

Stormwater Master Plan for the Town of Chester, Vermont

FINAL REPORT

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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 Chester. This final SWMP report for the Town of Chester represents significant efforts and collaborations over the last several years between the Town, FEA, 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 better manage stormwater runoff to reduce sediment and nutrient pollution to the Williams 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) (**Section 4.3**). 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

Chester is a 55.9 square mile town located in Windsor County in Southern Vermont (**Figure 1**). The 90-acre village center is located between the Williams River and Middle Branch of the Williams River. As of the 2020 census, Chester has a total population of 3,005 people (U.S. Census Bureau 2020). The Town’s area is primarily (80.9%) forested (**Table 1**). Chester is bordered by 9 Vermont towns (Windham, Grafton, Rockingham, Springfield, Weathersfield, Baltimore, Cavendish, Ludlow, and Andover). Most of the roads in Chester are municipal, with 14.4% of the Town’s road length on Vermont State Roads and 4.4% of the Town’s road length on private roads (**Table 2**). Chester lies within the Black River and Williams River watersheds.

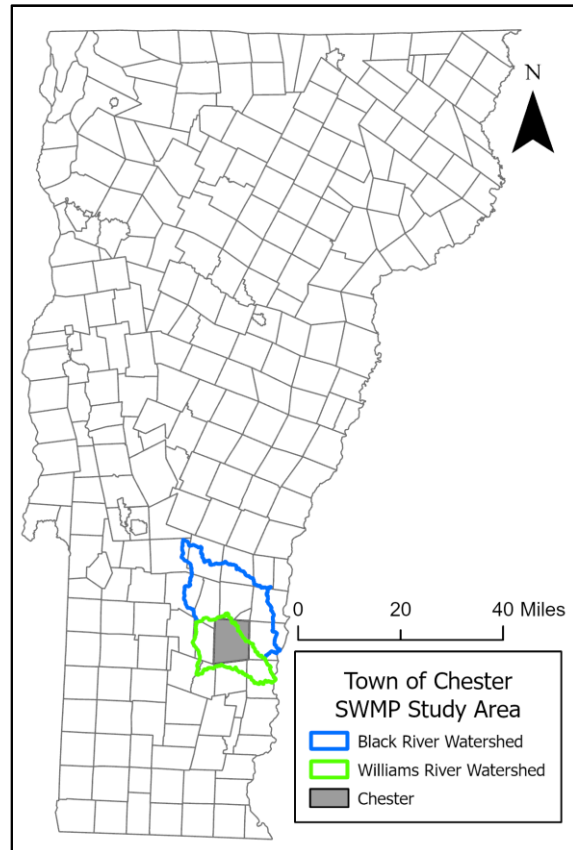


Figure 1: Town of Chester and Associated Watershed Location Map

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

Landcover/Landuse Type	Percent of Town Area
Agriculture	7.1%
Barren	0.1%
Developed	6.8%
Forest	80.9%
Grassland/Herbaceous	0.6%
Open Water	0.1%
Shrub/Scrub	2.2%
Wetland	2.2%

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

AOT Class	Description	Length (miles)	Percent of Town Road Length (excluding discontinued)
1	Class 1 Town Highway	2.48	1.9%
2	Class 2 Town Highway	12.5	9.4%
3	Class 3 Town Highway	74.6	56.4%
4	Class 4 Town Highway	17.6	13.3%
5	State Forest Highway	-	-
6	National Forest Highway	-	-
7	Legal Trail	-	-
8 & 9	Private Road	5.81	4.4%
30	Vermont State Highway	19.1	14.4%
40	US Highway	-	-
Other	-	0.22	0.2%
96	Discontinued Road	0.88	-



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

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

Soil Hydrogroup	Area (acres)	Percent of Town Area
A	2,630	7.34%
B	8,560	23.90%
C	17,259	48.18%
D	6,758	18.90%
Water	127	0.35%

3.0 Stormwater Management Planning Library

3.1 Mapping Data

VTDEC Municipal Roads Program

A Road Erosion Inventory (REI) for the Town of Chester was conducted by the Mount Ascutney Regional Commission (MARC, formerly known as the Southern Windsor County Regional Planning Commission) in 2015. 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. As of 2022, of the 760 hydrologically connected segments inventoried in Chester, 299 (32.4%) did not meet MRGP standards and 319 (34.6%) partially met MRGP standards ([link](#)). Roads in the Town with segments that did not meet or partially met MRGP standards included Popple Dungeon Road, Murdoch Road, and Smokeshire Road, among others. The MRGP specifies a timeline for bringing all road segments up to standards. Unimproved 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 Chester were collected in a series of flights conducted during 2016 as part of the VT LiDAR Initiative. The 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 MARC for Town roads in Chester are available online (<https://vtculverts.org/>). The dataset includes the structure dimensions and overall conditions but does not include the presence/absence of erosion. Most culverts were rated as fair or good. About 7% are rated as poor. We reviewed the culvert data to refine the selection of non-stream culverts that were focused on during field surveys.

Town of Chester Stormwater Infrastructure Mapping Project

This dataset was produced by the Vermont Department of Environmental Conservation (VTDEC) in 2017. The Stormwater Mapping Project documents the connectivity of stormwater infrastructure on private and public land within the Town of Chester. These data show the paths of stormwater from different areas of impervious surface (**Figure 2**). The associated report identifies three high priority sites for improvement, and points to another four sites of moderate priority. Eleven potential retrofit projects were identified in this study.



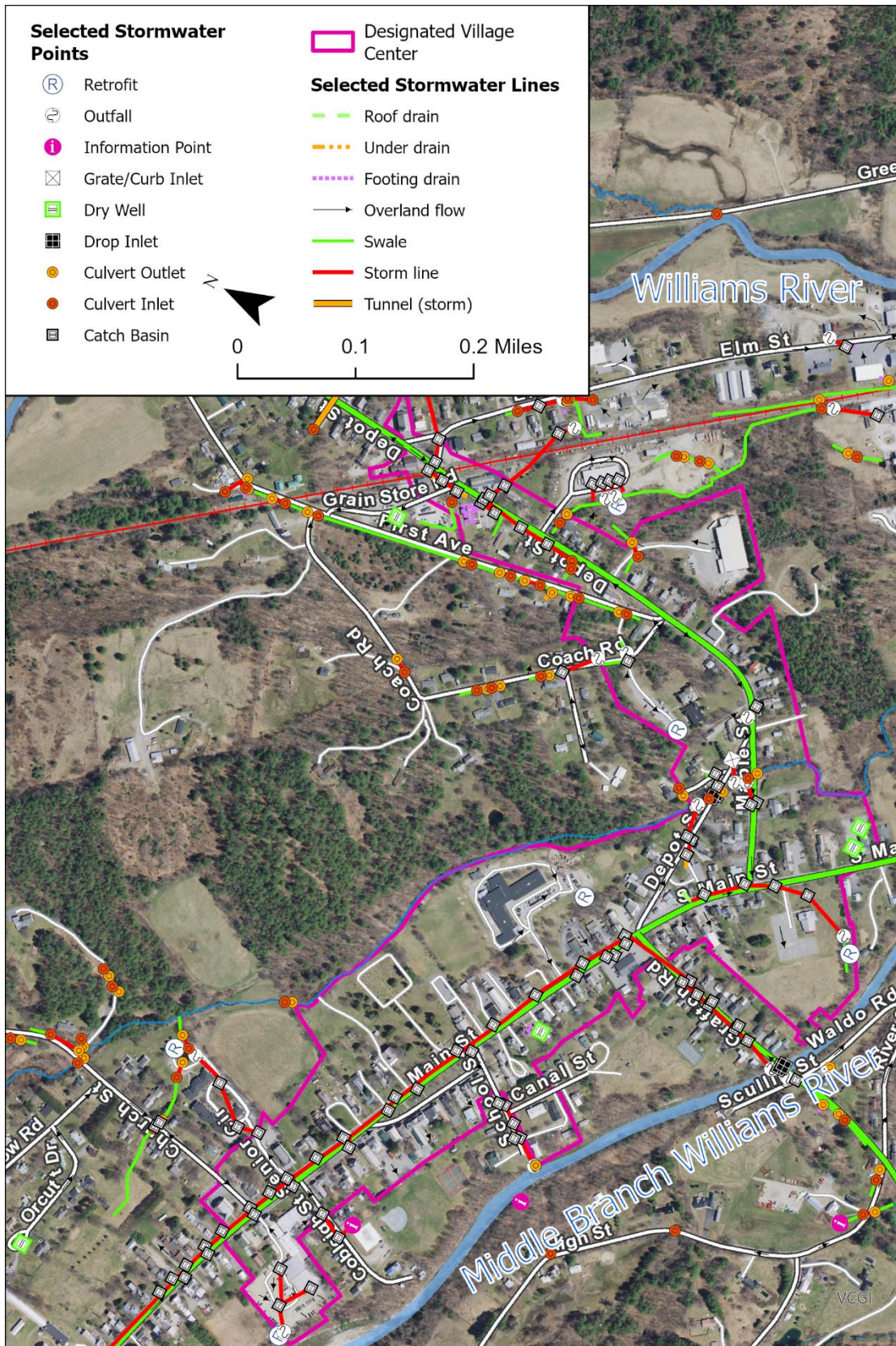


Figure 2: Chester Stormwater Infrastructure Map

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 will be informed by flood hazard potentials to mitigate flood damage within the Village center.

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 River, the Williams River, the Saxtons River, and the adjacent portion of the Connecticut river and related tributaries. 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 have been implemented (either on-going, in progress, or completed). Basin 11 consists of 3 major watersheds: the West River Watershed, the Saxtons River Watershed, and the Williams River Watershed. Roughly 84% of the basin is forested, with about 5% agriculture and about 6% developed.

In Basin 11, Chester is located in the Williams River Watershed. The Williams River mainstem is 40 miles long and drains 202 square miles of Vermont. The Williams River is most heavily impacted by pollution from sediment and nutrients, increased temperature resulting from loss of riparian vegetation and dam impoundments, and flow alteration. The Tactical Basin Plan draws focus to a number of potential projects for the Williams River. Those of particular relevance to Chester include providing technical assistance related to Nutrient Management Planning and determining high sources of nutrients in the Williams River near the Chester/Rockingham line.



Williams River Water Quality/Aquatic Habitat Assessment Report

This report on water quality in the Williams 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 old landfills. The study identified stressors of all of these types except old landfills in Chester. The most common stressors in Chester were hazardous waste sites. The biological health of the river for macroinvertebrates was generally very good to excellent, however, a number of sites need to be sampled for the first time. All sample sites included in the report had E. coli levels above the 126 mg/100 mL EPA standards for swimmable waters. Impaired sites from this study could make good improvement sites under the SWMP.

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. Researchers collected water samples at outfalls and junctions in stormwater systems and tested them for chemical and biological pollutants. No illicit discharges were detected in Chester.

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

FEA, under contract to the Windham County Natural Resources Conservation District, conducted a Phase 2 Stream Geomorphic Assessment (SGA) of selected reaches on the Williams River mainstem and its tributaries in 2014 and 2015. The locations of these reaches can be seen in **Figures 3 through 5**. Major stressors in these reaches included human-caused channel and valley constrictions, mainly from road and development encroachments on the river corridor. Channel straightening and stream bank armoring have all brought the Williams River channel away from its natural geomorphology and caused increased risk of damage and erosion during high flow events. Geomorphic conditions in these reaches were generally low fair to poor, with five reaches being rated as poor. Roads near these reaches could make good improvement sites under the SWMP. The locations of these reaches are shown in **Figure 6**.



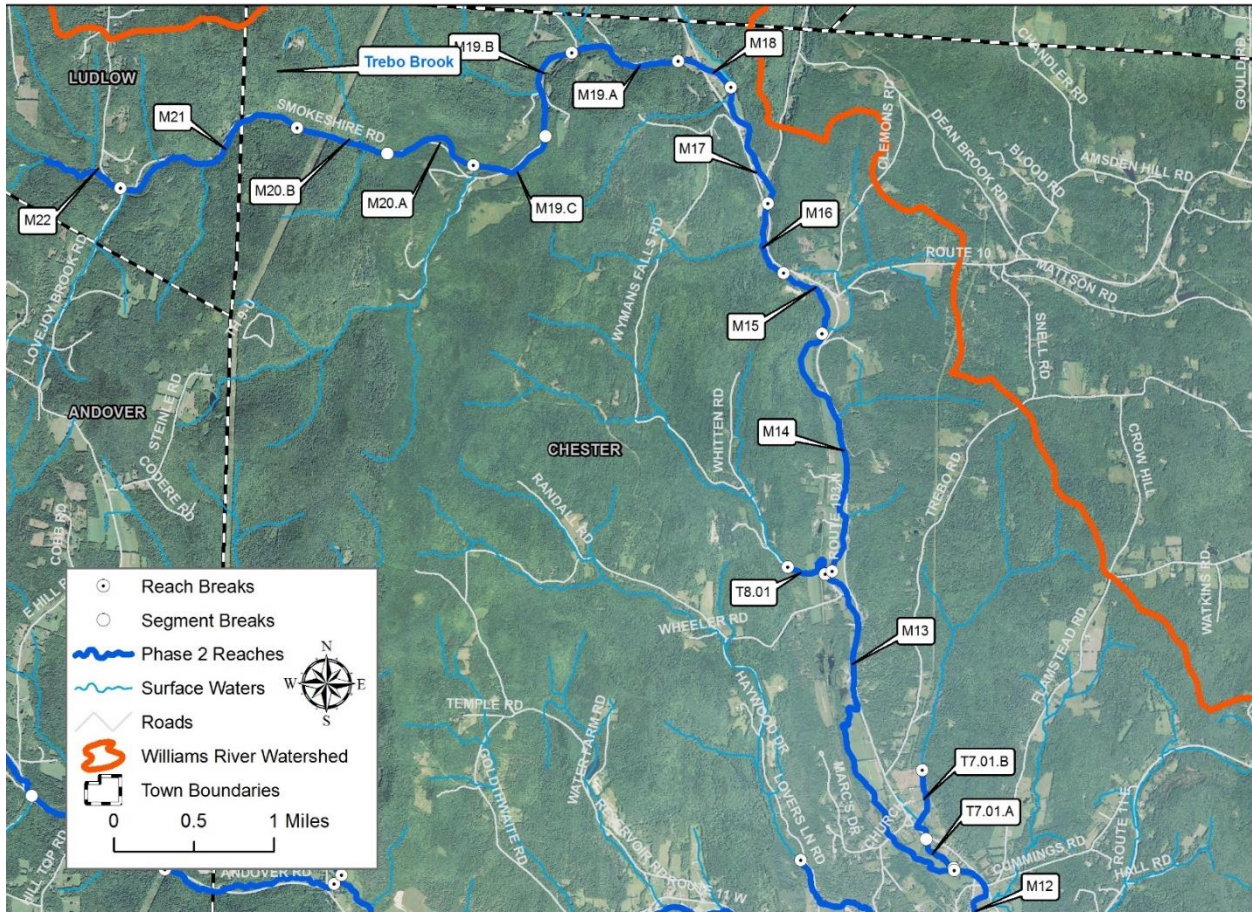


Figure 3: Upper Mainstem Phase II Reaches (FEA and WCNRC, 2015)

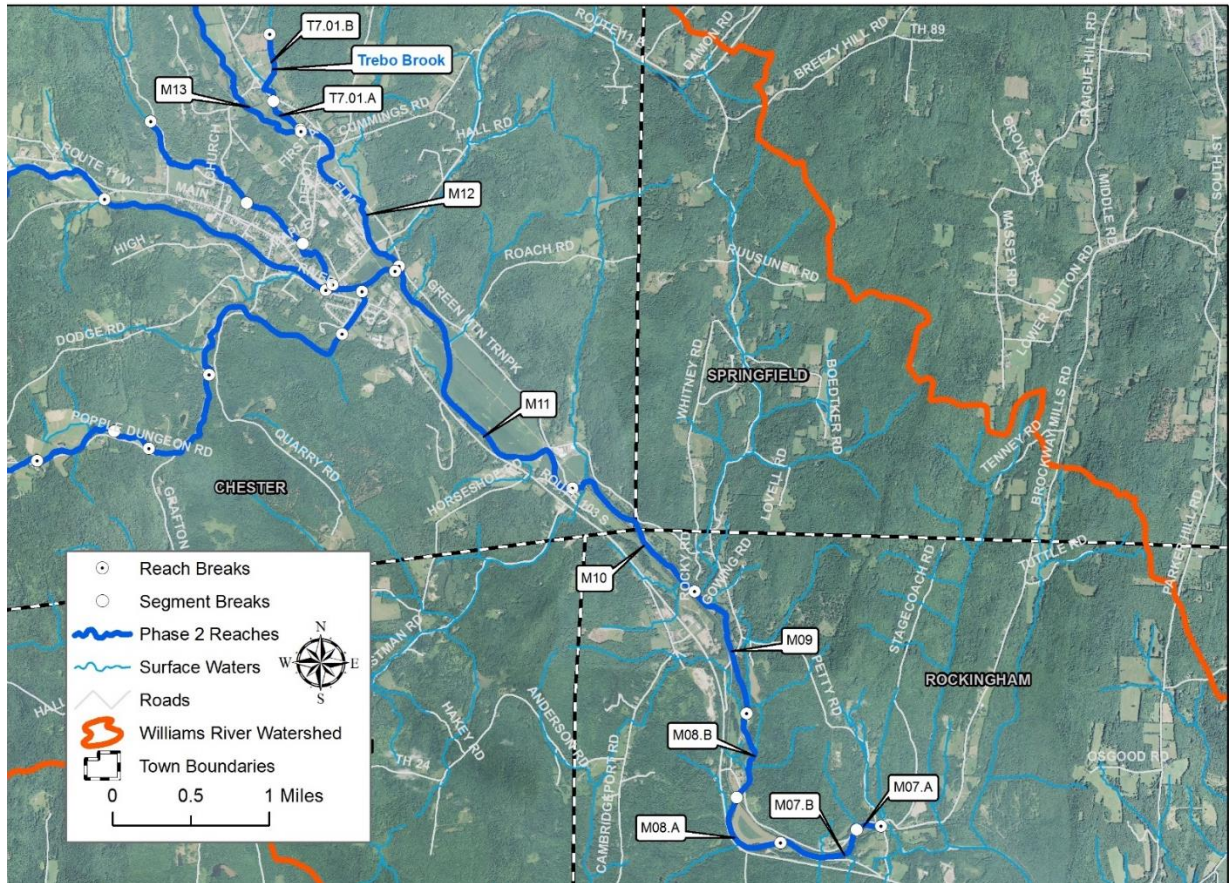


Figure 4: Lower Mainstem Phase II Reaches (FEA and WCNRC, 2015)

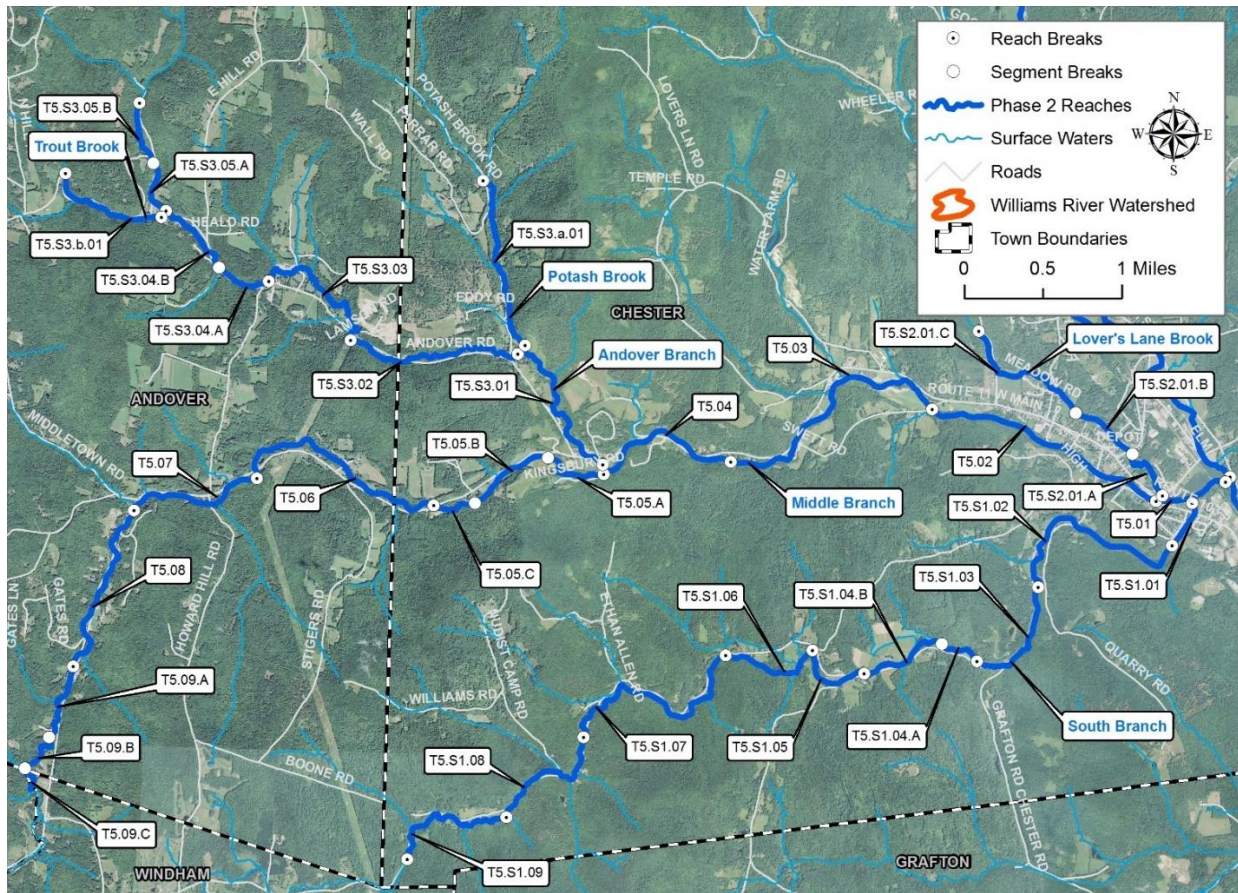


Figure 5: Middle Branch, South Branch, and Tributaries Phase II Reaches (FEA and WCNCRD, 2015)

3.3 Town Planning and Permitting

Chester Town Plan

The Chester Town Plan was adopted by the Town in May 2020 and was developed by the Chester Planning Commission with assistance from MARC. This plan aims to guide future growth and development of land, public services, and facilities, and to protect the environment. One of the main goals for the municipal plan is to “improve the quality of air, water, wildlife, and land resources.” Chester plans to relocate a section of Popple Dungeon Road that is eroding and sliding into the river and to replace the stone culvert under North Street in Stone Village. The Town is susceptible to flooding and experienced severe flood damage during Hurricane Irene in 2011. FEMA flood hazard mapping will be used to inform project selection to address flood risk and minimize damage.

Chester Unified Development Bylaws

This document was adopted by the Town of Chester in 2017. The document contains provisions that promote the development of the Town in a way that prevents erosion and sedimentation of surface waters and minimizes potential damages from future flood events. It limits development in flood hazard areas such as floodplains, 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.

Chester Local Hazard Mitigation Plan

This document was prepared by the Town of Chester and the MARC and adopted in 2021. 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. Flooding and erosion were identified as significant natural hazards. High priority actions and mitigation strategies associated with flooding and erosion include completing erosion and flood mitigation efforts on vulnerable stretch of Route 35, to design and implement a stormwater system to stabilize the river bank, and to make continued progress towards implementing MRGP best management practices.

3.4 Data Gaps

The data sources and information describing stormwater and watershed management in the Town of Chester are thorough and primarily up to date. The stormwater infrastructure mapping was completed in 2017, so there may have been important updates to the drainage systems within the Town 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 Chester. 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 22 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 three project categories described below.

- **Green Stormwater Infrastructure (GSI) Installation/Retrofit (20)** – 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 (1)** – Areas of high sediment and nutrient loading due to road, embankment, and ditch erosion.
- **Gully Stabilization (1)** – Problem areas where stormwater erosion has formed a gully, resulting in a nutrient and sediment source.

4.2 Evaluation and Prioritization of Problem Areas

Twenty-two (22) 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 32% to 66%. Additional information about the unified prioritization methods can be found in **Section 4.3** and **Table 5**.

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 22 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 Chester, 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/ft³ 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 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 CHE-01 – Chester Town Garage (30%)**

Problems Identified: Catch basins drain half of the parking lot and garage roof. They outlet into an eroding swale to the southwest. The swale drains to a wetland adjacent the sand pile.

Proposed Best Management Practice(s): Stone check dams in swales; Bioretention basin

Estimated Cost Effectiveness: \$20,000-\$30,000/kg P/year

2. **Project CHE-03/14 – Main Street, Behind the Elementary School (30%)**

Problems Identified: A large portion of the paved and gravel parking lot drains to a low point. Water pools in the lawn during rain. The ponded water flows along the drive and into the stream.

Proposed Best Management Practice(s): Grass swales and two (2) bioretention basins

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

3. **Project CHE-06 – VT Route 103 South, High School Parking Lot (30%)**

Problems Identified: The large paved parking lot of the high school drains to a low point on the southeast side. This grassy area is currently used for school bus parking. This is likely to be a future 3-acre stormwater site.

Proposed Best Management Practice(s): Grass swales and Infiltration basin

Estimated Cost Effectiveness: \$25,000-\$30,000/kg P/year

4. **Project CHE-13 – Main Street Cemetery (30%)**

Problems Identified: A storm line with a very large drainage area passes by an unused lawn on town-owned land in front of the cemetery.

Proposed Best Management Practice(s): Particle Separator Device and Subsurface Infiltration

Estimated Cost Effectiveness: \$30,000-\$50,000/kg P/year



5. Project CHE-17 – Grafton Road (30%)

Problems Identified: A large untreated stormwater system drains through pipes and catch basins into the Middle Branch Williams River.

Proposed Best Management Practice(s): Particle Separator Device

Estimated Cost Effectiveness: \$45,000-\$55,000/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 Chester. 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-owned property will aid the Town in proactively addressing and maintaining these features to avoid future stormwater problems.

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 167 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.



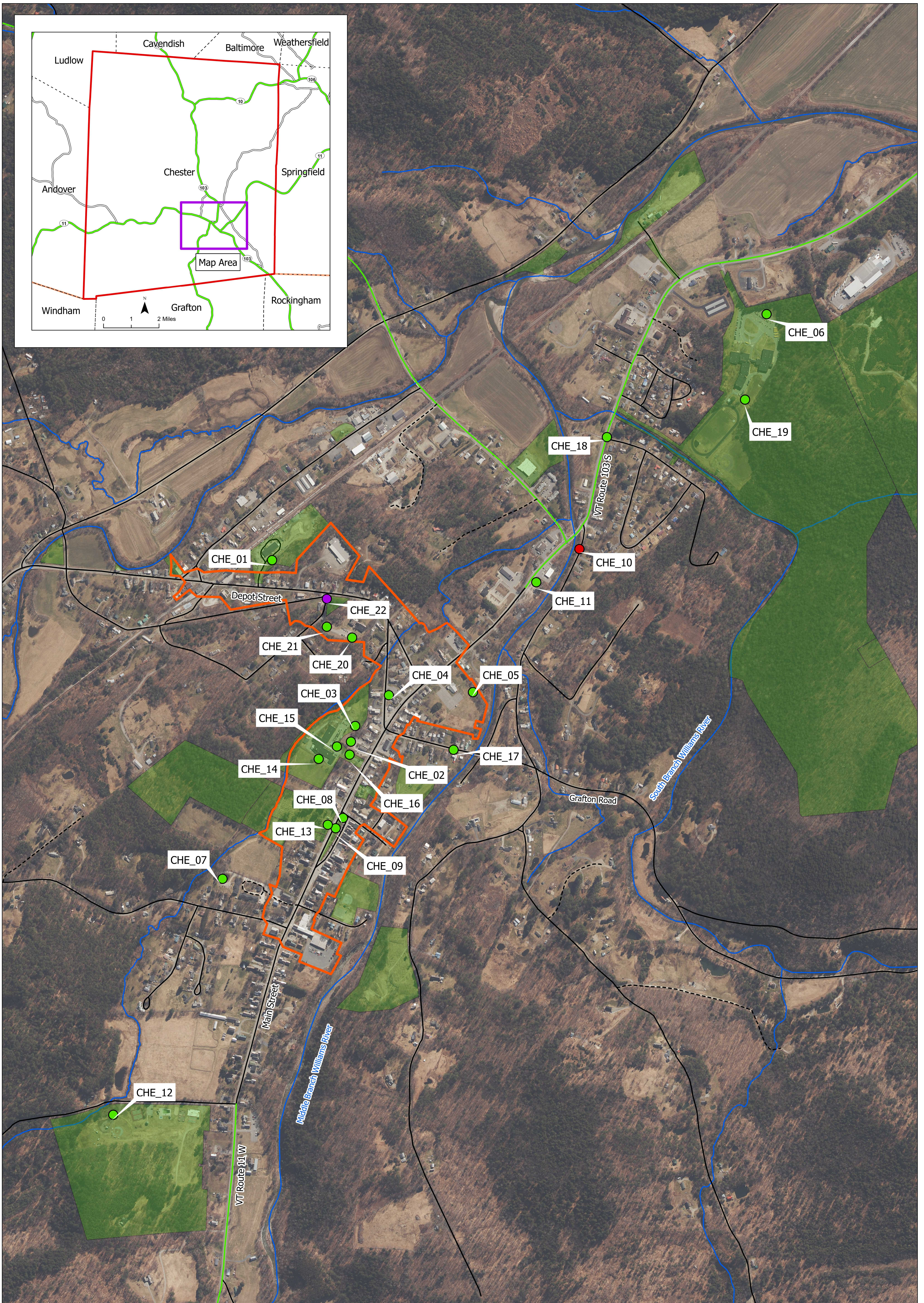
6.0 References

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- Environmental Protection Agency (EPA), 2016. Methodology for developing cost estimates for Opti-Tool.
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- Watershed Management Division, Vermont Agency of Natural Resources, October, 2014. The Williams River and its Watershed: Water Quality and Aquatic Habitat Assessment Update.



APPENDIX A

Project Location Map (24"x36")



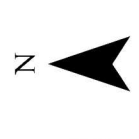
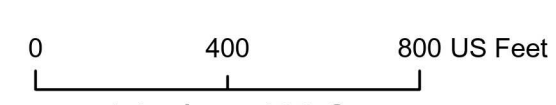

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www.fitzgeraldenvironmental.com

Town of Chester
Stormwater Master Plan Study Area
Project Location Map

Notes:
 -Project locations and recommendations are based on field assessments conducted on 12/6/22 and 6/16/23

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 	Roads <ul style="list-style-type: none"> Town Road State Highway Private Road 	Surface Waters <ul style="list-style-type: none"> Chester Village Center Town Boundaries Municipal Parcels
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 1 inch = 400 feet

APPENDIX B

Project Prioritization Summary Tables
(11"x17")

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

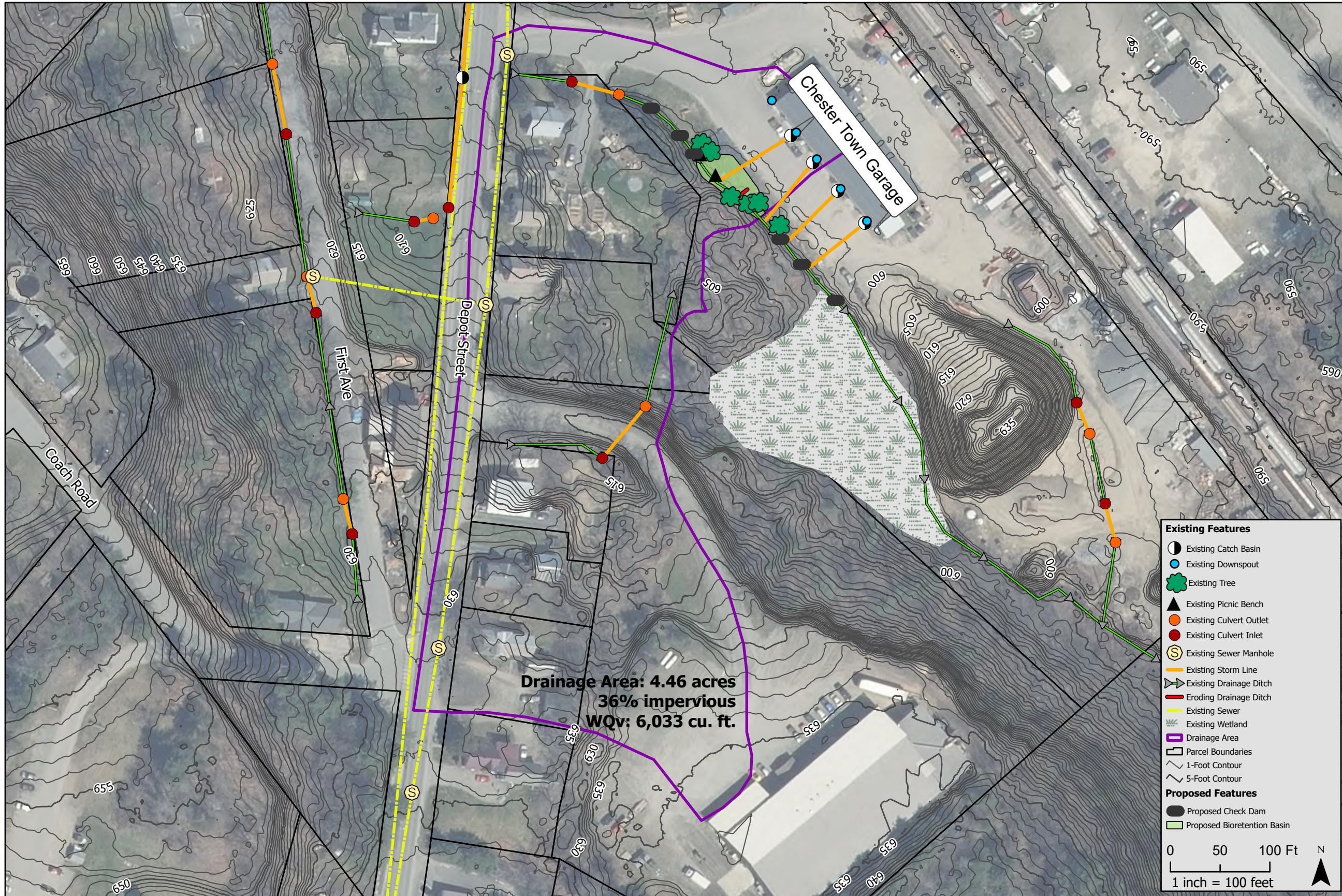
Project ID	Project Type	Location	Description	Preliminary Recommendations	Total Acreage	Impervious Acreage	% Impervious	P Load (lb/yr)	WQv (cf)	BMP Type	BMP Volume (cf)	BMP P Reduction (lb/yr)	Erosion P Reduction (lb/yr)	Total P Reduction (lb/yr)	Gully Mitigation	Landowner	Project/ Permitting Complexity	Infrastructure Conflicts	Total Cost	Project Efficiency \$/lb	Ease of O&M	Co-Benefits Sum	Total Score	Possible	Final Score %
CHE_01	GSI	Town Garage Road - Chester Town Garage	Catch basins drain half of the parking lot and garage roof. They outlet into an eroding swale to the southwest. The swale drains to a wetland adjacent the sand pile.	Retrofit the existing swale to infiltrate if soils allow, or gravel wetland if soils poorly infiltrate. A narrow basin could be installed if the swale area was widened.	1.70	0.98	57%	2.8	3,495	Gravel Wetland	4,054	1.65	1.00	2.65	1	3	2	0	31,200	11,778	2	3	33	50	66%
CHE_05	GSI	South Main Street - Church	The town stormwater infrastructure outfalls into a densely wooded area behind the church.	Divert the underground pipes to a treatment feature in the grassy area behind the church. The feature could be surface or subsurface infiltration. Most of the church roof and parking lot could be treated along with the drainage area of the stormwater pipes.	7.02	3.33	47%	10.1	12,152	Infiltration Chambers	12,160	9.46	2.00	11.46	0	0	2	0	146,600	12,795	0	1	28	50	56%
CHE_06	GSI	VT Route 1035 - High School Parking Lot	The large paved parking lot of the high school drains to a low point on the southeast side. This grassy area is currently used for school bus parking. This is likely to be a future 3-acre stormwater site.	A practice here could treat just surface runoff from the parking lot, or capture the runoff from the entire school. This could be a surface or subsurface infiltration feature. To capture more runoff, divert the swale coming from the west into the practice.	31.72	4.91	15%	25.7	21,802	Infiltration Chambers	16,000	22.13	0.00	22.13	0	3	2	0	259,700	11,734	0	3	28	50	56%
CHE_12	GSI	Lovers Lane Road - Town Park	A large gravel parking area drains to a torn up corner near the stream. It looks like there may be work going on in this location.	Install a feature in the corner of the parking lot. This could be a rain garden or infiltration feature. The feature would need substantial pretreatment for all the gravel.	0.49	0.26	53%	0.8	941	Bioretention (w/ underdrain)	940	0.37	2.22	2.59	1	3	0	0	30,200	11,642	1	3	26	50	52%
CHE_22	Road Erosion	Coach Road	There is no swale at the bottom of the road and erosion is developing.	Install a new swale or a sediment trap.	0.48	0.07	16%	0.2	330	Dry Swale (infiltrating)	330	0.37	0.15	0.52	0	3	2	0	4,500	8,621	2	2	25	50	50%
CHE_13	GSI	Main Street - Cemetery	A storm line with a very large drainage area passes by an unused lawn on town-owned land in front of the cemetery.	Install a large subsurface infiltration feature in the green space. Tie in the stormline and send water under the sidewalk to treat it.	9.38	5.00	53%	14.5	18,045	Infiltration Chambers	5,200	9.26	0.00	9.26	0	3	1	1	132,500	14,302	0	1	24	50	48%
CHE_08	GSI	Main Street - Village Green	An area of untreated town impervious runs off to the road and flows along the curb of the village green before entering a catch basin.	Install a series of curb cuts along the south side of the green with small infiltration basins or chambers. Any number of small features could be installed wherever utilities allow. Small surface infiltration features could overflow to the existing flow path on the road.	0.77	0.58	76%	1.5	2,040	Infiltration Basin	1,100	1.39	0.00	1.39	0	3	2	0	21,100	15,224	2	2	23	50	46%
CHE_14	GSI	Main Street - Behind Elementary School	Water floods in the low point behind the building causing a hazard for students. The ponded water flows along the drive and into the stream.	Regrade the driveway to mitigate flooding. Install a shallow swale on the northwest side to direct water toward the stream. The flat grade and likely high water table will make treatment difficult. This site could have an underdrained swale or a shallow infiltration basin if the soils allow.	3.14	1.12	36%	3.8	4,228	Dry Swale (w/ underdrain)	2,000	1.41	0.00	1.41	0	3	0	1	27,700	19,673	2	4	23	50	46%
CHE_18	GSI	Marshall Road	An entire neighborhood drains through pipes and catch basins into the South Branch Williams River with no treatment.	Install small bioretention features surrounding many of the catch basins. Raise the inlets to pool water in the bioretention features. A swirl separator under the road is another option. With landowner approval, a larger infiltration feature could be installed across Route 103 on private property.	35.79	6.01	17%	29.9	26,116	Bioretention (infiltrating)	760	4.47	0.19	4.65	0	0	0	1	45,700	9,826	1	1	22	50	44%
CHE_03	GSI	Main Street - Elementary School Parking lot	A large portion of the paved and gravel parking lot drains to a low point at the southeast corner. Water pools in the lawn area during rain.	Install a raingarden or bioretention in the grassy low point of the lawn area. Install a stable outlet toward the stream.	2.54	1.32	52%	3.9	4,780	Bioretention (no underdrain)	1,610	2.44	0.00	2.44	0	3	2	1	38,700	15,848	0	4	21	50	42%
CHE_07	GSI	Senior Circle	An existing wet pond has very little storage because the outlet invert is too low. The parcel has an existing VTDEC operational stormwater permit that appears to be up to date (5345-9050), however the pond was designed in the 1980's.	Retrofit the wet pond to raise the pipe inverts to add storage capacity to the existing feature.	12.69	3.30	26%	12.9	13,072	Wet pond/ Created Wetland	13,100	1.98	0.00	1.98	0	0	0	0	38,600	19,495	1	2	21	50	42%
CHE_16	GSI	Main Street - Elementary School Access Drive	Water pools along the edge of the pavement of the access drive to the Elementary School.	Add a swale along the length of the drive to relieve ponding. This project could direct water to an infiltrating practice installed for CHE_15.	0.07	0.06	93%	0.2	218	Dry Swale (infiltrating)	220	0.15	0.00	0.15	0	3	2	0	4,300	27,922	2	3	21	50	42%
CHE_17	Swirl Separator	Grafton Road	A large untreated stormwater system drains through pipes and catch basins into the Middle Branch Williams River.	Install a swirl separator under the street and tie in the last catch basin in the system.	29.03	13.11	45%	40.3	48,104	Swirl Separator	1	9.48	0.00	9.48	0	3	2	1	162,000	17,085	0	0	21	50	42%
CHE_15	GSI	Main Street - Elementary School	The access road to the Elementary School has no ditch. Water flows along the edge of the pavement down toward the school.	Regrade the grass area and install an infiltrating swale or a small surface infiltration basin.	0.14	0.11	81%	0.3	388	Infiltration Basin	390	0.29	0.00	0.29	0	3	2	0	8,500	29,720	2	2	20	50	40%
CHE_02	GSI	Main Street - Behind Dentist's Office	The parking lot and building drain to a low point to the north. The existing practice looks like an underdrained swale.	Retrofit the existing practice to infiltrate runoff.	0.44	0.20	46%	0.6	744	Infiltration Basin	750	0.59	0.00	0.59	0	0	2	0	13,400	22,559	2	2	19	50	38%

Stormwater Master Plan - Town of Chester
 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 %
CHE_09	GSI	Main Street - Village Green	An area of untreated town impervious runs off to the road and flows along the curb of the village green before entering a catch basin.	Install a series of curb cuts along the north side of the green with small infiltration basins or chambers. Any number of small features could be installed wherever utilities allow. Small surface infiltration features could overflow to the existing flow path on the road.	0.58	0.30	51%	0.9	1,079	Infiltration Basin	1,100	0.85	0.00	0.85	0	2	0	0	21,100	24,823	2	2	19	50	38%
CHE_10	Gully	River Street	A slightly eroding swale passes through a culvert under the road. A gully is forming down the river bank.	Stabilize the gully with stone. Retrofit the swale to infiltrate if soils allow.	16.56	0.52	3%	9.4	4,705	Dry Swale (infiltrating)	430	2.20	0.37	2.57	2	0	0	0	14,500	5,642	2	1	19	50	38%
CHE_21	GSI	41 Coach Road	Drainage flows down Coach Rd toward the town park.	Install a small BMP to catch the small amount of runoff before it heads downhill toward the town park.	0.57	0.10	17%	0.5	431	Infiltration Basin	430	0.46	0.00	0.46	0	0	2	0	9,200	19,913	2	2	19	50	38%
CHE_04	GSI	Depot Street - Bank Parking Lot	The paved bank parking lot drains into the town-controlled stormwater infrastructure.	Install a small infiltration or bioretention feature in the lawn in front of the bank.	0.32	0.19	61%	0.5	688	Infiltration Basin	690	0.53	0.00	0.53	0	0	2	1	13,300	25,189	2	1	18	50	36%
CHE_11	GSI	VT Route 103S - Diner Parking Lot	A gravel parking lot (Country Girl Diner) has water pooling at the downhill side.	Install an infiltration feature at the southeast end of the parking lot where the water pools. This feature would need pretreatment for the gravel. This could also be a good site for permeable pavers.	0.67	0.56	85%	1.4	1,963	Infiltration Basin	1,200	1.34	0.00	1.34	0	0	0	0	28,900	21,647	2	3	18	50	36%
CHE_19	GSI	VT Route 103 - Behind High School	Most of the school roof and the back parking lot drain into a vegetated swale.	Retrofit the existing swale into a gravel wetland to treat the whole roof before water enters the underground system.	5.29	1.80	34%	6.2	6,834	Gravel Wetland	6,840	3.43	0.00	3.43	0	3	2	0	156,000	45,455	0	4	18	50	36%
CHE_20	GSI	Coach Road - Apartment Building Parking Area	A small parking lot drains to a grassy area which discharges to a wooded area. There is mostly diffuse flow in the woods with limited erosion. This may cause nuisance flooding downslope at two residences.	Install a small infiltration basin or similar BMP at the edge of the parking lot.	0.77	0.32	42%	1.0	1,190	Bioretention (infiltrating)	1,190	0.99	0.19	1.18	0	0	2	0	44,200	37,617	1	2	16	50	32%

APPENDIX C

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



Drainage Area: 4.46 acres
36% impervious
WQv: 6,033 cu. ft.


Existing Features

- Existing Catch Basin
- Existing Downspout
- Existing Tree
- Existing Picnic Bench
- Existing Culvert Outlet
- Existing Culvert Inlet
- Existing Sewer Manhole
- Existing Storm Line
- Existing Drainage Ditch
- Eroding Drainage Ditch
- Existing Sewer
- Existing Wetland
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

Proposed Features

- Proposed Check Dam
- Proposed Bioretention Basin

0 50 100 Ft N
 1 inch = 100 feet



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www.fitzgeraldenvironmental.com

Notes:
 - Conceptual design based on FEA field visit in 2024
 - Contours from 2016 lidar (VGGI)

Project CHE-01 Conceptual Design
Stormwater Master Plan
Overall Watershed Plan

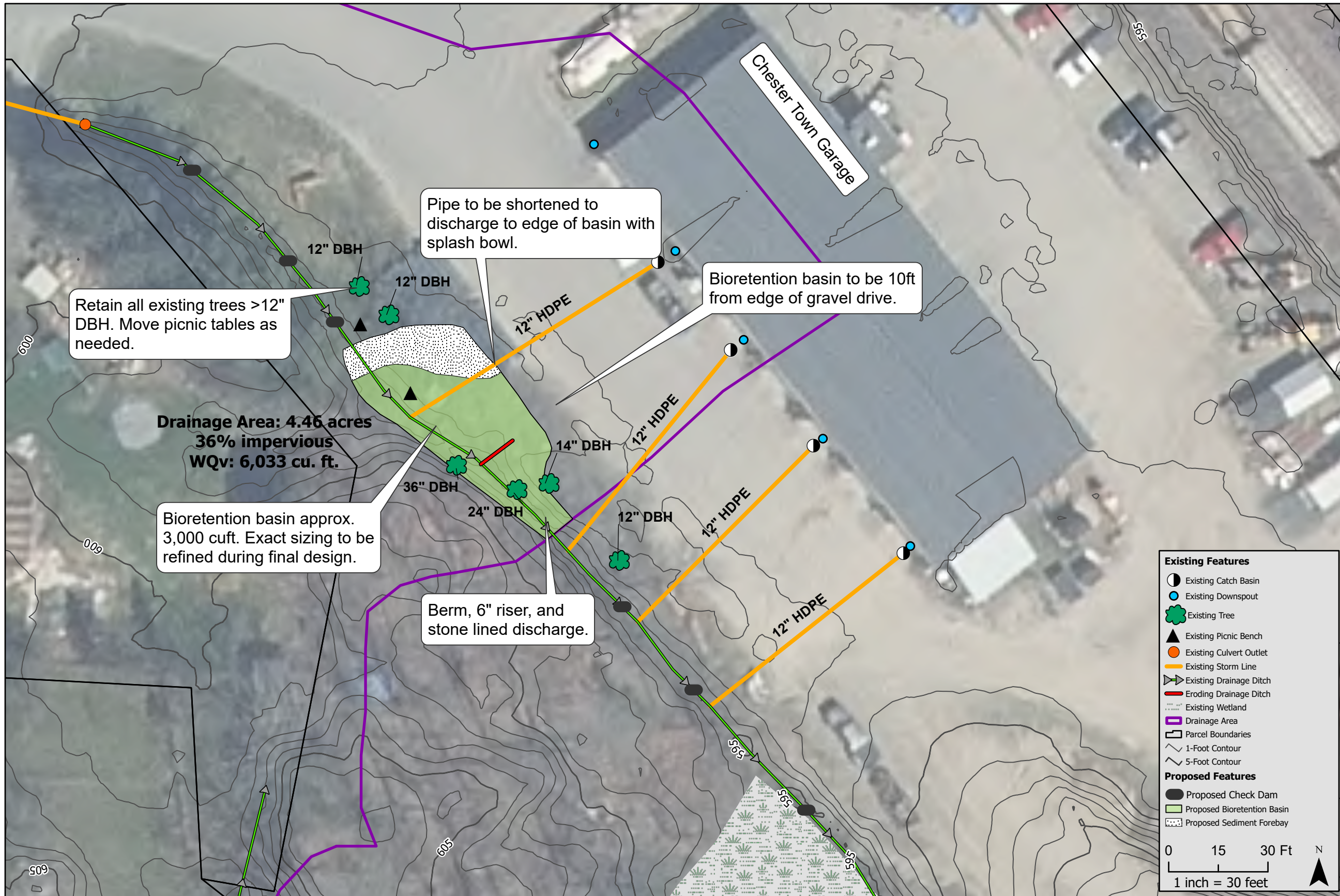
Chester Town Garage
Chester, VT

MAP BY JWC	CHECKED EPF
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SCALE
 1 inch = 100 feet

DATE
 March 26, 2025

SHEET NO.
SHEET 1



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Notes:
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 - Contours from 2016 lidar (VGGI)

**Project CHE-01 Conceptual Design
 Stormwater Master Plan
 Overall Site Plan**

**Chester Town Garage
 Chester, VT**

MAP BY: JWC
 CHECKED: EPF

SCALE: 1 inch = 30 feet

DATE: April 2, 2025

SHEET NO. **SHEET 2**

Existing Features

- Existing Catch Basin
- Existing Downspout
- Existing Tree
- Existing Picnic Bench
- Existing Culvert Outlet
- Existing Storm Line
- Existing Drainage Ditch
- Eroding Drainage Ditch
- Existing Wetland
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

Proposed Features

- Proposed Check Dam
- Proposed Bioretention Basin
- Proposed Sediment Forebay

0 15 30 Ft
 1 inch = 30 feet

Retain all existing trees >12" DBH. Move picnic tables as needed.

Drainage Area: 4.46 acres
36% impervious
WQv: 6,033 cu. ft.

Bioretention basin approx. 3,000 cuft. Exact sizing to be refined during final design.

Pipe to be shortened to discharge to edge of basin with splash bowl.

Bioretention basin to be 10ft from edge of gravel drive.

Berm, 6" riser, and stone lined discharge.

S:\2022\22041_VTDEC_SWMP\CAD\SWMP_CONCEPTDESIGNS.DWG 4/9/2025 11:38:44 AM

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.

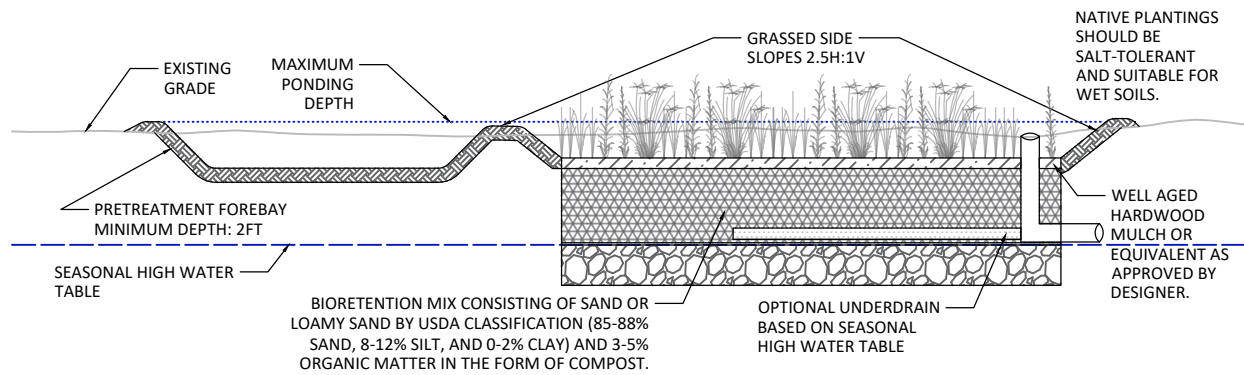
OPERATION OF MAINTENANCE NOTES

- THE FLOW PATH FROM THE LEVEL SPREADER DOWN THE STEEP SLOPE SHOULD BE INSPECTED REGULARLY AFTER RAIN EVENTS TO VERIFY THAT THERE IS NOT CONCENTRATED FLOW FROM THE FEATURE DOWN THE HILL.
- THE SEDIMENT TRAP SHOULD BE CLEARED OF SEDIMENT WHEN SEDIMENT DEPTH REACHES 1/2 OF THE TOTAL DEPTH OF THE FEATURE.
- THE PROJECT SITE SHOULD BE INSPECTED FOLLOWING ANY MAJOR STORM EVENT WITHIN THE YEAR AFTER INSTALLATION.
- AFTER THE FIRST YEAR, THE PROJECT SITE SHOULD BE INSPECTED SEMI-ANNUALLY.
- INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

DESIGN NOTES FOR FINAL DESIGN

- VERIFY WELL STATUS BEFORE INITIATING WORK ON FINAL DESIGN. IF WELL IS ACTIVE, NO INFILTRATION PRACTICES SHOULD BE INSTALLED AT THIS SITE.
- ADDITIONAL MODELING IS REQUIRED TO DETERMINE PRECISE SIZING OF THE BIORETENTION BASIN OR SEDIMENT TRAP.

*NOTES ADAPTED FROM SLR CONCEPT DESIGNS



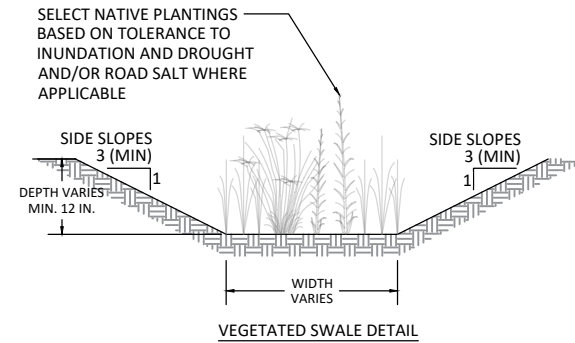
BIORETENTION BASIN

N.T.S.

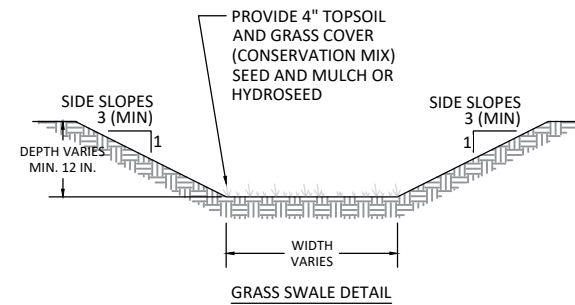
Preliminary Cost Opinion

Project CHE-01

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 1,000	\$ 1,000
Common Excavation	100	CY	\$ 25	\$ 2,500
Hauling	100	CY	\$ 20	\$ 2,000
Bioretention Soil	75	CY	\$ 80	\$ 6,000
Topsoil	10	CY	\$ 65	\$ 650
Stone Check Dams	6	LS	\$ 100	\$ 600
Basin Outflow Device and Stone Outlet	1	LS	\$ 1,500	\$ 1,500
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	\$ 8,000	\$ 8,000
Construction Oversight	1	LS	\$ 3,500	\$ 3,500
Subtotal				\$ 28,950
Contingency (20%)				\$ 5,790
Total				\$ 34,740



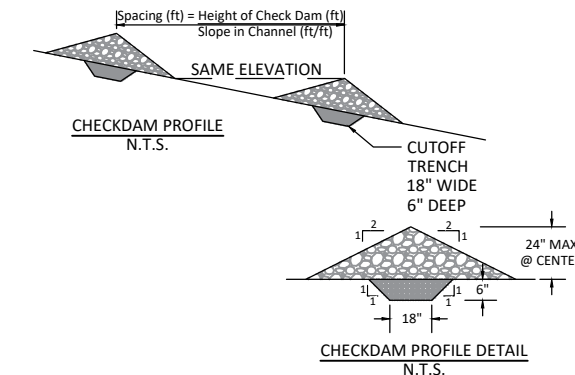
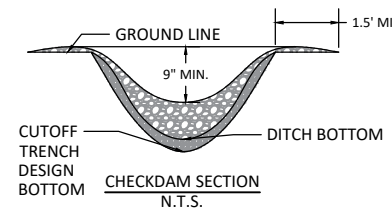
VEGETATED SWALE DETAIL



GRASS SWALE DETAIL

VEGETATED SWALE

N.T.S.



STONE CHECKDAM

N.T.S.

- USE 12 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 UPSTREAM DAM 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



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Notes:

Project CHE-01 Conceptual Design

Stormwater Master Plan
Project Typical Details
Chester Town Garage
Chester, VT
NOT FOR CONSTRUCTION

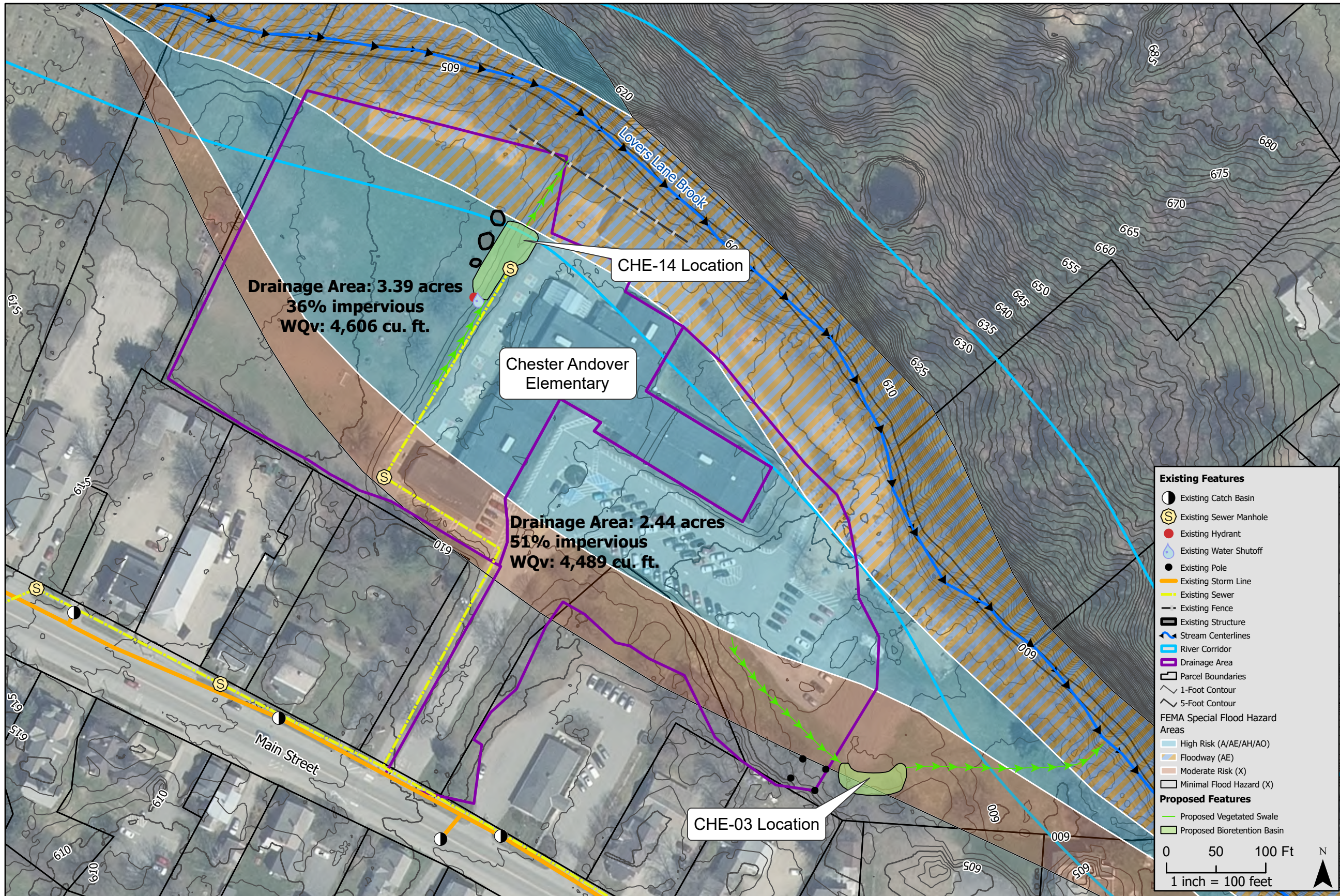
JWC EPF
DRAWN CHECKED

N.T.S.
SCALE

2025-03-21
DATE

SHEET 3

SHEET NO.



Drainage Area: 3.39 acres
36% impervious
WQv: 4,606 cu. ft.

CHE-14 Location

Chester Andover Elementary

Drainage Area: 2.44 acres
51% impervious
WQv: 4,489 cu. ft.

CHE-03 Location

Existing Features

- Existing Catch Basin
- Existing Sewer Manhole
- Existing Hydrant
- Existing Water Shutoff
- Existing Pole
- Existing Storm Line
- Existing Sewer
- Existing Fence
- Existing Structure
- Stream Centerlines
- River Corridor
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

FEMA Special Flood Hazard Areas


- High Risk (A/AE/AH/AO)
- Floodway (AE)
- Moderate Risk (X)
- Minimal Flood Hazard (X)

Proposed Features

- Proposed Vegetated Swale
- Proposed Bioretention Basin

0 50 100 Ft N
 1 inch = 100 feet

Fitzgerald Environmental Associates, LLC



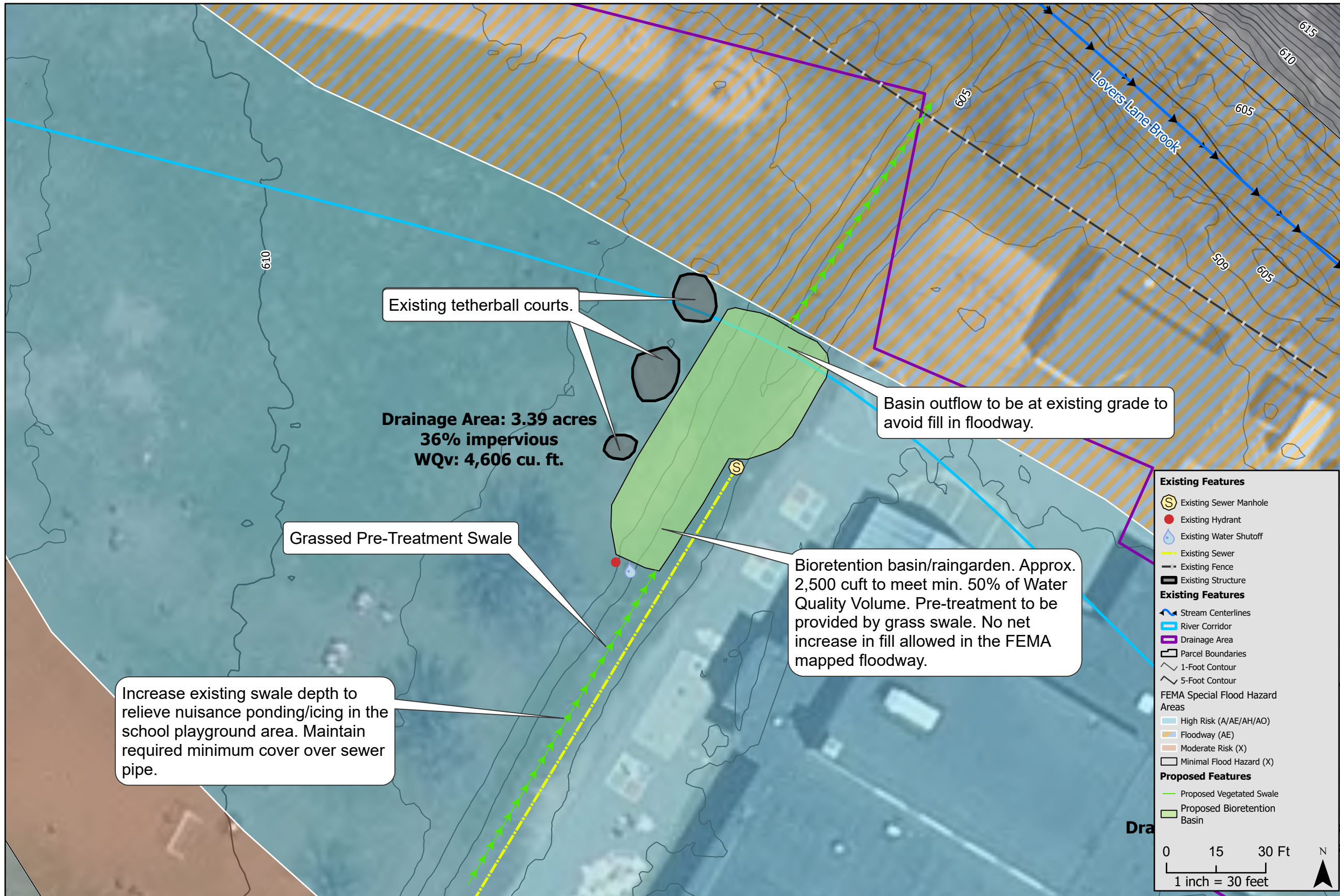
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Notes:
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 - Contours from 2016 lidar (VGGI)

Project CHE-03/14 Conceptual Design
 Stormwater Master Plan
 Overall Watershed Plan

Chester Andover Elementary
 Chester, VT

MAP BY	JWC	EPF
CHECKED		
SCALE	1 inch = 100 feet	
DATE	April 29, 2025	
SHEET NO.	SHEET 1	



Existing Features

- Existing Sewer Manhole
- Existing Hydrant
- Existing Water Shutoff
- Existing Sewer
- Existing Fence
- Existing Structure

Existing Features

- Stream Centerlines
- River Corridor
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

FEMA Special Flood Hazard Areas

- High Risk (A/AE/AH/AO)
- Floodway (AE)
- Moderate Risk (X)
- Minimal Flood Hazard (X)

Proposed Features

- Proposed Vegetated Swale
- Proposed Bioretention Basin

0 15 30 Ft
 1 inch = 30 feet

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Notes:
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 - Contours from 2016 lidar (VGGI)

Project CHE-14 Conceptual Design Stormwater Master Plan Overall Site Plan

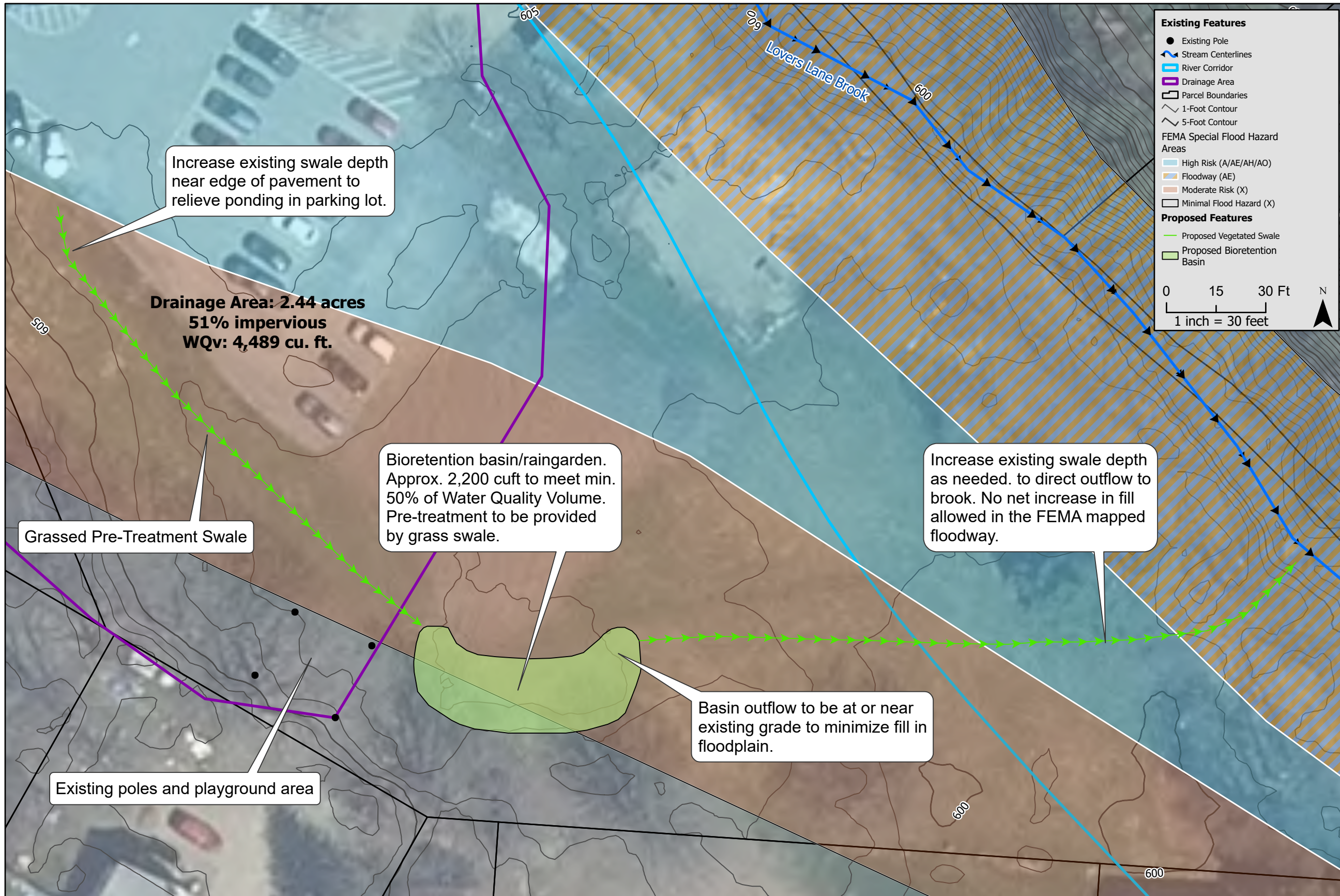
Chester Andover Elementary Chester, VT

MAP BY: JWC
 CHECKED: EPF

SCALE: 1 inch = 30 feet

DATE: April 14, 2025

SHEET 2
 SHEET NO.



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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
- Contours from 2016 lidar (VGGI)

Project CHE-03 Conceptual Design
 Stormwater Master Plan
 Overall Site Plan

Chester Andover Elementary
 Chester, VT

JWC EPF
 MAP BY CHECKED

1 inch = 30 feet
 SCALE

April 2, 2025
 DATE

SHEET 3
 SHEET NO.

Increase existing swale depth near edge of pavement to relieve ponding in parking lot.

Increase existing swale depth as needed. to direct outflow to brook. No net increase in fill allowed in the FEMA mapped floodway.

Bioretention basin/raingarden. Approx. 2,200 cuft to meet min. 50% of Water Quality Volume. Pre-treatment to be provided by grass swale.

Basin outflow to be at or near existing grade to minimize fill in floodplain.

Grassed Pre-Treatment Swale

Existing poles and playground area

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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.

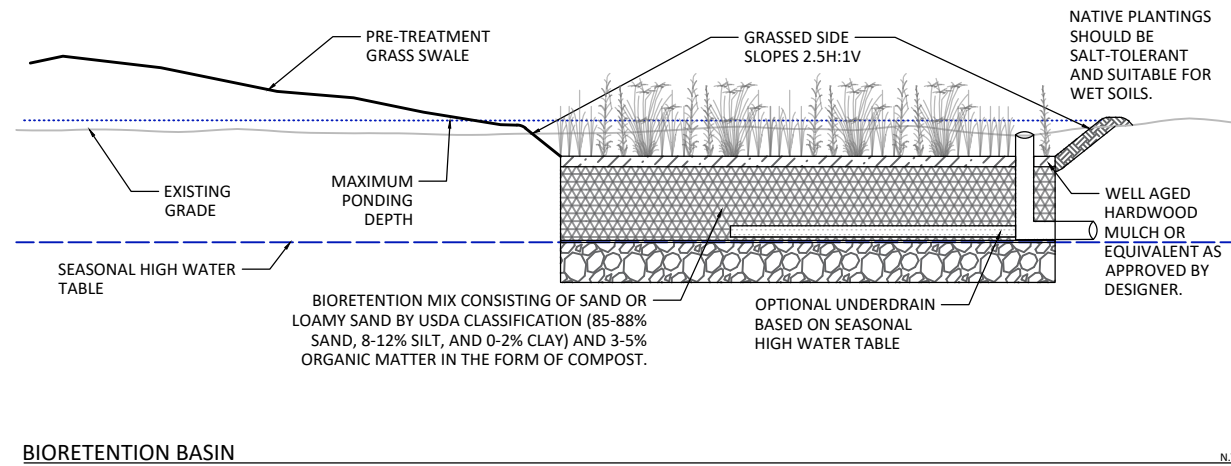
OPERATION OF MAINTENANCE NOTES

- THE FLOW PATH FROM THE LEVEL SPREADER DOWN THE STEEP SLOPE SHOULD BE INSPECTED REGULARLY AFTER RAIN EVENTS TO VERIFY THAT THERE IS NOT CONCENTRATED FLOW FROM THE FEATURE DOWN THE HILL.
- THE SEDIMENT TRAP SHOULD BE CLEARED OF SEDIMENT WHEN SEDIMENT DEPTH REACHES 1/2 OF THE TOTAL DEPTH OF THE FEATURE.
- THE PROJECT SITE SHOULD BE INSPECTED FOLLOWING ANY MAJOR STORM EVENT WITHIN THE YEAR AFTER INSTALLATION.
- AFTER THE FIRST YEAR, THE PROJECT SITE SHOULD BE INSPECTED SEMI-ANNUALLY.
- INSPECT FOR EROSION PATHS OR CONCENTRATED FLOW, AS NEEDED REDISTRIBUTE STONE TO REMOVE CONCENTRATED FLOW PATHS.

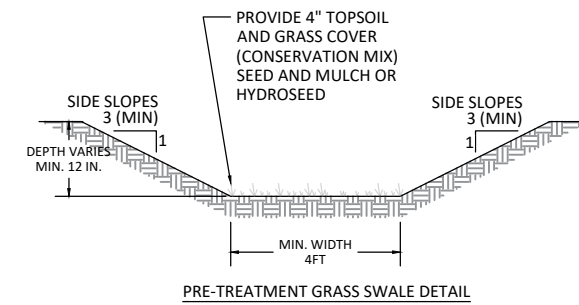
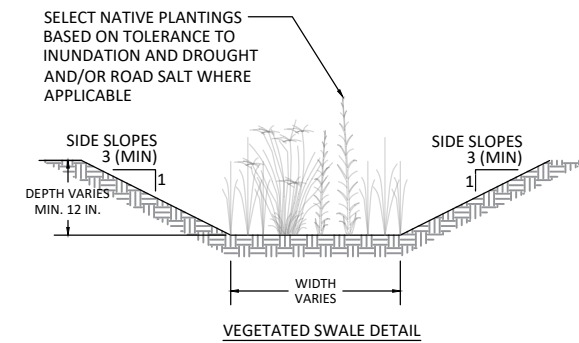
DESIGN NOTES FOR FINAL DESIGN

- VERIFY WELL STATUS BEFORE INITIATING WORK ON FINAL DESIGN. IF WELL IS ACTIVE, NO INFILTRATION PRACTICES SHOULD BE INSTALLED AT THIS SITE.
- ADDITIONAL MODELING IS REQUIRED TO DETERMINE PRECISE SIZING OF THE BIORETENTION BASIN OR SEDIMENT TRAP.

*NOTES ADAPTED FROM SLR CONCEPT DESIGNS



BIORETENTION BASIN



VEGETATED SWALE N.T.S.

Preliminary Cost Opinion

Project CHE-03 & CHE-14

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 1,500	\$ 1,500
Common Excavation	200	CY	\$ 25	\$ 5,000
Hauling	200	CY	\$ 20	\$ 4,000
Bioretention Soil	150	CY	\$ 80	\$ 12,000
Topsoil	20	CY	\$ 65	\$ 1,300
Basin Outflow Device and Stone Outlet	2	LS	\$ 1,000	\$ 2,000
Plantings	2	LS	\$ 500	\$ 1,000
Misc. Erosion Control and Site Restoration	2	LS	\$ 1,500	\$ 3,000
Laborer	60	HR	\$ 50	\$ 3,000
Final Design & Permitting	1	LS	\$ 12,000	\$ 12,000
Construction Oversight	1	LS	\$ 5,000	\$ 5,000
			Subtotal	\$ 49,800
			Contingency (20%)	\$ 9,960
			Total	\$ 59,760



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Notes:

Project CHE-03/14 Conceptual Design

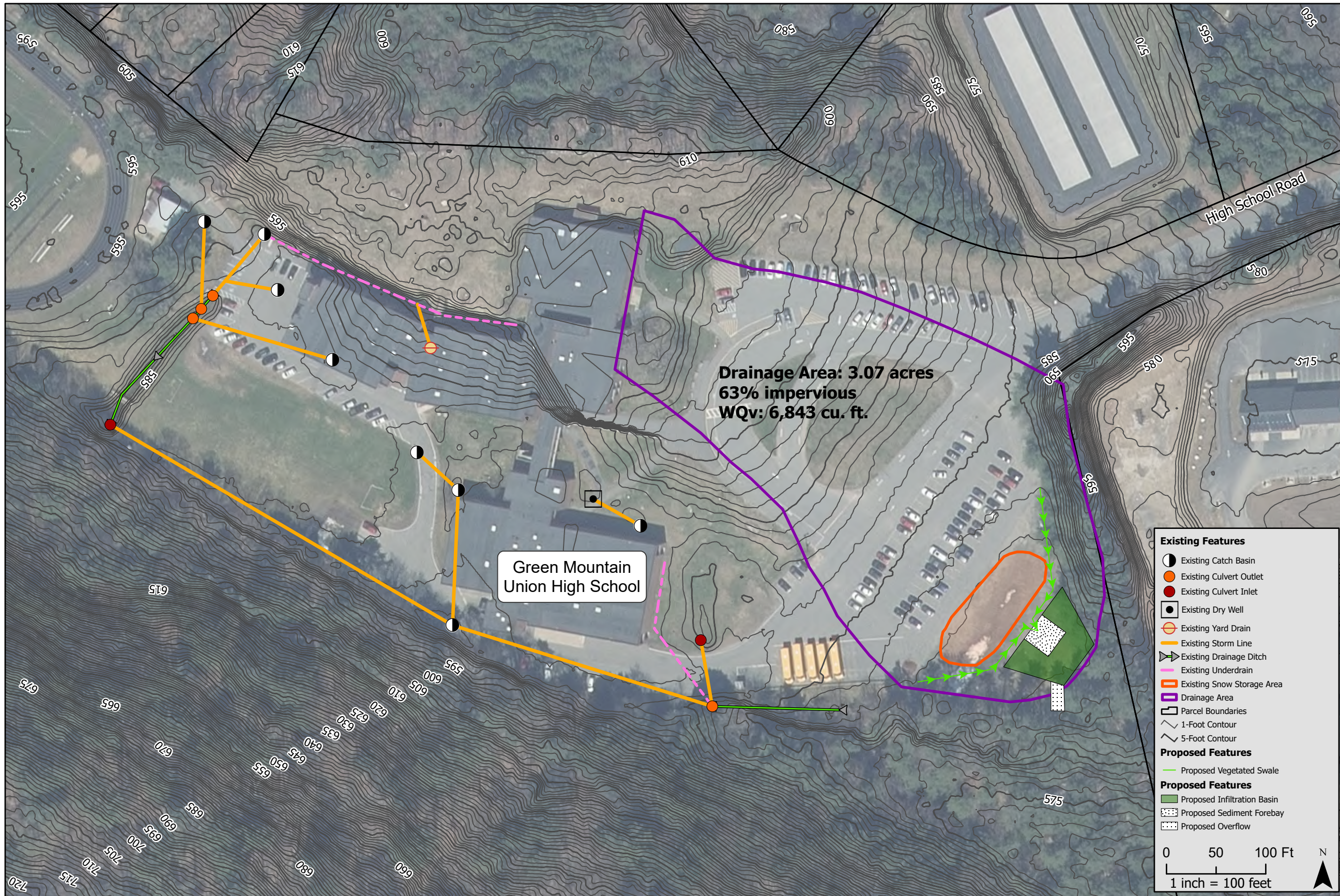
Stormwater Master Plan
 Project Typical Details
 Chester Andover Elementary School
 Chester, VT
NOT FOR CONSTRUCTION

JWC DRAWN EPF CHECKED

SCALE N.T.S.

DATE 2025-03-21

SHEET NO. SHEET 4



Existing Features

- Existing Catch Basin
- Existing Culvert Outlet
- Existing Culvert Inlet
- Existing Dry Well
- Existing Yard Drain
- Existing Storm Line
- Existing Drainage Ditch
- Existing Underdrain
- Existing Snow Storage Area
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

Proposed Features

- Proposed Vegetated Swale
- Proposed Infiltration Basin
- Proposed Sediment Forebay
- Proposed Overflow

0 50 100 Ft
 1 inch = 100 feet

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Notes:
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 - Contours from 2016 lidar (VGGI)

Project CHE-06 Conceptual Design Stormwater Master Plan Overall Watershed Plan

Green Mountain Union High School Chester, VT

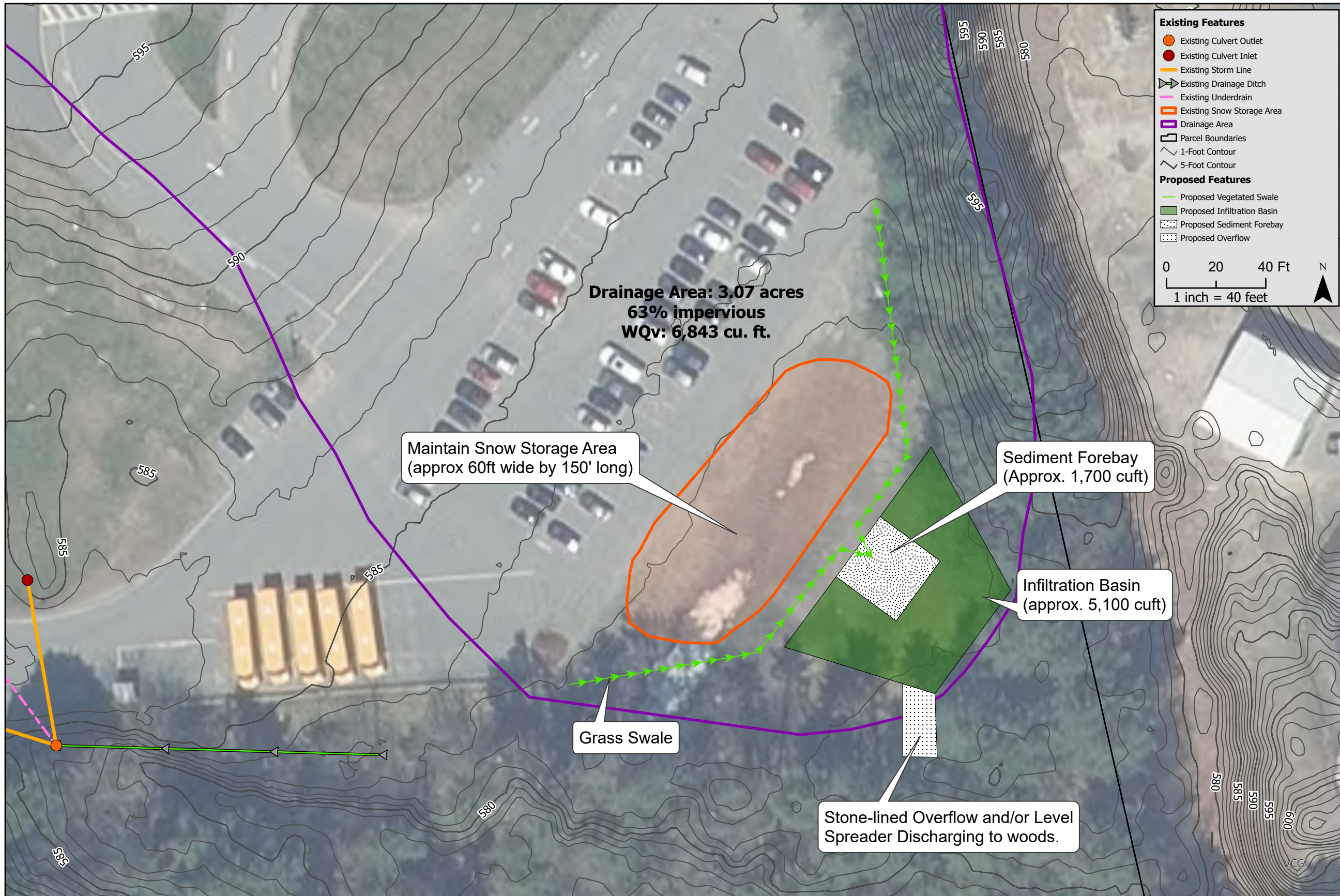
MAP BY: JWC
 CHECKED: EPF

SCALE: 1 inch = 100 feet

DATE: March 26, 2025

SHEET 1

SHEET NO.



Existing Features

- Existing Culvert Outlet
- Existing Culvert Inlet
- Existing Storm Line
- Existing Drainage Ditch
- Existing Underdrain
- Existing Snow Storage Area
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

Proposed Features

- Proposed Vegetated Swale
- Proposed Infiltration Basin
- Proposed Sediment Forebay
- Proposed Overflow

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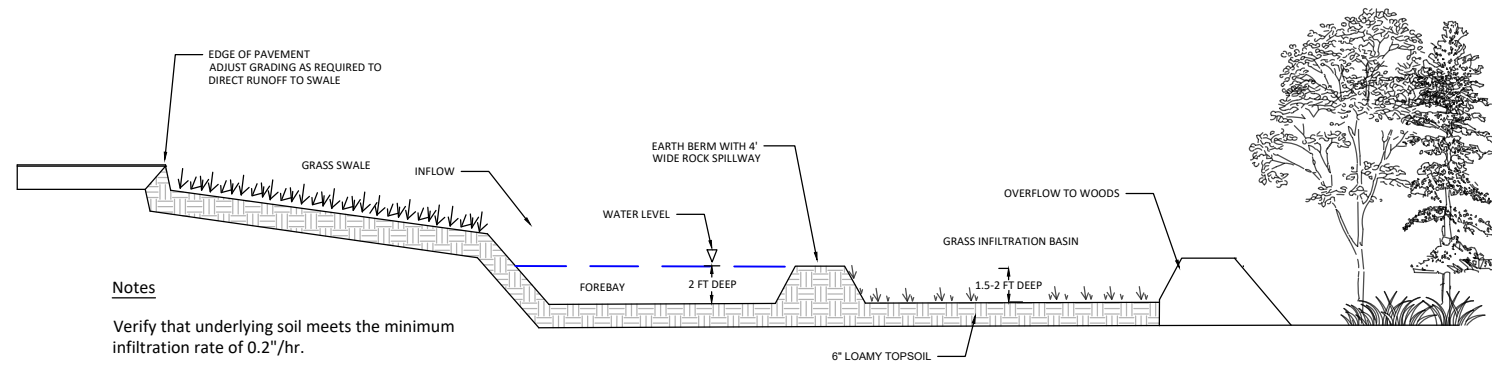
Notes:
- Conceptual design based on FEA field visit in 2024
- Contours from 2016 lidar (VGGI)

Project CHE-06 Conceptual Design
Stormwater Master Plan
Overall Site Plan

Green Mountain Union High School
Chester, VT

MAP BY	JWC	CHECKED	EPF
SCALE	1 inch = 40 feet		
DATE	March 27, 2025		
SHEET NO.	SHEET 2		

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Notes
Verify that underlying soil meets the minimum infiltration rate of 0.2"/hr.

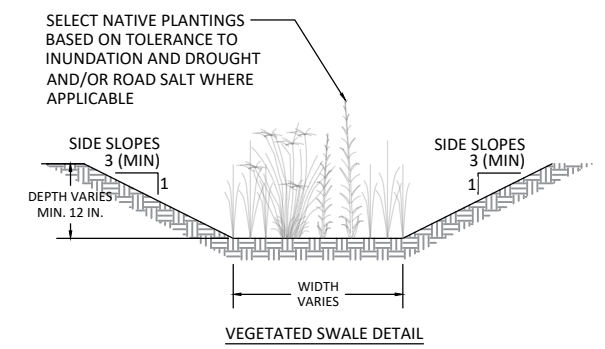
PROFILE: GRASS INFILTRATION BASIN WITH FOREBAY

N.T.S.

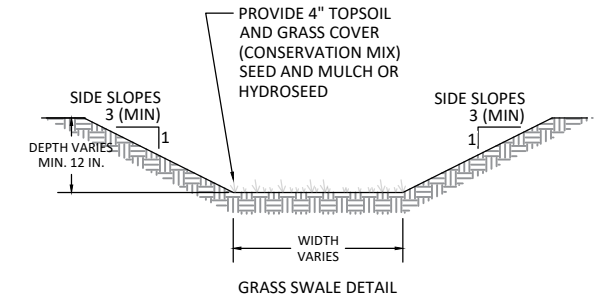
Preliminary Cost Opinion

Project CHE-06

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 2,000	\$ 2,000
Common Excavation	250	CY	\$ 25	\$ 6,250
Hauling	250	CY	\$ 20	\$ 5,000
Topsoil	100	CY	\$ 65	\$ 6,500
Type I Stone Fill	30	CY	\$ 75	\$ 2,250
Basin Outflow Device	1	LS	\$ 3,000	\$ 3,000
Grass Swales	300	LF	\$ 9	\$ 2,700
Seeding and Mulching Basin	1	LS	\$ 1,500	\$ 1,500
Misc. Erosion Control and Site Restoration	1	LS	\$ 3,000	\$ 3,000
Laborer	40	HR	\$ 50	\$ 2,000
Final Design & Permitting	1	LS	\$ 12,000	\$ 12,000
Construction Oversight	1	LS	\$ 5,000	\$ 5,000
			Subtotal	\$ 51,200
			Contingency (20%)	\$ 10,240
			Total	\$ 61,440



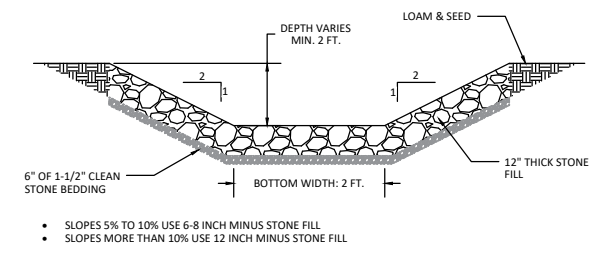
VEGETATED SWALE DETAIL



GRASS SWALE DETAIL

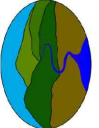
VEGETATED SWALE

N.T.S.



STONE LINED BASIN OVERFLOW

N.T.S.

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Notes:

Project CHE-06 Conceptual Design

Stormwater Master Plan
 Project Typical Details
 Green Mountain Union High School
 Chester, VT
NOT FOR CONSTRUCTION

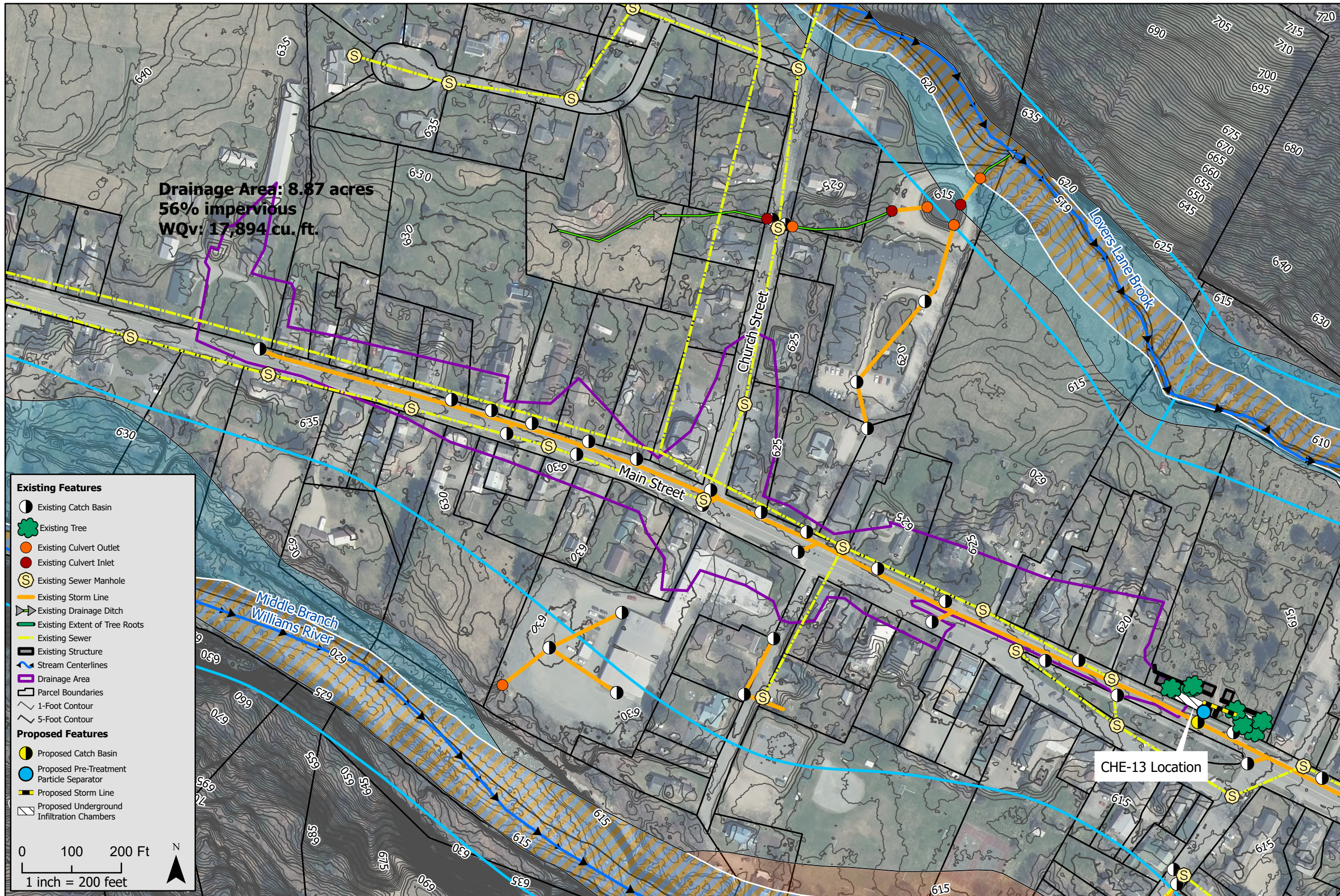
JWC
DRAWN

EPF
CHECKED

SCALE
 N.T.S.

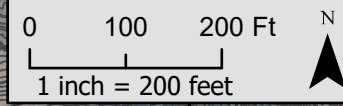
DATE
 2025-03-21

SHEET 3
SHEET NO.




Drainage Area: 8.87 acres
56% impervious
WQv: 17,894 cu. ft.

- Existing Features**
- Existing Catch Basin
 - Existing Tree
 - Existing Culvert Outlet
 - Existing Culvert Inlet
 - Ⓢ Existing Sewer Manhole
 - Existing Storm Line
 - Existing Drainage Ditch
 - Existing Extent of Tree Roots
 - Existing Sewer
 - Existing Structure
 - Stream Centerlines
 - Drainage Area
 - Parcel Boundaries
 - 1-Foot Contour
 - 5-Foot Contour
- Proposed Features**
- Proposed Catch Basin
 - Proposed Pre-Treatment Particle Separator
 - Proposed Storm Line
 - Proposed Underground Infiltration Chambers



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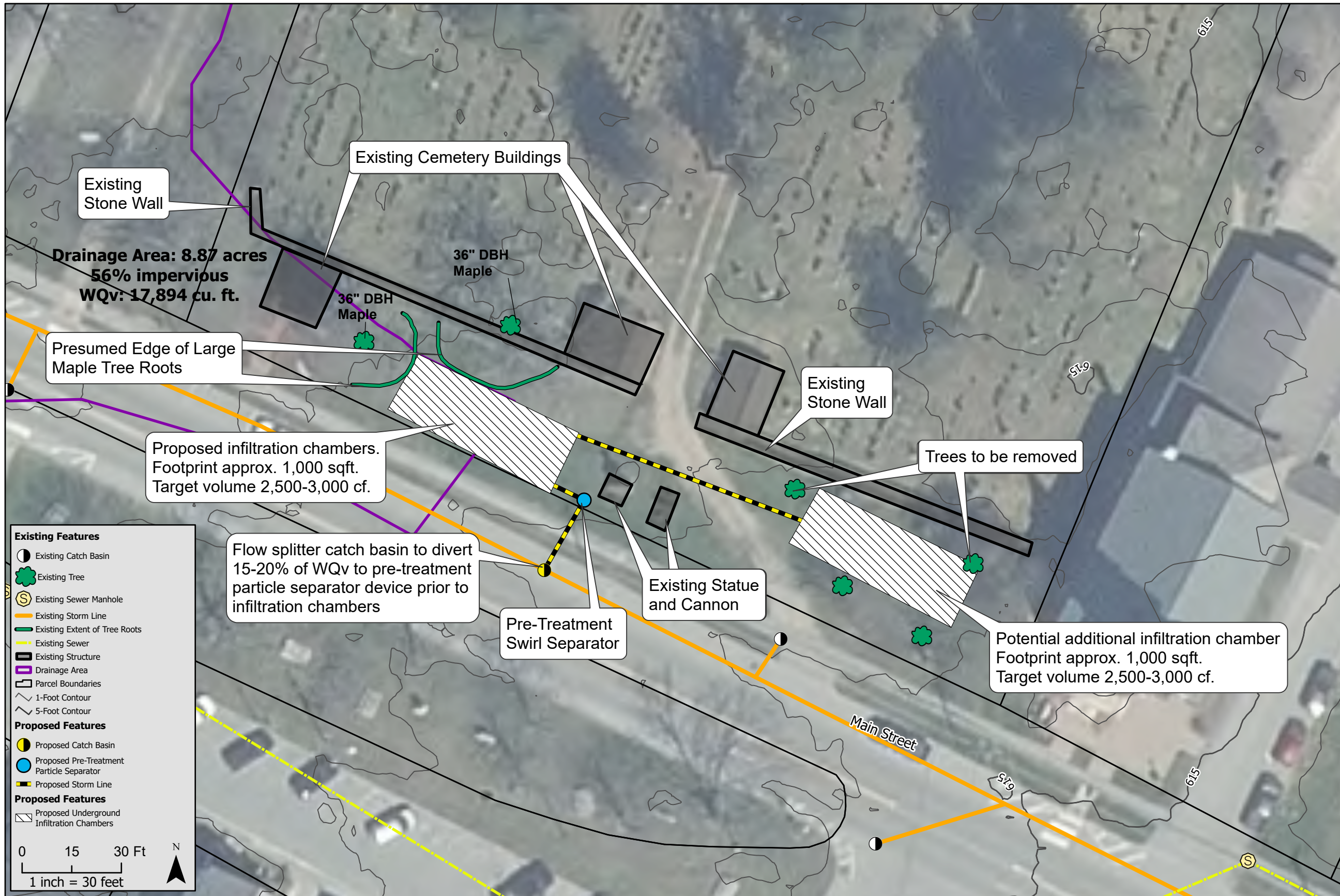
Notes:

- Conceptual design based on FEA field visit in 2024
- Contours from 2016 lidar (VGGI)

Project CHE-13 Conceptual Design
Stormwater Master Plan
Overall Watershed Plan

Main Street
 Chester, VT

MAP BY	JWC	EPF
CHECKED		
SCALE	1 inch = 200 feet	
DATE	April 28, 2025	
SHEET NO.	SHEET 1	



Drainage Area: 8.87 acres
56% impervious
WQv: 17,894 cu. ft.

Existing Cemetery Buildings

Existing Stone Wall

36" DBH Maple

36" DBH Maple

Presumed Edge of Large Maple Tree Roots

Proposed infiltration chambers.
 Footprint approx. 1,000 sqft.
 Target volume 2,500-3,000 cf.

Flow splitter catch basin to divert 15-20% of WQv to pre-treatment particle separator device prior to infiltration chambers

Pre-Treatment Swirl Separator

Existing Statue and Cannon

Existing Stone Wall

Trees to be removed

Potential additional infiltration chamber
 Footprint approx. 1,000 sqft.
 Target volume 2,500-3,000 cf.

Existing Features


- Existing Catch Basin
- Existing Tree
- Existing Sewer Manhole
- Existing Storm Line
- Existing Extent of Tree Roots
- Existing Sewer
- Existing Structure
- Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

Proposed Features

- Proposed Catch Basin
- Proposed Pre-Treatment Particle Separator
- Proposed Storm Line
- Proposed Underground Infiltration Chambers

0 15 30 Ft
 1 inch = 30 feet

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Notes:
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 - Contours from 2016 lidar (VGGI)

Project CHE-13 Conceptual Design
 Stormwater Master Plan
 Overall Site Plan
 Main Street
 Chester, VT

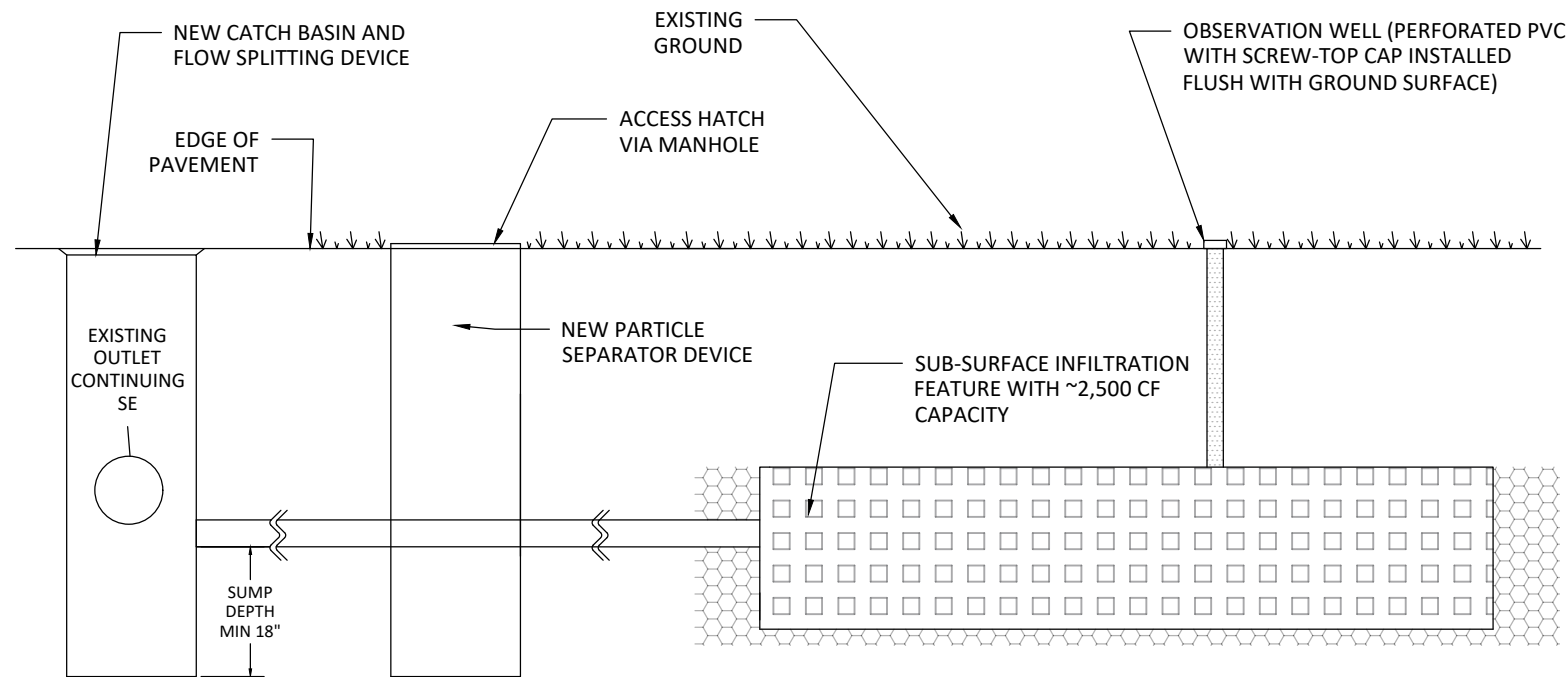
MAP BY: JWC
 CHECKED: EPF

SCALE: 1 inch = 30 feet

DATE: April 28, 2025

SHEET NO. SHEET 2

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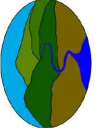


INFILTRATION CHAMBERS: R-TANK TYPICAL DETAIL N.T.S

Preliminary Cost Opinion

Project CHE-13

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 6,000	\$ 6,000
Common Excavation	400	CY	\$ 25	\$ 10,000
Hauling	300	CY	\$ 20	\$ 6,000
Topsoil	30	CY	\$ 65	\$ 1,950
New Catch Basin with Flow Splitter	1	LS	\$ 6,000	\$ 6,000
Sawcut and Repave; Repair Sidewalk/Curb	1	LS	\$ 5,000	\$ 5,000
8" SDR11 Pipe	120	LF	\$ 20	\$ 2,400
Contech - CS-5 Swirl Separator	1	LS	\$ 16,500	\$ 16,500
Ferguson - R-Tank HD System	2	LS	\$ 12,000	\$ 24,000
Misc. Erosion Control and Site Restoration	1	LS	\$ 5,000	\$ 5,000
Laborer	120	HR	\$ 50	\$ 6,000
Final Design & Permitting	1	LS	\$ 20,000	\$ 20,000
Construction Oversight	1	LS	\$ 8,000	\$ 8,000
			Subtotal	\$ 116,850
			Contingency (20%)	\$ 23,370
			Total	\$ 140,220

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Notes:

Project CHE-13 Conceptual Design

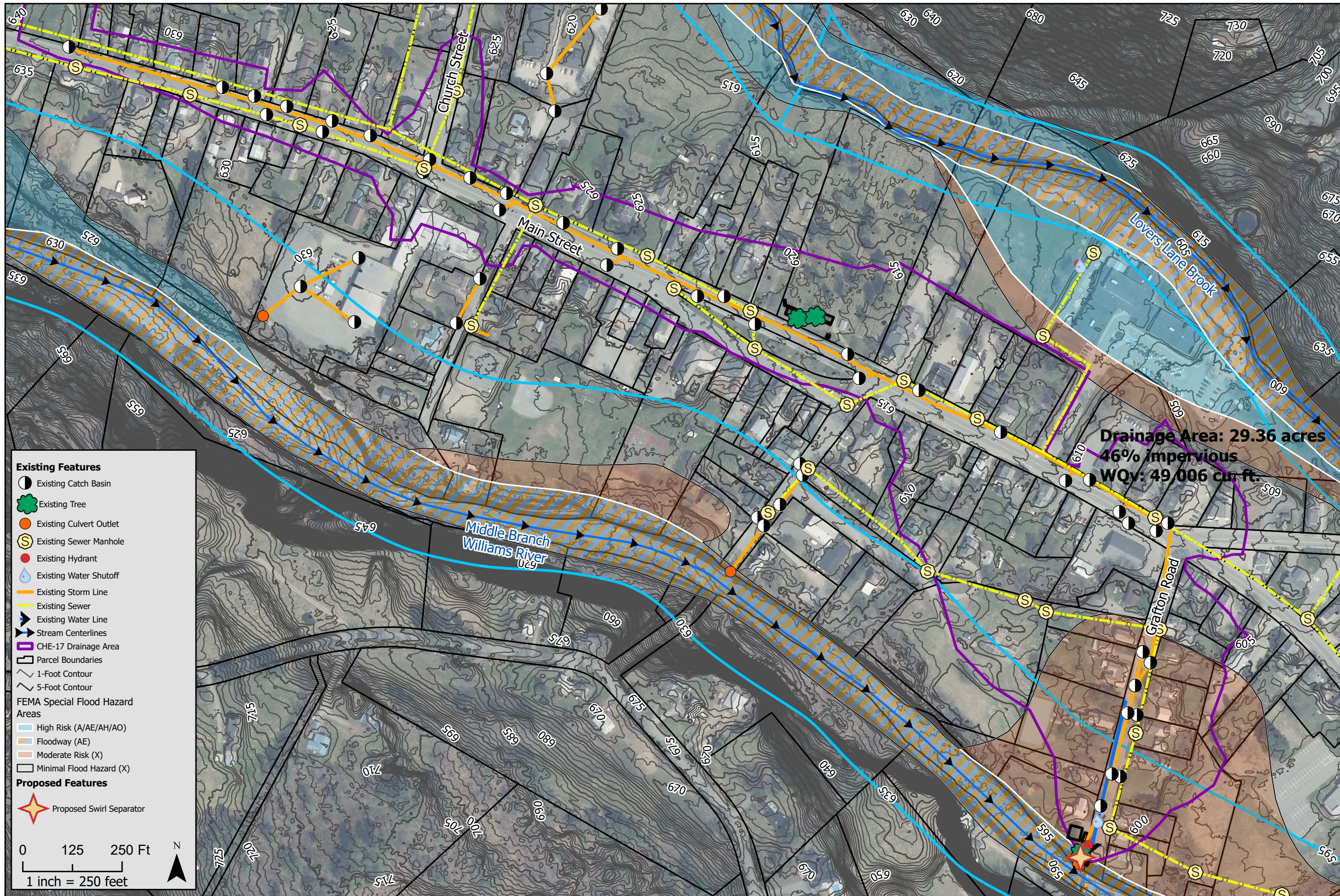
Stormwater Master Plan
 Project Typical Details
 Main Street
 Chester, VT
NOT FOR CONSTRUCTION

JWC EPF
DRAWN CHECKED

SCALE N.T.S.

DATE 2025-04-30

SHEET 3
SHEET NO.



Existing Features

- Existing Catch Basin
- Existing Tree
- Existing Culvert Outlet
- Existing Sewer Manhole
- Existing Hydrant
- Existing Water Shutoff
- Existing Storm Line
- Existing Sewer
- Existing Water Line
- Stream Centerlines
- CHE-17 Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour

FEMA Special Flood Hazard Areas

- High Risk (A/AE/AH/AO)
- Floodway (AE)
- Moderate Risk (X)
- Minimal Flood Hazard (X)

Proposed Features

- Proposed Swirl Separator

0 125 250 Ft
1 inch = 250 feet

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Notes:

- Conceptual design based on FEA field visit in 2024
- Contours from 2016 lidar (VGGI)

Project CHE-17 Conceptual Design
Stormwater Master Plan
Overall Watershed Plan

Grafton Street
Chester, VT

MAP BY	JWC	EPF
		CHECKED
SCALE	1 inch = 250 feet	
DATE	March 27, 2025	
SHEET NO.	SHEET 1	

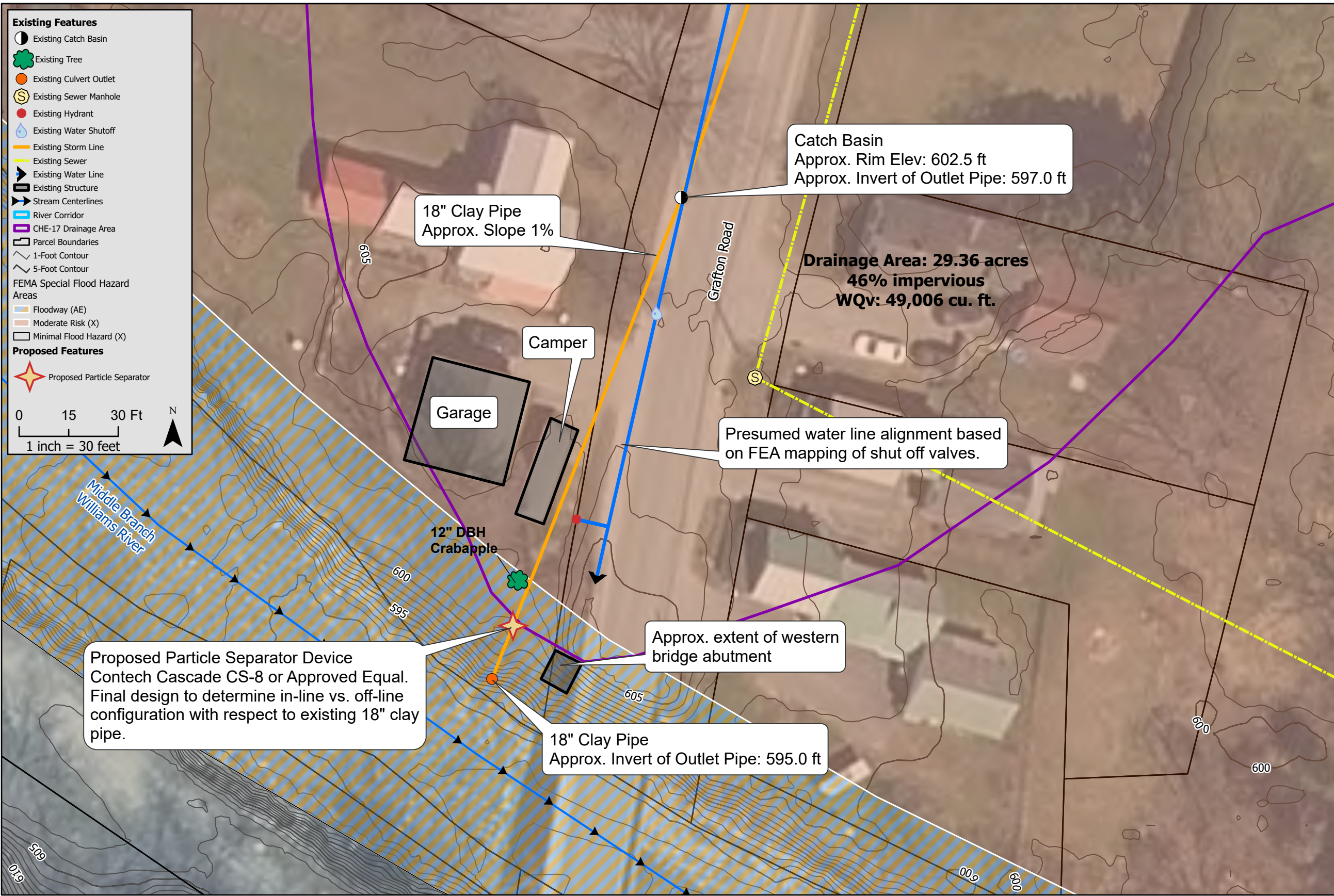
Existing Features

- Existing Catch Basin
- Existing Tree
- Existing Culvert Outlet
- Existing Sewer Manhole
- Existing Hydrant
- Existing Water Shutoff
- Existing Storm Line
- Existing Sewer
- Existing Water Line
- Existing Structure
- Stream Centerlines
- River Corridor
- CHE-17 Drainage Area
- Parcel Boundaries
- 1-Foot Contour
- 5-Foot Contour
- FEMA Special Flood Hazard Areas
 - Floodway (AE)
 - Moderate Risk (X)
 - Minimal Flood Hazard (X)

Proposed Features

- Proposed Particle Separator

0 15 30 Ft
1 inch = 30 feet



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Notes:

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Project CHE-17 Conceptual Design
Stormwater Master Plan
Overall Site Plan

Grafton Street
Chester, VT

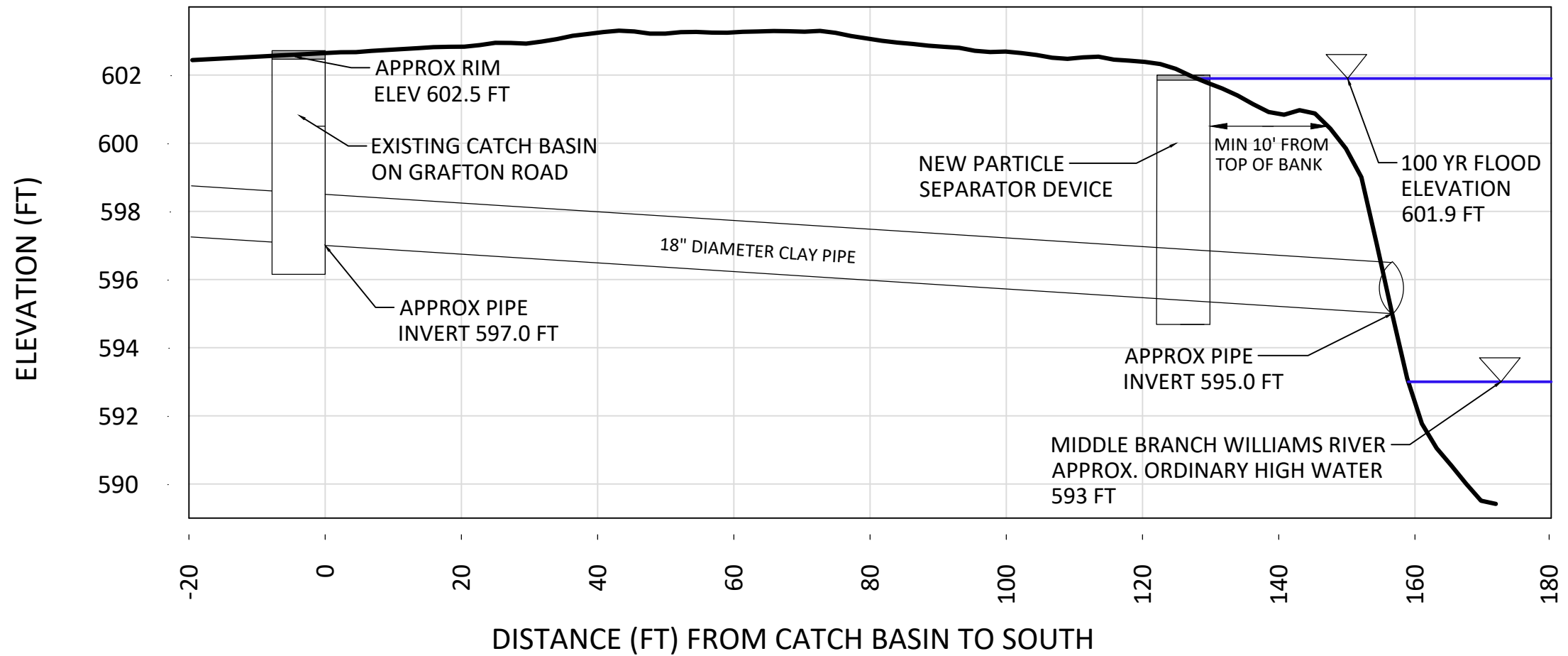
JWC EPF
MAP BY CHECKED

1 inch = 30 feet
SCALE

April 2, 2025
DATE

SHEET 2
SHEET NO.

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Preliminary Cost Opinion

Project CHE-17

Item	Quantity	Unit	Unit Price	Cost
Mobilization/Demobilization	1	LS	\$ 3,000	\$ 3,000
Common Excavation	30	CY	\$ 25	\$ 750
Hauling	30	CY	\$ 20	\$ 600
Topsoil	10	CY	\$ 65	\$ 650
Cut Existing Clay Pipe; New Tie-in	1	LS	\$ 5,000	\$ 5,000
Contech - CS-8 Swirl Separator	1	LS	\$ 45,000	\$ 45,000
Misc. Erosion Control and Site Restoration	1	LS	\$ 3,000	\$ 3,000
Laborer	60	HR	\$ 50	\$ 3,000
Final Design & Permitting	1	LS	\$ 15,000	\$ 15,000
Construction Oversight	1	LS	\$ 5,000	\$ 5,000
Subtotal				\$ 81,000
Contingency (20%)				\$ 16,200
Total				\$ 97,200

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Notes:

Project CHE-17 Conceptual Design

Stormwater Master Plan
 Project Typical Details
 Grafton Street
 Chester, VT
NOT FOR CONSTRUCTION

JWC DRAWN EPF CHECKED

1" = 4' V; 1" = 20' H
 SCALE

March 21, 2019
 DATE

SHEET 3
 SHEET NO.