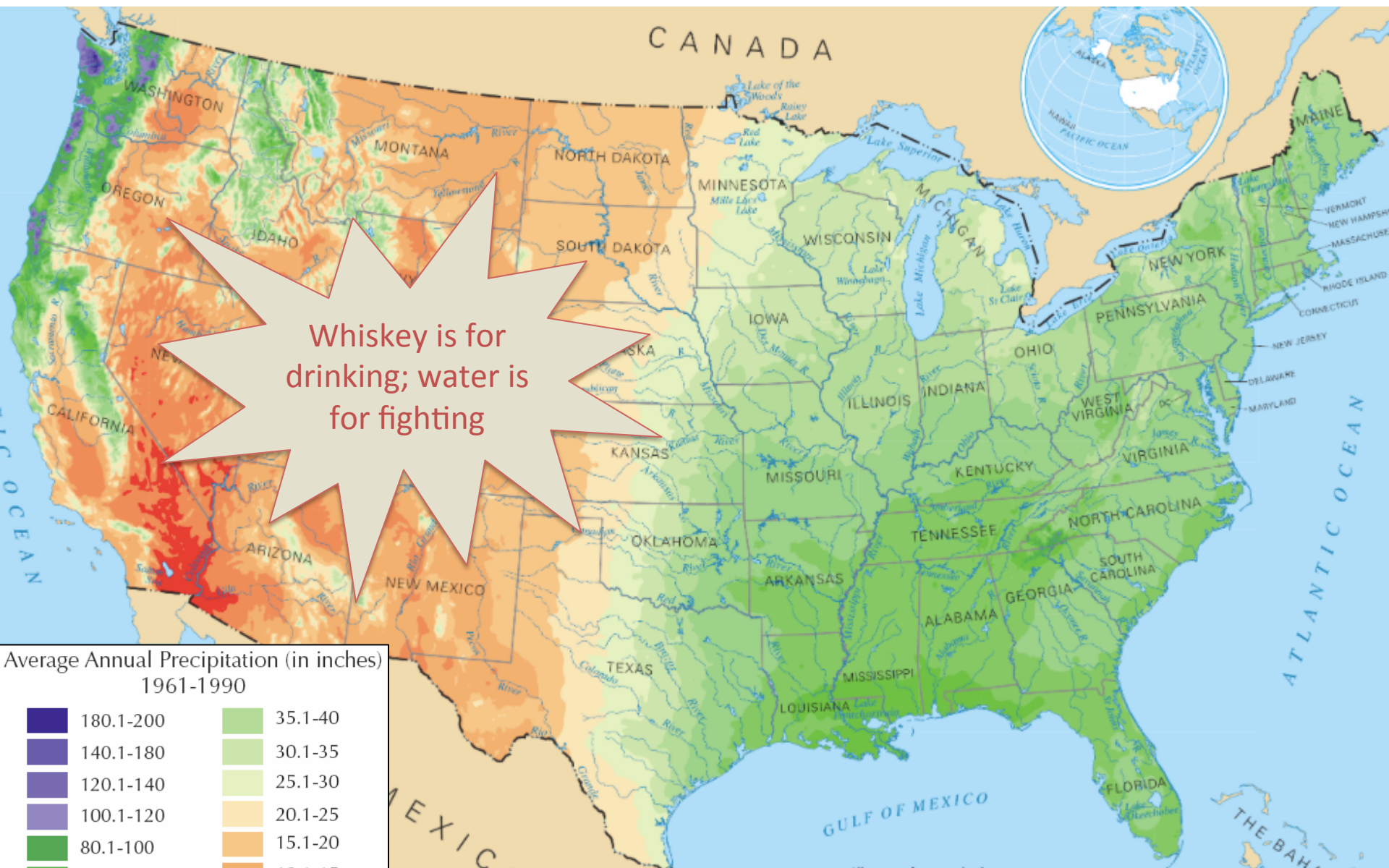


# Regional Collaboration around Water: Nagog Pond as a Case Study

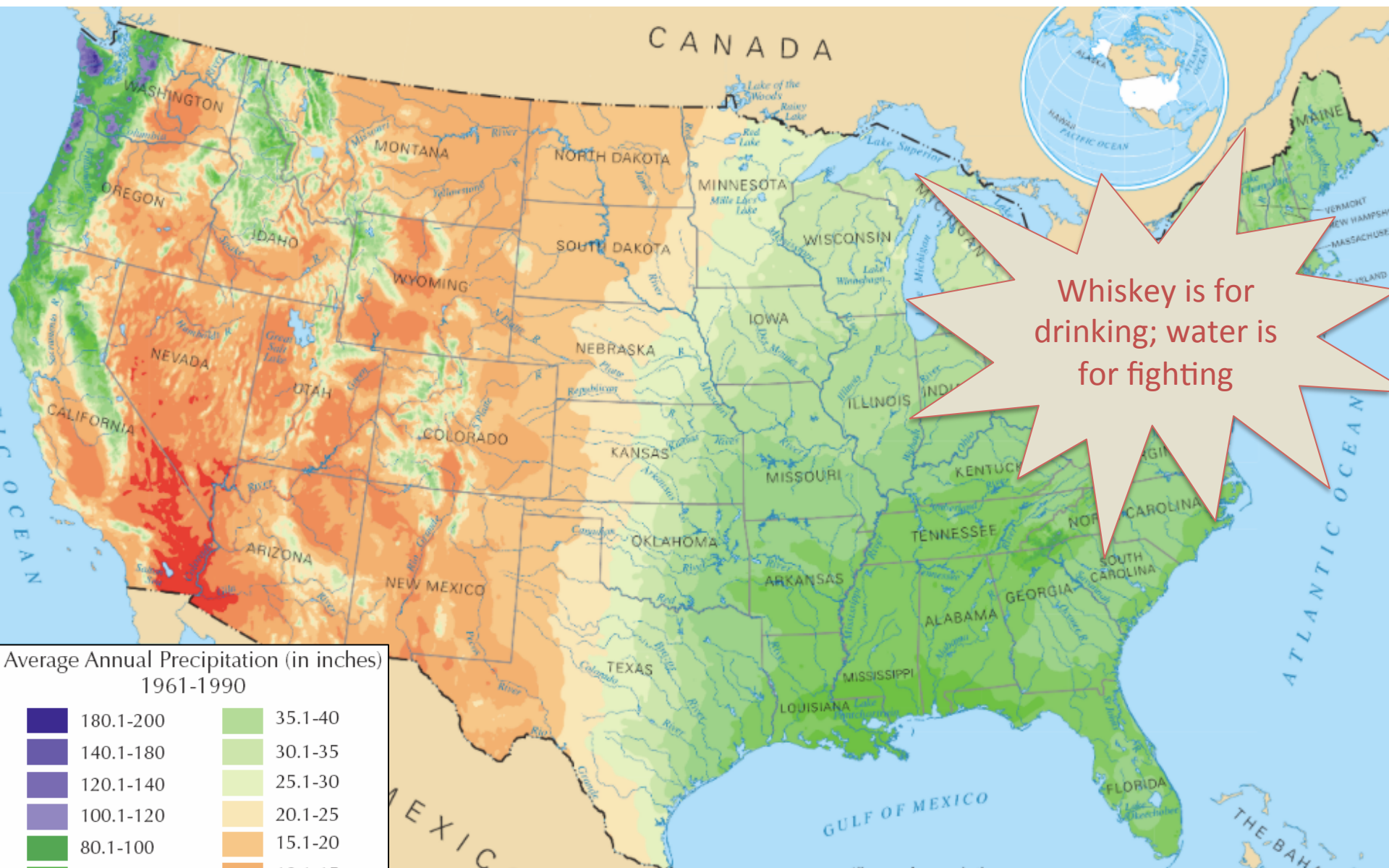


Dr. Kim Kastens

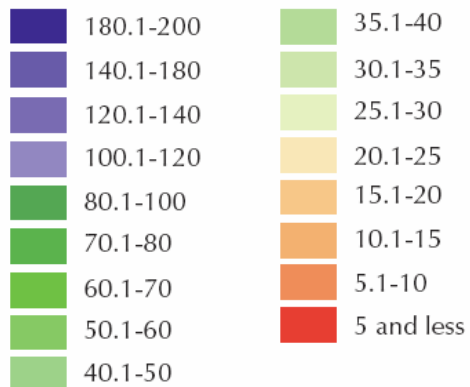
Sunday Forum  
First Parish in Concord  
25 February 2018



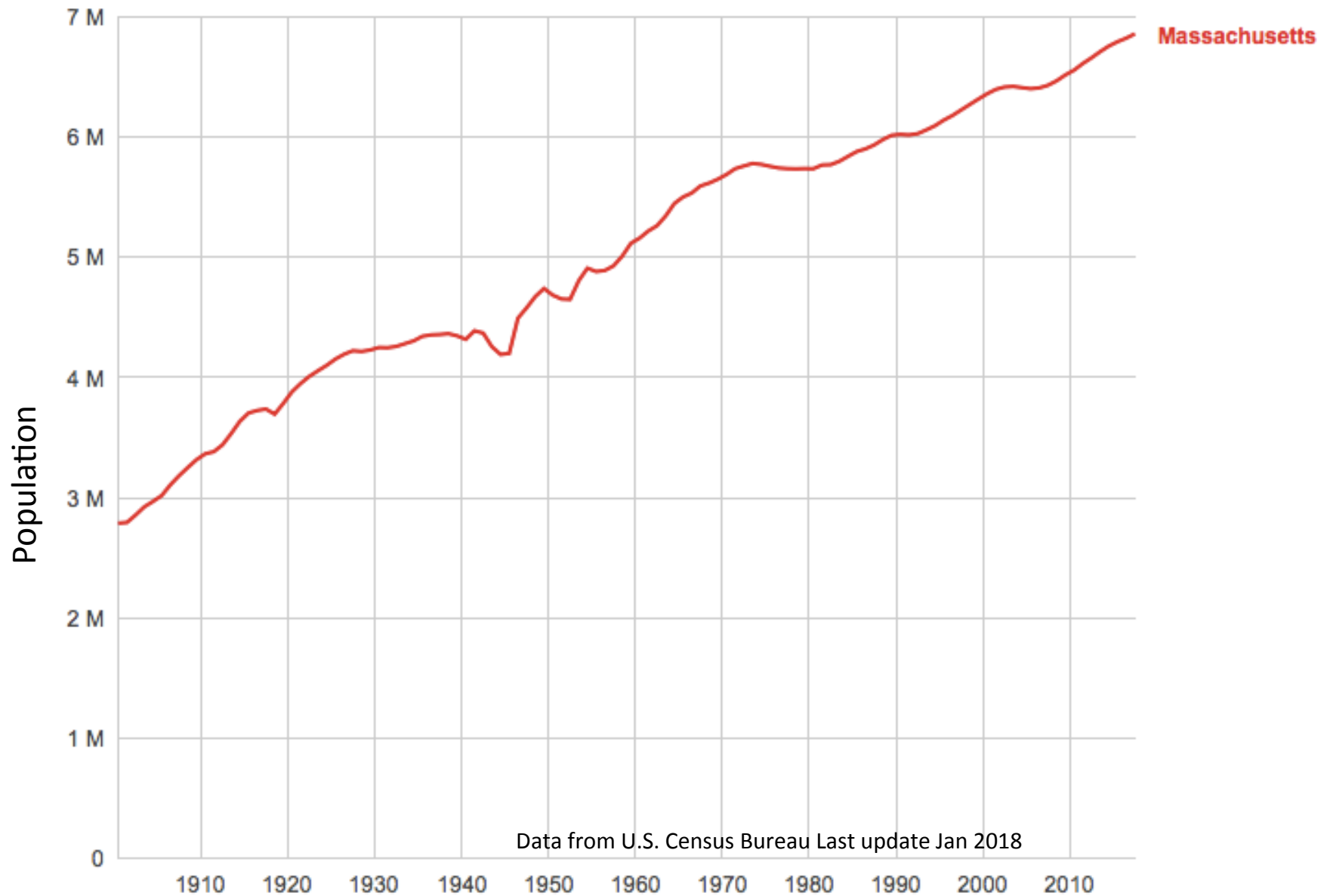




Average Annual Precipitation (in inches)  
1961-1990



# Challenges to local water supplies: increasing demand





# Challenges to local water supply: changing climate

- More precipitation overall...BUT...
- Higher ratio of rain to snow
- More concentrated into big storms
- More runoff, less infiltration into groundwater
- More frequent droughts in summer & fall



## Climate Change Resilience Plan



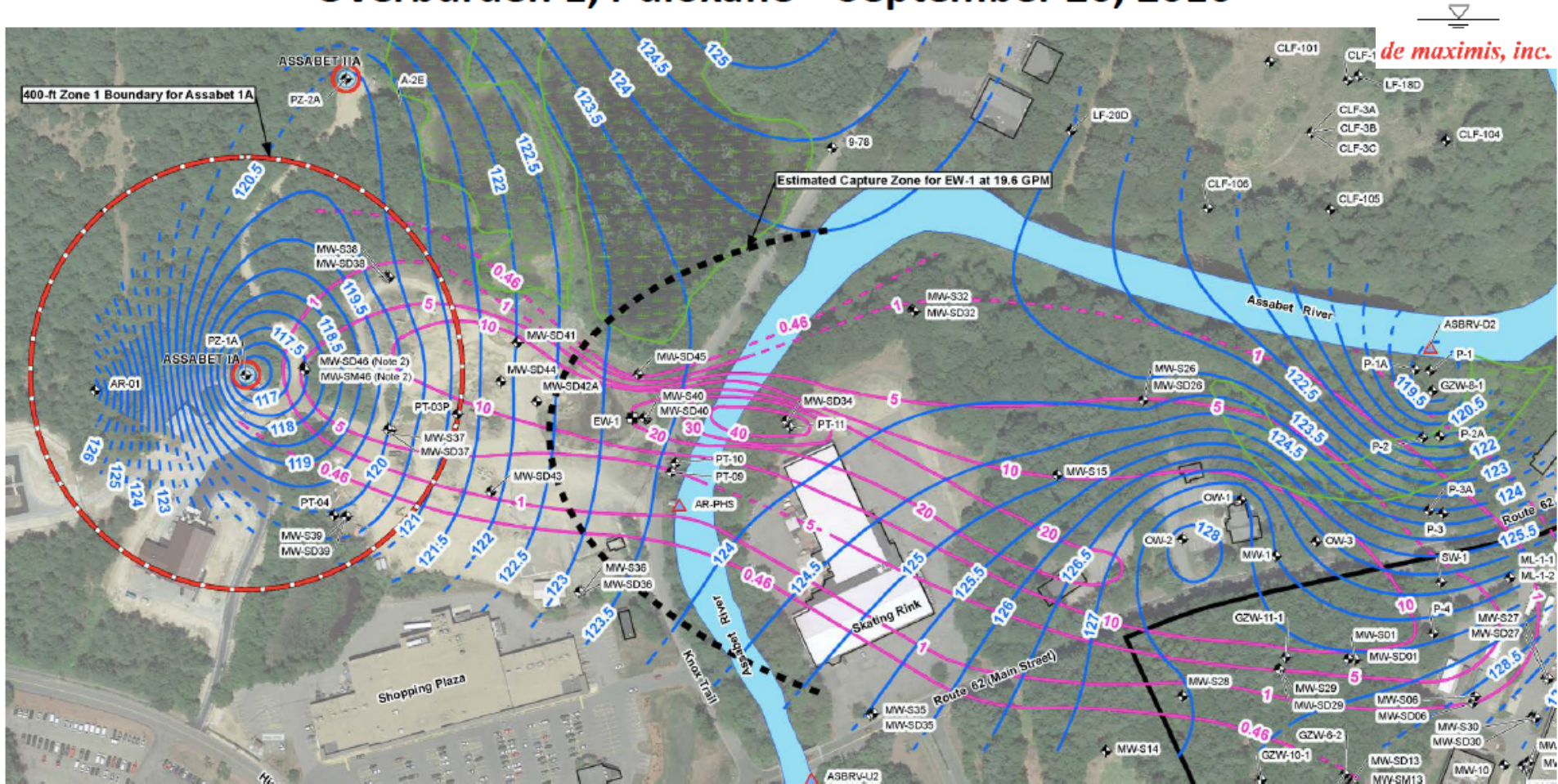
**The Changing Northeast Climate**  
OUR CHOICES, OUR LEGACY

Climate Change Impacts in the United States

## CHAPTER 16 NORTHEAST

## Threats to local water supplies: pollution

## Overburden 1,4-dioxane – September 26, 2016



Assabet 1  
water  
well

Plume of carcinogenic solvent in groundwater

# NMI/Starmet Superfund Site



# The Case Study of Nagog Pond



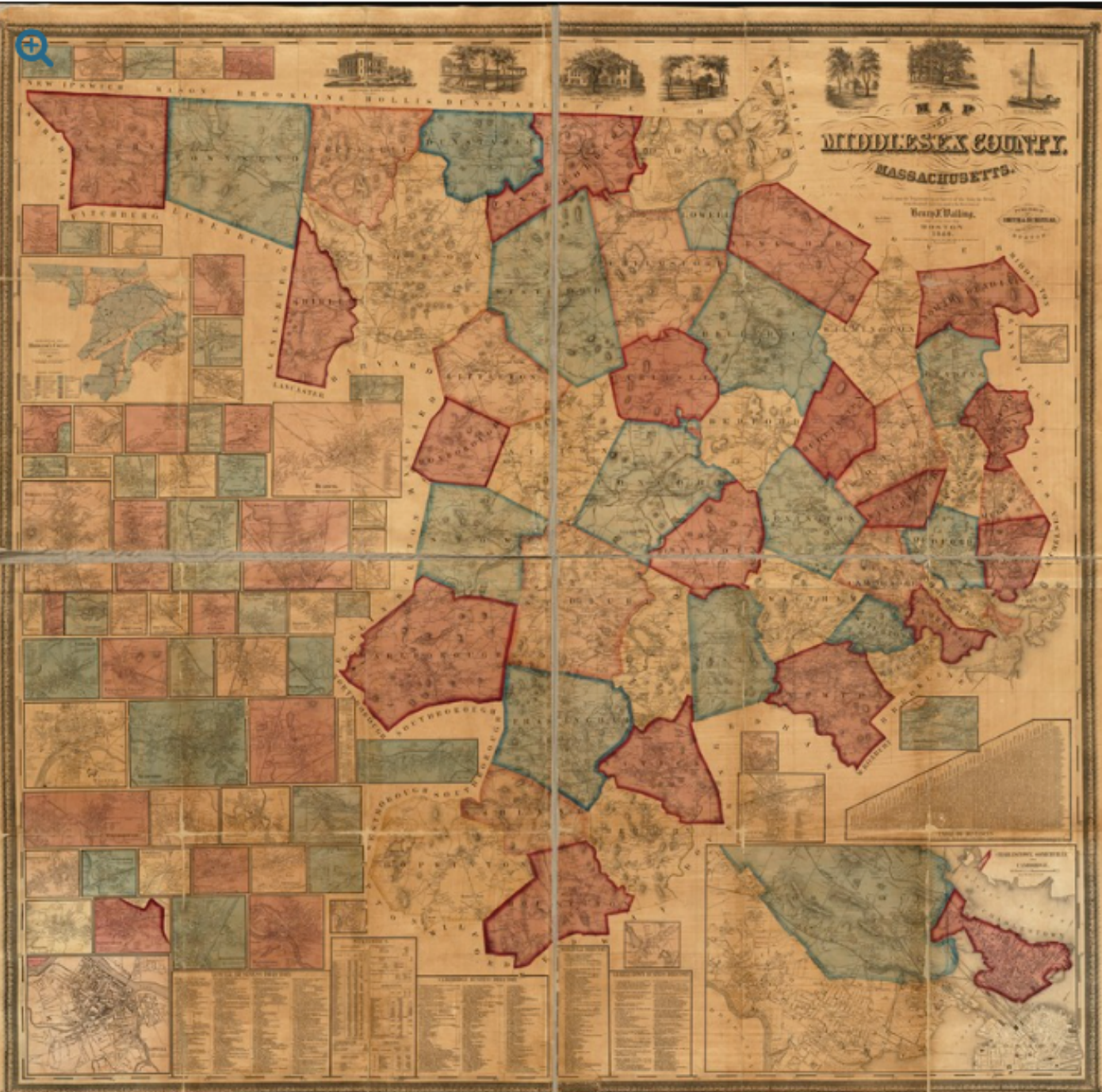
Blue Moon over Nagog Pond, David Wolf, Acton



## SuAsCo Watershed

- Sudbury River
- Assabet River
- Concord River





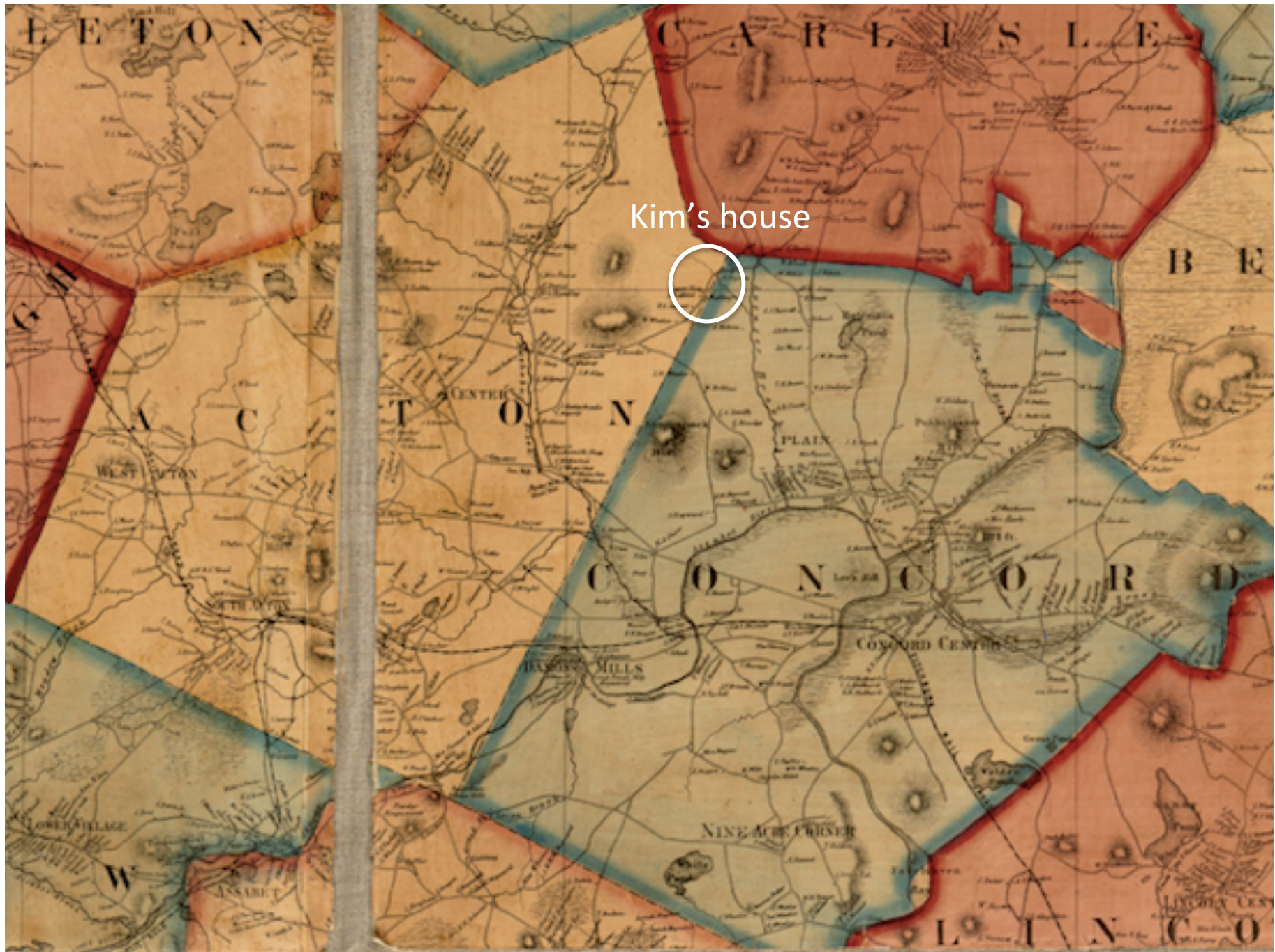
1856 Map of  
Middlesex County





Map reproduction courtesy of the Norman B. Leventhal Map Center at the Boston Public Library





Map reproduction courtesy of the Norman B. Leventhal Map Center at the Boston Public Library





THE TOWN OF  
**CONCORD**  
MASSACHUSETTS



Building Energy Audits

Comprehensive Sustainable Energy  
Comm

[Home](#) › [Government](#) › [Departments](#) › [Municipal Light Plant](#) › [Electric Service](#) › [Sustainability Initiatives](#) › [Sustainability In Action](#)

## **Sustainability In Action**

On July 25, 2011, the Concord Board of Selectmen voted to adopt the following four sustainability principles:

- 1) Reduce dependence upon fossil fuels, underground metals, and minerals;
- 2) Reduce dependence upon synthetic chemicals and other manufactured substances;
- 3) Reduce encroachment upon nature; and
- 4) Meet human needs fairly and efficiently.



Littleton

Acton

Concord

Nagog Pond



# Great Ponds of Massachusetts



Walden Pond  
Concord



Sandy (Flint's) Pond  
Lincoln



Fort Pond  
Littleton



Fresh Pond  
Cambridge



Spy Pond  
Arlington



Nagog Pond  
Acton/Littleton

Massachusetts Ordinance of 1641-1647: “Everie Inhabitant who is a hous-holder shall have free fishing and fowling, in any Great Ponds, Coves and Rivers ... no town shall appropriate to any particular person or persons, any great Pond containing more than ten acres of land...”

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# LAWS AND RESOLVES

PASSED BY THE

Legislature of Massachusetts

DURING THE

SESSION OF 1884.

---

**AN ACT to authorize the town of Concord to increase its Water Supply.**  
*Be it enacted, etc., as follows:*

**SECT. 1.** The town of Concord, in addition to the powers now conferred upon it by law, is hereby authorized to supply itself and its inhabitants and other persons, towns and corporations on the line of its water works with pure water to extinguish fires, generate steam and for domestic and other purposes, and may establish public fountains and hydrants and regulate their use, and discontinue the same, and may collect rates to be paid for the use of the water.

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# LAWS AND RESOLVES

PASSED BY THE

Legislature of Massachusetts

DURING THE

SESSION OF 1884.

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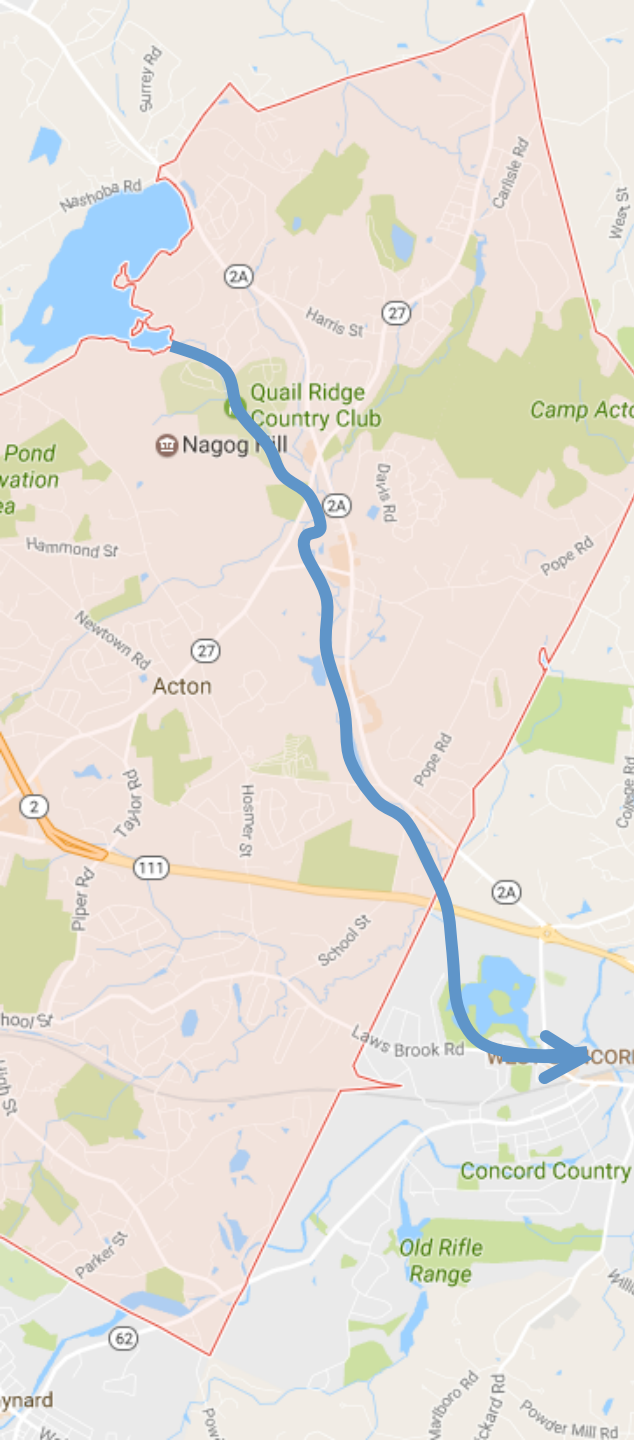
**SECT. 10.** Nothing contained in this act shall prevent the town of Acton nor the town of Littleton from taking the waters of said Nagog Pond whenever said towns or either of them may require the same for similar purposes, and in case of such taking by either of said towns or both of them, if from any reason the supply of water in said pond shall not be more than sufficient for the needs of the inhabitants of the towns of Acton and Littleton, then the needs of the inhabitants of said towns shall be first supplied ; and

WRIGHT

Acton, Littleton & Concord all have rights to withdraw water from Nagog Pond.

Only Concord has exercised this right.





## Potential concerns:

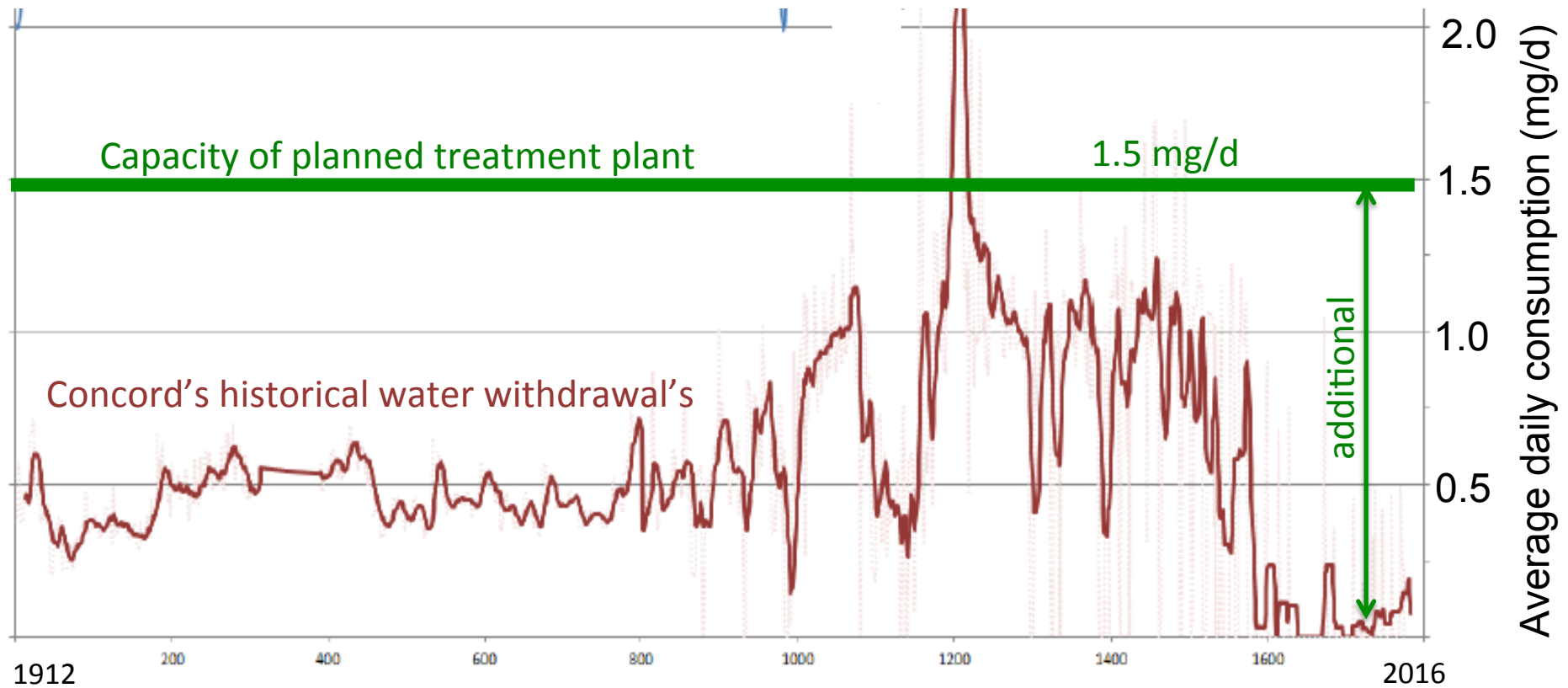
- Could additional withdrawals harm Nagog Pond?
- Could additional withdrawals harm downstream ecosystems, including wetlands and cold water fishery?
- Could additional withdrawals from Nagog Pond decrease water available in Acton's wells?

## Nagog Pond Water Treatment Plant

Exterior Rendering



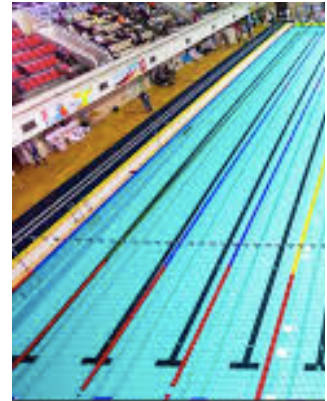
Concord's planned water treatment plant will enable more water to be withdrawn than has been taken historically.



Data from Concord's Sept 12, 2016 presentation to Acton BoS



# Is 1.5 million gallons per day a lot?



2.3 Olympic-sized swimming pools

**2016 AWD Water System Pumped**  
In million gallons

**Average for 2016**  
1.63 million gallons per day \*

<http://www.actonwater.com/operations/pumped>

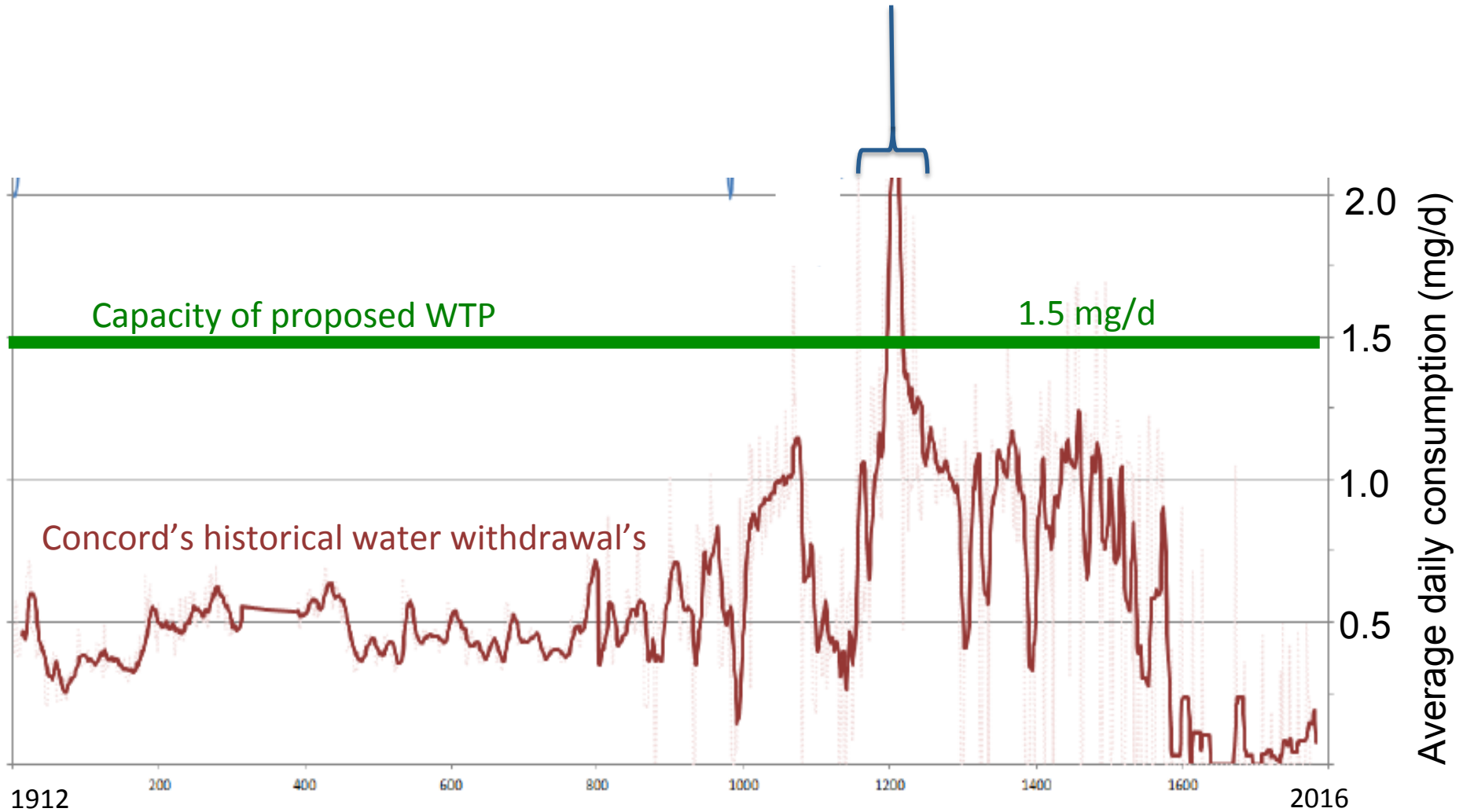


# Massachusetts Water Management Act

- Came into effect in 1985
- New water usage after that date has to be “permitted,” and is subject to multiple constraints.
- Historical water usage, prior to that date was grandfathered in, and is referred to as “registered.”
- Historical water usage, for the purpose of establishing registrations, was based on usage during the years 1981-1985.



The only time that Concord's withdrawals from Nagog Pond reached 1.5 mgd was during the period when the WMA registrations were being determined.



Prepared in cooperation with the  
Massachusetts Department of Environmental Protection

## Refinement and Evaluation of the Massachusetts Firm-Yield Estimator Model Version 2.0



Scientific Investigations Report 2011–5125

### Firm yield:

... if water were  
withdrawn at the “firm  
yield” rate...

...and no water was  
released downstream...

...during the “drought of  
record,” the reservoir  
would fail.

Levin, S. B., Archfield, S. A., & Massey, A. J. (2011). Refinement and evaluation of the Massachusetts Firm-Yield Estimator Model version 2.0 US Geological Survey Scientific Investigations Report 2011-5125).



“The reservoir would fail” means the pond level would fall to the level of the intake pipe.



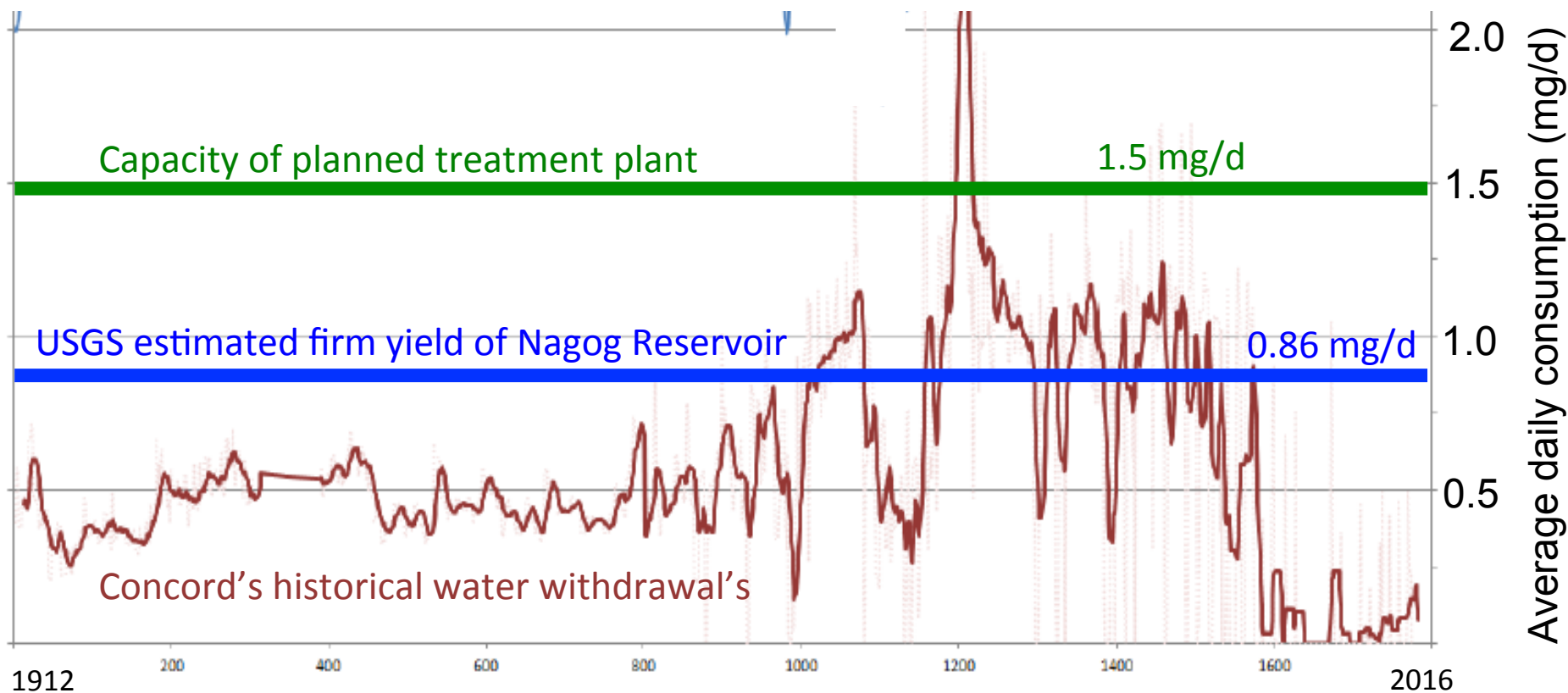
Example of a failed reservoir out west.

Prepared in cooperation with the  
Massachusetts Department of Environmental Protection

## Refinement and Evaluation of the Massachusetts Firm-Yield Estimator Model Version 2.0



USGS's estimated firm yield  
for Nagog Pond reservoir is  
0.86 mg/d



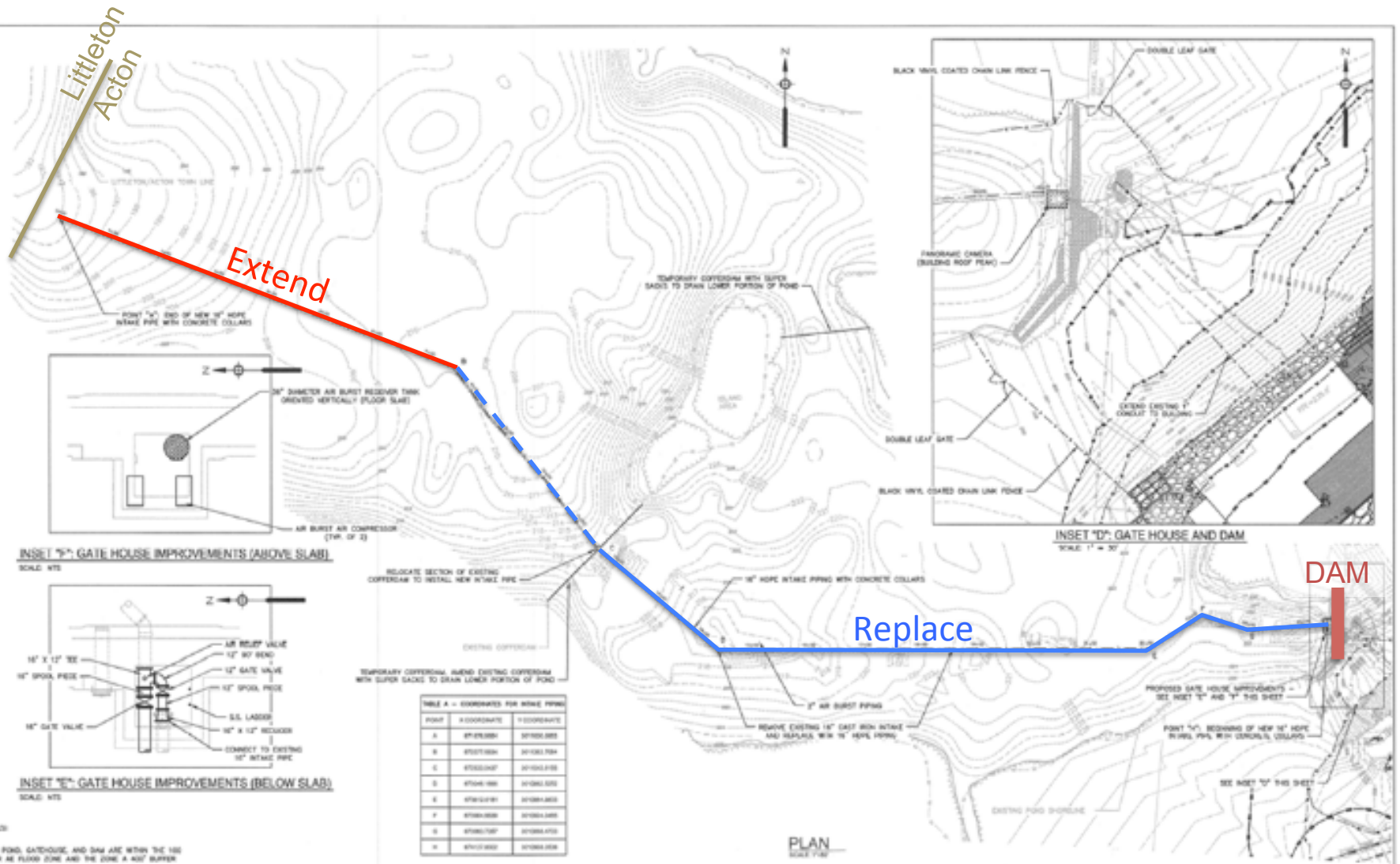


“The intake pipe extends approximately 1,800 feet into Nagog Pond... Physical inspections of the intake pipe have indicated that it has significantly deteriorated... proposing to replace it with a new ... pipe.”

(from Nagog Pond Water Treatment Plant MEPA Environmental Impact Report)

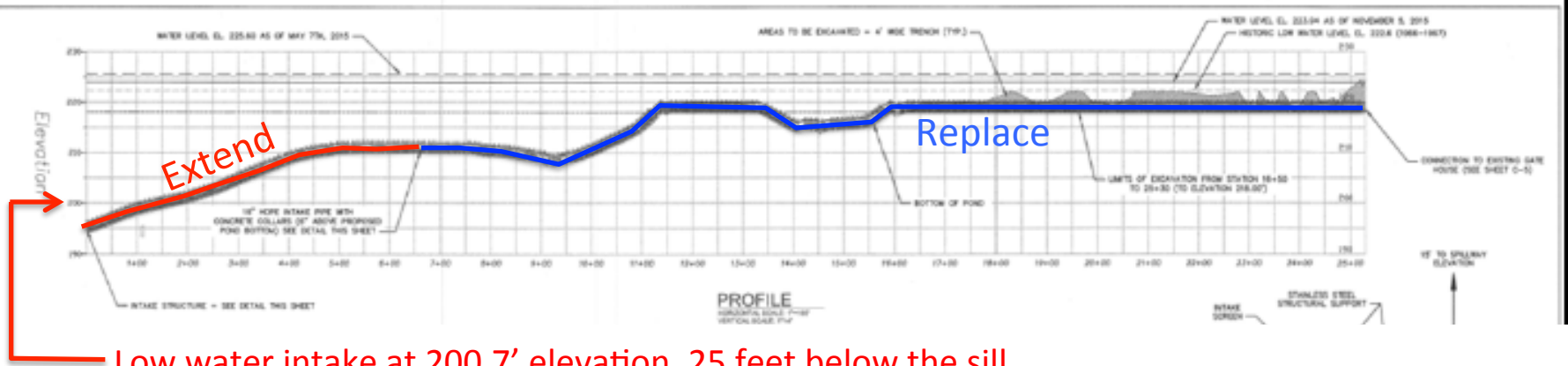
# Intake

## NOI – Supplemental Layout



# Intake

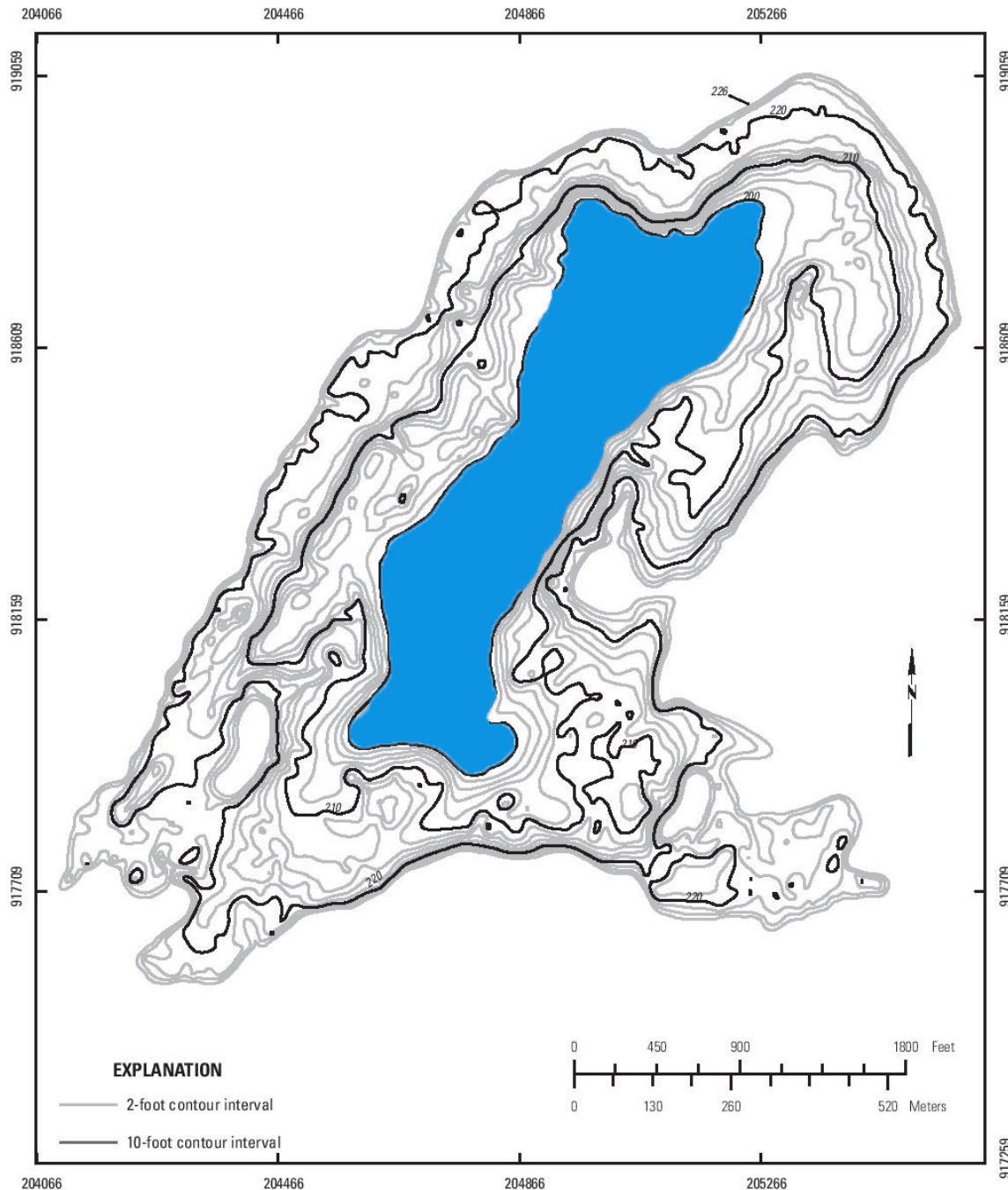
## NOI – Supplemental Profile



From Sheet no C-6 of engineering drawings dated August 2016



# Nagog Pond



Nagog Pond if water were withdrawn down to the proposed lower intake (200' elevation).

Bathymetry from Appendix 2 of Levin, S. B., Archfield, S. A., & Massey, A. J. (2011). Refinement and evaluation of the Massachusetts Firm-Yield Estimator Model version 2.0 (Vol. Scientific Investigations Report 2011-5125): US Geological Survey.

Color added.

# Barker Pond: a 15 foot deep pond in Acton, MA



Lucy Kirshner

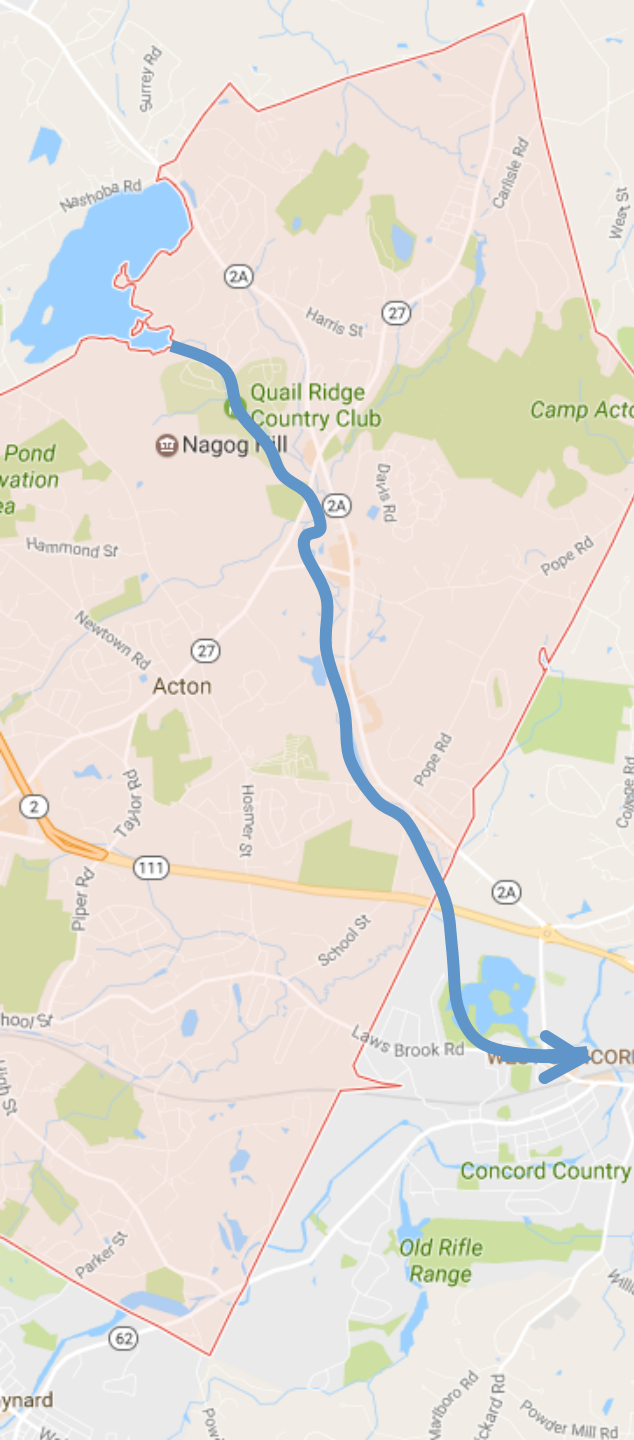
In 2006, before the pond lost its outflow...



Lucy Kirshner

In 2009, when the outflow was blocked...





## Potential concerns:

- Could additional withdrawals harm Nagog Pond?
- Would additional withdrawals harm downstream ecosystems, including wetlands and the Nagog Brook cold water fishery?
- Would additional withdrawals from Nagog Pond decrease water available in Acton's wells?



## Nagog Brook, February 2018



Robert Sekuler

(This image was video of the flowing brook in the Forum presentation.)

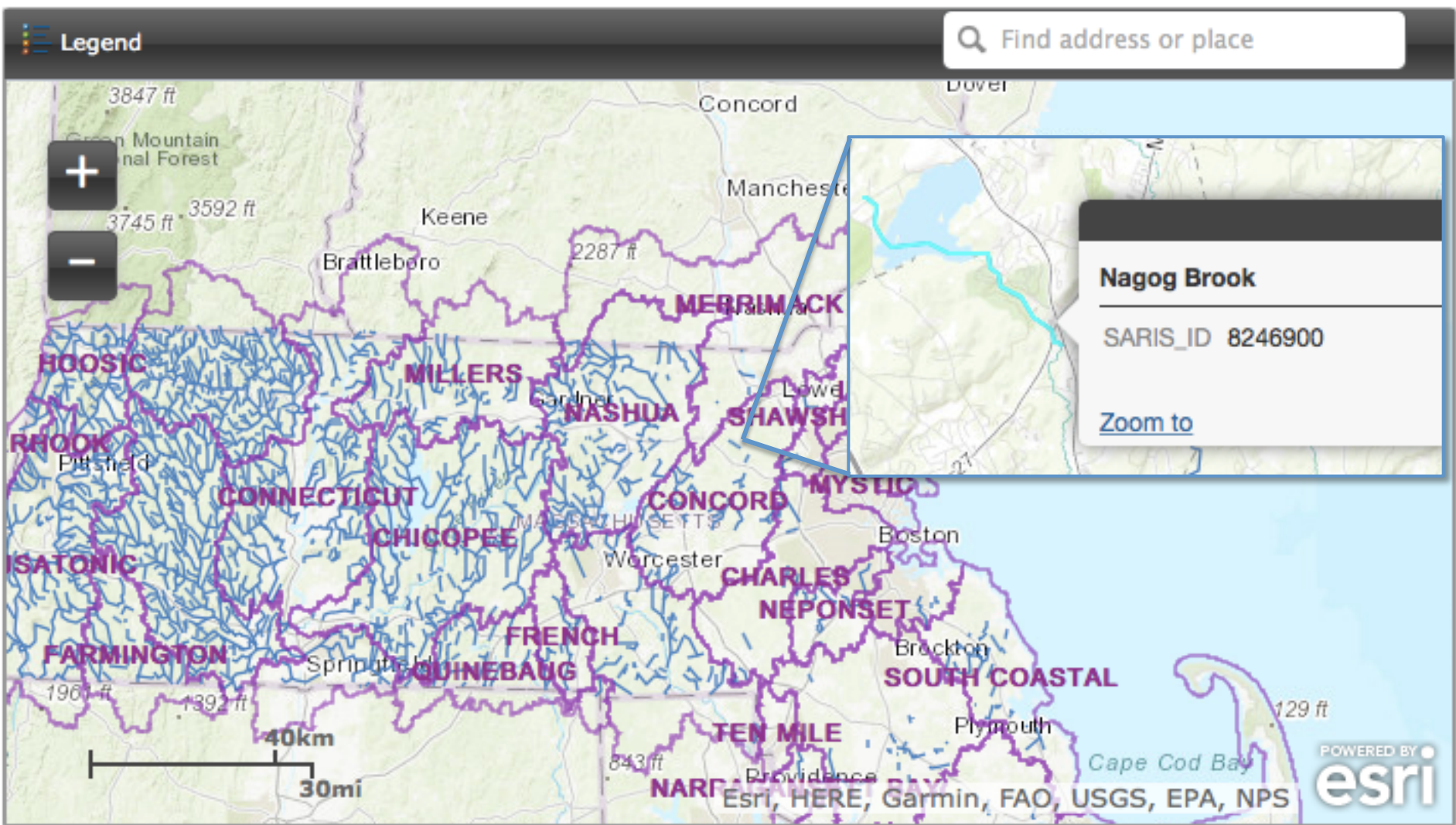
# Massachusetts Cold Water Fishery Resource under the Sustainable Water Management Initiative

- Cold water fishery is taken as indicator of a healthy ecosystem.
- To be designated as a CWFR, brook, brown or rainbow trout reproduction has been determined to take place in the stream.
- If a CWFR may be impacted, the Water Management Act requires permit applicants to evaluate plans for shifting their withdrawal elsewhere or taking other mitigation measures.

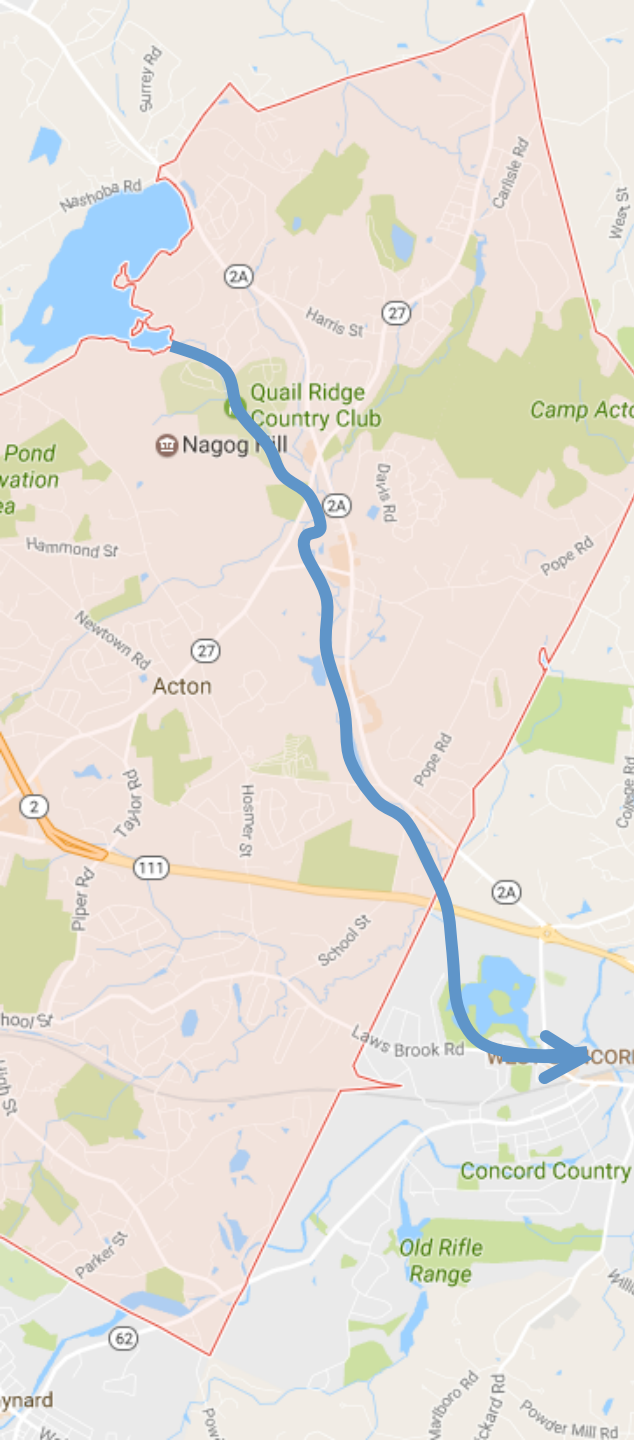


# Coldwater Fish Resources Map

Below is an interactive map of Coldwater Fish Resources (CFRs) in watersheds across Massachusetts. Zoom in and then click on a stream for its name and unique SARIS code.

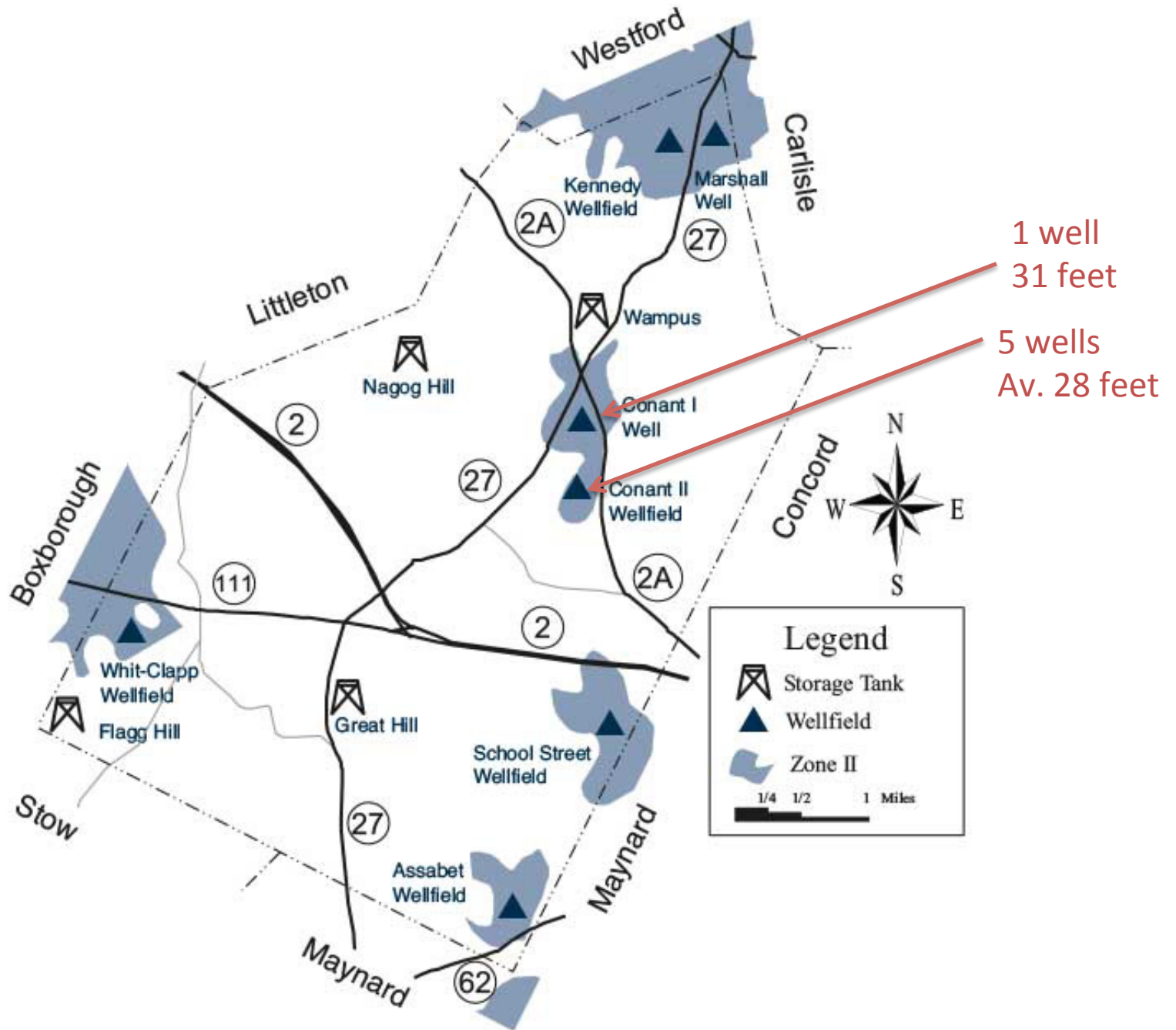


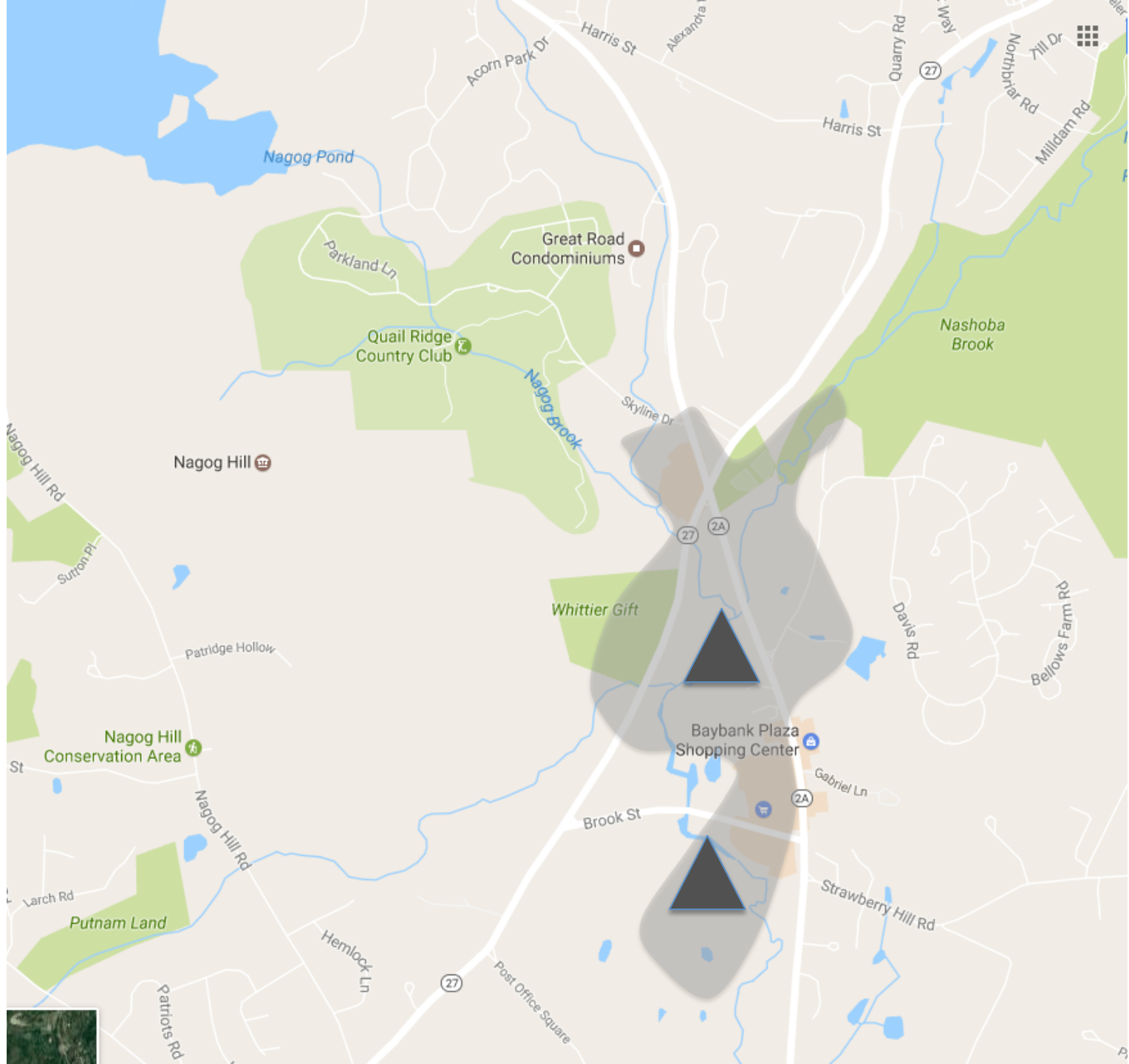




## Potential concerns:

- Could additional withdrawals harm Nagog Pond?
- Could additional withdrawals harm downstream ecosystems, including wetlands and cold water fishery?
- Could additional withdrawals from Nagog Pond decrease water available in Acton's wells?

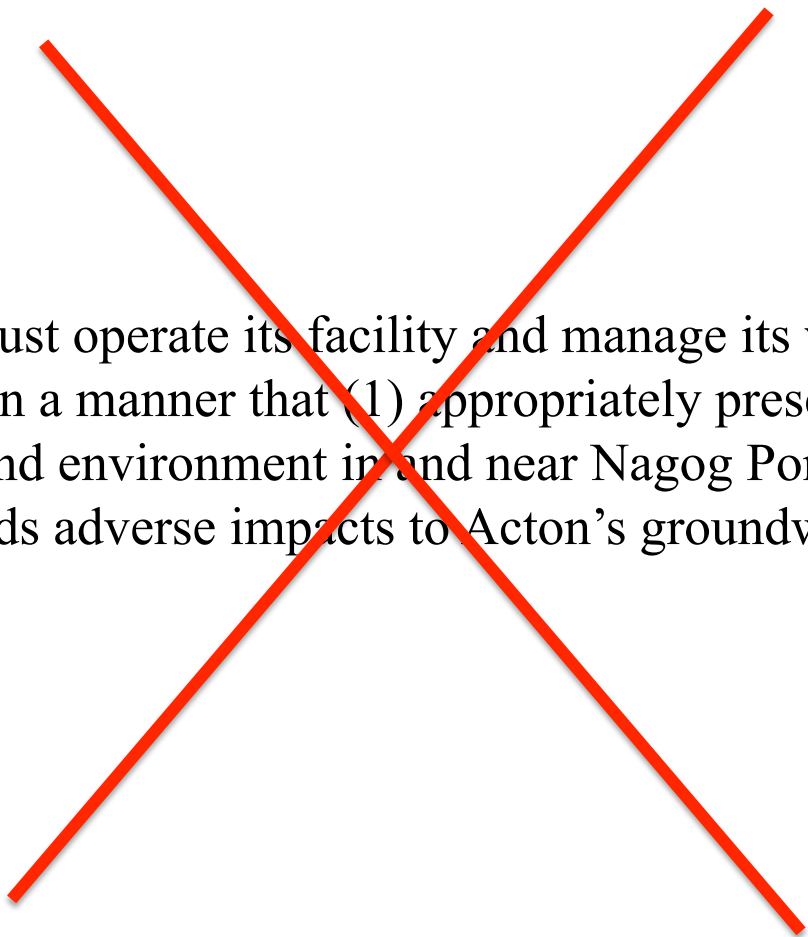






## Sequence of Legal Events (partial)

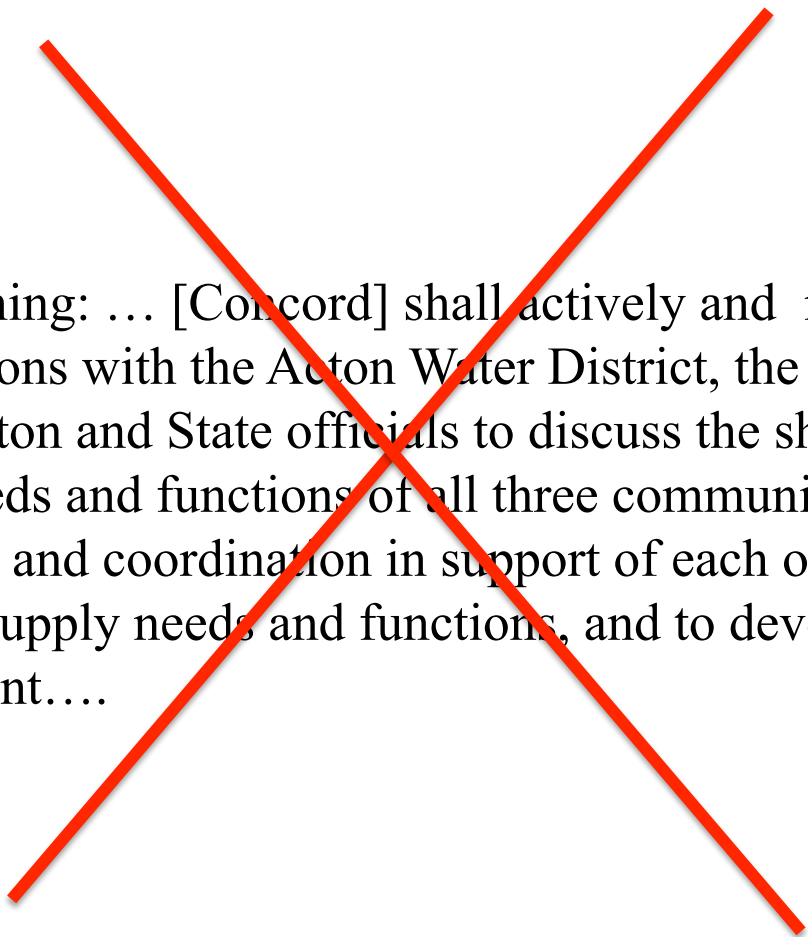
- Concord applies for Special Use permit and Site Plan Special Permit to build Water Treatment Plant at Nagog Pond (November 2015)
- Hearings and deliberations by Acton Board of Selectman on Concord's application (Jan 2016 – March 2017)
- Acton BoS votes yes to approve Concord's application, but with terms and conditions
- Concord sues in Land Court for judicial relief from “onerous and capricious terms and conditions” (April 2017)
- Closed door negotiations → Modified Draft Special Permit Decision document submitted to Land Court.
- Land court remands case back to Acton BoS (October 2017)
- Public hearing is re-opened, a new round of public comments are taken, BoS deliberates, BoS votes to reject the decision (November 2017)
- Concord amended their complaint to the Land Court
- The case has gone back to Land Court and has a court date of July 28, 2018



3.3.8: [Concord] must operate its facility and manage its withdrawals from Nagog Pond in a manner that (1) appropriately preserves and protects the water and environment in and near Nagog Pond and Nagog Brook, and (2) avoids adverse impacts to Acton's groundwater resources.

~~3.3.7: [Concord] shall develop a reasonably tailored monitoring and reporting program, ... with the objective of the program being to generate data that will enable Concord, the Acton Water District, Littleton and state regulatory agencies to better understand the relationship between Nagog Pond water withdrawal rates and water levels, Nagog Brook flow levels and rate, and recharge of groundwater in the vicinity of the Acton Water District's Conant I and Conant II wells ... The program shall include a baseline data collection component—data collected for some specified period of time prior to the operation of the new plant.~~





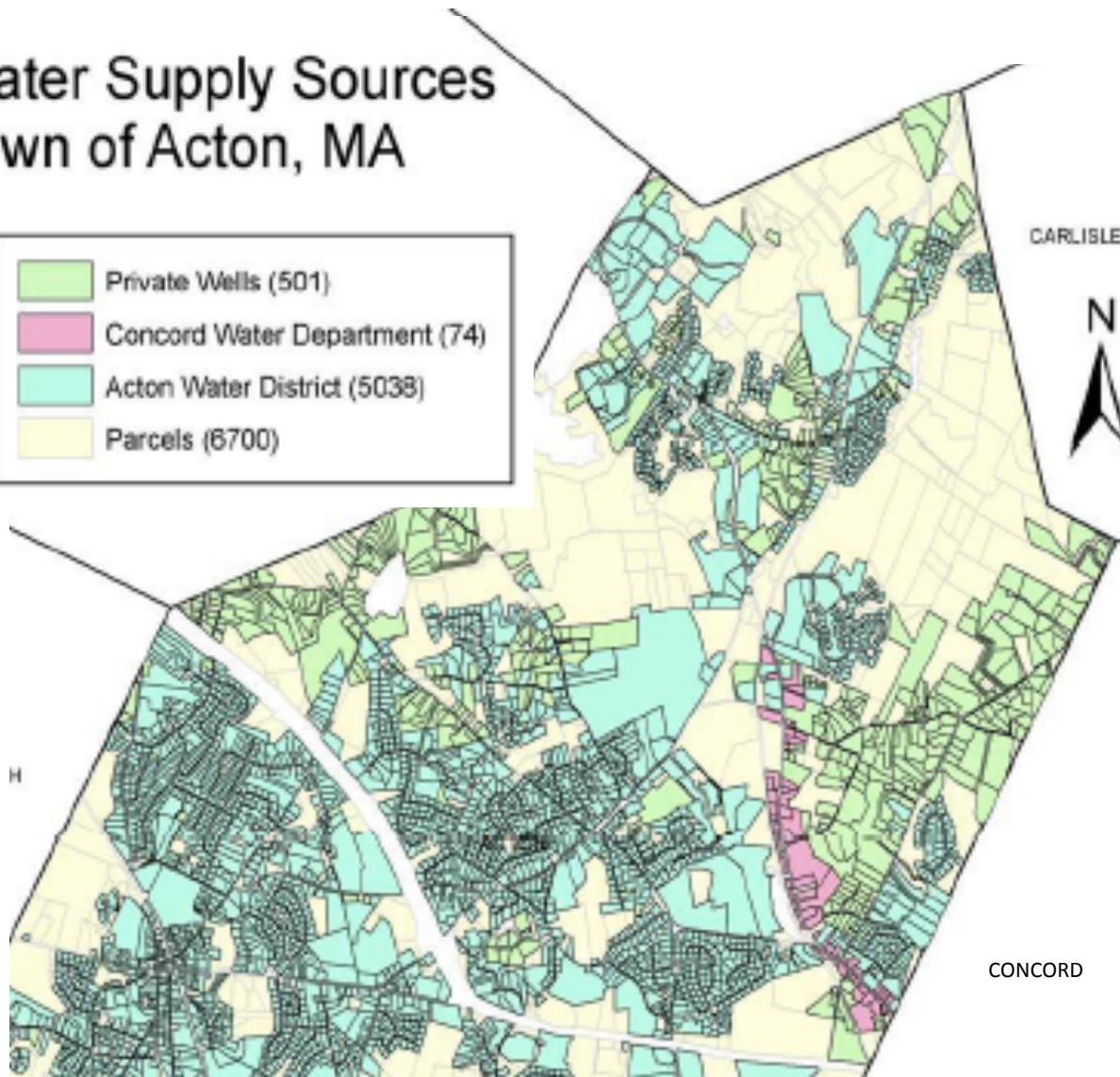
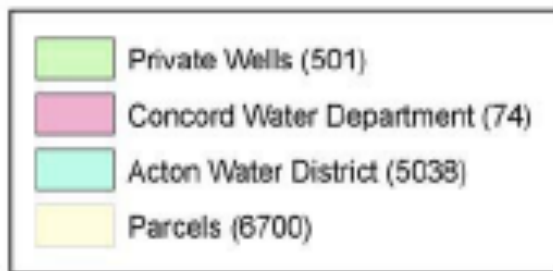
3.3.9: Regional Planning: ... [Concord] shall actively and in good faith participate in discussions with the Acton Water District, the Town of Acton, and appropriate Littleton and State officials to discuss the short and long-term water supply needs and functions of all three communities, to discuss mutual aid, assistance and coordination in support of each other's short-term and long-term water supply needs and functions, and to develop a regional water supply agreement....

# Can we use this Nagog situation as an opportunity to learn to share water rather than fight over water?

- Scale back the water treatment capacity to the USGS/MassDEP firm yield estimate
- Commit to a continuous trickle of water through the lower outflow to support the cold water fishery
- Commit to not dropping the pond level below X feet below the sill, where X would be designed to avoid eutrophication
- Collaborate on regional hydrological modeling and data collection to understand surface and subsurface connection, if any, between Nagog Pond and Acton water wells.

In fact, Nagog water is being served to both Acton and Concord

## Water Supply Sources Town of Acton, MA



Can we use these Rt2A customers as a model for water sharing?

... rather than a bone of contention?

(From Acton Water District)



# Can we use this Nagog situation as an opportunity to learn to share water rather than fight over water?



- Under a formal, written water-sharing agreement, Concord sells some Nagog finished water to the AWD.
- AWD sells this water to the Rt 2A customers (currently 74 customers).
- Agreement would include the acknowledgement that Nagog is a regionally important shared resource, and the possibility of scaling up Acton's share over time.

# Lessons Learned

- A whole series of tough decisions around water and development are coming to eastern Massachusetts, and we are not ready: not in public understanding, nor science, nor policy, nor decision-making processes.
- We need a venue other than hearing rooms and law courts to talk about regional water needs. We need to be able to talk with one another, neighbor to neighbor.
- We need a regional hydrologic model and water data system, kept continuously updated, so as to be able to ask “what if?” questions to guide decision-making. The basic science exists, but it needs to be localized...
- The Water Management Act registration system, established in 1986, needs an update to take into account new science and climate change.
- In the 21<sup>st</sup> century, every decision about development needs to be viewed through the lens of its impact on water quality and quantity.