

# Development of VTrans' Phosphorus Control Plans for the Vermont Lake Champlain Basin

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## Services / Expertise

TMDL Implementation Support  
Phosphorus Control Planning  
TS4 Permit Compliance  
Stormwater BMPs  
Regulatory Compliance & Reporting  
Spatial Analysis & Mapping  
ArcGIS Online  
Mobile Field Applications

## Market

State Government

## Project Location

Vermont

## Date Completed

2016–Present

## Project Owner

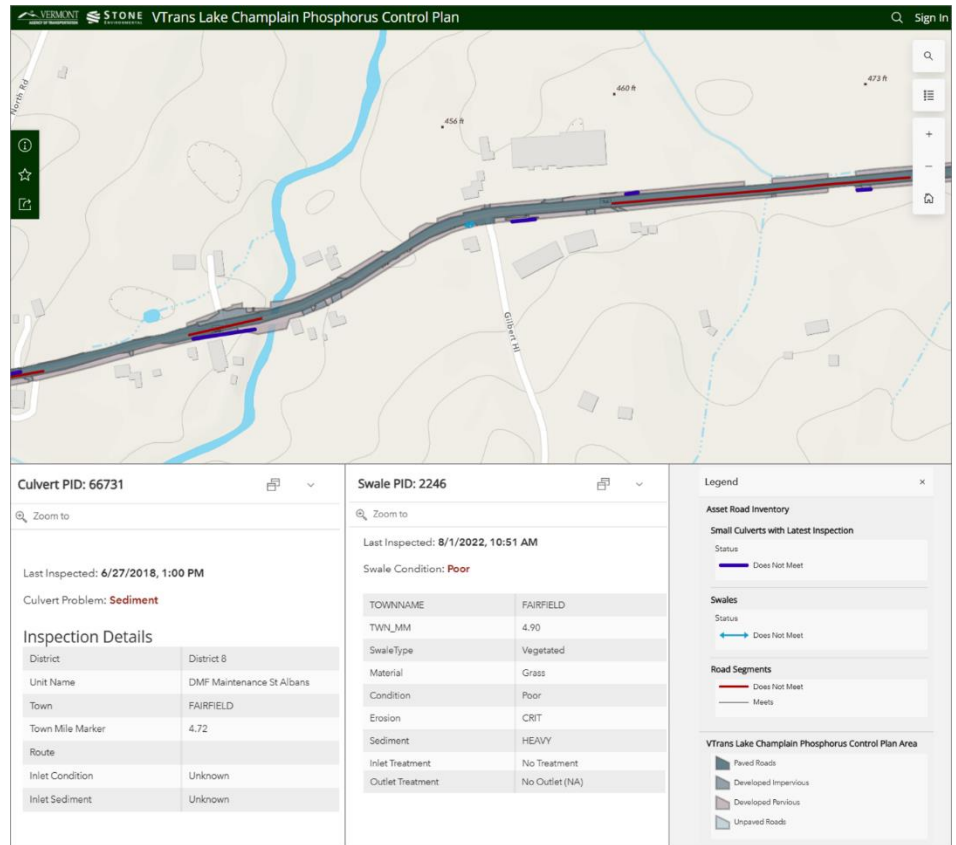
Vermont Agency of Transportation  
Highway Division Maintenance Bureau

## Project Manager

Amy Macrellis  
[amacrellis@stone-env.com](mailto:amacrellis@stone-env.com)

## Link to Hub Site

<https://arcg.is/OKL4WP0>



Stone developed web-based data evaluation/prioritization tools to communicate VTrans' Phosphorus Control Planning efforts. The graphic above illustrates how asset conditions recorded in the Small Culvert Inventory and TS4 Swale Inventory are applied to determine whether a hydrologically connected road segment "Meets" or "Does Not Meet" standards. This web map (available at <https://arcg.is/0q4qii0>) was developed to communicate the status of road segments for project development.

**THE** Environmental Protection Agency (EPA) finalized the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) in June 2016 for the 12 segments in the Vermont portion of the Lake Champlain Basin. As part of Vermont's "all-in" approach to meeting its phosphorus reduction targets under the Lake Champlain Phosphorus TMDL, VTrans is required to reduce phosphorus loading from roads, rights-of-way, and facilities it owns or controls by over 20% (a total reduction of 1,606 kg/yr) by June 17, 2036. What VTrans "owns and controls" in 11 of the lake segments includes 1,374 miles (~5,900 acres) of paved highways, 417 acres of impervious surface at its parcel-based facilities, and nearly 9,500 acres of right-of-way and greenspace at its facilities.

In recognition of the magnitude of the work and in keeping with VTrans's commitment to maintaining compliance with swiftly evolving state and federal environmental regulations, the agency has been working with the Vermont Agency of Natural Resources (ANR) and a Stone Environmental-led consultant team since early 2016 to develop the framework for a



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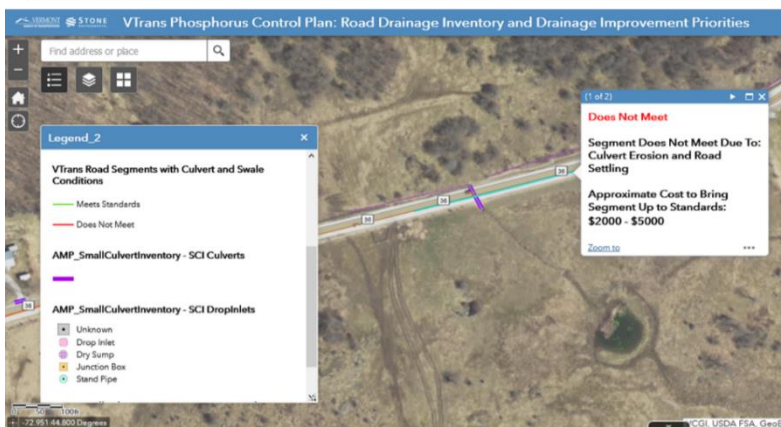
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series of Phosphorus Control Implementation Plans (PCIPs). Beginning in the Missisquoi Basin, Stone first defined the “PCIP Area,” including roadway miles and non-road impervious areas, using best-available GIS datasets. We identified road segments and VTrans facilities (airports, garages, park and rides, etc.) that may produce the greatest reductions in phosphorus loads as a result of BMP implementation. Stone developed innovative techniques to identify areas of significant hydrologic connectivity, substantial runoff accumulation, and potential localized erosion along state managed roadways. To validate the results, Stone and VTrans conducted field verification using ArcGIS Online and Collector for ArcGIS. The approach piloted in the Missisquoi basin was extended to other VTrans-controlled lands throughout the Lake Champlain Basin as basin-wide LiDAR and other supporting datasets became available in 2017.

Stone worked with VTrans and ANR to meet interim milestones that informed the development of the basin-wide generalized PCIP in 2018-19, culminating in the submittal of the basin-wide Generalized Phosphorus Control Plan to ANR on April 1, 2020 and VTrans's first four-year Phosphorus Control Implementation Plan (PCIP) on October 1, 2020. The PCIP documents historic improvements and operations and identifies that an additional P load reduction of 230 kg/yr is required for achievement of the P reduction target specified for the term of the PCIP (2021-2024). VTrans will achieve this P load reduction through improved tracking and accounting of maintenance activities and capital projects already being developed and completed, as well as strategic implementation of combinations of structural and non-structural practices, including emerging strategies such as natural resource restoration projects. The strategies VTrans may pursue in PCIP implementation are not limited to those outlined in the PCIP submitted to ANR, but those represent 311 kg/yr of potential P load reduction—well above the additional P load reduction of 230 kg/yr needed to achieve the TS4's 25% cumulative P load reduction target by October 2024.

Stone's work with the VTrans Phosphorus Control Plan involves a high level of data management, acquisition, analysis/processing, visualization, and data sharing in informative, actionable, and user-friendly ways. The work includes utilization of VTrans datasets including the Small Culvert Inventory, road network, MATS database, MOB EPWQ TS4 Inventory, and other external datasets (i.e. land cover, tax parcel data, LiDAR, SSURGO database). Throughout the project, Stone utilized and continues to develop and deploy innovative Esri tools to collect data (Survey123, Collector), visualize and display analysis results (ArcGIS Online, Web App Builder, Operations Dashboard, and Hub), and to provide progress reports tracking the status of the work (Hub). Our innovative Hub progress report, prepared for VTrans and ANR as one of the required TS4 compliance submittals (<https://arcg.is/0KL4WP0>), bundled all of the above into a single narrative outlining the status of the work and is updated as implementation proceeds.

Score	Culvert Condition	Culvert Erosion	Culvert Sediment	Culvert Sink Hole	Road Settling	Swale Condition
5	Critical	Severe	Plugged	Severe	Grade	Critical
4	Poor	Moderate	Heavy	Major	--	Poor



Stone developed web-based data evaluation/prioritization tools to summarize VTrans' Phosphorus Control Planning efforts. The graphic below illustrates how asset conditions recorded in the Small Culvert Inventory are characterized (table at top) to determine whether a hydrologically connected road segment “Meets” or “Does Not Meet” standards. A web application was developed (screenshot to the left) to communicate status of all road segments for project prioritization and development. The photo at right was collected during 2020 field inventory.





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We worked seamlessly across Bureau lines to raise awareness of VTrans' phosphorus control permit obligations and improve integration of phosphorus-reducing components into capital projects and maintenance activities. In October 2024, we submitted the Phase 2 PCIP to ANR, reporting that VTrans achieved 28% of its phosphorus reduction target by the end of 2023 and setting priorities and projects for 2025 to 2028. Stone also prepared a PCIP for VTrans' roads, rights-of-way, and facilities in the Lake Memphremagog watershed, which was submitted to ANR on April 1, 2025.

