

Assessment of Phosphorus Loads from Tile Drainage in the Jewett Brook Watershed of St. Albans Bay

Venue: Vermont Environmental Consortium

Date: June 6, 2018

Presented by: Dave Braun

Tile drainage

Subsurface drainage is an essential management practice on many farm fields.



In fields otherwise too wet to farm efficiently, tile drainage enables:

- Reduced soil compaction
- Reduced soil erosion
- More efficient nutrient uptake by crops
- Timely equipment access
- Timely application of conservation measures
- Increased crop yields

Tile drainage dramatically changes the hydrologic behavior of a field, reducing surface runoff by enhancing infiltration and ground water transmission.

This is a study in three parts:

Task 1: Tile Drainage Literature Review (Completed)

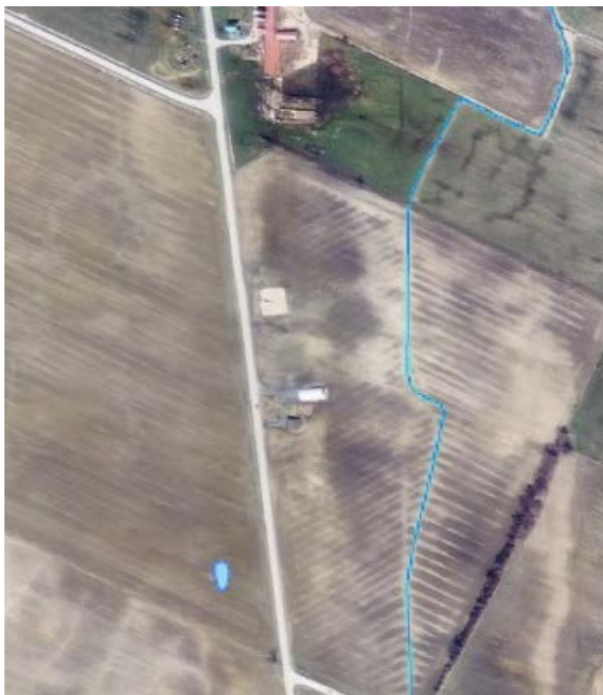
- Written by Don Meals and Julie Moore
- 252 publications reviewed
- Used as a basis for VTANR's required tile drain report to legislature, January 2017

Task 2: Monitoring of Tile Drainage Systems (Completed)

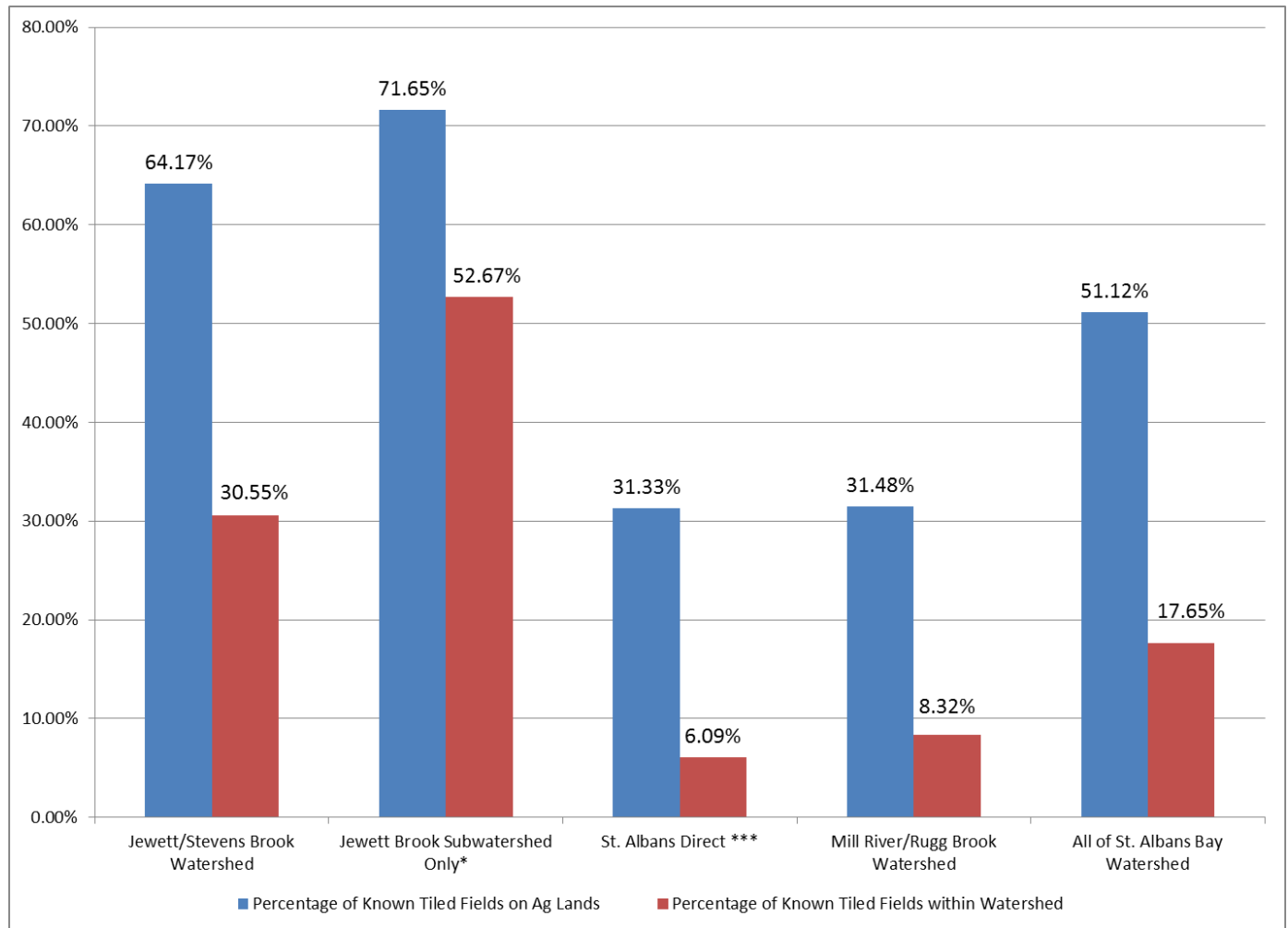
- Participation by 6 farmers
- Monitoring 12 tile drains (April 2017 – March 2018)
- Characterization of tile drainage systems
- Continuous flow measurement and composite water sample collection
- Analysis for total and dissolved P and total N

Task 3: P Load Estimation of Tile Drainage Systems (2018)

- Analysis of associations between water quality and agronomic data
- Evaluation of Jewett Brook P load
- Assessment of tile drain P load significance



Identifiable Tiled Agricultural Fields from Vermont AAFM's 2015 Cropland Inventory



Study field and tile drainage system characterization

Site Characterization Report (March 1, 2017) describes:

- Construction of tile drainage systems
- Surface inlets to tile drains
- Crop production in study fields
- Field soil types
- Soil Test P in study fields
- Manure and fertilizer applications

	Site	Area (A)	Crop	Soil Survey Data % of field, type, slope class, hydrologic group	Soil Test P	Fertilizer Application	Manure Application	Cover Crop
Farmer1	JBT01	25	2016: Silage corn 2017: Soybean	82%: Kingsbury clay, 0 to 3%, D 10%: Massena stony loam, 0 to 3%, C/D 8%: Kingsbury clay, 3 to 8%, D	7.2	2016: starter at plant 2017: starter at plant	2016: None 2017: None	2016: None 2017: Unknown
Farmer1	JBT02	4.7	2016: Silage corn 2017: Soybean	69%: Kingsbury clay, 3 to 8%, D 31%: Kingsbury clay, 0 to 3%, D	9.3	2016: starter at plant 2017: starter at plant	2016: None 2017: None	2016: None 2017: Unknown
Farmer1	JBT04	5.7	2016: Silage corn 2017: Soybean	100%: Kingsbury clay, 0 to 3%, D	4.5	2016: starter at plant 2017: starter at plant	2016: None 2017: None	2016: None 2017: Unknown

Tile drainage system construction



- All 12 systems selected are standard, perforated, corrugated drain pipe.
- Most were installed within the last decade.
- The outfalls range in diameter from 4–12 inches.
- 9 of the 12 tile drains discharge to ditches. The 3 remaining (JBT01, JBT02, and JBT04) discharge directly to Jewett Brook.
- The tile drains range from 3–5 feet below ground, with most in the 3–4 feet range.
- All study fields have patterned drainage except JBT16, which has a dendritic (branching) system.
- Drain spacing is in the typical range of 25–40 feet, with the exception of JBT18 and JBT19, which have 80-foot spacing.

Surface inlet to JBT14 tile drain (3 systems have known inlets; blind inlets also possible)



Monitoring manhole construction



JBT11 monitoring station



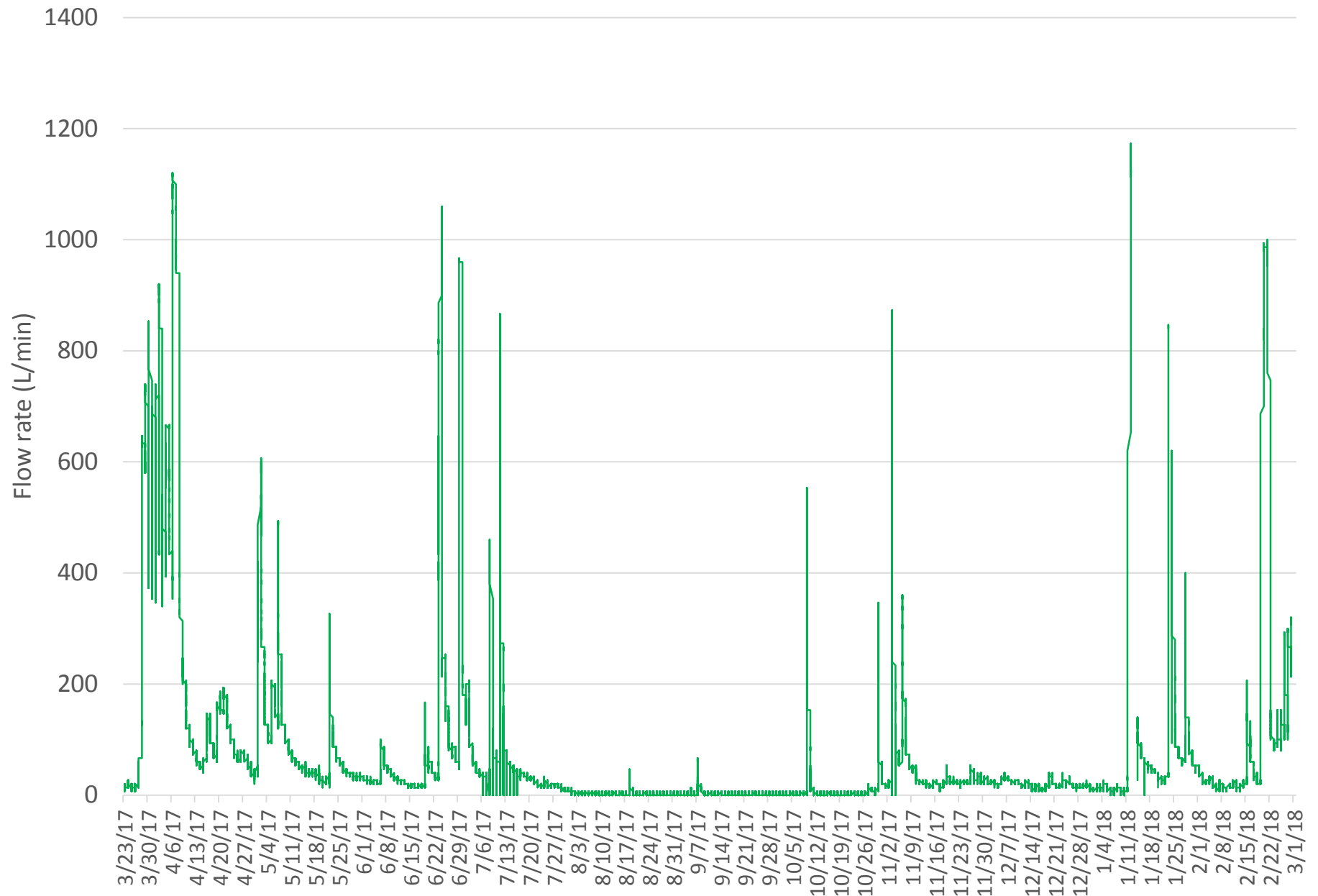
Typical instrument shelter (JBT11)



Waterflux 3000 flowmeter at JBT11, April 20, 2017



JBT01 flow rate



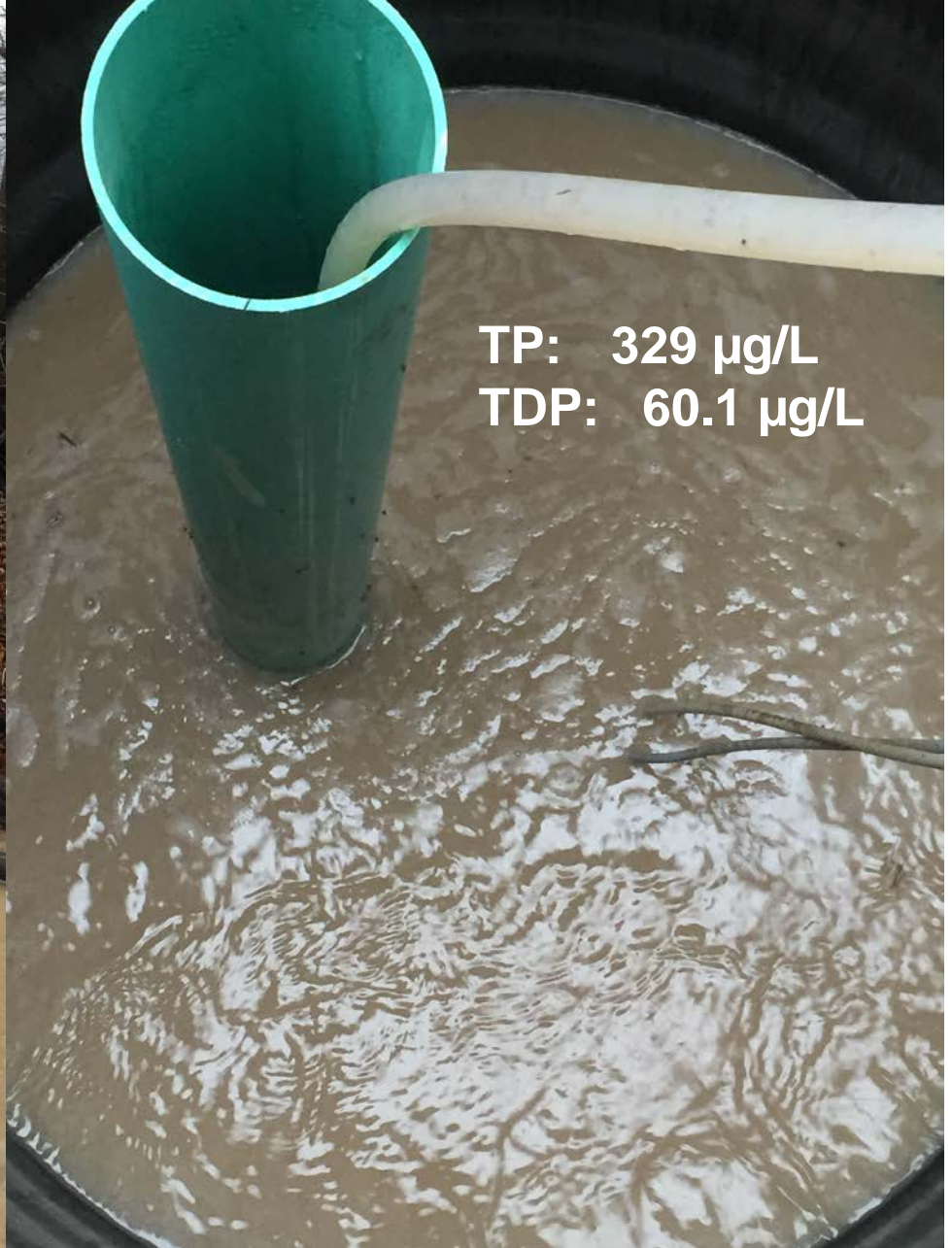
JBT11 flowing clear, April 20, 2017



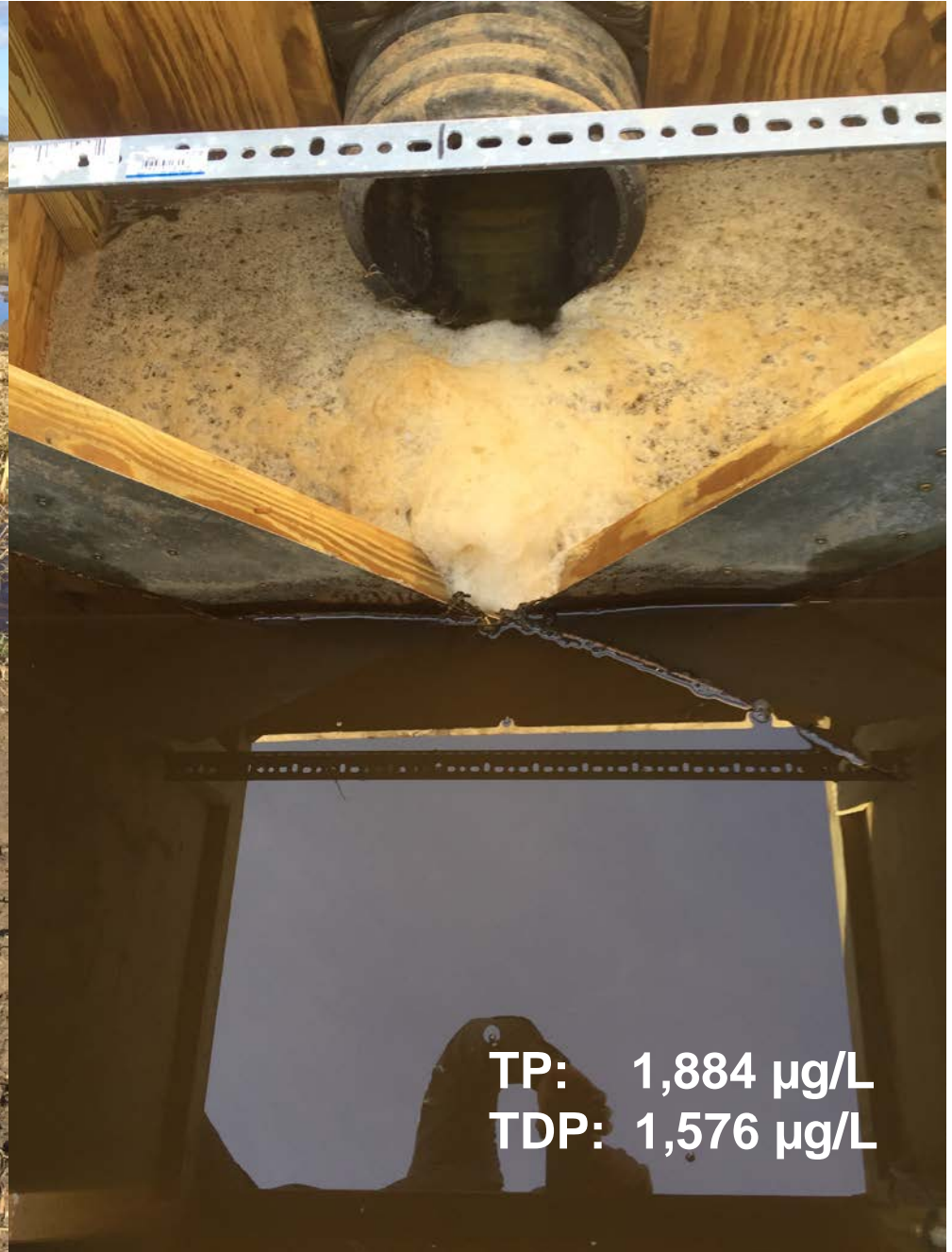
Tile drain muddying already turbid Jewett Brook



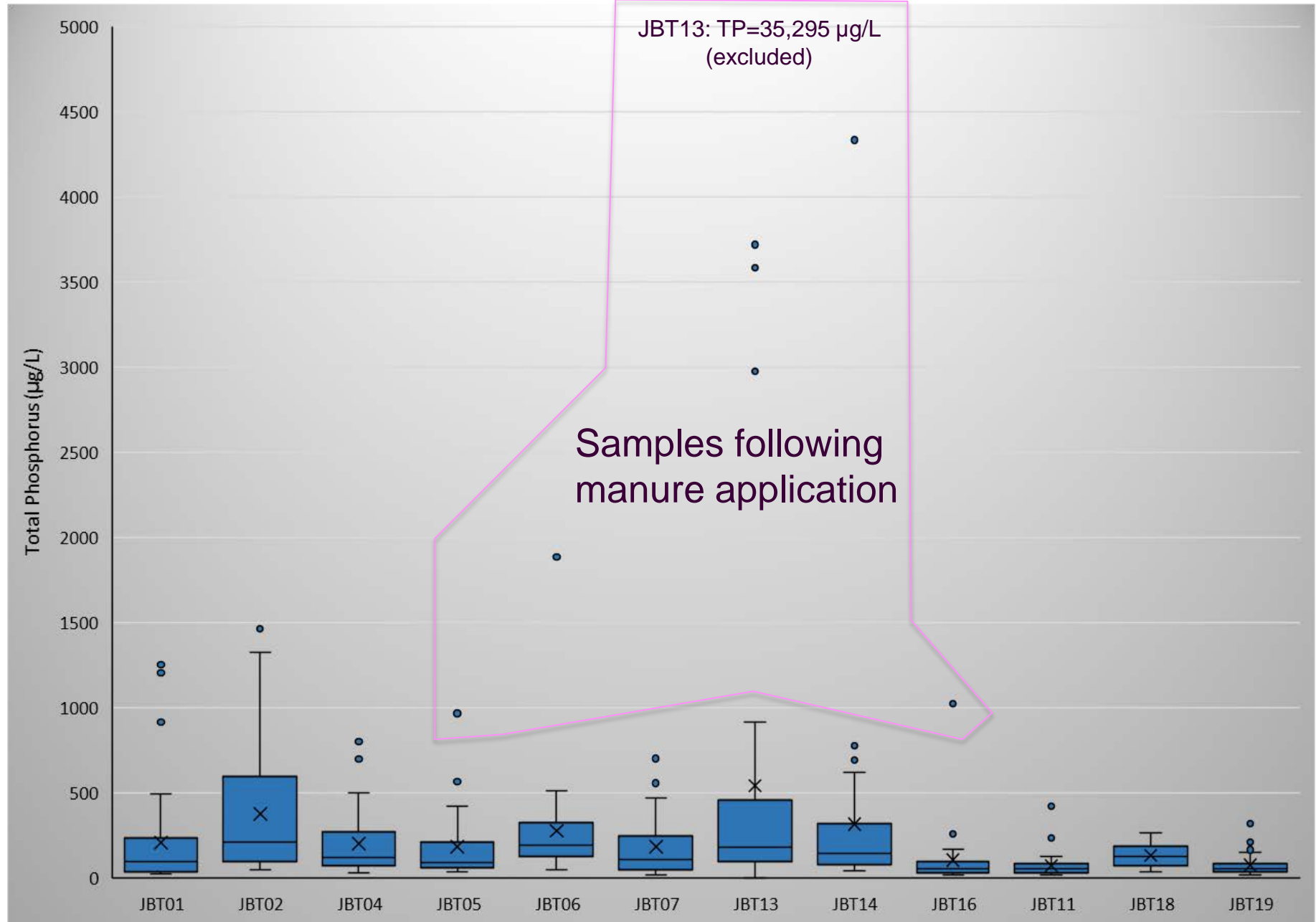
JBT01 flowing muddy, November 3, 2017



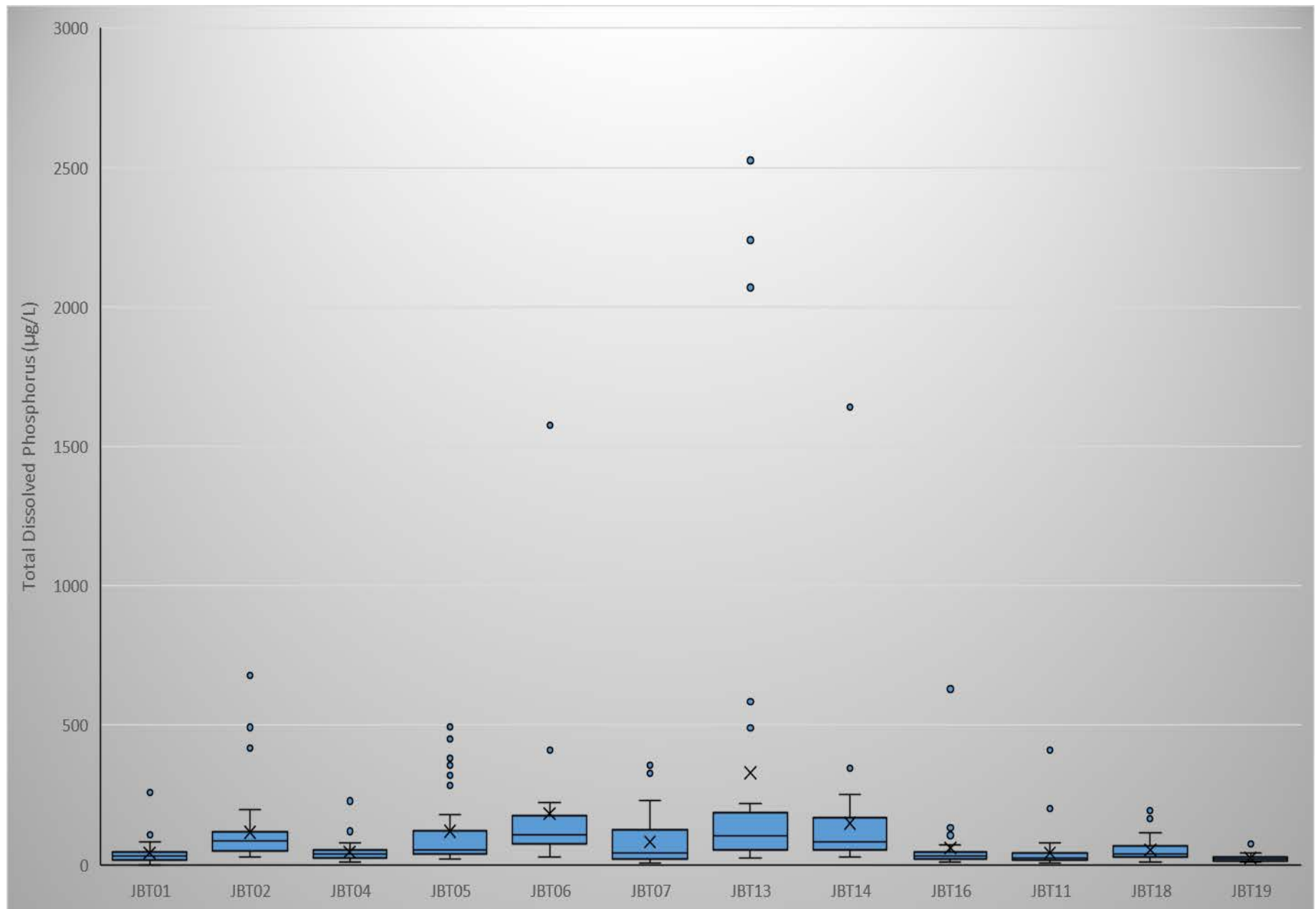
JBT06 field on October 27, 2017 after manure injection



Distributions of Total P EMCs (April – Nov. 2017)

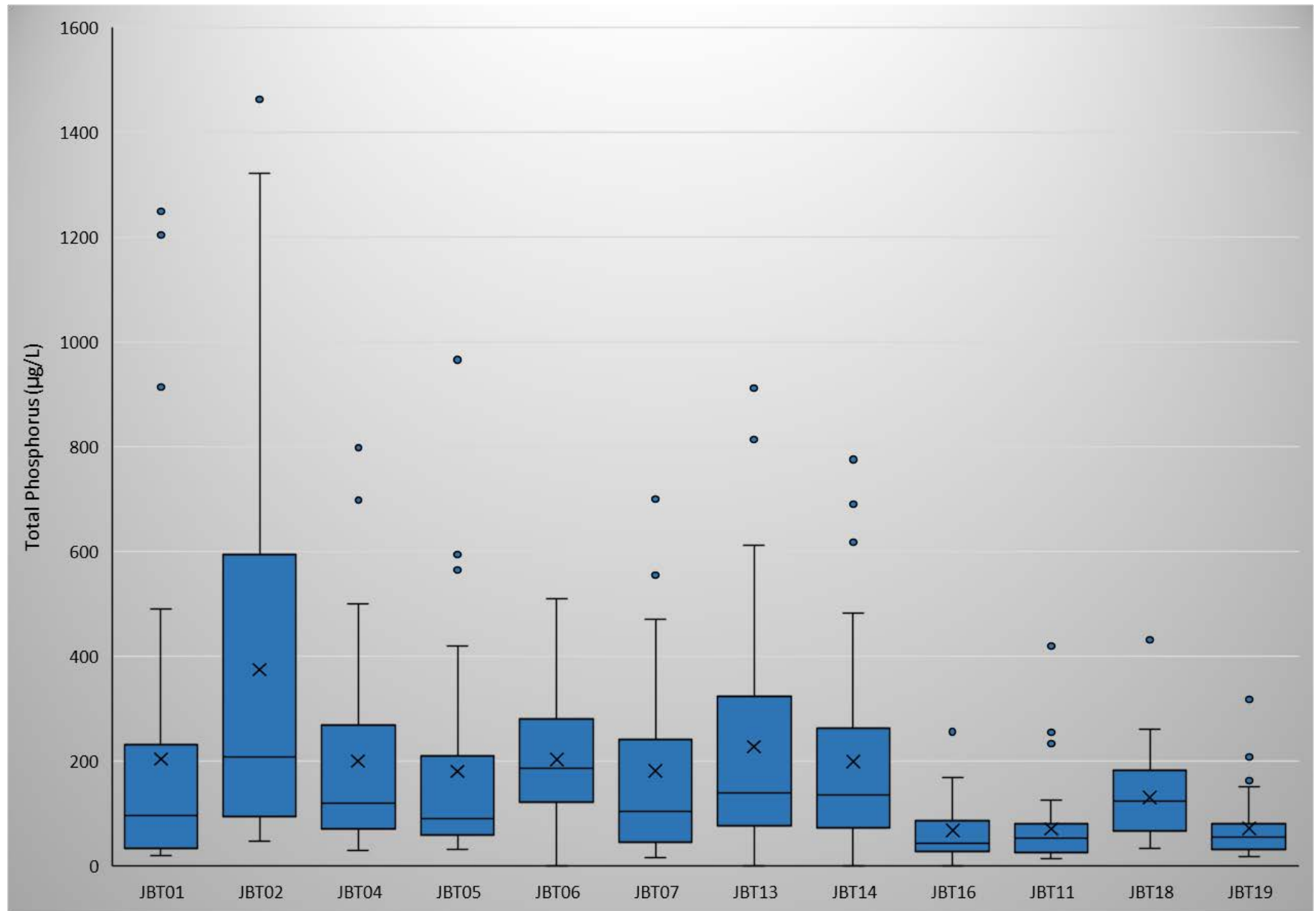


Distributions of TDP EMCs (April – Nov. 2017)



Distributions of Total P EMCs (April – Nov. 2017)

Samples following manure application removed



P Loading

- Between April and November 2017 (~7 months), Total P loads contributed by individual tile drains ranged from 0.15 kg to 13.4 kg.
- Accounting for the drainage area, the P loading rates ranged from 0.04 to 0.82 kg/ha (average 0.33 kg/ha).
- Load calculations for the remainder of the year are in progress.
- Clearly, the proportion of the P load contributed by tile drains is not insignificant.

Questions:

In progress:

1. Associations between WQ and AG variables
2. Proportion of Jewett Brook P load contributed by tile drains

Three related research questions / farmer concerns

1. Are surface inlets the main route for P transport to tile drains, particularly where we find high P concentrations following manure application?
2. Are conditions in the Jewett Brook watershed representative of conditions in the wider Lake Champlain Basin?
3. Given multiple tradeoffs between surface runoff and subsurface drainage, is the net effect of tile drainage increased or decreased P export?



Thank you

Dave Braun

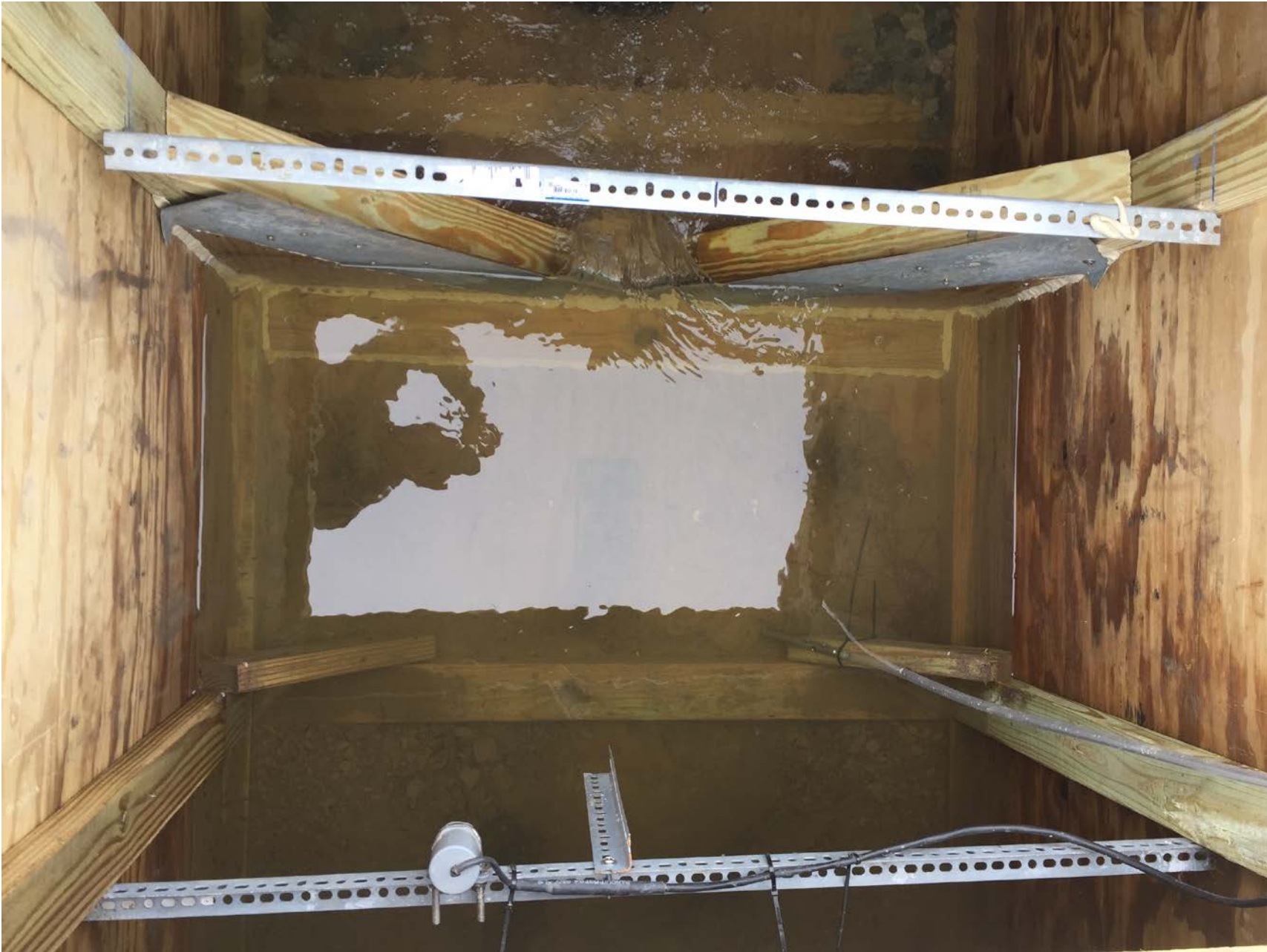
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Runoff and Erosion on Tiled Field (JBT14)



90-degree V Weir and Level Sensor at JBT06



Station JBT01

