Physical Stability of Typha and Marl Soils in Everglades STAs

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Suspension of loose marl soil occurs in STAs, here via bioturbation

- Can STA management practices reduce effects of suspension on Water TP?

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Background and Problem Statement

- Calcareous marl soils accrued in SAV-dominated STAs over 20 years
- Appears less physically stable, compared to antecedent organic soils
- Marl may be impediment to achieving WQBEL, if easily suspended

Objectives

- Evaluate physical and chemical stability of STA marl soils
- Consolidate marl to improve physical stability, increase soil aggregation and modify P storage to reduce internal P loading
- Reduce TP in water discharged from the STAs

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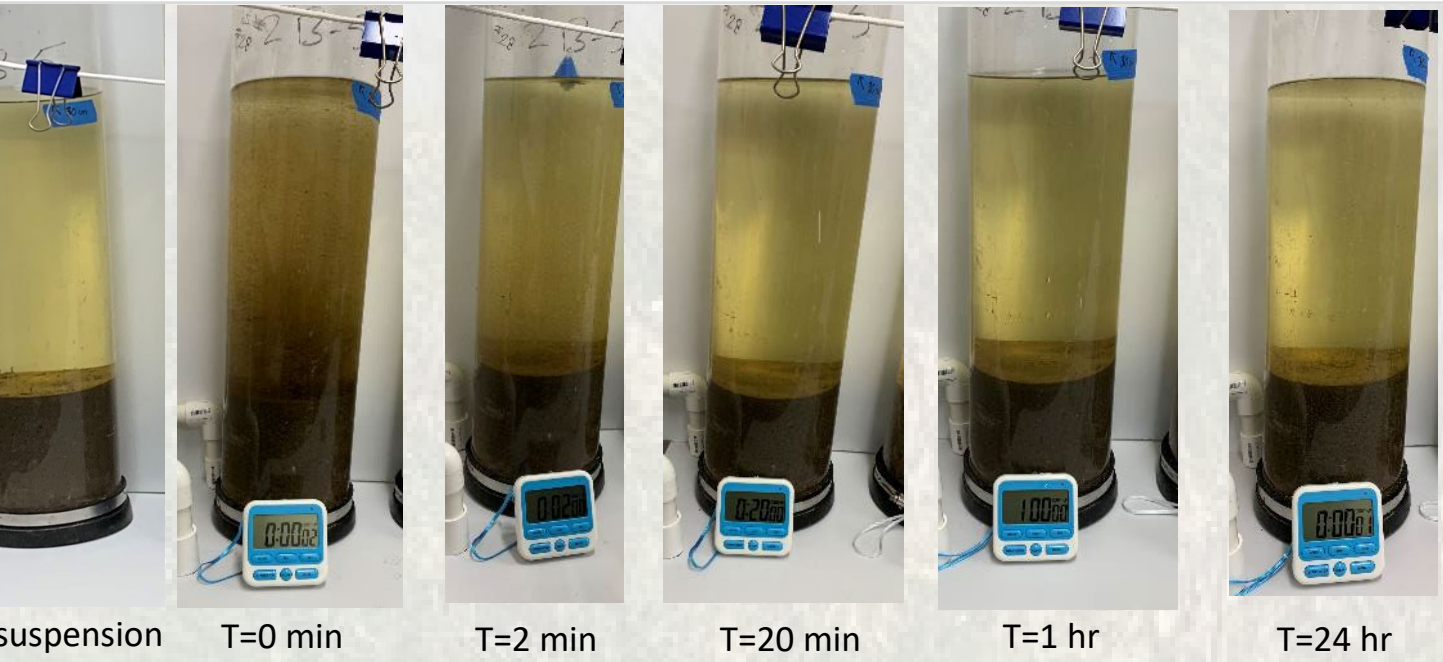
Physical Stability Assessment

Standard amount of energy applied to each core



T=Pre-suspension

T=0 min

T=2 min

T=20 min

T=1 hr

T=24 hr

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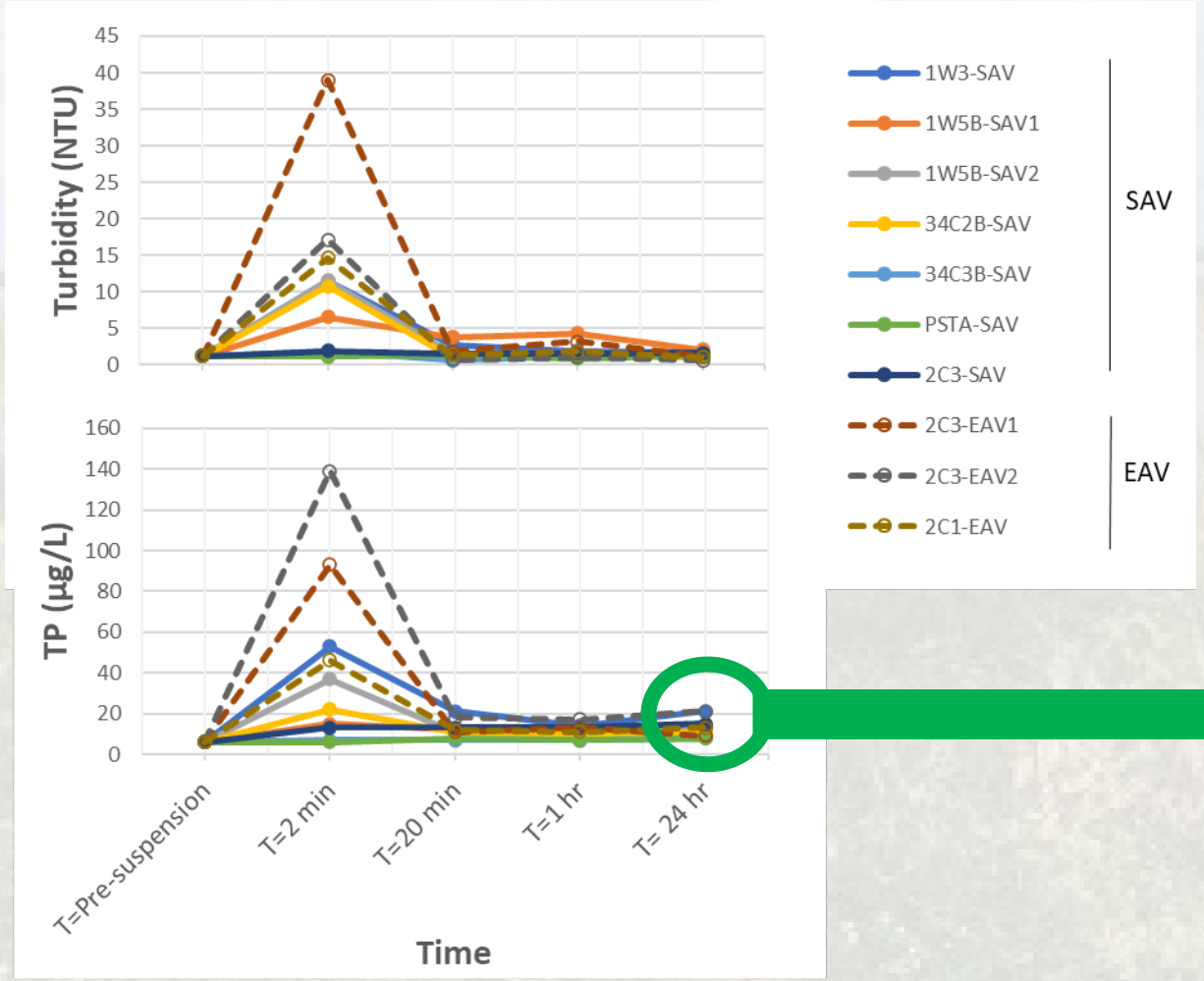
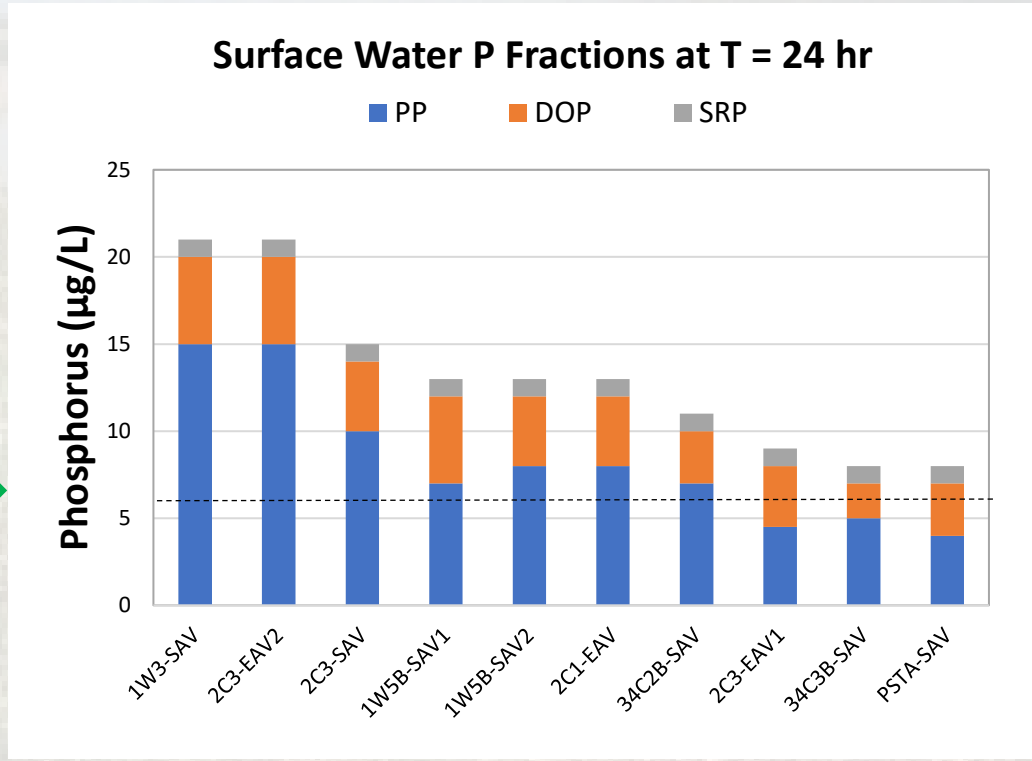
Water TP and Turbidity quickly reduced after suspension

Differences in TP remain after 24 hr





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Emergent Aquatic Vegetation (EAV)

produce organic detritus, leaf fragments, low calcium content

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Cattail as OM source to Marl

- "Mixed Marsh" in the STAs
- SAV areas have become colonized by cattail
- Does cattail leaf litter alter stability characteristics of soils and surface flocs?
  - Mitigate soil P flux?
  - Sustain/increase soil stability?
- Litter microbes support P uptake from water (Grace et al. 2008, Qualls and Richardson 2000)
- Slower litter decomp at depth in soil (DeBusk and Reddy 2005, Schipper et al. 1995)

Cattail Encroachment into STA-1W Cell 2B/4

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Would OM amendment improve marl soil physical or chemical stability?

- Increase P limitation
- Improve soil P stability through microbial aggregation of soil particles

Amendment Material	TP (mg/kg)	TN (%)	TC (%)	C:N Ratio (wt:wt)
Fresh Rice Hulls	1030	0.54	41.7	78
Biochar	869	1.02	42.9	43
Wood Chips	326	0.53	47.7	90
Sugarcane Bagasse	293	0.45	46.0	103
Cattail - STA-3/4 Cell 2B	166	0.47	49.2	105
Humic OM	160	2.25	47.2	21
Cattail - PSTA	**137**	**0.47**	**48.6**	**104**
Cardboard	47	<0.24*	46.3	>196**
Bagasse Plates	43	<0.24*	45.3	>192**

* Result is below the method detection limit of 0.236 %
** TN result was below the detection limit.

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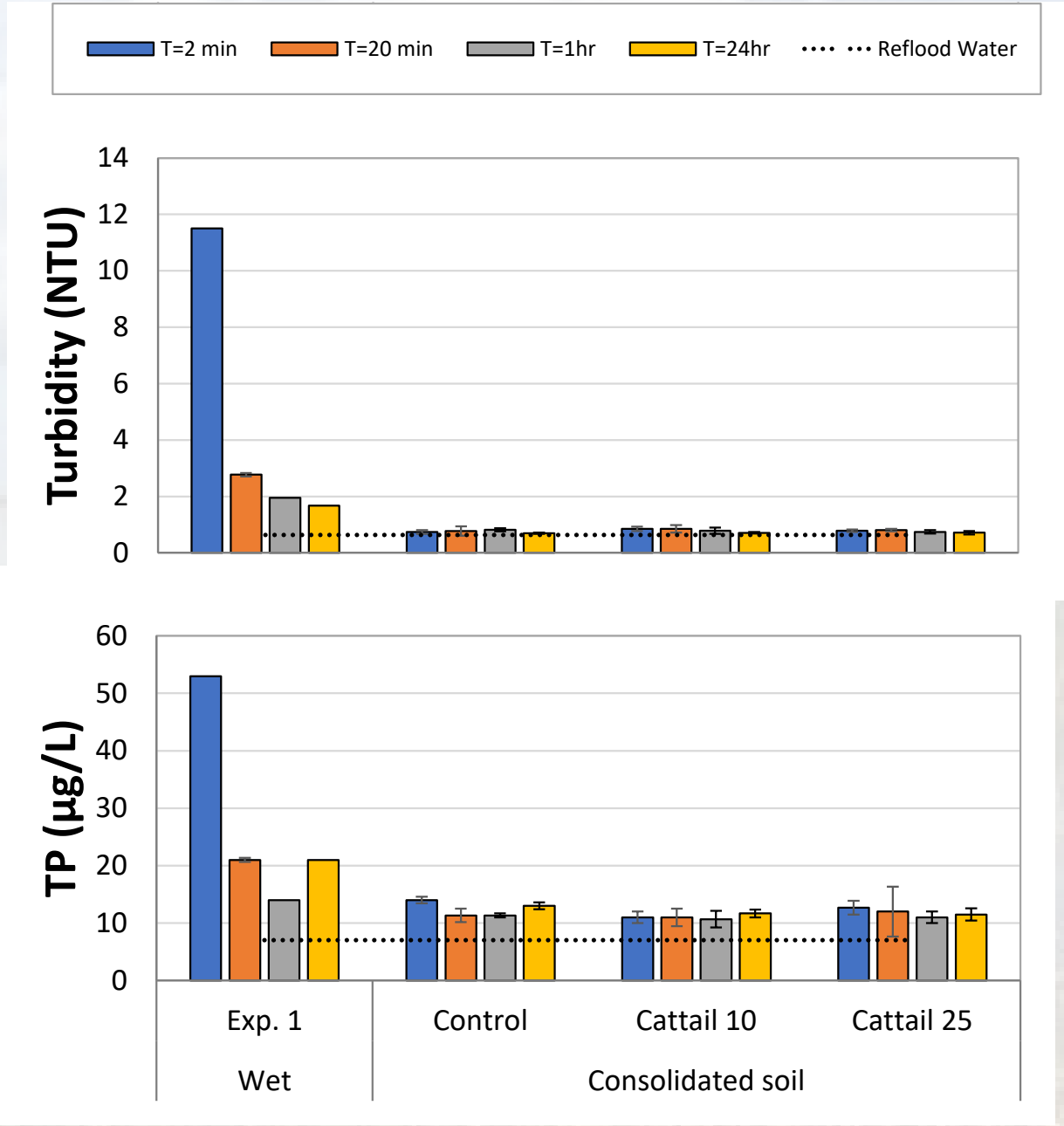
Marl consolidation increased short-term physical stability

- Turbidity at 2 min lower across all consolidated soil treatments
- TP lower in Consolidated Control and Cattail amended than current ("Wet") field condition



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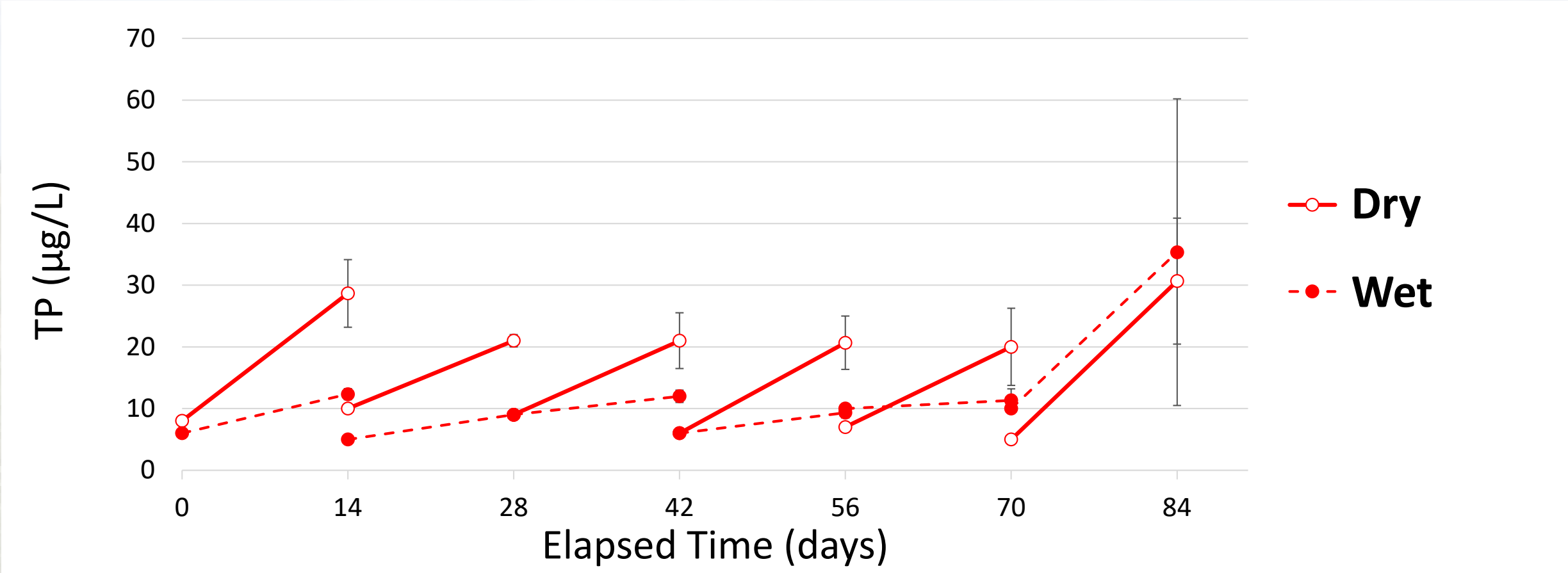
Won’t drying marl soil increase P flux?

Long-term assessment over 84 days



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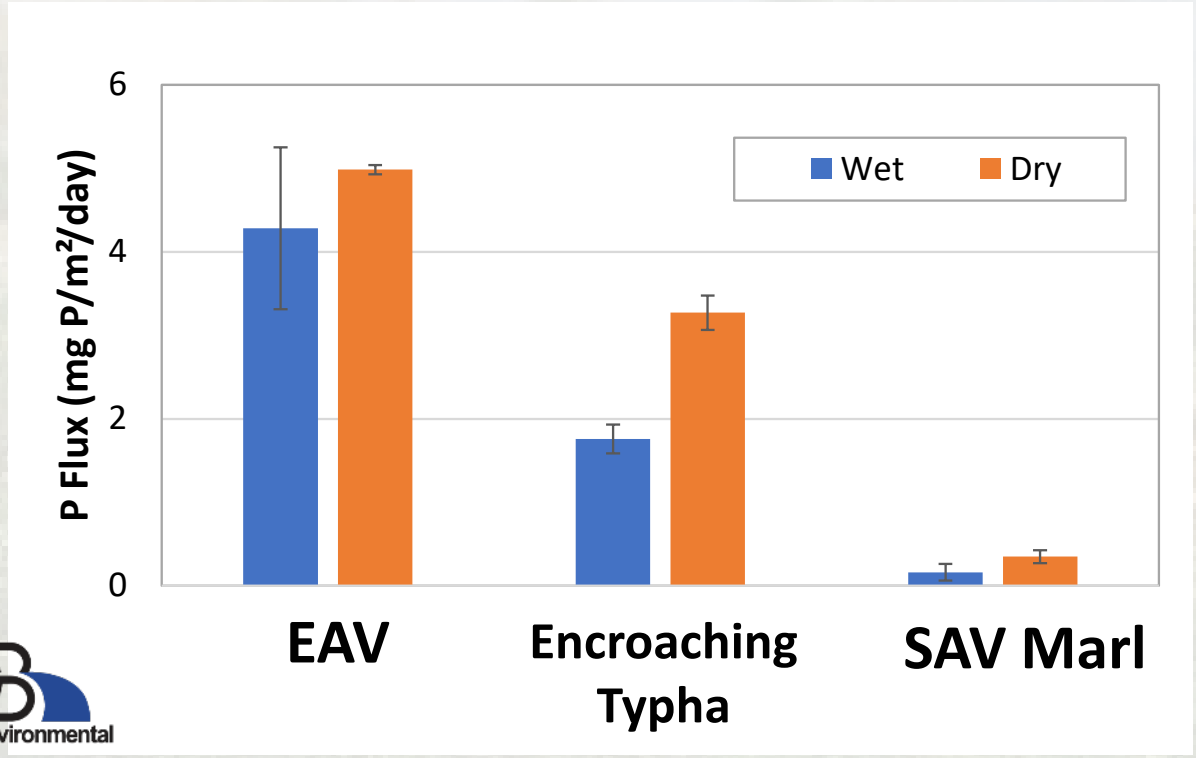
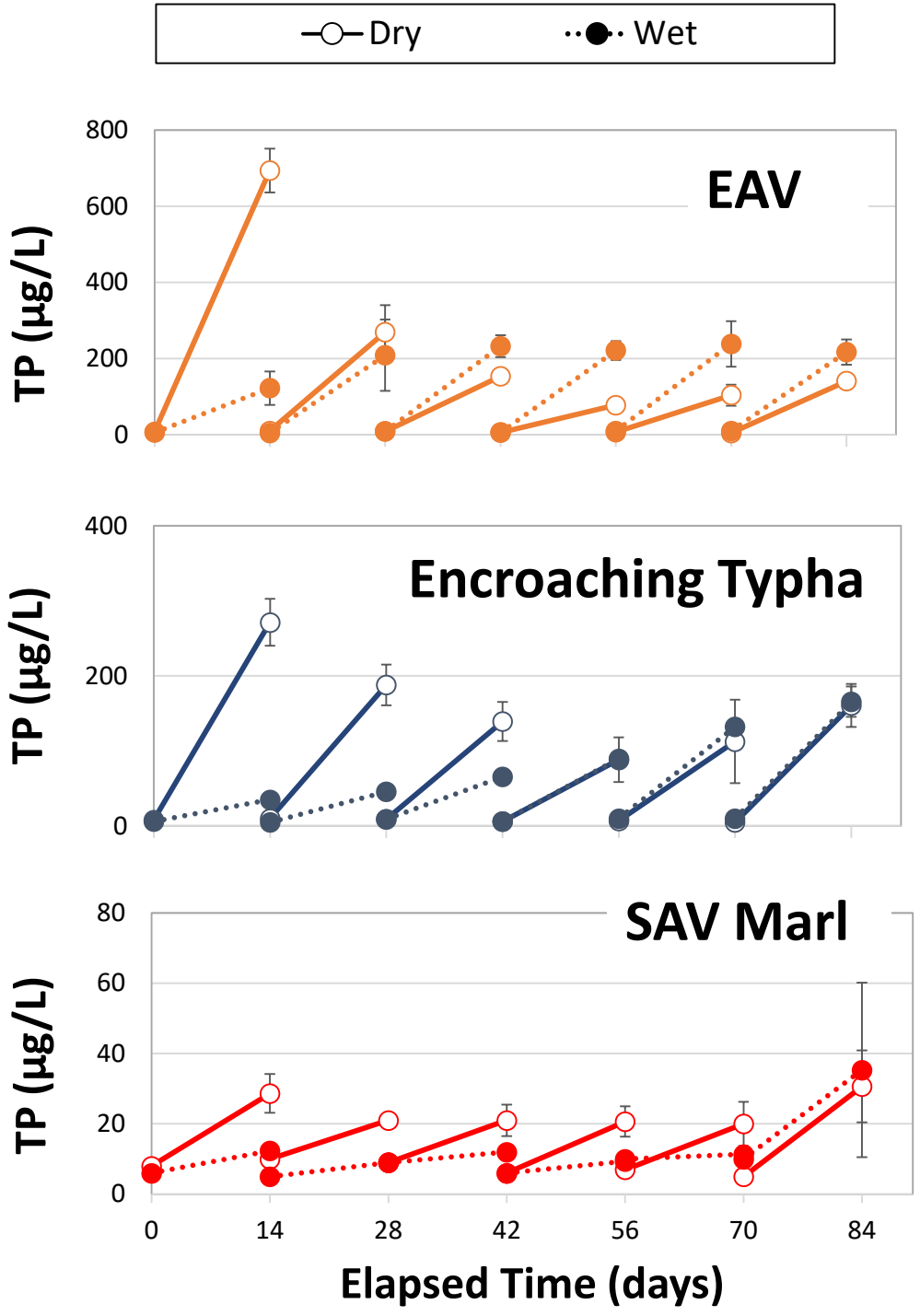
Effect of Dryout

- Greater increase in soil P flux in some soils, EAV, but short-lived
- Significant effect of drying and location





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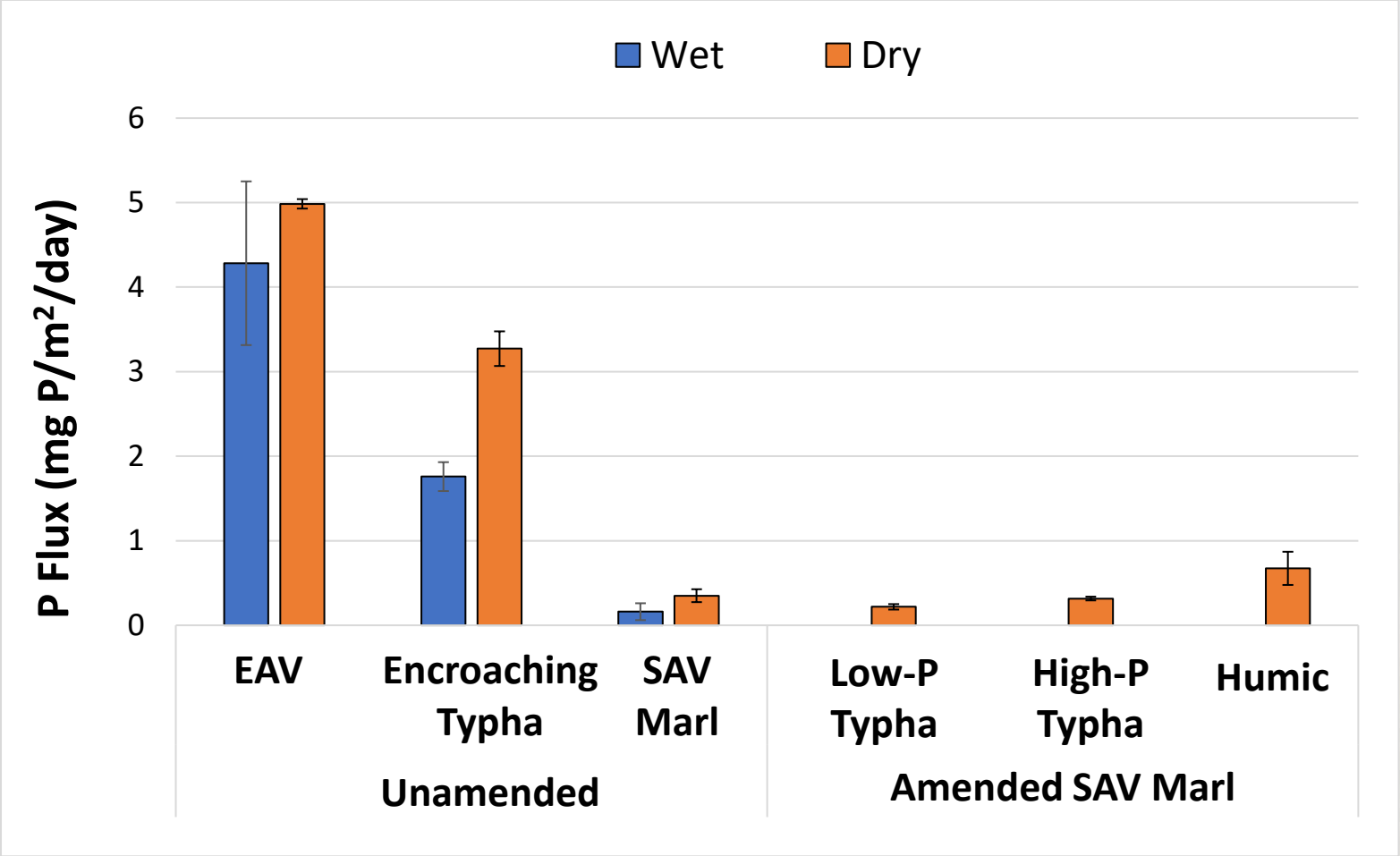
Long-term soil P flux affected more by site than dryout or OM amendment



- Marl flux low compared to soils from areas long-dominated by EAV, or recently encroaching EAV
- **Typha leaves mixed into marl soil** had no effect
- Humic OM increased soil P flux

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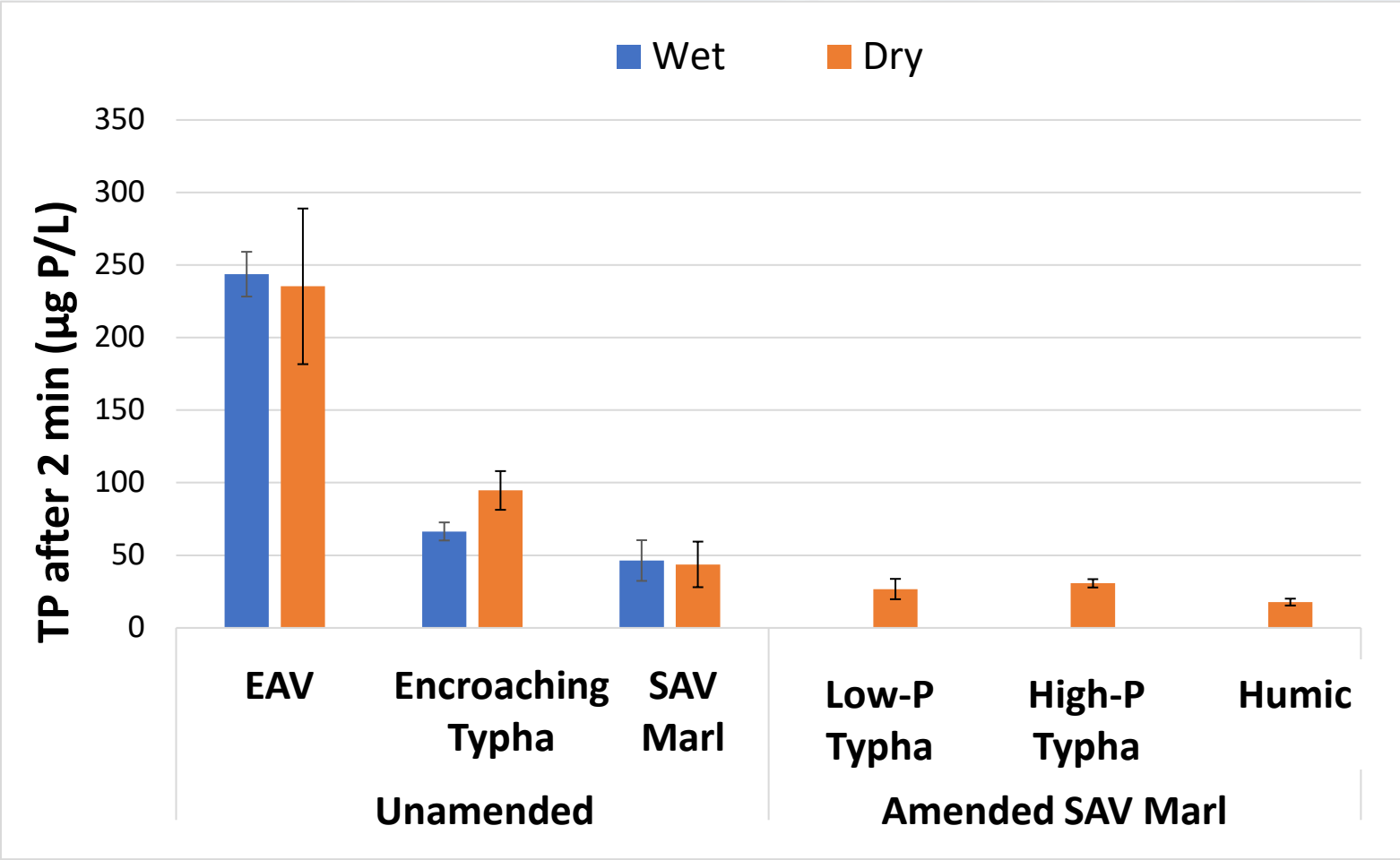
TP after suspension when flooded 12 weeks



- Both marls showed lower TP than EAV

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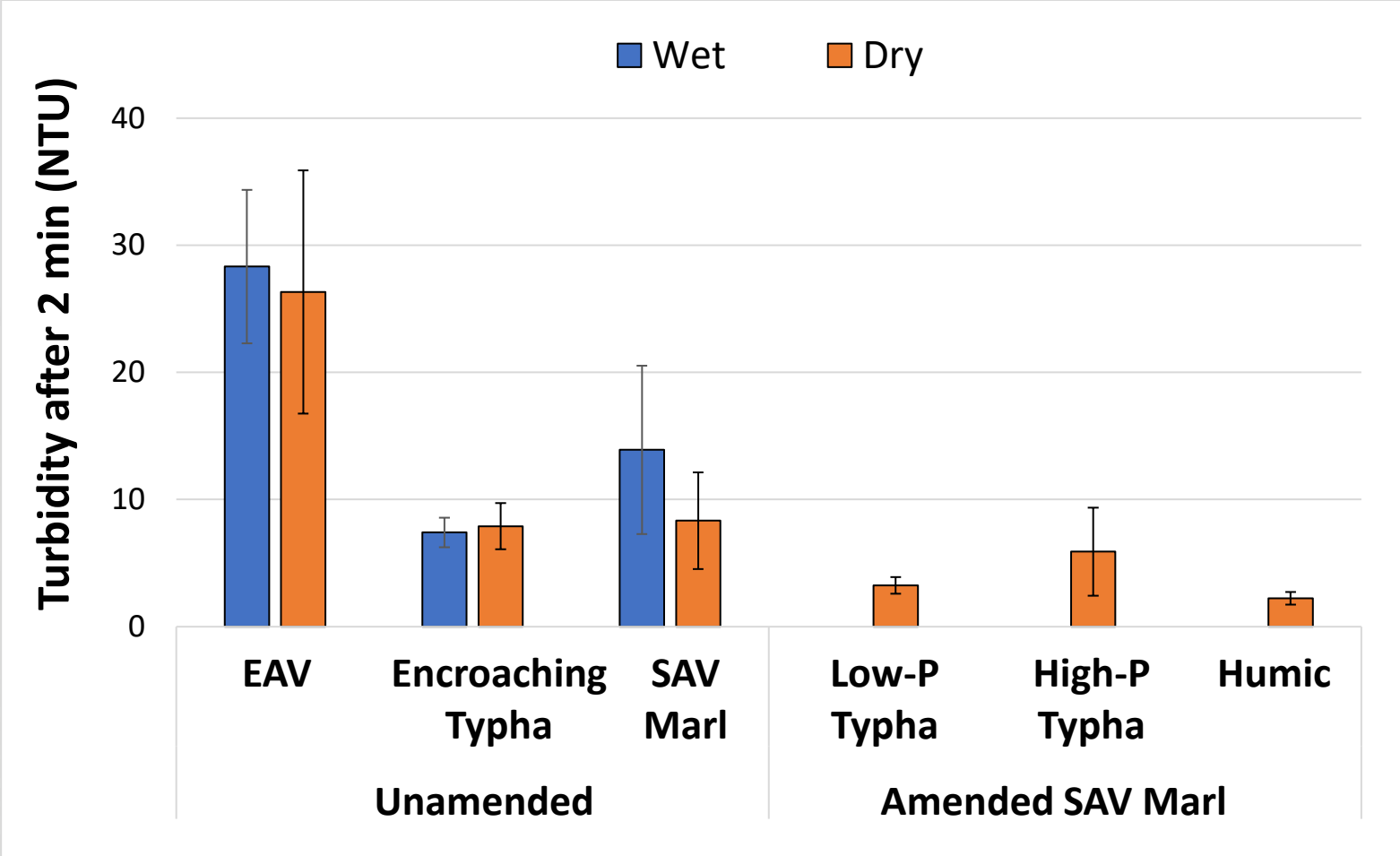
Turbidity after suspension when flooded 12 weeks



- Both marls more stable than EAV soil
- Drying had no effect on turbidity after 12 weeks rehydration
- Amendments had no measurable effect (ANOVA)

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Rapid SAV germination after drying (within a few weeks) may stabilize soil

Continuously Flooded

Dried Marl Soil, Reflooded 5 weeks

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Management Implications

- EAV soils easily suspend and contribute P to overlying water column
  - By contrast, marl soils were not problematic and re-settled quickly
- Consolidation improved marl stability immediately after flooding
  - Suspension was reduced, turbidity and water TP decreased
  - **"Window" for SAV germination and growth**
- 12 weeks after rewetting, stability of dried soil no different than wet soils
- Drying organic, P-rich EAV soils caused high soil P flux
- Long-term P flux from dried marl amended with *Typha* was no different (no better/no worse) than wet marl soils

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Acknowledgements

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