Long-term Dynamics of Nitrogen and Phosphorus Concentrations in Waters of a Restored Forested Wetland

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Background

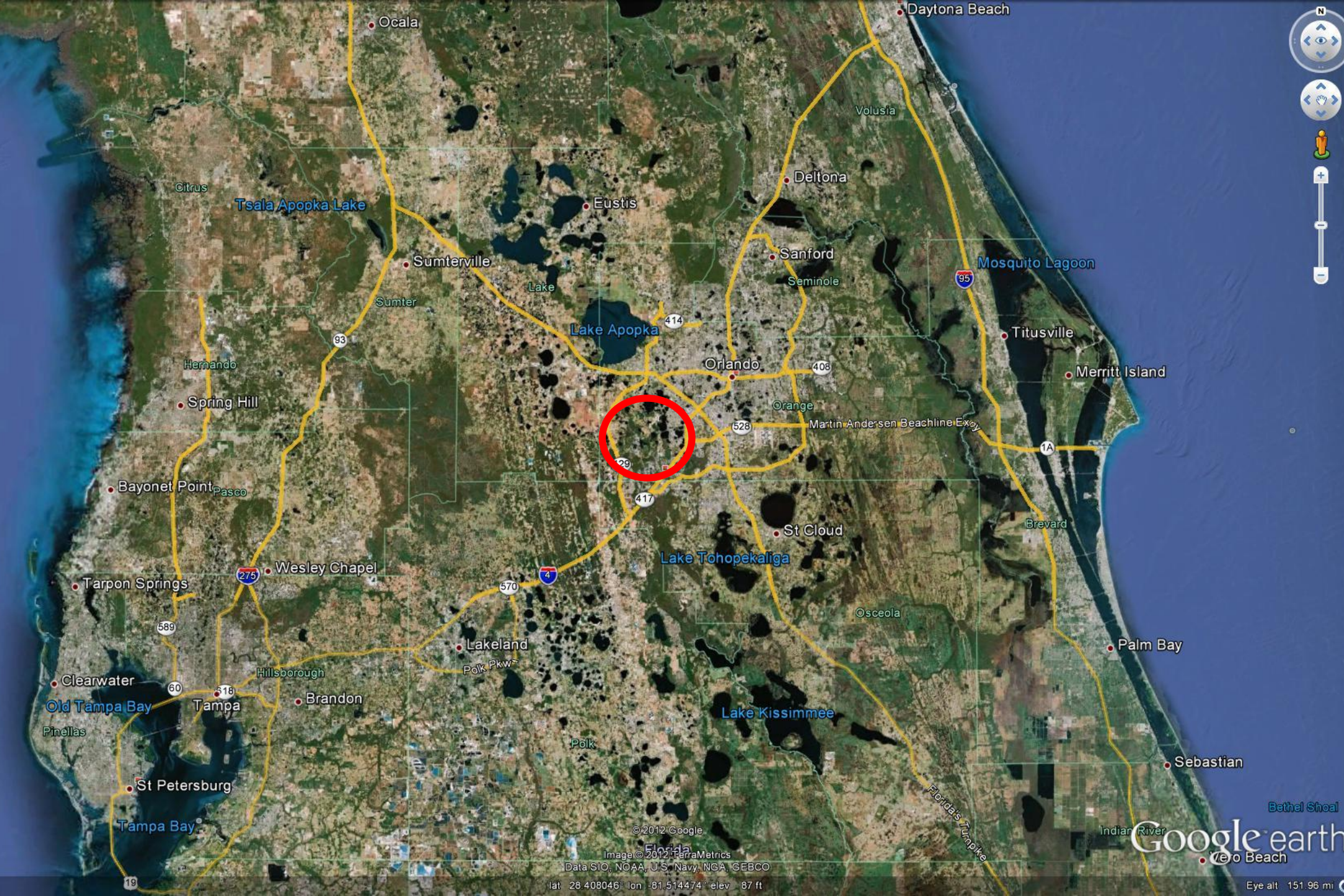
- In Florida, many previously altered forested wetlands have been enhanced through hydrologic restoration
- Desired outcome is restoration of original wetland functions, e.g. hydrologic, habitat, nutrient cycling and water quality improvement
- Rate at which water quality-related function is restored may vary considerably, based on severity of prior impact

Background (cont.)

- A 90 ha forested wetland parcel, dominated by cypress, magnolia and red maple, was hydrologically-altered in late 1960s due to construction of an adjacent canal.
- The wetland was reflooded in 1993 in an effort to restore wetland functions.

Scope and Objective

- Characterization of floodwater chemistry in hydrologically-altered wetland immediately after reflooding, and again 19 years later
- Evaluation of short- and long-term nutrient release from rehydrated wetland soils
  - Soil/water core incubations (pre-flooding and 19 years post-flooding)
- Evaluate utility of soil-water microcosm approach as a predictive tool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Volusia
Citrus
Tsala Apopka Lake
Eustis
Deltona
Sumterville
Sanford
Mosquito Lagoon
Seminole
Lake
Sumter
Lake Apopka
Titusville
Hernando
Orlando
Merritt Island
Spring Hill
Orange
Martin Andersen Beachline Expy
Bayonet Point
Pasco
St Cloud
Brevard
Lake Tohopekaliga
Wesley Chapel
Tarpon Springs
Osceola
Lakeland
Palm Bay
Hillsborough
Polk Pkwy
Clearwater
Old Tampa Bay
Tampa
Brandon
Lake Kissimmee
Pinellas
Polk
Sebastian
St Petersburg
Tampa Bay
Florida's Turnpike
Bethel Shoal
Indian River
Vero Beach
©2012 Google
Image © 2012 TerraMetrics
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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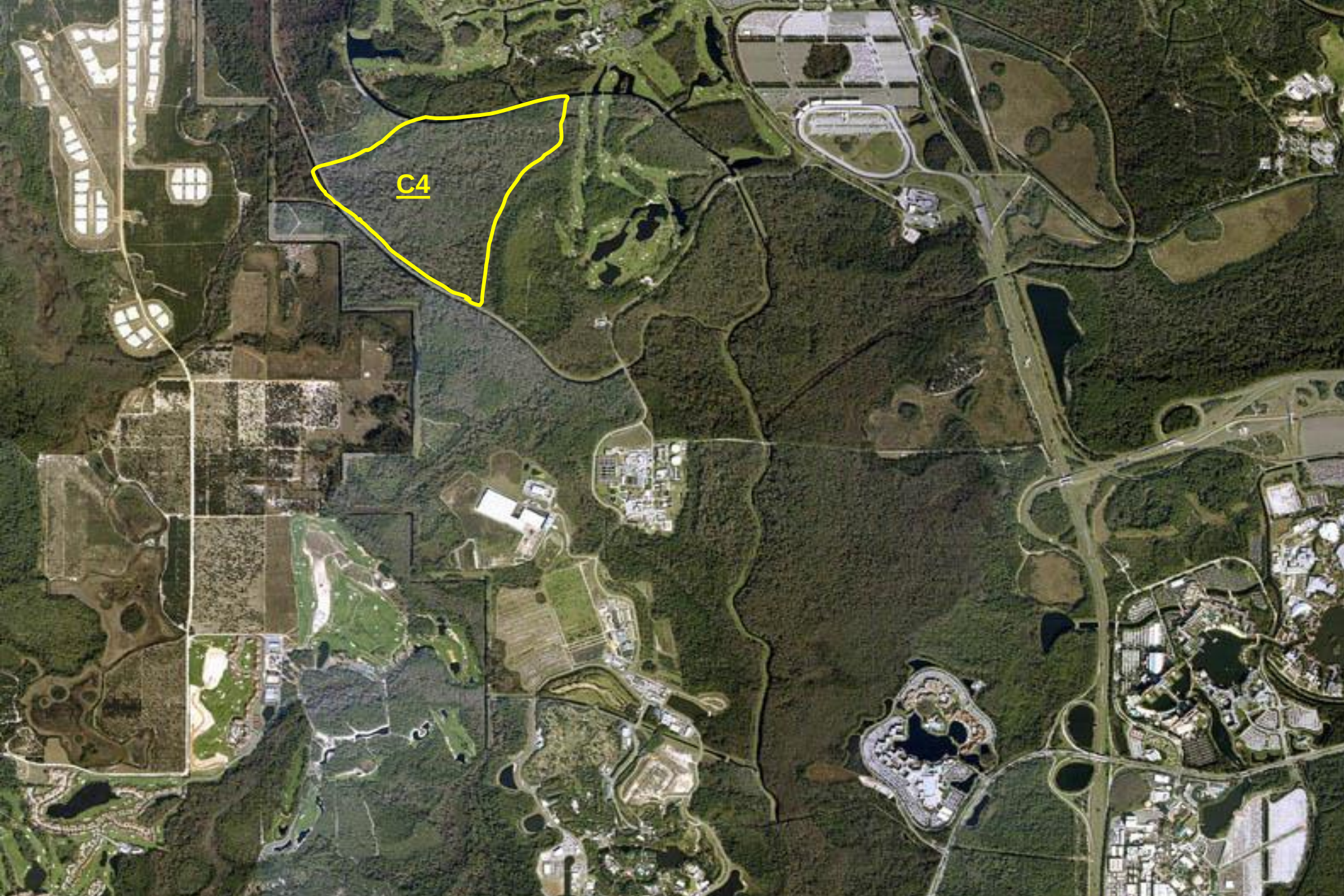
Google earth
Eye alt 151.96 mi


C4


28.0
27.7
27.4
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M (NGVD)
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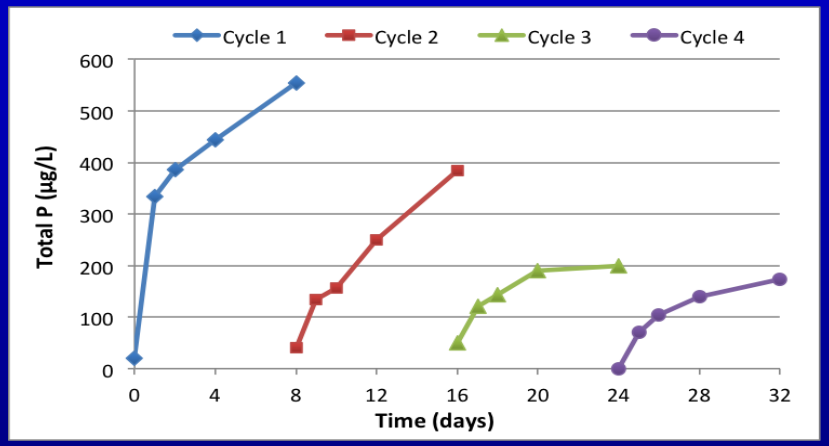
91.0
90.0
89.0
88.0
87.0
FT (NGVD)
Jan-92
Apr-92
Jul-92
Oct-92
Feb-93
May-93
Aug-93
Dec-93
1992
1993
1994
GROUND ELEVATION
WELL 5

Soil Core Study

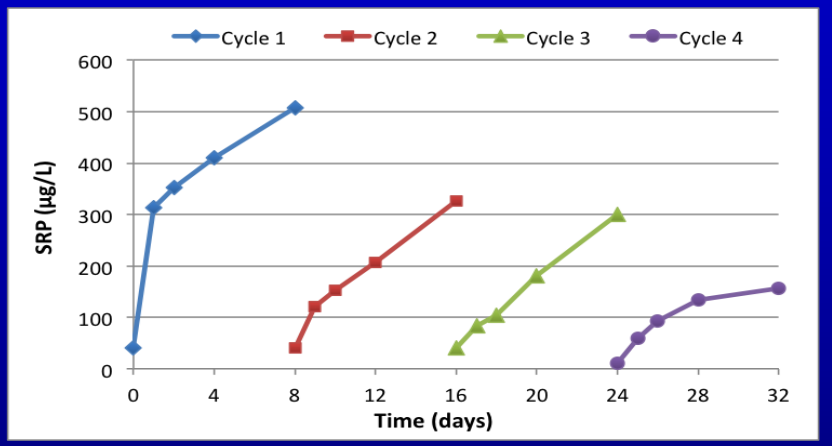
- Intact soil cores (15cm dia.) collected in 1993 (pre-hydration) and in 2012
- Incubated under 8 and 32 day HRT regimes with local canal water
- Water column depth = 25cm
- Water column slowly mixed via air bubbles
- Repeated floodwater N & P analysis

Pre-hydration (1993) soil core incubation results - Phosphorus

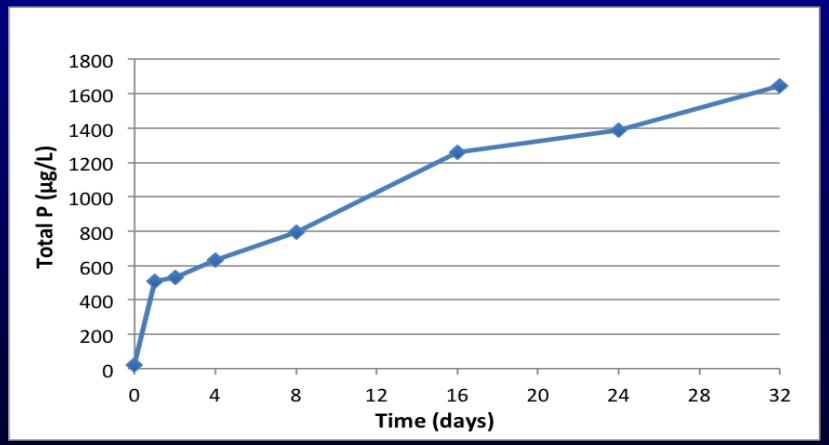
Total P (µg/L)



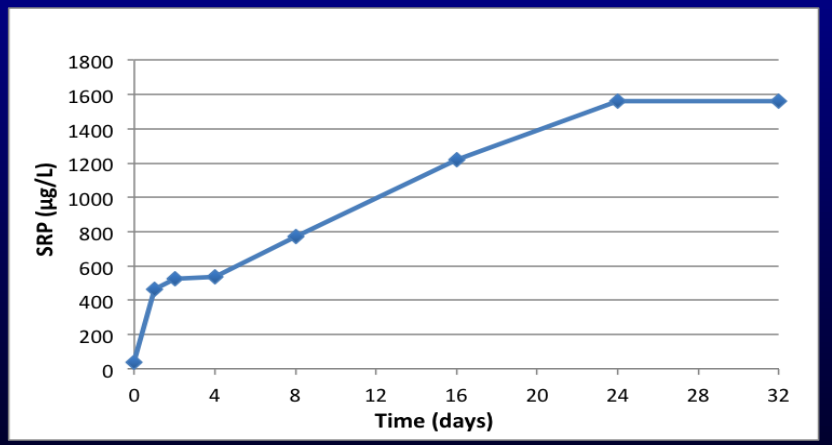
SRP (µg/L)



8-day HRT

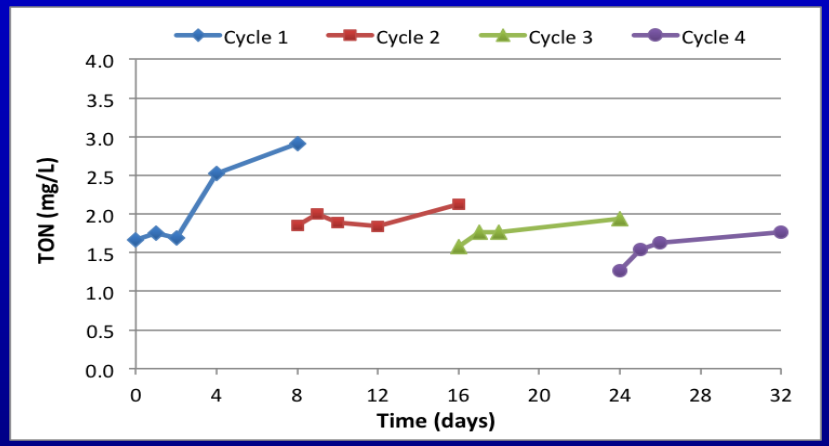


32-day HRT

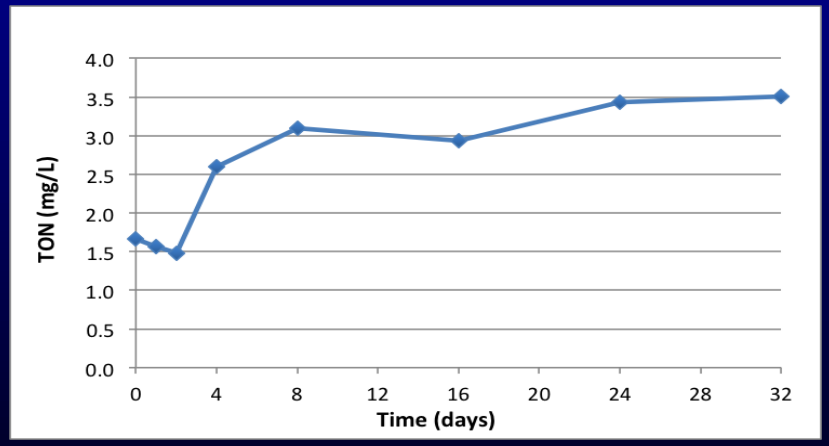


Pre-hydration (1993) soil core incubation results - Nitrogen

Total Organic N (mg/L)

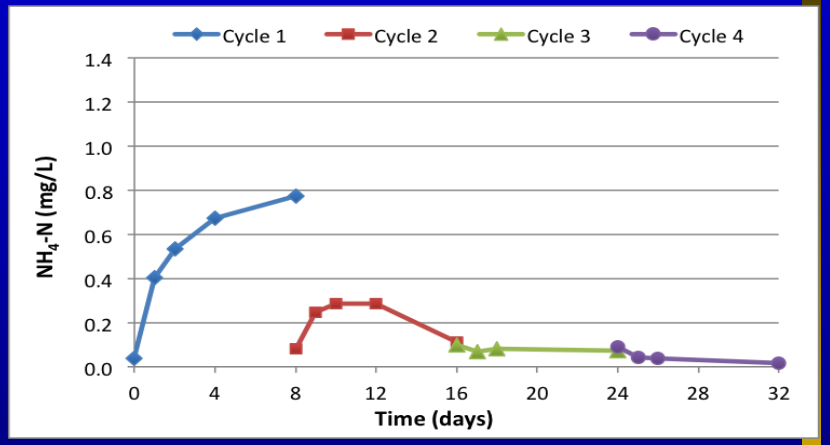


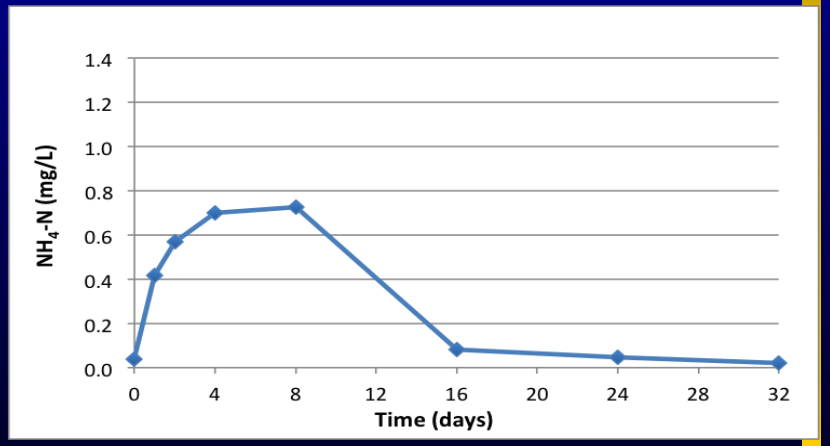
8-day HRT



32-day HRT

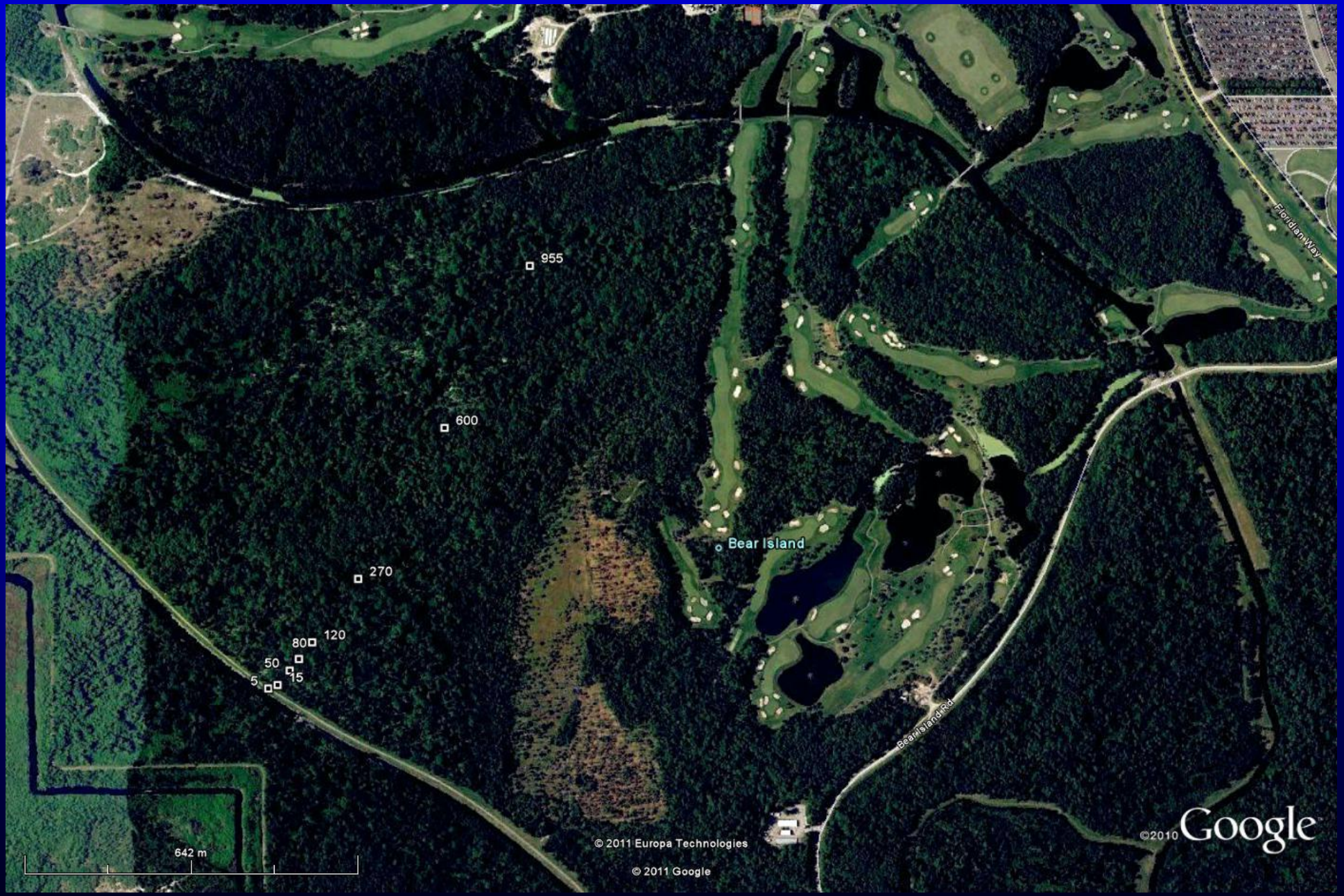
NH4- N (mg/L)





Surface Water Quality Sampling

- N&P samples collected along a transect from inflow to outflow – immediately after hydration in 1993, and 18 years later, in 2011
- N&P samples collected in downstream reference wetlands with minimal hydrologic alteration


955
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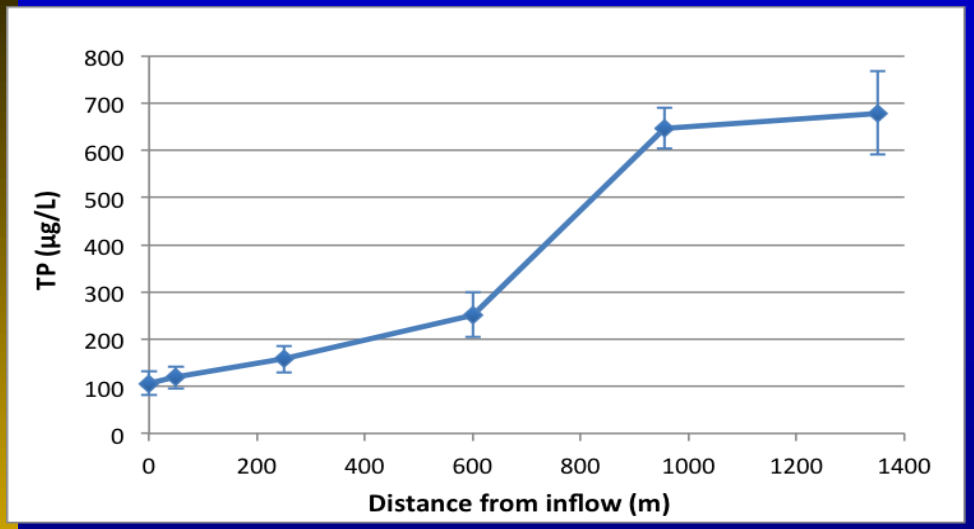
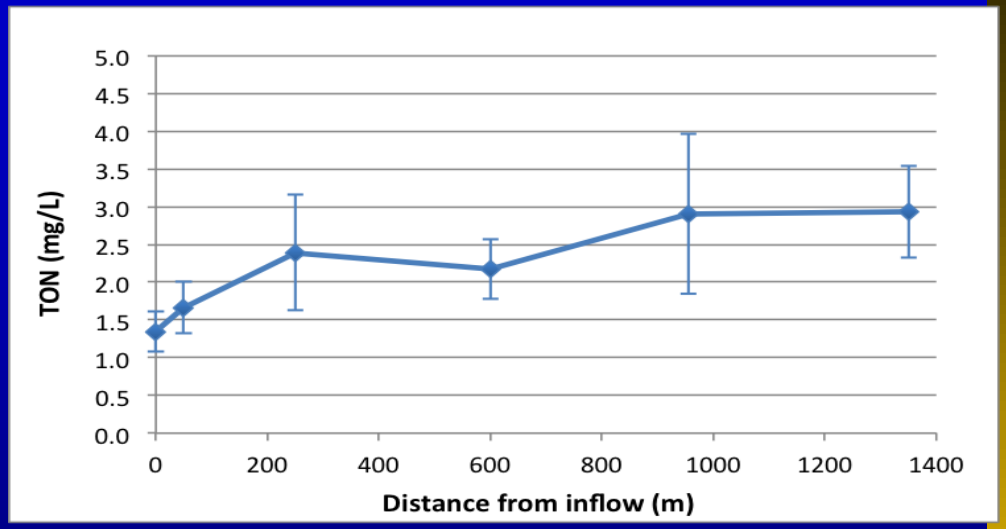
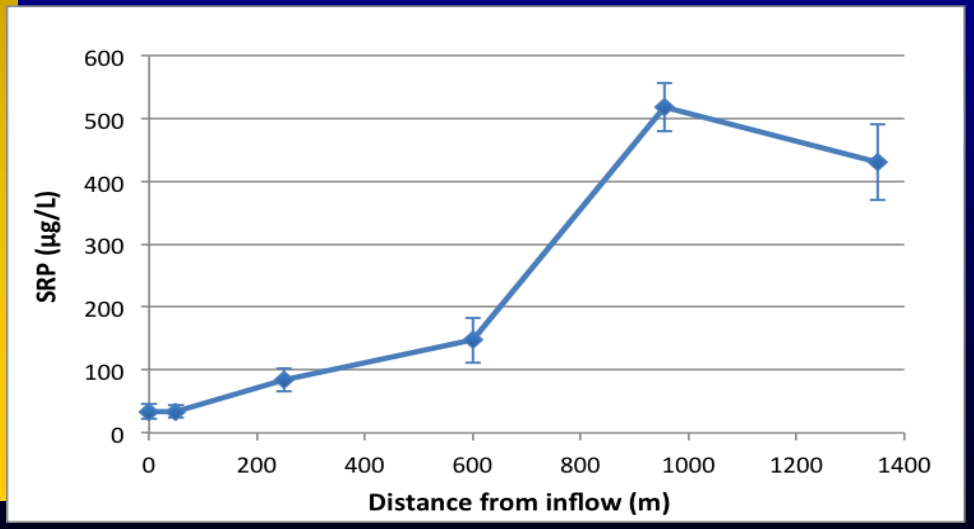
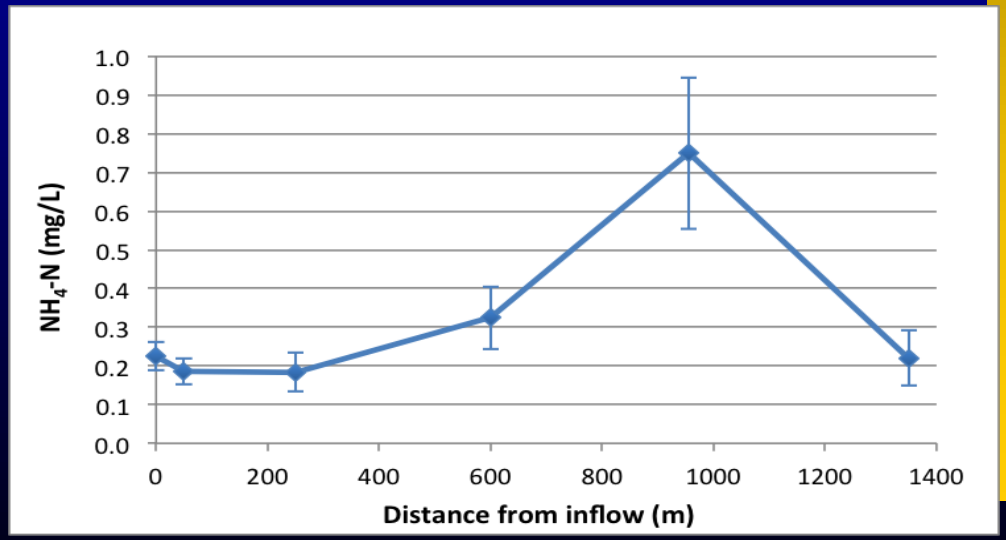
Bear Island
Floridian Way
Bear Island Rd
642 m
© 2011 Europa Technologies
© 2011 Google
©2010 Google

Rehydrated wetland transects: 1993 WQ monitoring results – immediately after hydration (mean ± SE of monthly measurements)







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4
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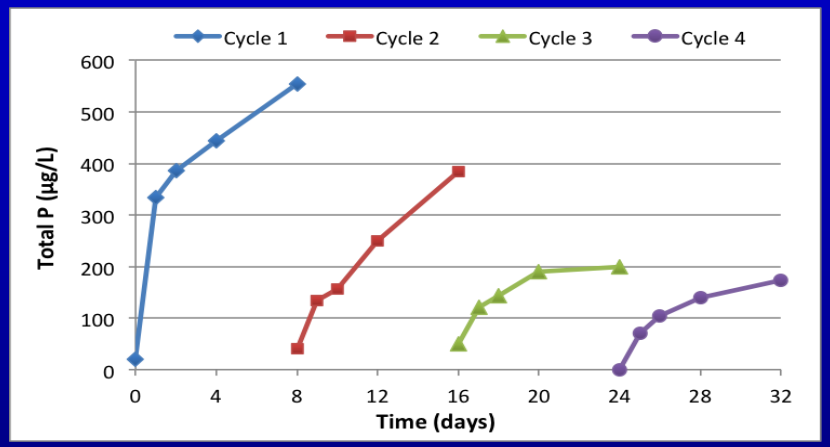
6 3/8/12

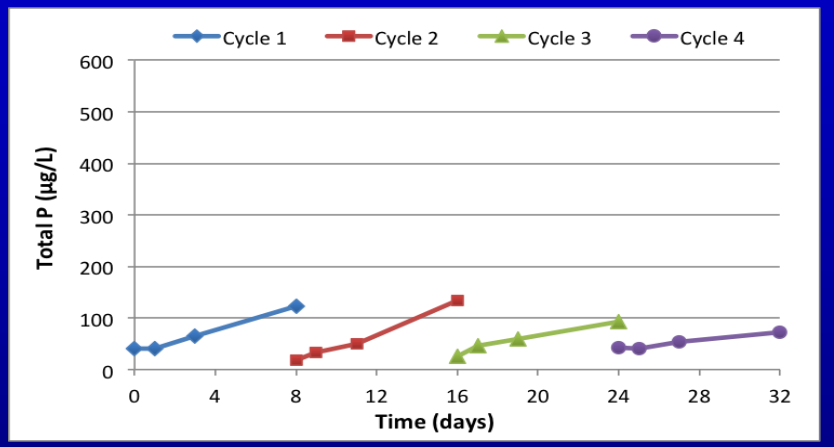
Comparison of pre-hydration (1993) and 2012 soil core incubation results – Total P

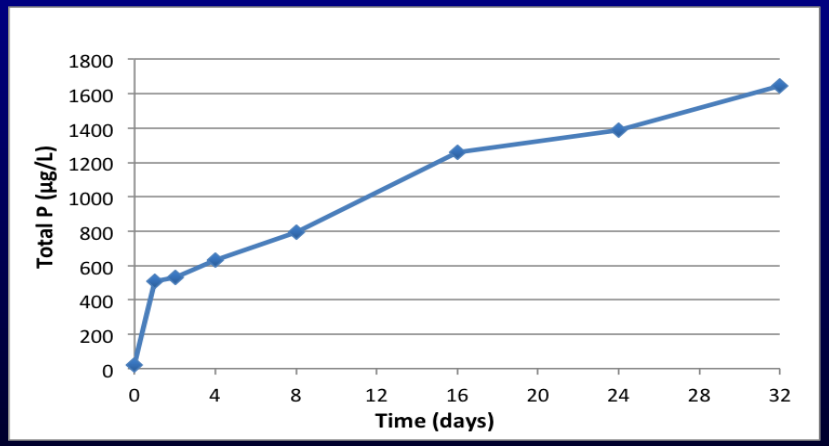
Pre-hydration (1993)

Re-study (2012)

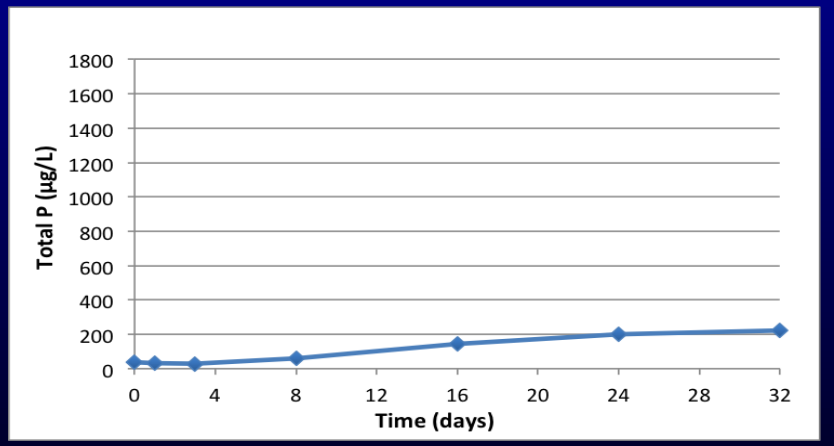


8-day HRT



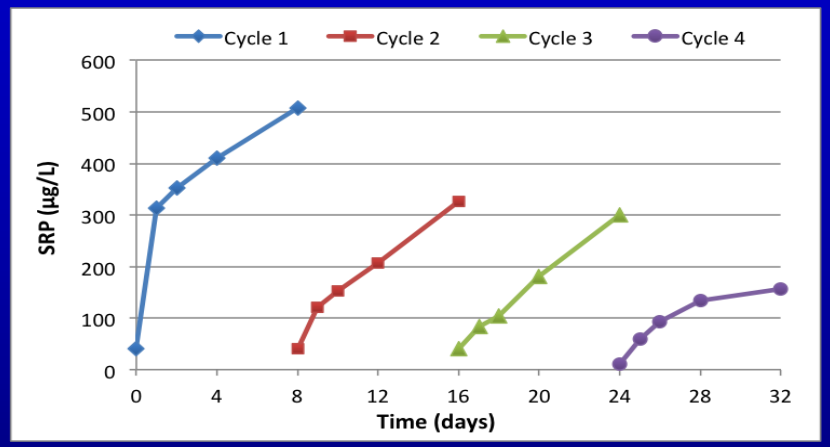


32-day HRT



Comparison of pre-hydration (1993) and 2012 soil core incubation results – Soluble reactive P

Pre-hydration (1993)



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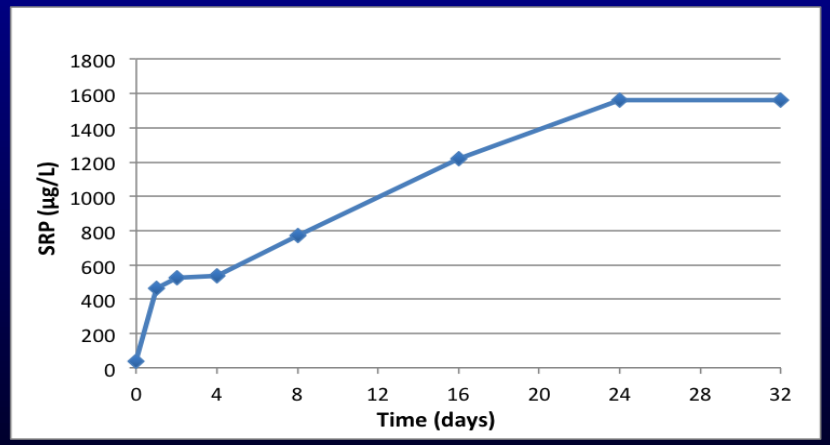
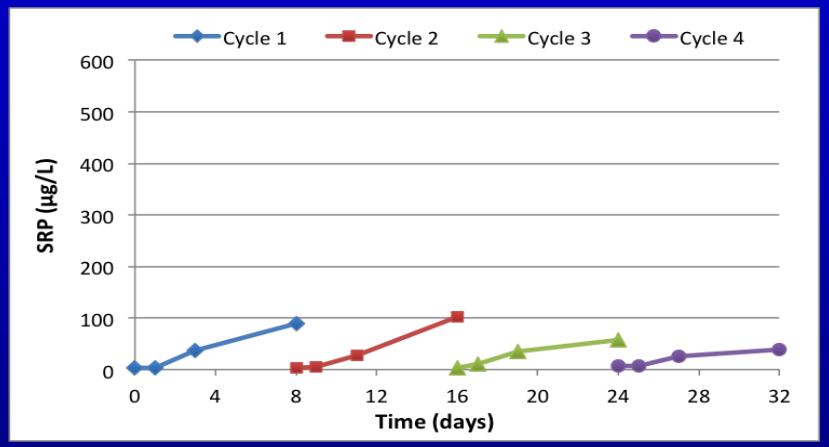
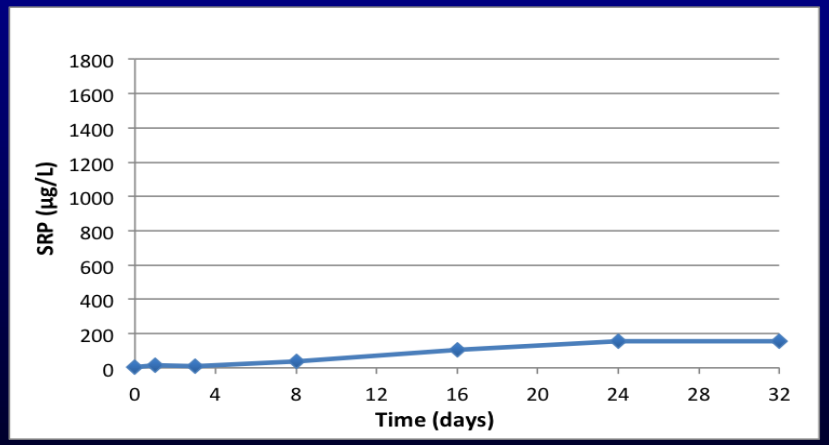


32-day HRT

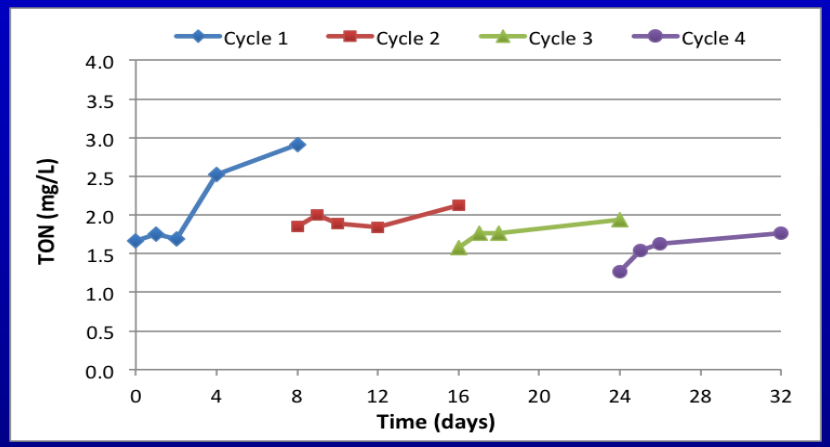
Re-study (2012)



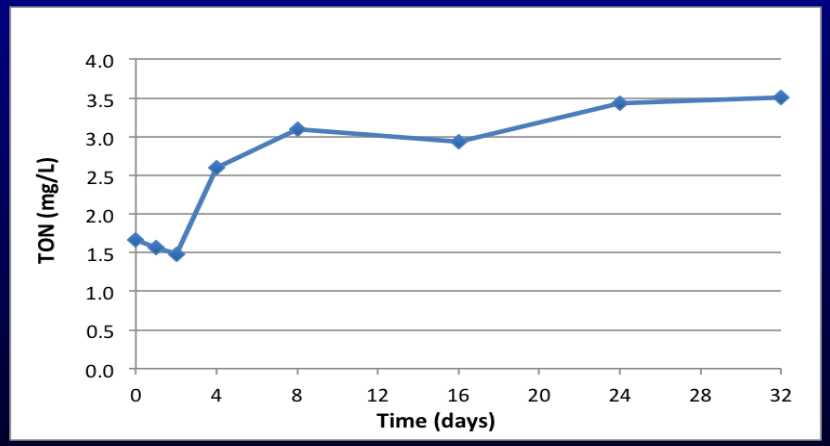


Comparison of pre-hydration (1993) and 2012 soil core incubation results – Total organic N

Pre-hydration (1993)

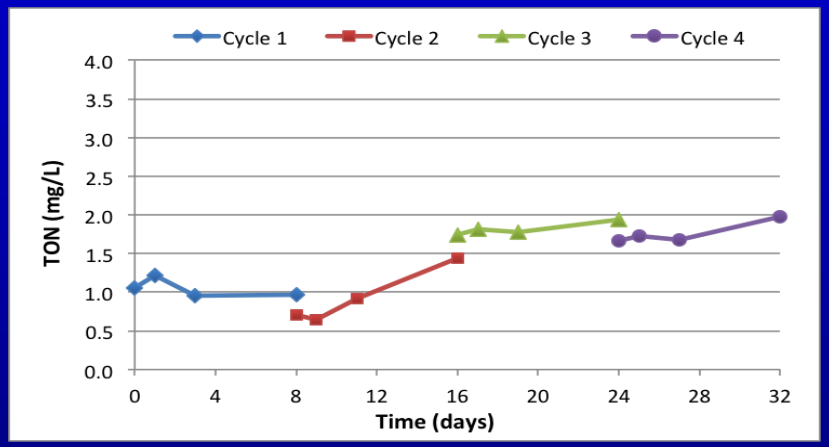


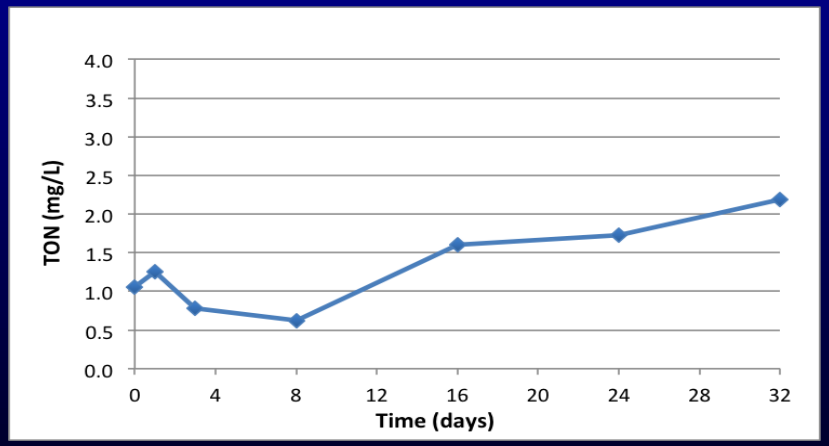
8-day HRT



32-day HRT

Re-study (2012)



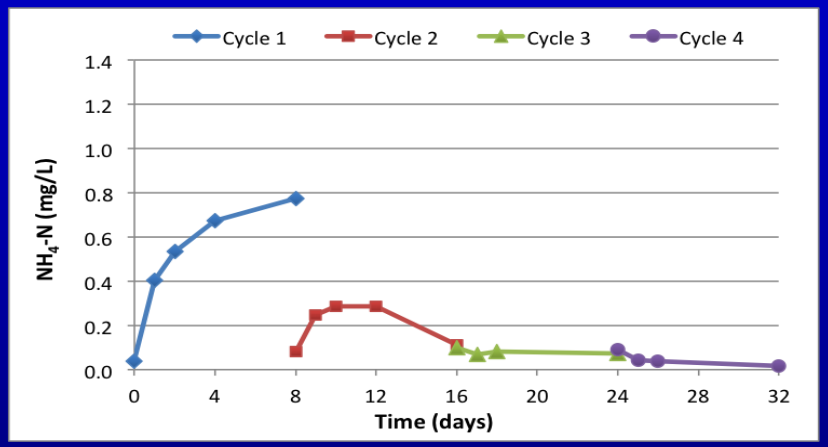


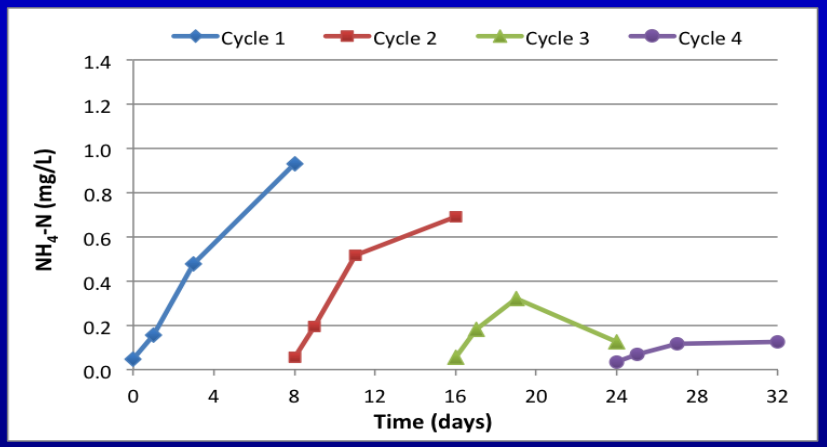
Comparison of pre-hydration (1993) and 2012 soil core incubation results – NH_4-N

Pre-hydration (1993)

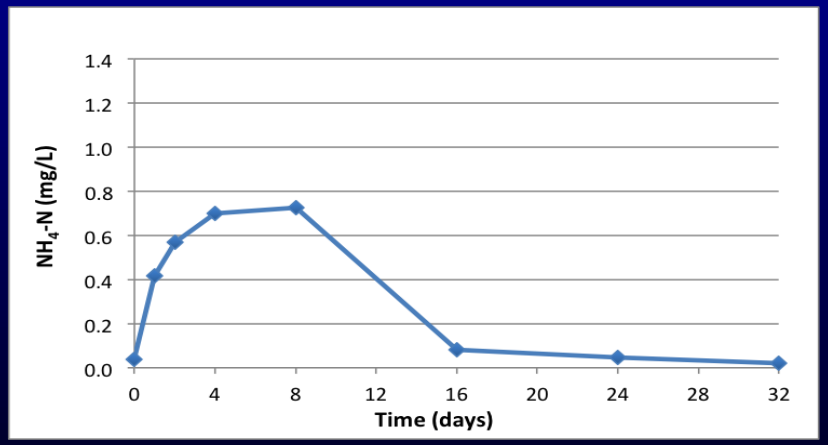
Re-study (2012)

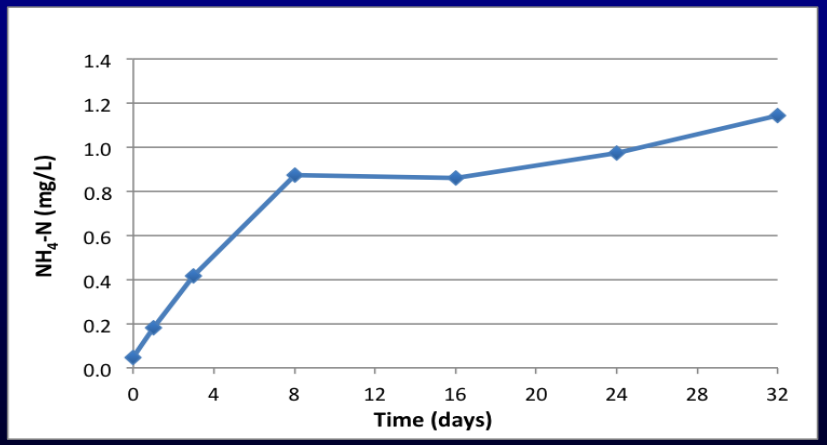
8-day HRT



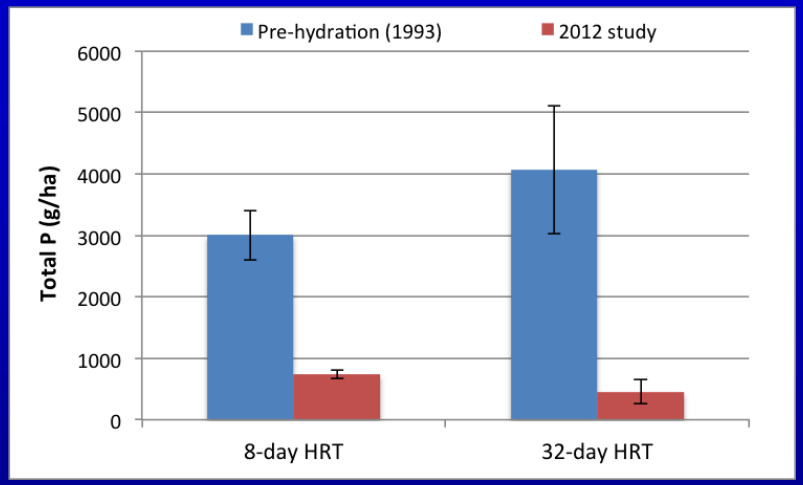


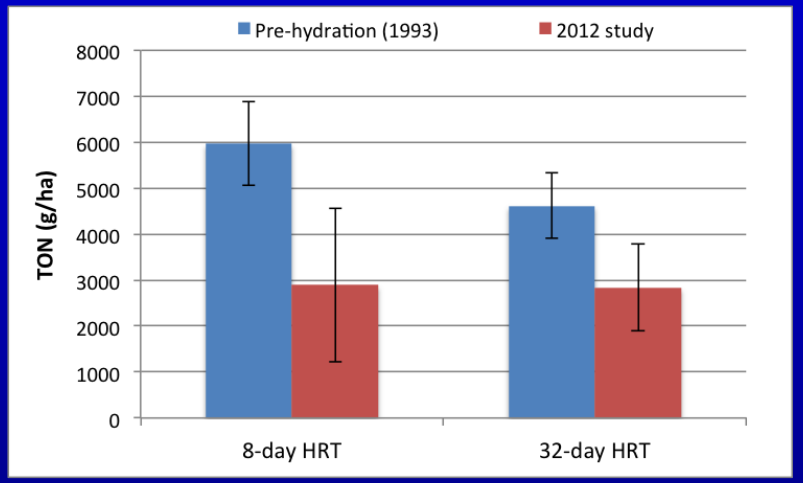
32-day HRT

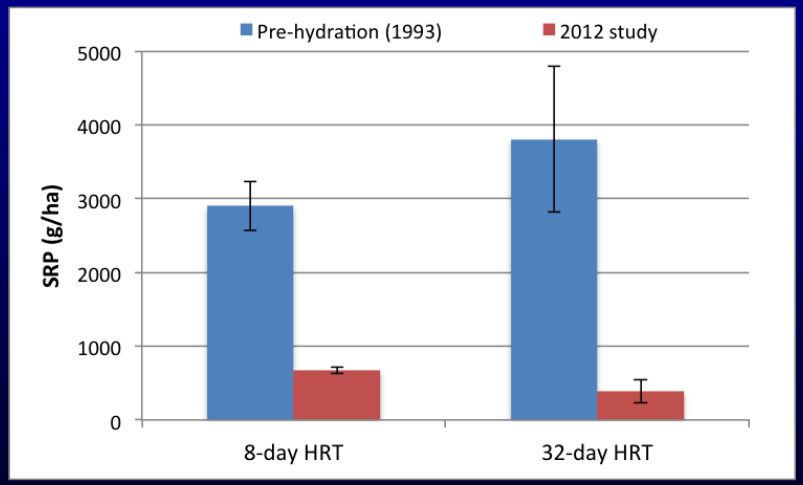


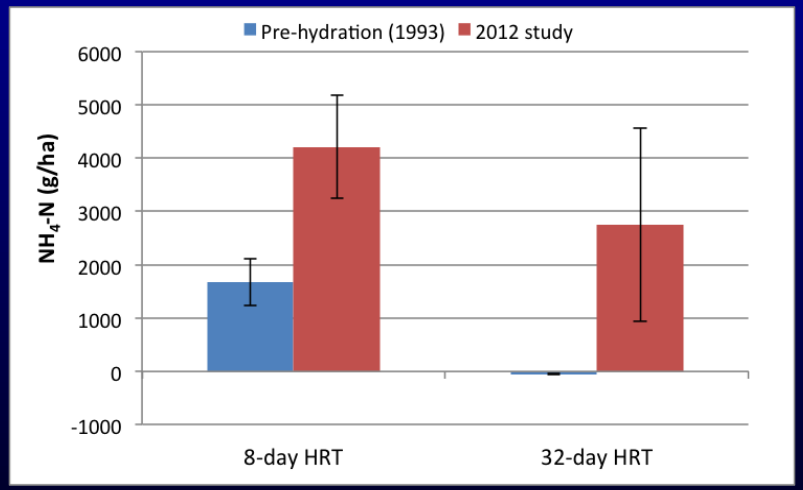


Cumulative flux during 32-day soil core incubations
(mean ± SE)

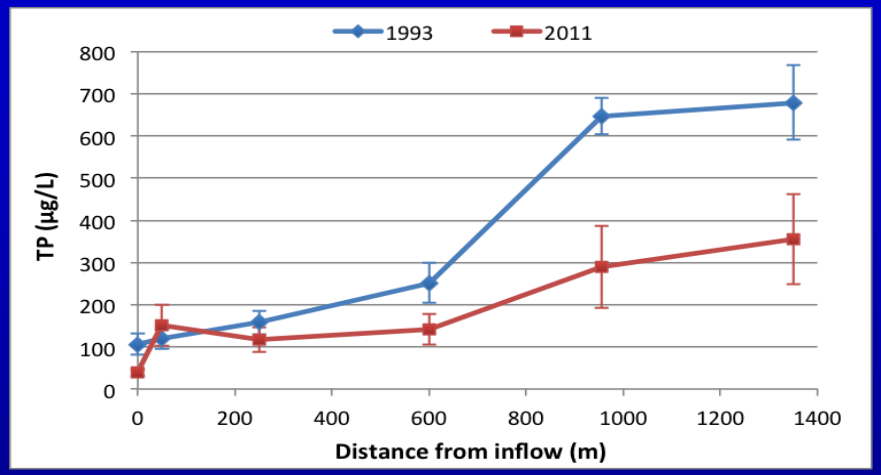


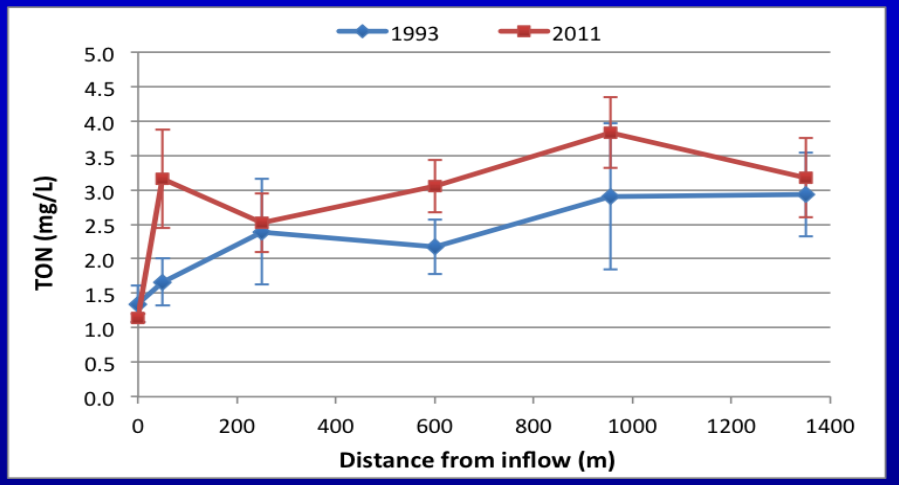


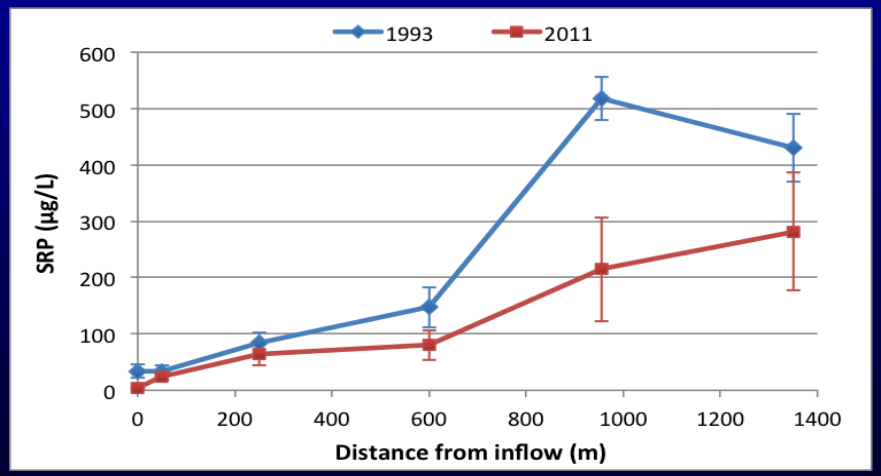


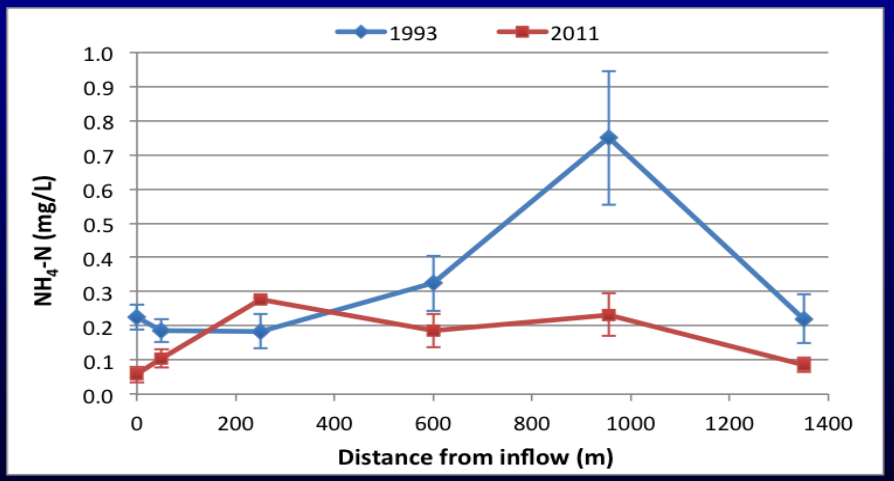


Rehydrated wetland transect: 1993 and 2011 surface WQ monitoring results (mean ± SE of monthly measurements)

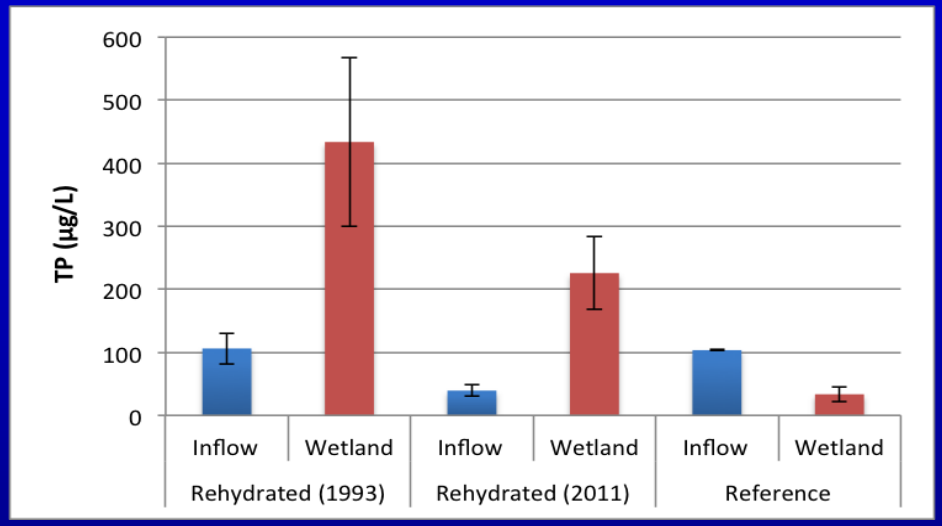


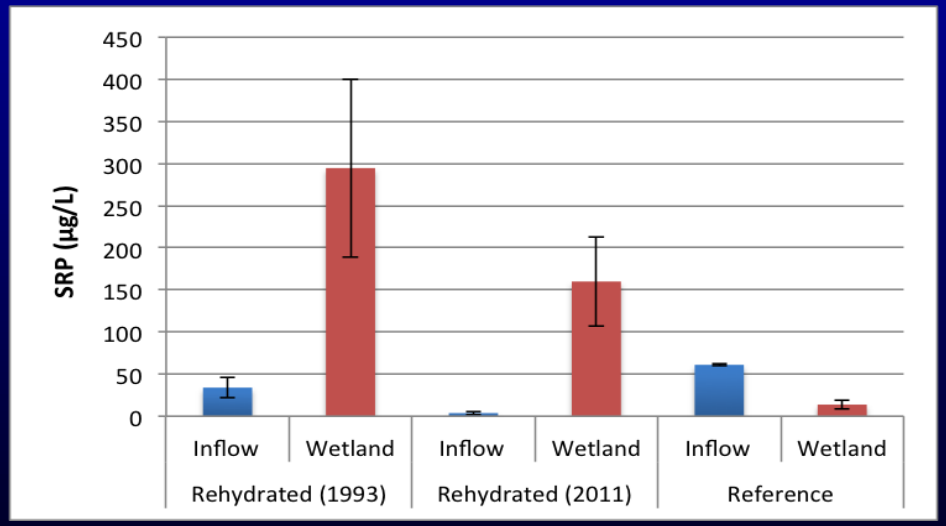




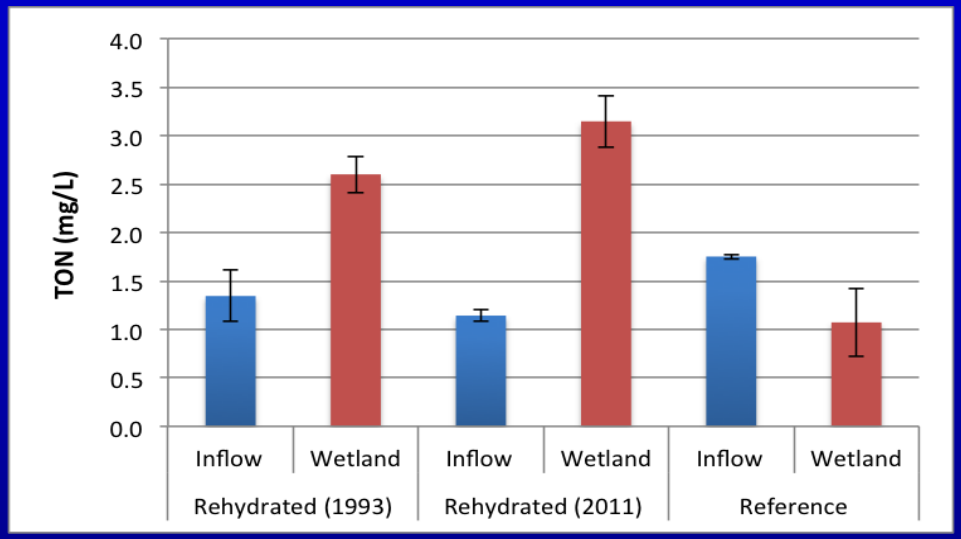


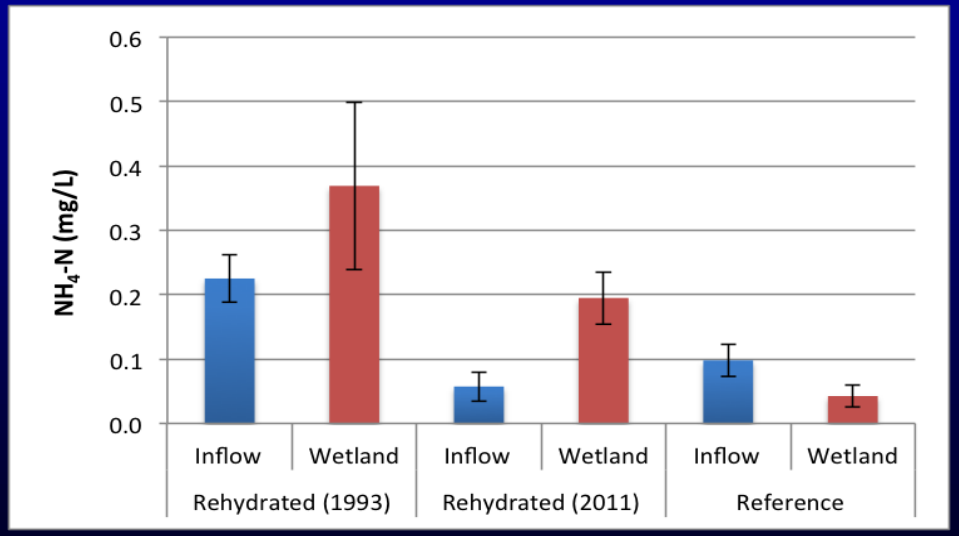
Rehydrated wetland transect comparison with reference wetland (mean values ± SE)





Rehydrated wetland transect comparison with reference wetland (mean values ± SE)





Conclusions

- Hydrologically-altered wetland soils can act as a source of nutrients—even after more than 18 years post-flooding.
- Core incubation studies indicate that TP and SRP flux from the wetland soils has significantly decreased; this is supported by recent and historical field monitoring results.
- Field monitoring results suggest a decrease in the flux of soil ammonium, but little change in flux of organic N.
- Compared to downstream reference wetlands, nutrient concentrations in overlying water in the restored wetland remain elevated.