

POLLUTANT LOAD ANALYSIS

LAKE WENTWORTH & CRESCENT LAKE



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What is Modeling?

Mathematically traces water and phosphorus through the lake

Uses inputs like:

- ▣ Rainfall
- ▣ Watershed boundary
- ▣ Land use maps
- ▣ Septic system survey
- ▣ Local expertise
- ▣ Established lake science

Handwritten mathematical derivation of the relativistic energy equation $E = mc^2$. The derivation starts with the boxed equation $E = mc^2$ and shows the mass m as a function of velocity v and rest mass m_0 : $m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}}$. It then defines the Lorentz factor $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$ and uses the binomial expansion for γ when $v \ll c$: $\gamma \approx 1 + \frac{1}{2} \frac{v^2}{c^2}$. Finally, it substitutes this into the energy equation to get $E \approx m_0 c^2 \left(1 + \frac{1}{2} \frac{v^2}{c^2} \right) = m_0 c^2 + \frac{1}{2} m_0 v^2$, where the final term is boxed.

Why Use a Model?

- When you can't measure something directly, because...
 - ▣ It happened in the past
 - ▣ It will happen in the future
 - ▣ Impractical to experiment with
 - ▣ Risky to experiment with

Handwritten mathematical derivation of the relativistic energy formula $E = mc^2$. The derivation starts with the boxed equation $E = mc^2$ and shows the relationship between mass m and velocity v . It then uses the condition $\frac{v}{c} = \gamma \ll 1$ to approximate the relativistic mass formula, leading to the final boxed result $E \approx m_0 c^2 + \frac{1}{2} m_0 v^2$.

$$E = mc^2 = \left\{ m = \frac{m_0}{\sqrt{1 - \frac{v^2}{c^2}}} \right.$$
$$\frac{v}{c} = \gamma \ll 1 \Rightarrow (1 - \gamma^2)^{-1/2} \approx 1 + \frac{\gamma^2}{2}$$
$$\Rightarrow E \approx m_0 c^2 \left(1 + \frac{v^2/c^2}{2} \right) = m_0 c^2 + \frac{1}{2} m_0 v^2$$

Lake Loading Response Model

- Started as a university-level teaching tool
- Evolved over many years
- Used on over 30 lakes in NH
- Consists of large Excel spreadsheet
- Maps used to create many input numbers
- Strong local support

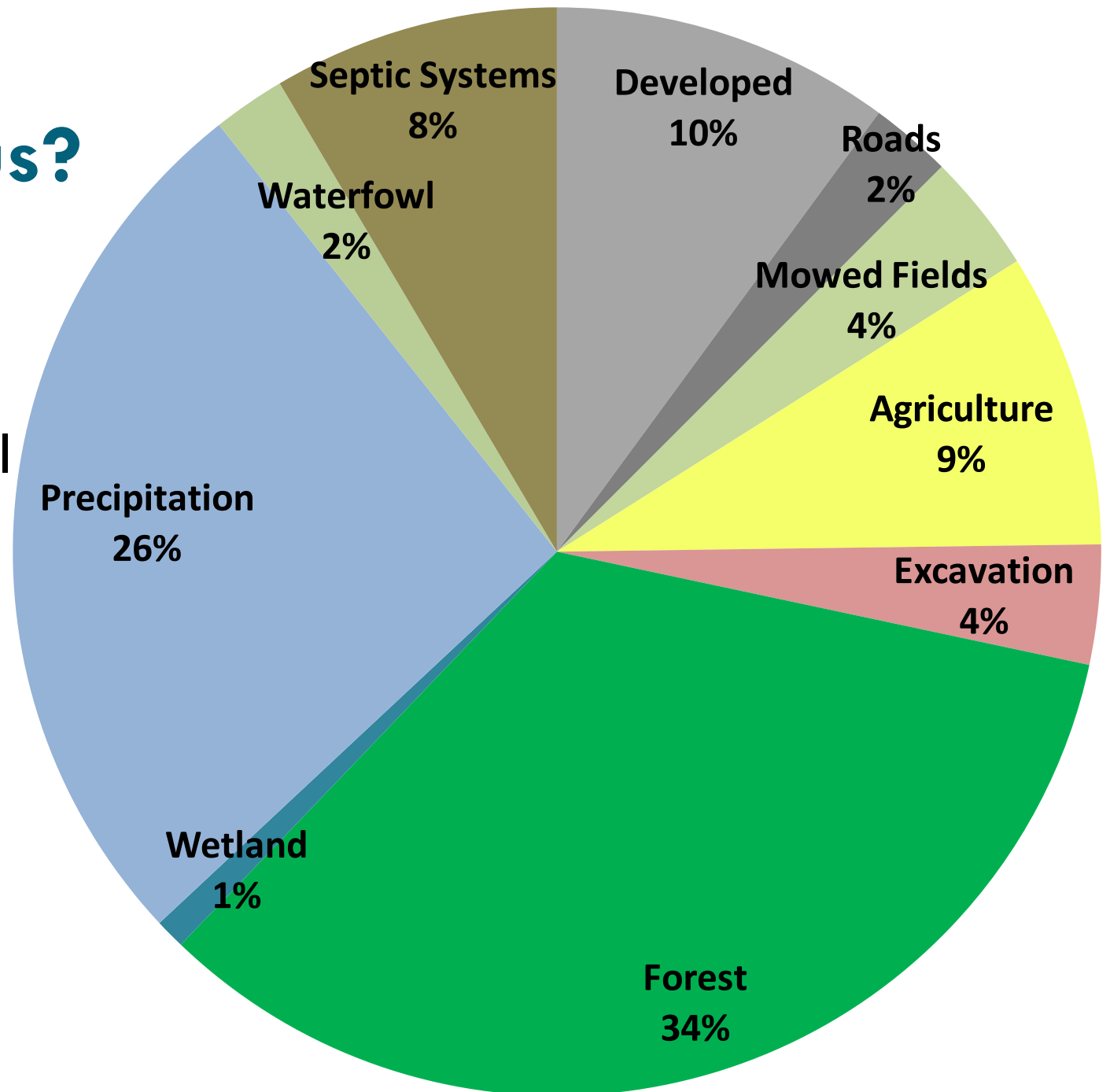


Possible Sources of Phosphorus

- Atmosphere, *from industry and exhaust*
- Septic Systems
- Waterfowl
- Land Use
 - Row crops, pasture, urban areas *very high*
 - Forest and wetlands *very low*
- Internal loading from sediments

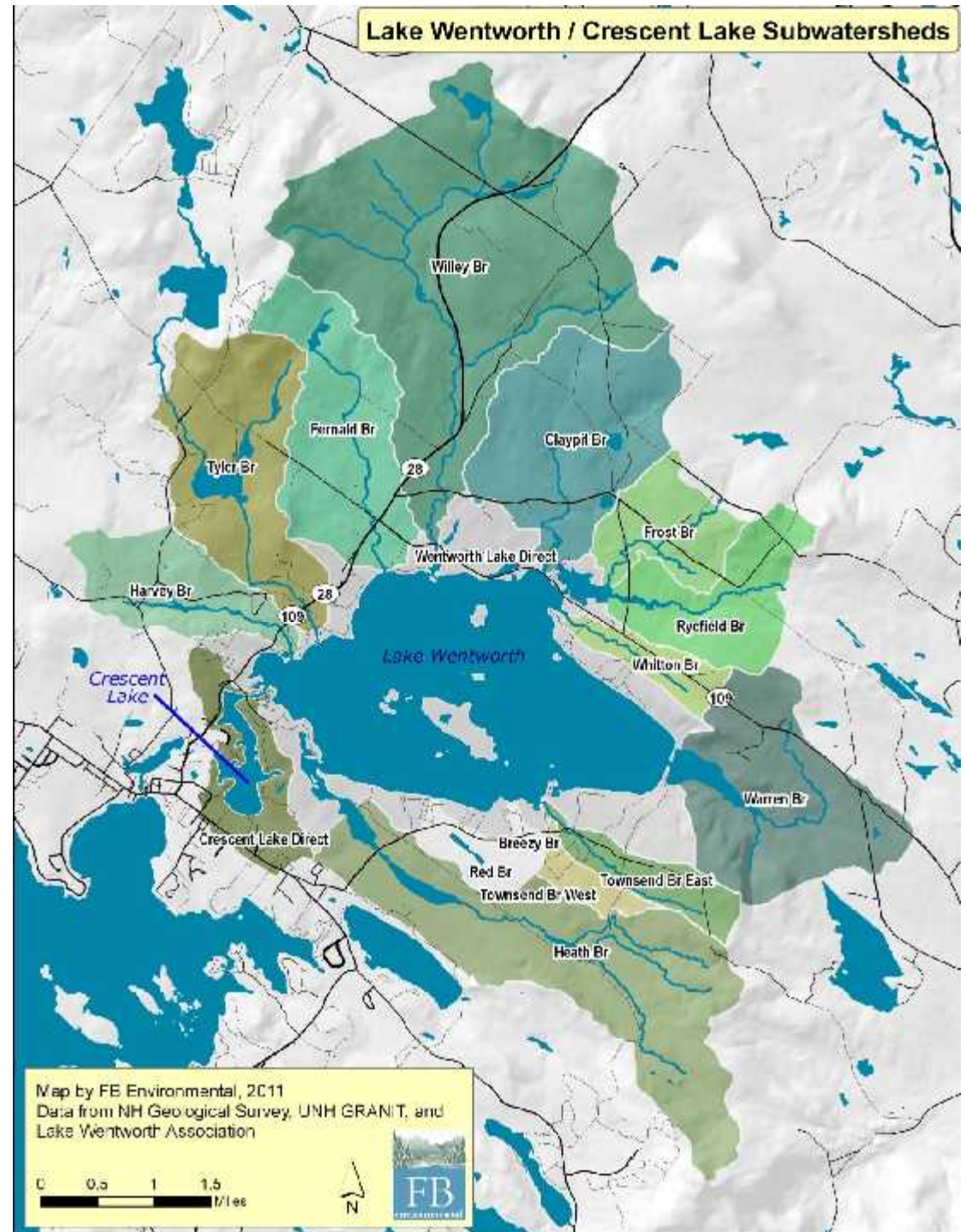
Sources of Phosphorus?

- 1/3 from forest
- 1/4 is rainfall
- About 1/3 can be managed



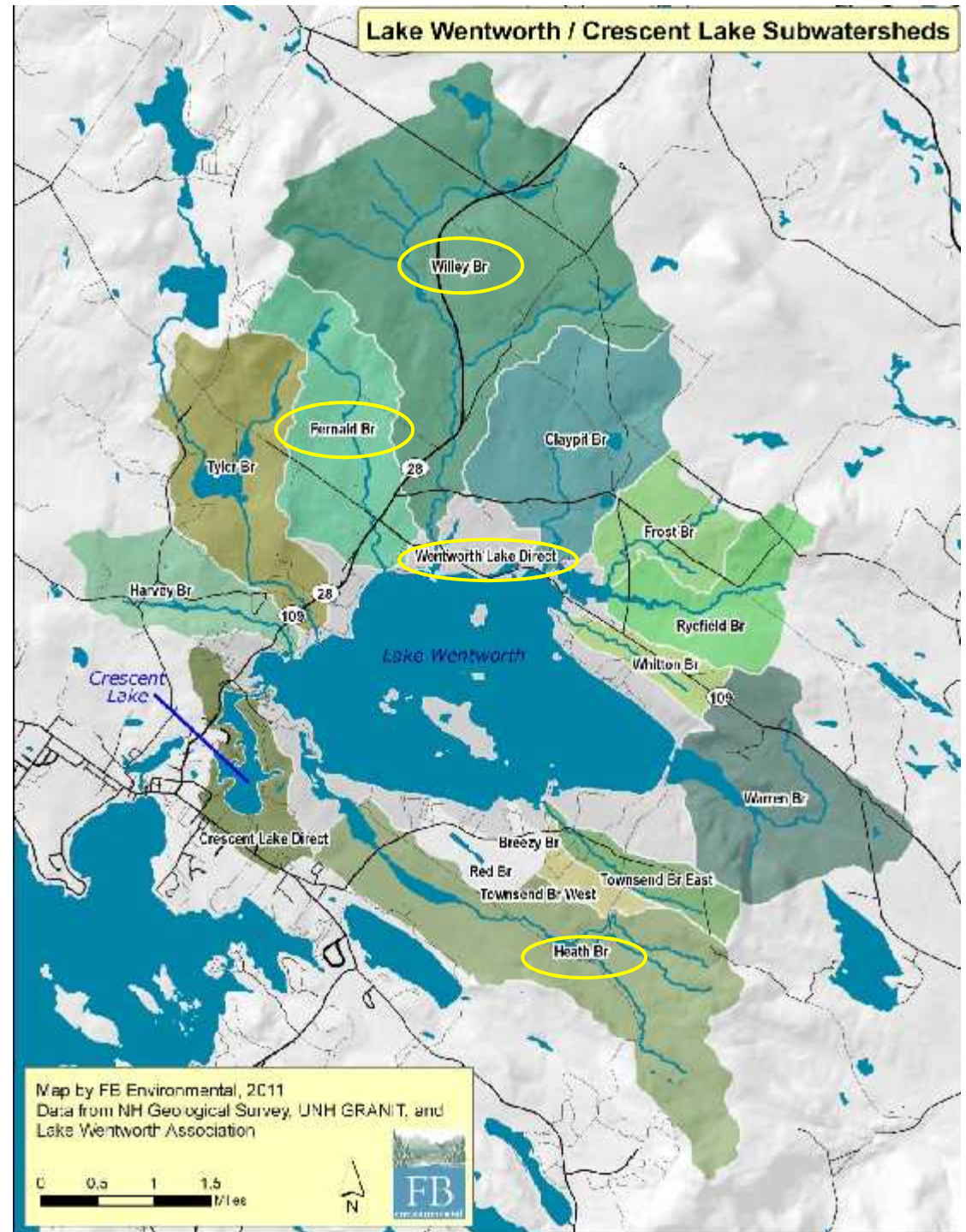
Where is the Phosphorus?

- Crescent Lake is mostly Lake Wentworth, in terms of water
- 96% of water
- ~70% of phosphorus



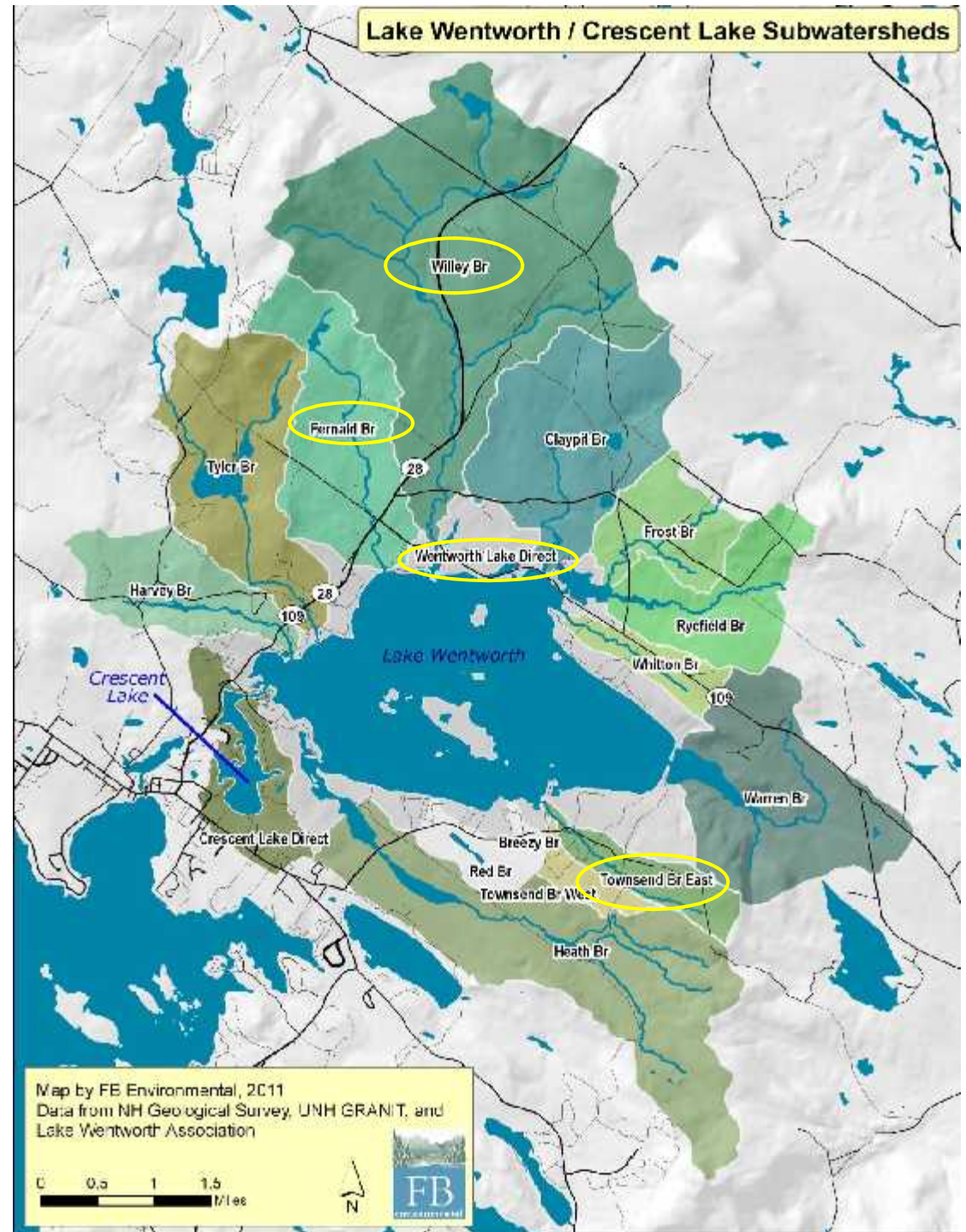
Where is the Phosphorus?

- *Largest watersheds generate most P*
- Willey Br.
- Shoreland & Islands
- Heath Brook
- Fernald Brook



Where is the Phosphorus?

- *But considering concentrations:*
- Townsend Brook East
- Shoreland & Islands
- Fernald Brook
- Willey Brook



Limitations:

The model can't see the difference

