

# Estimated Phosphorus Load Reductions from Leaf Litter Removal in the Lake Champlain drainage area, Vermont

**Prepared in cooperation with:**

Chittenden County Regional Planning Committee

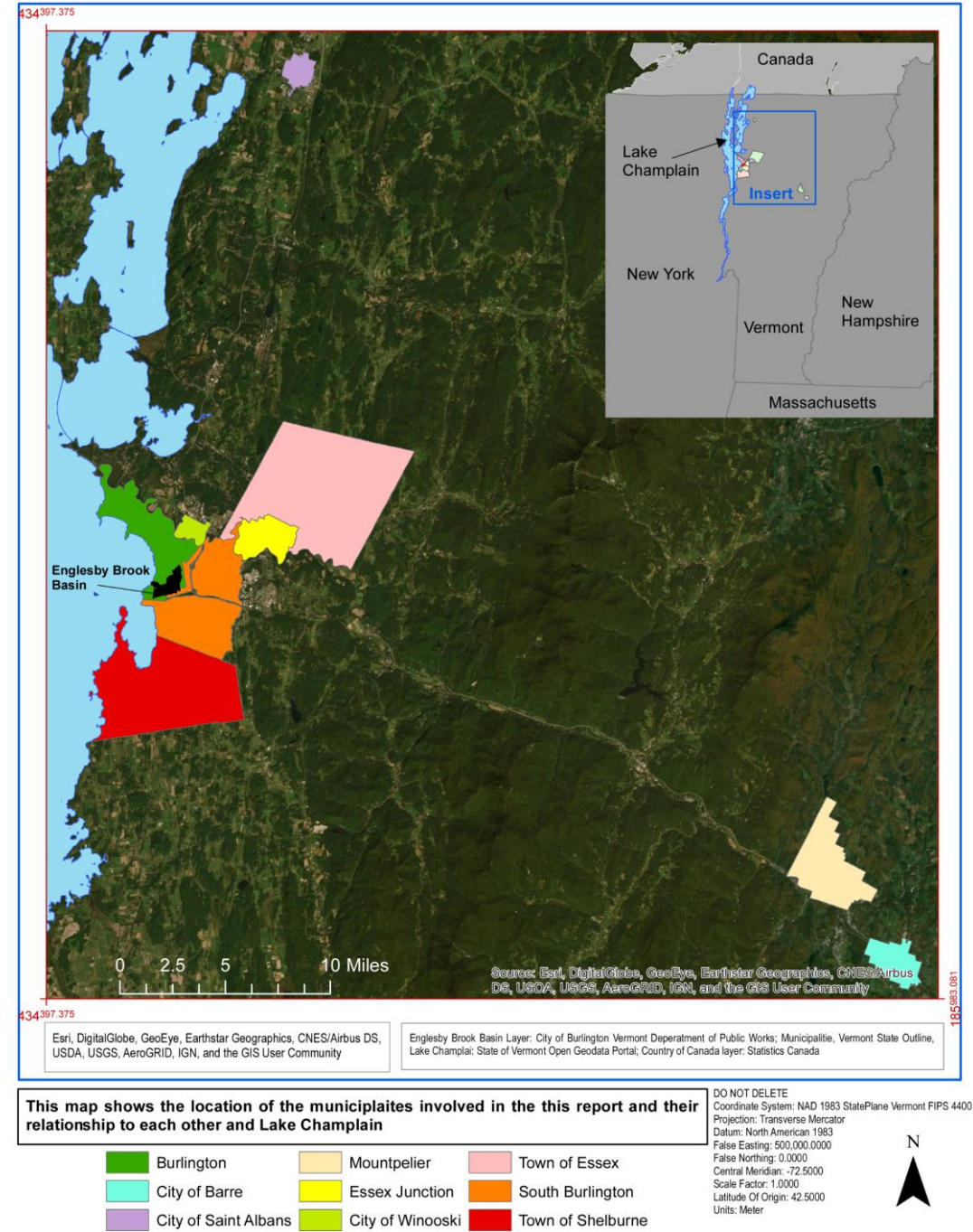
Vermont Department of Environmental Conservation

City of South Burlington and other cooperating Vermont municipalities

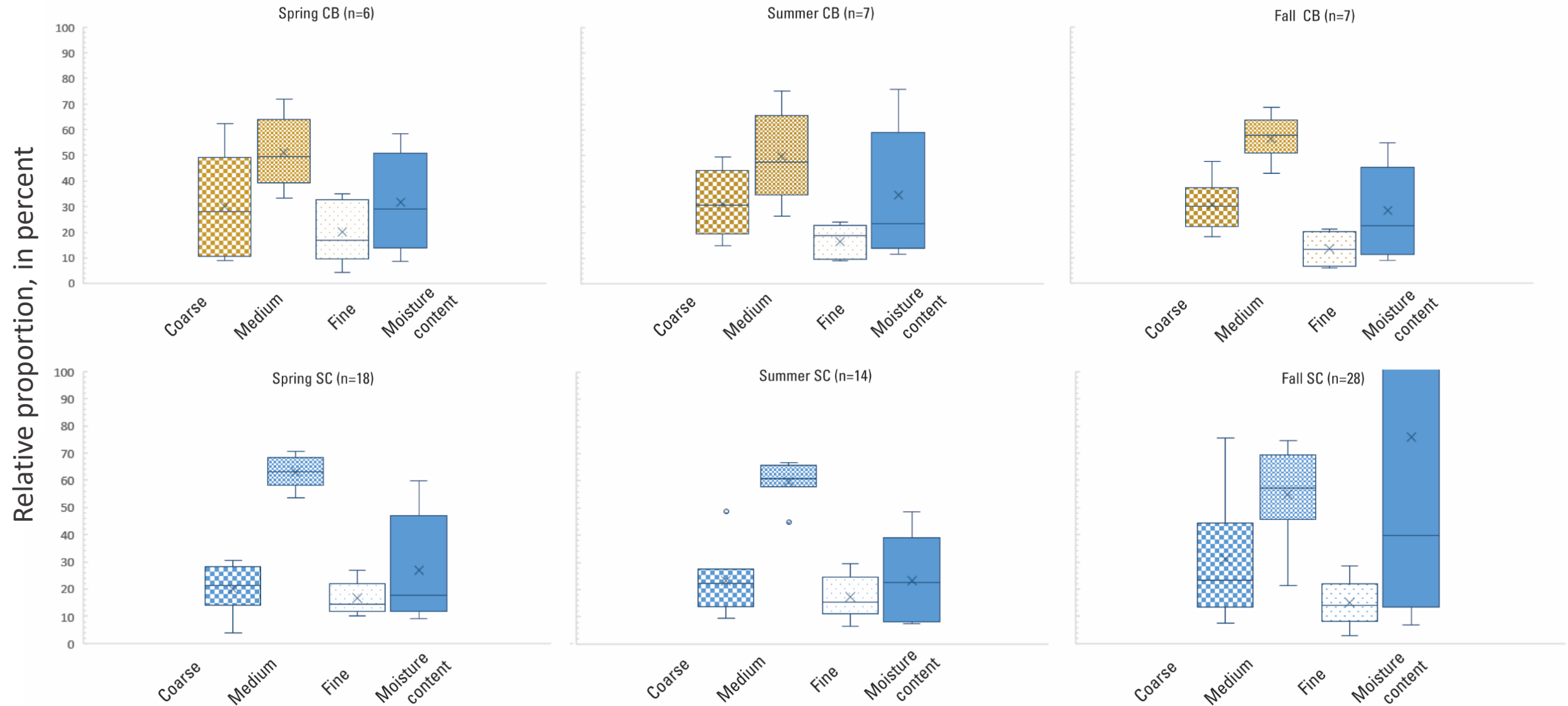


# Study background

- Recent studies and WI DNR policy show potential for increasing credits for leaf removal
- Nine cooperating municipalities
- Seven MS4/TMDL communities
- Characterize physiochemistry of Catch Basin (CB) and Street Cleaner (SC) solids collected between Sept 2017 and Nov 2018
- Interim credits and modeling to explore potential increase of load reduction credits for leaf management



# Grain-size distribution



*Provisional data subject to change*

# Solid Sample Analytes

- Submit samples to RTI Labs, MI for analysis of total organic carbon, total Kjeldahl nitrogen, and total phosphorus

Analyte	Method	Reporting level	Unit
Total organic carbon	EPA 415.1	0.5	mg/kg
Total Kjeldahl nitrogen	EPA 351.2	0.5	mg/kg
Total Phosphorus	SM_4500-P-F	0.1	mg/kg

- Includes field and lab replicate samples and blank samples

# Blank Sample Analysis

Constituent	Organic carbon (mg/kg)	Total Kjeldahl nitrogen (mg/kg)	Total phosphorus (mg/kg)	Moisture content (percent)
Reporting limit	1900	14	0.08	1
Blank-not rinsed	260	990	91	<b>1</b>
Blank-acid rinsed-wet	ND	89	0.59	23
Blank-acid rinsed-dry	ND	25	1	ND
Detection level	500	--	100	--
Average (2013)	E250	--	E50	--

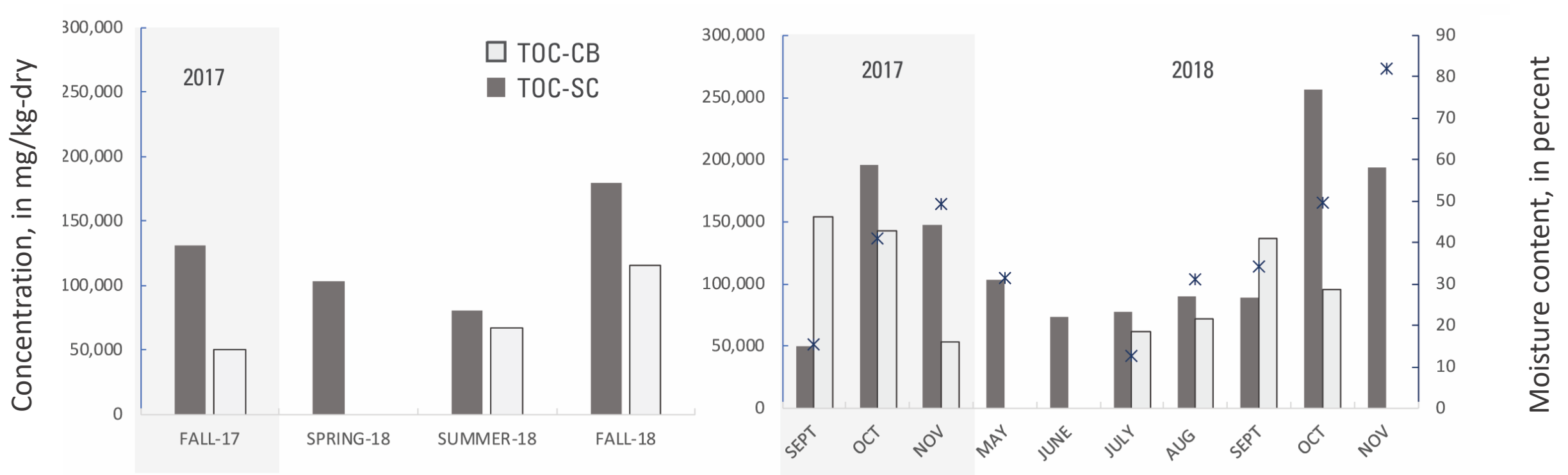
*Provisional data subject to change*

# Replicate Sample Analysis

Sample date/time	Material type	GSF	Total organic carbon	Total Kjeldahl nitrogen	Total phosphorus	Moisture content
9/27/17 8:00	CB	Total	79000	1600	320	14
9/27/17 8:05	CB	Total	29000	1400	350	18
RPD	CB	Total	92.6	13.3	8.96	25
9/29/17 8:00	CB	Total	61000	1500	330	28
9/29/17 8:05	CB	Total	64000	1600	340	34
RPD	CB	Total	4.80	6.45	2.99	19.4
11/29/17 13:45	SC	Total	190000	2900	520	55
11/29/17 13:50	SC	Total	140000	4300	570	58
RPD	SC	Total	30.3	38.9	9.17	5.3
10/4/18 17:30	SC	Coarse	46000	320	35	--
10/4/18 17:35	SC	Coarse	17000	1900	38	--
RPD	SC	Coarse	92.1	142	8.22	--
10/4/18 17:30	SC	Medium	25000	900	240	--
10/4/18 17:35	SC	Medium	23000	1100	250	--
RPD	SC	Medium	8.33	20.0	4.08	--
10/4/18 17:30	SC	Fine	41000	2100	570	--
10/4/18 17:35	SC	Fine	42000	2200	530	--
RPD	SC	Fine	2.41	4.65	7.27	--

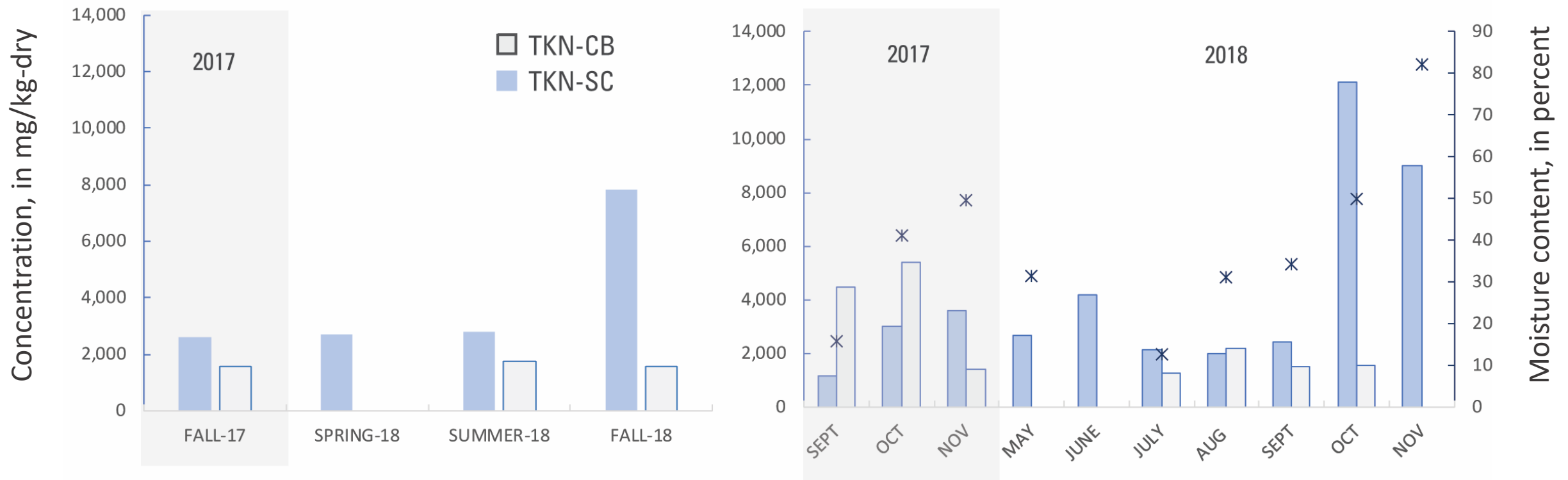
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# Seasonal and monthly TOC concentrations



*Provisional data subject to change*

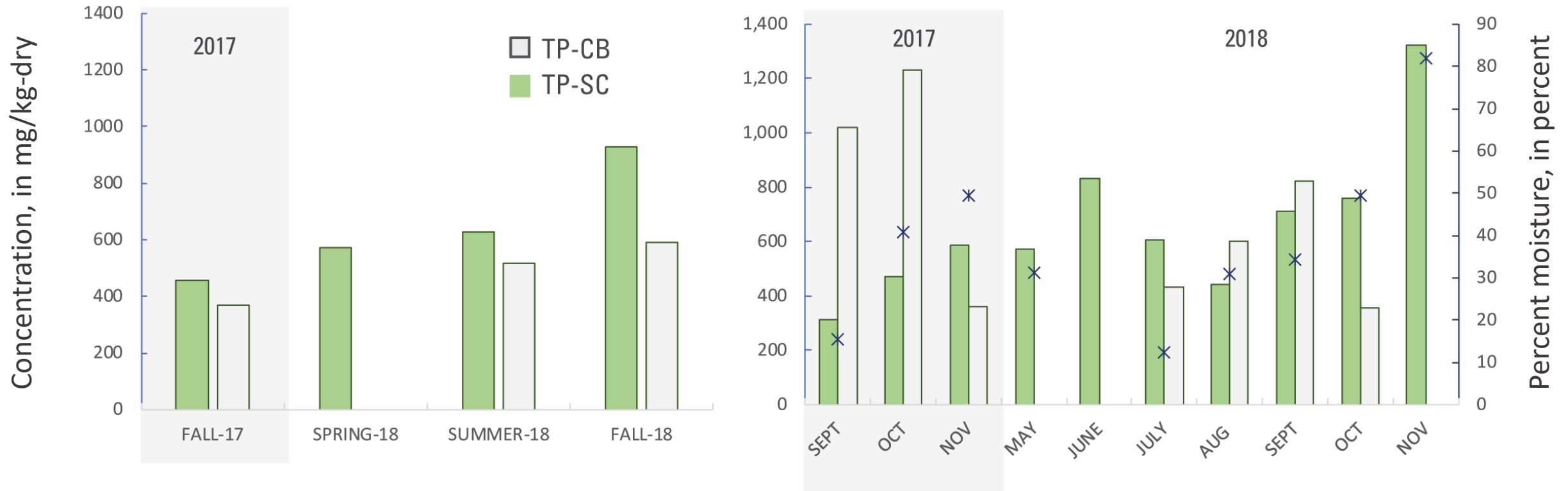
# Seasonal and monthly TKN concentrations



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# Seasonal and monthly total P concentrations



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# Total P concentrations by SC Routes



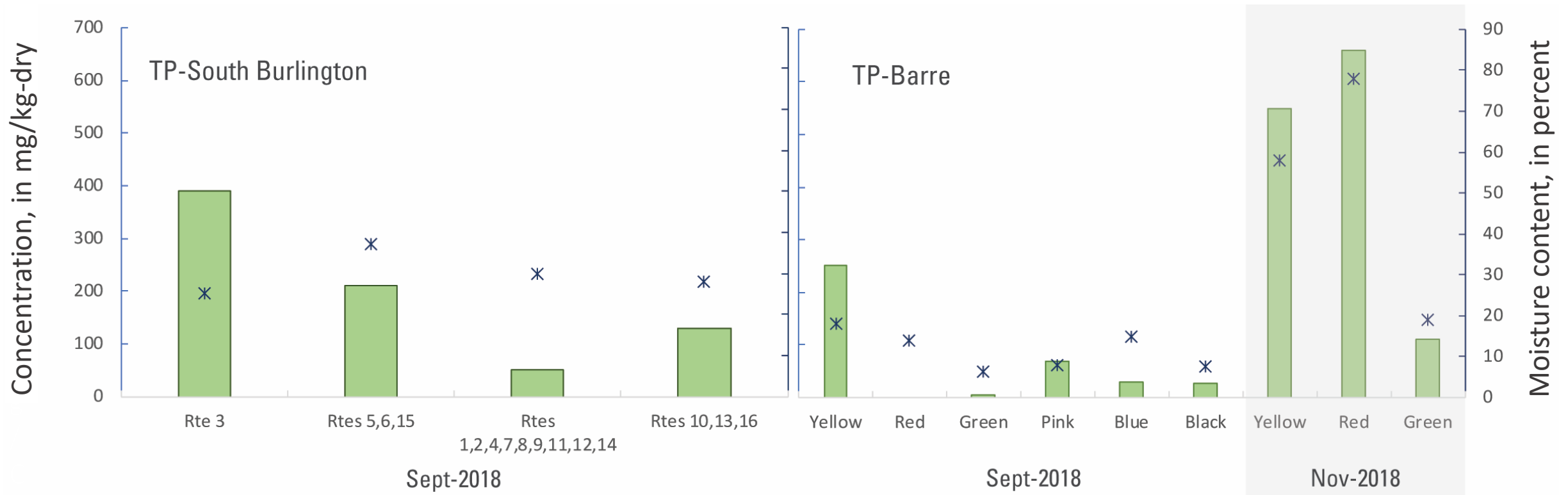
September 2018 SC materials



November 2018 SC materials

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# Total P concentrations by SC Routes



*Provisional data subject to change*

# Concentrations of precip and added materials

Sample	Collection date	Total organic carbon	Total dissolved nitrogen	Total nitrogen	Total dissolved phosphorous	Total phosphorous
Bulk precip	8/7/2019	0.133	0.271	0.252	<b>0.010</b>	<b>0.010</b>
1-hr pine needles	11/30/2018	0.785	0.259	0.291	0.011	<b>0.010</b>
2-hr pine needles	11/30/2018	1.34	0.252	0.313	0.019	<b>0.010</b>
1-hr leaves	11/30/2018	1.49	0.335	0.437	0.234	0.202
2-hr leaves	11/30/2018	2.00	0.286	0.442	0.194	0.156
22-hr leaves	11/30/2018	0.519	0.334	0.506	0.298	0.266

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Englesby Brook concentrations between 1999 and 2009 ranged from 0.019 and 11.9 mg/L and were about 0.367 mg/L on average (Medalie 2007, 2012)

*Provisional data subject to change*



# Interim Credits-VTDEC and UVM

- Tree cover analysis supplied to DEC by UVM Spatial Analysis Lab(SAL)
- Interim credits for participating MS4s by Analysis and Assessment Project - Dr. Clay Williams (UVM NSC202), and Jim Pease and Hank Ainley (VTDEC)
- Explore if MS4 community were to manage leaves according to the Wisconsin DNR Phosphorus Reduction Credit for Leaf Management:
- What credit based on current sweeping catch basin/street cleaning practices?
- What credit if a town were to increase SC in not only MDR land-use but for streets with > 17% tree cover?

# Interim Credits-example

## Catch basin cleaning (CB)

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 from Catchbasin Cleaning Credit (Assumes cleaning 2x/year) (kg/yr)
St. Albans	St. Albans Bay - DD	20.79	2000	0.00	1 every year	1.36

*Provisional data subject to change*

# Interim Credits-example

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## Street cleaning (SC)

MS4	SWAT Drainage Area	TMDL Target Municipal Roads Phosphorus Load Reduction (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
St. Albans	St. Albans Bay - DD	20.79	2017	10.89	10.9

*Provisional data subject to change*



# Interim Credits-example

## 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
Downtown	St. Albans Bay - DD	Twice Weekly	1.2	31.9	17.4	<17%	--	--	--
East	St. Albans Bay - DD	Monthly	1.2	71.5	25.8	28.5	32.0	5.4	26.2
West	St. Albans Bay - DD	Monthly	1.2	61.1	28.6	<17%	--	--	--

*Provisional data subject to change*

# Interim Credits

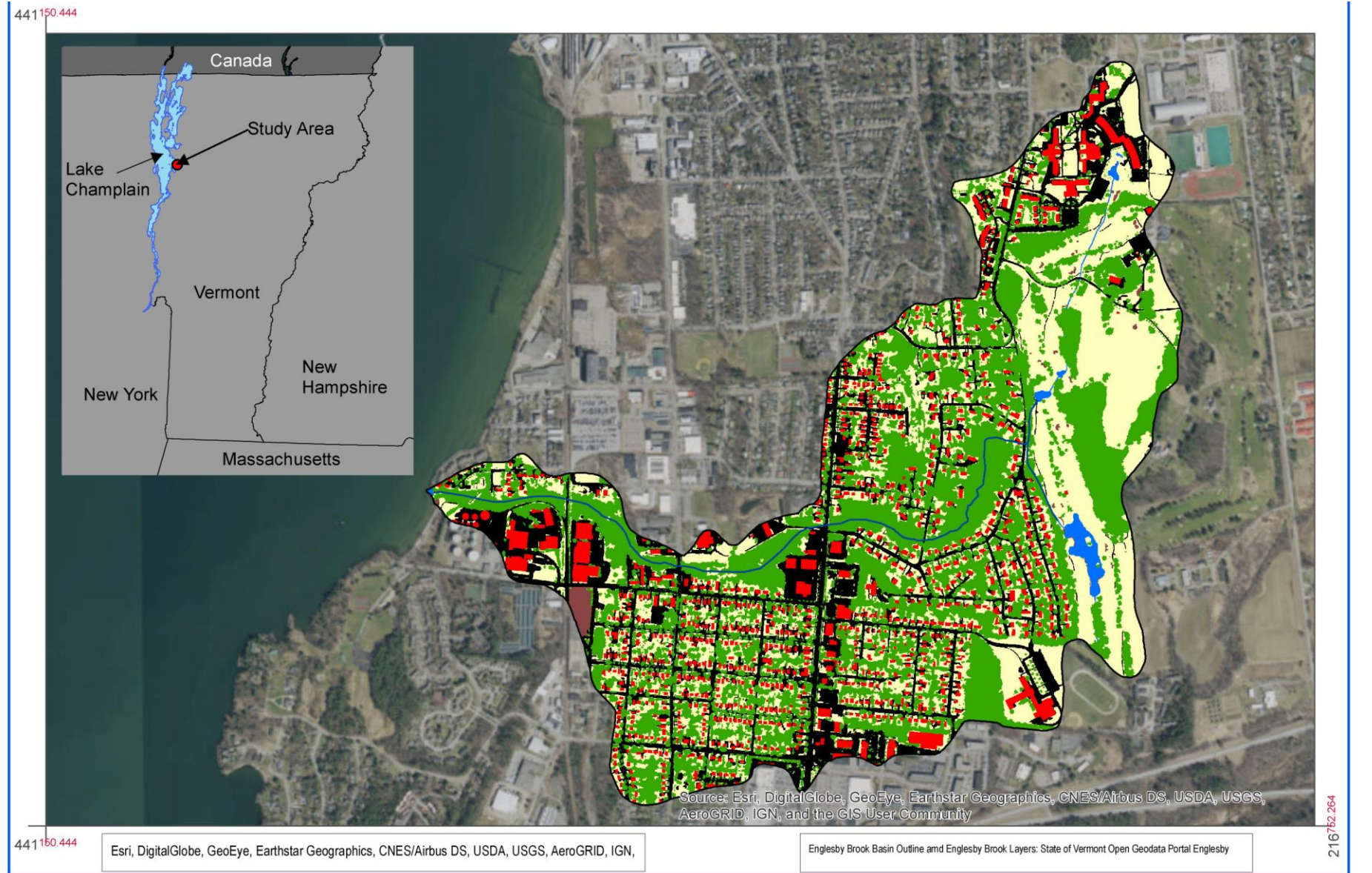
- Leaf management by SWAT drainage area within each MS4 community

SWAT Drainage Area	Phosphorus Load kg/yr	Route Credit if Wisconsin Method Implemented kg/yr	Total Additional Credits as % of Target
Burlington			
Burlington Bay - DD	129.9	22.1	61.8
Winooski River	80.0	13.6	67.6
LaPlatte River	4.34	0.74	44.1
Main Lake - DD	4.25	0.72	87.1
Saint Albans			
St. Albans Bay - DD	32.0	5.44	26.2
Winooski			
Winooski River	20.5	3.48	21.7
Shelburne			
LaPlatte River	38.6	6.57	24.7
South Burlington			
Burlington Bay - DD	3.42	0.581	50.9
Winooski River	39.0	6.62	30.3
LaPlatte River	86.6	14.7	38.2
Essex Junction			
Malletts Bay - DD	8.78	1.49	19.3
Winooski River	67.2	11.4	74.3
Essex			
Lamoille River	12.1	2.06	53.9
Malletts Bay - DD	11.4	1.94	29.2
Winooski River	102	17.4	65.4

*Provisional data subject to change*

# Englesby Brook basin

- DEC (VT05-10):  
384 acres
- FRP (Stone2017):  
605 acres
- Medalie 2007:  
Topo: 595 acres  
Sewer: 518 acres
- SLAMM 2020:  
non-CSO: 535 acres



**A land cover map of the englesby Brook Basin located in Burlington and South Burlington**

## Englesby Land Cover

	Water		Roads		Grass/Shrubs
	Tree Canopy		Railroads		Buildings
			Other Paved		Bare Soil

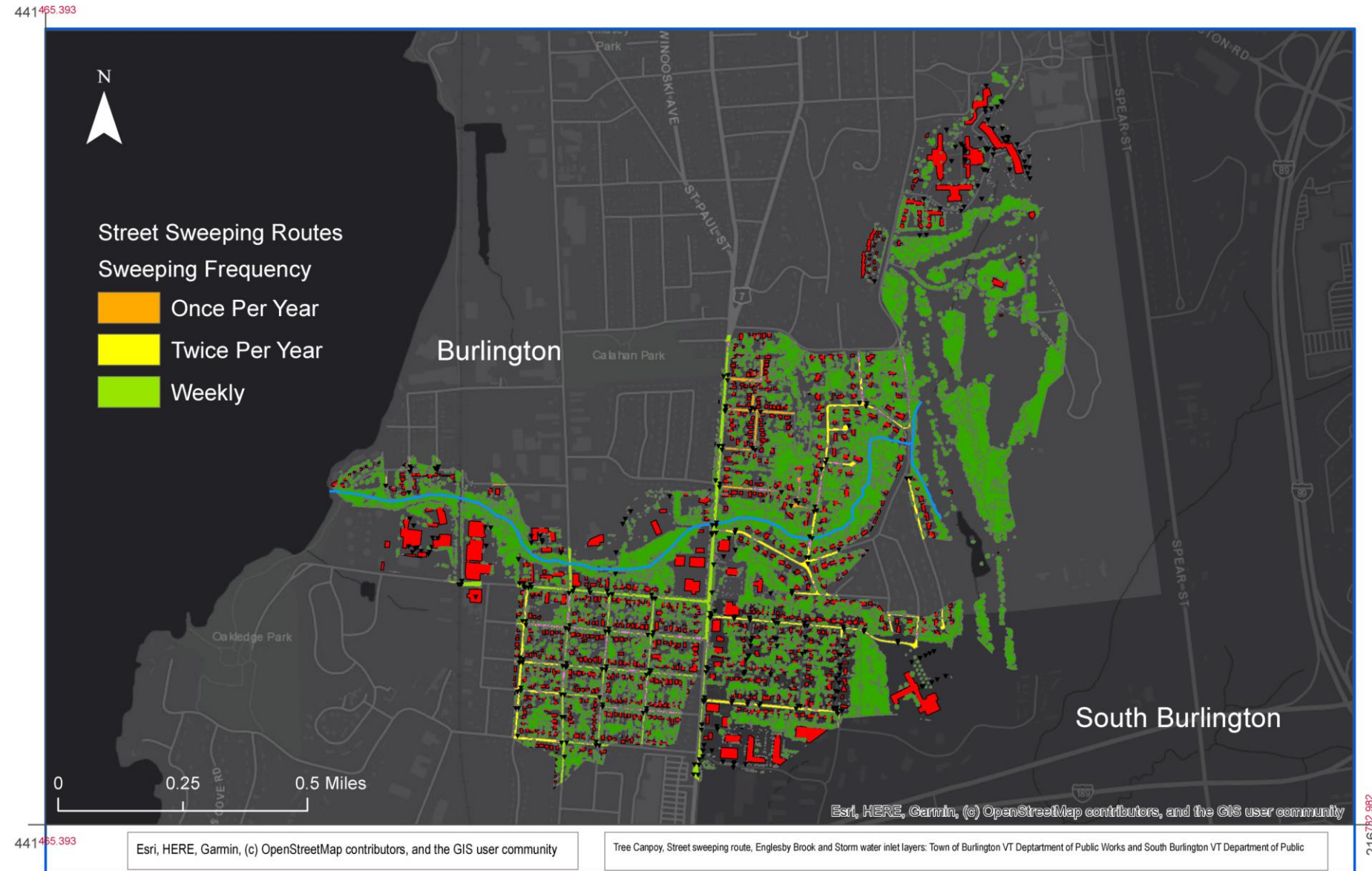
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False Easting: 500,000.0000  
False Northing: 0.0000  
Central Meridian: -72.5000  
Scale Factor: 1.0000

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# Englesby Brook basin

- Tree cover and SC routes by frequency in Burlington and South Burlington



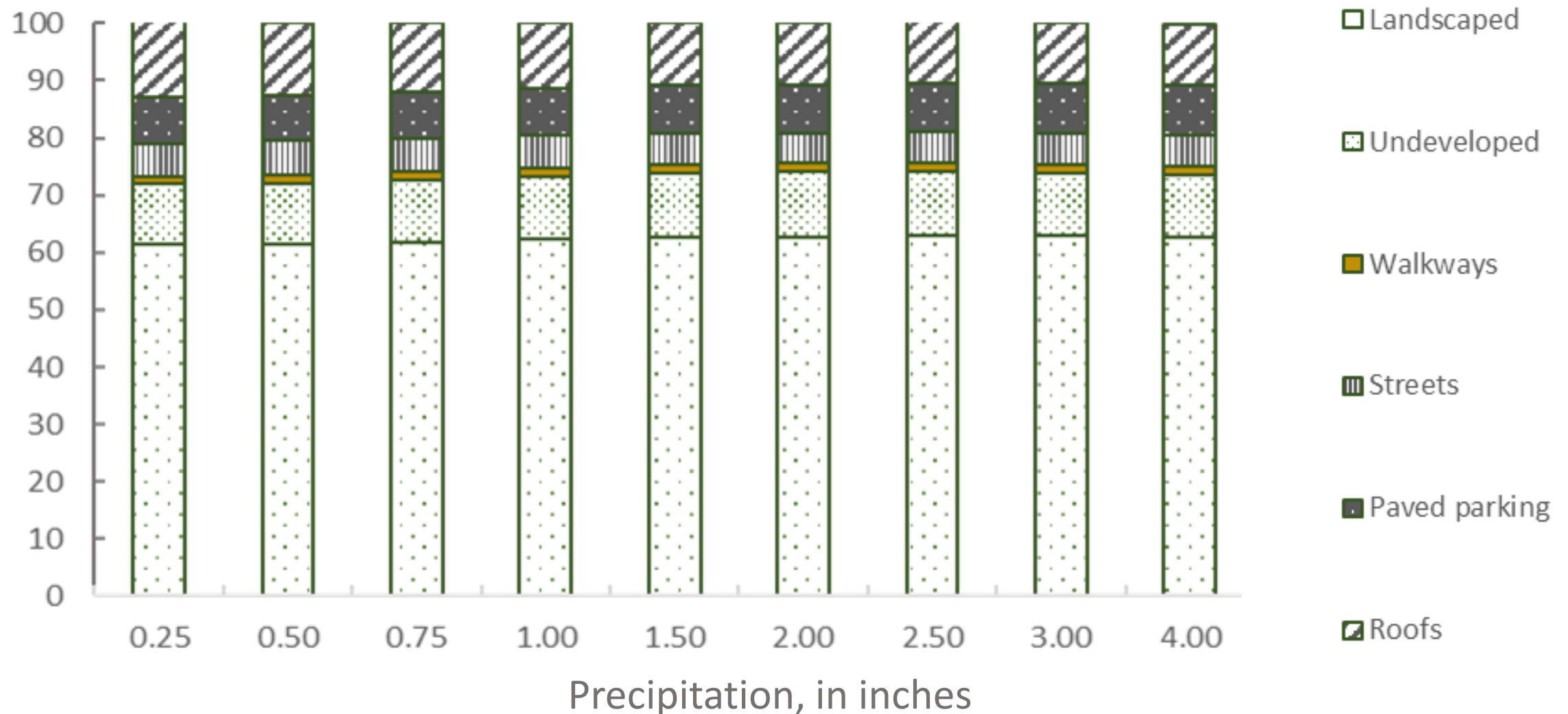
This is a map of the tree cover and street sweeping routes in the Englesby Brook Storm System drainage basin that is located in Burlington and South Burlington Vermont.

- Stormwater Inlets
- Englesby Brook
- Road Tree Cover
- Tree Canopy
- Rooftops

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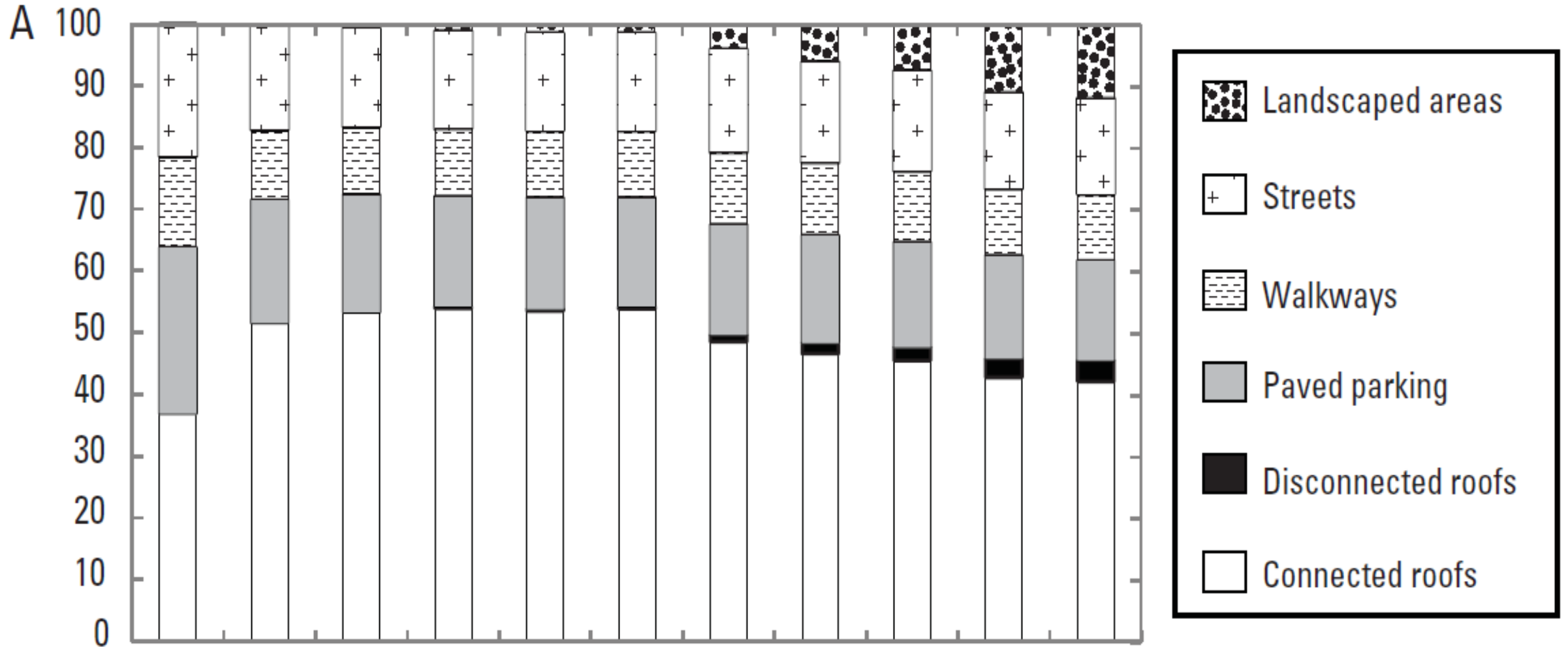
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# Percent contributions of major source areas



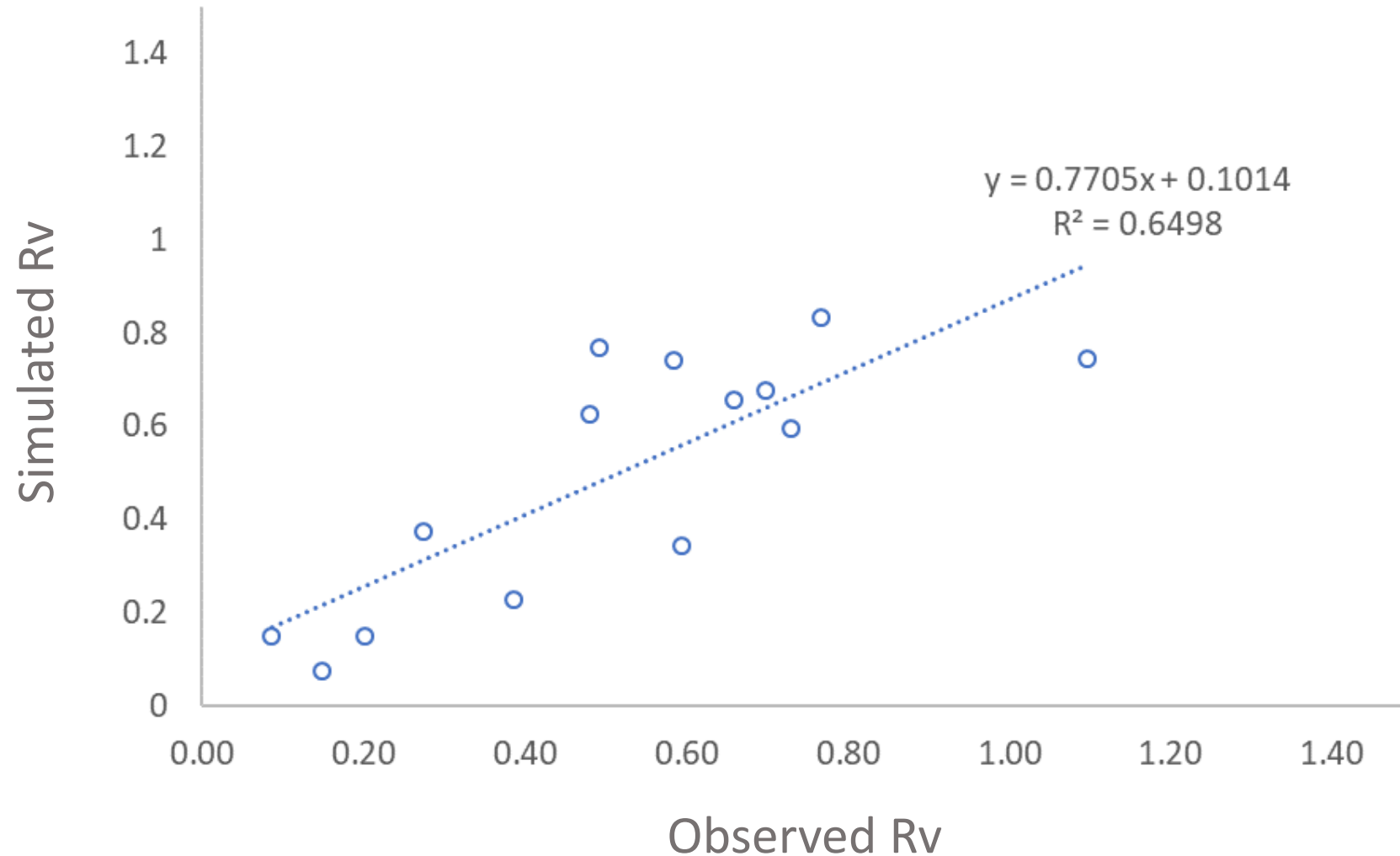
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# Percent contributions of major source areas- Cambridge, MA study



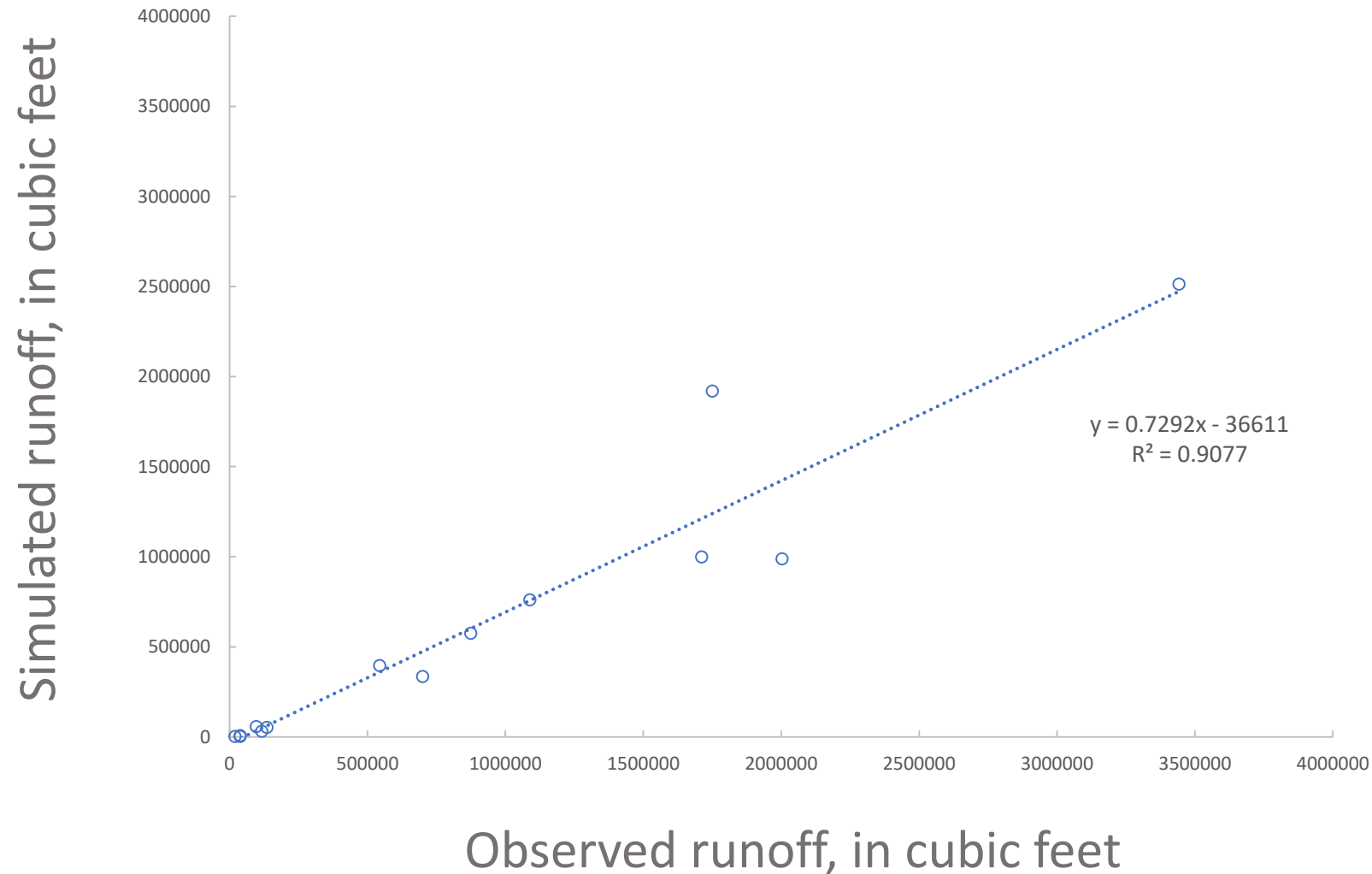
*Sorenson, 2013*

# Simulated vs Observed Runoff Coefficients



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# Simulated vs Observed Runoff



*Provisional data subject to change*



# Summary

- Vermont study area CB and SC materials have similar GSF distributions
- CB materials less sensitive to seasonality
- CB coarser in spring/summer and SC coarser in fall
- SC materials dominated by organics/leaves in the fall
- Blank samples indicate equipment not a source of bias
- Replicates good for total P, more variable for TOC and TKN (coarse)
- Catch Basin TOC, TKN, and total P conc highest in fall samples
- Street Cleaning TOC, TKN, and total P conc highest in fall 18 and June 18
- Estimated total P content in CB and SC piles similar to CSB (2016)

# Summary

- Interim credits show potential for increasing CB, SC and Leaf credits
- SLAMM runoff calibration to 1999 data considered good
- Calibrated SLAMM scenario results to evaluate interim credits results and support development of long term credits

# Next Steps

- Complete calibration for pollutants (Phosphorus) with 1999 data
- Validate model performance with 2000 data
- Run model scenarios to support development of long-term credits
- Complete draft and submit for Center review- May 1, 2020
- Technical reviewers:      Laura Medalie –USGS, NEWSC, VT-NH District  
                                     Judy Horwathich –USGS, WIWSC, Milwaukee



A photograph of a street corner. On the left, a concrete wall runs along the sidewalk. A person's legs and feet are visible on the sidewalk. In the center, a red fire hydrant is next to a grey utility pole. The ground is covered with brown leaves. A car is visible in the background on the right.

Questions?

Thank you!