



Lake Carmi Crisis Response Plan

Improved Water Quality via State Route 236 Culvert Replacement Project

Vermont Department of
Environmental Conservation

March 2, 2020





Presentation Overview

- I. Lake Carmi Water Quality Summary
- II. Crisis Response Plan Update
- III. Proposed Culvert Replacement Project
 - Project Details
 - Water Quality Benefit
 - Roles of Different Actors
 - Funding Mechanism
 - Timeline

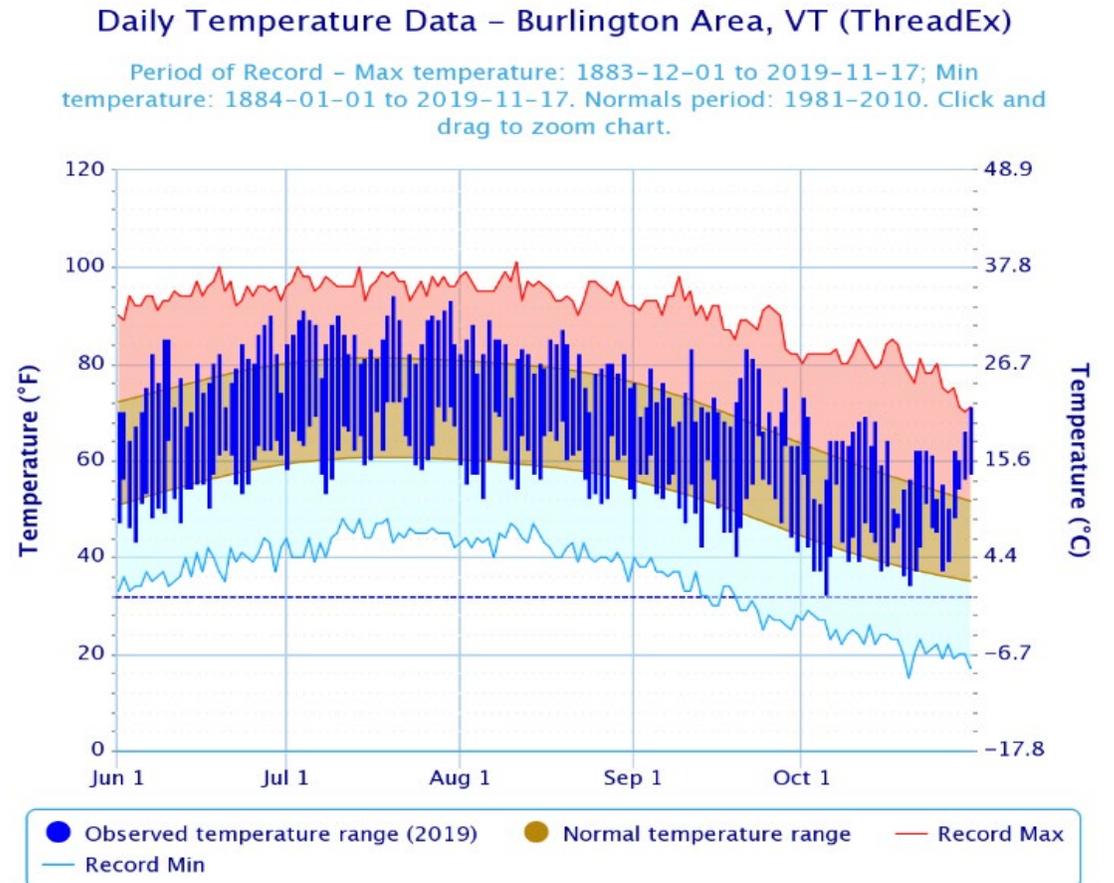
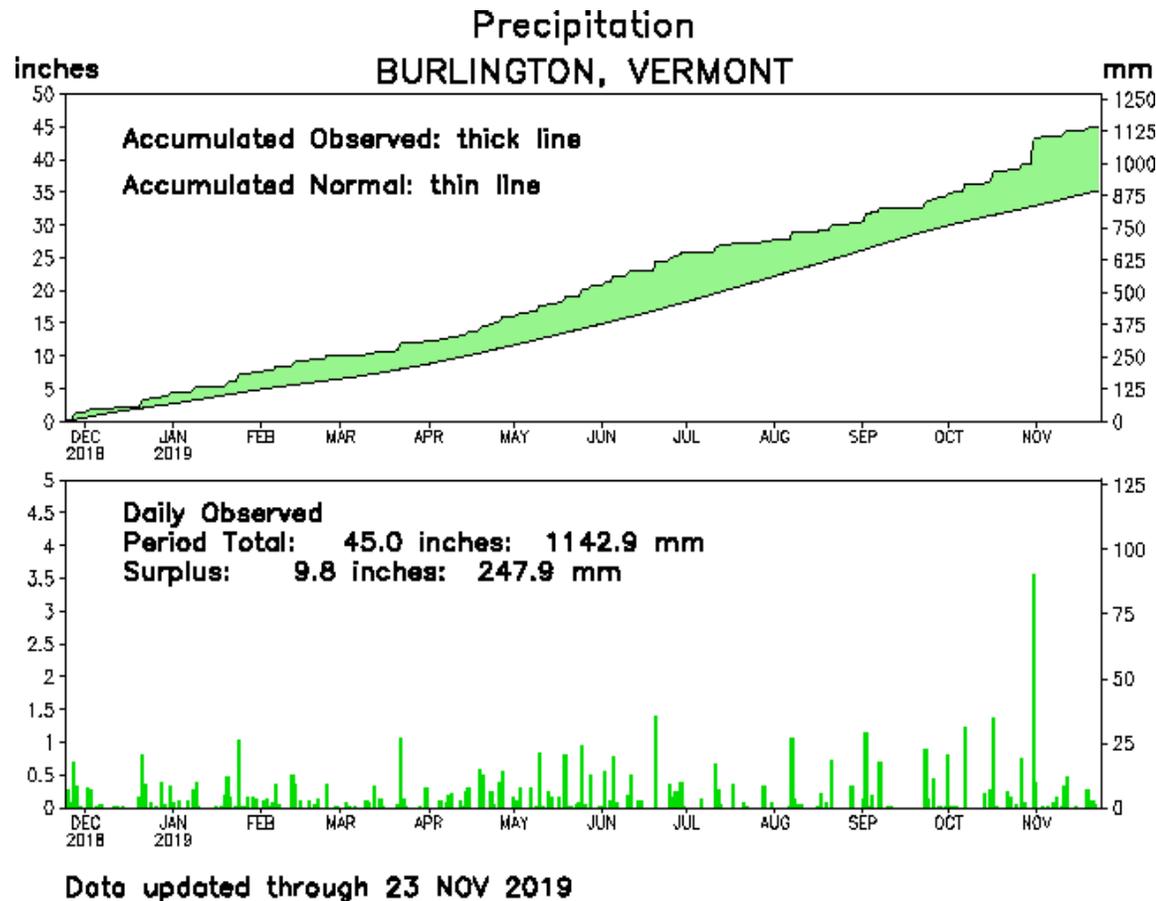


Bottom Line Up Front

- State-funded project covering engineering, design, and construction
- Replacing two culverts will reduce nutrient-rich sediment currently transported to lake from neighboring lands
- Road and culvert upgrades play an important role in overall phosphorus reduction to Lake Carmi
 - Tackling phosphorus loading from these sources is an important step in the right direction
- While State's funding originates as a loan to Town, the loan will be forgiven at 100% at project completion

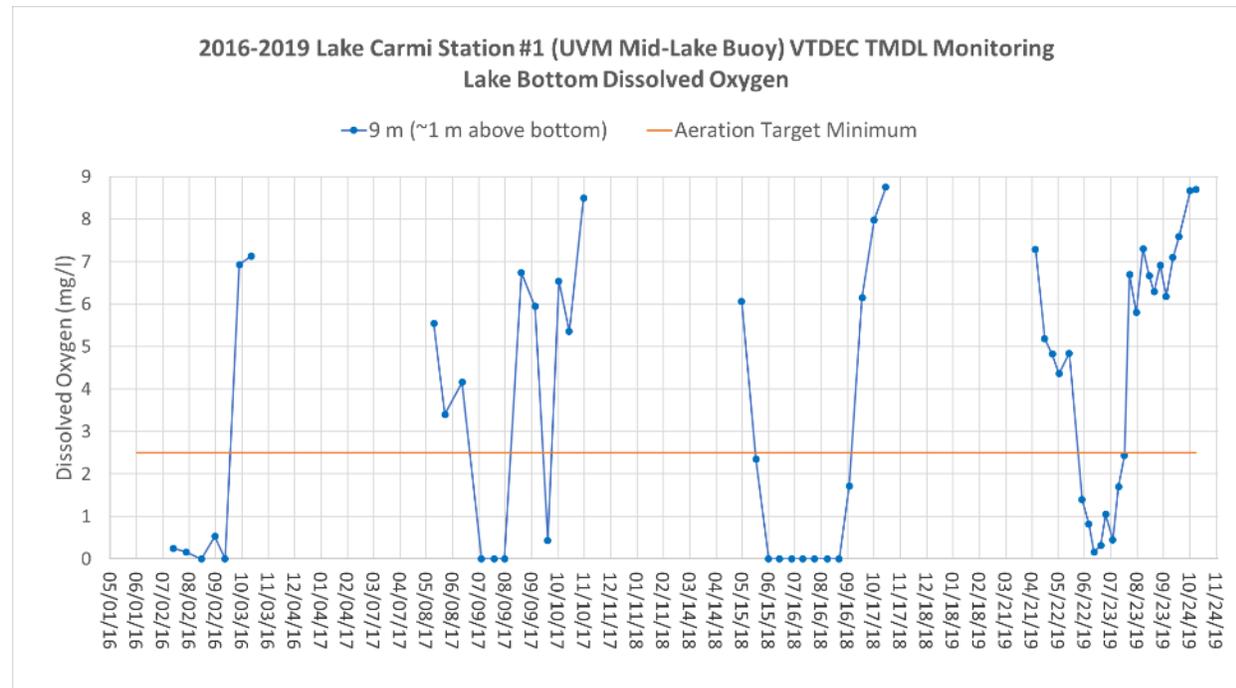
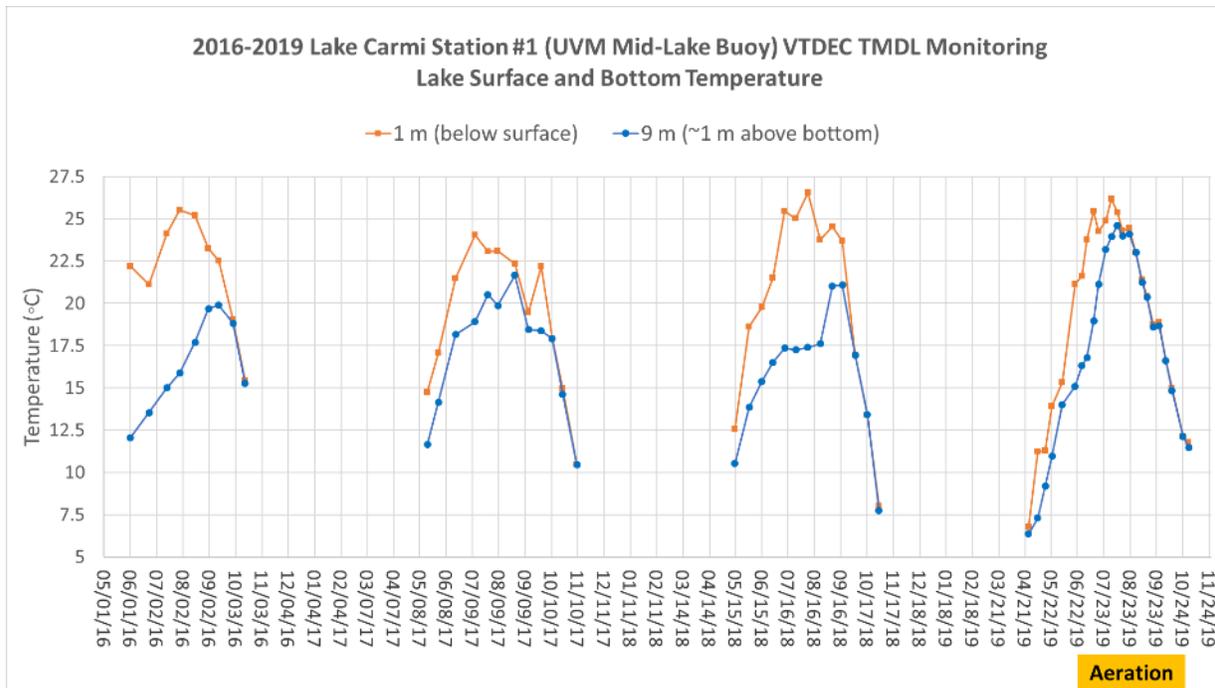
Lake Carmi Water Quality Summary

- 2019 was a mix of improved water quality and 30 days of blooms
- Large rainfall events and high temperatures this summer created ideal conditions for cyanobacteria blooms around the Northeast



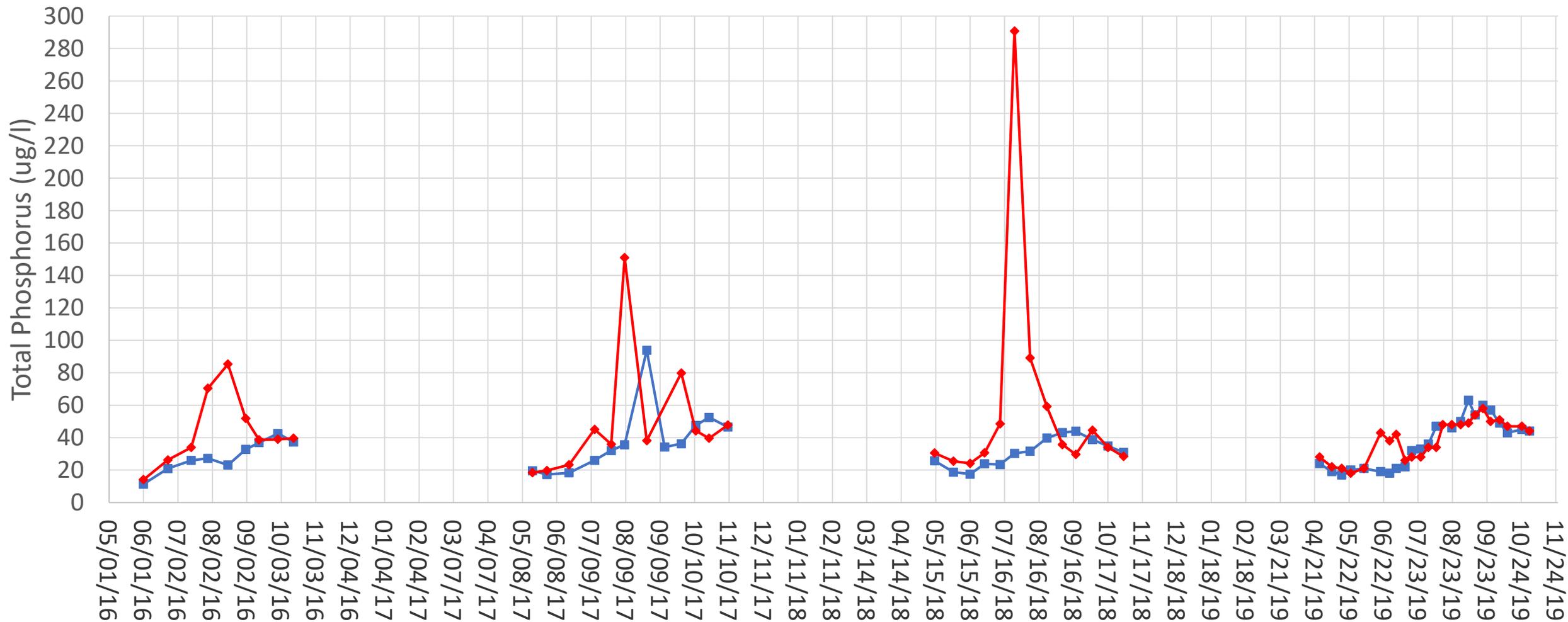
Lake Carmi Water Quality Summary

- Lake aeration system achieved goal of mixing water column to allow dissolved oxygen to reach lake bottom
- Internal phosphorus loading reduced compared to previous years



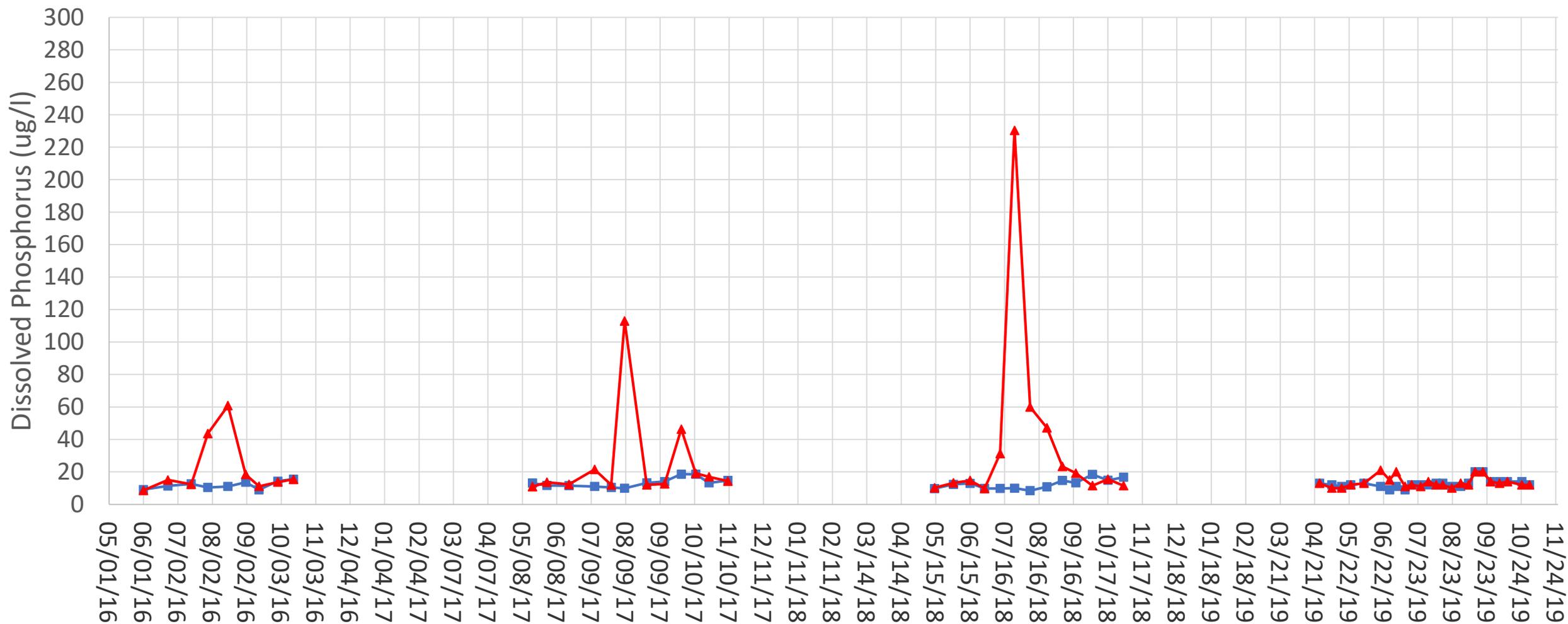
2016-2019 Lake Carmi Station #1 (UVM Mid-Lake Buoy) VTDEC TMDL Monitoring Lake Bottom Total Phosphorus

■ 0.2 m (surface grab sample) ◆ 8.0 m (~2 m above bottom grab sample)



2016-2019 Lake Carmi Station #1 (UVM Mid-Lake Buoy) VTDEC TMDL Monitoring Lake Bottom Dissolved Phosphorus

■ 0.2 m (surface grab sample) ▲ 8.0 m (~2 m above bottom grab sample)



Aeration

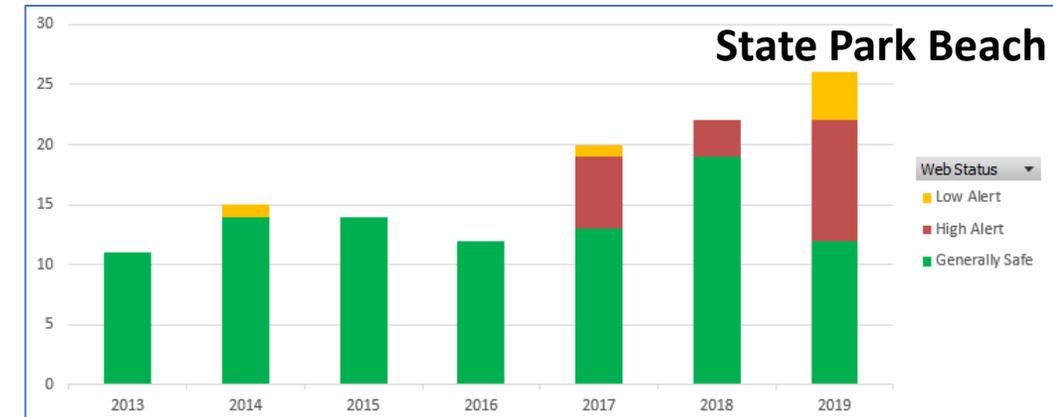
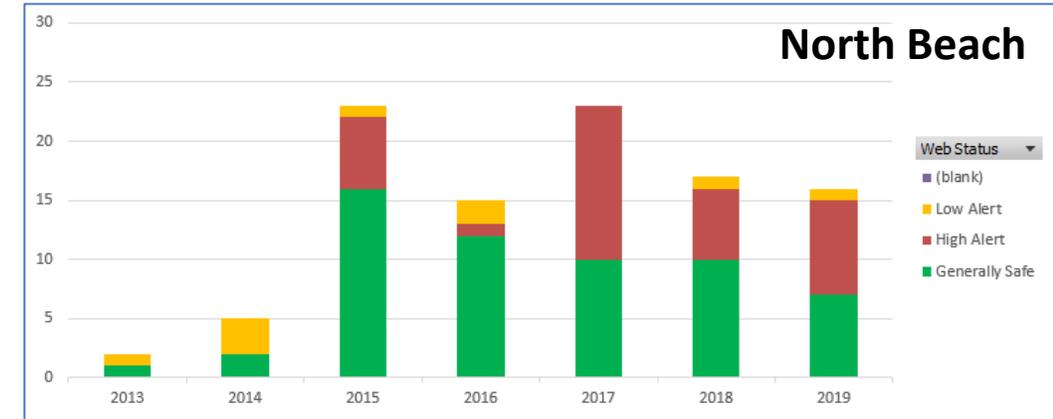
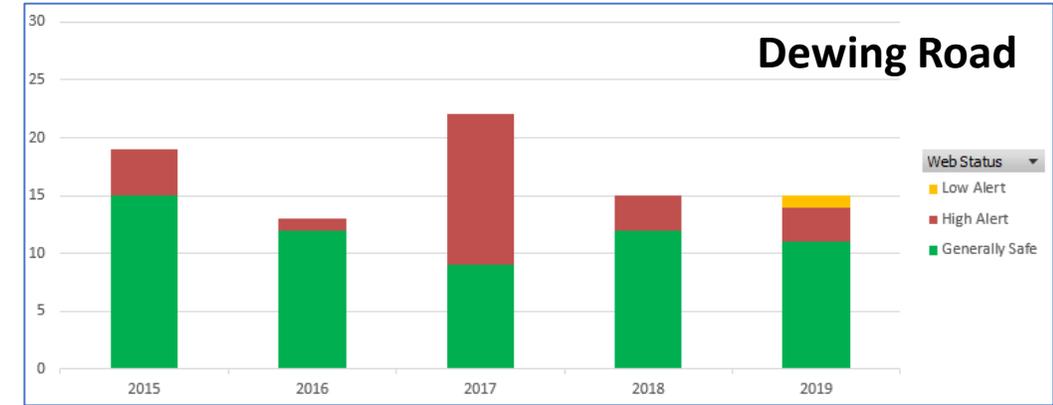
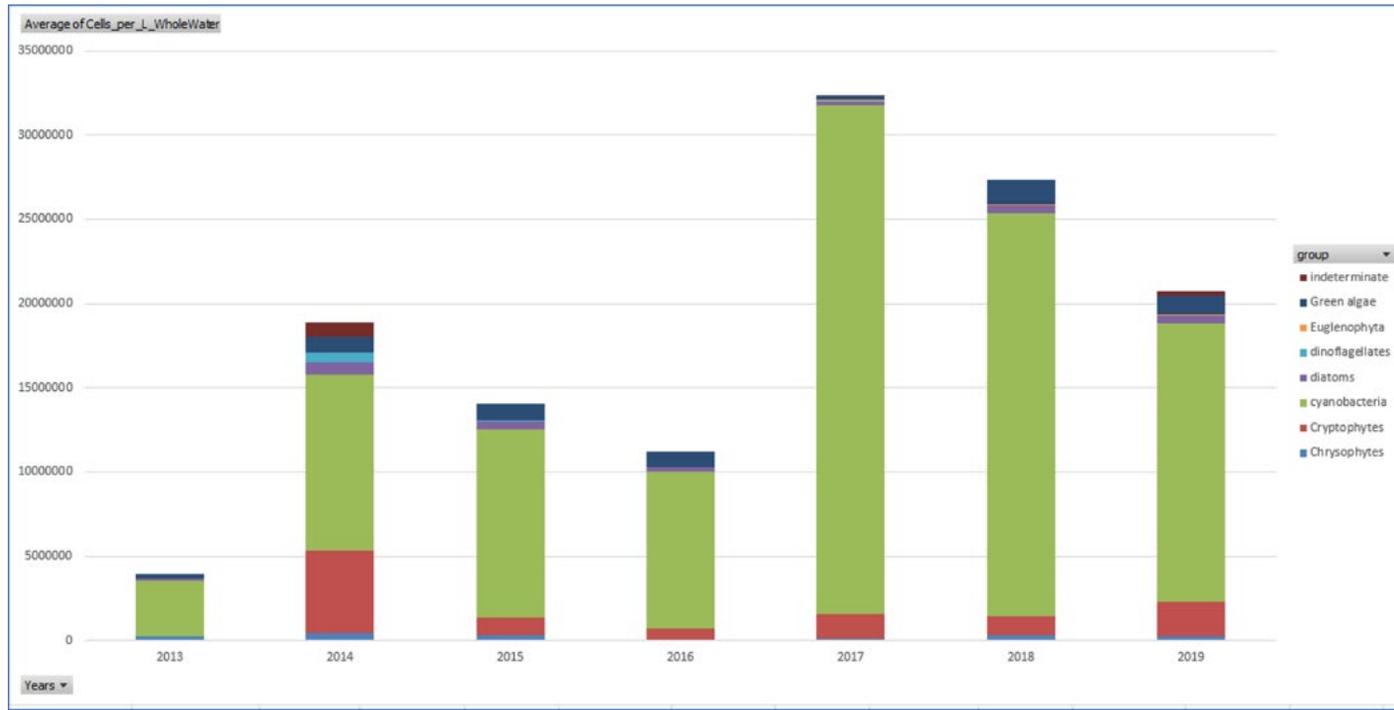
Lake Carmi Water Quality Summary

- 2019 Phosphorus concentrations in seven tributaries similar to previous years and fueled blooms in lake

Stream mouth	# sampling dates in 2019	2019 average P (ug/l) (27 ug/l meets VWQS)	2015-2017 average P (ug/l)
Marsh	9	109	94.4
Dicky	11	46	42
Dewing	7	50	49
Hammond North	4	59	50
Kane	8	41	67
Wescott	5	20	33
Sandy Bay	7	66	131

Lake Carmi Water Quality Summary

- Blooms are highly variable
- Surface & subsurface accumulations moved by wind, waves & currents



Lake Carmi Water Quality Summary

2019 Aeration System Details

Objectives:

- Mix water column and allow dissolved oxygen to reach the lake bottom
- Reduce internal phosphorus loading (from sediments in oxygen-depleted lake zones)
- Reduce phosphorus available to microorganisms which can fuel algal blooms

Targets:

- Maintain water temp within 2.5° C from 1 meter above bottom to 1 meter below surface
- Maintain minimum dissolved oxygen level of 2.5 mg/l one meter above the bottom

Performance:

- System operated from June 23 to Oct 25, 2019, 95% uptime
 - 2019 electricity costs were \$17,933 or \$4,484 per month
- Met goal of mixing water column to allow oxygen to reach lake bottom
 - Internal phosphorus loading less than previous years
- System can be optimized in 2020 to further reduce sediment P release
 - System must be complemented by actions in watershed to reduce external loading

LAKE CARMİ CRISIS RESPONSE PLAN

Version 2.0 Issued August 22, 2018



Photo credit: Larry Myott



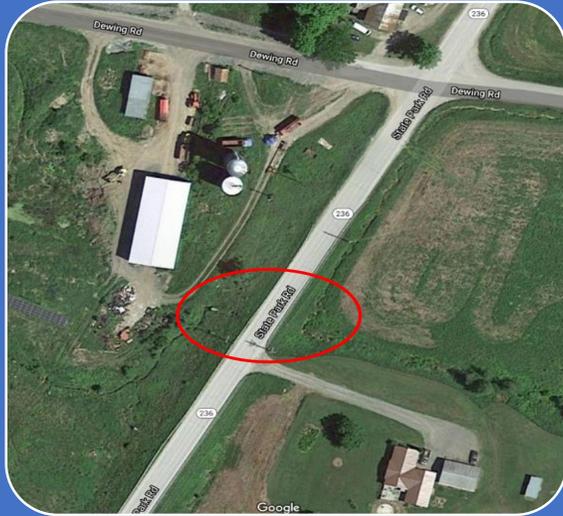
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Crisis Response Plan Update

- Lakes in Crisis Response Plan published in 2018
- Plan documents projects reducing P loading to Lake Carmi
 - Projects listed as Ag, Roads, Nat Res, Lakeshore & In-Lake
- ANR, AAFM and AOT are the lead state partners
 - NRCS, UVM, Franklin Watershed Committee involved
- Current Status: 28 projects funded at \$1.94M
 - Most projects completed or ongoing; plan to be updated
- **Upcoming in 2020:**
 - Manure Injection – UVM Extension
 - Private Road Inventory – LCBP funds, NRPC to implement
 - Groundwater Study: DEC
 - Lake Water Quality Monitoring: UVM Geology
 - Aeration System continues operation

Proposed Culvert Replacement Project



Culvert PID 65818

- **Project Definition:** Eligible nonpoint source pollution reduction project in the watershed of a Lake in Crisis
- Culverts transport surface water runoff (stormwater) under roads
- Culvert is 350 feet south of Dewing Rd on Rt 236, half a mile from Lake Carmi
- Culvert flows into Dewing Brook, 3rd largest tributary to lake

Crisis Response Plan & Franklin Stormwater Master Plan: Culvert is problematic for erosion & sediment-rich runoff



- High levels of bank erosion up and downstream; scouring threatens culvert upstream and downstream; downstream bank armor failing; large pool d/s, culvert footer is slumping in
- Sinkhole in the road shoulder has formed above the upstream end of culvert; rocks have been installed to stabilize the scour pool at downstream end of culvert.
- Culvert replacement is one alternative as confirmed in the Hydraulic Study

Technical Rationale for Culvert Replacement from Hydraulic Study

Existing culvert specifications:

- Drains 2 intermittent stream channels with a slope of 7.0%
- Made of corrugated metal pipe with a diameter of 3 feet (7 square foot opening)
- Does not meet the current standards of the VTrans Hydraulic Manual

Failure of existing culvert:

- A 2-foot vertical drop and scour pool now present at outlet
- A section of pipe has separated, creating a 9-foot wide sinkhole on the downslope of VT-236 allowing sediment to enter structure from overhead
- Separation of pipe section has also resulted in sediment scouring from beneath the structure
- Structure constricts the channel width, resulting in an increased potential for debris blockage



Culvert Replacement Project Details

VTrans Hydraulics Memo Standards:

- Replacement must meet current VTrans hydraulic standards, state environmental standards regarding span length and opening height, and allow for roadway grade and site constraints
- High velocities are anticipated at the outlet of these structures during storms; stone fill will be needed at the structure's inlet & outlet to resist erosion and prevent a new scour hole

Replacement Culvert Specifications:

- A minimum 4.5-foot diameter corrugated metal pipe, with 16 square feet of waterway area
- Add 6-inch baffles as a means of roughening the interior surface to decrease velocities and extent of erosion at the outlet of the structure
- Excavation would be 16' deep, making a VOSHA safe construction width of 66' wide.
- New culvert length: 100' with stepped and graded subbase extending paved length to 150'
- Substantial inlet and outlet head and wing walls would be required
- Ample riprap to dissipate, slow and control storm water
- Guardrail will be removed and replaced with new
- Based on similar recent projects elsewhere in the state, cost is estimated at \$350,000

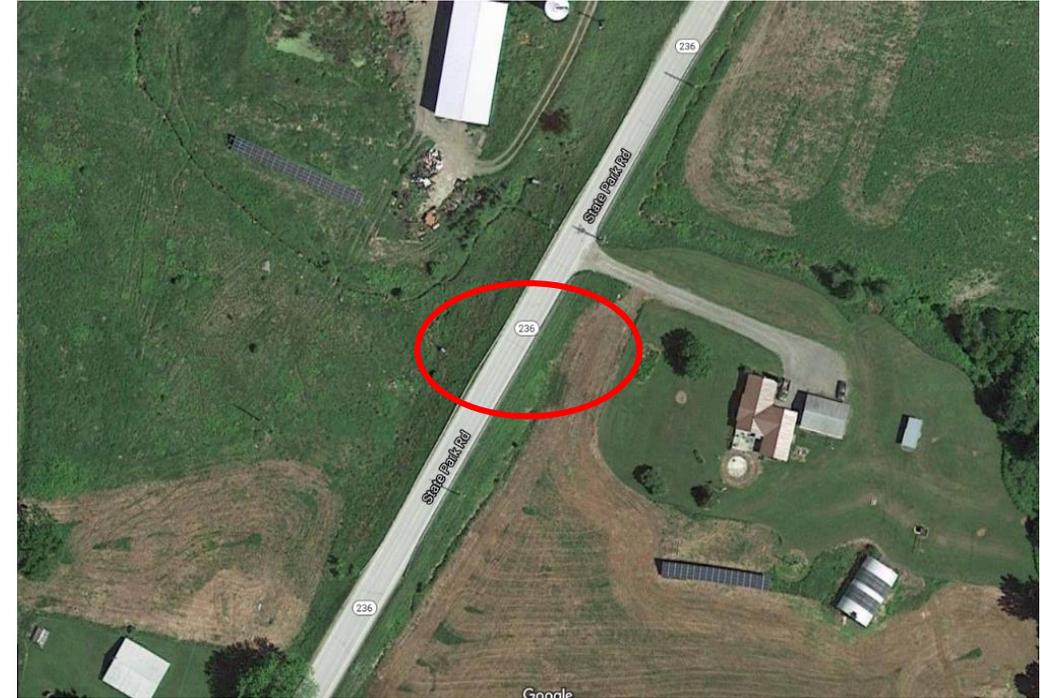
Replacement of a second culvert

Vtrans suggested replacement of culvert PID 65819

- Problematic due to inlet scour, separation of pipe from wall, and 2.5 ft vertical drop and scour pool at outlet, collectively leading to erosion and sediment transport in high-flow events
- New culvert: 3-foot diameter corrugated metal pipe, with 7.1 ft² of waterway area

Economy of Scale

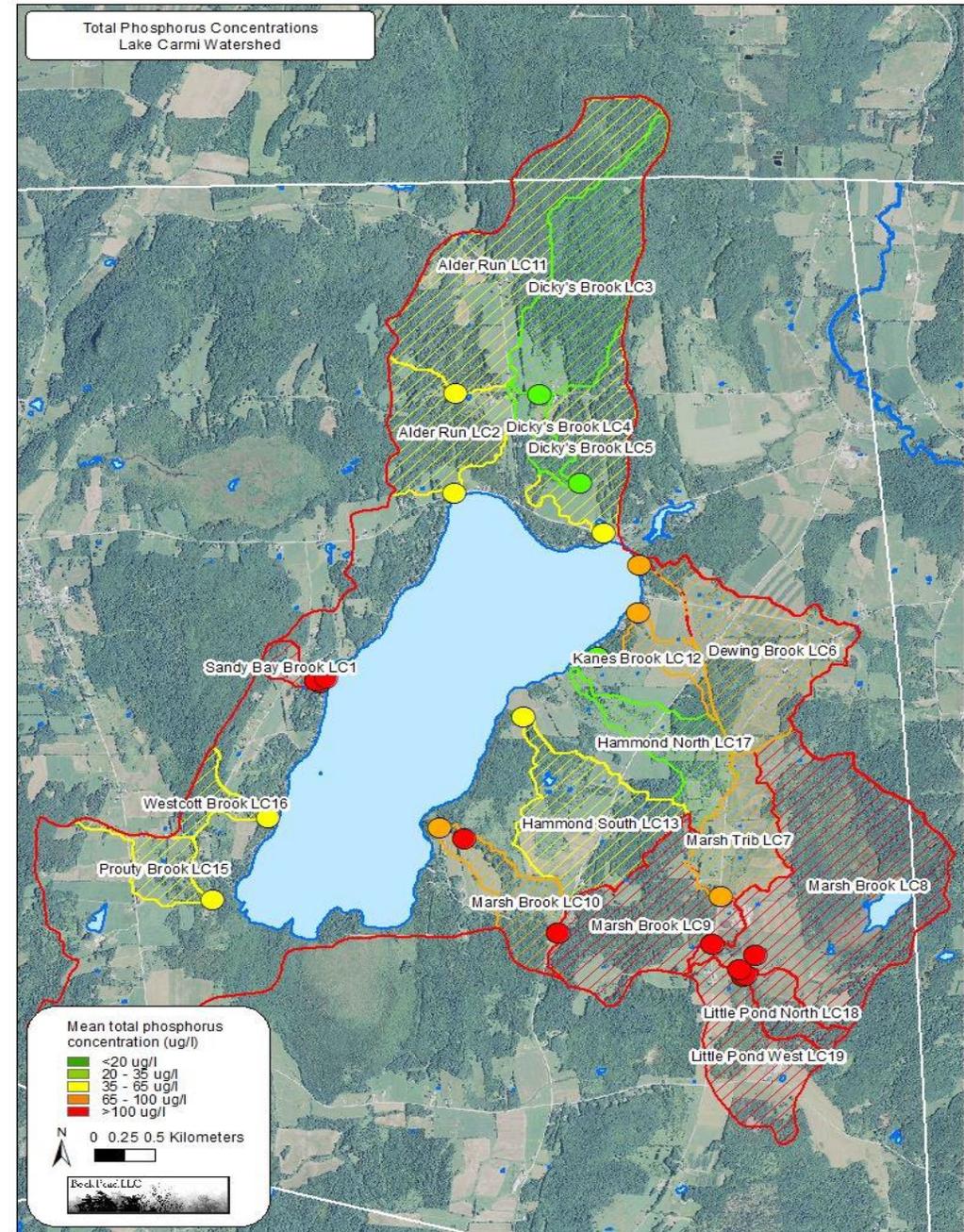
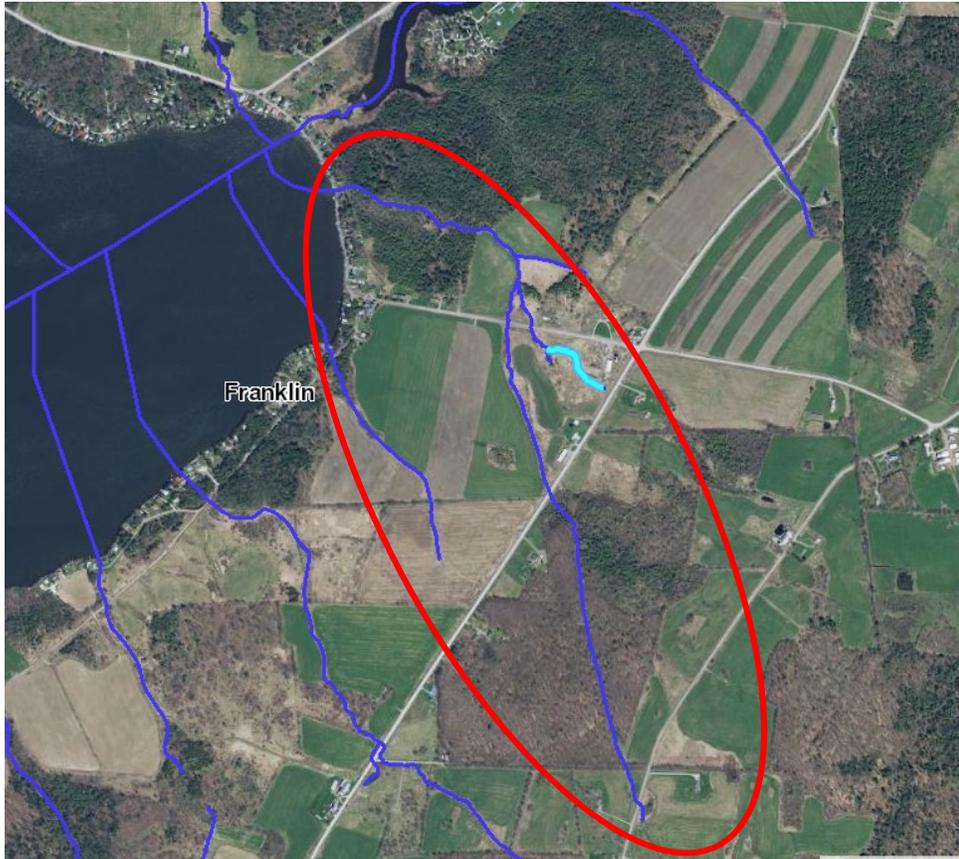
- Closing road and construction set-up is costly, cost savings exist if two culverts replaced at once (one mobilization & detour package with message boards and flaggers)
- Both culverts could be replaced for around \$400,000, or an additional cost of \$50,000 for the second culvert
- If bids for 2 culverts are too high, Town can reject them and rebid just the first one



Culvert Replacement Project

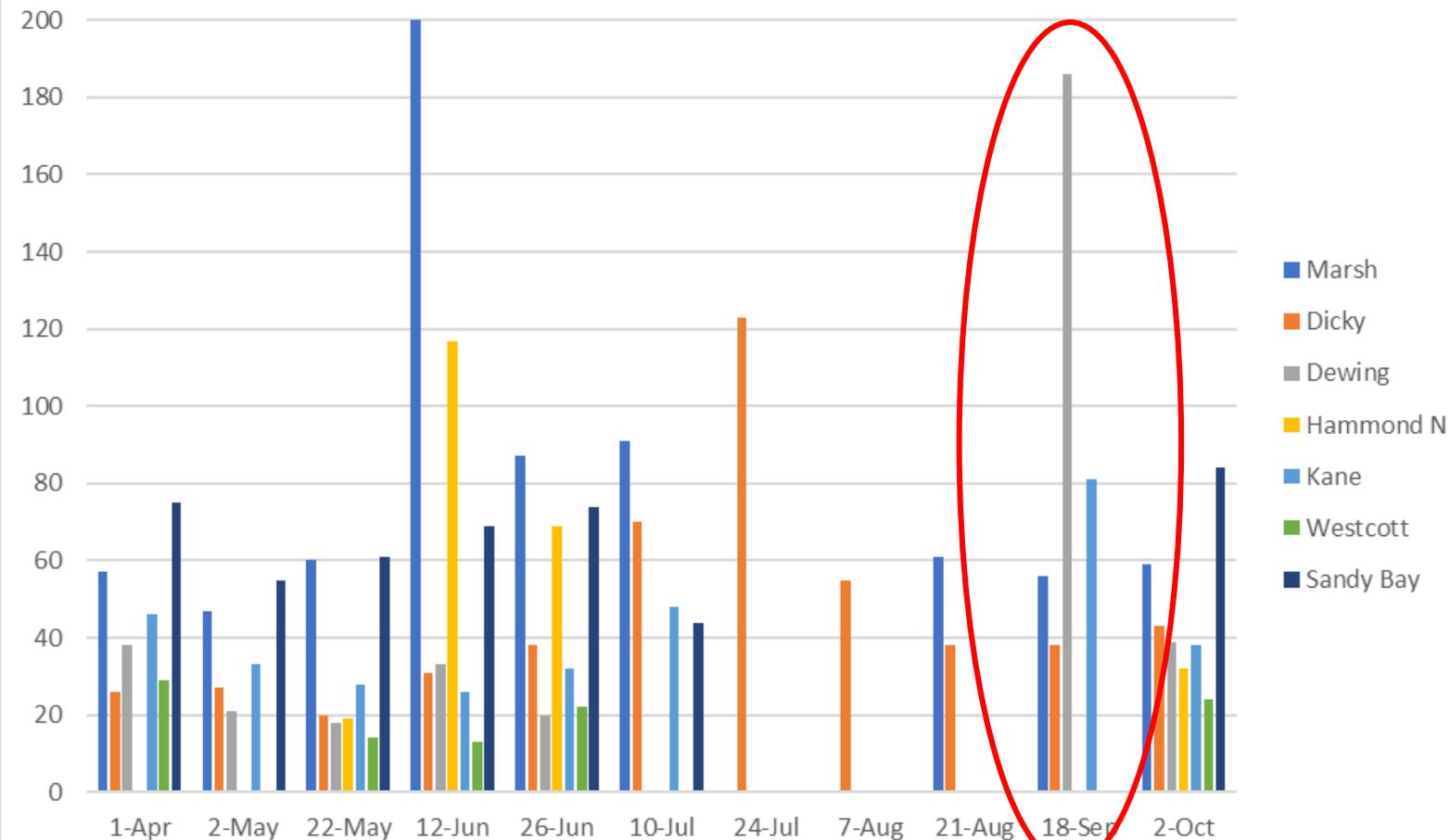
Water Quality Benefit

- Culverts flow into Dewing Brook
- Dewing Brook in second highest phosphorus loading category 2007-18



Culvert Replacement Project

2019 Phosphorus Concentrations at Tributary Mouths



Purpose: Replacing failed culverts that transport sediment to lake will have significant clean water benefits

- Dewing Brook had 2nd highest phosphorus concentration at tributary mouth in 2019
- In storm events, high velocity flow transports phosphorus rich sediment from scour pool and sinkhole into Lake Carmi, leading to increased phosphorus loading
- Presence of blooms in NE corner of Lake Carmi can be partially attributed to P loading from sediment-laden tribs in this area

Aerial Photo of 2017 Bloom in Northeast Corner of Lake



Roles of Different Actors

DEC

- Overall project coordination and support
- Provide funding
- Monitor water quality benefit of project

VTrans

- Serve as a technical resource for project
- Expedite approvals, attend meetings, approve work and provide other necessary support

Town of Franklin

- Apply for funding
- Hire & oversee project consultant
- Procure construction contractor (w/ support from consultant)

Project Consultant

- Project planning & scoping
- Complete design work & obtain permits
- Handle procurement of construction contractor
- Hold required meetings
- Develop traffic detour plans, erosion & sediment control plans, etc.
- Construction oversight & site inspection
- Budget of \$50,000 for this consultant

Construction Contractor

- Construct replacement culverts as per contract

Funding Mechanism & Budget

- Proposal: Use VT Clean Water State Revolving Fund loan to fund this project
 - Funding is for preliminary engineering, final design and construction funding
 - Loan would be forgiven at 100% and would function like a grant with no financial liability to Town of Franklin once FY20 Intended Use Plan (IUP) is finalized
 - Intended Use Plan for CWSRF would confirm loan forgiveness
 - Town applies for funding after IUP effective (7/1/2020); loan must be executed within 1 yr
 - Forgiveness written into loan and triggered immediately, but project must be completed
 - Estimated total project cost of \$450,000: \$50,000 for consultant and \$400,000 for works
 - Advantage of this approach: funds earmarked for this project & expected **available** in July
 - Town can access a portion of the funding sooner to get started on design & planning
- DEC views these funds operating as grant and will provide Town with access to DEC technical experts to support financial management, procurement, and reporting
 - With the support of DEC, the project management consultant, and VTrans, the workload for the Town is limited and manageable

Notional Timeline

March 2020:
If project is
approved,
procure
consulting
engineer

July 2020:
Procure
Construction
Contractor

October
2020:
Complete
Construction
& Site
Inspections

May 2020:
Project
Planning,
Scoping,
Design &
Permitting

September
2020:
Commence
Construction



Thanks for your attention!
Questions?

