



SOUTHWESTERN
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Biosolids Land Application and Phosphorus Cycling

Eureka Joshi

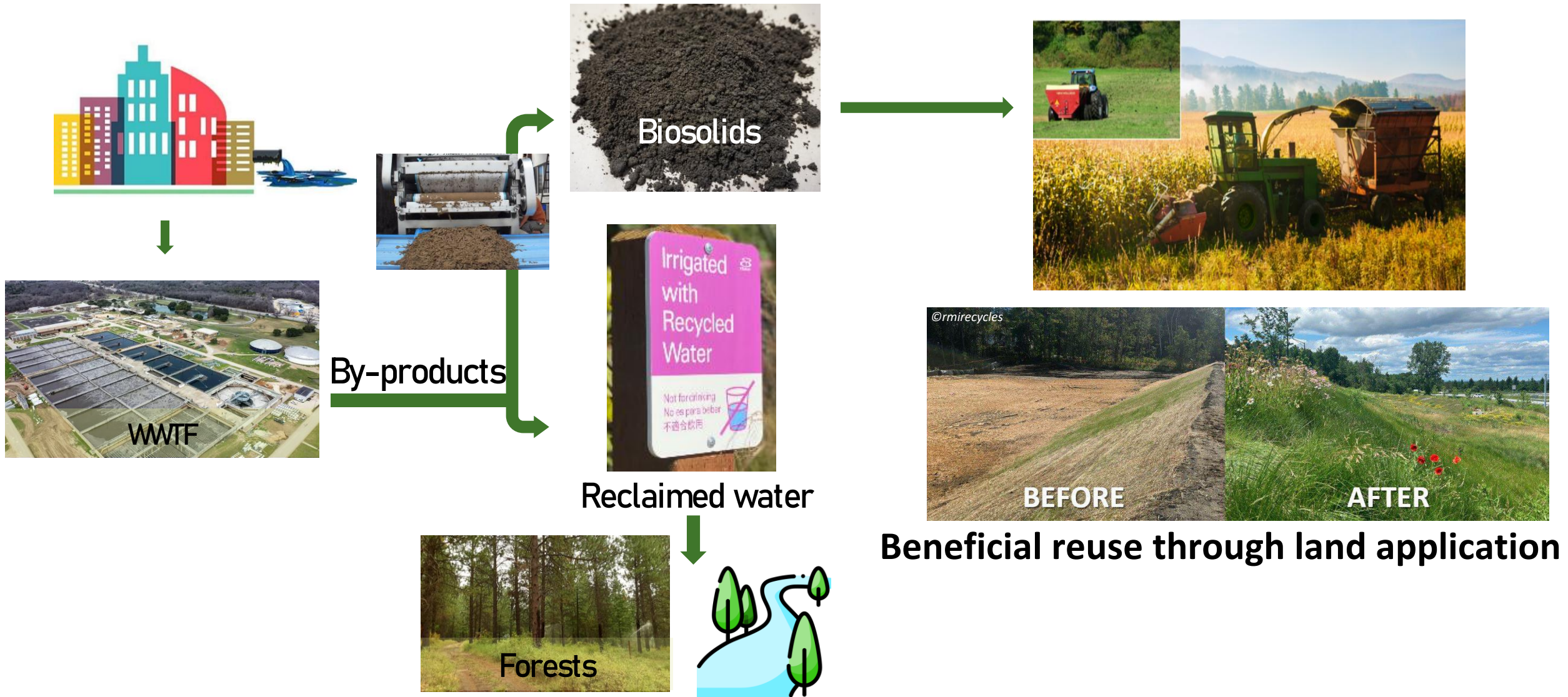
July 30th, 2026

Via RMI Recycles

The Walnut Creek Wastewater Treatment Plant in Austin, TX



Beneficial Reuse of Wastewater By-products



What are Biosolids?

- Residual byproduct from wastewater treatment
- Rich in organic matter and nutrients
- EPA defines biosolids as sludge treated for land conditioner/fertilizer usage
- **Sewage sludge:** residuals from wastewater treatment vs. **Biosolids:** Treated sewage sludge that meets land application standards (40 CFR Part 503)



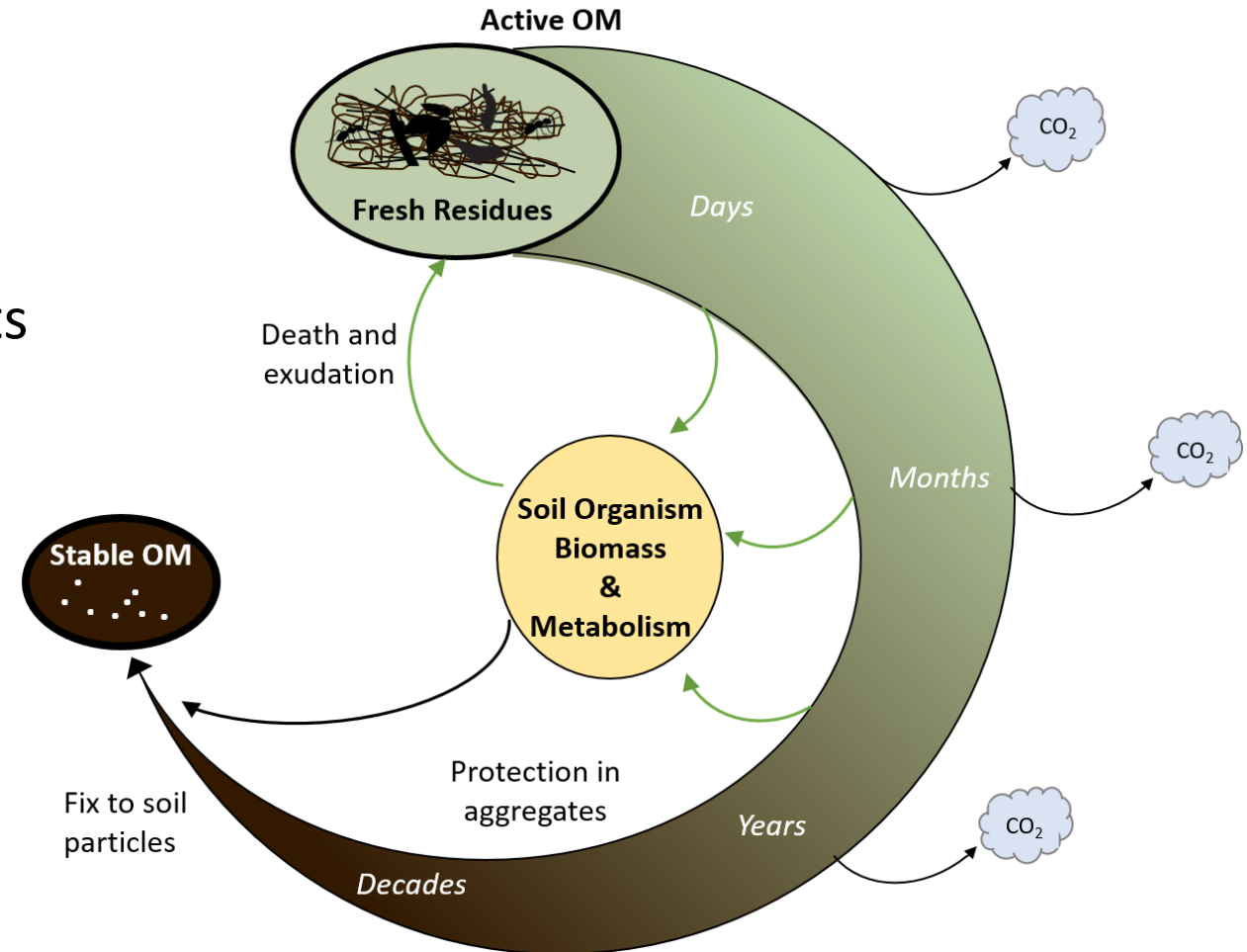
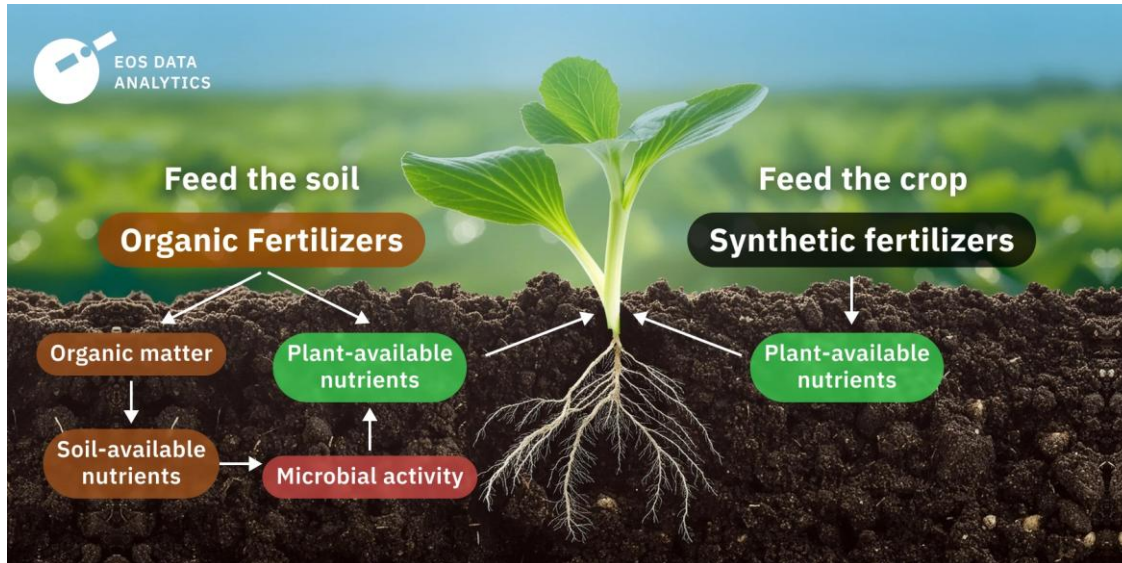
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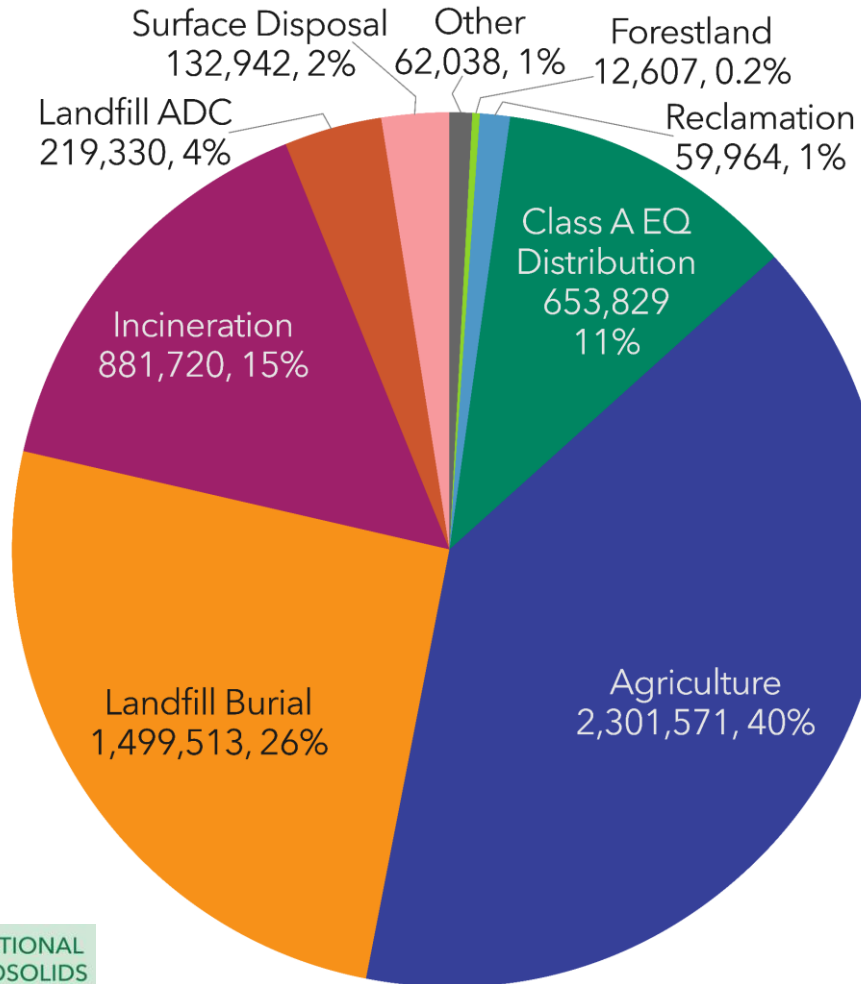
Biosolids and yard waste pile at Hornsby Bend, Austin, TX

Biosolids and Soil Health Benefits

- Improved aggregation and structure
- Higher CEC and water holding capacity
- Nutrient recycling, microbial diversity
- Carbon sequestration
- Residual effect; slow-release of nutrients



United States
Biosolids Use & Disposal 2018
(dry metric tons, %)
Total: 5,823,000



Biosolids Reuse in the United States



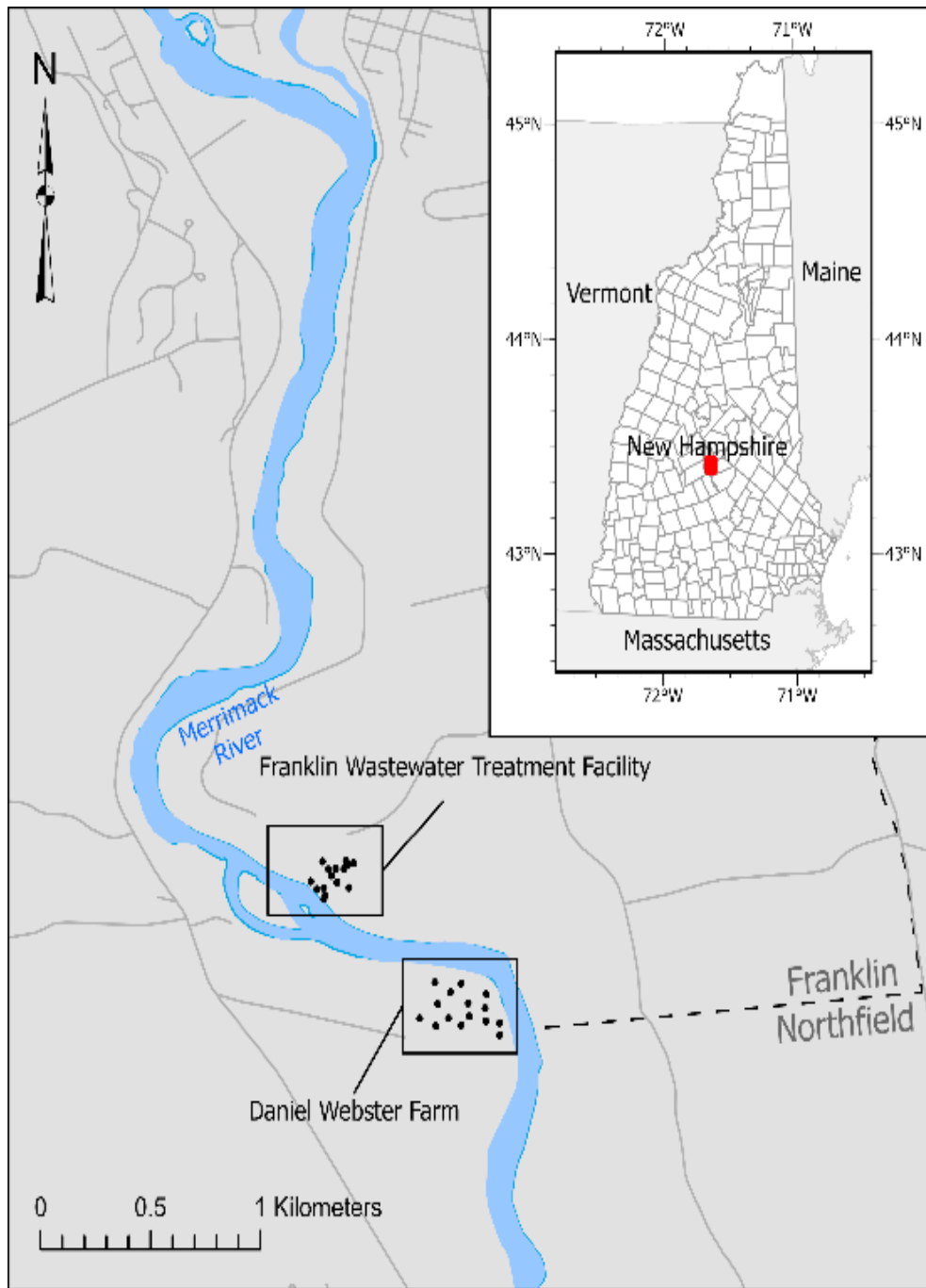
Land application of biosolids can be a cost-effective way to support agricultural production.

©NH Extension

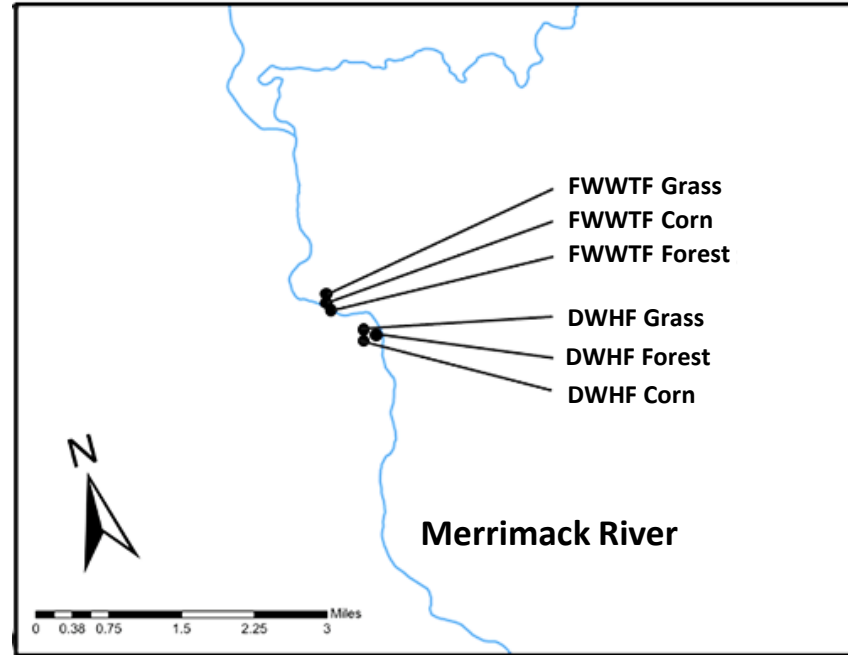
Biosolids and The Phosphorus Problem

- Critical nutrient for crops but low soil availability
- High amount of P in biosolids
- N-based application rates to meet crop demand can lead to overapplication of P and soil P buildup
- Increased risk of environmental P losses to surface and ground waters





Study Facilities & Experimental Design



- Annual biosolids application in Spring
- Five plots in each vegetation type
- Topsoil (0-10 cm) and subsoil (10-30 cm) sampling

Facility	Estd.	Vegetation Type
Franklin WWTF	1997	Treated Corn Grass Buffer Forest Buffer
Daniel Webster Home Farm	2022	Treated Corn Grass Buffer Forest Buffer

Merrimack River is one of the greatest contributor of nutrients to the Gulf of Maine



Franklin WWTF adjacent to the Merrimack River in NH



Merrimack River (NHDES)

When life gives you biosolids, make soil samples

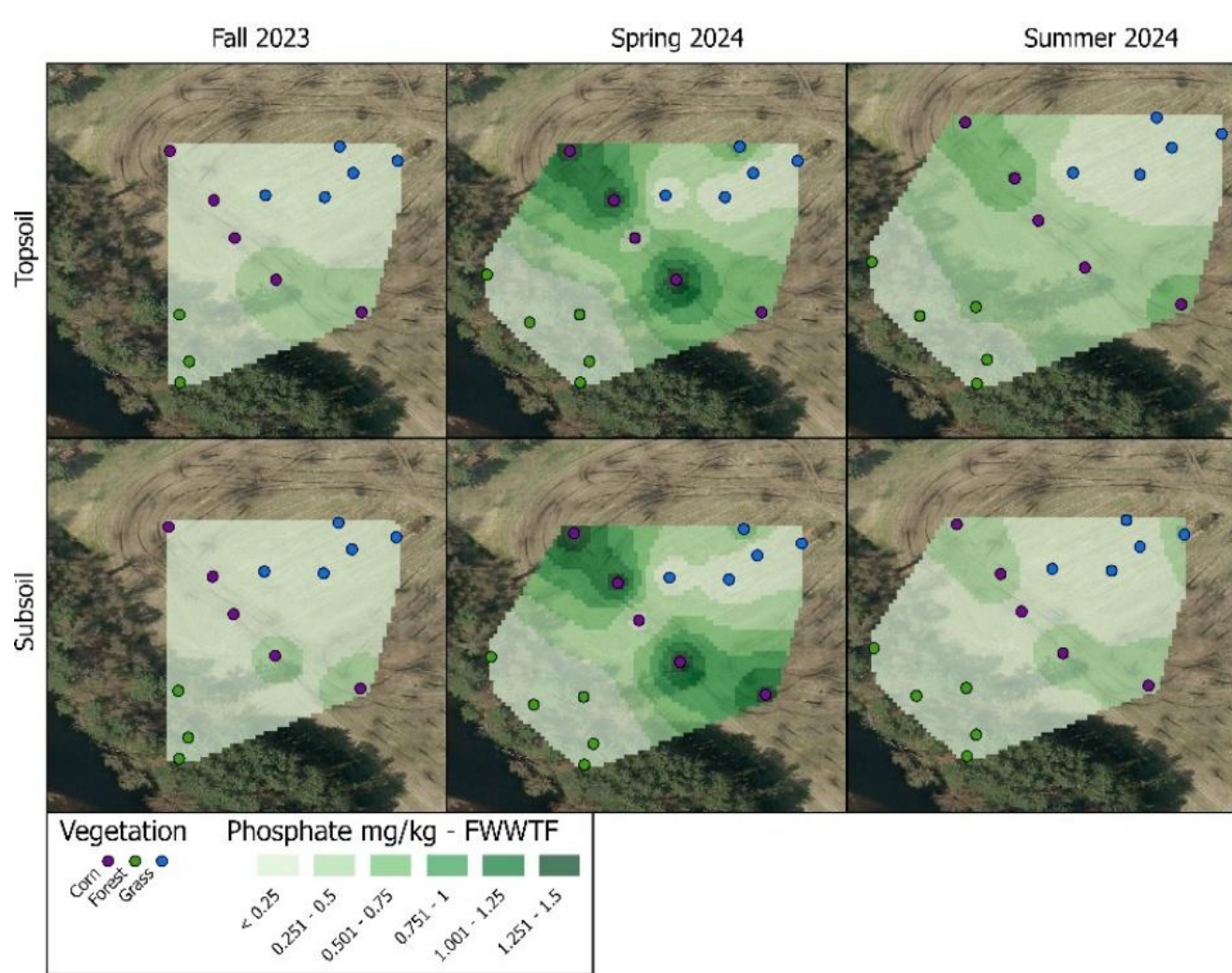


Samantha Killian

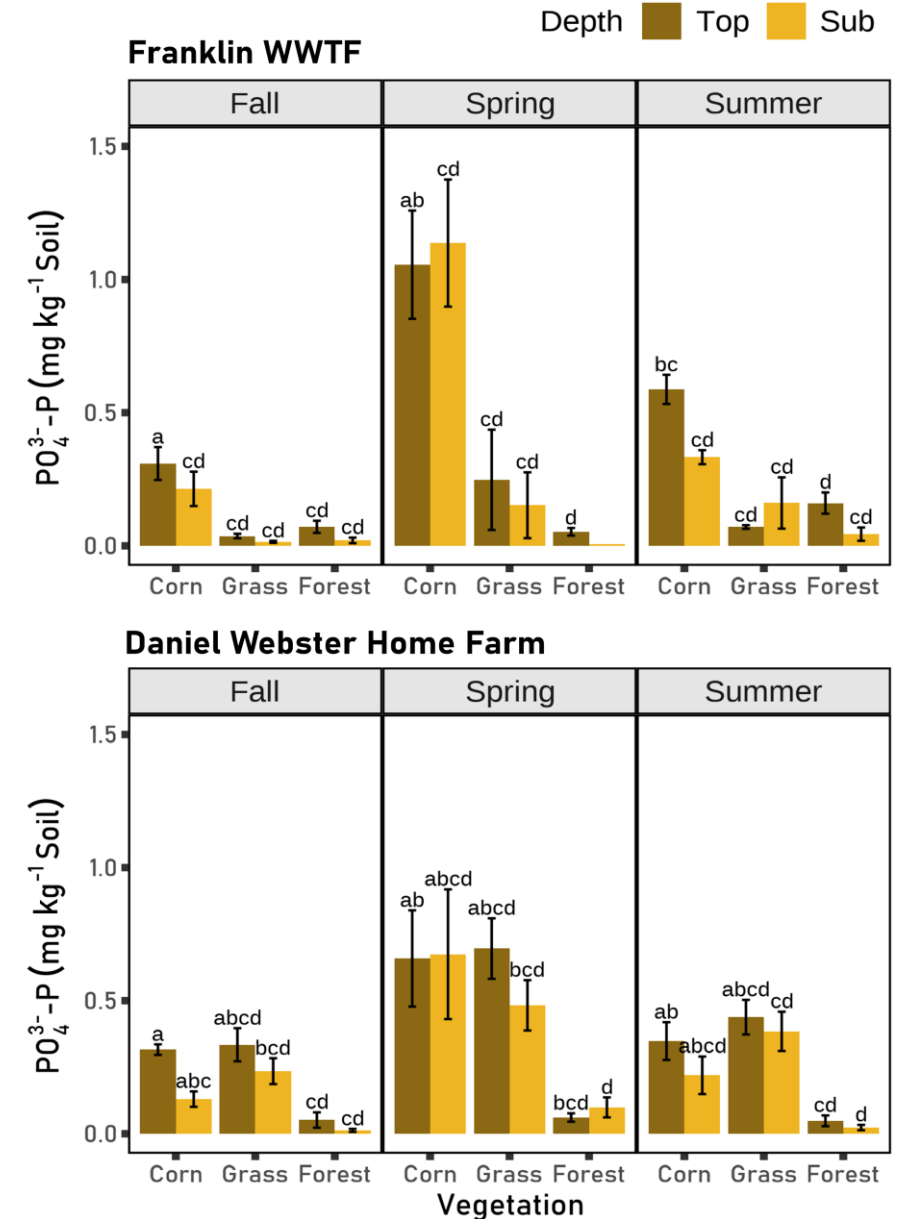


Reese Hitchcock & Via Gueterres

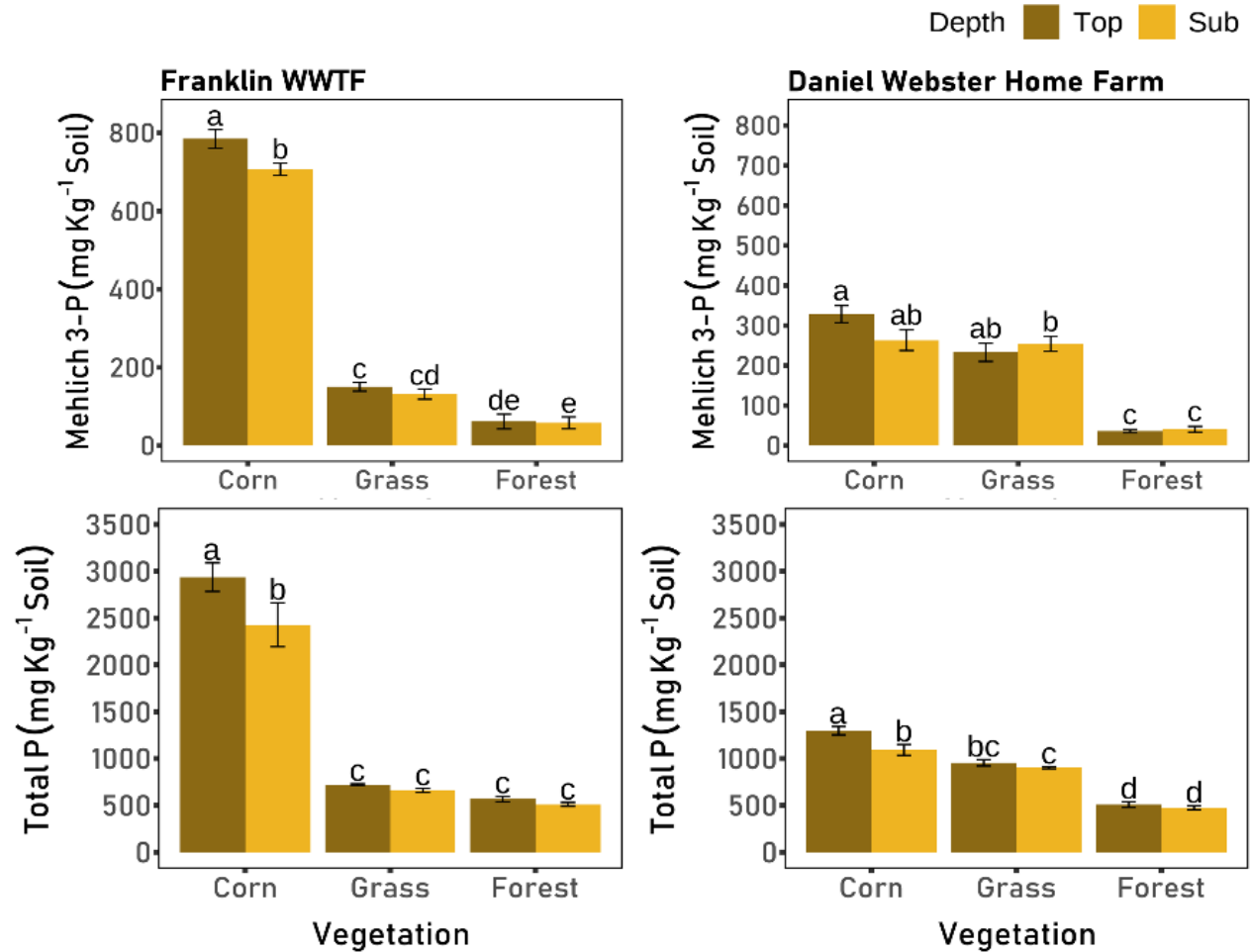
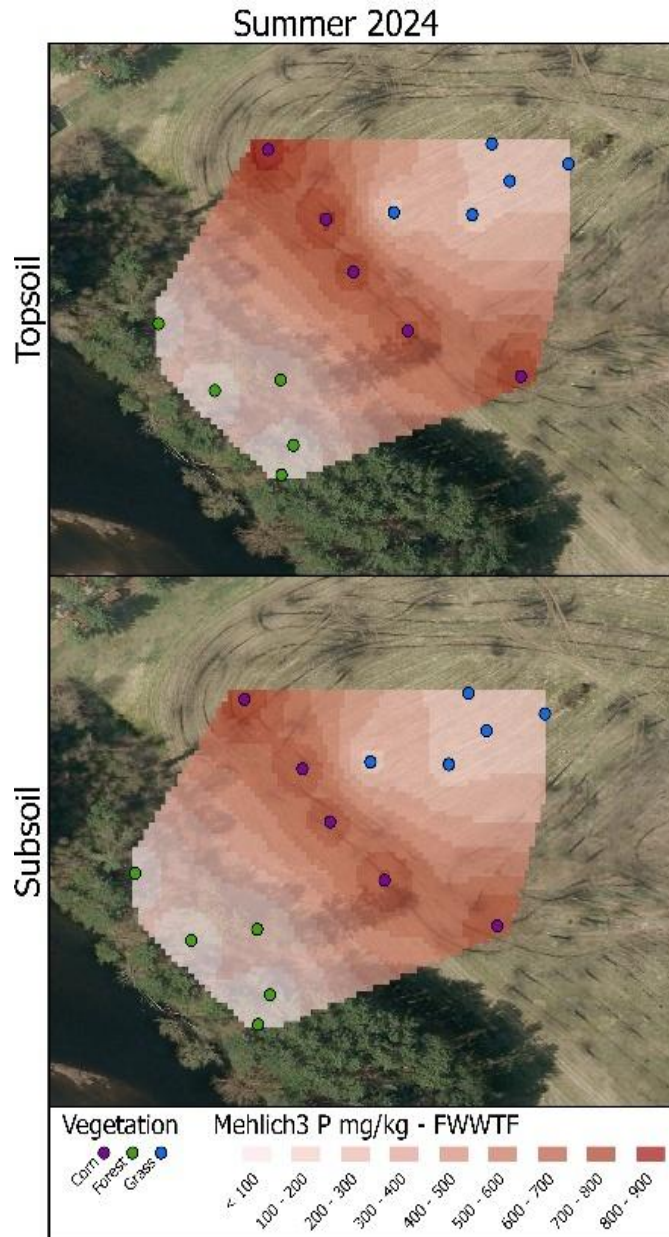
Higher soil P concentrations with operation time



- Highest orthophosphate concentrations in biosolids-amended corn at long-established facility in Spring



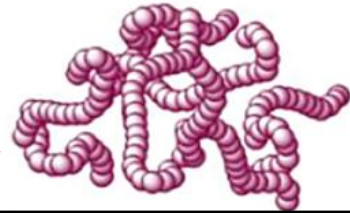
Higher soil P concentrations with operation time



- Highest Mehlich-3P and total P concentrations in biosolids-amended corn at long-established facility
- Topography can influence nutrient transport

Decomposition of organic P compounds

Dead and
decomposing
material



SOM (Complex Polymer)

Depolymerization

Enzymes

microbes



Monomers (small molecules)

CO₂

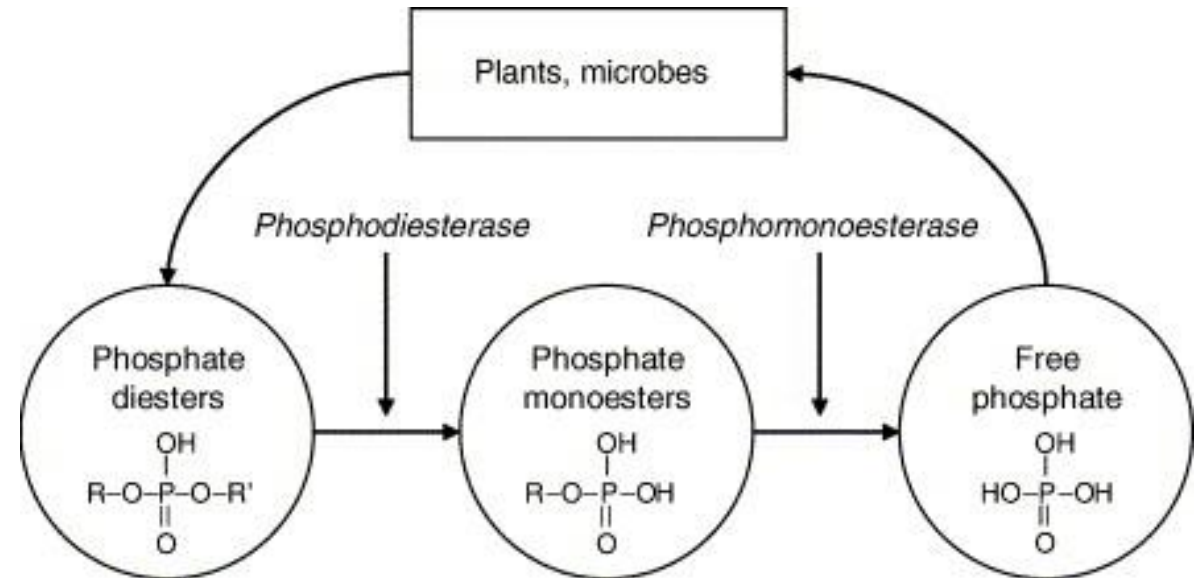
Mineralization



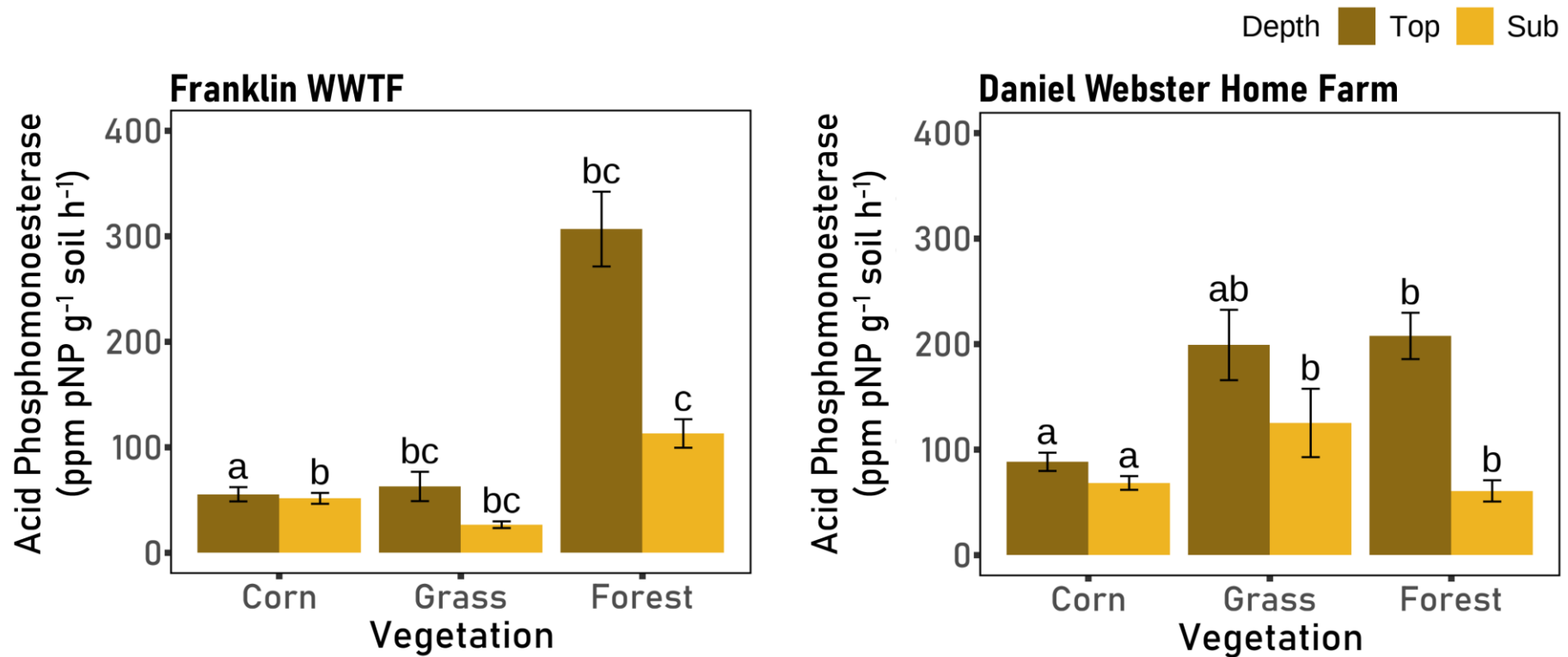
Phosphate

Plant and
microbial
uptake

- Phosphomonoesterase hydrolyze P monoester to phosphate



Suppression of phosphomonoesterase activity with P availability



- P availability controls enzyme activity for P acquisition
- Suppression of enzymatic breakdown of organic P pool with surplus of P in biosolids

Conclusions

- Phosphorus can buildup in soil with longer operation time
- Increase in P availability can suppress biological activity
- Topography plays an important role in nutrient transport
- Best management practices with P considerations is crucial
 - Optimization of benefits of biosolids to improve soil health and minimize P loss
- Important to consider both benefits and risks

Acknowledgements

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 - Samantha Killian
 - Via Gueterres
 - Reese Hitchcock



Questions, Comments?

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