Brewster Ponds Coalition

Septic Systems, Phosphorus and Ponds

- Septic System Impact on Pond Water Quality
  - Phosphorus
  - PFAs and Toxics
- Methods to Address Phosphorus in Ponds

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Ponds Are a Complicated Ecosystems

Pollutants Enter and Leave Ponds in Various Ways – A Dynamic Process

Bird waste

Rain deposition

Deposition of vege-tation (leaves, etc.)

Storm runoff in

Surface flow in
(Bogs and streams on some ponds)

Groundwater flow in
(including from septic systems)

Stream flow out

Groundwater flow out

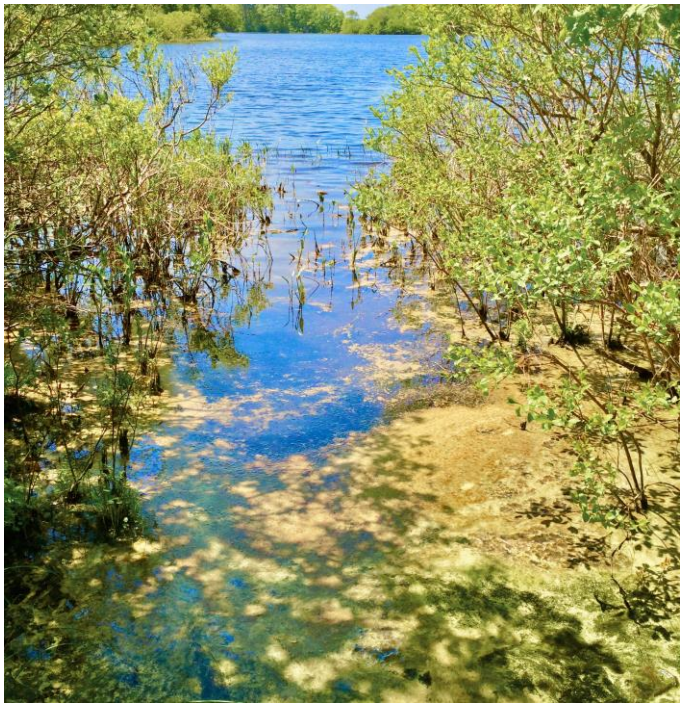
Uptake and release by water plants and algae

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

Uptake and release by fish and other animals

Why the Concern About Phosphorus?

- Two major nutrients impact ponds – phosphorus and nitrogen
- Impact of high nutrients on ponds:
  - Lower clarity – largely due to algae
    - Chlorophyl-A used as an algae indicator
  - Algae blooms – green masses on water
  - Increased risk of cyanobacteria (blue-green algae) blooms
    - Can release toxics making water unsafe for people and pets
  - Higher algae depletes oxygen in water
    - Called “anoxia”
    - Can lead to fish kills
    - Decreases fauna in sediments, causing imbalance



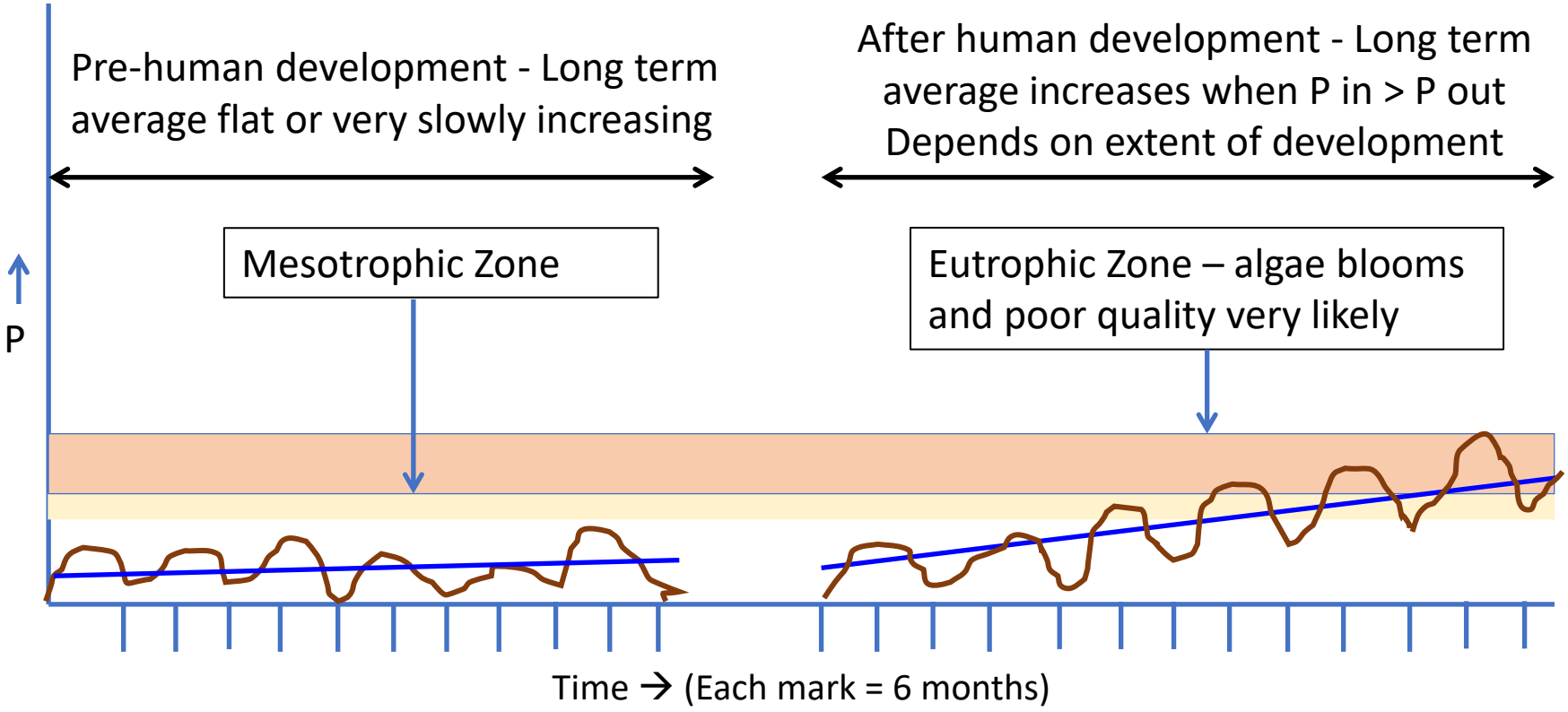
Phosphorus is most often the limiting nutrient in Cape ponds

Phosphorus Accumulates in Ponds Over Time

- Higher P = more algae bloom risk (though nitrogen levels also important)

Natural Phosphorus Sources:
- Vegetation detritus, birds, wildlife

Human Phosphorus Sources:
- **Septic Systems,** fertilizer, pet waste



Sediments store P from year to year and release P in summer if DO is low

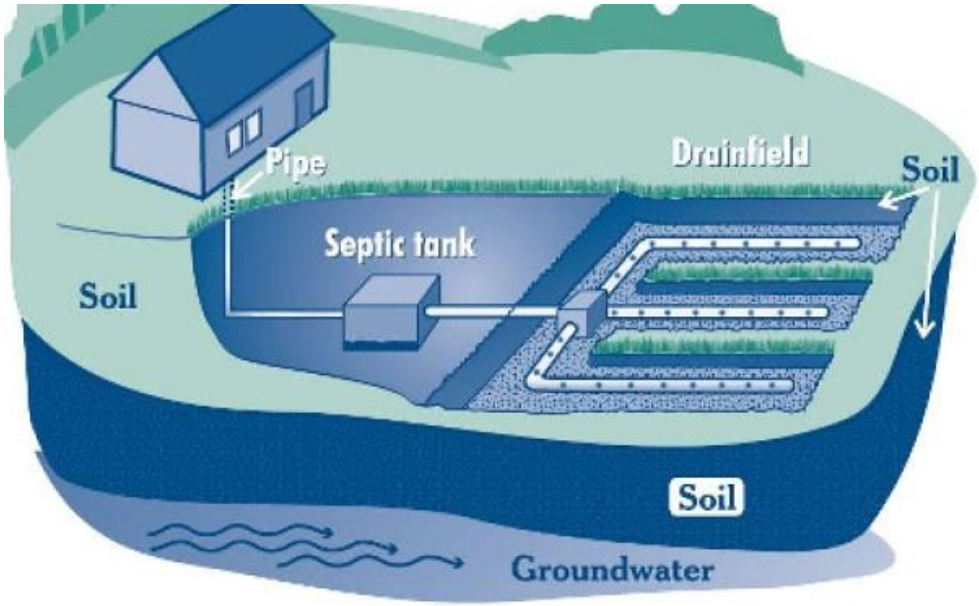
Problems occur when P rises, even if only in summer

Pollution Sources for Cape Cod Ponds

- **Septic tanks often the major source for nutrients – P & N**
  - Also for toxic chemicals like PFAs and pharmaceuticals
- Other important human-related sources:
  - Road and driveway runoff during rain – silt, salts, oil
  - Lawns and gardens near ponds - fertilizers runoff
  - Cranberry bogs – nutrients, 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
- Sediments often a critical factor in pond impairment
  - Low DO (<2 ppm) at pond bottom releases P from sediments

Septic System Impact on Groundwater & Ponds

- Greatest from:
  - Systems close to and upgradient of ponds and wells
  - Systems close to groundwater level (i.e. pond levels)
  - Old systems – leach pits and especially cesspools
  - Poorly managed systems – overloaded, not pumped regularly
- Not extreme in any year, but adds to load in ponds over time

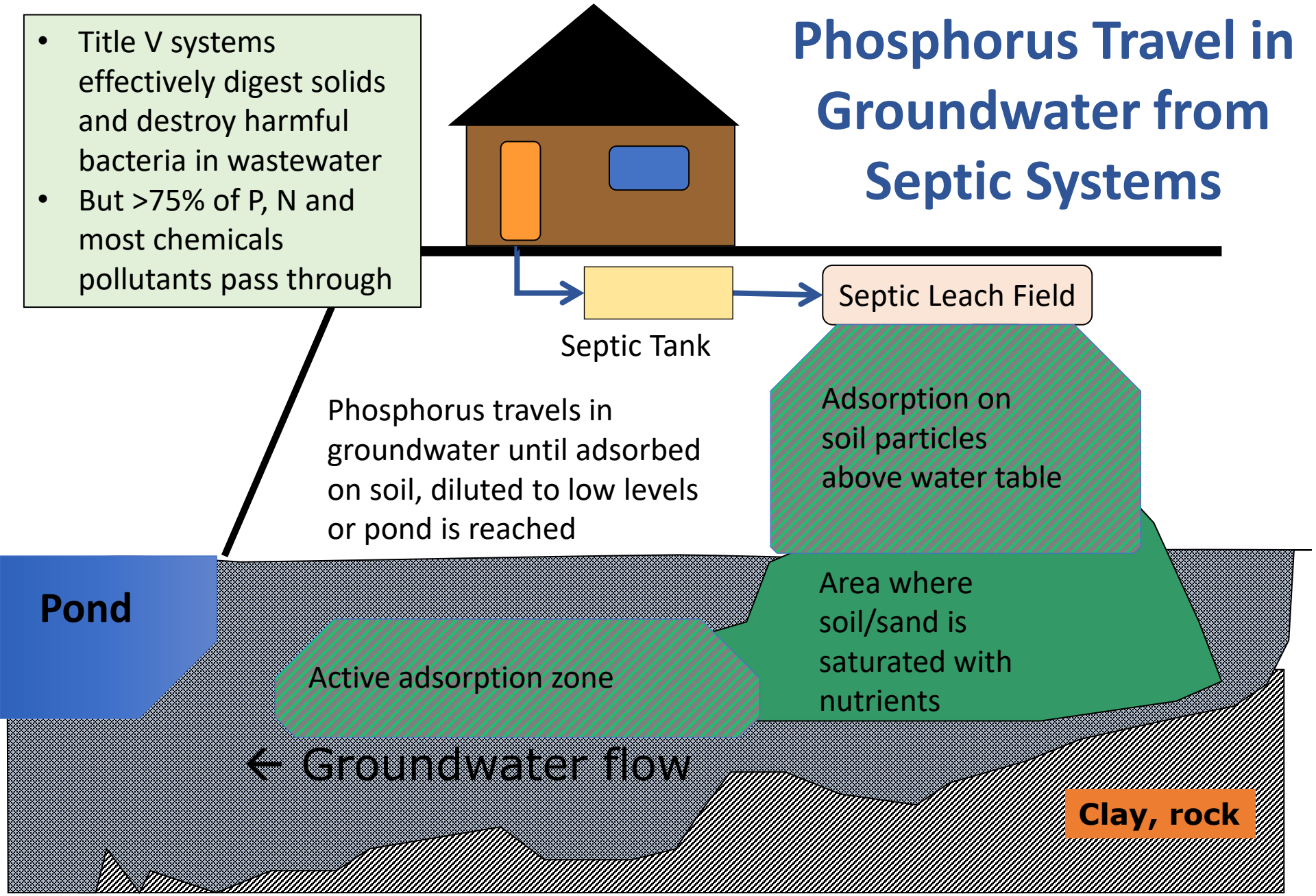


Typical Title V Septic System Layout

Septic Tank being pumped out

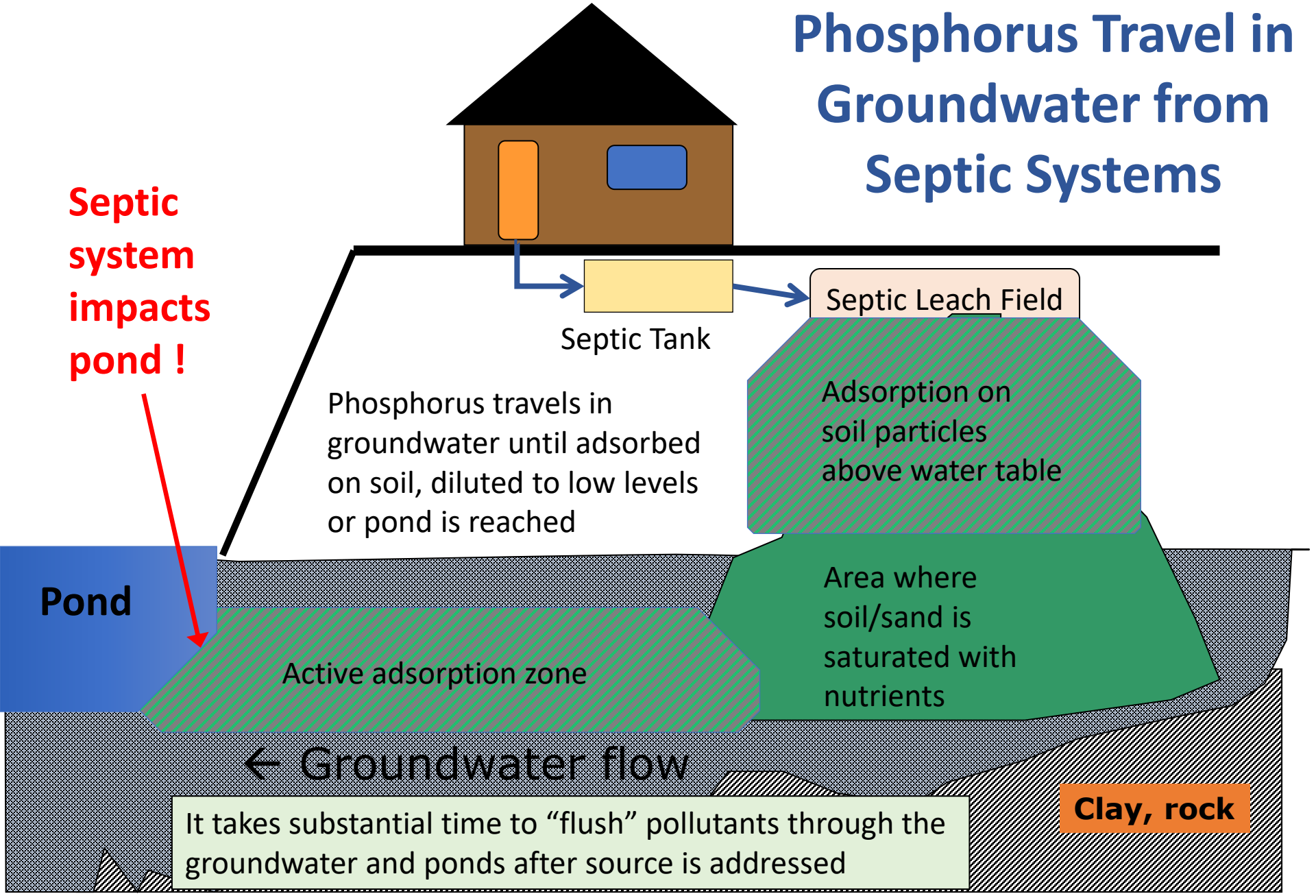
Phosphorus Travel in Groundwater from Septic Systems

- Title V systems effectively digest solids and destroy harmful bacteria in wastewater
- But >75% of P, N and most chemicals pollutants pass through



Septic system has not impacted pond yet

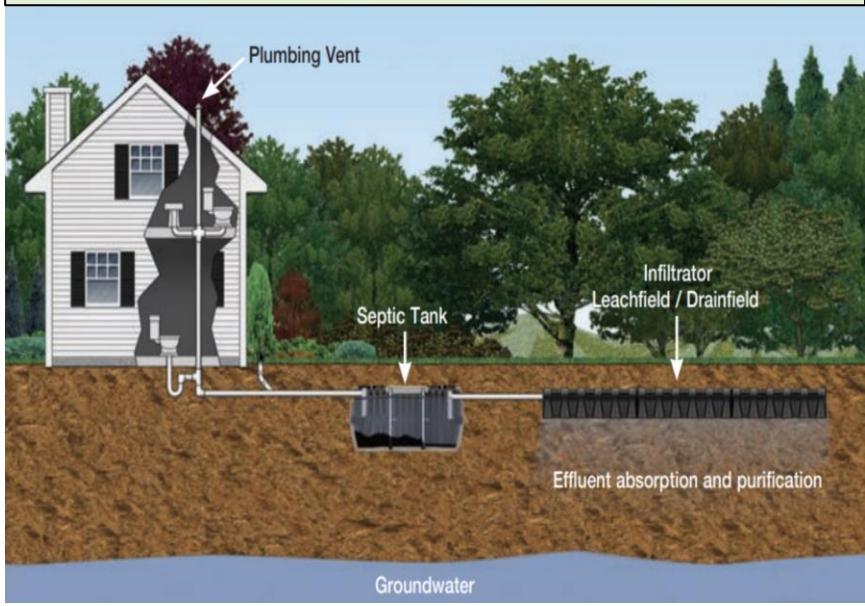
Phosphorus Travel in Groundwater from Septic Systems



How far away from ponds do septic systems need to be to not impact ponds?

- Rule of thumb – systems upgradient & <300 ft from ponds might impact within the life of a typical house (50 years)
- Many variables influence this:
  - Age of house
  - Distance to pond
  - Elevation of leach field above pond
  - Number of people in house
  - Year round use or summer only
  - Iron and manganese levels in soil (they adsorb P)
  - How many septic systems nearby
  - Are there fertilized lawns using P
- Actual distance for Cape ponds likely varies, not well known
  - Brewster Ponds Coalition starting a study to clarify this

Groundwater moves 0.5 to 2 ft/day through sand, but P maybe only 0.005 to 0.02 ft/day. At 0.01 ft/day, would take 27 years to move 100 ft. But reality depends on many things.



Example - Cobb's Pond, Brewster

- Cobb's has large groundwater catchment area, including old settled areas
- Phosphorus from septic systems, cesspools & outhouses has had hundreds of years to accumulate and migrate. Likely large amount of P in groundwater moving toward pond

3 Strategies to Address Phosphorus in Ponds

1) Prevention of P addition and allow 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
- Try to collect algae mechanically or filter out
- Oxidation to speed up algae life cycle and prevent fish death due to low O2 in water

5 Methods to Address Phosphorus

1) Reduce P inputs to below outflow levels (Strategy 1)
   - Septic system upgrades to A/I systems to reduce P at upgradient septic systems
   - Sewer systems to eliminate septic systems
   - Reduce road runoff
   - Reduce fertilizer runoff from lawns, gardens, bogs
   - Moderate to high cost for septic system upgrades depending on number of upgradient septic systems
   - High cost for sewers
   - Long term solution
   - Impact/benefits takes many years to realize due to P in sediments and groundwater
   - May not feasible for some ponds

5 Methods to Address Phosphorus

2) Dredging or partial dredging of sediments (Strategy 2)

- Remove muck & sediments at bottom of ponds that serve as a reservoir of P
- If pond can be drained, then drain and remove using excavators, heavy equipment
- If pond cannot be drained, need to do using a dredging barge.
- High cost
- Very effective and quick effects
- Disruption of pond use for the season when work done
- Major ecological disruption however done
- Approval very difficult to obtain
- May have access problems for heavy equipment or dredging barge
- Difficult in kettle hole ponds – cannot drain

5 Methods to Address Phosphorus

3) Macrophyte harvesting (Strategy 2)

- Cut rooted plants or harvest floating plants using a harvesting barge, various cutting tools or manually remove
- Do not kill rooted plants – allow to regrow to take up more P from sediments
- Send removed plants to compost facility (great compost!)
- 1,000 kg of plants removed (dry weight) = 2 kg of P removed
- Low cost if harvester available and place to send vegetation
  - Brewster owns a harvester barge
  - Compost facility can accept vegetation
- Slow to show effect – requires multiple harvesting over several years due to limited rate of removal and stored P in sediments
- Can only work if many macrophytes in pond
- Requires good technique to prevent ecological impacts and spreading of invasive/nuisance plants
- Approval likely if no or low impact on threatened species

5 Methods to Address Phosphorus

3) Alum addition (Strategy 3)

- Spread alum (liquid or powder) over entire or section of pond
- Alum precipitates P from water, settles P to bottom
- Precipitate does not leach and not biologically available
- Moderate cost
- Very quick results – immediate improvement
- Mixed effectiveness over longer term, depending on amount of alum, extent of P inflow into pond, other factors
- Precipitate will eventually break down and re-release P – 5 to 20 years
- Likely has to be repeated after precipitate breaks down
- Moderate ecological impact – changes pond sediments where some pond life lives, may impact fish during work
- Commonly used practice, often approved

5 Methods to Address Phosphorus

4) Oxidation (Strategy 3)

- Install air bubblers at pond bottom – various types (e.g. SolarBee)
- Aerated water inhibits P re-introduction to water from sediments
- Results in fully aerated pond, which also helps life in pond
- Does not remove or stabilize P
- May not impact plant growth (for better or worse) since P is still present to feed macrophytes
- Moderate cost – more than alum, far less than dredging
- Requires continued maintenance and energy
- Many different aerator systems to choose from
- Varied effectiveness – less effective and more costly (more aerators) in larger lakes
- Often used, easy approval

Conclusion

- Septic systems are a major source of nutrients and chemicals impacting ponds
- If septic system discharges and other sources are not addressed, water quality in our ponds will get worse
  - More algae and cyanobacteria blooms
  - Possible fish kills, reduced animal life
  - More pond closures to protect health
  - Risks to wells and drinking water – public and private
- Solutions require:
  - Understanding of nutrient and biological conditions in ponds
  - Understanding which septic systems impact ponds
  - Technically sound studies to evaluate best options in terms of cost, time and effectiveness
  - Broad support from the people of Cape Cod
  - Sound funding
  - A good number of years to implement and show effects