

Implementation of Flow Restoration Plans to Address Stormwater Impaired Streams South Burlington, Vermont

Thomas J. DiPietro, Jr. Stormwater Superintendent Deputy Director of Public Works

David P. Wheeler Assistant Stormwater Superintendent Project Manager



Overview of South Burlington

- Population: ~18,000
- Area: 16.6 mi²
- Public Roadway: ~95 Miles
- Major Features:
 - Airport
 - Interstate
 - University of Vermont
 - University Mall Target coming!
- Stormwater Infrastructure*:
 - 6,491 Catch Basins (3,164 publicly owned)
 - 176 Miles of Stormwater Conveyance (91 miles public)
 - ~350 Culverts (~200 City owned)



* Infrastructure values from March 2018



In early 2000's, South Burlington was at the center of the Vermont "stormwater wars"

- Most state permits (141)
- Most expired state permits (98)
- Most impaired watersheds (6)
- Most streams draining directly into the Lake (not Shelburne Pond, the LaPlatte or the Winooski River) (5)
- Most annual housing starts (average of 250)
- Most CLF lawsuits in past 5 years (7!)
- Most "special case" stormwater management issues, from the UVM dairy/ag farms to City Center and BIA



South Burlington Stormwater Utility Development Timeline

- <u>2002</u> State-level Legislation Enabling SW Utilities
- <u>December 2003</u> Stormwater Utility Feasibility Study
- 2003 to 2005 Public outreach and utility development
- <u>March 2005</u> City sewer ordinance updated to include stormwater and establish a stormwater user fee
- <u>April 2005</u> First SW fees assessed (billed in July)
- <u>May 2005</u> Stormwater Superintendent hired
- <u>August 2006</u> City Council resolution establishing requirements for City take over of residential stormwater treatment systems



Stormwater Impaired Streams

- Five different stormwater impaired watersheds can be found in South Burlington.
- Approximately 61% of the land area in South Burlington is in a stormwater impaired watershed.

South Burlington

Stormwater Services



Stormwater TMDL Regulatory History

- Pre-2006 VT DEC assessed the City's streams and put them on Vermont's 303(d) list of impaired waters. The cause of impairment: "unmanaged stormwater runoff".
- 2006 2008 EPA approved Total Maximum Daily Loads (TMDL) prepared by VT DEC for the City's impaired streams, which established a specific stream flow reduction target during the one-year, 24-hour storm event (2.1" over 24 hours).
- 2012 VT DEC re-issued MS4 permit requiring permittees to "develop and submit a comprehensive FRP for the portion of each stormwater-impaired watershed within the permittee's boundaries".
- June 2016 EPA and VT DEC finalized a Phosphorous TMDL for Lake Champlain.
- October 2016 City submitted FRPs to VT DEC for approval.
- 2032 City must complete implementation of the FRP.

South Burlington Stormwater Services



Stormwater TMDL Stream Flow Modification Requirements

Watershed	Watershed Size (acres)	Required Reduction During High Flow Event	Suggested Increase During Low Flow Event
Bartlett Brook	736	-11.6%	9.3%
Centennial Brook	885	-51.6%	23.2%
Englesby Brook	605	-34.4%	11.2%
Munroe Brook	3,484	-6.6%	9.5%
Potash Brook	4,495	-16.0%	11.0%

Note: All flow targets represent the values proposed in FRPs based on calculations of future non-jurisdictional impervious area growth completed as part of FRP preparation and not the values included in TMDLs.



Bartlett Brook Watershed

- 736 Acres
- 145 Acres of impervious surface
 - Residential Developments
 - Commercial Properties
- Agricultural Land

South Burlington Stormwater Services

- Soils: Sand layer on Clay
- Steep Slope: 290'/1.3 miles



Streambank Erosion in Bartlett Brook



The BMP DSS Model

- VT DEC used the Best Management Practice Decision Support System (BMP DSS) Model to assess stream flow.
- Developed by Tetratech as part of work completed by EPA in Prince George County, MD.
- Adapted for use in VT by DEC and Tetratech. Calibrated based on actual flow data.
- An existing / baseline model was prepared.
- Proposed BMPs are added to the model and their impact on stream flow can be assessed.



Flow Duration Curve

Figure 5. High flow portion of the flow duration curves for Bartlett Brook and attainment streams.



Percent of Time that Flow is Equaled or Exceeded



Bartlett Brook Flow Reduction Requirements

TADIE 7. Dartiett Drook TMDL nigh now anocation at Q0.57	Table 7.	Bartlett	Brook	TMDL	high	flow	allocation	at (Q0.3%
---	----------	----------	-------	------	------	------	------------	------	-------

Westeland	Stormwater reduction from current Urban/Developed areas	-8.8 %	
Allocation	Additional stormwater flow reduction from Urban/Developed areas to account for future growth	-24.4 %	-33.2 %
Load Allocation	Stormwater reduction from Agriculture/Open are	eas	-0.7 %
Total Bartlett	Brook watershed stormwater flow reduction allocat	tion at Q0.3%	-33.9 %

Table 1: TMDL flow targets and modified targets with revised future growth

Flow Target	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow* Q 95 (± %) Increase		
TMDL Targets (Stormwater allocation only)	-8.80	8.80		
TMDL Targets with 50 acres of Non- Jurisdictional Future Growth	-33.20	13.20		
TMDL Modified Targets with 5.7 acres of Non- Jurisdictional Future Growth*	-11.60	9.30		
 * Modified target was calculates as: -(8.8%) + (-24.4%)*(5.7 ac/50 ac) = -11.60% *The low flow target is not actionable under the TMDL, but is included because improving base flow in the waters is still a water quality goal. 				



What is a Flow Restoration Plan?

- An FRP identifies the stormwater Best Management Practices (BMPs) necessary to manage stormwater runoff, reduce stream flow, and restore stream health.
- Required elements of a FRP include:
 - Identification of Required Stormwater Controls
 - Design and Construction Schedule
 - Financial Plan
 - Identification of Regulatory Assistance
 - 2032 Deadline



Simplified FRP Development Process

- Review State's Existing Conditions model (aka "pre-2002 model").
- Update Existing Conditions model to include BMPs constructed between 2002 and 2016 (aka the "Post-2002 Model").
- Identify new opportunities for BMP installation in the watershed. Include these BMPs in the model (conduct a "Credit Run").
- Iterate. Evaluate model results. Repeat step 3 until model predicts that the required stream flow reductions are achieved.



Finding BMP Opportunities

- Prioritize projects on City owned property
- Identify retrofit opportunities of existing BMPs
- Include upgrades to systems of all expired State Stormwater permit holders
- Avoid impacts to wetland buffers, streams buffers, riparian corridors
- Minimize utility conflicts



FRP Financial Plan & Schedule

• Cost estimates are based on storage volume, BMP Type and Site conditions:

Table 4.	Retrofit	unit costs	and ad	justment	factors
----------	----------	------------	--------	----------	---------

BMP	Base Cost (\$/ft ³)
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	1.00
New BMP in partially developed area	1.50
New BMP in developed area	2.00
Adjustment factor for large aboveground basin projects	0.50

South Burlington

FRP Financial Plan & Schedule

Watershed	Number of BMPs in Flow Restoration Plan	FRP Cost	South Burlington's "Share"
Bartlett Brook	18	\$3,500,000	\$3,450,000
Centennial Brook	27	\$10,250,000	\$6,694,000
Englesby Brook	5	\$900,000	\$128,700
Munroe Brook	3	\$7,000,000	\$48,000
Potash Brook	109	\$17,000,000	\$13,750,000
Total	159	\$38,650,000	\$24,070,700



Stormwater TMDL Stream Flow Modification Requirements

Watershed	Watershed Size (acres)	Required Reduction During High Flow Event	Suggested Increase During Low Flow Event
Bartlett Brook	736	-11.6%	9.3%
Centennial Brook	885	-51.6%	23.2%
Englesby Brook	605	-34.4%	11.2%
Munroe Brook	3,484	-6.6%	9.5%
Potash Brook	4,495	-16.0%	11.0%

Note: All flow targets represent the values proposed in FRPs based on calculations of future non-jurisdictional impervious area growth completed as part of FRP preparation and not the values included in TMDLs.



Bartlett Brook FRP Financial Plan & Schedule

SB ID	Project Name	BMP Landowner	New or Retrofit	ВМР Туре	Soil	Land Use	BMP Drainage Area	lmperv Managed	Rounded Cost	Cost per Impervious Acre Managed	CPv Managed	Overall Rank (All watersheds)	Fiscal Year
BB0003	BBC	MS4 Owned	New	Gravel Wetland	D	Residential	81.97	15.86	\$1,000,000	\$63,055	1.690	5	2017
BB0014	Pinnacle at Spear Pond A	Private	Retrofit	Detention Pond	D	Residential	10.25	3.77	\$20,000	\$5,357	0.430	94	2018
BB0015	Pinnacle at Spear Pond B	Private	Retrofit	Detention Pond	C/D	Residential	3.45	0.97	\$27,000	\$27,843	0.113	139	2018
BB0004	BBSTS Expansion	Private	Retrofit	Detention Pond	D	Commercial	16.06	9.34	\$378,000	\$40,491	0.550	62	2020
BB0010	Horticulture Farm Bioretention	MS4 Owned	New	Bioretention	В	Residential	20.08	2.72	\$268,000	\$98,522	1.520	16	2020
BB0011	Horticulture Farm Detention Pond	MS4 Owned	Retrofit	Detention Pond	A/B	Residential	7.66	1.24	\$185,000	\$149,184	0.091	136	2020
BB0005	Brownell Way	MS4 Owned	New	Infiltration Basin	А	Residential	3.35	0.97	\$91,000	\$93,382	0.077	124	2021
BB0006	Brownell Way-3	MS4 Owned	New	Bioretention	С	Residential	0.20	0.05	\$25,000	\$511,918	0.021	148	2021
BB0007	Deerfield Drive 1	MS4 Owned	New	Infiltration Basin	А	Residential	2.31	0.98	\$141,000	\$143,952	0.120	104	2021
BB0008	Deerfield Drive 2	MS4 Owned	New	Bioretention	С	Residential	1.61	0.59	\$116,000	\$196,353	0.099	152	2021
BB0012	Irish Farm Condos Pond B	Private	Retrofit	Gravel Wetland	А	Residential	16.30	4.02	\$247,000	\$61,518	0.273	93	2021
BB0017	Whatley Road	MS4 Owned	New	Bioretention	D	Residential	3.32	1.07	\$189,000	\$176,313	0.155	147	2021
BB0018	Windsor Court	MS4 Owned	New	Infiltration Basin	А	Residential	1.05	0.30	\$27,000	\$88,969	0.023	110	2021
BB0009	Holiday Inn Parking Lot	Private	New	Underground Detention	В	Commercial	5.01	3.34	\$189,000	\$56,552	0.310	42	2023
BB0013	Laurel Hill Detention Pond	MS4 Owned	R	Detention Pond	А	Residential	121.90	15.87	\$167,000	\$10,554	0.370	131	2024
BB0016	Underwood Stormwater Pond	MS4 Owned	New	Detention Pond	D	Residential	38.15	4.33	\$222,000	\$51,341	0.840	30	2025
BB0001	1690 Shelburne Road	MS4 Owned/ Private	New	Underground Detention	B/D	Transportation	0.81	0.55	\$199,000	\$361,573	0.120	127	2028
BB0002	Allen Road	MS4 Owned	New	Detention Pond	С	Residential	6.38	1.62	\$69,000	\$42,482	0.072	99	2028

BMPDSS Run Summary

Model Run	Description	High Flow Reduction	BMPDSS Model Run Date
TMDL Modified Targets of Non-Jurisdictional Future Growth		-11.60	-
DEC Existing Condition Model	DEC's existing model, includes all Post2002 BMPs	-1.71	1/31/2014
Revised Existing Condition Model	Model Revisions to existing BMPs	-2.54	12/9/2014
Credit3 Model with GSI	Add GSI Practices to Credit2 model scenario	-22.56	12/9/2014
Percent of Modified	Target Managed (with Credit3_GSI run)	194%	-













SCALE: NOT TO SCALE

SCALE: NOT TO SCALE

Cost \$765,000

- Area Treated
 - 16.37 Acres Impervious
 - Cost: \$46,730/IA Treated
- Phosphorus
 - Reduction: 36 lbs/yr
 - Cost: \$21,250/lb Reduced
- Flow Reduction (1-yr storm)
 - Inflow: 8.41 CFS

South Burlington Stormwater Services

- Outflow: 0.95 CFS
- Flow Reduction 88%
- Cost: \$102,550/CFS Reduced



				GRIFFIN & GRIFFIN		
		APPROXIMATE		UNIT	TOTAL	
ITEM NO.	ITEM DESCRIPTION	QUANTITY	UNIT	PRICE	COST	
A-1	MOBILIZATION/DEMOBILIZATION	1	LS	\$3,000.00	\$3,000.0	
A-2	SITE PREPARATION AND RESTORATION	1	LS	\$100.00	\$100.0	
A-3	12" HDPE PIPE	250	LF	\$172.00	\$43,000.0	
A-4	18" HDPE PIPE	210	LF	\$185.00	\$38,850.0	
A-5	24" HDPE PIPE	930	LF	\$186.00	\$172,980.0	
A-6	30" HDPE PIPE	230	LF	\$201.00	\$46,230.0	
A-7	48" CATCH BASIN	7	EACH	\$3,000.00	\$21,000.0	
A-8	72" DIAMETER CATCH BASIN	3	EACH	\$5,000.00	\$15,000.0	
A-9	72" CATCH BASIN W/WEIR	1	EACH	\$6,000.00	\$6,000.0	
A-10	BACKFLOW PREVENTERS	1	LS	\$10,000.00	\$10,000.0	
A-11	SWIRL SEPARATOR	1	EACH	\$43,000.00	\$43,000.0	
A-12	GRAVEL WETLAND	1	LS	\$278,190.00	\$278,190.0	
A-13	WOOD CHIP TRAIL	1	LS	\$3,500.00	\$3,500.0	
A-14	ESCP	1.0	LS	\$8,000.00	\$8,000.0	
A-15	ABANDON EXISTING DRAINS	1	LS	\$7,000.00	\$7,000.0	
A-16	FENCE	1	LS	\$13,000.00	\$13,000.0	
A-17	POLY LINER	23000	SF	\$0.40	\$9,200.0	
A-18	CONCRETE SIDEWALK	22	SY	\$100.00	\$2,200.0	
A-19	CONCRETE CURB	25	LF	\$50.00	\$1,250.0	
A-20	TEST PIT	30	EACH	\$350.00	\$10,500.0	
ALL-1	BORROW FILL	100	CY	\$25.00	\$2,500.0	
ALL-2	UNSUITABLE MATERIAL	100	CY	\$40.00	\$4,000.0	
ALL-3	WATER SERVICE/MAIN RELOCATION	9	EACH	\$500.00	\$4,500.0	
ALL-4	SEWER HOUSE SERVICE RELOCATION	4	EACH	\$500.00	\$2,000.0	
ALL-5	UTILITY RELOCATION	12	EACH	\$500.00	\$6,000.0	
ALL-6	TRENCH ROCK EXCAVATION	5	CY	\$200.00	\$1,000.0	
ALL-7	GRAVEL WETLAND PLANTINGS	1	LS	\$13,000.00	\$13,000.0	
					Amer	















































11.6%

11.86%

*Phosphorous TMDL may require implementation of these practices

BMP Drainage Areas Not Constructed* = \$1.9M

> South Burlington Stormwater Services







Contact Us

Tom DiPietro **David Wheeler** South Burlington Public Works Stormwater Services stormwater@sburl.com www.sburlstormwater.com Phone: (802) 658-7961 @SBPubWorks





Bioretention Area



Installation of Detention Pond



Upgrade 3 Ponds



Market St Culvert Installed



Installation of Culvert on Moss Glen Lane



Installation of Detention Pond