

# Characterization of Tile Drainage Systems in the Jewett Brook Watershed



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*Cover Photo:  
Installing a pipe  
trap and monitoring  
manhole at the end  
of one of the tile  
drains to be  
monitored.*

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# 1. Introduction

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This report is intended to document the detailed data collected on the 12 tile-drained fields selected for monitoring, as well as present summary level data on field conditions throughout the Jewett Brook watershed. Data describing the monitored tile-drained fields were obtained through field reconnaissance, interviews with participating farmers, review of nutrient management plans, and analysis of the USDA-NRCS SSURGO soils dataset. However, at this time summary level data on field conditions throughout the Jewett Brook watershed are not available.

In Task 2, Stone will use data describing the monitored fields to evaluate associations between agronomic factors and measured nutrient concentrations and loads in tile drain flow. These data will also be used in Task 3 in extrapolating phosphorus loading rate estimates from the 12 monitored tile drains to the scale of the Jewett Brook watershed. This extrapolation will also require certain watershed-scale data, including estimates of the tile-drained acreage among various crops, soil types, and soil test phosphorus classes. For example, to scale up from unit-area phosphorus loading at study fields in silage corn production with clay soils and “optimum” soil-test phosphorus, we require tile drainage, cropping, soils, and soil test phosphorus information at the watershed scale. These watershed-scale data will also be important in determining how representative the monitored tile-drained fields are to conditions in the watershed as a whole.

Stone is currently in discussions with the Vermont Agency of Agriculture, Food, and Markets (AAFM) concerning access to data AAFM obtained in preparing a *2015 Cropland Inventory of St. Albans Bay*. This cropland inventory includes critical data on the distributions and types of tile drainage systems throughout the watershed from AAFM’s interpretation of aerial imagery collected under ideal springtime conditions. AAFM classified fields in the watershed as tile-drained or not tile-drained, and then further characterized tile drainage systems as either systematic or dendritic. AAFM also recorded soil test phosphorus concentrations for a majority of fields in the watershed by reviewing nutrient management plans for nine farms. Because of restrictions on dissemination of personally protected information, AAFM cannot provide Stone with the relevant spatial data layers; therefore we have asked AAFM to perform certain GIS analyses and provide the needed summary data. By providing only summary statistics, neither AAFM nor Stone would disseminate any protected information. It is unclear whether AAFM will be able to provide the requested summary data. It would be outside the scope of the present project for Stone to conduct the mapping and analyses necessary to reproduce these data, and at the present time we would likely be unsuccessful in obtaining as many nutrient management plans as AAFM was able to review.

## 2. Characterization of Study Fields

Data describing the monitored tile-drained fields were obtained through field reconnaissance, interviews with participating farmers, review of nutrient management plans, and analysis of the USDA-NRCS SSURGO soils dataset. All six participating farmers provided information about the fields and tile drainage systems we are investigating. Data related to the selected tile drainage systems are presented in Table 1. Agronomic data for the study fields are presented in Table 2.

*Table 1: Construction of the Selected Tile Drainage Systems*

Farmer	Site	Year installed	Outfall diam. (in.)	Outfall position	Depth (ft)	Nominal spacing (feet)	Surface inlet type	Comment
Farmer1	JBT01	~2012	6	will surcharge	3-5	25	None	
Farmer1	JBT02	~2012	4	underwater	3-5	25	None visible	
Farmer1	JBT04	~2012	4	will surcharge	3-5	25	None visible	
Farmer2	JBT05	2011	8	will surcharge	3-4	35	None	Majority of field outside Jewett Brook watershed
Farmer2	JBT06	?	12	will surcharge	?	?	3 visible standpipes	Significant erosion (gully)
Farmer3	JBT07	2011	4	may surcharge	3-4	40	None	Tile exposed ~6'
Farmer3	JBT11	2010	8	will surcharge	3-4	40	None visible	Water control structure near outlet: depth=60", pipe=18" off bottom
Farmer4	JBT13	2013	6	will surcharge	3	40	Confirm standpipe #1 does not flow to outlet	
Farmer4	JBT14	2013	8	will surcharge	3	40	Confirm standpipe #1 does not flow to outlet	
Farmer5	JBT16	~2004	4	may surcharge	3-4	Dendritic	Surface inlet at northern property boundary, 100 yards into field from road	Cropped to edge of bank
Farmer6	JBT18	2006	6	will surcharge	3	80	None visible	
Farmer6	JBT19	2006	6	will surcharge	3	80	None visible	

**Table 2. Agronomic Data for the Study Fields**

Farmer	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
Farmer2	JBT05	94	2016: Silage corn 2017: Silage corn	30%: Kingsbury clay, 0 to 3%, D 30%: Massena stony loam, 0 to 3%, C/D 29%: Covington clay, D 10%: Georgia stony loam, 3 to 8%, C	?	2016: pop-up at plant 2017: pop-up at plant	Fall 2016: inject Fall 2017: inject	2016: Winter rye 2017: Winter rye
Farmer2	JBT06	91	2016: Silage corn 2017: Silage corn	51%: Covington clay, D 36%: Massena stony loam, 0 to 3%, C/D 7%: Kingsbury clay, 0 to 3%, D 6%: Georgia stony loam, 3 to 8%, C	?	2016: pop-up at plant 2017: pop-up at plant	Fall 2016: inject Fall 2017: inject	2016: Winter rye 2017: Winter rye
Farmer3	JBT07	28	Continuous silage corn	53%: Covington clay, D 37%: Kingsbury clay, 0 to 3%, D 10%: Massena stony loam, 0 to 3%, C/D	12	2016: 5 gal/A pop-up at plant 2017: 5 gal/A pop-up at plant	Fall 2016: 6,000 gal/A Fall 2017: 6,000 gal/A	2016: None 2017: None
Farmer3	JBT11	51	Continuous alfalfa hay	58%: Massena stony loam, 0 to 3%, C/D 16%: Georgia stony loam, 3 to 8%, C 15%: Georgia stony loam, 0 to 3%, C 11%: Covington clay, D	4	2016: No P 2017: No P	2016: None 2017: None	2016: NA 2017: NA
Farmer4	JBT13	22	Continuous silage corn	52%: Massena stony loam, 0 to 3%, C/D 47%: Kingsbury clay, 0 to 3%, D	?	2016: No P 2017: No P	2016: 6,000 gal/A at plant 2017: 6,000 gal/A at plant	2016: Winter rye 2017: Winter rye
Farmer4	JBT14	33	Continuous silage corn	97%: Massena stony loam, 0 to 3%, C/D 3%: Binghamville silt loam, C/D	?	2016: No P 2017: No P	2016: 6,000 gal/A at plant 2017: 6,000 gal/A at plant	2016: Winter rye 2017: Winter rye
Farmer5	JBT16	7.0	Continuous silage corn	76%: Massena stony loam, 0 to 3%, C/D 10%: Lyons stony loam, C/D 6%: Covington clay, D 4%: St. Albans slaty loam, 3 to 8%, A 3%: Georgia stony loam, 0 to 3%, C	?	2016: pop-up at plant 2017: pop-up at plant	Fall 2016: incorporated Fall 2017: incorporated	2016: Winter rye 2017: Winter rye or triticale
Farmer6	JBT18	11	2016: Hay (clover) 2017: Hay (clover)	43%: Kingsbury clay, 0 to 3%, D 25%: Massena stony loam, 0 to 3%, C/D 17%: Georgia stony loam, 0 to 3%, C 15%: Covington clay, D	?	2016: No P 2017: No P	2016: 12 ton/A in mid-May 2017: composted chicken manure	2016: NA 2017: NA
Farmer6	JBT19	10	2016: Hay (clover) 2017: Hay (clover)	48%: Kingsbury clay, 0 to 3%, D 43%: Lyons stony loam, C/D 7%: Massena stony loam, 0 to 3%, C/D	?	2016: No P 2017: No P	2016: 12 ton/A in mid-May 2017: composted chicken manure	2016: NA 2017: NA



While Table 1 and Table 1Table 2 provide information about the fields and their respective drainages systems, some data gaps remain. We will attempt to fill in these data gaps with follow-up correspondences with participating farmers and their crop consultants. In particular, soil test phosphorus data are not presented for most of the study fields because we have been unable to review the nutrient management plan for every farm. Crop consultants are currently revising nutrient management plans for two of the farms and have committed to providing us with the updated plans when available. Follow-up farm visits are needed to review the nutrient management plans of two other farms. Additional data on soil test phosphorus concentrations in the study fields will be presented in the final report.



*Figure 1. JBT06 Outfall (12-inch diameter)*

The following sections describe critical aspects of the construction of the tile drainage systems as well as agronomic factors in the study fields. These sections refer to the data presented in Tables 1 and 2.

## 2.1. Construction of Tile Drainage Systems

All twelve tile drainage systems selected for monitoring are constructed of standard, perforated, corrugated drain pipe. Tile drains were installed in most of the study fields within the last decade. The outfalls of these



*Figure 2. Submerged Outlet of JBT02 Discharging Directly to Jewett Brook*

systems range in diameter from 4–12 inches; there are four 4-inch, four 6-inch, three 8-inch, and one 12-inch diameter outfalls (Figure 1). Nine of the 12 tile drains discharge to drainage ditches, generally close to the bottom of the ditch such that submergence is common. The remaining three, JBT01, JBT02 (Figure 2), and JBT04, drain contiguous fields and discharge directly to Jewett Brook. The depths of the tile drains generally range from 3–5 feet below ground surface, with most in the 3–4 foot range. There do not appear to be any exceptionally shallow or deep tile drains. All but one of the study fields has patterned tile drainage. Only JBT16 has a dendritic (branching) system. Drain spacing among the patterned tile

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drain systems is in the typical range of 25–40 feet, with the exception of JBT18 and JBT19, which have 80-foot spacing that is unusually wide.

## 2.2. Surface Inlets to Tile Drains

There are no known surface inlets into ten of the twelve tile drainage systems selected for this study. In field JBT06, there is a cluster of three standpipes in a wet area that are connected to the underlying tile lines. Field JBT16 is believed to have one surface inlet. The presence of this inlet has not yet been confirmed, however, it is believed to be along the property boundary on the north side of the field, approximately 300 feet into the field from the road. There is also a standpipe close to the JBT13 and JBT14 fields that may or may not be connected with the tile drainage system underlying one of these fields. Alternately, this standpipe could be connected with a tile drain in an adjacent field. A dye test is planned to clarify to which tile drain this standpipe is connected.

## 2.3. Crop Production in Study Fields

Nine of the twelve study fields were in silage corn production in 2016. Three of these—JBT01, JBT02, and JBT04—will be planted in soybeans in 2017, while the remaining six will remain in corn. Three fields—JBT11, JBT18, and JBT19—are in continuous hay production. JBT11 was seeded in 2015 in alfalfa hay and JBT18 and JBT19 were seeded in 2016 for clover hay production.

Five of the corn fields being monitored were seeded with a cover crop of winter rye in 2016. At least four of these same fields are expected to be seeded in winter rye again in 2017, whereas the fifth (JBT16) may be seeded in triticale.

## 2.4. Study Field Soil Types

Two soil complexes comprise most of the area of the study fields. These complexes are the Massena-Lyons stony loams and Kingsbury-Covington clays. Kingsbury-Covington clays are the principle soils in seven of the twelve study fields. Massena-Lyon stony loams are the principle soils in four fields. The remaining field, JBT19, has a roughly equal acreage in both soil complexes.

Massena-Lyons soils are deep, level to gently sloping, somewhat poorly drained and poorly drained, loamy soils in depressional areas (Flynn and Joslin 1979). These soils formed in glacial till. The Massena soils are at a slightly higher position in the landscape than the Lyons soils. Both soils have a seasonal high water table. Without drainage, crop production on Massena-Lyons soils may be limited by wetness and a high water table.

Clays in the Kingsbury-Covington complex are deep and somewhat poorly drained to poorly drained (Flynn and Joslin 1979). They formed in water laid deposits of clay on old lake plains. Kingsbury soils are at a higher position in the landscape than Covington soils. Both soils have a seasonal high water table. Without drainage, crop production on Kingsbury-Covington soils may be limited by wetness due to their slow permeability.

Georgia stony loam is also a significant soil in several of the study fields. Georgia stony loam comprises 31 percent of field JBT11, 17 percent of JBT18, 10 percent of JBT05, and lesser percentages of fields JBT06 and JBT16. Georgia stony loams are deep and moderately well drained, in contrast to the other dominant soils among the study fields (Flynn and Joslin 1979). They are stony or extremely stony and they formed in glaciated uplands in western Franklin County.

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## 2.5. Soil Test Phosphorus Levels in Study Fields

At this time, we lack sufficient soil test phosphorus data for the study fields to make any generalizations or comparisons.

## 2.6. Manure and Fertilizer Applications in Study Fields

In 2016, the manure and fertilizer application methods of the six participating farmers on the study fields differed dramatically. Manure application methods on the cornfields included fall surface application (JBT07), fall incorporation (JBT16), fall injection (JBT05 and JBT06), and spring application at planting (JBT13 and JBT14). No manure was applied to JBT01, JBT02, or JBT04. A small amount of “pop-up” or starter fertilizer containing P was applied at planting on all the cornfields except JBT13 and JBT14.

On the three hay fields, no commercial fertilizer containing P was applied. Manure was applied to the two clover hay fields, JBT18 and JBT19, in mid-May. Field JBT11 apparently received no P in any form.

The only change anticipated in manure and fertilizer applications for 2017 is that composted chicken manure will be applied to fields JBT18 and JBT19. Actual manure and fertilizer applications in 2017 will be documented for inclusion in the final report and in the agronomic factors association analysis.



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## 3. References

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Flynn, D.J. and R.V. Joslin. 1979. Soil Survey of Franklin County, Vermont. USDA Soil Conservation Service.