Phosphorus Control Plans for the Essex Junction and Essex Town MS4s

STONE ENVIRONMENTAL

PROJECT NO.

20241008

PREPARED FOR:

Chelsea Mandigo
Water Quality Superintendent
City of Essex Junction

Ann Costandi, P.E.
Water Quality Director / Staff Engineer
Town of Essex

SUBMITTED BY:

Amy Macrellis / *Senior Water Quality Specialist*
Stone Environmental, Inc.
535 Stone Cutters Way
Montpelier / VT 05602
amacrellis@stone-env.com
802.229.1884

Acknowledgements and Disclaimer

This project was undertaken by Stone Environmental, Inc. for the City of Essex Junction and the Town of Essex, with funding provided by the Vermont Agency of Transportation, STP MM18(2) (2019-2021) and by the MS4s (2024).

The intent of this plan is to present data collected, evaluations, analysis, and cost estimates for the Essex Junction and Essex Town Phosphorus Control Plans, completed under a contract between the City of Essex Junction and the consultant team, including Stone Environmental, Inc., Horsley Witten Group, and Stantec. Updates to the April 1, 2021 PCPs were completed by Stone Environmental, Inc. under contracts with the City and Town in early 2024.

It is noted that on July 1, 2022 the Village of Essex Junction became an independent city and is now recognized as the City of Essex Junction.

The Essex Junction and Essex Town PCPs were prepared to meet compliance requirements for the *VPDES General Permit 3-9014 (2023) for Stormwater Discharges from Regulated Small Municipal Separate Storm Sewer Systems (MS4s) and Certain Developed Lands* for the City of Essex Junction and the Town of Essex. The presented plan is in draft form and will be revised by the MS4s as needed. Further, it will remain a working document, subject to change as projects are further investigated. Neither of the MS4s are bound in any way to the proposed BMP lists included in this plan document. This PCP and its implementation are contingent upon the MS4s' ability to gain permits and to gain municipal funding approval.

Phosphorus Control Plans for the Essex Junction and Essex Town MS4s

Cover Photo: This outlet gully, off Saxonhollow Drive in Essex Town, was stabilized following submittal of the 2021 PCP.

Contents

Figures

Tables

1. Introduction

As required by the Vermont Municipal Separate Storm Sewer System General Permit (MS4 Permit)[1], the City of Essex Junction and Town of Essex are required to develop Phosphorus Control Plans (PCPs) "designed to achieve a level of phosphorus (P) reduction equivalent to the percent reduction target for developed land in the associated TMDL lake segment(s) as applied to municipally owned developed lands".

Developed lands that are not under the City's or Town's ownership or control are not the MS4s' responsibility under this PCP. Developed lands owned and controlled by the Vermont Agency of Transportation (VTRANS), for instance, are regulated under the Vermont DEC *General Permit 3-9007 for Stormwater Discharges from the State Transportation Separate Storm Sewer System (TS4)* and its attendant PCP requirements. VTrans roadways and rights-of-way were not included in Essex Town's MS4 impervious or pervious surface areas to be managed under the PCP. Portions of VT Route 15 and VT Route 2A were similarly excluded for Essex Junction (Section 2). The MS4s may, however, coordinate with VTrans regarding implementation of individual retrofits or other projects where it is mutually beneficial for them to do so.

Similarly, school properties in Essex Junction and Essex Town are all part of the Essex Westford School District, and many of the school facilities have operational stormwater permits from Vermont DEC. These properties are owned and controlled by the school district, so although they are quasi-municipal in nature these properties are not included in the MS4s' PCP areas or phosphorus target reductions. Most of the Essex Westford school campuses located in Essex Junction and Essex Town are subject to the "3-acre site" requirements of Vermont DEC General Permit 3-9050[2], and are therefore required to obtain permit coverage and retrofit subject sites to improve the level of stormwater treatment. While schools are not part of the City or Town MS4 areas, school properties may have open space that represents opportunity for collaboration on retrofits that benefit both the School District and the MS4(s), and this PCP retains flexibility for schools and MS4s to work together in the future.

The Phosphorus Control Plan first documents the areas and resulting phosphorus base load subject to the conditions of the PCPs. It then describes progress towards target P reductions achieved by the Essex Junction and Essex Town MS4s through implementation of structural stormwater treatment practices (STPs) owned, controlled, or maintained by the MS4s via inspection/maintenance agreements, through improvements to hydrologically connected road segments and culvert outlets, and through performance of non-structural practices such as street sweeping and catch basin cleaning within their PCP areas from 2010-2020, as updated through December 2023.

The PCP then documents a menu of structural STPs, municipal road segment and culvert outlet repairs, enhanced non-structural controls (particularly street sweeping), and implementation of enhanced ordinances or regulations to address sub-jurisdictional impervious surfaces that the Essex Junction and Essex Town MS4s may use to achieve required P reductions from municipally-owned developed lands.

[1] https://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/MS4/Final VT MS4 GP 2023.pdf
[2] https://dec.vermont.gov/watershed/stormwater/9050/3-acre-properties

While the plan is conservative and demonstrates both the City and Town have identified sufficient improvements to meet and exceed their target phosphorus reductions, elements related to hydrologically connected road segments meeting standards will necessarily change based on re-inventory, road and outlet maintenance practices, and on the frequency and intensity of future storm events. Thus, the presented plan is in draft form and will be revised by the MS4s as needed. This PCP is contingent on Board approval or adoption for both Essex Junction and Essex Town. It will remain a working document, subject to change as projects are further investigated. Implementation of the PCP is also contingent upon the MS4s' ability to gain permits and to gain municipal funding approval.

2. Phosphorus Control Plan Areas, Base Loads, and Reductions Required

Using GIS datasets and spreadsheet summaries, Stone estimated the developed lands P base load and target load reductions for the City and Town's rights-of-way (ROW), municipally owned parcels, and other municipally owned or controlled lands that collectively constitute the PCP area[3] (Map 1). Roadways, rights-of-way, and facilities owned and controlled by VTrans but located within the City or Town were excluded. The City of Essex Junction is required to meet an annual P load reduction target of 31.7 kg/yr, while the Town of Essex must reach an annual P load reduction target of 74.6 kg/yr - a 20% reduction from base conditions for both municipalities (Table 1).

Table 1. Phosphorus base loads and reduction targets by lake segment[3]

Lake Segment	Drainage Area	Acres (All Developed Land Use Classes)	P Base Load (kg/yr)	Total Developed Lands P Target Reduction	Total P Reduction Target (kg/yr)
City of Essex Junction Summary					
Main Lake	Winooski River	208.8	111.9	20.2%	22.6
Malletts Bay	Malletts Bay - DD	133.8	44.5	20.5%	9.1
Total		*342.5*	*156.4*		*31.7*
Town of Essex Summary					
Main Lake	Winooski River	378.7	215.8	20.2%	43.6
Malletts Bay	Lamoille River	85.2	83.9	20.5%	17.2
Malletts Bay	Malletts Bay - DD	145.2	67.3	20.5%	13.8
Total		*609.2*	*367.0*		*74.6*

Note: The P base loads and target P reductions were developed using the developed lands GIS dataset and loading rate tables provided by VT DEC in January 2019. VT DEC updated the loading rate tables in fall 2019 to include classifications for developed pervious land use by hydrologic soil group. The P base loads were re-calculated based on the updated loading rate table, but this update did not significantly change the P base loads for Essex City/Town.

Essex Town is considering incorporation of two "Three-Acre" sites (Pinewood Section H, permit IDs 1-1523 / 3426-9050) and Oakridge / Forestdale (permit ID 3790-9010.R1) into their MS4 (Section 3.3). Incorporating the Oakridge/Forestdale subdivision would require the MS4 to increase its PCP Area by approximately 30 acres, including 10.7 acres of impervious cover. The incorporation would increase the MS4's phosphorus base load in the Main Lake segment by approximately 16.4 kg/yr and would add ~3.3 kg/yr to the Town's target P reduction. A similar assessment is underway for Pinewood Section H, which will be provided when available.

[3] Stone Environmental (2020) "Essex Phosphorus Control Plans – Revised Drafts of Area, Base Load, and Target Reductions" Submitted to Essex Town & City and ANR January 15, 2020.

3. Structural Stormwater Treatment Practices

Structural STPs that may be credited towards P reduction for the PCP per Section 8.2.A.3 of the MS4 Permit[1] include:

- Retrofits to municipally owned properties;
- Implementation of STP upgrades or retrofits to treat existing impervious after the adoption of the 2002 VSMM;
- Implementation of STPs after July 1, 2010 on developed lands not subject to the state's operational stormwater permit;
- Management of stormwater and STPs including non-municipally-owned lands subject to an operational stormwater permit that does not otherwise require an upgrade of the stormwater system to comply with Vermont Department of Environmental Conservation (DEC) stormwater regulations, provided that the MS4 assumes responsibility for the stormwater system and/or establishes a maintenance agreement with the property owner(s) to ensure maintenance.

Phosphorus reductions were calculated for constructed and design-phase STPs under Essex Junction/Town ownership or management jurisdiction, and which are eligible for P reduction credit, using the Agency of Natural Resources' (ANR) Best Management Practice (BMP) Tracking Table[4].

The annual P load reductions achieved or expected from completed and design-phase structural STPs summarized in Figure 1 range from over 150% of the PCP Area's target load allocation (14.3 kg/yr) in Essex Junction's Malletts Bay Lake segment, to roughly half of the target P load reductions in the Town's Malletts Bay segment. In the Main Lake segment for both the Town and City, identification of additional projected structural STPs was completed during development of the 2021 PCP to meet target P reductions. Details of the structural STPs are presented below.

[4] https://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/MS4/BMPTrackingTable_03132020.xlsx

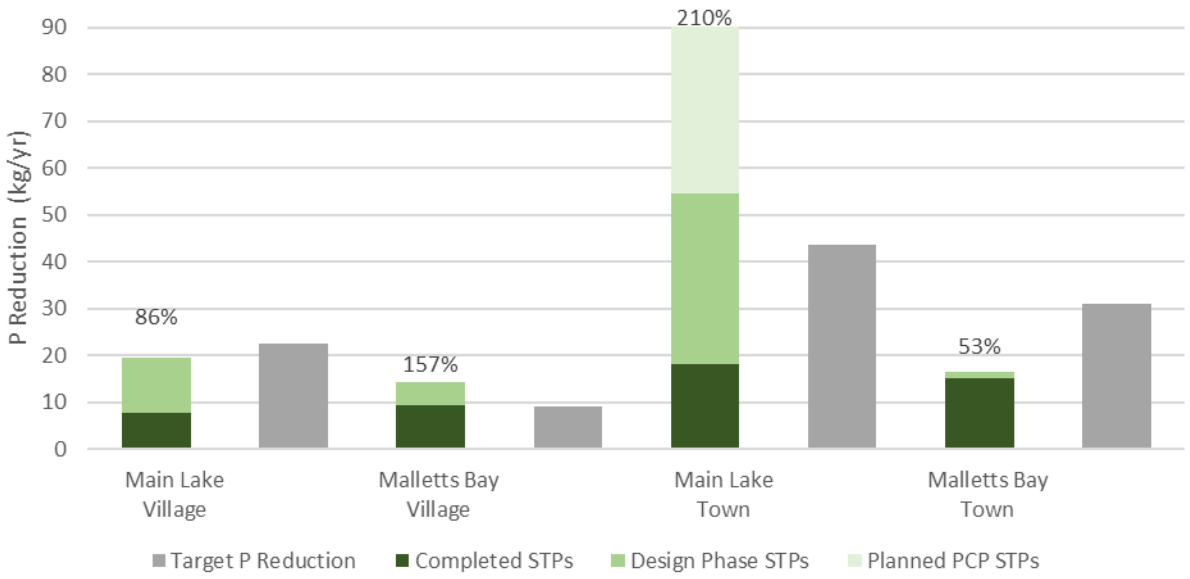


Figure 1. Summary of annual P load reductions from existing, design-phase, and projected structural STPs as compared to required target P reductions (kg/yr). See Tables 2 and 6 for completed STPS; Tables 3 and 7 for design-phase STPs, and Tables 5 and 8 for projected STPs.

3.1. Essex Junction Completed and Design-Phase Structural STPs

At the time of the 2021 report, a total of eight creditable structural STPs had been completed. Since then, one additional practice has been completed in the City (Table 2, Appendix B-1, and Map 2). Together, these STPs manage stormwater from a combined 35 acres of impervious area and 54 acres of pervious area. As seen in Table 2 and Figure 1, in the Malletts Bay Lake segment, combined P load reductions from completed projects exceed the P target reduction (9.3 kg/yr or 102% of the total required P reduction). Completed STPs account for 34% of the City's required P reduction in the Main Lake segment (7.6 kg/yr). For the new Acorn Circle cul-de-sac retrofit, the impervious surface in the middle of the cul-de-sac was removed and a sand filter installed in the same location. Therefore, the full P credit for that practice combines the net decrease in impervious surface with the appropriate credit for the sand filter, providing a total P reduction of 0.97 kg/yr.

Table 2. Essex Junction Completed Structural STPs

Site Name	Permit No.	Lake Segment	BMP Type	Impervious (acres)	Pervious (acres)	Storage Volume (ft^3)	P Credit (kg/yr)	% of P Target
Acorn Circle cul-de-sac retrofit - impervious removal		Main Lake	Impervious Removal	-0.06	0.06	0	0.03	0.13%
Acorn Circle cul-de-sac retrofit - media filter with specialized media		Main Lake	Sand Filter (underdrain)	0.70	1.1	3,613	0.94	4.1%
Village Walk POI 1	6653-9010	Main Lake	Infiltration Basin	3.3	6.2	26,586	5.11	23%
Village Walk POI 2	6653-9010	Main Lake	Infiltration Basin	0.63	1.2	12,803	0.99	4.4%
Village Walk POI 3	6653-9010	Main Lake	Infiltration Basin	0.32	1.0	6,849	0.58	2.6%
Total Main Lake				**4.9**	**9.6**	**49,851**	**7.6**	**34%**
5 Corners North	4989-INDO	Malletts Bay	Underground Detention	13.89	17.0	11,892	0.72	7.9%
Fairview Drive/Main St Gravel Wetland	1-1074 SN 002	Malletts Bay	Gravel Wetland	3.75	18.8	40,800	2.06	23%
Mansfield Brickyard Gravel Wetland	2-0317/2-0952	Malletts Bay	Gravel Wetland	11.39	6.3	70,153	6.08	67%
Taft Street S/N 001	6006-9020.1	Malletts Bay	Wet pond/ Wetland	0.48	1.0	3,528	0.22	2.5%
Taft Street S/N 002	6006-9020.1	Malletts Bay	Wet pond/ Wetland	0.54	1.0	2,090	0.22	2.4%
Total Malletts Bay				**30.1**	**44.0**	**128,463**	**9.3**	**102%**

Four additional creditable structural STPs are in design phases (Table 3, Appendix B-2, and Map 2) in the City, which collectively may manage stormwater from a combined 41 acres of impervious area and 63 acres of pervious surface. Since the City's required P load reduction for the Malletts Bay Lake segment is met primarily through STPs constructed for compliance with the Indian Brook Flow Restoration Plan, the additional practices listed in Table 3 are not further advanced in this PCP. Design-phase STPs are anticipated to account for an additional 52% of the City's required P reduction in the Main Lake segment (11.8 kg/yr).

Table 3. Essex Junction Design-Phase Structural STPs

Site Name	Permit No.	Lake Segment	BMP Type	Impervious (acres)	Pervious (acres)	Storage Volume (ft^3)	P Credit (kg/yr)	% of P Target
Hiawatha Infiltration Gallery Retrofit		Main Lake	Infiltration Chambers	11.7	20.9	14,244	11.8	52%
	Total Main Lake			**11.7**	**20.9**	**14,244**	**11.8**	**52%**
Countryside Cluster Homes A,B,C and Essex Parks East and West	2-0289	Malletts Bay	Extended Dry Detention Pond	13.9	17.0	11,892	0.72	7.9%
Countryside Dr Intersection	2-0155	Malletts Bay	Infiltration Chambers	3.75	18.8	40,800	2.1	23%
Grove St.	2-0187	Malletts Bay	Infiltration Chambers	8.7	14.7	2,047	2.3	25%
	Total Malletts Bay			**29.0**	**42.0**	**54,739**	**5.1**	**56%**

3.2. Essex Junction Projected Structural STPs

In the 2021 PCP, additional structural STP opportunities were screened at the desktop level in the portions of the City draining directly to the Winooski River, primarily south and southwest of the Five Corners area in residential subdivisions underlain by deep, well-drained and relatively flat Adams and Windsor series loamy sands. The subdivisions hosting these closed drainage systems are well suited to an "invisible green stormwater infrastructure" approach, where retrofits to replace existing catchbasins with drywells, or to add subsurface infiltration chambers as offline treatment for existing catchbasins, would improve water quality while reducing residents' concern about maintenance of vegetated surface green infrastructure practices.

Projected retrofit opportunities were screened first by reviewing the stormwater infrastructure inventory and LiDAR topography with land cover and soil data to identify drainage areas contributing flow to individual catch basins or drainage system outlets as appropriate. The retrofits were further screened for environmental constraints including but not limited to wetlands or wetland buffers; hydric soils; streams, floodplains and river corridors; and rare, threatened, or endangered species. Where possible, retrofit opportunities were sited to minimize conflicts with overhead and underground utilities (including cable/telecom, electric, gas, water, and sewer). Confirmation of the presence of utilities will be required as retrofits conceptually identified in this PCP move forward into design phases.

Almost 40 conceptual structural STP retrofits were identified in the City's Winooski River direct drainages (Map 2, Appendix B-4, and Appendix B-6). Of these, a substantial opportunity was found at the intersection of South Street and Wilkinson Drive for retrofit of a grass channel with an outlet structure into an infiltration basin or trench with enhanced storage, managing 7.9 acres of impervious for a potential P load reduction of 8.9 kg/yr (EJ-WR-038, Table 5 and Map 2). Of the remaining opportunities, the Killoran Drive cul-de-sac contains opportunities to both reduce impervious cover and install subsurface drywells or infiltration practices. Immediately to the south, a similar approach could be applied at the neighborhood scale along Cascadnac, Owaissa, and Wenonah Avenues (Table 5, Map 2). Collectively, these green stormwater infrastructure retrofits would manage at least 11 impervious acres and result in a P load reduction of 12.3 kg P/yr. Projected structural STP retrofits that were considered but not further advanced are listed in Appendix B-6.

3.2.1. Structural STP Implementation Cost Estimation

For newly proposed structural STPs in both Essex Junction and Essex Town, implementation costs were estimated using construction costs from recent implementation projects, recent projects completed by consulting team members, unit costs per cubic foot of storage from stormwater retrofits recently completed by the Vermont Agency of Transportation, the EPA's Opti-Tool unit cost estimates, and adjustments to the Opti-Tool[5] unit cost estimates completed for a selection of projects in Vermont and Massachusetts (Table 4). The unit-based implementation costs did not include design and permitting, so a 25% adjustment factor was applied. A factor of 1.25 was applied to the projected unit-based costs to account for the cost differential observed by both MS4s during the implementation of FRP projects. Unit costs were adjusted to account for estimated 2% annual inflation for the three elapsed years since the April 2021 PCP (2022-2024).

[5] https://www3.epa.gov/region1/npdes/stormwater/ma/green-infrastructure-stormwater-bmp-cost-estimation.pdf

Table 4. Projected Structural STP implementation unit cost assumptions

BMP Type	Unit cost (2021 $/cf)	Unit cost (2024 $/cf)
Bioretention (infiltrating)	$23	$25
Bioretention (w/ underdrain)	$28	$30
Dry Swale (infiltrating)	$17	$19
Dry Swale (w/ underdrain)	$19	$21
Gravel Wetland	$17	$19
Infiltration Basin	$12	$13
Infiltration Chambers	$20	$22
Infiltration Trench	$20	$22
Porous Pavement	$25	$27
Sand filter (infiltrating)	$20	$22
Sand filter (w/ underdrain)	$23	$25

Table 5. Essex Junction Summary of Projected Structural STPs, Main Lake Segment

Unique IDs	Site Name	Year Planned	BMP Type	Impervious area (acres)	Pervious area (acres)	Storage volume (ft^3)	Practice Efficiency (%)	P Credit (kg/yr)	% of P Target	Cost Estimate ($2024)	$/CF	$/acre impervious managed	$/kg P/yr
EJ-WR-027 EJ-WR-028 EJ-WR-029 EJ-WR-030	Killoran Drive: Drywells or infiltration chambers at existing catch basins; impervious removal in cul de sac	2029	Infiltration Trench	1.68	1.72	5,821	100.0%	1.81	8.0%	$126,300	$22	$75,179	$69,779
EJ-WR-031 EJ-WR-032 EJ-WR-033 EJ-WR-034 EJ-WR-035 EJ-WR-036 EJ-WR-037	Cascadnac Ave, Owaissa Ave., and Wenonah Ave.: Drywells or infiltration chambers at existing catch basin locations	2032	Infiltration Trench	1.42	1.20	5,910	100.0%	1.60	7.1%	$125,900	$21	$88,662	$78,688
EJ-WR-038	Tyler Drive, Wilkinson Drive - South St. intersection - retrofit/expand	2027	Infiltration Basin	7.86	5.46	28,096	99.8%	8.87	39.3%	$178,900	$6	$22,761	$20,161
TOTALS				**10.96**	**8.38**	**39,827**		**12.28**		**$431,100**	**$11**	**$39,334**	**$35,095**

3.3. Essex Town Existing and Design-Phase Structural STPs

Since the 2021 PCP was submitted, three structural STPs were completed or incorporated, now totaling 14 creditable STPs for the Town (Table 6 and Appendix B-1). Together, they manage stormwater from a combined 56 acres of impervious area and 73 acres of pervious area. In the Malletts Bay Lake segment, combined P load reductions from completed projects account for 15.0 kg/yr or 48% of the total required P reduction. Completed STPs, primarily constructed to advance completion of the Indian Brook Flow Restoration Plan, account for 80% of the Town's required P reduction in the Main Lake segment (18.1 kg/yr). Two of the three new STPs in Essex Town are cul-de-sac retrofits similar to those completed at Acorn Circle in the City, combining impervious removal with infiltration or filtering treatment retrofits. These two cul-de-sac retrofits provide a P credit of 4.21 kg/yr. Additionally, the Town recently took over operational permit 3585-9010 from the permittee, incorporating it into the Essex Town MS4.

Table 6. Essex Town Completed Structural STPs

Site Name	Permit No.	Lake Segment	BMP Type	Impervious (acres)	Pervious (acres)	Storage Volume (ft^3)	P Credit (kg/yr)	% of P Target
Essex Police Station	7025.9014.ARA	Main Lake	Bioretention (underdrain)	1.1	2.5	3,554	0.82	1.9%
Essex Police Station	7025.9014.ARA	Main Lake	Grass Channel	1.1	2.5	978	0.10	0.23%
Kellogg Rd Detention Pond	5944-INDO.R	Main Lake	Sand Filter (underdrain)	9.50	4.0	170,450	7.27	17%
Oakwood Drive cul-de-sac retrofit - impervious removal		Main Lake	Impervious Removal	-0.1	0.1	0	0.14	0.32%
Oakwood Drive cul-de-sac retrofit - media filter with specialized media		Main Lake	Sand Filter (underdrain)	2.13	0.0	11,500	3.09	7.1%
Perkins Bend 002	3081-9010.R	Main Lake	Infiltration Basin	6.00	7.3	1,520	1.88	4.3%
Sage Circle retrofit - impervious removal		Main Lake	Impervious Removal	-0.065	0.65	0	0.06	0.14%
Sage Circle retrofit - infiltration trenches		Main Lake	Infiltration Trench	0.80	0.0	6,096	0.92	2.1%
Saxon Hill ROW S/N 001	3585-9010.T	Main Lake	Dry Swale (underdrain)	1.14	0.9	12,460	0.93	2.1%
Tanglewood Drive infiltration - Birchwood Manor	5263-9015	Main Lake	Bioretention (infiltrating)	1.81	0.0	6,423	2.00	4.6%
Thompson Drive infiltration	4181-9015.3	Main Lake	Infiltration Trench	0.80	0.0	2,795	0.90	2.1%
Total Main Lake				**24.3**	**17.9**	**215,777**	**18.1**	**80%**
Essex Outlets Pond A	6262-9020	Malletts Bay	Underground Detention	5.65	9.1	74,139	2.98	10%
Essex Outlets Pond B	6262-9020	Malletts Bay	Gravel Wetland	3.77	1.2	40,772	1.97	6%
Essex Outlets Pond C	6262-9020	Malletts Bay	Gravel Wetland	11.85	10.3	290,966	6.24	20%
Essex Town Center-Essex Outlets	4002-INDS.A	Malletts Bay	Wet pond/ Wetland	6.45	6.1	28,009	0.39	1%
Sydney Drive - Woodlands II- Lang Farm Parcel	1-1186	Malletts Bay	Infiltration Chambers	4.04	28.8	38,812	3.39	11%
Total Malletts Bay				**31.8**	**55.4**	**472,698**	**15.0**	**48%**

Six structural STPs are in design phases (Table 7 and Appendix B-2) in the Town. In 2022-23, Essex Town worked with VHB to advance preliminary engineering for four of the high-priority retrofits specified in the 2021 PCP, primarily in the Main Lake segment (Appendix B-4). In the Malletts Bay Lake segment, a pair of STPs associated with the Indian Brook Flow Restoration Plan account for management of 0.9 kg/yr, and an expansion/conversion of Autumn Knoll's existing wet pond to a gravel wetland could provide additional P reduction of 2.5 kg/yr for a combined 11% of the Town's required P reduction. For the Main Lake segment, the Town may receive at least 36 kg/yr (84% of target) from a combination of different retrofits. Most notably, the David Dr. Outfall retrofit as advanced through preliminary engineering could manage nearly 21 kg P/yr (48% of P reduction target).

Essex Town is considering whether to incorporate two "three-acre" sites under their MS4 Permit: Pinewood Section H (1-1523 / 3426-9050) and Oakridge / Forestdale (3790-9010.R1). Particularly in the case of Pinewood Section H, given the age of the project and related dated modeling and general lack of information, it is taking time to fully realize the implications. Essex Town is investigating how taking over the permit will impact the Town's phosphorus loading and removal target. The Town will update the PCP once that information is available.

Table 7. Essex Town Design-Phase Structural STPs

Site Name	Permit No.	Lake Segment	BMP Type	Impervious (acres)	Pervious (acres)	Storage Volume (ft^3)	P Credit (kg/yr)	% of P Target
2OLET120 Logwood Circle stormline and catchbasin retrofits (EX-WR-041-43)		Main Lake	Infiltration Chambers	3.9	7.3	12,763	4.5	10%
David Dr. Outfall	1-0896, 1-0552, 1-1463	Main Lake	Infiltration Chambers	16.0	16.3	61,028	20.8	48%
Meadows Edge/Steeplebush retrofit		Main Lake	Gravel Wetland	8.7	16.9	33,149	7.5	17%
Outfall 126: Fort Ethan Allen (Ryan St.)		Main Lake	Infiltration Chambers	3.4	2.2	12,239	3.9	9%
		Total Main Lake		**32.1**	**42.5**	**116,874**	**36**	**84%**
Autumn Knoll S/N 001 retrofit	4367-9010.R	Malletts Bay	Gravel Wetland	3.02	2.4	10,846	2.5	8%
Church of Jesus Christ of Latter Day Saints, South Vault	1-1319	Malletts Bay	Sand Filter (underdrain)	1.83	0.7	13,286	0.9	3%
Church of Jesus Christ of Latter Day Saints, North Vault	1-1319	Malletts Bay	Detention Chambers	-	-	-	-	0%
		Total Malletts Bay		**4.9**	**3.1**	**24,132**	**3.4**	**11%**

3.4. Essex Town Projected Structural STPs

In the Essex Town MS4, two substantial STPs are located in the Sunderland Brook watershed and included in that FRP (Outfall 126 and David Drive Outfall) but are not required under that plan (Table 8 and Appendix B-4). While the David Drive Outfall retrofit, also identified in that FRP, would move forward only if absolutely necessary, the Outfall 199 retrofit was advanced into preliminary engineering in 2022-23 as described above. Outfall 126 also represents a strong project that the Town may consider implementing. Coupled with completed and anticipated improvements to hydrologically connected road segments and

culvert outlets (Section 4.2), these structural STP retrofits alone would likely be sufficient to meet target P reductions for the Main Lake segment (Section 7).

In the event that the Town chooses not to prioritize additional structural STPs in the Sunderland Brook watershed, and in order to provide flexibility to the Town in meeting MS4 target P reductions, additional BMP identification was conducted in 2020-1 as described below.

The Essex Town MS4 has incorporated over 40 operational permits into its MS4 permit. Most of the STPs included in these permits were constructed before the 2010 base monitoring period for the Lake Champlain P TMDL and thus are not presently eligible for P reduction credit – and many are located in the Malletts Bay Lake segment. However, for those in the Alder Brook and direct Winooski watersheds, they represent opportunities for strategic retrofit to achieve compliance with the MS4's P reduction obligations under the Essex Town PCP. While many of the incorporated permits include only closed drainage systems to outlets or grass channels, four sites were selected for further review in consultation with the Town during development of the 2021 PCP. Autumn Knoll and Meadows Edge are now in preliminary engineering (Table 7), the two sites below may be advanced if necessary:

- Convert existing dry extended detention pond at Craftsbury Court (3581-9010.R) to a gravel wetland, maintaining the existing basin's storage volume.
  - This concept appears feasible and represents a reasonable P reduction (approximately2.8 kg/yr). The retrofit opportunity was included in the projected list of structural STPs (EX-WR-040, Table 8).
- Convert existing grass swales in the Old Stage Village Development (3579-9010.R) into dry swales.
  - While maintenance of the existing swales is needed, the soils appear to have limited suitability for infiltration compared to other areas in Town, and open space for construction of STPs outside of the existing grass channels is limited (Appendix B-5).

Additional structural STP opportunities were screened in the Main Lake segment at the desktop level, focusing on areas where closed drainage system outlets were identified as Not Meeting Standards through the 2017 REI (Section 4.2). In many cases, the subdivisions hosting these closed drainage systems were constructed on highly infiltrative and highly erodible soils, such that focused retrofits to replace existing catchbasins with drywells, or to add subsurface infiltration chambers as offline infiltration practices for existing catchbasins, would both improve water quality and reduce downstream flow and velocity at the drainage system outlets. Eleven such opportunities were identified in the Alder Brook watershed and in Winooski River direct drainages along Foster Road, Saxonhollow Road and Hillside Avenue, Sand Hill Road, Greenbriar Drive and Greenfield Road, and Wildwood Drive (Table 8, Map 2). Three opportunities were identified along Logwood Circle, where video inspection of the stormline network identified five lines in need of replacement. In this instance, the stormlines could be replaced with perforated HDPE in stone bedding to effectively function as infiltration trenches, and if feasible or desired, the associated catchbasins could be replaced with drywells. Collectively, these green stormwater infrastructure retrofits would manage at least 26 impervious acres and result in a P load reduction of 29.8 kg P/yr.

Table 8. Essex Town, Summary of Projected Structural STPs

ID	Site Name	Permit No.	Year Planned	Lake Segment	BMP Type	Impervious (acres)	Pervious (acres)	Storage volume (ft^3)	P Credit (kg/yr)	% of P Target	Estimated Cost ($2024)	$/CF	$/acre impervious	$/kg P/yr
EX-WR-002	CB772-775 Foster Rd drywells		2034	Main Lake	Infiltration Trench	1.34	2.42	4,559	1.54	4%	$96,800	$21	$72,239	$62,972
EX-WR-003 EX-WR-004 EX-WR-005 EX-WR-006 EX-WR-007	Saxonhollow and Hillside Ave: Drywells or chambers		2029	Main Lake	Infiltration Trench	2.86	5.75	10,251	3.29	8%	$217,900	$21	$76,189	$66,231
EX-WR-008	CB1046-1050 Sand Hill Rd drywells		2032	Main Lake	Infiltration Trench	0.87	2.49	3,024	1.02	2%	$64,200	$21	$73,793	$63,180
EX-WR-009	CB957-960 Greenbriar Dr drywells		2032	Main Lake	Infiltration Trench	0.77	1.22	2,697	0.88	2%	$57,700	$21	$74,935	$65,477
EX-WR-010	CB964 968-970 Greenfield Rd drywells		2032	Main Lake	Infiltration Trench	1.09	2.53	3,743	1.74	4%	$79,500	$21	$72,936	$45,694
EX-WR-011 EX-WR-012	Wildwood: Drywells or chambers		2032	Main Lake	Infiltration Trench	0.47	0.90	1,882	0.70	2%	$40,300	$21	$85,745	$57,571
EX-WR-039	2OLET88 Tanglewood Drive and Fern Hollow Road retrofits (Alternative 4)		2026	Main Lake	Dry Swale (w/ underdrain)	6.66	11.50	18,774	4.44	10%	$435,100	$23	$65,334	$97,953
EX-WR-040	2OLET56 Craftsbury Court pond retrofit	3581-9010.R	2034?	Main Lake	Gravel Wetland	2.55	7.31	20,100	2.81	6%	$362,600	$18	$142,196	$129,120
MAIN LAKE TOTALS						**32.57**	**50.37**	**126,058**	**37.24**	**85%**	**$2,258,500**	**$18**	**$69,344**	**$60,655**

4. Municipal Hydrologically Connected Road Segments

The Municipal Roads Requirements outlined in Section 8.3 of the MS4 Permit[1] reflect those of the Municipal Roads General Permit[6] (MRGP), which require municipalities to implement a long-term plan to improve hydrologically connected road drainage systems to a set of standards included in the Permit. MS4s were initially required to conduct a Road Erosion Inventory (REI) and Implementation Table for all municipal hydrologically connected road segments by April 1, 2020, though this deadline was extended. The 2023 MS4 General Permit requires MS4s to complete the next REI reassessment by April 1, 2028. The REI is used to determine if road segments met the standards of Section 8.3.C of the MS4 Permit, while the Implementation Table is used to prioritize improvement of road segments that need to be brought up to standards. The results of the Essex Junction and Essex Town REIs can be found on the MRGP Implementation Table Portal[7]. The results summarized in this section were obtained from the Implementation Table Portal in January 2024.

The improvements required to bring a road segment up to standards vary based on road category but can involve BMPs such as stabilizing ditches with vegetation/stone, installing turn outs, and/or stabilizing erosion at culvert outlets. The ANR has defined P crediting methodologies in a Tracking and Accounting SOP[8], which are based on pre- and post-construction road conditions as well as road typology (paved and unpaved roads with ditches, paved roads with catch basin outlets, and Class 4 roads). Standards and crediting for paved and unpaved roads with ditches and Class 4 roads are applied at the road segment level, while standards and crediting for paved roads with catch basins are derived from the volume of erosion stabilized at drainage system outlets (Appendix C).

Both Essex Junction's and Essex Town's MS4s have been proactively completing improvements to bring road segments up to standards and stabilize erosion at outlets since the 2018 MS4 General Permit became effective. As required by the MS4 Permit, hydrologically connected road segments that Do Not Meet or Partially Meet standards must be brought up to standards, with the highest-priority improvements to be completed within the 2018-2022 permit term. Hydrologically connected paved-curbed culvert outlet improvements completed through December 2023 or anticipated in the Essex Junction MS4 (Figure 2) account for up to 176% (16 kg/yr) of annual P load reduction in the Malletts Bay Lake segment where the P reduction target is already met, but only a small proportion (15% or 3.4 kg/yr) of the P load reduction needed in the City's Main Lake segment. In contrast, completed and remaining road segment repairs and outlet stabilization measures in the Essex Town MS4 may account for 40% (12.4 kg/yr) of the target P reduction in the Malletts Bay lake segment, and 56% (24.5 kg/yr) in the Main Lake segment. The P reductions achieved through completed roadway improvements, and anticipated P reductions from planned improvements as identified in the REI and Implementation Tables, are detailed below for both MS4s.

[6] https://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/MRGP_2023_Final.pdf

7 https://anrweb.vt.gov/DEC/IWIS/MRGPReportViewer.aspx?ViewParms=True&Report=Portal

[8] https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/TrackingAccounting/Standard Operating Procedures for Tracking & Accounting of Developed Lands Regulatory Projects & Non-Regulatory Clean Water Projects.pdf

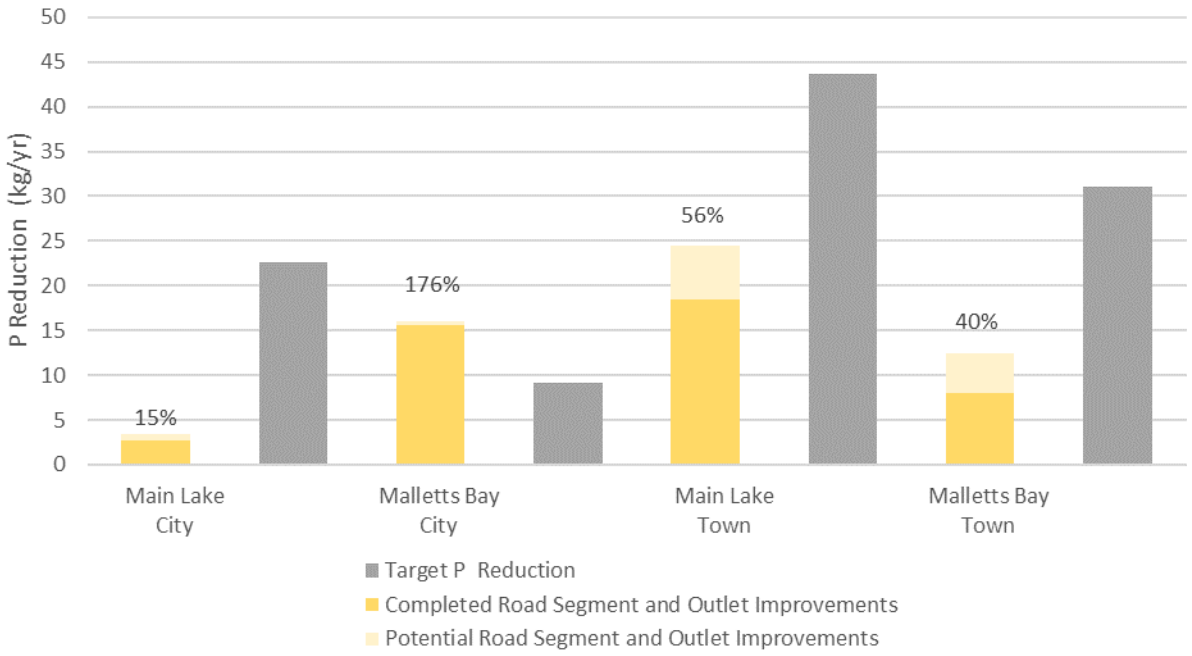


Figure 2. Essex Junction and Essex Town, total P reduction from existing and remaining outlet and road segment improvements as compared to required total P reduction (kg/yr). See Table 15 for Essex Junction summary and Table 22 for Essex Town summary.

Cost Estimation for Improvements to Bring Hydrologically Connected Road Segments and Outlets Up to Standards

For road segments and closed drainage outlets where improvements are required to come into compliance with MRGP standards, implementation costs were estimated using construction costs from recent projects completed by both MS4s, recent projects completed by consulting team members, and unit costs per road segment and outlet drawn from a review of Municipal Roads Grants-in-Aid data completed for the project *Cost Effectiveness and Operation & Maintenance Standards of Clean Water Projects in Vermont*, where final outputs were submitted to Vermont DEC in March 2021. Unit cost estimates were refined in 2021-2022 by Fitsgerald Environmental Associates (FEA) as they completed a 10-year Gravel Road Stormwater Management Plan (RSWMP) for Essex Town's hydrologically connected and un-connected road segments (Appendix D). For the 2023-4 PCP update, 2021 unit costs were adjusted for inflation at 3%/year for the three elapsed years from 2021-2024.

For paved roads with ditches, gravel roads, and Class 4 roads, planning level estimates of the estimated cost to bring each road segment up to standards were calculated on a per-road-segment basis using median cost to bring road segments partially or fully up to standards (Table 9). For paved roads with catch basins to outlets, improvement costs were estimated on a per-outlet basis using the median cost of outlet improvement projects completed by the City and Town to date, after including a 25% contingency (Table 10). Outlets that were determined to be partially meeting standards were estimated at 50% of the median outlet repair cost. Additional unit cost estimation resources for common crown, shoulder, ditch, and culvert improvements are presented in Table 11.

For both road segment and outlet improvements, costs presented in this PCP should be considered order-of-magnitude estimates. Furthermore, the repairs needed to bring closed drainage and culvert outlets up to

standards are extremely variable, depending upon the unique conditions of each closed drainage system and outlet.

Table 9. Summary of Costs to Improve Road Segments, Municipal Roads Grants-in-Aid Review

	2021 $		2024 $	
Municipal Roads Grants-in-Aid Summary Statistic	Partially Meets	Does Not Meet	Partially Meets	Does Not Meet
Class 3 Mean Improvement Cost per 100 m	$4,200	$5,600	$4,600	$6,100
Class 3 Median Improvement Cost per 100 m	$3,800	$4,300	$4,200	$4,700
Class 3 Mean Improvement Cost per mile	$67,600	$88,800	$73,900	$97,000
Class 3 Median Improvement Cost per mile	$61,000	$67,700	$66,700	$74,000

Table 10. Summary of Recent Essex Junction and Essex Town Paved Road-Catch Basin Outlet Stabilization Cost

Project Name	2021 $/project	2021 Project Cost +25% Contingency	2024 Project Cost +25% Contingency
Town - Saybrook Road Outlet (Town provided some material)	$3,974	$4,970	$5,430
Town - Bobolink Circle Outlet	$5,744	$7,180	$7,850
Village-Juniper Ridge Rd Outlet	$7,509	$9,390	$10,260
Village-Corduroy Rd Outlets 1090 & 1091	$7,987	$9,990	$10,920
Village-Corduroy Rd Outlet 1094	$18,020	$22,530	$24,620
Village-40 Beech St	$11,480	$14,350	$15,680
Average Project Cost	$9,119	$11,400	$12,460
Median Project Cost	**$7,800**	**$9,800**	**$10,710**

Table 11. Unit Cost Resources for Common MRGP Practices

Practice	Units	2017 $	2021 $	2024 $
Crowning Road	LF	$5	$6	$7
Culvert Headwall / Armor	each	$300	$320	$350
Culvert Turnout	each	$200	$210	$229
Drainage Culvert	each	$1,500	$1,570	$1,716
Driveway Culvert	each	$750	$790	$863
Grass-lined Ditch	LF	$8	$9	$10
Removing Grader Berm	LF	$5	$6	$7
Stone-Lined Ditch	LF	$25	$27	$30

2021 unit costs assume an annual inflation rate of 1.5% and 4 elapsed calendar years (2017-2021).
2024 unit costs assume an annual inflation rate of 3.0% and 3 elapsed calendar years (2021-2024).
Sources: Fitzgerald Environmental Associates and Milone-Macbroom, submitted to CCRPC and the Town of Jericho, 2017; Fitzgerald Environmental Associates Gravel RSWMP, 2022 (Appendix D).

4.1. Essex Junction Completed and Planned Improvements to Bring Hydrologically Connected Road Segments up to Standards

Of the 39 km (385 road segments) of hydrologically connected roadway in Essex Junction, approximately 10.9 km (109 segments) were identified as Not Meeting Standards in the 2017 REI. Most of these road segments are paved roads with catch basins associated with 14 culvert outlets (Table 12, Table 13, and Map 2). Since completing the 2017 REI, the Essex Junction MS4 has proactively implemented roadway improvements[9] including the stabilization of 10 eroding outlets along paved roadway with curbs through December 2023 (Table 12). Most of these improvements are tracked correctly in the MRGP datasets. Outlet 1094 (EJCT104) off Corduroy Road was stabilized in October 2020 (Better Roads grant 0670). This outlet appears in the REI outlets dataset, but the details of condition and improvements completed are not reflected. The repair stabilized 49 cubic yards of erosion, resulting in an estimated P load reduction of 1.72 kg/yr that is included in Table 12 and Table 15. Similarly, Outlet 1020 (EJCT103) off Greenwood Avenue was stabilized in the spring of 2020, repairing 78.4 cubic yards of erosion using FEMA funds following the Halloween 2019 storm. *These outlet inventory details should be added to the MRGP inventory of hydrologically connected outlets.*

Table 12. Summary of hydrologically connected Paved-Curbed road segments and outlets with stabilization measures implemented, Essex Junction

Lake Segment	Outlet ID (REI)	Outlet ID (Essex Jct)	Road Name	Total Road Segments	Erosion Volume Managed (yd³)	P Load Reduction (kg/yr)
Malletts Bay	EJCT034	1OLET1149	ATHENS DR	2	43	1.50
	EJCT039	1OLET1158	FAIRVIEW DR	1	38	1.33
	EJCT045	1OLET1154	JUNIPER RIDGE RD	2	85	2.98
			SYCAMORE LN	1		
	EJCT050	1OLET1134	ASPEN DR	2	24	0.84
			BEECH ST	6		
			COUNTRYSIDE DR	2		
			TAMARACK DR	2		
	EJCT055	1OLET1085	BRICKYARD RD	1	3.3	0.17
	EJCT056	1OLET1090	CORDUROY RD	2	12	0.42
	EJCT057	1OLET1091	CORDUROY RD	1	12	0.42
	EJCT104	1OLET1094	CORDUROY RD	1	49	1.72
			MASON DR	1		
	EJCT065	1OLET1074	ROSEWOOD LN	2	178	6.23
Total	*9*			*26*	*444*	*15.6*
Main Lake	EJCT103	1OLET1020	GREENWOOD AV	4	78	2.75
			S HILL DR	2		
Total	*1*			*6*	*78*	*2.75*

The completed outlet repairs resulted in an estimated 444 cubic yards of erosion managed and 14.7 kg/yr of P reduction within the Malletts Bay Lake segment, and 78 cubic yards or erosion managed for 2.75 kg/yr in P reduction in the Main Lake segment (Table 12). Stabilizing the remaining culvert outlets with identified rill or gully erosion will result in an estimated additional 10.0 cubic yards of erosion managed with 0.41 kg/yr P

[9] https://anrweb.vt.gov/DEC/IWIS/MRGPReportViewer.aspx?ViewParms=False&Report=ProgressReport&MunicipalityID=280

load reduction in the Malletts Bay Lake segment, and 18.6 cubic yards of outlet erosion stabilized for 0.65 kg/yr P load reduction in the Main Lake segment (Table 13). Estimated implementation cost for remaining outlet erosion stabilization measures is $42,400 (Table 14). The total estimated P reduction for existing and planned roadway improvements in Essex Junction is 3.4 kg/yr (15%) and 16.0 kg/yr (176%) for the Main Lake and Mallets Bay Lake Segments, respectively (Table 15).

Table 13. Summary of hydrologically connected paved road segments and outlets with stabilization measures needed, Essex Junction

Lake Segment	Outlet ID (REI)	Outlet ID (Essex Jct)	Road Name	Segments Not Meeting Standards	Segments Partially Meeting Standards	Erosion Volume to be Managed (yd^3)	Estimated P Load Reduction (kg/yr)
Malletts Bay	EJCT055	1OLET1085	BRICKYARD RD	0	1	3.3	0.17
	EJCT066	1OLET1073	BRIAR LN	1	0	6.7	0.23
			ROSEWOOD LN	2	0		
	Total			*3*	*1*	*10.0*	*0.41*
Main Lake	EJCT076	1OLET1117	WOODS END DR	1	0	12.4	0.44
	EJCT090	1OLET1023	SILVER BOW TERR	1	0	6.1	0.21
	Total			*2*	*0*	*18.6*	*0.65*

Table 14. Estimated Implementation Costs for Catch Basin Outlet Stabilization, Essex Junction

Lake Segment	Outlet ID (REI)	Outlet ID (Essex Jct)	Road Name	Estimated Outlet Stabilization Cost ($2021)	Estimated Outlet Stabilization Cost ($2024)
Malletts Bay	EJCT055	1OLET1085	BRICKYARD RD	$4,900	$5,400
	EJCT065	1OLET1074	ROSEWOOD LN	$9,800	$10,700
	EJCT066	1OLET1073	BRIAR LN	$9,800	$10,700
			ROSEWOOD LN		
	Total			*$24,500*	*$26,800*
Main Lake	EJCT076	1OLET1117	WOODS END DR	$9,800	$10,700
	EJCT090	1OLET1023	SILVER BOW TERR	$4,500	$4,900
	Total			*$14,300*	*$15,600*
TOTAL OUTLET STABILIZATION COST				*$38,800*	*$42,400*

Table 15. Essex Junction total P reductions from existing and planned hydrologically connected roadway brought up to standards, paved-curbed road segments and related outlet stabilization (kg/yr)

Lake Segment	Competed Outlet Stabilization P Reduction	Planned Outlet Stabilization P Reduction	Total Outlet Stabilization P Reduction	Target P Reduction	% of Target P Reduction
Main Lake	2.7	0.65	3.4	22.6	15.0%
Malletts Bay	15.6	0.41	16.0	9.1	176%
Total	*18.4*	*1.1*	*19.4*	*31.7*	61%

4.2. Essex Town Completed and Planned Improvements to Bring Hydrologically Connected Road Segments up to Standards

Of the 57.9 km of hydrologically connected roadway in the Essex Town MS4, 9.8 km (114 road segments) were required to be brought up to standards in the initial 2017 REI. In Essex Town, a smaller proportion of these road segments (23 in total) are paved roads with catch basins associated with 13 culvert outlets (Table 16, Table 17, and Appendix C). As of this report, 53 open-drainage road segments and four culvert outlets have been partially or fully brought up to standards. In 2021-2022, Fitzgerald Environmental Associates (FEA) completed a 10-year Gravel RSWMP for Essex Town's hydrologically connected and un-connected road segments (Appendix D). This plan was initially created only for hydrologically connected road segments, and then amended to incorporate all gravel roads in Essex Town. The 10-year work plan serves as a general guide and is adjusted by the Town as gravel roads change - particularly in response to severe storms and flooding in 2023.

Since completing the 2017 REI, the Essex Town MS4 has prioritized bringing Class 4 and gravel road segments up to standards[10], while strategically completing outlet rehabilitation at a few locations. Outlet 2OLET065 off Bobolink Circle was stabilized in 2019, resulting in an estimated P load reduction of 3.01 kg/yr (Table 16). Three additional outlet gullies, including substantial erosion at outlet 2OLET112 off Saxonhollow Drive, were stabilized in 2021-2023 for a total of 444 cubic yards of outlet erosion stabilized and a P load reduction of 18.3 kg/yr. Completing repairs at the remaining identified culvert outlets will result in an estimated 107 cubic yards of erosion stabilization and an estimated 2.75 kg/yr P load reduction at outlets on paved roads with curbs in the Main Lake segment (Table 17), and 16 cubic yards of erosion managed with an estimated P load reduction of 0.58 kg/yr in the Malletts Bay Lake segment. Implementation costs are estimated at $80,300 (Table 18).

Table 16. Summary of hydrologically connected Paved-Curbed road segments and outlets with stabilization measures implemented, Essex Town

Lake Segment	Outlet ID (REI)	Outlet ID (Essex Town)	Road Name	Total Road Segments	Erosion Volume Managed (yd^3)	P Load Reduction (kg/yr)
Main Lake	ESSX026	2OLET065	BOBOLINK CIR	1	86	3.01
	ESSX051	2OLET187	FOSTER RD	3	8	0.28
	ESSX062	2OLET112	SAXONHOLLOW DR	5	311	10.91
			HILLSIDE CIR	3		
	ESSX065	2OLET119	GREENFIELD DR	1	39	4.11
Total	*4*			*13*	*444*	*18.32*

[10] https://anrweb.vt.gov/DEC/IWIS/MRGPReportViewer.aspx?ViewParms=False&Report=ProgressReport&MunicipalityID=69

Table 17. Summary of hydrologically connected paved road segments and outlets with stabilization measures needed, Essex Town

Lake Segment	Outlet ID (REI)	Outlet ID (Essex Town)	Road Name	Segments Not Meeting Standards	Segments Partially Meeting Standards	Erosion Volume to be Managed (yd^3)	Estimated P Load Reduction (kg/yr)
Malletts Bay	ESSX022	2OLET239	WHITCOMB MEADOWS LN	0	1	1	0.05
	ESSX053	2OLET068	CIRCLE DR	2	0	15	0.53
	Total	*2*		*2*	*1*	*16*	*0.58*
Main Lake	ESSX031	2OLET150	WINDRIDGE RD	1	0	9	0.32
	ESSX035	2OLET153	WILDWOOD DR	1	0	4	0.14
	ESSX036	2OLET152	WILDWOOD DR	0	1	2	0.11
	ESSX042	2OLET186	GREENBRIAR DR	0	1	2	0.11
	ESSX043	2OLET135	SAND HILL RD	1	0	10	0.35
	ESSX045	5OLET137	SAND HILL RD	7	0	44	1.56
	ESSX056	2OLET171	PINEWOOD DR	0	1	1	0.05
	ESSX064	2OLET118	GREENFIELD CT	1	0	45	1.58
			GREENFIELD RD	2	0		
	ESSX066	2OLET172	HEATHERBUSH RD	0	2	2	0.11
			PINEWOOD DR	0	1		
			VALLEYVIEW DR	0	4		
	Total	*9*		*17*	*12*	*151.44*	*4.31*

Table 18. Estimated Implementation Costs for Catch Basin Outlet Stabilization, Essex Town

Lake Segment	Outlet ID (REI)	Outlet ID (Essex Town)	Road Name	Estimated Outlet Stabilization Cost ($2021)	Estimated Outlet Stabilization Cost ($2024)
Malletts Bay	ESSX022	2OLET239	WHITCOMB MEADOWS LN	$4,900	$5,400
	ESSX053	2OLET068	CIRCLE DR	$9,800	$10,700
	Total	*2*		*$14,700*	*$16,100*
Main Lake	ESSX031	2OLET150	WINDRIDGE RD	$9,800	$10,700
	ESSX035	2OLET153	WILDWOOD DR	$9,800	$10,700
	ESSX036	2OLET152	WILDWOOD DR	$4,900	$5,400
	ESSX042	2OLET186	GREENBRIAR DR	$4,900	$5,400
	ESSX043	2OLET135	SAND HILL RD	$9,800	$10,700
	ESSX056	2OLET171	PINEWOOD DR	$4,900	$5,400
	ESSX064	2OLET118	GREENFIELD CT	$9,800	$10,700
			GREENFIELD RD		
	ESSX066	2OLET172	HEATHERBUSH RD	$4,900	$5,400
			PINEWOOD DR		
			VALLEYVIEW DR		
	Total	*9*		*$58,800*	*$64,300*
TOTAL OUTLET STABILIZATION COST				*$73,500*	*$80,300*

Since the 2020 report, the Town implemented improvements to bring 10 gravel road segments fully up to standards and 28 gravel road segments partially up to standards (Table 19 and Table 20). In accordance with the MRGP Tracking and Accounting SOP, segments brought fully up to standards receive a P credit of 80% of the P load, and segments brought partially up to standards receive a P credit of 40%. Together with previously reported updates, the Town has improved 53 road segments for a total P reduction of 8.04 kg/yr, nearly all of which is in the Malletts Bay Lake segment (Table 19).

In 2021, grass- and stone-lined ditches were added to Osgood Hill Road, Catella Road, and Hanley Lane using Grants-in-Aid Funding, providing an associated P credit of 1.72 kg/yr (Table 20). In 2022, the Sawmill Road cul-de-sac, Old Pump Road, and Gray Way also received new grass- and stone-lined ditches in addition to upsized culverts, for an associated P credit of 0.82 kg/yr.

Table 19. Essex Town summary of road segments fully or partially meeting standards by road type

Lake Segment	Road Segments Managed by Roadway Type			Total Road Segments	Segment P Reduction by Road Type			Total P Load Reduction	Target P Reduction	% of Total P Reduction
	Class 4	Gravel	Paved - Non Curbed		Class 4	Gravel	Paved - Non Curbed			
Reported in 2020										
Main Lake	0	0	0	0	0.00	0.00	0.00	0.00	43.6	0.0%
Malletts Bay	1	14	0	15	0.25	2.67	0.00	2.92	31.0	9.4%
Total	*1*	*14*	*0*	*15*	*0.25*	*2.67*	*0.00*	*2.92*	*74.6*	
Updated in 2021-2023										
Main Lake	0	1	0	1	0.00	0.08	0.00	0.08	43.6	0.2%
Malletts Bay	0	37	0	37	0.00	5.12	0.00	5.04	31.0	16.3%
Total	*0*	*38*	*0*	*38*	*0.00*	*5.20*	*0.00*	*5.12*	*74.6*	
Total Updated Road Segments										
Main Lake	0	1	0	1	0.00	0.08	0.00	0.08	43.6	0.2%
Malletts Bay	1	51	0	52	0.25	7.79	0.00	7.96	31.0	25.7%
Total	*1*	*52*	*0*	*53*	*0.25*	*7.87*	*0.00*	*8.04*	*74.6*	

Table 20. Essex Town summary of road segments updated 2021-2023 and associated P credit

Lake Segment	Road Name	Segments Partially Updated		Segments Fully Updated		Total P Load Reduction
		Count	P reduction	Count	P reduction	
Main Lake	BRIGHAM HILL RD	0	0.00	1	0.08	0.08
	Total	*0*	*0.00*	*1*	*0.08*	
Malletts Bay	CATELLA RD	8	0.82	1	0.25	5.12
	HANLEY LN	2	0.50	0	0.00	
	OLD PUMP RD	2	0.32	1	0.25	
	OSGOOD HILL RD	2	0.15	0	0.00	
	SAWMILL RD	0	0.00	1	0.24	
	GRAY WAY	1	0.07	0	0.00	
	BRIGHAM HILL LN	3	0.41	2	0.15	
	CURVE HILL RD	1	0.08	0	0.00	
	DISCOVERY RD	1	0.08	0	0.00	
	INDIAN BROOK RD	1	0.08	0	0.00	
	LOST NATION RD	8	1.01	4	0.70	
	Total	*29*	*3.52*	*9*	*1.60*	

Implementation cost estimates for remaining hydrologically-connected road segments in Essex Town were drawn from the Gravel RSWMP where appropriate, and adjusted for inflation assuming a 3% annual inflation rate and three elapsed years (2021-2023). Bringing the remaining gravel and paved, uncurbed road segments up to standards may result in an additional 5.57 kg/yr P load reduction from 24 road segments, primarily located in the Malletts Bay Lake segment (Table 21). Implementation costs for these improvements are estimated to be approximately $56,700 (Table 22).

The total estimated P reduction for existing and planned roadway improvements in the Town is 24.5 kg/yr (56%) for the Main Lake segment and 12.4 kg/yr (40%) for the Malletts Bay Lake segment (Table 23).

Table 21. Essex Town summary of road segments requiring improvements and P Load reductions (assuming a full fix) by road type

Lake Segment	Road Name	Segments Managed by Roadway Type		Segment P Reduction by Road Type		Total Potential P Load Reduction	Target P Reduction	% of Total P Reduction
		Gravel	Paved - Non Curbed	Gravel	Paved - Non Curbed			
Main Lake	BRIGHAM HILL LN	3		0.63		1.75	31.0	6%
	BRIGHAM HILL RD	2		0.51				
	COLONEL PAGE RD	1		0.15				
	OLD STAGE RD		1		0.46			
	Total	*6*	*1*	*1.29*	*0.46*			
Malletts Bay	ESSEX HIGHLANDS		1		0.27	3.82	43.6	9%
	HANLEY LN	1		0.05				
	NAYLOR RD	1		0.11				
	OSGOOD HILL RD	4		0.71				
	DISCOVERY RD	2		0.50				
	INDIAN BROOK RD	3		1.07				
	LOST NATION RD	4		0.99				
	SUSIE WILSON BYP		1		0.11			
	Total	*15*	*2*	*3.44*	*0.38*			

Table 22. Estimated Implementation Costs for Hydrologically Connected Road Segment Improvements, Essex Town

Lake Segment	Road Name	Segments Managed by Roadway Type		Estimated Road Segment Improvement Cost ($2021)	Estimated Road Segment Improvement Cost ($2024)
		Gravel	Paved - Non Curbed		
Main Lake	BRIGHAM HILL LN	3		$11,400	$18,400
	BRIGHAM HILL RD	2		$12,400	$10,700
	COLONEL PAGE RD	1		$3,800	$2,800
	OLD STAGE RD		1	$4,300	$3,000
	Total	*6*	*1*	*$31,900*	*$34,900*
Malletts Bay	ESSEX HIGHLANDS		1	$11,900	$2,500
	HANLEY LN	1		$23,800	$2,000
	NAYLOR RD	1		$20,000	$1,700
	OSGOOD HILL RD	4		$11,400	$12,200
	DISCOVERY RD	2		$3,800	$9,300
	INDIAN BROOK RD	3		$4,300	$5,700
	LOST NATION RD	4		$119,000	$21,600
	SUSIE WILSON BYP		1	$63,300	$1,700
	Total	*15*	*2*	*$257,500*	*$56,700*
TOTAL ROAD SEGMENT IMPROVEMENT COST				*$289,400*	*$91,600*

Table 23. Essex Town P load reductions from existing and remaining hydrologically connected road segments by road type (kg/yr)

Lake Segment	Segment P Reduction by Road Type				Total P Load Reduction	Target P Reduction	% of Total P Reduction
	Class 4	Gravel	Paved - Non Curbed	Paved - Curbed			
Segments Improved							
Main Lake	0.00	0.08	0.00	18.32	18.39	43.6	42.2%
Malletts Bay	0.25	7.79	0.00	0.00	8.04	31.0	25.9%
Total	*0.25*	*7.87*	*0.00*	*18.32*	*26.43*	*74.6*	
Segments Not or Partially Meeting Standards							
Main Lake	0.00	1.29	0.46	4.31	6.06	43.6	13.9%
Malletts Bay	0.00	3.44	0.38	0.58	4.40	31.0	14.2%
Total	*0.00*	*4.74*	*0.84*	*4.89*	*10.46*	*74.6*	
Combined Improvement Summary							
Main Lake	0.00	1.37	0.46	22.63	24.46	43.6	56.1%
Malletts Bay	0.25	11.23	0.38	0.58	12.44	31.0	40.1%
Total	*0.25*	*12.61*	*0.84*	*23.20*	*36.89*	*74.6*	

5. Non-Structural Controls

The City and Town conduct a non-structural program that includes street sweeping and catch basin cleaning for a total of 134 ac of impervious roadway in the Town and 112 ac in the City. The Town utilizes a 2016 vacuum sweeper that sweeps streets twice per year during the spring and fall months. The City utilizes a 2013 vacuum sweeper and sweeps the streets with more than 17% tree cover first in the fall before moving to remaining streets. Most streets are swept at least twice in the fall. Spring sweeping of all streets is conducted along with spot cleaning around catch basins before storms in the summer months. Main travel routes in the City are swept three to four times per year. Catch basins are cleaned once every four years in the Town and once every three years in the City. The annual P load reductions achieved by current non-structural controls for the years 2020-2023 are summarized in Figure 3 and further described below.

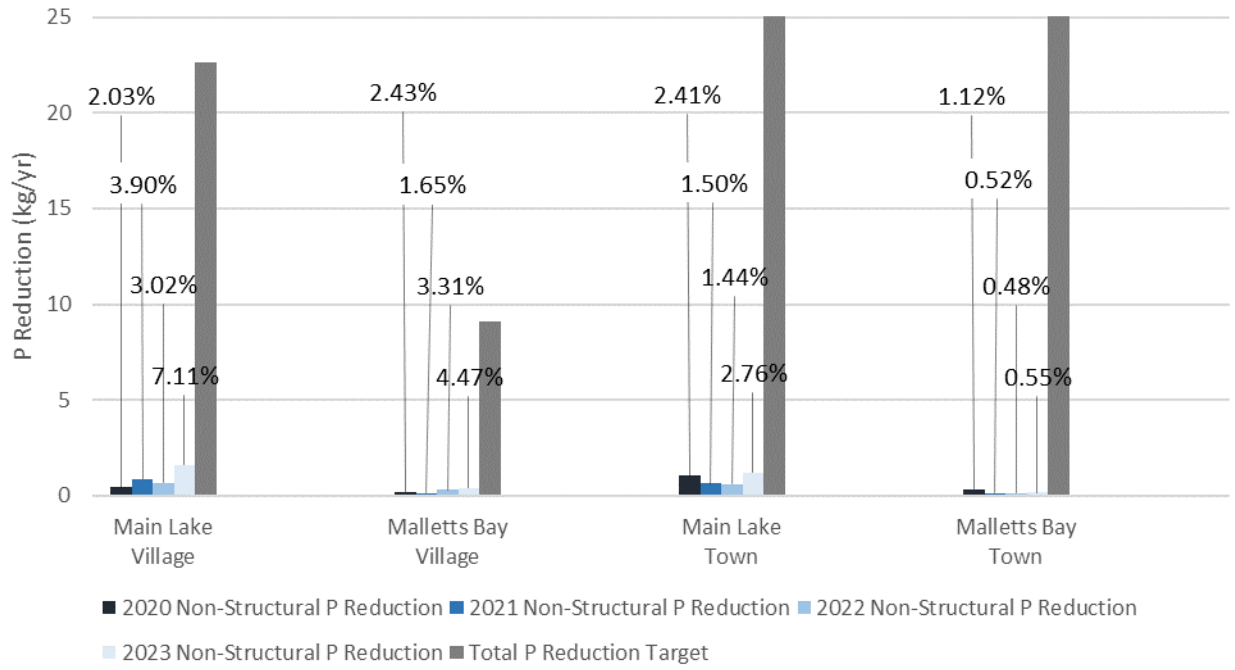


Figure 3. Essex Junction and Essex Town, annual P reduction from 2020-2023 from non-structural controls (kg/yr). See Tables 24, 25, 26, and 27 for Essex Junction, and Tables 28, 29, 30, and 31 for Essex Town. Note that the Total P Reduction Targets for Essex Town extend beyond the limits of the y axis in this graph.

5.1. Essex Junction Non-Structural Controls

The City achieves an average 1.18 kg/yr reduction from current street sweeping and catch basin cleaning practices (Table 24 and Figure 3). The highest yearly P credit was 2.02 kg/yr, in 2023, almost double the yearly totals from 2021 and 2022. This increase is due largely to the City sweeping more streets with >17% tree cover four times in the fall.

Table 24. Essex Junction non-structural practices P credits by year

Lake Segment	2020	2021	2022	2023	Average
Catch Basing Cleaning P Credit (kg/yr)					
Main Lake	0.30	0.30	0.30	0.30	0.30
Malletts Bay	0.15	0.15	0.15	0.15	0.15
Total	*0.45*	*0.45*	*0.45*	*0.45*	*0.45*
Street Sweeping P Credit (kg/yr)					
Main Lake	0.15	0.58	0.38	1.31	0.61
Malletts Bay	0.07	0.00	0.15	0.26	0.12
Total	*0.23*	*0.58*	*0.53*	*1.56*	*0.73*
Total Non-Structural P Credit (kg/yr)					
Main Lake	0.46	0.89	0.69	1.61	0.91
Malletts Bay	0.22	0.15	0.30	0.41	0.27
Total	*0.68*	*1.04*	*0.99*	*2.02*	*1.18*

Note: Current non-structural controls in City of Essex Junction include sweeping routes two times per year (spring and fall), using a vacuum assisted sweeper. This achieves a 2% maximum reduction credit, discounted 90% to account for 2000 start of the present sweeping regime. Streets swept one time per year received half of this credit (1%). Sweeping routes with >17% tree cover four times in the fall with any technology receives a 17% P reduction efficiency, with the 90% discount. Catch basin cleaning occurs once every 2-3 years, as inspections warrant.

The Blue Route was previously identified as the most impactful route to sweep in terms of P credit (Appendix E, Table 25, and Table 26). By sweeping roads on this route four or more times in the fall, the City was able to significantly increase P credits for street sweeping (Figure 3, Table 26, and Table 27). In 2023, the sum of all sweeping methods on the Blue Route received a P credit of 1.1 kg/yr, compared to 0.40 kg/yr in 2022 and 0.49 kg/yr in 2021. This increase can be attributed to more streets being swept four times in the fall, which provided a P credit of 0.76 kg/yr, or 69% of the total credit for the Blue Route in 2023. In 2022, sweeping the Blue Route four times in the fall made up 46% of the Blue Route's total P credit, and in 2021, it made up 25% of the Blue Route's total.

Table 25. Essex Junction, streets swept 2x/year in the spring and fall and associated P credit with 90% discount, 2021-2023

Lake Segment	Route Color	Road Miles	Paved Road Area (acres)	P Reduction (kg/yr)
		2021		
Main Lake	Blue	27.25	56.17	0.27
	Dark/Light Green	0.63	1.30	0.0054
	Pink	9.00	18.55	0.048
	Pink/Red	2.10	4.33	0.016
Total		*38.98*	*80.34*	*0.34*
		2022		
Main Lake	Blue	12.48	25.72	0.095
	Dark/Light Green	0.71	1.46	0.0092
	Pink	2.32	4.78	0.035
Total		*15.51*	*31.96*	*0.14*
Malletts Bay	Light Green	0.64	1.32	0.0080
	Red	17.41	35.88	0.11
Total		*18.05*	*37.19*	*0.12*
		2023		
Main Lake	Blue	31.89	65.71	0.24
	Dark/Light Green	0.63	1.30	0.0027
	Pink/Red	1.75	3.61	0.0074
	Pink	13.80	28.44	0.048
Total		*48.07*	*99.05*	*0.30*
Malletts Bay	Light Green	0.44	0.91	0.0055
	Red	13.03	26.85	0.082
Total		*13.47*	*27.76*	*0.088*

Note: Estimated P reduction approximated assuming two lane widths of 8.5 feet swept per street to convert road miles to acres.

Table 26. Essex Junction, streets swept 4x in the fall with >17% tree cover and associated P credit with 90% discount, 2021-2023

Lake Segment	Route Color	Road Name	Number of Times Swept in the Fall	Road Miles	Paved Road Area (acres)	P Reduction (kg/yr)
			2021			
Main Lake	Blue	Wilkinson Drive	4	1.96	4.04	0.12
Total			*4*	*1.96*	*4.04*	*0.12*
			2022			
Main Lake	Blue	Hayden Street	4	0.92	1.90	0.058
		Wilkinson Drive	8	3.92	8.08	0.12
Total			*12*	*4.84*	*9.97*	*0.18*
			2023			
Main Lake	Blue	Hayden Street	6	1.38	2.84	0.058
		Loubier Drive	6	1.38	2.84	0.058
		Orchard Terrace	4	1.48	3.05	0.094
		Tyler Drive	4	1.36	2.80	0.086
		Wilkinson Drive	5	2.45	5.05	0.12
		Park Street	5	3.60	7.42	0.18
		Pearl Street	7	3.71	7.64	0.13
		West Street Ext.	4	0.40	0.82	0.025
	Pink	Woods End Drive	4	1.76	3.63	0.11
Total			*45*	*17.52*	*36.10*	*0.87*
Malletts Bay	Light Green	Grove Street	4	1.24	2.56	0.066
Total			*4*	*1.24*	*2.56*	*0.066*

Note: Estimated P reduction approximated assuming two lane widths of 8.5 feet swept per street to convert road miles to acres.

Table 27. Essex Junction, summary of P reduction credit for all sweeping methods by route, 2021-2023, with 90% discount applied

Route	Main Lake (kg/yr)	Malletts Bay (kg/yr)
2021		
Blue	0.49	
Dark/Light Green	0.0086	
Pink	0.066	
Pink/Red	0.020	
Total	*0.58*	*0.00*
2022		
Blue	0.40	
Dark Green	0.032	
Dark/Light Green	0.012	
Light Green		0.026
Pink	0.059	
Pink/Red	0.0082	
Red		0.18
Total	*0.51*	*0.20*
2023		
Blue	1.1	
Dark/Light Green	0.0059	
Light Green		0.10
Pink	0.18	
Pink/Red	0.016	
Red		0.16
Total	*1.31*	*0.26*

Note: Estimated P reduction approximated assuming two lane widths of 8.5 feet swept per street to convert road miles to acres.

5.2. Essex Town Non-structural Controls

The Town achieves an average 1.09 kg/yr P reduction from current street sweeping and catch basin cleaning practices (Table 28 and Figure 3). The Town's highest yearly P credit (1.37 kg/yr) was achieved in 2023, largely due to the addition of sweeping streets with >17% tree cover four times in the fall.

Town Routes 1, 3, 5, and 11, located in the Main Lake segment, were previously identified as the most impactful routes on which to focus sweeping efforts due to their total road miles and amount of tree cover (Appendix E). Sweeping streets with >17% tree cover four times in the fall was not achieved until 2023, when this was achieved on one street each in routes 1, 11, and 13. The addition of this street sweeping method more than doubled the total P credit achieved for the Main Lake segment, which was 1.00 kg/yr in 2023 as compared to 0.43 kg/yr in 2022 and 0.45 kg/yr in 2021.

Table 28. Essex Town P credits for non-structural controls by year

Lake Segment	2020	2021	2022	2023	Average
Catch Basing Cleaning P Credit (kg/yr)					
Main Lake	0.20	0.20	0.20	0.20	0.20
Malletts Bay	0.067	0.067	0.067	0.067	0.067
Total	*0.27*	*0.27*	*0.27*	*0.27*	*0.27*
Street Sweeping P Credit (kg/yr)					
Main Lake	0.85	0.45	0.43	1.00	0.68
Malletts Bay	0.28	0.09	0.08	0.10	0.14
Total	*1.13*	*0.55*	*0.51*	*1.11*	*0.82*
Total Non-Structural P Credit (kg/yr)					
Main Lake	1.05	0.65	0.63	1.20	0.88
Malletts Bay	0.35	0.16	0.15	0.17	0.21
Total	*1.40*	*0.81*	*0.78*	*1.37*	*1.09*

Note: Current non-structural controls in Essex Town include sweeping routes 2 times per year (spring and fall), using a vacuum assisted sweeper. This achieves a 2% maximum reduction credit, discounted 60% to account for 2004 start of present sweeping regime. Streets swept one time per year received half of this credit (1%). Additionally, sweeping routes with >17% tree cover 4 times in the fall with any technology receives a 17% P reduction efficiency, with the 60% discount. Catch basin cleaning occurs once every four years, as inspections warrant.

Table 29. Essex Town, streets swept 2x/year in the spring and fall and associated P credit with 90% discount, 2021-2023

Town Route	Road Miles		Paved Road Area (Acres)		P Reduction (kg/yr)	
	Main Lake	Malletts Bay	Main Lake	Malletts Bay	Main Lake	Malletts Bay
2021						
1	8.1	1.4	16.6	2.8	0.080	0.011
2	3.5		7.3		0.035	
3	7.1		14.6		0.070	
4		4.2		8.7		0.035
5	4.6	0.1	9.4	0.2	0.047	0.00084
6	4.0		8.2		0.040	
7						
8	0.8		1.6		0.0077	
9	0.8	2.1	1.6	4.3	0.0077	0.017
10	1.7	0.8	3.5	1.7	0.017	0.0070
11	5.2		10.7		0.052	
12	5.3		10.9		0.052	
13	4.2		8.7		0.042	
Total	*45*	*9*	*93*	*18*	*0.45*	*0.072*
2022						
1	12.8	1.7	26.3	3.5	0.078	0.0070
2	3.2		6.7		0.021	
3	5.2		10.8		0.030	
4		1.8		3.6		0.015
5	6.6		13.7		0.047	
6	5.6		11.4		0.036	
7		0.5		1.1		0.0054
8	1.8		3.7		0.017	
9	0.5	2.1	1.0	4.3	0.0048	0.017
10	1.8	0.9	3.8	1.9	0.018	0.0052
11	5.0		10.4		0.039	
12	6.3		12.9		0.050	
13	4.0		8.2		0.025	
Total	*53*	*7*	*109*	*14*	*0.37*	*0.050*
2023						
1	33.8	4.0	69.7	8.3	0.077	0.013
2	2.3		4.7		0.023	
3	9.3		19.2		0.054	
4		1.7		3.5		0.014
5	4.7	0.1	9.8	0.2	0.047	0.00084
6	4.2		8.7		0.033	
7		2.2		4.6		0.022
8		0.9		1.9		0.0077
9	0.5	2.3	1.0	4.7	0.0048	0.017
10	1.7	0.9	3.5	1.9	0.017	0.0052
11	2.2		4.6		0.019	
12	10.0		20.6		0.052	
13	7.5		15.5		0.034	
Total	*76*	*12*	*157*	*25*	*0.36*	*0.080*

Note: Estimated P reduction approximated assuming two lane widths of 8.5 feet swept per street to convert road miles to acres.

Table 30. Essex Town, streets swept 4x in the fall with >17% tree cover and associated P credit with 90% discount, 2023 only

Lake Segment	Route Number	Road Name	Number of Times Swept in the Fall	Road Miles	Paved Road Area (Acres)	P Reduction (kg/yr)
			2023			
Main Lake	1	Wildwood Drive	5	2.45	5.05	0.08
	11	Sand Hill Road	5	11.45	23.59	0.39
	13	Tanglewood Drive	4	2.88	5.93	0.12
Total			*14*	*16.78*	*34.58*	*0.59*

Note: Estimated P reduction approximated assuming two lane widths of 8.5 feet swept per street to convert road miles to acres.

Table 31. Essex Town summary of P reduction credit for all sweeping methods by route, 2021-2023, with 60% discount applied

	Main Lake			Malletts Bay		
Town Route	2021 P Credit (kg/yr)	2022 P Credit (kg/yr)	2023 P Credit (kg/yr)	2021 P Credit (kg/yr)	2022 P Credit (kg/yr)	2023 P Credit (kg/yr)
1	0.080	0.080	0.47	0.012	0.0096	0.013
2	0.035	0.029	0.0314			
3	0.070	0.053	0.062			
4				0.035	0.025	0.025
5	0.047	0.050	0.0501	0.00084	0.00042	0.00084
6	0.0397	0.038	0.0361			
7				0.013	0.020	0.028
8	0.012	0.017	0.0074	0.0055		0.0093
9	0.0077	0.0062	0.0048	0.019	0.019	0.0187
10	0.017	0.018	0.0178	0.0070	0.0086	0.0086
11	0.052	0.053	0.12			
12	0.052	0.051	0.0524			
13	0.042	0.034	0.16			
Total	*0.45*	*0.43*	*1.00*	*0.093*	*0.082*	*0.10*

Note: Estimated P reduction approximated assuming two lane widths of 8.5 feet swept per street to convert road miles to acres.

The MS4 permit does allow sharing of implementation costs between permitted MS4s, and Section 6.3 of the permit explains the requirements for sharing implementation. During PCP development, the concept of sharing the phosphorus reduction credit accrued from potential sweeping enhancements was explored. In an example case between Essex and Essex Junction, Essex can enter into a written agreement with Essex Junction to perform enhanced street sweeping to achieve Essex Junction's total P reduction. This agreement would be included in the PCPs of both MS4s and could be reported on annually by Essex. In Essex Junction's PCP, Vermont DEC would require alternative options to achieve the P reductions in case the enhanced street sweeping or sharing agreement does not materialize. The alternative options would be planned for later years in the PCP, similar to the future growth component for FRPs. While at this time it does not appear that credit sharing will be necessary for either MS4 to meet P reduction targets, it remains an option for future consideration if and as needed.

6. Municipal Ordinances or Regulations and Future Growth

Building on a previous code review completed in 2019 by the Vermont League of Cities and Towns (VLCT), a targeted review of local ordinances and regulations was completed to evaluate:

- Compliance with Vermont MS4 General Permit requirements,
- Consistency with State stormwater management standards,
- Effectiveness in promoting green infrastructure and environmentally sensitive site design, and
- Opportunities to earn phosphorus-reduction credit.

The following City and Town documents were reviewed:

- Town and City Stormwater Management Ordinance (Essex Town Ordinance 10.20 and City Code Section 1901)
- City of Essex Junction Land Development Code
- Town of Essex Public Works Standard Specifications for Construction
- Town of Essex Subdivision Regulations
- Town of Essex Zoning Regulations

Appendix F includes the detailed results of the ordinance review and recommendations for future adjustments. Both Essex Junction and the Town of Essex anticipate beginning extensive reviews of and updates to their local land development regulations in 2021, representing a timely opportunity for the recommendations contained in Appendix F to be considered and ultimately implemented.

Appendix F also contains recommendations regarding enhancements to reporting on the inspection and maintenance of sub-jurisdictional stormwater BMPs, should the MS4s choose to include these practices as creditable in meeting MS4-required P load reductions in the PCPs in the future. In addition, if the City or Town choose to reduce the applicability threshold for local stormwater permitting below 0.5 acres of impervious surface, the reviewers recommended establishing an offsite mitigation program or a fee-in-lieu program allowing small projects the option to pay a fee instead of constructing on-site practices. Add offsets as an option, not strictly fee based. The City and Town may also consider adding a requirement for a property to demonstrate they have maximized treatment of stormwater on site before applicants can offset or pay fees, similar to the Engineering Feasibility Assessment (EFA) process under the Vermont DEC General Permit 3-9050.

A one-time fee may also be charged to developers turning over streets and associated drainage infrastructure to the City or Town for management. Enabling language exists in both municipalities' ordinances to allow both of these recommendations to move forward, and refinements completed during the upcoming broader review process may enable both the City and Town stormwater programs to generate revenue to put towards retrofits of municipally owned properties.

7. Progress Summary and Plan for Meeting Phosphorus Targets

Summarizing the P reduction benefits of structural STPs, and the benefits of present and required future MRGP improvements to road segments and outlets, demonstrates that the Essex Junction and Essex Town MS4s have both made substantial progress towards meeting the P reduction targets required under the Lake Champlain P TMDL and each MS4's general permit (Figure 4). In the Malletts Bay Lake segment, constructed and design-phase structural STPs, and other measures committed to through various regulatory requirements, well exceed or nearly meet P reduction targets without increasing the frequency or extent of non-structural measures in both Essex Junction and Essex Town (Figure 4). Non-structural controls, and particularly enhanced street sweeping measures, represent a small proportion of the P reductions that are possible to be gained in this Lake segment, and are generally not necessary in order to meet target P reductions for either MS4.

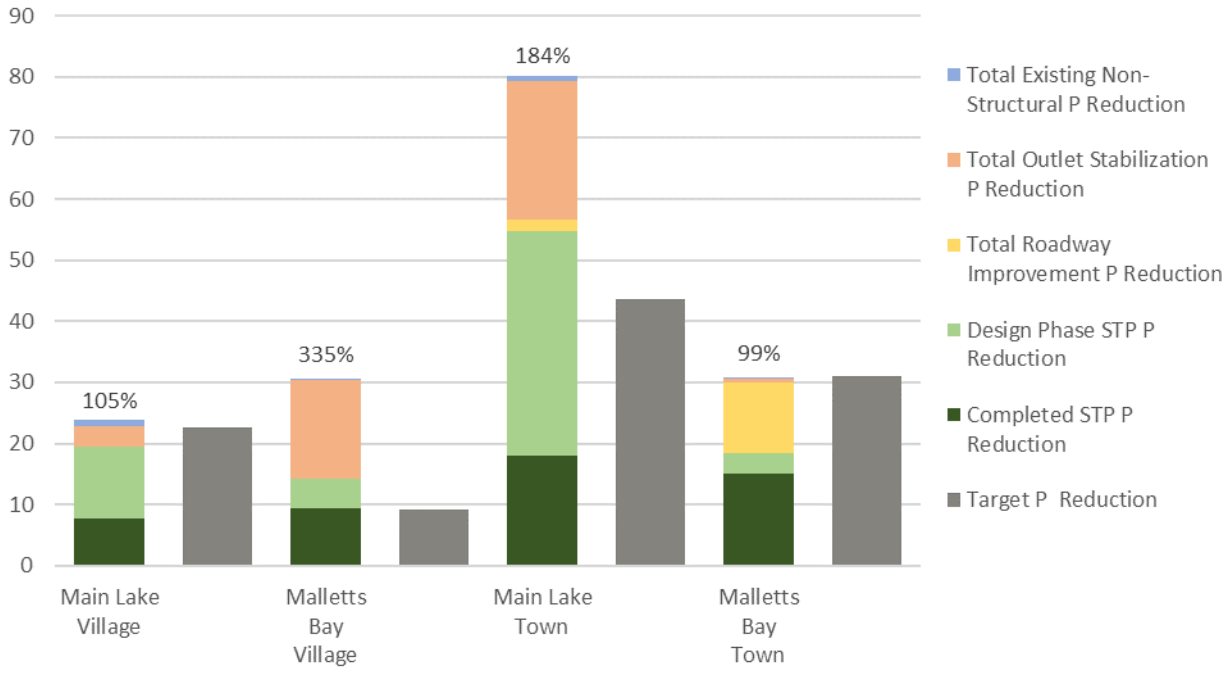


Figure 4. P load reductions (kg/yr) credited to existing and design-phase structural STPs, existing and required road segment and outlet improvements, and existing non-structural BMPs and controls, Essex Junction and Essex Town

In the Main Lake segment, constructed and design-phase BMPs, including stormwater retrofits, road segment improvements, and outfall stabilization, as well as structural measures that will be required under FRPs and the MRGP, exceed P reduction targets without implementing additional structural STPs or increasing the frequency or extent of non-structural measures in both Essex Junction and Essex Town. The planned structural STPs identified in Sections 3.2 and 3.4, coupled with the limited enhancements to street sweeping on routes with >17% tree cover (Section 5), represent one path that both MS4s may take to achieve remaining required P reductions (Figure 5 and Table 32).

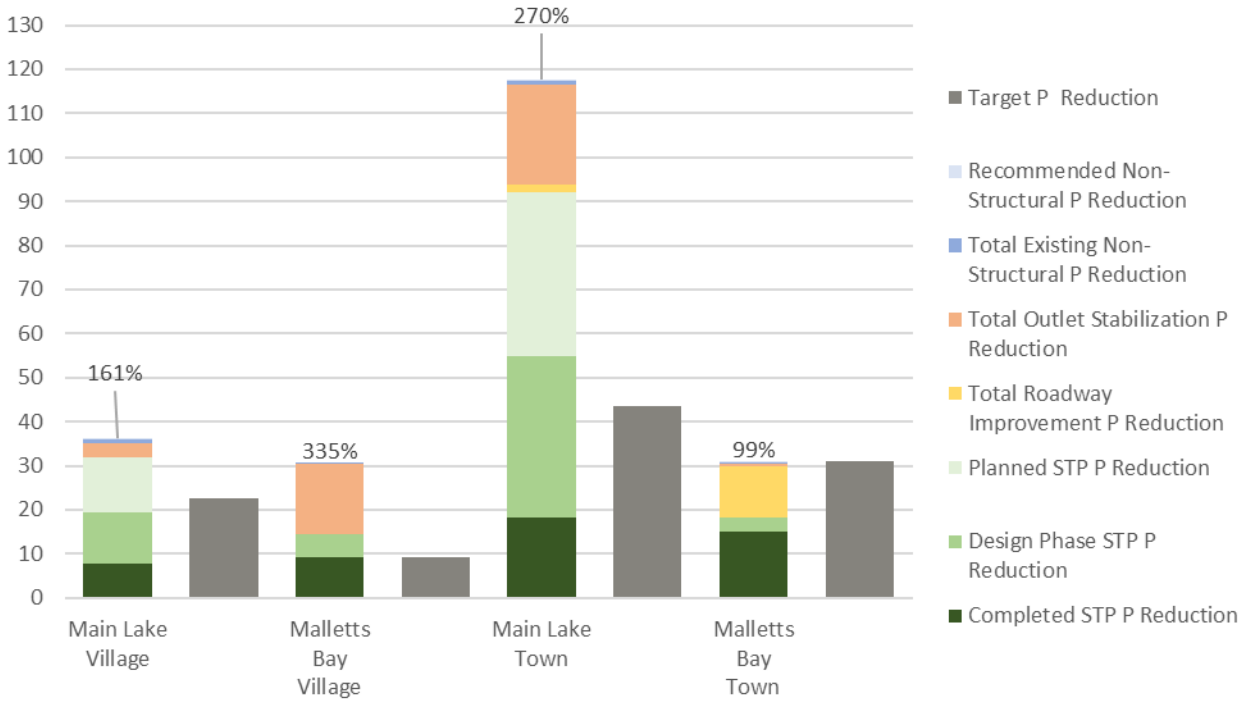


Figure 5. P load reductions (kg/yr) credited to existing, design-phase, and projected structural STPs, existing and required road segment and outlet improvements, and existing and recommended non-structural controls, Essex Junction and Essex Town

Table 32. Existing, Design-Phase, and Projected BMP P Reduction Summary

Lake Segment	Existing BMPs (kg/yr)	Design-Phase STPs and Remaining MRGP (kg/yr)	Projected BMP P Reduction (kg/yr)	Total BMP P Reduction (kg/yr)	Target P Reduction (kg/yr)	% of Total P Reduction
City of Essex Junction Summary						
Main Lake	11.3	12.5	12.6	36.4	22.6	161.0%
Malletts Bay	25.2	5.4	0.0	30.6	9.1	335.5%
Total	*36.5*	*17.9*	*12.6*	*67.0*	*31.7*	
Town of Essex Summary						
Main Lake	37.4	42.8	37.4	117.6	43.6	269.7%
Malletts Bay	23.0	7.8	0.1	30.8	31.0	99.3%
Total	*60.3*	*50.6*	*37.5*	*148.4*	*74.6*	

Enhanced street sweeping measures may provide substantial reasonable assurance for the remaining P reductions necessary to meet target P reductions in the Main Lake segment. However, enhanced sweeping regimes are not anticipated to be necessary in order for either Essex Junction or Essex Town to meet MS4 target P reductions.

8. Implementation Schedule

A draft implementation schedule for the Essex Junction MS4 and Essex Town MS4 PCPs is presented on the following page. This schedule will be adjusted following consultation with Vermont DEC and on an annual basis as required by Part 8.2.F of the 2023 MS4 General Permit.

This PCP represents a broad overview and remains a working document, subject to change as projects are further investigated. Projected projects, particularly structural stormwater treatment practices, require further evaluation to determine their feasibility and to refine the high-level cost estimates provided in this document. The next step is to advance design for priority structural STPs as provided in the draft implementation schedule, adjusting prioritization as conditions warrant. Projected retrofit projects with the highest cost-effectiveness and few barriers to implementation, or which are already in scoping or design phases, are likely to be advanced first. These structural stormwater retrofits include but are not limited to:

Essex Junction:

- Hiawatha
- Tyler Drive, Wilkinson Drive, and South Street

Essex Town:

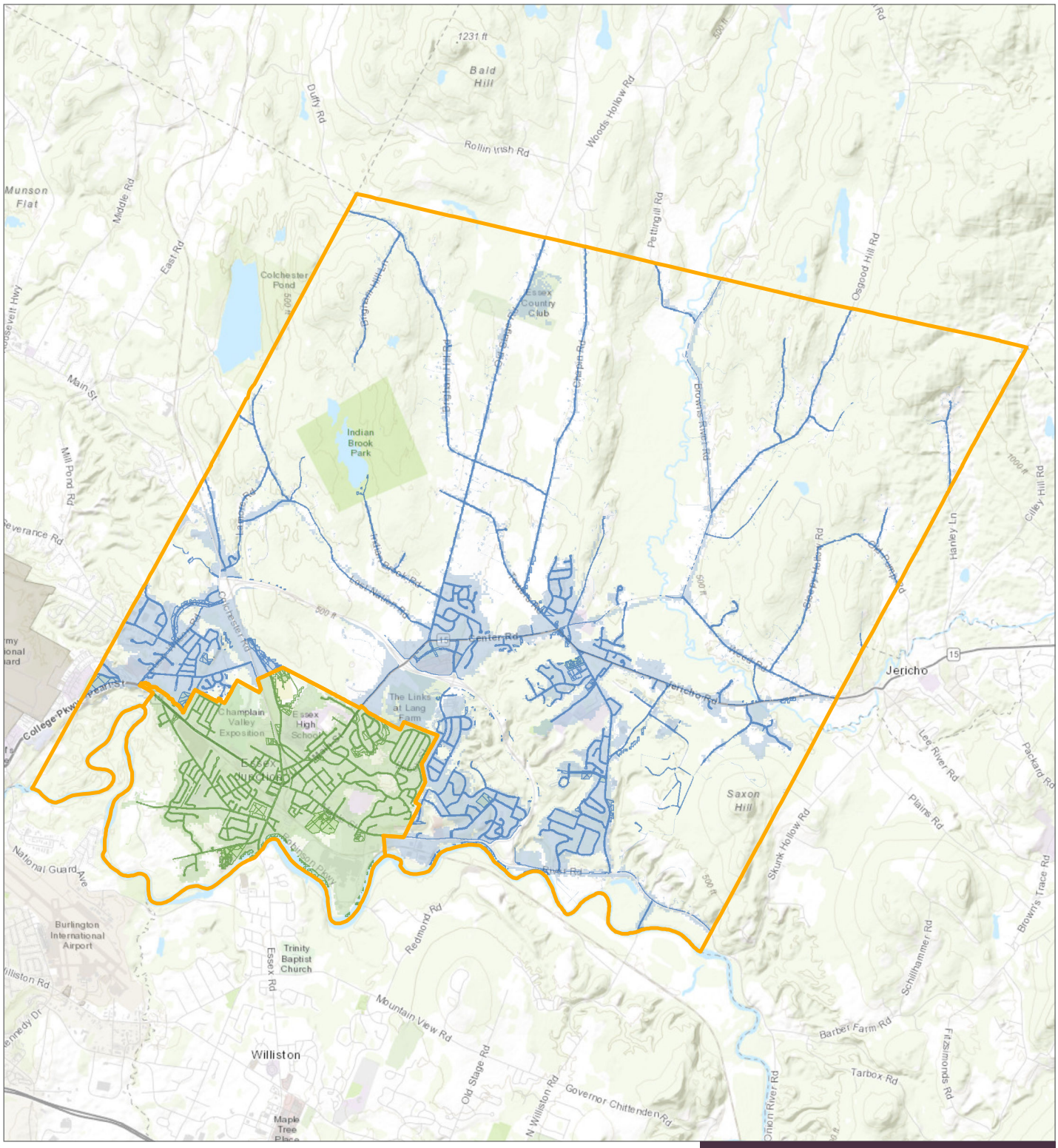
- Autumn Knoll
- Meadow's Edge
- Outfall 199
- Tanglewood Drive and Fern Hollow Road
- Logwood Circle

DRAFT Implementation Schedule for Phosphorus Control Plans

Essex Junction and Essex Town MS4s

Project No.	Project Description	Permit and Calendar Cycles																PCPs Complete June 17, 2036
		2018 MS4 GP			2023 MS4 GP					2028 MS4 GP					2033 MS4 GP			
		REI Update						REI Update				REI Update						
		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	
1	Sunderland Brook FRP STP Implementation	done?																
2	Indian Brook FRP STP Impementation	construct remaining designed STPs																
3	2020 Design Phase Structural STPs	complete designs		construction														
4	Essex Junction MS4 Proposed PCP Structural STPs																	
	Hiawatha																	
	Tyler Drive - Wilkinson Drive																	
	Killoran Drive																	
	Cascadnac-Owaissa-Wenowah																	
5	Essex Town MS4 Proposed PCP Structural STPs																	
	Outfall 126																	
	Outfall 199																	
	Meadows Edge / Steeplebush																	
	Logwood Circle																	
	Tanglewood Dr. & Fern Hollow																	
	Saxonhollow and Hillside																	
	Sand Hill, Greenbriar, Greenfield, Wildwood																	
	David Dr. Outfall if needed																	
6	Essex Junction Hydrologically Connected Road Segments / Outlets	Complete stabilization at outlets not meeting standards								Complete stabilization at outlets not meeting standards if any additional identified								
7	Essex Town Hydrologically Connected Road Segments	Develop gravel RS			Implement gravel road management plan													
8	Essex Town Hydrologically Connected Outlets		complete stabilization at outlets not meeting standards							complete stabilization at outlets not meeting standards if any identified								
9	Non-Structural Controls - Enhanced Street Sweeping bot Select Main Lake Routes		develop tracking & training		implement enhanced sweeping and adjust as needed													
10	Subjurisdictional Stormwater and Future Growth	Review and adjust local ordinances			Implement and monitor lowering jurisdicitonal threshold, fee-in-lieu, transfer fees, O&M reporting as desired													

Appendix A – Maps



LEGEND

- Town and Village Boundaries
- Essex Town Phosphorus Control Plan Area
- Village of Essex Junction Phosphorus Control Plan Area
- Essex Town Developed Areas (ANR)
- Village of Essex Junction Developed Areas (ANR)

N

0 1

Miles

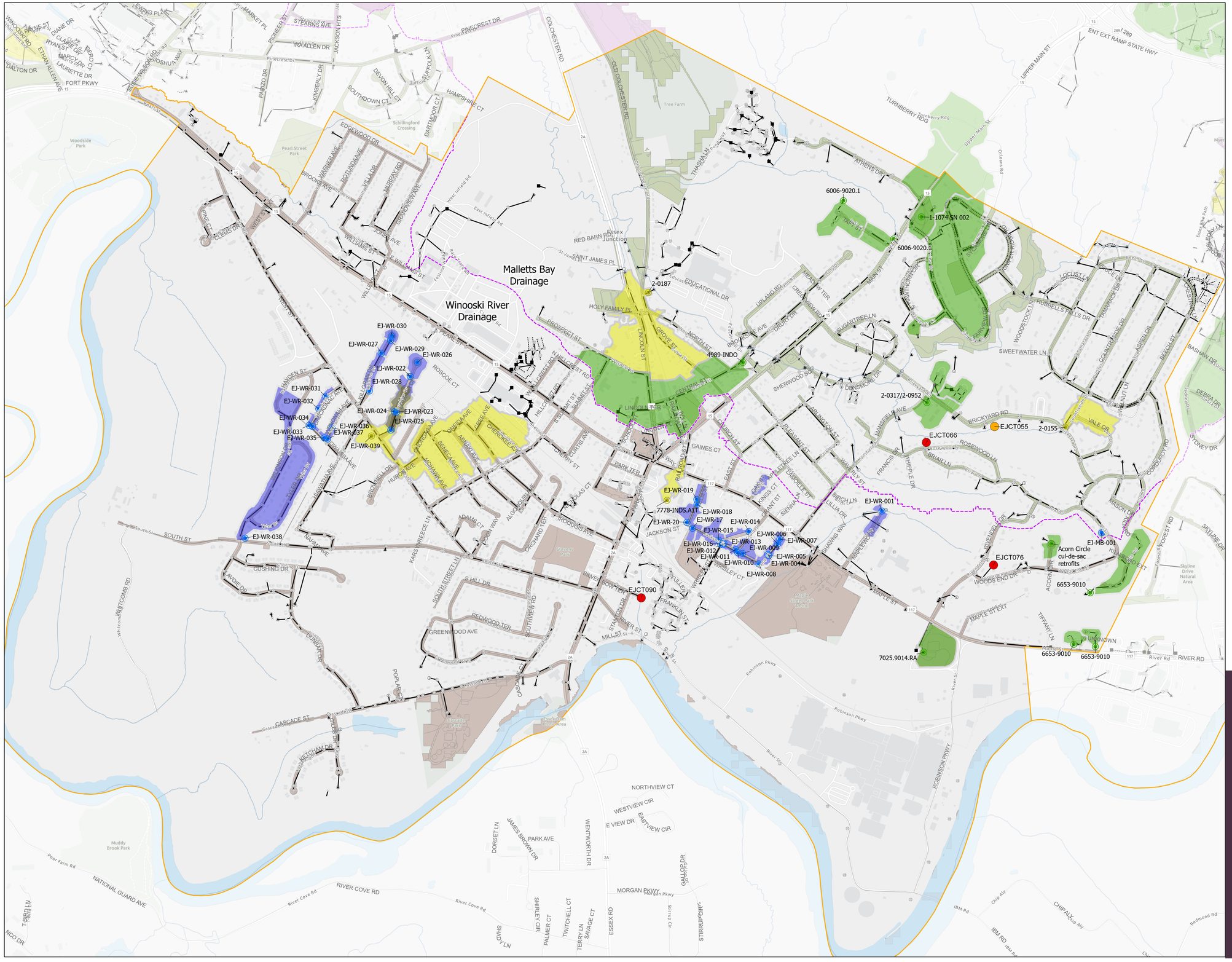
Map 1: Phosphorus Control Plan Areas

Essex Phosphorus Control Plan

Prepared for City of Essex Junction and Town of Essex, VT

STONE ENVIRONMENTAL

Path: O:\PROJ-18\WRM\18-123 Essex PCP\Data\GIS\MapDocuments\PresentationsAndReports\Figure1_PCP_Areas_20201217.mxd Saved:



LEGEND

Essex Junction PCP Area (Stone)
- Malletts Bay - DD
- Winooski River

Lake Champlain Drainage Areas

Essex Junction Outfalls
- Does Not Meet
- Partially Meets

Structural STP Drainage Areas
- Complete
- Design Phase
- Planned

Structural STP Locations
- Complete
- Design Phase
- Planned

Essex Storm Sewer Points
- Catch Basin
- STM
- Inlet
- Outlet
- Manhole

Essex Storm Sewer Lines
- Culvert
- Storm
- Underdrain
- MS4 Boundaries
- Road Centerlines (VCGI E911)
- Rivers (VCGI)
- Lakes (VCGI)

Path: O:\PROJ-24\WRM\20241008 Essex Town-Essex Junction PCP Updates\Data\GIS\MapDocuments\EssexPCPFigures\EssexPCPFigures_SSB.aprx
Saved: 3/11/2024 by sbailey

Map 2
Essex Junction PCP Practices Structural STPs, Road Segments Not or Partially Meeting Standards, and Outlet Stabilization

Essex Phosphorus Control Plan

Prepared for the City of Essex Junction and Town of Essex, VT

STONE ENVIRONMENTAL

N

0 1,000 2,000

Feet

LEGEND

Essex Town PCP Area (Stone)
- Lamoille River
- Malletts Bay - DD
- Winooski River

Lake Champlain Drainage Areas

Essex Town Outfalls
- Does Not Meet
- Partially Meets

Essex Town Road Segments
- Does Not Meet
- Partially Meets

Structural STP Locations
- Complete
- Design Phase
- Planned

Structural STP Drainage Areas
- Complete
- Design Phase
- Planned

Essex Storm Sewer Points
- Catch Basin
- STM
- Inlet
- Outlet
- Manhole

Essex Storm Sewer Lines
- Culvert
- Storm
- Underdrain
- MS4 Boundaries
- Road Centerlines (VCGI E911)
- Rivers (VCGI)
- Lakes (VCGI)

Date Saved: 3/12/2024 2:22 PM

Path: O:\PROJ-24\WRM\20241008 Essex Town-Essex Junction PCP Updates\Data\GIS\MapDocuments\EssexPCPFigures\EssexPCPFigures_558.aprx

Map 3
Essex Town PCP Practices
Structural STPs and Outlet Stabilization

Essex Phosphorus Control Plan

Prepared for the City of Essex Junction and Town of Essex, VT

STONE ENVIRONMENTAL

N

0 2,500 5,000

Feet

LEGEND

- MS4 Boundaries

Essex Junction PCP Area (Stone)
- Malletts Bay - DD
- Winooski River

Essex Town PCP Area (Stone)
- Lamoille River
- Malletts Bay - DD
- Winooski River

Lake Champlain Drainage Areas

Outfalls Requiring Fix
- Does Not Meet
- Partially Meets

Road Segments Requiring Fix
- Does Not Meet
- Partially Meets

Essex Sewer Outfalls and Catchbasins
- Catch Basin
- STM
- Inlet
- Outlet

Essex Storm Sewer Manholes

Essex Storm Sewer Lines

Road Centerlines (VCGI E911)

Date Saved: 3/11/2024 9:04 AM

Path: O:\PROJ-24\WRM\20241008 Essex Town-Essex Junction PCP Updates\Data\GIS\MapDocuments\EssexPCPFigures\EssexPCPFigures_SSB.aprx

Map 4
Essex Junction and Essex Town MRGP Road Segments and Outlets Not Meeting or Partially Meeting Standards

Essex Phosphorus Control Plan

Prepared for Village of Essex Junction and Town of Essex, VT

STONE ENVIRONMENTAL

Appendix B – Details for Existing, Design Phase, and Projected Structural STPs

B-1: Completed Structural STPs

B-2: FRP and Capital Projects Design-Stage Structural STPs

B-3: Operational Permit Retrofit Information – Essex Town

B-4: Preliminary Design Reports and Plans for Priority Structural STPs – Essex Town

B-5: PCP-Identified Projected Structural STPs

B-6: Additional Projected Structural STP Retrofit Opportunities

Appendix B, Table B-1: Details for Completed Structural Stormwater Treatment Practices

ID	Site Name	Land Owner	MS4	Permit No.	Year Completed	BMP Status	Applicable FRP	LC TMDL Drainage Area	LC TMDL Lake Segment	BMP Type	Impervious area (acres)	Pervious area (acres)	Storage volume (ft^3)	P Base Load Before Treatment (kg/yr)	Practice Efficiency (%)	P Credit (kg/yr)	% of P Target Reduction
6653-9010	Village Walk POI 1	Village	Essex Junction MS4	6653-9010	2015	Complete	n/a	Winooski River	Main Lake	Infiltration Basin	3.32	6.22	26,586	5.15	99.2%	5.11	23%
6653-9010	Village Walk POI 2	Village	Essex Junction MS4	6653-9010	2015	Complete	n/a	Winooski River	Main Lake	Infiltration Basin	0.63	1.23	12,803	0.99	100.0%	0.99	4%
6653-9010	Village Walk POI 3	Village	Essex Junction MS4	6653-9010	2015	Complete	n/a	Winooski River	Main Lake	Infiltration Basin	0.32	0.96	6,849	0.58	100.0%	0.58	3%
TAP TA 18(2) Acc	Acorn Circle cul-de-sac retrofit - impervious removal	Village	Essex Junction MS4		2022	Complete	n/a	Winooski River	Main Lake	Impervious Removal	-0.06	0.06	0	1.36		0.03	0%
TAP TA 18(2) Acc	Acorn Circle cul-de-sac retrofit - media filter with specialized media	Village	Essex Junction MS4		2022	Complete	n/a	Winooski River	Main Lake	Sand Filter (w/ underdrain)	0.70	1.10	3,613	1.04	52.7%	0.94	4%
6006-9020.1	Taft Street S/N 001	Village	Essex Junction MS4	6006-9020.1	2016	Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Wet pond/ Created Wetland	0.48	1.02	3,528	0.41	54.9%	0.22	2%
6006-9020.1	Taft Street S/N 002	Village	Essex Junction MS4	6006-9020.1	2016	Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Wet pond/ Created Wetland	0.54	0.96	2,090	0.46	47.4%	0.22	2%
1-1074 SN 002	Fairview Drive/Main St Gravel Wetland	Village	Essex Junction MS4	1-1074 SN 002	2019	Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Gravel Wetland	3.75	18.77	40,800	3.32	62.2%	2.06	23%
2-0317/2-0952	Mansfield Brickyard Gravel Wetland	Private	Essex Junction MS4	2-0317/2-0952	2020	Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Gravel Wetland	11.39	6.28	70,153	9.47	65.3%	6.08	67%
4989-INDO	5 Corners North	Essex School D	Essex Junction MS4	4989-INDO		Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Underground Detention	13.89	17.00	11,892	11.66	8.0%	0.72	8%
3081-9010.R	Perkins Bend 002	Town	Essex Town MS4	3081-9010.R	2010	Complete	n/a	Winooski River	Main Lake	Infiltration Chambers	6.00	7.30	1,520	8.39	22.4%	1.88	4%
7025.9014.ARA	Essex Police Station	Town	Essex Town MS4	7025.9014.ARA	2014	Complete	n/a	Winooski River	Main Lake	Bioretention (w/ underdrain)	1.14	2.50	3,554	1.85	44.4%	0.82	2%
7025.9014.ARA	Essex Police Station	Town	Essex Town MS4	7025.9014.ARA	2014	Complete	n/a	Winooski River	Main Lake	Grass Channel	1.14	2.50	978	1.85	5.2%	0.10	0.2%
5944-INDO.R	Kellogg Rd Detention Pond	Town	Essex Town MS4	5944-INDO.R	2011	Complete	Sunderland Brook	Winooski River	Main Lake	Wet pond/ Created Wetland	9.50	14.00	170,450	11.54	63.0%	7.27	17%
5263-9015	Tanglewood Drive infiltration (Birchwood Manor)	Town	Essex Town MS4	5263-9015	2012	Complete	n/a	Winooski River	Main Lake	Bioretention (infiltrating)	1.81	1.00	6,423	2.04	97.8%	2.00	5%
4181-9015.3	Thompson Drive infiltration	Town	Essex Town MS4	4181-9015.3	2014	Complete	n/a	Winooski River	Main Lake	Infiltration Trench	0.80	0.20	2,795	0.90	99.8%	0.90	2%
TAP TA 18(2) Oal	Oakwood Drive cul-de-sac retrofit - impervious removal	Town	Essex Town MS4		2022	Complete	n/a	Winooski River	Main Lake	Impervious Removal	-0.10	0.10	0	3.29		0.14	0%
TAP TA 18(2) Oal	Oakwood Drive cul-de-sac retrofit - media filter with specialized media	Town	Essex Town MS4		2022	Complete	n/a	Winooski River	Main Lake	Sand Filter (w/ underdrain)	2.13	0.00	11,500	3.43	54.5%	3.09	7%
TAP TA 18(2) Sag	Sage Circle cul-de-sac retrofit - impervious removal	Town	Essex Town MS4		2022	Complete	n/a	Winooski River	Main Lake	Impervious Removal	-0.07	0.65	0	0.85		0.06	0%
TAP TA 18(2) Sag	Sage Circle cul-de-sac retrofit - infiltration trenches	Town	Essex Town MS4		2022	Complete	n/a	Winooski River	Main Lake	Infiltration Trench	0.80	0.00	6,096	0.92	100.0%	0.92	2%
3585-9010.T	Saxon Hill ROW S/N 001	Town	Essex Town MS4	3585-9010.T	2005	Complete	n/a	Winooski River	Main Lake	Dry Swale (w/ underdrain)	1.14	0.85	12,460	1.47	63.0%	0.93	2%
1-1186	Sydney Drive - Woodlands II- Lang Farm Parcel	Town	Essex Town MS4	1-1186	2020	Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Infiltration Chambers	4.04	28.76	38,812	3.68	92.2%	3.39	11%
4002-INDS.A	Essex Town Center- Essex Outlets	Private	Essex Town MS4	4002-INDS.A		Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Wet pond/ Created Wetland	6.45	6.08	28,009	1.00	51.9%	0.39	1%
6262-9020	Essex Outlets Pond A	Private	Essex Town MS4	6262-9020		Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Wet pond/ Created Wetland	5.65	9.07	74,139	4.77	62.4%	2.98	10%
6262-9020	Essex Outlets Pond B	Private	Essex Town MS4	6262-9020		Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Wet pond/ Created Wetland	3.77	1.22	40,772	3.12	0.63	1.97	6%
6262-9020	Essex Outlets Pond C	Private	Essex Town MS4	6262-9020		Complete	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Wet pond/ Created Wetland	11.85	10.30	290,966	9.90	63.0%	6.24	20%

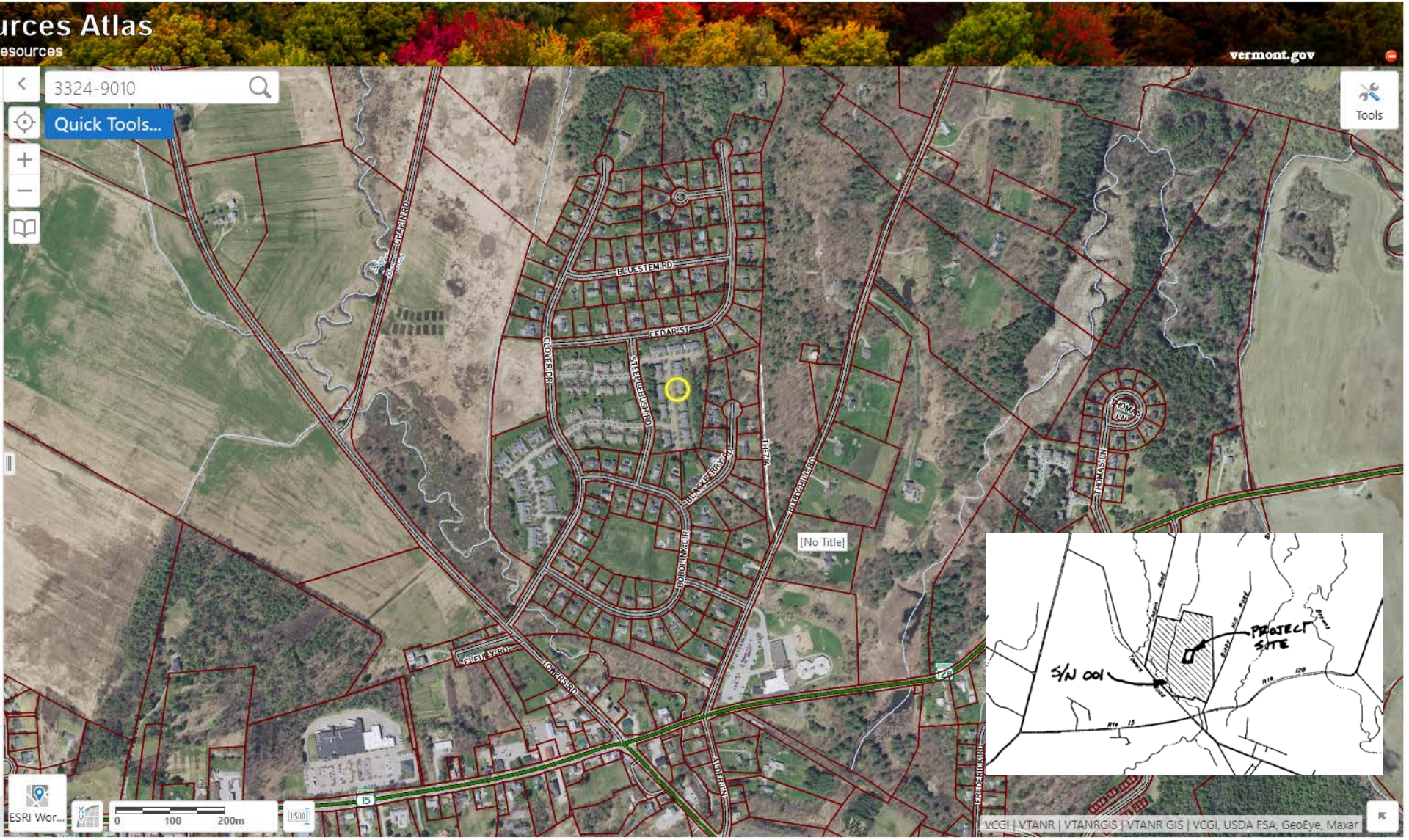
Note: n/a = not applicable

Appendix B, Table B-2: Details for Design-Phase Structural Stormwater Treatment Practices

ID	Site Name	Land Owner	MS4	Permit No.	Year Planned Construction	BMP Status	Applicable FRP	LC TMDL Drainage Area	LC TMDL Lake Segment	BMP Type	Impervious area (acres)	Pervious area (acres)	Storage volume (ft^3)	P Base Load Before Treatment (kg/yr)	Practice Efficiency (%)	P Credit (kg/yr)	% of P Target Reduction
EJ-WR-039	Hiawatha Infiltration Gallery Retrofit	Essex Westford School District	Essex Junction MS4			Preliminary Design (<100%)	n/a	Winooski River	Main Lake	Infiltration Chambers	11.71	20.88	14,244	13.50	87.7%	11.84	52%
2-0289	Countryside Cluster Homes A,B,C and Essex Parks East and West	Private	Essex Junction MS4	2-0289	2020	Final Design (100%)	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Extended Dry Detention Pond	13.89	17.00	11,892	12.29	13.0%	0.72	8%
2-0155	Countryside Dr Intersection	ROW	Essex Junction MS4	2-0155		Preliminary Design (<100%)	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Infiltration Chambers	1.95	3.30	4,792	1.65	68.0%	1.12	12%
2-0187	Grove St.	ROW	Essex Junction MS4 and VTrans	2-0187		Preliminary Design (<100%)	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Infiltration Chambers	8.71	14.68	2,047	7.37	31.2%	2.30	25%
EX-WR-001	Meadows Edge/Steeplebush retrofit	Town	Essex Town MS4			Preliminary Design (<100%)	n/a	Winooski River	Main Lake	Gravel Wetland	8.73	16.87	33,149	13.65	52.9%	7.50	17%
EX-WR-041	2OLET120 Logwood Circle stormline and catchbasin retrofits	Town	Essex Town MS4			Preliminary Design (<100%)	n/a	Winooski River	Main Lake	Infiltration Chambers	3.94	7.26	12,763	4.55	99.3%	4.50	10%
Outfall 126	Outfall 126: Fort Ethan Allen (Ryan St.)	Town	Essex Town MS4		2027?	Preliminary Design (<100%)	Sunderland Brook	Winooski River	Main Lake	Infiltration Chambers	9.84	10.58	12,239	4.33	99.8%	3.90	9%
1-0896, 1-0552, 1-1463	David Dr. Outfall	ROW	Essex Town MS4	1-0896, 1-0552, 1-1463	2032?	Preliminary Design (<100%)	Sunderland Brook	Winooski River	Main Lake	Infiltration Chambers	16.00	16.30	61,028	21.58	96.5%	20.80	48%
EX-LR-001	Autumn Knoll S/N 001 retrofit	Town	Essex Town MS4			Preliminary Design (<100%)	n/a	Lamoille River	Malletts Bay	Gravel Wetland	3.02	2.39	10,846	3.99	57.7%	2.50	8%
1-1319_p1_South	Church of Jesus Christ of Latter Day Saints, South Vault	Private	Essex Town MS4	1-1319	2024	Final Design (100%)	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Sand filter (w/ underdrain)	1.83	0.67	13,286	1.52	60.0%	0.91	3%
1-1319_p2_North	Church of Jesus Christ of Latter Day Saints, North Vault	Private	Essex Town MS4	1-1319	2024	Final Design (100%)	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Detention Chambers (negligible P treatment)	---	---	---	---	---	---	0%

Note: n/a = not applicable

Meadows Edge/ Steeplebush 3324-9010.R



Meadows Edge/ Steeplebush 3324-9010.R


CEDAR COURT
BLUESTEM ROAD
CEDAR STREET
Steeplebush East
Steeplebush West
PRIVATE
PRIVATE
PRIVATE
UNDEFINED OWNERSHIP
UNDEFINED OWNERSHIP
LAGOON NOT OWNED BY TOWN
The Commons at Meadows Edge
TOWERS ROAD
=KEY=
— PRIVATE SYSTEM OR UNKNOWN OWNERSHIP
IMPERVIOUS AREA NOT INCLUDED IN TOWN PERMIT COVERAGE UNDER 3-9010
NO FEES PAID FOR THESE AREAS BY TOWN
AREAS HAVE ASSOCIATIONS

Meadows Edge/
Steeplebush 3324-9010.R
6+ acre impervious
Grass channels
Detention pond

Autumn Knoll 4367-9010.R (~2002)

S/N 001

Existing dry ED = 0.39 kg/yr

Existing wet ED = 1.88 kg/yr

Autumn Knoll 4367-9010.R (~2002)

S/N 001

Existing dry ED = 0.39 kg/yr

Existing wet ED = 1.88 kg/yr

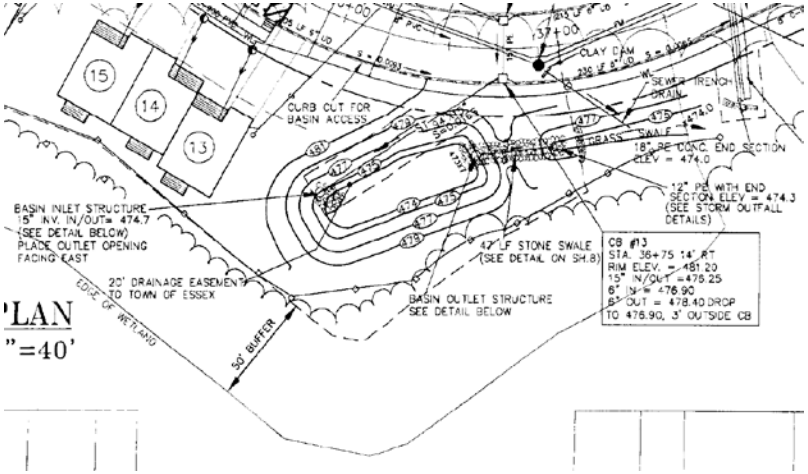
Autumn Knoll 4367-9010.R

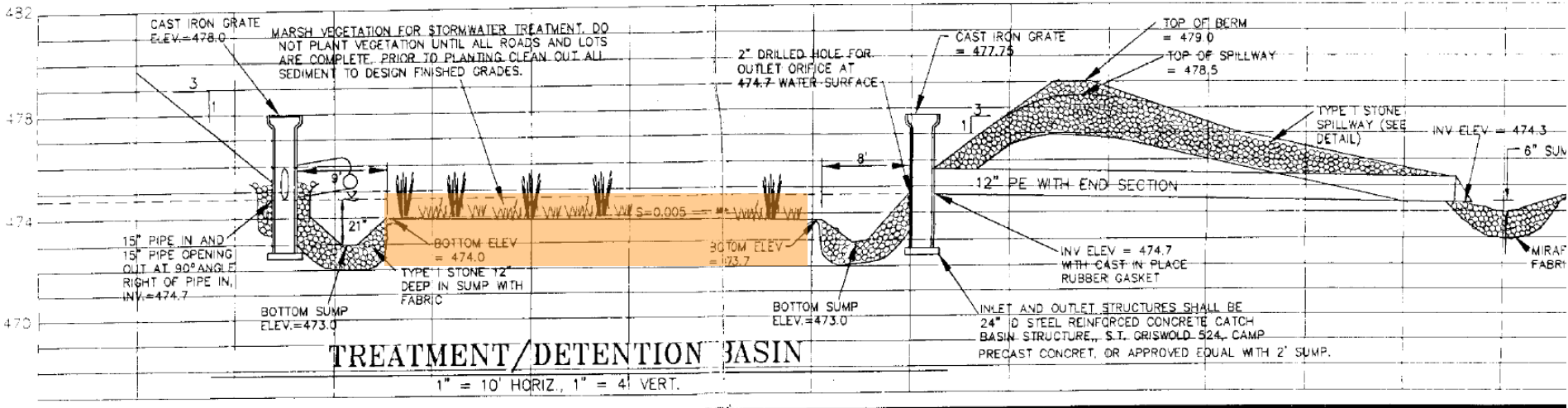
S/N 001(~2002)

Existing Wet ED = 1.88 kg/yr

Expand / Convert to gravel wetlands = 1.15 kg/yr

Total = 3.03 kg/yr +





Old Stage Village 3579-9010.R

4.12 ac impervious

Grass channels

Old Stage Village 3579-9010.R

4.12 ac impervious

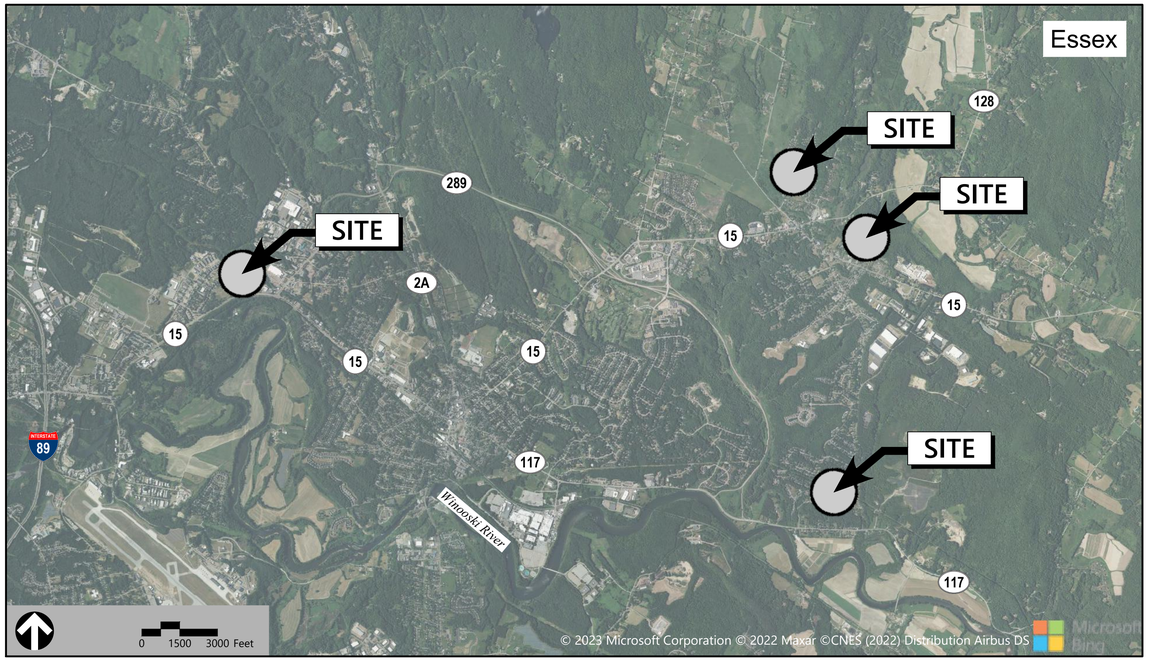
Grass channels

Site Plans

Issued for	**Review**
Date Issued	**June 30, 2023**
Latest Issue	**June 30, 2023**

CCRPC Essex Stormwater

Essex, VT 05452



vhb.com

vhb

40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

Owner

Chittenden County Regional Planning Commission
Chris Dubin
110 West Canal Street, Suite 202
Winnoski, VT 05404

Owner

Town of Essex DPW
Annie Costandi, PE
5 Jericho Road
Essex, VT 05452

Applicant

VHB
40 IDX Drive
Suite 100, Building 200
South Burlington, 05403

Sheet Index

VHB Project : 58644.06 CCRPC Essex Stormwater
Issued for : Review 30, 2023

Legend

Exist.	Prop.	
		PROPERTY LINE
		PROJECT LIMIT LINE
		RIGHT-OF-WAY/PROPERTY LINE
		EASEMENT
		BUILDING SETBACK
		PARKING SETBACK
10+00	10+00	BASELINE
		CONSTRUCTION LAYOUT
		ZONING LINE
		TOWN LINE
		LIMIT OF DISTURBANCE
		WETLAND LINE WITH FLAG
		FLOODPLAIN
BLSF	BLSF	BORDERING LAND SUBJECT TO FLOODING
BZ	BZ	WETLAND BUFFER ZONE
NDZ	NDZ	NO DISTURB ZONE
200'RA	200'RA	200' RIVERFRONT AREA
		GRAVEL ROAD
EOP	EOP	EDGE OF PAVEMENT
BB	BB	BITUMINOUS BERM
BC	BC	BITUMINOUS CURB
CC	CC	CONCRETE CURB
CG	CG	CURB AND GUTTER
CC	ECC	EXTRUDED CONCRETE CURB
CC	MCC	MONOLITHIC CONCRETE CURB
CC	PCC	PRECAST CONC. CURB
SGE	SGE	SLOPED GRAN. EDGING
VGC	VGC	VERT. GRAN. CURB
		LIMIT OF CURB TYPE
		SAWCUT
		BUILDING
	EN	BUILDING ENTRANCE
	LD	LOADING DOCK
		BOLLARD
D	D	DUMPSTER PAD
		SIGN
		DOUBLE SIGN
		STEEL GUARDRAIL
		WOOD GUARDRAIL
		PATH
		TREE LINE
		WIRE FENCE
		FENCE
		STOCKADE FENCE
		STONE WALL
		RETAINING WALL
		STREAM / POND / WATER COURSE
		DETENTION BASIN
		HAY BALES
		SILT FENCE
		SILT SOCK / STRAW WATTLE
4	4	MINOR CONTOUR
20	20	MAJOR CONTOUR
10	10	PARKING COUNT
	C10	COMPACT PARKING STALLS
DYL	DYL	DOUBLE YELLOW LINE
SL	SL	STOP LINE
		CROSSWALK
		ACCESSIBLE CURB RAMP
		ACCESSIBLE PARKING
VAN	VAN	VAN-ACCESSIBLE PARKING

Exist.	Prop.	
		CONCRETE
		HEAVY DUTY PAVEMENT
		BUILDINGS
		RIPRAP
		CONSTRUCTION EXIT
27.35 TC×	27.35 TC×	TOP OF CURB ELEVATION
26.85 BC×	26.85 BC×	BOTTOM OF CURB ELEVATION
132.75 ×	132.75 ×	SPOT ELEVATION
45.0 TW× 38.5 BW	45.0 TW× 38.5 BW	TOP & BOTTOM OF WALL ELEVATION
		BORING LOCATION
		TEST PIT LOCATION
MW	MW	MONITORING WELL
UD	UD	UNDERDRAIN
12"D	12"D>	DRAIN
6"RD	6"RD>	ROOF DRAIN
12"S	12"S	SEWER
FM	FM	FORCE MAIN
OHW	OHW	OVERHEAD WIRE
6"W	6"W	WATER
4"FP	4"FP	FIRE PROTECTION
	2"DW	DOMESTIC WATER
3"G	G	GAS
E	E	ELECTRIC
STM	STM	STEAM
T	T	TELEPHONE
FA	FA	FIRE ALARM
CATV	CATV	CABLE TV
		CATCH BASIN CONCENTRIC
		CATCH BASIN ECCENTRIC
		DOUBLE CATCH BASIN CONCENTRIC
		DOUBLE CATCH BASIN ECCENTRIC
		GUTTER INLET
		DRAIN MANHOLE CONCENTRIC
		DRAIN MANHOLE ECCENTRIC
TD		TRENCH DRAIN
		PLUG OR CAP
CO	CO	CLEANOUT
		FLARED END SECTION
		HEADWALL
S		SEWER MANHOLE CONCENTRIC
S		SEWER MANHOLE ECCENTRIC
CS	CS	CURB STOP & BOX
WV	WV	WATER VALVE & BOX
TSV	TSV	TAPPING SLEEVE, VALVE & BOX
		FIRE DEPARTMENT CONNECTION
HYD	HYD	FIRE HYDRANT
WM	WM	WATER METER
PIV	PIV	POST INDICATOR VALVE
W	W	WATER WELL
GC	GC	GAS GATE
GM	GM	GAS METER
E	EMH	ELECTRIC MANHOLE
EM	EM	ELECTRIC METER
		LIGHT POLE
T	TMH	TELEPHONE MANHOLE
T	T	TRANSFORMER PAD
		UTILITY POLE
		GUY POLE
		GUY WIRE & ANCHOR
HH	HH	HAND HOLE
PB	PB	PULL BOX
		MATCHLINE

Abbreviations

General

ABAN	ABANDON
ACR	ACCESSIBLE CURB RAMP
ADJ	ADJUST
APPROX	APPROXIMATE
BIT	BITUMINOUS
BS	BOTTOM OF SLOPE
BWLL	BROKEN WHITE LANE LINE
CONC	CONCRETE
DYCL	DOUBLE YELLOW CENTER LINE
EL	ELEVATION
ELEV	ELEVATION
EX	EXISTING
FDN	FOUNDATION
FFE	FIRST FLOOR ELEVATION
GRAN	GRANITE
GTD	GRADE TO DRAIN
LA	LANDSCAPE AREA
LOD	LIMIT OF DISTURBANCE
MAX	MAXIMUM
MIN	MINIMUM
NIC	NOT IN CONTRACT
NTS	NOT TO SCALE
PERF	PERFORATED
PROP	PROPOSED
REM	REMOVE
RET	RETAIN
R&D	REMOVE AND DISPOSE
R&R	REMOVE AND RESET
SWEL	SOLID WHITE EDGE LINE
SWLL	SOLID WHITE LANE LINE
TS	TOP OF SLOPE
TYP	TYPICAL

Utility

CB	CATCH BASIN
CMP	CORRUGATED METAL PIPE
CO	CLEANOUT
DCB	DOUBLE CATCH BASIN
DMH	DRAIN MANHOLE
CIP	CAST IRON PIPE
COND	CONDUIT
DIP	DUCTILE IRON PIPE
FES	FLARED END SECTION
FM	FORCE MAIN
F&G	FRAME AND GRATE
F&C	FRAME AND COVER
GI	GUTTER INLET
GT	GREASE TRAP
HDPE	HIGH DENSITY POLYETHYLENE PIPE
HH	HANDHOLE
HW	HEADWALL
HYD	HYDRANT
INV	INVERT ELEVATION
I=	INVERT ELEVATION
LP	LIGHT POLE
MES	METAL END SECTION
PIV	POST INDICATOR VALVE
PWW	PAVED WATER WAY
PVC	POLYVINYLCHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
R=	RIM ELEVATION
RIM=	RIM ELEVATION
SMH	SEWER MANHOLE
TSV	TAPPING SLEEVE, VALVE AND BOX
UG	UNDERGROUND
UP	UTILITY POLE

Notes

General

1. CONTRACTOR SHALL NOTIFY "DIG-SAFE" (1-888-344-7233) AT LEAST 72 HOURS BEFORE EXCAVATING.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY. CONSTRUCTION ACTIVITIES SHALL BE IN ACCORDANCE WITH OSHA STANDARDS AND LOCAL REQUIREMENTS.
3. ACCESSIBLE ROUTES, PARKING SPACES, RAMPS, SIDEWALKS AND WALKWAYS SHALL BE CONSTRUCTED IN CONFORMANCE WITH THE FEDERAL AMERICANS WITH DISABILITIES ACT AND WITH STATE AND LOCAL LAWS AND REGULATIONS (WHICHEVER ARE MORE STRINGENT).
4. AREAS DISTURBED DURING CONSTRUCTION AND NOT RESTORED WITH IMPERVIOUS SURFACES (BUILDINGS, PAVEMENTS, WALKS, ETC.) SHALL RECEIVE [##] INCHES LOAM AND SEED.
5. WITHIN THE LIMITS OF THE BUILDING FOOTPRINT, THE SITE CONTRACTOR SHALL PERFORM EARTHWORK OPERATIONS REQUIRED UP TO SUBGRADE ELEVATIONS.
6. WORK WITHIN THE LOCAL RIGHTS-OF-WAY SHALL CONFORM TO LOCAL MUNICIPAL STANDARDS. WORK WITHIN STATE RIGHTS-OF-WAY SHALL CONFORM TO THE LATEST EDITION OF THE STATE HIGHWAY DEPARTMENTS STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES.
7. UPON AWARD OF CONTRACT, CONTRACTOR SHALL MAKE NECESSARY CONSTRUCTION NOTIFICATIONS AND APPLY FOR AND OBTAIN NECESSARY PERMITS, PAY FEES, AND POST BONDS ASSOCIATED WITH THE WORK INDICATED ON THE DRAWINGS, IN THE SPECIFICATIONS, AND IN THE CONTRACT DOCUMENTS. DO NOT CLOSE OR OBSTRUCT ROADWAYS, SIDEWALKS, AND FIRE HYDRANTS, WITHOUT APPROPRIATE PERMITS.
8. TRAFFIC SIGNAGE AND PAVEMENT MARKINGS SHALL CONFORM TO THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.
9. AREAS OUTSIDE THE LIMITS OF PROPOSED WORK DISTURBED BY THE CONTRACTOR'S OPERATIONS SHALL BE RESTORED BY THE CONTRACTOR TO THEIR ORIGINAL CONDITION AT THE CONTRACTOR'S EXPENSE.
10. IN THE EVENT THAT SUSPECTED CONTAMINATED SOIL, GROUNDWATER, AND OTHER MEDIA ARE ENCOUNTERED DURING EXCAVATION AND CONSTRUCTION ACTIVITIES BASED ON VISUAL, OLFACTORY, OR OTHER EVIDENCE, THE CONTRACTOR SHALL STOP WORK IN THE VICINITY OF THE SUSPECT MATERIAL TO AVOID FURTHER SPREADING OF THE MATERIAL, AND SHALL NOTIFY THE OWNER IMMEDIATELY SO THAT THE APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN.
11. CONTRACTOR SHALL PREVENT DUST, SEDIMENT, AND DEBRIS FROM EXITING THE SITE AND SHALL BE RESPONSIBLE FOR CLEANUP, REPAIRS AND CORRECTIVE ACTION IF SUCH OCCURS.
12. DAMAGE RESULTING FROM CONSTRUCTION LOADS SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDITIONAL COST TO OWNER.
13. CONTRACTOR SHALL CONTROL STORMWATER RUNOFF DURING CONSTRUCTION TO PREVENT ADVERSE IMPACTS TO OFF SITE AREAS, AND SHALL BE RESPONSIBLE TO REPAIR RESULTING DAMAGES, IF ANY, AT NO COST TO OWNER.
14. THIS PROJECT DISTURBS MORE THAN ONE ACRE OF LAND AND FALLS WITHIN THE NPDES CONSTRUCTION GENERAL PERMIT (CGP) PROGRAM AND EPA JURISDICTION. PRIOR TO THE START OF CONSTRUCTION CONTRACTOR IS TO FILE A CGP NOTICE OF INTENT WITH THE EPA AND PREPARE A STORMWATER POLLUTION PREVENTION PLAN IN ACCORDANCE WITH THE NPDES REGULATIONS. CONTRACTOR SHALL CONFIRM THE OWNER HAS ALSO FILED A NOTICE OF INTENT WITH THE EPA.

Utilities

1. THE LOCATIONS, SIZES, AND TYPES OF EXISTING UTILITIES ARE SHOWN AS AN APPROXIMATE REPRESENTATION ONLY. THE OWNER OR ITS REPRESENTATIVE(S) HAVE NOT INDEPENDENTLY VERIFIED THIS INFORMATION AS SHOWN ON THE PLANS. THE UTILITY INFORMATION SHOWN DOES NOT GUARANTEE THE ACTUAL EXISTENCE, SERVICEABILITY, OR OTHER DATA CONCERNING THE UTILITIES, NOR DOES IT GUARANTEE AGAINST THE POSSIBILITY THAT ADDITIONAL UTILITIES MAY BE PRESENT THAT ARE NOT SHOWN ON THE PLANS. PRIOR TO ORDERING MATERIALS AND BEGINNING CONSTRUCTION, THE CONTRACTOR SHALL VERIFY AND DETERMINE THE EXACT LOCATIONS, SIZES, AND ELEVATIONS OF THE POINTS OF CONNECTIONS TO EXISTING UTILITIES AND, SHALL CONFIRM THAT THERE ARE NO INTERFERENCES WITH EXISTING UTILITIES AND THE PROPOSED UTILITY ROUTES, INCLUDING ROUTES WITHIN THE PUBLIC RIGHTS OF WAY.
2. WHERE AN EXISTING UTILITY IS FOUND TO CONFLICT WITH THE PROPOSED WORK, OR EXISTING CONDITIONS DIFFER FROM THOSE SHOWN SUCH THAT THE WORK CANNOT BE COMPLETED AS INTENDED, THE LOCATION, ELEVATION, AND SIZE OF THE UTILITY SHALL BE ACCURATELY DETERMINED WITHOUT DELAY BY THE CONTRACTOR, AND THE INFORMATION FURNISHED IN WRITING TO THE OWNER'S REPRESENTATIVE FOR THE RESOLUTION OF THE CONFLICT AND CONTRACTOR'S FAILURE TO NOTIFY PRIOR TO PERFORMING ADDITIONAL WORK RELEASES OWNER FROM OBLIGATIONS FOR ADDITIONAL PAYMENTS WHICH OTHERWISE MAY BE WARRANTED TO RESOLVE THE CONFLICT.
3. SET CATCH BASIN RIMS, AND INVERTS OF SEWERS, DRAINS, AND DITCHES IN ACCORDANCE WITH ELEVATIONS ON THE GRADING AND UTILITY PLANS.
4. RIM ELEVATIONS FOR DRAIN AND SEWER MANHOLES, WATER VALVE COVERS, GAS GATES, ELECTRIC AND TELEPHONE PULL BOXES, AND MANHOLES, AND OTHER SUCH ITEMS, ARE APPROXIMATE AND SHALL BE SET/RESET AS FOLLOWS:
   A. PAVEMENTS AND CONCRETE SURFACES: FLUSH
   B. ALL SURFACES ALONG ACCESSIBLE ROUTES: FLUSH
   C. LANDSCAPE, LOAM AND SEED, AND OTHER EARTH SURFACE AREAS: ONE INCH ABOVE SURROUNDING AREA AND TAPER EARTH TO THE RIM ELEVATION.
5. THE LOCATION, SIZE, DEPTH, AND SPECIFICATIONS FOR CONSTRUCTION OF PROPOSED PRIVATE UTILITY SERVICES SHALL BE INSTALLED ACCORDING TO THE REQUIREMENTS PROVIDED BY, AND APPROVED BY, THE RESPECTIVE UTILITY COMPANY (GAS, TELEPHONE, ELECTRIC, FIRE ALARM, ETC.). FINAL DESIGN LOADS AND LOCATIONS TO BE COORDINATED WITH OWNER AND ARCHITECT.
6. CONTRACTOR SHALL MAKE ARRANGEMENTS FOR AND SHALL BE RESPONSIBLE FOR PAYING FEES FOR POLE RELOCATION AND FOR THE ALTERATION AND ADJUSTMENT OF GAS, ELECTRIC, TELEPHONE, FIRE ALARM, AND ANY OTHER PRIVATE UTILITIES, WHETHER WORK IS PERFORMED BY CONTRACTOR OR BY THE UTILITIES COMPANY.
7. UTILITY PIPE MATERIALS SHALL BE AS FOLLOWS, UNLESS OTHERWISE NOTED ON THE PLAN:
   A. WATER PIPES SHALL BE [TYPE(S)]
   B. SANITARY SEWER PIPES SHALL BE POLYVINYL CHLORIDE (PVC) SEWER PIPE
   C. STORM DRAINAGE PIPES SHALL BE [TYPE(S)]
   D. PIPE INSTALLATION AND MATERIALS SHALL COMPLY WITH THE STATE PLUMBING CODE WHERE APPLICABLE. CONTRACTOR SHALL COORDINATE WITH LOCAL PLUMBING INSPECTOR PRIOR TO BEGINNING WORK.
8. CONTRACTOR SHALL COORDINATE WITH ELECTRICAL CONTRACTOR AND SHALL FURNISH EXCAVATION, INSTALLATION, AND BACKFILL OF ELECTRICAL FURNISHED SITEWORK RELATED ITEMS SUCH AS PULL BOXES, CONDUITS, DUCT BANKS, LIGHT POLE BASES, AND CONCRETE PADS. SITE CONTRACTOR SHALL FURNISH CONCRETE ENCASEMENT OF DUCT BANKS IF REQUIRED BY THE UTILITY COMPANY AND AS INDICATED ON THE DRAWINGS.
9. CONTRACTOR SHALL EXCAVATE AND BACKFILL TRENCHES FOR GAS IN ACCORDANCE WITH GAS COMPANY'S REQUIREMENTS.
10. ALL DRAINAGE AND SANITARY STRUCTURE INTERIOR DIAMETERS (4' MIN.) SHALL BE DETERMINED BY THE MANUFACTURER BASED ON THE PIPE CONFIGURATIONS SHOWN ON THESE PLANS AND LOCAL MUNICIPAL STANDARDS. FOR MANHOLES THAT ARE 20 FEET IN DEPTH AND GREATER, THE MINIMUM DIAMETER SHALL BE 5 FEET.

Layout and Materials

1. DIMENSIONS ARE FROM THE FACE OF CURB, FACE OF BUILDING, FACE OF WALL, AND CENTER LINE OF PAVEMENT MARKINGS, UNLESS OTHERWISE NOTED.
2. CURB RADII ARE [##] FEET UNLESS OTHERWISE NOTED.
3. CURBING SHALL BE [TYPE] WITHIN THE SITE UNLESS OTHERWISE INDICATED ON THE PLANS.
4. SEE ARCHITECTURAL DRAWINGS FOR EXACT BUILDING DIMENSIONS AND DETAILS CONTIGUOUS TO THE BUILDING, INCLUDING SIDEWALKS, RAMPS, BUILDING ENTRANCES, STAIRWAYS, UTILITY PENETRATIONS, CONCRETE DOOR PADS, COMPACTOR PAD, LOADING DOCKS, BOLLARDS, ETC.
5. PROPOSED BOUNDS AND ANY EXISTING PROPERTY LINE MONUMENTATION DISTURBED DURING CONSTRUCTION SHALL BE SET OR RESET BY A PROFESSIONAL LAND SURVEYOR.
6. PRIOR TO START OF CONSTRUCTION, CONTRACTOR SHALL VERIFY EXISTING PAVEMENT ELEVATIONS AT INTERFACE WITH PROPOSED PAVEMENTS, AND EXISTING GROUND ELEVATIONS ADJACENT TO DRAINAGE OUTLETS TO ASSURE PROPER TRANSITIONS BETWEEN EXISTING AND PROPOSED FACILITIES.

Demolition

1. CONTRACTOR SHALL REMOVE AND DISPOSE OF EXISTING MANMADE SURFACE FEATURES WITHIN THE LIMIT OF WORK INCLUDING BUILDINGS, STRUCTURES, PAVEMENTS, SLABS, CURBING, FENCES, UTILITY POLES, SIGNS, ETC. UNLESS INDICATED OTHERWISE ON THE DRAWINGS. REMOVE AND DISPOSE OF EXISTING UTILITIES, FOUNDATIONS AND UNSUITABLE MATERIAL BENEATH AND FOR A DISTANCE OF 10 FEET BEYOND THE PROPOSED BUILDING FOOTPRINT INCLUDING EXTERIOR COLUMNS.
2. EXISTING UTILITIES SHALL BE TERMINATED, UNLESS OTHERWISE NOTED, IN CONFORMANCE WITH LOCAL, STATE AND INDIVIDUAL UTILITY COMPANY STANDARD SPECIFICATIONS AND DETAILS. THE CONTRACTOR SHALL COORDINATE UTILITY SERVICE DISCONNECTS WITH THE UTILITY REPRESENTATIVES.
3. CONTRACTOR SHALL DISPOSE OF DEMOLITION DEBRIS IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS, ORDINANCES AND STATUTES.
4 THE DEMOLITION LIMITS DEPICTED IN THE PLANS IS INTENDED TO AID THE CONTRACTOR DURING THE BIDDING AND CONSTRUCTION PROCESS AND IS NOT INTENDED TO DEPICT EACH AND EVERY ELEMENT OF DEMOLITION. THE CONTRACTOR IS RESPONSIBLE FOR IDENTIFYING THE DETAILED SCOPE OF DEMOLITION BEFORE SUBMITTING ITS BID/PROPOSAL TO PERFORM THE WORK AND SHALL MAKE NO CLAIMS AND SEEK NO ADDITIONAL COMPENSATION FOR CHANGED CONDITIONS OR UNFORESEEN OR LATENT SITE CONDITIONS RELATED TO ANY CONDITIONS DISCOVERED DURING EXECUTION OF THE WORK.
5. UNLESS OTHERWISE SPECIFICALLY PROVIDED ON THE PLANS OR IN THE SPECIFICATIONS, THE ENGINEER HAS NOT PREPARED DESIGNS FOR AND SHALL HAVE NO RESPONSIBILITY FOR THE PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF HAZARDOUS MATERIALS, TOXIC WASTES OR POLLUTANTS AT THE PROJECT SITE. THE ENGINEER SHALL NOT BE RESPONSIBLE FOR ANY CLAIMS OF LOSS, DAMAGE, EXPENSE, DELAY, INJURY OR DEATH ARISING FROM THE PRESENCE OF HAZARDOUS MATERIAL AND CONTRACTOR SHALL INDEMNIFY AND HOLD HARMLESS THE ENGINEER FROM ANY CLAIMS MADE IN CONNECTION THEREWITH. MOREOVER, THE ENGINEER SHALL HAVE NO ADMINISTRATIVE OBLIGATIONS OF ANY TYPE WITH REGARD TO ANY CONTRACTOR AMENDMENT INVOLVING THE ISSUES OF PRESENCE, DISCOVERY, REMOVAL, ABATEMENT OR DISPOSAL OF ASBESTOS OR OTHER HAZARDOUS MATERIALS.

Erosion Control

1. PRIOR TO STARTING ANY OTHER WORK ON THE SITE, THE CONTRACTOR SHALL NOTIFY APPROPRIATE AGENCIES AND SHALL INSTALL EROSION CONTROL MEASURES AS SHOWN ON THE PLANS AND AS IDENTIFIED IN FEDERAL, STATE, AND LOCAL APPROVAL DOCUMENTS PERTAINING TO THIS PROJECT.
2. CONTRACTOR SHALL INSPECT AND MAINTAIN EROSION CONTROL MEASURES ON A WEEKLY BASIS (MINIMUM) OR AS REQUIRED PER THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP). THE CONTRACTOR SHALL ADDRESS DEFICIENCIES AND MAINTENANCE ITEMS WITHIN TWENTY-FOUR HOURS OF INSPECTION. CONTRACTOR SHALL PROPERLY DISPOSE OF SEDIMENT SUCH THAT IT DOES NOT ENCUMBER OTHER DRAINAGE STRUCTURES AND PROTECTED AREAS.
3. CONTRACTOR SHALL BE FULLY RESPONSIBLE TO CONTROL CONSTRUCTION SUCH THAT SEDIMENTATION SHALL NOT AFFECT REGULATORY PROTECTED AREAS, WHETHER SUCH SEDIMENTATION IS CAUSED BY WATER, WIND, OR DIRECT DEPOSIT.
4. CONTRACTOR SHALL PERFORM CONSTRUCTION SEQUENCING SUCH THAT EARTH MATERIALS ARE EXPOSED FOR A MINIMUM OF TIME BEFORE THEY ARE COVERED, SEEDED, OR OTHERWISE STABILIZED TO PREVENT EROSION.
5. UPON COMPLETION OF CONSTRUCTION AND ESTABLISHMENT OF PERMANENT GROUND COVER, CONTRACTOR SHALL REMOVE AND DISPOSE OF EROSION CONTROL MEASURES AND CLEAN SEDIMENT AND DEBRIS FROM ENTIRE DRAINAGE AND SEWER SYSTEMS.

Existing Conditions Information

1. BASE PLAN: THE PROPERTY LINES SHOWN WERE DETERMINED BY AN ACTUAL FIELD SURVEY CONDUCTED BY [WHOM], [AND FROM PLANS OF RECORD]. THE TOPOGRAPHY AND PHYSICAL FEATURES ARE BASED ON AN ACTUAL FIELD SURVEY PERFORMED ON THE GROUND BY [WHOM], DURING [DATE(S)]. [OTHER SERVICES].
   A. DELINEATION OF THE WETLANDS AND PLACEMENT OF THE FLAGS WAS PERFORMED BY: [WHOM]
   B. FLAGS MARKING THE WETLANDS WERE LOCATED BY: [WHOM] , [HOW]
2. TOPOGRAPHY: ELEVATIONS ARE BASED ON [NGVD DATUM].
3. GEOTECHNICAL DATA INCLUDING TEST PIT AND BORING LOCATIONS AND ELEVATIONS WERE OBTAINED FROM [NAME].

Document Use

1. THESE PLANS AND CORRESPONDING CADD DOCUMENTS ARE INSTRUMENTS OF PROFESSIONAL SERVICE, AND SHALL NOT BE USED, IN WHOLE OR IN PART, FOR ANY PURPOSE OTHER THAN FOR WHICH IT WAS CREATED WITHOUT THE EXPRESSED, WRITTEN CONSENT OF VHB. ANY UNAUTHORIZED USE, REUSE, MODIFICATION OR ALTERATION, INCLUDING AUTOMATED CONVERSION OF THIS DOCUMENT SHALL BE AT THE USER'S SOLE RISK WITHOUT LIABILITY OR LEGAL EXPOSURE TO VHB.
2. CONTRACTOR SHALL NOT RELY SOLELY ON ELECTRONIC VERSIONS OF PLANS, SPECIFICATIONS, AND DATA FILES THAT ARE OBTAINED FROM THE DESIGNERS, BUT SHALL VERIFY LOCATION OF PROJECT FEATURES IN ACCORDANCE WITH THE PAPER COPIES OF THE PLANS AND SPECIFICATIONS THAT ARE SUPPLIED AS PART OF THE CONTRACT DOCUMENTS.
3. SYMBOLS AND LEGENDS OF PROJECT FEATURES ARE GRAPHIC REPRESENTATIONS AND ARE NOT NECESSARILY SCALED TO THEIR ACTUAL DIMENSIONS OR LOCATIONS ON THE DRAWINGS. THE CONTRACTOR SHALL REFER TO THE DETAIL SHEET DIMENSIONS, MANUFACTURERS' LITERATURE, SHOP DRAWINGS AND FIELD MEASUREMENTS OF SUPPLIED PRODUCTS FOR LAYOUT OF THE PROJECT FEATURES.

vhb.com

40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by WAF | Checked by CHS

Issued for: Review | Date: June 30 2023

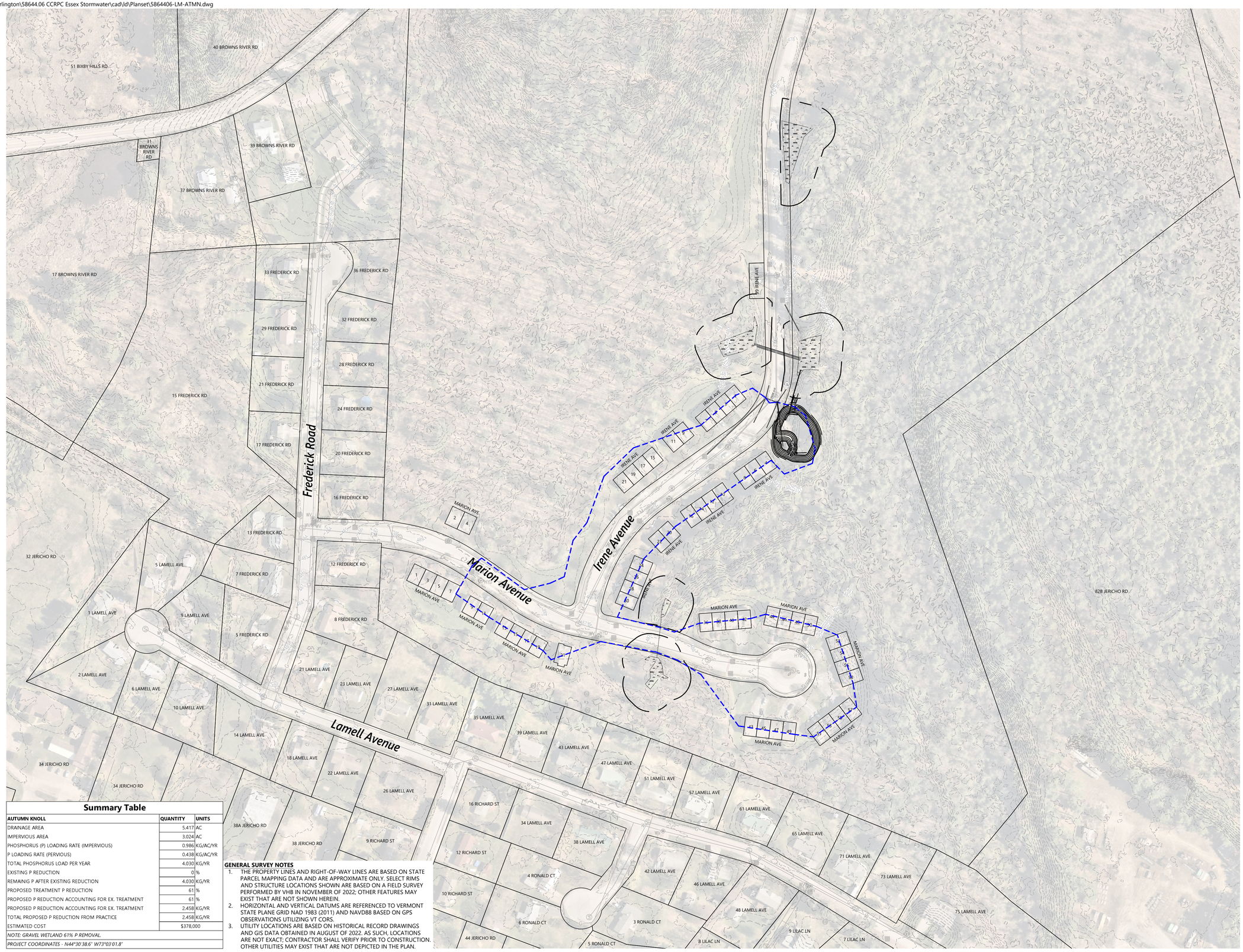
Not Approved for Construction

Drawing Title: Legend and General Notes

Drawing Number: C0.01

Sheet 2 of 12

Project Number: 58644.06



Summary Table

AUTUMN KNOLL	QUANTITY	UNITS
DRAINAGE AREA	5.417	AC
IMPERVIOUS AREA	3.024	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.986	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.438	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	4.030	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	4.030	KG/YR
PROPOSED TREATMENT P REDUCTION	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	2.458	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	2.458	KG/YR
ESTIMATED COST	$378,000	
NOTE: GRAVEL WETLAND 61% P REMOVAL.		
PROJECT COORDINATES - N44°30'38.6" W73°03'01.8"		

GENERAL SURVEY NOTES

1. THE PROPERTY LINES AND RIGHT-OF-WAY LINES ARE BASED ON STATE PARCEL MAPPING DATA AND ARE APPROXIMATE ONLY. SELECT RIMS AND STRUCTURE LOCATIONS SHOWN ARE BASED ON A FIELD SURVEY PERFORMED BY VHB IN NOVEMBER OF 2022; OTHER FEATURES MAY EXIST THAT ARE NOT SHOWN HEREIN.
2. HORIZONTAL AND VERTICAL DATUMS ARE REFERENCED TO VERMONT STATE PLANE GRID NAD 1983 (2011) AND NAVD88 BASED ON GPS OBSERVATIONS UTILIZING VT CORS.
3. UTILITY LOCATIONS ARE BASED ON HISTORICAL RECORD DRAWINGS AND GIS DATA OBTAINED IN AUGUST OF 2022. AS SUCH, LOCATIONS ARE NOT EXACT; CONTRACTOR SHALL VERIFY PRIOR TO CONSTRUCTION. OTHER UTILITIES MAY EXIST THAT ARE NOT DEPICTED IN THE PLAN.

vhb.com
vhb
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 50 100 200Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK | Checked by CHS

Issued for: Review

Date: June 30 2023

Not Approved for Construction

Drawing Title
Autumn Knoll Site Plan

Drawing Number
C1.01

Sheet 3 of 12

Project Number
58644.06

Summary Table

AUTUMN KNOLL	QUANTITY	UNITS
DRAINAGE AREA	5.417	AC
IMPERVIOUS AREA	3.024	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.986	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.438	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	4.030	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	4.030	KG/YR
PROPOSED TREATMENT P REDUCTION	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	2.458	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	2.458	KG/YR
ESTIMATED COST	$378,000	
NOTE: GRAVEL WETLAND 61% P REMOVAL.		
PROJECT COORDINATES - N44°30'38.6" W73°03'01.8"		

vhb.com
vhb
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 10 20 40 Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK
Checked by CHS
Issued for Review
Date June 30 2023

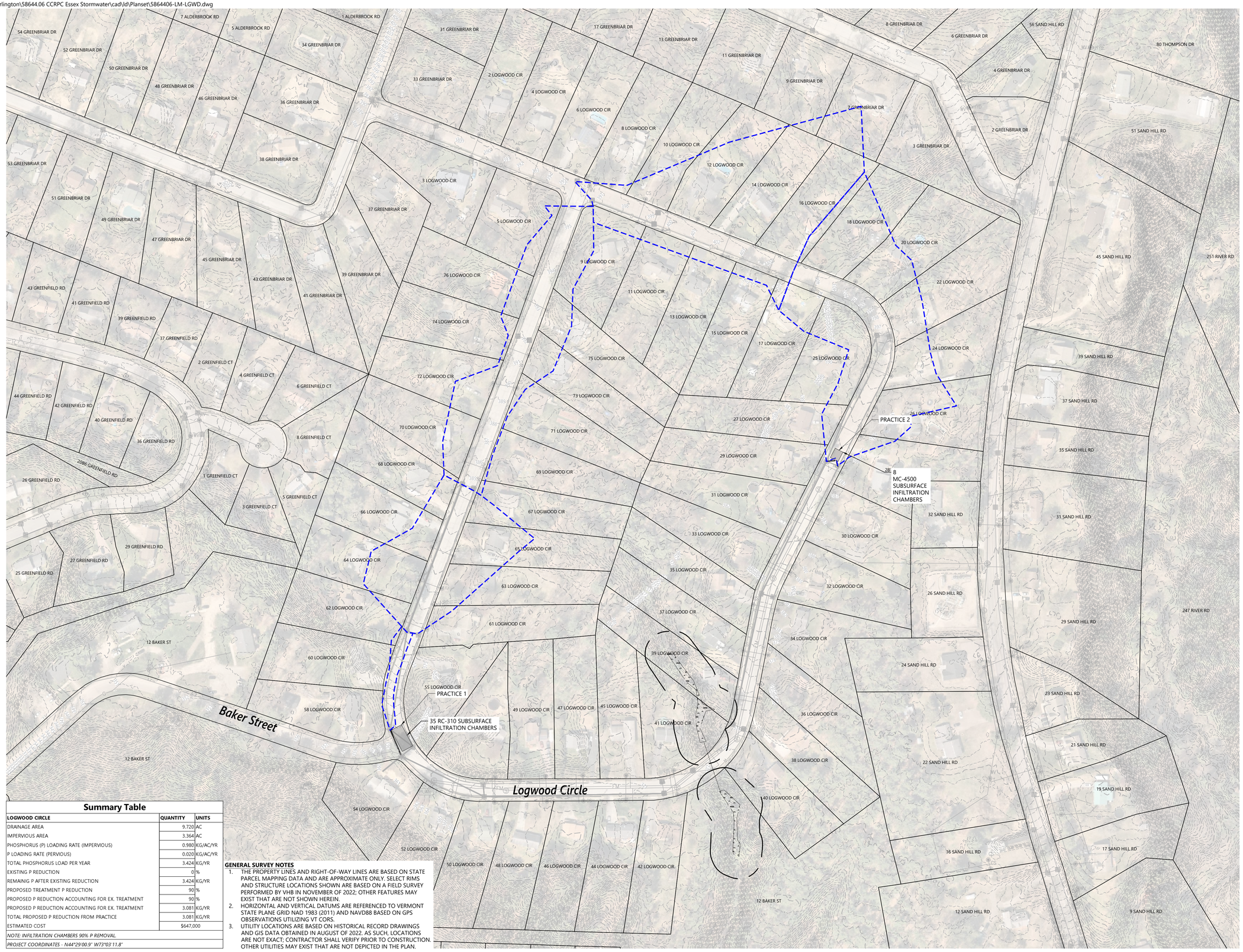
Not Approved for Construction

Drawing Title
Autumn Knoll
Stormwater Practice

Drawing Number
C1.02

Sheet 4 of 12

Project Number
58644.06



Summary Table

LOGWOOD CIRCLE	QUANTITY	UNITS
DRAINAGE AREA	9.720	AC
IMPERVIOUS AREA	3.364	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.020	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	3.424	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	3.424	KG/YR
PROPOSED TREATMENT P REDUCTION	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	3.081	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	3.081	KG/YR
ESTIMATED COST	$647,000	
NOTE: INFILTRATION CHAMBERS 90% P REMOVAL		
PROJECT COORDINATES - N44°29'00.9" W73°03'11.8"		

GENERAL SURVEY NOTES

1. THE PROPERTY LINES AND RIGHT-OF-WAY LINES ARE BASED ON STATE PARCEL MAPPING DATA AND ARE APPROXIMATE ONLY. SELECT RIMS AND STRUCTURE LOCATIONS SHOWN ARE BASED ON A FIELD SURVEY PERFORMED BY VHB IN NOVEMBER OF 2022; OTHER FEATURES MAY EXIST THAT ARE NOT SHOWN HEREIN.
2. HORIZONTAL AND VERTICAL DATUMS ARE REFERENCED TO VERMONT STATE PLANE GRID NAD 1983 (2011) AND NAVD88 BASED ON GPS OBSERVATIONS UTILIZING VT CORS.
3. UTILITY LOCATIONS ARE BASED ON HISTORICAL RECORD DRAWINGS AND GIS DATA OBTAINED IN AUGUST OF 2022. AS SUCH, LOCATIONS ARE NOT EXACT; CONTRACTOR SHALL VERIFY PRIOR TO CONSTRUCTION. OTHER UTILITIES MAY EXIST THAT ARE NOT DEPICTED IN THE PLAN.

vhb.com
vhb
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 50 100 200

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK
Checked by CHS

Issued for
Review

Date
June 30 2023

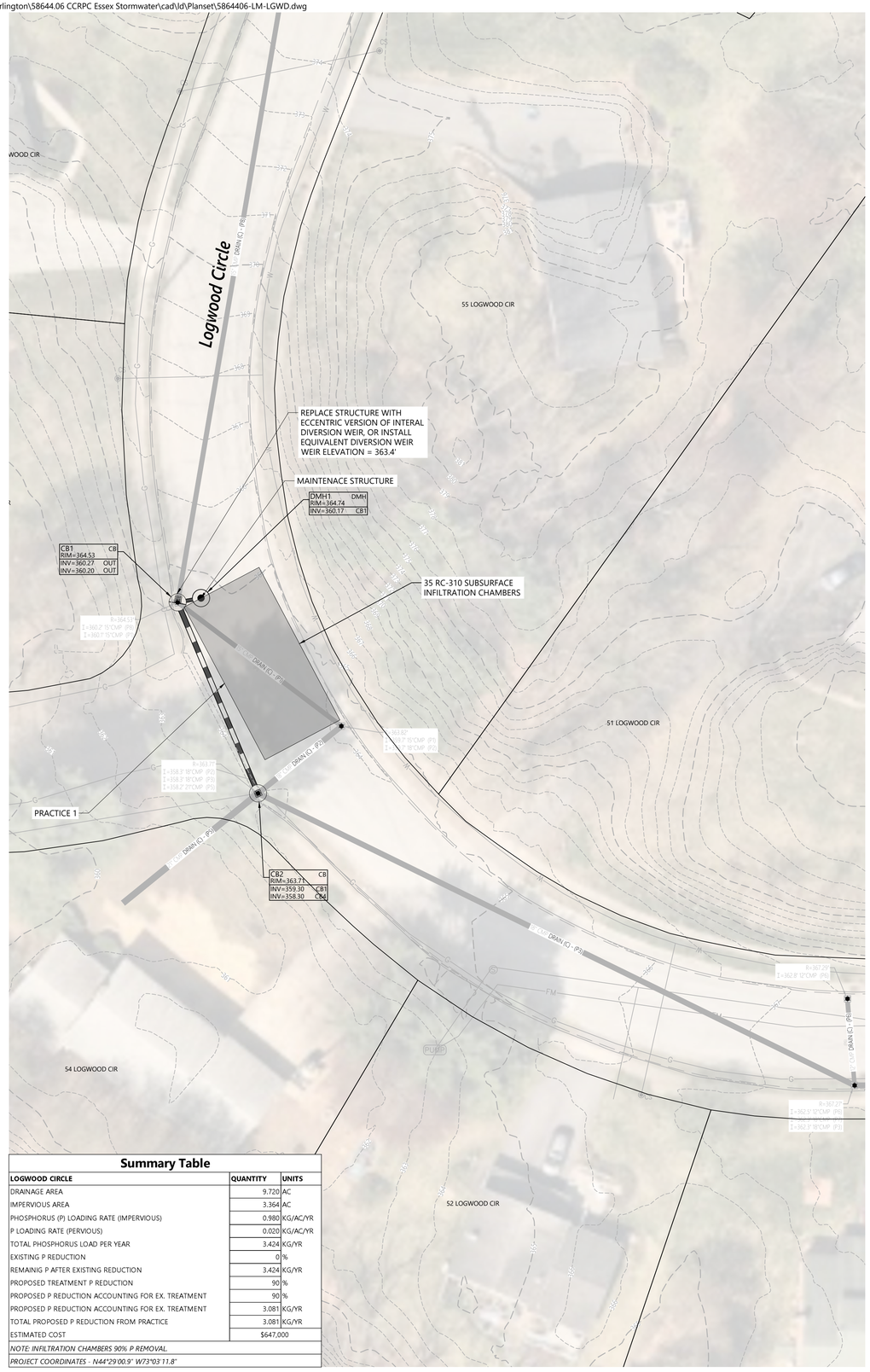
Not Approved for Construction

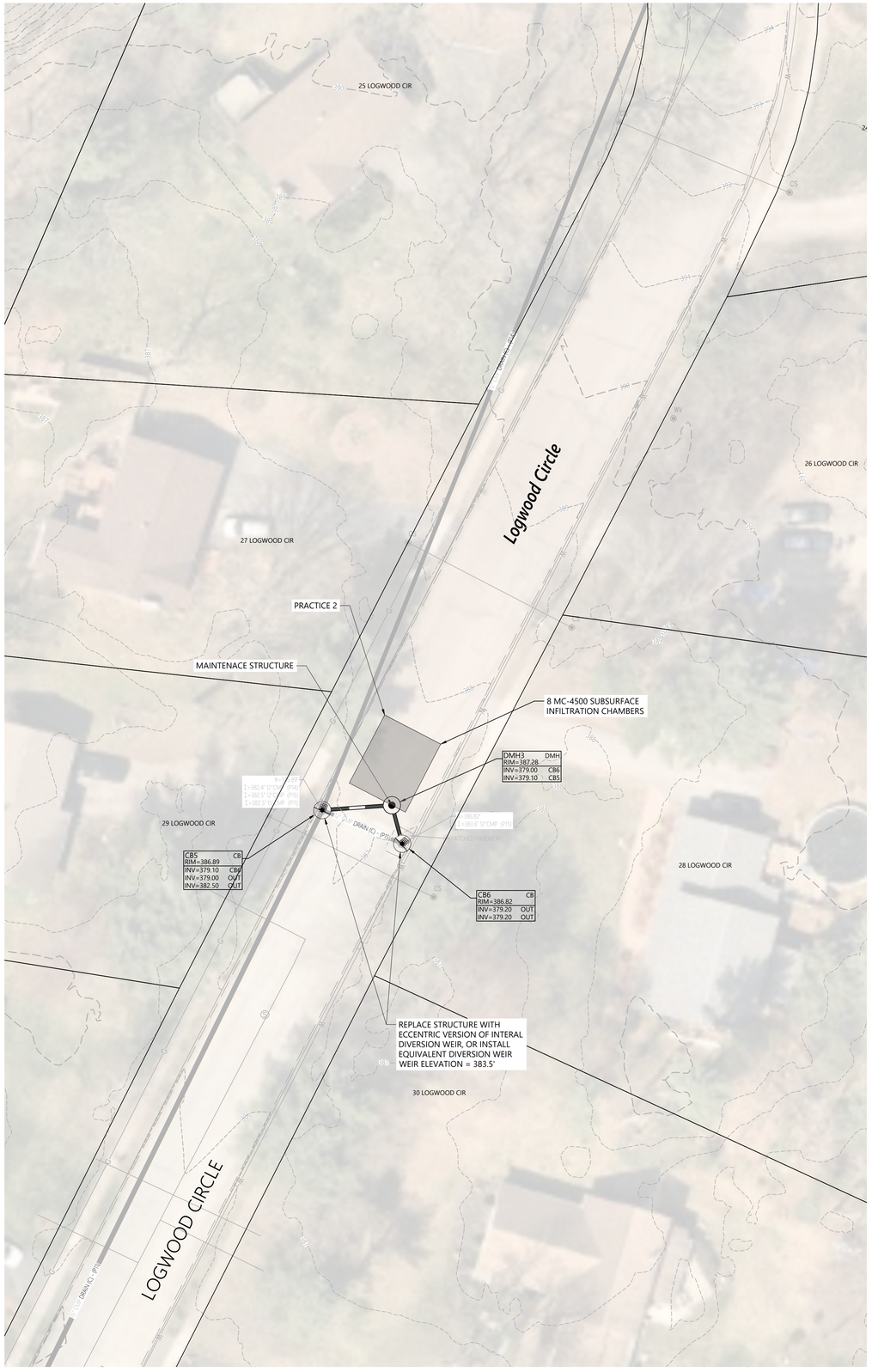
Drawing Title
Logwood Circle
Site Plan

Drawing Number
C2.01

Sheet 5 of 12

Project Number
58644.06





Summary Table

LOGWOOD CIRCLE	QUANTITY	UNITS
DRAINAGE AREA	9.720	AC
IMPERVIOUS AREA	3.364	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.020	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	3.424	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	3.424	KG/YR
PROPOSED TREATMENT P REDUCTION	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	3.081	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	3.081	KG/YR
ESTIMATED COST	$647,000	
NOTE: INFILTRATION CHAMBERS 90% P REMOVAL.		
PROJECT COORDINATES - N44°29'00.9" W73°03'11.8"		

vhb.com
vhb
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 10 20 40 Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK
Checked by CHS

Issued for
Review

Date
June 30 2023

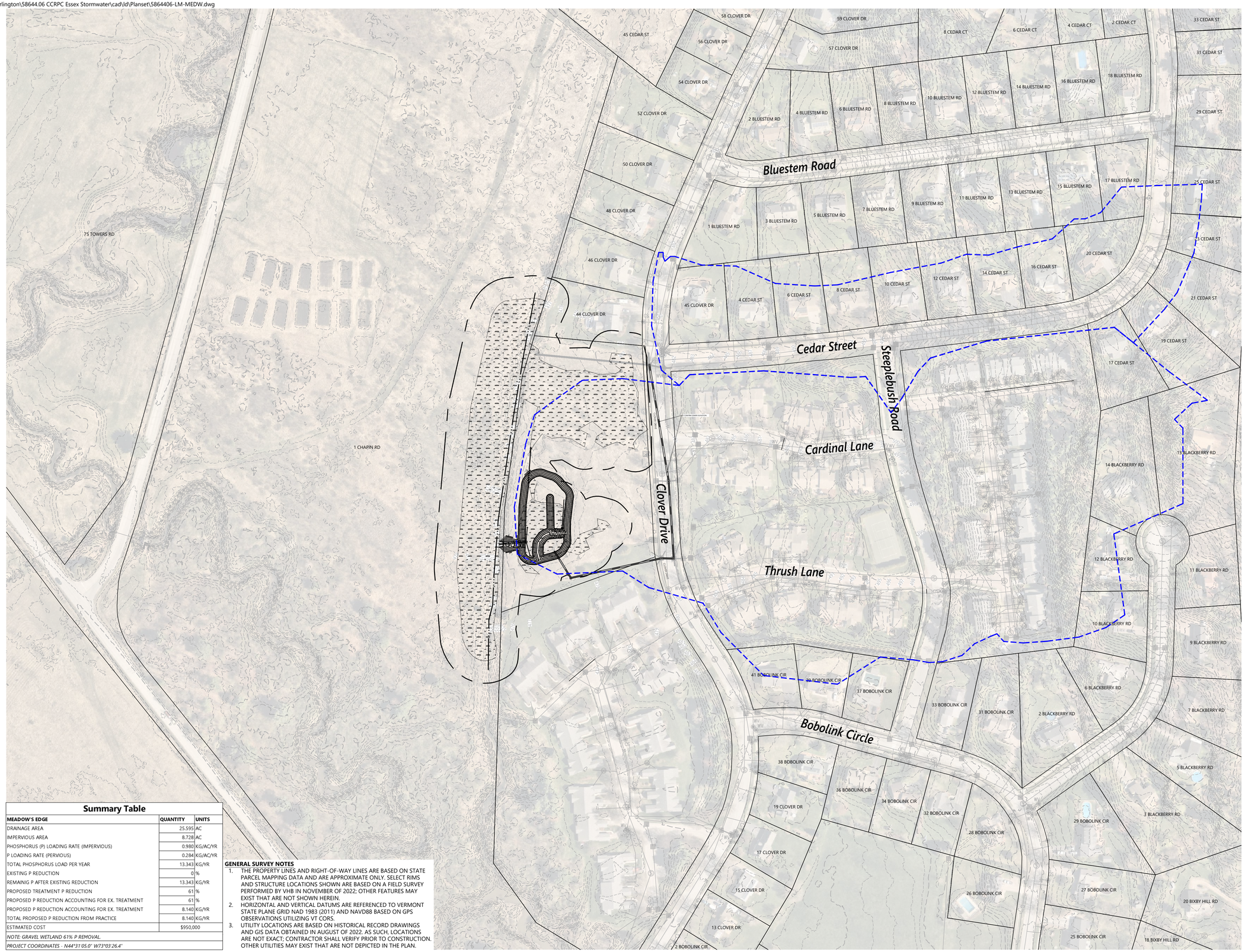
Not Approved for Construction

Drawing Title
Logwood Circle Stormwater Practice

Drawing Number
C2.02

Sheet 6 of 12

Project Number
58644.06



Summary Table

MEADOW'S EDGE	QUANTITY	UNITS
DRAINAGE AREA	25.595	AC
IMPERVIOUS AREA	8.728	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.284	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	13.343	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	13.343	KG/YR
PROPOSED TREATMENT P REDUCTION	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	8.140	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	8.140	KG/YR
ESTIMATED COST	$950,000	
NOTE: GRAVEL WETLAND 61% P REMOVAL		
PROJECT COORDINATES - N44°31'05.0" W73°03'26.4"		

GENERAL SURVEY NOTES

1. THE PROPERTY LINES AND RIGHT-OF-WAY LINES ARE BASED ON STATE PARCEL MAPPING DATA AND ARE APPROXIMATE ONLY. SELECT RIMS AND STRUCTURE LOCATIONS SHOWN ARE BASED ON A FIELD SURVEY PERFORMED BY VHB IN NOVEMBER OF 2022; OTHER FEATURES MAY EXIST THAT ARE NOT SHOWN HEREIN.
2. HORIZONTAL AND VERTICAL DATUMS ARE REFERENCED TO VERMONT STATE PLANE GRID NAD 1983 (2011) AND NAVD88 BASED ON GPS OBSERVATIONS UTILIZING VT CORS.
3. UTILITY LOCATIONS ARE BASED ON HISTORICAL RECORD DRAWINGS AND GIS DATA OBTAINED IN AUGUST OF 2022. AS SUCH, LOCATIONS ARE NOT EXACT; CONTRACTOR SHALL VERIFY PRIOR TO CONSTRUCTION. OTHER UTILITIES MAY EXIST THAT ARE NOT DEPICTED IN THE PLAN.

vhb.com

40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 50 100 200Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK | Checked by CHS

Issued for: Review | Date: June 30 2023

Not Approved for Construction

Drawing Title
Meadow's Edge
Site Plan

Drawing Number
C3.01

Sheet 7 of 12

Project Number
58644.06

Summary Table

MEADOW'S EDGE	QUANTITY	UNITS
DRAINAGE AREA	25.595	AC
IMPERVIOUS AREA	8.728	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.284	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	13.343	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	13.343	KG/YR
PROPOSED TREATMENT P REDUCTION	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	8.140	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	8.140	KG/YR
ESTIMATED COST	$950,000	
NOTE: GRAVEL WETLAND 61% P REMOVAL.		
PROJECT COORDINATES - N44°31'05.0" W73°03'26.4"		

vhb.com
vhb
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 10 20 40Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK | Checked by CHS

Issued for Review | Date June 30 2023

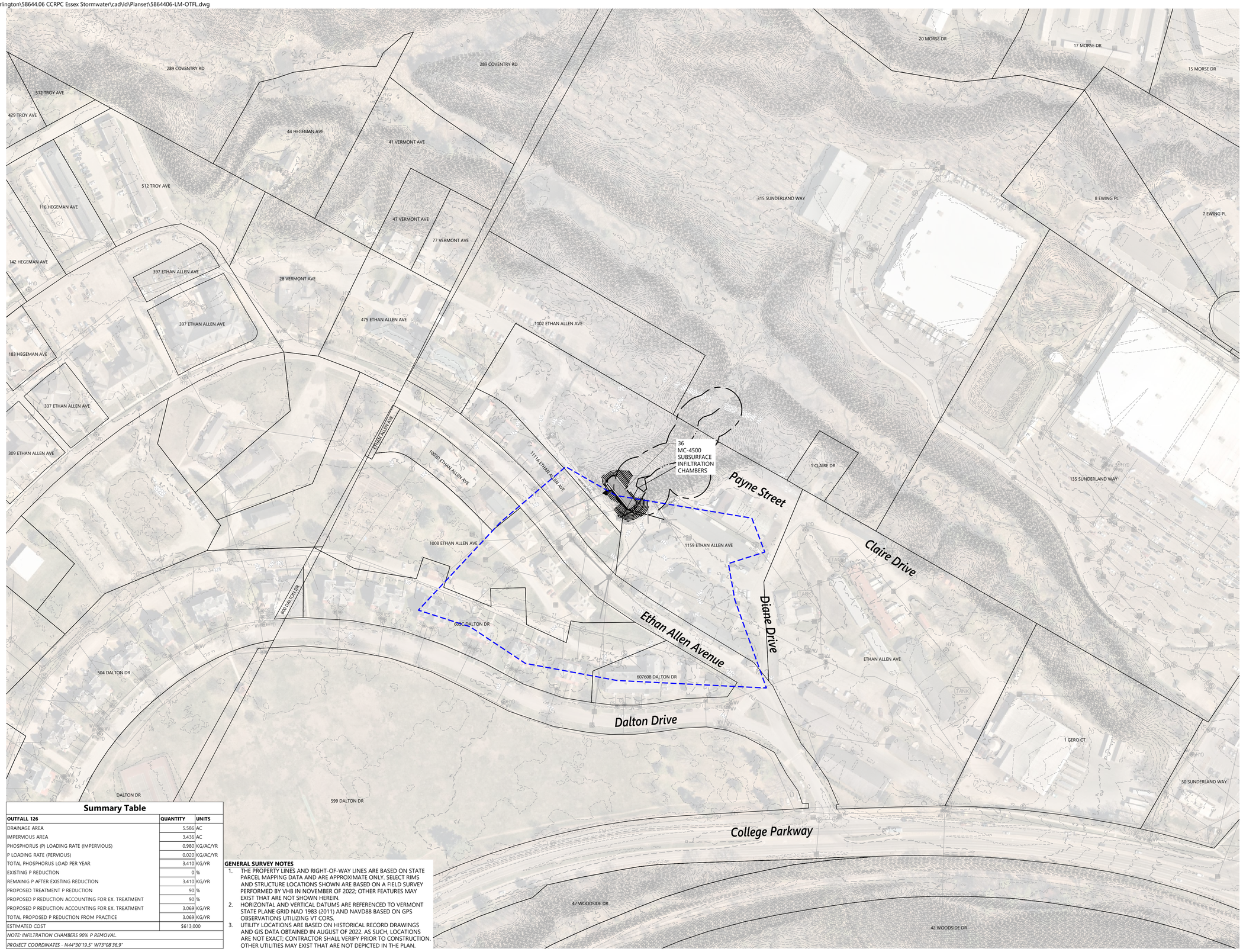
Not Approved for Construction

Drawing Title
Meadow's Edge Stormwater Practice

Drawing Number
C3.02

Sheet 8 of 12

Project Number 58644.06



Summary Table		
OUTFALL 126	**QUANTITY**	**UNITS**
DRAINAGE AREA	5.586	AC
IMPERVIOUS AREA	3.436	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.020	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	3.410	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	3.410	KG/YR
PROPOSED TREATMENT P REDUCTION	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	3.069	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	3.069	KG/YR
ESTIMATED COST	$613,000	
NOTE: INFILTRATION CHAMBERS 90% P REMOVAL.		
PROJECT COORDINATES - N44°30'19.5" W73°08'36.9"		

GENERAL SURVEY NOTES

1. THE PROPERTY LINES AND RIGHT-OF-WAY LINES ARE BASED ON STATE PARCEL MAPPING DATA AND ARE APPROXIMATE ONLY. SELECT RIMS AND STRUCTURE LOCATIONS SHOWN ARE BASED ON A FIELD SURVEY PERFORMED BY VHB IN NOVEMBER OF 2022; OTHER FEATURES MAY EXIST THAT ARE NOT SHOWN HEREIN.
2. HORIZONTAL AND VERTICAL DATUMS ARE REFERENCED TO VERMONT STATE PLANE GRID NAD 1983 (2011) AND NAVD88 BASED ON GPS OBSERVATIONS UTILIZING VT CORS.
3. UTILITY LOCATIONS ARE BASED ON HISTORICAL RECORD DRAWINGS AND GIS DATA OBTAINED IN AUGUST OF 2022. AS SUCH, LOCATIONS ARE NOT EXACT; CONTRACTOR SHALL VERIFY PRIOR TO CONSTRUCTION. OTHER UTILITIES MAY EXIST THAT ARE NOT DEPICTED IN THE PLAN.

vhb.com
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 50 100 200Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd

Designed by ERK | Checked by CHS

Issued for: Review | Date: June 30 2023

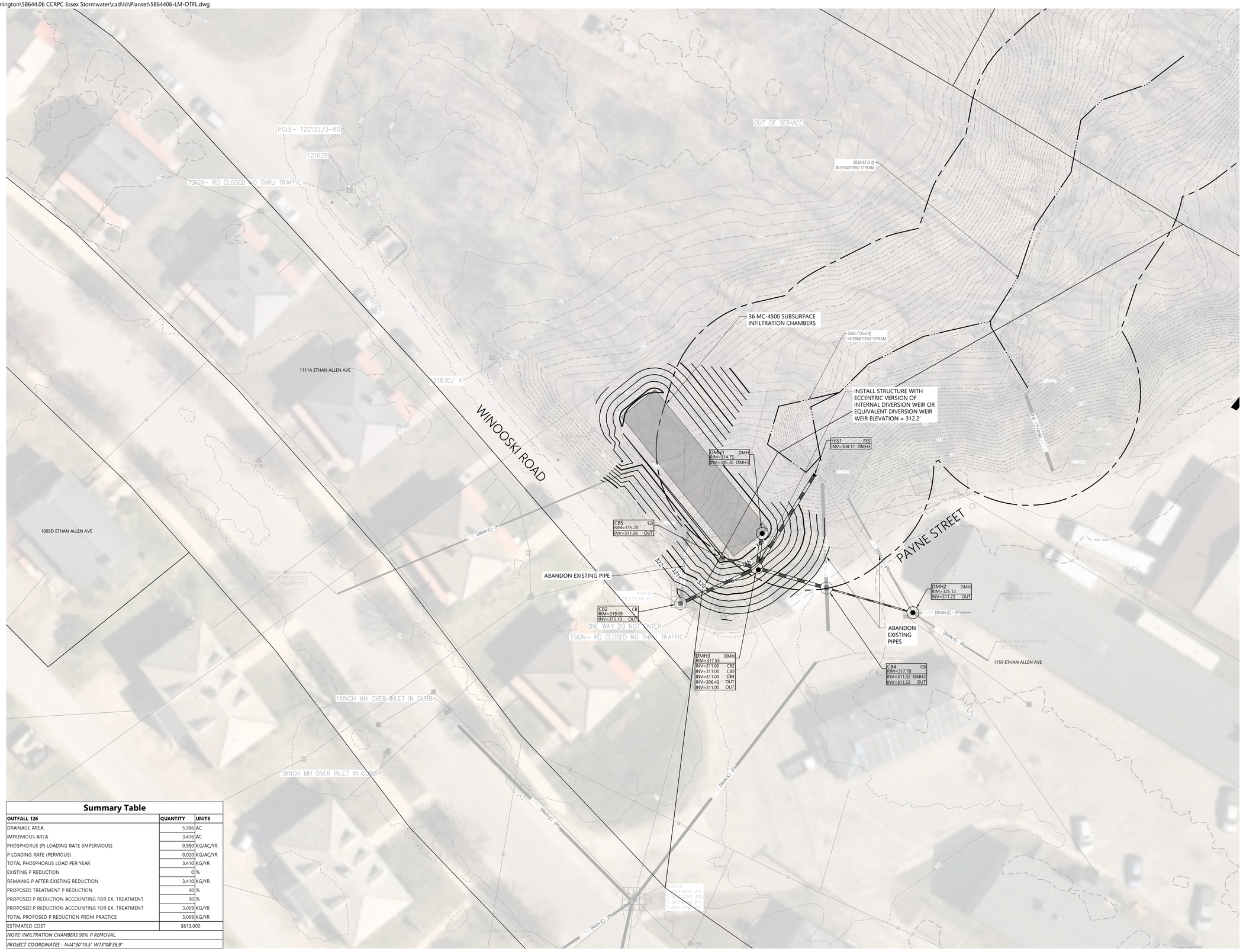
Not Approved for Construction

Drawing Title
Outfall 126
Site Plan

Drawing Number
C4.01

Sheet 9 of 12

Project Number
58644.06



Summary Table		
OUTFALL 126	**QUANTITY**	**UNITS**
DRAINAGE AREA	5.586	AC
IMPERVIOUS AREA	3.436	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.020	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	3.410	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	3.410	KG/YR
PROPOSED TREATMENT P REDUCTION	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	3.069	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	3.069	KG/YR
ESTIMATED COST	$613,000	
NOTE: INFILTRATION CHAMBERS 90% P REMOVAL.		
PROJECT COORDINATES - N44°30'19.5" W73°08'36.9"		

vhb.com
vhb
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

0 10 20 40 Feet

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by ERK | Checked by CHS

Issued for Review | Date June 30 2023

Not Approved for Construction

Drawing Title
Outfall 126
Stormwater Practice

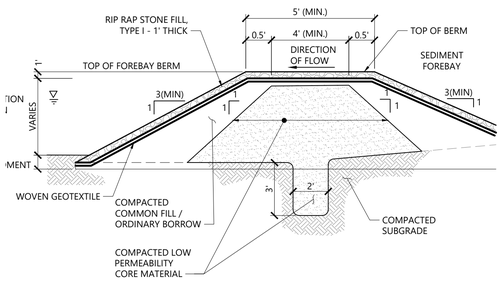
Drawing Number
C4.02

Sheet 10 of 12

Project Number
58644.06

NOTES

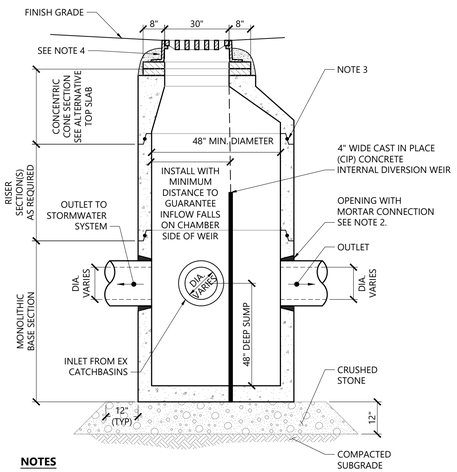
1. CORE MATERIAL SHALL HAVE A PERMEABILITY OF LESS THAN 1X10^-5 INCHES PER HOUR.
2. THE BERM SECTION MAY BE BASED ON THE RESULTS OF FURTHER GEOTECHNICAL INVESTIGATIONS.
3. SEE SPECIFICATIONS FOR EMBANKMENT MATERIALS.



Sediment Forebay Berm

1/16

N.T.S. Source: VHB REV LD_164



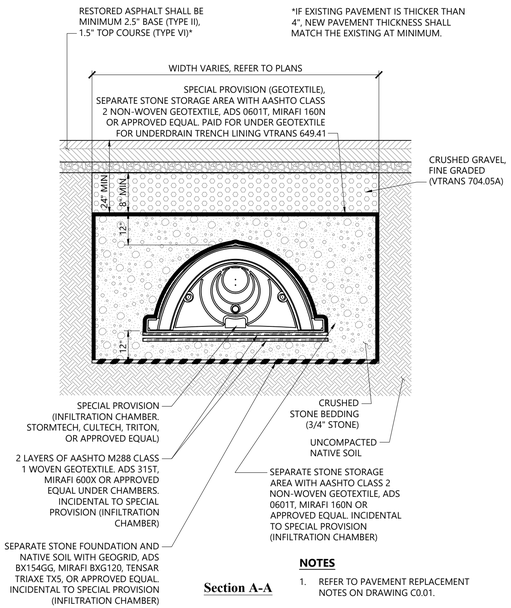
NOTES

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. PROVIDE OPENINGS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
4. CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM).
5. PROVIDE HOODED OUTLET PIPES AS DEPICTED ON CATCH BASIN DETAIL, ONLY FOR PIPES WHICH OUTLET TO EITHER A MAINTENANCE ACCESS MANHOLE OR THE COMBINED SEWER SYSTEM

Catch Basin with Internal Diversion Weir

7/22

N.T.S. Source: VHB LD_100



Section A-A

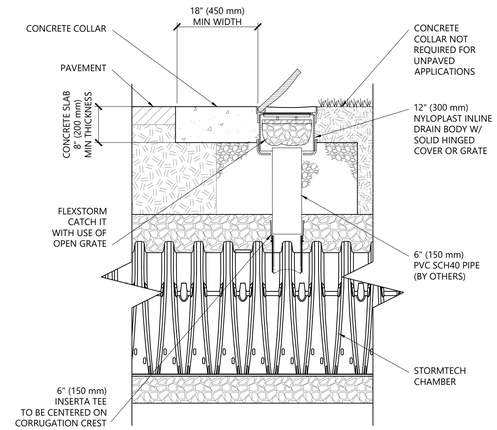
NOTES

1. REFER TO PAVEMENT REPLACEMENT NOTES ON DRAWING C0.01.

Infiltration Chamber Section

3/22

N.T.S. Source: VHB LD_

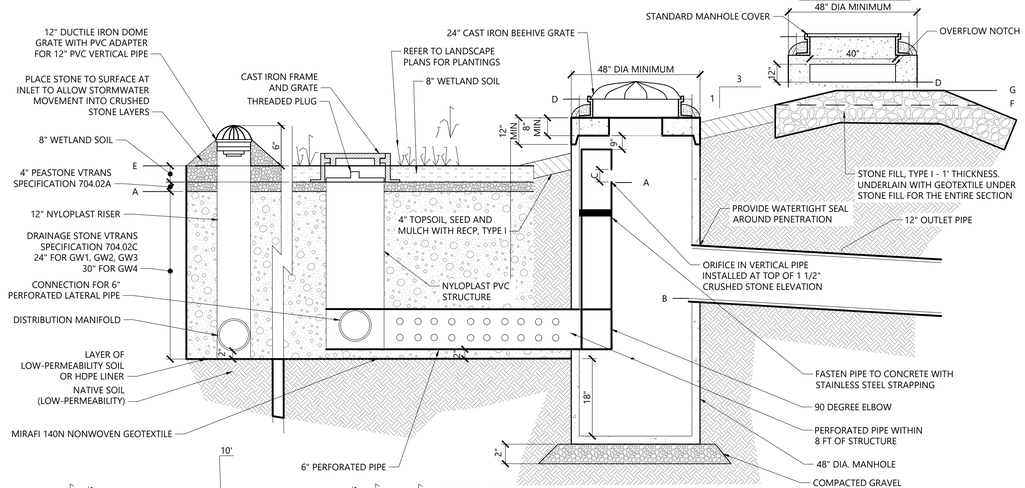


Stormtech 6" Inspection Port Detail

1/17

N.T.S. Source: VHB LD_

Alternate OCS Top



GRAVEL WETLAND TYPICAL

OVERFLOW STONE SWALE

NOTES

1. GRASSED SIDE SLOPES WITHIN TREATMENT WETLANDS SHALL HAVE 3:1 SIDE SLOPES MAXIMUM.
2. GRAVEL WETLAND MEDIA (CRUSHED STONE, 2") SHALL EXTEND LATERALLY TO THE LIMITS OF THE ELEVATION OF THE 3/8" CRUSHED STONE LAYER WITHIN THE BAYS.
3. NO WOODY VEGETATION >2" IN DIAMETER SHALL BE PLANTED OR ALLOWED TO GROW ON THE DAM, WITHIN 15' OF THE DAM OR TOE OF THE EMBANKMENT, OR WITHIN 25' OF A PRINCIPAL SPILLWAY OUTLET

Gravel Wetland Elevations/Dimensions

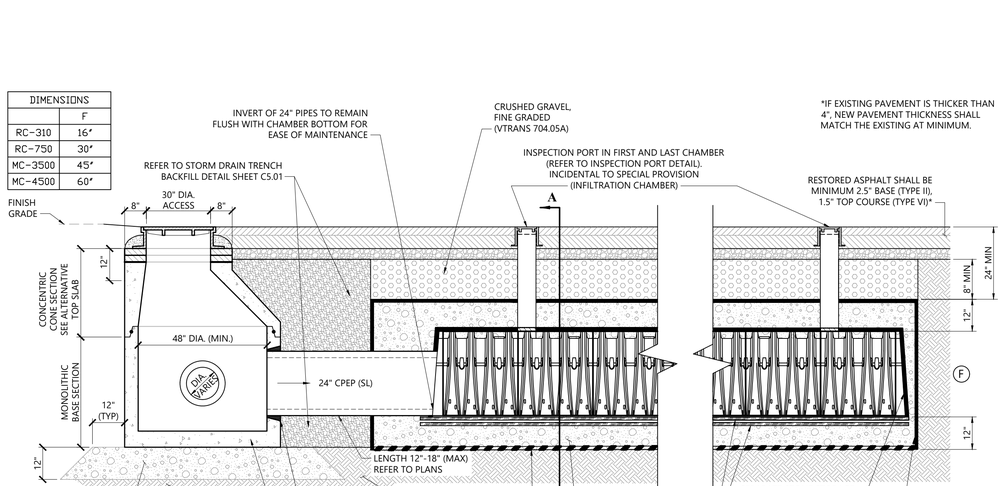
	GRAVEL WETLAND
Location	
A	
B	
C	
D	
E	
F	
G	

Gravel Wetland (Single Bay)

10/21

N.T.S. Source: VHB LD_VT

DIMENSIONS	
	F
RC-310	16'
RC-750	30'
MC-3500	45'
MC-4500	60'



NOTES

1. ALL MANHOLE AND CATCH BASIN SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. REFER TO PAVEMENT REPLACEMENT NOTES ON DRAWING C0.01.

Typical Profile - Infiltration Chamber

7/22

N.T.S. Source: VHB LD_

vhb.com
40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by WAF Checked by CHS

Issued for Review Date June 30 2023

Not Approved for Construction

Drawing Title
Site Details

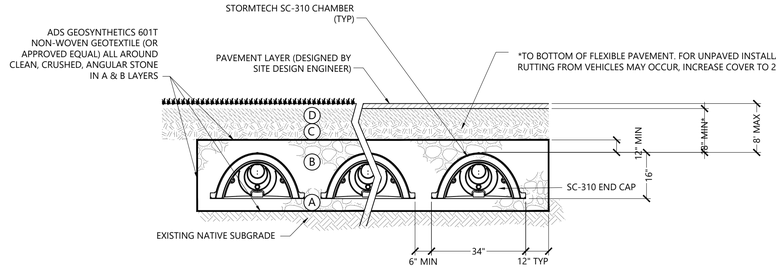
Drawing Number
C5.01

Sheet 11 of 12

Project Number
58644.06

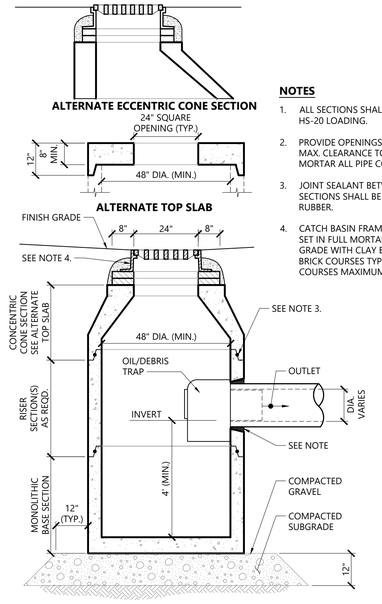
NOTES

1. FOR ALL SYSTEMS INSTALL ISOLATOR ROW GEOTEXTILE IN ACCORDANCE WITH MANUFACTURERS GUIDANCE. INSTALL ISOLATOR ROWS AS SHOWN ON SYSTEM PLAN VIEWS.
2. THE CONTRIBUTING DRAINAGE AREA TO EACH SYSTEM SHALL HAVE DENSE AND VIGOROUS VEGETATIVE COVER, AND SHALL RECEIVE FINAL STABILIZATION PRIOR TO ACCEPTING RUNOFF.



Typical Section - Stormtech SC 310 System

N.T.S. Source: VHB 11/16 LD_



NOTES

1. ALL SECTIONS SHALL BE DESIGNED FOR HS-20 LOADING.
2. PROVIDE OPENINGS FOR PIPES WITH 2" MAX. CLEARANCE TO OUTSIDE OF PIPE. MORTAR ALL PIPE CONNECTIONS.
3. JOINT SEALANT BETWEEN PRECAST SECTIONS SHALL BE PREFORMED BUTYL RUBBER.
4. CATCH BASIN FRAME AND GRATE SHALL BE SET IN FULL MORTAR BED. ADJUST TO GRADE WITH CLAY BRICK AND MORTAR (2 BRICK COURSES TYPICALLY, 5 BRICK COURSES MAXIMUM).

Deep Sump Catch Basin

N.T.S. Source: VHB 9/20 LD_VT

vhb.com

vhb

40 IDX Dr
Building 100 Suite 200
South Burlington, VT 05403
802.497.6100

CCRPC
Essex Stormwater

Essex, VT 05452

No.	Revision	No.	Date	Appvd.

Designed by WAF | Checked by CHS

Issued for Review | Date June 30 2023

Not Approved for Construction

Drawing Title
Site Details

Drawing Number
C5.02

Sheet 12 of 12

Project Number
58644.06

Saved Friday, June 9, 2023 3:27:18 PM EKAMMAN Plotted Friday, June 30, 2023 7:21:07 PM Chris Halle-Sills

Memorandum

To: Annie Costandi, PE
5 Jericho Road
Essex, VT 05452

Date: 6/30/2023

Project #: 58644.06

From: Chris Hale-Sills, PE
Peter Smiar, PE

Re: Autumn Knoll Retrofits Design Summary

Existing Conditions

Autumn Knoll is a residential subdevelopment located along Irene Avenue and Marion Avenue in Essex Vermont. The landscape is mostly residential with lawn and landscaped areas that give way to surrounding woods outside of the existing property boundaries. There is an existing wet pond stormwater practice located next to 4 Irene Avenue, built post 2002. NRCS soil mapping shows the primary soils on site as Munson and Raynham Silt Loams, HSG C/D, and on-site soil testing by VHB in 2023 confirmed poor conditions for infiltration due to high groundwater and dense silty material.

Proposed Design and Constraints

For this project, a gravel wetland with sediment forebay is proposed in the location of the existing wet pond. The practice was designed to meet current stormwater standards for the water quality volume, and has not been evaluated for full permit compliance for larger storms (1-year and above). The practice is, however, still sized to safely convey storms up to and including the 100-year event. Estimated cost for this project is $378,000 which includes a 20% contingency.

The largest constraint for this project is the outlet pipe, which drains north to a channel draining to a wetland. This channel sits in the wetland's buffer, and VHB worked to avoid any new work in said buffer. This invert, combined with the inlet invert, and the water quality volume requirements of a gravel wetland, drives the design, and required the expansion of the practice beyond it's current borders.

AUTUMN KNOLL (Loading from DEC's 2022 Phosphorus SOP)	**QUANTITY**	**UNITS**
DRAINAGE AREA	5.417	AC
IMPERVIOUS AREA	3.024	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.986	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.438	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	4.030	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	4.030	KG/YR
PROPOSED TREATMENT P REDUCTION	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	2.458	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	2.458	KG/YR

Memorandum

To: Annie Costandi, PE
5 Jericho Road
Essex, VT 05452

Date: 6/30/2023

Project #: 58644.06

From: Chris Hale-Sills, PE
Peter Smiar, PE

Re: Meadows Edge/Steeplebush Retrofits Design Summary

Existing Conditions

The Meadows Edge/Steeplebush project is located in a residential neighborhood along Clover Drive between Thrush Lane and Bluestem Road in Essex Vermont. The landscape is mostly residential with lawn and landscaped areas, and a large meadow to the west. There is an existing wet pond located in the meadow to the west, built pre 2002. The meadow area is heavily overgrown, and the existing practice may not function as intended in its current state. NRCS soil mapping shows the primary soils on site as Scantic and Cabot Silt Loams, HSG C/D and D respectively. On-site soil testing by VHB in 2023 confirmed poor conditions for infiltration due to high groundwater and dense silty material.

Proposed Design and Constraints

For this project, a gravel wetland with sediment forebay is proposed in the location of the existing wet pond. The practice was designed to meet current stormwater standards for the water quality volume, and has not been evaluated for full permit compliance for larger storms (1-year and above). The practice is sized to safely convey 100-year storm. Estimated cost for this project is $950,000 which includes a 20% contingency.

The largest constraint for this project is the potential on-site wetland areas. Because the practice was built so long ago, and not well maintained, many areas of the field may be considered wetlands. VHB determined that the best solution would be disturbing only the area in the meadow originally designed to be a wet pond, and any necessary inflow pipe changes. This project has an additional challenge of attempting to connect the drainage area and outfall immediately to the North, at Clover Drive and Cedar Street. This connection, and a desire to avoid wetland disturbance, results in a very long and large drainage pipe at an extremely shallow slope (0.3%), in order to reach the required outfall invert.

MEADOW'S EDGE	QUANTITY	UNITS
DRAINAGE AREA	25.595	AC
IMPERVIOUS AREA	8.728	AC
PHOSPHORUS (P) LOADING (IMPERVIOUS)	0.758	KG/AC/YR
P LOADING (PERVIOUS)	0.011	KG/AC/YR
TOTAL P	6.801	KG/YR
EXISTING P REDUCTION	0	%
REMAIN P AFTER EXISTING REDUCTION	6.801	KG/YR
PROPOSED TREATMENT P REDUCTION	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	61	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	4.149	KG/YR
PROPOSED TREATMENT P REDUCTION OF TOTAL P	4.149	KG/YR

Memorandum

To: Annie Costandi, PE
5 Jericho Road
Essex, VT 05452

Date: 6/30/2023

Project #: 58644.06

From: Chris Hale-Sills, PE
Peter Smiar, PE

Re: EX-WR-041 to 43 Logwood Circle Retrofit Design Summary

Existing Conditions

Logwood Circle is a residential area located between Greenbriar Drive and Baker Street near VT Route 117. These three projects include sections of drainage pipe that need to be replaced regardless due to deterioration. The surrounding landscape is residential with lawn and landscaped areas giving way to wooded areas behind back yards, and in the middle area of the circle, which is separately drained. There is no existing water quality treatment system on site, but a closed drainage system conveys stormwater to Baker Street in the south. NRCS soil mapping shows the primary soils on site as Adams and Windsor loamy sands, HSG A. On-site soil testing by VHB in 2023 confirmed good soil quality for infiltration, and a tested infiltration rate of 22.6 in/hr (reduced to 11.3 in/hr for calculations per the VT 2017 Stormwater Management Manual).

Proposed Design and Constraints

For this project, two sets of subsurface infiltration chambers are proposed one at the intersection of Logwood Circle and Baker Street, and one on the east side of Logwood Circle. The practices were designed to meet current stormwater standards for the water quality volume, and have not been evaluated for full permit compliance for larger storms (1-year and above). The practices are both offline, and will let stormwater flow according to existing drainage patterns during larger storm events. Estimated cost for this project is $647,000, which includes a 20% contingency.

The largest constraints for this project are the water table depth at the Baker Street intersection, and the inverts of existing drainage pipes. For the most part, existing utilities appear to be to the sides of the right-of-way.

LOGWOOD CIRCLE (Loading from DEC's 2022 Phosphorus SOP)	QUANTITY	UNITS
DRAINAGE AREA	11.203	AC
IMPERVIOUS AREA	3.942	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.020	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	4.008	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	4.008	KG/YR
PROPOSED TREATMENT P REDUCTION	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	3.607	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	3.607	KG/YR

Memorandum

To: Annie Costandi, PE
5 Jericho Road
Essex, VT 05452

Date: 6/30/2023

Project #: 58644.06

From: Chris Hale-Sills, PE
Peter Smiar, PE

Re: Outfall 126 Retrofit Design Summary

Existing Conditions

Outfall 126 is the confluence of several drainage systems located in the Fort Ethan Allen area of Essex. The outfalls lie in a wooded area near Winooski Road and Payne Street. The surrounding landscape is residential with lawn and landscaped areas, and wooded areas to the northeast. There is no existing treatment. Water drains to an intermittent tributary, then to Sunderland Brook. NRCS soil mapping shows the primary soils on site as Adams and Windsor loamy sands, HSG A. On-site soil testing by VHB in 2023 confirmed good soil quality for infiltration, and a tested infiltration rate of 12.2 in/hr (reduced to 6.1 in/hr for calculations per the VT 2017 Stormwater Management Manual).

Proposed Design and Constraints

For this project, subsurface infiltration chambers are proposed in a location best suited to balance cut and fill, and to intercept as many drainage pipes as possible. The practice was designed to meet current stormwater standards for the water quality volume, and has not been evaluated for full permit compliance for larger storms (1-year and above). The practice is, however, offline, and sized to safely convey storms up to and including the 100-year event. Estimated cost for this project is $613,000 which includes a 20% contingency.

The largest constraints for this project are the volume of cut and fill needed to install the subsurface chambers in an wooded gulley area, and the difficulty in intercepting the four (4) existing drainage pipes. The existing drainage pipes proved difficult to locate due to underbrush, and at least one structure that appears to be paved over (south of proposed CB4). Consideration was given to keeping the installed system low enough to allow flexibility for inlet pipes.

OUTFALL 126 (Loading from DEC's 2022 Phosphorus SOP)	QUANTITY	UNITS
DRAINAGE AREA	5.586	AC
IMPERVIOUS AREA	3.436	AC
PHOSPHORUS (P) LOADING RATE (IMPERVIOUS)	0.980	KG/AC/YR
P LOADING RATE (PERVIOUS)	0.020	KG/AC/YR
TOTAL PHOSPHORUS LOAD PER YEAR	3.410	KG/YR
EXISTING P REDUCTION	0	%
REMAINIG P AFTER EXISTING REDUCTION	3.410	KG/YR
PROPOSED TREATMENT P REDUCTION	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	90	%
PROPOSED P REDUCTION ACCOUNTING FOR EX. TREATMENT	3.069	KG/YR
TOTAL PROPOSED P REDUCTION FROM PRACTICE	3.069	KG/YR

Appendix B, Table B-5: Details for PCP Projected Stormwater Treatment Practices

ID	Site Name	Land Owner	MS4	Permit No.	Year Planned	BMP Status	FRP	LC TMDL Drainage Area	LC TMDL Lake Segment	BMP Type	Impervious area (acres)	Pervious area (acres)	Storage volume (ft^3)	P Base Load Before Treatment (kg/yr)	Practice Efficiency (%)	P Credit (kg/yr)	% of P Target Reduction	Estimated Implementation Cost ($2021)	$/CF managed	$/acre impervious managed	$/kg P/yr managed
EJ-WR-026	Loubier Drive cul de sacs impervious removal	City	Essex Junction MS4		2027	Planned	n/a	Winooski River	Main Lake	Impervious removal	0.19	0.00	n/a	0.22	97.2%	0.21	0.9%	$10,000	n/a	$52,632	$47,619
EJ-WR-027	CB54 and CB55 Killoran Drive drywells	City	Essex Junction MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.31	0.44	1,194	0.36	100.0%	0.36	1.6%	$23,900	$20	$77,097	$67,311
EJ-WR-028	CB56 and CB57 Killoran Drive drywells	City	Essex Junction MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.91	0.96	3,154	1.04	99.6%	1.03	4.6%	$63,100	$20	$69,341	$61,144
EJ-WR-029	CB1425 Killoran Drive drywell	City	Essex Junction MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.41	0.32	1,472	0.46	99.8%	0.46	2.1%	$29,500	$20	$71,951	$63,630
EJ-WR-030	Killoran Drive cul de sac impervious removal	City	Essex Junction MS4		2029	Planned	n/a	Winooski River	Main Lake	Impervious removal	0.05	0.00	n/a	0.06	100.0%	0.06	0.3%	$2,500	n/a	$50,000	$41,667
EJ-WR-031	CB35 Cascadnac Ave drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.43	0.17	1,586	0.48	100.0%	0.48	2.1%	$31,800	$20	$73,953	$65,742
EJ-WR-032	CB36 Cascadnac Ave drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.14	0.17	639	0.16	100.0%	0.16	0.7%	$12,800	$20	$91,429	$80,110
EJ-WR-033	CB37 Cascadnac Ave drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.11	0.20	541	0.13	99.0%	0.13	0.6%	$10,900	$20	$99,091	$86,740
EJ-WR-034	CB42 Cascadnac and Owaissa Ave drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.19	0.19	802	0.22	98.5%	0.21	0.9%	$16,100	$20	$84,737	$75,664
EJ-WR-035	CB43 Owaissa and Wenonah drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.23	0.16	933	0.26	98.4%	0.26	1.1%	$18,700	$20	$81,304	$73,085
EJ-WR-036	CB44 Wenonah Ave drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.19	0.21	802	0.22	98.5%	0.21	0.9%	$16,100	$20	$84,737	$75,536
EJ-WR-037	CB706 Wenonah & Owaissa drywell	City	Essex Junction MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.13	0.10	606	0.15	99.0%	0.15	0.6%	$12,200	$20	$93,846	$83,724
EJ-WR-038	Tyler Drive, Wilkinson Drive - South St. intersection - retrofit/expand	City	Essex Junction MS4		2025	Planned	n/a	Winooski River	Main Lake	Infiltration Basin	7.86	5.46	28,096	8.89	99.8%	8.87	39.3%	$168,600	$6	$21,450	$19,000
EX-WR-002	CB772-775 Foster Rd drywells	Town	Essex Town MS4		2034	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	1.34	2.42	4,559	1.55	99.5%	1.54	4%	$91,200	$20	$68,060	$59,329
EX-WR-003	CB884 CB885 Saxonhollow drywells	Town	Essex Town MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.65	1.57	2,305	0.76	99.6%	0.76	2%	$46,200	$20	$71,077	$61,039
EX-WR-004	CB889 CB890 CB891 Saxonhollow and Hillside drywells	Town	Essex Town MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.77	1.66	2,697	0.89	99.6%	0.89	2%	$54,000	$20	$70,130	$60,712
EX-WR-005	CB892 893 894 895 Saxonhollow Hillside drywells	Town	Essex Town MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.71	1.00	2,501	0.81	99.7%	0.81	2%	$50,100	$20	$70,563	$61,819
EX-WR-006	CB897 898 Hillside Ave drywells	Town	Essex Town MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.44	0.78	1,619	0.51	99.8%	0.51	1%	$32,400	$20	$73,636	$64,005
EX-WR-007	CB898 899 Hillside Ave drywells	Town	Essex Town MS4		2029	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.29	0.74	1,129	0.34	98.0%	0.33	1%	$22,600	$20	$77,931	$68,098
EX-WR-008	CB1046-1050 Sand Hill Rd drywells	Town	Essex Town MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.87	2.49	3,024	1.02	99.5%	1.02	2%	$60,500	$20	$69,540	$59,539
EX-WR-009	CB957-960 Greenbriar Dr drywells	Town	Essex Town MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.77	1.22	2,697	0.88	99.6%	0.88	2%	$54,400	$20	$70,649	$61,732
EX-WR-010	CB964 968-970 Greenfield Rd drywells	Town	Essex Town MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	1.09	2.53	3,743	1.86	93.5%	1.74	4%	$74,900	$20	$68,716	$43,050
EX-WR-011	CB1120 1121 Wildwood Dr drywells	Town	Essex Town MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.24	0.54	949	0.38	96.1%	0.36	1%	$19,000	$20	$80,851	$52,545
EX-WR-012	CB1122 1123 Wildwood Dr drywells	Town	Essex Town MS4		2032	Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.23	0.36	933	0.35	96.3%	0.34	1%	$18,700	$20	$81,304	$55,765
EX-WR-039	2OLET88 Tanglewood Drive and Fern Hollow Road retrofits (Alternative 4)	Town	Essex Town MS4		2026	Planned	n/a	Winooski River	Main Lake	Dry Swale (w/ underdrain)	6.66	11.50	18,774	10.10	44.0%	4.44	10%	$410,000	$22	$61,565	$92,302
EX-WR-040	2OLET56 Craftsbury Court pond retrofit	Town	Essex Town MS4	3581-9010.F	2034?	Planned	n/a	Winooski River	Main Lake	Gravel Wetland	2.55	7.31	20,100	5.51	63.0%	2.81	6%	$341,700	$17	$134,000	$121,678

Note: n/a = not applicable

Appendix B, Table B-6: Details for Projected Stormwater Treatment Practices Not Advanced in PCP

ID	Site Name	Land Owner	MS4	Permit No.	BMP Status	FRP	LC TMDL Drainage Area	LC TMDL Lake Segment	BMP Type	Impervious area (acres)	Pervious area (acres)	Storage volume (ft^3)	P Base Load Before Treatment (kg/yr)	Practice Efficiency (%)	P Credit (kg/yr)	% of P Target Reduction	Estimated Implementation Cost ($2021)	$/CF managed	$/acre impervious managed	$/kg P/yr managed
EJ-MB-001	Briar Lane cul-de-sac impervious removal	City	Essex Junction MS4		Planned	Indian Brook	Malletts Bay Direct Drainage	Malletts Bay	Impervious removal	0.17	0.00	n/a	0.14	98.5%	0.14	1.5%	$2,500	n/a	$14,706	$17,857
EJ-WR-001	Maplewood Lane cul-de-sac	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Sand filter (w/ underdrai	0.60	1.12	2,142	1.01	49.4%	0.50	2.2%	$49,300	$23	$82,167	$98,883
EJ-WR-002	CB754 and CB755 Oak St drywells	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.23	0.24	837	0.26	99.9%	0.26	1.2%	$16,800	$20	$73,043	$64,279
EJ-WR-003	CB756 Oak St drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.23	0.24	837	0.26	99.9%	0.26	1.2%	$16,800	$20	$73,043	$64,279
EJ-WR-004	CB541 Camp drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.26	0.16	926	0.29	97.6%	0.29	1.3%	$18,600	$20	$71,538	$64,877
EJ-WR-005	CB542 Camp drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.20	0.10	708	0.23	97.6%	0.22	1.0%	$14,200	$20	$71,000	$64,538
EJ-WR-006	CB543 Camp drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.05	0.20	209	0.06	98.1%	0.06	0.3%	$4,200	$20	$84,000	$71,535
EJ-WR-007	CB544 Camp drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.09	0.16	339	0.10	97.9%	0.10	0.4%	$6,800	$20	$75,556	$66,975
EJ-WR-008	CB538 Camp and Jackson drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.19	0.42	731	0.22	98.0%	0.22	1.0%	$14,700	$20	$77,368	$68,015
EJ-WR-009	CB536 Jackson drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.25	0.77	1,002	0.29	98.0%	0.29	1.3%	$20,100	$20	$80,400	$69,578
EJ-WR-010	CB537 Jackson and Grant drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.23	0.27	842	0.26	97.8%	0.26	1.1%	$16,900	$20	$73,478	$65,904
EJ-WR-011	CB535 Grant and Jackson drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.15	0.21	555	0.17	97.8%	0.17	0.7%	$11,200	$20	$74,667	$66,674
EJ-WR-012	CB531 Jackson and Wrisley drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.15	0.21	555	0.17	97.8%	0.17	0.7%	$11,200	$20	$74,667	$66,674
EJ-WR-013	CB532 MCGregor and Jackson drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.14	0.13	506	0.16	97.7%	0.16	0.7%	$10,200	n/a	$72,857	$65,663
EJ-WR-014	CB546 McGregor and Grant drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.33	0.26	1,185	0.37	97.7%	0.37	1.6%	$23,800	$20	$72,121	$65,182
EJ-WR-015	CB533 Jackson and McGregor drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.68	0.64	2,461	0.77	97.7%	0.75	3.3%	$49,300	$20	$72,500	$65,325
EJ-WR-017	CB525 Elm and Jackson drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.18	0.30	675	0.21	97.9%	0.20	0.9%	$13,600	$20	$75,556	$67,119
EJ-WR-018	CB521 Elm St drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.32	0.31	1,160	0.36	97.7%	0.36	1.6%	$23,200	$20	$72,500	$65,290
EJ-WR-019	CB522 Elm St drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.16	0.39	623	0.19	98.0%	0.18	0.8%	$12,500	$20	$78,125	$68,385
EJ-WR-020	CB523 Elm and Jackson drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	1.33	0.23	4,628	1.49	99.8%	1.49	6.6%	$92,600	n/a	$69,624	$62,282
EJ-WR-022	CB90 Loubier Drive drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.81	0.88	2,953	0.92	99.9%	0.92	4.1%	$59,100	$20	$72,963	$64,157
EJ-WR-023	CB91 Loubier Drive drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.43	0.72	1,614	0.49	99.9%	0.49	2.2%	$32,300	$20	$75,116	$65,337
EJ-WR-024	CB92 Loubier Drive drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.43	0.89	1,644	0.50	100.0%	0.50	2.2%	$32,900	$20	$76,512	$66,071
EJ-WR-025	CB757 Loubier Drive drywell	City	Essex Junction MS4		Planned	n/a	Winooski River	Main Lake	Infiltration Trench	0.21	0.75	860	0.25	100.0%	0.25	1.1%	$17,300	$20	$82,381	$69,319
3081-9010.R	Perkins Bend 002 impervious	Town	Essex Town MS4	3081-	Planned	n/a	Winooski River	Main Lake	Impervious removal	0.30	0.00	n/a	0.31	96.8%	0.30	1%	$2,500	n/a	$8,333	$8,333
3579-9010.R	Old Stage Village S/N 001 RETROFIT	Town	Essex Town MS4	3579-9010.R	Planned	n/a	Winooski River	Main Lake	Dry Swale (w/ underdrain)	4.18	33.60	13,838	12.43	38.7%	4.81	11%	$263,000	$19	$62,919	$54,678
Outfall 199	Outfall 199-Morse Dr.	Town	Essex Town MS4		Planned	Sunderla	Winooski River	Main Lake	Infiltration Trench	5.18	3.00	5,009	6.48	80.2%	5.20	11.92%	$38,600	$8	$7,452	$7,425

Note: n/a = not applicable

Appendix C – Credit Calculation Details for Road Drainage Outlet Stabilization BMPs

							Equation 1: Rate of Erosion, E = (VS)/T								Equation 2: Phosphorus Loading Rate, P = E (Sc)		Phosphorus Load Reduction Efficiency and Credit	
										V		S	T	E	Sc	P		
MS4	Outlet Unique ID	Essex Outlet ID	Lake Drainage Area	Erosion type	Assessment Reason	Meets Standards?	Erosion length measured from outlet (ft)	Erosion width (ft)	Erosion depth (ft)	Erosion Volume From Outlet (ft3)	Erosion Volume (yd3)	Sediment bulk density (kg/ft3)	Age of erosion observed (yrs)	Sediment erosion rate (kg sediment/yr)	Sediment to phosphorus weight converstion (kg P/kg sediment)	P loading rate, pre-mitigation (kg/year)	Extent of erosion addressed (full or partial)	Phosphorus Reduction (kg/yr), 80% for full, 40% for partial
Essex Junction City	EJCT015	1OLET1146	Malletts Bay - DD	Sheet Flow or No	Reassessment	Fully Meets				-	-	35.08		-	0.000694	0.000		0.000
Essex Junction City	EJCT034	1OLET1149	Malletts Bay - DD	Sheet Flow or No	Work	Fully Meets				1,155	43	35.08	15	2,701	0.000694	1.875	Full	1.500
Essex Junction City	EJCT039	1OLET1158	Malletts Bay - DD	Sheet Flow or No	Work completed	Fully Meets				1,026	38	35.08	15	2,399	0.000694	1.665	Full	1.332
Essex Junction City	EJCT055	1OLET1085	Malletts Bay - DD	Rill Erosion	Reassessment	Partially Meets				90	3	35.08	5	629	0.000694	0.436	Partial	0.175
Essex Junction City	EJCT056	1OLET1090	Malletts Bay - DD	Sheet Flow or No	Work completed	Fully Meets				324	12	35.08	15	758	0.000694	0.526	Full	0.421
Essex Junction City	EJCT057	1OLET1091	Malletts Bay - DD	Sheet Flow or No	Work completed	Fully Meets				324	12	35.08	15	758	0.000694	0.526	full	0.421
Essex Junction City	EJCT065	1OLET1074	Malletts Bay - DD	Sheet Flow or No	Work completed	Fully Meets				4,800	178	35.08	15	11,226	0.000694	7.791	Full	6.233
Essex Junction City	EJCT066	1OLET1073	Malletts Bay - DD	Gully Erosion	Reassessment	Does Not Meet				180	7	35.08	15	421	0.000694	0.292		0.000
Essex Junction City	EJCT076	1OLET1117	Winooski River	Gully Erosion	Reassessment	Does Not Meet				336	12	35.08	15	786	0.000694	0.545		0.000
Essex Junction City	EJCT090	1OLET1023	Winooski River	Gully Erosion	Reassessment	Does Not Meet				165	6	35.08	15	386	0.000694	0.268		0.000
Essex	ESSX022	2OLET239	Lamoille River	Rill Erosion	Initial inventory	Partially Meets				27	1	35.08	5	189	0.000694	0.131	Partial	0.053
Essex	ESSX026	2OLET065	Winooski River	Sheet Flow or No	Work completed	Fully Meets				2,322	86	35.08	15	5,430	0.000694	3.769	Full	3.015
Essex	ESSX030	2OLET147	Winooski River	Sheet Flow or No	Initial inventory	Fully Meets				-	-	35.08		-	0.000694	0.000		0.000
Essex	ESSX031	2OLET150	Winooski River	Gully Erosion	Initial inventory	Does Not Meet				243	9	35.08	15	568	0.000694	0.394		0.000
Essex	ESSX033	2OLET123	Winooski River	Sheet Flow or No	Initial inventory	Fully Meets				-	-	35.08		-	0.000694	0.000		0.000
Essex	ESSX034	2OLET154	Winooski River	Sheet Flow or No	Initial inventory	Fully Meets				-	-	35.08		-	0.000694	0.000		0.000
Essex	ESSX035	2OLET153	Winooski River	Gully Erosion	Initial inventory	Does Not Meet				108	4	35.08	15	253	0.000694	0.175		0.000
Essex	ESSX036	2OLET152	Winooski River	Rill Erosion	Initial inventory	Partially Meets				54	2	35.08	5	379	0.000694	0.263	Partial	0.105
Essex	ESSX042	2OLET186	Winooski River	Rill Erosion	Initial inventory	Partially Meets				54	2	35.08	5	379	0.000694	0.263	Partial	0.105
Essex	ESSX043	2OLET125	Winooski River	Gully Erosion	Initial inventory	Does Not Meet				270	10	35.08	15	631	0.000694	0.438		0.000
Essex	ESSX051	2OLET187	Winooski River	Sheet Flow or No	Work completed	Fully Meets				216	8	35.08	15	505	0.000694	0.351	Full	0.280
Essex	ESSX053	2OLET068	Lamoille River	Gully Erosion	Initial inventory	Does Not Meet				405	15	35.08	15	947	0.000694	0.657		0.000
Essex	ESSX056	2OLET171	Winooski River	Rill Erosion	Initial inventory	Partially Meets				27	1	35.08	5	189	0.000694	0.131	Partial	0.053
Essex	ESSX062	2OLET112	Winooski River	Sheet Flow or No	Work completed	Fully Meets	120	10	7	8,400	311	35.08	15	19,645	0.000694	13.633	Full	10.907
Essex	ESSX064	2OLET118	Winooski River	Gully Erosion	Initial inventory	Does Not Meet				1,215	45	35.08	15	2,841	0.000694	1.972		0.000
Essex	ESSX065	2OLET119	Winooski River	Sheet Flow or No	Work	Fully Meets	16	11	6	1,056	39	35.08	5	7,409	0.000694	5.142	Full	4.113
Essex	ESSX066	2OLET172	Winooski River	Rill Erosion	Initial inventory	Partially Meets				54	2	35.08	5	379	0.000694	0.263	Partial	0.105

Appendix D – Gravel Road Stormwater Management Plan, Essex Town

To: Annie Costandi, P.E. – Director of Stormwater Operations
From: Evelyn Boardman, Frank Piasecki, and Evan Fitzgerald
Re: Gravel Road Improvement Plan for the Town of Essex
Date: September 1, 2022

Introduction

The Town of Essex hired Fitzgerald Environmental Associates (FEA) in the winter of 2021 to formulate an implementation plan that will outline the steps needed to bring hydrologically connected segments in Essex into compliance per the VTDEC Municipal Roads General Permit MRGP (VTDEC, 2018). Completed in December 2021, the plan outlined how the Town of Essex could meet the MRGP within allocated funding over the next (5) years.

In 2022, FEA has extended the plan to cover all gravel roads in the Town of Essex. FEA completed a Road Erosion Inventory (REI) of all non-hydrologically connected gravel roads that are not subject to the MRGP and applied unitized costs to estimate the total cost of the work. The updated plan includes all gravel roads (MRGP and non-MRGP), organized into annual work plans over the next ten (10) years. The anticipated work on Sawmill Road to be completed in 2022 is also presented in the work plans and tables.

Non-Hydrologically Connected Gravel Road Erosion Inventory

FEA generated 100-meter segments on all non-hydrologically connected gravel roads. Each road segment was visited and assessed following the MRGP guidance for hydrologically connected roads (VTDEC, 2018). The field application created by FEA required the direct entry of the percentage of crown, berm, and drainage compliance/noncompliance, following the data collection format used by CCRPC in the 2017 REI. This allows for better refined estimates of the extent and cost of road upgrades.

191 road segments were assessed in the spring of 2021. FEA applied the MRGP compliance logic to the non-MRGP segments and found that 99 (52%) would not meet MRGP standards and 74 (39%) would partially meet MRGP standards. The 19 segments (10%) that would fully meet MRGP standards were not included in cost estimates or work plans.

We assumed that all areas of noncompliance for drainage should be translated into length for ditch installation or improvement. Ditch costs generally drive the overall segment cost due to the higher cost of labor and materials relative to crown or berm improvements, as well as the higher frequency of required ditch work compared to culvert or conveyance improvements.

Cost Estimation

FEA provided the Town with unit costs for standard practices needed to bring road segments up to MRGP standards in 2021 (Table 1). These cost estimates were developed to support road erosion mitigation concept designs completed by FEA and Milone & MacBroom Inc. for towns in Chittenden County as part of a prior project (FEA & MMI, 2017). Town Staff reviewed the unit cost estimates and suggested revisions based on recent project costs for ditch installation. FEA updated the unit costs for cross-culvert or driveway culvert replacements, which have gone up due to recent supply shortages (Table 1). The remaining items were deemed adequate to cover the anticipated labor and materials costs to complete

the upgrades, accounting for future inflation. This determination accounted for the fact that the Town anticipates hiring private contractors to complete the majority of the MRGP upgrades.

FEA and the Town reviewed the Town budget allocation for gravel road upgrades and opportunities for grant funding during the kick-off meeting. Known funding considerations are listed below:

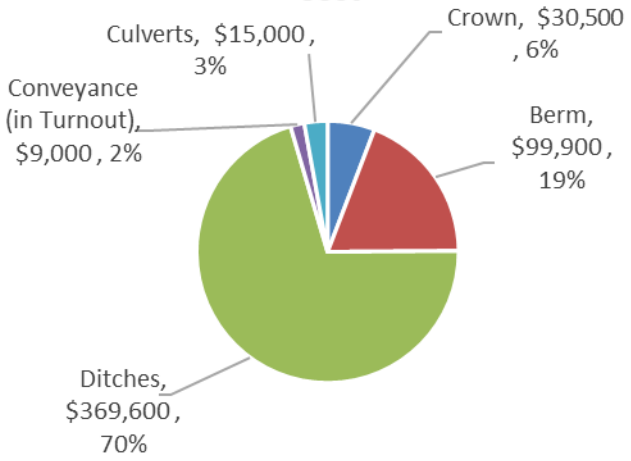
- Approximately $40,000 - $70,000 is available for gravel road upgrades annually.
  - The municipal operating budget is $17,420.
  - The Better Roads grant may provide $20,000 approximately every other year.
  - The Grant-in-Aid program provides approximately $36,000 per year. The Town indicated that this money will be allocated to gravel road improvements.

The total estimated cost to bring all MRGP segments into compliance is approximately $150,000. The total estimated cost to bring the remaining gravel roads into compliance is approximately $890,000. The combined estimated cost to upgrade all gravel roads is $1.04 million dollars. A subset of the non-MRGP segments was selected for the work plan (85 of the 191 non-connected segments, 45%). The selected segments are contiguous with connected segments that require work. The combined estimated cost to upgrade all MRGP segments and the subset of non-MRGP segments is $580,000. This includes an inflation adjustment (2% annual inflation in annual increments) for the total costs based on the year in which the upgrades are expected to be completed (Federal Reserve, 2021).

Dividing the total cost over duration of the plan, the average annual cost to bring all segments into compliance is $52,700. In the division of upgrades into annual work plans, we grouped road work to keep the connected and non-connected segments on any given road together. Annual costs were kept under the upper end of the available budget, $70,000. After factoring in inflation, the highest annual cost was the 2031 total of $67,284 to complete upgrades on Naylor Road, Sleepy Hollow Road, and Lost Nation Road. If the Town does not receive sufficient grant funding to complete the work that year, some of the remaining work on non-connected segments could be shifted to later years.

As mentioned previously, the quantity of ditch work needed has the largest effect on the overall cost as ditch work amounts to 70% of the total estimated cost without adjustments for inflation (Figure 1). The cost breakdown of the different types of work needed is very similar between the MRGP and non-MRGP segments. For the ditch cost estimate, FEA has applied the cost per linear foot for installing a new ditch for all drainage work needed. For grass-lined ditches, the estimated cost for installation of a new ditch is approximately 40% more than stabilizing an existing ditch. For stone-lined ditches the estimated cost for installation of a new ditch is approximately 20% more than stabilizing an existing ditch. In many cases the actual costs could end up being significantly lower because

Figure 1: Work Needed by Base Cost



Note: Costs expressed in 2021 USD

stabilizing or cleaning an existing ditch requires less excavation and trucking than creating a new ditch. In other words, we believe the ditch cost estimates are generally on the conservative side.

There are also factors that may increase costs beyond our estimates on certain road segments. In some cases, additional road work that was not documented in the 2017 REI data may be necessary. For example, on road segments requiring extensive slope stabilization or raising of the road grade, a portion or all of the required work may not have been documented by the REI, and therefore is not accounted for in the cost estimates. Additionally, events such as severe storms may cause segments to fall out compliance or set back the work, leading to costs above and beyond the estimates included in this plan.

Implementation Plan

This plan provides an outline of overall cost and budget needed to upgrade all remaining segments identified in the 2017 REI as partially meeting or not meeting MRGP standards. The Town may swap years or segments on the fly as needed. The deadline for full MRGP compliance is 2036, so as long as all intermediate deadlines are met, the Town may delay some of the work on connected roads beyond the 2032 completion date for MRGP work assumed in this plan if budget or work capacity place unforeseen constraints on the work plan. Work on non-connected roads may also extend beyond the 2032 scope of the plan, as there is no regulatory deadline for the upgrades.

This plan consists of a series of tables and maps intended to guide the Town of Essex over the next 10 years. The attachments outlined below provide additional documentation for our cost assumptions, as well as the work plans and maps. Attachments C, D, E, and F will likely be most useful for the Town to reference frequently for MRGP improvement planning and tracking.

Table 1: Estimated inflation-adjusted unit costs from 2017 memo as applied to REI data for MRGP upgrade cost estimates.

Road Erosion Inventory Component		Practice	Units	Original 2016-2017 Cost Assumptions	2016-2017 Unit Cost Estimate	Inflation Adjusted Costs By Plan Year									
						2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
							1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Road Surfaces	Crown Not Meeting Standards	Improve Road Crown	Linear Foot	Conservative labor assumption for grader/operator; no materials	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
	Grader Berm Present	Remove Grader Berm/ Lower Shoulder	Linear Foot	Conservative labor assumption for grader/operator; no materials	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5	$ 5
Drainage	Drainage Not Meeting Standards and Slope >5%	New Stone-Lined Ditch	Linear Foot	$16/LF of stone + $9/LF of excavation and trucking; approx 0.5 CY/LF stone	$ 25	$ 32	$ 33	$ 34	$ 35	$ 36	$ 37	$ 38	$ 39	$ 40	$ 41	$ 42
	Drainage Not Meeting Standards, Slope 5-8%, and 2 or More Cross Culverts/Turnouts	New Grass-Lined Ditch	Linear Foot	$4/LF excavation plus seed/mulch	$ 8	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12
	Drainage Not Meeting Standards, Slope 5-8%, and 0-1 Cross Culverts/Turnouts	New Grass-Lined Ditch with Stone Check Dams	Linear Foot	$4/LF excavation plus seed/mulch; Check dams spaced every 12.5' with conservative labor assumption for excavator/operator and 1 CY stone per dam	N/A	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16	$ 16
	Drainage Not Meeting Standards and Slope <5	New Grass-Lined Ditch	Linear Foot	$4/LF excavation plus seed/mulch	$ 8	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12	$ 12
	Poor Conveyance*	Install/Improve Turnout	Each	Conservative labor assumption for excavator/operator; 2 CY stone per turnout	$ 200	$ 500	$ 510	$ 520	$ 530	$ 541	$ 552	$ 563	$ 574	$ 585	$ 597	$ 609
Culverts	Cross Culvert Undersized or Eroded	New/Upgrade Cross-Culvert (18" to 24")	Each	Conservative labor assumption for excavator/operator; approx. $25/LF for culvert	$ 1,500	$ 2,200	$ 2,244	$ 2,289	$ 2,335	$ 2,382	$ 2,430	$ 2,479	$ 2,529	$ 2,580	$ 2,632	$ 2,685
	Driveway Culvert Undersized or Eroded	New/Upgrade Driveway Culvert	Each	Conservative labor assumption for excavator/operator; approx. $25/LF for culvert	$ 750	$ 800	$ 816	$ 832	$ 849	$ 866	$ 883	$ 901	$ 919	$ 937	$ 956	$ 975
	Culvert Header/Outlet Erosion	Install Culvert Headwall/ Armor	Each	Conservative labor assumption for excavator/operator; approx. 2-3 CY stone	$ 300	$ 300	$ 306	$ 312	$ 318	$ 324	$ 330	$ 337	$ 344	$ 351	$ 358	$ 365

*Cost to fix poor conveyance was raised to reflect more extensive work often associated with repair of roadside rill or gully erosion

**2% inflation multiplier for annual unit costs

Attachments

- Attachment A: Calculation Methods for Cost Estimation (8.5” x 11”)
- Attachment B: Data Table of All Work Needed and Cost Estimates by Segment (11” x 17”)
- Attachment C: Implementation Plan Summary by Road (11” x 17”)
- Attachment D: Annual Work Plans (11” x 17”)
- Attachment E: Map of MRGP Compliance and Non-Connected Road Status (24” x 36”)
- Attachment F: Implementation Plan Map (24” x 36”)
- Attachment G: Map of all Surveyed Road Segments (24” x 36”)

References

Federal Reserve, September 22, 2021, Federal Open Market Committee Projections Materials. https://www.federalreserve.gov/monetarypolicy/fomcprojtabl20210922.htm

VTDEC – Vermont Department of Environmental Conservation, 2018, Vermont Pollutant Discharge Elimination System (VPDES) General Permit 3-9040 for Stormwater Discharges from Municipal Roads. January 26, 2018. http://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/Permitinformation/MunicipalRoads/sw_FinalMRGP.pdf

Attachment A
Essex MRGP Implementation Plan

Calculation Methods for MRGP Implementation Cost Estimation

Note: Equations below are shown with unit costs for 2021.

- **Crown**
  - REI Variable: % of road crown in compliance (~100-meter segment)
  - Calculation:
    - *Crown work needed (feet) = Road segment length * 3.2808 * (1 – (% of road crown in compliance/100)) * 3.2808*
    - **Crown work cost ($) = Crown work needed (feet) * $5.00**
- **Berm**
  - REI Variable: % of road with berm (~200-meter road side)
  - Calculation:
    - *Berm removal needed (feet) = (Road segment length * 2 * 3.2808) * (% of road with berm/100)*
    - **Berm work cost ($) = Berm work needed (feet) * $5.00**
- **Drainage**
  - REI Variable: % of road drainage in compliance (~200-meter road side)
  - Calculation (Before Inflation):
    - *Drainage work needed (feet) = (Road segment length * 2 * 3.2808) * (1 – (% of road drainage in compliance/100))*
    - **<5% Slope drainage work cost ($) = Drainage work needed (feet) * $12.00**
    - **5-8% Slope drainage work (grass) cost ($) = Drainage work needed (feet) * $12.00**
    - **5-8% Slope drainage work (grass with check dams) cost ($) = Drainage work needed (feet) * $16.00**
    - **>8% Slope drainage work cost ($) = Drainage work needed (feet) * $32.00**
- **Drainage – Conveyances**
  - REI Variable: Poor Conveyances
  - Calculation (Before Inflation):
    - **Conveyance improvement cost ($) = # Poor Conveyances * $500**
- **Cross Culverts**
  - REI Variable: # Undersized or Eroded Cross Culverts
  - Calculation (Before Inflation):
    - **Cross culvert replacement cost ($) = # Undersized or Eroded Cross Culverts * $2200**
- **Driveway Culverts**
  - REI Variable: # Undersized or Eroded Driveway Culverts
  - Calculation (Before Inflation):
    - **Conveyance improvement cost ($) = # Undersized or Eroded Driveway Culverts * $800**
- **Culvert Header and Outlet Erosion**
  - REI Variables: # Eroded Culvert Headers, # Eroded Culvert Outlets
  - Calculation (Before Inflation):
    - **Header installation cost ($) = # Eroded Culvert Headers * $300**
    - **Outlet stabilization cost ($) = # Eroded Culvert Outlets * $300**

An inflation adjustment of 2% for each year of the plan was assigned to all costs.

Attachment B

RDDR = Adequacy of Road Drainage, % of Both Sides of Road with Adequate Road Drainage

BERM = Presence of Berm, % of Both Sides of Road with a Berm or High Shoulder

CROWN = Adequacy of Road Crown, % of Road Segment with Adequate Crown

Essex MRGP Implementation Plan
All Work Needed and Cost Estimates by Segment

											Quantity								Base Cost (No Inflation)								
											Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	CROWN (%)	BERM (%)	RDDR (%)	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
BIXBY HILL RD	9254	Non-Connected	100	3.0	Gravel	Does Not Meet	50%	50%	20%	Grass	164	328	525						$ 800	$ 1,600	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 8,700
BIXBY HILL RD	9256	Non-Connected	100	7.4	Gravel	Partially Meets	100%	30%	80%	Check Dams	0	197	131						$ -	$ 1,000	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 3,100
BIXBY HILL RD	9257	Non-Connected	100	9.6	Gravel	Does Not Meet	60%	20%	55%	Stone	131	131	295						$ 700	$ 700	$ 9,400	$ -	$ -	$ -	$ -	$ -	$ 10,800
BIXBY HILL RD	9258	Non-Connected	100	3.1	Gravel	Does Not Meet	60%	20%	50%	Grass	131	131	328						$ 700	$ 700	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,300
BIXBY HILL RD	9259	Non-Connected	100	7.7	Gravel	Does Not Meet	100%	20%	65%	Check Dams	0	131	230						$ -	$ 700	$ 3,700	$ -	$ -	$ -	$ -	$ -	$ 4,400
BIXBY HILL RD	9261	Non-Connected	100	2.5	Gravel	Partially Meets	100%	40%	100%	Grass	0	262	0						$ -	$ 1,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,300
BIXBY HILL RD	9262	Non-Connected	100	1.6	Gravel	Does Not Meet	100%	10%	100%	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
BIXBY HILL RD	9263	Non-Connected	100	4.9	Gravel	Partially Meets	100%	40%	60%	Grass	0	262	262						$ -	$ 1,300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,400
BIXBY HILL RD	9264	Non-Connected	100	8.1	Gravel	Partially Meets	100%	40%	50%	Stone	0	262	328						$ -	$ 1,300	$ 10,500	$ -	$ -	$ -	$ -	$ -	$ 11,800
BIXBY HILL RD	9265	Non-Connected	100	1.7	Gravel	Does Not Meet	100%	80%	100%	Grass	0	525	0				1		$ -	$ 2,600	$ -	$ -	$ -	$ -	$ 300	$ -	$ 2,900
BIXBY HILL RD	9266	Non-Connected	100	3.1	Gravel	Does Not Meet	80%	35%	90%	Grass	66	230	66	1		1	1		$ 300	$ 1,100	$ 800	$ 500	$ -	$ 300	$ 300	$ -	$ 3,300
BIXBY HILL RD	9267	Non-Connected	100	2.8	Gravel	Partially Meets	100%	20%	70%	Grass	0	131	197						$ -	$ 700	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 3,100
BIXBY HILL RD	9268	Non-Connected	100	2.8	Gravel	Does Not Meet	100%	20%	90%	Grass	0	131	66				1		$ -	$ 700	$ 800	$ -	$ -	$ -	$ 300	$ -	$ 1,800
BIXBY HILL RD	9269	Non-Connected	100	8.0	Gravel	Does Not Meet	80%	30%	20%	Stone	66	197	525						$ 300	$ 1,000	$ 16,800	$ -	$ -	$ -	$ -	$ -	$ 18,100
BRIGHAM HILL LN	12865	Non-Connected	39	11.3	Gravel	Does Not Meet	0%	0%	0%	Stone	129	0	257						$ 600	$ -	$ 8,200	$ -	$ -	$ -	$ -	$ -	$ 8,800
BRIGHAM HILL LN	12866	Non-Connected	100	14.6	Gravel	Does Not Meet	0%	0%	0%	Stone	328	0	656						$ 1,600	$ -	$ 21,000	$ -	$ -	$ -	$ -	$ -	$ 22,600
BRIGHAM HILL LN	12867	Non-Connected	100	8.1	Gravel	Does Not Meet	0%	0%	0%	Stone	328	0	656						$ 1,600	$ -	$ 21,000	$ -	$ -	$ -	$ -	$ -	$ 22,600
BRIGHAM HILL LN	12868	Non-Connected	100	5.7	Gravel	Does Not Meet	40%	0%	0%	Check Dams	197	0	656						$ 1,000	$ -	$ 10,500	$ -	$ -	$ -	$ -	$ -	$ 11,500
BRIGHAM HILL LN	12869	Non-Connected	100	2.5	Gravel	Does Not Meet	80%	10%	40%	Grass	66	66	394						$ 300	$ 300	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 5,300
BRIGHAM HILL LN	12870	Connected	100	4.6	Gravel	Does Not Meet	100%	25%	50%	Grass	0	164	328						$ -	$ 800	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 4,700
BRIGHAM HILL LN	12871	Connected	100	3.7	Gravel	Does Not Meet	90%	20%	60%	Grass	33	131	262						$ 200	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,000
BRIGHAM HILL LN	12872	Connected	100	6.2	Gravel	Partially Meets	80%	20%	60%	Check Dams	66	131	262						$ 300	$ 700	$ 4,200	$ -	$ -	$ -	$ -	$ -	$ 5,200
BRIGHAM HILL LN	12873	Connected	100	1.0	Gravel	Partially Meets	100%	10%	70%	Grass	0	66	197			1	1		$ -	$ 300	$ 2,400	$ -	$ -	$ 300	$ 300	$ -	$ 3,300
BRIGHAM HILL LN	12874	Non-Connected	100	3.0	Gravel	Does Not Meet	70%	50%	40%	Grass	98	328	394						$ 500	$ 1,600	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 6,800
BRIGHAM HILL LN	12875	Non-Connected	100	1.9	Gravel	Does Not Meet	50%	40%	50%	Grass	164	262	328						$ 800	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,000
BRIGHAM HILL LN	12876	Connected	100	0.3	Gravel	Partially Meets	90%	30%	40%	Grass	33	197	394			1	1		$ 200	$ 1,000	$ 4,700	$ -	$ -	$ 300	$ 300	$ -	$ 6,500
BRIGHAM HILL LN	12877	Connected	100	6.0	Gravel	Partially Meets	100%	40%	45%	Stone	0	262	361						$ -	$ 1,300	$ 11,500	$ -	$ -	$ -	$ -	$ -	$ 12,800
BRIGHAM HILL LN	12878	Connected	100	0.5	Gravel	Partially Meets	100%	10%	100%	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
BRIGHAM HILL LN	12879	Connected	100	2.6	Gravel	Partially Meets	80%	10%	60%	Grass	66	66	262						$ 300	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,700
BRIGHAM HILL RD	12886	Connected	100	1.6	Gravel	Does Not Meet	100%	40%	60%	Grass	0	262	262	1		1	1		$ -	$ 1,300	$ 3,100	$ 500	$ -	$ 300	$ 300	$ -	$ 5,500
BRIGHAM HILL RD	12887	Non-Connected	30	11.1	Gravel	Does Not Meet	100%	30%	65%	Stone	0	59	69	1					$ -	$ 300	$ 2,200	$ 500	$ -	$ -	$ -	$ -	$ 3,000
BRIGHAM HILL RD	12897	Non-Connected	100	1.9	Gravel	Partially Meets	90%	20%	60%	Grass	33	131	262						$ 200	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,000
BRIGHAM HILL RD	12899	Connected	100	1.5	Gravel	Partially Meets	100%	10%	50%	Grass	0	66	328			1	1		$ -	$ 300	$ 3,900	$ -	$ -	$ 300	$ 300	$ -	$ 4,800
BRIGHAM HILL RD	12903	Non-Connected	100	2.2	Gravel	Does Not Meet	100%	25%	80%	Grass	0	164	131						$ -	$ 800	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,400
BRIGHAM HILL RD	12904	Non-Connected	100	7.5	Gravel	Does Not Meet	90%	30%	80%	Check Dams	33	197	131						$ 200	$ 1,000	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 3,300
BRIGHAM HILL RD	12907	Non-Connected	100	2.8	Gravel	Does Not Meet	60%	30%	60%	Grass	131	197	262						$ 700	$ 1,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,800
BRIGHAM HILL RD	12908	Non-Connected	100	2.8	Gravel	Does Not Meet	100%	30%	70%	Grass	0	197	197						$ -	$ 1,000	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 3,400
BRIGHAM HILL RD	12910	Non-Connected	100	1.4	Gravel	Partially Meets	100%	10%	60%	Grass	0	66	262						$ -	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,400
BRIGHAM HILL RD	12911	Non-Connected	100	5.8	Gravel	Does Not Meet	100%	0%	70%	Check Dams	0	0	197						$ -	$ -	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,100
BRIGHAM HILL RD	12912	Connected	100	4.2	Gravel	Does Not Meet	100%	20%	50%	Grass	0	131	328						$ -	$ 700	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 4,600

Attachment B

RDDR = Adequacy of Road Drainage, % of Both Sides of Road with Adequate Road Drainage

BERM = Presence of Berm, % of Both Sides of Road with a Berm or High Shoulder

CROWN = Adequacy of Road Crown, % of Road Segment with Adequate Crown

Essex MRGP Implementation Plan
All Work Needed and Cost Estimates by Segment

											Quantity								Base Cost (No Inflation)								
											Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	CROWN (%)	BERM (%)	RDDR (%)	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
CATELLA RD	19276	Connected	100	1.2	Gravel	Partially Meets	100%	10%	80%	Grass	0	66	131						$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900
CATELLA RD	19283	Non-Connected	100	6.5	Gravel	Partially Meets	100%	10%	80%	Check Dams	0	66	131						$ -	$ 300	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 2,400
CATELLA RD	19284	Non-Connected	34	1.7	Gravel	Partially Meets	100%	20%	80%	Grass	0	45	45						$ -	$ 200	$ 500	$ -	$ -	$ -	$ -	$ -	$ 700
CATELLA RD	19285	Non-Connected	100	6.4	Gravel	Partially Meets	100%	20%	70%	Check Dams	0	131	197						$ -	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,800
CATELLA RD	19287	Connected	100	4.3	Gravel	Partially Meets	100%	20%	100%	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
CATELLA RD	19290	Connected	100	3.9	Gravel	Partially Meets	100%	10%	100%	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
CHAPIN RD	20758	Non-Connected	100	4.3	Gravel	Partially Meets	100%	20%	100%	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
CHAPIN RD	20760	Non-Connected	100	1.7	Gravel	Partially Meets	100%	15%	100%	Grass	0	98	0						$ -	$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ 500
CHAPIN RD	20761	Non-Connected	100	2.0	Gravel	Does Not Meet	100%	20%	100%	Grass	0	131	0	1					$ -	$ 700	$ -	$ 500	$ -	$ -	$ -	$ -	$ 1,200
CHAPIN RD	20763	Non-Connected	100	1.0	Gravel	Partially Meets	100%	25%	100%	Grass	0	164	0						$ -	$ 800	$ -	$ -	$ -	$ -	$ -	$ -	$ 800
CHAPIN RD	20764	Non-Connected	100	1.0	Gravel	Partially Meets	100%	40%	100%	Grass	0	262	0						$ -	$ 1,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,300
CHAPIN RD	20765	Non-Connected	100	2.2	Gravel	Does Not Meet	100%	30%	40%	Grass	0	197	394						$ -	$ 1,000	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 5,700
CHAPIN RD	20766	Non-Connected	100	2.1	Gravel	Partially Meets	100%	50%	90%	Grass	0	328	66						$ -	$ 1,600	$ 800	$ -	$ -	$ -	$ -	$ -	$ 2,400
CHAPIN RD	20767	Non-Connected	100	1.0	Gravel	Partially Meets	100%	20%	100%	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
CHAPIN RD	20768	Non-Connected	100	1.3	Gravel	Partially Meets	100%	25%	100%	Grass	0	164	0						$ -	$ 800	$ -	$ -	$ -	$ -	$ -	$ -	$ 800
CHAPIN RD	20769	Non-Connected	100	0.8	Gravel	Partially Meets	100%	15%	100%	Grass	0	98	0						$ -	$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ 500
CHAPIN RD	20770	Non-Connected	100	0.9	Gravel	Partially Meets	100%	10%	60%	Grass	0	66	262						$ -	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,400
CHAPIN RD	20771	Non-Connected	100	2.3	Gravel	Does Not Meet	100%	60%	100%	Grass	0	394	0						$ -	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,000
CHAPIN RD	20772	Non-Connected	100	1.8	Gravel	Does Not Meet	100%	50%	100%	Grass	0	328	0	1		1			$ -	$ 1,600	$ -	$ 500	$ -	$ 300	$ -	$ -	$ 2,400
CHAPIN RD	20776	Non-Connected	100	0.6	Gravel	Does Not Meet	70%	30%	80%	Grass	98	197	131						$ 500	$ 1,000	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 3,100
CHAPIN RD	20777	Non-Connected	100	1.9	Gravel	Does Not Meet	40%	50%	50%	Grass	197	328	328						$ 1,000	$ 1,600	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,500
CHAPIN RD	20778	Non-Connected	100	1.7	Gravel	Does Not Meet	30%	50%	80%	Grass	230	328	131						$ 1,100	$ 1,600	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 4,300
CHAPIN RD	20779	Non-Connected	100	1.9	Gravel	Does Not Meet	40%	40%	50%	Grass	197	262	328						$ 1,000	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,200
CHAPIN RD	20784	Non-Connected	100	3.7	Gravel	Does Not Meet	70%	50%	50%	Grass	98	328	328						$ 500	$ 1,600	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,000
CHAPIN RD	20785	Non-Connected	100	1.7	Gravel	Does Not Meet	60%	60%	50%	Grass	131	394	328						$ 700	$ 2,000	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,600
CHAPIN RD	20786	Non-Connected	100	2.9	Gravel	Does Not Meet	20%	60%	0%	Grass	262	394	656						$ 1,300	$ 2,000	$ 7,900	$ -	$ -	$ -	$ -	$ -	$ 11,200
CHAPIN RD	20788	Non-Connected	100	1.7	Gravel	Does Not Meet	80%	40%	75%	Grass	66	262	164						$ 300	$ 1,300	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 3,600
CHAPIN RD	20789	Non-Connected	100	1.8	Gravel	Partially Meets	80%	50%	100%	Grass	66	328	0						$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,900
CHAPIN RD	20790	Non-Connected	100	2.8	Gravel	Does Not Meet	80%	55%	85%	Grass	66	361	98						$ 300	$ 1,800	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ 3,300
CHAPIN RD	20791	Non-Connected	100	3.2	Gravel	Does Not Meet	80%	70%	50%	Grass	66	459	328						$ 300	$ 2,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,500
CHAPIN RD	20792	Non-Connected	100	2.3	Gravel	Does Not Meet	80%	85%	100%	Grass	66	558	0						$ 300	$ 2,800	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,100
CHAPIN RD	20793	Non-Connected	100	1.1	Gravel	Does Not Meet	80%	25%	100%	Grass	66	164	0						$ 300	$ 800	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,100
CHAPIN RD	20794	Non-Connected	100	2.1	Gravel	Does Not Meet	80%	20%	90%	Grass	66	131	66	1		1	1		$ 300	$ 700	$ 800	$ 500	$ -	$ 300	$ 300	$ -	$ 2,900
CHAPIN RD	20796	Non-Connected	100	1.3	Gravel	Does Not Meet	90%	20%	100%	Grass	33	131	0	1			1		$ 200	$ 700	$ -	$ 500	$ -	$ -	$ 300	$ -	$ 1,700
CILLEY HILL RD	22478	Non-Connected	100	6.2	Gravel	Does Not Meet	100%	35%	60%	Check Dams	0	230	262						$ -	$ 1,100	$ 4,200	$ -	$ -	$ -	$ -	$ -	$ 5,300
CILLEY HILL RD	22479	Non-Connected	48	6.1	Gravel	Partially Meets	90%	50%	60%	Check Dams	16	158	126						$ 100	$ 800	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 2,900
COLONEL PAGE RD	25107	Non-Connected	100	3.8	Gravel	Does Not Meet	70%	0%	15%	Grass	98	0	558						$ 500	$ -	$ 6,700	$ -	$ -	$ -	$ -	$ -	$ 7,200
COLONEL PAGE RD	25108	Non-Connected	100	2.5	Gravel	Does Not Meet	100%	20%	100%	Grass	0	131	0					1	$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ 750	$ 1,450
COLONEL PAGE RD	25110	Non-Connected	100	4.8	Gravel	Does Not Meet	100%	60%	60%	Grass	0	394	262						$ -	$ 2,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 5,100
COLONEL PAGE RD	25111	Non-Connected	100	2.9	Gravel	Does Not Meet	100%	50%	40%	Grass	0	328	394						$ -	$ 1,600	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 6,300

Attachment B

RDDR = Adequacy of Road Drainage, % of Both Sides of Road with Adequate Road Drainage

BERM = Presence of Berm, % of Both Sides of Road with a Berm or High Shoulder

CROWN = Adequacy of Road Crown, % of Road Segment with Adequate Crown

Essex MRGP Implementation Plan
All Work Needed and Cost Estimates by Segment

											Quantity								Base Cost (No Inflation)								
											Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	CROWN (%)	BERM (%)	RDDR (%)	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
COLONEL PAGE RD	25114	Connected	100	2.7	Gravel	Partially Meets	100%	30%	80%	Grass	0	197	131						$ -	$ 1,000	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,600
COLONEL PAGE RD	25115	Non-Connected	100	10.3	Gravel	Does Not Meet	60%	0%	70%	Stone	131	0	197	1		1	1		$ 700	$ -	$ 6,300	$ 500	$ -	$ 300	$ 300	$ -	$ 8,100
COLONEL PAGE RD	25116	Non-Connected	100	7.2	Gravel	Does Not Meet	60%	0%	90%	Check Dams	131	0	66	1				1	$ 700	$ -	$ 1,000	$ 500	$ -	$ -	$ -	$ 750	$ 2,950
COLONEL PAGE RD	25117	Non-Connected	100	3.6	Gravel	Does Not Meet	80%	0%	40%	Grass	66	0	394						$ 300	$ -	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 5,000
CURVE HILL RD	29864	Non-Connected	100	7.4	Gravel	Partially Meets	100%	20%	60%	Check Dams	0	131	262						$ -	$ 700	$ 4,200	$ -	$ -	$ -	$ -	$ -	$ 4,900
CURVE HILL RD	29865	Connected	95	4.8	Gravel	Partially Meets	100%	40%	80%	Grass	0	248	124						$ -	$ 1,200	$ 1,500	$ -	$ -	$ -	$ -	$ -	$ 2,700
CURVE HILL RD	29866	Non-Connected	100	5.8	Gravel	Partially Meets	100%	40%	50%	Check Dams	0	262	328						$ -	$ 1,300	$ 5,200	$ -	$ -	$ -	$ -	$ -	$ 6,500
DISCOVERY RD	33114	Non-Connected	12	5.8	Gravel	Partially Meets	90%	0%	90%	Check Dams	4	0	8						$ -	$ -	$ 100	$ -	$ -	$ -	$ -	$ -	$ 100
DISCOVERY RD	33115	Non-Connected	100	4.6	Gravel	Partially Meets	90%	0%	80%	Grass	33	0	131						$ 200	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,800
DISCOVERY RD	33117	Connected	100	0.4	Gravel	Partially Meets	100%	40%	100%	Grass	0	262	0						$ -	$ 1,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,300
DISCOVERY RD	33118	Non-Connected	100	2.9	Gravel	Partially Meets	100%	0%	80%	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
DISCOVERY RD	33119	Non-Connected	100	5.4	Gravel	Partially Meets	90%	0%	80%	Check Dams	33	0	131						$ 200	$ -	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 2,300
DISCOVERY RD	33120	Connected	100	3.9	Gravel	Partially Meets	100%	20%	70%	Grass	0	131	197						$ -	$ 700	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 3,100
DISCOVERY RD	33121	Connected	100	7.4	Gravel	Partially Meets	90%	25%	50%	Check Dams	33	164	328	2					$ 200	$ 800	$ 5,200	$ 1,000	$ -	$ -	$ -	$ -	$ 7,200
ESSEX HIGHLANDS	20395.1	Connected	100	0.0	Paved	Does Not Meet	100%	0%	100%	Grass	0	0	0	1		4	2		$ -	$ -	$ -	$ 500	$ -	$ 1,200	$ 600	$ -	$ 2,300
FLEURY RD	98531	Non-Connected	61	1.0	Gravel	Does Not Meet	70%	0%	50%	Grass	60	0	201						$ 300	$ -	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 2,700
FLEURY RD	98532	Non-Connected	100	1.2	Gravel	Does Not Meet	40%	0%	30%	Grass	197	0	459						$ 1,000	$ -	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 6,500
GRAY WY	105272	Non-Connected	100	2.0	Gravel	Does Not Meet	20%	60%	80%	Grass	262	394	131	1					$ 1,300	$ 2,000	$ 1,600	$ 500	$ -	$ -	$ -	$ -	$ 5,400
HANLEY LN	108356	Connected	100	1.3	Gravel	Partially Meets	100%	0%	100%	Grass	0	0	0			3	3		$ -	$ -	$ -	$ -	$ -	$ 900	$ 900	$ -	$ 1,800
INDIAN BROOK RD	115890	Non-Connected	100	2.5	Gravel	Partially Meets	100%	10%	100%	Grass	0	66	0			1			$ -	$ 300	$ -	$ -	$ -	$ 300	$ -	$ -	$ 600
INDIAN BROOK RD	115899	Non-Connected	100	4.4	Gravel	Does Not Meet	100%	30%	70%	Grass	0	197	197	1		1			$ -	$ 1,000	$ 2,400	$ 500	$ -	$ 300	$ -	$ -	$ 4,200
INDIAN BROOK RD	115900	Non-Connected	100	3.3	Gravel	Partially Meets	100%	25%	75%	Grass	0	164	164						$ -	$ 800	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 2,800
INDIAN BROOK RD	115901	Non-Connected	100	2.4	Gravel	Partially Meets	100%	10%	75%	Grass	0	66	164						$ -	$ 300	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 2,300
INDIAN BROOK RD	115902	Non-Connected	100	1.8	Gravel	Partially Meets	70%	10%	60%	Grass	98	66	262						$ 500	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,900
INDIAN BROOK RD	115905	Non-Connected	100	1.9	Gravel	Partially Meets	100%	40%	85%	Grass	0	262	98						$ -	$ 1,300	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ 2,500
INDIAN BROOK RD	115906	Non-Connected	100	4.0	Gravel	Partially Meets	100%	30%	80%	Grass	0	197	131						$ -	$ 1,000	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,600
INDIAN BROOK RD	115907	Non-Connected	100	3.6	Gravel	Partially Meets	100%	10%	80%	Grass	0	66	131						$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900
INDIAN BROOK RD	115908	Non-Connected	100	2.3	Gravel	Does Not Meet	80%	60%	60%	Grass	66	394	262						$ 300	$ 2,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 5,400
INDIAN BROOK RD	115913	Connected	100	4.1	Gravel	Partially Meets	100%	40%	50%	Grass	0	262	328						$ -	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,200
LAMORE RD	100981.0001	Non-Connected	100	1.0	Gravel	Does Not Meet	100%	10%	100%	Grass	0	66	0	1			1		$ -	$ 300	$ -	$ 500	$ -	$ -	$ 300	$ -	$ 1,100
LAMORE RD	100981.0002	Non-Connected	100	2.5	Gravel	Partially Meets	100%	40%	75%	Grass	0	262	164						$ -	$ 1,300	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 3,300
LAMORE RD	100981.0003	Non-Connected	100	2.5	Gravel	Partially Meets	100%	40%	60%	Grass	0	262	262						$ -	$ 1,300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,400
LAMORE RD	100981.0004	Non-Connected	100	1.5	Gravel	Partially Meets	100%	35%	50%	Grass	0	230	328						$ -	$ 1,100	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,000
LAMORE RD	100981.0005	Non-Connected	100	4.0	Gravel	Partially Meets	100%	40%	50%	Grass	0	262	328						$ -	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,200
LAMORE RD	100981.0006	Non-Connected	100	6.5	Gravel	Partially Meets	100%	15%	50%	Check Dams	0	98	328						$ -	$ 500	$ 5,200	$ -	$ -	$ -	$ -	$ -	$ 5,700
LAMORE RD	100981.0007	Non-Connected	100	3.4	Gravel	Does Not Meet	100%	70%	100%	Grass	0	459	0						$ -	$ 2,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,300
LAMORE RD	122720	Non-Connected	10	2.3	Gravel	Does Not Meet	100%	0%	50%	Grass	0	0	34	1					$ -	$ -	$ 400	$ 500	$ -	$ -	$ -	$ -	$ 900
LAMORE RD	122721	Non-Connected	100	5.2	Gravel	Does Not Meet	100%	0%	40%	Check Dams	0	0	394	1					$ -	$ -	$ 6,300	$ 500	$ -	$ -	$ -	$ -	$ 6,800
LAMORE RD	122722	Non-Connected	100	4.2	Gravel	Partially Meets	100%	10%	80%	Grass	0	66	131						$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900
LOST NATION RD	127148	Non-Connected	100	1.0	Gravel	Partially Meets	100%	0%	70%	Grass	0	0	197						$ -	$ -	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 2,400

Attachment B

RDDR = Adequacy of Road Drainage, % of Both Sides of Road with Adequate Road Drainage

BERM = Presence of Berm, % of Both Sides of Road with a Berm or High Shoulder

CROWN = Adequacy of Road Crown, % of Road Segment with Adequate Crown

Essex MRGP Implementation Plan
All Work Needed and Cost Estimates by Segment

											Quantity								Base Cost (No Inflation)								
											Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	CROWN (%)	BERM (%)	RDDR (%)	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
LOST NATION RD	127149	Non-Connected	100	8.0	Gravel	Does Not Meet	60%	40%	40%	Stone	131	262	394						$ 700	$ 1,300	$ 12,600	$ -	$ -	$ -	$ -	$ -	$ 14,600
LOST NATION RD	127150	Non-Connected	100	3.6	Gravel	Partially Meets	100%	40%	80%	Grass	0	262	131						$ -	$ 1,300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,900
LOST NATION RD	127151	Non-Connected	100	0.7	Gravel	Does Not Meet	100%	20%	20%	Grass	0	131	525						$ -	$ 700	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 7,000
LOST NATION RD	127152	Non-Connected	100	2.7	Gravel	Partially Meets	100%	40%	50%	Grass	0	262	328						$ -	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,200
LOST NATION RD	127156	Non-Connected	100	5.3	Gravel	Does Not Meet	85%	40%	90%	Check Dams	49	262	66						$ 200	$ 1,300	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ 2,500
LOST NATION RD	127157	Non-Connected	100	2.8	Gravel	Partially Meets	100%	25%	90%	Grass	0	164	66						$ -	$ 800	$ 800	$ -	$ -	$ -	$ -	$ -	$ 1,600
LOST NATION RD	127158	Non-Connected	100	5.5	Gravel	Does Not Meet	100%	40%	40%	Check Dams	0	262	394						$ -	$ 1,300	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 7,600
LOST NATION RD	127159	Non-Connected	100	12.3	Gravel	Does Not Meet	80%	0%	80%	Stone	66	0	131						$ 300	$ -	$ 4,200	$ -	$ -	$ -	$ -	$ -	$ 4,500
LOST NATION RD	127163	Non-Connected	100	1.4	Gravel	Does Not Meet	70%	20%	60%	Grass	98	131	262						$ 500	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,300
LOST NATION RD	127164	Non-Connected	100	2.9	Gravel	Does Not Meet	80%	20%	60%	Grass	66	131	262						$ 300	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,100
LOST NATION RD	127165	Non-Connected	100	4.3	Gravel	Does Not Meet	70%	80%	25%	Grass	98	525	492			1	1		$ 500	$ 2,600	$ 5,900	$ -	$ -	$ 300	$ 300	$ -	$ 9,600
LOST NATION RD	127166	Non-Connected	100	5.0	Gravel	Does Not Meet	100%	20%	40%	Check Dams	0	131	394						$ -	$ 700	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 7,000
LOST NATION RD	127167	Non-Connected	100	3.1	Gravel	Does Not Meet	100%	10%	80%	Grass	0	66	131					1	$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ 750	$ 2,650
LOST NATION RD	127182	Non-Connected	100	5.8	Gravel	Does Not Meet	60%	30%	20%	Check Dams	131	197	525						$ 700	$ 1,000	$ 8,400	$ -	$ -	$ -	$ -	$ -	$ 10,100
LOST NATION RD	127183	Non-Connected	100	3.9	Gravel	Does Not Meet	90%	30%	60%	Grass	33	197	262						$ 200	$ 1,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,300
LOST NATION RD	127187	Connected	100	0.1	Gravel	Partially Meets	100%	60%	60%	Grass	0	394	262						$ -	$ 2,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 5,100
LOST NATION RD	127188	Connected	100	2.0	Gravel	Partially Meets	100%	50%	60%	Grass	0	328	262						$ -	$ 1,600	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,700
LOST NATION RD	127192	Connected	100	5.4	Gravel	Partially Meets	100%	30%	50%	Check Dams	0	197	328						$ -	$ 1,000	$ 5,200	$ -	$ -	$ -	$ -	$ -	$ 6,200
LOST NATION RD	127195	Non-Connected	100	2.1	Gravel	Partially Meets	100%	0%	80%	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
LOST NATION RD	127196	Non-Connected	22	2.7	Gravel	Partially Meets	60%	10%	100%	Grass	29	14	0						$ 100	$ 100	$ -	$ -	$ -	$ -	$ -	$ -	$ 200
LOST NATION RD	127197	Non-Connected	100	8.4	Gravel	Does Not Meet	80%	10%	60%	Stone	66	66	262						$ 300	$ 300	$ 8,400	$ -	$ -	$ -	$ -	$ -	$ 9,000
MCGEE RD	131698	Non-Connected	100	8.0	Gravel	Does Not Meet	40%	20%	80%	Check Dams	197	131	131						$ 1,000	$ 700	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 3,800
MCGEE RD	131699	Non-Connected	55	2.6	Gravel	Partially Meets	100%	20%	90%	Grass	0	72	36						$ -	$ 400	$ 400	$ -	$ -	$ -	$ -	$ -	$ 800
MCGEE RD	131702	Non-Connected	100	9.8	Gravel	Does Not Meet	60%	10%	30%	Stone	131	66	459	1					$ 700	$ 300	$ 14,700	$ 500	$ -	$ -	$ -	$ -	$ 16,200
NAYLOR RD	139691	Connected	100	3.0	Gravel	Partially Meets	100%	0%	80%	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
NAYLOR RD	139693	Non-Connected	100	2.6	Gravel	Does Not Meet	60%	20%	90%	Grass	131	131	66						$ 700	$ 700	$ 800	$ -	$ -	$ -	$ -	$ -	$ 2,200
NAYLOR RD	139694	Non-Connected	100	1.4	Gravel	Does Not Meet	20%	30%	70%	Grass	262	197	197						$ 1,300	$ 1,000	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 4,700
OLD PUMP RD	144613	Non-Connected	100	6.9	Gravel	Partially Meets	100%	40%	80%	Check Dams	0	262	131						$ -	$ 1,300	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 3,400
OLD PUMP RD	144615	Connected	100	5.2	Gravel	Partially Meets	80%	20%	90%	Check Dams	66	131	66						$ 300	$ 700	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ 2,000
OLD PUMP RD	144618	Non-Connected	100	2.9	Gravel	Partially Meets	100%	10%	90%	Grass	0	66	66			1			$ -	$ 300	$ 800	$ -	$ -	$ 300	$ -	$ -	$ 1,400
OLD PUMP RD	144619	Connected	100	4.8	Gravel	Does Not Meet	100%	0%	80%	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
OLD PUMP RD	144621	Connected	100	4.0	Gravel	Partially Meets	100%	0%	40%	Check Dams	0	0	394						$ -	$ -	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 4,700
OLD PUMP RD	144622	Non-Connected	100	2.7	Gravel	Does Not Meet	100%	70%	20%	Grass	0	459	525						$ -	$ 2,300	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 8,600
OLD PUMP RD	144623	Non-Connected	100	9.2	Gravel	Does Not Meet	100%	10%	60%	Stone	0	66	262	1					$ -	$ 300	$ 8,400	$ 500	$ -	$ -	$ -	$ -	$ 9,200
OLD STAGE RD	46638.1	Connected	100	0.1	Paved	Does Not Meet	100%	0%	92%	Grass	0	0	52	3		2			$ -	$ -	$ 600	$ 1,500	$ -	$ 600	$ -	$ -	$ 2,700
OSGOOD HILL RD	146349	Non-Connected	100	4.5	Gravel	Does Not Meet	100%	10%	50%	Grass	0	66	328					1	$ -	$ 300	$ 3,900	$ -	$ -	$ -	$ -	$ 750	$ 4,950
OSGOOD HILL RD	146350	Non-Connected	100	3.5	Gravel	Partially Meets	100%	10%	90%	Grass	0	66	66						$ -	$ 300	$ 800	$ -	$ -	$ -	$ -	$ -	$ 1,100
OSGOOD HILL RD	146351	Non-Connected	100	3.7	Gravel	Does Not Meet	100%	0%	70%	Grass	0	0	197						$ -	$ -	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 2,400
OSGOOD HILL RD	146356	Connected	100	3.9	Gravel	Does Not Meet	80%	20%	80%	Grass	66	131	131	1					$ 300	$ 700	$ 1,600	$ 500	$ -	$ -	$ -	$ -	$ 3,100
OSGOOD HILL RD	146357	Connected	100	3.3	Gravel	Partially Meets	100%	10%	100%	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300

Attachment B

RDDR = Adequacy of Road Drainage, % of Both Sides of Road with Adequate Road Drainage

BERM = Presence of Berm, % of Both Sides of Road with a Berm or High Shoulder

CROWN = Adequacy of Road Crown, % of Road Segment with Adequate Crown

Essex MRGP Implementation Plan
All Work Needed and Cost Estimates by Segment

											Quantity								Base Cost (No Inflation)								
											Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	CROWN (%)	BERM (%)	RDDR (%)	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
OSGOOD HILL RD	146360	Connected	100	3.2	Gravel	Partially Meets	100%	20%	100%	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
OSGOOD HILL RD	146361	Connected	100	2.0	Gravel	Does Not Meet	100%	30%	70%	Grass	0	197	197	2					$ -	$ 1,000	$ 2,400	$ 1,000	$ -	$ -	$ -	$ -	$ 4,400
OSGOOD HILL RD	146362	Connected	100	2.4	Gravel	Partially Meets	80%	40%	70%	Grass	66	262	197						$ 300	$ 1,300	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 4,000
OSGOOD HILL RD	146363	Connected	100	2.6	Gravel	Partially Meets	90%	10%	80%	Grass	33	66	131						$ 200	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,100
OSGOOD HILL RD	146364	Non-Connected	100	3.0	Gravel	Partially Meets	80%	10%	100%	Grass	66	66	0						$ 300	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 600
OSGOOD HILL RD	146365	Non-Connected	100	4.8	Gravel	Partially Meets	90%	0%	90%	Grass	33	0	66						$ 200	$ -	$ 800	$ -	$ -	$ -	$ -	$ -	$ 1,000
OSGOOD HILL RD	146366	Non-Connected	100	3.1	Gravel	Partially Meets	90%	0%	100%	Grass	33	0	0						$ 200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 200
OSGOOD HILL RD	146367	Non-Connected	100	3.2	Gravel	Does Not Meet	100%	10%	100%	Grass	0	66	0			1			$ -	$ 300	$ -	$ -	$ -	$ 300	$ -	$ -	$ 600
OSGOOD HILL RD	146368	Non-Connected	100	1.1	Gravel	Does Not Meet	100%	20%	100%	Grass	0	131	0					1	$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ 750	$ 1,450
OSGOOD HILL RD	146369	Non-Connected	100	1.8	Gravel	Partially Meets	80%	10%	100%	Grass	66	66	0						$ 300	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 600
OSGOOD HILL RD	146370	Non-Connected	100	2.1	Gravel	Partially Meets	100%	30%	100%	Grass	0	197	0						$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000
OSGOOD HILL RD	146381	Non-Connected	100	3.0	Gravel	Partially Meets	100%	10%	60%	Grass	0	66	262						$ -	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,400
OSGOOD HILL RD	146382	Non-Connected	100	4.5	Gravel	Does Not Meet	100%	0%	100%	Grass	0	0	0	1					$ -	$ -	$ -	$ 500	$ -	$ -	$ -	$ -	$ 500
OSGOOD HILL RD	146383	Non-Connected	100	4.0	Gravel	Partially Meets	100%	0%	100%	Grass	0	0	0		1	1	2		$ -	$ -	$ -	$ -	$ 1,500	$ 300	$ 600	$ -	$ 2,400
OSGOOD HILL RD	146384	Non-Connected	100	5.4	Gravel	Partially Meets	100%	0%	90%	Check Dams	0	0	66						$ -	$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ 1,000
OSGOOD HILL RD	146385	Non-Connected	100	2.6	Gravel	Does Not Meet	100%	20%	60%	Grass	0	131	262						$ -	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,800
OSGOOD HILL RD	146386	Non-Connected	100	4.1	Gravel	Does Not Meet	100%	30%	30%	Grass	0	197	459						$ -	$ 1,000	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 6,500
PETTINGILL RD	149991	Non-Connected	100	9.3	Gravel	Partially Meets	100%	0%	100%	Stone	0	0	0						$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
PETTINGILL RD	149992	Non-Connected	100	6.7	Gravel	Partially Meets	100%	20%	50%	Check Dams	0	131	328						$ -	$ 700	$ 5,200	$ -	$ -	$ -	$ -	$ -	$ 5,900
SAWMILL RD	164009	Non-Connected	102	3.9	Gravel	Partially Meets	100%	25%	100%	Grass	0	167	0						$ -	$ 800	$ -	$ -	$ -	$ -	$ -	$ -	$ 800
SAWMILL RD	164010	Connected	56	10.5	Gravel	Does Not Meet	80%	0%	0%	Stone	37	0	365						$ 200	$ -	$ 11,700	$ -	$ -	$ -	$ -	$ -	$ 11,900
SAWMILL RD	164012	Non-Connected	100	1.5	Gravel	Does Not Meet	80%	40%	100%	Grass	66	262	0						$ 300	$ 1,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,600
SAWMILL RD	164013	Non-Connected	100	2.5	Gravel	Partially Meets	100%	40%	85%	Grass	0	262	98						$ -	$ 1,300	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ 2,500
SAWMILL RD	164014	Non-Connected	100	5.0	Gravel	Partially Meets	100%	35%	75%	Grass	0	230	164						$ -	$ 1,100	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 3,100
SAWMILL RD	164015	Non-Connected	100	4.6	Gravel	Partially Meets	100%	20%	80%	Grass	0	131	131						$ -	$ 700	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,300
SAWMILL RD	164016	Non-Connected	100	2.3	Gravel	Partially Meets	100%	10%	100%	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
SAWMILL RD	164017	Non-Connected	100	1.1	Gravel	Partially Meets	90%	40%	60%	Grass	33	262	262						$ 200	$ 1,300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,600
SAWMILL RD	164018	Non-Connected	100	4.8	Gravel	Does Not Meet	30%	40%	30%	Grass	230	262	459						$ 1,100	$ 1,300	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 7,900
SAWMILL RD	164019	Non-Connected	100	4.5	Gravel	Does Not Meet	60%	30%	40%	Grass	131	197	394						$ 700	$ 1,000	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 6,400
SAWMILL RD	164020	Non-Connected	100	2.9	Gravel	Does Not Meet	80%	20%	75%	Grass	66	131	164						$ 300	$ 700	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 3,000
SAXON HILL RD	164245	Non-Connected	19	5.5	Gravel	Does Not Meet	0%	50%	50%	Check Dams	61	61	61						$ 300	$ 300	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ 1,600
SAXON HILL RD	164246	Non-Connected	100	3.1	Gravel	Does Not Meet	0%	85%	45%	Grass	328	558	361						$ 1,600	$ 2,800	$ 4,300	$ -	$ -	$ -	$ -	$ -	$ 8,700
SAXON HILL RD	164247	Non-Connected	100	2.0	Gravel	Does Not Meet	0%	85%	30%	Grass	328	558	459						$ 1,600	$ 2,800	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 9,900
SAXON HILL RD	164248	Non-Connected	100	1.7	Gravel	Does Not Meet	0%	85%	15%	Grass	328	558	558						$ 1,600	$ 2,800	$ 6,700	$ -	$ -	$ -	$ -	$ -	$ 11,100
SAXON HILL RD	164249	Non-Connected	100	2.7	Gravel	Does Not Meet	70%	60%	30%	Grass	98	394	459	1	1	1	1		$ 500	$ 2,000	$ 5,500	$ 500	$ 1,500	$ 300	$ 300	$ -	$ 10,600
SAXON HILL RD	164250	Non-Connected	100	3.2	Gravel	Does Not Meet	80%	50%	50%	Grass	66	328	328	1		1	1		$ 300	$ 1,600	$ 3,900	$ 500	$ -	$ 300	$ 300	$ -	$ 6,900
SAXON HILL RD	164251	Non-Connected	100	4.0	Gravel	Does Not Meet	25%	80%	30%	Grass	246	525	459						$ 1,200	$ 2,600	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 9,300
SAXON HILL RD	164252	Non-Connected	100	2.7	Gravel	Does Not Meet	10%	70%	40%	Grass	295	459	394	1			1		$ 1,500	$ 2,300	$ 4,700	$ 500	$ -	$ -	$ 300	$ -	$ 9,300
SAXON HILL RD	164253	Non-Connected	100	5.5	Gravel	Does Not Meet	20%	0%	0%	Check Dams	262	0	656						$ 1,300	$ -	$ 10,500	$ -	$ -	$ -	$ -	$ -	$ 11,800
SAXON HILL RD	164254	Non-Connected	100	1.2	Gravel	Does Not Meet	0%	75%	0%	Grass	328	492	656						$ 1,600	$ 2,500	$ 7,900	$ -	$ -	$ -	$ -	$ -	$ 12,000

Attachment B

RDDR = Adequacy of Road Drainage, % of Both Sides of Road with Adequate Road Drainage

BERM = Presence of Berm, % of Both Sides of Road with a Berm or High Shoulder

CROWN = Adequacy of Road Crown, % of Road Segment with Adequate Crown

Essex MRGP Implementation Plan
All Work Needed and Cost Estimates by Segment

											Quantity								Base Cost (No Inflation)								
											Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	CROWN (%)	BERM (%)	RDDR (%)	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
SLEEPY HOLLOW RD	168383	Non-Connected	19	5.2	Gravel	Does Not Meet	100%	90%	60%	Check Dams	0	110	49						$ -	$ 600	$ 800	$ -	$ -	$ -	$ -	$ -	$ 1,400
SLEEPY HOLLOW RD	168384	Non-Connected	100	5.0	Gravel	Partially Meets	100%	30%	100%	Check Dams	0	197	0						$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000
SLEEPY HOLLOW RD	168386	Non-Connected	100	3.0	Gravel	Partially Meets	70%	0%	100%	Grass	98	0	0						$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 500
SLEEPY HOLLOW RD	168388	Non-Connected	100	5.7	Gravel	Does Not Meet	100%	0%	0%	Check Dams	0	0	656						$ -	$ -	$ 10,500	$ -	$ -	$ -	$ -	$ -	$ 10,500
SLEEPY HOLLOW RD	168399	Non-Connected	100	3.6	Gravel	Partially Meets	100%	20%	60%	Grass	0	131	262						$ -	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,800
SLEEPY HOLLOW RD	168400	Non-Connected	100	4.8	Gravel	Partially Meets	100%	25%	100%	Grass	0	164	0						$ -	$ 800	$ -	$ -	$ -	$ -	$ -	$ -	$ 800
SLEEPY HOLLOW RD	168401	Non-Connected	100	4.1	Gravel	Partially Meets	100%	20%	100%	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
SUSIE WILSON BYP	64904.1	Connected	100	3.0	Paved	Partially Meets	100%	0%	80%	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
TOWERS RD	186360	Non-Connected	75	1.2	Gravel	Partially Meets	100%	0%	100%	Grass	0	0	0						$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOWERS RD	186361	Non-Connected	100	0.9	Gravel	Partially Meets	80%	0%	80%	Grass	66	0	131						$ 300	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900

Essex Gravel Roads Plan
Implementation Plan Summary

								Quantity								Cost Estimate									
								Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts					
Road	Hydrologic Connectivity	Does Not Meet	Partially Meets	Very High Priority	Total Segments	% of Segments	Year	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Total Base Cost	Inflation Adjusted Cost[4]
SAWMILL RD	**Connected**	1		1	1		2022	37	-	365						$ 200	$ -	$ 11,700	$ -	$ -	$ -	$ -	$ -	$ 11,900	$ 11,900
SAWMILL RD	Non-Connected	4	5		9		2022	525	1,804	1,673	-	-	-	-	-	$ 2,600	$ 9,000	$ 20,100	$ -	$ -	$ -	$ -	$ -	$ 31,700	$ 31,700
BRIGHAM HILL LN	**Connected**	2	6		8		2023	197	1,083	2,067			2	2		$ 1,000	$ 5,400	$ 32,900	$ -	$ -	$ 600	$ 600	$ -	$ 40,500	$ 41,310
BRIGHAM HILL LN	Non-Connected	2			2		2023	262	591	722	-	-	-	-	-	$ 1,300	$ 2,900	$ 8,600	$ -	$ -	$ -	$ -	$ -	$ 12,800	$ 13,056
CURVE HILL RD	**Connected**		1		1		2024	-	248	124						$ -	$ 1,200	$ 1,500	$ -	$ -	$ -	$ -	$ -	$ 2,700	$ 2,809
CURVE HILL RD	Non-Connected		2		2		2024	-	394	591	-	-	-	-	-	$ -	$ 2,000	$ 9,400	$ -	$ -	$ -	$ -	$ -	$ 11,400	$ 11,861
LOST NATION RD	Non-Connected	3	3		6		2024	225	999	1,640	0	0	0	0	0	$ 1,100	$ 5,000	$ 32,800	$ -	$ -	$ -	$ -	$ -	$ 38,900	$ 40,472
SAXON HILL RD	Non-Connected	5			5		2025	1,197	1,804	2,493	2	-	1	2	-	$ 5,900	$ 9,000	$ 32,500	$ 1,000	$ -	$ 300	$ 600	$ -	$ 49,300	$ 52,318
SUSIE WILSON BYP	**Connected**		1		1		2025	-	-	131	-	-	-	-	0	$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600	$ 1,698
DISCOVERY RD	**Connected**		3		3		2026	33	558	525	2					$ 200	$ 2,800	$ 7,600	$ 1,000	$ -	$ -	$ -	$ -	$ 11,600	$ 12,556
DISCOVERY RD	Non-Connected		4		4		2026	70	-	402	-	-	-	-	-	$ 400	$ -	$ 5,400	$ -	$ -	$ -	$ -	$ -	$ 5,800	$ 6,278
LOST NATION RD	Non-Connected	5			5		2026	262	984	1,542	-	-	1	1	1	$ 1,300	$ 5,000	$ 20,000	$ -	$ -	$ 300	$ 300	$ 750	$ 27,650	$ 29,929
SAXON HILL RD	Non-Connected	5			5		2027	1,143	2,128	1,898	1	1	1	1	-	$ 5,600	$ 10,700	$ 23,000	$ 500	$ 1,500	$ 300	$ 300	$ -	$ 41,900	$ 46,261
ESSEX HIGHLANDS	**Connected**	1			1		2027	-	-	-	1	-	4	2	-	$ -	$ -	$ -	$ 500	$ -	$ 1,200	$ 600	$ -	$ 2,300	$ 2,539
HANLEY LN	**Connected**		1		1		2027	-	-	-			3	3		$ -	$ -	$ -	$ -	$ -	$ 900	$ 900	$ -	$ 1,800	$ 1,987
OLD STAGE RD	**Connected**	1			1		2027	-	-	52	3	-	2	-	-	$ -	$ -	$ 600	$ 1,500	$ -	$ 600	$ -	$ -	$ 2,700	$ 2,981
CATELLA RD	**Connected**		2		2		2028	-	197	-						$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000	$ 1,126
CATELLA RD	Non-Connected		2		2		2028	-	176	242	0	0	0	0	0	$ -	$ 900	$ 3,600	$ -	$ -	$ -	$ -	$ -	$ 4,500	$ 5,068
BRIGHAM HILL RD	**Connected**	2	1		3		2028	-	459	919	1		2	2		$ -	$ 2,300	$ 10,900	$ 500	$ -	$ 600	$ 600	$ -	$ 14,900	$ 16,780
BRIGHAM HILL RD	Non-Connected	5	2		7		2028	197	951	1,444	-	-	-	-	-	$ 1,100	$ 4,800	$ 18,500	$ -	$ -	$ -	$ -	$ -	$ 24,400	$ 27,478
COLONEL PAGE RD	**Connected**		1		1		2029	-	197	131						$ -	$ 1,000	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,600	$ 2,987
COLONEL PAGE RD	Non-Connected	7			7		2029	427	853	1,870	2	0	1	1	2	$ 2,200	$ 4,300	$ 26,500	$ 1,000	$ -	$ 300	$ 300	$ 1,500	$ 36,100	$ 41,468
GRAY WY	Non-Connected	1			1		2030	262	394	131	1	-	-	-	-	$ 1,300	$ 2,000	$ 1,600	$ 500	$ -	$ -	$ -	$ -	$ 5,400	$ 6,327
OLD PUMP RD	**Connected**	1	2		3		2030	66	131	591						$ 300	$ 700	$ 7,300	$ -	$ -	$ -	$ -	$ -	$ 8,300	$ 9,725
OLD PUMP RD	Non-Connected	2	2		4		2030	-	853	984	1	-	1	-	-	$ -	$ 4,200	$ 17,600	$ 500	$ -	$ 300	$ -	$ -	$ 22,600	$ 26,480
NAYLOR RD	**Connected**		1		1		2031	-	-	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600	$ 1,912
NAYLOR RD	Non-Connected	2			2		2031	394	328	262	-	-	-	-	-	$ 2,000	$ 1,700	$ 3,200	$ -	$ -	$ -	$ -	$ -	$ 6,900	$ 8,246
SLEEPY HOLLOW RD	Non-Connected	2	2		4		2031	98	307	705	-	-	-	-	-	$ 500	$ 1,600	$ 11,300	$ -	$ -	$ -	$ -	$ -	$ 13,400	$ 16,014
LOST NATION RD	**Connected**		3		3		2031	-	919	853						$ -	$ 4,600	$ 11,400	$ -	$ -	$ -	$ -	$ -	$ 16,000	$ 19,121
LOST NATION RD	Non-Connected	2	2		4		2031	164	394	1,115	-	-	-	-	-	$ 900	$ 2,000	$ 15,500	$ -	$ -	$ -	$ -	$ -	$ 18,400	$ 21,990
CATELLA RD	**Connected**		1		1		2032	-	66	131						$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900	$ 2,316
OSGOOD HILL RD	**Connected**	2	4		6		2032	164	853	656	3					$ 800	$ 4,300	$ 8,000	$ 1,500	$ -	$ -	$ -	$ -	$ 14,600	$ 17,797
OSGOOD HILL RD	Non-Connected	2	5		7		2032	197	525	66	-	-	1	-	1	$ 1,000	$ 2,600	$ 800	$ -	$ -	$ 300	$ -	$ 750	$ 5,450	$ 6,644
INDIAN BROOK RD	**Connected**		1		1		2032	-	262	328						$ -	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,200	$ 6,339
INDIAN BROOK RD	Non-Connected	2	7		9		2032	164	1,476	1,411	1	-	2	-	-	$ 800	$ 7,300	$ 17,000	$ 500	$ -	$ 600	$ -	$ -	$ 26,200	$ 31,938
	Connected Total	10	28		38			496	4,973	7,005	10	0	13	9	0	$ 2,500	$ 24,900	$ 102,200	$ 5,000	$ -	$ 3,900	$ 2,700	$ -	$ 141,200	$ 155,884
	Non-Connected Total	49	36		85			5,589	14,961	19,192	8	1	8	5	4	$ 28,000	$ 75,000	$ 267,400	$ 4,000	$ 1,500	$ 2,400	$ 1,500	$ 3,000	$ 382,800	$ 423,525
	Overall Total	**59**	**64**		**123**			**6,085**	**19,934**	**26,197**	**18**	**1**	**21**	**14**	**4**	**$ 30,500**	**$ 99,900**	**$ 369,600**	**$ 9,000**	**$ 1,500**	**$ 6,300**	**$ 4,200**	**$ 3,000**	**$ 524,000**	**$ 579,410**

Annual Cost Summary

Year	Segments	Total Base Cost	Inflation Adjusted Cost[4]
2022	10	$ 43,600	$ 43,600
2023	10	$ 53,300	$ 54,366
2024	9	$ 53,000	$ 55,141
2025	6	$ 50,900	$ 54,015
2026	12	$ 45,050	$ 48,764
2027	8	$ 48,700	$ 53,769
2028	14	$ 44,800	$ 50,452
2029	8	$ 38,700	$ 44,454
2030	8	$ 36,300	$ 42,531
2031	14	$ 56,300	$ 67,284
2032	24	$ 53,350	$ 65,033
Total	**123**	**$ 524,000**	**$ 579,410**

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Quantity: Road Surfaces Crown (ft)	Quantity: Road Surfaces Berm (ft)	Quantity: Drainage Ditches (ft)	Quantity: Drainage Conveyance (in Turnout)	Quantity: Culverts Cross Culvert	Quantity: Culverts Header	Quantity: Culverts Outlet	Quantity: Culverts Driveway Culvert	Base Cost (No Inflation): Road Surfaces Crown	Base Cost (No Inflation): Road Surfaces Berm	Base Cost (No Inflation): Drainage Ditches	Base Cost (No Inflation): Drainage Conveyance (in Turnout)	Base Cost (No Inflation): Culverts Cross Culvert	Base Cost (No Inflation): Culverts Header	Base Cost (No Inflation): Culverts Outlet	Base Cost (No Inflation): Culverts Driveway Culvert	Base Cost (Total)
2022	SAWMILL RD	164010	Connected	56	10.5	Gravel	Does Not Meet	Stone	37	0	365						$ 200	$ -	$ 11,700	$ -	$ -	$ -	$ -	$ -	$ 11,900
	SAWMILL RD	164012	Non-Connected	100	1.5	Gravel	Does Not Meet	Grass	66	262	0						$ 300	$ 1,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,600
	SAWMILL RD	164018	Non-Connected	100	4.8	Gravel	Does Not Meet	Grass	230	262	459						$ 1,100	$ 1,300	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 7,900
	SAWMILL RD	164019	Non-Connected	100	4.5	Gravel	Does Not Meet	Grass	131	197	394						$ 700	$ 1,000	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 6,400
	SAWMILL RD	164020	Non-Connected	100	2.9	Gravel	Does Not Meet	Grass	66	131	164						$ 300	$ 700	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 3,000
	SAWMILL RD	164013	Non-Connected	100	2.5	Gravel	Partially Meets	Grass	0	262	98						$ -	$ 1,300	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ 2,500
	SAWMILL RD	164014	Non-Connected	100	5.0	Gravel	Partially Meets	Grass	0	230	164						$ -	$ 1,100	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 3,100
	SAWMILL RD	164015	Non-Connected	100	4.6	Gravel	Partially Meets	Grass	0	131	131						$ -	$ 700	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,300
	SAWMILL RD	164016	Non-Connected	100	2.3	Gravel	Partially Meets	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
	SAWMILL RD	164017	Non-Connected	100	1.1	Gravel	Partially Meets	Grass	33	262	262						$ 200	$ 1,300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,600
								Total	**561**	**1804**	**2039**	**0**	**0**	**0**	**0**	**0**	**$ 2,800**	**$ 9,000**	**$ 31,800**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 43,600**
								Inflation Adjusted									**$ 2,800**	**$ 9,000**	**$ 31,800**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 43,600**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Quantity: Road Surfaces Crown (ft)	Quantity: Road Surfaces Berm (ft)	Quantity: Drainage Ditches (ft)	Quantity: Drainage Conveyance (in Turnout)	Quantity: Culverts Cross Culvert	Quantity: Culverts Header	Quantity: Culverts Outlet	Quantity: Culverts Driveway Culvert	Base Cost (No Inflation): Road Surfaces Crown	Road Surfaces Berm	Drainage Ditches	Drainage Conveyance (in Turnout)	Culverts Cross Culvert	Culverts Header	Culverts Outlet	Culverts Driveway Culvert	Base Cost (Total)
2023	BRIGHAM HILL LN	12873	Connected	100	1.0	Gravel	Partially Meets	Grass	0	66	197			1	1		$ -	$ 300	$ 2,400	$ -	$ -	$ 300	$ 300	$ -	$ 3,300
	BRIGHAM HILL LN	12876	Connected	100	0.3	Gravel	Partially Meets	Grass	33	197	394			1	1		$ 200	$ 1,000	$ 4,700	$ -	$ -	$ 300	$ 300	$ -	$ 6,500
	BRIGHAM HILL LN	12877	Connected	100	6.0	Gravel	Partially Meets	Stone	0	262	361						$ -	$ 1,300	$ 11,500	$ -	$ -	$ -	$ -	$ -	$ 12,800
	BRIGHAM HILL LN	12878	Connected	100	0.5	Gravel	Partially Meets	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
	BRIGHAM HILL LN	12879	Connected	100	2.6	Gravel	Partially Meets	Grass	66	66	262						$ 300	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,700
	BRIGHAM HILL LN	12870	Connected	100	4.6	Gravel	Does Not Meet	Grass	0	164	328						$ -	$ 800	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 4,700
	BRIGHAM HILL LN	12871	Connected	100	3.7	Gravel	Does Not Meet	Grass	33	131	262						$ 200	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,000
	BRIGHAM HILL LN	12872	Connected	100	6.2	Gravel	Partially Meets	Check Dams	66	131	262						$ 300	$ 700	$ 4,200	$ -	$ -	$ -	$ -	$ -	$ 5,200
	BRIGHAM HILL LN	12874	Non-Connected	100	3.0	Gravel	Does Not Meet	Grass	98	328	394						$ 500	$ 1,600	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 6,800
	BRIGHAM HILL LN	12875	Non-Connected	100	1.9	Gravel	Does Not Meet	Grass	164	262	328						$ 800	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 6,000
								Total	**459**	**1673**	**2789**	**0**	**0**	**2**	**2**	**0**	**$ 2,300**	**$ 8,300**	**$ 41,500**	**$ -**	**$ -**	**$ 600**	**$ 600**	**$ -**	**$ 53,300**
								Inflation Adjusted									**$ 2,346**	**$ 8,466**	**$ 42,330**	**$ -**	**$ -**	**$ 612**	**$ 612**	**$ -**	**$ 54,366**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

									Quantity								Base Cost (No Inflation)								
									Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
2024	CURVE HILL RD	29865	Connected	95	4.8	Gravel	Partially Meets	Grass	0	248	124						$ -	$ 1,200	$ 1,500	$ -	$ -	$ -	$ -	$ -	$ 2,700
	LOST NATION RD	127149	Non-Connected	100	8.0	Gravel	Does Not Meet	Stone	131	262	394						$ 700	$ 1,300	$ 12,600	$ -	$ -	$ -	$ -	$ -	$ 14,600
	LOST NATION RD	127151	Non-Connected	100	0.7	Gravel	Does Not Meet	Grass	0	131	525						$ -	$ 700	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 7,000
	LOST NATION RD	127197	Non-Connected	100	8.4	Gravel	Does Not Meet	Stone	66	66	262						$ 300	$ 300	$ 8,400	$ -	$ -	$ -	$ -	$ -	$ 9,000
	CURVE HILL RD	29864	Non-Connected	100	7.4	Gravel	Partially Meets	Check Dams	0	131	262						$ -	$ 700	$ 4,200	$ -	$ -	$ -	$ -	$ -	$ 4,900
	CURVE HILL RD	29866	Non-Connected	100	5.8	Gravel	Partially Meets	Check Dams	0	262	328						$ -	$ 1,300	$ 5,200	$ -	$ -	$ -	$ -	$ -	$ 6,500
	LOST NATION RD	127150	Non-Connected	100	3.6	Gravel	Partially Meets	Grass	0	262	131						$ -	$ 1,300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,900
	LOST NATION RD	127152	Non-Connected	100	2.7	Gravel	Partially Meets	Grass	0	262	328						$ -	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,200
	LOST NATION RD	127196	Non-Connected	22	2.7	Gravel	Partially Meets	Grass	29	14	0						$ 100	$ 100	$ -	$ -	$ -	$ -	$ -	$ -	$ 200
								Total	**225**	**1640**	**2355**	**0**	**0**	**0**	**0**	**0**	**$ 1,100**	**$ 8,200**	**$ 43,700**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 53,000**
								Inflation Adjusted									**$ 1,144**	**$ 8,531**	**$ 45,465**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 55,141**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Quantity: Road Surfaces Crown (ft)	Quantity: Road Surfaces Berm (ft)	Quantity: Drainage Ditches (ft)	Quantity: Drainage Conveyance (in Turnout)	Quantity: Culverts Cross Culvert	Quantity: Culverts Header	Quantity: Culverts Outlet	Quantity: Culverts Driveway Culvert	Base Cost (No Inflation): Road Surfaces Crown	Base Cost (No Inflation): Road Surfaces Berm	Base Cost (No Inflation): Drainage Ditches	Base Cost (No Inflation): Drainage Conveyance (in Turnout)	Base Cost (No Inflation): Culverts Cross Culvert	Base Cost (No Inflation): Culverts Header	Base Cost (No Inflation): Culverts Outlet	Base Cost (No Inflation): Culverts Driveway Culvert	Base Cost (Total)
2025	SAXON HILL RD	164250	Non-Connected	100	3.2	Gravel	Does Not Meet	Grass	66	328	328	1	0	1	1		$ 300	$ 1,600	$ 3,900	$ 500	$ -	$ 300	$ 300	$ -	$ 6,900
	SAXON HILL RD	164251	Non-Connected	100	4.0	Gravel	Does Not Meet	Grass	246	525	459						$ 1,200	$ 2,600	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 9,300
	SAXON HILL RD	164252	Non-Connected	100	2.7	Gravel	Does Not Meet	Grass	295	459	394	1			1		$ 1,500	$ 2,300	$ 4,700	$ 500	$ -	$ -	$ 300	$ -	$ 9,300
	SAXON HILL RD	164253	Non-Connected	100	5.5	Gravel	Does Not Meet	Check Dams	262	0	656						$ 1,300	$ -	$ 10,500	$ -	$ -	$ -	$ -	$ -	$ 11,800
	SAXON HILL RD	164254	Non-Connected	100	1.2	Gravel	Does Not Meet	Grass	328	492	656						$ 1,600	$ 2,500	$ 7,900	$ -	$ -	$ -	$ -	$ -	$ 12,000
	SUSIE WILSON BYP	64904.1	Connected	100	3.0	Paved	Partially Meets	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
								Total	**1197**	**1804**	**2625**	**2**	**0**	**1**	**2**	**0**	**$ 5,900**	**$ 9,000**	**$ 34,100**	**$ 1,000**	**$ -**	**$ 300**	**$ 600**	**$ -**	**$ 50,900**
								Inflation Adjusted									**$ 6,261**	**$ 9,551**	**$ 36,187**	**$ 1,061**	**$ -**	**$ 318**	**$ 637**	**$ -**	**$ 54,015**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

									Quantity								Base Cost (No Inflation)								
									Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
2026	DISCOVERY RD	33117	Connected	100	0.4	Gravel	Partially Meets	Grass	0	262	0						$ -	$ 1,300	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,300
	DISCOVERY RD	33120	Connected	100	3.9	Gravel	Partially Meets	Grass	0	131	197						$ -	$ 700	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 3,100
	DISCOVERY RD	33121	Connected	100	7.4	Gravel	Partially Meets	Check Dams	33	164	328	2					$ 200	$ 800	$ 5,200	$ 1,000	$ -	$ -	$ -	$ -	$ 7,200
	LOST NATION RD	127163	Non-Connected	100	1.4	Gravel	Does Not Meet	Grass	98	131	262						$ 500	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,300
	LOST NATION RD	127164	Non-Connected	100	2.9	Gravel	Does Not Meet	Grass	66	131	262						$ 300	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,100
	LOST NATION RD	127165	Non-Connected	100	4.3	Gravel	Does Not Meet	Grass	98	525	492			1	1		$ 500	$ 2,600	$ 5,900	$ -	$ -	$ 300	$ 300	$ -	$ 9,600
	LOST NATION RD	127166	Non-Connected	100	5.0	Gravel	Does Not Meet	Check Dams	0	131	394						$ -	$ 700	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 7,000
	LOST NATION RD	127167	Non-Connected	100	3.1	Gravel	Does Not Meet	Grass	0	66	131					1	$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ 750	$ 2,650
	DISCOVERY RD	33114	Non-Connected	12	5.8	Gravel	Partially Meets	Check Dams	4	0	8						$ -	$ -	$ 100	$ -	$ -	$ -	$ -	$ -	$ 100
	DISCOVERY RD	33115	Non-Connected	100	4.6	Gravel	Partially Meets	Grass	33	0	131						$ 200	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,800
	DISCOVERY RD	33118	Non-Connected	100	2.9	Gravel	Partially Meets	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
	DISCOVERY RD	33119	Non-Connected	100	5.4	Gravel	Partially Meets	Check Dams	33	0	131						$ 200	$ -	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 2,300
								Total	**365**	**1542**	**2469**	**2**	**0**	**1**	**1**	**1**	**$ 1,900**	**$ 7,800**	**$ 33,000**	**$ 1,000**	**$ -**	**$ 300**	**$ 300**	**$ 750**	**$ 45,050**
								Inflation Adjusted									**$ 2,057**	**$ 8,443**	**$ 35,720**	**$ 1,082**	**$ -**	**$ 325**	**$ 325**	**$ 812**	**$ 48,764**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Quantity: Road Surfaces Crown (ft)	Quantity: Road Surfaces Berm (ft)	Quantity: Drainage Ditches (ft)	Quantity: Drainage Conveyance (in Turnout)	Quantity: Culverts Cross Culvert	Quantity: Culverts Header	Quantity: Culverts Outlet	Quantity: Culverts Driveway Culvert	Base Cost (No Inflation): Road Surfaces Crown	Base Cost (No Inflation): Road Surfaces Berm	Base Cost (No Inflation): Drainage Ditches	Base Cost (No Inflation): Drainage Conveyance (in Turnout)	Base Cost (No Inflation): Culverts Cross Culvert	Base Cost (No Inflation): Culverts Header	Base Cost (No Inflation): Culverts Outlet	Base Cost (No Inflation): Culverts Driveway Culvert	Base Cost (Total)
2027	ESSEX HIGHLANDS	20395.1	Connected	100	0.0	Paved	Does Not Meet	Grass	0	0	0	1	0	4	2		$ -	$ -	$ -	$ 500	$ -	$ 1,200	$ 600	$ -	$ 2,300
	HANLEY LN	108356	Connected	100	1.3	Gravel	Partially Meets	Grass	0	0	0			3	3		$ -	$ -	$ -	$ -	$ -	$ 900	$ 900	$ -	$ 1,800
	OLD STAGE RD	46638.1	Connected	100	0.1	Paved	Does Not Meet	Grass	0	0	52	3		2			$ -	$ -	$ 600	$ 1,500	$ -	$ 600	$ -	$ -	$ 2,700
	SAXON HILL RD	164245	Non-Connected	19	5.5	Gravel	Does Not Meet	Check Dams	61	61	61						$ 300	$ 300	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ 1,600
	SAXON HILL RD	164246	Non-Connected	100	3.1	Gravel	Does Not Meet	Grass	328	558	361						$ 1,600	$ 2,800	$ 4,300	$ -	$ -	$ -	$ -	$ -	$ 8,700
	SAXON HILL RD	164247	Non-Connected	100	2.0	Gravel	Does Not Meet	Grass	328	558	459						$ 1,600	$ 2,800	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ 9,900
	SAXON HILL RD	164248	Non-Connected	100	1.7	Gravel	Does Not Meet	Grass	328	558	558						$ 1,600	$ 2,800	$ 6,700	$ -	$ -	$ -	$ -	$ -	$ 11,100
	SAXON HILL RD	164249	Non-Connected	100	2.7	Gravel	Does Not Meet	Grass	98	394	459	1	1	1	1		$ 500	$ 2,000	$ 5,500	$ 500	$ 1,500	$ 300	$ 300	$ -	$ 10,600
								Total	**1143**	**2128**	**1950**	**5**	**1**	**10**	**6**	**0**	**$ 5,600**	**$ 10,700**	**$ 23,600**	**$ 2,500**	**$ 1,500**	**$ 3,000**	**$ 1,800**	**$ -**	**$ 48,700**
								Inflation Adjusted									**$ 6,183**	**$ 11,814**	**$ 26,056**	**$ 2,760**	**$ 1,656**	**$ 3,312**	**$ 1,987**	**$ -**	**$ 53,769**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

									Quantity								Base Cost (No Inflation)								
									Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
2028	BRIGHAM HILL RD	12886	Connected	100	1.6	Gravel	Does Not Meet	Grass	0	262	262	1		1	1		$ -	$ 1,300	$ 3,100	$ 500	$ -	$ 300	$ 300	$ -	$ 5,500
	BRIGHAM HILL RD	12899	Connected	100	1.5	Gravel	Partially Meets	Grass	0	66	328			1	1		$ -	$ 300	$ 3,900	$ -	$ -	$ 300	$ 300	$ -	$ 4,800
	BRIGHAM HILL RD	12912	Connected	100	4.2	Gravel	Does Not Meet	Grass	0	131	328						$ -	$ 700	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 4,600
	BRIGHAM HILL RD	12903	Non-Connected	100	2.2	Gravel	Does Not Meet	Grass	0	164	131						$ -	$ 800	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,400
	BRIGHAM HILL RD	12904	Non-Connected	100	7.5	Gravel	Does Not Meet	Check Dams	33	197	131						$ 200	$ 1,000	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 3,300
	BRIGHAM HILL RD	12907	Non-Connected	100	2.8	Gravel	Does Not Meet	Grass	131	197	262						$ 700	$ 1,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,800
	BRIGHAM HILL RD	12908	Non-Connected	100	2.8	Gravel	Does Not Meet	Grass	0	197	197						$ -	$ 1,000	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 3,400
	BRIGHAM HILL RD	12911	Non-Connected	100	5.8	Gravel	Does Not Meet	Check Dams	0	0	197						$ -	$ -	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,100
	BRIGHAM HILL RD	12897	Non-Connected	100	1.9	Gravel	Partially Meets	Grass	33	131	262						$ 200	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,000
	BRIGHAM HILL RD	12910	Non-Connected	100	1.4	Gravel	Partially Meets	Grass	0	66	262						$ -	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,400
	CATELLA RD	19287	Connected	100	4.3	Gravel	Partially Meets	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
	CATELLA RD	19290	Connected	100	3.9	Gravel	Partially Meets	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
	CATELLA RD	19284	Non-Connected	34	1.7	Gravel	Partially Meets	Grass	0	45	45						$ -	$ 200	$ 500	$ -	$ -	$ -	$ -	$ -	$ 700
	CATELLA RD	19285	Non-Connected	100	6.4	Gravel	Partially Meets	Check Dams	0	131	197						$ -	$ 700	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,800
								Total	**197**	**1784**	**2604**	**1**	**0**	**2**	**2**	**0**	**$ 1,100**	**$ 9,000**	**$ 33,000**	**$ 500**	**$ -**	**$ 600**	**$ 600**	**$ -**	**$ 44,800**
								Inflation Adjusted									**$ 1,239**	**$ 10,135**	**$ 37,163**	**$ 563**	**$ -**	**$ 676**	**$ 676**	**$ -**	**$ 50,452**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Quantity: Road Surfaces Crown (ft)	Quantity: Road Surfaces Berm (ft)	Quantity: Drainage Ditches (ft)	Quantity: Drainage Conveyance (in Turnout)	Quantity: Culverts Cross Culvert	Quantity: Culverts Header	Quantity: Culverts Outlet	Quantity: Culverts Driveway Culvert	Base Cost (No Inflation): Road Surfaces Crown	Base Cost (No Inflation): Road Surfaces Berm	Base Cost (No Inflation): Drainage Ditches	Base Cost (No Inflation): Drainage Conveyance (in Turnout)	Base Cost (No Inflation): Culverts Cross Culvert	Base Cost (No Inflation): Culverts Header	Base Cost (No Inflation): Culverts Outlet	Base Cost (No Inflation): Culverts Driveway Culvert	Base Cost (Total)
2029	COLONEL PAGE RD	25114	Connected	100	2.7	Gravel	Partially Meets	Grass	0	197	131						$ -	$ 1,000	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,600
	COLONEL PAGE RD	25107	Non-Connected	100	3.8	Gravel	Does Not Meet	Grass	98	0	558						$ 500	$ -	$ 6,700	$ -	$ -	$ -	$ -	$ -	$ 7,200
	COLONEL PAGE RD	25108	Non-Connected	100	2.5	Gravel	Does Not Meet	Grass	0	131	0					1	$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ 750	$ 1,450
	COLONEL PAGE RD	25110	Non-Connected	100	4.8	Gravel	Does Not Meet	Grass	0	394	262						$ -	$ 2,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 5,100
	COLONEL PAGE RD	25111	Non-Connected	100	2.9	Gravel	Does Not Meet	Grass	0	328	394						$ -	$ 1,600	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 6,300
	COLONEL PAGE RD	25115	Non-Connected	100	10.3	Gravel	Does Not Meet	Stone	131	0	197	1		1	1		$ 700	$ -	$ 6,300	$ 500	$ -	$ 300	$ 300	$ -	$ 8,100
	COLONEL PAGE RD	25116	Non-Connected	100	7.2	Gravel	Does Not Meet	Check Dams	131	0	66	1				1	$ 700	$ -	$ 1,000	$ 500	$ -	$ -	$ -	$ 750	$ 2,950
	COLONEL PAGE RD	25117	Non-Connected	100	3.6	Gravel	Does Not Meet	Grass	66	0	394						$ 300	$ -	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 5,000
								Total	**427**	**1050**	**2001**	**2**	**0**	**1**	**1**	**2**	**$ 2,200**	**$ 5,300**	**$ 28,100**	**$ 1,000**	**$ -**	**$ 300**	**$ 300**	**$ 1,500**	**$ 38,700**
								Inflation Adjusted									**$ 2,527**	**$ 6,088**	**$ 32,278**	**$ 1,149**	**$ -**	**$ 345**	**$ 345**	**$ 1,723**	**$ 44,454**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

									Quantity								Base Cost (No Inflation)								
									Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
2030	OLD PUMP RD	144619	Connected	100	4.8	Gravel	Does Not Meet	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
	OLD PUMP RD	144621	Connected	100	4.0	Gravel	Partially Meets	Check Dams	0	0	394						$ -	$ -	$ 4,700	$ -	$ -	$ -	$ -	$ -	$ 4,700
	OLD PUMP RD	144615	Connected	100	5.2	Gravel	Partially Meets	Check Dams	66	131	66						$ 300	$ 700	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ 2,000
	GRAY WY	105272	Non-Connected	100	2.0	Gravel	Does Not Meet	Grass	262	394	131	1					$ 1,300	$ 2,000	$ 1,600	$ 500	$ -	$ -	$ -	$ -	$ 5,400
	OLD PUMP RD	144622	Non-Connected	100	2.7	Gravel	Does Not Meet	Grass	0	459	525						$ -	$ 2,300	$ 6,300	$ -	$ -	$ -	$ -	$ -	$ 8,600
	OLD PUMP RD	144623	Non-Connected	100	9.2	Gravel	Does Not Meet	Stone	0	66	262	1					$ -	$ 300	$ 8,400	$ 500	$ -	$ -	$ -	$ -	$ 9,200
	OLD PUMP RD	144613	Non-Connected	100	6.9	Gravel	Partially Meets	Check Dams	0	262	131						$ -	$ 1,300	$ 2,100	$ -	$ -	$ -	$ -	$ -	$ 3,400
	OLD PUMP RD	144618	Non-Connected	100	2.9	Gravel	Partially Meets	Grass	0	66	66			1			$ -	$ 300	$ 800	$ -	$ -	$ 300	$ -	$ -	$ 1,400
								Total	**328**	**1378**	**1706**	**2**	**0**	**1**	**0**	**0**	**$ 1,600**	**$ 6,900**	**$ 26,500**	**$ 1,000**	**$ -**	**$ 300**	**$ -**	**$ -**	**$ 36,300**
								Inflation Adjusted									**$ 1,875**	**$ 8,084**	**$ 31,049**	**$ 1,172**	**$ -**	**$ 351**	**$ -**	**$ -**	**$ 42,531**

Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Quantity: Road Surfaces Crown (ft)	Quantity: Road Surfaces Berm (ft)	Quantity: Drainage Ditches (ft)	Quantity: Drainage Conveyance (in Turnout)	Quantity: Culverts Cross Culvert	Quantity: Culverts Header	Quantity: Culverts Outlet	Quantity: Culverts Driveway Culvert	Base Cost (No Inflation): Road Surfaces Crown	Base Cost (No Inflation): Road Surfaces Berm	Base Cost (No Inflation): Drainage Ditches	Base Cost (No Inflation): Drainage Conveyance (in Turnout)	Base Cost (No Inflation): Culverts Cross Culvert	Base Cost (No Inflation): Culverts Header	Base Cost (No Inflation): Culverts Outlet	Base Cost (No Inflation): Culverts Driveway Culvert	Base Cost (Total)
2031	LOST NATION RD	127187	Connected	100	0.1	Gravel	Partially Meets	Grass	0	394	262						$ -	$ 2,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 5,100
	LOST NATION RD	127188	Connected	100	2.0	Gravel	Partially Meets	Grass	0	328	262						$ -	$ 1,600	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,700
	LOST NATION RD	127192	Connected	100	5.4	Gravel	Partially Meets	Check Dams	0	197	328						$ -	$ 1,000	$ 5,200	$ -	$ -	$ -	$ -	$ -	$ 6,200
	LOST NATION RD	127182	Non-Connected	100	5.8	Gravel	Does Not Meet	Check Dams	131	197	525						$ 700	$ 1,000	$ 8,400	$ -	$ -	$ -	$ -	$ -	$ 10,100
	LOST NATION RD	127183	Non-Connected	100	3.9	Gravel	Does Not Meet	Grass	33	197	262						$ 200	$ 1,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 4,300
	LOST NATION RD	127148	Non-Connected	100	1.0	Gravel	Partially Meets	Grass	0	0	197						$ -	$ -	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 2,400
	LOST NATION RD	127195	Non-Connected	100	2.1	Gravel	Partially Meets	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
	NAYLOR RD	139691	Connected	100	3.0	Gravel	Partially Meets	Grass	0	0	131						$ -	$ -	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,600
	NAYLOR RD	139693	Non-Connected	100	2.6	Gravel	Does Not Meet	Grass	131	131	66						$ 700	$ 700	$ 800	$ -	$ -	$ -	$ -	$ -	$ 2,200
	NAYLOR RD	139694	Non-Connected	100	1.4	Gravel	Does Not Meet	Grass	262	197	197						$ 1,300	$ 1,000	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 4,700
	SLEEPY HOLLOW RD	168383	Non-Connected	19	5.2	Gravel	Does Not Meet	Check Dams	0	110	49						$ -	$ 600	$ 800	$ -	$ -	$ -	$ -	$ -	$ 1,400
	SLEEPY HOLLOW RD	168388	Non-Connected	100	5.7	Gravel	Does Not Meet	Check Dams	0	0	656						$ -	$ -	$ 10,500	$ -	$ -	$ -	$ -	$ -	$ 10,500
	SLEEPY HOLLOW RD	168384	Non-Connected	100	5.0	Gravel	Partially Meets	Check Dams	0	197	0						$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000
	SLEEPY HOLLOW RD	168386	Non-Connected	100	3.0	Gravel	Partially Meets	Grass	98	0	0						$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 500
								Total	**656**	**1947**	**3067**	**0**	**0**	**0**	**0**	**0**	**$ 3,400**	**$ 9,900**	**$ 43,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 56,300**
								Inflation Adjusted									**$ 4,063**	**$ 11,831**	**$ 51,389**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 67,284**

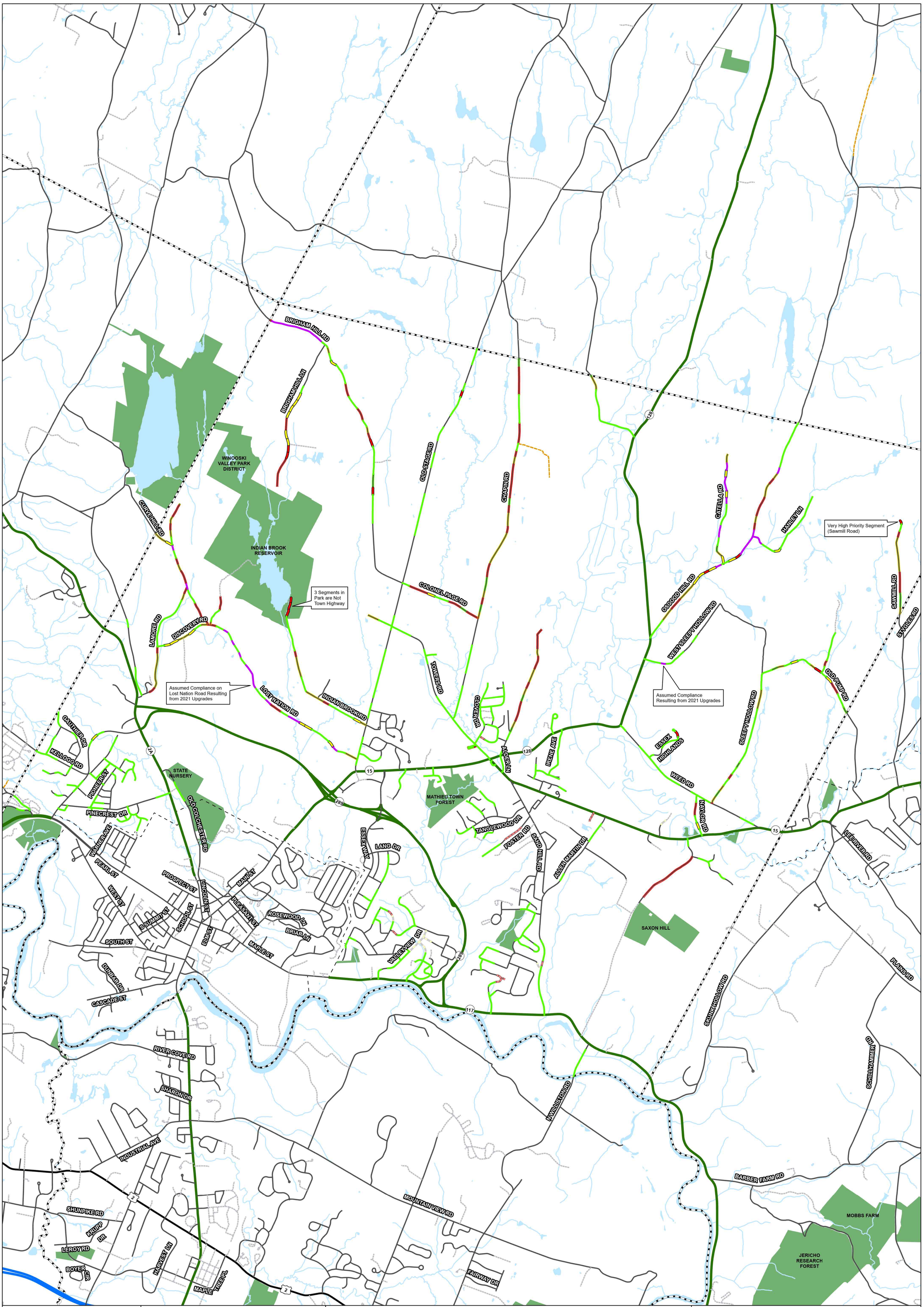
Note: Assumed 2% annual inflation.

Attachment D

Essex MRGP Implementation Plan
Annual Work Plans

									Quantity								Base Cost (No Inflation)								
									Road Surfaces		Drainage		Culverts				Road Surfaces		Drainage		Culverts				
Plan Year	Road	Segment ID	Hydro-Connected	Length (m)	Slope	Road Type	Standards	Ditch Type	Crown (ft)	Berm (ft)	Ditches (ft)	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Crown	Berm	Ditches	Conveyance (in Turnout)	Cross Culvert	Header	Outlet	Driveway Culvert	Base Cost (Total)
2032	INDIAN BROOK RD	115913	Connected	100	4.1	Gravel	Partially Meets	Grass	0	262	328						$ -	$ 1,300	$ 3,900	$ -	$ -	$ -	$ -	$ -	$ 5,200
	INDIAN BROOK RD	115899	Non-Connected	100	4.4	Gravel	Does Not Meet	Grass	0	197	197	1		1			$ -	$ 1,000	$ 2,400	$ 500	$ -	$ 300	$ -	$ -	$ 4,200
	INDIAN BROOK RD	115908	Non-Connected	100	2.3	Gravel	Does Not Meet	Grass	66	394	262						$ 300	$ 2,000	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 5,400
	INDIAN BROOK RD	115890	Non-Connected	100	2.5	Gravel	Partially Meets	Grass	0	66	0			1			$ -	$ 300	$ -	$ -	$ -	$ 300	$ -	$ -	$ 600
	INDIAN BROOK RD	115900	Non-Connected	100	3.3	Gravel	Partially Meets	Grass	0	164	164						$ -	$ 800	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 2,800
	INDIAN BROOK RD	115901	Non-Connected	100	2.4	Gravel	Partially Meets	Grass	0	66	164						$ -	$ 300	$ 2,000	$ -	$ -	$ -	$ -	$ -	$ 2,300
	INDIAN BROOK RD	115902	Non-Connected	100	1.8	Gravel	Partially Meets	Grass	98	66	262						$ 500	$ 300	$ 3,100	$ -	$ -	$ -	$ -	$ -	$ 3,900
	INDIAN BROOK RD	115905	Non-Connected	100	1.9	Gravel	Partially Meets	Grass	0	262	98						$ -	$ 1,300	$ 1,200	$ -	$ -	$ -	$ -	$ -	$ 2,500
	INDIAN BROOK RD	115906	Non-Connected	100	4.0	Gravel	Partially Meets	Grass	0	197	131						$ -	$ 1,000	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,600
	INDIAN BROOK RD	115907	Non-Connected	100	3.6	Gravel	Partially Meets	Grass	0	66	131						$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900
	CATELLA RD	19276	Connected	100	1.2	Gravel	Partially Meets	Grass	0	66	131						$ -	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 1,900
	OSGOOD HILL RD	146357	Connected	100	3.3	Gravel	Partially Meets	Grass	0	66	0						$ -	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 300
	OSGOOD HILL RD	146360	Connected	100	3.2	Gravel	Partially Meets	Grass	0	131	0						$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ 700
	OSGOOD HILL RD	146361	Connected	100	2.0	Gravel	Does Not Meet	Grass	0	197	197	2					$ -	$ 1,000	$ 2,400	$ 1,000	$ -	$ -	$ -	$ -	$ 4,400
	OSGOOD HILL RD	146362	Connected	100	2.4	Gravel	Partially Meets	Grass	66	262	197						$ 300	$ 1,300	$ 2,400	$ -	$ -	$ -	$ -	$ -	$ 4,000
	OSGOOD HILL RD	146363	Connected	100	2.6	Gravel	Partially Meets	Grass	33	66	131						$ 200	$ 300	$ 1,600	$ -	$ -	$ -	$ -	$ -	$ 2,100
	OSGOOD HILL RD	146356	Connected	100	3.9	Gravel	Does Not Meet	Grass	66	131	131	1					$ 300	$ 700	$ 1,600	$ 500	$ -	$ -	$ -	$ -	$ 3,100
	OSGOOD HILL RD	146367	Non-Connected	100	3.2	Gravel	Does Not Meet	Grass	0	66	0			1			$ -	$ 300	$ -	$ -	$ -	$ 300	$ -	$ -	$ 600
	OSGOOD HILL RD	146368	Non-Connected	100	1.1	Gravel	Does Not Meet	Grass	0	131	0					1	$ -	$ 700	$ -	$ -	$ -	$ -	$ -	$ 750	$ 1,450
	OSGOOD HILL RD	146364	Non-Connected	100	3.0	Gravel	Partially Meets	Grass	66	66	0						$ 300	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 600
	OSGOOD HILL RD	146365	Non-Connected	100	4.8	Gravel	Partially Meets	Grass	33	0	66						$ 200	$ -	$ 800	$ -	$ -	$ -	$ -	$ -	$ 1,000
	OSGOOD HILL RD	146366	Non-Connected	100	3.1	Gravel	Partially Meets	Grass	33	0	0						$ 200	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 200
	OSGOOD HILL RD	146369	Non-Connected	100	1.8	Gravel	Partially Meets	Grass	66	66	0						$ 300	$ 300	$ -	$ -	$ -	$ -	$ -	$ -	$ 600
	OSGOOD HILL RD	146370	Non-Connected	100	2.1	Gravel	Partially Meets	Grass	0	197	0						$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000
								Total	**525**	**3182**	**2592**	**4**	**0**	**3**	**0**	**1**	**$ 2,600**	**$ 15,800**	**$ 31,300**	**$ 2,000**	**$ -**	**$ 900**	**$ -**	**$ 750**	**$ 53,350**
								Inflation Adjusted									**$ 3,169**	**$ 19,260**	**$ 38,155**	**$ 2,438**	**$ -**	**$ 1,097**	**$ -**	**$ 914**	**$ 65,033**

Note: Assumed 2% annual inflation.



Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

MRGP Compliance & Gravel Road Status

Town of Essex, VT

MRGP Segment Compliance
- Does Not Meet
- Does Not Meet (Paved Curbed)
- Partially Meets
- Partially Meets (Paved Curbed)
- Fully Meets - Upgraded
- Fully Meets

Non-MRGP Gravel Road Segment Status
- Does Not Meet
- Partially Meets
- Fully Meets

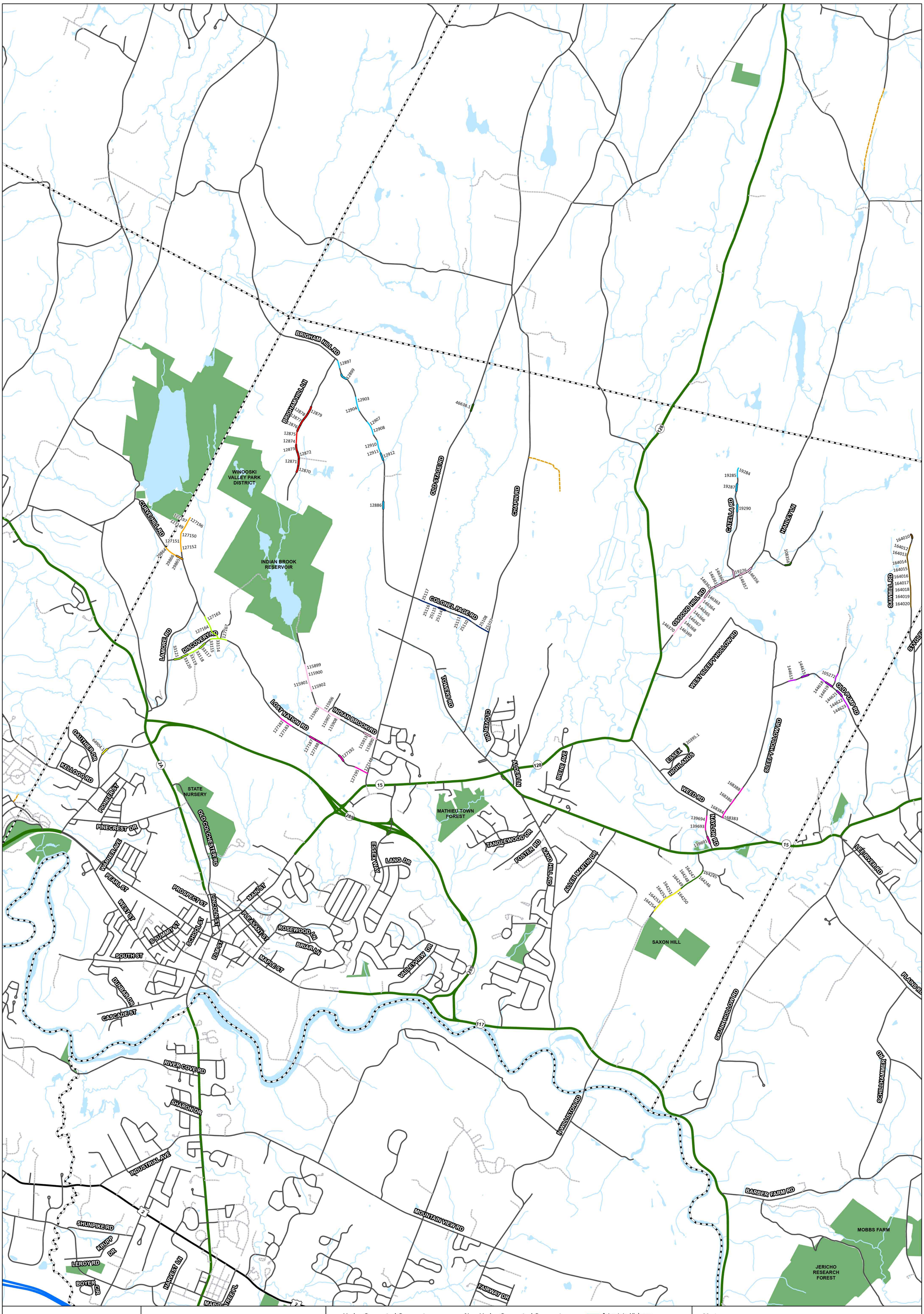
- Interstate Highway
- US Highway
- Vermont State Highway
- Town Highway
- Legal Trail
- State Forest Highway
- Other Road Type
- Waterbodies
- Surface Waters
- Public Conserved Lands
- Town Boundaries
- Village Boundary

Notes:
- Road erosion inventory data for MRGP segments were field recorded by CCRPC staff for the 2016 and 2017 Municipal Road Erosion Inventories.
- Road erosion inventory data for Non-MRGP gravel road segments were field recorded by FEA staff in 2022. Status was evaluated using MRGP standards.

Created by: EHB/FCP **Date:** July 29, 2022

0 2,000 4,000 Feet

N



Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

Implementation Plan

Town of Essex, VT

Hydro-Connected Segments
- 2022
- 2023
- 2024
- 2025
- 2026
- 2027
- 2028
- 2029
- 2030
- 2031
- 2032

Non-Hydro-Connected Segments
- 2022
- 2023
- 2024
- 2025
- 2026
- 2027
- 2028
- 2029
- 2030
- 2031
- 2032

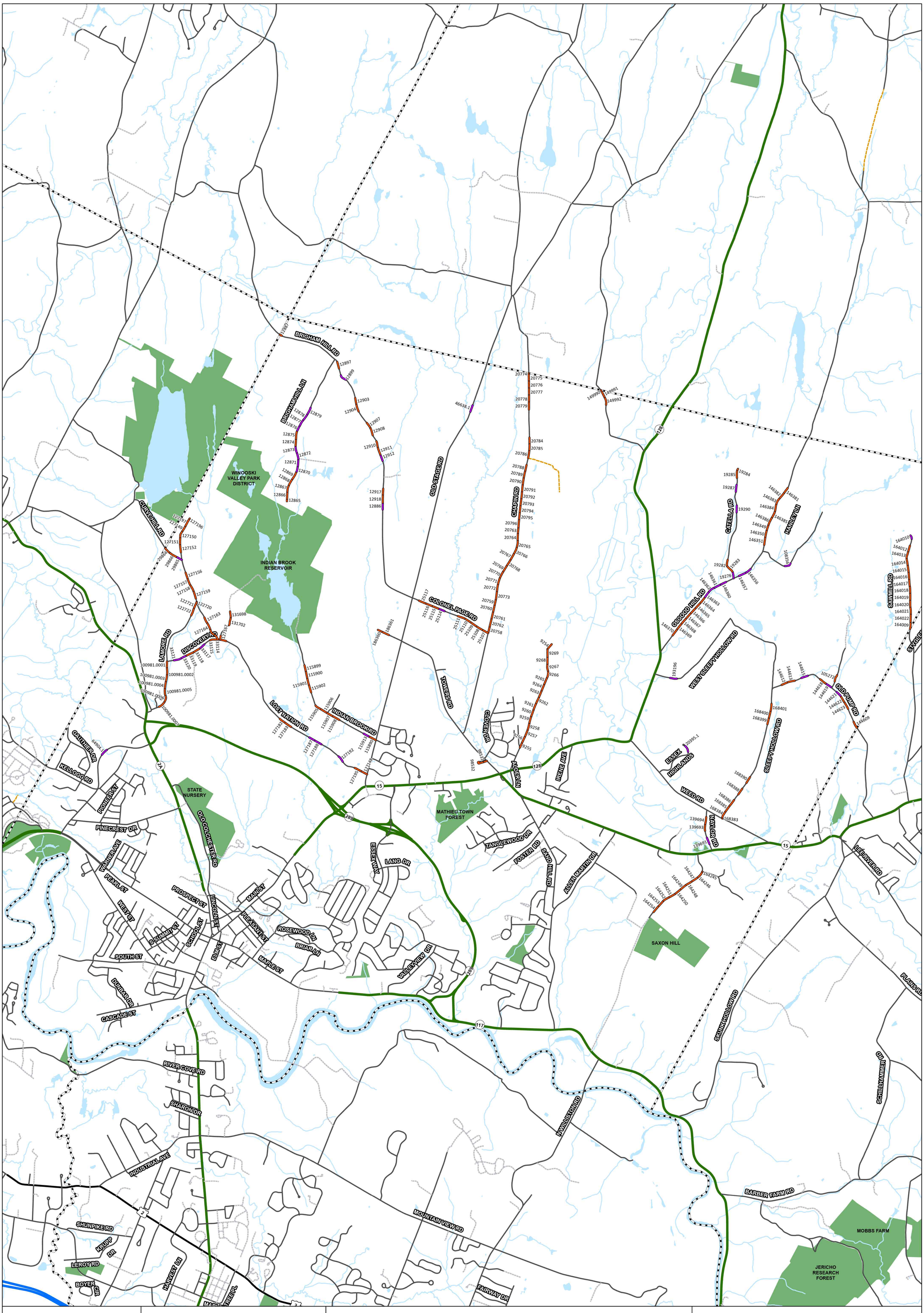
- Interstate Highway
- US Highway
- Vermont State Highway
- Town Highway
- Legal Trail
- State Forest Highway
- Other Road Type
- Public Conserved Lands
- Town Boundaries
- Surface Waters
- Waterbodies

Notes:
- Road erosion inventory data for MRGP segments were field recorded by CCRPC staff for the 2016 and 2017 Municipal Road Erosion Inventories.
- Road erosion inventory data for Non-MRGP gravel road segments were field recorded by FEA staff in 2022. Status was evaluated using MRGP standards.

Created by: FCP **Date:** August 30, 2022

0 2,000 4,000 Feet

N



Fitzgerald Environmental Associates, LLC
18 Severance Green, Suite 203
Colchester, VT 05446
Telephone: 802.876.7778
www.fitzgeraldenvironmental.com

Surveyed Road Segments

Town of Essex, VT

Surveyed Road Segments
- Non-Hydro-Connected Road Segments
- Hydro-Connected Road Segments

- Interstate Highway
- US Highway
- Vermont State Highway
- Town Highway
- Legal Trail
- State Forest Highway
- Other Road Type
- Public Conserved Lands
- Town Boundaries
- Surface Waters
- Waterbodies

Notes:
- Road erosion inventory data for MRGP segments were field recorded by CCRPC staff for the 2016 and 2017 Municipal Road Erosion Inventories.
- Road erosion inventory data for Non-MRGP gravel road segments were field recorded by FEA staff in 2022. Status was evaluated using MRGP standards.

Created by: FCP **Date:** August 31, 2022

0 2,000 4,000 Feet

N

Appendix E - Street Sweeping Route Maps and Details

Winooski River

Malletts Bay - DD

VT-15

VT-2A

VT-117

Sweeper Routes > 17% forested

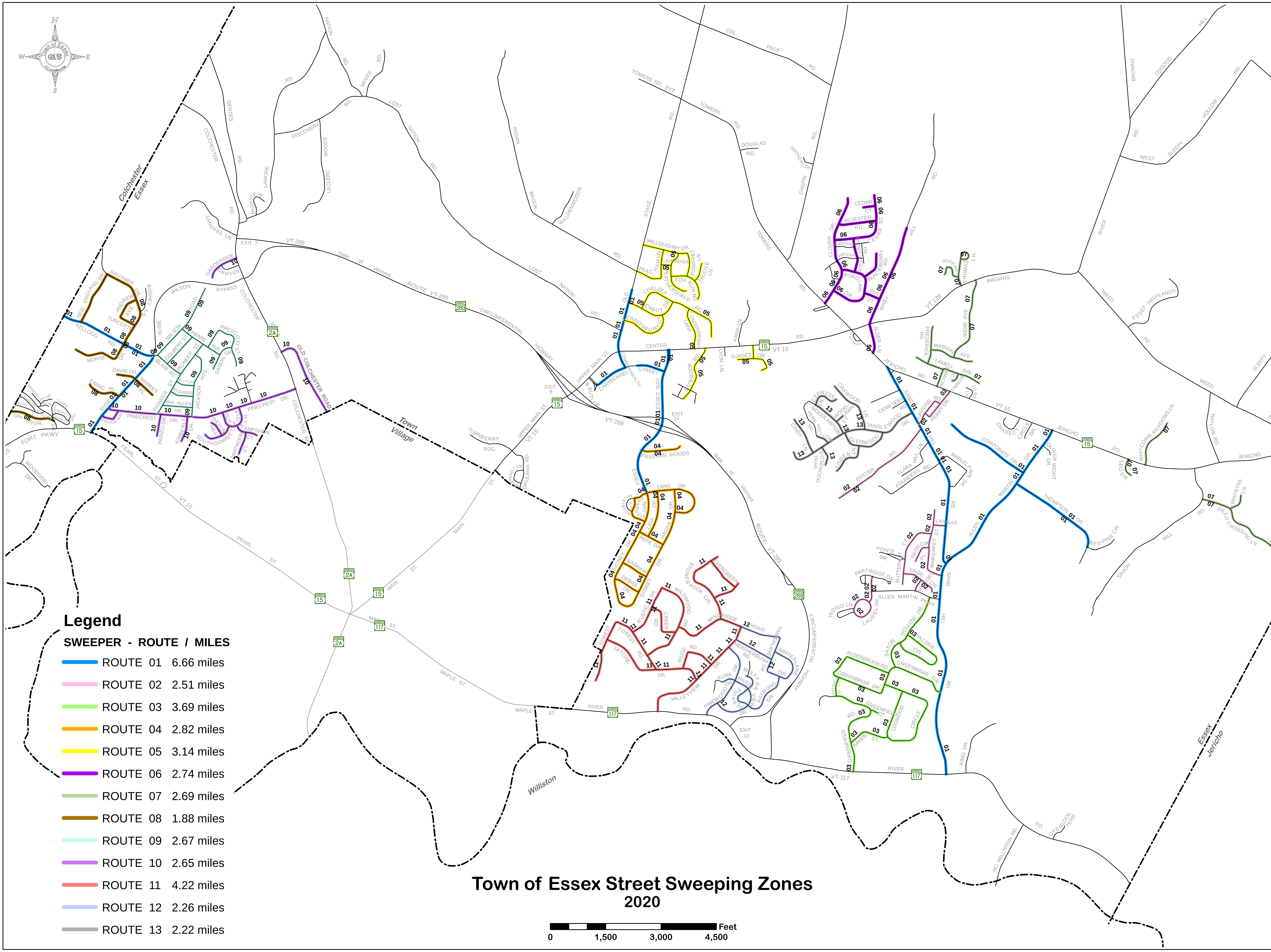
- Malletts Bay - DD (Malletts Bay), Green
- Winooski River (Main Lake), Green
- Winooski River (Main Lake), Blue

Sweeper Routes < 17% forested

- Winooski River (Main Lake), Red
- Malletts Bay - DD (Malletts Bay), Red

Essex Junction Sweeper Routes

N



Legend
SWEEPER - ROUTE / MILES
ROUTE 01 6.66 miles
ROUTE 02 2.51 miles
ROUTE 03 3.69 miles
ROUTE 04 2.82 miles
ROUTE 05 3.14 miles
ROUTE 06 2.74 miles
ROUTE 07 2.69 miles
ROUTE 08 1.88 miles
ROUTE 09 2.67 miles
ROUTE 10 2.65 miles
ROUTE 11 4.22 miles
ROUTE 12 2.26 miles
ROUTE 13 2.22 miles
Town of Essex Street Sweeping Zones
2020
0
1,500
3,000
4,500
Feet
Colchester
Essex
Town
Village
Williston
Essex
Jericho

Essex Junction

The Village of Essex Junction currently manages its municipal streets in the following way:

1. The Village has about 112 acres of impervious roadway surface that it manages both for catchbasin cleaning, street sweeping and leaf and litter control. Most of the Village streets are curbed or bermed on the roadway edge. The Village owns a 2013 vacuum sweeper and sweeps the streets 2x/year during the sweeping season. Main travel routes are swept 3-4x/yr. The Village also has a vactor and cleans catchbasins on average about 1 basin/2years. The Village does not have a municipal leaf collection program. Catchbasin cleanings, leaves and street sweeper materials are stockpiled separately at the WWTP at 69 Cascade St. The Village has not adopted an ordinance that prohibits residents from placement of leaves in the street

2. If the Village were to implement a higher frequency of street sweeping during October-November on the blue and green sweeping routes and adopt the Wisconsin DNR method of leaf management it could achieve a 12.9 kg/yr. net phosphorus reduction from Essex Junction Village Streets to the Winooski River and Malletts Bay. This would require an increase from 2-3 sweepings per year on these routes to 6-8 sweepings per year. The sweeping frequency would need to be adjusted to 2x/October and 2x/November. The Village's current sweeping practices have been in effect since about 2008 and therefore the credit has been prorated to the time frame of the TMDL monitoring period (2000-2009). The current sweeping practice removes about .65 kg/yr. of phosphorus from Essex Junction Streets to the Winooski River and Malletts Bay. Similarly, the Village's catchbasin cleaning practice has been in place since 2008. Therefore, the total creditable practices are 1.12 kg/yr.

3. There is a Lake Champlain TMDL phosphorus control plan requirement for the Village of Essex Junction and the current practices achieve about 5% (1.12 kg/yr.) of the target (23.08 kg/yr.). The target includes 2 different SWAT drainages as shown.

4. The attached table lists ineligible routes first (<17 percent tree cover) and then eligible routes by SWAT model drainage area ranked from highest to lowest in percentage of tree cover. The ranking places the highest phosphorus loading routes first based on the fact that there is a linear relationship between leaf area cover and dissolved phosphorus loading (Janke, 2018).

5. The Village of Essex Junction implemented their current catchbasin cleaning practice after 2008, and as stated above, it is therefore a creditable practice. If the Village were to adopt the most effective practice for catchbasin cleaning (2x/yr.) it could achieve a credit of 2.27 kg/yr.

			CATCH BASIN CLEANING				STREET SWEEPING		
MS4	SWAT Drainage Area	TMDL Target Municipal Roads Phosphorus Load Reduction (kg/yr)	Approximate Year Current CB Cleaning Practice Implemented	Current CB Cleaning Credit % of Target Prorated (-10%/yr) to TMDL Monitoring Period (2000-2009)	Current Catchbasin Cleaning Frequency	Max P Load Catchbasin Cleaning Credit (Assumes cleaning 2x/year) (kg/yr)	Approximate Year Current Sweeping Practice Implemented	Current Sweeping Credit % of Target Prorated (-10%/yr) to TMDL Monitoring Period (2000-2009)	Total Credits for Current Practices as % of Target
Essex Junction	Malletts Bay - DD	7.72	2008	1.95	1 every 2 years	0.75	2000/2013	3.42	5.4
Essex Junction	Winooski River	15.36	2008	1.98	1 every 2 years	1.52	2000/2013	2.58	4.6

								LEAF MANAGEMENT	
Sweeper Route ID	SWAT Drainage Area	Sweeping Frequency	Loading Rate kg/ac/yr	Route Acres per SWAT Drainage	Impervious acreage per SWAT Drainage	Tree Cover Percentage Per SWAT Drainage	Phosphorus Load kg/yr	Route Credit if Wisconsin Method Implemented kg/yr	Total Additional Credits as % of Target
Red	Malletts Bay - DD	2x/yr mainly	0.83	60.0	32.3	<17%			
Red	Winooski River	2-3x/yr mainly	1.12	13.8	9.2	<17%			
Green	Winooski River	2x/yr mainly	1.12	23.7	11.9	27.8	13.3	2.3	14.7
Green	Malletts Bay - DD	2x/yr mainly	0.83	21.3	10.6	22.5	8.8	1.5	19.3
Blue	Winooski River	2x/yr mainly	1.12	88.8	48.2	21.2	53.9	9.2	59.6

Malletts Bay - DD	8.78	1.49	19.34
Winooski River	53.87	9.16	59.63

Winooski River

Malletts Bay - DD

VT-15

VT-2A

VT-117

Sweeper Routes > 17% forested

- Malletts Bay - DD (Malletts Bay), Green
- Winooski River (Main Lake), Green
- Winooski River (Main Lake), Blue

Sweeper Routes < 17% forested

- Winooski River (Main Lake), Red
- Malletts Bay - DD (Malletts Bay), Red

Essex Junction Sweeper Routes

N

Credit Requirement	**Barre**	**Montpelier**	**Burlington**	**Essex Junction**	**Essex**	**Shelburne**	**St. Albans**	**South Burlington**	**Winooski**
Routes with curb and gutter drainage systems	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eligible Routes (Routes with tree canopy 17% or greater)	BC1-Red BC3-Orange BC4-Green BC5-Purple BC6-Black BC7-Yellow	All Routes	BT8 BT9 BT10 BT12 BT13 BT14 BT15 BT17 BT18 BT19 BT21 BT22 BT23	Blue Green	EX22 EX24 EX19-21 EX11 EX14 EX17-18 EX15-16 EX4 EX8-9 EX6-7 EX25-26 EX12	North South	East	SB2 SB3 SB13-16 SB20-24 SB25-26 SB6 SB9	W3 W5
Ordinance prohibiting residents from placement of leaves in the street.	No	Yes	Yes	No	No	No	No	No	No
Municipal leaf collection provided at least 4 times in October and November	No 6-8x/yr.	Yes	Yes, for BT1, BT2, BT5	No 2-3x/yr.	No 2x/yr.	No 2x/yr. with some fall sweeping	No, 8x/yr	No 2x/yr. with some fall sweeping	No, 8x/yr
Within 24 hours of leaf collection, remaining leaf litter in the street must be collected	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Essex

The Town of Essex currently manages its municipal streets in the following way:

1. The Town has about 134 acres of impervious roadway surface that it manages both for catchbasin cleaning, street sweeping and leaf and litter control. Most but not all of the Town streets are curbed or bermed on the roadway edge. The Town owns or shares a 2013 vacuum sweeper and sweeps the streets 2x/year during the sweeping season. Swept material and catchbasin cleaning material are disposed of at the Essex Transfer Station on Landfill La. The Town also shares a vactor and cleans catchbasins on average about 1 basin/4 years. The Town does not have a municipal leaf collection program. Catchbasin cleanings, leaves and street sweeper materials are stockpiled separately at the Essex Transfer Station. The Town has not adopted an ordinance that prohibits residents from placement of leaves in the street.

2. If the Town were to implement a higher frequency of street sweeping during October-November on the eligible routes and adopt the Wisconsin DNR method of leaf management it could achieve a 21.4 kg/yr. net phosphorus reduction from Essex Streets to the Lamoille River, the Winooski River and Malletts Bay. This would require an increase from 2 sweepings per year on these routes to 6 sweepings per year. The sweeping frequency would need to be adjusted to 2x/October and 2x/November. The Town's current sweeping practices have been in effect since about 2003 and therefore the credit has been prorated to the time frame of the TMDL monitoring period (2000-2009). The current sweeping practice removes about .75 kg/yr. of phosphorus from Essex Streets to the Lamoille River, Winooski River and Malletts Bay. Similarly, the Town's catchbasin cleaning practice has been in place since 2008. Therefore, the total creditable practices are 1.03 kg/yr.

3. There is a Lake Champlain TMDL phosphorus control plan requirement for the Town of Essex and the current practices achieve about 3% (1.03 kg/yr.) of the target (36.98 kg/yr.). The target includes 3 different SWAT drainages as shown.

4. The Tree Cover Percentage Per SWAT Drainage column lists in bold the routes (EX6, , 12, 22) with the highest phosphorus loading zone per SWAT based on the fact that there is a linear relationship between leaf area cover and dissolved phosphorus loading (Janke, 2018).

5. The Town of Essex implemented their current catchbasin cleaning practice in 2008 and as stated above it is therefore a creditable practice. If the Town were to adopt the most effective practice for catchbasin cleaning (2x/yr.) it could achieve a credit of 3.31 kg/yr.

			CATCH BASIN CLEANING				STREET SWEEPING		
MS4	SWAT Drainage Area	TMDL Target Municipal Roads Phosphorus Load Reduction (kg/yr)	Approximate Year Current CB Cleaning Practice Implemented	Current CB Cleaning Credit % of Target Prorated (-10%/yr) to TMDL Monitoring Period (2000-2009)	Current Catchbasin Cleaning Frequency	Max P Load Catchbasin Cleaning Credit (Assumes cleaning 2x/year) (kg/yr)	Approximate Year Current Sweeping Practice Implemented	Current Sweeping Credit % of Target Prorated (-10%/yr) to TMDL Monitoring Period (2000-2009)	Total Credits for Current Practices as % of Target
Essex	**Lamoille River**	**3.82**	**2008**	**0.61**	**1 every 4 years**	**0.23**	**2003**	**2.13**	**2.7**
Essex	**Malletts Bay - DD**	**6.64**	**2008**	**0.66**	**1 every 4 years**	**0.55**	**2003**	**1.72**	**2.4**
Essex	**Winooski River**	**26.52**	**2008**	**0.76**	**1 every 4 years**	**2.54**	**2003**	**2.14**	**2.9**

									LEAF MANAGEMENT	
Town Route	Sweeper Route ID	SWAT Drainage Area	Sweeping Frequency	Loading Rate kg/ac/yr	Route Acres per SWAT Drainage	Impervious acreage per SWAT Drainage	Tree Cover Percentage Per SWAT Drainage	Phosphorus Load kg/yr	Route Credit if Wisconsin Method Implemented kg/yr	Total Additional Credits as % of Target
1	**EX22**	**Lamoille River**	**Two times per year**	**1.14**	**1.8**	**0.9**	**40.1**	**1.0**	**0.2**	**4.4**
1	EX23	Malletts Bay - DD	Two times per year	0.82	12.9	6.4	<17%			
1	EX24	Winooski River	Two times per year	1.12	35.4	19.4	21.6	21.7	3.7	13.9
2	EX19	Lamoille River	Two times per year	1.14	0.1	0.0	53.2	0.0	0.0	0.1
2	EX20	Winooski River	Two times per year	1.12	16.7	8.6	17.5	9.6	1.6	6.1
3	EX21	Winooski River	Two times per year	1.12	24.0	11.7	29.7	13.1	2.2	8.4
4	EX10	Malletts Bay - DD	Two times per year	0.82	15.5	7.1	<17%			
4	EX11	Winooski River	Two times per year	1.12	5.0	2.0	17.2	2.2	0.4	
5	EX13	Malletts Bay - DD	Two times per year	0.82	0.9	0.4	<17%			
5	EX14	Winooski River	Two times per year	1.12	21.9	10.5	18.5	11.7	2.0	7.5
6	EX17	Lamoille River	Two times per year	1.14	2.5	1.0	35.5	1.1	0.2	5.0
6	EX18	Winooski River	Two times per year	1.12	16.7	7.3	26.2	8.1	1.4	5.2
7	EX15	Lamoille River	Two times per year	1.14	20.0	8.8	15.6	10.0	1.7	44.4
7	EX16	Winooski River	Two times per year	1.12	0.0	0.0	21.5	0.0	0.0	
8	EX4	Malletts Bay - DD	Two times per year	0.82	7.2	3.5	<17%			
8	EX5	Winooski River	Two times per year	1.12	6.9	3.6	<17%			
9	EX8	Malletts Bay - DD	Two times per year	0.82	12.1	6.7	20.0	5.6	0.9	14.2
9	EX9	Winooski River	Two times per year	1.12	4.5	2.3	41.9	2.6	0.4	1.7
10	**EX6**	**Malletts Bay - DD**	**Two times per year**	**0.82**	**8.5**	**3.6**	**26.2**	**3.0**	**0.5**	**7.6**
10	EX7	Winooski River	Two times per year	1.12	9.7	4.3	27.0	4.8	0.8	3.1
11	EX25	Winooski River	Two times per year	1.12	29.8	11.3	33.0	12.6	2.1	8.1
12	EX26	Winooski River	Two times per year	1.12	16.4	7.4	22.3	8.3	1.4	5.3
13	**EX12**	**Winooski River**	**Two times per year**	**1.12**	**16.3**	**6.7**	**42.5**	**7.4**	**1.3**	**4.8**

Lamoille River		**12.11**	**2.06**	**53.92**
Malletts Bay - DD		**8.53**	**1.45**	**21.84**
Winooski River		**102.06**	**17.35**	**65.41**

Essex Sweeper Routes

Sweeper Routes > 17% Forest Cover by Swat Drain

	EX11		EX21
	EX12		EX22
	EX14		EX24
	EX15		EX25
	EX16		EX26
	EX17		EX6
	EX18		EX7
	EX19		EX8
	EX20		EX9

VT-15

VT-289

VT-117

Mallets Bay Direct Watershed

Lamoille River Watershed

Winooski River Watershed

N

Essex Sweeper Routes

Malletts Bay Direct Watershed

Winooski River Watershed

VT-2A

VT-15

Sweeper Routes > 17% Forest Cover by Swat Drain

EX11	EX21
EX12	EX22
EX14	EX24
EX15	EX25
EX16	EX26
EX17	EX6
EX18	EX7
EX19	EX8
EX20	EX9

N

Credit Requirement	**Barre**	**Montpelier**	**Burlington**	**Essex Junction**	**Essex**	**Shelburne**	**St. Albans**	**South Burlington**	**Winooski**
Routes with curb and gutter drainage systems	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eligible Routes (Routes with tree canopy 17% or greater)	BC1-Red BC3-Orange BC4-Green BC5-Purple BC6-Black BC7-Yellow	All Routes	BT8 BT9 BT10 BT12 BT13 BT14 BT15 BT17 BT18 BT19 BT21 BT22 BT23	Blue Green	EX22 EX24 EX19-21 EX11 EX14 EX17-18 EX15-16 EX4 EX8-9 EX6-7 EX25-26 EX12	North South	East	SB2 SB3 SB13-16 SB20-24 SB25-26 SB6 SB9	W3 W5
Ordinance prohibiting residents from placement of leaves in the street.	No	Yes	Yes	No	No	No	No	No	No
Municipal leaf collection provided at least 4 times in October and November	No 6-8x/yr.	Yes	Yes, for BT1, BT2, BT5	No 2-3x/yr.	No 2x/yr.	No 2x/yr. with some fall sweeping	No, 8x/yr	No 2x/yr. with some fall sweeping	No, 8x/yr
Within 24 hours of leaf collection, remaining leaf litter in the street must be collected	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Appendix F - Essex Stormwater Code Review

Horsley Witten Group
Sustainable Environmental Solutions
112 Water Street • 6th Floor • Boston, MA 02109
857-263-8193 • horsleywitten.com

MEMORANDUM

To: Annie Costandi, Town of Essex Stormwater Coordinator
Chelsea Mandigo, Village of Essex Junction Stormwater Coordinator

From: Lori Kennedy and Anne Kitchell, HW

Date: March 29, 2021

Re: Essex Stormwater Code Review

Cc: Amy Macrellis, Stone Environmental; Amanda Ludlow, Stantec

---

As part of the Phosphorus Control Plan (PCP) development for the Village of Essex Junction (Village) and Town of Essex (Town), the Horsley Witten Group Inc. (HW) reviewed the following Village and Town documents as they relate to stormwater management:

- Town and Village Stormwater Management Ordinance (Essex Town Ordinance 10.20 and Village Code Section 1901)
- Village of Essex Junction Land Development Code (LDC)
- Village Public Works Details
- Town of Essex Public Works Standard Specifications for Construction
- Town of Essex Subdivision Regulations
- Town of Essex Zoning Regulations

Building on a previous code review completed in 2019 by the Vermont League of Cities and Towns (VLCT), HW targeted this review to evaluate:

- Compliance with Vermont MS4 General Permit requirements,
- Consistency with State stormwater management standards,
- Effectiveness in promoting green infrastructure and environmentally sensitive site design, and
- Opportunities to earn phosphorus-reduction credit.

This memorandum summarizes HW's findings and recommendations, and incorporates feedback provided by Village and Town stormwater staff on the draft memorandum.

MS4 Permit Compliance

HW reviewed the Stormwater Ordinance to assess its compliance with the Vermont MS4 General Permit. Overall, the Stormwater Ordinance and the Village LDC meet MS4 General Permit requirements by:

1) Prohibiting illicit discharges,
2) Requiring construction-site stormwater management on projects disturbing less than 1 acre, and
3) Requiring post-construction stormwater management for projects disturbing more than 1 acre but creating or redeveloping less than 1 acre of impervious cover.

Table 1 summarizes how the Stormwater Ordinance and the Village LDC meet the requirements of the MS4 General Permit and provides recommendations for improving clarity and consistency.

Post-Construction Stormwater Management Consistency with VT General Permits and Guidelines

The MS4 General Permit requires that permittees review their existing policies, regulations, and ordinances to determine their consistency with the requirements of the Secretary's general permits, rules, and guidelines. As a first step toward meeting that requirement, HW completed a preliminary review of the Essex Stormwater Management Ordinance, the Town of Essex Public Works Standard Specifications for Construction, the Village LDC, and the Village Public Works Details to assess their consistency with the substantive requirements of the:

- Vermont General Permit 3-9050 (2020) for Operational Stormwater Discharges,
- Vermont Stormwater Management Manual Rule and Design Guidance (2017), and
- Road Stormwater Management Standards (Municipal Roads General Permit 3-9030, Part 6 and MS4 General Permit, Part 8.3.C.).

This review was not meant to be comprehensive; rather, the focus was on illuminating opportunities to improve local post-construction stormwater management and enable the Village and Town to earn phosphorus-reduction credit toward their reduction target for the Lake Champlain TMDL (per MS4 General Permit Part 8.2). Table 2 summarizes the findings of this review.

Table 1. Village and Town Code Compliance with Vermont MS4 General Permit

MS4 Permit Section	Requirement	Stormwater Management Ordinance (Essex Town Ordinance 10.20 and Village Code Section 1901)		Village Land Development Code	
		Relevant Section/ Provision	Comments/ Recommendations	Relevant Section/ Provision	Comments/ Recommendations
6.2.3.a.(2) Illicit Discharge Detection and Elimination	Applicability: >1 acre land disturbance Requirements: Effectively prohibit non-stormwater discharges into the regulated small MS4 and implement appropriate enforcement procedures and actions.	§10.20.050 Illicit Discharge	Meets MS4 Permit requirements	§713.C Illicit Discharge Detection and Elimination	Meets MS4 Permit requirements
6.2.4.a.(3) Construction-Site Stormwater Management	Applicability: <1 acre land disturbance (state covers >1 acre) Requirements: At a minimum, require implementation of the measures in the *Low Risk Site Handbook for Erosion Prevention and Sediment Control*	§10.20.060 Erosion and Sediment Control Requires erosion and sediment control for all projects and an Erosion Control Permit for projects disturbing <1 acre and creating or redeveloping 0.5 to 1 acre of impervious area. Requires compliance with small-site erosion-control guidelines provided in Appendix A.	Add reference to the *Low Risk Site Handbook for Erosion Prevention and Sediment Control* Either compare and reconcile Appendix A to the Handbook or remove Appendix A	§514: Approval of Activities Involving the Disturbance of Less than One (1) Acre Requires applicant to submit an erosion and sediment control plan indicating compliance with the *Low Risk Site Handbook*. §713.D. Construction Site Stormwater Runoff Control Defines standards for inspection and maintenance of erosion and sediment controls	Meets MS4 Permit requirements

MS4 Permit Section	Requirement	Stormwater Management Ordinance (Essex Town Ordinance 10.20 and Village Code Section 1901)		Village Land Development Code	
		Relevant Section/ Provision	**Comments/ Recommendations**	**Relevant Section/ Provision**	**Comments/ Recommendations**
6.2.5.f.-g. Post-Construction Stormwater Management	Applicability: >1 acre land disturbance and <1 acre of impervious cover created or redeveloped. Requirements: Develop and implement an ordinance that: (1) prevents or minimizes water quality impacts from runoff, (2) utilizes a combination of structural, non-structural, and LID/GSI practices; (3) ensures long-term O&M, and (4) includes procedures for inspecting projects for compliance.	§12.20.070 Development Storm Water Management Applicable to projects that disturb >1 acre and "*create new or is an expansion of old impervious surfaces that are equal to or greater than one-half (1/2) acre*". Exempts additions/modifications to existing single-family homes. Requires stormwater management per VT standards; construction inspections; maintenance easements and as-built plans. §10.20.080 Stormwater Control, Operation and Maintenance Requires maintenance per VT standards; maintenance agreement and covenant, right of entry, and record-keeping.	Meets MS4 Permit requirements Clarify Ordinance applicability language at §12.20.072 Clarify or remove single-family home exemption (should not be exempt if disturbs over 1 acre)	§713.D.4: Stormwater Management Standards Requires site design to minimize runoff; stormwater management per VSMM §713.F Operation and Maintenance of Stormwater Systems Requires O&M plan with inspection and maintenance schedule and responsible party §713.D Procedures for Enforcement of Maintenance Requirements Establishes procedures for enforcing maintenance requirements	Meets MS4 Permit requirements Consider adding a requirement to §713 for submission of as-built plans

Table 2. Consistency with State General Permits and Stormwater Manual

State Permit/Manual	State Requirements	Applicable Local Ordinance/Regulation	Comments/Recommendations
Vermont General Permit for Operational Stormwater Discharges 3-9050 (2020)	Eligible projects include: • Development or redevelopment of one or more acres of impervious surface (changing to ½ acre effective July 1, 2022) • Expansion of existing impervious surface by more than 5,000 square feet, such that the total resulting impervious surface is equal to or greater than 1 acre	Ordinance §10.20.072 • Sets threshold at ½ acre impervious area • Allows acceptance of a VT Stormwater Permit as evidence of compliance Village LDC §515 • Sets thresholds of 1 acre land disturbance or creating a total resulting impervious surface of 1 acre or more • Requires review in accordance with VT GP 3-9020 and GP 3-9015 or other appliable state permits • Requires evidence of compliance with VT state requirements	Ordinance: • Clarify applicability language at §10.20.072 • Review and update definitions (e.g., "land disturbance" and "redevelopment") Village LDC: • Update GP 3-9015 reference to GP 3-9050
Vermont Stormwater Management Manual Rule and Design Guidance (2017)	• Provides instructions for site planning and stormwater treatment practice (STP) • Establishes requirements to meet standards for groundwater recharge, water quality, channel protection, overbank flood protection, extreme flood control, and post-construction soil depth and quality • Defines acceptable STPs and feasibility considerations	Ordinance §10.20.073 and LDC §713.D.4 References the Vermont Storm Water Management Manual (volumes I and II), latest version Ordinance §10.20.074 and LDC §713.D.4 Sets requirements for peak rate control, groundwater recharge, water quality treatment (min. 80% TSS, 40% TP), channel protection, discharge to sensitive resources, hotspots.	Update references to VSMM Reconcile Ordinance Appendix D with VSMM Revise Ordinance §10.20.074 and Village LDC §713.D.4.: • Add/strengthen requirements for low impact development site planning and design • Update %TSS and %TP reduction and TMDL language • Add requirements for flood control and soil quality

State Permit/Manual	State Requirements	Applicable Local Ordinance/Regulation	Comments/Recommendations
Road Stormwater Management Standards (Municipal Roads General Permit 3-9030, Part 6 and MS4 General Permit, Part 8.3.C.	Establishes standards for: • Revegetation of disturbed areas, • Roadway cross-slope, • Shoulder berms • Drainage ditches • Culverts • Catch-basin outlet stabilization	<u>Town DPW Standard Specifications for Construction</u> • Chapter 5 provides technical specifications for streets and stormwater control facilities. • Of particular interest for revisions: o §502.1 Geometric standards for streets Table 1 o §511.2 Open Drainage o §511.5.4 Drainage Outlets o Appendix A – Details <u>Village Public Works Details</u> • Provides typical plan and detail for paved street with catch basins, underdrain	Update Town DPW specifications to match MRGP standards for: • Minimum cross slopes • Drainage swale depth and turn-out • Drainage ditch headwalls • Stone aprons or plunge pools at culvert outlets • Check dam specifications Village Public Works Details: • Consider adding details for unpaved roads, open drainage, drainage outlets, and culverts meeting MRGP standards

Green Infrastructure and Environmentally Sensitive Site Design

HW reviewed the Town's Zoning Regulations, Subdivision Regulations, Stormwater Ordinance, and DPW construction specs and details and the Village LDC to identify gaps and potential barriers to implementing green infrastructure and more environmentally sensitive development projects. The intent of this review was to highlight regulatory areas the jurisdictions may want to revisit when updating the codes. Findings and recommendations are presented below in three general categories: site design, green infrastructure, and climate resilience.

Site Design

Development regulations have a direct impact on how development activities can improve or degrade the local environment. HW noted several areas for each jurisdiction to look at in more detail include:

1. The Town Subdivision/Zoning Regulations and Village LDC do not go far enough with provisions to improve existing stormwater management conditions during redevelopment or road improvements (widening or realignment). As most future development is likely to be redevelopment/infill, these projects present an opportunity to improve existing conditions in impaired watersheds. During the next round of code updates, consider clearly establishing water quality improvement objectives for redevelopment, set thresholds for triggering stormwater retrofits during road or parking lot improvements, or offer incentives for going above and beyond on water quality treatment or open space protection.

2. The Town lighting standards offer an opportunity to better address Dark Sky objectives. This is worth a more detailed dive into what the existing standards are, if they are compliant with Dark Sky, and how willing the Town is to tackle this issue. The Village lighting standards offer a great model to start from. LDC Section 704 has Dark Sky Complaint requirements for residential exterior lighting and is very detailed on commercial and business lighting. Consider extending to other uses such as recreational facilities.

3. The Village LDC includes a 15-foot minimum undisturbed riparian buffer (below the threshold considered protective) but does include some good language related to restoration. We recommend looking at the Town's requirements, which include some good provisions related to stream crossings at right angles, minimum culvert diameters, etc. Also, consider provisions for allowing third parties such as land trusts to manage buffers.

4. Lot geometry, streets, and parking standards can inadvertently restrict creative design, create excess impervious cover, and fail to protect the natural services of urban trees and open space. Based on the Center for Watershed Protection (CWP) Codes and Ordinance Worksheet (for post-construction stormwater), both the Town and Village score relatively high for environmental/water resources protection. Riparian buffer, open space, cluster/village/planned unit developments (PUD) design, and parking provisions are areas where both jurisdictions have done a good job. The Village LDC Section 273 PUD, for example, describes water resource protection goals. Table 3 summarizes several areas related to streets and lot geometry where the regulations differ from CWP recommendations.

Table 3. Current Standards Compared to Center for Watershed Protection (CWP) Standards

Category	CWP Standards	Town of Essex Current Standards	Village of Essex Junction Current Standards
Road width for low volume roads	• 18-22 ft width • 45 ft or less for ROW	• minimum of 24 ft • ROW width of 60ft	• Local residential = 28 ft paved width with 50 ft ROW • Private streets = 20 ft paved and 40 ft ROW widths • Transit-oriented development (TOD) street requirements
Cul-de-sacs	• 70-90 ft minimum diameter • Allow alternative turnaround designs	100 ft; alternative cul-de-sac designs allowed if recommended by Town Engineer (e.g., with island, hammerhead, loop de lanes), but there are no designs in the DPW materials	75 ft diameter, 100 ft ROW
Parking ratios	• 3 spaces per 1,000 gross SF for professional offices (other use ratios also provided). Ratios should be based on actual needs • Shared parking and mass transit provisions • Set maximums	• 4 spaces per 1,000 gross SF • In line with shopping center and SFR ratios • Town did a great job with o flexibility for modifying parking ratio o shared parking provisions o bike space requirements • No required % for compact or electric vehicles	• 3.5 spaces per 1,000 gross SF for professional offices; in line with SFR (2 per dwelling) • Ratio based on "net uses" for shopping centers • TOD parking ratios all meet • Waiver criteria allow for reductions based on shared parking, usage studies, and other
Minimum frontage and setback requirements for an equivalent ½ acre residential	Frontage: <80 ft Front Setback: ≤20 ft Rear: ≤25 ft Side: ≤8 ft	• Low residential lot meets min rear yard, but exceeds front (25-40 ft), side (10-15 ft) and frontage (100 ft) • PUD can meet rear (15-20 ft) and frontage (75-100 ft) • This may not be critical if Town is not having problems with creative designs	• R-1 and R-2 both meet all recommended setbacks and frontage • TOD has no min setbacks and sets a max front setback of 20 ft
Sidewalks	• 4 ft min • Encouraged alternative layouts • Pitch to pervious	• 5 ft minimum • Required on two-sides (except for dead end streets) • Should allow for more flexibility to use alternative pedestrian paths that do not follow road layout	• 8 ft min in TOD, but within context of pedestrian friendly design
Driveways	• 9 ft minimum width • Shared driveways	• 10 ft min width • Shared driveway provisions provided but there is a limitation to 2 dwellings	• 12 ft minimum, 20 ft max • Up to 5 dwellings shared driveway

Green Stormwater Infrastructure

HW identified several areas that could present barriers to widespread implementation of green stormwater infrastructure within the Town and Village regulations and DPW materials. Table 4 summarizes these areas for a more detailed look:

Table 4. Opportunities to Advance Green Infrastructure in Codes

Category	Town of Essex	Village of Essex Junction
Definitions	• Ensure that there is consistency between definitions in regulations and stormwater ordinance • Revisit definitions of hard surface, impervious cover, stormwater retention, runoff, and streetscape to make sure they are not prohibitive to green infrastructure • Consider addition of terms "watershed", "retrofit", "buffer restoration", "unpaved road" or other MS4 Permit-related terms	
Documentation	• Application materials (i.e., site plan review applications) should include information on watershed, TMDL targets, and pollutant load calculations • Make a break from mylar? Consider requirements for hard copy plan sets and feasibility of including/or switching over to digital design plans, as-builts, etc. Would geospatial or spreadsheet-based submittal of drainage infrastructure data assist in development of tracking database for inspection and maintenance? Be consistent with Public Works specifications.	
BMP preferences and specifications	• Multiple locations in the regulations and DPW specifications list specific BMP types (temporary or post-construction) as preferred practices. These do not include newer generation stormwater technologies or an emphasis on the volume reduction benefits of green infrastructure (recharge, reuse, evapotranspiration). • Silt fence and pond references, for example, should be replaced (or at least expanded upon) to include filter socks, bioretention, rainwater harvesting, etc. • The erosion and sediment control requirements in DPW materials could use an update, especially as relates to inspection procedures, preferred practices, and use of fertilizer for seeding (without soil test). • There are several references to plastic mesh erosion control matting that should be removed.	• Similar to Town comments. • We recommend the Town and Village update and combine DPW specifications and standards. Review for consistency with Stormwater Ordinance Appendix D and consider consolidating Appendix D with DPW standards.

Category	Town of Essex	Village of Essex Junction
Permeable pavement (or any alternative to concrete or asphalt)	• Not currently mentioned • Allow flexibility for use of pervious materials in parking lots, driveways, streets, sidewalks, etc. • If the Town wants to promote permeable pavements or exert control on the material specifications and construction requirements, will need to update specs.	• LCD Section 909 walkways and bike paths. Does concrete, bituminous paving, or gravel requirement prohibit permeable pavement alternatives?
Curbing	• Mentioned frequently as being required (although "partial curbing" appears once) • Could be interpreted as a barrier to alternative road designs or green streets depending on how the Town Engineer is applying the regulations.	• Section 906 requires all streets to have curbing on each side but does offer a waiver option. Would be better if allowed alternatives for stormwater management.
Street trees	• No explicit prohibition of tree pits or other vegetated BMPs, but there is no mention of the benefits of trees for stormwater management or other co-benefits that would make it a more accepted practice. • Parking lot requirement for trees that requires raised curb and landscaping could be prohibitive for use of bioretention and other vegetative surface practices. • The Town already has areas in the code dedicated to trees and landscaping and it may be worth establishing urban and rural tree management goals in the context of stormwater, climate, and human health objectives.	• Landscaping requirements in Chapter 2 General Regulations for Public Streets may want to explicitly address vegetation management for stormwater practices placed in the road ROW. • 710. Is there an issue with GI in the visibility triangle. If not, will want to specify low veg <30 inches. • 719. Landscaping. Great job outlining role of trees and landscaping in heat reduction, energy efficiency, stormwater management, air quality; Mature tree credit, salt tolerant, parking lot landscaping for stormwater are mentioned, performance bond etc. • Town should look at Village requirements when they merge
O&M	Evaluate costs to the Village/Town for long-term O&M of accepted roads and associated drainage/stormwater facilities and operational permits. Consider revisions to fee schedules to ensure sufficient funding for ongoing street sweeping, catch basin cleaning, and stormwater facility maintenance and replacement.	

Climate Resilience

HW also identified areas with the Town and Village regulations that present opportunities to promote climate mitigation and adaptation:

1) Do more to promote rainwater harvesting and reuse as a viable option for runoff reduction and water conservation.
2) Consider requiring a percentage of parking spaces at businesses and public properties to be dedicated for hybrid or electric vehicles to encourage reduced phosphorus loads from combustion engines. Consider offering incentives for installing electric vehicle charging stations.
3) For solar arrays, consider establishing specific zoning standards that outline siting preferences; tree, forest, viewshed protection objectives; and allowable/unallowable hydrologic alterations. Also consider adding design standards for parking lot solar awnings/covers.
4) For tree canopy cover in parking lots, consider adding language that references cooling, air quality, rainfall interception, and evapotranspiration benefits as objectives and establishing percent coverage targets.
5) Open space & Floodplain district regulations could include more emphasis on maintaining or restoring watershed function and improving the Town's resiliency rather than just ensuring recreational access. Similarly, the Village's LCD Section 6 Flood Plain could do a better job of linking floodplain function with climate resilience. Consider adding language related to invasives management, reforestation, and buffer enhancement to open space, buffer, or mitigation sections.
6) Add carbon calculation requirements as part of application packages as a way to help decision-makers evaluate the cost/benefit of site development proposals.
7) Add to landscaping language about using tree species that are more adaptive to changing climate patterns.
8) Add language requiring new public buildings to meet LEED standards, at a minimum, or achieve certification, at best.

Phosphorus-Reduction Crediting Opportunities

The MS4 General Permit allows permittees to take phosphorus-reduction credit for "implementation of municipal ordinances or other regulations to address sub-jurisdictional impervious surfaces." The following sections describe Stormwater Ordinance and Village LDC changes that the Village and Town might consider to enable phosphorus-reduction credit on non-municipal projects that are not otherwise subject to an operational stormwater permit.

Applicability Thresholds (Subjurisdictional Projects)

With the Ordinance's current applicability threshold for *Development Storm Water Management* (§10.20.072), the Village/Town can take phosphorus-reduction credit for stormwater treatment practices (STPs) on projects creating or redeveloping between 0.5 acre and 1 acre of new impervious cover. When the state lowers its applicability threshold for operation permits in July 2022, that credit will end unless the

Village/Town lowers the Ordinance applicability threshold. HW recommends that the Village and Town consider requiring smaller projects (e.g., creating or redeveloping >10,000 sf of impervious cover) to apply for a local stormwater permit.

Before selecting a lower threshold, HW recommends that the Town and Village evaluate the potential costs and benefits of different threshold levels. Considerations might include:

- How many projects would be expected at each threshold level (e.g., >10,000 sf, >5,000 sf),
- Typical phosphorus reduction credit for those projects,
- Staff hours required for permit application review, inspections, enforcement, and tracking.

Phosphorus-Reduction Documentation

The Town currently requires Stormwater Permit applicants, including those permitted under a state Operational Permit, to submit all stormwater plan documents and phosphorus reduction calculations. The Village does not currently require submission of stormwater plan documents and calculations for projects receiving state permits. HW recommends revisions to the Stormwater Ordinance §10.20.072 (State Permits paragraph), §10.20.076, and Appendix C, and the Village LDC §513, §514, and §713.D.4 to require stormwater management plan submissions (for local and state permits) to include all data needed to document phosphorus loading and reductions (pre- and post-development site land use and impervious cover; subwatershed; impervious and pervious drainage area; STP type, volume, and infiltration rate; phosphorus load, removal efficiency, and reduction). To improve tracking efficiency, HW recommends requiring standardized data submission via an online form (linked to ArcGIS online database) or using VT DEC's BMP Tracking Table spreadsheet.

Long-term Operation and Maintenance (O&M)

For MS4 permittees to take credit for phosphorus reduction on subjurisdictional projects, the MS4 General Permit requires that: "*the MS4 shall establish a maintenance agreement with the property owner(s) to ensure long-term maintenance of the BMP(s). The maintenance agreement can be conditions in a local permit, or part of a municipally-approved plan*." DEC issued informal guidance in 2019 that MS4 permittees would need to ensure maintenance of structural practices for subjurisdictional projects, beyond requiring long-term O&M as part of a local permit.

The Ordinance and Village LDC currently include requirements for routine maintenance, inspections, maintenance agreement and covenant, right-of-access for inspections, and record-keeping. HW recommends clarifying with DEC whether the Village/Town will need to report annually on inspections/maintenance of subjurisdictional STPs, and if so, what form that may take. The Village/Town could consider requiring an annual self-report from holders of local stormwater permits, certifying that they have inspected and maintained their STPs in accordance with their O&M plan. Self-reporting would be paired with an audit by Village/Town staff of a select number of permits and STPs annually. Alternatively, the Village/Town staff could annually inspect those STPs themselves.

Offsite Stormwater Mitigation

If the Village/Town decide to reduce the Ordinance applicability threshold below 0.5 acres, HW recommends exploring options to formalize a program for offsite stormwater mitigation. The Village LDC does not include provisions allowing for offsite mitigation. The Ordinance includes language at §10.20.100 allowing the Town to waive stormwater management requirements for projects that meet certain conditions, as long as acceptable mitigation measures are provided. Among the acceptable mitigation measures are: 1) the creation of a stormwater management facility or other drainage improvements on previously developed properties that lack adequate stormwater facilities, and 2) monetary contributions (fee-in-lieu) to fund stormwater management activities "such as research and studies". The section also states that if a project is granted a waiver, the applicant must "pay a fee based on the impact of the impervious area created in an amount to be determined by the Town."

The Village and Town could consider several regulatory revisions that would provide flexibility for optimizing stormwater management locations, maximizing phosphorus reduction, and easing phosphorus-reduction tracking and crediting. Options may include:

1) Eliminating the waiver allowance at Ordinance §10.20.100.
2) Requiring on-site stormwater management to the maximum extent practicable, as demonstrated with an engineering feasibility analysis.
3) Or, establishing other criteria by which applicants would demonstrate eligibility for offsite mitigation.
4) Allowing applicants to pay a stormwater impact fee in lieu of fully meeting stormwater standards on site. The Village and Town could allocate those funds toward retrofit projects identified in the Village/Town Phosphorus Control Plan.
5) Allowing applicants to directly implement STPs at an approved offsite location to provide equivalent stormwater mitigation.