



# Nutrients In Brewster Ponds

- Why they are a problem
- Sources
- Methods to address

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# Brewster Ponds Background

- 83 Ponds in Brewster,
  - Spread over entire town
  - All sizes - 740 acres (Long Pond) to 1/10 acre
- A major attraction and economic resource for recreation and tourism
  - 10,000's enjoy the ponds through public and private access for:
    - Swimming - Fishing - Kayaking, paddleboarding
    - Sailing - Ice skating - Water skiing
- Nearly 700 properties are pond-front or pond-view
  - Among the highest valued in Brewster
- Critical natural resource
  - Habitat for fish, turtles, frogs, snakes, dragonflies, damselflies, geese, ducks, and many more
  - Endangered species at several ponds

- **All our drinking water is from groundwater**
- **The same water that is in ponds - all connected**
- **5 Town wells and likely >200 private wells**



# All Brewster Ponds Are Kettlehole Ponds

- Small watershed areas, few inlets, often no outlets
- Depend on precipitation and ground water
- Long water detention times
- Often with residential development nearby
- Possible past pollution from historic agriculture
  - Grazing, farms, bogs
- Cranberry bogs on some
- Slow accumulation of organic matter over time
- High Iron and Phosphorus in bottom sediments



- **Natural water quality was very good**
  - Good pH, Soft, High Clarity
  - Low Phosphorus, nitrogen, algae
- **Pond water quality is sensitive to small changes in inputs**

# The Nutrient 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
  - Can reach nuisance levels far above natural levels
  - May reduce usability of pond – i.e. choke ponds with “weeds”
- P is conserved – settles to pond bottom at end of growing season, accumulates over years

# Ponds Are a Complicated Ecosystems

Pollutants Enter and Leave Ponds in Various Ways



Storm runoff in



Bird waste

Rain deposition

Deposition of vegetation (leaves, etc.)

Fertilizer from yards bogs, gardens

Surface flow in (Bogs and streams on some ponds)

Stream flow out

Groundwater (including nutrients from septic systems)

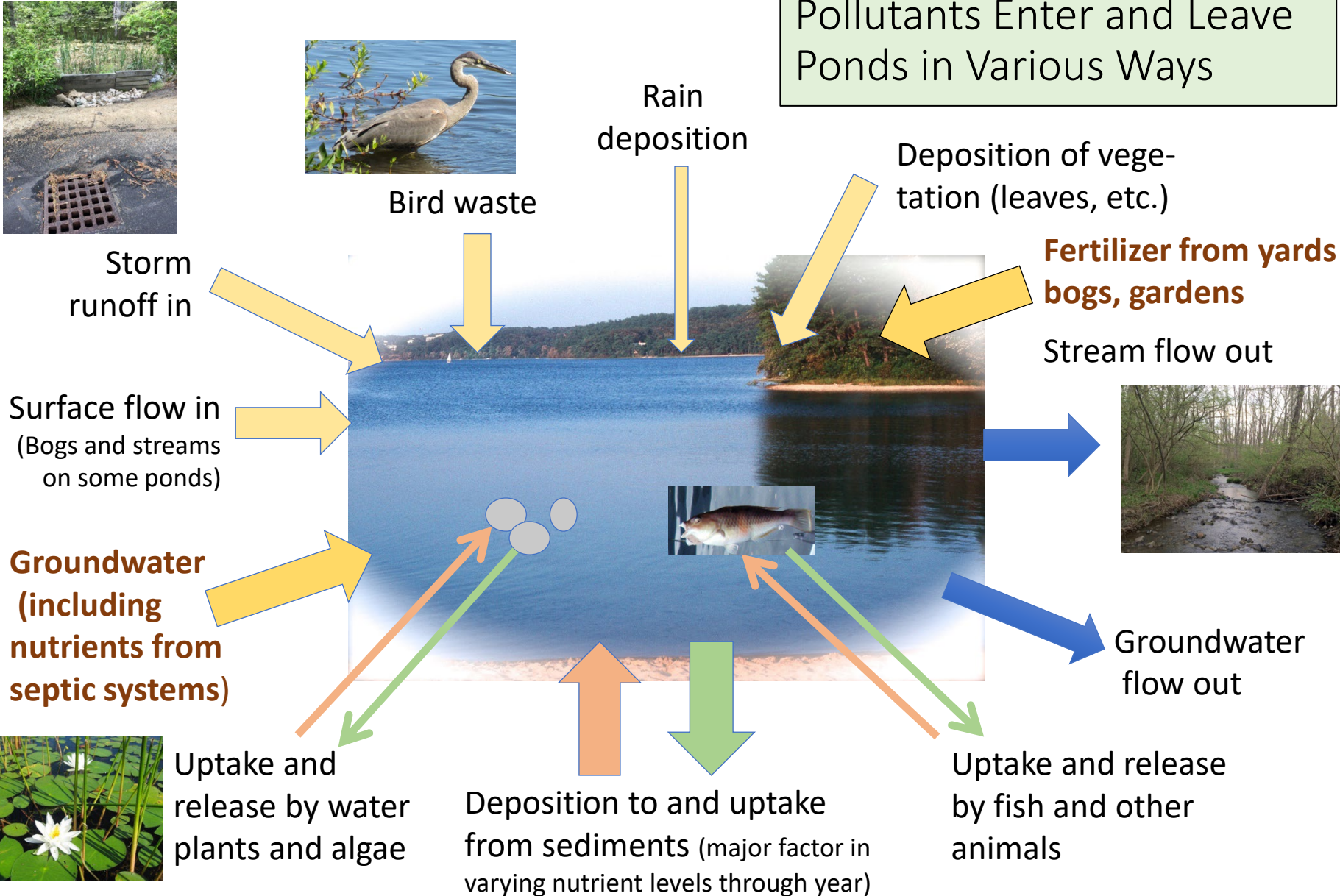


Uptake and release by water plants and algae

Deposition to and uptake from sediments (major factor in varying nutrient levels through year)

Uptake and release by fish and other animals

Groundwater flow out



# Nutrient Pollution Sources for Brewster Ponds

- **Septic tanks are the critical source for nutrients, chemicals**
  - If upstream of and/or close to ponds
  - Worse if septic systems overloaded or not pumped out regularly
  - All houses in Brewster rely on septic tanks
  - ~1 million gallons/day discharged to groundwater
- Other important sources:
  - Road and driveway runoff during rain – silt, salts, oil
  - Fertilizers and pesticides running off lawns and gardens near ponds
  - Cranberry bogs – nutrients, maybe pesticides – contribution unclear
  - Animal waste – especially from dogs
- Sources that add nutrients with little ability to control:
  - Plant deposition (leaves, pollen, etc.)
  - Birds, other wildlife
  - Rainfall deposition

Internal load from sediments a critical factor in pond impairment

- Low DO (<2 ppm) at pond bottom promotes release of P from sediments
- Not easily controllable and strongly skewed to summer
- Key factor in why water quality and cyanobacteria is worst in summer

# 3 Strategies to Address the P Problem

(To prevent high phosphorus causing “algae” blooms)

- 1) Prevention of Phosphorus addition
  - Allow natural attenuation to reduce P
- 2) Phosphorus removal from pond
  - Dredging
  - Macrophyte “harvesting”
- 3) P 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 O<sub>2</sub> in water

# Methods to Address Phosphorus

## 1) Reduce P inputs to below outflow levels

- Reduce loading from controllable sources
  - Septic systems are critical source
  - Other sources important – fertilizer, active cranberry bogs, pet waste
- Takes a long time to show results due to long water retention times in ponds and phosphorus in sediments
- Not a feasible strategy to fix ponds with current problems

## 2) Dredging or partial dredging of sediments

- Very expensive, but very effective and quick effects
- Major ecological disruption
- Approval usually difficult to obtain
- Difficult in kettle hole ponds – cannot drain

## 3) Alum addition

- Alum precipitates P from water, settles P to bottom
- Precipitate can break down and re-release P in 5 to 20 years
- Commonly used practice, often approved
- Can be costly, but less than dredging

# Methods to Address Phosphorus

- 4) Oxidation - Install air bubblers at pond bottom – (e.g. SolarBee)
  - Aerated water inhibits P re-introduction to water from sediments
  - Requires continued maintenance and energy
  - Cost varies based on pond size and depth, plus has operation cost
  - Often used, easy approval
  - Varied effectiveness – less effective in deeper and larger lakes
- 5) Water plant harvesting (if many plants present)
  - 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
    - Stored P in sediments take time to reduce
  - Requires good technique to prevent ecological impacts and spreading invasive/nuisance plants
  - Approval likely if no impact on threatened species

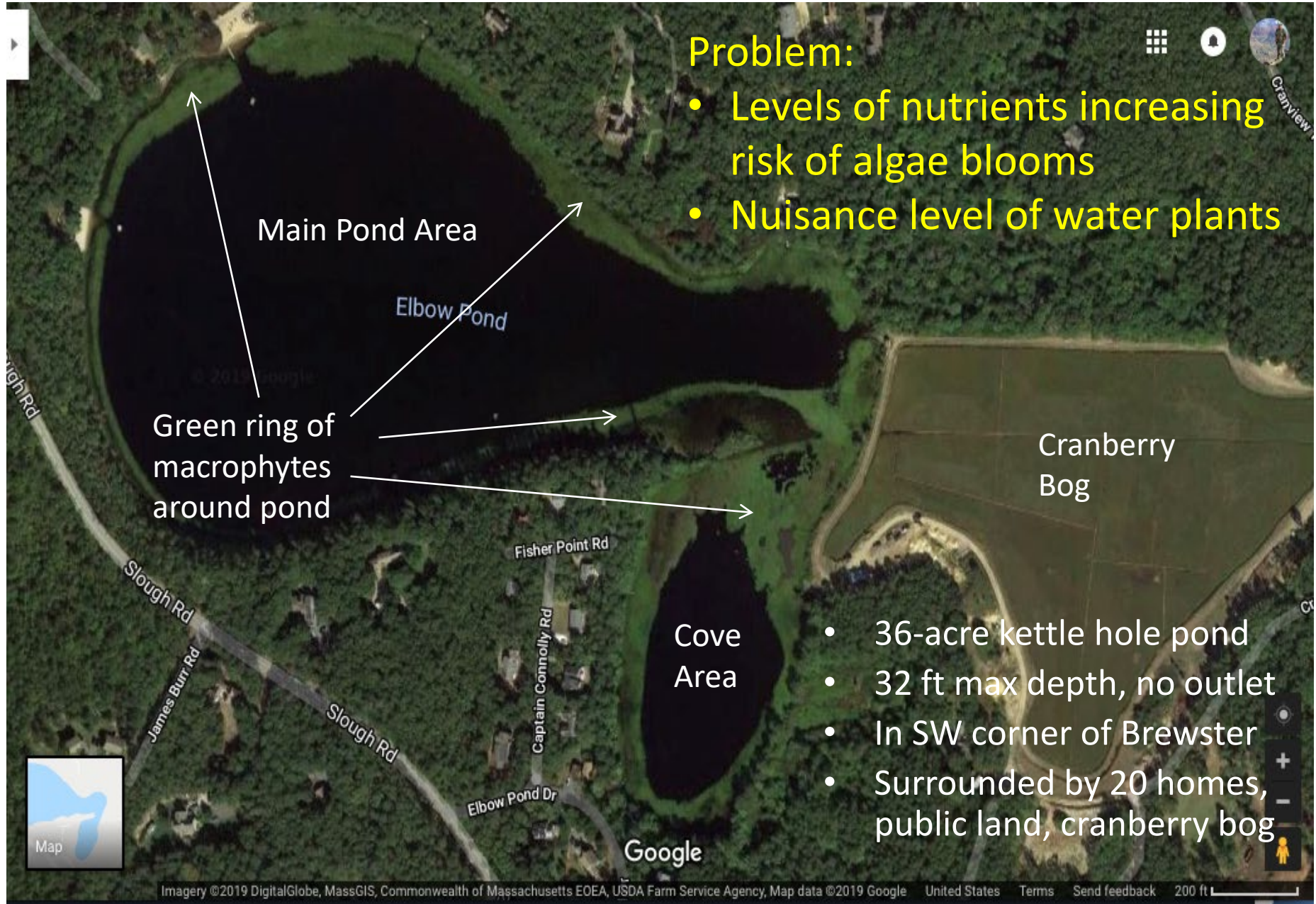
# Process to Implement Improvement Projects



- Organize community and gain support for a project
- Pond Study
  - Understand problem, nutrient sources
- Alternative evaluation
  - Evaluate cost, effectiveness, obstacles
- Method selection, project design
- Conservation Commission Approval
- MA Natural Heritage Bureau Approval
- Implement Work
- Testing to Measure Effectiveness

Fund-  
raising

# Elbow Pond Macrophyte Harvesting Project



## Problem:

- Levels of nutrients increasing risk of algae blooms
- Nuisance level of water plants

- 36-acre kettle hole pond
- 32 ft max depth, no outlet
- In SW corner of Brewster
- Surrounded by 20 homes, public land, cranberry bog

# Elbow Pond Water Plant Harvesting Project

- Remove nutrients, reduce nuisance water plants using Town harvesting barge
  - Do not kill plants - allow regrowth to take up more P
  - Not in shallow water – avoid impact on reeds, damselflies, turtles
- Take removed plants to Town compost center
  - Weigh plants removed, determine P removal
  - Plants make excellent compost
- Test water quality before & after
- Repeat several times to reduce P

## Results:

- 4 harvesting campaigns – 2019 - 2021
- Increased fish and turtles
- No impact on endangered species
- Some improved clarity and plant reduction
- Limited ability to work in cove area due to low water levels
- Limited impact on P level due to P stored in sediments



# How to Keep Ponds Healthy

- **What can you do to help keep ponds healthy?**
  - Minimize lawns - instead plant native plants
  - Minimize use of fertilizer and pesticides
  - Never dump medicines, oils, bleach, pesticides or chemicals into sinks or toilets
  - Keep septic systems in good condition
    - Pump out periodically
  - Minimize use of salt in winter for removing ice
  - Pick up pet waste
  - Cover bare ground – do not let rain carry silt into ponds
  - Don't harm pond life – e.g. don't remove turtles, frogs
  - Don't feed the geese, swans or ducks – we want them to live naturally, and not to increase geese

**Thank You**

