

Research on Adaptation to Climate Change in the Lake Champlain Basin

High School Webinar Series, Part I



12 November 2012
Courtney D Giles, PhD
University of Vermont



- *In the last installation of Streams...*
- *Overview of the RACC effort and progress*
- *Streams 2012*
 - Research Questions & Team Assignments
 - Sampling Locations & Schools
 - Your Progress
- Next Steps

Last time...

Orientation Week
St. Michael's College





RACC
Research on Adaptation
to Climate Change

Orientation Week
St. Michael's College



time...

Watershed processes...



RACC

Research on Adaptation
to Climate Change

Orientation Week
St. Michael's College



time...



Stream sampling...

Orientation Week
St. Michael's College



*Macroinvertebrate
sampling...*



time...





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to Climate Change

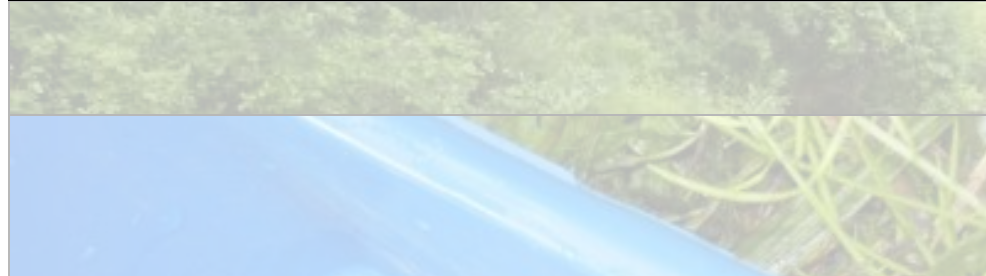
Orientation Week
St. Michael's College



*Macroinvertebrate
classification and counting*



time...



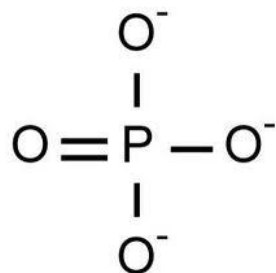


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to Climate Change

Last time...

Phosphorus = Nutrient of Concern



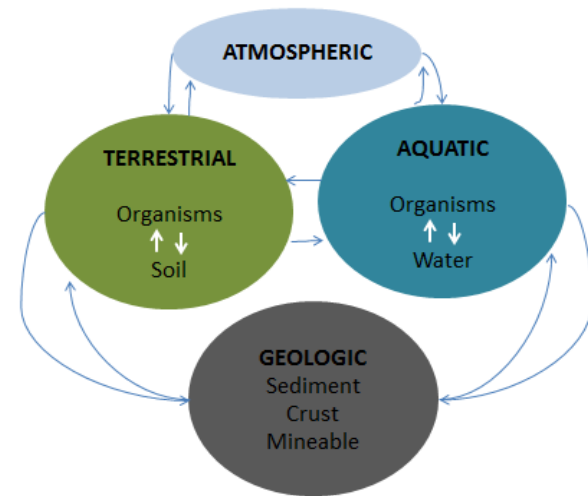
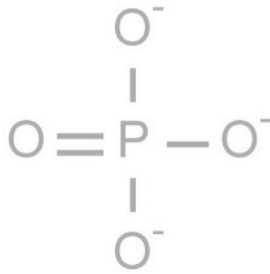


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The Global P Cycle

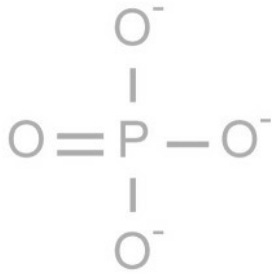


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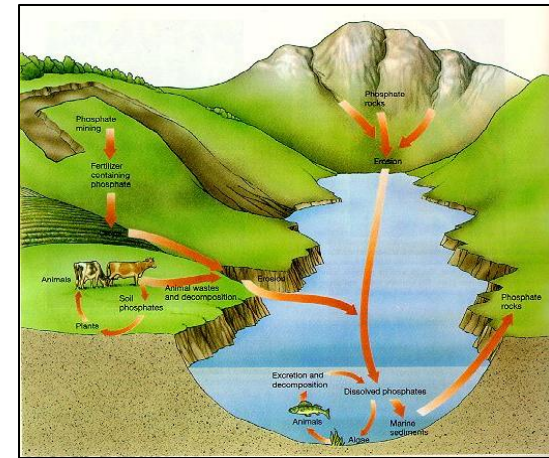
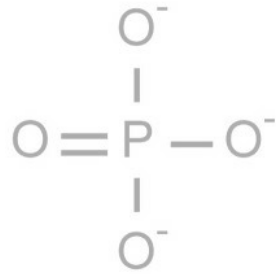


Phosphorus Availability
and Limitation in the
Environment



Last time...

Phosphorus = Nutrient of Concern



**Phosphorus in the
Lake Champlain Basin**



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to Climate Change

...effort and progress

The Lake Champlain Basin





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to Climate Change

...effort and progress

**Lake & stream
water quality**

The Lake Champlain Basin





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to Climate Change

...effort and progress

Lake & stream
water quality



Watershed
processes

The Lake
Champlain
Basin





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...effort and progress

Lake & stream
water quality



Watershed
processes



Land management
and policy

The Lake
Champlain
Basin

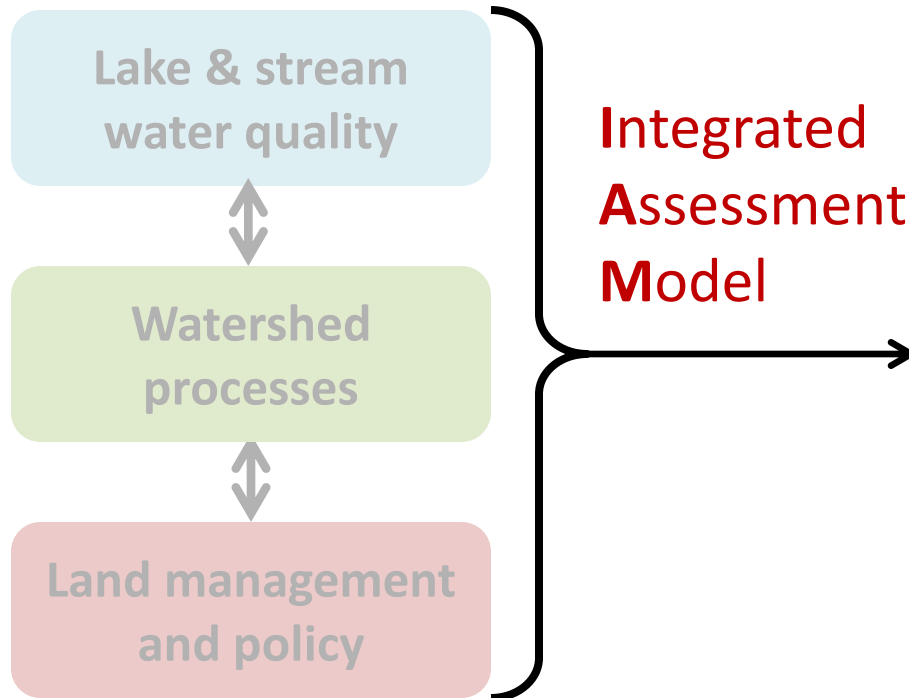




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Research on Adaptation
to Climate Change

...effort and progress



The Lake
Champlain
Basin





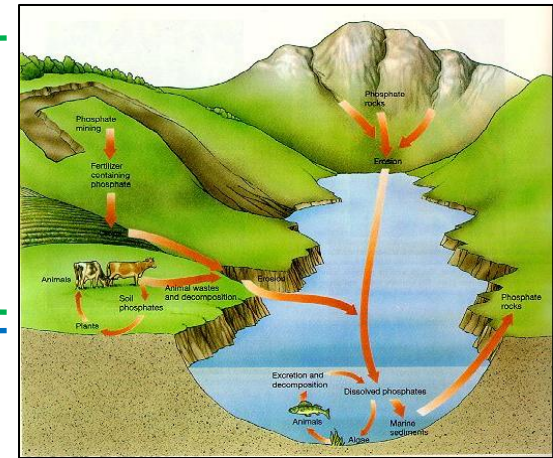
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Nutrient and Sediment Inputs

External

Internal



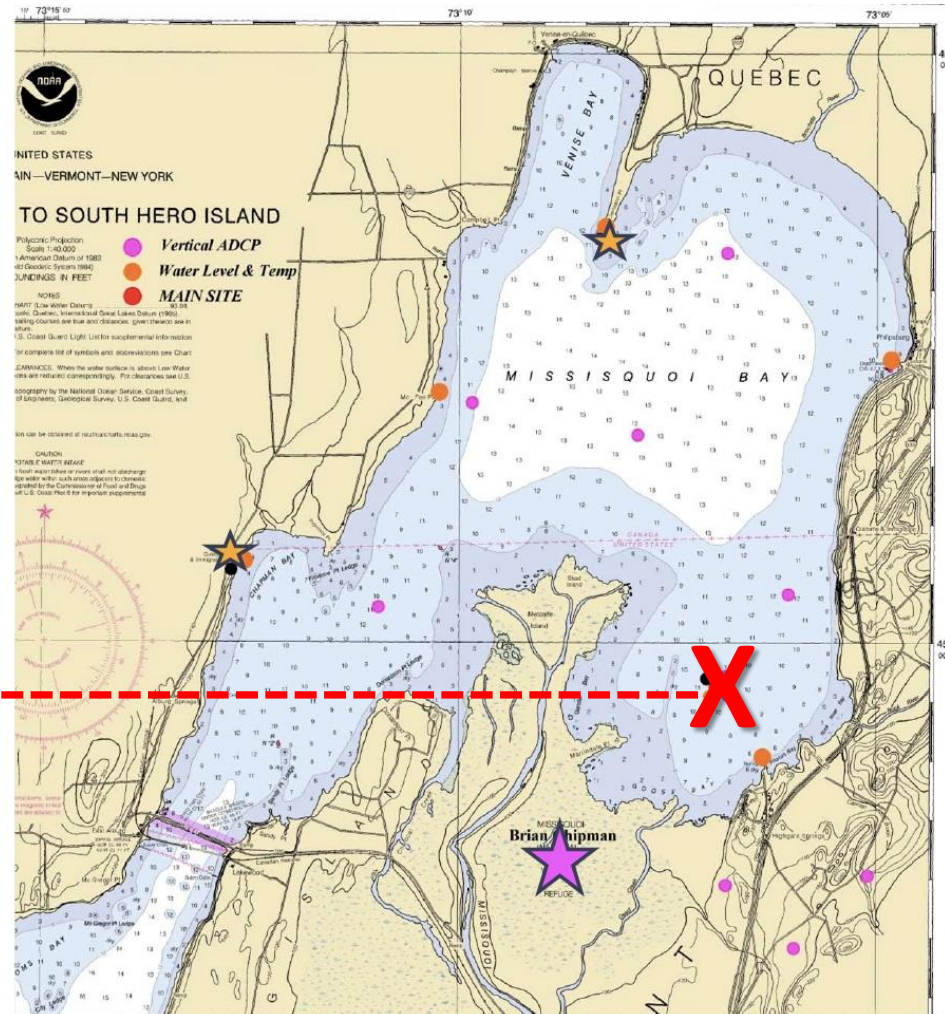
Phosphorus in the
Lake Champlain Basin



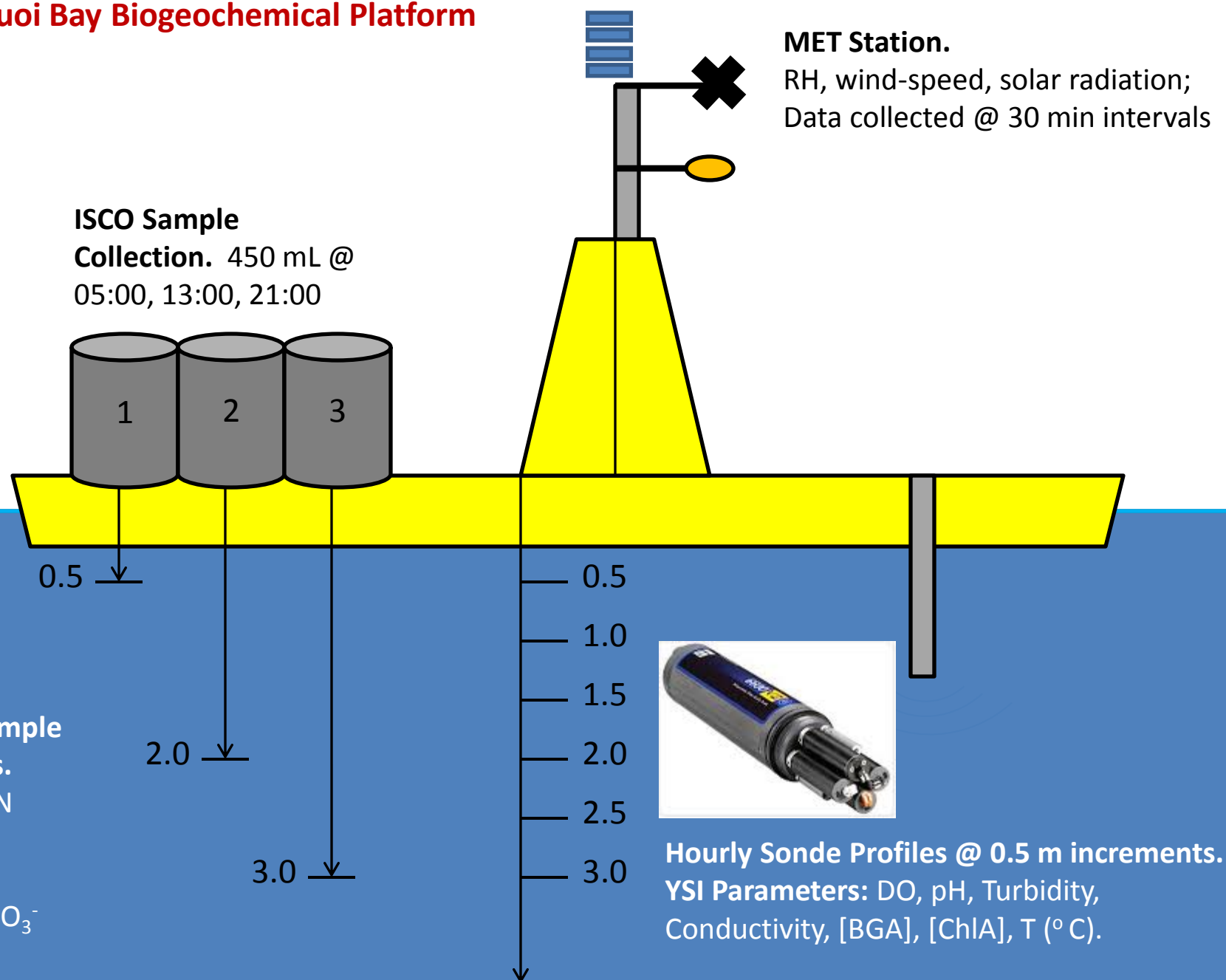
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Missisquoi Bay Research



Missisquoi Bay Biogeochemical Platform





TO SOUTH HERO ISLAND

Vertical ADCP
Water Level & Temp
MAIN SITE

CAUTION
1983 Edition
Chart may be obsolete or may not show changes
in the area. For the latest information, consult the
National Ocean Service's Hydrographic Survey of
the St. Lawrence River and Gulf of St. Lawrence.

VENISE BAY
MISSISQUOI BAY
GULF OF ST. LAWRENCE
ST. LAWRENCE RIVER
QUEBEC
VERMOREL
BRIAN'S SHIPMAN
NANTUCKET

1983

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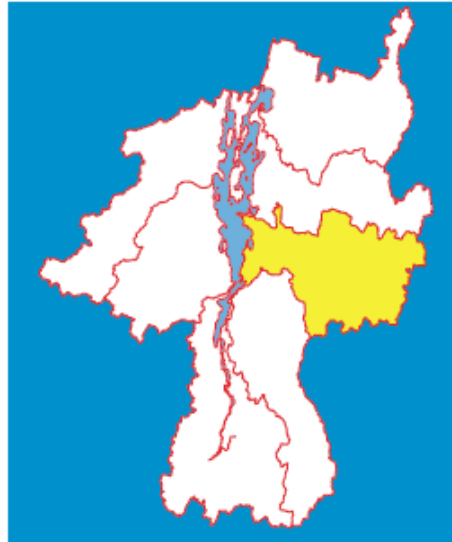
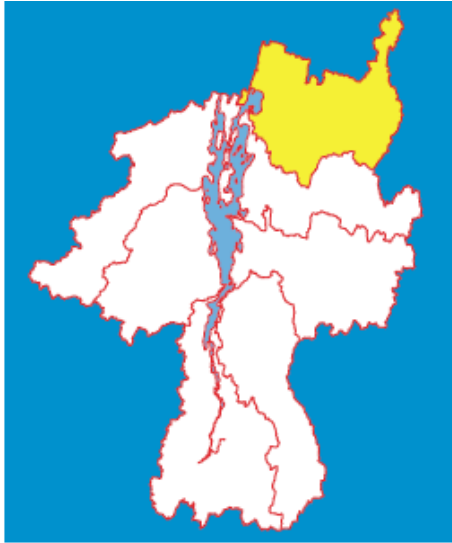




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Watershed Research

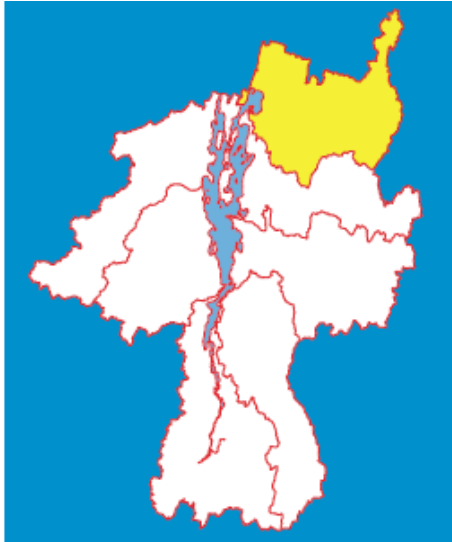




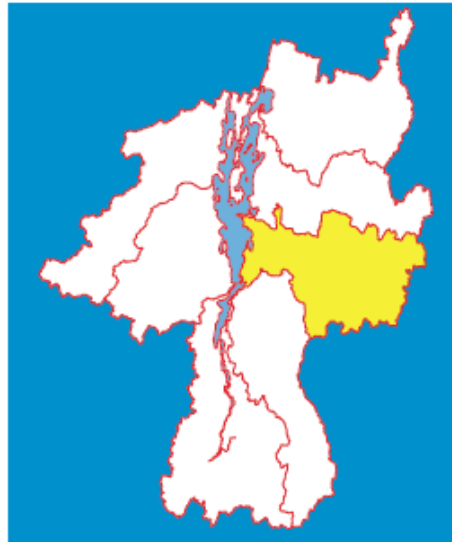
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to Climate Change

Watershed Research



Missisquoi
Forested/ Agricultural



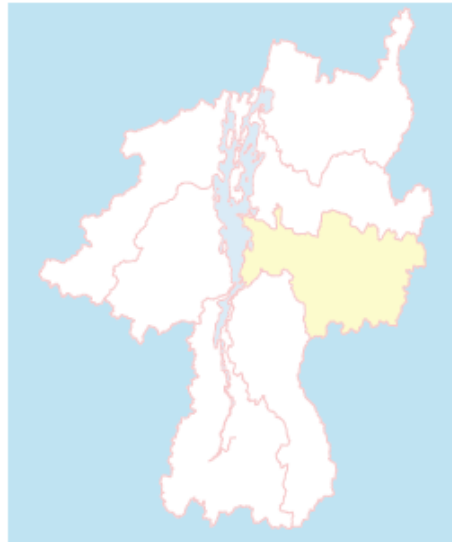
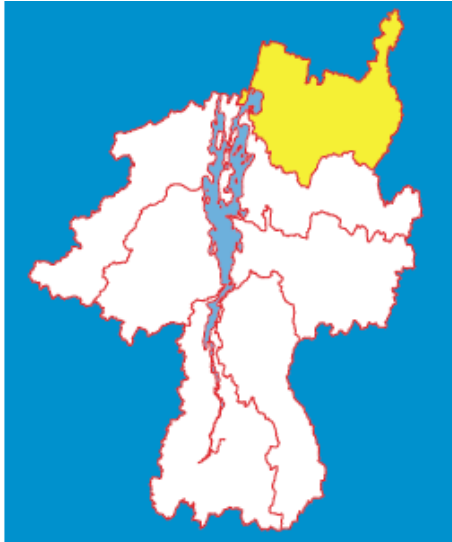
Winooski
Urban/ Mixed Land-use



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to Climate Change

Watershed Research



Missisquoi



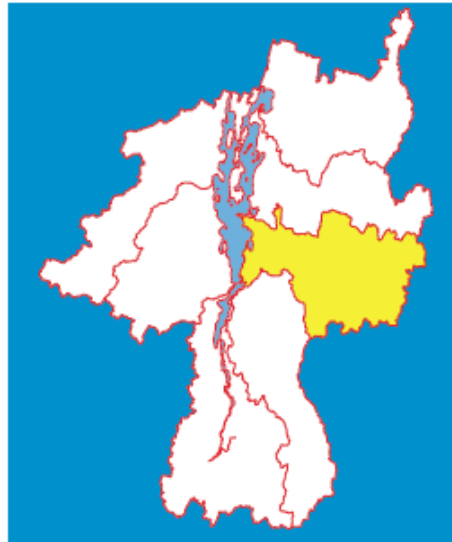
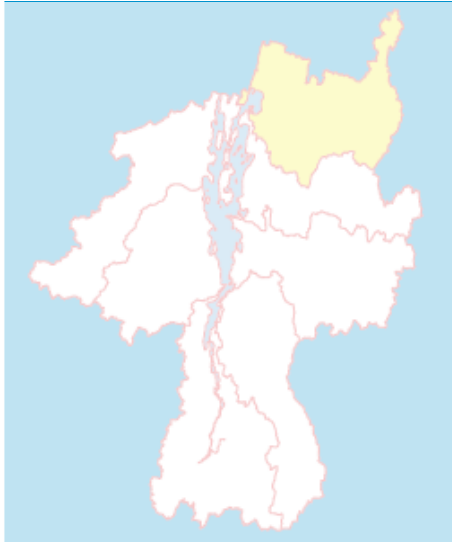
★ RACC/USGS



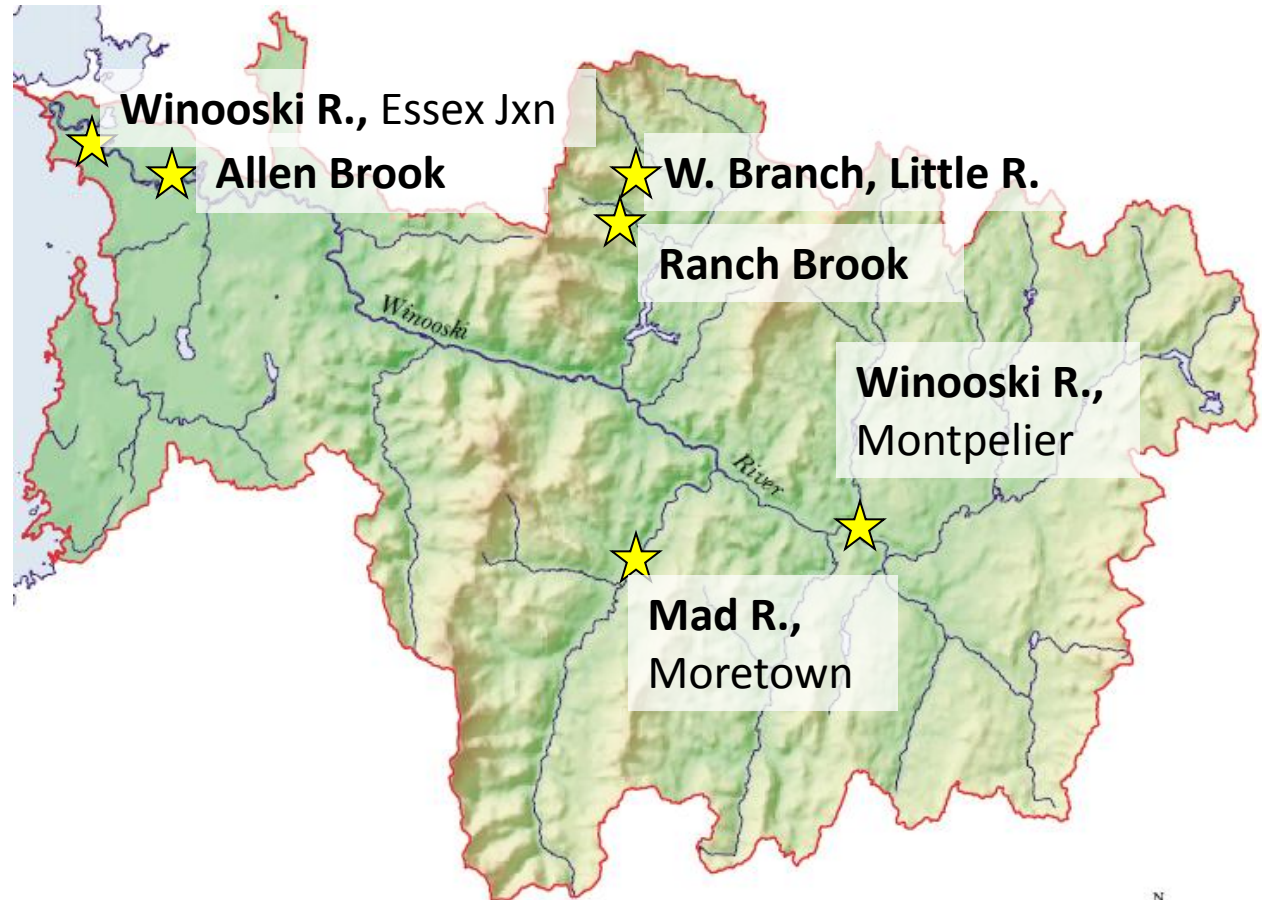
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to Climate Change

Watershed Research



Winooski

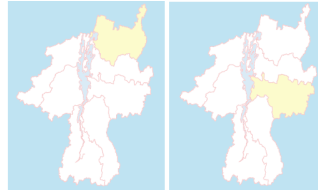




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Watershed Research



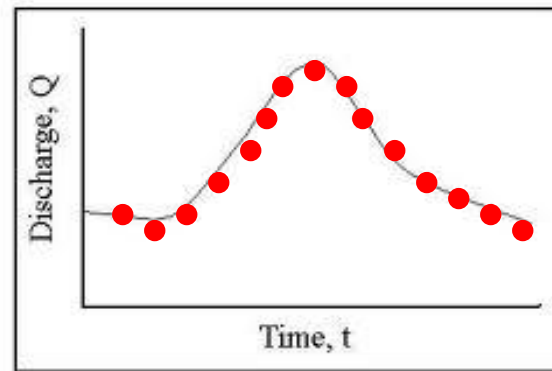
Missisquoi

Winooski



Concentration
[M / V]

X



Discharge
[V / T]

=

Σ Load
[M / T]



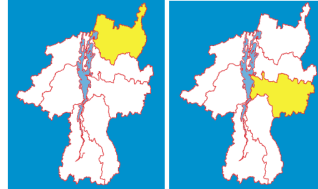
*Mass
Transport*



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to Climate Change

Watershed Research



Missisquoi

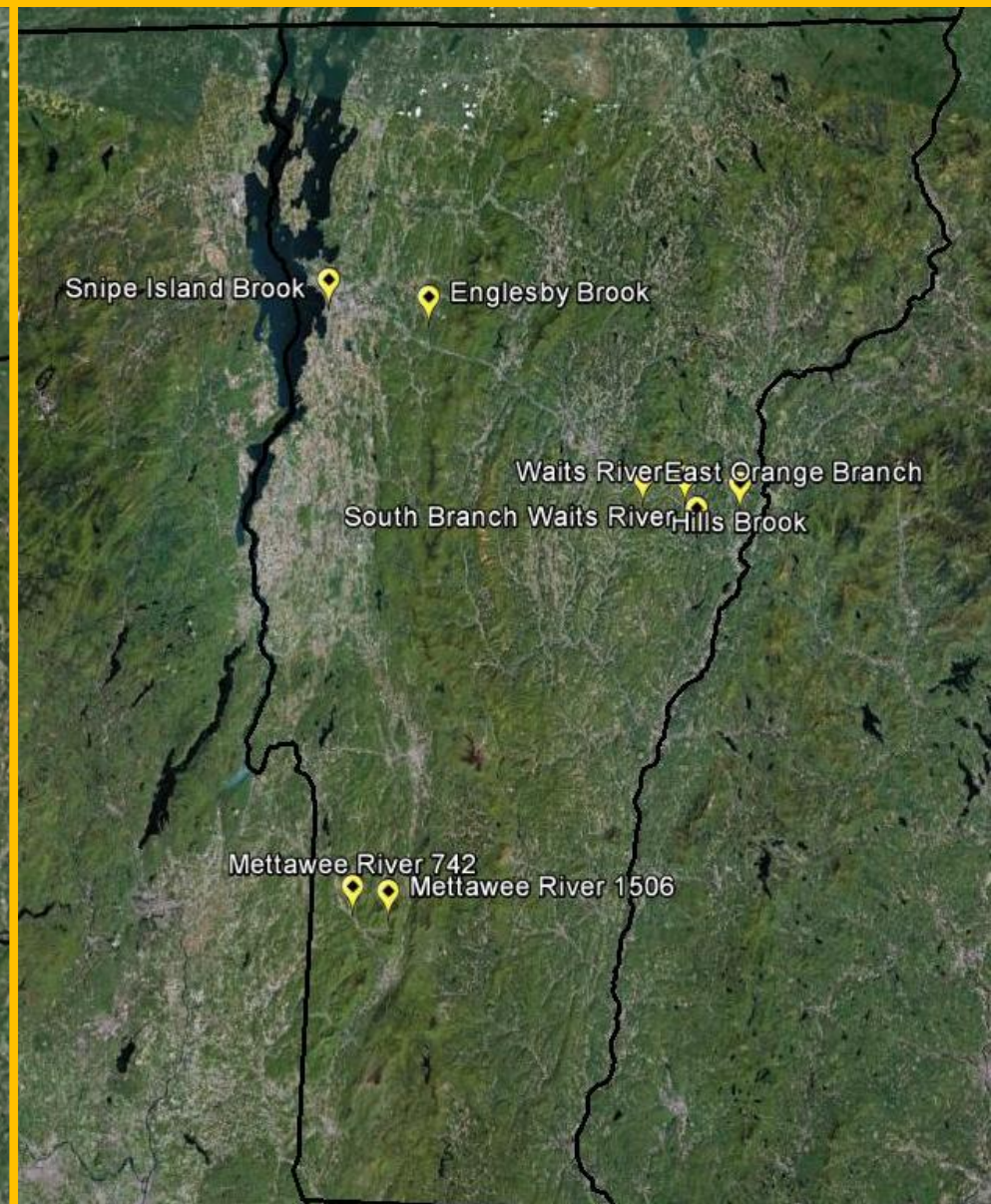
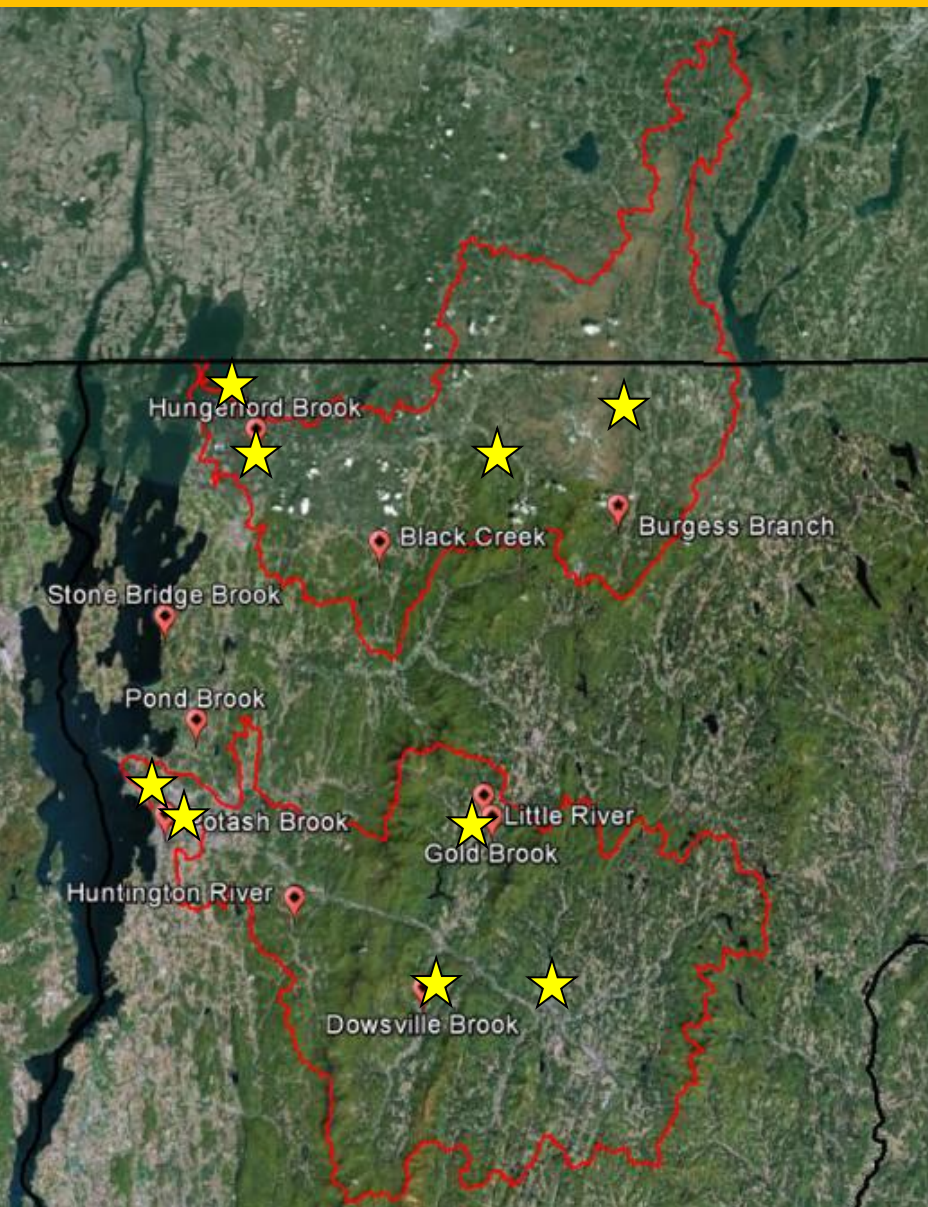
Winooski



RACC

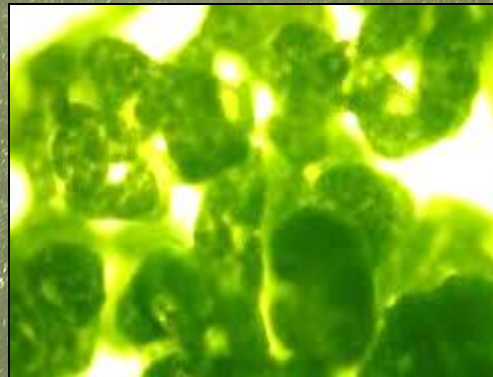
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to Climate Change

Watershed Research



Noteworthy weather and bloom developments

- Near drought conditions
- Lots of sun!
- Two bloom events in Missisquoi Bay (July, August)
- Massive fish and clam-kill in Quebec (August)
- Large storm in September; Observed impacts in Lake.





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to Climate Change

Overview

- *In the last installation of STREAMS...*
- *Overview of the RACC effort and progress*
- ***Streams 2012***
 - Research Questions & Team Assignments
 - Sampling Locations & Schools
 - Your Progress
- Next Steps

STREAMS 2012 – Research Questions

(1) How does water quality change in response to precipitation events?
How do land use patterns affect the physical condition of and water quality in streams?

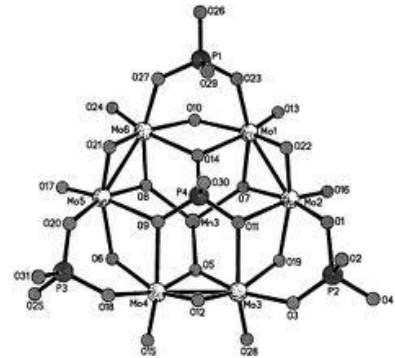
STREAMS 2012 – Research Questions

(1) How does water quality change in response to precipitation events?
How do land use patterns affect the physical condition of and water quality in streams?

**Soil
Transects**



**Total Suspended
Sediment**



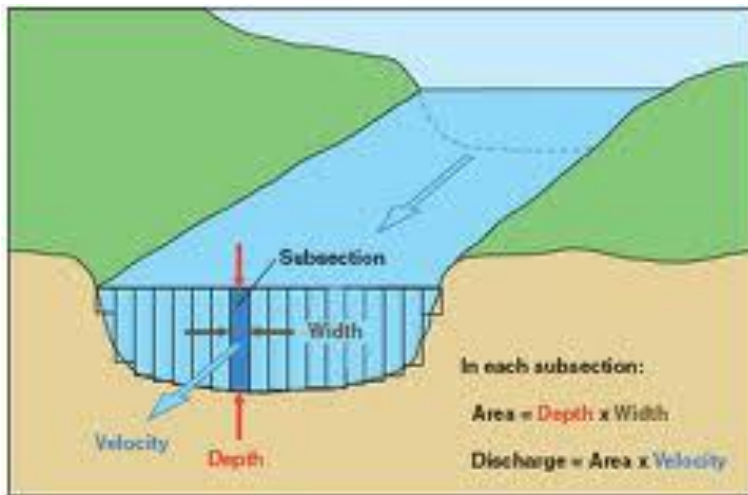
Total Phosphorus



STREAMS 2012 – Research Questions

(1) How does water quality change in response to precipitation events?
How do land use patterns affect the physical condition of and water quality in streams?

$$Q = \frac{A \cdot L \cdot C}{T}$$



Q = Discharge [L^3/T]
A = Cross-sectional Area [L^2]
C = Roughness correction
T = Time [T]

STREAMS 2012 – Research Questions

(1) How does water quality change in response to precipitation events?
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(2) How quickly do macroinvertebrate communities recolonize streams after storm events?



STREAMS 2012 – Research Questions

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(3) How has land use changed in response to a changing Vermont climate?

THE LAKE CHAMPLAIN BASIN ATLAS

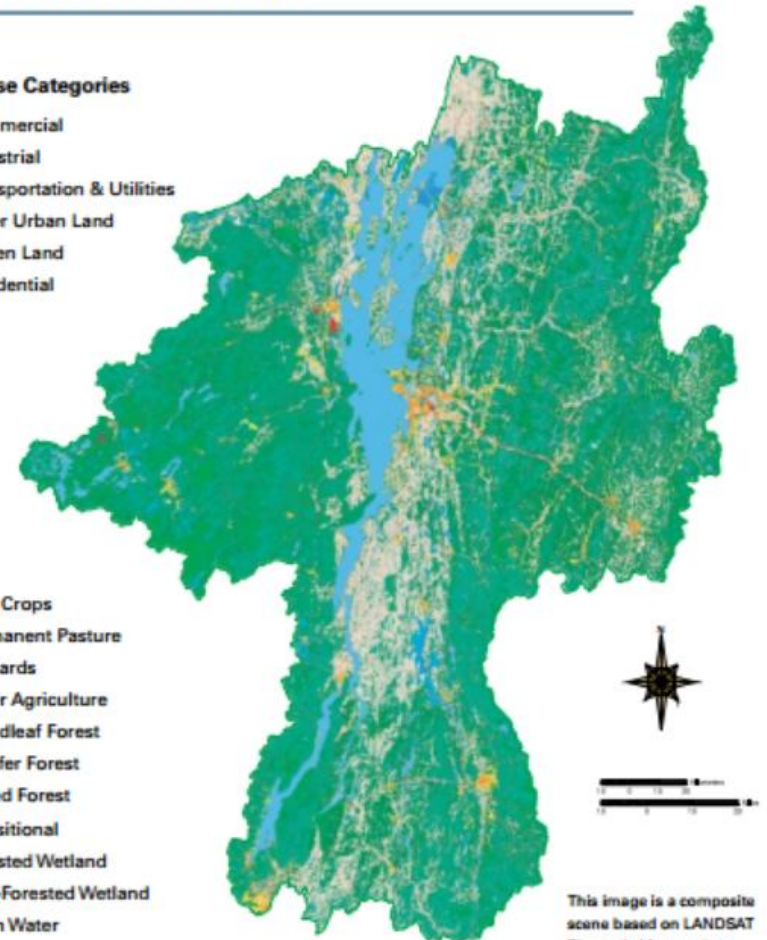
Land Uses in the Basin

Land Use Categories

- Commercial
- Industrial
- Transportation & Utilities
- Other Urban Land
- Barren Land
- Residential

- Row Crops
- Permanent Pasture
- Orchards
- Other Agriculture
- Broadleaf Forest
- Conifer Forest
- Mixed Forest
- Transitional
- Forested Wetland
- Non-Forested Wetland
- Open Water

Map by Northern Cartographic



This image is a composite scene based on LANDSAT Thematic Mapper data acquired from 1991 to 1993.

STREAMS 2012 – Team Assignments

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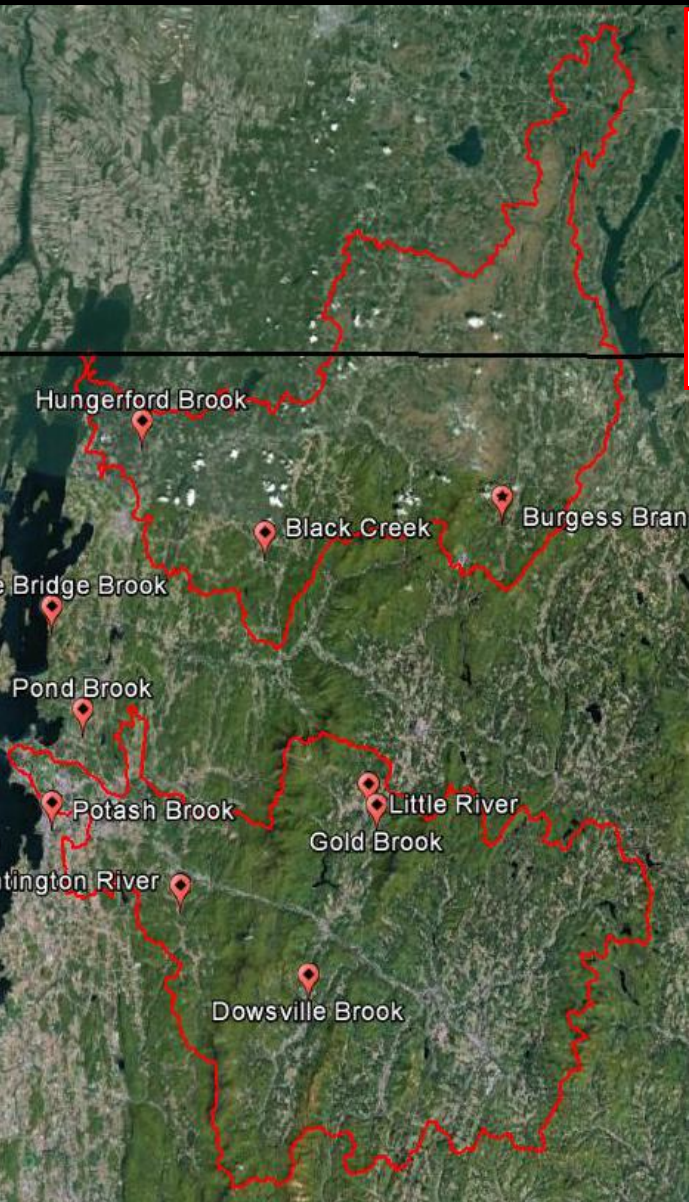
(2) How quickly do macroinvertebrate communities recolonize streams after storm events?

(3) How has land use changed in response to a changing Vermont climate?

Group A	Group B	Group C
<ul style="list-style-type: none">• Water Chemistry• Discharge• Soil Sampling	<ul style="list-style-type: none">• Water Chemistry• Discharge	<ul style="list-style-type: none">• Community Land Use History
	<ul style="list-style-type: none">• Macroinvertebrate:<ul style="list-style-type: none">-Habitat-Community- Stream Temp.	
		<ul style="list-style-type: none">• Community Land Use History

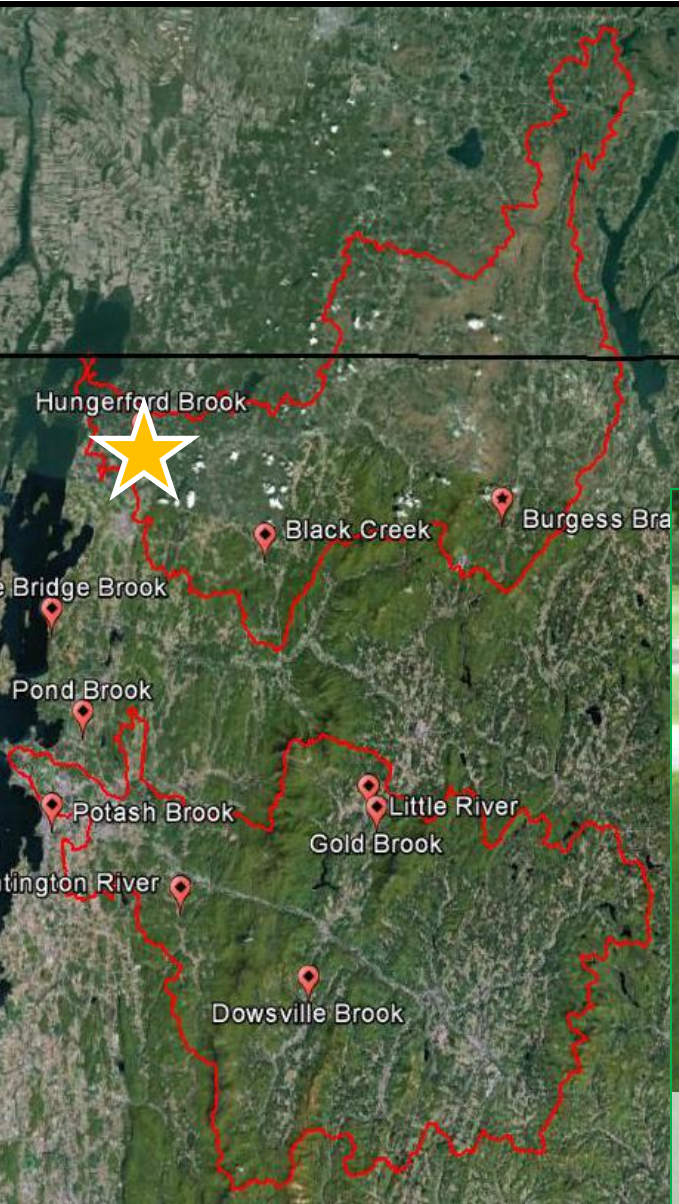
STREAMS 2012 – Sampling Locations

Group A Stage Sensor Stewarding



SCHOOL	Stream Site/ Watershed	Stream Name
Bellows Free Academy - Fairfax	Mississquoi	Black Creek
Lake Region Union High School	Mississquoi	Burgess Branch
Mississquoi Valley Union Middle/High School	Mississquoi	Hungerford Brook
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Group A Stage Sensor Stewarding

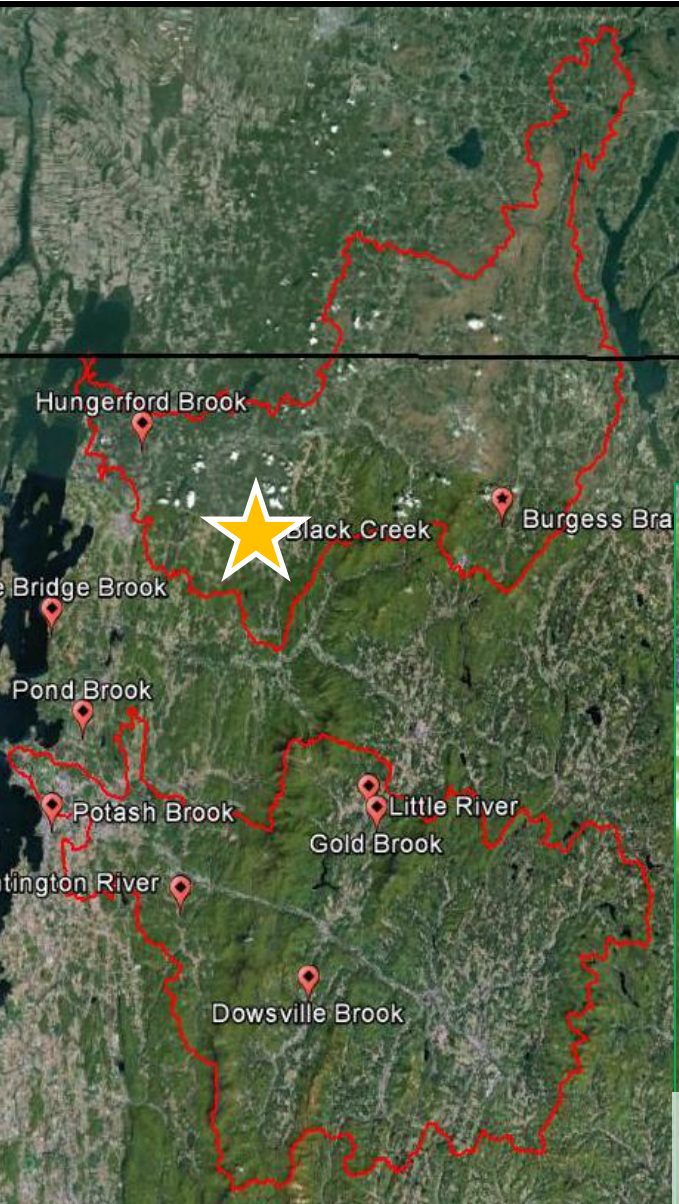


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Missisquoi Valley Union

Group A Stage Sensor Stewarding

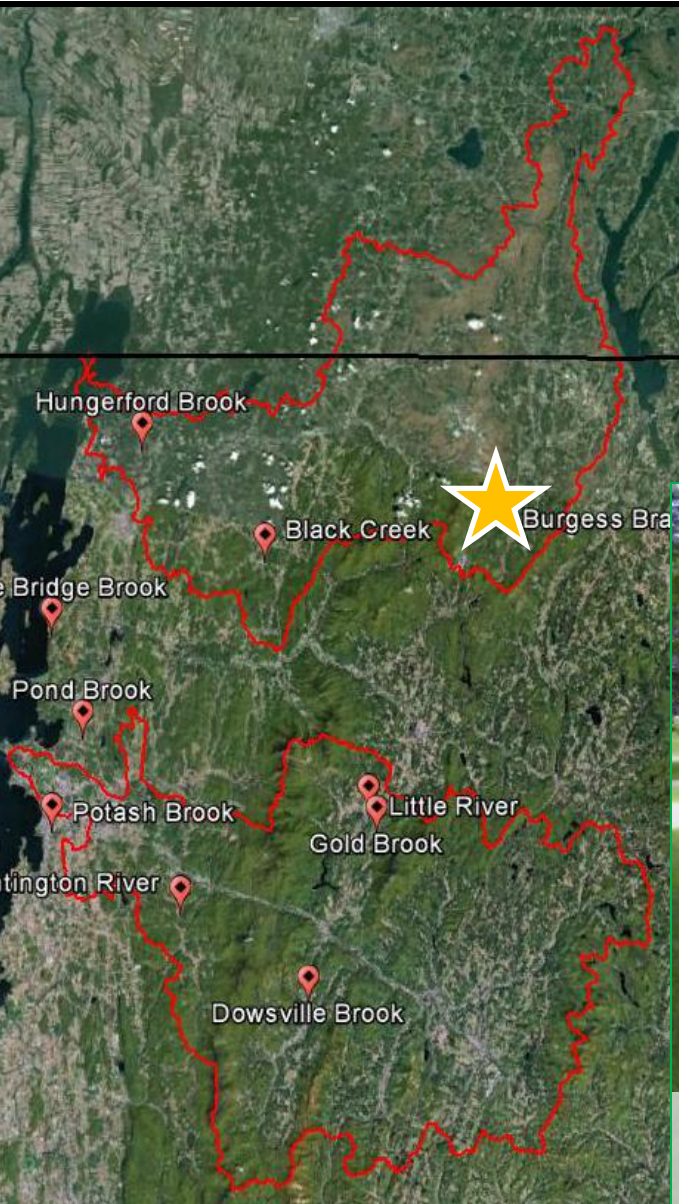


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Bellows Free Academy-Fairfax

Group A Stage Sensor Stewarding

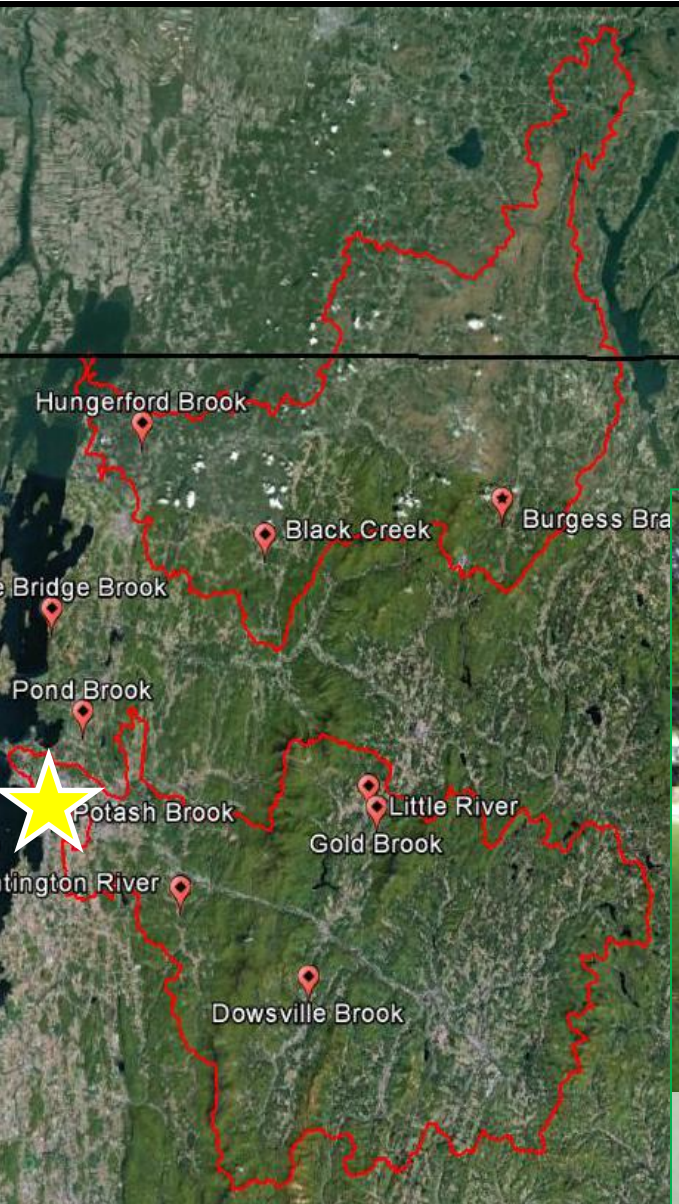


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Lake Region Union High School

Group A Stage Sensor Stewarding

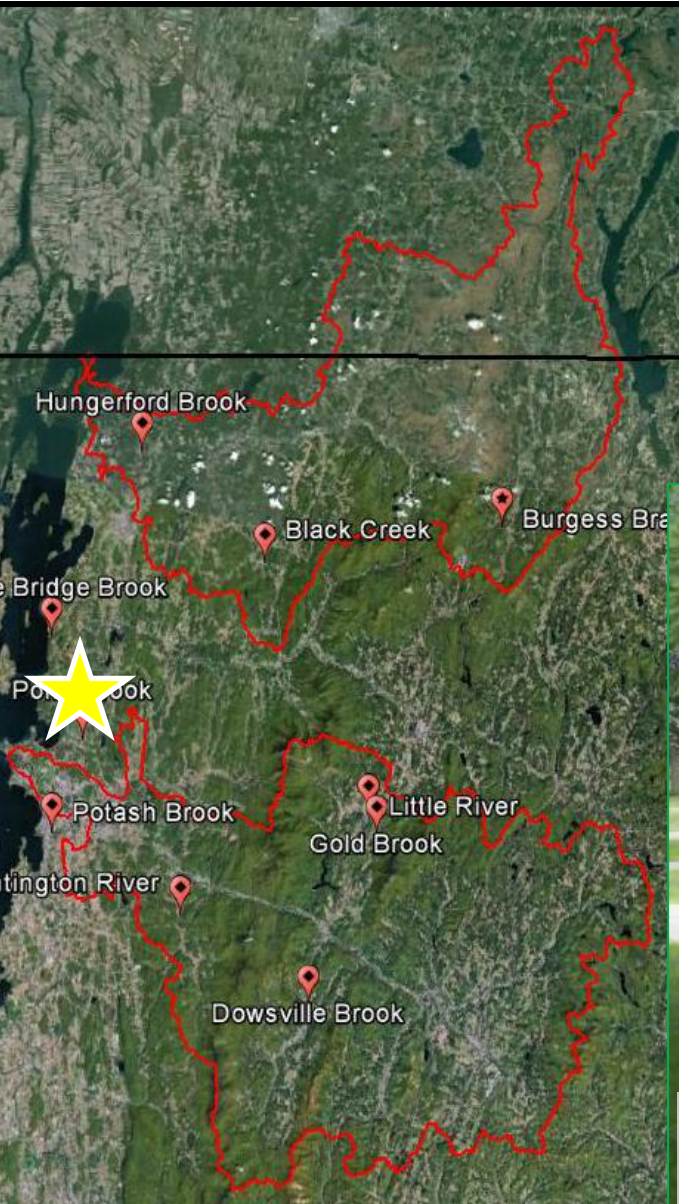


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Rice Memorial High School

Group A Stage Sensor Stewarding

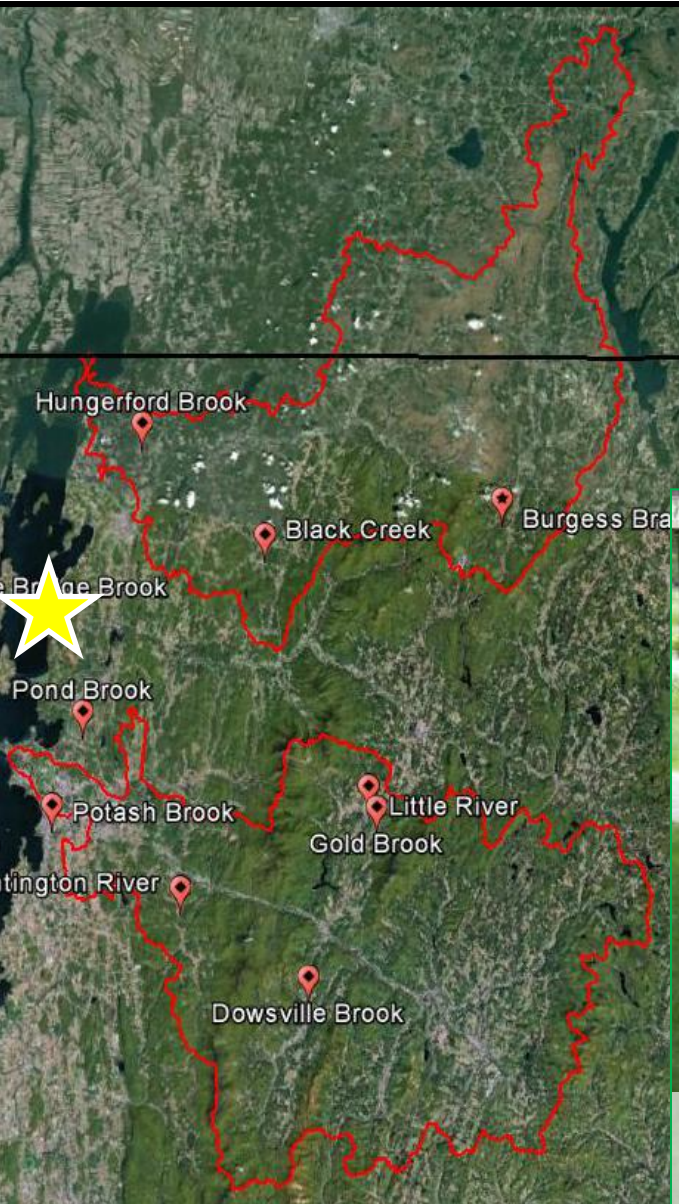


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Colchester High School

Group A Stage Sensor Stewarding

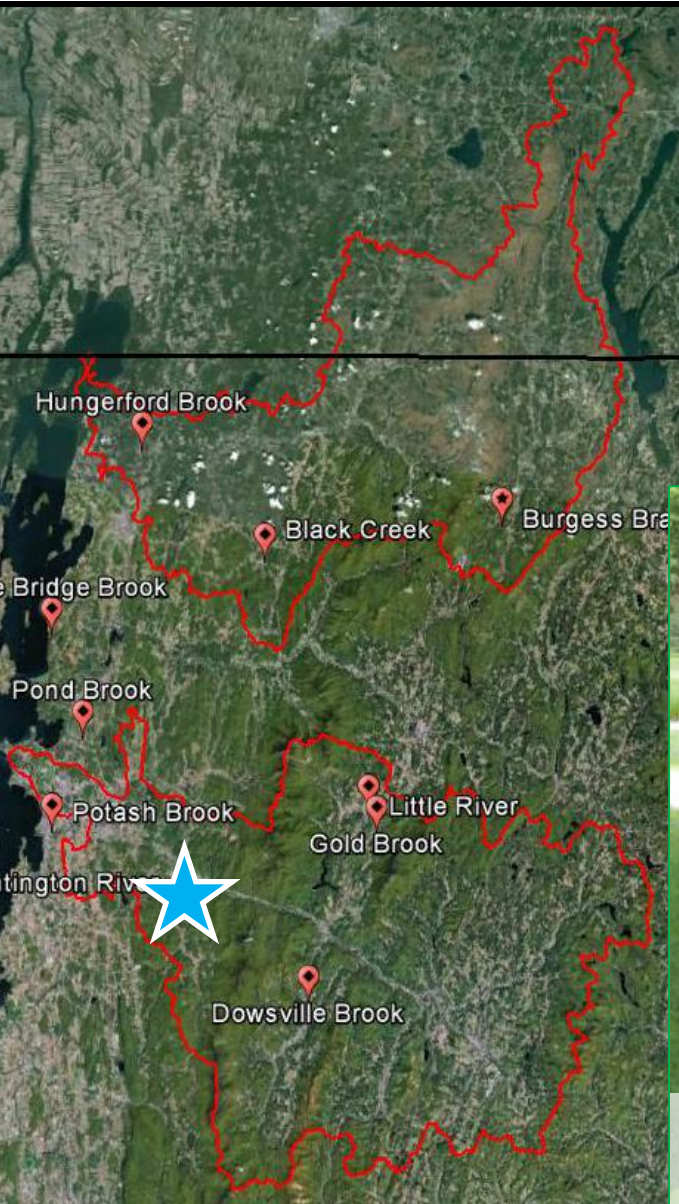


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Milton High School

Group A Stage Sensor Stewarding

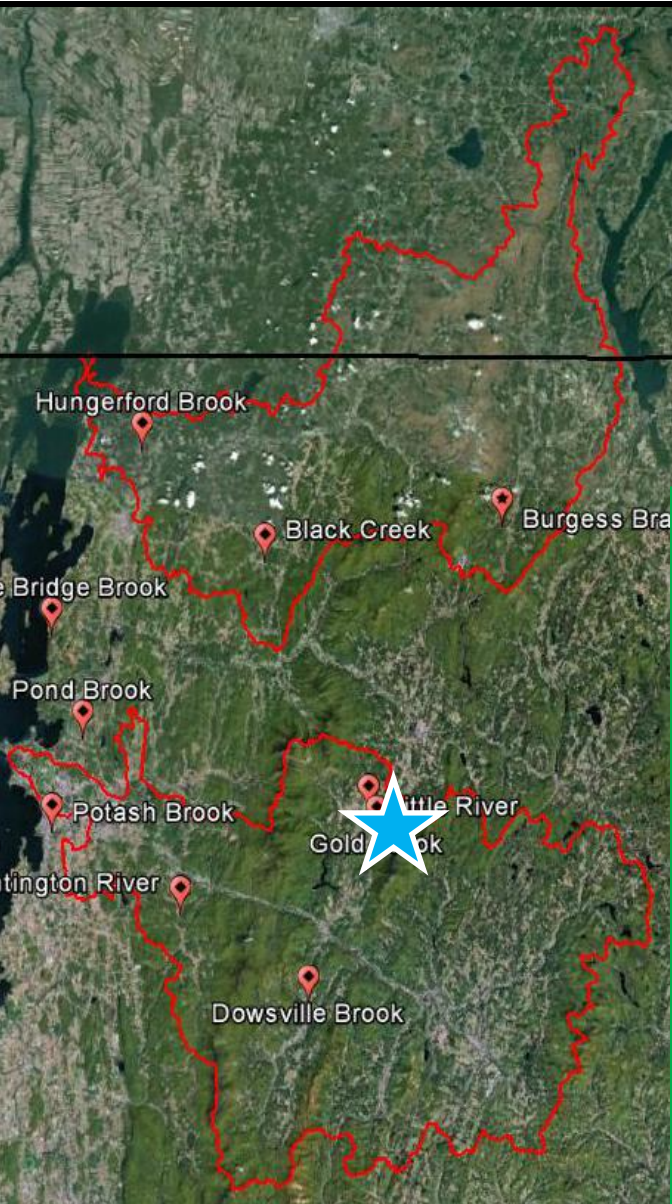


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Vermont Commons School

Group A Stage Sensor Stewarding

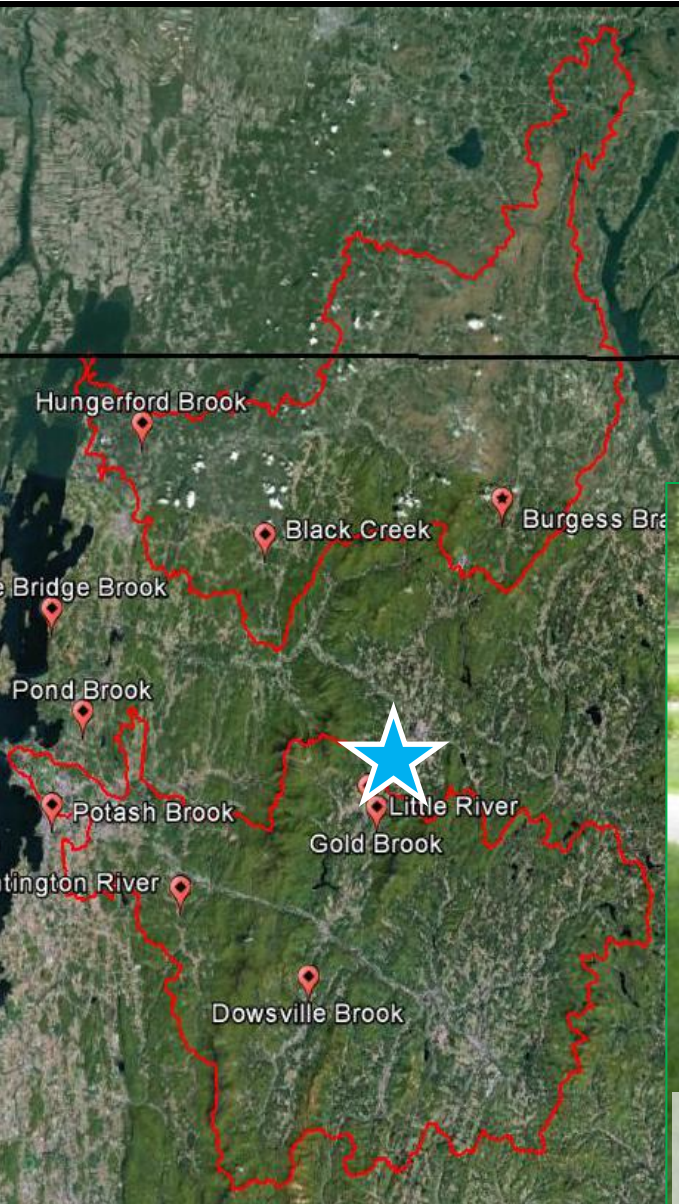


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Stowe High School

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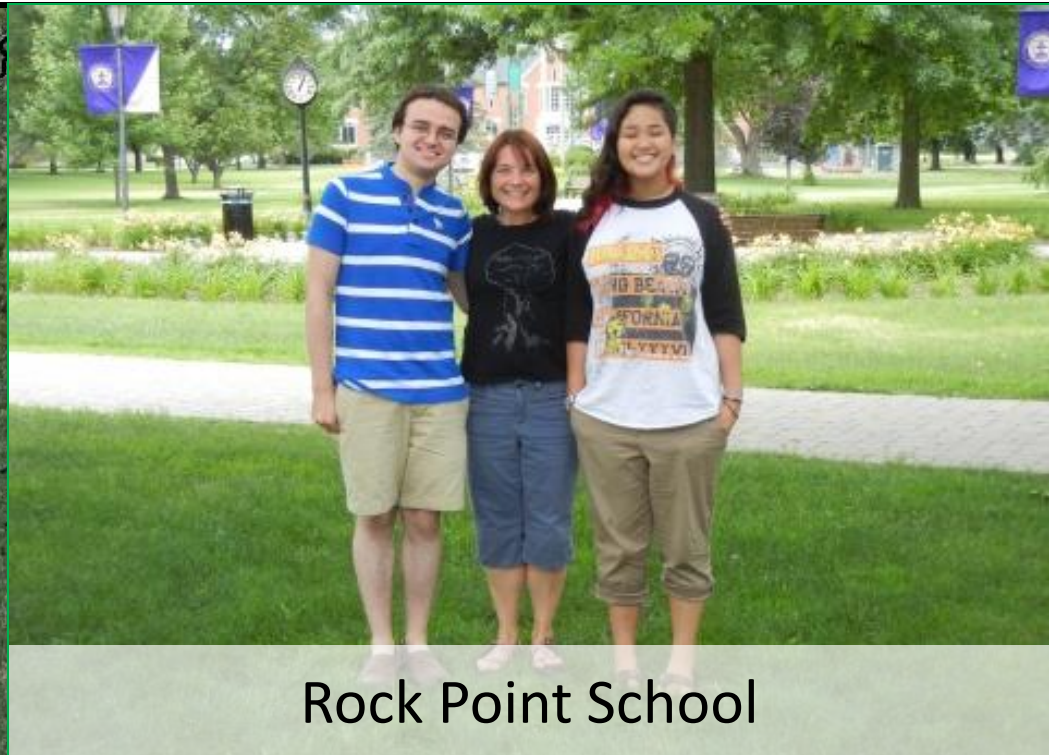
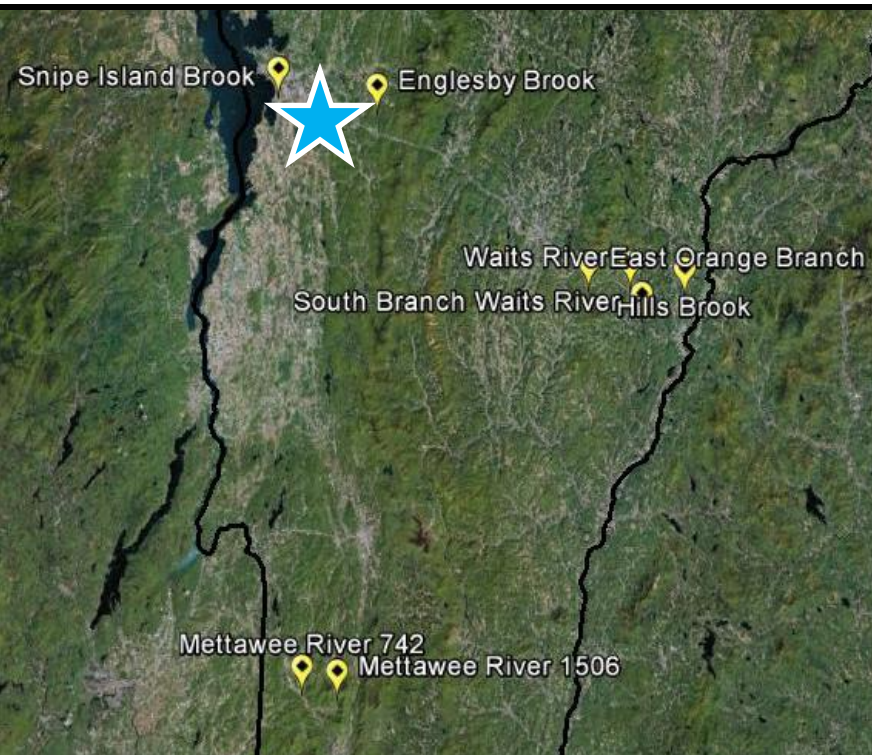


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Peoples Academy

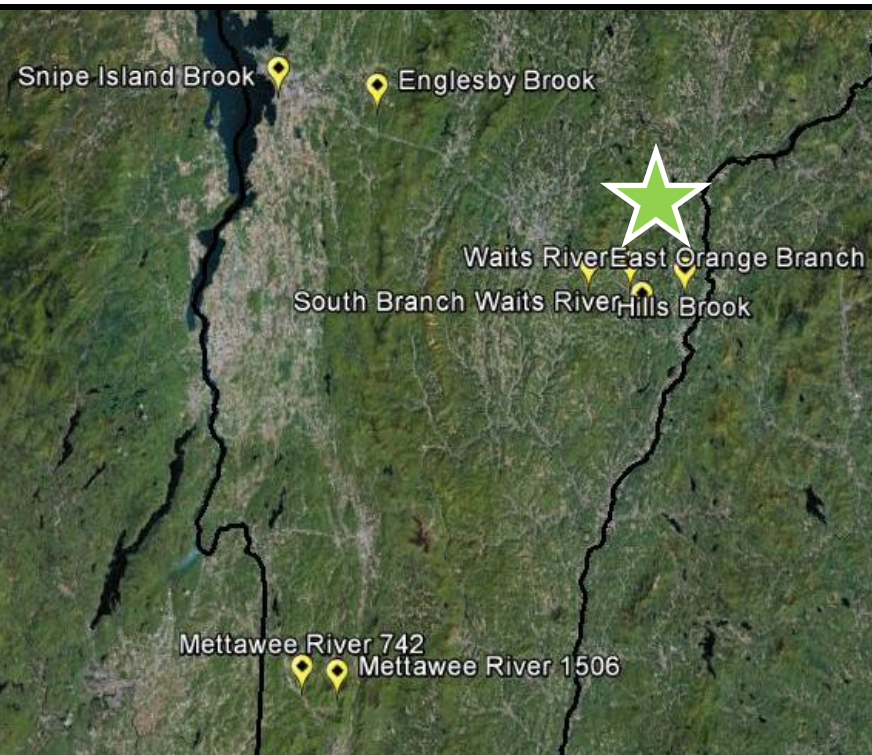
Group B Macroinvertebrate Recolonization



Rock Point School

SCHOOL		Stream Site/ Watershed	Stream Name
Rock Point School	★	Lake Champlain Direct	Snipe Island Brook
Rock Point School		Lake Champlain Direct	Englesby Brook
Burr and Burton Academy		Poultney / Mettawee	Mettawee River
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Oxbow Union High School - Hildebrandt		Connecticut River	Hills Brook
Oxbow Union High School - Hildebrandt		Connecticut River	East Orange Branch
Oxbow Union High School - Valley		Connecticut River	Waits River
Oxbow Union High School - Valley		Connecticut River	South Branch Waits

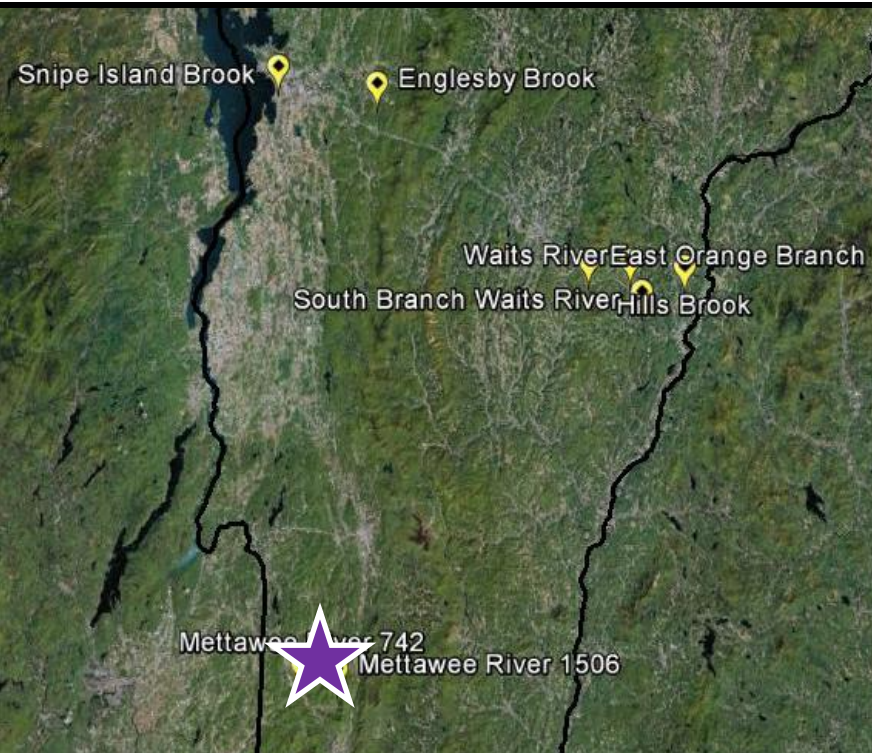
Group B Macroinvertebrate Recolonization



Oxbow Union High School

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Group B Macroinvertebrate Recolonization



Burr and Burton Academy

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Rock Point School		Lake Champlain Direct	Snipe Island Brook
Rock Point School		Lake Champlain Direct	Englesby Brook
Burr and Burton Academy	★	Poultney / Mettawee	Mettawee River
Burr and Burton Academy		Poultney / Mettawee	Mettawee River
Oxbow Union High School - Hildebrandt		Connecticut River	Hills Brook
Oxbow Union High School - Hildebrandt		Connecticut River	East Orange Branch
Oxbow Union High School - Valley		Connecticut River	Waits River
Oxbow Union High School - Valley		Connecticut River	South Branch Waits



Group B Macroinvertebrate Recolonization

New York



Puerto Rico



<i>SCHOOL</i>	<i>Stream Site/ Watershed</i>		<i>Stream Name</i>
University Gardens High School, Puerto Rico			Rivera Stream
University Gardens High School, Puerto Rico	Puerto Nuevo		Senorial Stream
Jose E Aponte de la Torre High School - Puerto Rico	Rio Grande de Loiza		Maracuto Creek
Jose E Aponte de la Torre High School - Puerto Rico	Rio Bayamon		
Poughkeepsie High School, NY	NY		Indian Kill River
Poughkeepsie High School, NY	NY		Fall Kill River

Group B Macroinvertebrate Recolonization

New York

Puerto Rico



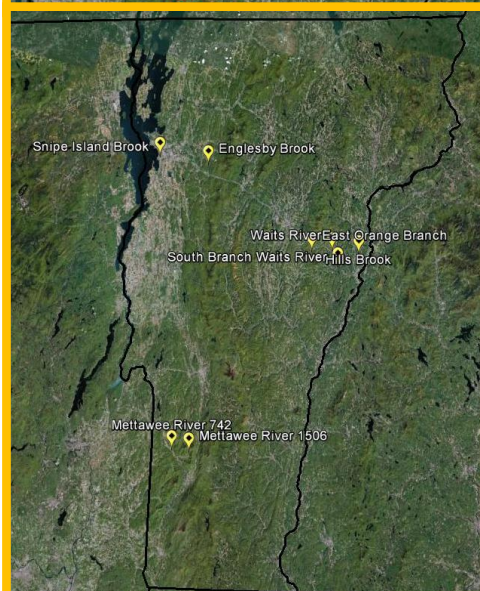
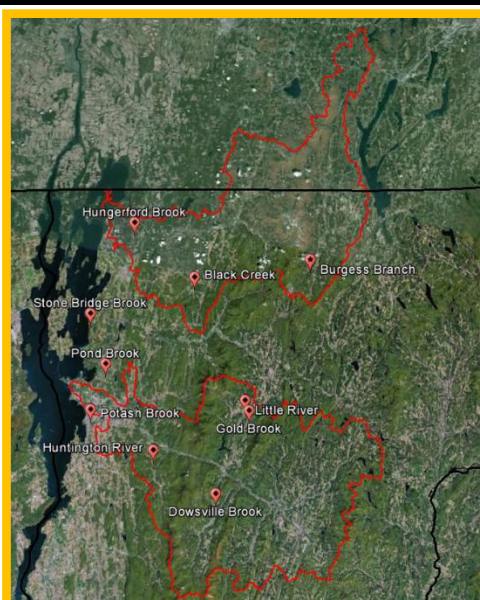
University Gardens &
Jose E Aponte de la Torre School



Poughkeepsie High School

Stream Site/ Watershed		Stream Name
co co	Puerto Nuevo	Rivera Stream
	Rio Grande de Loiza	Senorial Stream
	Rio Bayamon	Maracuto Creek
NY		Indian Kill River
NY		Fall Kill River

Water Quality Analysis



SCHOOL	Stream Site/ Watershed	Stream Name
Bellows Free Academy - Fairfax	Missisquoi	Black Creek
Lake Region Union High School	Missisquoi	Burgess Branch
Missisquoi Valley Union Middle/High School	Missisquoi	Hungerford Brook
Colchester High School	Lake Champlain Direct	Pond Brook
Rice Memorial High School - Boardman	Lake Champlain Direct	Potash Brook
Milton Senior High School	Lake Champlain Direct	Stone Bridge Brook
Harwood Union High School	Winooski	Dowsville Brook
Vermont Commons School	Winooski	Huntington River
Stowe High School	Winooski	Gold Brook
Peoples Academy	Winooski	Little River
Rock Point School	Winooski	Snipe Island Brook
Rock Point School	Winooski	Englesby Brook
Burr and Burton Academy	Poultney / Mettawee	Mettawee River
Burr and Burton Academy	Poultney / Mettawee	Mettawee River
Oxbow Union High School - Hildebrandt	Connecticut River	Hills Brook
Oxbow Union High School - Hildebrandt	Connecticut River	East Orange Branch
Oxbow Union High School - Valley	Connecticut River	Waits River
Oxbow Union High School - Valley	Connecticut River	South Branch Waits
Poughkeepsie High School, NY	NY	Indian Kill River
Poughkeepsie High School, NY	NY	Fall Kill River
University Gardens High School, Puerto Rico	Puerto Nuevo	Senorial Stream
University Gardens High School, Puerto Rico	Puerto Nuevo	Rivera Stream
Jose E Aponte de la Torre High School - Puerto Rico	Rio Bayamon	
Jose E Aponte de la Torre High School - Puerto Rico	Rio Grande de Loiza	Maracuto Creek

Congratulations!

- What we've accomplished this season:
 - **Stage Sensor Stewarding (Group A)**
 - Stage Data (~ 5 events at 3-week intervals; 3 groups)
 - Soil sampling (6 events)
 - **Macroinvertebrate Post-Storm Recolonization (Group B)**
 - Baseline (pre-storm) macroinvertebrate collections
 - Temperature sensors installed
 - **Water quality analysis (30 samples collected)**
 - Total Suspended Solids (TSS; n = 3)
 - Total Phosphorus (TP; n = 4)
 - Total Nitrogen (TN; n = 4)

Congratulations!



Dowsville Brook











































Black Creek



Potash Brook

Total Suspended Solids
by Katie Chang

Next Steps

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Dr. Declan McCabe
Saint Michael's College





Thank You!