Elbow Pond Improvement Project

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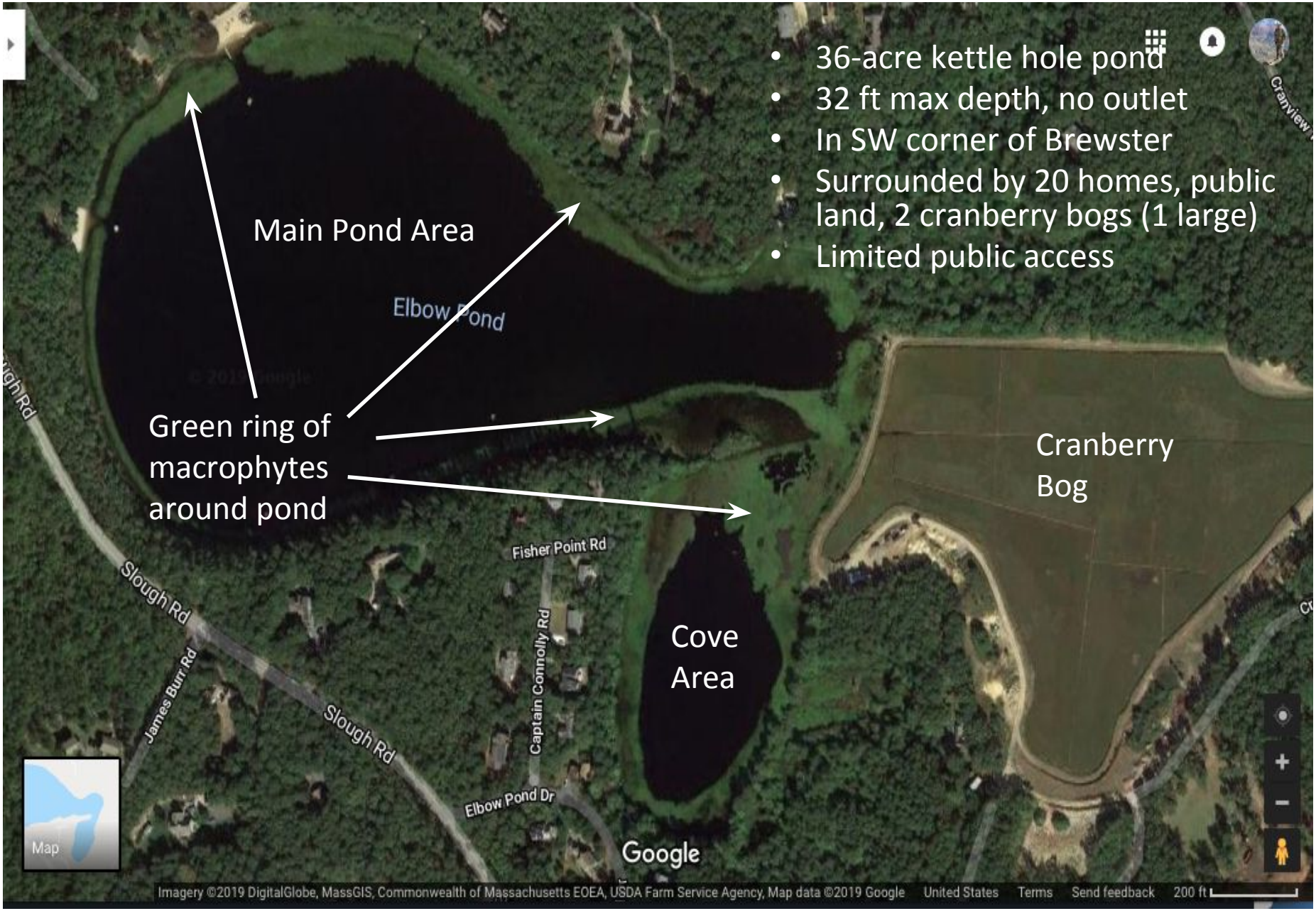
Elbow Pond



- 36-acre kettle hole pond
- 32 ft max depth, no outlet
- In SW corner of Brewster
- Surrounded by 20 homes, public land, 2 cranberry bogs (1 large)
- Limited public access

The Problem

- High Nutrients – especially phosphorus (P)
  - Causes risk of algae and cyanobacteria blooms
  - Which makes water unswimmable, dangerous for pets
  - And reduces fish and amphibian life
  - And causes odors and impacts property values
- High P also promotes growth of water plants
  - Watershield, lilies, milfoil, bladderwort, others - some invasive
  - Now present far above natural or historic levels
  - Also reduces usability of pond
- P is conserved – settles to pond bottom at end of growing season so accumulates over years

Process to Implement Improvement Project

- Organize community and gain support for a project
- Pond Study
- Conservation Commission Approval
- MA Natural Heritage Bureau Approval
- Agreement on Use of Town Equipment and Composting Facility
- Implement Work
- Testing to Measure Effectiveness

Fund-raising

Pond Study

- Must be done by independent expert to be credible
  - We used Horsely-Witten – the Town's pond consultant
- Contents
  - Define water quality, problem
  - Evaluate alternatives
    - Effectiveness
    - Cost
    - Advantages and risks
  - Recommendations
  - Comments on future pond water quality management (i.e. sustainability)
- Took 2 months, cost ~$14,000
  - Used PALs and Brewster Pond study data, so limited sampling, which kept cost down

Need to Understand Pond Phosphorus Mass Balance

- Source in Elbow Pond mostly past vegetation deposition and fertilizer use in adjacent cranberry bogs
- Little from septic systems, roads, yards

Bird waste

Rain deposition

Deposition of vege-tation (leaves, etc.)

Fertilizer from bogs, yards, gardens

Storm runoff (roads, roofs, yards, forest)

Surface flow in

Surface flow out

Groundwater flow in (including P from septic systems)

Groundwater flow out

Uptake and release by water plants and algae

Deposition to and uptake from sediments

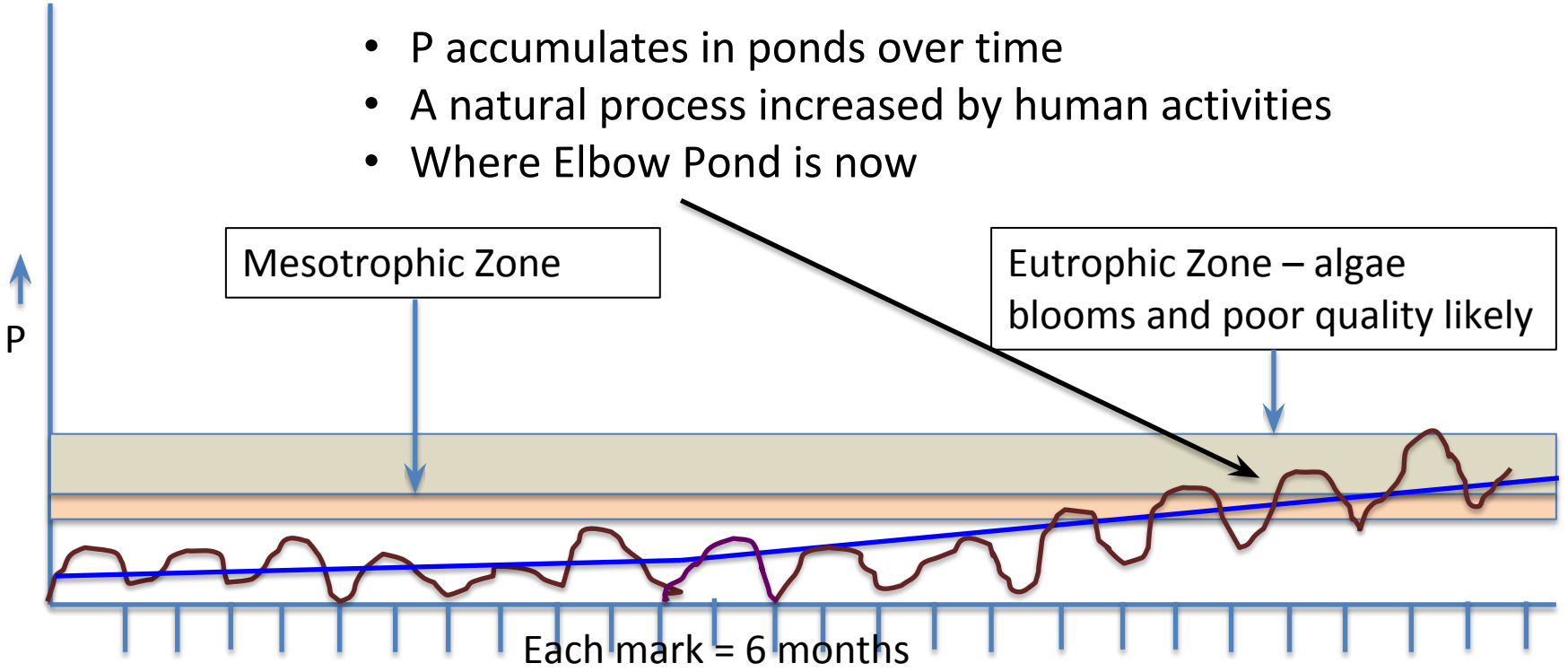
Uptake and release by fish and other fauna, fish migration

Phosphorus Accumulation in Ponds Over Time

Natural Phosphorus Sources:
- **Leaves, needles, vegetation detritus**
- Birds
- Volcanic ash deposition
- Groundwater inflow

Human Phosphorus Sources:
- Road runoff
- **Fertilizer**
- Septic tanks
- Acid rain
- Livestock
- Pets

- P accumulates in ponds over time
- A natural process increased by human activities
- Where Elbow Pond is now



- Bottom sediments store P from season to season, resulting increased water concentrations in warm seasons when P is released from sediments
- Cape soil very low in P so does not leach much phosphorus to ponds

3 Strategies to Address the P Problem
(To prevent High P causing "algae" blooms)

1) Prevention of P addition and natural attenuation
2) Phosphorus removal from pond
   - Dredging
   - Macrophyte "harvesting"
3) Phosphorus stabilization in bottom sediments
   - Alum Addition
   - Oxidation

If algae blooms occur, options become:
- Wait it out until algae/cyanobacteria dies out
- Biological seeding with plants/microbes that "eat" algae
- Algaecides
- Oxidation to speed up algae life cycle, prevent fish death due to low O2 in water

Methods to Address Phosphorus

1) Reduce P inputs to below outflow levels
   - Only controllable source may be active cranberry bog
     - But bog fertilizer practices have State agricultural exemptions
     - Should be low source if good practices followed
   - Not a feasible strategy, but need to study bog effect and ways to reduce P input
2) Dredging or partial dredging of sediments
   - Very expensive, but very effective and quick effects
   - Major ecological disruption however done
   - Approval very difficult to obtain
   - Difficult in kettle hole ponds – cannot drain
   - Not a feasible strategy for Elbow Pond

5 Methods to Address Phosphorus

3) Alum addition
- Alum precipitates P from water, settles P to bottom
- Precipitate does not leach and not biologically available
- Precipitate can break down and re-release P – 5 to 20 years
- Commonly used practice, often approved
- Cost at Elbow Pond ~$150,000

5) Oxidation
- Install air bubblers at pond bottom – various types (e.g. SolarBee)
- Requires continued maintenance and energy – on-going basis
- Aerated water inhibits P re-introduction to water from sediments
- Cost >$100,000 due to pond size and depth, plus operation cost
- Often used, easy approval
- Varied effectiveness – less effective and more costly in deeper and larger lakes like Elbow Pond

- Both not recommended - cost and uncertain effectiveness

5 Methods to Address Phosphorus

5) Macrophyte harvesting
   - 1 ton (1,000 kg) of plants removed = 2 kg of P removed
   - Low cost if harvester available and place to send removed vegetation
     - Brewster owns a harvester barge
     - Compost facility can accept vegetation
   - Slow to show effect – requires multiple harvesting over several years
   - Works if many macrophytes, as in Elbow Pond
   - Requires good technique to prevent ecological impacts and spreading of invasive/nuisance plants
   - Approval likely if no or low impact on threatened species

Strategy recommended by Horsely-Witten after study

Proposed Work

- Remove macrophytes using Town harvesting barge
  - Focus on nuisance plants – milfoil, watershield
  - Clip rooted plants ~ 1 foot from bottom
  - Do not kill plants - allow regrowth to take up more P
  - Not in very shallow water – avoid impact on reeds, Plymouth gentian, amphibians. Minimize impact on damsel & dragonflies
  - Up to 50% of macrophyte ring (likely less due to threatened species)
- Take removed plants to Town compost center
  - Weigh plants removed to determine P removal
  - Plants will make excellent compost
- Monitor water quality before and after work
- Repeat several times until P in sediments and water column reduced to levels below mesotrophic zone
  - <10 mg/l Total P in water column

Approvals

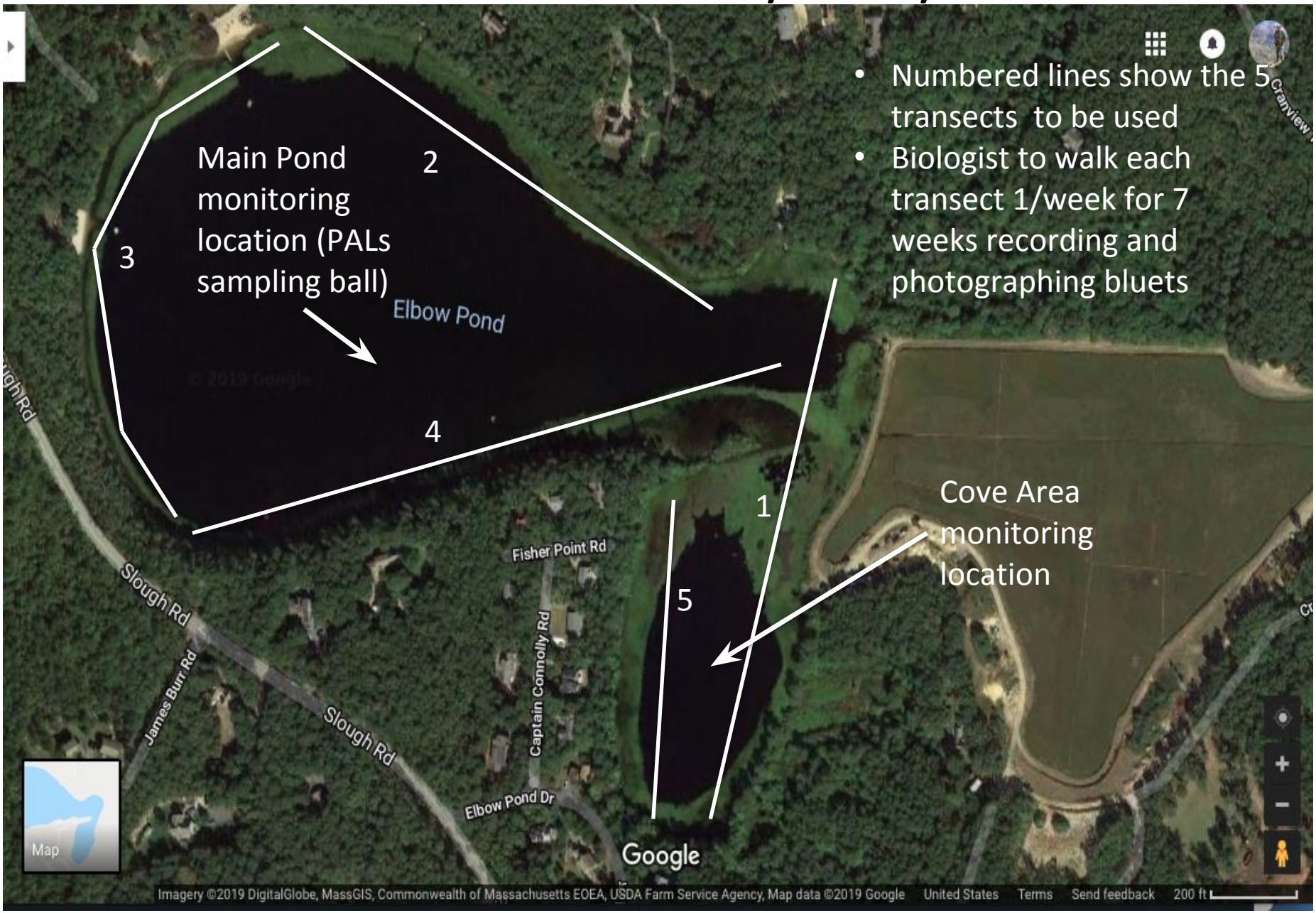
- Notice of Intent filed with Brewster Conservation Commission & MA DEP Natural Heritage Bureau
- Cons Com gave approval in April subject to Natural Heritage approval
- Natural Heritage concerned about impact on threatened species found in H-W study
  - 4 threatened plants found study: **resupinate bladderwort**, pond arrowhead, Plymouth gentian, Carolina redroot
  - 2 threatened damselflies found: **Pine Barrens bluet (blue) and Scarlet bluet (red)**
  - Botanical and biological studies required
  - Studies to be done in June and July, report early August
- Hired botanists for bladderwort study - ~$1,000
- Peter Trull, a member of FOEP and qualified biologist, doing damselfly study

Botanical Survey

- To be done in July by approved botanists (when bladderwort blooms)
- Goal: locate and map any state-listed plants, focus on resupinate bladderwort
- Work Scope:
  - Plot the areas occupied by state-listed species on the map.
  - Record water depths in areas where listed species are found
  - Estimate population for each state-listed species with notes on population vigor, co-occurring species, and habitat conditions
- Record and plot on the map any findings of invasive plants
- Prepare a report of survey work including maps and photos

Key Objective: Identify areas to avoid in macrophyte harvesting to avoid impacting threatened species

Elbow Pond Damselfly Study Plan



- Numbered lines show the 5 transects to be used
- Biologist to walk each transect 1/week for 7 weeks recording and photographing bluets

Monitoring and Evaluation

- Water quality monitoring before the initial harvesting and between 2 weeks and 1 month after harvesting
- Additional monitoring and ~2 months after harvesting
  - Show the impact of regrowth of macrophytes on P levels
- Sampling at 2 locations – main pond and cove
- Testing for dissolved oxygen, temperature profile, pH and clarity (Secchi disk)
- Samples analyzed for alkalinity, P, N, and chlorophyll
- Monitoring under the PALS program will continue unless the above make this redundant
- Sampling to be done by Elbow Pond volunteers
- Report on effectiveness by consultant – to go to DEP and Conservation Commission

Schedule and Outlook

- Studies to be completed in late July
- Agreement with Town regarding use of harvesting barge and compost facility in July
- Natural Heritage approval early August
- Brewster Cons Com approval in August
- Initial harvesting work in late August or September
- Repeat harvesting work in early summer 2020

Pine Barrens Bluet

Scarlet Bluet

Costs

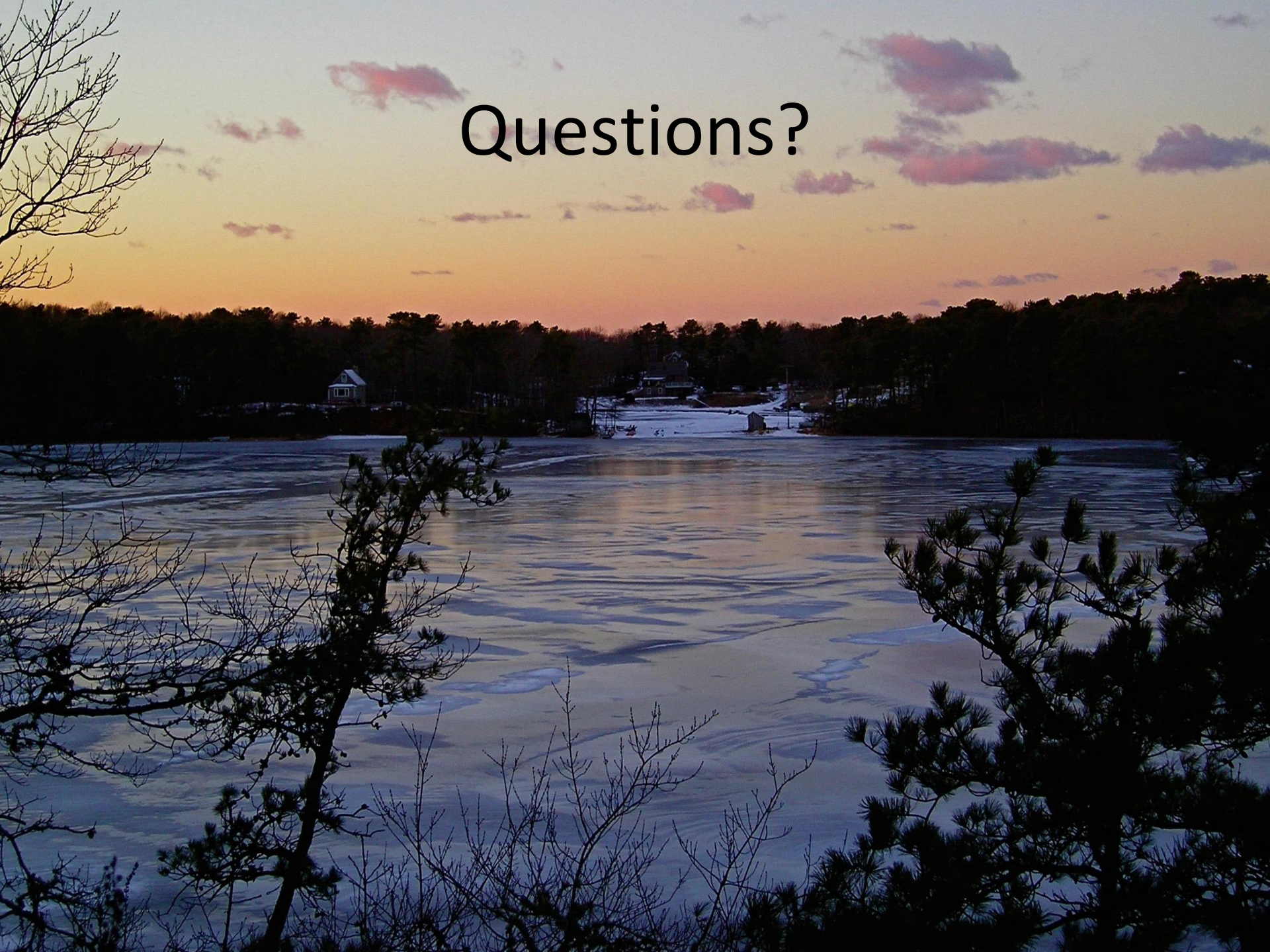
Total Hopefully <$28,000

- Horsely-Witten Pond Study - $14,000
- H-W costs for meetings with DEP, others ~ $2,000
- Brewster Conservation Commission fee - $35
  - Almost all fees waived – environmentally beneficial project
- DEP Natural Heritage fees - $555
- Botanical Survey ~$1,000
- Biological Survey ~$1,400
- Fee for use of Town harvesting barge and composting facility – to be determined, but hopefully not high
- Monitoring and evaluation <$4,000
  - Includes H-W post work evaluation report

Key Challenges

- Fundraising
  - Small number (~30) homeowners around pond, so cost per homeowner a concern
  - Most homeowners contributing, but some are not
- MA Natural Heritage Bureau approval
  - Can seem there is more concern about a few species than overall health of pond
  - Dot i's, cross t's – no relief for small privately funded project
- Agreement with Town for use of harvesting barge and composting center
  - First time, novel project, so breaking new ground
- Frustration among Friends of Elbow Pond due to length of study and approval process, and cost

But we are confident the project will get approved and proceed – and will be effective!


Questions?