LAKE OSCAWANA

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Northeast Aquatic Research, LLC

Presentation for residents of Putnam Valley, NY

November 10, 2018

PRESENTATION OUTLINE

- Basic Limnology (Lake Science) Review
- Annual Monitoring Program Description
- 2018 Water Quality Overview
- 2016-2018 Intensive Data Review / Aquatic Plant Management Planning
- New aquatic plant management considerations given recent findings
- Proposed updates to TMDL Implementation Plan (w/NYDEC) & NY 303d list explained…
- Reference TMDL and PH 2008 reports – what more do we know now and how does that affect management approaches?
- Watershed Assessment/Data & Cooperation with Town MS4 requirements
- Updates to testing at "biofilter" and considerations for future projects
- Summary and time for questions

BASIC LIMNOLOGY (LAKE SCIENCE) REVIEW

1 Data Collection → 2 Lake science/ interpret results → 3 Lake management

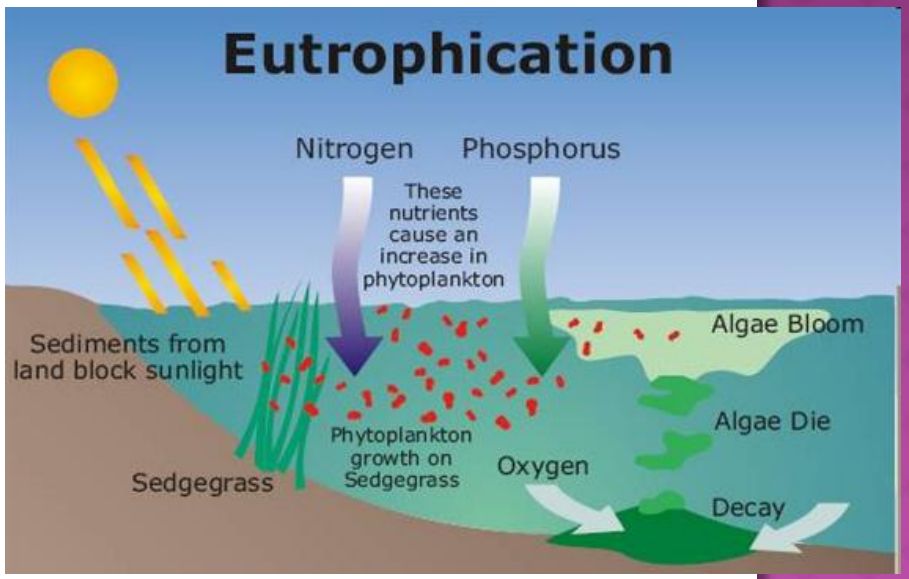
Invasive Species	HABs (cyanobacteria)

Bad water quality affects: recreation, human health, local economy, property values, & changes the ecosystem

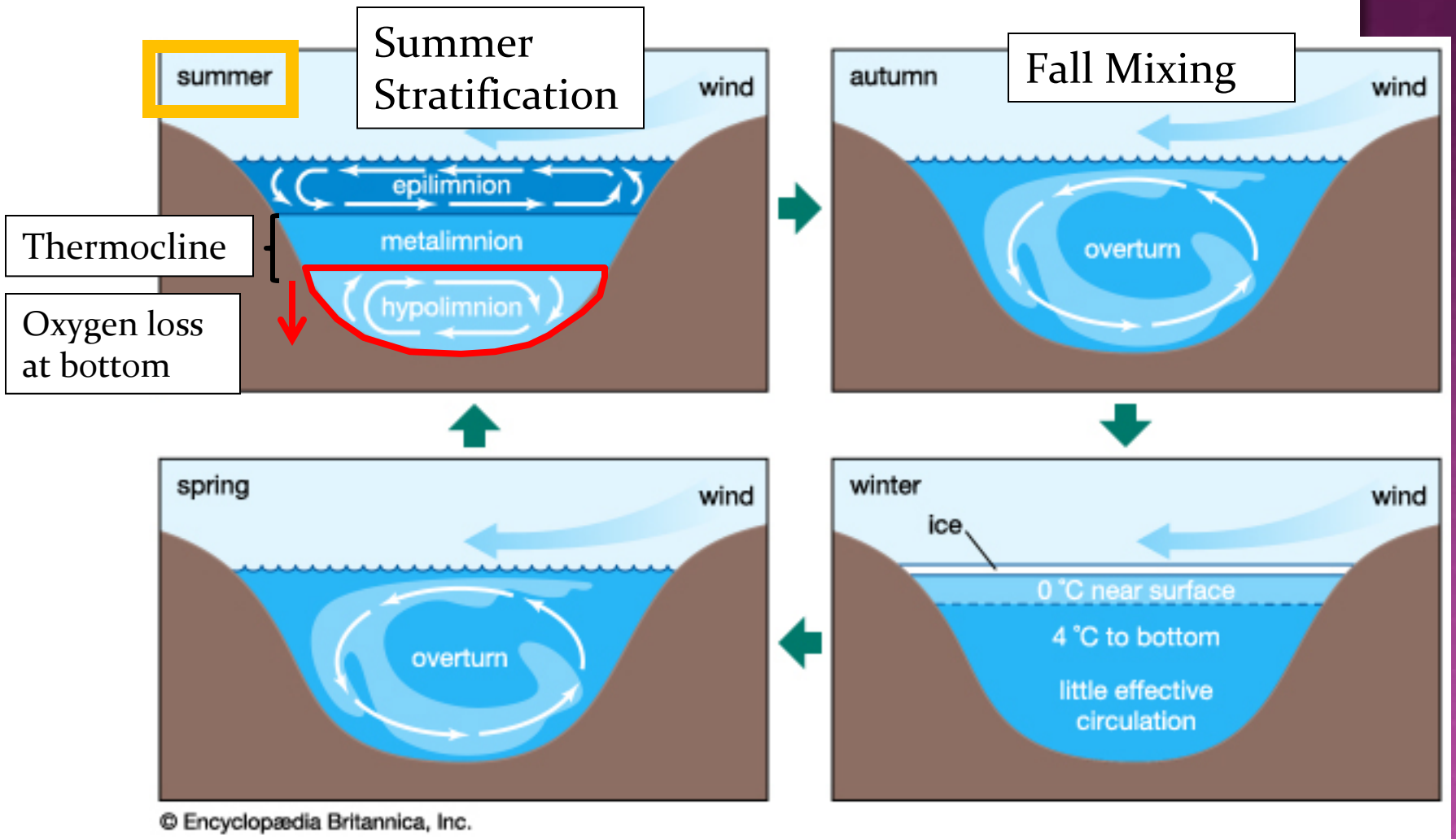
REVIEW: NUTRIENT POLLUTION (I.E. NITROGEN & PHOSPHORUS)

- Where are nutrients coming from?
  - Variability from month to month & year to year.
  - Streams, groundwater, septic systems, road runoff, internal

- Excess NutrientsCause:
  - More plants
  - Algae
  - O2 loss
  - Bad clarity
  - Recycling of nutrients



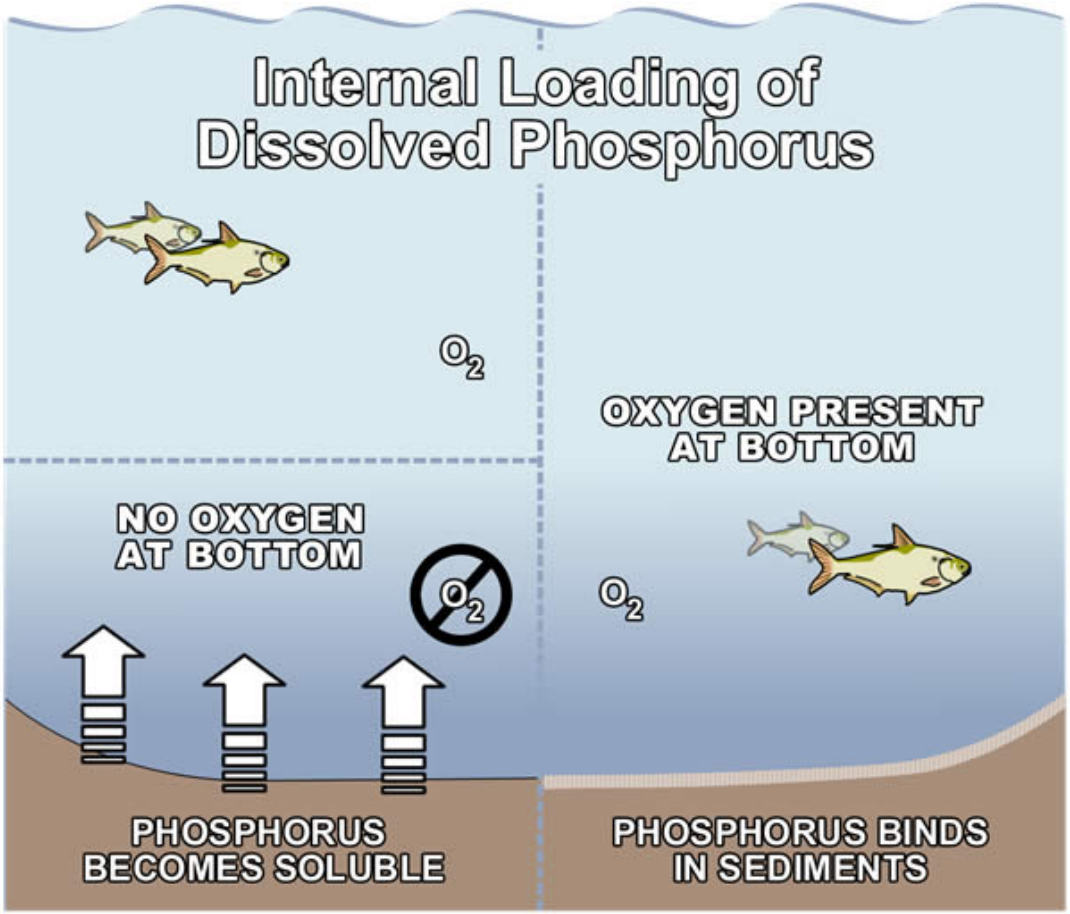
REVIEW: LAKE TEMPERATURE AND MIXING



Temperature & oxygen profile measurements to track seasonal changes

REVIEW: WHY IS STRATIFICATION IMPORTANT?

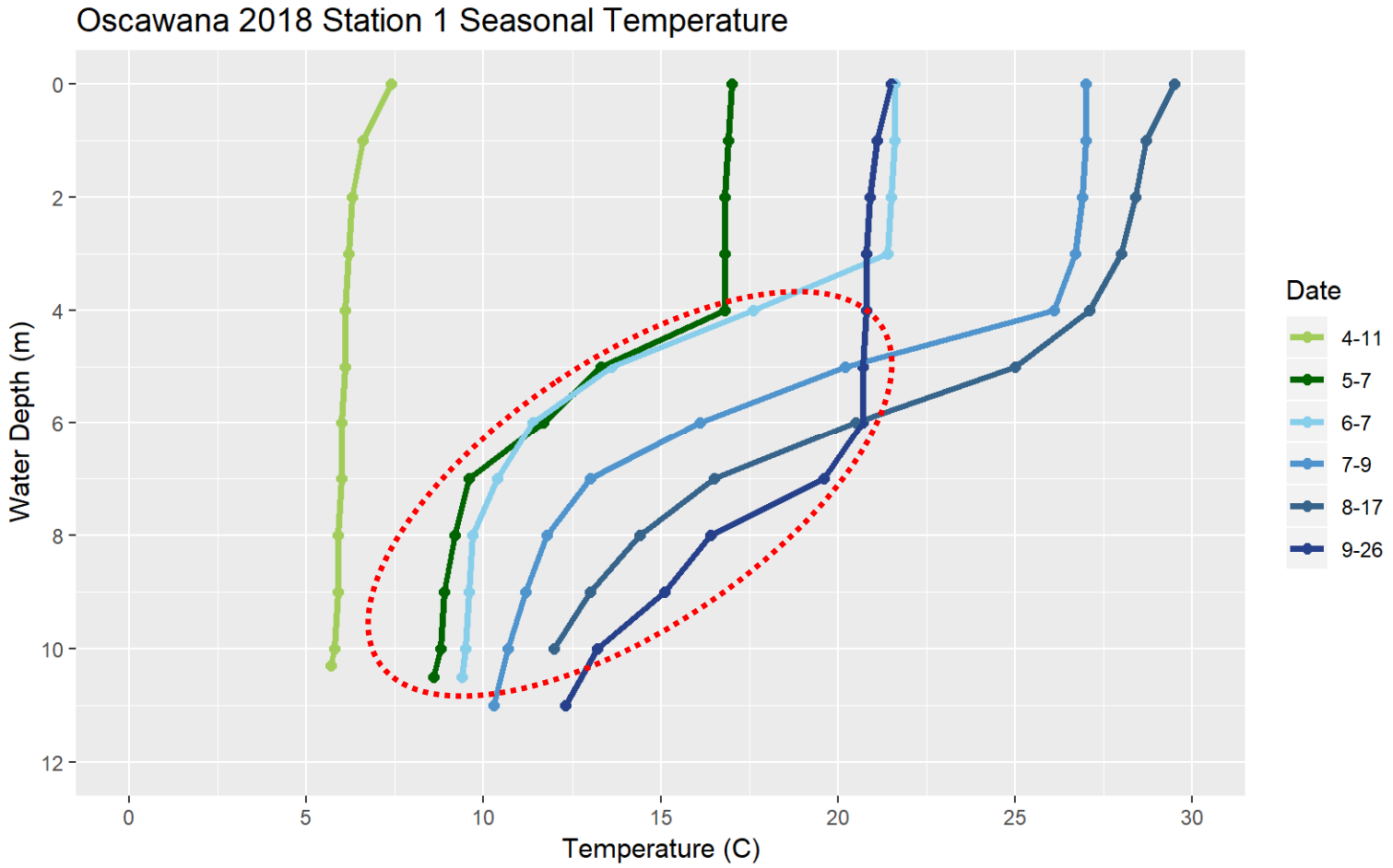
- Because it is related to internal recycling of nutrients (internal loading) from lake bottom mud



2018 WATER QUALITY

STARTING WITH TEMPERATURE:

- Thermal stratification in 2018 (temperature change with depth)

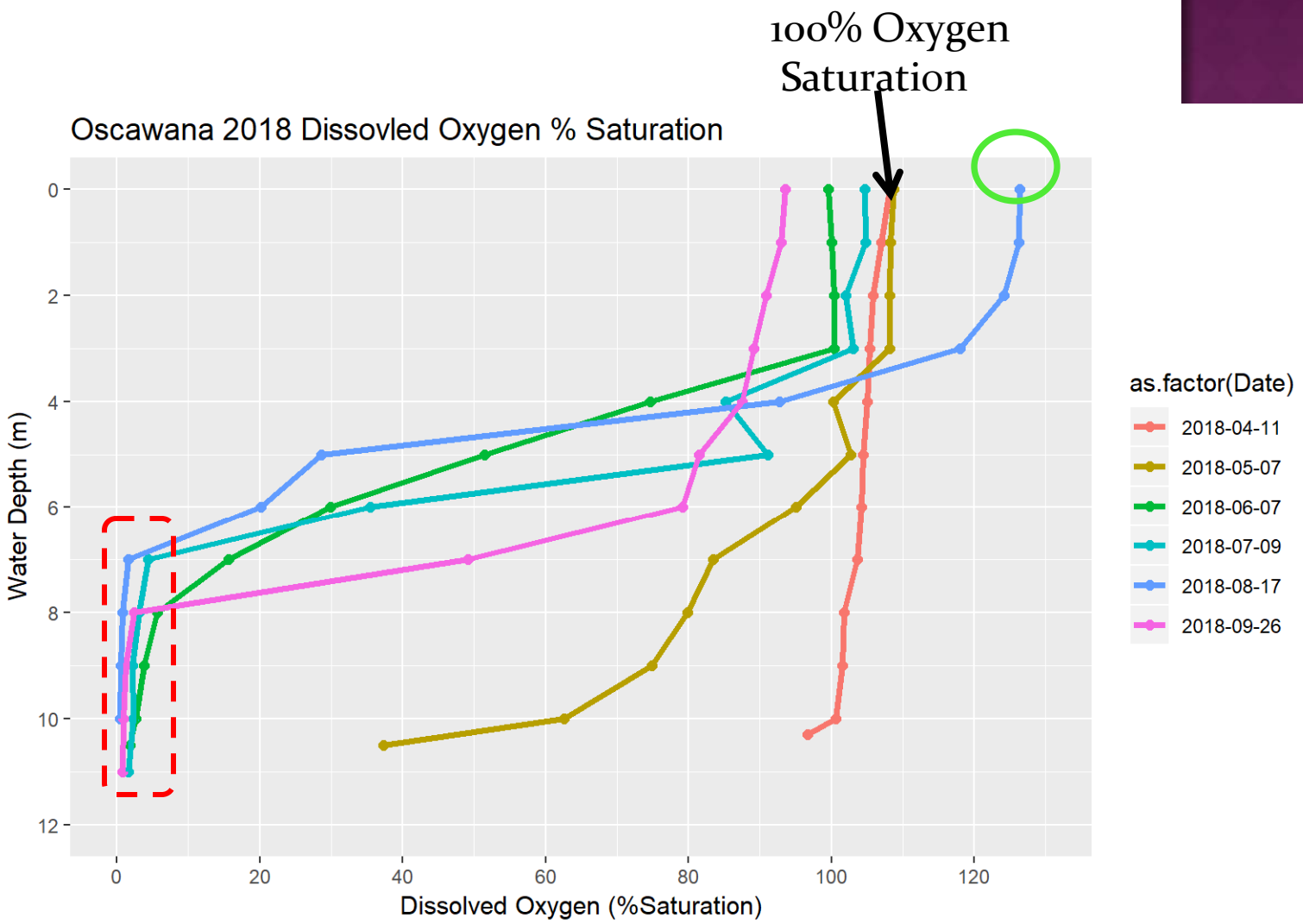


2018 DISSOLVED OXYGEN (% SATURATION)

By June there is no oxygen at the bottom.

By August there is no oxygen below 7m

(better than 2016!)

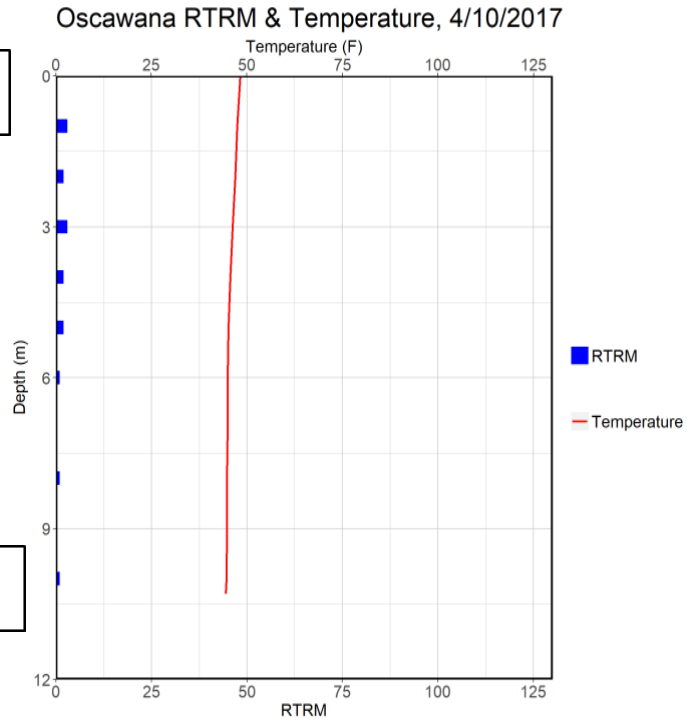


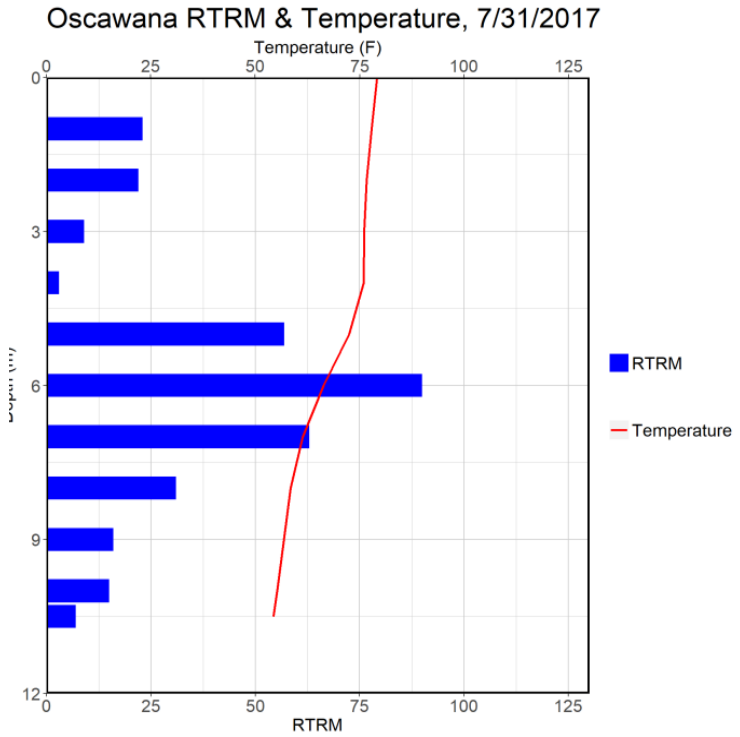
INTERPRETING RTRM GRAPHS IN WQ REPORTS:
RESISTANCE TO MIXING = TEMPERATURE DRIVEN DENSITY CHANGES

The higher the RTRM value **(blue bars)** the more energy required to mix water layers

Surface

Bottom



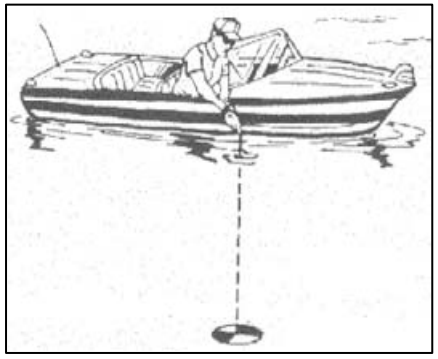


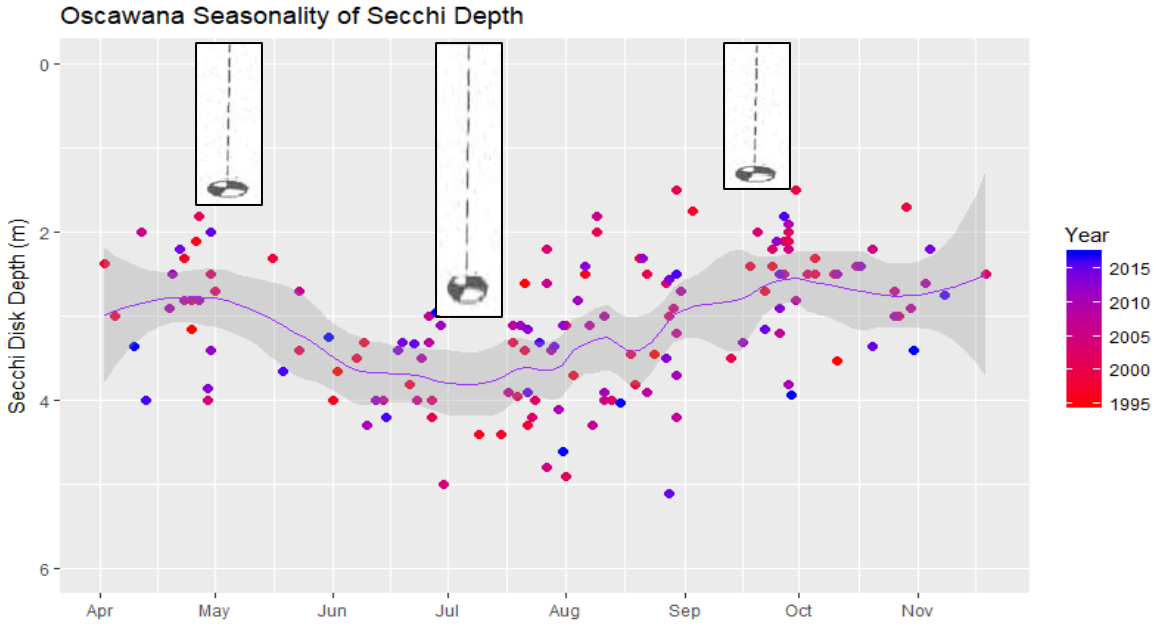
SECCHI DISK DEPTH (METERS)

- A MEASUREMENT OF WATER CLARITY

LARGER NUMBERS ARE BETTER FOR SECCHI!

Date	Station 1	Station 2	Station 3
4/11/2018	2.20	2.20	2.10
5/7/2018	2.80	2.90	2.75
6/7/2018	3.40	3.30	3.15
7/9/2018	4.60	4.85	4.30
8/17/2018	3.27	3.30	3.45
9/26/2018	2.65	2.50	2.50





2018 PHOSPHORUS CONCENTRATIONS

(MICROGRAMS/LITER)

THE LOWER THE PHOSPHORUS THE BETTER!

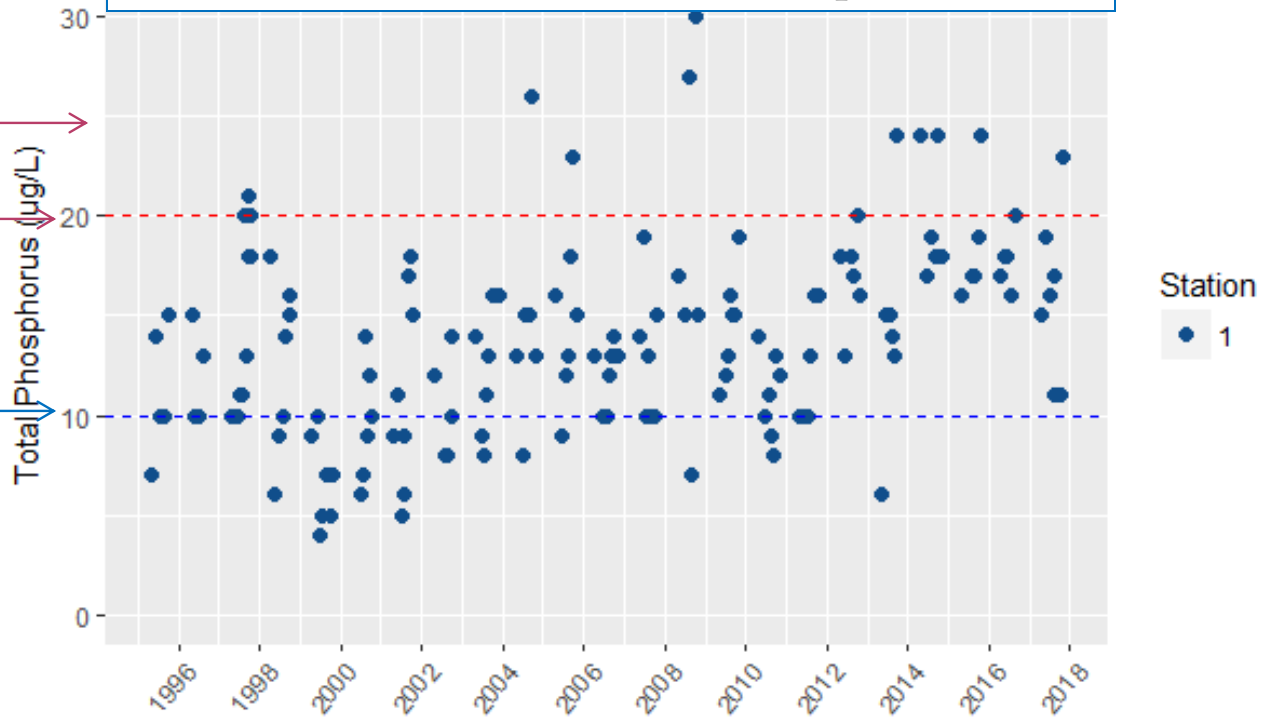
Total Phosphorus Results 2018 at Station 1 (deep hole)				
Date	1-meters	4-meters	6-meters	9-meters
4/11/2018	14	23	10	18
5/7/2018	18	22	16	28
6/7/2018	10	14	16	23
7/9/2018	12	15	31	112
8/17/2018	17	30	32	261
9/26/2018	20	16	16	552

Historical Station 1: 1m Total Phosphorus Data

>25 = HABs

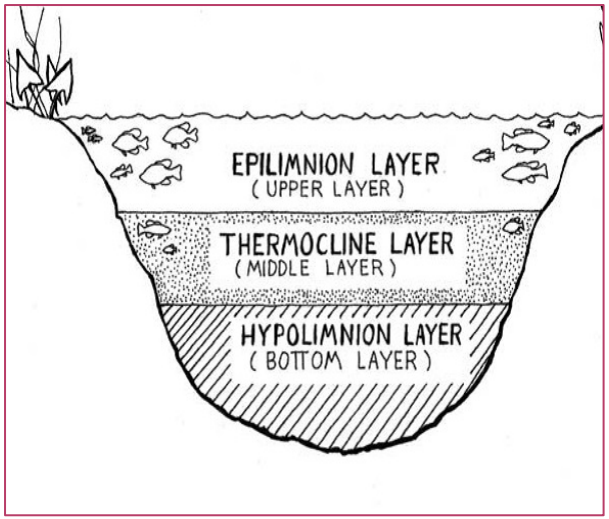
>20 = Bad

< 10 = Great



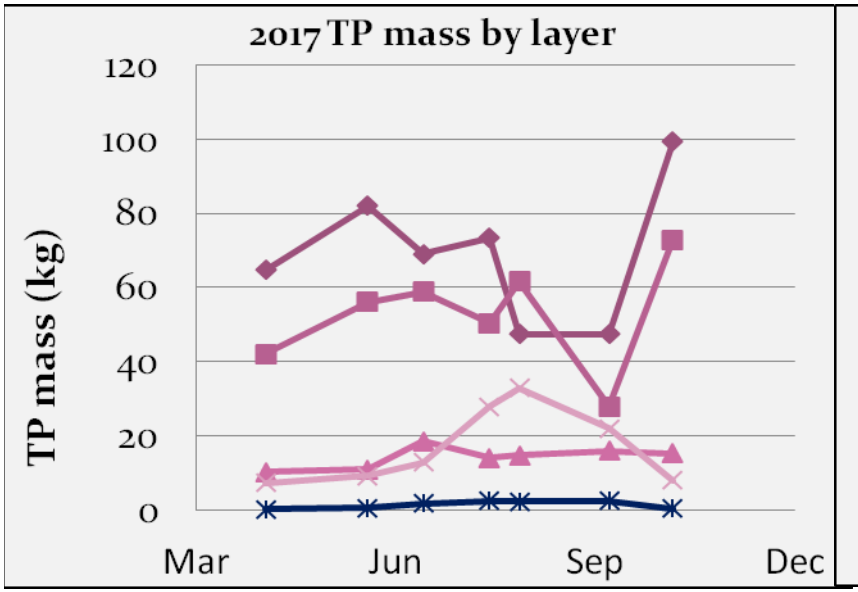
PHOSPHORUS MASS

(KILOGRAMS IN THE LAKE PER MONTH)

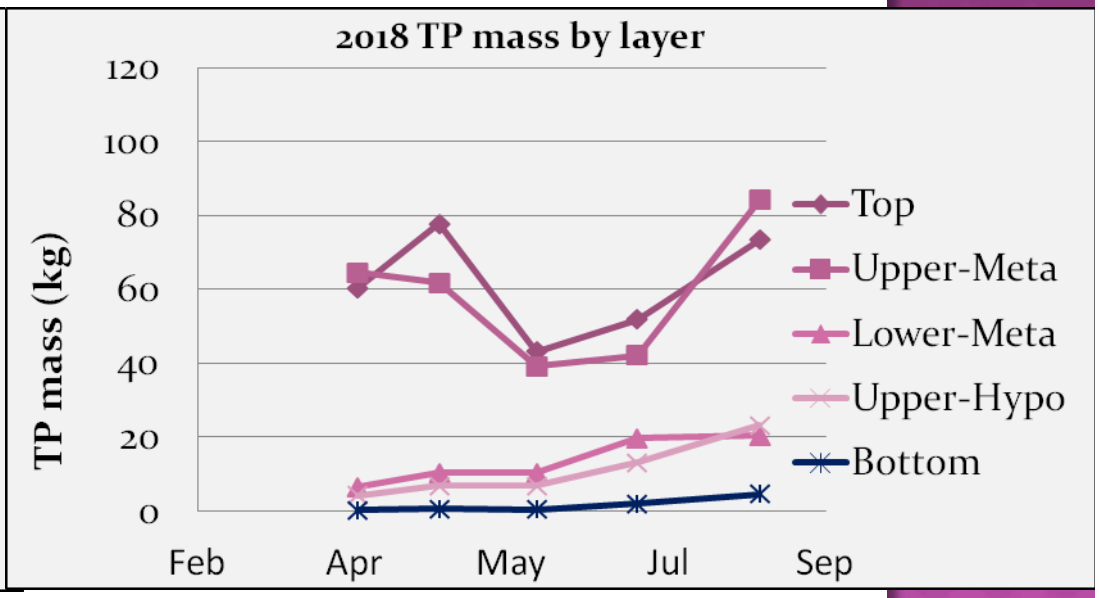


- Top (Epilimnion)
- Upper-Metalimnion
- Lower-Metalimnion
- Upper-Hypolimnion
- Bottom (Hypolimnion)

2017

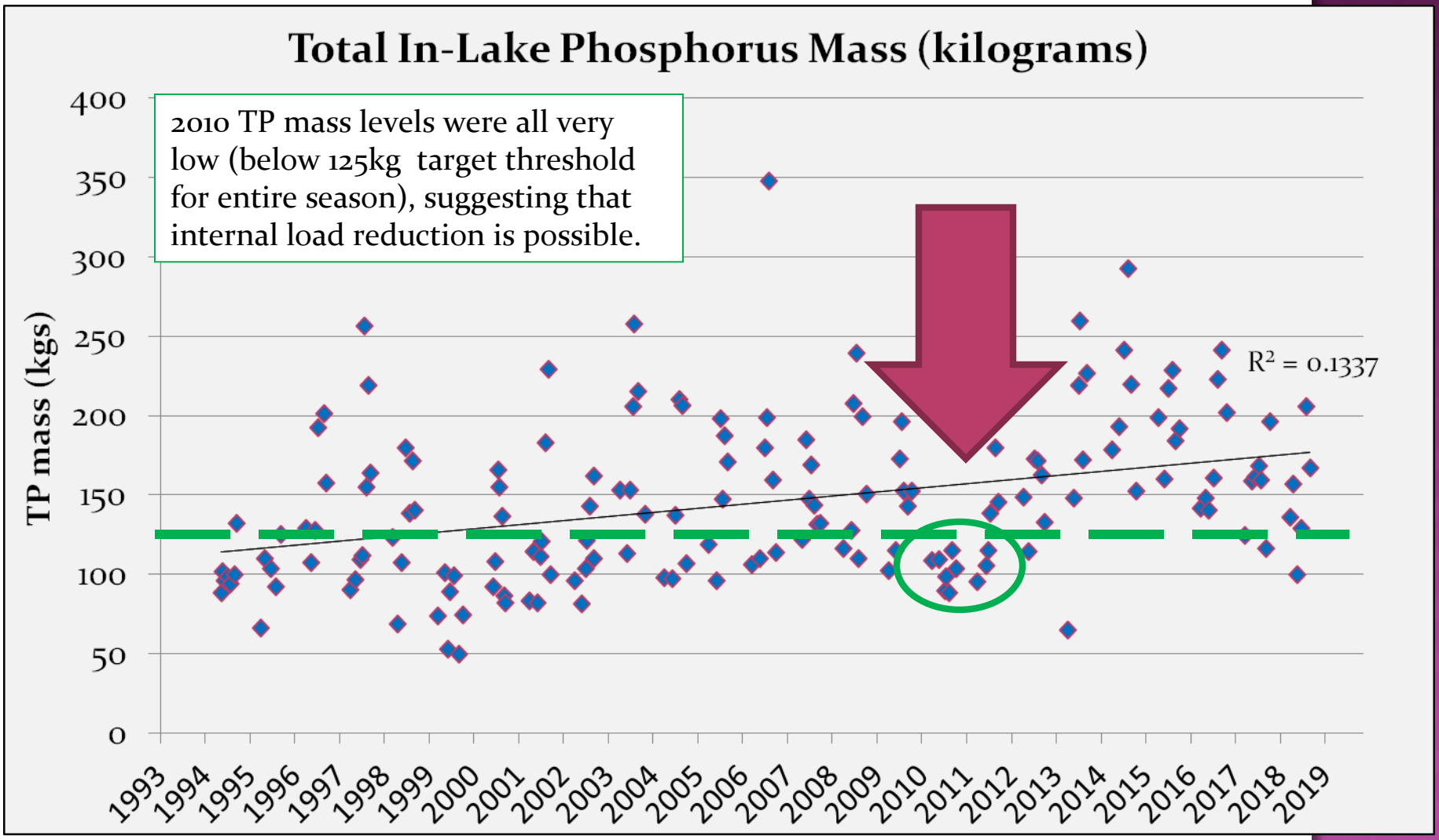


2018



HISTORICAL TREND IN TP MASS

- A QUANTITY BASED ON MEASURED CONCENTRATIONS



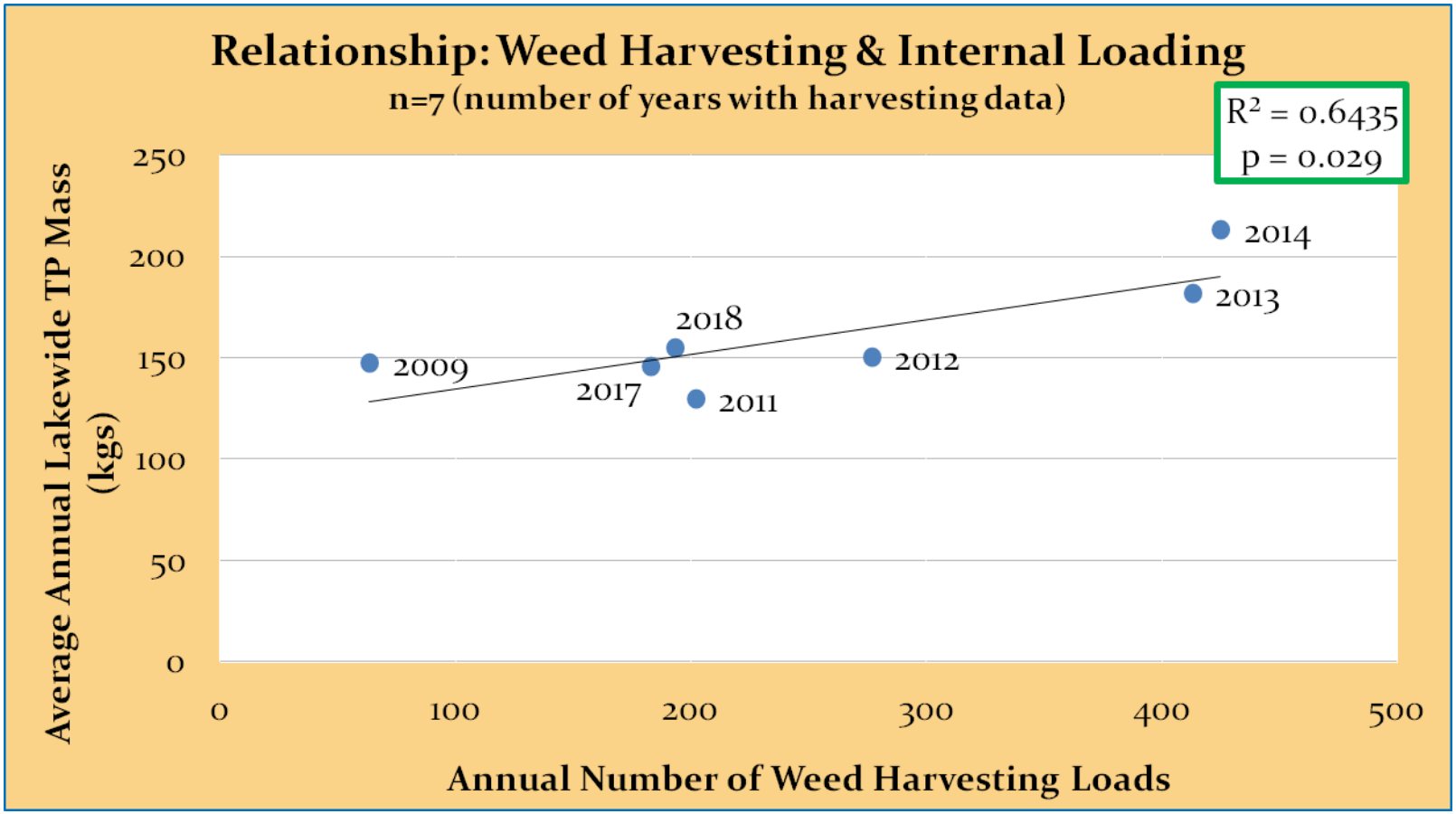
REVISITING A FEW HYPOTHESES FROM 2017:

- If internal loading was suppressed via reduction in external (watershed) nutrient loading, how did that happen?
  - Septic system pump-outs
  - Weed harvesting
  - Watershed improvements & stream data
- Does weed harvesting impact water quality?
  - Primarily through sediment disturbances in shoreline areas

IMPACT OF WEED HARVESTING ON WATER QUALITY

- VIA ANALYSIS OF WEED HARVESTING TIME SHEETS/ DESCRIPTIONS

People may think it's related to grass carp but it really appears to be related to weed harvesting efforts…



SEDIMENT DISTURBANCE LIKELY INCREASES PHOSPHORUS LOADING FROM SHALLOW SEDIMENTS (I.E. ABELE COVE)

Note: **Dredging sediments removes material**, usually resulting in long-term decreases in phosphorus, but weed **harvesting in shallow areas repeatedly disturbs sediments with little removal**.

Short-Term Nitrogen and Phosphorus Release during the Disturbance of Surface Sediments: A Case Study in an Urbanised Estuarine System (Gold Coast Broadwater, Australia)

April 2017

Assessment of the Risk of Phosphorus Loading Due to Resuspended Sediment

May 2001 · Journal of Environmental Quality 30(3):960-6

DOI: 10.2134/jeq2001.303960x

Source · PubMed

Effect of Sediment Resuspension of Phosphorus Flux to Lake Erie

Stephanie Hummel Advisor: Gerald Matisoff

Department of Earth, Environmental, and Planetary Sciences Case Western Reserve University Cleveland, OH 44106

Erie have increased in both number and size and have

RESULTS

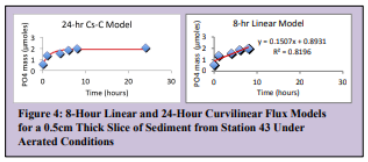


Figure 4: 8-Hour Linear and 24-Hour Curvilinear Flux Models for a 0.5cm Thick Slice of Sediment from Station 43 Under Aerated Conditions

- In every experiment, concentration increased with time.
- Experiments conducted under nitrogen released more phosphorus because

Table 1: Increase in Phosphorus Concentration in the Lake the GLWQA target loading.

	[ ] Increase
	%
Batch, Station 43	2.6-30.6
Incubation, Station 43	0.2-0.6
Batch, Station 91M	8.7-39.8
Incubation, Station 91M	0.05-1.2

Hydrobiologia

January 1992, Volume 228, Issue 1, pp 91–99 | Cite as

Phosphorus release from resuspended sediment in the shallow and wind-exposed Lake Arresø, Denmark

Authors Authors and affiliations

Martin Søndergaard, Peter Kristensen, Erik Jeppesen

- Scientific Publications Suggest Sediment Disturbance Increases Internal Phosphorus Loading in Shallow Sediments
  - http://nsgl.gso.uri.edu/ohsu/ohsuwr14002.pdf
  - https://www.researchgate.net/publication/11938960_Assessment_of_the_Risk_of_Phosphorus_Loading_Due_to_Resuspended_Sediment
  - https://www.researchgate.net/publication/315890052_Short-Term_Nitrogen_and_Phosphorus_Release_during_the_Disturbance_of_Surface_Sediments_A_Case_Study_in_an_Urbanised_Estuarine_System_Gold_Coast_Broadwater_Australia
  - https://link.springer.com/article/10.1007%2FBF00006480

- Sediment plume behind harvester – It does work to remove Eurasian milfoil (temporarily) but it's messy

TRANSPORT OF SEDIMENT & NUTRIENTS

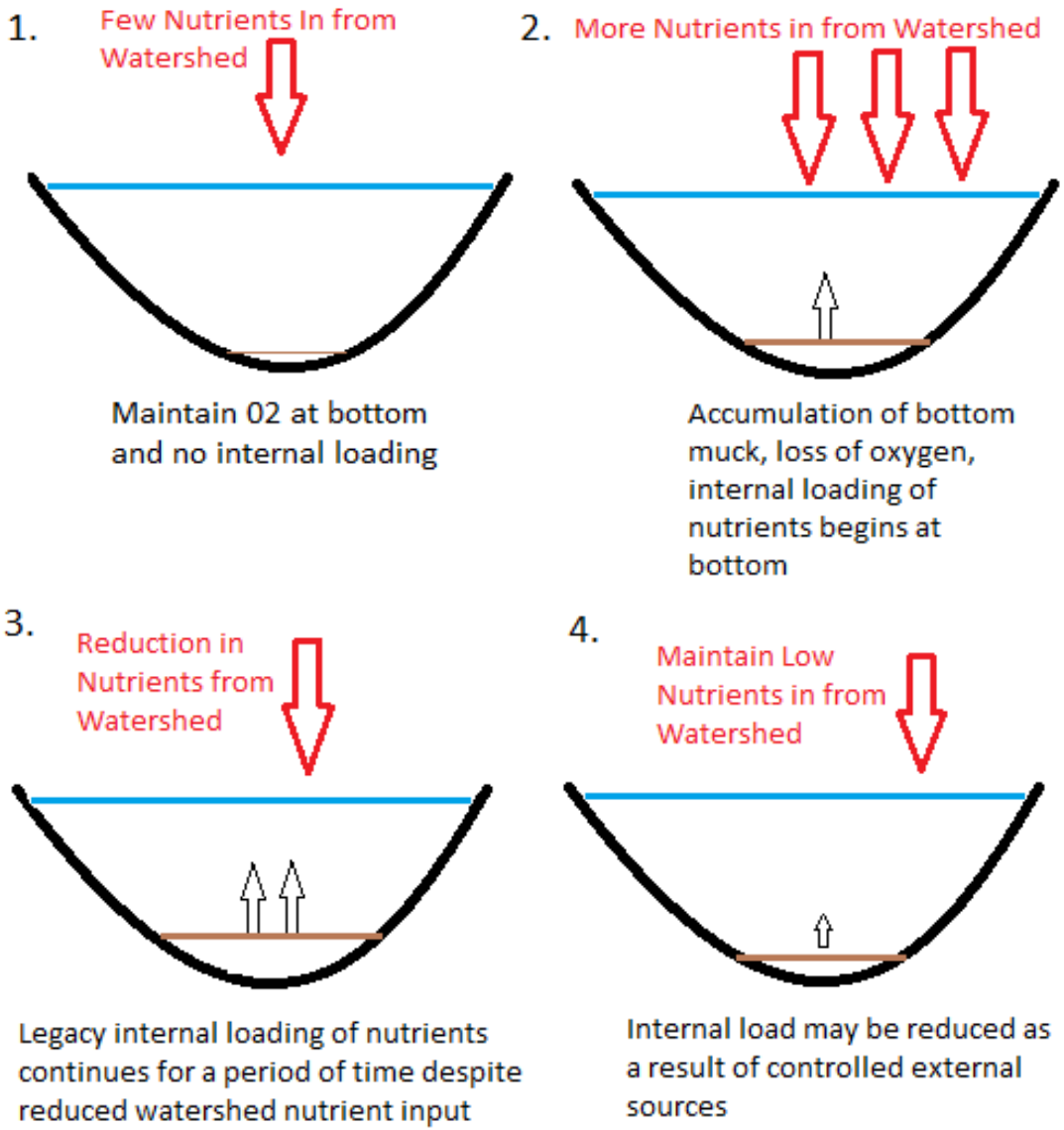
Below: Satellite image example of wind/current sediment transport across water (Long Island Sound)

<u>Oscawana Lake, Abele Cove</u>

(June 2018) – sediment disturbance from weed harvester

NEW PLAN:

- Reduce Internal Loading without Alum and Without Aeration
- Annual P-mass changes dramatically from year to year….
  - Related to harvesting and septic pumping?
- Detective work will hopefully pay off…

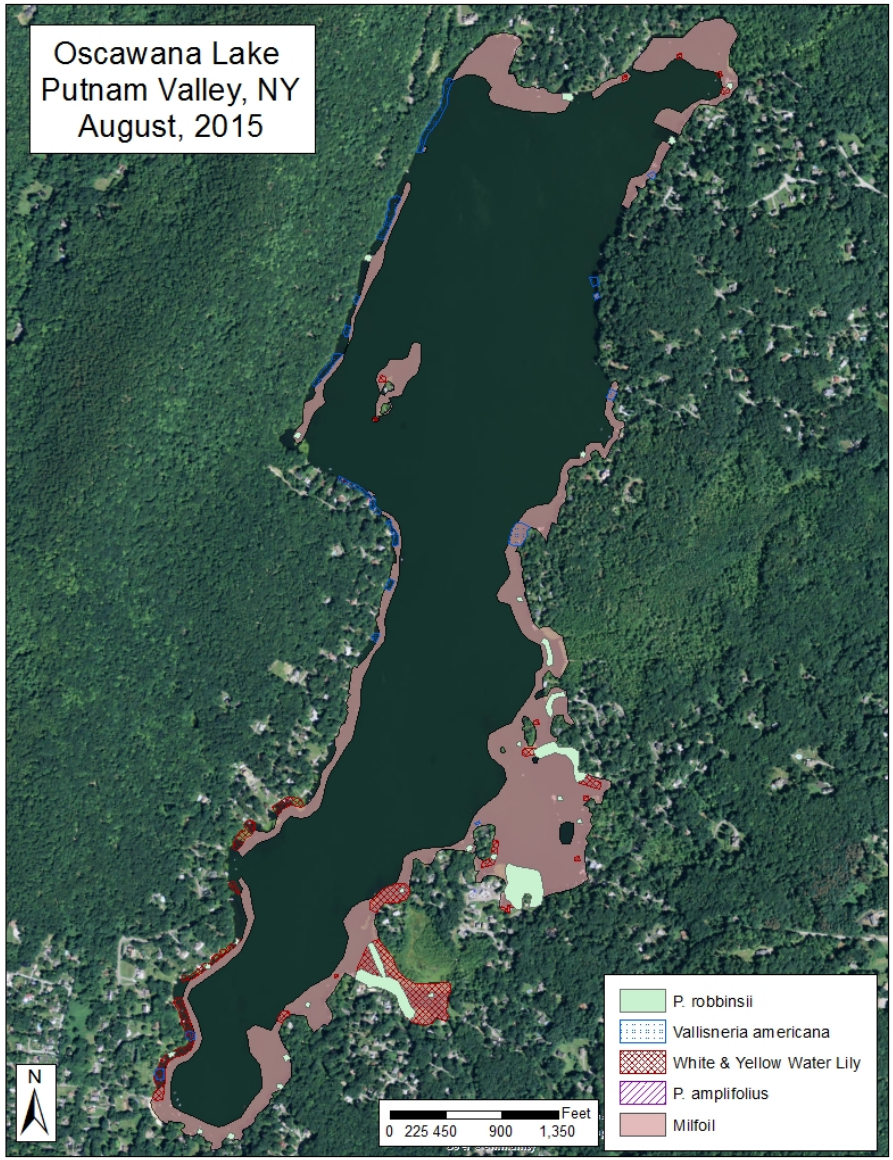


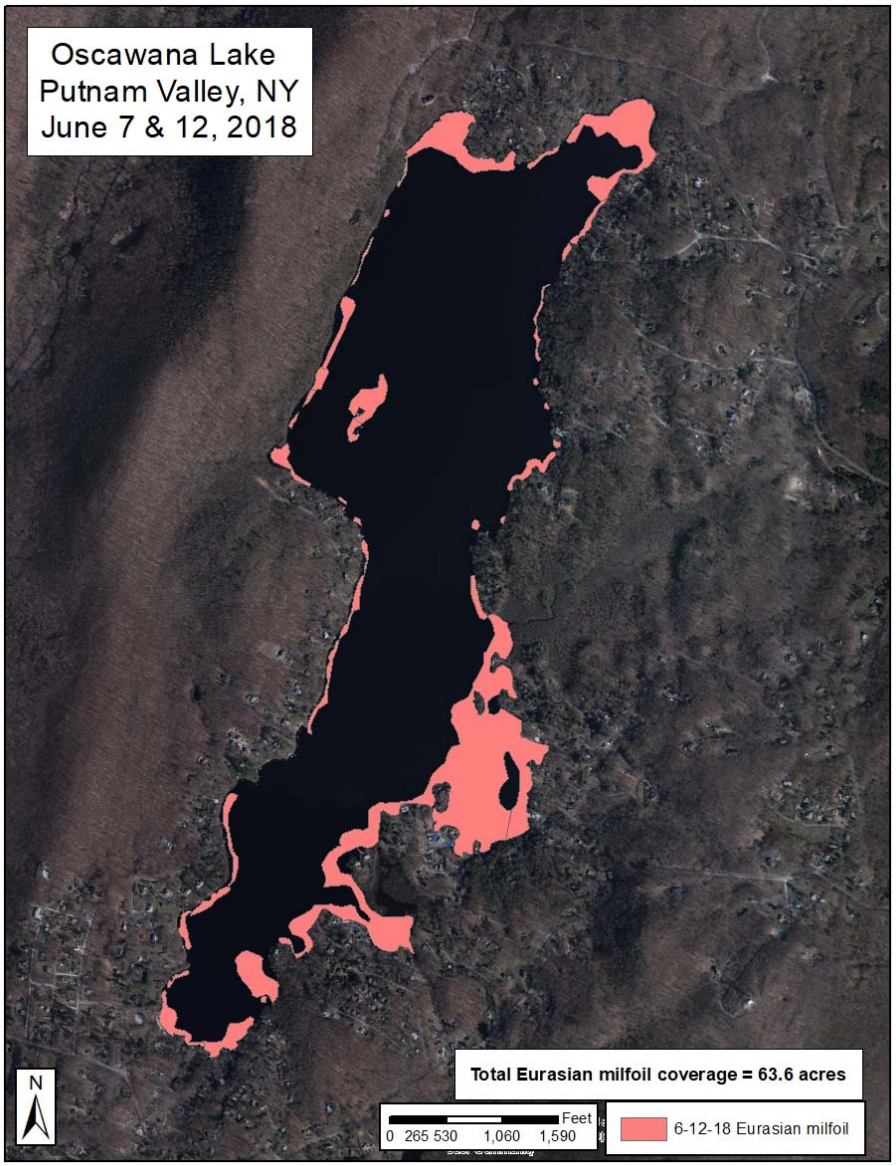
PRELIMINARY 2018 WEED HARVESTING DATA

- Frequent disturbance of Abele Cove sediments is not good for water quality
- Disturbance of water lilies should not be performed with a weed harvester and requires a wetlands permit
- Despite Abele Cove sedimentation and plant growth, the outflow is not presently affected (water simply flows around and over everything – no stagnation observed in 2018, both outflows now checked monthly)

	2018 Weed Harvesting Season
16	skimming "floaters" loads
36	Total Loads from Abele Cove
183	Total Harvesting Loads in 2018
20%	**% Loads in 2018 from Abele Cove**
9%	% Loads cleaning up "floaters" and plant fragments

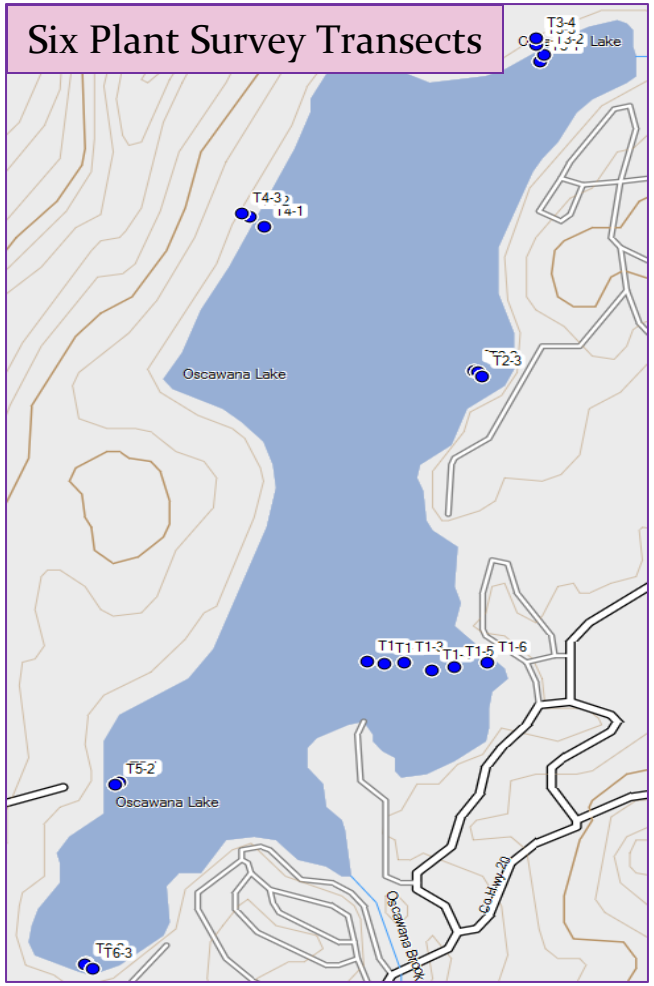
2015 VS. 2018 EURASIAN MILFOIL COVERAGE





2016 & 2017 AQUATIC PLANT ANALYSIS

– ESTABLISHED A BASELINE FOR STUDYING LONG TERM EFFECTS OF GRASS CARP



Date	July 22nd	June 12th	July 22nd	June 12th	July 22nd	June 12th
Year	**2015**	**2018**	**2015**	**2018**	**2015**	**2018**
Species Name	**Count**	**Count**	**% Frequency**	**% Frequency**	**Overall %**	**Overall %**
Myriophyllum spicatum	183	191	69	86	41	49
Ceratophyllum demersum	20	15	8	7	3	1
Potamogeton amplifolius	108	108	41	49	10	26
Potamogeton robbinsii	17	50	6	23	5	17
Vallisneria americana	15	29	6	13	2	11
Filamentous algae	13	13	5	6	2	6

DISPELLING MYTHS OF GRASS CARP

- NEED to be CAREFUL in stocking too many grass carp
- Oscawana was NOT under-stocked initially – DEC was being careful to avoid past mistakes
- Early stocking cases in NY lead to OVERSTOCKED lakes and decimation of plants/increases in algae
- Possible to re-stock in 2019 (at low levels) **IF** harvester operations are reduced

Goal: Find happy medium without falling over the edge

Survival rates vary

Kirk & Socha (2003) SC study from 1989 to 2002 estimated ~10% survival over 5-9yrs

Plant control and effect on water quality vary

Macenia et al. (1992) & Kogan (1974) studies saw increase in blue-green algae with elimination of plants via grass carp

Lower stocking densities & partial plant control appears to have minimal impact on phytoplankton

Pipalova (2002)

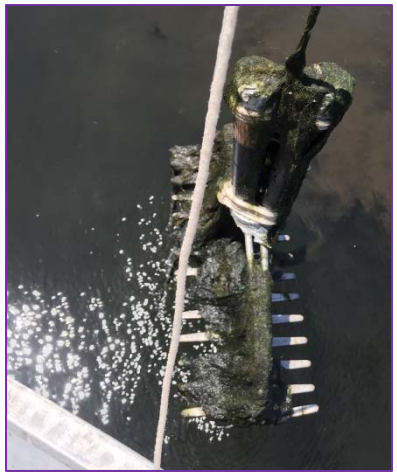
Bonar et al. (2002)

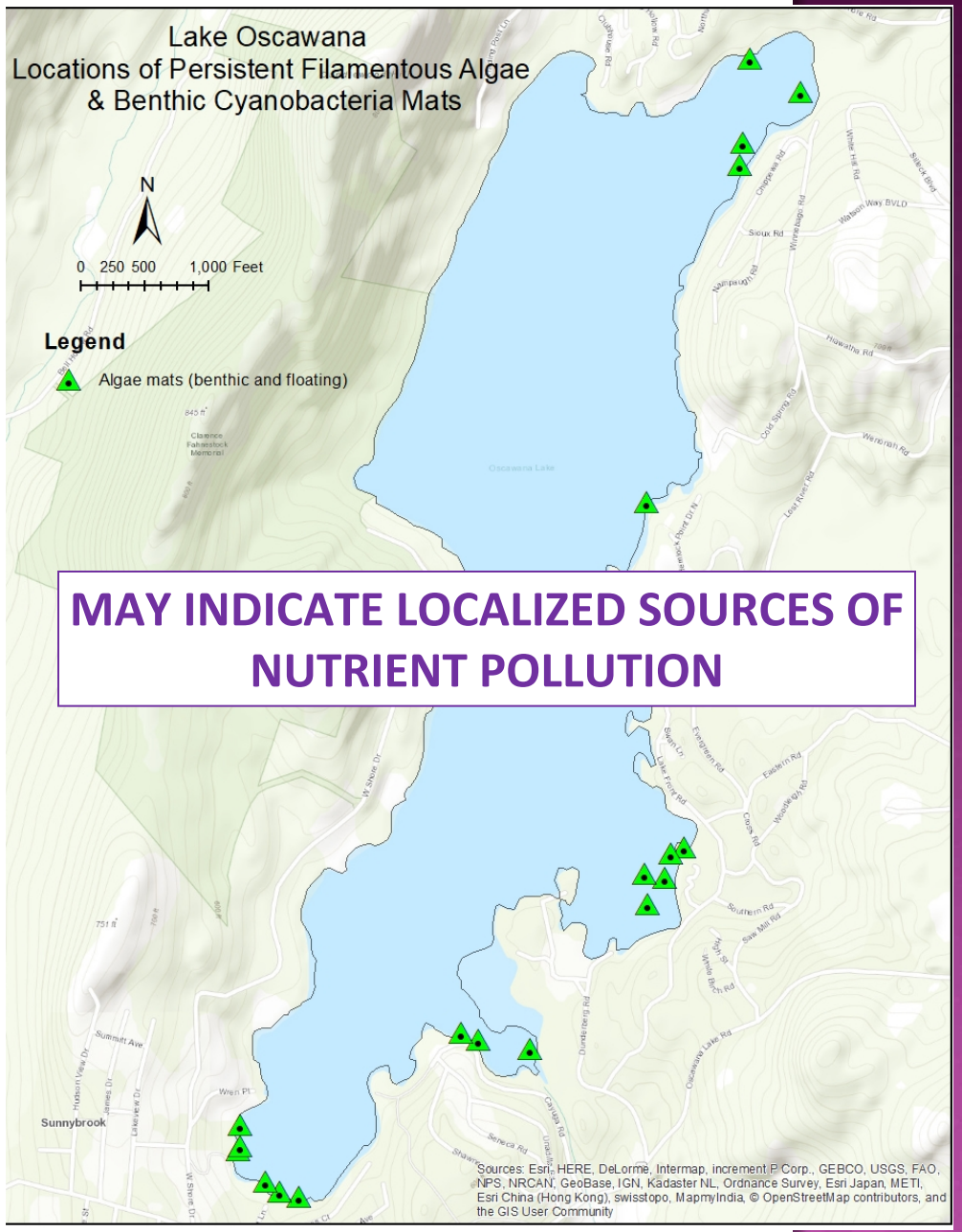
Cassani et al. (1995)

PAY ATTENTION TO NON-PLANKTONIC ALGAE

- 1. Filamentous green algae blobs

- 2. Bottom-dwelling cyanobacteria mats





NY DEC STATUS OF OSCAWANA = 4A/4C

Impaired Waters NOT Included on the NYS Section 303(d) List

Not all impaired waters of the state are included on the Section 303(d) List. By definition, the List is limited to impaired waters that require development of a Total Maximum Daily Load (TMDL). A list of Other Impaired Waterbody Segments Not Listed (PDF, 83 KB) on the 303(d) List Because Development of a TMDL is Not Necessary is also available. The purpose of this supplemental list is to provide a more comprehensive inventory of waters that do not fully support designated uses and that are considered to be impaired. (NOTE: This list will be updated upon USEPA approval of the Proposed Final 2016 List.)

There are three (3) categories of justification for not including an impaired waterbody on the Section 303(d) List:

- Category 4a Waters - TMDL development is not necessary because a TMDL has already been established for the segment/pollutant.
- Category 4b Waters - A TMDL is not necessary because other required control measures are expected to result in restoration in a reasonable period of time.
- Category 4c Waters - A TMDL is not appropriate because the impairment is the result of pollution, rather than a pollutant that can be allocated through a TMDL.

- Note: not all polluted lakes are on the "impaired" 303d list (lakes may be polluted with nutrients, but the NY DEC has to know about that in order for the lakes to be listed) – they add lakes every year and seldom take them off…
- NY DEC still considers Oscawana "Impaired" but it is "borderline" and could potentially be delisted in future.
  - Town needs to apply for water quality improvement grants in 2019
  - DEC agreed to an update of the TMDL Implementation Plan with new data and proposed projects
    - Original TMDL did not include internal loading estimates! And projected unrealistic reductions in regulated stormwater conveyance areas…
  - EPA format Watershed-based plans will guide this new TMDL Implementation Plan

RECOMMENDATIONS FROM 2008 PH PLAN

- AND NEAR UPDATED INFORMATION / NEW OPTIONS FOR FUTURE

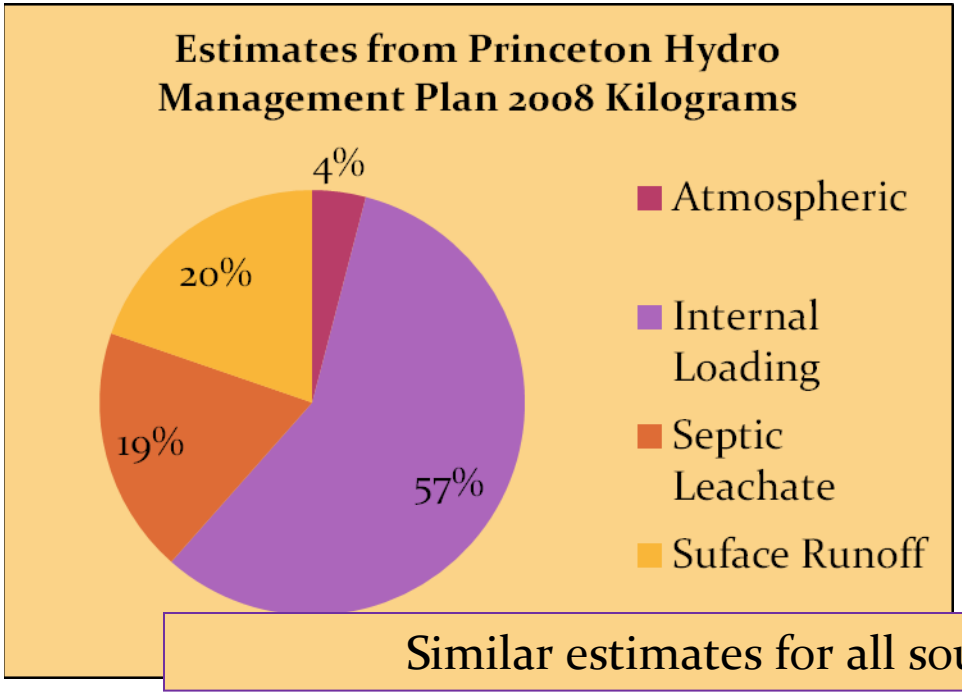
- 1. Alum or Aeration for Internal Load Control… >$254,000-$668,000 over 5yrs (did not happen)
  - Intensive review of phosphorus data suggests that internal load intensity is related to both external loading (septic system pumping in 2010 & 2017-18) and loading of shallow sediment to deep water via weed harvesting
- 2. $215,000 over 5yrs for Mechanical weed harvesting…
  - Well, is it worth it to continue this method given new findings?
  - Are residents open to other combination methods of control?

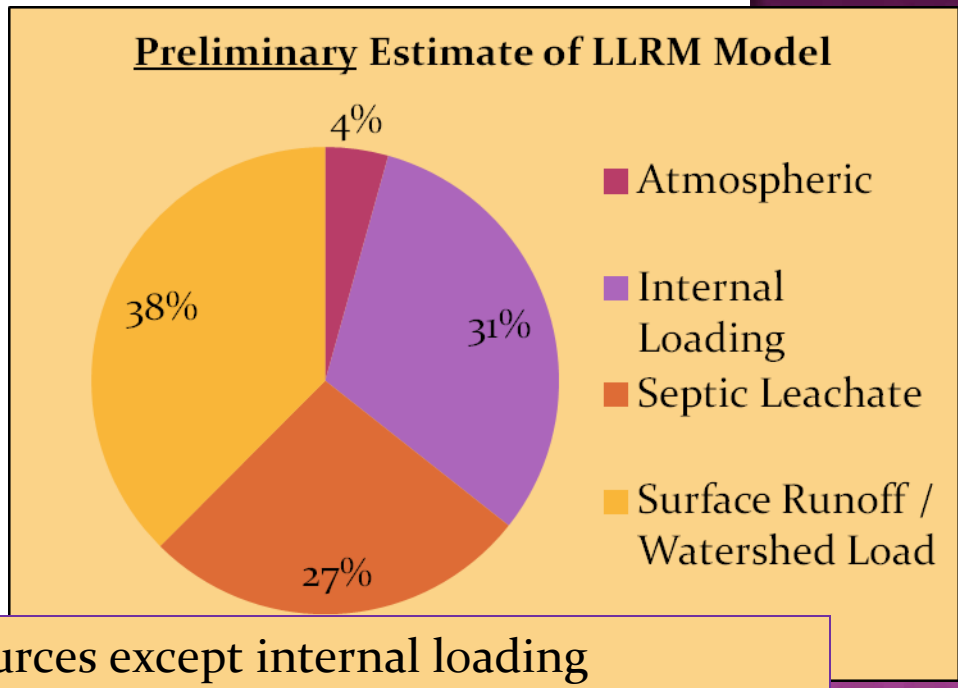
Management Action	Estimated Costs (in 2008 Dollars)	Proposed Timeline 2008	2009	2010	2011	2012	2013	5-Year Total
IN-LAKE NUTRIENT LOAD								
Alum P-Inactivation								
Sampling, bench tests, permitting	$50,000.00		$50,000					$50,000
Implementation Costs	$200,000.00			$200,000				$200,000
Operating Costs (post-monitoring)	additional water quality monitoring costs			$1,000	$1,000	$1,000	$1,000	$4,000
Metric	Surface / bottom water TP concentrations, chlorophyll a concentrations and Secchi disk water clarity							
Artificial Circulation								
Design of System Costs	approx. $10,000.00				$10,000			$10,000
Implementation Costs*	$190,000.00				$190,000			$190,000
Operating Costs (per month of operation -- Elec. / Maint.)	$2,600 / month				$15,600	$15,600	$15,600	$46,800
* does not include any purchase of land, if required								

Lake Oscawana - Restoration Program

Management Action	Estimated Costs (in 2008 Dollars)	Proposed Timeline 2008	2009	2010	2011	2012	2013	5-Year Total
VEGETATION MANAGEMENT								
Mechanical Harvesting								
New mechanical weed harvester	approx. $90,000.00		$90,000					$90,000
Annual operating costs	approx. $25,000.00		$25,000	$25,000	$25,000	$25,000	$25,000	$125,000

NUTRIENT LOADING MODELS COMPARISON



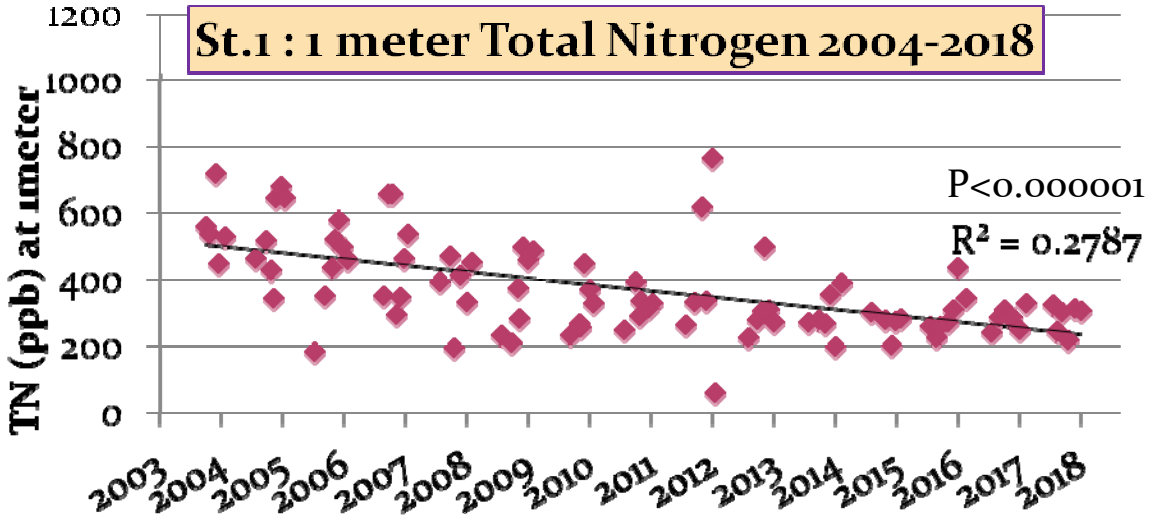


Similar estimates for all sources except internal loading

- Likely an initial over-estimate of internal loading in PH report
- LLRM septics estimated from 2008 conditions & # of systems as stated in 2008 TMDL report
  - 2017-2018: septic updates and regular pumping % should be a bit lower
- Supported by NEAR field data and mass Phosphorus calculations
  - The internal loading rate is an estimate of 2002-2017

SEPTIC SYSTEM IMPACTS LESSENING OVER THE YEARS WITH UPDATES AND PUMPING

- Septic pump-out law passed in 2010
  - 2010 & 2017 Best water quality years
- Evidence of surface water impacts from shoreline concentration monitoring (shoreline areas often higher phosphorus than open water)
- Evidence of decreasing Total Nitrogen trend in lake



Statistically significant!

Date	TN
4/11/2018	320
5/7/2018	240
6/7/2018	298
7/9/2018	214
8/17/2018	311
9/26/2018	301

SEPTIC SYSTEM UPDATE GRANTS:

Think of it as an Investment in your Property and your lake

LO residents may receive a grant from the County Health Department if you live within 250 feet from the lake

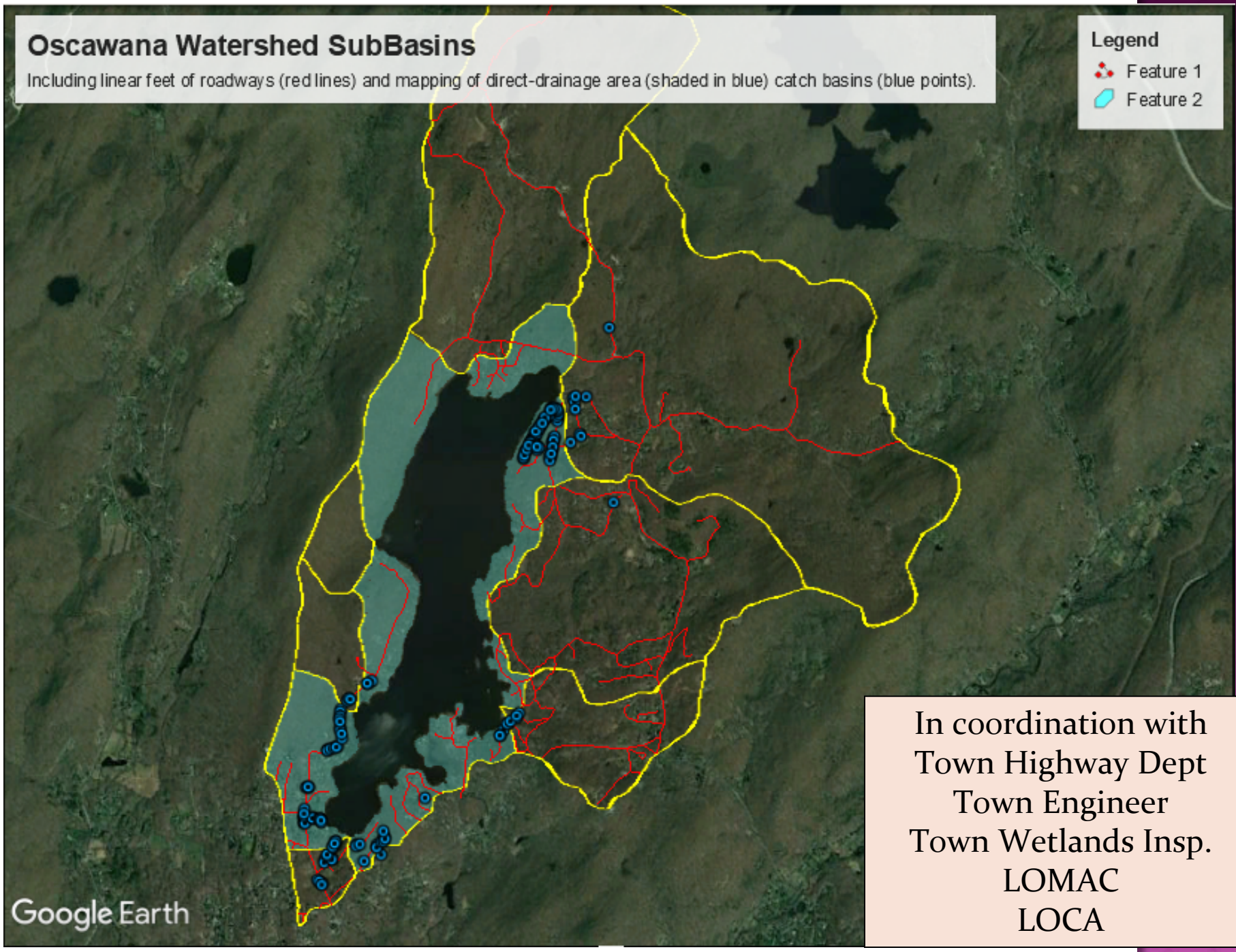
If you live 250 feet from the lake and need repair of your septic system, you can receive up to $10,000 (50% match of the cost). You will receive a letter from the health department if you are eligible.

MS4 (MUNICIPAL SEPARATE STORM SEWER SYSTEM) PROGRESS

- STORMWATER IMPROVEMENT EFFORTS IN PUTNAM VALLEY OVERALL

Year	Basins Cleaned	Illicit Discharges	Stop Work Orders	%LID Training Programs	% MS4 conveyance system mapped in GIS	%On-site wastewater inspections
2008-2009	(Not reviewed)					
2009-2010	(Not reviewed)					
2010-2011	144	2	39	100%	0%	1%
2011-2012	144	3	6	50%	0%	1%
2012-2013	144	2	16	0%	0%	1%
2013-2014	144	8	47	0%	0%	1%
2014-2015	144	8	47	0%	50%	1%
2015-2016	144	3	47	0%	50%	1%
2016-2017	144	0	16	25%	50%	20%
2017-2018	30	5	15	0%	60%	20%
2018-2019	(Report coming Marcy 2019)					

Not exactly clear how many catch basins had been cleaned each year, but most MS4 reporting years appear to have cleaned "all" once per year **(removing sand / debris)**



In coordination with
Town Highway Dept
Town Engineer
Town Wetlands Insp.
LOMAC
LOCA

Western Biofilter

	Sample ID	Description	Date	Nitrate	Total Nitrogen	Total Phosphorus
2	Oscawana Inlet 5 #2	Culvert Flowing into Plunge Pool	2/27/2018	103	140	10
3	Oscawana Inlet 5 #3	Plunge Pool Outlet	2/27/2018	119	167	9
4	Oscawana Inlet 5 #4	Biofilter Outflow to Lake	2/27/2018	87	169	16
	Oscawana Inlet 5 #5	Groundwater seepage at road	2/27/2018	1061	1326	199

QUESTIONS?