access Road - Next to Entrance to Parking Lot C	There is an eroding gravel turn-around and entry to the parking lot. Downhill, parking lot C is grass and has low water quality impact	Install a small infiltration basin to treat runoff from the paved road and gravel turn-around before it enters the existing swale.	4.84	0.82	17%	4.05	3,570	Infiltration Basin	2,680	3.50	0.00	3.50	0	0	2	1	\$ 25,700	\$ 7,347	2	1	24	50	48%
LON_18	GSI	VT Route 11	A large gravel parking lot drains directly into the West River.	Install a surface infiltration basin in the southern corner of the parking lot. Install grass pretreatment swales on both sides of the parking lot to capture more runoff. Ensure a stable overflow into the river.	2.04	0.94	46%	2.86	3,444	Infiltration Basin	3,260	2.66	0.00	2.66	0	0	0	1	\$ 52,800	\$ 19,835	2	3	20	50	40%
LON_20	GSI	Goodaleville Road	A long stretch of steep road is too narrow for a conventional ditch. Sediment is eroding down the hill through an undersized settling pond and into the river.	Expand the small feature at the bottom of the hill to fill the flat space. Install a narrow ditch leading into the new feature.	2.39	0.02	1%	1.25	503	Wet Pond/Created Wetland	300	0.42	0.93	1.34	1	0	0	1	\$ 7,500	\$ 5,585	1	1	20	50	40%
LON_05	GSI	VT Route 100 - Green space next to road, some is mowed, some is meadow	Impervious area from gravel, road, and buildings drains through this area to the river.	There is an existing small wet pond. The size of the existing feature could be increased to add storage capacity.	10.88	5.56	51%	16.37	20,126	Wet Pond/Created Wetland	20,130	7.92	0.19	8.11	0	0	0	0	\$ 355,500	\$ 43,862	1	2	15	50	30%
LON_04	GSI	VT Route 100 - Green area behind shopping center	A large portion of the parking lot and some of the building drain to this area. The drainage area includes paved and gravel impervious.	Install a sand filter or surface infiltration in the green area. There is a fair amount of space with utilities unlikely. The area is currently used for overflow parking.	0.57	0.51	90%	1.28	1,765	Infiltration Basin	1,800	1.23	0.00	1.23	0	0	0	0	\$ 32,200	\$ 26,136	2	1	13	50	26%

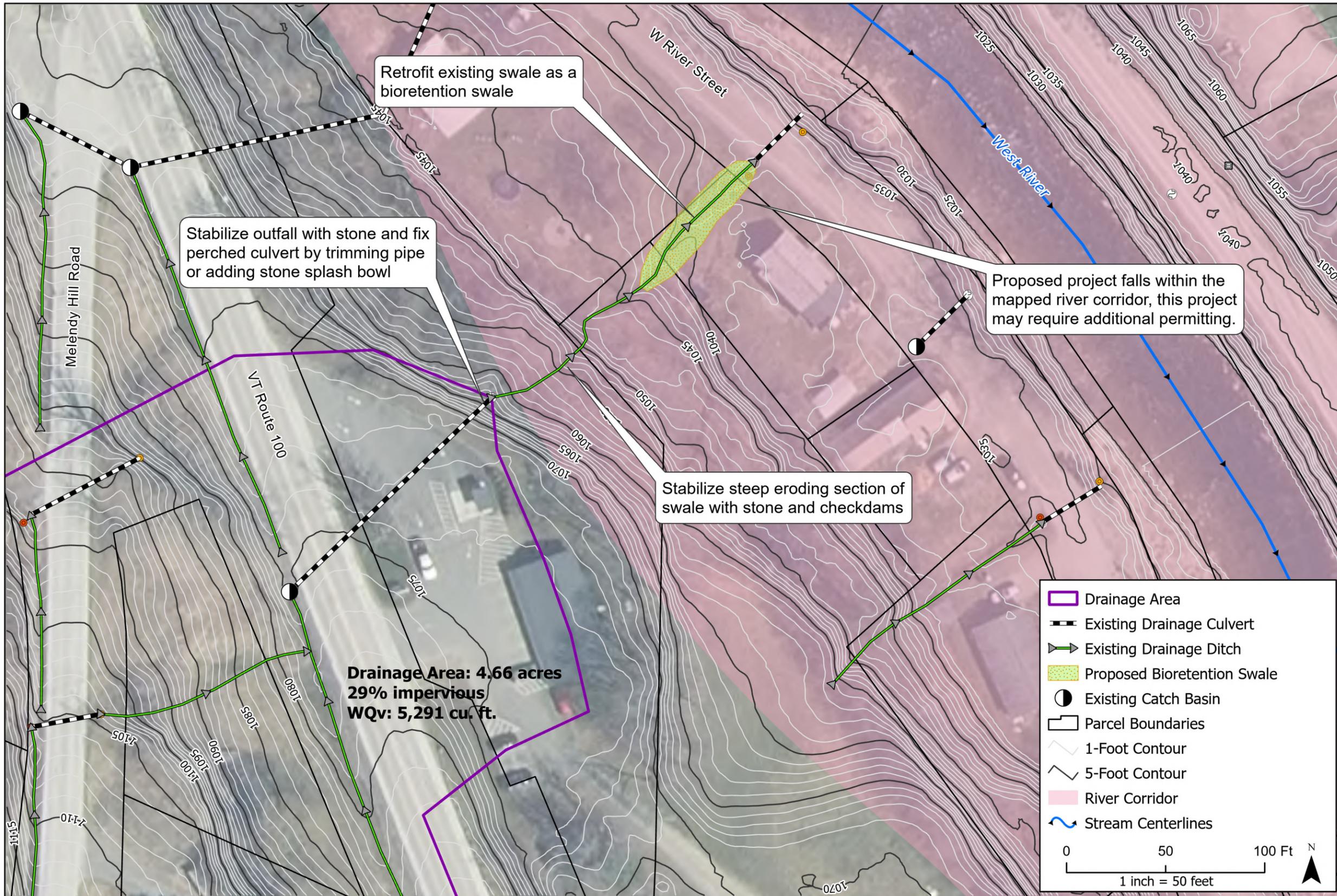
Stormwater Master Plan - Town of Londonderry
 Non-Unified Prioritization Project Table
 March 28, 2025

Additional 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

Project ID	Project Type	Location	Description	Preliminary Recommendations	Water Quality Benefits								Additional Benefits	Additional Benefits Score	Total Score
					Nutrient Reduction	Sediment Reduction	Drainage Area	Impervious Drainage	Connectivity to Surface Waters	Landowner Support	O&M Requirements	Cost and Constructability			
					4	4	1	3	3	2	2	6			
LON_17	Gully	Pingree Park Road - Hiking trail behind park	A large gully has formed down to the river from the trail crossing.	Stabilize the gully with stone.	4	4	1	2	3	1	2	1	E, IC	2	20
LON_19	Road Erosion	Cobble Ridge Road - Bridge over West River	The corner of the bridge is falling apart from erosion. The ditch on east side of the bridge is eroding into the river.	Install a sediment trap on the east side at the bottom of the ditch. Stabilize the gully on the west side with stone and concrete as needed.	3	3	1	2	3	1	1	3	IC	1	18
LON_11	Road Erosion	Goodaleville Road	A steep section of the hill with a narrow eroding road has very erodible soil. An under drain was installed in the uphill slope to relieve issues. MRGP said to ignore this stretch because it's hopeless.	Install one or more French mattresses to slow water that is conveyed to the downhill side of the road. Stabilize the gully with stone.	3	3	1	2	2	1	1	3	CPA	1	17
LON_01	Road Erosion	Intersection of VT Route 100 and Route 11 - SE side of triangle	A small gully is forming from runoff from the large paved area uphill.	Stabilize the gully with stone or install a small bioretention feature in the green space.	2	2	0	0	2	1	2	6	HV	1	16
LON_12	Stream	Spring Hill Road	The outside bend of the stream is undermining the road.	Possible solutions include a rock vein, coir logs, or stone armoring.	1	1	1	0	3	1	2	5	IC	1	15
LON_13	Gully	West River Street	A large gully is forming off the road at the cross culvert. The headwall failed and erosion is coming up onto the road surface.	Stabilize the slope and gully with stone. Install a new culvert and new headwall.	3	3	1	0	2	1	1	2	CPA, IC	2	15
LON_02	Stream	VT Route 11 - River bank next to Liquor Store parking lot	The river bank is eroding along the outside bend. A large paved area drains over the bank. The existing erosion is minor but has potential to grow.	Stabilize the bank with plantings. Divert parking lot runoff with a swale so it does not flow down over the bank.	1	1	0	1	3	0	1	5		0	12

APPENDIX C

**30% Conceptual Designs
(11"x17")**



Fitzgerald
Environmental
Associates, LLC

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Notes:
- Conceptual design based on FEA field visit in 2024

Project LON-07 Conceptual Design

Stormwater Master Plan

VT Route 100

Londonderry, VT

MAP BY: FCP

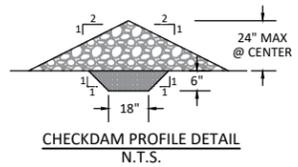
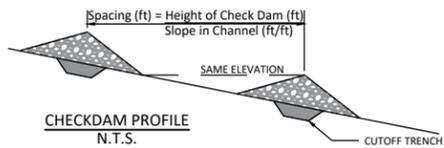
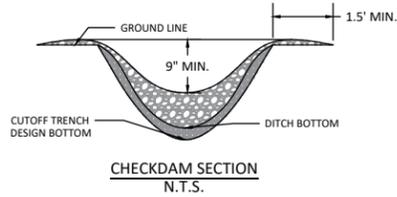
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SCALE: 1 inch = 50 feet

DATE: April 4, 2025

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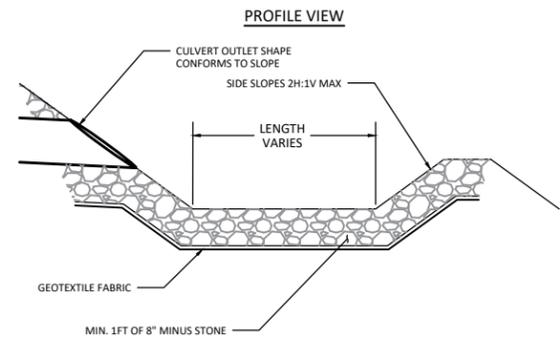
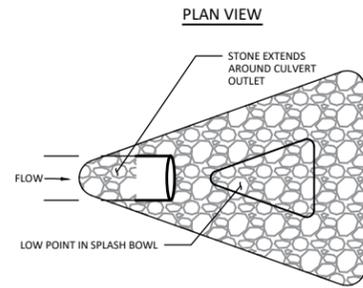
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- USE 6 INCH MINUS STONE FILL
- SIDE SLOPES 2:1 OR FLATTER
- SPAN WIDTH OF CHANNEL AND UP SIDES OF BANKS
- SPACE SO THAT THE TOE OF THE UPHILL CHECKDAM IS THE ELEVATION OF THE CREST OF THE DOWNSTREAM DAM
- PERIODICALLY REMOVE ACCUMULATED SEDIMENT AND DEBRIS TO ALLOW CHANNEL TO DRAIN THROUGH THE STONE AND PREVENT LARGE FLOWS FROM CARRYING SEDIMENT OVER THE DAM
- IF SIGNIFICANT EROSION OCCURS BETWEEN DAMS, A LINER OF STONE SHOULD BE INSTALLED

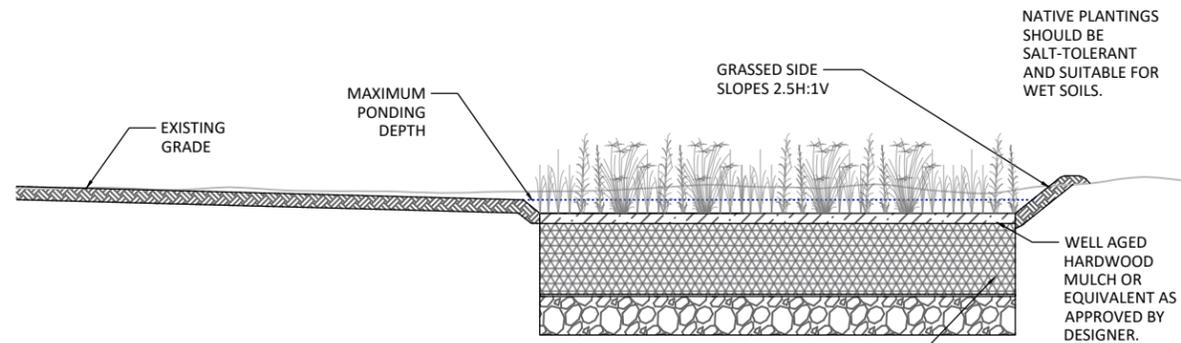
STONE CHECKDAM

N.T.S.



CULVERT OUTLET SPLASH BOWL

N.T.S.



WELL-DRAINED LOW ORGANIC TOPSOIL CONSISTING OF SAND OR LOAMY SAND BY USDA CLASSIFICATION (85-88% SAND, 8-12% SILT, AND 0-2% CLAY) AND 3-5% ORGANIC MATTER IN THE FORM OF COMPOST.

- VERIFY DEPTH TO SEASONAL HIGH WATER TABLE IS GREATER THAN 3FT FROM BOTTOM OF PRACTICE. IF LESS, INSTALL UNDERDRAIN IN BIORETENTION FEATURE.
- DETERMINE INFILTRATION RATE OF UNDERLYING SOILS. IF LESS THAN 0.2 IN/HR, INSTALL UNDERDRAIN IN BIORETENTION FEATURE.

BIORETENTION

N.T.S.

Preliminary Cost Opinion

Project LON-07

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 1,500	\$ 1,500
Common Excavation	10	CY	\$ 25	\$ 250
Hauling	10	CY	\$ 20	\$ 200
Well-Drained Low Organic Topsoil (Sandy Loam)	5	CY	\$ 80	\$ 400
Stone Outlet	1	LS	\$ 3,000	\$ 3,000
Plantings	1	LS	\$ 500	\$ 500
Misc. Erosion Control and Site Restoration	1	LS	\$ 1,500	\$ 1,500
Laborer	24	HR	\$ 50	\$ 1,200
Final Design & Permitting	1	LS	\$ 6,000	\$ 6,000
Construction Oversight	1	LS	\$ 3,000	\$ 3,000
			Subtotal	\$ 17,550
			Contingency (20%)	\$ 3,510
			Total	\$ 21,060

Notes:

Project LON-07 Conceptual Design
Stormwater Master Plan

VT Route 100
Londonderry, VT

NOT FOR CONSTRUCTION

DRAWN FCP

CHECKED JHB

SCALE

N.T.S.

DATE

2025-04-04

SHEET NO.

SHEET 2



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

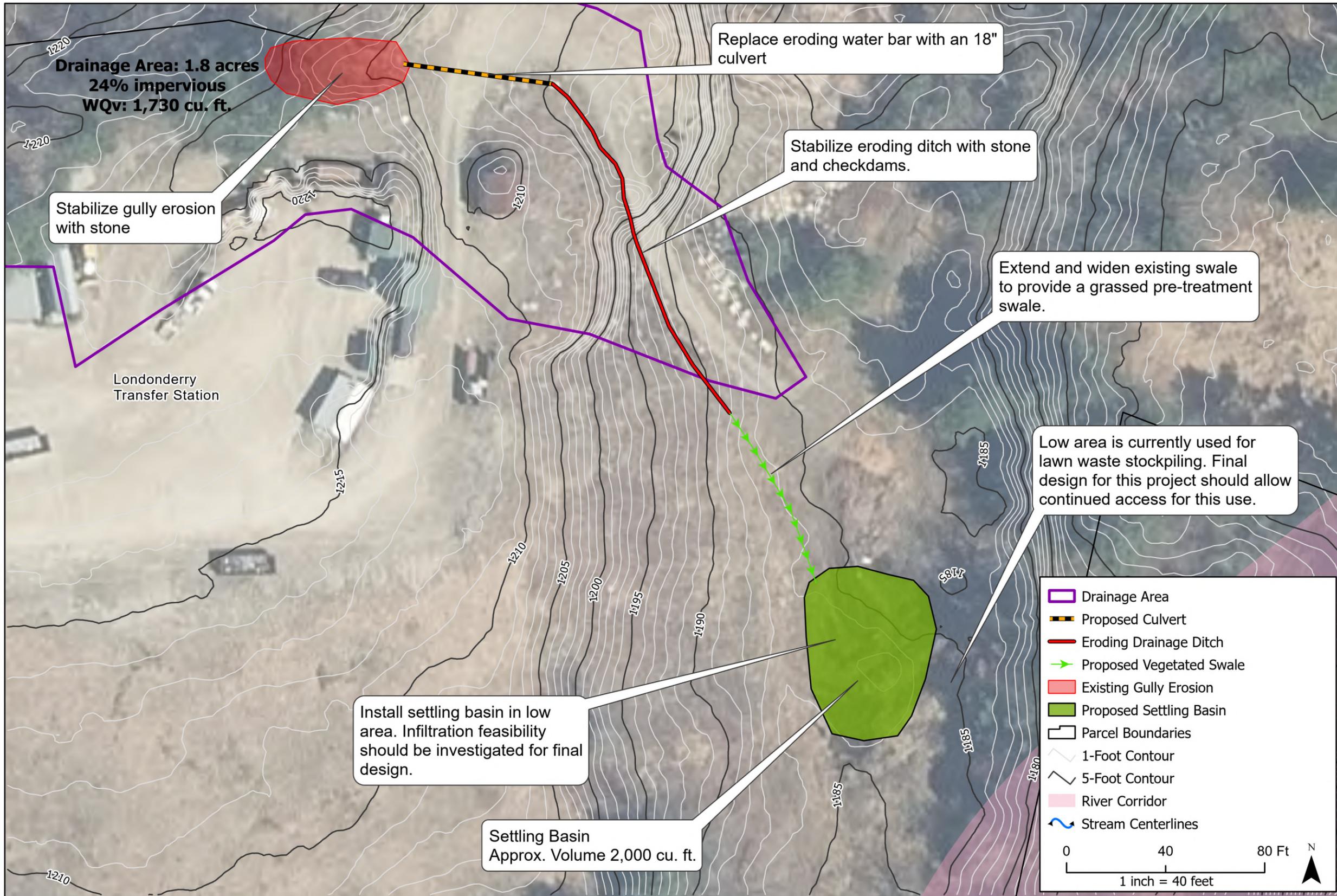
OPERATION OF MAINTENANCE NOTES

- MAINTENANCE OF THE BIORETENTION FEATURE INCLUDES OCCASIONAL WEEDING TO MAINTAIN THE SELECTED PLANTS.
- DURING THE FIRST YEAR OF OPERATION, WATERING, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
- THE ACCUMULATION OF SEDIMENT WITHIN THE BIORETENTION SWALE 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 AT CULVERT OUTLET, 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.

*NOTES ADAPTED FROM SLR CONCEPT DESIGNS



Drainage Area: 1.8 acres
24% impervious
WQv: 1,730 cu. ft.

Stabilize gully erosion with stone

Replace eroding water bar with an 18" culvert

Stabilize eroding ditch with stone and checkdams.

Extend and widen existing swale to provide a grassed pre-treatment swale.

Low area is currently used for lawn waste stockpiling. Final design for this project should allow continued access for this use.

Install settling basin in low area. Infiltration feasibility should be investigated for final design.

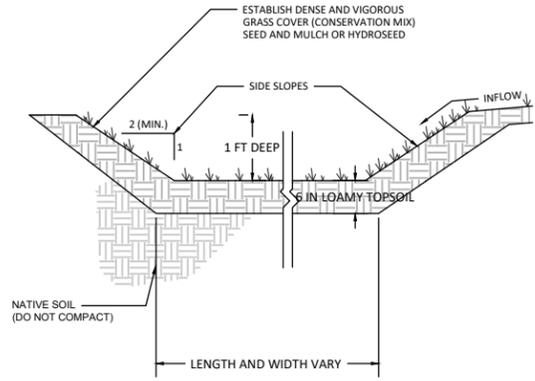
Settling Basin
 Approx. Volume 2,000 cu. ft.

	Drainage Area
	Proposed Culvert
	Eroding Drainage Ditch
	Proposed Vegetated Swale
	Existing Gully Erosion
	Proposed Settling Basin
	Parcel Boundaries
	1-Foot Contour
	5-Foot Contour
	River Corridor
	Stream Centerlines

0 40 80 Ft N
 1 inch = 40 feet

 Fitzgerald Environmental Associates, LLC 164 Main Street, Suite 2 Colchester, VT 05446 Telephone: 802.876.7778 www.fitzgeraldenvironmental.com	
Notes: - Conceptual design based on FEA field visit in 2024	
Project LON-10 Conceptual Design Stormwater Master Plan Londonderry Transfer Station Londonderry, VT	
FCP <small>MAP BY</small>	JHB <small>CHECKED</small>
SCALE: 1 inch = 40 feet	
DATE: April 30, 2025	
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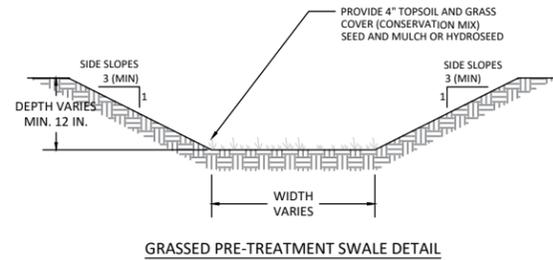


VERIFY DEPTH TO WATER TABLE:
3-FT MIXED RUNOFF

VERIFY INFILTRATION RATE OF UNDERLYING SOIL >0.2
INCHES/HOUR

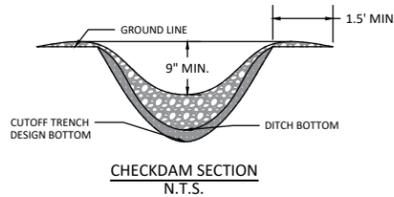
PRETREATMENT REQUIRED FOR NON-ROOFTOP RUNOFF

GRASSED SETTLING BASIN N.T.S

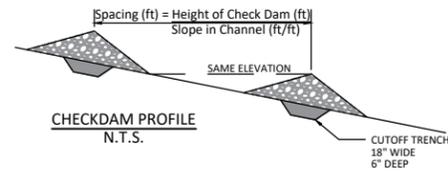


GRASSED PRE-TREATMENT SWALE DETAIL

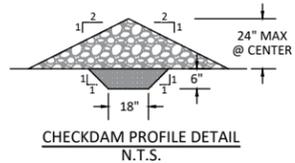
VEGETATED SWALE N.T.S



CHECKDAM SECTION N.T.S.



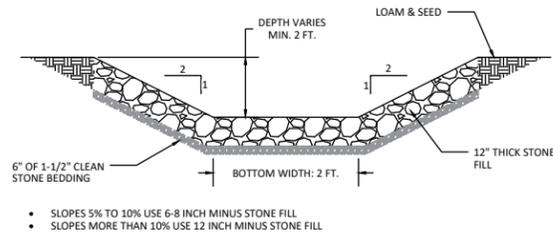
CHECKDAM PROFILE N.T.S.



CHECKDAM PROFILE DETAIL N.T.S.

- USE 6 INCH MINUS STONE FILL
- SIDE SLOPES 2:1 OR FLATTER
- SPAN WIDTH OF CHANNEL AND UP SIDES OF BANKS
- SPACE SO THAT THE TOE OF THE UPHILL CHECKDAM IS THE ELEVATION OF THE CREST OF THE DOWNSTREAM DAM
- PERIODICALLY REMOVE ACCUMULATED SEDIMENT AND DEBRIS TO ALLOW CHANNEL TO DRAIN THROUGH THE STONE AND PREVENT LARGE FLOWS FROM CARRYING SEDIMENT OVER THE DAM
- IF SIGNIFICANT EROSION OCCURS BETWEEN DAMS, A LINER OF STONE SHOULD BE INSTALLED

STONE CHECKDAM N.T.S



- SLOPES 5% TO 10% USE 6-8 INCH MINUS STONE FILL
- SLOPES MORE THAN 10% USE 12 INCH MINUS STONE FILL

STONE LINED DITCH GULLY STABILIZATION N.T.S

Preliminary Cost Opinion

Project LON-10

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 2,500	\$ 2,500
Common Excavation	100	CY	\$ 25	\$ 2,500
Hauling	75	CY	\$ 20	\$ 1,500
Install 18" HDPE	60	LF	\$ 90	\$ 5,400
Install Pretreatment Swale	2	LS	\$ 1,500	\$ 3,000
Stone Outlet	1	LS	\$ 1,000	\$ 1,000
Plantings	1	LS	\$ 500	\$ 500
Type I Stone Fill	20	CY	\$ 75	\$ 1,500
Misc. Erosion Control and Site Restoration	1	LS	\$ 1,500	\$ 1,500
Laborer	40	HR	\$ 50	\$ 2,000
Final Design & Permitting	1	LS	\$ 10,000	\$ 10,000
Construction Oversight	1	LS	\$ 4,000	\$ 4,000
			Subtotal	\$ 35,400
			Contingency (20%)	\$ 7,080
			Total	\$ 42,480

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 SETTLING 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 SETTLING 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 OVER THE STONE CHECKDAMS, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

DESIGN NOTES FOR FINAL DESIGN

- VERIFY THAT NATIVE SOILS HAVE AN INFILTRATION RATE OF AT LEAST 0.2 IN/HR.
- INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO PROVIDE 24 INCHES OF USDA SAND TO LOAMY SAND AS NOTED IN THE VERMONT STORMWATER TREATMENT STANDARDS.
- COORDINATE WITH THE TRANSFER STATION TO VERIFY THAT A STORMWATER PRACTICE IN CLOSE PROXIMITY TO THE LANDFILL WILL NOT HAVE ANY NEGATIVE IMPACTS.

*NOTES ADAPTED FROM SLR CONCEPT DESIGNS



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Notes:

Project LON-10 Conceptual Design

Stormwater Master Plan

Londonderry Transfer Station

Londonderry, VT

NOT FOR CONSTRUCTION

FCP

JHB

SCALE

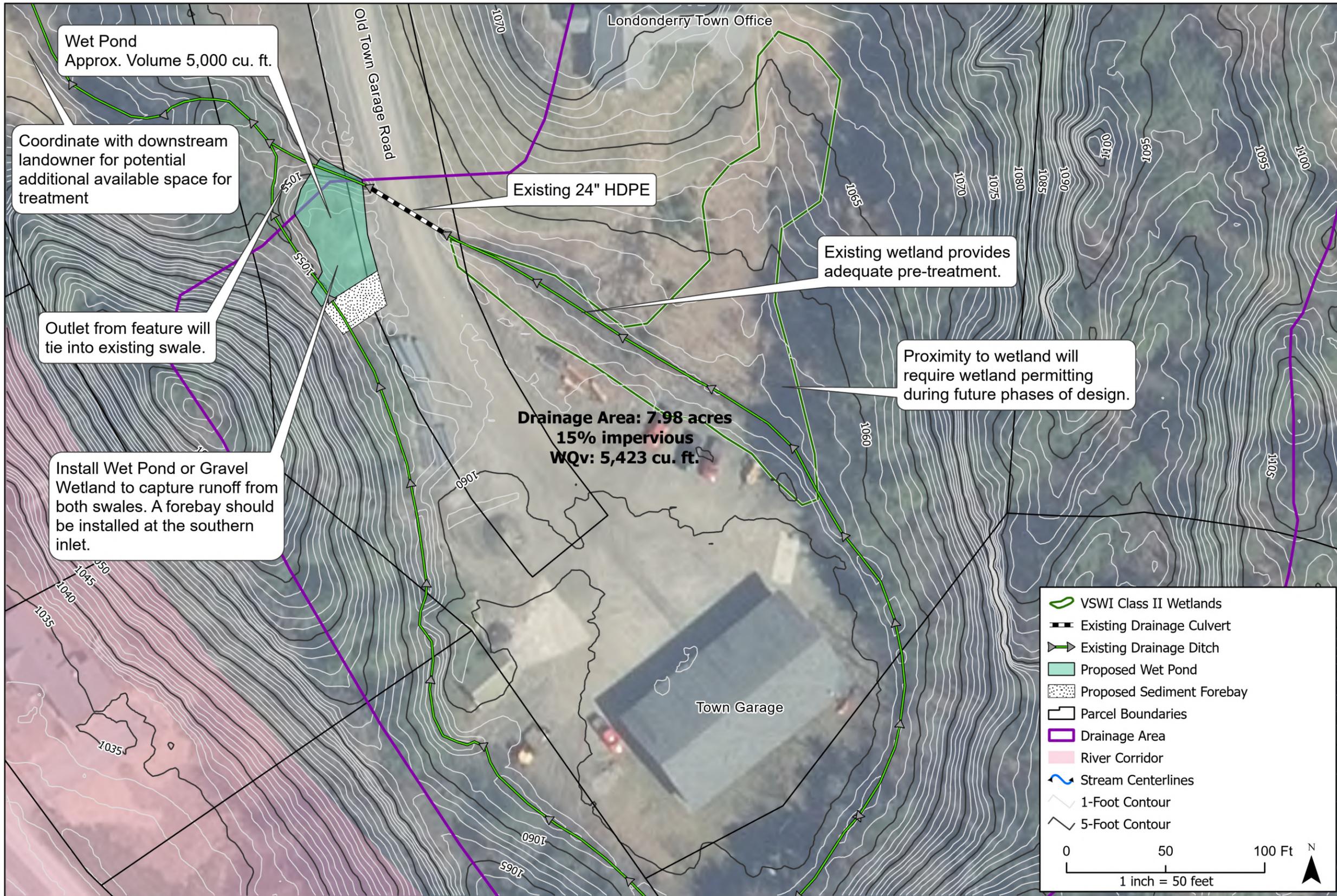
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DATE

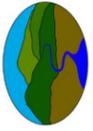
2025-02-26

SHEET NO.

SHEET 2



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Notes:
- Conceptual design based on FEA field visit in 2024

**Project LON-15 Conceptual Design
Stormwater Master Plan**

**Old Town Garage Road
Londonderry, VT**

MAP BY: FCP | CHECKED: JHB

SCALE: 1 inch = 50 feet

DATE: April 29, 2025

SHEET 1

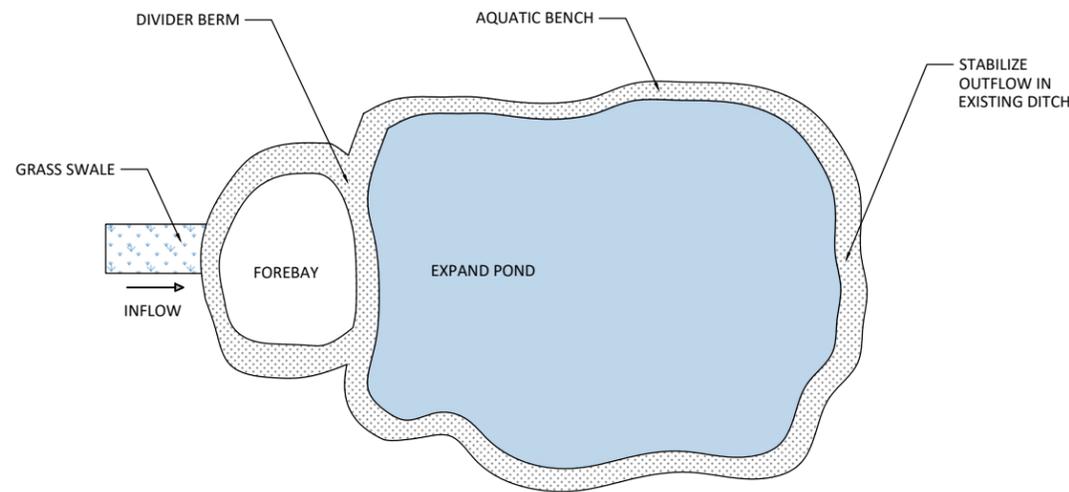
SHEET NO.

-  VSWI Class II Wetlands
-  Existing Drainage Culvert
-  Existing Drainage Ditch
-  Proposed Wet Pond
-  Proposed Sediment Forebay
-  Parcel Boundaries
-  Drainage Area
-  River Corridor
-  Stream Centerlines
-  1-Foot Contour
-  5-Foot Contour

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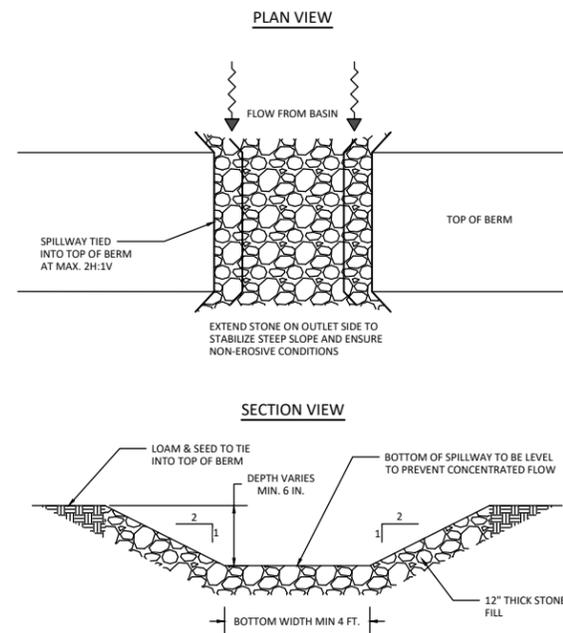
1 inch = 50 feet

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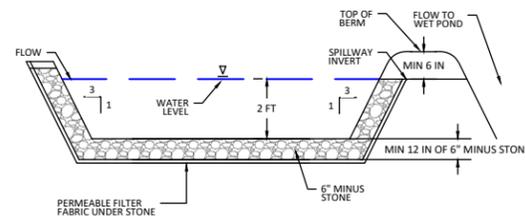
WET POND PLAN VIEW

N.T.S.



BASIN OUTLET SPILLWAY

N.T.S.



SEDIMENT FOREBAY

N.T.S.

Preliminary Cost Opinion

Project LON-15

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 3,000	\$ 3,000
Common Excavation	250	CY	\$ 25	\$ 6,250
Hauling	200	CY	\$ 20	\$ 4,000
Install Pretreatment Forebay	1	LS	\$ 1,500	\$ 1,500
Type I Stone Fill	10	CY	\$ 75	\$ 750
Stone Outlet	1	LS	\$ 1,000	\$ 1,000
Outlet Pipe	1	LS	\$ 2,000	\$ 2,000
Plantings	1	LS	\$ 1,500	\$ 1,500
Misc. Erosion Control and Site Restoration	1	LS	\$ 3,000	\$ 3,000
Laborer	80	HR	\$ 50	\$ 4,000
Final Design & Permitting	1	LS	\$ 10,000	\$ 10,000
Construction Oversight	1	LS	\$ 5,000	\$ 5,000
			Subtotal	\$ 42,000
			Contingency (20%)	\$ 8,400
			Total	\$ 50,400



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Notes:

Project LON-15 Conceptual Design

Stormwater Master Plan

Old Town Garage Road

Londonderry, VT

NOT FOR CONSTRUCTION

FCP

JHB

DRAWN

CHECKED

N.T.S.

SCALE

2025-02-26

DATE

SHEET 2

SHEET NO.

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.
- WOODY VEGETATION THAT IS MORE THAN 2 INCHES IN DIAMETER SHALL NOT BE PLANTED OR ALLOWED TO GROW ON THE DAM OR WITHIN 15 FEET OF THE DAM OR THE TOE OF THE EMBANKMENT

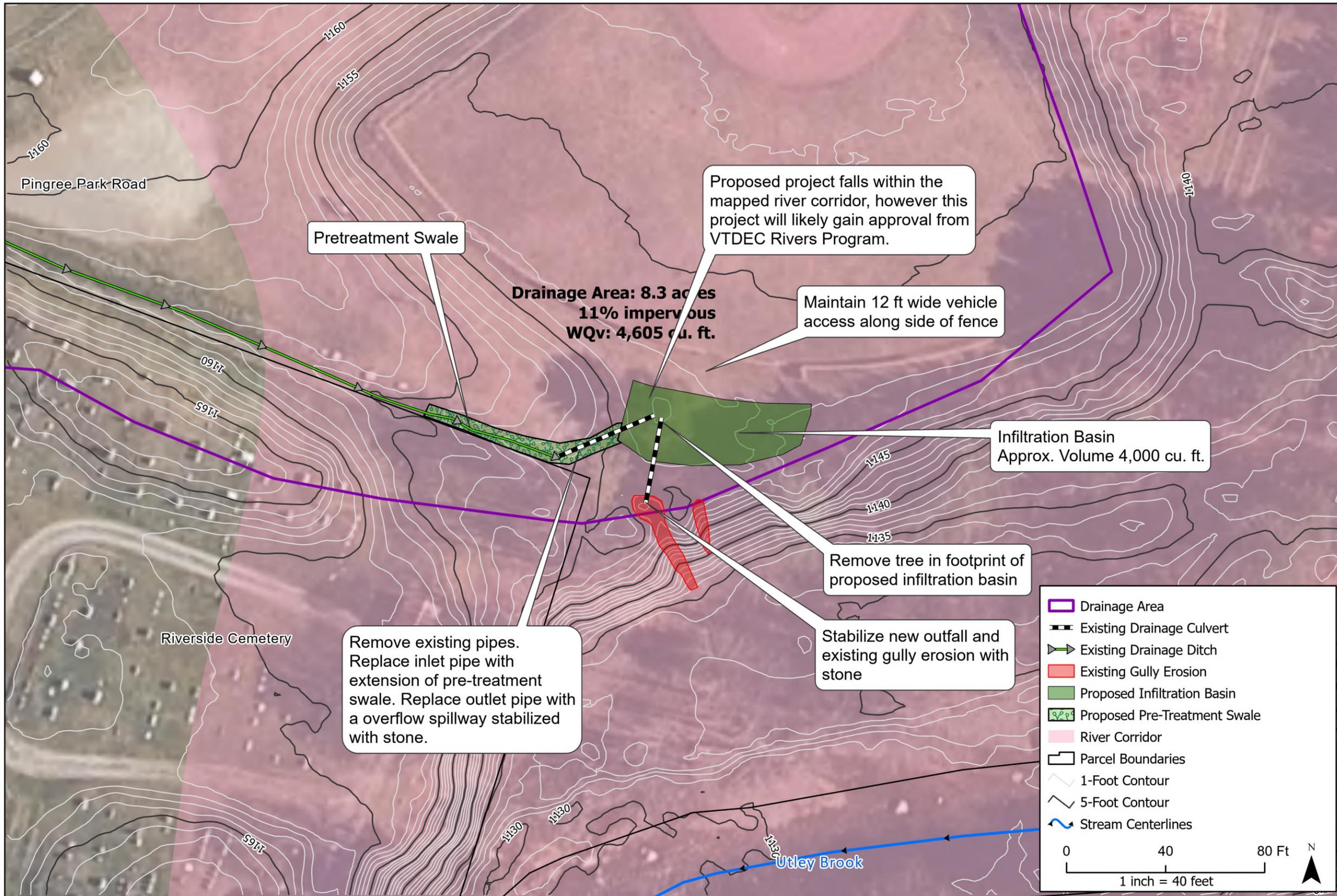
OPERATION OF MAINTENANCE NOTES

- TERRESTRIAL AND AQUATIC PLANTS SHALL BE PLANTED IN ACCORDANCE WITH A PLANTING PLAN PROVIDED BY THE DESIGN ENGINEER.
- DURING THE FIRST YEAR OF OPERATION, WEEDING, AND REPLACEMENT OF DEAD PLANTS IS IMPORTANT FOR PROPER ESTABLISHMENT.
- THE ACCUMULATION OF SEDIMENT WITHIN THE FOREBAY SHOULD BE MONITORED. REMOVE SEDIMENT AFTER APPROXIMATELY 6 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

- INVESTIGATE SOILS TO DETERMINE AMENDMENTS NEEDED TO MINIMAL INFILTRATION TO SUPPORT A PERMANENT POOL.

*NOTES ADAPTED FROM SLR CONCEPT DESIGNS



Legend

- Drainage Area
- Existing Drainage Culvert
- Existing Drainage Ditch
- Existing Gully Erosion
- Proposed Infiltration Basin
- Proposed Pre-Treatment Swale
- River Corridor
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour
- Stream Centerlines

0 40 80 Ft N

1 inch = 40 feet

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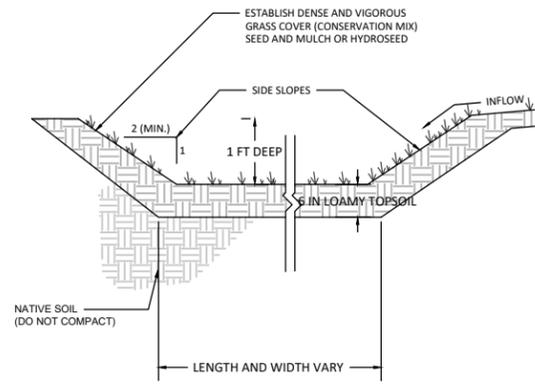
Notes:
- Conceptual design based on FEA field visit in 2024

**Project LON-16 Conceptual Design
Stormwater Master Plan**

**Pingree Park
Londonderry, VT**

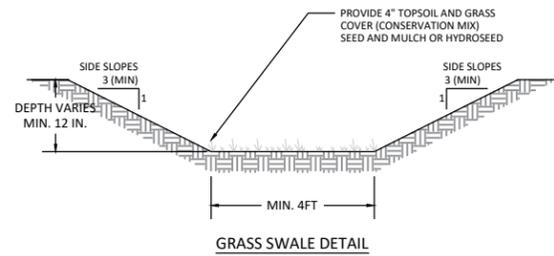
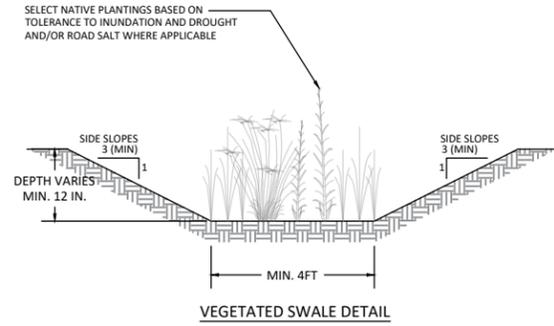
FCP	JHB
MAP BY	CHECKED
SCALE: 1 inch = 40 feet	
DATE: February 26, 2025	
SHEET 1	
SHEET NO.	

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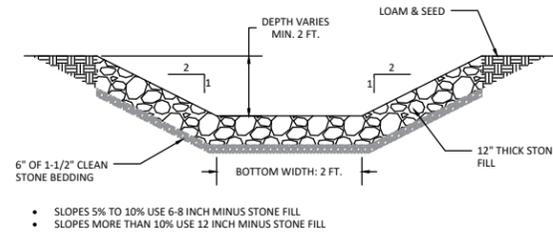


VERIFY DEPTH TO WATER TABLE:
3-FT MIXED RUNOFF
VERIFY INFILTRATION RATE OF UNDERLYING SOIL >0.2
INCHES/HOUR
PRETREATMENT REQUIRED FOR NON-ROOFTOP RUNOFF

INFILTRATION BASIN N.T.S.

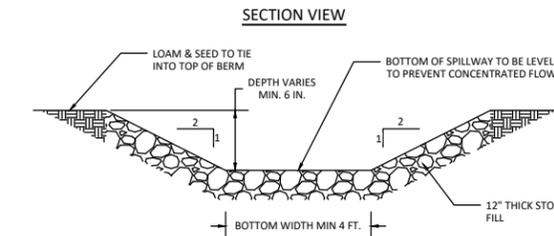
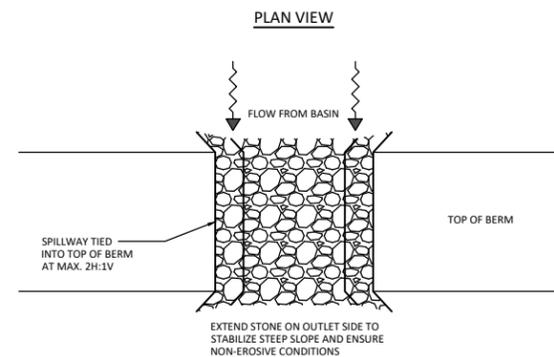


VEGETATED SWALE N.T.S.



- SLOPES 5% TO 10% USE 6-8 INCH MINUS STONE FILL
- SLOPES MORE THAN 10% USE 12 INCH MINUS STONE FILL

STONE LINED DITCH GULLY STABILIZATION N.T.S.



Basin Outlet Spillway N.T.S.

Preliminary Cost Opinion

Project LON-16

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 2,500	\$ 2,500
Common Excavation	30	CY	\$ 25	\$ 750
Hauling	30	CY	\$ 20	\$ 600
Topsoil	5	CY	\$ 50	\$ 250
Install Pretreatment Swale	1	LS	\$ 1,500	\$ 1,500
Type I Stone Fill	30	CY	\$ 75	\$ 2,250
Stone Outlet	1	LS	\$ 1,000	\$ 1,000
Plantings	1	LS	\$ 500	\$ 500
Misc. Erosion Control and Site Restoration	1	LS	\$ 2,000	\$ 2,000
Laborer	40	HR	\$ 50	\$ 2,000
Final Design & Permitting	1	LS	\$ 10,000	\$ 10,000
Construction Oversight	1	LS	\$ 4,000	\$ 4,000
			Subtotal	\$ 27,350
			Contingency (20%)	\$ 5,470
			Total	\$ 32,820

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



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Notes:

Project LON-16 Conceptual Design

Stormwater Master Plan

Pingree Park

Londonderry, VT

NOT FOR CONSTRUCTION

FCP
DRAWN

JHB
CHECKED

N.T.S.

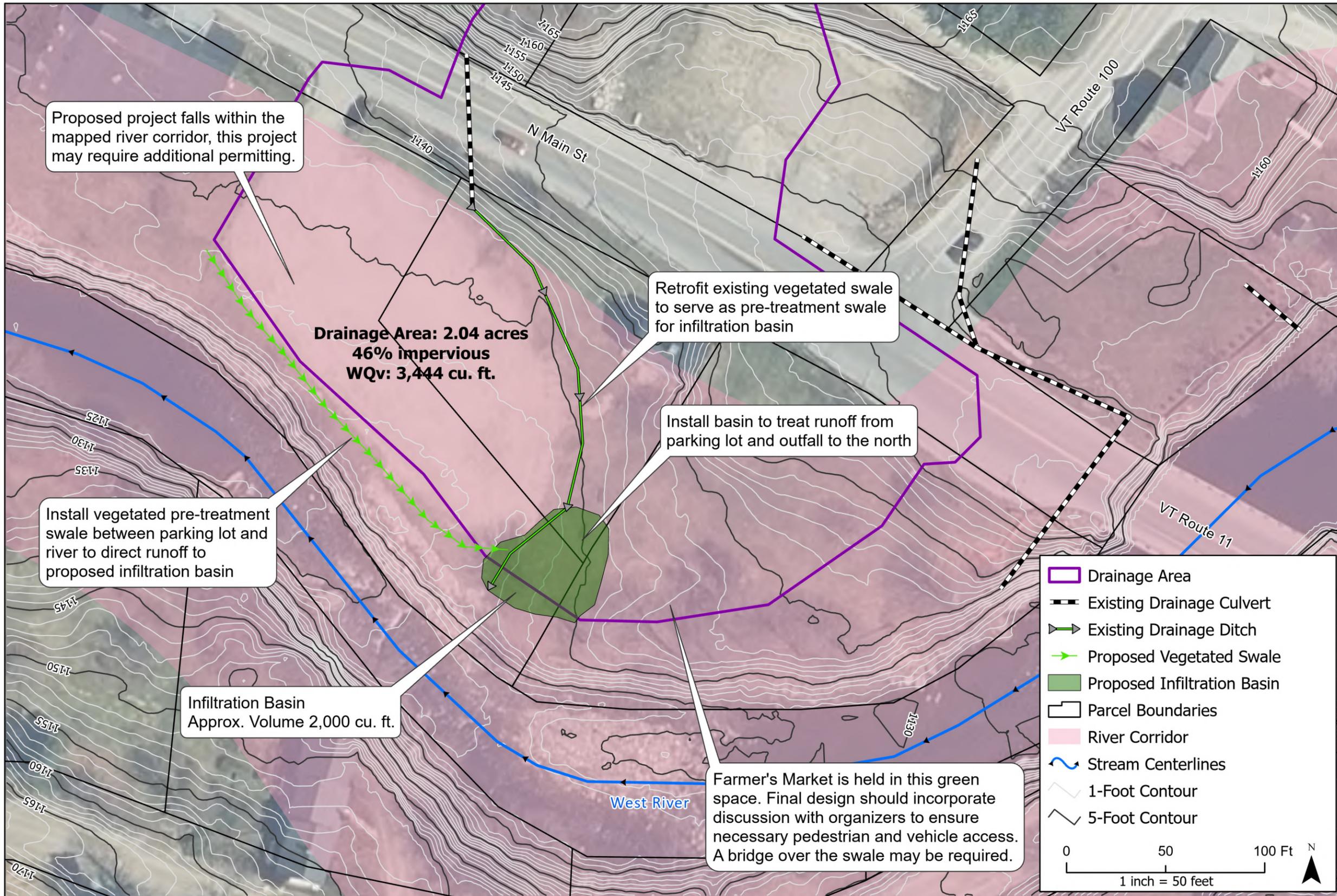
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2025-02-26

DATE

SHEET 2

SHEET NO.



Proposed project falls within the mapped river corridor, this project may require additional permitting.

Drainage Area: 2.04 acres
46% impervious
WQv: 3,444 cu. ft.

Retrofit existing vegetated swale to serve as pre-treatment swale for infiltration basin

Install basin to treat runoff from parking lot and outfall to the north

Install vegetated pre-treatment swale between parking lot and river to direct runoff to proposed infiltration basin

Infiltration Basin
 Approx. Volume 2,000 cu. ft.

Farmer's Market is held in this green space. Final design should incorporate discussion with organizers to ensure necessary pedestrian and vehicle access. A bridge over the swale may be required.

Legend

- Drainage Area
- Existing Drainage Culvert
- Existing Drainage Ditch
- Proposed Vegetated Swale
- Proposed Infiltration Basin
- Parcel Boundaries
- River Corridor
- Stream Centerlines
- 1-Foot Contour
- 5-Foot Contour

0 50 100 Ft N

1 inch = 50 feet

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Notes:
- Conceptual design based on FEA field visit in 2024

Project LON-18 Conceptual Design
Stormwater Master Plan

North Main Street
Londonderry, VT

FCP	JHB
MAP BY	CHECKED

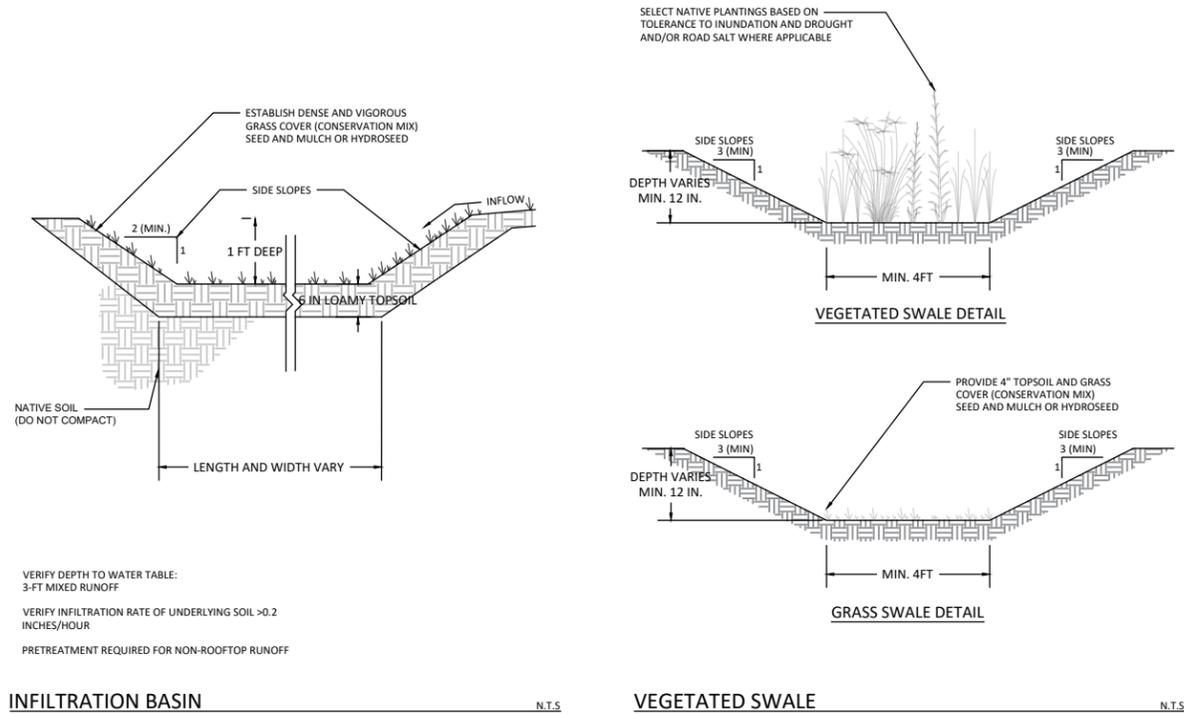
SCALE: 1 inch = 50 feet

DATE: April 29, 2025

SHEET 1

SHEET NO.

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Preliminary Cost Opinion

Project LON-18

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 1,500	\$ 1,500
Common Excavation	100	CY	\$ 25	\$ 2,500
Hauling	80	CY	\$ 20	\$ 1,600
Install Pretreatment Swales	2	LS	\$ 1,500	\$ 3,000
Stone Outlet	1	LS	\$ 1,000	\$ 1,000
Plantings	1	LS	\$ 500	\$ 500
Misc. Erosion Control and Site Restoration	1	LS	\$ 1,500	\$ 1,500
Laborer	40	HR	\$ 50	\$ 2,000
Final Design & Permitting	1	LS	\$ 10,000	\$ 10,000
Construction Oversight	1	LS	\$ 5,000	\$ 5,000
			Subtotal	\$ 28,600
			Contingency (20%)	\$ 5,720
			Total	\$ 34,320



EXISTING INFILTRATION BASIN DESIGNED BY FEA

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



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Notes:

Project LON-18 Conceptual Design

Stormwater Master Plan

North Main Street

Londonderry, VT

NOT FOR CONSTRUCTION

DRAWN FCP

CHECKED JHB

SCALE N.T.S.

DATE 2025-02-26

SHEET NO. SHEET 2