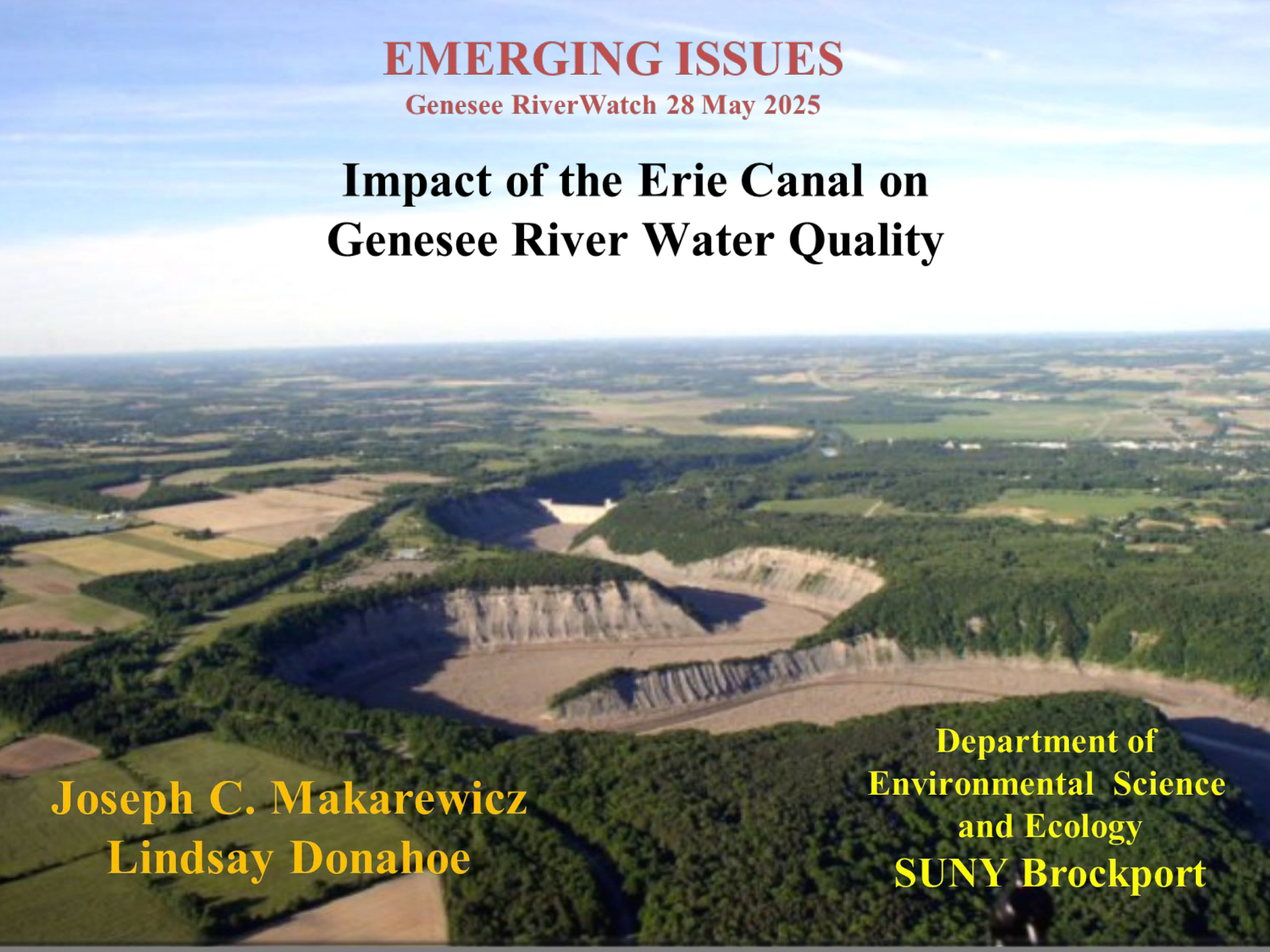
EMERGING ISSUES

Genesee RiverWatch 28 May 2025

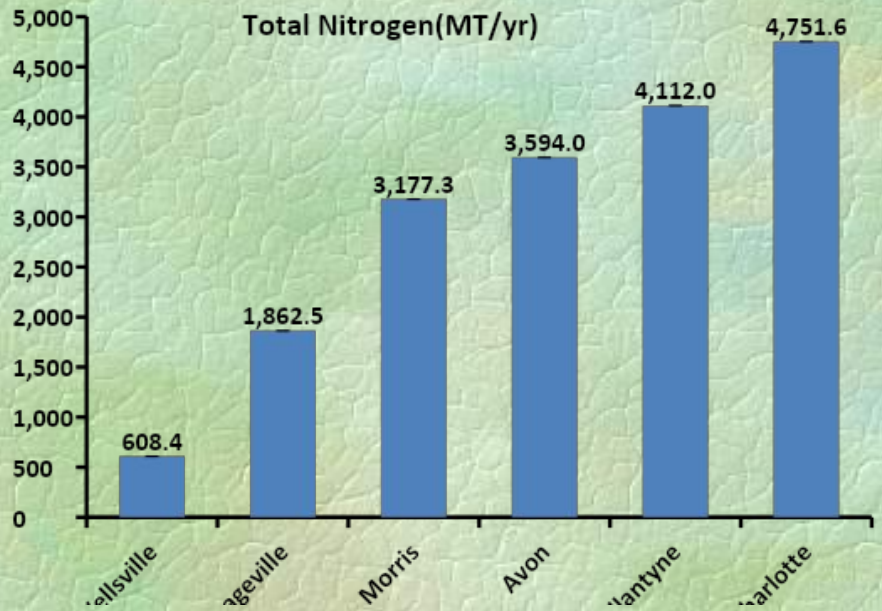
Impact of the Erie Canal on Genesee River Water Quality

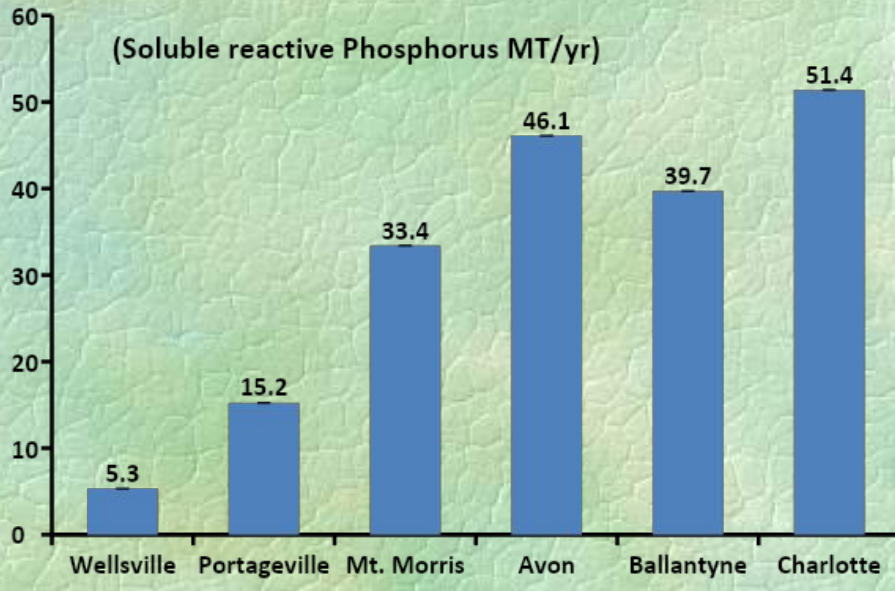


Joseph C. Makarewicz
Lindsay Donahoe

Department of
Environmental Science
and Ecology
SUNY Brockport

Nutrient Loading along the Genesee River Why phosphorus?





Makarewicz et al. 2015. Utilizing intensive monitoring and simulations for identifying sources of phosphorus and sediment, and for directing, siting and assessing BMPs: The Genesee River example. Journal of Great Lakes Research)

Total Phosphorus Genesee River - Main Stem		
Land-use / Activity	Current Load	Percent of Allocated Load
	kg TP/yr	%
Agricultural Crops	94,404	28.3
Tile Drainage	17,828	5.3
Farm Animals (CAFO only)	29,440	8.8
Stream bank Erosion	16,553	5.0
Wetlands	1,002	0.3
Quarry	0	0.0
Groundwater	97,822	29.3
Forest	18,087	5.4
Urban Runoff	6,196	1.9
Wastewater Treatment	38,406	11.5
Septic Systems	13,952	4.2

SWAT Model
Soil Water Assessment tool

Anthropogenic Sources
59.7% of P Load to Lake Ontario

Point Sources=
17.6% of P load

Nonpoint Sources
42% of P load

(Makarewicz et al. 2015. Utilizing intensive monitoring and simulations for identifying sources of phosphorus and sediment, and for directing, siting and assessing BMPs: The Genesee River example. Journal of Great Lakes Research)

Percent Effectiveness of BMPs (%) – Entire Main Stem Genesee River

AgBMPs: 2017-2021
~$6.5 million, SWCD

Upgrades
Geneseo (T&V) and Friendship (T)
~$11 million WQIP

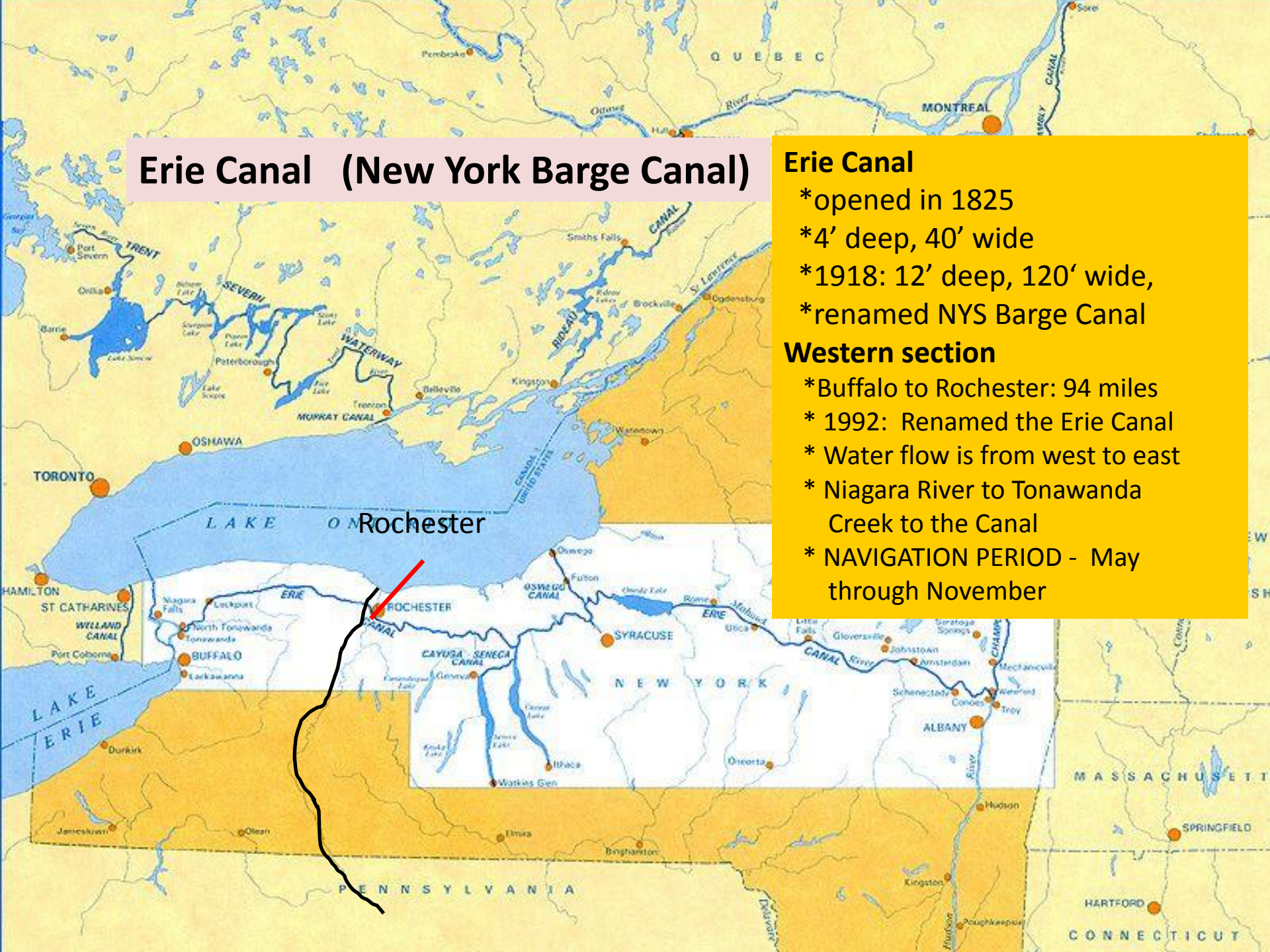
Stream Bank Restoration
$3 million, GRW, 15 Projects
Mallard's, Chamberlain & Edelweiss Farms

Possible Management Scenario			Total Phosphorus	
Category	Subcategory	BMP	TP Percent Reduction	kg P/yr
Forest	Forest	Natural Watershed	38.1	157,058
land		Buffer Strips	11.6	47,651
		Grassed Waterways	23.4	96,594
		Fertilizer Reduction (100%)	2.4	9,712
		Manure Use	7.1	29,400
		TP -Tertiary	9.2	37,764
	Septic	Remove all Septic	3.4	13,952
	Stabilization	Stream Bank Basin-wide Stabilization	11.6	47,725
s + ment			**32.9**	**135,714**

We know where many of the problems are in the Genesee River.
We also have programs to remediate the Genesee River watershed underway.

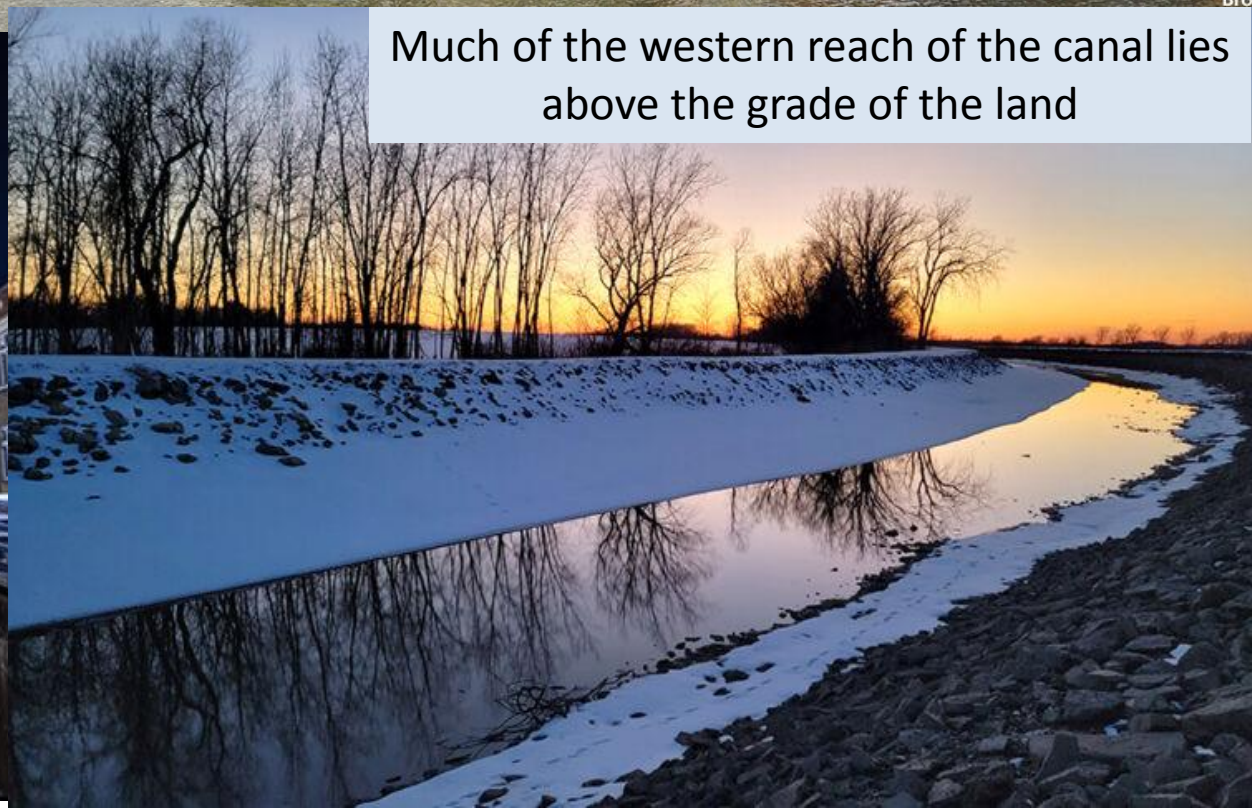
2015 - Genesee River Nine Key Element Plan for Sediment and Phosphorus -BMPs
The major goal is to control sediment, nutrients, and pathogens entering the river.
2024 – Canaseraga Creek Watershed Working Group – A major source of phosphorus and sediment
Develop a BMP plan for the Canaseraga Creek watershed.

However, there is no mention of the Erie Canal in the Nine Element Plan of DEC.
The amount of knowledge on the impact of the Erie Canal on the Genesee River is poorly known or understood.


Erie Canal (New York Barge Canal)
Erie Canal
*opened in 1825
*4' deep, 40' wide
*1918: 12' deep, 120' wide,
*renamed NYS Barge Canal
Western section
*Buffalo to Rochester: 94 miles
* 1992: Renamed the Erie Canal
* Water flow is from west to east
* Niagara River to Tonawanda Creek to the Canal
* NAVIGATION PERIOD - May through November
Rochester
QUEBEC
MONTREAL
TORONTO
OSHAWA
HAMILTON
ST CATHARINES
BUFFALO
SYRACUSE
ALBANY
NEW YORK
PENNSYLVANIA
LAKE ERIE
LAKE ONTARIO
TRENT
SEVERN
WATERWAY
MURRAY CANAL
RIDEAU
ERIE CANAL
OSWEGO CANAL
CAYUGA - SEneca CANAL
WELLAND CANAL
CHAMPLAIN CANAL
MASSACHUSETTS
SPRINGFIELD
HARTFORD
CONNECTICUT

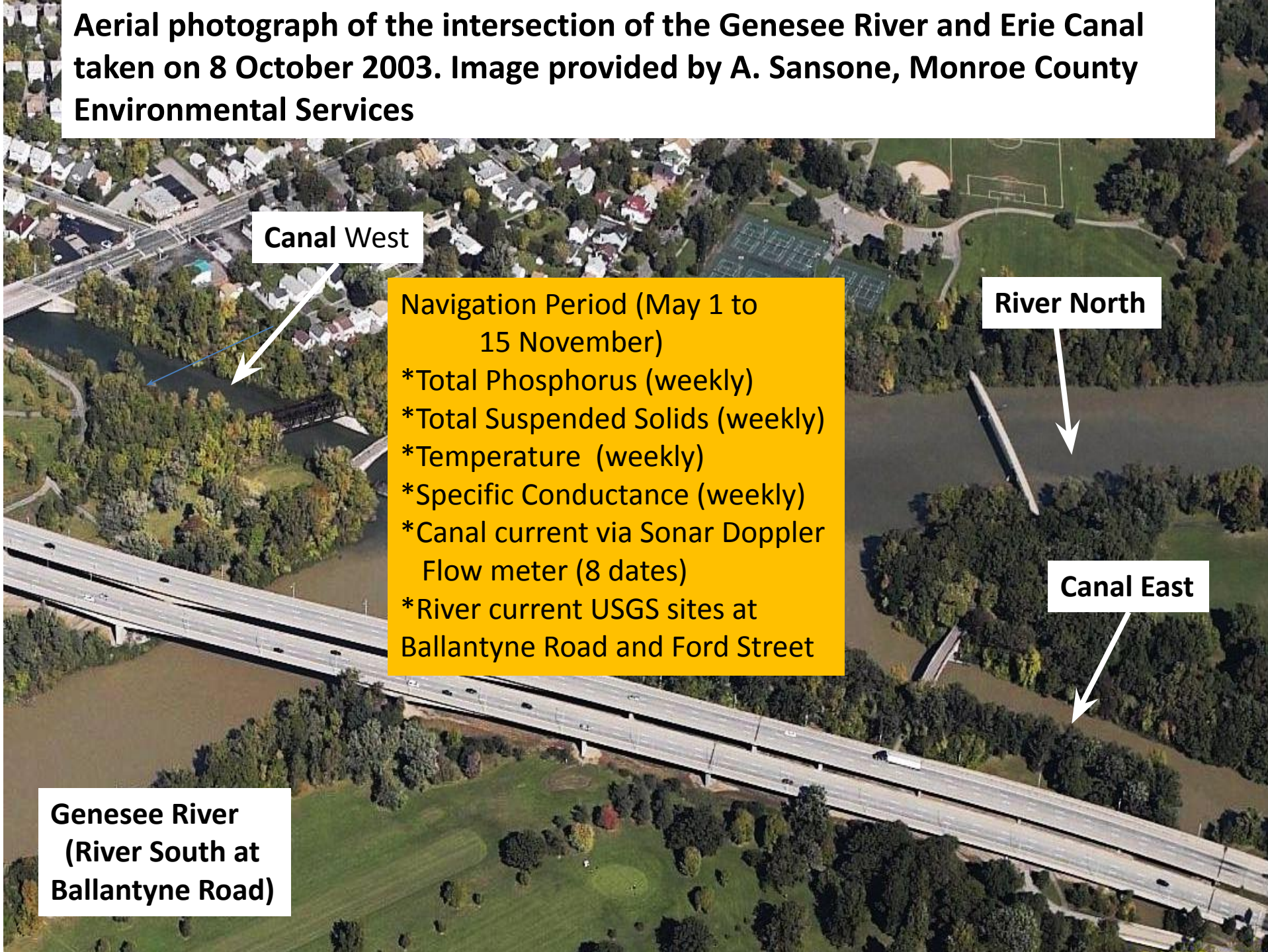
Low Bridge
Navigation Period: May to November

Much of the western reach of the canal lies above the grade of the land

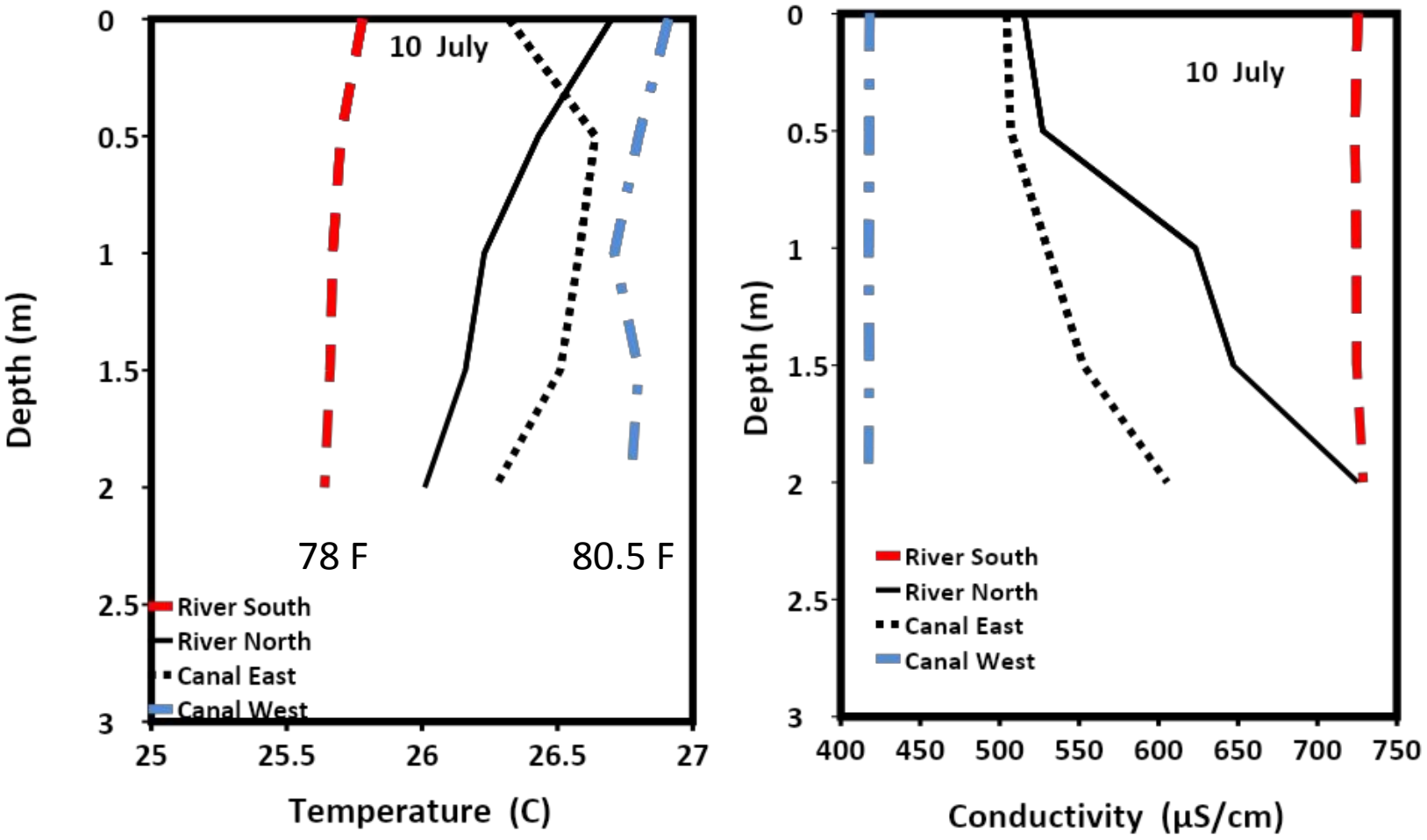


The results presented here are for the navigation period – the period when water flows throug
the canal and mixes with the Genesee River.
From ~mid-November to ~mid-April, the Guard Gates are lowered isolating the
Canal from the River. The western section of the canal is drained.

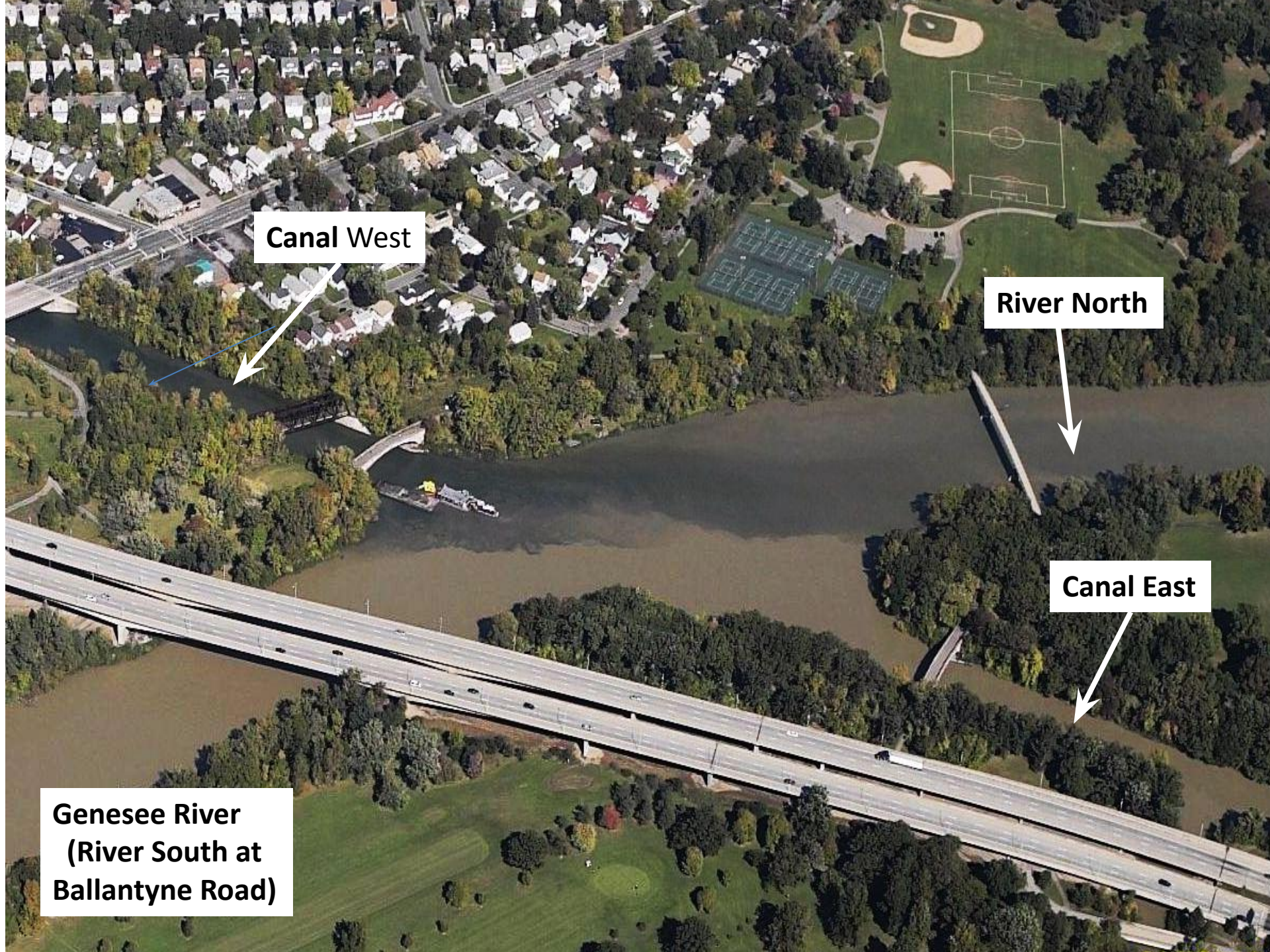
Aerial photograph of the intersection of the Genesee River and Erie Canal taken on 8 October 2003. Image provided by A. Sansone, Monroe County Environmental Services



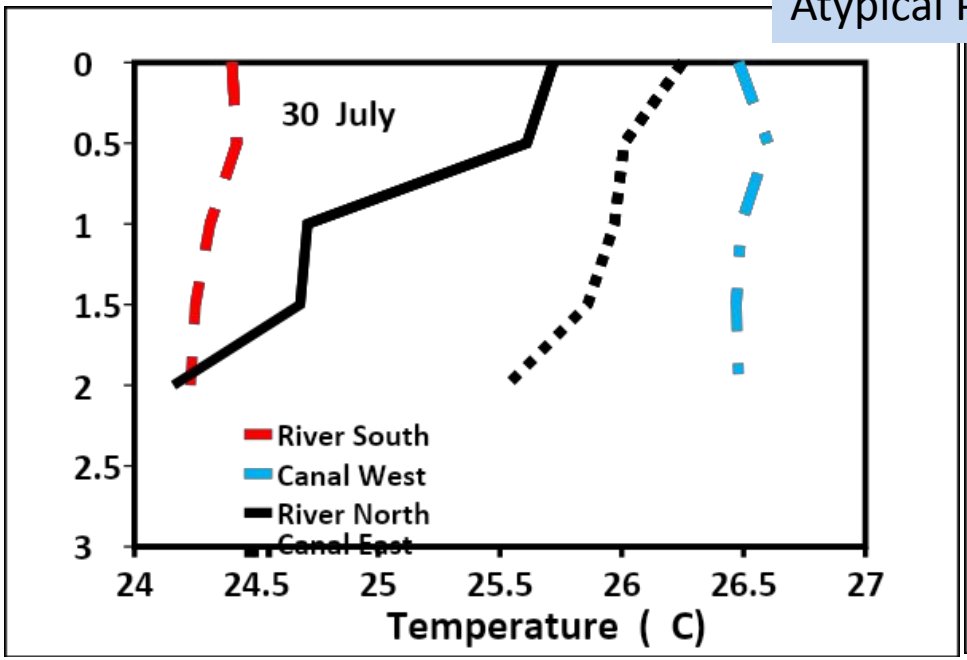
Typical Depth Profiles

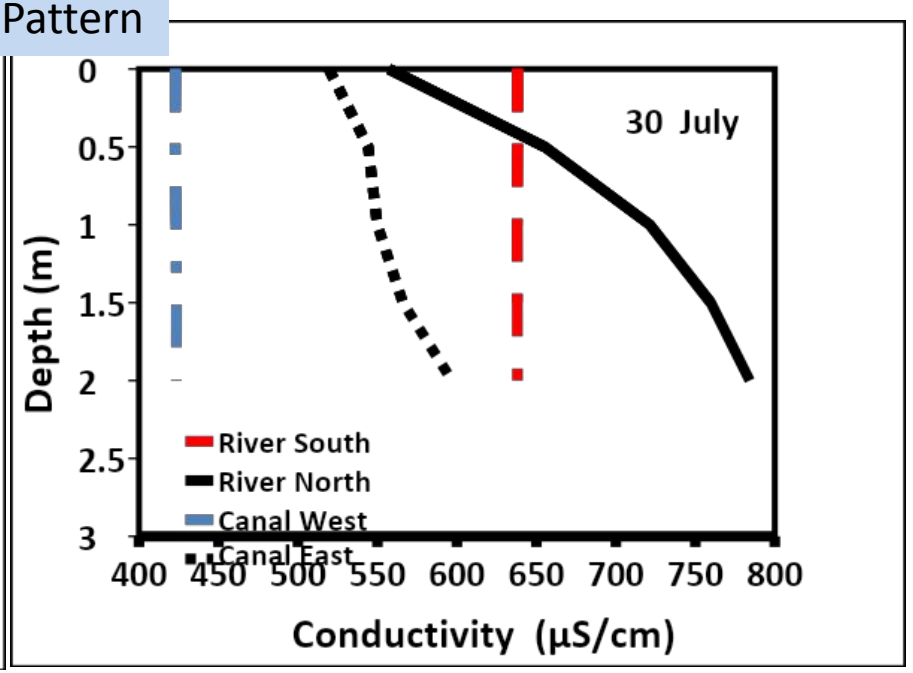


Specific Conductance (conductivity) is a proxy measure of dissolved material in the water.

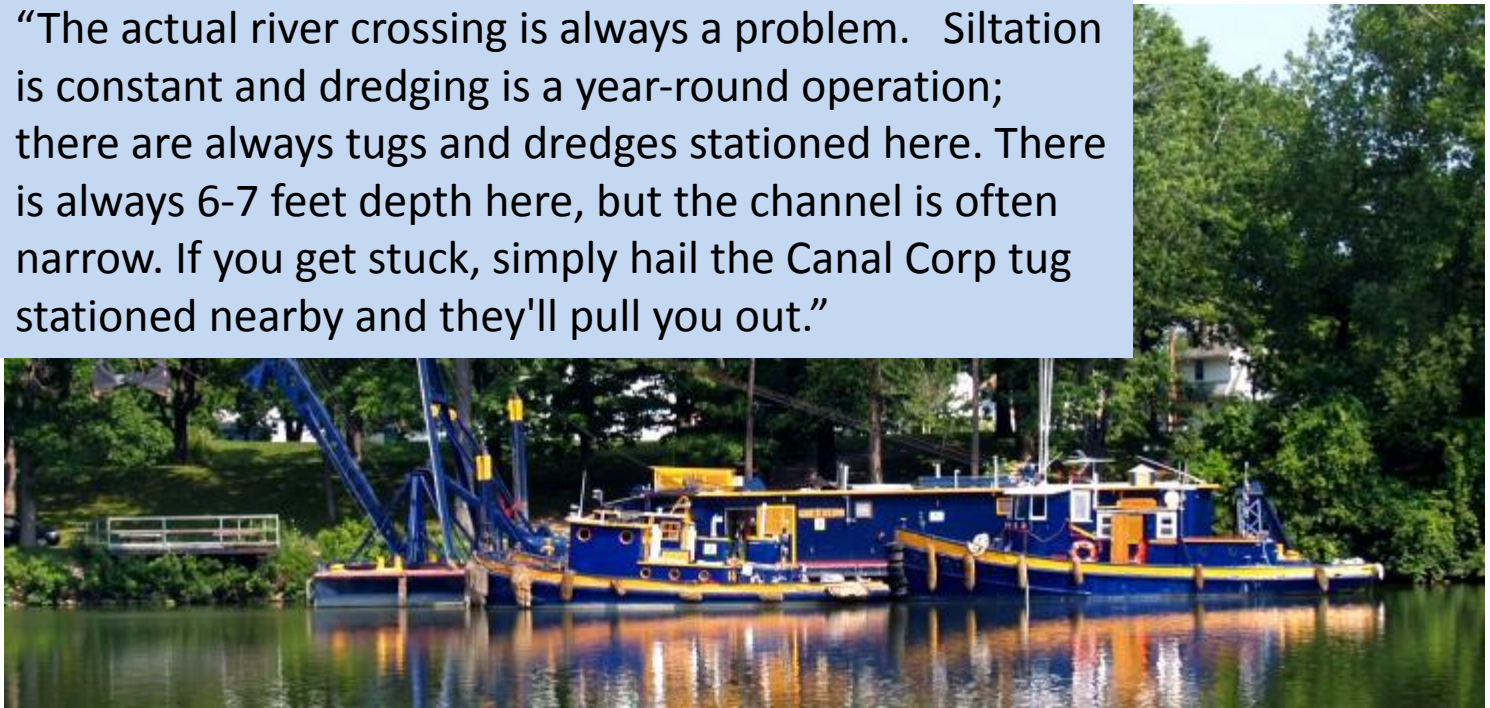

Canal West
River North
Canal East
Genesee River
(River South at
Ballantyne Road)

Atypical Pattern



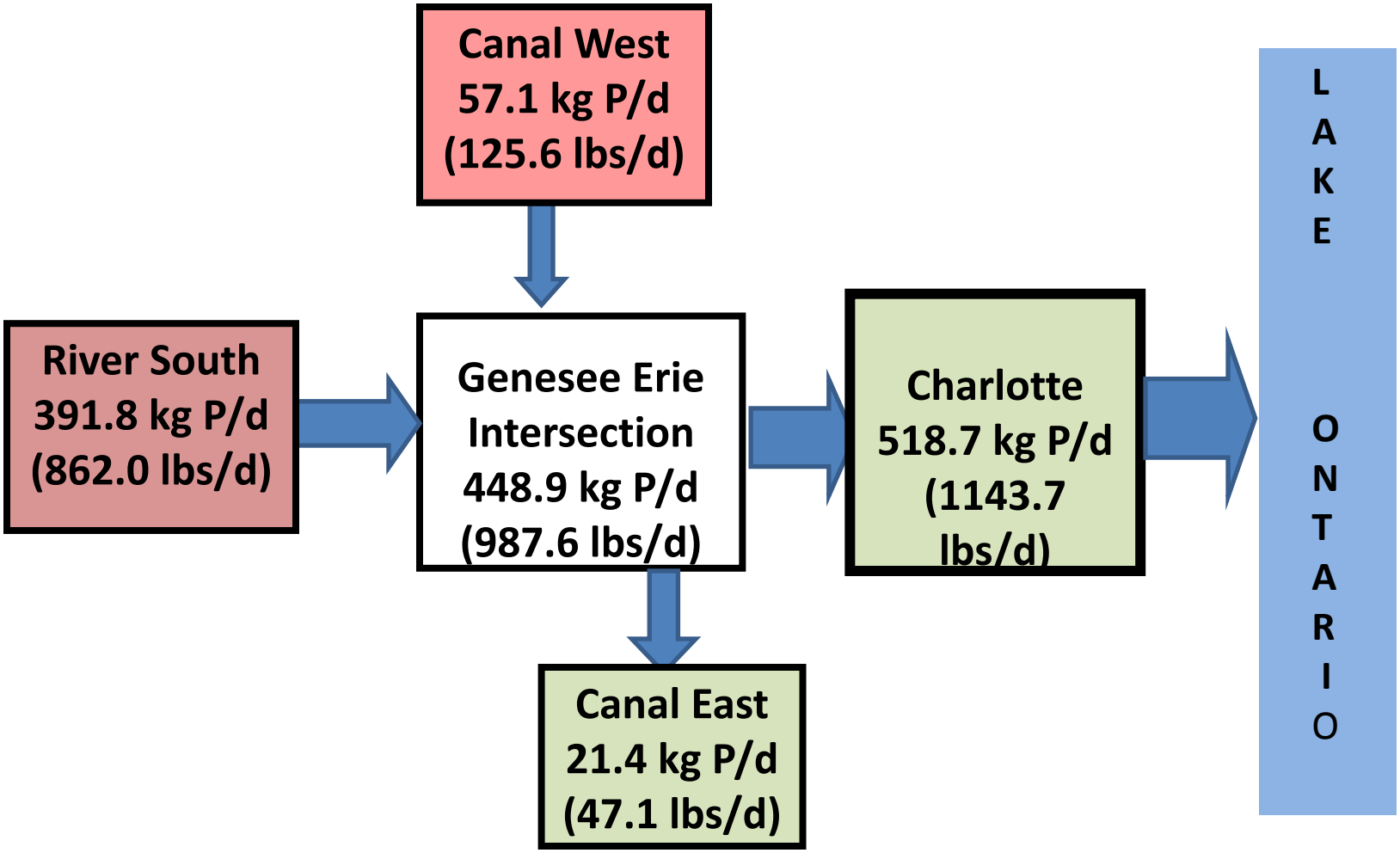


"The actual river crossing is always a problem. Siltation is constant and dredging is a year-round operation; there are always tugs and dredges stationed here. There is always 6-7 feet depth here, but the channel is often narrow. If you get stuck, simply hail the Canal Corp tug stationed nearby and they'll pull you out."

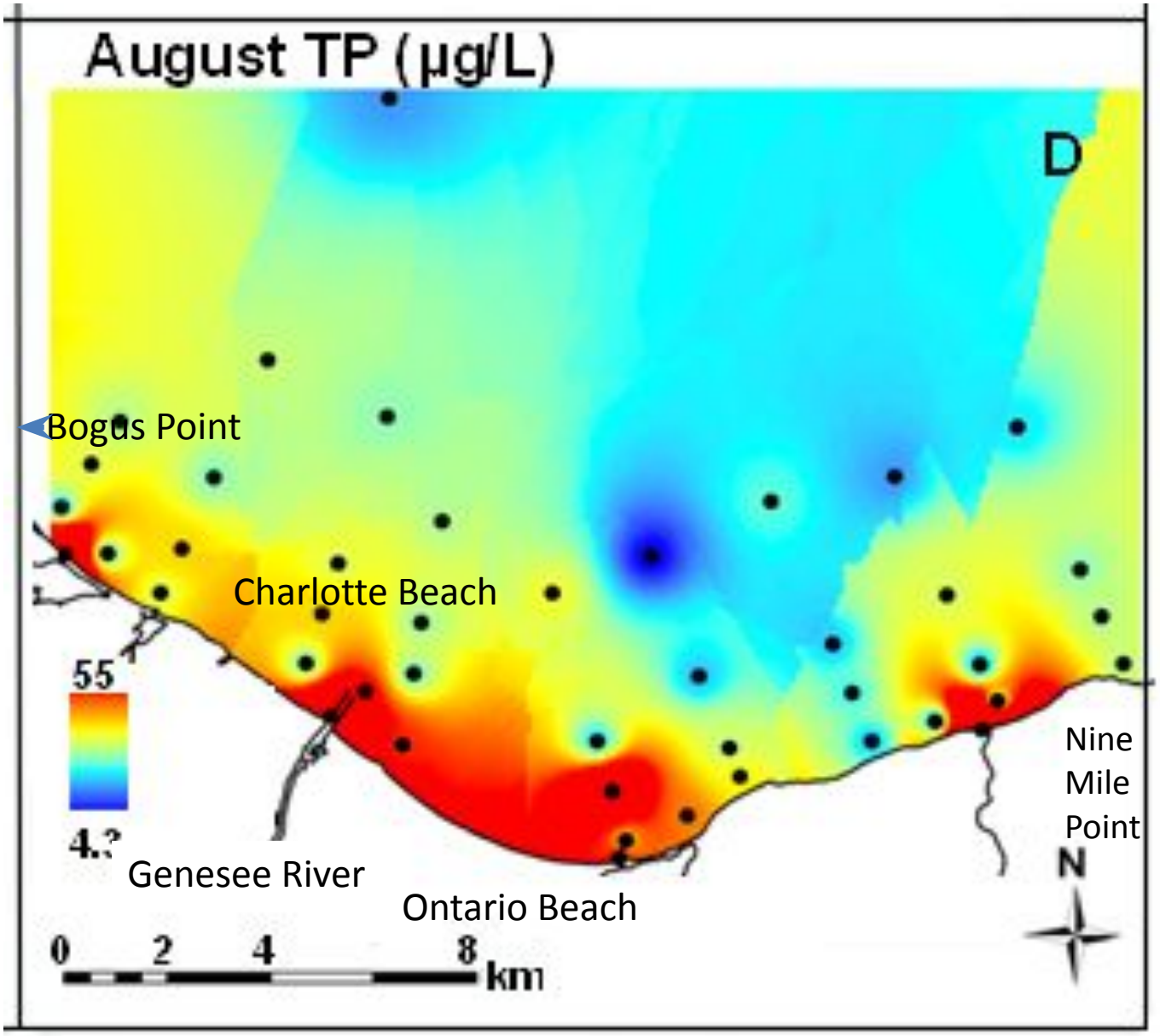


Rainfall
Gates closed

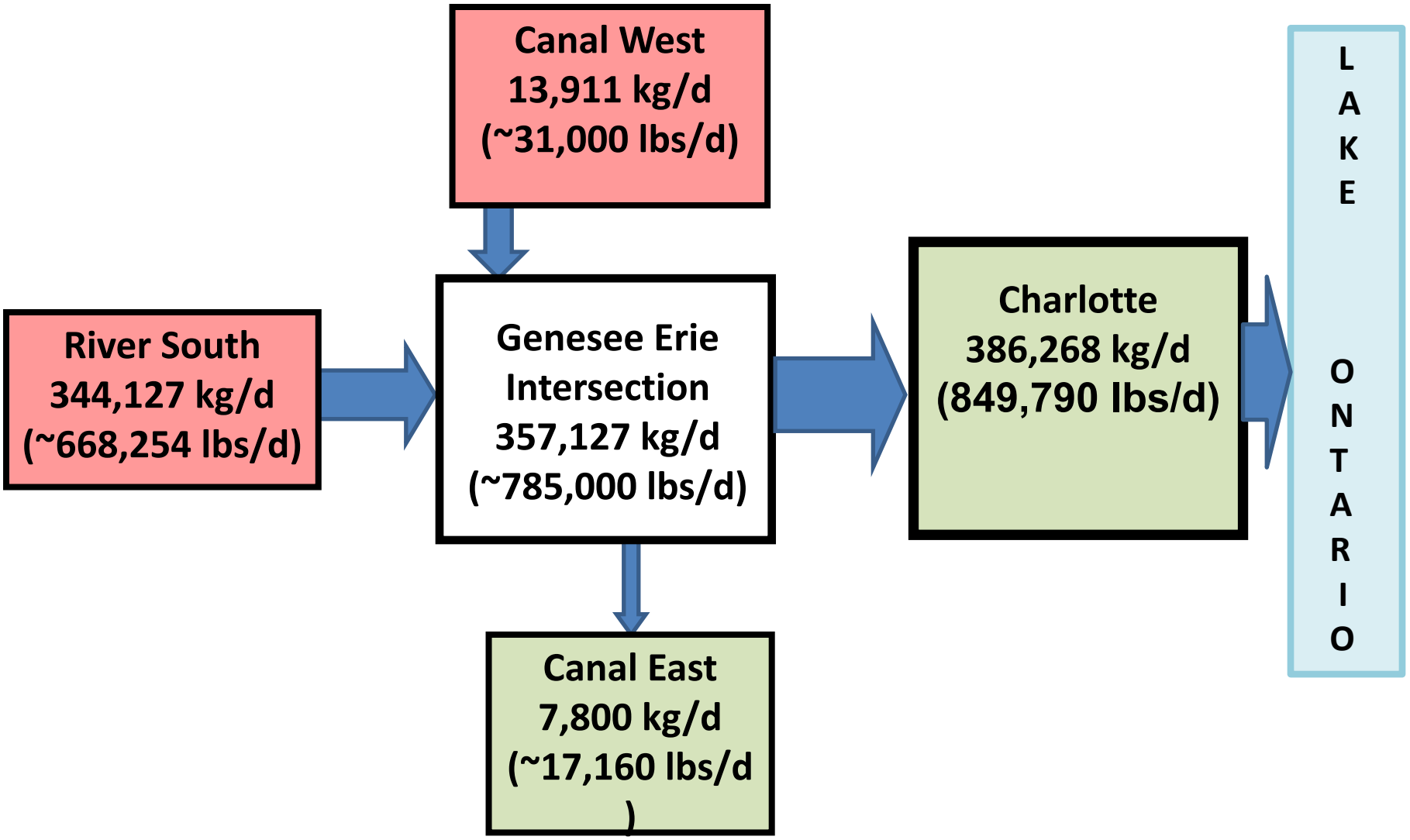
Flux of Total Phosphorus through the Genesee River during the "Navigation period" (May to November)

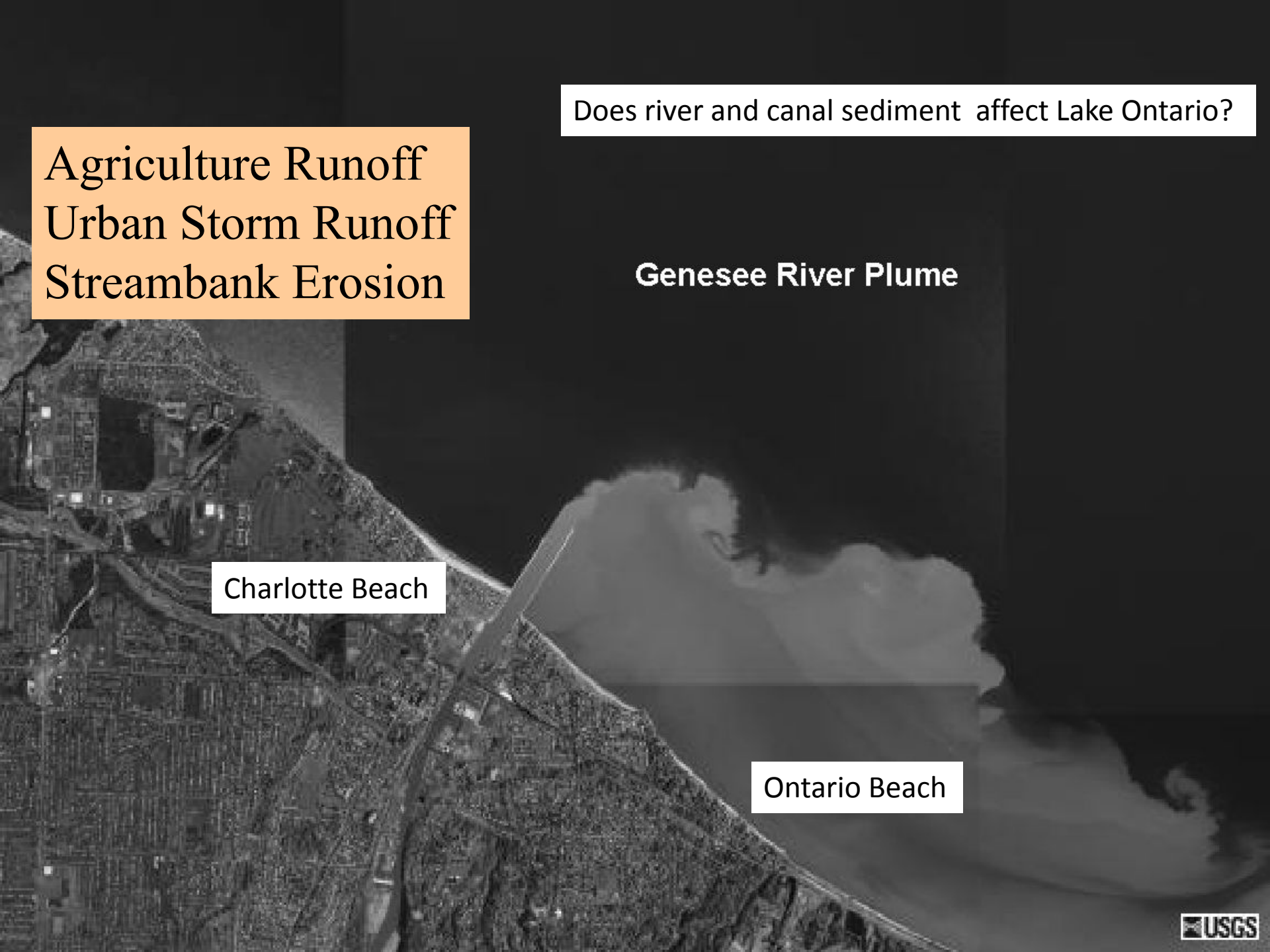


Mean Total Phosphorus
(55.9 ug P/L)


August TP (µg/L)
D
Bogus Point
Charlotte Beach
55
4.3
Genesee River
Ontario Beach
Nine
Mile
Point
N
0
2
4
8
km

Flux of Total Suspended Solids (sediment) during the "Navigation period"



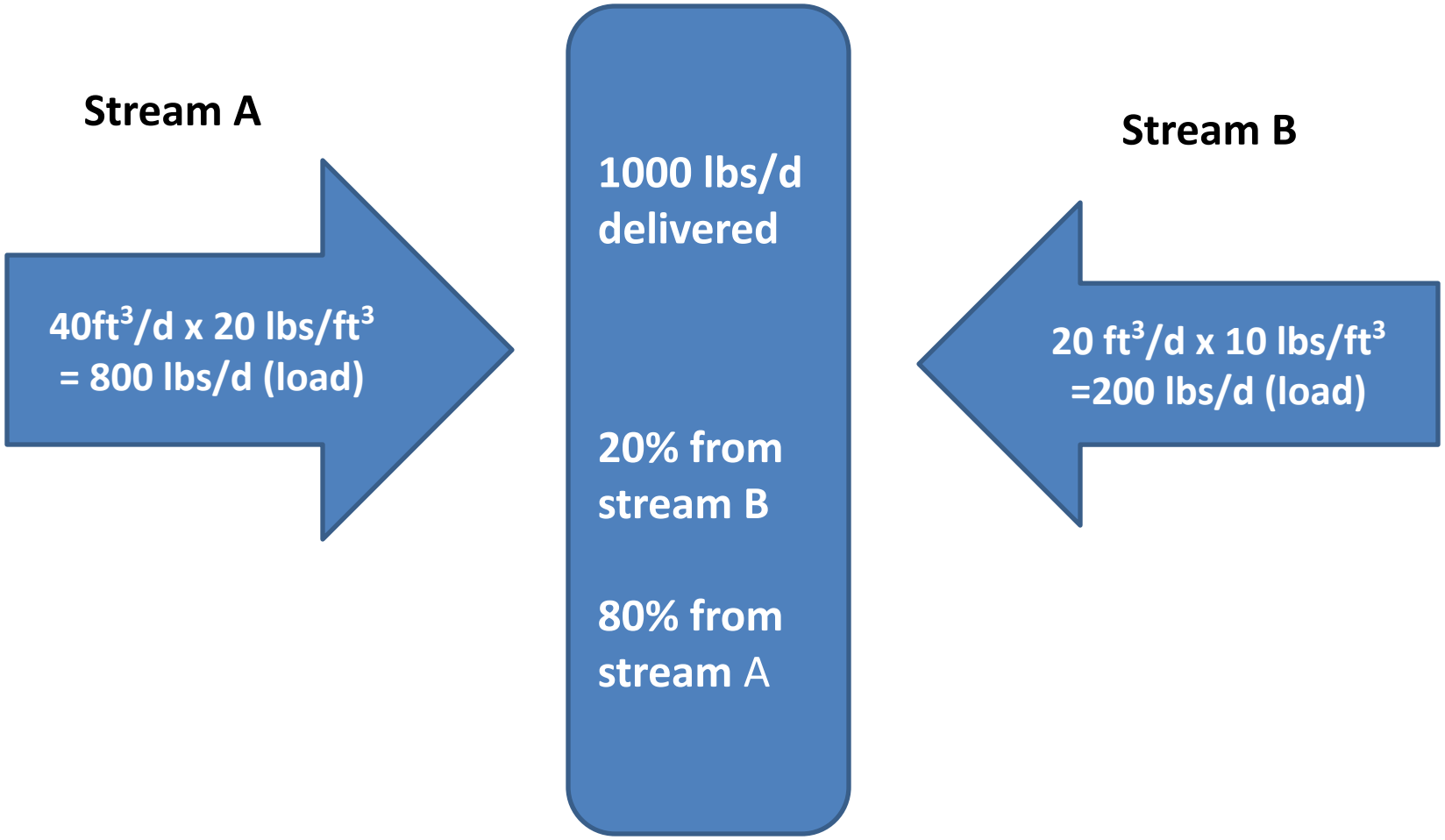

Does river and canal sediment affect Lake Ontario?
Agriculture Runoff
Urban Storm Runoff
Streambank Erosion
Genesee River Plume
Charlotte Beach
Ontario Beach
USGS

What is the cause of the enhanced levels of phosphorus and sediment in the Erie Canal?

- A good question that needs to be answered. We do not know.
- Would not expect? Small watershed.
- Higher than expected considering that much of the canal is above the topographic grade of the surrounding land area.
- As early as 1876, it was recognized that sedimentation was a problem In the western portion of the canal. Construction and maintenance of locks at Lockport were thought to be the problem?
- It is not from Lake Erie or the Niagara River as TP and TSS concentrations are low.
- Buffalo River and Harbor, which drains into the Niagara River.
- Discharge from the many towns along the canal.
- 53 stormwater sewer outfalls that discharge into the Erie Canal west of the Genesee River.
- Geology? Is it natural? Bedrock of the Erie Canal is underlain by Dolostone and Rochester Shale. Susceptible to erosion and containing phosphorus.

What is the impact of the Erie Canal on the Genesee River?

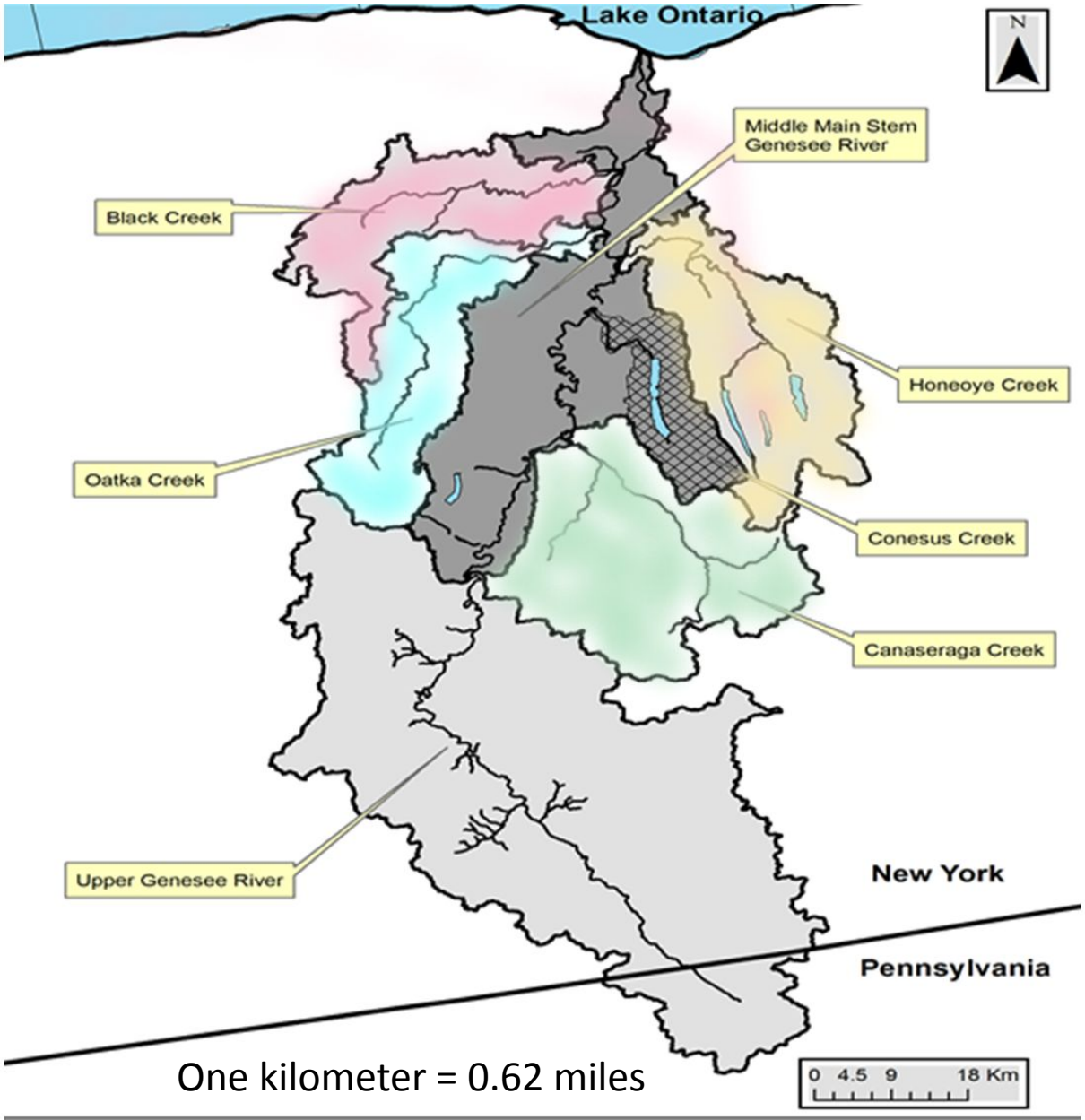
Mass balance is method used to track and account for the mass of substances within a system



The percent contribution (mass balance) of Canal West and River South based on average conductivity to downstream sites River North and Canal East on selected dates in 2012.

	Canal West		River South	
Date	River North	Canal East	River North	Canal East
26-Jun	70	50	30	50
10-July	39	61	61	39
19-Aug	67	74	33	26
3-Sep	41	77	59	23
15-Oct	45	68	55	32

How do inputs from the Erie Canal compare to major sub-watersheds of the Genesee River?



One kilometer = 0.62 miles

Comparison of average 2012 daily flow and TP and TSS loads during the navigation season (28 April 2012 to 15 November 2012) of Canal West and Canal East with the 2011 summer+autumn (June 21 to December 21) daily flow and TP and TSS loads of major tributaries of the Genesee River.

	Flow (m^3/d)	TP (kg P/d)	**% of Genesee Load**	TSS(kg/d)	**% of Genesee Load**
Canal West	1.00×10^6	57.1	**14.8**	13,911	**4.1**
Canal East	0.41×10^6	-21.4	**-5.6**	-7,800	**-2.3**
Canaseraga Ck	0.66×10^6	67.3	**17.4**	102,325	**30.2**
Black Creek	0.21×10^6	18.8	**4.8**	2,715	**0.8**
Oatka Creek	0.30×10^6	13.0	**3.4**	3,240	**1.0**
Conesus Creek	0.11×10^6	18.4	**4.8**	4,488	**1.3**
Honeoye Creek	0.12×10^6	7.5	**1.9**	2,800	**0.8**
Genesee River					
Summer+fall	4.60×10^6	385.5	**100**	338,606	**100**
Summer only	1.00×10^6				

Summary

- The Genesee River and the Erie Canal have an effect on each other.
- Canal East and Genesee River North are a mixture of water from Canal West and River South.
- Mass balance analysis indicates Erie Canal West provides 39 to 77% of dissolved materials to River North during the summer navigation period.
- The high average daily load of TP (14.8%) and sediment (TSS) load (4.1%) from Canal West to River North are higher than 4 of the 5 major tributaries of the Genesee River.
- The high level of TP and sediment is a significant anthropogenic transfer from Lake Erie via the Erie Canal to the lower gorge of the Genesee River and eventually to Lake Ontario previously not quantified or identified.
- The Canal impact is magnified due to low flows of water in the Genesee during the summer while summer Canal flow is relatively consistent due to continuous inputs from Lake Erie.

Suggestions

- **The Nine Element Plan provides for adaptive management of the Genesee River watershed. The Erie Canal should be identified in the DEC Nine Key Element Management Plan as an area of concern.**

- **Unlike the Genesee River, research on the Erie Canal west of Rochester has been minimal to identify sources .**

We simply do not know where the P and sediment are coming from in the canal.

- **NYSDEC and the NYS Canal Corporation, which operates the Erie Canal, should develop a strategy to investigate and control the inputs from the Erie Canal to the Genesee River. The study presented here is in many ways a preliminary study**

- **Such a strategy should evaluate aesthetic impairments, potential interference on human use of the resource, and other negative impacts (pathogens) In the lower gorge of the Genesee.**

- **With the further development of a New State Park in the lower gorge, efforts should be developed to provide a better experience to boaters, kayakers, local residents, and potential tourists.**

Has the remediation of the Genesee River watershed been a success or a failure?
We do not know!!!

~$20 million have been spent on remediation of the Genesee River. Yet we have no information on failure or success of these efforts on the river itself - that is the river ecosystem.

There is no river monitoring for TP or TSS to determine if the remediation efforts have had an impact!

Adaptive management is called for in the Nine Element Management Plan. Adaptive management requires knowledge of failure or success of the remediation efforts.

At least every five years, a phosphorus and sediment seasonal monitoring of the river should occur.

Thank you!

EPA Limnology Class, Lake Guardian, SUNY Brockport

Current metrics for evaluating TP and TSS.

- **Miles of grassed waterways added to fields**
- **Acres of cover crops in fields**
- **Miles of stream bank stabilized**

Such metrics are good for estimating the progress for a specific remediation project. However, such metrics tell us nothing about the conditions in the Genesee River itself

Total coliform bacteria: group of bacteria found in soil, water, intestines of humans an animals. Used as an indicator or warning of potential harmful bacteria.

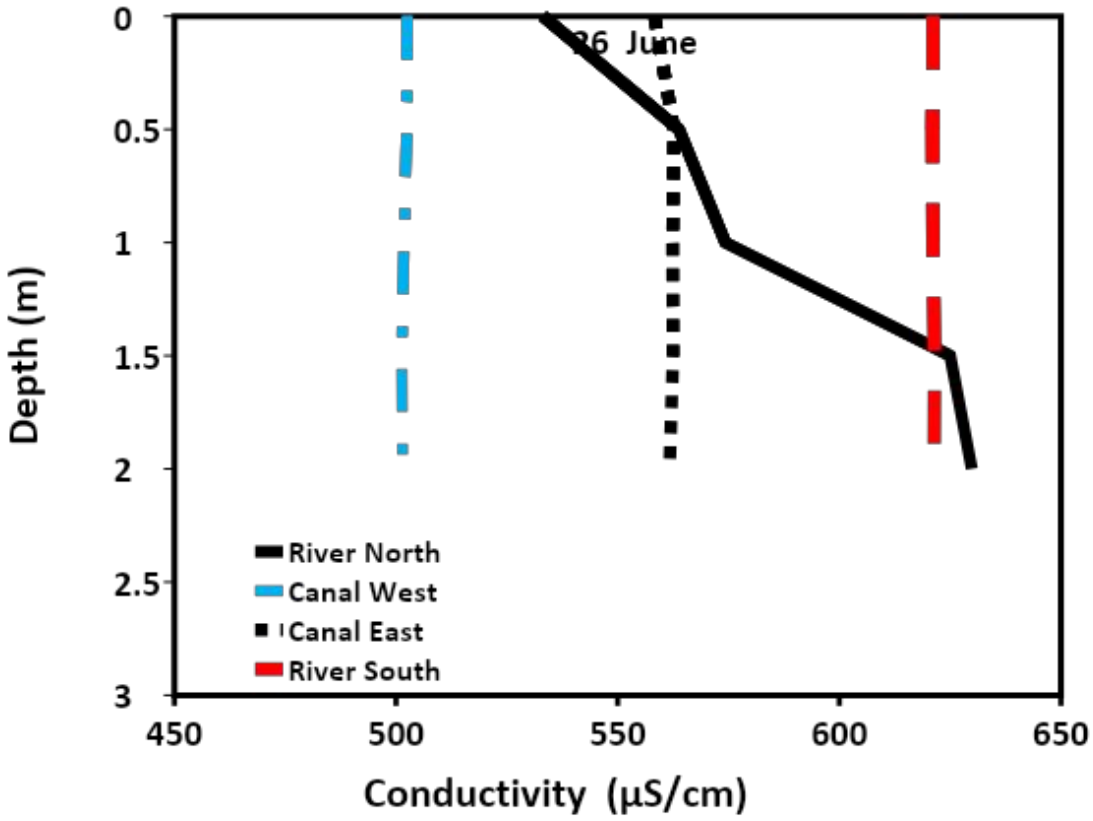
Average total coliforms (CFU/100ml) during the navigation period (May-November)

River South (Genesee at Ballantyne Rd)	10,932 +/- 3,719
Canal West (Erie Canal west of Genesee)	6,500 +/- 2,000*
Canal East (Erie Canal east of Genesee)	14,000 +/-6,300*

*Significantly different at P=0.05

- **Average (±SE) total phosphorus, chlorophyll, and phycocyanin concentrations at 39 sites along the New York shoreline of Lake Ontario (LO) from 2003 to 2009 (May through September). Nearshore Lake Ontario, river, and embayment values represent surface samples (minimum 1-m water depth). Lake Ontario offshore samples taken due north of Hamlin Beach, NY, from a depth of 1 m at sites with a depth of 30 and 100m. Unpublished data of Makarewicz.**

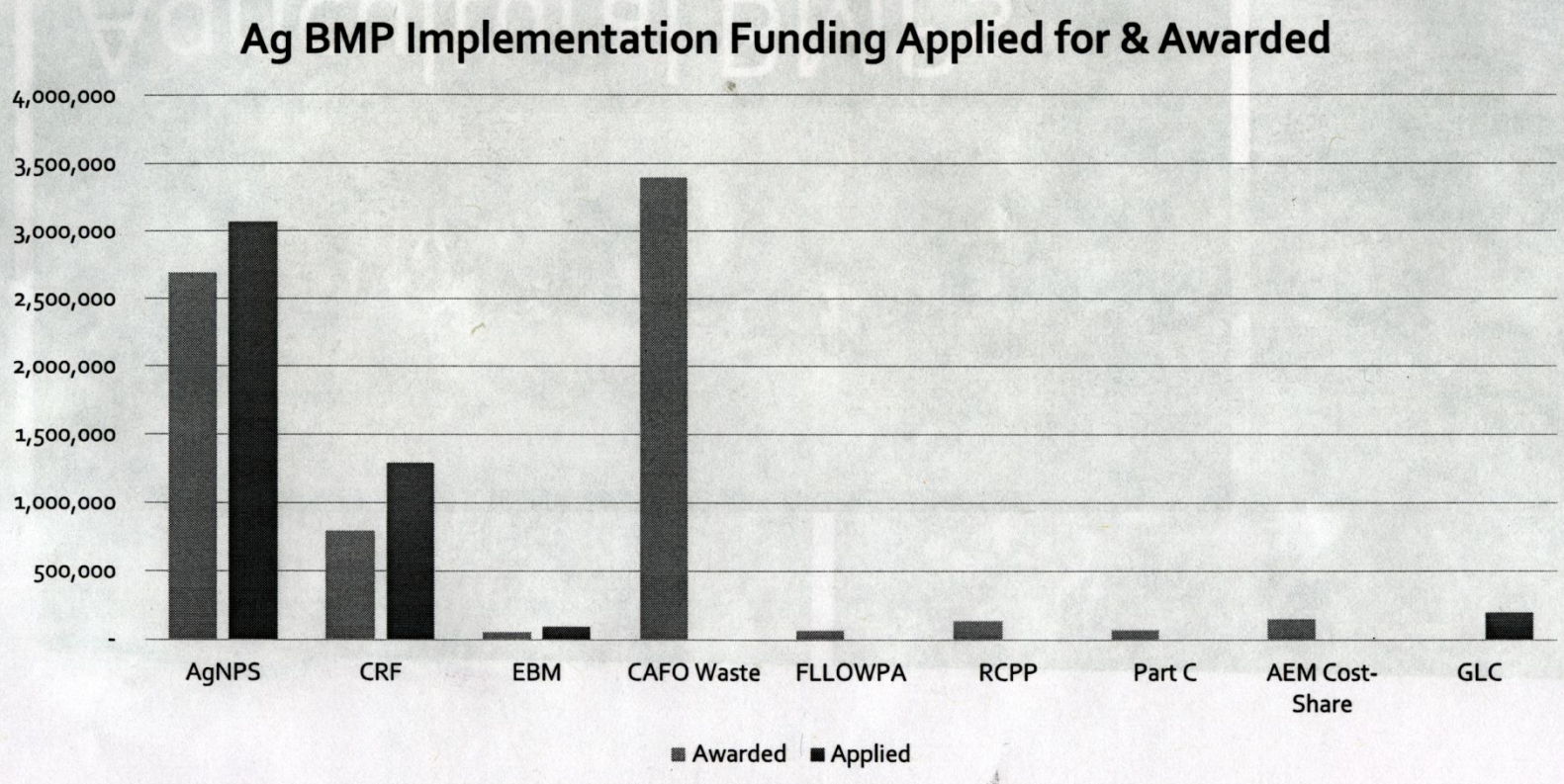
	Total Phosphorus (µg P/L)	Chlorophyll (µg/L)	Phycocyanin (µg/L)
Nearshore Lake Ontario	62.0±7.4	19.1±4.1	17.8±2.2
Rivers/Creeks	83.8±6.5	6.5±0.8	13.2±3.0
Embayments	129.7±59.6	20.0±2.4	237.5±207.6
LO - 30m depth	9.9±0.7	2.0±0.17	5.5±1.2
LO - 100m depth	9.5±0.7	2.6±0.26	6.1±1.3

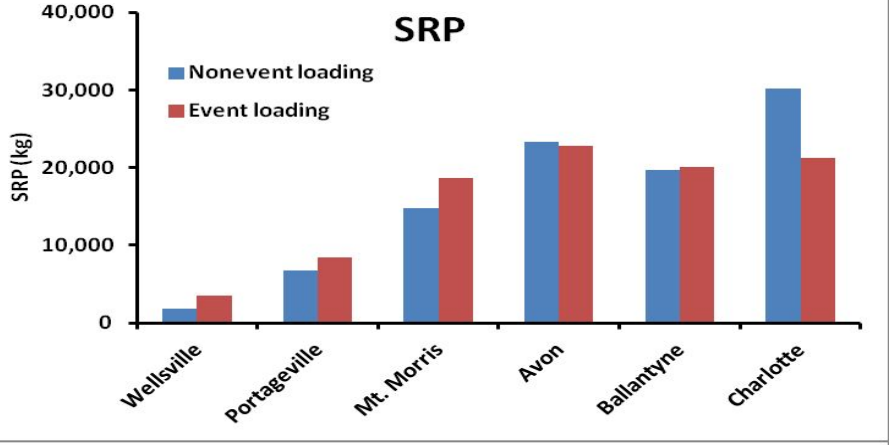


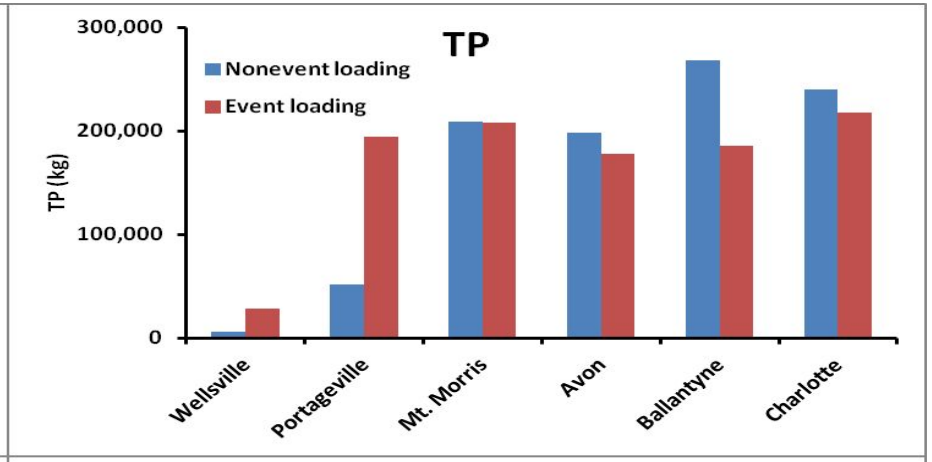
An inch of rain fell in the Rochester area in the preceding 24 hours. Can only speculate on factors. Kendrick/Elmwood sewershed drains an area east of the Genesee River and drains

Summary of Ag BMP Funding by the SWCDs in the Genesee River Basin

2017-2021




SRP
Nonevent loading
Event loading
SRP (kg)
40,000
30,000
20,000
10,000
0
Wellsville
Portageville
Mt. Morris
Avon
Ballantyne
Charlotte


TP
Nonevent loading
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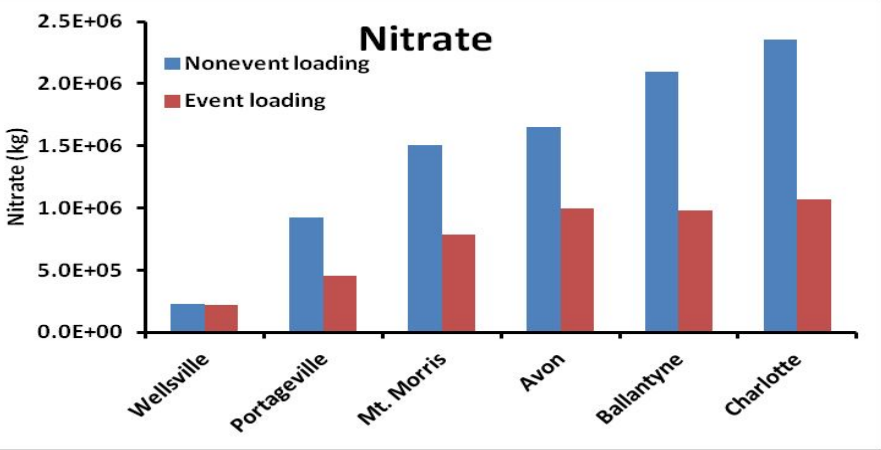
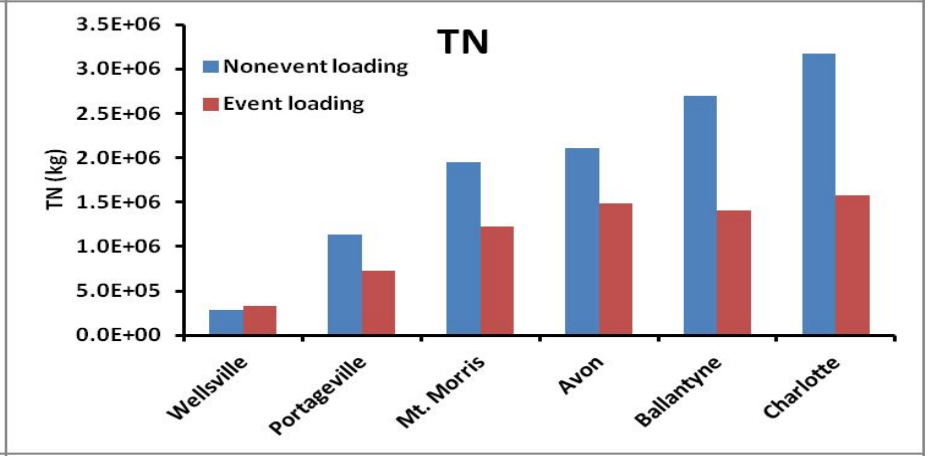
TP (kg)
300,000
200,000
100,000
0
Wellsville
Portageville
Mt. Morris
Avon
Ballantyne
Charlotte


Nitrate
Nonevent loading
Event loading
Nitrate (kg)
2.5E+06
2.0E+06
1.5E+06
1.0E+06
5.0E+05
0.0E+00
Wellsville
Portageville
Mt. Morris
Avon
Ballantyne
Charlotte


TN
Nonevent loading
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TN (kg)
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2.0E+06
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0.0E+00
Wellsville
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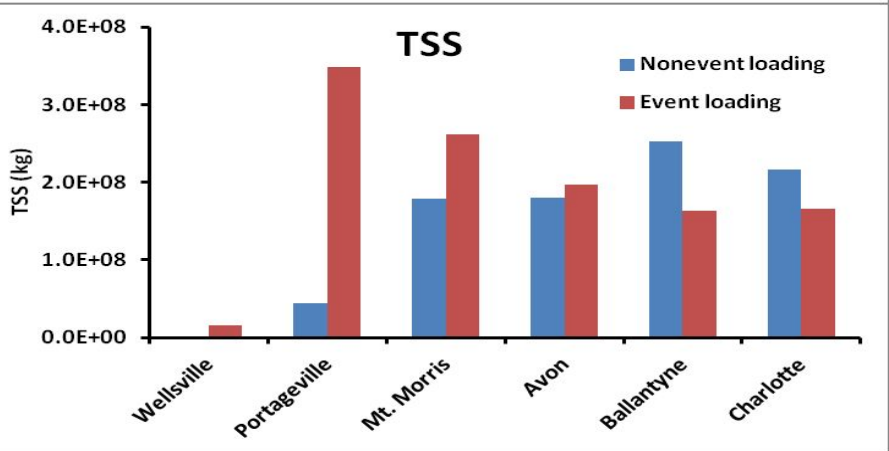
Avon
Ballantyne
Charlotte


TSS
Nonevent loading
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TSS (kg)
4.0E+08
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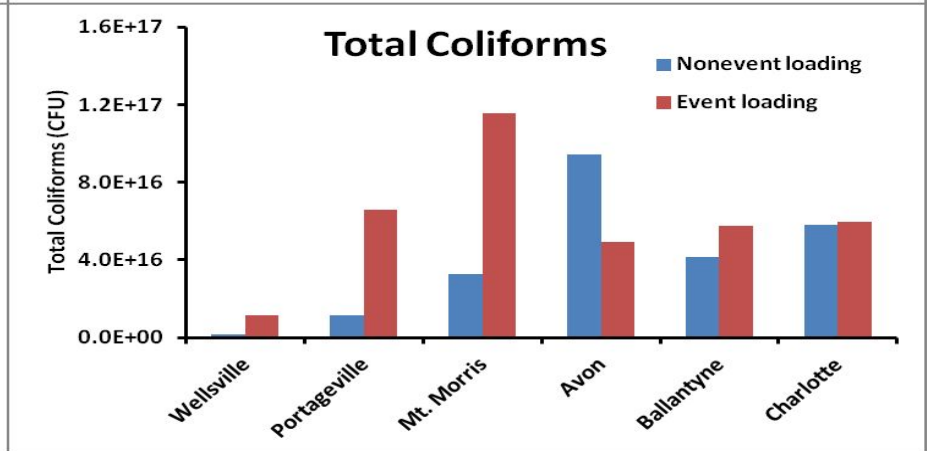
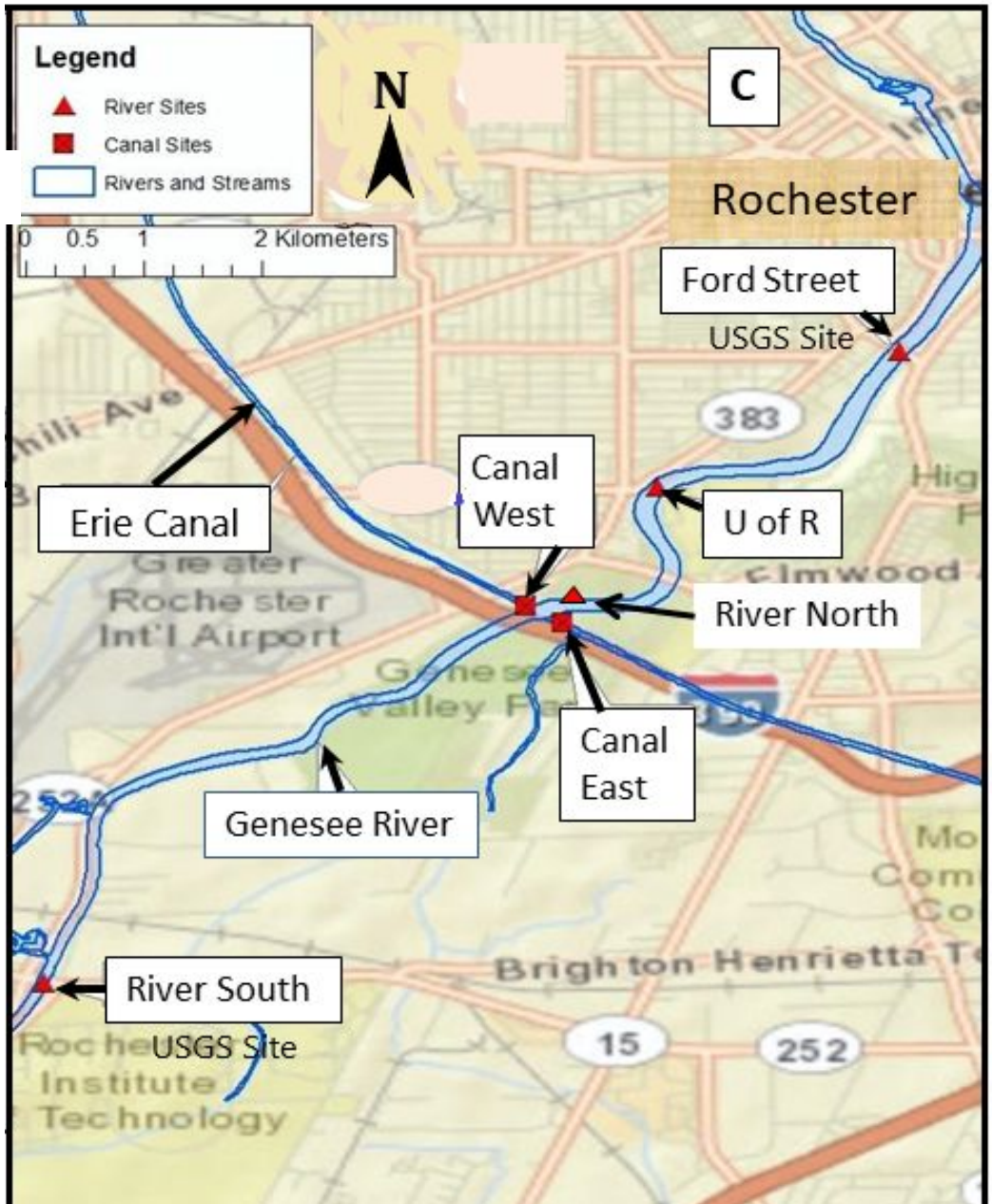
1.0E+08
0.0E+00
Wellsville
Portageville
Mt. Morris
Avon
Ballantyne
Charlotte


Total Coliforms
Nonevent loading
Event loading
Total Coliforms (CFU)
1.6E+17
1.2E+17
8.0E+16
4.0E+16
0.0E+00
Wellsville
Portageville
Mt. Morris
Avon
Ballantyne
Charlotte


C.P. WARD



Navigation Period (May 1 to 15 November)

*Total Phosphorus (weekly)

*Total Suspended Solids (weekly)

*Temperature (weekly)

*Specific Conductance (weekly)

*Canal current via Sonar Dopple Flow meter (8 dates)

*River current USGS sites at Ballantyne Road and Ford Street