Is it Making a Difference?

What 20 Years of Water Quality Trends Tell Us

Alison Field-Juma, Executive Director

March 21, 2019

OARS

© 2006 - Organization for the Assabet River

Science-based Advocacy to restore the health of our rivers since 1987

Finding the causes of problems

Advocating for solutions

Science-based Advocacy to restore the health of our rivers since 1987

Engaging the community in science and stewardship

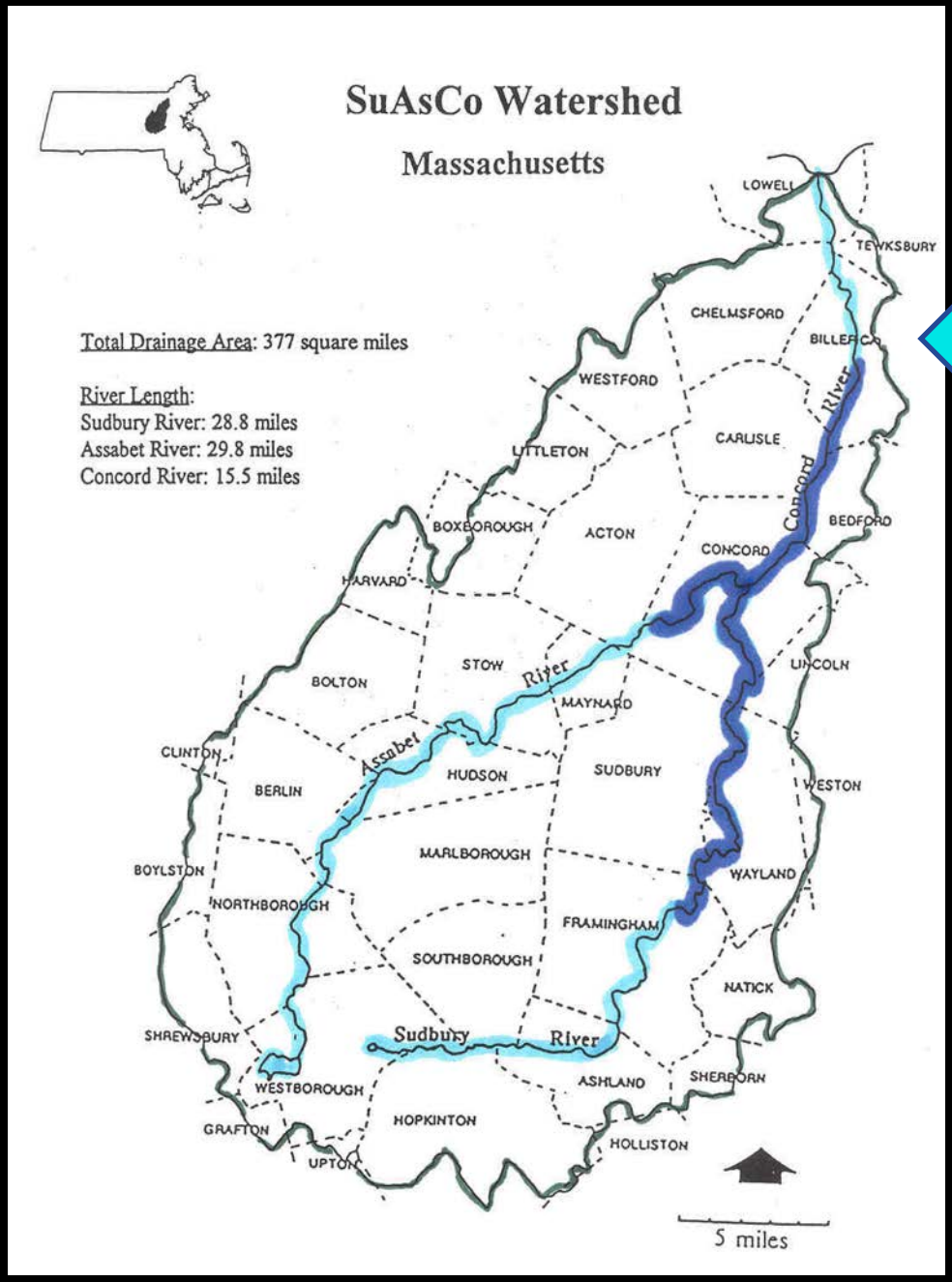
Science-based Advocacy to restore the health of our rivers since 1987

Educating the next generation

Science-based Advocacy to restore the health of our rivers since 1987

Celebrating successes

Science-based Advocacy to restore the health of our rivers since 1987

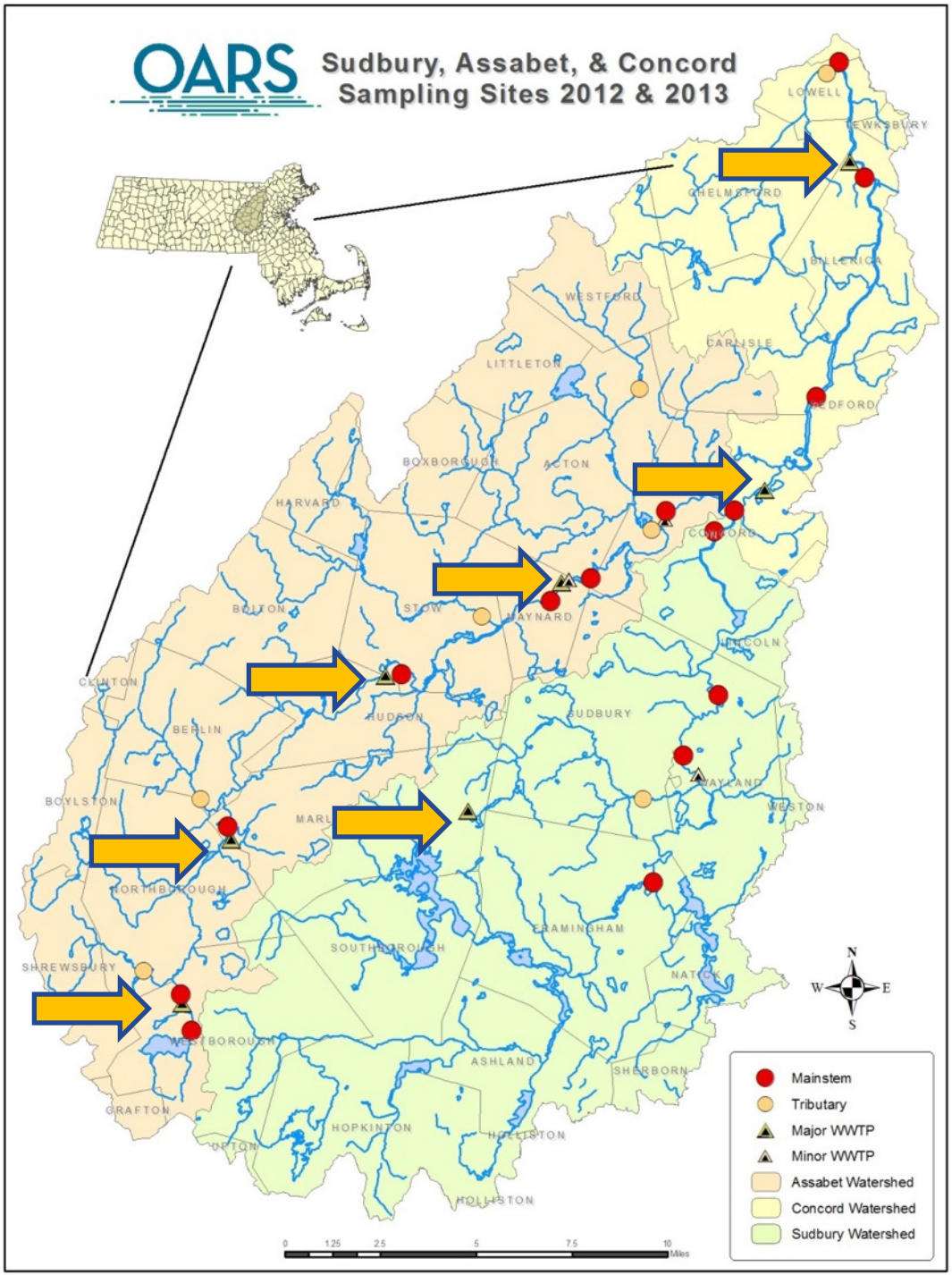


Wild & Scenic Rivers (dark blue)

These rivers are the drinking water supply of Billerica

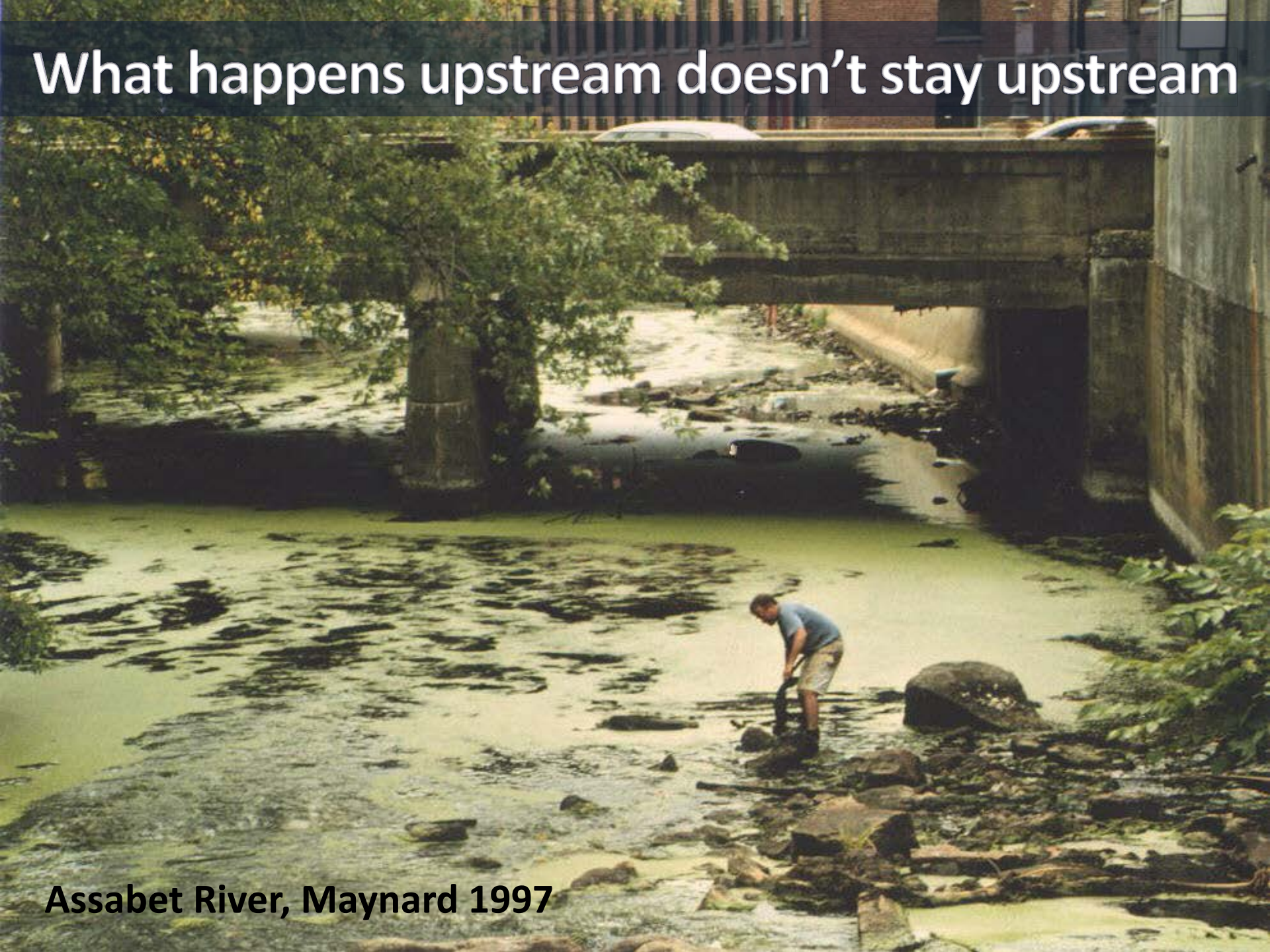
Human context and interactions:

- 8 major municipal wastewater treatment plants' discharges
- Water withdrawals from reservoirs, wells, the river and tributaries
- Intense development pressure, increasing impervious surface
- Industrial history left contaminated sediments, SuperFund sites, and dams
- Major recreational use



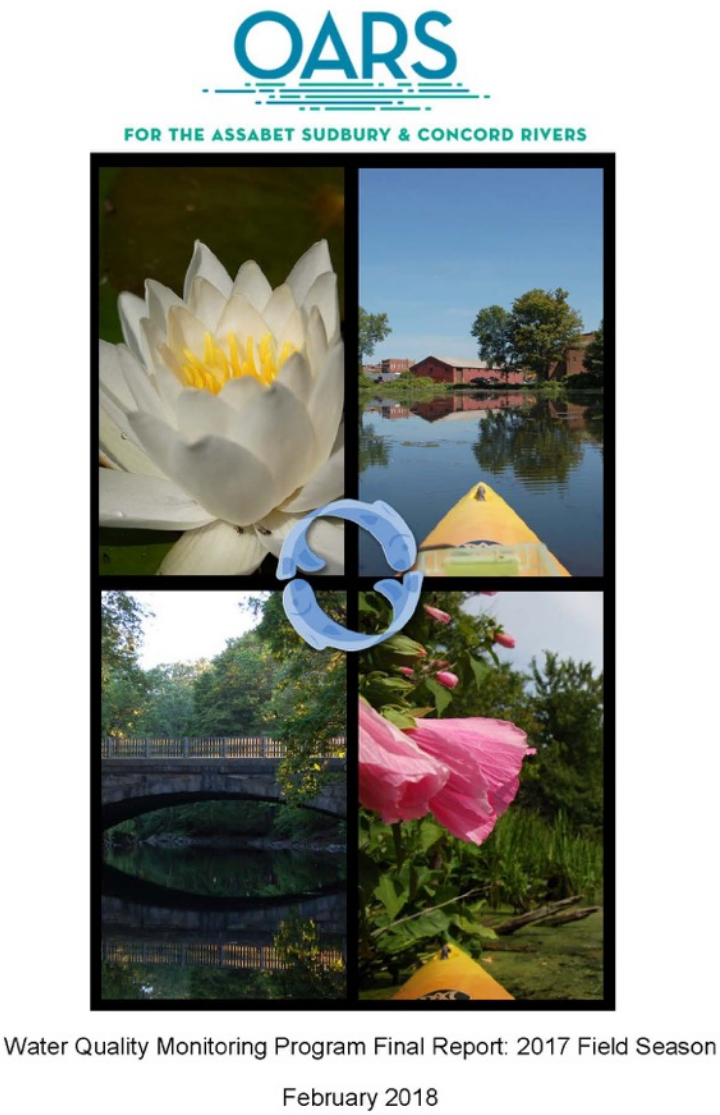
- Major Wastewater Treatment Plants:
  - 4 Assabet
  - 1 Sudbury
  - 2 Concord
  - 1 Hop Brook (Sudbury tributary)
- Dams:
  - 9 on Assabet
  - 3 on Concord
  - 7 on Sudbury

What happens upstream doesn't stay upstream



Assabet River, Maynard 1997

Oh no: 303d delisting!!



Quality Assurance Program Plan for data 2000-present

Monitoring Program Annual Report

www.oars3rivers.org/river/waterquality/reports

TMDL study
1999-2004

Assabet River
Total Maximum Daily Load
for
Total Phosphorus

Report Number: MA82B-01-2004-01

Control Number CN 201.0

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF ENVIRONMENTAL AFFAIRS
ELLEN ROY HERZFELDER, SECRETARY
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
ROBERT W. GOLLEDGE, Jr., COMMISSIONER
BUREAU OF RESOURCE PROTECTION
CYNTHIA GILES, ASSISTANT COMMISSIONER
DIVISION OF WATERSHED MANAGEMENT
GLENN HAAS, DIRECTOR

Page 1 of 104

Point sources contributed a majority of all four nutrient constituents evaluated during 4 of the 6 surveys . . . with the following point source percentage contributions:

- **Ortho-phosphorus: 97% - 98%,**
- **Total phosphorus: 82% - 97%**
- **Nitrate: 91% - 99%**
- **Total Nitrogen: 88% - 97%**

Non-point sources contributed the majority of TP and TN during wet weather events.

Sediment phosphorus flux was the principal non-point source during summertime low flow periods.

Required Phase 1: POTW effluents to **0.1 mg/L during the growing season and achieve a 90% reduction of phosphorus sediment flux.**

+ sediment/dam removal study

Phase 2: 2009 (actually 2019)


For the purpose of this TMDL, a substantial reduction in total biomass of at least 50% from July 1999 values is considered a minimum target for achieving designated uses.
Assabet River, Acton 2002

COMMONWEALTH OF MASS
DEPARTMENT OF ENVIRO

Nancy Stevens
Mayor, City of M
City Hall
140 Main Street
Marlborough, Ma

Donald Cowles
Chairman, Westb
238 Turnpike Roa
Westborough, Ma

Paul Ehrer
Executive Assista
73 Main Street
Town Hall
Hudson, MA 017

Walter Sokolowk
Superintendent, T
195 Main Street
Maynard, Massac

Re: Assabet Riv

Dear Mayor Steve

On April 1
remaining appeal
System ("NPDES
Plant Board, the C
discharges to the
efforts to resolve
contentious, exter

As your co
comply with NPD
consideration rega

As we earlier indicated in our response to comments to the draft permits and elsewhere on the public record, EPA and DEP intend to follow the recommended implementation plan and schedule that accompanies the Assabet River Phosphorus TMDL ("TMDL"). As explained in the TMDL implementation plan, the current phosphorus limit is an interim "Phase 1" limit. Depending on whether sediment remediation can reduce sediment phosphorus contributions enough to achieve water quality standards in the Assabet River, your facility may be required in the next permitting cycle to meet a more stringent "Phase 2" limit by 2014.

Consistent with the TMDL implementation schedule, EPA and DEP will initiate development of Phase 2 permits in Spring 2008. If we determine that sediment remediation is unlikely to achieve necessary phosphorus reductions based upon the information available at that time, the agencies will establish new Phase 2 phosphorus effluent limits designed to ensure compliance with water quality standards. As set forth in the TMDL schedule, the agencies will reissue NPDES permits to the Assabet communities upon expiration of the current permits, or five years after their effective dates. Compliance with any new phosphorus effluent limits will be required no later than April 2014. As Phase 2 phosphorus limits may be lower than the limits in the current permits, we once again strongly recommend that you give serious consideration to phosphorus removal technologies compatible with achieving phosphorus effluent limits lower than 0.1 mg/l.

We look forward to working closely with each of the communities over the coming months and years to facilitate an informed, efficient POTW upgrade process and to advance our concerted effort to restore the Assabet River watershed.

Sincerely,

Ira W. Leighton
Deputy Regional Administrator
U.S. Environmental Protection Agency
1 Congress Street
Boston, Massachusetts 02114-2023

Robert W. Golledge
Commissioner
Massachusetts Department of Environmental Protection
One Winter Street
Boston, Massachusetts 02108

2005

As Phase 2 phosphorus limits may be lower than the limits in the current permit, we once again strongly recommend that you give serious consideration to phosphorus removal technologies compatible with achieving phosphorus effluent limits **lower than 0.1 mg/l**.

Testing phosphorus-removal technologies, Hudson, 2006

Planning Assistance to States

Assabet River, Massachusetts
Sediment and Dam Removal Feasibility Study

September 2010

US Army Corps
of Engineers
New England District

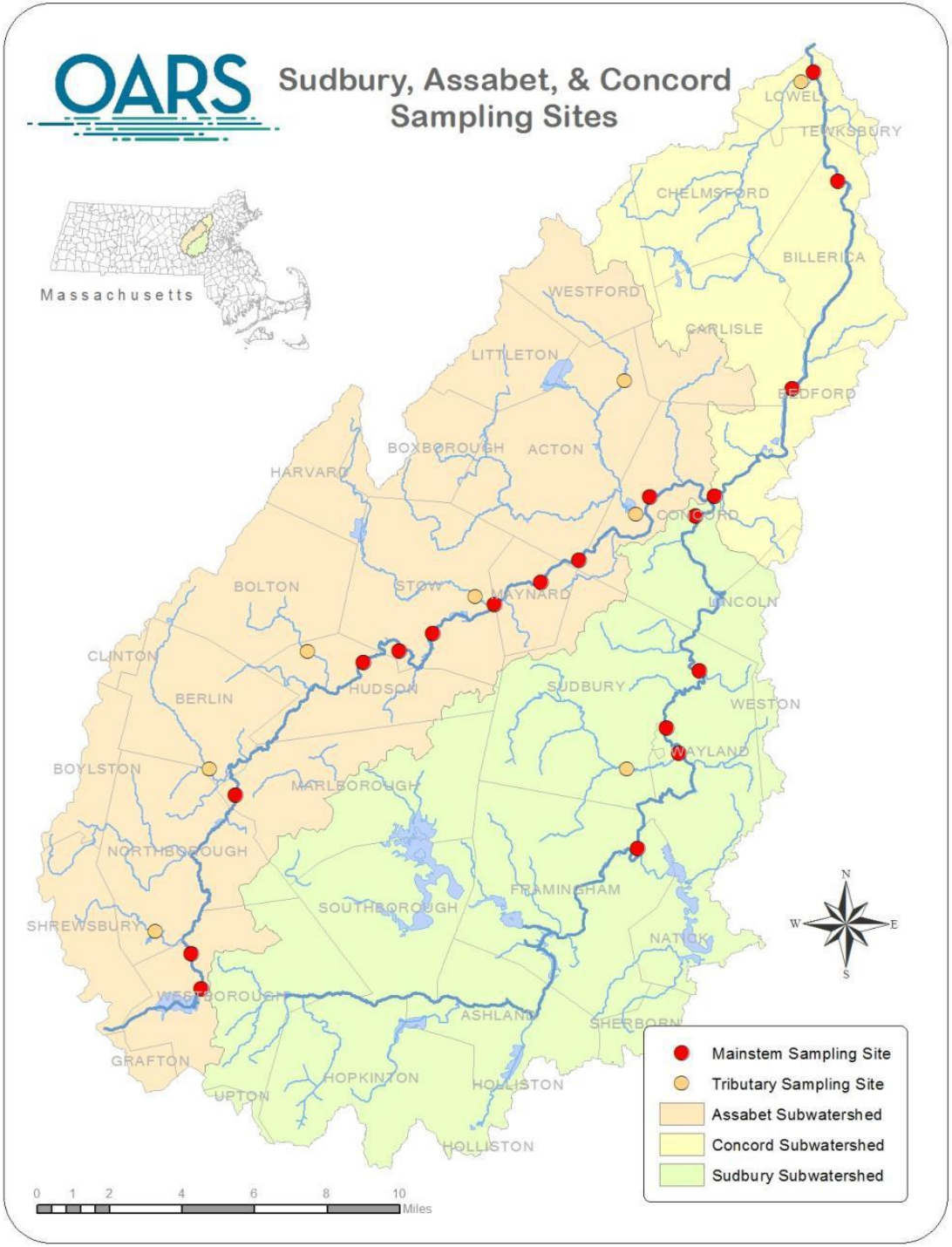
Dam!

Released in 2010

Dam removal would have a positive impact but is expensive and complicated

Recommended lower winter P limits before lowering summer P limits further

www.oars3rivers.org/our-work/river-restoration


OARS
Sudbury, Assabet, & Concord
Sampling Sites
Massachusetts
LOWELL
TEWKSBURY
CHELMSFORD
BILLERICA
WESTFORD
CARLISLE
LITTLETON
BEDFORD
BOXBOROUGH
ACTON
HARVARD
CONCORD
BOLTON
STOW
MAYNARD
LINCOLN
CLINTON
HUDSON
SUDBURY
BERLIN
WESTON
WAYLAND
BOYLSTON
MARLBOROUGH
NORTHBOROUGH
FRAMINGHAM
SOUTHBOROUGH
SHREWSBURY
NATICK
WESTBOROUGH
ASHLAND
SHERBORN
GRAFTON
HOPKINTON
HOLLISTON
UPTON
HOLLISTON
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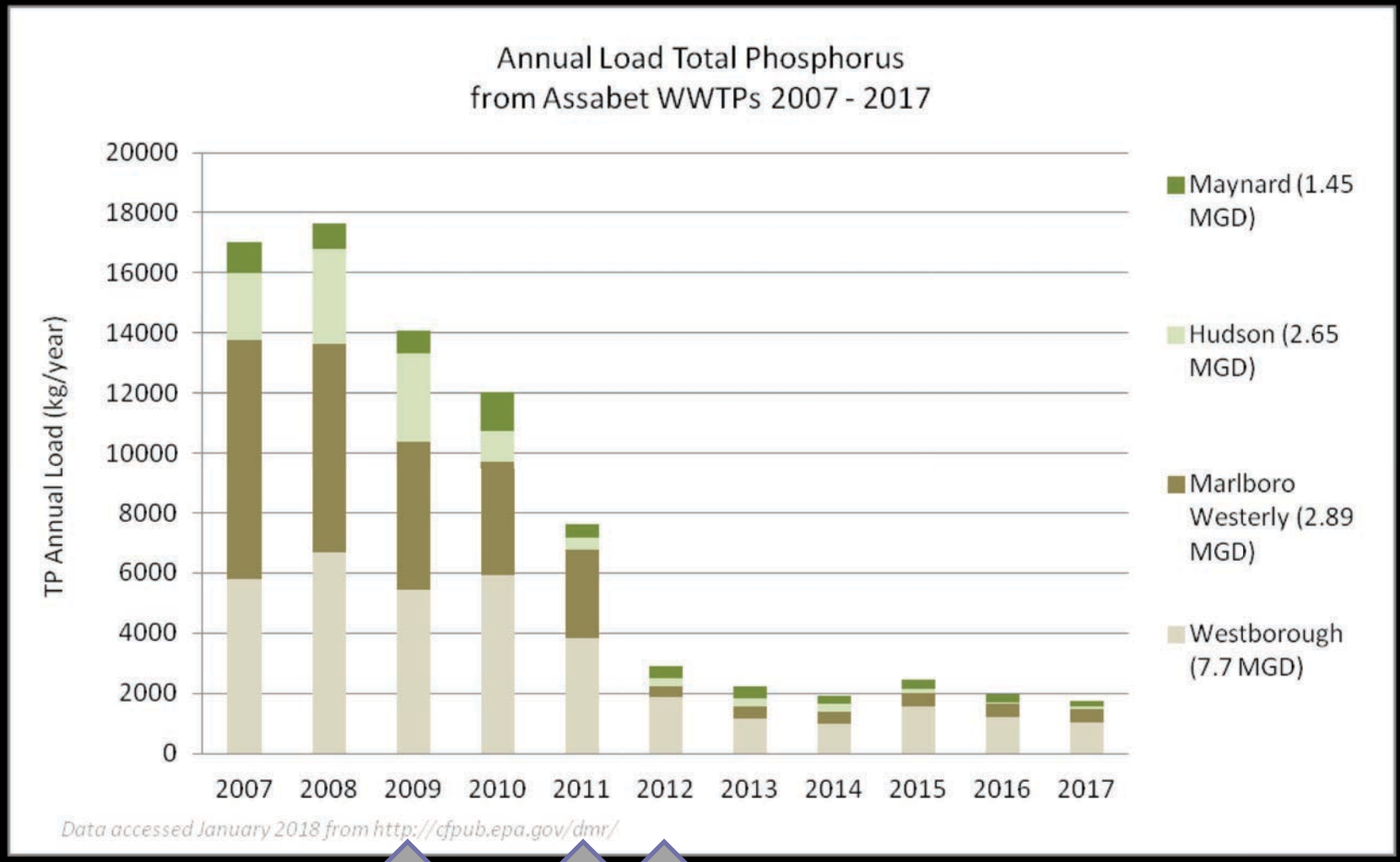
E
S
0 1 2 4 6 8 10
Miles
Mainstem Sampling Site
Tributary Sampling Site
Assabet Subwatershed
Concord Subwatershed
Sudbury Subwatershed

Table 1: Water Quality Sampling Sites 2017

Waterbody / Section	**Site Location**	Town	OARS Site #	SARIS #	Months Sampled	Lat/Long (d/m/s)	Measurements	
							WQ	Flow
Concord River	Rogers Street	Lowell	CND-009	46500	Mar, May – Sept, Nov	42°38' 08.89" / -71°18' 06.45"	√	(USGS)
Concord River	Lowell Street	Billerica	CND-045	46500	June - Aug	42°35'35.5"/ -71°17' 20.04"	√	
Concord River	Rte 225	Bedford	CND-110	46500	June - Aug	42°30' 33.0"/ -71°18' 48.6"	√	
Concord River	Lowell Rd. Bridge	Concord	CND-161	46500	Mar, May – Sept, Nov	42°27' 58.56"/- 71°21' 20.43"	√	
Sudbury River	Rte 62 / Boat House	Concord	SUD-005	47650	Mar, May – Sept, Nov	42°27' 29.8"/ -71°21' 58.8"	√	
Sudbury River	Sherman Bridge Rd.	Wayland	SUD-064	47650	May - Sept	42°23' 47.21" /- 71°21' 50.00"	√	
Sudbury River	River Road	Wayland	SUD-086	47650	May - Sept	42°22' 25.26"/ -71°22' 55.17"	√	
Sudbury River	Route 20	Wayland	SUD-096	47650	May – Sept	42° 21' 48"/ -71° 22'28"	√	
Sudbury River	Sudbury Landing	Framingham	SUD-144	47650	May - Sept	42°19' 32.1" /- 71°23' 50.8"	√	(USGS)
Assabet River / Lower	Route 2	Concord	ABT-026	46775	Mar, May – Sept, Nov	42°27' 56.96"/ -71°23' 27.92"	√	
Assabet River / Lower	Rte 62 / Canoe access	Acton	ABT-063	46775	June - Aug	42°26' 28.29"/ -71°25' 48.65"	√	
Assabet River / Lower	Rte 62/ USGS Gage	Maynard	ABT-077	46775	Mar, May – Sept, Nov	42°25' 56.00"/ -71°26' 58.55"	√	(USGS)
Assabet River/ Impound.	White Pond Road	Stow/Maynard	ABT-095	46775	June – Aug	42°25'23.6"/- 71°28'29.5"	in-situ	
Assabet River/Impound.	Sudbury Road	Stow	ABT-134	46775	June – Aug	42°24'41.8"/- 71°30'30.0"	in-situ	
Assabet River / Upper	Rte 62 / Gleasondale	Stow	ABT-144	46775	June - Aug	42°24' 16.26"/ -71°31' 34.70"	√	
Assabet River/Impound.	Cox Street	Hudson	ABT-162	46775	June – Aug	42°23'59.1"/-71°32'45.0"	in-situ	
Assabet River / Upper	Robin Hill Road	Marlborough	ABT-238	46775	June - Aug	42°20' 42.61"/ -71°36' 50.92"	√	
Assabet River / Upper	Route 9	Westborough	ABT-301	46775	Mar, May – Sept, Nov	42°16' 59.61"/ -71°38' 19.44"	√	
Assabet River/ Headwater	Mill Road	Westborough	ABT-312	46775	Mar, May-Sept, Nov	42°16' 26"/ -71°37' 56"	√	OARS
River Meadow Brook	Thorndike Street	Lowell	RVM-005	46525	June - Aug	42°37' 54.54"/ -71°18' 30.70"	√	
Nashoba Brook	Commonwealth Av.	Concord	NSH-002	unnamed	Mar, May – Sept, Nov	42°27' 32.05"/ -71°23' 49.35"	√	OARS
Nashoba Brook	Wheeler Lane	Acton	NSH-047	46875	Mar, May – Sept, Nov	42°30' 46.71"/ -71°24' 15.83"	√	(USGS)
Elizabeth Brook	White Pond Road	Stow	ELZ-004	47125	Mar, May – Sept, Nov	42°25' 36.96"/ -71°29' 07.01"	√	
Danforth Brook	Rte 85	Hudson	DAN-013	47275	Mar, May – Sept, Nov	42°24' 13.65"/ -71°34' 28.64"	√	OARS
North Brook	Pleasant St.	Berlin	NTH-009	47375	Mar, May – Sept, Nov	42°21' 25.67"/ -71°37' 45.48"	√	OARS
Hop Brook	Otis Street	Northborough	HOP-011	47600	Mar, May – Sept, Nov	42°17' 31.27"/ -71°39' 27.04"	√	OARS
Hop Brook	Landham Road	Sudbury	HBS-016	47825	May - Sept	42°21' 26.5" / -71°24' 11.7"	√	

WWTP annual loads decreasing with upgrades

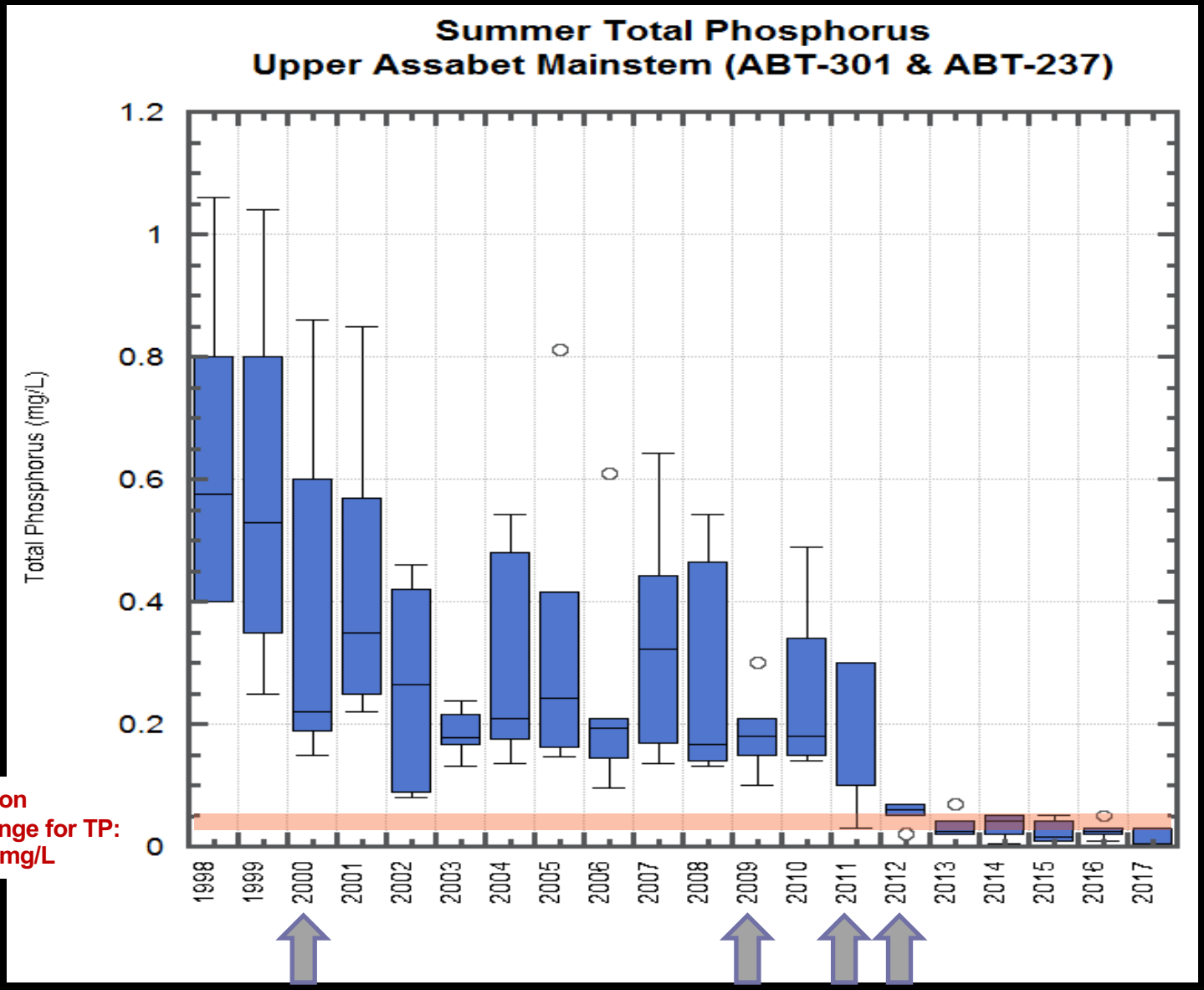


2009
Hudson
0.1mg/L

2011
Maynard
0.1 mg/L

2012
4 WWTPs
0.1 mg/L

OARS water quality sampling results: Phosphorus



Eutrophication threshold range for TP: 0.023 – 0.05 mg/L

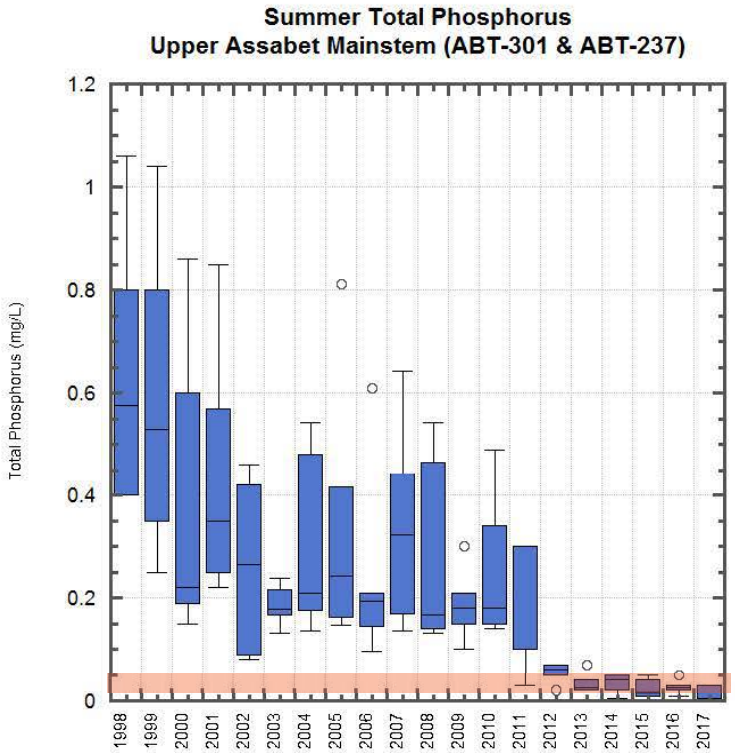
'00 Assabet WWTPs to 0.75mg/L

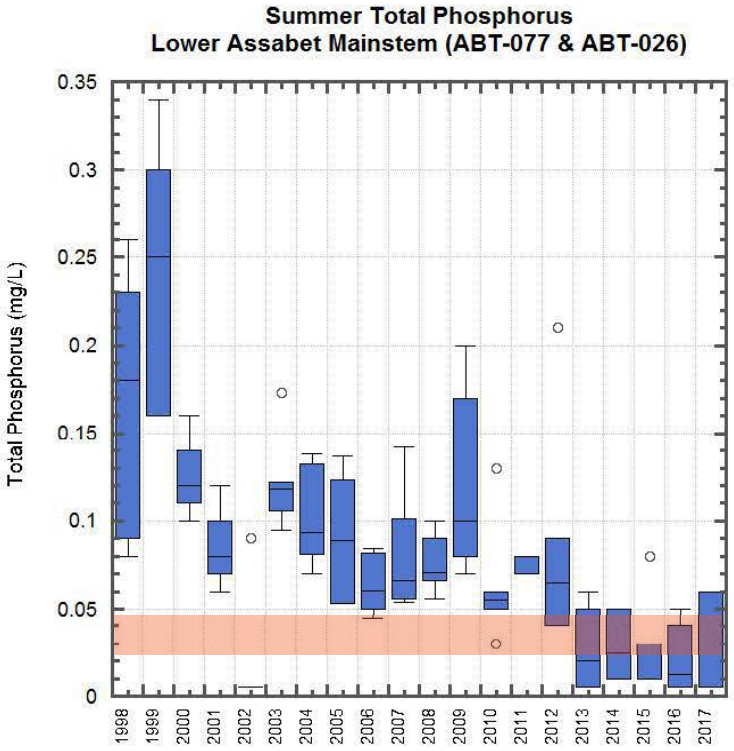
2009 Hudson 0.1mg/L

2011 Maynard 0.1 mg/L

2012 4 WWTPs 0.1 mg/L

Figure 11: Summer Total Phosphorus in Upper and Lower Assabet Mainstem

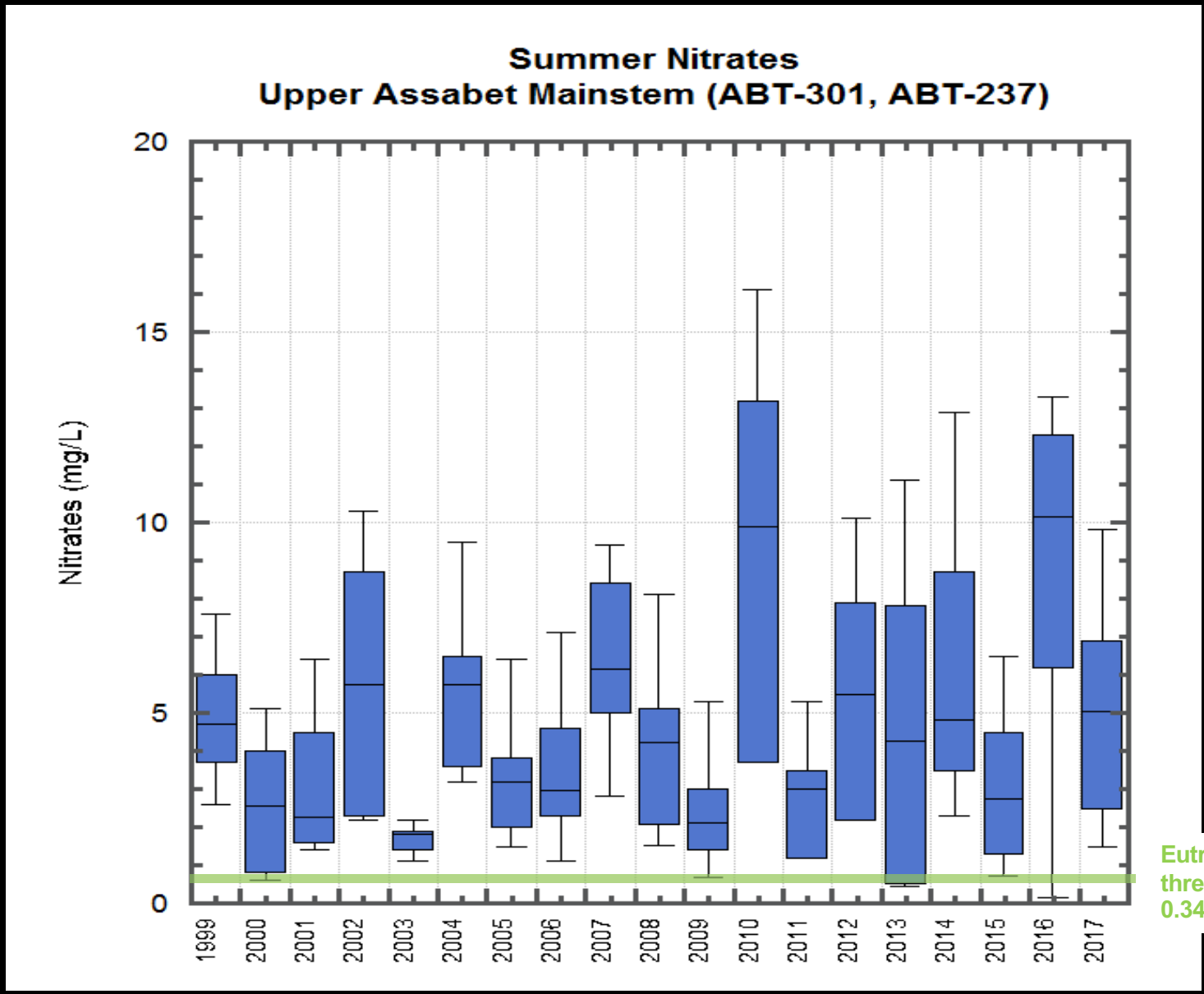




		Total Phosphorus - Mann-Kendall test statistics											
Section	Type	All dates						Late					
		years	tau	s	z	p	Trend	years	tau	s	z	p	Trend
Upper ABT	conc.	1993-2017	-0.679	-7390	-12.25	0.0000	downward	1999-2017	-0.595	-3830	-9.38	0.0000	downward
Upper ABT	flow-weighted	1993-2017	-0.61	-6634	-11.00	0.0000	downward	1999-2017	-0.582	-3749	-9.18	0.0000	downward
Middle ABT	conc.	1993-2017	-0.738	-2049	-9.372	0.0000	strong down	1999-2017	-0.629	-1004	-6.91	0.0000	downward
Middle ABT	flow-weighted	1993-2017	-0.665	-1845	-8.435	0.0000	downward	1999-2017	-0.581	-927	-6.375	0.0000	downward
Lower ABT	conc.	1993-2017	-0.599	-6690	-10.87	0.0000	downward	1999-2017	-0.489	-3150	-7.728	0.0000	downward
Lower ABT	flow-weighted	1993-2017	-0.566	-6323	-10.27	0.0000	downward	1999-2017	-0.472	-3037	-7.436	0.0000	downward

NST = no significant trend

OARS water quality sampling results: Nitrates



OARS' Work: Water Quality Trends…
same volunteer 10 years later…

Are we there yet?

Ben Smith Impoundment, 2006

Aquatic biomass assessments

Clean Water Act Class B goal:
50% reduction in biomass

Total biomass assessment, OARS

Duckweed assessment
Alice Rojko, DEP

Figure 22: Total Floating Biomass, Hudson Impoundment

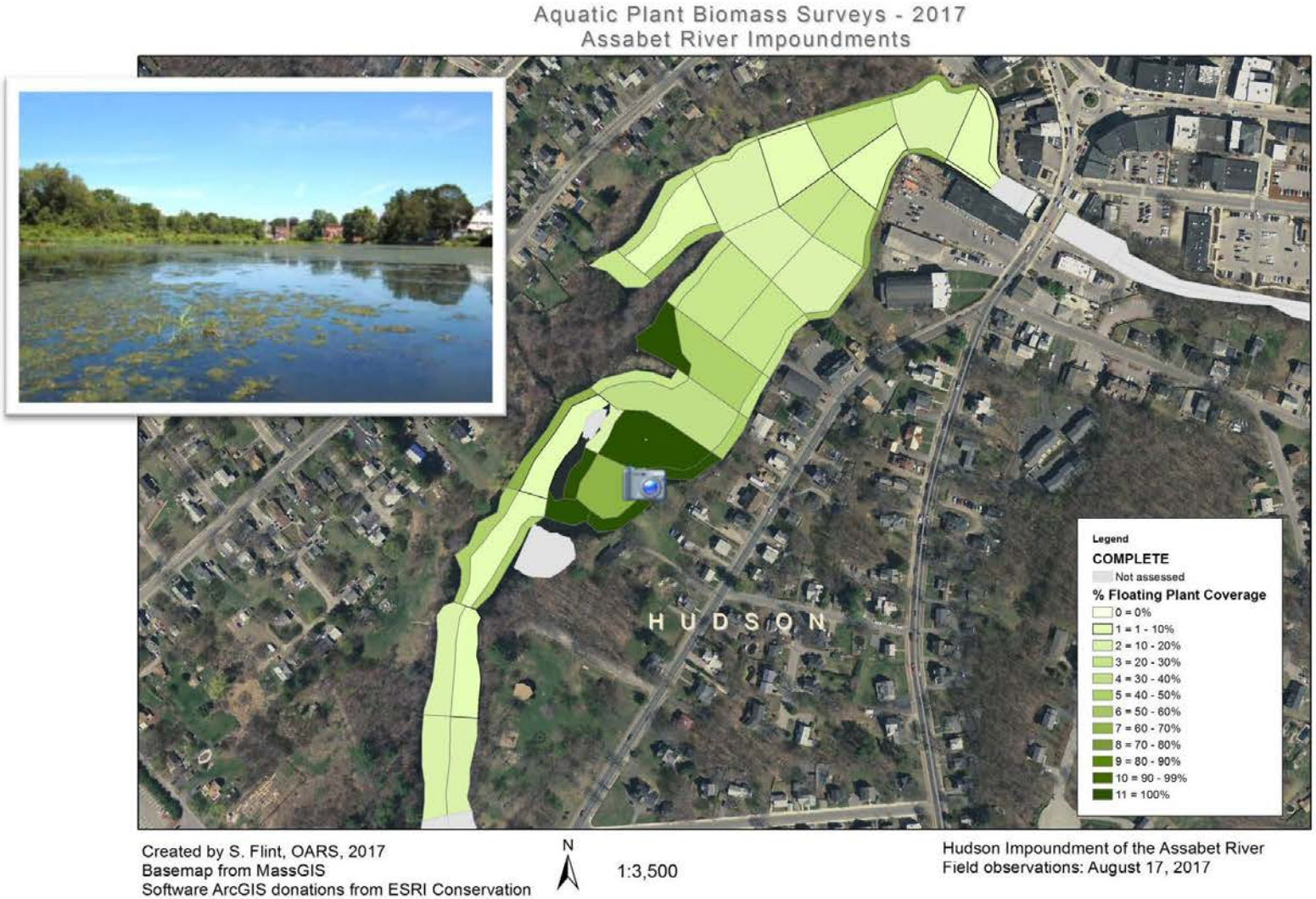


Figure 21: Total Floating Biomass, Gleasondale Impoundment

Figure 20: Total Floating Biomass, Ben Smith

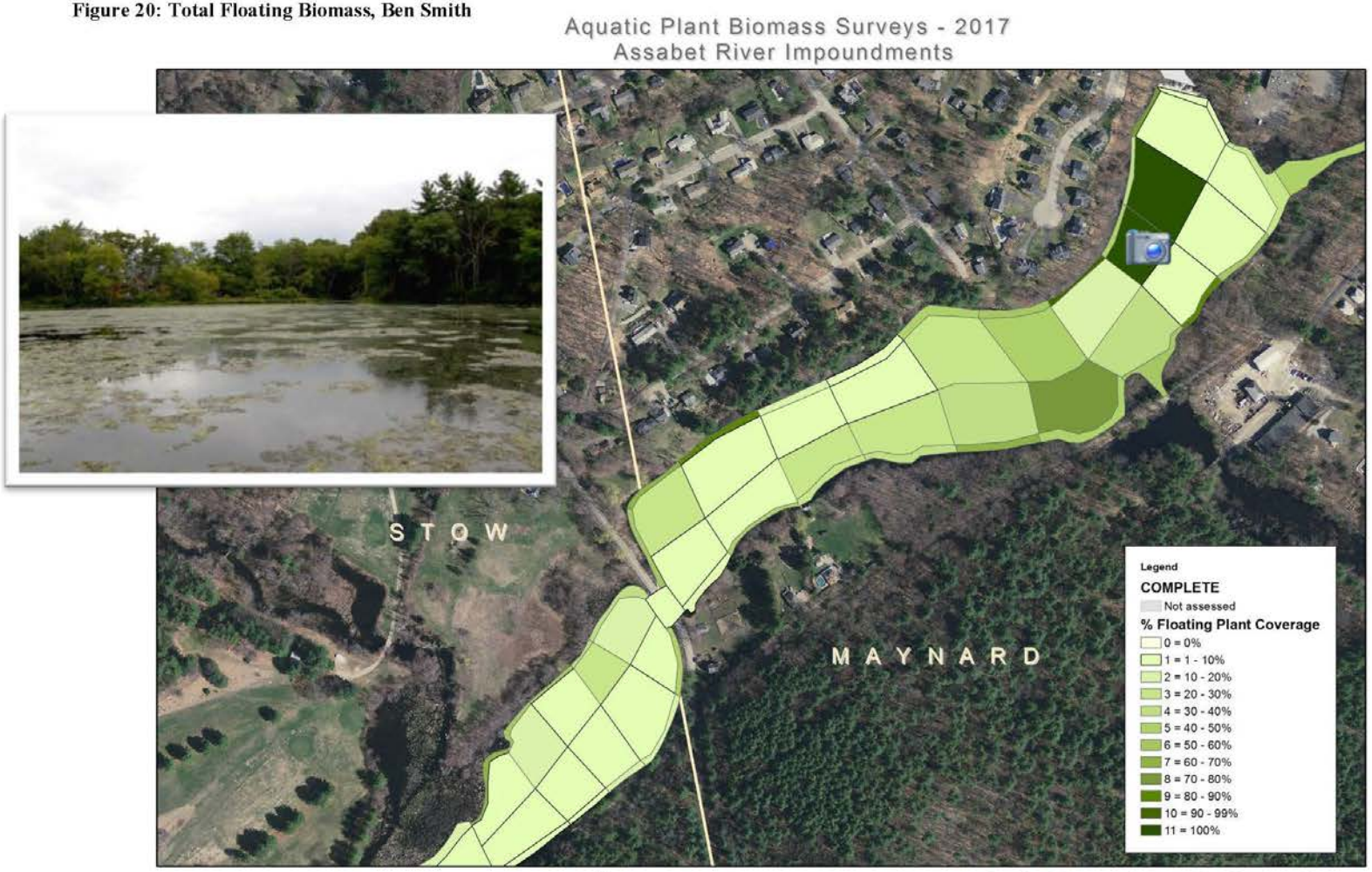
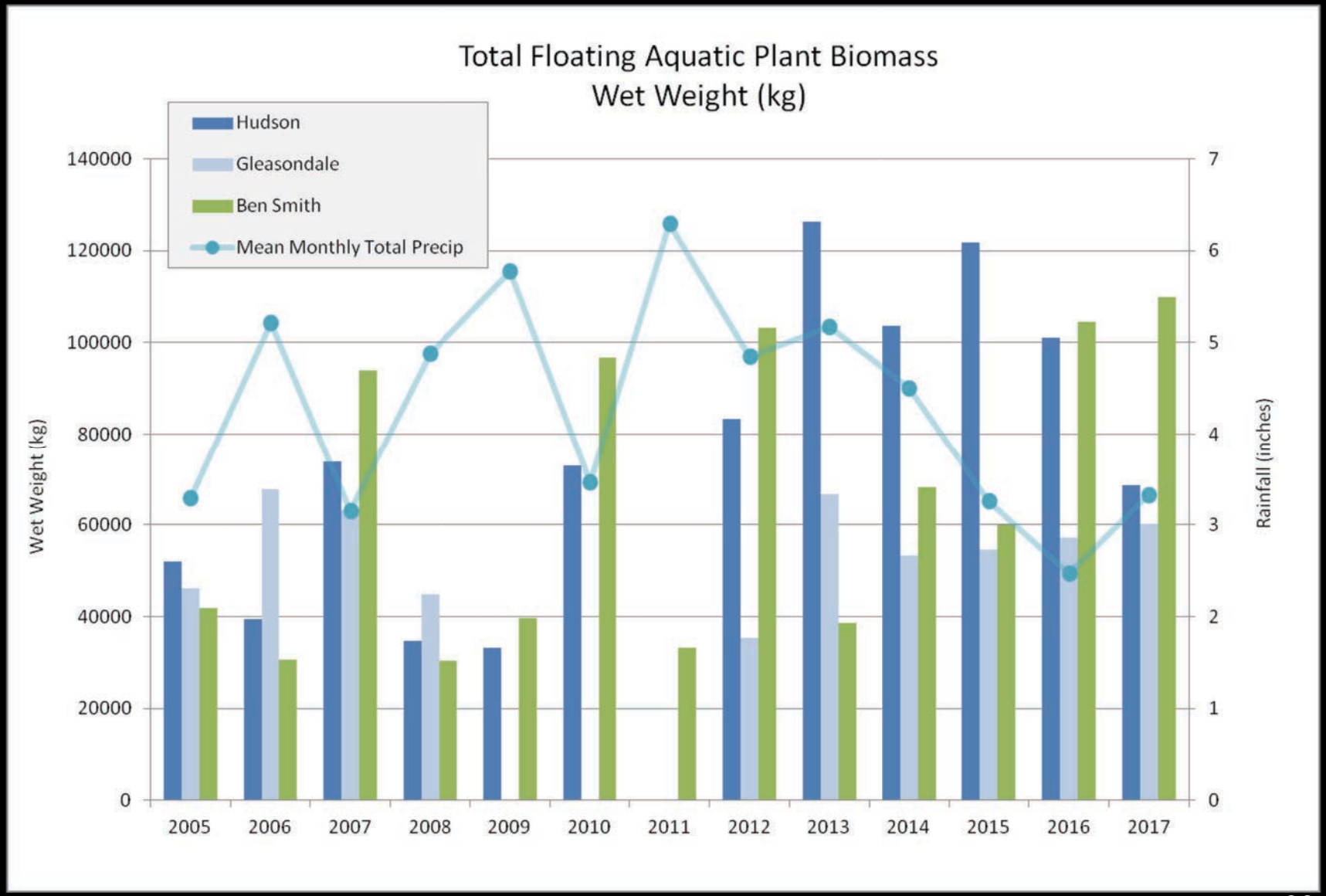


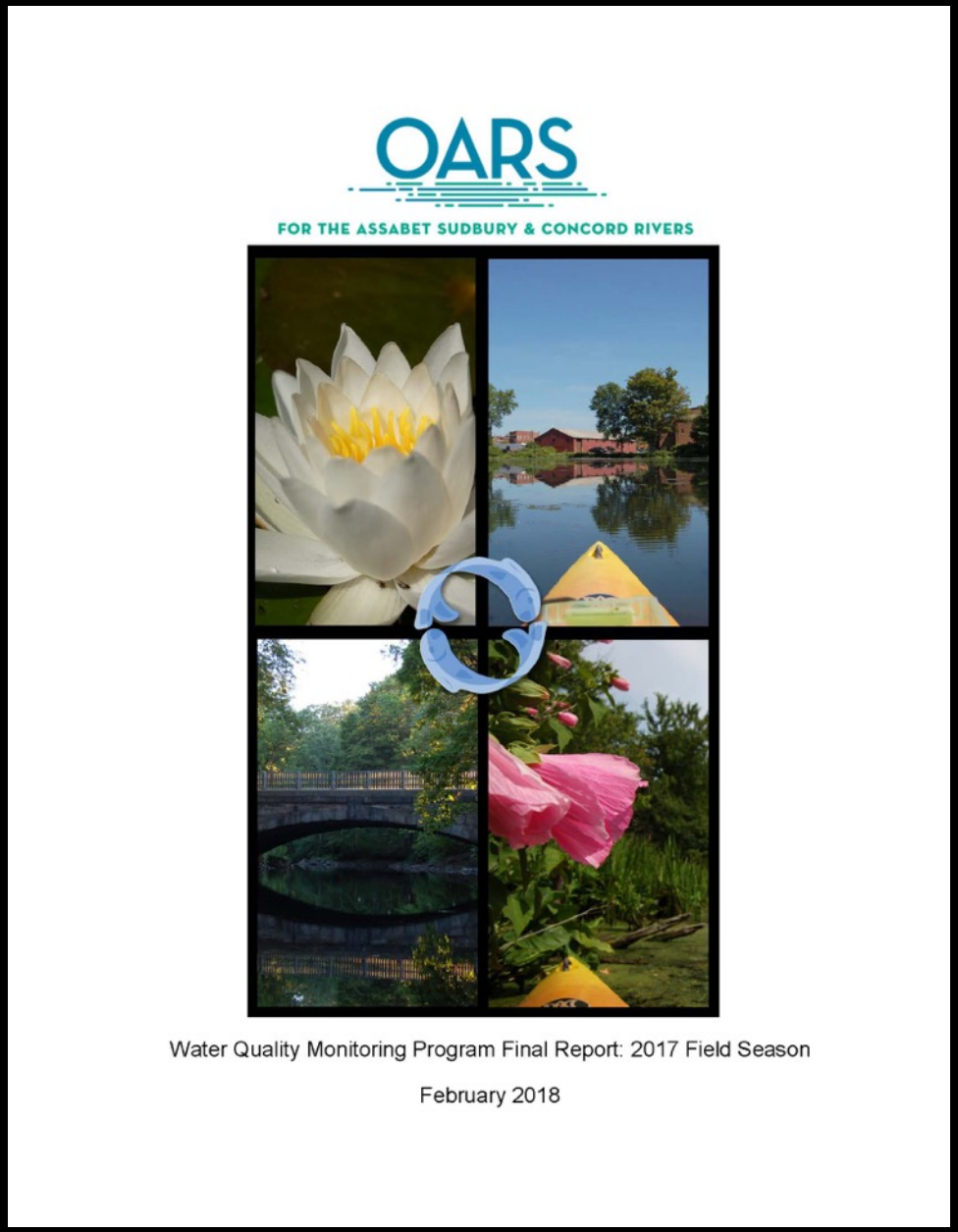
Figure 20: Total Floating Biomass, Ben Smith, August 29, 2014

2005 Biomass Survey

Total Plant Biomass
Ben Smith Impoundment - Assabet River, Maynard, MA

OARS biomass sampling results





Assabet River water quality trends:

- Total phosphorus in water column decreased
- Nitrates in water column may be increasing
- Plant growth in impoundments is transitioning . . . will take longer to see a clear overall trend

Progress:

- Concord River delisted for P
- Less duckweed
- Improved recreation and habitat

The role of impoundments

USGS
science for a changing world

Prepared in cooperation with the
Massachusetts Department of Environmental Protection

Changes in Phosphorus Concentrations and Loads in the Assabet River, Massachusetts, October 2008 through April 2014

Scientific Investigations Report 2016–5063

U.S. Department of the Interior
U.S. Geological Survey

USGS Study 2008-2014

Goals:

- Document changes in phosphorus concentrations and loads before, during, and after TMDL implementation
- Assess the effects of seasonal differences in mandated effluent TP concentrations
- Examine the effects of two impoundments on the river's phosphorus dynamics.

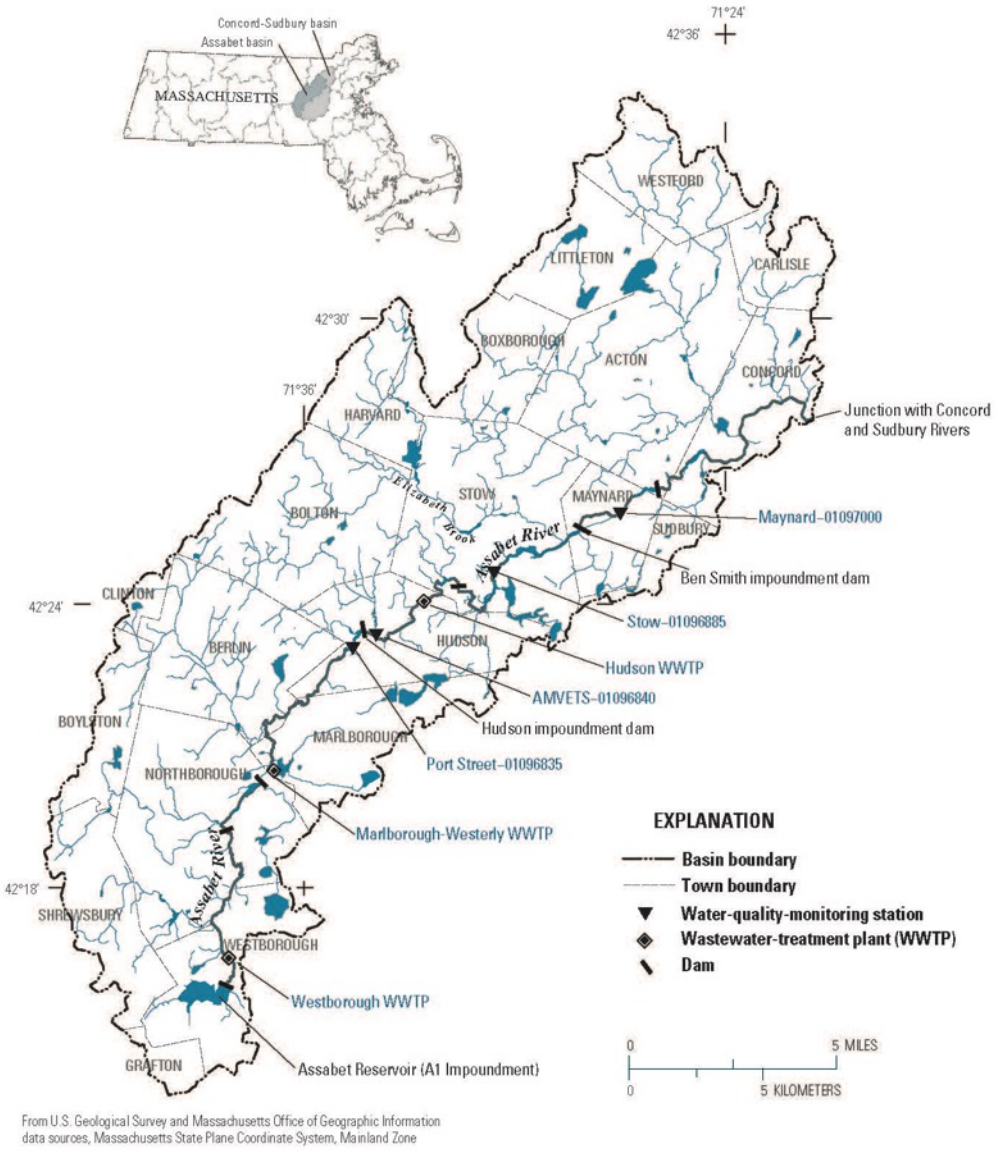
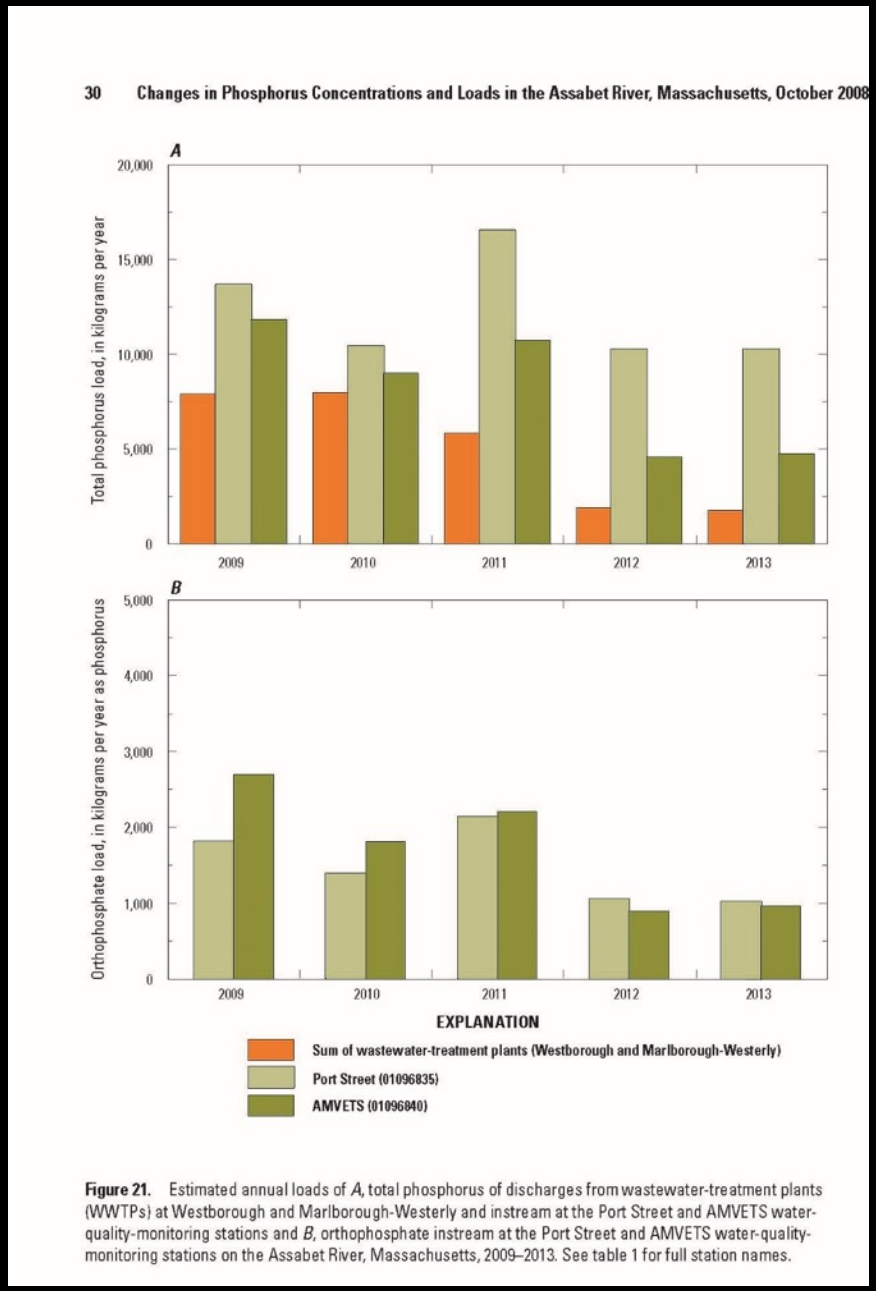


Figure 1. Locations of water-quality-monitoring stations, wastewater-treatment plants, and impoundment dams in the study area along the Assabet River Basin in central Massachusetts. See table 1 for full station names. Modified from Zimmerman and Sorenson (2005, fig. 1).



Results:

- Reductions in median TP instream loads between 2009 and 2013 were comparable to the reductions in WWTP effluent loads.
- The non-growing season median effluent concentrations after the upgrades were 0.06 to 0.1 mg/L, well below the permit limit of 1.0 mg/L. Excellent optimization!
- The Hudson impoundment may have been a sink for particulate phosphorus since loads of TP entering the impoundment were larger than those leaving (but some uncertainty about loads at upstream monitoring station).
- TP and ortho P loads leaving Ben Smith impoundment were slightly greater than those that entered the impoundment during each full year. The differences are not large and may reflect additions from tributaries and overland runoff.
- Questions? Ask Jon Morrison, USGS!

It still has some bad weeks.

Ben Smith impoundment, Maynard, August 2017


But lots more good weeks.

How did we do it?

SCIENCE ADVOCACY PERMITS $$$ Operation

The future:

The GOOD: recreational use, scenic values, quality of life, ecology/wildlife

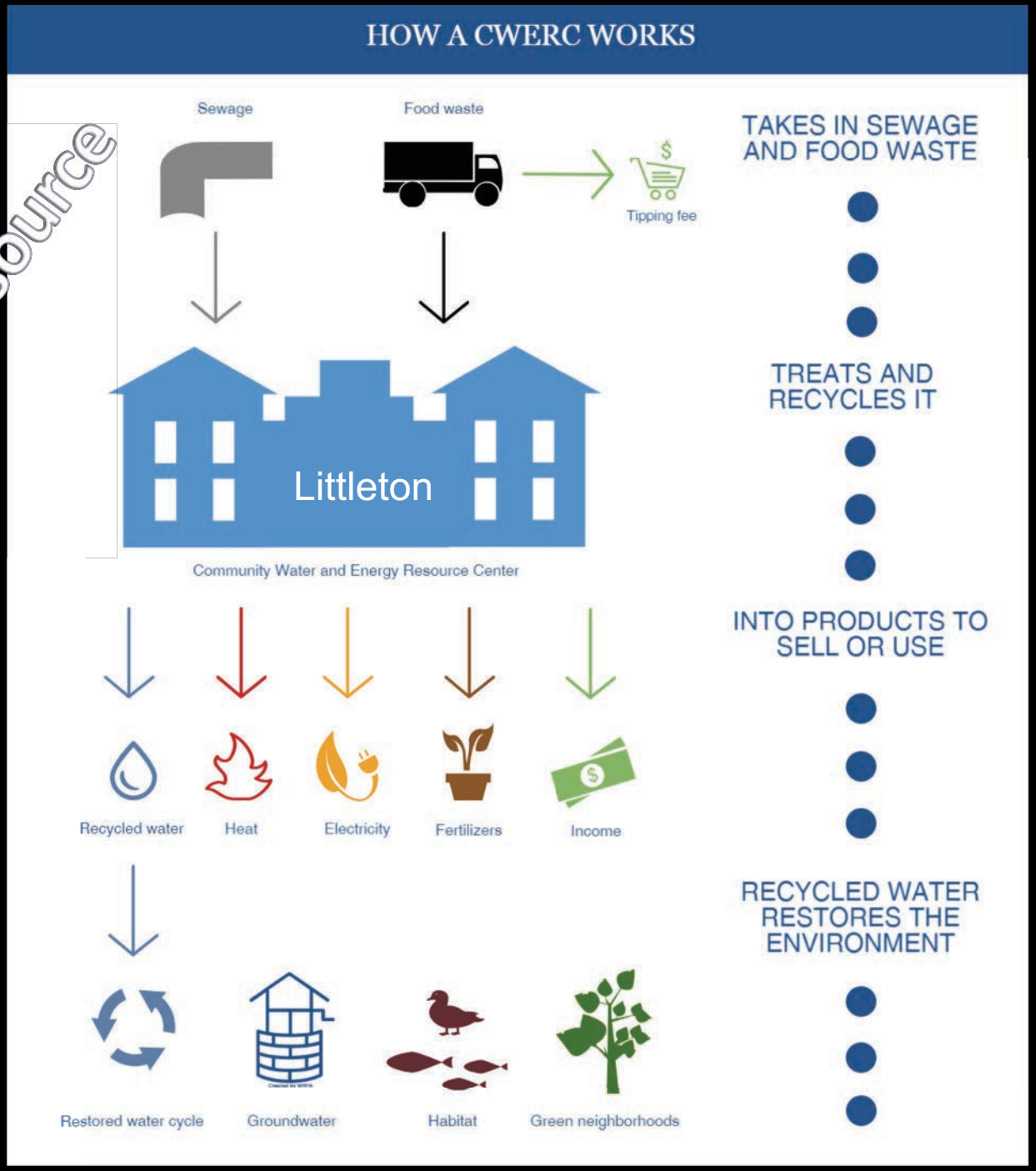
The BAD: cost, emerging contaminants, invasive plants, impacts of climate change

The CHALLENGING: dam removal, does time take too long?

The BIG IDEA: waste = resource + $. WRRFs → CWERCs

Community Water and Energy Resource Centers

Waste = resource



www.crwa.org

Thank you for being on the frontlines of clean water