



CENTENNIAL BROOK FLOW RESTORATION PLAN

City of South Burlington, Vermont

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1. Executive Summary

This Flow Restoration Plan (FRP) for the Centennial Brook watershed was developed in accordance with requirements in the Municipal Separate Storm Sewer System (MS4) General Permit #3-9014 (2012). Once approved by the Vermont Department of Environmental Conservation (VTDEC) this FRP will become part of the Stormwater Management Plans (SWMP) prepared by the MS4 permittees in the Centennial Brook watershed. This includes the City of South Burlington, the Vermont Agency of Transportation (VTrans), the City of Burlington, Burlington International Airport (BTV), and the University of Vermont (UVM). The Centennial Brook FRP will act as a guidance document for the MS4 entities as they implement the stormwater Best Management Practices (BMPs) necessary to attain the flow restoration targets established by the Centennial Brook Total Maximum Daily Load (TMDL). The Centennial Brook TMDL was approved by the U.S. Environmental Protection Agency (EPA) on September 28, 2007. The TMDL suggests a 23.2% increase in stream flow during low flow conditions, and requires a 63.4% reduction in stream flow during high flow conditions (established as the 1-year storm event).

Development of the Centennial Brook FRP was an iterative process that utilized the Vermont Best Management Practice Decision Support System (BMPDSS) model maintained by VTDEC. This model was created by VTDEC and its partners as part of the initial TMDL development. The BMPDSS model allows the user to add, remove, or modify information related to the existing and proposed stormwater BMPs in the watershed. The BMPDSS then predicts the impacts that these changes will have on stream flow. In 2002, VTDEC provided a “Baseline Condition” BMPDSS model for Centennial Brook. This version of the BMPDSS model included all stormwater BMPs that existed in the watershed prior to 2002 and provided an estimated stream flow during the 1-year storm event. The goal of the FRP is to reduce stream flow by 63.4% during this target storm event.

In July 2013, at the request of the City of South Burlington, the Chittenden County Regional Planning Commission (CCRPC)¹ completed a study to estimate the expected non-jurisdictional impervious area growth² in the Centennial Brook watershed over the next 20 years. The original TMDL assigned a non-jurisdictional impervious growth of 40 acres, whereas the CCRPC study estimated 5 acres based on the actual non-jurisdictional growth rate from 2003 to 2010. With the revised future growth, the high-flow target (Q0.3%) would be reduced from 63.4% to 51.6%³.

The BMPDSS Baseline Condition model was provided to the City and updated to include all BMPs that were constructed in the watershed after 2002. This version of the model became known as the “Existing Condition”, or Post-2002, model run. Finally, existing BMPs were evaluated to determine if they could be retrofit to provide improved treatment and detention of stormwater runoff and new BMPs were added to the BMPDSS model until the required stream flow reduction target was achieved. This version of the model became known as the “Proposed Condition” model, or Credit Model run⁴.

¹ Chittenden County Regional Planning Commission (CCRPC). 2013. Non Jurisdictional Impervious Surface Analysis for the Centennial Brook Watershed.

² “Non-jurisdictional” refers to new impervious surfaces where the parcel’s total impervious area is less than 1 acre and not required to obtain a State stormwater permit.

³ See Table 1: The Modified target was calculated as: $-(49.9\%) + (63.4-49.9\%)*(5\text{ ac}/40\text{ ac}) = -51.6\%$

⁴ Refer to original Centennial Brook Flow Restoration Plan dated October 1, 2016 for additional detail on the iterative process to identify proposed projects.

The current Proposed Condition BMPDSS model run that meets the required 51.9% reduction in stream flow during the 1-year storm event includes a total of 23 sites; seven (7) retrofits to existing BMPs, one (1) new detention system, thirteen (13) new infiltration systems, one (1) gravel wetland, and one (1) new bioretention system. The total cost for implementation of these BMPs is estimated at approximately \$7,370,000.

The final list of proposed BMPs were ranked based on best value and feasibility. The MS4 permit requires that the BMPs identified in the FRP be constructed within 20 years of the effective date of the 2012 MS4 permit, which results in a December 5, 2032 deadline. The MS4s involved in the Centennial Brook FRP worked together to develop an implementation schedule for Centennial Brook. BMPs that are currently covered by expired State of Vermont stormwater permits were included at the front of the schedule, so that the associated properties could complete the required stormwater improvements and achieve permit compliance. Other BMPs located on land owned or controlled by the MS4 entities were given priority over those that were located on private property. The remaining projects were scheduled based on their ability to contribute to stream flow reductions, cost effectiveness, and constructability.

A financial plan was also developed in conjunction with the implementation schedule. The City of South Burlington has been financing the required stormwater BMPs by utilizing funds raised by stormwater utility fees, State and Federal grants, as well as low interest loan programs.

2. Background

Centennial Brook and its watershed are located in Chittenden County, principally in the City of South Burlington, and encompass an area of approximately 1.4 square miles. Centennial Brook is a small second order tributary to the Winooski River, with its confluence located about one half mile above the Winooski Dam. At river mile (RM) 0.8 it divides into two branches. The southern branch is 0.8 miles in length and includes within its drainage from the I-89 interchange and Route 2 east of the interchange in South Burlington. The east branch is 1.3 miles in length and drains dense residential areas from the upper portion of the watershed. The entire stream and its tributaries are Class B waters designated as cold water fish habitat pursuant to the Vermont Water Quality Standards.

Centennial Brook has been identified as not attaining water quality standards and has been placed on the list of impaired waters in accordance with Section 303(d) of the Federal Clean Water Act. In 2007, the EPA approved the Centennial Brook Stormwater TMDL⁵. This TMDL requires reductions in stormwater flows during high flow conditions. Increases in stream base flow were also recommended, but are not required under the TMDL. The flow targets are the basis for the FRP, developed in accordance with the Municipal Separate Storm Sewer System (MS4) General Permit Subpart IV.C.1 as a required part of the MS4s Stormwater Management Program (SWMP).

The purpose of this Flow Restoration Plan (FRP) is to outline a plan for the retrofit of existing impervious surfaces with stormwater management Best Management Practices (BMPs) (e.g. gravel wetlands, infiltration basins, etc.) to meet the TMDL flow targets. The TMDL required that watershed hydrology must be controlled in the Centennial Brook Watershed to reduce high flow discharges, in order to restore degraded water quality and achieve compliance with the Vermont Water Quality Standards (VWQS).

⁵ The EPA approval of the Centennial Brook TMDL can be viewed at the following links:

https://ofmpub.epa.gov/waters10/attains_impaired_waters.show_tmdl_document?p_tmdl_doc_blobs_id=72381

Four (4) MS4s including the City of South Burlington, the City of Burlington, the University of Vermont (UVM), and the Vermont Agency of Transportation (VTRANS) own impervious cover within the Centennial Brook Watershed.

2.1. Centennial Brook Total Maximum Daily Load (TMDL)

In response to Centennial Brook not meeting the Vermont water quality standards, it was placed on the list of impaired waters in accordance with Section 303(d) of the Federal Clean Water Act. Most watershed reaches are rated as poor for sediment content. The VTDEC developed TMDLs for impaired watersheds using flow as a surrogate for pollutant loading⁶. The basis for the TMDL development was the comparison of modeled Flow Duration Curves (FDCs) between impaired and attainment watersheds. The Program for Predicting Polluting Particles Passage through Pits, Puddles, and Ponds, Urban Catchment Model (P8) was used to model gauged and ungauged watersheds in Vermont and develop Flow Duration Curves (FDCs) from which a normalized high flow and low flow per drainage area in square miles (cfs/sq.mi.) were extracted.

For the purposes of the Centennial Brook Stormwater TMDL, VTDEC determined that the low flow target would be represented by the 95th percentile (Q95%) of the curve and the high flow target would be represented by the 5th percentile (Q0.3%). The high and low flow values from the FDCs were then compared between impaired watersheds and comparable attainment watersheds to determine a percent change. The high flow target required a total 63.4% reduction in watershed flow allocation during the 1-year storm event. UVM and DEC have discussed the exclusion of flows derived from agricultural/open space lands, which would reduce the 63.4% TMDL reduction target to 63.0%.

As part of the FRP development, the Chittenden County Regional Planning Commission (CCRPC) completed a study to estimate the expected non-jurisdictional impervious area growth in the Centennial Brook watershed over the next 20 years. Non-jurisdictional growth by definition the impervious area that does not require a stormwater permit, and is therefore important to account for within the 20 year management plan. The original TMDL assigned a non-jurisdictional impervious growth of 40 acres, whereas the CCRPC study estimated 5 acres based on the actual non-jurisdictional growth rate from 2003 to 2010. With the revised future growth, the high-flow target (Q0.3%) would be reduced from 63.4% to 51.6%⁷ as summarized in Table 1 below. The modified flow target was considered, but ultimately the original (unmodified) flow target of 16.5%, was incorporated into the FRP planning process and proposed BMP implementation scenario.

Table 1. TMDL Flow Target and modified target with revised future growth

Flow Target	Target High Flow Q 0.3(± %) Reduction
TMDL Target from current Urban/Developed areas	-49.9%
TMDL Targets with 40 acres of Non-Jurisdictional Future Growth	-63.4%
TMDL <i>Modified</i> Targets with 5 acres of Non-Jurisdictional Future Growth ¹	-51.6%
1 Modified target was calculated as: $-[(49.9\%) + (63.4\% - 49.9\%)(5 \text{ ac}/40 \text{ ac})] = -15.6\%$	

⁷ VTDEC. 2007. Centennial Brook TMDL

2.2 MS4 Permit Background and Requirements

On December 5, 2012, Vermont's revised MS4 Permit was issued. Included in the 2012 MS4 permit issuance were new requirements for municipalities to develop FRPs to implement the stormwater TMDLs. The FRPs were required to be developed for each impaired watershed by October 1, 2016, and include the following elements:

- 1) An identification of the required controls
- 2) A design and construction schedule
- 3) A financial plan
- 4) A regulatory analysis
- 5) The identification of regulatory assistance, and
- 6) Identification of any third party implementation.

The schedule required implementation of the required BMPs as soon as possible, but no later than 20 years from the effective date of the permit, before December 5, 2032. In 2018 the State revised the MS4 Permit to include additional requirements to address the Lake Champlain Phosphorous TMDL. As part of the permit renewal, each MS4 was required to submit an updated Notice of Intent (NOI) and Stormwater Management Program (SWMP), including updated Flow Restoration Plans.

3. BMPDSS Model

In an effort to implement the Vermont Stormwater TMDLs, the VTDEC worked with an external consultant (TetraTech) to develop the computer-based VT BMPDSS, a VT-specific hydrologic BMP assessment model. This modeling tool was developed by TetraTech, Inc., with considerable investment from EPA Region 3 and Prince George's County, Maryland, and was adapted for use in Vermont using funding from the Vermont Agency of Natural Resources (ANR). The purpose of the modeling tool was to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios to help MS4 communities identify different BMP options and associated costs.

The information for each BMP entered into the BMPDSS model includes: drainage area, storage volume, outlet control structures and geographic location. The remaining data needed to calculate flow simulations is built into the model and includes: topography, soil types, impervious cover, and rainfall data.

In order to complete a flow target assessment, VTDEC developed three model scenarios for each impaired watershed, including a Baseline Condition Model (Pre-2002), an Existing Condition Model (Post-2002), and a Proposed Condition Model (Credit).

3.1 Baseline Condition Model (Pre-2002)

The Baseline Scenario Model includes all stormwater BMPs installed prior to issuance of the VT Stormwater Design Standards in 2002. The purpose of this model was to quantify the flows in the stream prior to beginning the Flow Restoration Planning process and establish a baseline from which to measure.

3.2 Existing Condition Model (Post-2002)

The Existing Condition Model includes all existing BMPs in the Baseline Condition Model, as well as the addition of any BMPs that have been constructed since 2002 in the Centennial Brook watershed. The purpose of the model is to show current flows in Centennial Brook. This allows the State and MS4 communities to track progress toward the high flow attainment target. On a routine basis, the Existing Condition BMPDSS model is revised to include any recently constructed BMPs, including BMPs designed and constructed by the MS4s, as well as BMPs constructed as part of commercial development and redevelopment. Additionally, the Existing Conditions Model is updated to reflect any changes to existing BMPs, such as revised drainage areas, modification of outlet control structures, or changes in storage volumes. The results of the Existing Condition Model are compared to the Baseline Condition Model to determine if the 51.6% reduction in high flow has been achieved.

The Proposed Condition Model includes all BMPs in the Existing Condition Model, which in turn includes all BMPs from the Baseline Condition Model, as well as a collection of proposed BMPs that can achieve the high flow reduction target in the Centennial Brook watershed. The iterative process of developing the list of proposed BMPs is detailed further in the original Centennial Brook FRP, dated October 1, 2016.

3.3 Proposed Condition Model (Credit)

The Proposed Condition Model includes a total of 24 sites; seven (7) retrofits to existing BMPs, two (2) new detention systems, fourteen (14) new infiltration systems, and one (1) new bioretention system. Credit toward the flow target is also provided by stormwater BMPs from the Existing Condition Model. A summary table of the proposed BMPs is included in Appendix A, along with individual summary sheets describing each proposed BMP the Centennial Brook FRP.

A summary table of the BMPDSS Model Results is shown below in Table 2.

Table 2: Summary of BMPDSS Model Results

Description	Q03 High Flow	
	(cfs)	% Reduction
Baseline Condition	33.28	-
Existing Condition	23.2	14.8%
Proposed Condition	15.98	51.9%

The BMPDSS model did not predict a significant increase in the stream base flow despite the preferential selection of infiltration-based BMPs when possible given site constraints such as soil type. It has been noted by the VTDEC and other BMPDSS model users that the model tends to under represent infiltration-based BMPs and is not sensitive enough to accurately predict base flow increases as a result of smaller infiltration-based BMPs. It is expected that actual base flow increases will be higher than predicted by the BMPDSS.

3.4 Project Ranking

All proposed BMPs identified as part of FRP development in the five stormwater impaired watersheds of Potash, Bartlett, Englesby, Centennial, and Munroe Brook were ranked and a project prioritization was created. Considerations that factored into the ranking of BMP projects include the estimated benefit of a BMP towards the FRP’s flow restoration targets, and the amount of impervious area treated. The comprehensive ranking matrix ranked the proposed BMP projects based on the following criteria, which were grouped into four general categories as shown in Table 3.

Table 3: Project Ranking Matrix

Category	ID	Criteria
Cost/Operations	A	Project Cost per Impervious Acre
Project Design Metrics	B	Impervious Acres Managed (ac)
	C	Channel Protection Volume (CPv) Mitigated, (ie. 1-year Storm)
	D	Volume Infiltrated (ac-ft)
Project Implementation	E	Permits
	F	Land Availability
Other Project Benefits/Constraints	G	Flood Mitigation (Is existing flooding issue mitigated by project?)
	H	TMDL Flow Target Addressed (Q03, Q95)
	I	Lake Champlain Phosphorus TMDL
	J	Other Project Benefits/Constraints

Values for each criteria were identified and assigned a relative score, so that proposed BMP projects could be ranked based on a total score. A full description of the ranking criteria is presented in Table D-1 in Appendix B, and a scoring key is presented in Table D-2 in Appendix B. The final scoring of proposed BMP projects in the Centennial Brook Watershed is presented Table E-2 in Appendix C.

4. Design and Construction Schedule

A Design and Construction (D&C) schedule is a required element of the final FRP. This schedule must show how the proposed BMPs included in the FRP can be implemented over a timeframe of less than 20 years from the date of MS4 permit issuance. This means that all BMPs associated with FRPs must be implemented prior to December 5, 2032. The City of South Burlington owns impervious surface in five stormwater impaired watersheds; Bartlett, Englesby, Centennial, Munroe, and Potash Brook. Therefore, proposed stormwater BMPs in all five watersheds were considered when developing a realistic D&C schedule for the City. However, only the projects located within the Centennial Brook watershed are presented in the implementation schedule in Appendix C.

In addition to a project’s score within the BMP ranking matrix, development of a BMP implementation schedule required the consideration of additional factors, such as expired State of Vermont stormwater permits, properties containing more than 3 acres of impervious area, and land owned or controlled by the MS4 entities. Additionally, private property redevelopment and development of the City’s Phosphorus

Control Plan (PCP) may cause certain projects to gain or lose priority within the implementation schedule in the future.

5. Financial Plan

Subject to the requirements of the MS4 permit, a financial plan is required as part of the FRP. This plan must provide initial BMP cost estimates and demonstrate the means by which BMP implementation will be financed. The financial plan must also include the steps that each MS4 will take to implement the finance plan. Initial BMP cost estimates were calculated in 2014 using cost values that were current at that time. Once projects were scheduled over the 20 year implementation schedule, an annual 3% inflation rate (based on historic trends in the construction cost index¹) was applied. Table E-3 in Appendix C presents inflation adjusted project costs for each BMP project. Applying this inflation rate provides a more accurate annual cost for BMP construction in the later years of the schedule.

5.1. City of South Burlington Financial Plan

In 2005, the City of South Burlington created Vermont's first stormwater utility. Under the stormwater utility system, all developed properties in the City pay an impervious area-based stormwater fee using an Equivalent Residential Unit (ERU) system. These stormwater fees provide the City with a stable funding source that is used to comply with State and Federal stormwater regulations and maintain stormwater infrastructure throughout the City. The stormwater utility was created with the understanding that there would be future stormwater costs related to the five stormwater impaired watersheds located in South Burlington, as well as costs related to future implementation of projects required by the Lake Champlain Phosphorous TMDL. The City is currently utilizing funds generated from stormwater utility fees to fund FRP related costs.

Once the BMP cost and implementation schedule was developed, the City of South Burlington Stormwater Utility was able to incorporate this information into its existing stormwater rate model. The City evaluated two different scenarios for funding the BMPs included in the FRP. The first scenario assumed that there would be no grant funding available to assist with implementation. The second scenario assumed that grant funding of approximately \$250,000 per year would be available in 2018 through 2029, and that this amount would increase to \$500,000 in 2030, 2031, and 2032. The resulting annual cost to a single family residential property and commercial property owner containing 1 acre of impervious area is summarized in Table 5. Calculations for "Commercial Property Containing 1 Acre Impervious Area" in Table 4 assume an Equivalent Residential Unit (ERU) rate of 17 and do not take into account the City's relative tier factors based on percent impervious cover.

¹ RSMean. "Historical Cost Indexes." <https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf>

Table 4: Annual Stormwater Fee Paid by Property Owners Under Different FRP Funding Scenarios

Fiscal Year	Funding Scenario 1 - Receive No Grants		Funding Scenario 2 - Receive \$250,000 in Grants Annually	
	Single Family Residential Property	Commercial Property Containing 1 Acre Impervious Area	Single Family Residential Property	Commercial Property Containing 1 Acre Impervious Area
2018	\$80.28	\$1,364.76	\$80.28	\$1,364.76
2019	\$82.44	\$1,401.48	\$82.08	\$1,395.36
2020	\$84.60	\$1,438.20	\$83.88	\$1,425.96
2021	\$87.12	\$1,481.04	\$85.68	\$1,456.56
2022	\$90.00	\$1,530.00	\$87.48	\$1,487.16
2023	\$93.24	\$1,585.08	\$89.28	\$1,517.76
2024	\$96.84	\$1,646.28	\$91.08	\$1,548.36
2025	\$100.80	\$1,713.60	\$92.88	\$1,578.96
2026	\$105.12	\$1,787.04	\$94.68	\$1,609.56
2027	\$109.80	\$1,866.60	\$96.48	\$1,640.16
2028	\$114.84	\$1,952.28	\$98.28	\$1,670.76
2029	\$119.88	\$2,037.96	\$100.08	\$1,701.36
2030	\$124.92	\$2,123.64	\$101.88	\$1,731.96
2031	\$129.96	\$2,209.32	\$103.68	\$1,762.56
2032	\$135.00	\$2,295.00	\$105.48	\$1,793.16

It is the City's expectation that significant funding from the State of Vermont and other Federal sources will be available to help with the cost of stormwater TMDL implementation. The State of Vermont has already taken initial steps towards providing this funding. In 2015, the Vermont legislature created the Clean Water Fund (CWF). The CWF was provided with \$2,005,000 in 2016 and \$7,688,000 in 2016. While these initial investments are not at the level necessary to provide significant funding to the MS4 communities subject to stormwater TMDLs, it is our understanding that the State is working to provide additional funding to the CWF in the future. The City of South Burlington intends to work closely with our legislative representatives to ensure that funding is made available for the stormwater improvements included in the FRPs. The City of South Burlington will also pursue funding from existing and new grant sources from other organizations including, but not limited to, VTDEC, the Vermont Agency of Transportation, and the Lake Champlain Basin Program.

5.2 City of Burlington Financial Plan

In 2009, the City of Burlington followed the example of the City of South Burlington in implementing an impervious area based stormwater fee to provide the City of Burlington with a stable funding source to maintain stormwater infrastructure throughout the City and to comply with numerous State and Federal stormwater regulations including the Stormwater TMDLs, Lake Champlain TMDL and Combined Sewer requirements. Implementation of retrofits for which the City is responsible will ultimately be the responsibility of the stormwater ratepayers. In order to limit the impact to the ratepayers, the City intends to leverage existing and new grant and loan sources, as they are available. Later analyses will determine exactly which retrofit financial obligations (i.e. paying into project completed elsewhere in the watershed) will be necessary for the City to meet its obligations in

Centennial Brook as the City continues to work in partnership with the other Centennial Brook MS4s. Additionally, as part of the Integrated Planning effort, the City will be completing a financial capability assessment (FCA) to evaluate the long-term ability of ratepayers to fund these and other Clean Water Act obligations. An FCA doesn't mean that Clean Water Act obligations won't be met – but may point to an adjustment of the overall schedule of implementation of all of the City of Burlington's obligations, including implementation of this and other Flow Restoration Plan projects, in order to mitigate the impact of stormwater and wastewater rates increasing at an unsustainable rate for the Burlington community. This FRP and SWMP will be amended with an updated financial plan, including stormwater rate projections for this and other Clean Water Act obligations once the FCA under the Integrated Plan is completed. The City is aware that due to the nature of the several joint/regional projects that are part of the Centennial Brook watershed plan and the fact that other MS4s may not be pursuing the possible scheduling flexibilities associated with integrated permitting, it is likely that significant adjustments of implementation schedules and associated financial planning will not be plausible for this watershed. This reality will be evaluated within the context of the FCA and the Integrated Planning effort.

5.3 University of Vermont Financial Plan

Under the current budgeting process, the University would establish project funds to fulfill the University of Vermont's obligation. We would endeavor to pursue federal and state stormwater grant opportunities.

5.4 Vermont Agency of Transportation Financial Plan

Planning level costs were independently estimated for each VTrans project using a consistent spreadsheet-based method for all projects. As such, some cost estimates may differ slightly from those presented in other FRP documents. VTrans will request state and federal funding for the appropriate amount to implement the BMPs as outlined in their design and construction schedule. For those projects that will require a joint effort with another municipality, VTrans will request funding for their portion of the cost share. In watersheds where VTrans is either not meeting or exceeding their allocated target there may be cost sharing between MS4s.

5.5 Burlington International Airport Financial Plan

A financial plan that estimates the costs for implementing the BMPs and describes a strategy for financing is a required element of the FRP. The financing plan includes the steps each permittee will take to implement the financing plan. The City of South Burlington Potash Brook and Centennial Brook FRPs include cost estimates for each of the BMPs, using 2014 cost estimates with an annual 3% inflation rate as noted above. The VTDEC and the contributing MS4 permittees within these watersheds have signed a Memorandum of Agreement (MOA) to perform monitoring and other data collection required under the MS4 permitting program. Each MS4 permittee, including BTV, has been assigned a percentage of the total cost of the contracted work over a five-year timeframe. This type of collaborative arrangement will also apply to implementation and financing of the BMPs.

As described in the FRPs, it is BTV's expectation that significant funding from the State of Vermont and other Federal sources will be available to help with the cost of stormwater TMDL implementation. In 2015, the Vermont legislature created the Clean Water Fund (CWF). This fund was provided with

\$2,005,000 in 2015 and \$7,688,000 in 2016, and will likely receive additional funding in the years to come. The City of South Burlington and Burlington Airport intend to work closely with legislative representatives to ensure that this funding is made available for the stormwater improvements included in the FRPs.

The Burlington Airport also intends to seek funding for implementing its commensurate share of the BMPs within the watersheds, including requests from the CWF and other sources. BTV is committed to participating in a cost share with the City of South Burlington to implement its FRP in a manner that is fair and reasonable for the airport. It is also noted that BTV reserves the right to achieve its FRP commitments through implementing projects of its own choosing that may not be identified on South Burlington’s present list of proposed watershed improvement projects.

5.6 Proposed BMP Cost Estimates

The Proposed Condition Model that achieved the required 51.6% reduction in stream flow during the 1-year storm event included 23 BMPs costing approximately \$7,370,000. Cost estimates were developed based on a simple spreadsheet method that calculated base construction cost as a product of the design control volume, the unit cost, and the site adjustment factor, as outlined in Table 5 below¹. Additionally, permitting, engineering, land acquisition, and O&M costs were factored into the total cost estimate.

Table 5: Proposed BMP Unit Costs and Adjustment Factors

BMP	Base Cost (\$/ft3)
Detention Basin	\$2
Infiltration Basin	\$4
Underground Chamber (infiltration or detention)	\$12
Bioretention	\$10
Green Infrastructure/ Underground Chamber Combo	\$22
Site Type	Cost Multiplier
Existing BMP retrofit	0.25
New BMP in undeveloped area	1
New BMP in partially developed area	1.5
New BMP in developed area	2
Adjustment factor for large aboveground basin projects	0.5

A summary of all project costs for each proposed BMP in the Centennial Brook Watershed are included in Table E-1 in Appendix C.

¹ Methodology based on Horsley Witten Group Memorandum (Page 11).

6. Regulatory Analysis

In accordance with the MS4 permit, an FRP requires a regulatory analysis that identifies and describes what, if any additional regulatory authorities that the permittees will need in order to effectively implement the FRP.

Currently, stormwater runoff within the Centennial Brook watershed is regulated primarily by the VTDEC, City of South Burlington, City of Burlington, and VTrans. VTDEC regulates new developments through issuance of Stormwater Discharge Permits with technical requirements as outlined in the 2017 Vermont Stormwater Management Manual. The City of South Burlington and City of Burlington require improved stormwater practices and low impact development for new developments through their stormwater ordinances and Land Development Regulations (LDRs). VTrans regulates stormwater discharges to the state Right of Way through 19 V.S.A. §1111 “Permitted use of the right-of-way”.

The City of South Burlington updated the stormwater requirements in its LDRs in June 2016.¹ The revised LDRs require that any project resulting in ½ acre or more of impervious area implement stormwater controls that prioritize infiltration. The revised LDRs also contain new requirements for properties that are being redeveloped. It is the City’s expectation that these changes will result in gradual improvements in stormwater management over the course of the 20 year BMP implementation schedule.

The City of South Burlington also revised its “Ordinance Regulating the Use of Public and Private Sanitary Sewerage and Stormwater Systems” in October 2015.² The ordinance provides a policy regarding the handling of expired VTDEC stormwater permits located in South Burlington. The City will continue to take over responsibility for exclusively residential stormwater systems that complete upgrades. In addition, the revised ordinance allows commercial properties with expired permits to obtain coverage under the City’s MS4 permit if upgrades to the stormwater system are completed. These properties will still be responsible for maintaining their systems, but the permit coverage required by the State of Vermont can now be provided through the City’s MS4 permit instead of obtaining coverage under one of VTDEC’s other permit programs.

A full list of the expired State of Vermont permits with discharges to Centennial Brook is presented in Table 6 in Section 7.

¹ Section 12.03 – Stormwater Management Standards, “South Burlington Land Development Regulations,” dated 8/6/18, can be viewed at the following link:
<http://www.southburlingtonvt.gov/Planning/LDR%20Amendments/2018-5/LDRs%20Complete%20Effective%208-6-2018%20reduced.pdf>

² South Burlington’s “Ordinance Regulating the Use of Public and Private Sanitary Sewerage and Stormwater Systems,” dated 10/5/15, can be viewed at the following link:
http://www.southburlingtonvt.gov/document_center/planning/Sewerage_Stormwater_Systems.pdf

7. Third Party Implementation

In accordance with the MS4 permit, a FRP requires identification of the name of any party, other than the permittee, that is responsible for implementing any portion of the FRP. A full list of VTDEC permits discharging to the Centennial Brook and the type of system covered under the permit is included in Table 6. Several of the expired permits may have obtained new permit coverage under a Residual Designation Authority (RDA) permit from VTDEC.

Table 6. Expired Permits Within The Centennial Brook Watershed

PERMIT NUMBER	Project Name	PERMIT BUSINESS	EXPDATE
2-0126		Larkin Realty	7/1/1985
1-0871	Summer Woods	CGPM Inc.	6/30/1994
1-0946	Queensbury Rd and Bluff Court	O'Brien Brothers Agency, Inc.	6/30/1995
1-1257	Quarry Ridge (Centennial Heights)	Quarry Ridge Homeowners Association (So Burlington Realty)	6/30/2001
4330-INDS		South Burlington School District	9/19/2011
4524-INDS	Benson Development	Benson Development LP	3/26/2012
5932-INDS	Precourt Properties	Precourt Investment Co., LLC	12/30/2013

7.1 Expired Permit Proposed Retrofits

All expired permit holders in the Centennial Brook watershed will be required to obtain valid State stormwater permit coverage. This can be accomplished through a process that the State has identified in their current draft Stormwater Permitting Rule, or through the City's Stormwater Upgrade Feasibility Analysis (SUFA) process. Refer to sburlstormwater.com/download-material/ for the latest available version of the City's Stormwater Upgrade Feasibility Analysis (SUFA) document.

As noted in the SUFA, "FRPs for the stormwater impaired watersheds located in the City contain a preliminary assessment of the stormwater treatment potential of some sites. If an FRP identifies an STP on a site, then the site must install either the specified STP or an STP that provides equivalent or greater treatment. In addition, final FRPs will contain a schedule indicating when various retrofits must occur. Properties that choose to construct STPs must do so before November 15, 2023, or the date specified in the FRP, whichever is sooner." The City may revise the date included in the ordinance depending upon the dates included in the final version of State of Vermont Stormwater Permitting Rule. The City expects that VTDEC will finalize the rule in 2019. This will provide the City with sufficient time to update its ordinance.

The City has identified specific retrofit projects for BMPs with expired State of Vermont permits. These projects are included in Table C-1: Final Proposed BMPs for Centennial Brook FRP in Appendix A. All other expired permits in the Centennial Brook Watershed will be required to complete upgrades as determined by the technical standards included in the City's SUFA.

8. Appendices

Appendix A - Stormwater BMP Site Inspection Field Sheets

Appendix B – Future Growth Memorandum

Appendix C – Centennial Brook Flow Restoration Plan Proposed Best Management Practices

Table C-1: Final Proposed BMPs for Centennial Brook FRP

Centennial Brook FRP BMP Summary Sheets

Appendix D – Project Ranking

Table D-1: BMP Ranking Criteria Key

Table D-2: BMP Ranking Scoring Key

Appendix E – Proposed Cost Estimates, Prioritization Ranking, and Implementation Schedule

Table E-1: Project Cost Estimates

Table E-2: Centennial Brook Watershed BMP Project Scoring

Table E-3: Centennial Brook Watershed BMP Project Implementation Schedule

APPENDIX A

CENTENNIAL BROOK FRP PROPOSED BMPs

Centennial Brook Flow Restoration Plan

Table C-1: Final Proposed BMPs for the Centennial Brook FRP

Project ID	Project Name	BMP Address	BMP Landowner	MS4s with Impervious Area	New or Existing	BMP Type	Expired Permit	Drainage Area (acres)	Impervious Area Managed	Impervious %	CPv Managed (ac-ft)	Volume Infiltrated (ac-ft)	BMP Description
CB0001	140 East Ave Residence	Bilodeau Ct, Burlington	MS4 Owned	Burlington	New	Bio		0.63	0.18	28%	0.046	0.046	Construct a bioretention area in underutilized private green space. Divert drainage from existing drainage structure in Bilodeau Court. Alternative practice may include permeable pavement shoulders/parking lanes in the road ROW.
CB0002	Best Western Windjammer Infiltration Basin A	North of Williston Rd and east of Dorset St, South Burlington	Private	South Burlington	New	IB	6323-9030	29.42	21.82	74%	2.023	2.023	Site drainage area currently includes only Best Western property. Outfall is severely eroded and is headcutting to the east and may soon reach paved access road. Concept includes stabilizing outfall and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from Williston Road drainage network and redirect drainage from abutting commercial properties.
CB0003	Best Western Windjammer Infiltration Basin B	North of Williston Rd and east of Dorset St, South Burlington	Private	South Burlington	New	IB	6323-9030	4.09	1.33	33%	0.053	0.053	Outfall is located west of Best Western. Site drainage area currently includes only Best Western property. Moderate erosion occurring. Concept includes stabilizing outfalls and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from the Williston Road drainage network. A portion of this drainage area could be directed to Retrofit 22 if necessary.
CB0004	Case Parkway Center Island	Case Pkwy, South Burlington	MS4 Owned	Burlington	Existing	Bio	No Permit	0.86	0.23	27%	0.042	0.042	Proposed bioretention area in center island on Case Parkway. Direct road drainage to bioretention using a speed bump across Case Parkway. The bioretention could underdrain/overflow to existing drainage system and outfall.
CB0006	Chamberlin School	South of Hanover St and west of Airport Pkwy, South Burlington	MS4 Owned	South Burlington	New	IG	No Permit	31.49	9.69	31%	1.955	1.955	Underground detention in open space of school property. It seems possible to collect drainage off of White Street (and upgradient residential neighborhood) and connect to existing system via school entrance. Underground chambers could be designed as infiltration pending results of soils test pitting. (note HSG – D on east side of school property; HSG – B on west side of school property).
CB0007	Clover St GSI	Clover St and Berkley St, South Burlington	MS4 Owned/Private	South Burlington	New	IG	No Permit	3.82	1.40	37%	0.073	0.073	30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).
CB0008	Dumont Ave Infiltration Chambers	Dumont Ave, South Burlington	MS4 Owned	South Burlington, BTV	New	IG	No Permit	3.93	0.86	22%	0.047	0.047	Divert flows from existing catchbasins and convey down Dumont Ave via pipe or swale to underground recharge chambers on empty lot. Options exist for practice type, siting and conveyance mechanism depending on depth to GW, existing inverts, and future use by Airport. Discharge to existing pipe outlet at Airport basin.
CB0009	Duval St GSI	Duval St, South Burlington	MS4 Owned/Private	South Burlington	New	IG	No Permit	3.57	0.99	28%	0.048	0.048	30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).
CB0010	Fielding Lane Condos Infiltration Gallery	Richard Terr and Clover St, South Burlington	Private	South Burlington	New	IG	No Permit	18.74	5.14	27%	0.148	0.148	Detention-retention facility. Open parcel adjacent to Fielding Lane Condos – seems to be owned by Fielding Lane Condos, existing surface storage available below outfall pipe. Would require access from Fielding Lane.

CB0011	Fletcher Allen Green Space	Carrigan Dr, Burlington	MS4 Owned	Burlington, UVM	Existing	Bio		0.89	0.53	59%	0.131	0.131	Proposed bioretention area in green space near hospital entrance. Redirect existing roadway trench drains into practice. Site currently drains to the UVM East Campus Pond.
CB0012	Fletcher Allen Parking Lot	Carrigan Dr, Burlington	MS4 Owned	Burlington	Existing	Bio		0.83	0.61	74%	0.097	0.097	Proposed bioretention area in existing drainage feature. Site is currently managed by existing swales, curb cuts, and a drainage depression. Swales and depression are currently eroding. Raise existing catchbasin frame/grate to provide ponding for bioretention.
CB0013	Grove Street Parking Lot	Grove St, Burlington	MS4 Owned	Burlington	New	IG	1-0811	8.82	2.33	26%	0.205	0.205	Divert existing drainage network and capture runoff from parking lot and direct to proposed underground recharge system. Low point in road drainage area is immediately south of the City parking lot. Consider replacing parking lot with permeable pavement.
CB0014	I-89 Cloverleaf Underground Detention	I-89 Exit 14 interchange, South Burlington	MS4 Owned	South Burlington, VTrans	Existing	UD	2-0126; 6323-9030; 2-0619	39.17	17.18	44%	2.35	0	Detention structure bounded by northbound lanes and off-ramp (directing traffic to westbound Williston Rd). Existing culvert drains all upgradient area from interchange and Williston Rd. Modify outlet to install new control structure for Cpv storage.
CB0015	I-89 Exit 14 Detention Pond	I-89 Exit 14 interchange, South Burlington	Public or MS4 Owned (depending on option)	South Burlington, VTrans	New	GW	No Permit	13.07	3.58	27%	2.87	0	Location flexible depending on evaluation. Most downstream location would be across from drainage outlet, below water main (best location for embankment – maximizes storage), but impact to water main R/W likely and partially on private property. Alternative is to move embankment upgradient to limit of I-89 R/W – would reduce available storage, but keep all work w/in VTrans jurisdiction.
CB0016	Jaycee Park	Patchen Rd north of White St, South Burlington	MS4 Owned	South Burlington	New	IG	No Permit	15.73	6.42	41%	0.898	0.898	Pretreatment tank to underground infiltration chambers. Pretreatment could be proprietary device (e.g. StormCeptor or equal) before underground chambers. Access would need to be coordinated with playing fields. Flow diversion structure would be in Patchen Road, with depth to drain pipe at approx 6.5 feet.
CB0018	N Henry Court	N Henry Ct, South Burlington	MS4 Owned	South Burlington, BTV	New	IG	No Permit	1.03	0.33	32%	0.024	0.024	Dead-end road with excess impervious cover. Currently, drainage comes down the road and flows directly down a steep slope to the stream/wetland area below. Install a rain garden/bio with an overflow to a leaching catch basin at end of road. Dumping of yard waste and debris was also observed down the slope. An old corrugated discharge pipe was found down in stream.
CB0019	North Campus Pond Retrofit	University Rd, Burlington	MS4 Owned	Burlington, UVM	Existing	DP		76.94	45.99	60%	4.719995	0	Proposed expansion of existing North Campus Pond to over control existing and future development. Raise existing embankment (10' +/-) to provide additional capacity. May consider horizontal expansion to the north and/or south.
CB0021	Patchen Rd & Pine St Infiltration Gallery	Pine St and Patchen Rd, South Burlington	Private	South Burlington	New	IG	No Permit	20.41	5.40	26%	0.913	0.913	Underground detention or infiltration (depending on soils). Diversion of flows from Patchen Road feasible, incoming pipe from open space/low point behind lots too deep to capture. Single lot also contains SF house (see photo). Would require diversion structure and pretreatment tank/structure.
CB0022	Patchen Road Kettle Hole	Patchen Rd south of I-89, South Burlington	MS4 Owned/Private	South Burlington, VTrans	New	IG	6292-9030	14.06	5.45	39%	0.268	0.268	Detention Pond (or infiltration basin if soils are acceptable). Directly convey runoff from contributing area off Patchen Road down slope to sediment forebay. Modify existing 30" culvert headwall (under I-89) to achieve required flow control. Could pick up Kirby Rd.

CB0023	Picard Circle Infiltration	Picard Cir, South Burlington	MS4 Owned	South Burlington, BTV	New	IG	No Permit	69.80	21.06	30%	0.682	0.682	Subsurface infiltration system. All houses within Picard Circle have been purchased by Airport and are now abandoned. Significant site area exists within yards and the road for major underground infiltration/ detention system. Constraints include depth of existing drainage pipe and depth above groundwater (adjacent brook approx 14 feet below existing ground).
CB0024	Queensbury Pond Retrofit	Queensbury Rd, South Burlington	Private	South Burlington	Existing	IB	1-0946	7.60	2.88	38%	0.16	0.16	Existing dry detention pond. Modify outlet to create an infiltration basin. Existing pond might predate subdivision (newer PVC outlet connects to older CMP barrel). Facility appears to have additional storage capacity to expand drainage area (level run confirmed this is feasible).
CB0025	Retrofit of Main Street UVM Pond	North of Williston Rd and East Terr, South Burlington	MS4 Owned	South Burlington, Burlington, UVM	Existing	DP		39.64	17.51	44%	3.89	0	Repair outlet structure. Retrofit options include expanding the pond southward toward Williston Road or eastward as part of Retrofit #24 for additional storage, extended detention, and improved water quality. Site has the ability to capture drainage from Williston Road, adjacent commercial properties, and unmanaged UVM land.
CB0027	Staples Plaza Underground Detention A	West of I-89 Exit 14 interchange, South Burlington	Private	South Burlington	New	UD	No Permit	2.50	2.50	100%	0.26	0	Convert landscaped island to bioswale w/ UG storage to manage parking and small roof. Overflow to existing drain. Add trees for cover, shading, interception. Reduce width of one-way aisle for bioswale. Flat roof drains internally, discharges to drain inlet east of building. Modify internal roof drains, install trays, or use other blue roof design to provide temporary detention.

Centennial Brook FRP BMP Summary Sheet

Site name: 140 East Ave Residence		South Burlington ID: CB0001			
Approximate address:	Bilodeau Ct, Burlington	MS4 where BMP is located:	Burlington	New or existing BMP?	New
Proposed BMP type:	Bioretention				



Estimated project cost	\$44,000	MS4s contributing drainage to BMP	Burlington						
Drainage area (acres)	0.63		Primary land use in drainage	Residential					
Impervious acres managed	0.18			2 or more landowners?	Yes				
% Impervious	28%				CPv managed (ac-ft)	0.05			
Land owner of BMP location	MS4 Owned					Volume infiltrated (ac-ft)	0.05		
BMP Footprint Size (acres)							Primary or secondary BMP?	Secondary	
BMP Depth (feet)								Expired permit(s)?	
Hydrologic soil group	A/B								

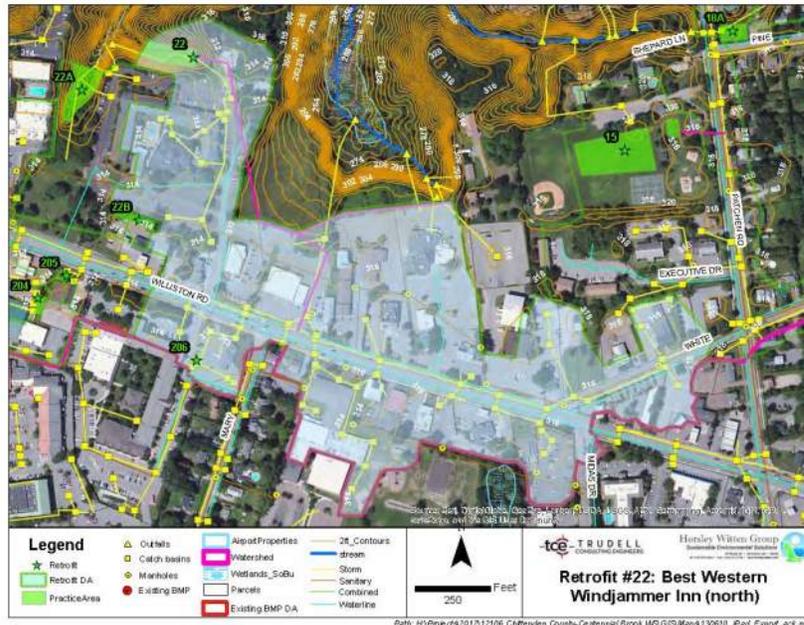
Proposed BMP description:	Feasibility concerns:
Construct a bioretention area in underutilized private green space. Divert drainage from existing drainage structure in Bilodeau Court. Alternative practice may include permeable pavement shoulders/parking lanes in the road ROW.	Proposed site location is on private property. Utilities may present conflicts for retrofit opportunities.

Centennial Brook FRP BMP Summary Sheet

Site name:	Best Western Windjammer Infiltration Basin A	South Burlington ID:	CB0002
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Approximate address:	North of Williston Rd and east of Dorset St, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
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Proposed BMP type:	Infiltration Basin
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Estimated project cost	\$557,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	29.42		
Impervious acres managed	21.82	Primary land use in drainage	Commercial/Industrial
% Impervious	74%	2 or more landowners?	Yes
Land owner of BMP location	Private	CPv managed (ac-ft)	2.02
BMP Footprint Size (acres)		Volume infiltrated (ac-ft)	2.02
BMP Depth (feet)		Primary or secondary BMP?	Primary
Hydrologic soil group	A	Expired permit(s)?	6323-9030

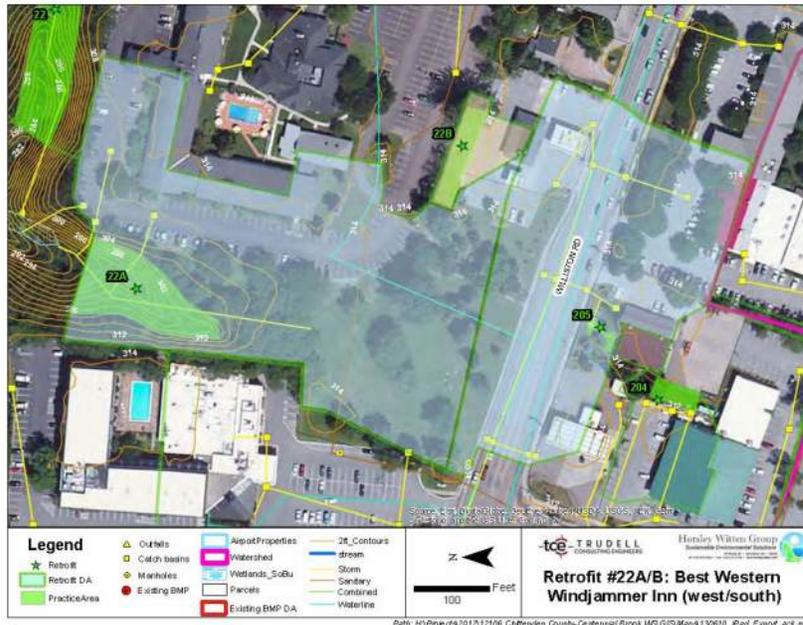
Proposed BMP description:	Feasibility concerns:
Site drainage area currently includes only Best Western property. Outfall is severely eroded and is headcutting to the east and may soon reach paved access road. Concept includes stabilizing outfall and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from Williston Road drainage network and redirect drainage from abutting commercial properties.	Priority project. The proposed site could manage a large drainage area that is unmanaged and unstable. Since the outfall is in need of immediate repair, feasibility is high. Planning considerations include the redirection of flow from abutting commercial properties.

Centennial Brook FRP BMP Summary Sheet

Site name: Best Western Windjammer Infiltration Basin B **South Burlington ID:** CB0003

Approximate address:	North of Williston Rd and east of Dorset St, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
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Proposed BMP type: Infiltration Basin



Estimated project cost	\$81,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	4.09		Primary land use in drainage	Commercial/Industrial
Impervious acres managed	1.33		2 or more landowners?	No
% Impervious	33%		CPv managed (ac-ft)	0.05
Land owner of BMP location	Private		Volume infiltrated (ac-ft)	0.05
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	6323-9030
Hydrologic soil group	A/B			

Proposed BMP description:	Feasibility concerns:
<p>Outfall is located west of Best Western. Site drainage area currently includes only Best Western property. Moderate erosion occurring. Concept includes stabilizing outfalls and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from the Williston Road drainage network. A portion of this drainage area could be directed to Retrofit 22 if necessary.</p>	<p>Good. May make economic sense to divert some or all of this area to Retrofit site #22.</p>

Centennial Brook FRP BMP Summary Sheet

Site name: Case Parkway Center Island		South Burlington ID: CB0004			
Approximate address:	Case Pkwy, South Burlington	MS4 where BMP is located:	Burlington	New or existing BMP?	Existing
Proposed BMP type:	Bioretention				

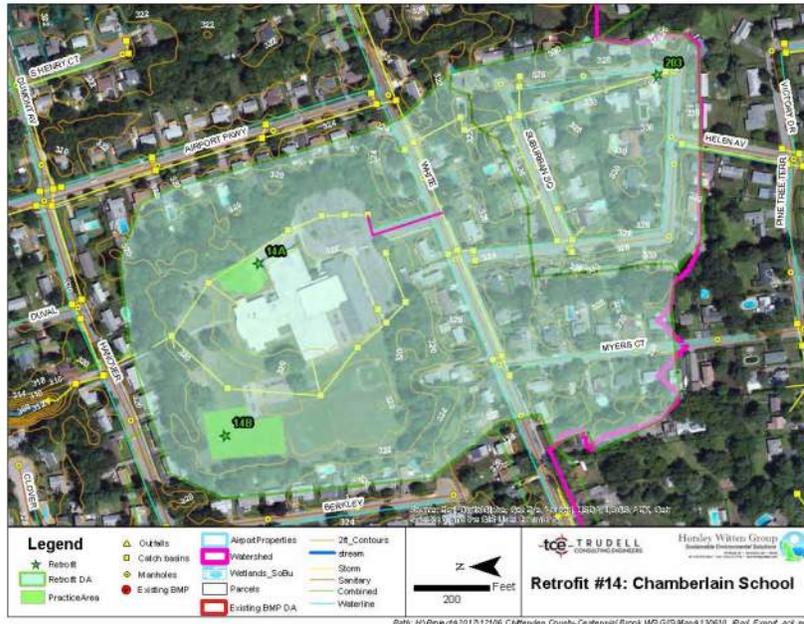


Estimated project cost	\$25,000	MS4s contributing drainage to BMP	Burlington						
Drainage area (acres)	0.86		Primary land use in drainage	Residential					
Impervious acres managed	0.23			2 or more landowners?	Yes				
% Impervious	27%				CPv managed (ac-ft)	0.04			
Land owner of BMP location	MS4 Owned					Volume infiltrated (ac-ft)	0.04		
BMP Footprint Size (acres)							Primary or secondary BMP?	Secondary	
BMP Depth (feet)								Expired permit(s)?	
Hydrologic soil group	A								

Proposed BMP description:	Feasibility concerns:
Proposed bioretention area in center island on Case Parkway. Direct road drainage to bioretention using a speed bump across Case Parkway. The bioretention could underdrain/overflow to existing drainage system and outfall.	Site currently is within the drainage area for the UVM North Campus Pond.

Centennial Brook FRP BMP Summary Sheet

Site name: Chamberlain School		South Burlington ID: CB0006			
Approximate address:	South of Hanover St and west of Airport Pkwy, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				

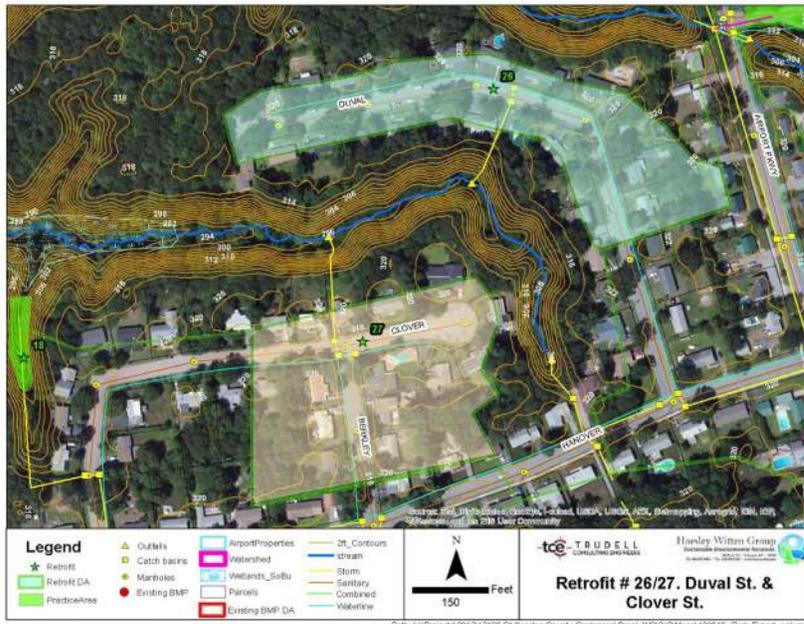


Estimated project cost	\$1,216,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	31.49		Primary land use in drainage	Institutional
Impervious acres managed	9.69		2 or more landowners?	Yes
% Impervious	31%		CPv managed (ac-ft)	1.96
Land owner of BMP location	MS4 Owned		Volume infiltrated (ac-ft)	1.96
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	B/Not Rated			

Proposed BMP description:	Feasibility concerns:
Underground detention in open space of school property. It seems possible to collect drainage off of White Street (and upgradient residential neighborhood) and connect to existing system via school entrance. Underground chambers could be designed as infiltration pending results of soils test pitting. (note HSG – D on east side of school property; HSG – B on west side of school property).	Existing drainage system (12” cmp) drains building and parking lot. Would need to verify capacity to add addition upgradient lands – only need to be sized for 1- YR. Cpv.

Centennial Brook FRP BMP Summary Sheet

Site name: Clover St GSI		South Burlington ID: CB0007			
Approximate address:	Clover St and Berkley St, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				



Estimated project cost	\$72,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	3.82		Primary land use in drainage	Residential
Impervious acres managed	1.40		2 or more landowners?	Yes
% Impervious	37%		CPv managed (ac-ft)	0.07
Land owner of BMP location	MS4 Owned/ Private		Volume infiltrated (ac-ft)	0.07
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	A			

Proposed BMP description:	Feasibility concerns:
30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).	Small drainage area; requires participation by homeowners.

Centennial Brook FRP BMP Summary Sheet

Site name:	Dumont Ave Infiltration Chambers	South Burlington ID:	CB0008
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Approximate address:	Dumont Ave, South Burlington	MS4 where BMP is located:	BTV	New or existing BMP?	New
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Proposed BMP type:	Infiltration Gallery
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Estimated project cost	\$27,000	MS4s contributing drainage to BMP	South Burlington, BTV
Drainage area (acres)	3.93		Primary land use in drainage
Impervious acres managed	0.86	2 or more landowners?	Yes
% Impervious	22%	CPv managed (ac-ft)	0.05
Land owner of BMP location	MS4 Owned	Volume infiltrated (ac-ft)	0.05
BMP Footprint Size (acres)		Primary or secondary BMP?	Primary
BMP Depth (feet)		Expired permit(s)?	No Permit
Hydrologic soil group	A		

Proposed BMP description:	Feasibility concerns:
Divert flows from existing catchbasins and convey down Dumont Ave via pipe or swale to underground recharge chambers on empty lot. Options exist for practice type, siting and conveyance mechanism depending on depth to GW, existing inverts, and future use by Airport. Discharge to existing pipe outlet at Airport basin.	Invert at White St. 321.40. Distance to vacant lot on corner – approx. 580' @ .005 slope; pipe outlets at 318.5'. Storage would be below grade. Depth to GW could be an issue and eliminate infiltration option. For above grade system inverts at White/Delaware would need to be raised. May be possible by resetting pipe inverts. Possible to create sand filter on top of UG chambers or shallow infiltration basin.

Centennial Brook FRP BMP Summary Sheet

Site name: Duval St GSI		South Burlington ID: CB0009			
Approximate address:	Duval St, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				



Estimated project cost	\$79,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	3.57		Primary land use in drainage	Residential
Impervious acres managed	0.99		2 or more landowners?	Yes
% Impervious	28%		CPv managed (ac-ft)	0.05
Land owner of BMP location	MS4 Owned/ Private		Volume infiltrated (ac-ft)	0.05
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	A			

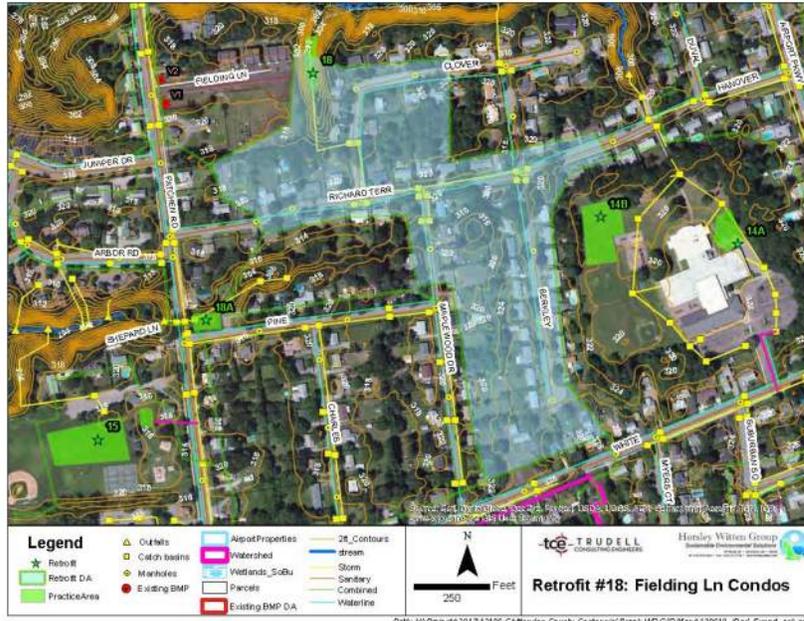
Proposed BMP description:	Feasibility concerns:
30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).	Small drainage area; requires participation by homeowners.

Centennial Brook FRP BMP Summary Sheet

Site name: Fielding Lane Condos Infiltration Gallery **South Burlington ID:** CB0010

Approximate address:	Richard Terr and Clover St, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
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Proposed BMP type: Infiltration Gallery

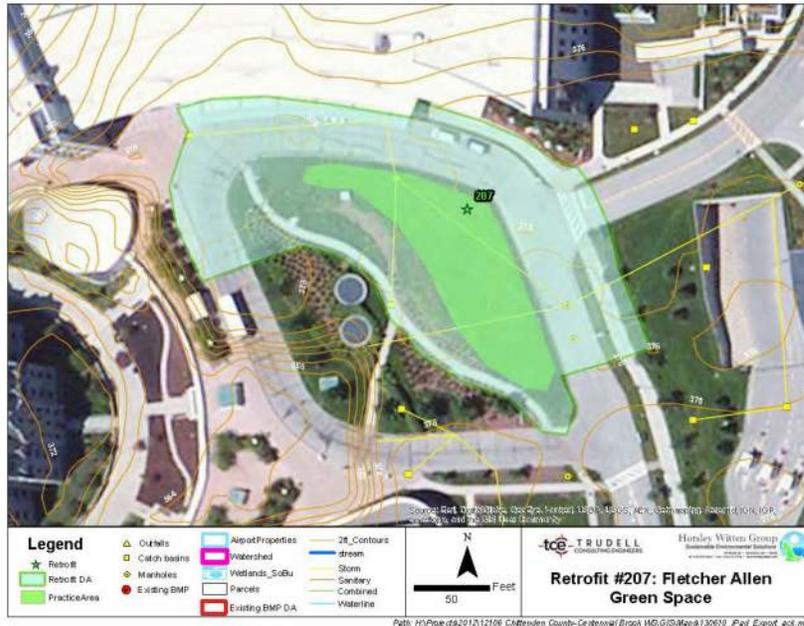


Estimated project cost	\$208,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	18.74		Primary land use in drainage	Residential
Impervious acres managed	5.14		2 or more landowners?	Yes
% Impervious	27%		CPv managed (ac-ft)	0.15
Land owner of BMP location	Private		Volume infiltrated (ac-ft)	0.15
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	A			

Proposed BMP description:	Feasibility concerns:
Detention-retention facility. Open parcel adjacent to Fielding Lane Condos – seems to be owned by Fielding Lane Condos, existing surface storage available below outfall pipe. Would require access from Fielding Lane.	Likely private land - Major constraint is construction and maintenance access. Homeowners on Clover Street most impacted. Downgradient wetlands/stream below outfall pipe.

Centennial Brook FRP BMP Summary Sheet

Site name: Fletcher Allen Green Space		South Burlington ID: CB0011			
Approximate address:	Carrigan Dr, Burlington	MS4 where BMP is located:	Burlington	New or existing BMP?	Existing
Proposed BMP type:	Bioretention				



Estimated project cost	\$50,000	MS4s contributing drainage to BMP	Burlington, UVM						
Drainage area (acres)	0.89		Primary land use in drainage	Institutional					
Impervious acres managed	0.53			2 or more landowners?	No				
% Impervious	59%				CPv managed (ac-ft)	0.13			
Land owner of BMP location	MS4 Owned					Volume infiltrated (ac-ft)	0.13		
BMP Footprint Size (acres)							Primary or secondary BMP?	Secondary	
BMP Depth (feet)								Expired permit(s)?	
Hydrologic soil group	Not Rated								

Proposed BMP description:	Feasibility concerns:
Proposed bioretention area in green space near hospital entrance. Redirect existing roadway trench drains into practice. Site currently drains to the UVM East Campus Pond.	Moderate feasibility. Trench drain outlets are shallow so daylighting is possible. Plenty of green space for practice area. High profile location.

Centennial Brook FRP BMP Summary Sheet

Site name: Fletcher Allen Parking Lot		South Burlington ID: CB0012			
Approximate address:	Carrigan Dr, Burlington	MS4 where BMP is located:	Burlington	New or existing BMP?	Existing
Proposed BMP type:	Bioretention				

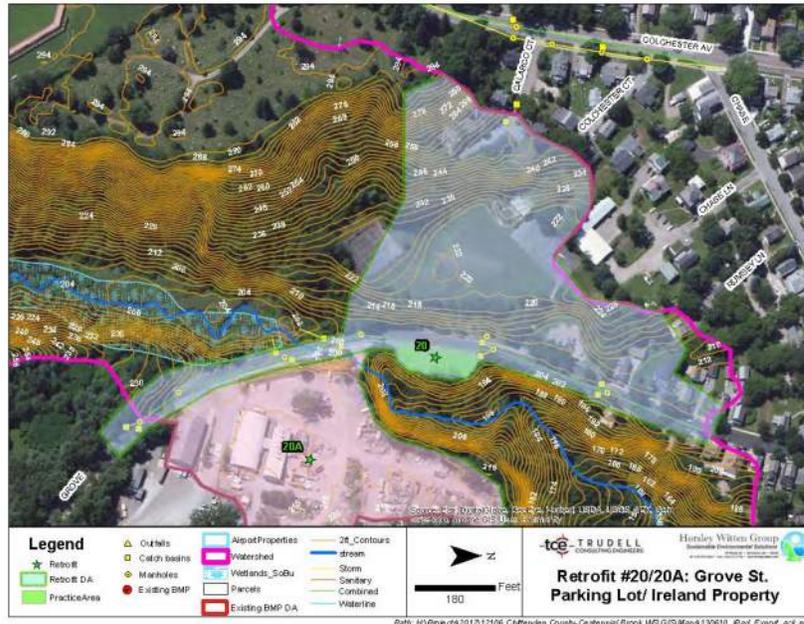


Estimated project cost	\$37,000	MS4s contributing drainage to BMP	Burlington	
Drainage area (acres)	0.83		Primary land use in drainage	Institutional
Impervious acres managed	0.61		2 or more landowners?	No
% Impervious	74%		CPv managed (ac-ft)	0.10
Land owner of BMP location	MS4 Owned		Volume infiltrated (ac-ft)	0.10
BMP Footprint Size (acres)			Primary or secondary BMP?	Secondary
BMP Depth (feet)			Expired permit(s)?	
Hydrologic soil group	D			

Proposed BMP description:	Feasibility concerns:
Proposed bioretention area in existing drainage feature. Site is currently managed by existing swales, curb cuts, and a drainage depression. Swales and depression are currently eroding. Raise existing catchbasin frame/grate to provide ponding for bioretention.	Easy retrofit and aesthetic improvement. Parking lot already has features necessary directing drainage to the retrofit practice location.

Centennial Brook FRP BMP Summary Sheet

Site name: Grove Street Parking Lot		South Burlington ID: CB0013			
Approximate address:	Grove St, Burlington	MS4 where BMP is located:	Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				



Estimated project cost	\$156,000	MS4s contributing drainage to BMP	Burlington						
Drainage area (acres)	8.82		Primary land use in drainage	Road					
Impervious acres managed	2.33			2 or more landowners?	Yes				
% Impervious	26%				CPv managed (ac-ft)	0.20			
Land owner of BMP location	MS4 Owned					Volume infiltrated (ac-ft)	0.20		
BMP Footprint Size (acres)							Primary or secondary BMP?	Primary	
BMP Depth (feet)								Expired permit(s)?	1-0811
Hydrologic soil group	B								

Proposed BMP description:	Feasibility concerns:
Divert existing drainage network and capture runoff from parking lot and direct to proposed underground recharge system. Low point in road drainage area is immediately south of the City parking lot. Consider replacing parking lot with permeable pavement.	High feasibility since parking lot is currently in poor condition. Adequate head to capture roadway drainage. Test pits or borings needed to confirm soils and depth to groundwater.

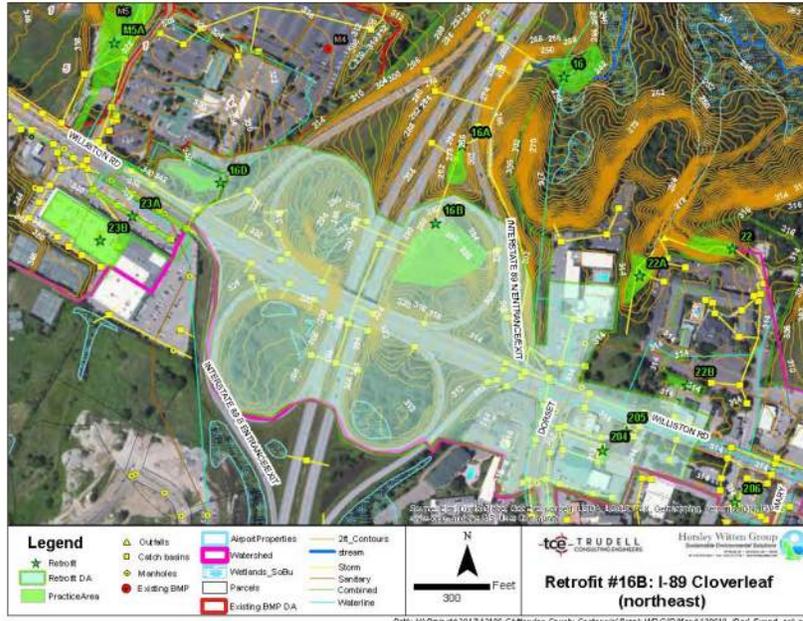
Centennial Brook FRP BMP Summary Sheet

Site name: I-89 Cloverleaf
Underground Detention

South Burlington ID: CB0014

Approximate address:	I-89 Exit 14 interchange, South Burlington	MS4 where BMP is located:	VTrans	New or existing BMP?	Existing
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Proposed BMP type: Underground Detention

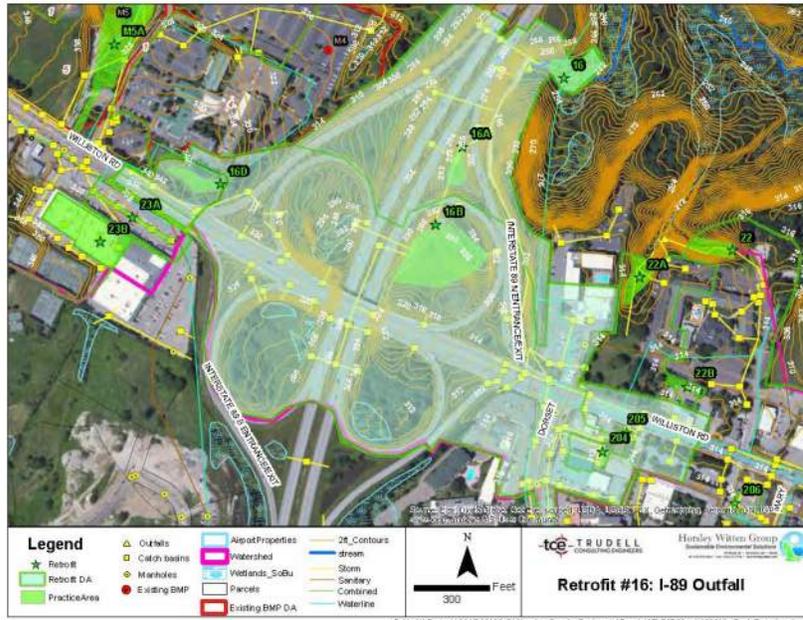


Estimated project cost	\$215,000	MS4s contributing drainage to BMP	South Burlington, VTrans
Drainage area (acres)	39.17		
Impervious acres managed	17.18	Primary land use in drainage	Transportation
% Impervious	44%	2 or more landowners?	Yes
Land owner of BMP location	MS4 Owned	CPv managed (ac-ft)	2.35
BMP Footprint Size (acres)		Volume infiltrated (ac-ft)	0.00
BMP Depth (feet)		Primary or secondary BMP?	Secondary
Hydrologic soil group	Not Rated	Expired permit(s)?	2-0126; 6323-9030; 2-0610

Proposed BMP description:	Feasibility concerns:
Detention structure bounded by northbound lanes and off-ramp (directing traffic to westbound Williston Rd). Existing culvert drains all upgradient area from interchange and Williston Rd. Modify outlet to install new control structure for Cpv storage.	Good location for retrofit. Existing outlet pipe (48" CMP) is easily accessible. Constraints: safety considerations from highway and existing wetlands (though mapped- all areas appear to be phrag dominated and isolated). Approx 14 of grade from invert to low point on off-ramp.

Centennial Brook FRP BMP Summary Sheet

Site name: I-89 Exit 14 Detention Pond		South Burlington ID: CB0015			
Approximate address:	I-89 Exit 14 interchange, South Burlington	MS4 where BMP is located:	VTrans	New or existing BMP?	New
Proposed BMP type:	Gravel Wetland				

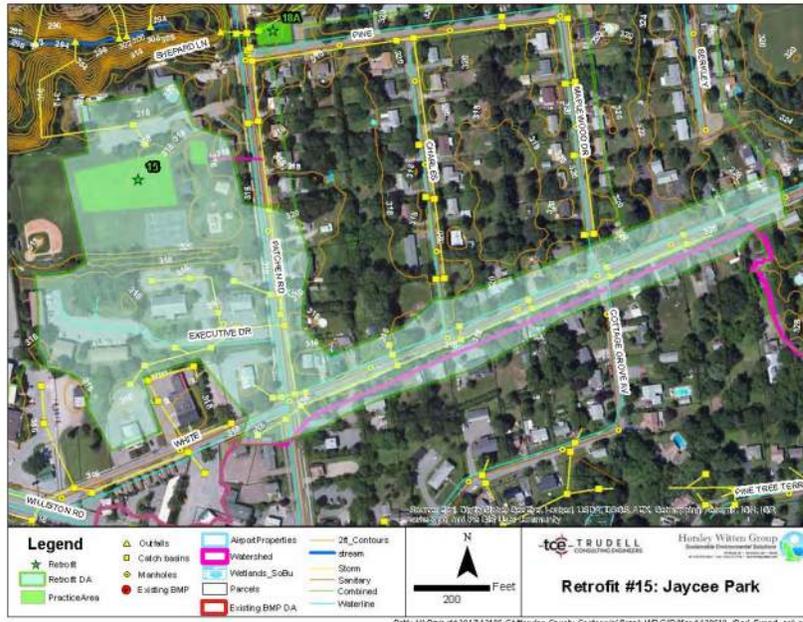


Estimated project cost	\$1,787,000	MS4s contributing drainage to BMP	South Burlington, VTrans	
Drainage area (acres)	13.07		Primary land use in drainage	Highway R/W
Impervious acres managed	3.58		2 or more landowners?	No
% Impervious	27%		CPv managed (ac-ft)	2.87
Land owner of BMP location	Public or MS4 Owned (depending on location)		Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	Not Rated			

Proposed BMP description:	Feasibility concerns:
Location flexible depending on evaluation. Most downstream location would be across from drainage outlet, below water main (best location for embankment – maximizes storage), but impact to water main R/W likely and partially on private property. Alternative is to move embankment upgradient to limit of I-89 R/W – would reduce available storage, but keep all work w/in VTrans jurisdiction.	Feasible, but constraints need to be quantified, including property ownership, wetlands impacts (see Phrag in photo), water main. Construction and maintenance access good, via water mail R/W. VTrans noted that prior rip rap work was NOT a permitting issues with COE or DEC.

Centennial Brook FRP BMP Summary Sheet

Site name: Jaycee Park		South Burlington ID: CB0016			
Approximate address:	Patchen Rd north of White St, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				

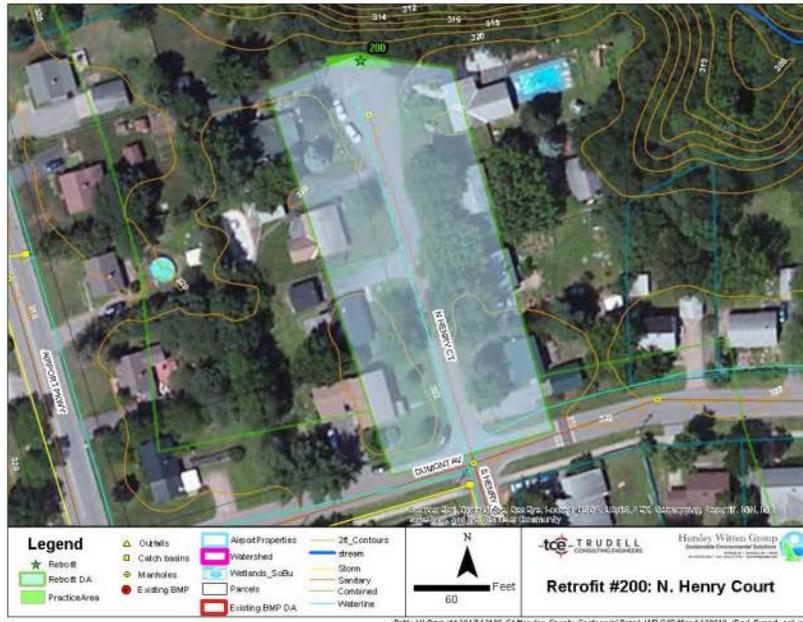


Estimated project cost	\$418,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	15.73		Primary land use in drainage	Park
Impervious acres managed	6.42		2 or more landowners?	Yes
% Impervious	41%		CPv managed (ac-ft)	0.90
Land owner of BMP location	MS4 Owned		Volume infiltrated (ac-ft)	0.90
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	A			

Proposed BMP description:	Feasibility concerns:
<p>Pretreatment tank to underground infiltration chambers. Pretreatment could be proprietary device (e.g. StormCeptor or equal) before underground chambers. Access would need to be coordinated with playing fields. Flow diversion structure would be in Patchen Road, with depth to drain pipe at approx 6.5 feet.</p>	<p>Flow diversion from Patchen Road drives depth of inflow approx 10.5 feet below grade (bottom of chambers 12-13 feet). Existing trees in park, reconstruction of fields Soils at design depth, unknown.</p>

Centennial Brook FRP BMP Summary Sheet

Site name: N Henry Court		South Burlington ID: CB0018			
Approximate address:	N Henry Ct, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				



Estimated project cost	\$27,000	MS4s contributing drainage to BMP	South Burlington, BTV	
Drainage area (acres)	1.03		Primary land use in drainage	Residential
Impervious acres managed	0.33		2 or more landowners?	Yes
% Impervious	32%		CPv managed (ac-ft)	0.02
Land owner of BMP location	MS4 Owned		Volume infiltrated (ac-ft)	0.02
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	No Permit
Hydrologic soil group	A			

Proposed BMP description:	Feasibility concerns:
<p>Dead-end road with excess impervious cover. Currently, drainage comes down the road and flows directly down a steep slope to the stream/wetland area below. Install a rain garden/bio with an overflow to a leaching catch basin at end of road. Dumping of yard waste and debris was also observed down the slope. An old corrugated discharge pipe was found down in stream.</p>	<p>Small project, but could be a good GI demonstration.</p>

Centennial Brook FRP BMP Summary Sheet

Site name: North Campus Pond Retrofit **South Burlington ID:** CB0019

Approximate address:	University Rd, Burlington	MS4 where BMP is located:	UVM	New or existing BMP?	Existing
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Proposed BMP type: Detention Pond



Estimated project cost	\$324,000	MS4s contributing drainage to BMP	Burlington, UVM
Drainage area (acres)	76.94		Primary land use in drainage
Impervious acres managed	45.99	2 or more landowners?	Yes
% Impervious	60%	CPv managed (ac-ft)	4.72
Land owner of BMP location	MS4 Owned	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)		Primary or secondary BMP?	Primary
BMP Depth (feet)		Expired permit(s)?	
Hydrologic soil group	B		

Proposed BMP description:	Feasibility concerns:
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<p>Proposed expansion of existing North Campus Pond to over control existing and future development. Raise existing embankment (10' +/-) to provide additional capacity. May consider horizontal expansion to the north and/or south.</p>	<p>Prior to advancing design, UVM will provide a build-out analysis of the contributing drainage area. Drainage area to be updated to reflect the additional portion of UVM that will be redirected to the North Campus Pond.</p>
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Centennial Brook FRP BMP Summary Sheet

Site name:	Patchen Rd & Pine St Infiltration Gallery	South Burlington ID:	CB0021
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Approximate address:	Pine St and Patchen Rd, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
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Proposed BMP type:	Infiltration Gallery
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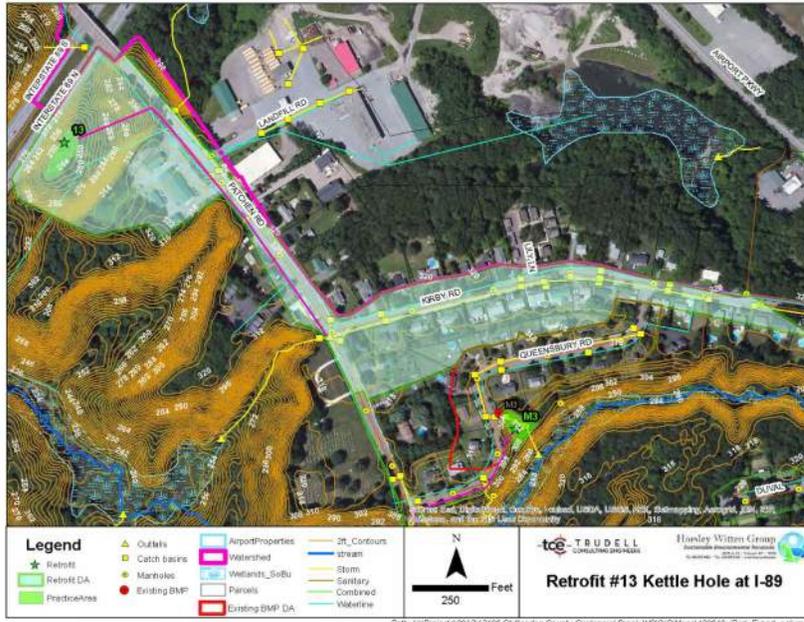


Estimated project cost	\$427,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	20.41	Primary land use in drainage	Residential
Impervious acres managed	5.40	2 or more landowners?	Yes
% Impervious	26%	CPv managed (ac-ft)	0.91
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.91
BMP Footprint Size (acres)		Primary or secondary BMP?	Primary
BMP Depth (feet)		Expired permit(s)?	No Permit
Hydrologic soil group	A		

Proposed BMP description:	Feasibility concerns:
<p>Underground detention or infiltration (depending on soils). Diversion of flows from Patchen Road feasible, incoming pipe from open space/low point behind lots too deep to capture. Single lot also contains SF house (see photo). Would require diversion structure and pretreatment tank/structure.</p>	<p>Pipe inverts in Patchen Rd. feasible to divert to underground storage, except west side of road would require crossing water and sewer. Depth of construction ~8 to 10 ft. Private ownership of parcel biggest constraint.</p>

Centennial Brook FRP BMP Summary Sheet

Site name: Patchen Road Kettle Hole		South Burlington ID: CB0022			
Approximate address:	Patchen Rd south of I-89, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				

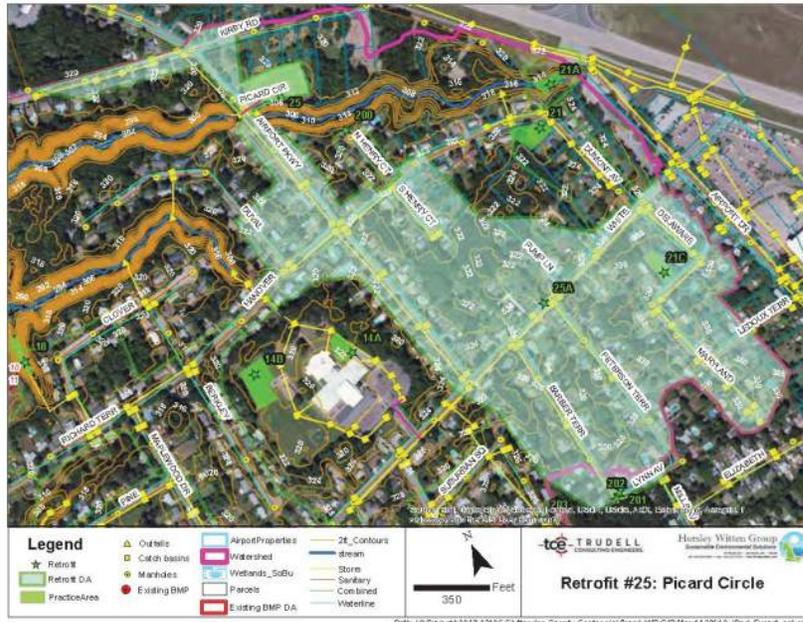


Estimated project cost	\$220,000	MS4s contributing drainage to BMP	South Burlington, VTrans	
Drainage area (acres)	14.06		Primary land use in drainage	Forest
Impervious acres managed	5.45		2 or more landowners?	Yes
% Impervious	39%		CPv managed (ac-ft)	0.27
Land owner of BMP location	MS4 Owned/ Private		Volume infiltrated (ac-ft)	0.27
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	6292-9030
Hydrologic soil group	A			

Proposed BMP description:	Feasibility concerns:
Detention Pond (or infiltration basin if soils are acceptable). Directly convey runoff from contributing area off Patchen Road down slope to sediment forebay. Modify existing 30" culvert headwall (under I-89) to achieve required flow control. Could pick up Kirby Rd.	Good site; final feasibility will require verification of wetland limits (soils generally upland), assessment of impacts to existing water main (runs through parcel, see blow-off valve in photo), and coordination with VTrans for ponding against I-89 R/W.

Centennial Brook FRP BMP Summary Sheet

Site name: Picard Circle Infiltration		South Burlington ID: CB0023			
Approximate address:	Picard Cir, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
Proposed BMP type:	Infiltration Gallery				

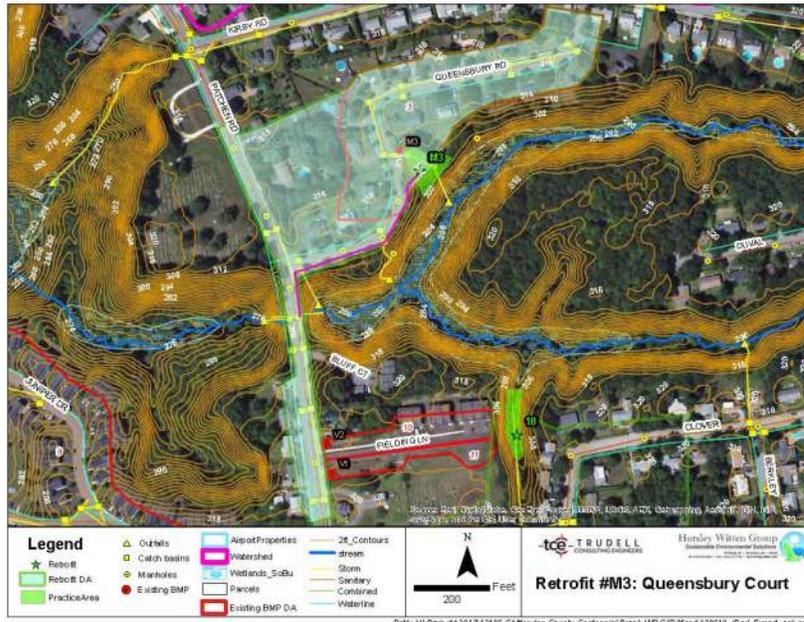


Estimated project cost	\$591,000	MS4s contributing drainage to BMP	South Burlington, BTV						
Drainage area (acres)	69.80		Primary land use in drainage	Residential					
Impervious acres managed	21.06			2 or more landowners?	Yes				
% Impervious	30%				CPv managed (ac-ft)	0.68			
Land owner of BMP location	MS4 Owned					Volume infiltrated (ac-ft)	0.68		
BMP Footprint Size (acres)							Primary or secondary BMP?	Primary	
BMP Depth (feet)								Expired permit(s)?	No Permit
Hydrologic soil group	A								

Proposed BMP description:	Feasibility concerns:
<p>Subsurface infiltration system. All houses within Picard Circle have been purchased by Airport and are now abandoned. Significant site area exists within yards and the road for major underground infiltration/ detention system.</p> <p>Constraints include depth of existing drainage pipe and depth above groundwater (adjacent brook approx 14 feet below existing ground).</p>	<p>Depth of existing drainage line in Airport Pkwy may preclude piping from existing infrastructure to new system. One option would be to install diversion structure and partially submerge existing piping system.</p>

Centennial Brook FRP BMP Summary Sheet

Site name: Queensbury Pond Retrofit		South Burlington ID: CB0024			
Approximate address:	Queensbury Rd, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	Existing
Proposed BMP type:	Infiltration Basin				



Estimated project cost	\$110,000	MS4s contributing drainage to BMP	South Burlington	
Drainage area (acres)	7.60		Primary land use in drainage	Residential
Impervious acres managed	2.88		2 or more landowners?	Yes
% Impervious	38%		CPv managed (ac-ft)	0.16
Land owner of BMP location	Private		Volume infiltrated (ac-ft)	0.16
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	1-0946
Hydrologic soil group	A			

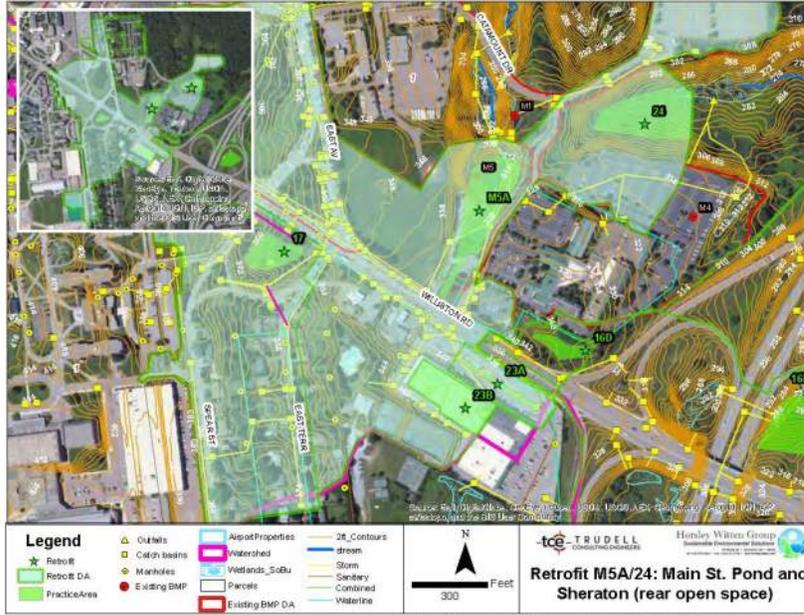
Proposed BMP description:	Feasibility concerns:
Existing dry detention pond. Modify outlet to create an infiltration basin. Existing pond might predate subdivision (newer PVC outlet connects to older CMP barrel). Facility appears to have additional storage capacity to expand drainage area (level run confirmed this is feasible).	Old CMP barrel, new 15" PVC outlet, sink hole evidence – top of existing embankment, scour hole at barrel outlet, Incoming 15" HDPE, eroded inflow channel

Centennial Brook FRP BMP Summary Sheet

Site name:	Retrofit of Main Street UVM Pond	South Burlington ID:	CB0025
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Approximate address:	North of Williston Rd and East Terr, South Burlington	MS4 where BMP is located:	UVM	New or existing BMP?	Existing
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Proposed BMP type:	Detention Pond
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Estimated project cost	\$365,000	MS4s contributing drainage to BMP	South Burlington, Burlington, UVM	
Drainage area (acres)	39.64		Primary land use in drainage	Institutional
Impervious acres managed	17.51		2 or more landowners?	Yes
% Impervious	44%		CPv managed (ac-ft)	3.89
Land owner of BMP location	MS4 Owned		Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)			Primary or secondary BMP?	Primary
BMP Depth (feet)			Expired permit(s)?	
Hydrologic soil group	C			

Proposed BMP description:	Feasibility concerns:
Repair outlet structure. Retrofit options include expanding the pond southward toward Williston Road or eastward as part of Retrofit #24 for additional storage, extended detention, and improved water quality. Site has the ability to capture drainage from Williston Road, adjacent commercial properties, and unmanaged UVM land.	Priority location with high feasibility. Additional storage volume can be added by excavating southward toward the adjacent dirt parking lot and Williston Road.

Centennial Brook FRP BMP Summary Sheet

Site name: Staples Plaza Underground Detention A **South Burlington ID:** CB0027

Approximate address:	West of I-89 Exit 14 interchange, South Burlington	MS4 where BMP is located:	South Burlington	New or existing BMP?	New
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Proposed BMP type: Underground Detention



Estimated project cost	\$334,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	2.50		Primary land use in drainage
Impervious acres managed	2.50	2 or more landowners?	No
% Impervious	100%	CPv managed (ac-ft)	0.26
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)		Primary or secondary BMP?	Secondary
BMP Depth (feet)		Expired permit(s)?	No Permit
Hydrologic soil group	Not Rated		

Proposed BMP description:	Feasibility concerns:
Convert landscaped island to bioswale w/ UG storage to manage parking and small roof. Overflow to existing drain. Add trees for cover, shading, interception. Reduce width of one-way aisle for bioswale. Flat roof drains internally, discharges to drain inlet east of building. Modify internal roof drains, install trays, or use other blue roof design to provide temporary detention.	This area could be managed in a larger retrofit downstream (Site # 24_M5). Primary outlet in catchbasin at lot entrance/exit. Rim to invert = 5.05'. Stalls are 18'x8', with a 27' drive aisle (60' and 57' curb to curb on the north and south side of island, respectively).

APPENDIX B
PROJECT RANKING

Centennial Brook Flow Restoration Plan
Table D-1: BMP Ranking Criteria Key

Category	ID	Criteria	Technical Description	Description
Cost/Operations	A	Project Cost	The project costs were grouped into categories from >\$50,000 to \$1,000,000 based on the range of projects proposed. Cost estimates were developed using the latest unit costs from VTrans as well as local experience. More expensive projects are ranked lower.	Project Costs include additional engineering, permitting, and construction. Transportation and utility conflicts, as well as overall constructability is also reflected in the cost.
Project Design Metrics	B	Impervious Acres Managed (ac)	Natural groupings within the range of impervious managed for the proposed projects were identified. More impervious managed receives a higher score.	The more impervious managed by a project, the higher the potential pollutant reduction. Additionally, the goal of the FRP is to manage existing impervious surfaces.
	C	Channel Protection Volume (CPv) Mitigated, (i.e.. 1-year Storm)	Groupings within the range of CPv volume storage were identified. The largest grouping receives the highest score. The CPv was estimated in HydroCAD, using local rainfall data.	The Channel Protection Volume (CPv) is the volume of stormwater runoff generated from the 1-year design storm (1.98" in Burlington). A BMP which provides CPv storage was determined to reduce the High-flow (Q0.3%), which is the flow rate exceeded 0.3% of the time (output from the State's BMPDSS model). Mitigating the CPv reduces channel erosion and excessive
	D	Volume Infiltrated (ac-ft)	Natural groupings within the range of volumes infiltrated for the BMPs were identified to which relative points were be assigned. The largest volume infiltrated was assigned the highest score. Volumes were calculated in HydroCAD.	The Volume Infiltrated indicates the amount of stormwater runoff that is infiltrated into the groundwater, and provides baseflow for the stream. The TMDL flow targets include a low-flow target, which is addressed by an infiltration-based BMP.
Project Implementation	E	Permitability	Permitability is simplified into two categories to reflect the common scenarios in permitting, as 1) minimal permitting, versus 2) Complex permitting issues. An itemized list of permits was included to inform the ranking, but was not used in the scoring.	Permitability is a measure of the expected level of effort to permit the project, based on knowledge that each type of permit takes varying amounts of time. Some common permits include Stormwater Construction, Local Zoning, Act 250 amendments, VTRANS ROW, etc.
	F	Land Availability	Public land is preferred, followed by regulated private land, and private land where the owners are known to be open to participate. Private land, in which participation of the owner is unknown is lower priority.	Land availability is critical for BMPs requiring open space for detention and access for the City. Properties owned by the City are ranked the highest, followed by privately owned land that has an expired permit, which provides leverage for owner participation.
Other Project Benefits	G	Flood Mitigation	Flood mitigation is categorized by the scale of the impact.	Flood mitigation is categorized by the scale of the impact. A neighborhood flooding issue is weighed more heavily than a localized drainage issue.
	H	TMDL Flow Target Addressed (Q03, Q95)	More weight is on BMPs that address both TMDL targets- the high-flow (Q0.3%) and low-flow targets (Q95%). The high-flow target is addressed by detention BMPs which storage the CP volume.	The goal of the FRP is to implement projects which address the TMDL flow targets. The high-flow target is measured as a reduction in the stream flow rate exceeded 0.3% of the time, while the low-flow target is an increase in the stream flow rate exceeded 95% of the time (baseflow). Projects which address both targets through storage or infiltration of the 1-year design storm are weighted the highest, followed by projects which address just the high-flow. Projects which do not address the full 1-year storm volume are weighted the lowest.
	I	Lake Champlain Phosphorus TMDL	Yes or no whether the proposed practice will provide benefit toward the Lake Champlain Phosphorus TMDL. This will be determined once the TMDL compliance metrics are released.	The Lake Champlain Phosphorus TMDL has been developed in the effort to reduce nutrient loading and consequential toxic algal blooms in Lake Champlain. The TMDL will require stormwater BMPs to meet a certain level of Total Phosphorus reduction. Each BMP will be evaluated against the TMDL compliance metrics, and scored yes or no if the project meets the TMDL standards.
	J	Other Project Benefits/Constraints	This criteria is to account for indirect project benefits like infrastructure improvements (e.g. aging culvert replacement, wetlands enhancement, and if it addresses an expired permit), or potential constraints (e.g. utility issues encountered during construction).	This criteria is to account for indirect project benefits like infrastructure improvements, community benefits, habitat creation, etc., as well as things that might constrain the project such as the potential of encountering utilities during construction.

Centennial Brook Flow Restoration Plan
 Table D-2: BMP Ranking Scoring Key

Category	ID	Criteria	Quality	Score
Cost/Operations	A	Relative Project Cost	\$1.00 - \$24,999	4
			\$25,000 - \$49,999	3
			\$49,999 - \$99,999	2
			\$100,000 - \$199,999	1
			\$200,000 - \$499,999	0
			\$500,000 +	-1
Project Design Metrics	B	Impervious Acres Managed (ac)	>10 acres	6
			>5-10 acres	5
			>4-5 acres	4
			>2-4 acres	3
			>1-2 acres	2
			< 1 acre	1
	C	Channel Protection Volume (CPv) Mitigated, (ie. 1-year Storm)	0 acres	0
			0.6-1.0 ac-ft	5
			0.4-0.6 ac-ft	4
			0.2-0.4 ac-ft	3
			0.05-0.2 ac-ft	2
			>0-0.05 ac-ft	1
D	Volume Infiltrated (ac-ft)	0 ac-ft	0	
		>2 ac-ft	5	
		1 - 2 ac-ft	4	
		0.5-1 ac-ft	3	
		0.1- 0.5 ac-ft	2	
		>0.01 - 0.1 ac-ft	1	
Project Implementation	E	Permitability	no infiltration	0
			Minimal Issues/Concerns or no permits	2
	F	Land Availability	Complex issues/Potential permit denial	0
			MS4 owned	4
Other Project Benefits	G	Flood Mitigation (Is existing flooding issue mitigated by project?)	Non MS4 owned regulated (expire permit)	3
			Non MS4 owned/Participatory Owner	2
			Unknown	0
			Not MS4 owned/Non participatory owner	-2
	H	TMDL Flow Target Addressed (Q03, Q95)	Neighborhood Wide Flooding Issue	3
			Infrastructure damage (e.g. Wet Basement)	2
			Nuisance Issue (ie. ponding, puddles, etc).	1
			None	0
	I	Lake Champlain Phosphorus TMDL	High and Low Flow Targets	3
			High Flow Target	2
			No target addressed in BMPDSS (just WQ treatment)	1
			Addressed TMDL	1
J	Other Project Benefits	Does not address TMDL	0	
		Infrastructure Improvement (e.g. Culvert Replacement)	1	
		Educational/Functional Benefit	1	
		Recreational Benefit	1	
		Natural Habitat Creation/Protection	1	
		Outfall Erosion Control	1	
Utility Issues/Uncertainty	-1			

APPENDIX C

PROPOSED BMP COST ESTIMATES, PRIORITIZATION RANKING, AND IMPLEMENTATION SCHEDULE

Centennial Brook Flow Restoration Plan
Table E-1: Project Cost Estimates

BMP ID	Project Name	Retrofit Description	Impervious Area Mangaged (acres)	Design Control Volume (ft3)	Base Unit Cost (\$/cu.ft.)	Site Adjust Factor	Site Specific Cost	Base Constr. Cost	Permits & Eng.	Land Cost	Summed Project Cost	Minimum Project Cost	Final Project Cost	Cost/ Imp. Acre	O&M
CB0001	140 East Ave Residence	Bio	0.18	1,800	\$10	1.5	\$0	\$27,000	\$10,000	\$7,200	\$44,200	\$25,000	\$44,200	\$249,000	\$1,300
CB0002	Best Western Windjammer Infiltration Basin A	IB	21.82	181,000	\$4	0.5	\$50,000	\$412,000	\$145,000	\$0	\$557,000	\$25,000	\$557,000	\$26,000	\$10,000
CB0003	Best Western Windjammer Infiltration Basin B	IB	1.33	30,000	\$4	0.5	\$0	\$60,000	\$21,000	\$0	\$81,000	\$25,000	\$81,000	\$61,000	\$2,400
CB0004	Case Parkway Center Island	Bio	0.23	1,000	\$10	1.5	\$0	\$15,000	\$6,000	\$0	\$21,000	\$25,000	\$25,000	\$110,000	\$800
CB0006	Chamberlin School	IG	9.69	60,473	\$12	1.5	\$0	\$1,088,514	\$127,000	\$0	\$1,215,514	\$25,000	\$1,215,514	\$125,000	\$10,000
CB0007	Clover St GSI	IG	1.40	1,700	\$12	1.5	\$0	\$30,600	\$11,000	\$30,000	\$71,600	\$25,000	\$71,600	\$51,000	\$2,100
CB0008	Dumont Ave Infiltration Chambers	IG	0.86	1,100	\$12	1.5	\$0	\$19,800	\$7,000	\$0	\$26,800	\$25,000	\$26,800	\$31,000	\$800
CB0009	Duval St GSI	IG	0.99	1,100	\$22	1.5	\$0	\$36,300	\$13,000	\$30,000	\$79,300	\$25,000	\$79,300	\$80,000	\$2,400
CB0010	Fielding Lane Condos Infiltration Gallery	IG	5.14	21,700	\$4	1	\$0	\$86,800	\$31,000	\$90,000	\$207,800	\$25,000	\$207,800	\$40,000	\$6,200
CB0011	Fletcher Allen Green Space	Bio	0.53	3,700	\$10	1	\$0	\$37,000	\$13,000	\$0	\$50,000	\$25,000	\$50,000	\$94,000	\$1,500
CB0012	Fletcher Allen Parking Lot	Bio	0.61	2,700	\$10	1	\$0	\$27,000	\$10,000	\$0	\$37,000	\$25,000	\$37,000	\$60,000	\$1,100
CB0013	Grove Street Parking Lot	IG	2.33	4,800	\$12	2	\$0	\$115,200	\$41,000	\$0	\$156,200	\$25,000	\$156,200	\$67,000	\$4,700
CB0014	I-89 Cloverleaf Underground Detention	UD	17.18	102,577	\$2	0.5	\$0	\$102,577	\$112,000	\$0	\$214,577	\$25,000	\$214,577	\$12,000	\$10,000
CB0015	I-89 Exit 14 Detention Pond	GW	3.58	125,016	\$12	1	\$0	\$1,500,189	\$227,000	\$60,000	\$1,787,189	\$25,000	\$1,787,189	\$500,000	\$10,000
CB0016	Jaycee Park	IG	6.42	19,211	\$12	1.5	\$0	\$345,798	\$72,000	\$0	\$417,798	\$25,000	\$417,798	\$65,000	\$10,000
CB0018	N Henry Court	IG	0.33	600	\$22	1.5	\$0	\$19,800	\$7,000	\$0	\$26,800	\$25,000	\$26,800	\$82,000	\$800
CB0019	North Campus Pond Retrofit	DP	45.99	205,603	\$2	0.25	\$100,000	\$202,801	\$121,000	\$0	\$323,801	\$25,000	\$323,801	\$7,000	\$10,000
CB0021	Patchen Rd & Pine St Infiltration Gallery	IG	5.40	8,600	\$12	1.5	\$0	\$353,970	\$55,000	\$18,000	\$426,970	\$25,000	\$426,970	\$79,000	\$10,000
CB0022	Patchen Road Kettle Hole	IG	5.45	11,674	\$4	0.25	\$25,000	\$36,674	\$33,000	\$150,000	\$219,674	\$25,000	\$219,674	\$40,000	\$6,600
CB0023	Picard Circle Infiltration	IG	21.06	14,700	\$12	1.5	\$273,400	\$538,000	\$53,000	\$0	\$591,000	\$25,000	\$591,000	\$28,000	\$17,700
CB0024	Queensbury Pond Retrofit	IB	2.88	26,700	\$4	0.25	\$25,000	\$51,700	\$19,000	\$39,600	\$110,300	\$25,000	\$110,300	\$38,000	\$3,300
CB0025	Main Street UVM Pond	DP	17.51	169,663	\$2	0.5	\$100,000	\$269,663	\$95,000	\$0	\$364,663	\$25,000	\$364,663	\$21,000	\$10,000
CB0027	Staples Plaza Underground Detention A	UD	2.50	11,600	\$12	2	\$0	\$278,400	\$56,000	\$0	\$334,400	\$25,000	\$334,400	\$134,000	\$10,000

Centennial Brook Flow Restoration Plan

Table E-2: Centennial Brook Watershed BMP Project Scoring

Project ID	Project Name	Expired Permit	MS4	BMP Type	Project Cost Estimate	BMP Description	Total Score
CB0023	Picard Circle Infiltration	No Permit	South Burlington	IG	\$591,000	Subsurface infiltration system. All houses within Picard Circle have been purchased by Airport and are now abandoned. Significant site area exists within yards and the road for major underground infiltration/ detention system. Constraints include depth of existing drainage pipe and depth above groundwater (adjacent brook approx 14 feet below existing ground).	27
CB0002	Best Western Windjammer Infiltration Basin A	6323-9030	South Burlington	IB	\$557,000	Site drainage area currently includes only Best Western property. Outfall is severely eroded and is headcutting to the east and may soon reach paved access road. Concept includes stabilizing outfall and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from Williston Road drainage network and redirect drainage from abutting commercial properties.	27
CB0025	Retrofit of Main Street UVM Pond		UVM	DP	\$365,000	Repair outlet structure. Retrofit options include expanding the pond southward toward Williston Road or eastward as part of Retrofit #24 for additional storage, extended detention, and improved water quality. Site has the ability to capture drainage from Williston Road, adjacent commercial properties, and unmanaged UVM land.	24
CB0016	Jaycee Park	No Permit	South Burlington	IG	\$418,000	Pretreatment tank to underground infiltration chambers. Pretreatment could be proprietary device (e.g. StormCeptor or equal) before underground chambers. Access would need to be coordinated with playing fields. Flow diversion structure would be in Patchen Road, with depth to drain pipe at approx 6.5 feet.	24
CB0019	North Campus Pond Retrofit		UVM	DP	\$324,000	Proposed expansion of existing North Campus Pond to over control existing and future development. Raise existing embankment (10' +/-) to provide additional capacity. May consider horizontal expansion to the north and/or south.	23
CB0006	Chamberlin School	No Permit	South Burlington	IG	\$1,215,000	Underground detention in open space of school property. It seems possible to collect drainage off of White Street (and upgradient residential neighborhood) and connect to existing system via school entrance. Underground chambers could be designed as infiltration pending results of soils test pitting. (note HSG – D on east side of school property; HSG – B on west side of school property).	22
CB0014	I-89 Cloverleaf Underground Detention	2-0126; 6323-9030; 2-0619	VTrans	UD	\$215,000	Detention structure bounded by northbound lanes and off-ramp (directing traffic to westbound Williston Rd). Existing culvert drains all upgradient area from interchange and Williston Rd. Modify outlet to install new control structure for Cpv storage.	21
CB0024	Queensbury Pond Retrofit	1-0946	South Burlington	IB	\$110,000	Existing dry detention pond. Modify outlet to create an infiltration basin. Existing pond might predate subdivision (newer PVC outlet connects to older CMP barrel). Facility appears to have additional storage capacity to expand drainage area (level run confirmed this is feasible).	20
CB0013	Grove Street Parking Lot	1-0811	Burlington	IG	\$156,000	Divert existing drainage network and capture runoff from parking lot and direct to proposed underground recharge system. Low point in road drainage area is immediately south of the City parking lot. Consider replacing parking lot with permeable pavement.	19
CB0021	Patchen Rd & Pine St Infiltration Gallery	No Permit	South Burlington	IG	\$427,000	Underground detention or infiltration (depending on soils). Diversion of flows from Patchen Road feasible, incoming pipe from open space/low point behind lots too deep to capture. Single lot also contains SF house (see photo). Would require diversion structure and pretreatment tank/structure.	18
CB0022	Patchen Road Kettle Hole	6292-9030	South Burlington	IG	\$220,000	Detention Pond (or infiltration basin if soils are acceptable). Directly convey runoff from contributing area off Patchen Road down slope to sediment forebay. Modify existing 30" culvert headwall (under I-89) to achieve required flow control. Could pick up Kirby Rd.	18
CB0010	Fielding Lane Condos Infiltration Gallery	No Permit	South Burlington	IG	\$208,000	Detention-retention facility. Open parcel adjacent to Fielding Lane Condos – seems to be owned by Fielding Lane Condos, existing surface storage available below outfall pipe. Would require access from Fielding Lane.	18

CB0011	Fletcher Allen Green Space		Burlington	Bio	\$50,000	Proposed bioretention area in green space near hospital entrance. Redirect existing roadway trench drains into practice. Site currently drains to the UVM East Campus Pond.	16
CB0012	Fletcher Allen Parking Lot		Burlington	Bio	\$37,000	Proposed bioretention area in existing drainage feature. Site is currently managed by existing swales, curb cuts, and a drainage depression. Swales and depression are currently eroding. Raise existing catchbasin frame/grate to provide ponding for bioretention.	16
CB0015	I-89 Exit 14 Detention Pond	No Permit	VTrans	GW	\$1,787,000	Location flexible depending on evaluation. Most downstream location would be across from drainage outlet, below water main (best location for embankment – maximizes storage), but impact to water main R/W likely and partially on private property. Alternative is to move embankment upgradient to limit of I-89 R/W – would reduce available storage, but keep all work w/in VTrans jurisdiction.	16
CB0007	Clover St GSI	No Permit	South Burlington	IG	\$72,000	30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).	16
CB0008	Dumont Ave Infiltration Chambers	No Permit	BTV	IG	\$27,000	Divert flows from existing catchbasins and convey down Dumont Ave via pipe or swale to underground recharge chambers on empty lot. Options exist for practice type, siting and conveyance mechanism depending on depth to GW, existing inverts, and future use by Airport. Discharge to existing pipe outlet at Airport basin.	15
CB0003	Best Western Windjammer Infiltration Basin B	6323-9030	South Burlington	IB	\$81,000	Outfall is located west of Best Western. Site drainage area currently includes only Best Western property. Moderate erosion occurring. Concept includes stabilizing outfalls and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from the Williston Road drainage network. A portion of this drainage area could be directed to Retrofit 22 if necessary.	15
CB0018	N Henry Court	No Permit	South Burlington	IG	\$27,000	Dead-end road with excess impervious cover. Currently, drainage comes down the road and flows directly down a steep slope to the stream/wetland area below. Install a rain garden/bio with an overflow to a leaching catch basin at end of road. Dumping of yard waste and debris was also observed down the slope. An old corrugated discharge pipe was found down in stream.	15
CB0009	Duval St GSI	No Permit	South Burlington	IG	\$79,000	30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).	14
CB0027	Staples Plaza Underground Detention A	No Permit	South Burlington	UD	\$334,000	Convert landscaped island to bioswale w/ UG storage to manage parking and small roof. Overflow to existing drain. Add trees for cover, shading, interception. Reduce width of one-way aisle for bioswale. Flat roof drains internally, discharges to drain inlet east of building. Modify internal roof drains, install trays, or use other blue roof design to provide temporary detention.	13
CB0001	140 East Ave Residence		Burlington	Bio	\$44,200	Construct a bioretention area in underutilized private green space. Divert drainage from existing drainage structure in Bilodeau Court. Alternative practice may include permeable pavement shoulders/parking lanes in the road ROW.	13
CB0004	Case Parkway Center Island		Burlington	Bio	\$25,000	Proposed bioretention area in center island on Case Parkway. Direct road drainage to bioretention using a speed bump across Case Parkway. The bioretention could underdrain/overflow to existing drainage system and outfall.	12

Centennial Brook Flow Restoration Plan

Table E-3: Centennial Brook Watershed BMP Project Implementation Schedule

Project ID	Project Name	Expired Permit	MS4	BMP Type	BMP Description	Implementation Year	Project Cost Estimate	Project Cost Estimate w/ Inflation
CB0023	Picard Circle Infiltration	No Permit	South Burlington	IG	Subsurface infiltration system. All houses within Picard Circle have been purchased by Airport and are now abandoned. Significant site area exists within yards and the road for major underground infiltration/ detention system. Constraints include depth of existing drainage pipe and depth above groundwater (adjacent brook approx 14 feet below existing ground).	2019	\$591,000	\$591,000
CB0008	Dumont Ave Infiltration Chambers	No Permit	BTV	IG	Divert flows from existing catchbasins and convey down Dumont Ave via pipe or swale to underground recharge chambers on empty lot. Options exist for practice type, siting and conveyance mechanism depending on depth to GW, existing inverts, and future use by Airport. Discharge to existing pipe outlet at Airport basin.	2020	\$27,000	\$32,000
CB0027	Staples Plaza Underground Detention A	No Permit	South Burlington	UD	Convert landscaped island to bioswale w/ UG storage to manage parking and small roof. Overflow to existing drain. Add trees for cover, shading, interception. Reduce width of one-way aisle for bioswale. Flat roof drains internally, discharges to drain inlet east of building. Modify internal roof drains, install trays, or use other blue roof design to provide temporary detention.	2021	\$334,000	\$411,000
CB0006	Chamberlin School	No Permit	South Burlington	IG	Underground detention in open space of school property. It seems possible to collect drainage off of White Street (and upgradient residential neighborhood) and connect to existing system via school entrance. Underground chambers could be designed as infiltration pending results of soils test pitting. (note HSG – D on east side of school property; HSG – B on west side of school property).	2023	\$1,215,500	\$1,586,000
CB0015	I-89 Exit 14 Detention Pond	No Permit	VTrans	DP	Location flexible depending on evaluation. Most downstream location would be across from drainage outlet, below water main (best location for embankment – maximizes storage), but impact to water main R/W likely and partially on private property. Alternative is to move embankment upgradient to limit of I-89 R/W – would reduce available storage, but keep all work w/in VTrans jurisdiction.	2023	\$1,787,000	\$2,332,000
CB0019	North Campus Pond Retrofit		UVM	DP	Proposed expansion of existing North Campus Pond to over control existing and future development. Raise existing embankment (10' +/-) to provide additional capacity. May consider horizontal expansion to the north and/or south.	2023	\$323,800	\$422,000
CB0024	Queensbury Pond Retrofit	1-0946	South Burlington	IB	Existing dry detention pond. Modify outlet to create an infiltration basin. Existing pond might predate subdivision (newer PVC outlet connects to older CMP barrel). Facility appears to have additional storage capacity to expand drainage area (level run confirmed this is feasible).	2024	\$110,000	\$148,000
CB0002	Best Western Windjammer Infiltration Basin A	6323-9030	South Burlington	IB	Site drainage area currently includes only Best Western property. Outfall is severely eroded and is headcutting to the east and may soon reach paved access road. Concept includes stabilizing outfall and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from Williston Road drainage network and redirect drainage from abutting commercial properties.	2025	\$557,000	\$771,000
CB0003	Best Western Windjammer Infiltration Basin B	6323-9030	South Burlington	IB	Outfall is located west of Best Western. Site drainage area currently includes only Best Western property. Moderate erosion occurring. Concept includes stabilizing outfalls and constructing a detention basin within existing gully. Expand current drainage area to intercept runoff from the Williston Road drainage network. A portion of this drainage area could be directed to Retrofit 22 if necessary.	2025	\$81,000	\$112,000

CB0025	Retrofit of Main Street UVM Pond		UVM	DP	Repair outlet structure. Retrofit options include expanding the pond southward toward Williston Road or eastward as part of Retrofit #24 for additional storage, extended detention, and improved water quality. Site has the ability to capture drainage from Williston Road, adjacent commercial properties, and unmanaged UVM land.	2025	\$364,600	\$505,000
CB0011	Fletcher Allen Green Space		Burlington	Bio	Proposed bioretention area in green space near hospital entrance. Redirect existing roadway trench drains into practice. Site currently drains to the UVM East Campus Pond.	2026	\$50,000	\$71,000
CB0012	Fletcher Allen Parking Lot		Burlington	Bio	Proposed bioretention area in existing drainage feature. Site is currently managed by existing swales, curb cuts, and a drainage depression. Swales and depression are currently eroding. Raise existing catchbasin frame/grate to provide ponding for bioretention.	2026	\$37,000	\$53,000
CB0013	Grove Street Parking Lot	1-0811	Burlington	IG	Divert existing drainage network and capture runoff from parking lot and direct to proposed underground recharge system. Low point in road drainage area is immediately south of the City parking lot. Consider replacing parking lot with permeable pavement.	2026	\$156,000	\$222,000
CB0021	Patchen Rd & Pine St Infiltration Gallery	No Permit	South Burlington	IG	Underground detention or infiltration (depending on soils). Diversion of flows from Patchen Road feasible, incoming pipe from open space/low point behind lots too deep to capture. Single lot also contains SF house (see photo). Would require diversion structure and pretreatment tank/structure.	2026	\$427,000	\$609,000
CB0022	Patchen Road Kettle Hole	6292-9030	South Burlington	IG	Detention Pond (or infiltration basin if soils are acceptable). Directly convey runoff from contributing area off Patchen Road down slope to sediment forebay. Modify existing 30" culvert headwall (under I-89) to achieve required flow control. Could pick up Kirby Rd.	2026	\$220,000	\$313,000
CB0007	Clover St GSI	No Permit	South Burlington	IG	30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).	2028	\$72,000	\$109,000
CB0009	Duval St GSI	No Permit	South Burlington	IG	30-ft wide residential streets with direct outfalls to streams, flat terrain, and good soils offer green street and neighborhood-scale disconnection opportunities (e.g., dry wells, rain gardens, pervious driveways, bump outs).	2028	\$79,000	\$119,000
CB0010	Fielding Lane Condos Infiltration Gallery	No Permit	South Burlington	IG	Detention-retention facility. Open parcel adjacent to Fielding Lane Condos – seems to be owned by Fielding Lane Condos, existing surface storage available below outfall pipe. Would require access from Fielding Lane.	2028	\$208,000	\$315,000
CB0016	Jaycee Park	No Permit	South Burlington	IG	Pretreatment tank to underground infiltration chambers. Pretreatment could be proprietary device (e.g. StormCeptor or equal) before underground chambers. Access would need to be coordinated with playing fields. Flow diversion structure would be in Patchen Road, with depth to drain pipe at approx 6.5 feet.	2028	\$418,000	\$632,000
CB0001	140 East Ave Residence		Burlington	Bio	Construct a bioretention area in underutilized private green space. Divert drainage from existing drainage structure in Bilodeau Court. Alternative practice may include permeable pavement shoulders/parking lanes in the road ROW.	2029	\$44,200	\$69,000
CB0004	Case Parkway Center Island		Burlington	Bio	Proposed bioretention area in center island on Case Parkway. Direct road drainage to bioretention using a speed bump across Case Parkway. The bioretention could underdrain/overflow to existing drainage system and outfall.	2029	\$25,000	\$39,000
CB0014	I-89 Cloverleaf Underground Detention	2-0126; 6323-9030; 2-0619	VTrans	UD	Detention structure bounded by northbound lanes and off-ramp (directing traffic to westbound Williston Rd). Existing culvert drains all upgradient area from interchange and Williston Rd. Modify outlet to install new control structure for Cpv storage.	2032	\$215,000	\$365,000

CB0018	N Henry Court	No Permit	South Burlington	IG	Dead-end road with excess impervious cover. Currently, drainage comes down the road and flows directly down a steep slope to the stream/wetland area below. Install a rain garden/bio with an overflow to a leaching catch basin at end of road. Dumping of yard waste and debris was also observed down the slope. An old corrugated discharge pipe was found down in stream.	2032	\$27,000	\$46,000
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