



Town of St. Albans Phosphorus Control Plan

Final Report

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SUBMITTED TO:

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1. Introduction and Project Overview

The Town of Saint Albans is a Municipal Separate Storm Sewer System (MS4) permit holder with a significant amount of developed lands (Figure 1) located in Franklin County within the Lake Champlain Basin. A phosphorus Total Maximum Daily Load (TMDL) was developed for Lake Champlain to reduce export of this nutrient that is harmful in excess to the lake. As a part of compliance with this TMDL and under the National Pollutant Discharge Elimination System (NPDES) MS4 permit, MS4 communities within the Lake Champlain Basin are required to complete a Phosphorus Control Plan (PCP) for municipally owned developed lands within their municipality.

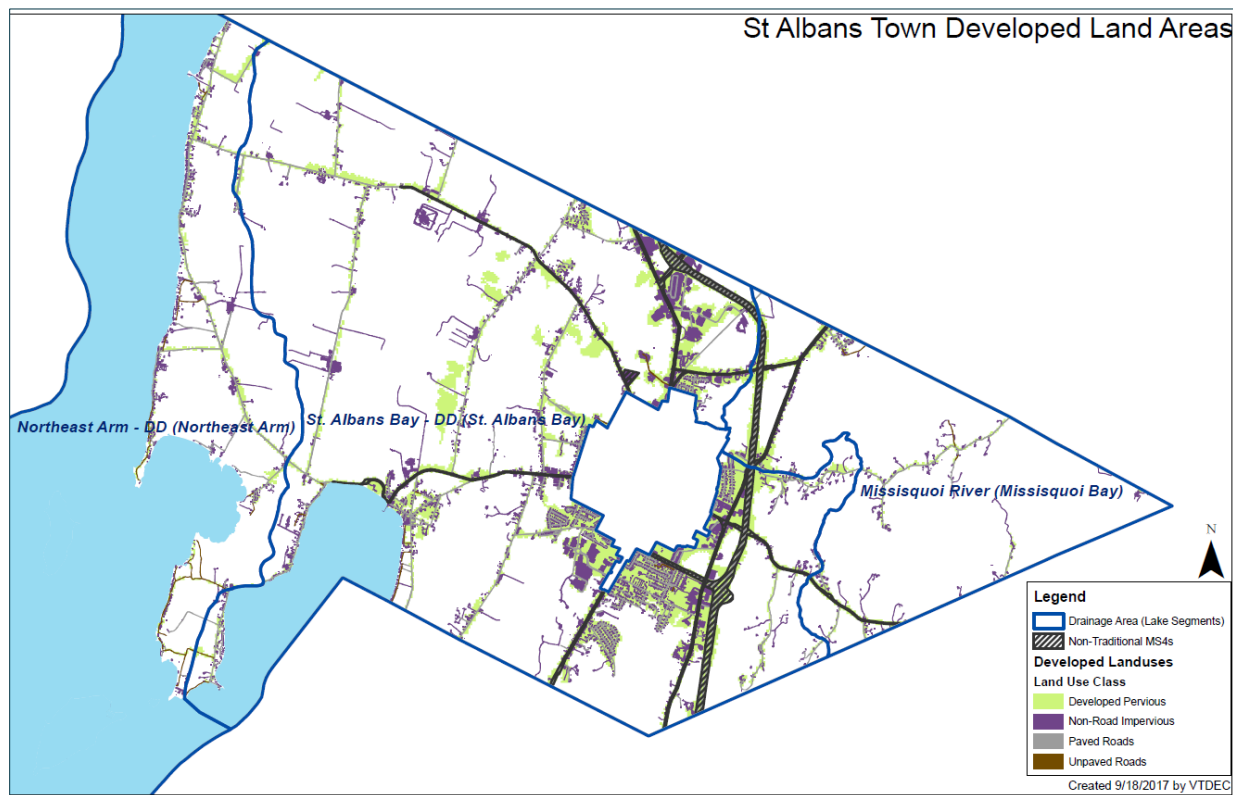


Figure 1. Developed lands in the Town of St. Albans (provided by VT DEC).

This PCP provides a plan for the Town to achieve the percent total phosphorus (TP) reduction target for the Northeast Arm Direct Drainage (7.2% target reduction), St. Albans Bay (21.7% target reduction), and Missisquoi Bay (34.2% target reduction) lake segments and select 3-acre parcels where the Town will manage the practice or take over the 3-acre permit under their MS4 (35% target reduction). This work built upon the work completed during the Stevens Brook and Rugg Brook Flow Restoration Plans (FRPs) and other planning projects. The development of the PCP included an assessment of existing structural and non-structural best management practices (BMPs), Town stormwater ordinances, and proposed structural and non-structural BMPs. This PCP identifies the suite of practices that will collectively achieve the required TP loading reductions for the Town.



2. PCP TP Reduction Target

Developed land within municipally owned and controlled areas in Town of St. Albans must comply with the TP reduction goals of the PCP including:

1. Municipal roads and municipal rights of way,
2. Municipally owned parcels (excluding schools), and
3. Sites subject to the 3-acre requirements for which the Town assumes full legal responsibility.

Developed lands within these municipal parcels are categorized as phosphorus baseload areas and count towards the Town's calculated phosphorus load (see Appendix A for a larger version of this map). The Town has nine parcels subject to Vermont 3-acre permit requirements that are fully or partially included in proposed structural practice drainage areas where the Town of St. Albans MS4 will assume full legal responsibility for the stormwater system. A map of developed lands, including municipal parcels and 3-Acre sites can be seen in Figure 2.

Municipal property and 3-acre sites that will be managed by the Town were identified. Several iterations were made throughout the project as new information became available. This analysis was completed using the best available parcel data for the Town with review by the Town's Stormwater Coordinator. Phosphorus loading rates, provided by the VT DEC, were applied to the area of each developed lands classification within the Town in order to calculate estimated phosphorus loads. A required phosphorus reduction (%) was then applied to the phosphorus loading estimates based on lake segment or 3-acre parcel status. These target reductions were established by the VT DEC.

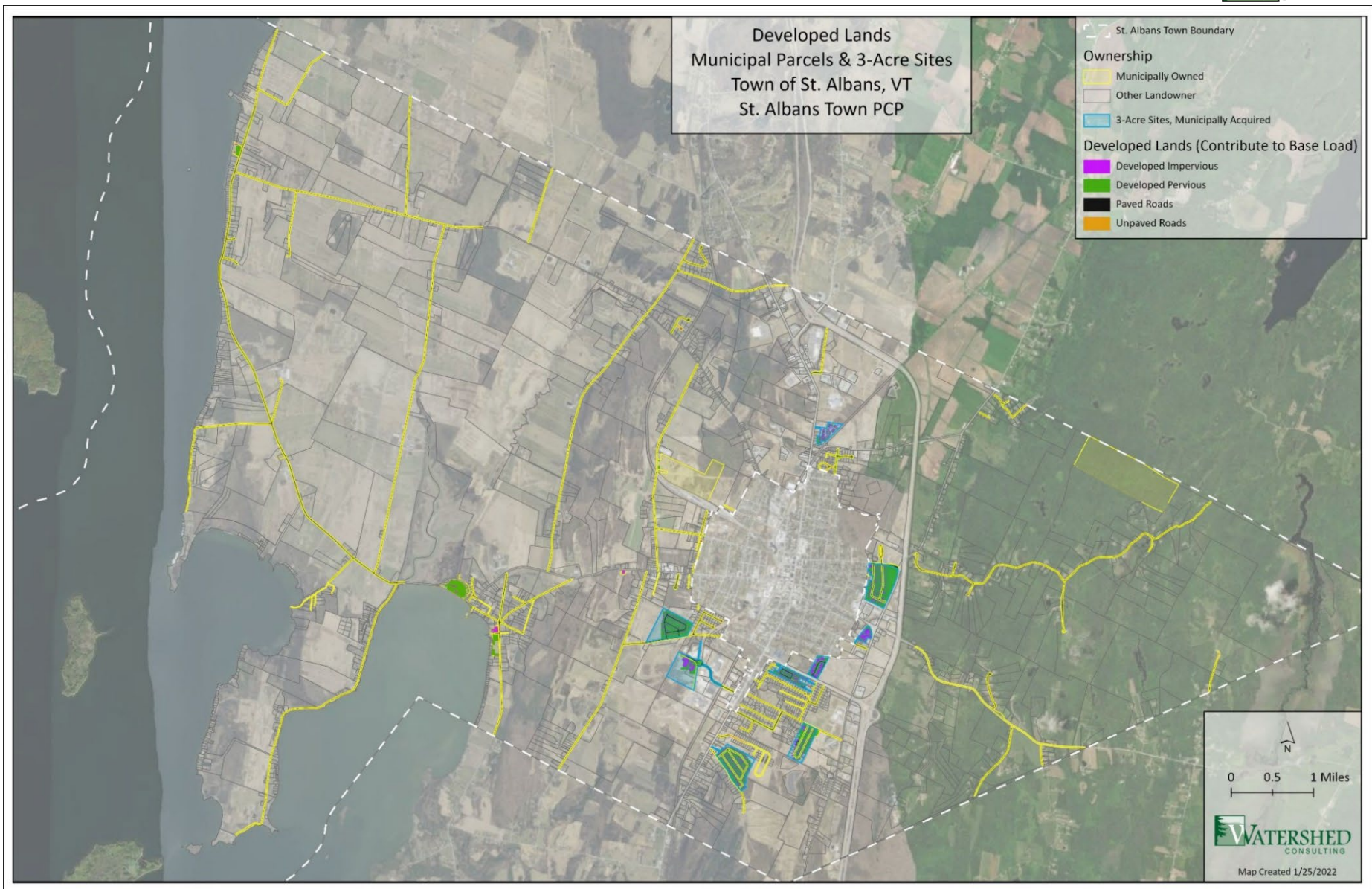


Figure 2. Map of municipal and 3-acre sites used to calculate the Town's TP reduction target.



The original draft 2017 PCP targets included all developed lands in the Town regardless of ownership, but the revised targets for the Town include only municipal developed lands and applicable 3-acre sites. As such, the required TP reduction was reduced to **69.08 kg/yr**. A summary of the area per developed land category is included in Table 1. A loading rate for each of the developed land classes, provided by the VT DEC, was applied to the categorized classes to determine the annual TP loading from that area (also included in Table 1).

In total, the area of municipal land subject to the PCP was determined to be 296.58 acres. The Town's TP baseload from that area, based on the loading rates applied to the developed land use classes, is 193.36 kg/yr. For the nine 3-acre parcels, which make up 197.49 acres, the TP baseload is 87.92 kg/yr. These 3-acre parcels are all in the Direct Drainage of St. Albans Bay, with a target reduction of 35%. The total base load for municipal parcels and 3-acre sites is 281.28 kg/year.

The municipal lands subject to the PCP in the Town fall within the St. Albans Bay, Northeast Arm, and Missisquoi River lake segment basins (Figure 3). These basins also include a significant portion of St. Albans City and Georgia with smaller portions of Fairfield, Swanton, and Fairfax. The stormwater impaired watersheds of Rugg Brook and Stevens Brook fall within the St. Albans Bay basin as well. The Town is subject to the required TP reductions for each lake segment basin, which are 21.7% for St. Albans Bay, 34.2% for the Missisquoi River, and 7.2% for the Northeast Arm. 3-acre sites acquired by the Town require a 35% TP reduction target.

The calculations for the reduction target included municipally owned developed lands including public roads. These were separated by the lake segment which it drains to (Table 1). Calculations were also done for the 3-acre sites that the Town will assume full legal responsibility for (Table 2). Note that some 3-acre sites contain municipal roads. The 3-acre site target reduction percentage was applied to these areas, and the developed land acreage was only counted once.



Figure 3. The Town of St. Albans falls within three lake basins.


Table 1. PCP Targets for St. Albans Town municipal parcels and roads.

SWAT Drainage Area	LU Class	Loading Rate Class	Acres	Loading Rate (kg/acre/year)	Annual P Load (kg/year)	Reduction Target (%)	Reduction Target (kg/year)
Missisquoi River	Developed Impervious	Impervious	1.538	0.981	1.508	34.2%	0.516
Missisquoi River	Developed Pervious	Developed Pervious	9.891	0.261	2.582	34.2%	0.883
Missisquoi River	Paved Roads	Impervious	12.062	0.981	11.833	34.2%	4.047
Missisquoi River	Unpaved Roads	Unpaved Roads	0.121	2.056	0.248	34.2%	0.085
Northeast Arm - DD	Developed Impervious	Impervious	2.751	1.002	2.757	7.2%	0.198
Northeast Arm - DD	Developed Pervious	Developed Pervious	28.636	0.298	8.533	7.2%	0.614
Northeast Arm - DD	Paved Roads	Impervious	27.119	1.002	27.173	7.2%	1.956
Northeast Arm - DD	Unpaved Roads	Unpaved Roads	0.332	2.067	0.686	7.2%	0.049
St. Albans Bay - DD	Developed Impervious	Impervious	14.888	1.059	15.767	21.7%	3.421
St. Albans Bay - DD	Developed Pervious	Developed Pervious	101.434	0.178	18.055	21.7%	3.918
St. Albans Bay - DD	Paved Roads	Impervious	97.114	1.059	102.843	21.7%	22.317
St. Albans Bay - DD	Unpaved Roads	Unpaved Roads	0.692	1.992	1.379	21.7%	0.299
Municipal Lands Subtotals:			296.58	--	193.36	--	38.31

Table 2. PCP Targets for St. Albans Town 3-acre sites for which the Town assumes fully legal responsibility.

SWAT Drainage Area	LU Class	Loading Rate Class	Acres	Loading Rate (kg/acre/year)	Annual P Load (kg/year)	Reduction Target (Percent)	Reduction Target (kg/year)
St. Albans Bay - DD	Developed Impervious	Impervious	39.031	1.059	41.334	35.0%	14.467
St. Albans Bay - DD	Developed Pervious	Developed Pervious	138.415	0.178	24.638	35.0%	8.623
St. Albans Bay - DD	Paved Roads	Impervious	19.281	1.059	20.419	35.0%	7.147
St. Albans Bay - DD	Unpaved Roads	Unpaved Roads	0.767	1.992	1.528	35.0%	0.535
3-acre Sites Subtotals:			197.49	--	87.92	--	30.77



A summary of the PCP Targets for the St. Albans Town municipal sites draining to different lake segments and the 3-acre sites for which the Town assumes full legal responsibility can be seen in Table 3 below. The base load for these sites is 281.28 kg/year and the total P reduction target is 69.08 kg/year.

Table 3. Acres of developed land within each lake segment and 3-acre parcels, and the associated base load, percent reduction target, and P reduction target (in kg/yr).

Lake Segment	Developed Land Area (acres)	Base Load (kg/year)	Percent Reduction Target	P Reduction Target (kg/year)
St. Albans Bay	214.13	138.04	20.5%	29.96
Northeast Arm	58.84	39.15	7.2%	2.82
Missisquoi River	23.61	16.17	34.2%	5.53
3-Acre Parcels	197.49	87.92	35.0%	30.77
Total	494.07	281.28	--	69.08

3. Existing Conditions Assessment

3.1. Structural BMPs

Structural BMPs are constructed practices such as gravel wetlands, bioretention areas, and infiltration chambers designed to manage stormwater runoff. To be eligible for credit towards the PCP, BMPs must have been constructed between 2002 and July 1st, 2010. BMPs installed after July 1st, 2010 will also receive credit for treating redeveloped or pre-existing impervious cover that did not require a new stormwater permit. Based on the Stevens Brook and Rugg Brook FRPs, existing stormwater permits, and information from Town staff, Watershed Consulting staff identified six existing structural BMPs for which the Town can receive credit towards their P reduction target. The location of these BMPs can be seen in Figure 4.

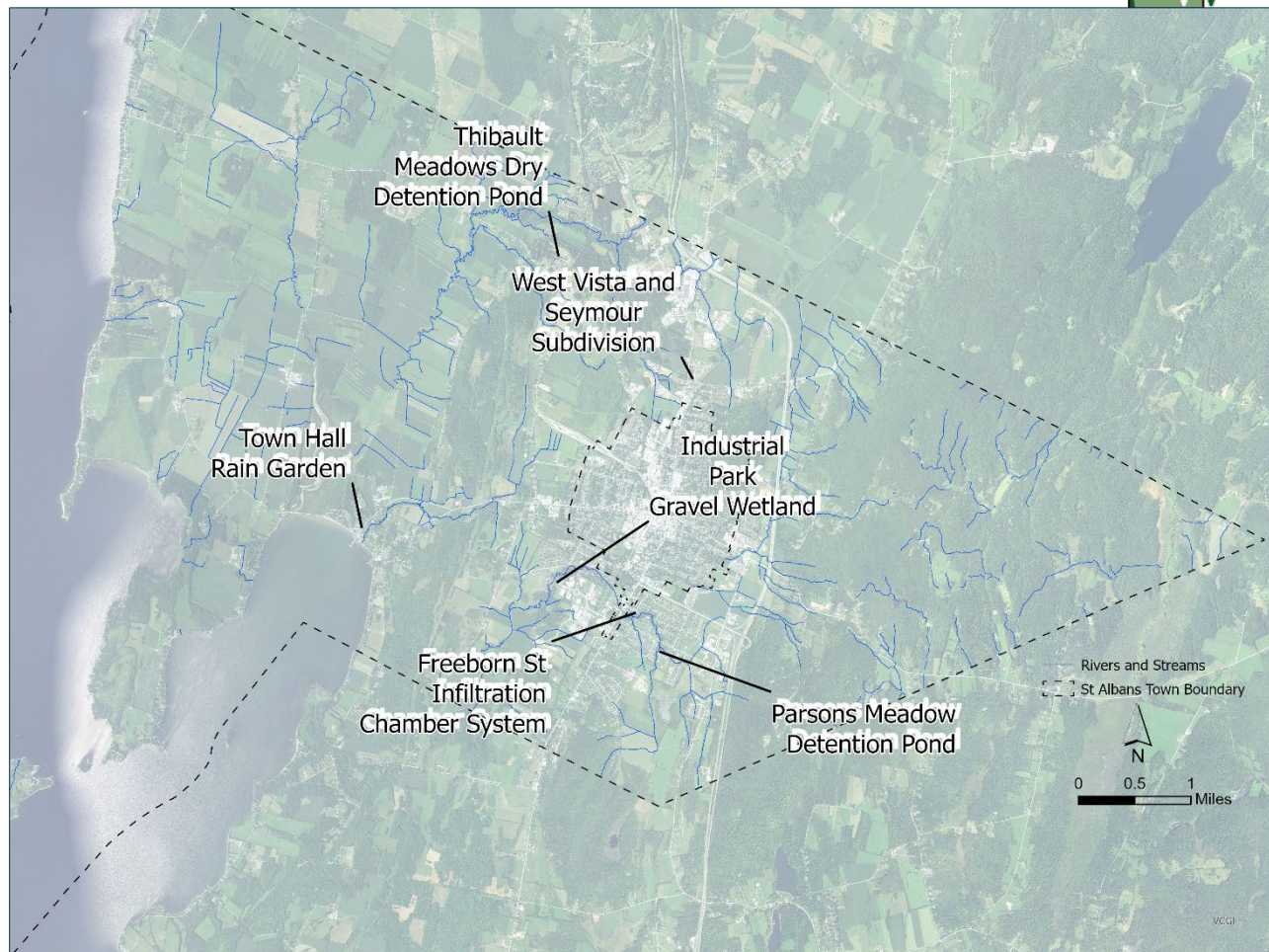


Figure 4. Location of existing BMPs eligible for PCP credit.

3.1.1 Desktop Assessment

To identify structural BMPs eligible for phosphorus reduction credit, the information provided by the Town during the project kickoff meeting, information from the Rugg Brook and Stevens Brook Flow Restoration Plans, and the Vermont DEC stormwater permits issued within the Town were reviewed. Six structural BMPs were identified. They include a series of infiltration chambers on Freeborn St, a gravel wetland at the Industrial Park, and the Town Hall rain garden. The list also includes two existing detention ponds and a dry detention basin at the Thibault Meadows subdivision. The existing gravel wetland at the Public Works facility was also assessed, but as this project was completed under a State stormwater permit post-2010, it is not eligible for credit under the PCP.

3.1.2 Field Assessments

Structural BMP Field Assessment

Table 4 below gives a summary of key field observations for these six structural BMPs. Additional sites were visited to assess potential for credit but were ineligible for credit either because they were constructed pre-2002, post-2010 due to a stormwater permit, or were later determined not to be a 3-acre site. These sites not eligible for PCP credit included:



- Church of the Rock
- Harbor View detention ponds
- NWMC South Campus Ponds
- Pine View Estates detention ponds
- South Pond A- NWMC (Hawk's Nest)
- Sunset Terrace detention pond
- Tanglewood Estates detention pond
- Town Garage Gravel Wetlands

Site notes for the six sites eligible for PCP credit are included in Table 4 below. Site photos are included below in Figures 5 through 10.

Table 4. Summary table of the six BMP sites visited in the Town of St. Albans that are eligible for phosphorus credit.

Site ID	Permit #	BMP Type	Location	Site Notes
Freeborn St. Infiltration Chamber System		Infiltration Chambers	10 Freeborn St	Infiltration chambers for townhomes off Freeborn Street. No maintenance concerns documented.
Industrial Park Gravel Wetland	7816-INDS	Gravel wetland	650 Industrial Park Rd	Gravel wetland located at the end of the Town Industrial Park. Design and maintenance concerns observed.
Parsons Meadow Detention Pond	3893-INDS	Detention Pond	5 Elizabeth St	Detention pond for the neighborhood of Parsons Meadow on Elizabeth Street. The gated pond is well vegetated and may need to be cleaned out. There are no other visible maintenance concerns.
Town Hall Rain Garden		Rain Garden	575 Lake Rd	Rain garden located along Lake Road in front of the United Methodist Church treating runoff from the Town Hall. The inlet catch basin needs maintenance. Vegetation efficacy should be addressed in the Spring.
Thibault Meadows Dry Detention Pond		Dry Detention Pond	151 Loomis St	Detention pond for a small housing development within a land easement. No visible issues. No known stormwater permits.
West Vista and Seymour Subdivision	3727-9010	Wet pond/wetland	2 Brittany Lane	This is an existing wet pond treating the West Vista subdivision. No visible maintenance concerns.



Freeborn St. Infiltration Chamber System

Infiltration chambers have been installed in the green space yard of the Freeborn Estates Townhomes on Potter Avenue. No visible maintenance concerns were observed (Figure 5).



Figure 5. Infiltration chambers on Freeborn St.

Industrial Park Gravel Wetland

A gravel wetland at the end of the Industrial Park collects and treat the runoff from the Park (Figure 6). There were issues documented during this field assessment including the swale running into the system downcutting, a plunge pool full of stagnant water, and an eroded outlet channel.



Figure 6. Gravel wetland managing stormwater from the Industrial Park and discharging to Rugg Brook.

Parsons Meadow Detention Pond

Detention pond for the Parsons Meadow subdivision. No maintenance concerns were noted other than cleaning out of vegetation (Figure 7).



Figure 7. Detention pond for Parsons Meadow.

West Vista and Seymour Subdivision

An existing BMP along Samantha Lane near Brittany Lane exists to treat the stormwater from West Vista and Seymour subdivision (Figure 8).



Figure 8. Existing practice for the West Vista and Seymour subdivision.



Town Hall Rain Garden

A rain garden designed to treat runoff from the Town Hall lot is located near the United Methodist Church (Figure 9). The inlet has some leaf debris over the grate, which could be cleared out easily. Other maintenance needs include vactoring upstream the catch basin. An additional assessment of plant survival and growth in the Spring is recommended to evaluate if additional planting is needed.



Figure 9. Rain garden treating runoff from the Town Hall.

Thibault Meadows Dry Detention Pond

A dry detention pond was constructed as a part of a seven-lot housing development off Ethel Court and adjacent to an agricultural field (Figure 10). The pond is located within an easement from F&M Thibault. There were no visible maintenance concerns with the catch basin or the outlet riser structure.



Figure 10. Dry detention pond along Loomis Lane for Thibault Meadows subdivision.



Road Based Practices

Municipalities in Vermont are required to conduct Road Erosion Inventories (REIs) as part of the town's Municipal Roads General Permit (MRGP). These REIs help to assess the condition of the municipal roads, looking specifically at hydrologically connected roads, one that is near a water resource, where water could be negatively impacted by erosion and runoff from the road¹. Each connected road segment can be scored as "Fully Meets", "Does Not Meet", or "Partially Meets". A "Fully Meets" road requires no current work. However, those road segments scored in the remaining categories will require upgrades to meet MRGP standards.

The road projects identified in the REI report and improved by the Town were inspected by Watershed Consulting staff in November 2021. A map of each segment's location is included in Appendix C. A summary table of the road segments that are eligible for credit are shown below in Table 5.

Table 5. Road segments identified in the REI report, noted by the Town as complete, and assessed by Watershed Consulting staff.

Road Name	Segment #	Road Type	Site Notes
French Hill Road	11070_FRENCH_HILL_RD_22509.1	Paved with open ditches	New cross culvert installed. Stone lined ditches on south side of road.
French Hill Road	11070_FRENCH_HILL_RD_22463.1	Paved with open ditches	Replaced failing cross culvert with upsized culvert.
Nason Street	11070_NASON_ST_43846.1	Paved with open ditches	New cross culvert and stone lined ditches.

¹

<https://anrweb.vt.gov/DEC/IWIS/MRGPREportViewer.aspx?ViewParms=False&Report=BaselineSummary&MunicipalityID=256>



**French Hill Road- Segment:
11070_FRENCH_HILL_RD_22509.1**

This road segment is hydrologically connected by direct surface drainage and was evaluated as Moderate Risk in the Road Erosion Risk Ranking. The existing ditches were stabilized along the side of the road with stone along both sides of French Hill Road. A swale runs along the south side of the road. A new cross culvert was installed with a head wall (Figure 11). This road was identified by the Town as a priority segment.



Figure 11. New cross culvert along French Hill Road.

**French Hill Road- Segment:
11070_FRENCH_HILL_RD_22463.1**

This project was identified in the REI and listed as a priority project to comply with the MRGP requirements. This road segment is hydrologically connected by direct surface drainage and evaluated as Moderate Risk in the Road Erosion Risk Ranking. The existing cross culvert was failing and undersized. This was replaced and upsized. A beaver exclusion device was installed. A header at the inlet was also installed to stabilize the bank. Stone was placed around the outlet for stabilization. A grate was affixed to the outlet pipe (Figure 12).



**Figure 12. Inlets to the new upsized cross culvert.
Note the beaver exclusion device installed.**

**Nason Street- Segment:****11070_NASON_ST_43846.1**

This segment is a hydrologically connected road via direct surface drainage. It was scored as Low Risk on the Road Erosion Risk Ranking. The REI identified this segment as having a bank eroding the culvert. A new culvert was installed, and swales were stone lined along the road (Figure 14 and Figure 13).



Figure 14. New cross culvert installed along Nason Street.



Figure 13. New stone added along ditch (south side of the road).

3.1.3 Existing Structural BMP Modeling

The crediting assessment considered the nine existing practices within the Town described above. Of these BMPs, three are road-based practices that were implemented following the Road Erosion Inventory (REI) in compliance with the Municipal Roads General Permit (MRGP).

The existing structural stormwater BMPs were modeled using the VT DEC's Stormwater Treatment Calculator (STP Calculator) methodology as embedded in the VT DEC BMP Tracking Table. This modeling involved verification and quantification of the drainage area for each BMP including differentiating impervious and pervious cover within the drainage areas, BMP type, and BMP Storage Volume. The annual TP reduction for each practice was then calculated using the performance curves for each of the BMP types (Table 6). See Appendix B for a map of the existing structural BMPs.

**Table 6. TP reduction crediting summary for existing structural stormwater BMPs.**

Map ID	Project Name	BMP Type	Total P Reduction (kg/year)
SAT001	Freeborn St. Infiltration Chamber System	Infiltration Chambers	1.47
SAT002	Industrial Park Gravel Wetland*	Gravel Wetland	7.43
SAT003	Town Hall Rain Garden	Bioretention (infiltrating)	0.31
SAT004E	Thibault Meadows Detention Pond	Extended Dry Detention Pond	0.57
SAT014	Parsons Meadows	Wet pond/ Created Wetland	2.03
SAT022	West Vista and Seymour Subdivision	Wet pond/ Created Wetland	4.48

* Retrofit of existing practice. Credit only includes new treatment.

In summary, the six existing structural BMPs eligible for TP reduction credit reduce TP loading in the Town of St. Albans by 16.3 kg/yr, 23.6% of the total reduction target of 69.08 kg/yr (Table 7). Complete modeling results for these BMPs can be found in Appendix E.

Table 7. TP reductions from existing structural BMPs within the Town of St. Albans.

Total Reduction Target (kg/year)	Total Reduction from Existing Structural BMPs (kg/year)	Total Reduction from Existing BMPs (% of target)
69.08	16.3	23.6%

3.2. Non-Structural Practices

Non-structural practices such as catchbasin cleaning and street sweeping are eligible for credit under the PCP. Currently, no credit is applied for these practices.

3.3 Stormwater Utility and Ordinance

The following is a summary of several potentially relevant Town plans, ordinances, and regulations.

The Stormwater Utility and Ordinance was developed in September 2020 to help address the impacts of stormwater pollution on the environment. Previously the Town used small amounts of the general fund revenues to complete stormwater management tasks. The Stormwater Utility helps the Town maintain compliance with their MS4 Permit under the National Pollution Discharge Elimination System (NPDES). The long term and strategic planning required by the Lake Champlain Phosphorus TMDL and the Stormwater Impaired Stream TMDL determined by the EPA and the VT DEC are key tasks.

The fee is determined by the amount of impervious surfaces on a parcel. Single Family Residential properties pay based on of the average amount of impervious on a typical single-family home, an Equivalent Residential Unit (ERU), determined to be 3,500 ft². For Non-Single Residential properties, the fee is determined by calculating the amount of impervious area on the property and dividing that value by the ERU. The Town of St. Albans Selectboard set the annual utility rate of \$50 per ERU on May 17, 2021.



For permitting requirements for non-jurisdictional projects that disturb less than one acre of land, regardless of whether disturbance is individual or as part of a common plan of development, approval of an Erosion and Sediment Control plan is necessary if they are not subject to the requirements of the Vermont Construction General Permit 3-9020, but meet any of the following criteria:

1. Any project disturbing more than 1,000 ft² of land area within a stream corridors and tributaries of Rugg Brook or Stevens Brook.
2. Any project disturbing more than 5,000 ft² of land area located within the boundaries of a Stormwater Impaired Watershed.
3. Projects disturbing more than 10,000 ft² of land area outside a Stormwater Impaired.
4. Any project that, in the opinion of the Zoning Administrator and or the Director of the Stormwater Department, has the potential to cause significant erosion, result in the transport of sediment to surface waters or the MS4, or endanger property or public safety if not properly mitigated and controlled
5. A Zoning Permit issued exclusively for the construction or modification of single family or two-family dwellings, camps, or accessory structures and appurtenances thereto, where no impervious surface or structure is proposed to be sited within 50 linear feet of the top of bank of Rugg Brook or Stevens Brook (note that standards are currently being updated and, when approved, a 100ft buffer will be required), shall not require approval of Simplified Stormwater Management Plan as defined in this Ordinance, unless a Plan is specifically required under the provisions of (4) above.

The Town of St. Albans Stormwater Management Program (SWMP), a requirement of the VT DEC NPDES, General Permit 3-9014 for stormwater discharges from Small MS4s, reflects measurable goals for developing and implementing the six minimum control measures of the permit and additional ones to protect water quality. The SWMP states that for projects that are sub-jurisdictional, compliance to the Low Risk Site Handbook for Erosion Prevention and Sediment Control is necessary. The Town will continue to identify opportunities to provide technical assistance to landowners to implement low impact BMPs.

The Unified Development Bylaws (UDBs), updated in 2018, required that all structures, impervious roadways and parking, and permeable roadways and parking be setback a minimum of 50 feet from the center of all watercourses. A vegetation and landscape plan are also required for review and approval for all new development in the Town. Note that these standards will soon be amended in updated by-laws.

3.4 MRGP Compliance

Any recent efforts to improve the condition of hydrologically connected municipal outfalls and road segments that do not meet MRGP standards are eligible for TP reduction credit. The three MRGP projects eligible for credit under the PCP and consist of three road segments, each of which is 100m in length. The linear loading rates for these road segments were calculated using the Vermont Agency of Natural Resources Department of Environmental Conservation's "Standard Operating Procedures for Tracking & Accounting of Stormwater Permit Programs: Municipal Roads General Permit (MRGP)" published on June 1, 2020. These rates were applied to each of these segments to determine the TP loading per segment. The linear loading rates can be found in Table 8. The three project locations in the Town are located within the St. Albans Bay and Missisquoi River, which are highlighted in Table 8.



Table 8. Linear loading rates table excerpted from the "Standard Operating Procedures for Tracking & Accounting of Stormwater Permit Programs: Municipal Roads General Permit (MRGP)".

Drainage Areas	Hydrologically Connected Segments									Un- connected Segments
	Fully Meets MRGP Standards			Partially Meets MRGP Standards			Does Not Meet MRGP Standards			
	<5%	5-10%	>10%	<5%	5-10%	>10%	<5%	5-10%	>10%	
Burlington Bay - CSO	1.555	2.073	2.592	4.665	6.220	7.775	7.775	10.367	12.959	1.230
Burlington Bay - DD	1.122	1.496	1.870	3.365	4.487	5.609	5.609	7.478	9.348	0.887
Isle La Motte - DD	0.786	1.048	1.310	2.357	3.143	3.929	3.929	5.238	6.548	0.621
Lamolle River	0.963	1.284	1.605	2.888	3.851	4.814	4.814	6.418	8.023	0.761
LaPlatte River	1.037	1.382	1.728	3.110	4.146	5.183	5.183	6.911	8.638	0.820
Lewis Creek	0.923	1.231	1.539	2.770	3.693	4.616	4.616	6.155	7.694	0.730
Little Otter Creek	1.126	1.501	1.877	3.378	4.504	5.630	5.630	7.507	9.384	0.890
Main Lake - DD	1.000	1.333	1.667	3.000	4.000	5.000	5.000	6.667	8.333	0.791
Malletts Bay - DD	0.899	1.199	1.499	2.698	3.597	4.496	4.496	5.995	7.493	0.711
Mettawee River	0.949	1.266	1.582	2.848	3.797	4.746	4.746	6.328	7.910	0.751
Missisquoi Bay - DD	1.041	1.387	1.734	3.122	4.162	5.203	5.203	6.937	8.672	0.823
Missisquoi River	1.013	1.350	1.688	3.038	4.051	5.064	5.064	6.752	8.440	0.801
Northeast Arm - DD	0.954	1.272	1.590	2.862	3.815	4.769	4.769	6.359	7.949	0.754
Otter Creek	0.946	1.262	1.577	2.839	3.786	4.732	4.732	6.310	7.887	0.748
Otter Creek - DD	0.869	1.159	1.449	2.608	3.477	4.347	4.347	5.795	7.244	0.687
Port Henry - DD	1.022	1.362	1.703	3.065	4.087	5.108	5.108	6.811	8.514	0.808
Poultney River	1.053	1.404	1.754	3.158	4.211	5.263	5.263	7.018	8.772	0.832
South Lake A - DD	0.967	1.289	1.611	2.900	3.867	4.833	4.833	6.444	8.055	0.764
South Lake B - DD	1.306	1.742	2.177	3.919	5.225	6.532	6.532	8.709	10.886	1.033
St. Albans Bay	0.992	1.323	1.654	2.977	3.969	4.961	4.961	6.615	8.269	0.784
Winooski River	1.145	1.527	1.908	3.435	4.580	5.725	5.725	7.634	9.542	0.905

REI data was utilized to determine segment slope and the pre-retrofit MRGP standard compliance level (i.e., Fully Meets, Partially Meets, or Does Not Meet). The post-retrofit condition was Fully Meet standards. The percent TP reduction was calculated using the change in MRGP standard compliance level. This percent reduction in compliance status was also obtained from "Standard Operating Procedures for Tracking & Accounting of Stormwater Permit Programs: Municipal Roads General Permit (MRGP)". The percent reductions are included in Table 9 below. For example, if a segment were originally assessed as "Does Not Meet" and, through an implemented fix of the segment, was reassessed as "Fully Meets" standards, that segment would receive an 80% reduction in TP loading.

Table 9. Phosphorus reduction efficiencies as determined by change in MRGP compliance.

To \ From		Pre-Construction Compliance Status	
		Partially Meets	Does Not Meet
Post Construction Compliance Status	Partially Meets	0%	40%
	Fully Meets	40%	80%

* Percent reductions are calculated relative to the loading rate for segments not meeting standards

The credit calculations for these three segments can be found in Table 10 below. In total, these three MRGP compliance projects will reduce P loading by 0.68 kg/yr. The crediting spreadsheet can be seen in Appendix D.

**Table 10. TP reduction summary table for the three MRGP compliance projects.**

Road Name	Road Segment ID	Lake Segment	Road Length (km)	Road Slope (%)	Road Material	Pre-Construction Standard	Pre-Construction P Loading (kg/km/yr)	Segment P Loading (kg/yr)	Post-Construction Standard	Post-Construction P Reduction (%)	Post-Construction P Reduction (kg/yr)
French Hill Road	11070_FRENCH_HILL_RD_22509.1	Missisquoi River	0.1	6.533	Paved with open ditches	Partially Meets	4.05	0.41	Fully Meets	40%	0.16
French Hill Road	11070_FRENCH_HILL_RD_22463.1	St. Albans Bay	0.1	2.107	Paved with open ditches	Partially Meets	2.98	0.30	Fully Meets	40%	0.12
Nason Street	11070_NASON_ST_43846.1	St. Albans Bay	0.1	1.655	Paved with open ditches	Does Not Meet	4.96	0.50	Fully Meets	80%	0.40
Total								1.20			0.68

3.5. Existing Conditions Modeling Summary

Modeling was completed for the six existing structural practices and the REI projects. The structural BMPs reduce TP loading by 16.3 kg/yr. The road project practices reduce TP loading by 0.68 kg/yr. In total, these practices provide an annual TP reduction of 16.98 kg. This reduction meets 24.58% of the Town's total target reduction of 69.08 kg/yr (Table 11). The complete BMP modeling table can be viewed in Appendix E.

**Table 11. TP reductions associated with existing structural practices and REI projects in the Town of St. Albans.**

Scenario	TP Reduction Target	Existing Structural BMPs	Existing REI Projects	Existing (Structural BMPs and REI Projects)
TP Reduction (kg/yr)	69.08	16.3	0.68	16.98
% of TP Reduction Target	--	23.6%	0.98%	24.58%

4. Proposed Conditions

4.1. *Proposed Conditions Review*

An assessment was completed to determine the most cost effective and feasible suite of structural and non-structural BMPs eligible for credit under the PCP. The evaluation considered structural practices including those identified during the Rugg Brook and Stevens Brook FRPs and upgrades under the REI.

4.2. *Proposed Structural BMPs*

A suite of proposed structural BMP locations was identified during previous tasks of this project. The contributing drainage area of these proposed BMPs were delineated, and structures were modeled and sized using HydroCAD stormwater modeling software. These efforts provided the required data to determine the TP credit that could be awarded for these BMPs using the Vermont DEC's STP Calculator methodology. An overview map of these sites is included as Appendix F.

Table 12 below contains the complete list proposed structural BMPs eligible for TP credit. The full crediting table is included as Appendix E.

**Table 12. Proposed structural BMP crediting summary table.**

Map ID	Project Name	BMP Category	TP Credit (kg/yr)
SAT006	SASH Interstate	Proposed	0.95*
SAT012	Tanglewoods	Proposed Retrofit	0.61
SAT013	Clyde Allen Dr	Proposed	2.92
SAT016	Sunset Terr	Proposed Retrofit	0.20
SAT020	Grice Brook Retirement Community Basin	Proposed	3.75
SAT021	McCrackens Homestead Estates (Nason St / Green Mt Dr)	Proposed	1.47
SAT023	Eastview Subdivision	Proposed	4.86
SAT004	Thibault Meadows Detention Pond Upgrade	Proposed Retrofit	4.39
SAT025	Town & Country	Proposed	3.04
SAT026	Summit Place	Proposed	0.89
SAT028	Meadowbrook Ln	Proposed	5.29
SAT029	Meadow Crossing	Proposed	3.01
SAT030	New Town Hall	Proposed	1.52**
SAT031	Pleasant View Estates	Proposed	2.84
SAT033	Hill Farm Estates	Proposed	8.60
SAT034	Pleasant View Estates 2	Proposed	1.15
SAT035	Thorpe Ave	Proposed	1.45
Total Credit			46.94

* This practice is partially within the City and contains VTrans impervious. Credit stated for the Town is 29.12% of the total credit for practice (3.26 kg/year).

** A voluntary practice has been identified but the design will need to be updated once the construction of the new Town Hall is complete.

A map of the proposed practice locations is included as Figure 15 below.

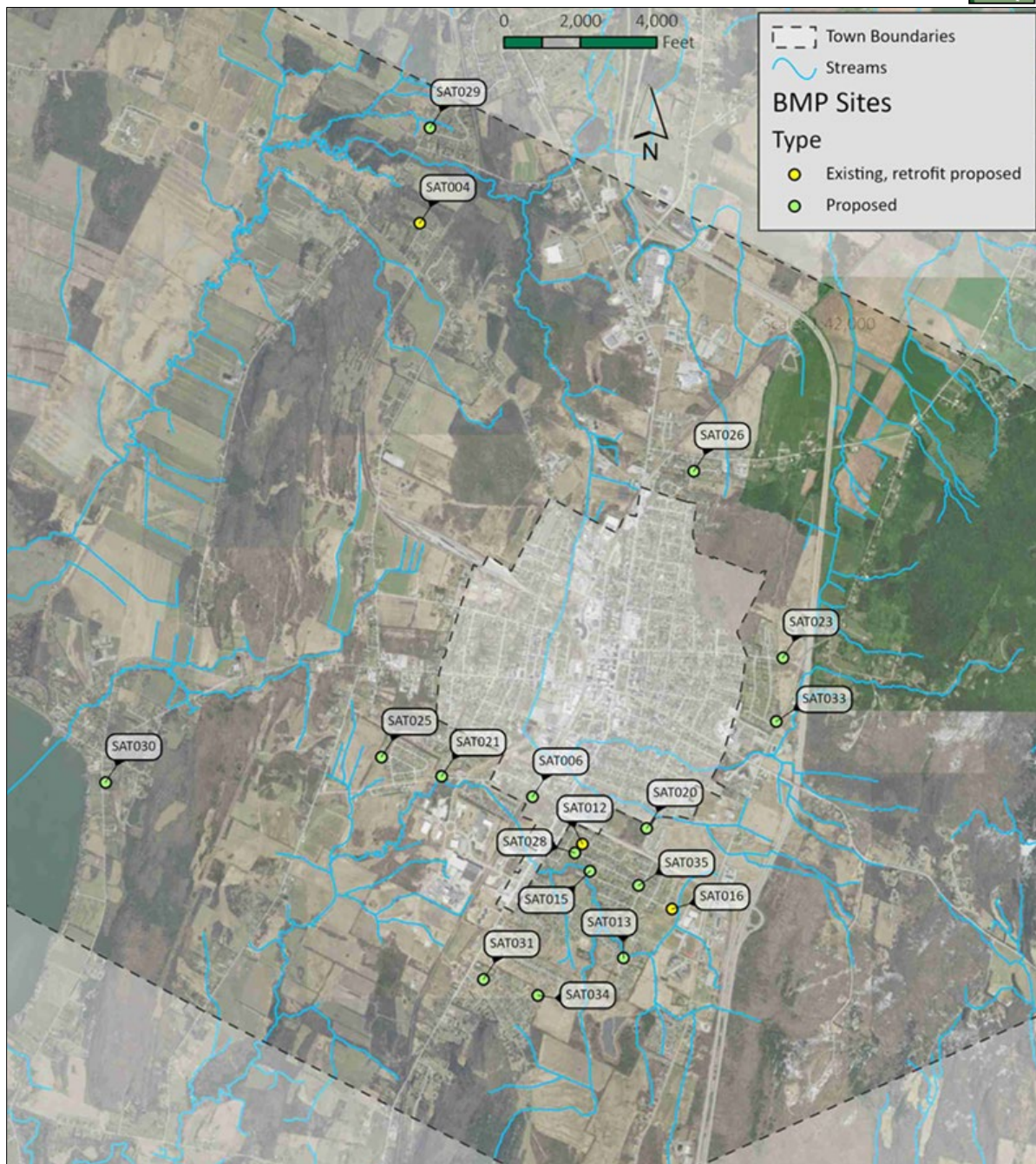


Figure 15. Overview map of proposed structural BMP locations.

4.3. *Non-Structural Practices*

Non-structural practices that address phosphorus loading are also eligible for reduction crediting. Two non-structural practices of focus are catch basin cleaning and street sweeping. The Town's Director of Public Works has indicated that no street sweeping has taken place this year. However, it was noted that typically, Harbor View Rd, the Industrial Park, and sections of High St and Samantha Ln are swept annually. No catchbasins have been vactored this year. However, there are plans to complete some vactoring this fall. They indicated that two years ago, catchbasins were vactored, but the records of these actions were lost.



At this time, non-structural practices are not recommended in this PCP. Prioritization will be given to structural BMPs and MRGP compliance projects. The Town of St. Albans has communicated that it does not currently plan to incorporate additional non-structural practices to their existing street sweeping and catch basin cleaning activities. If proposed some structural BMPs and MRGP compliance projects prove to be infeasible, this option could be explored further.

4.4. MRGP Proposed Projects Crediting

Additional TP reduction can be credited from road improvement projects that contribute to MRGP compliance in the Town. As described previously, credit can be applied for three existing road segments in the Town which have improved MRGP compliance status since the completion of the Town's Road Erosion Inventory (REI). Improvements to a list of other road segments are proposed here to provide additional TP crediting opportunities for the Town. During the Town's REI these segments were determined to have an MRGP compliance statuses of "Partially Meets" or "Does Not Meet". These segments and their TP reductions are outlined below in Table 13. Reductions are calculated using the Vermont DEC's "Standard Operating Procedures for Tracking & Accounting of Stormwater Permit Programs: Municipal Roads General Permit (MRGP)" document and assume that improvements would bring each segment's compliance status to "Fully Meets". A map of these segments is included as Appendix C and the full crediting table is included as Appendix D.

Table 13. Proposed MRGP compliance crediting opportunities in the Town.

Map ID	Road Segment ID	Pre-Construction Standard	Post-Construction P Reduction (kg/yr)
1	11070_ASHTON_DR_1303.1	Partially Meets	0.40
2	11070_BAYVIEW_DR_2717.1	Partially Meets	0.12
3	11070_BRONSON_RD_6140.1	Partially Meets	0.12
4	11070_BRONSON_RD_6148.1	Partially Meets	0.12
5	11070_BUTTON_RD_7996.1	Partially Meets	0.12
6*	11070_BUTTON_RD_7997.1	Partially Meets	0.06
6*	11070_BUTTON_RD_7997.1	Partially Meets	0.06
7	11070_CHURCH_RD_11162.1	Partially Meets	0.12
8	11070_CHURCH_RD_11159.1	Partially Meets	0.12
9	11070_CHURCH_RD_11164.1	Partially Meets	0.12
10	11070_CHURCH_RD_11165.1	Partially Meets	0.12
11	11070_CHURCH_RD_11166.1	Partially Meets	0.12
12	11070_COUNTY_RD_13714.1	Partially Meets	0.12
13	11070_DUNSMORE_RD_17186.1	Partially Meets	0.12
14	11070_FRED_LAKE_RD_22425.1	Partially Meets	0.12
15	11070_HATHAWAY_POINT_RD_26756.1	Partially Meets	0.12
16	11070_HATHAWAY_POINT_RD_26758.1	Partially Meets	0.12
17	11070_HATHAWAY_POINT_RD_26762.1	Partially Meets	0.12
18	11070_HATHAWAY_POINT_RD_26770.1	Partially Meets	0.12
19	11070_INDUSTRIAL_PARK_RD_30125.1	Partially Meets	0.02



Map ID	Road Segment ID	Pre-Construction Standard	Post-Construction P Reduction (kg/yr)
20	11070_INDUSTRIAL_PARK_RD_30133.1	Partially Meets	0.12
21	11070_KELLOGG_RD_31725.1	Partially Meets	0.12
22	11070_KELLOGG_RD_31727.1	Partially Meets	0.12
23	11070_LITTLE_COUNTY_RD_35116.1	Partially Meets	0.12
24	11070_MAQUAM_SHORE_RD_38072.1	Partially Meets	0.15
25	11070_MAQUAM_SHORE_RD_38070.1	Partially Meets	0.15
26	11070_MAQUAM_SHORE_RD_38105.1	Partially Meets	0.15
27	11070_MAQUAM_SHORE_RD_38106.1	Partially Meets	0.15
28	11070_MAQUAM_SHORE_RD_38107.1	Partially Meets	0.15
29	11070_RUGG_RD_56844.1	Partially Meets	0.04
30	11070_BRONSON_RD_6127.1	Does Not Meet	0.40
31	11070_BUTTON_RD_7998.1	Does Not Meet	1.36
32	11070_FAIRFAX_ST_20754.1	Does Not Meet	0.40
33	11070_HATHAWAY_POINT_RD_26767.1	Does Not Meet	0.40
34	11070_HIGH_ST_27655.1	Does Not Meet	0.40
35	11070_INDUSTRIAL_PARK_RD_30129.1	Does Not Meet	0.40
36	11070_INDUSTRIAL_PARK_RD_30132.1	Does Not Meet	0.40
37	11070_INDUSTRIAL_PARK_RD_30143.1	Does Not Meet	0.40
38	11070_KELLOGG_RD_31676.1	Does Not Meet	0.40
39	11070_GEORGIA_SHORE_RD_23307.1	Does Not Meet	0.40
		Total Credit	7.89
* Road segment is split between two lake segment basins, so credit was applied to each half of the segment depending on the applicable basin.			

4.5. Proposed Conditions Modeling Summary

Credit for the existing and proposed structural BMPs described above would contribute a large portion of the required TP reduction for the Town of St. Albans. Credit from the currently proposed structural BMPs alone (46.94 kg/year) would achieve 67.95% of the 69.08 kg/year reduction required for the Town. Completion of the MRGP compliance projects in tandem with the proposed structural BMPs and existing structural and REI projects would provide 71.81 kg/year of TP credit to achieve 103.95% of the Town's reduction target. Additional structural BMP opportunities may be available to supplement or replace currently proposed BMPs if any feasibility concerns were to arise in subsequent planning stages. Some of the projects as proposed in the Rugg Brook and Stevens Brook Flow Restoration Plans (FRPs) could also be modified to achieve greater TP reduction benefits. See Table 14 for a crediting summary.

**Table 14. St. Albans Town PCP crediting summary table.**

Scenario	Total Reduction Target	Existing Structural BMPs	Existing REI Projects	Existing (Structural BMPs and REI Projects)	Proposed Structural BMPs	Proposed REI Projects	Proposed (Structural BMPs and REI Projects)	Existing and Proposed (Structural BMPs and REI Projects)
TP Reduction (kg/yr)	69.08	16.3	0.68	16.98	46.94	7.89	54.83	71.81
% of TP Reduction Target	--	23.60%	0.98%	24.58%	67.95%	11.42%	79.37%	103.95%

5. BMP Ranking

A prioritization matrix was utilized in order to quantitatively rank the seventeen proposed structural BMPs. Considerations that factored into the ranking of projects included:

- Total Phosphorus (TP) removed
- Stormwater volume managed
- Stormwater volume infiltrated
- Ease of operation and maintenance (O&M)
- Permitting restrictions
- Impervious cover managed
- Project efficiency (\$/lbs. of P removed)
- BMP design status (i.e., final design, preliminary design, or planned)

Each of the factors noted in Appendix G were scored, and scores were totaled for each of the criteria. The projects were assigned a rank from 1 to 17 with those projects receiving the highest scores assigned the highest rank. The ranking table is included as Appendix G (worksheet 2).

5.1. Ranking Results

The seventeen proposed BMPs were ranked using the methodology described above and in Appendix G. The BMPs in order of rank and with their associated scores are shown below in Table 15.

Table 15. BMP Ranking summary table.

BMP Name	BMP Type	Score	Rank
Eastview Subdivision	Infiltration Basin	30	1
Thibault Meadows Detention Pond Upgrade	Infiltration Basin	30	1
Meadowbrook Ln	MC-3500 Infiltration Chambers	29	3
Meadow Crossing	Infiltration Basin	28	4
New Town Hall	Bioretention w/underdrain	28	4



BMP Name	BMP Type	Score	Rank
Tanglewoods	Gravel Wetland	26	6
Town & Country	Gravel Wetland	24	7
Summit Place	Bioretention w/underdrain	21	8
Pleasant View Estates	Gravel Wetland	21	8
Hill Farm Estates	Gravel Wetland	21	8
Grice Brook Retirement Community Basin	Wet Pond	20	11
Sunset Terr	Wet Pond	19	12
McCrackens Homestead Estates (Nason St / Green Mt Dr)	Wet Pond	17	13
SASH Interstate	Gravel Wetland	17	13
Pleasant View Estates 2	Gravel Wetland	16	15
Thorpe Ave	Gravel Wetland	16	15
Clyde Allen Dr	Gravel Wetland	15	17

6. Modeling Summary

6.1. Existing Conditions

Modeling results show that an annual TP reduction of 16.98 kg could be credited for existing structural and REI practices. This reduction meets 24.58% of the Town's total target reduction of 69.08 kg/yr (Table 16).

Table 16. TP reductions associated with current structural and nonstructural practices in the Town of St. Albans.

Scenario	TP Reduction Target	Existing Structural BMPs	Existing REI Projects	Existing (Structural BMPs and REI Projects)
TP Reduction (kg/yr)	69.08	16.3	0.68	16.98
% of TP Reduction Target	--	23.6%	0.98%	24.58%



6.2. Proposed Conditions

Upon implementation of the seventeen proposed structural BMPs and REI projects, an annual TP reduction of 54.83 kg is expected. This reduction for proposed projects meets 79.37% of the Town's total reduction target of 69.08 kg/yr (Table 17).

Table 17. TP reductions associated with proposed structural BMPs and REI projects in the Town of St. Albans.

Scenario	TP Reduction Target	Proposed Structural BMPs	Proposed REI Projects	Proposed (Structural BMPs and REI Projects)
TP Reduction (kg/yr)	69.08	46.94	7.89	54.83
% of TP Reduction Target	--	67.95%	11.42%	79.37%

6.3. Final Suite of PCP Practices

The final suite of practices included in the PCP includes:

- Six existing structural BMPs
- Three existing REI projects
- Thirty-nine proposed REI projects
- Seventeen proposed structural BMPs

Including both existing and proposed practices, a TP reduction of 71.81 kg/yr was estimated, 103.95% of the TP reduction target of 69.08 kg/yr (Table 18). The location of the existing practices, for credit and proposed retrofit, and proposed sites can be seen in Appendix F.

Table 18. TP reductions associated with the suite of practices included in the PCP, both existing and proposed.

Scenario	TP Reduction Target	Existing and Proposed Practices
TP Reduction (kg/yr)	69.08	71.81
% of TP Reduction Target	--	103.95%



7. Implementation Schedule

The PCP implementation schedule was created for the Town to ensure that the PCP will be fully implemented prior to the June 17, 2036 deadline. It is important to ensure that the developed schedule is feasible for the Town to implement while complying with MS4 permit requirements.

The schedule was divided into five phases, each of which are in three-year increments. This phased approach was used to ensure that the Town has the necessary time to obtain required permits, coordinate with private landowners as needed, obtain or budget for construction funding, and schedule construction activities. The BMP Ranking was also utilized in scheduling implementation of these projects, but due to the current status of several of these projects (i.e., final design completed or in progress), the projects are not always scheduled in order of rank.

See Table 19 for a summary of the number of projects scheduled per phase and the estimated implementation cost of those projects. See Appendix H for a full table of the implementation schedule.

Table 19. Number of projects and estimated project cost per implementation phase.

Phase	Year	Total Estimated Cost*	Number of Projects
Phase 1	2022	\$1,591,394	4
	2023		
	2024		
Phase 2	2025	\$1,007,000	3
	2026		
	2027		
Phase 3	2028	\$421,000	3
	2029		
	2030		
Phase 4	2031	\$305,000	4
	2032		
	2033		
Phase 5	2034	\$533,000	3
	2035		
	2036		
*Future cost estimates do not account for future inflation. Costs are preliminary and based on limited site investigation.			

Table 20 below shows the specific proposed BMPs scheduled for construction during each implementation phase.

**Table 20. Implementation Schedule with specific projects for each of the five phases of implementation.**

															Planned Phase		
			Phase 1			Phase 2			Phase 3			Phase 4			Phase 5		
BMP ID	COST	PROJECT	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
SAT006*	\$157,393.60	SASH Interstate*															
SAT012	\$491,000.00	Tanglewoods															
SAT013	\$600,000.00	Clyde Allen Dr															
SAT020	\$343,000.00	Grice Brook Retirement Community Basin															
SAT004	\$30,000.00	Thibault Meadows Detention Pond Upgrade															
SAT033	\$947,000.00	Hill Farm Estates															
SAT030	\$30,000.00	New Town Hall															
SAT025	\$84,000.00	Town & Country															
SAT031	\$163,000.00	Pleasant View Estates															
SAT034	\$174,000.00	Pleasant View Estates 2															
SAT016	\$37,000.00	Sunset Terr															
SAT023	\$191,000.00	Eastview Subdivision															
SAT026	\$45,000.00	Summit Place															
SAT029	\$32,000.00	Meadow Crossing															
SAT035	\$219,000.00	Thorpe Ave															
SAT021	\$203,000.00	McCrackens Homestead Estates (Nason St / Green Mt Dr)															
SAT028	\$111,000.00	Meadowbrook Ln															

* Note that the cost estimate for this project is 29% of the 100% design cost estimate to account for split credit between municipalities.



8. Summary

Modeling results show that an annual TP reduction of 16.98 kg could be credited for existing structural practices and REI projects. This reduction meets 24.58% of the Town's total target reduction of 69.08 kg/yr.

Modeling results also show that an annual TP reduction of 71.81 kg could be credited for existing and proposed structural BMPs and existing and proposed REI projects. This reduction for the full suite of projects meets 103.95% of the Town's total target reduction of 69.08 kg/yr.

Although these practices exceed the required TP reduction for the PCP, they offer a factor of safety in the event that one or more of the proposed practices must be modified or is unable to be completed due to unforeseen circumstances. These additional BMPs will also allow the Town to meet other water quality goals.