



MUNROE BROOK FLOW RESTORATION PLAN

TCE# 14-129
Shelburne, Vermont

Date:
May 10, 2016

Prepared For:
Town of Shelburne

Prepared By:
Trudell Consulting Engineers
The Horsley Witten Group

Horsley Witten Group
Sustainable Environmental Solutions

90 Route 6A • Sandwich, MA • 02563
Tel: 508-833-6600 • Fax: 508-833-3150 • www.horsleywitten.com



TRUDELL
Consulting Engineers

478 Blair Park Road, Williston, VT 05495 | 802 879 6331 | www.tcevt.com

Contents

1) EXECUTIVE SUMMARY	3
2) INTRODUCTION.....	4
3) IDENTIFICATION OF REQUIRED CONTROLS	5
4) VT BMPDSS WATERSHED MODEL RUNS.....	7
5) DESIGN AND CONSTRUCTION SCHEDULE	8
6) FINANCIAL PLAN	9

DRAFT

DRAFT

1) EXECUTIVE SUMMARY

Trudell Consulting Engineers and Horsley Witten Group (the Team) have completed the VT BMPDSS model runs and have successfully met the attainment goal dictated by the Munroe Brook Total Maximum Daily Load (TMDL). The attainment goals are set forth in the TMDL as flow targets were for high flow (Q0.3%) and low flow (Q95%) which are based upon the exceedance flow where the % designates the percent of time that stream flows are equal to or greater than them. The following tables provide the targets set forth in the TMDL and the results of the final FR6 scenario Vermont Best Management Practice Decision Support System (BMPDSS) model run.

Table 1: Summary of TMDL targets for Munroe Brook

Scenario	High Flow Target Reduction (%)	Low Flow Target Reduction (%)
2013 Conditions	6.2	-9.5
2013 Conditions with future growth (20 impervious acres)	6.6 ^a	-9.5 ^b
2013 Conditions + no Ag	4.8	-7.4
Current + no Ag + future growth ^c	5.2	-7.4

^a TMDL reduction target of 6.6% (allocation of 4.8% from current urban/developed areas, 0.4% future development, and 1.6% agricultural areas)

^b Augmentation target of 9.5% (allocation of 7.4% from current urban/developed areas, 0% future development, and 2.1% agricultural areas)

^c Recommended TMDL targets for urban stormwater management only, 2003 conditions & no ag

Table 2: Summary of Munroe Brook Flows Modeled at the Confluence of Lake Champlain

VT BMPDSS runs	Scenario	Area	Flow (cfs)	% Flow Change from
----------------	----------	------	------------	--------------------

	Description	(ac)			Base	
			High Q03	Low Q95	High Q03	Low Q95
ANR Original models	Attainment flow *		73.1	1.2		
	ANR Base (2002)	3,454	78.3	1.1	-	-
	ANR Credit (2013)	3,462	78.5	1.1	-0.3	-
TCE Updated Models (1/8/15)	Attainment flow**		73.3	1.2		
	TCE Base	3,454	78.5	1.08	-	-
	TCE Credit	3,483	80.5	1.08	-2.6	-
	FR6	3,483	77.3	1.08	-5.6	-

* Reflects 6.6% reduction of ANR Base flow

** Reflects 6.6% reduction of TCE Base flow

The results in this table indicate that the high flow target has been met by the BMPs included in the FRP but the low flow target has not. The nature of the detention based BMPs included to meet the high flow target are such that they have a negative impact on low flow targets. Given that the high flow target is required to be met and the low flow target is only recommended, the FRP has prioritized BMPs which help to meet the high flow target. Conditions within the watershed, in particular the soil types, are not conducive to BMPs which provide recharge and help to meet the low flow target.

2) INTRODUCTION

The State of Vermont Agency of Natural Resources (ANR) Department of Environmental Conservation (DEC) has issued a National Pollutant Discharge Elimination System (NPDES) General Permit 3-9014 (2012) for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems (MS4). The permit requires MS4 communities such as the Town of Shelburne that drain to waters that impaired for stormwater runoff to develop a Flow Restoration Plan (FRP) for these waters. Munroe Brook is currently included in the ANR Stormwater Impaired List (EPA's approved 303(d) List). The Town of Shelburne, in coordination with the Vermont Agency of Transportation and the City of South Burlington, has been working to develop a Munroe Brook FRP. The goal of this effort has been to identify Best Management Practices (BMPs) that will achieve compliance with the flow targets set forth in the Total Maximum Daily Load (TMDL) for Munroe Brook approved in September 2008.

The purpose of this FRP is to identify stormwater BMPs, including retrofits to existing BMPs, that will be recommended for implementation in an effort to meet the established

TMDL targets for Munroe Brook, with final goal being the removal of Munroe Brook from the State's Stormwater impaired list. MS4 permittees discharging to Munroe Brook will be working towards compliance with the NPDES General Permit which requires that all MS4 permittees (both Municipal and Non-Traditional MS4s) create an FRP for all stormwater impaired waters within their jurisdiction. The Munroe Brook Impaired Watershed is located almost entirely within the Town of Shelburne, with the exception of a small portion along the northern boundary that is located in the City of South Burlington. VTrans, which has been designated a Non-Traditional MS4, also has jurisdiction over portions of the drainage area along the U.S. Route 7 corridor.

DEC has EPA approved stormwater TMDLs for the Munroe Brook impaired water. This TMDL includes an aggregate waste load allocation (WLA) which applies to various watershed sources. No specific MS4 WLAs were specified. The flow targets are set forth in the *Total Maximum Daily Load to Address Biological Impairment in Munroe Brook* (September 2008). The attainment goals are set forth in the TMDL as flow targets were for high flow (Q0.3%) and low flow (Q95%) which are based upon the exceedance flow where the % designates the percent of time that stream flows are equal to or greater than them.

3) IDENTIFICATION OF REQUIRED CONTROLS

In 2014 field studies were performed throughout the Munroe Brook watershed to identify and evaluate existing BMPs that were candidates for retrofits as well as potential locations for new BMPs. BMPs were selected to be included in this FRP based on the results of this field work, potential construction costs, and the BMPs performance in the BMPDSS model. In general, priority was given to retrofit BMPs as they typically would provide a better cost/benefit ratio than new BMPs.

Each of the sites was reviewed to determine their ability to meet the channel protection criteria (CPv) of the 2002 Vermont Stormwater Manual. The CPv criteria requires 12 hour of center-of-mass detention time of the 1-year, 24-hour storm event in cold water fish habitats and 24-hours of detention for warm water fish habitats. As Munroe Brook is classified as a warm water fish habitat, the 24-hour detention standard was used. This criteria was utilized as part of the FRP evaluation since the 1-year, 24-hour storm event is a close approximation to the storm event associated with the Q0.3 flow.

It should be noted that while some field work was performed as part of identifying these candidate sites, no detailed hydrologic analysis, property research, engineering, wetlands delineation, nor other necessary studies were performed and there may be constraints that prevent certain sites from being utilized in the FRP. All sites will need an

Engineering Feasibility Analysis performed to determine the feasibility of installing a BMP in each location.

The following table lists the BMPs incorporated in this FRP and provides some general information about each BMP including their performance results. Detailed information for each BMP including a map of the area can be found in Appendix A.

Table 3: Summary of BMPs Included in FRP

BMP ID #	Model ID	Permit Number	Site Name	BMP Type	Notes
M1	134	1-0607 A	Westview Estates	WPond	Retrofit outlet structure, lower permanent pool
M2	135	1-0607 B	Westview Estates	WPond	Retrofit outlet structure, lower permanent pool
M3	138	1-0732 B	Deer Run	WPond	Retrofit outlet structure
M4	140	1-0732 C	Farmstead Drive	DPond	No change, BMP to be verified installed as assumed
M5	142	1-1155 P2	Pinnacle @ Spear	WPond	Retrofit outlet structure, converted to wet pond
M6	143	1-1155 P5	Pinnacle @ Spear	DPond	Retrofit outlet structure
M7	148	1-1155 P3	Pinnacle @ Spear	DPond	Retrofit outlet structure
M8	150	1-1291	Route 7	WPond	Storage expanded with underground storage
M9	152	1-1390	Automaster Mini	DPond	Retrofit outlet structure
M10	154	1-1400 A	Shelburne Meadows Business Park	DPond	Retrofit outlet structure, expanded storage
M11	156	1-1400 B	Shelburne Meadows Business Park	DPond	Retrofit outlet structure
M12	158	1-1534	Boulder Hill	DPond	Retrofit outlet structure, expanded storage
M13	160	6959-INDO	Roberts Mini Storage	DPond	No change
M14	161	6959-INDO	Roberts Mini Storage	DPond	No change
M15	171	4444-INDS	Sutton Farms	WPond	No change
M16	176	3443-INDS 2	South Pointe	DPond	Retrofit outlet structure
M17	178	4096-INDS P3	South Village	WPond	No change
M18	180	4096-INDS P1	South Village	WPond	No change

M19	182	4096-INDS P2	South Village	WPond	No change
M20	185	3928-INDO	Hullcrest Park	DPond	No change
M21	193	6938-INDS P1	Automaster Parking Expansion	DPond	No change
M22	194	6938-INDS P2	Automaster Parking Expansion	DPond	No change
M23	195	6909-INDS	Lilly Creek	DPond	No change
M27	199	1-0732 A	Deer Run	WPond	New BMP (located where BMP was never built)
M28A	205	N/A	Shelburne Camping	WPond	New BMP
M28B	206	N/A	Shelburne Camping	WPond	New BMP
M29	207	N/A	Shelburne Comms-Rice	WPond	New BMP
M32	201	N/A	Drew Lane	WPond	New BMP
M34	208	N/A	Hullcrest South	WPond	New BMP
M35	203	N/A	Morse Drive Neighborhood	WPond	New BMP

4) VT BMPDSS WATERSHED MODEL RUNS

The flow targets for the FRP were established in the TMDL (Table 1 above). The target for the high flow is Q0.3 = -6.60% and the recommended objective for the low flow is Q95 = 9.50%.

TMDL targets are expressed in % change in flow. These targets are developed by examining flows in unimpaired streams (known as attainment streams and comparing them to the subject impaired stream. BMPs were incorporated into the BMPDSS watershed model which models the impact each BMP has on the attainment goals. The Team then optimized these inputs through 6 iterations of the BMPDSS model to reach the targets. The results of these iterations are summarized in the table below.

VT BMPDSS runs	Scenario Description	Area (ac)	Flow (cfs)		% Flow Change from Base	
			High Q03	Low Q95	High Q03	Low Q95
ANR Original models	Attainment flow *		73.1	1.2		
	ANR Base (2002)	3,454	78.3	1.1	-	-
	ANR Credit (2013)	3,462	78.5	1.1	-0.3	-
TCE Updated Models (5/9/16)	Attainment flow**		73.3	1.2		
	TCE Base	3,454	78.5	1.08	-	-

	TCE Credit	3,483	80.5	1.08	-2.6	-
	FR1	3,483	77.3	1.08	1.5	-
	FR2	3,483	76.8	1.06	2.1	1.9
	FR3					
	FR4					
	FR5					
	FR6					

* Reflects 6.6% reduction of ANR Base flow

** Reflects 6.6% reduction of TCE Base flow

The above information indicates that the BMPs included in this FRP will meet the high flow target of the TMDL. The low flow suggested target is not met. This is the result of detention based BMPs being utilized to help meet the high flow target, which are counter-productive to meeting the low flow target. Only infiltration BMPs will serve to meet both the high and low targets simultaneously, the opportunities for which are low within the Munroe Brook watershed. It is recommended that all Engineering Feasibility Analyses performed for the BMPs in the FRP include an investigation into the possibility of providing infiltration.

5) DESIGN AND CONSTRUCTION SCHEDULE

The MS4 permit requires that this FRP include a design and construction schedule for the installation of BMPs. The permittees are required to implement the BMPs within 20 years of the issuance of the MS4 permit which is dated 12/5/12, meaning the BMPs must be implemented by the end of 2032. The BMPs included in this FRP will require varying amounts of permitting and design work prior to the beginning of construction, as well as will have varying costs. The permits that may be required for the implementation of the BMPs include, but are not necessarily limited to: Local Zoning permits, Act 250 permits/amendments, Construction General or Individual Erosion Control permits, and Wetland Impact permits.

The Team has ranked the BMPs in this FRP in terms of perceived ease of construction, estimated cost, and benefit as related to the BMPDSS model in the following table. The Team recommends that the permittees begin with implementing the “low hanging fruit” BMPs which allow for restoration to begin while the more difficult BMPs are being designed and permitted. Ultimately it will be up to the permittees as to how to schedule the implementation of the BMPs by the required date.

6) FINANCIAL PLAN

The MS4 permit also requires that this FRP include a financing plan which estimates the costs for implementing the FRP and describes a strategy for financing the plan. Costs for implementing the BMPs have been calculated based on the memorandum from Tetra Tech, Inc. dated October 30, 2007. These rates are a 2000 base year and have been updated to account for inflation to the year 2032 using a 2.5% inflation rate. The 2032 year was chosen as a conservative value, some or all BMPs will likely be implemented much earlier and have less inflation costs. The costs are calculated based on the following equation:

$$\text{Total Cost} = \text{Installation Cost (I)} + \text{Land Cost (L)} + \text{Fixed Cost (F)}$$

Where:

I = \$5/cf of CPv detention, inflated at 2.5% to year 2032 = \$11/cf

L = \$479,160/af

L = \$0 as it is not anticipated that property will required to be purchased

F = Design/permitting costs. Varies depending on whether a simple retrofit or new BMP

For new BMPs and retrofits requiring storage expansion, the value for I was calculated using the volume of the BMP. For retrofits requiring only a modification to the outlet structure, the I value was estimated based on conservative engineering judgement. The F value for all BMPs was calculated as 5% of the estimated I value. BMPs with no associated costs have been included in the BMPDSS model as they currently exist and as such there are no anticipated costs associated with them. The following table provides the anticipated costs associated with implementing each BMP.

BMP ID #	Site Name	Storage Volume (af)	I	F	Total
M1	Westview Estates	N/A	\$10,000	\$500	\$10,500
M2	Westview Estates	N/A	\$10,000	\$500	\$10,500
M3	Deer Run	N/A	\$15,000	\$750	\$15,750
M4	Farmstead Drive	N/A	\$1,000	\$50	\$1,050
M5	Pinnacle @ Spear	N/A	\$20,000	\$1,000	\$21,000
M6	Pinnacle @ Spear	N/A	\$20,000	\$1,000	\$21,000
M7	Pinnacle @ Spear	N/A	\$20,000	\$1,000	\$21,000
M8	Route 7	2.305	\$1,104,464	\$55,223	\$1,159,687
M9	Automaster (CEA 99 design)	N/A	\$12,500	\$625	\$13,125
M10	Shelburne Meadows Business Park	0.600	\$287,496	\$14,375	\$301,871
M11	Shelburne Meadows Business Park	N/A	\$15,000	\$750	\$15,750
M12	Boulder Hill	2.514	\$1,204,608	\$60,230	\$1,264,838
M13	Roberts Mini Storage	N/A	N/A	\$0	\$0
M14	Roberts Mini Storage	N/A	N/A	\$0	\$0

M15	Sutton Farms	N/A	N/A	\$0	\$0
M16	South Pointe	N/A	\$20,000	\$1,000	\$21,000
M17	South Village	N/A	N/A	\$0	\$0
M18	South Village	N/A	N/A	\$0	\$0
M19	South Village	N/A	N/A	\$0	\$0
M20	Hulcrest Park	N/A	N/A	\$0	\$0
M21	Automaster Parking Expansion	N/A	N/A	\$0	\$0
M22	Automaster Parking Expansion	N/A	N/A	\$0	\$0
M23	Lilly Creek	N/A	N/A	\$0	\$0
M27	Deer Run	0.507	\$242,934	\$12,147	\$255,081
M28A	Shelburne Camping	0.344	\$164,831	\$8,242	\$173,073
M28B	Shelburne Camping	0.597	\$286,059	\$14,303	\$300,362
M29	Shelburne Comms-Rice	3.568	\$1,709,643	\$85,482	\$1,795,125
M32	Drew Lane	0.870	\$416,869	\$20,843	\$437,712
M34	Hullcrest South	1.527	\$731,677	\$36,584	\$768,261
M35	Morse Drive Neighborhood	1.116	\$534,743	\$26,737	\$561,480
				Total	\$7,168,165

DRAFT