

# **Water Quality Monitoring in the Upper Winooski River Headwaters**

## **2019**

**Total phosphorus in the streams of Cabot-Marshfield-Plainfield after rain events**



Twinfield students learning about riparian buffers before planting trees along the Winooski River in Marshfield

**The Friends of the Winooski River in cooperation with  
the Headwaters Community Partnership  
with support from the LaRosa Grants Program**

**Prepared by Shawn White for  
The Vermont Department of Environmental Conservation  
January 2019**



## Water Quality Monitoring by the Winooski Headwaters Partnership

The Winooski Headwaters Partnership is composed of the Conservation Commissions of Plainfield, Marshfield, and Cabot; the Friends of the Winooski River; and community members of Headwaters towns. The Headwaters Partnership has been conducting water quality monitoring of the Winooski River and several of its tributaries since 2007. Parameters of interest have included *E. coli*, total phosphorus, total nitrogen, turbidity, chloride, and alkalinity. Monitoring sites have been chosen based on recreational contact, suspected pollutant sources, locations of waste water treatment plants, and a population of a Vermont listed threatened species. The following report describes the results of the Headwaters Partnership 2019 monitoring. For 2019, the Partnership focused on rain event sampling in order to learn more about how stormwater run-off is affecting local tributaries and the Winooski River mainstem.

### Methods

Total phosphorus samples were collected by Headwaters Partnership volunteers on four dates, all of which corresponded to rainfall events: 7/13/2019, 8/9/2019, 8/17/2019, and 9/12/2019. On 7/13, samples were only collected from tributaries, not the mainstem. Due to volunteer availability, the Cabot sites were sampled on the 8/9 rain date, while the Marshfield/Plainfield sites were sampled on 8/17. All sites except GB0.1 were sampled on 9/12.

A total of fifteen sites were sampled. Five sites were on the Winooski mainstem: two bracketing the village of Cabot (WIN86.9 and WIN85.5), one in Cabot flats (WIN83.8), one at site where a population of *M. margaritifera* are located (WIN72.8), and one downstream from the village of Plainfield (WIN70.7). Ten sites on eight Winooski River tributaries were also sampled: Great Brook (GB0.1), Wells Brook (WB01.), Nasmith Brook (NAB0.8), Beaver Meadow Brook (BMB0.2), Creamery Brook (CB0.1), Jug Brook (JB0.1), Cabot Recreation Field Tributary (RECFIELDTRIB0.1 and RECFIELDTRIB1.4), and Goat Farm Tributary (GFT0.1 and GFT0.6).

Maps and descriptions of the sampling site locations, including lats and longs are shown in **Appendix A**. Samples were collected in-stream via a grab method. Volunteers collecting samples were experienced samplers who had received a refresher training to review sampling procedures. Total phosphorus samples were analyzed at the Vermont Department of Environmental Conservation La Rosa laboratory by laboratory staff. Individual sample results, including the results for duplicate and blank samples, are listed in **Appendices B** and **C**. Quality assurance measures (duplicate sample relative percent differences) and control blank met target values in all cases.

## Results and Discussion

Rain events are difficult to sample since samplers have to be ready to visit their sampling sites without much notice. Since the samplers in the Headwaters program are volunteers that have other obligations, rain events had to be “called” based on weather forecasts well before the rain started. Because of this, two of the rain events sampled in 2019 were lackluster storms that did not produce the expected precipitation. Total precipitation for the rain events ranged from 0.2 inches to 0.71 inches (**Table 1**). Figure 1 shows Winooski River discharge on the sampling dates at the nearest Winooski River USGS station (downstream of Montpelier and its confluence with the North Branch River). Flow levels can be designated as high, medium, or low as compared to historical flow levels. Those levels that fall into the lowest quartile (<25%) of all flows are defined as low, those that fall in the middle two quartiles are medium, and those in the highest quartile (>75%) are high. Based on historical data from this stream gauge, all flow levels on these rain dates would be considered medium except for the flow level on 8/17, which would be considered low.

**Table 1.** Precipitation amounts (in inches) at Cabot 2.3 SW, VT weather station associated with the rain events sampled. Data was downloaded from the National Center for Environmental Information Climate Data Online service (<https://www.ncdc.noaa.gov/cdo-web/>)

Date	Rainfall on sampling date	rainfall on the day prior to sampling
7/13/2019	0.1	0.35
8/9/2019	0.71	(not available)
8/17/2019	0.18	0.02
9/12/2019	0	0.2

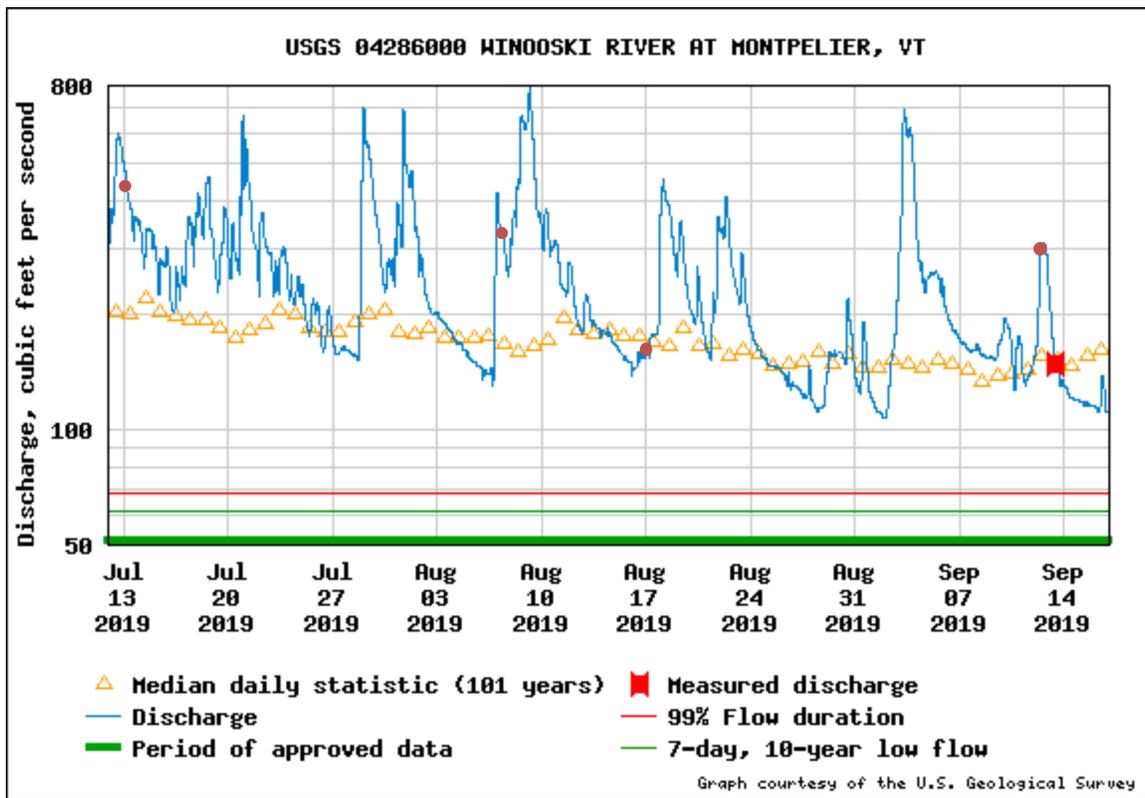


Figure 1. Discharge in the Winooski River at the nearest USGS station to the headwaters sampling sites. Red dots show the discharge on the sampling dates. USGS annual discharge statistics for this gauge in cuft/s: Min=17.0, 25<sup>th</sup> % = 198.0, Mean = 618.24, 75<sup>th</sup> % = 693.0, Max = 12,200 as retrieved from: [https://waterwatch.usgs.gov/index.php?sno=Winooski+&ds=dv01d\\_por&btnGo=GO&m=sitempnn](https://waterwatch.usgs.gov/index.php?sno=Winooski+&ds=dv01d_por&btnGo=GO&m=sitempnn)) on April 3, 2020.

Total Phosphorus, rain events

Total phosphorus (TP) levels in samples collected on the rain event sampling dates are shown in Figure 2. Levels ranged from 7 ug/l at the mouths of the unnamed tributary at Cabot Rec Fields (RECFIELD0.1), Creamery Brook (CB0.1), and Wells Brook (WB0.1) sites to ~50ug/l for three mainstem Winooski River sites (WIN72.8 and WIN70.7). While the highest rainfall and highest discharge levels (in Montpelier) were associated with the July 13 and August 9 sampling dates, the highest phosphorus levels were observed on Aug 9 and Aug 17, while the lowest levels were observed on September 12. The July 13 and Aug 9 samplings occurred after peak flow, and the Aug 17 and Sept 12 sampling occurred while flow was still rising.

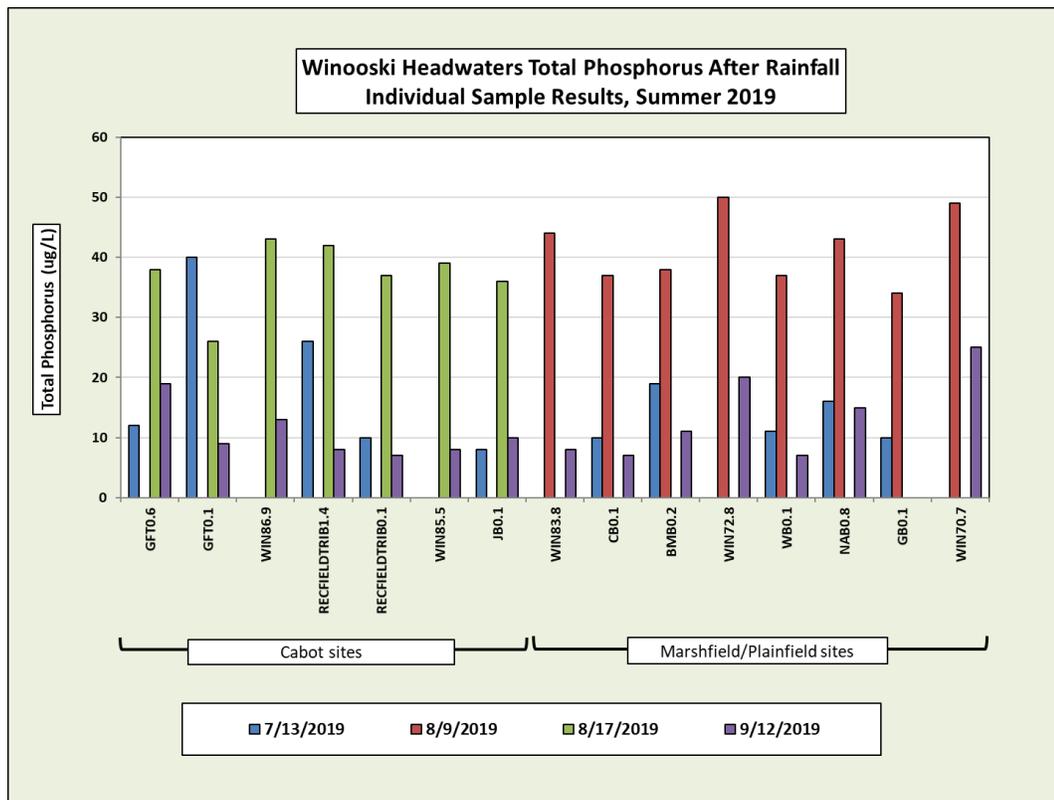


Figure 2. Total phosphorus levels at 15 sites on the Winooski River and its tributaries in the upper Winooski watershed on four rain-event sampling dates.

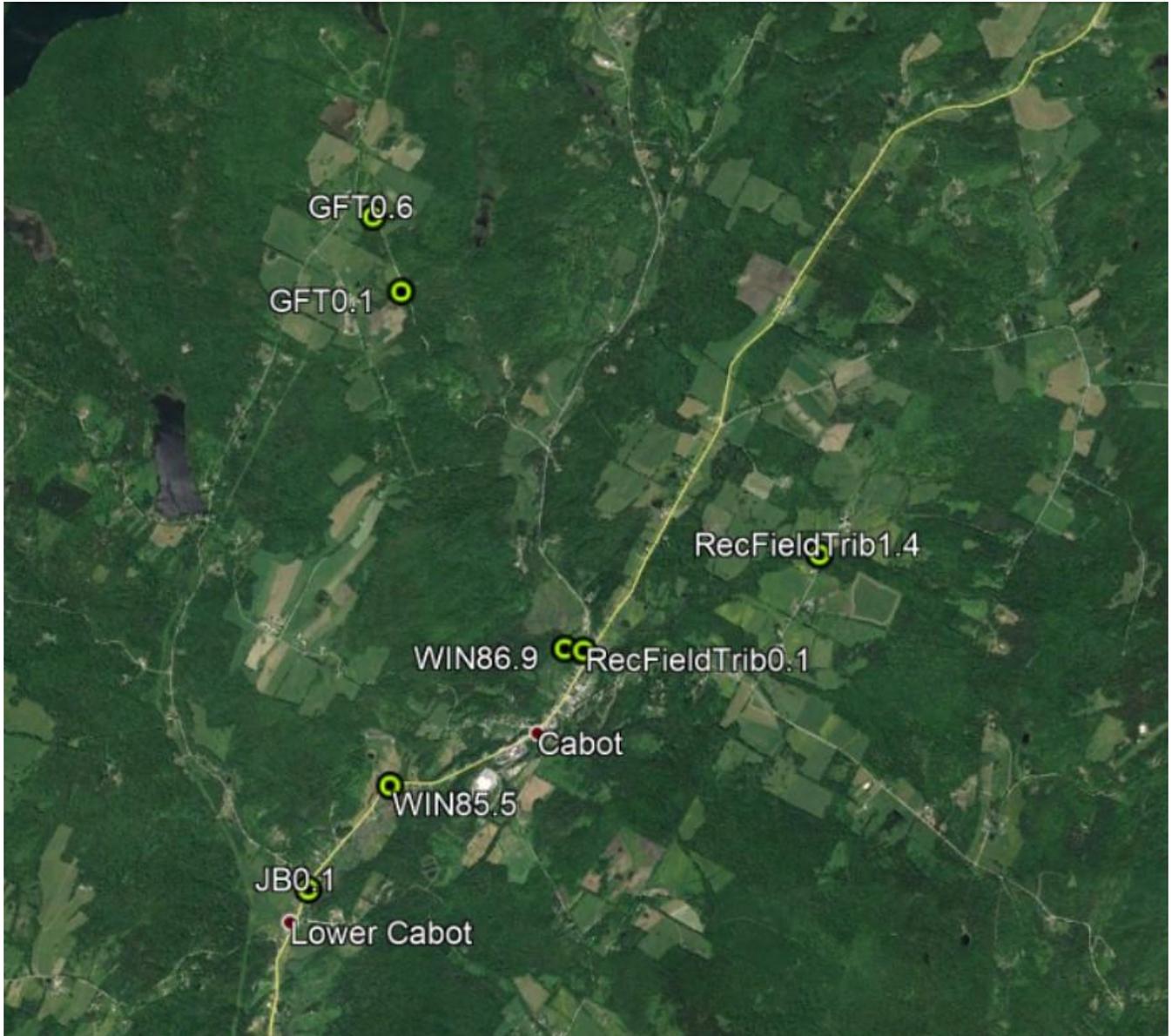
In 2018, rain event sampling revealed that Goat Farm and Rec Fields Trib in Cabot seemed to be exporting high levels of phosphorus (206 to 590 ug/L) during some (but not all) rain events. These extreme levels were not observed in 2019 on either stream. It is unclear whether problems on these streams have been resolved, or whether the 2019 sampling conditions were not conducive to revealing phosphorus sources. Given that associated flow levels at the Montpelier USGS stream gauge were either medium or low on the sampling dates, and that samplers generally reported moderate flows, we believe rainfall amounts and flows were not high enough to reveal the problems seen in 2018.

## Appendix A. Site Descriptions and Maps

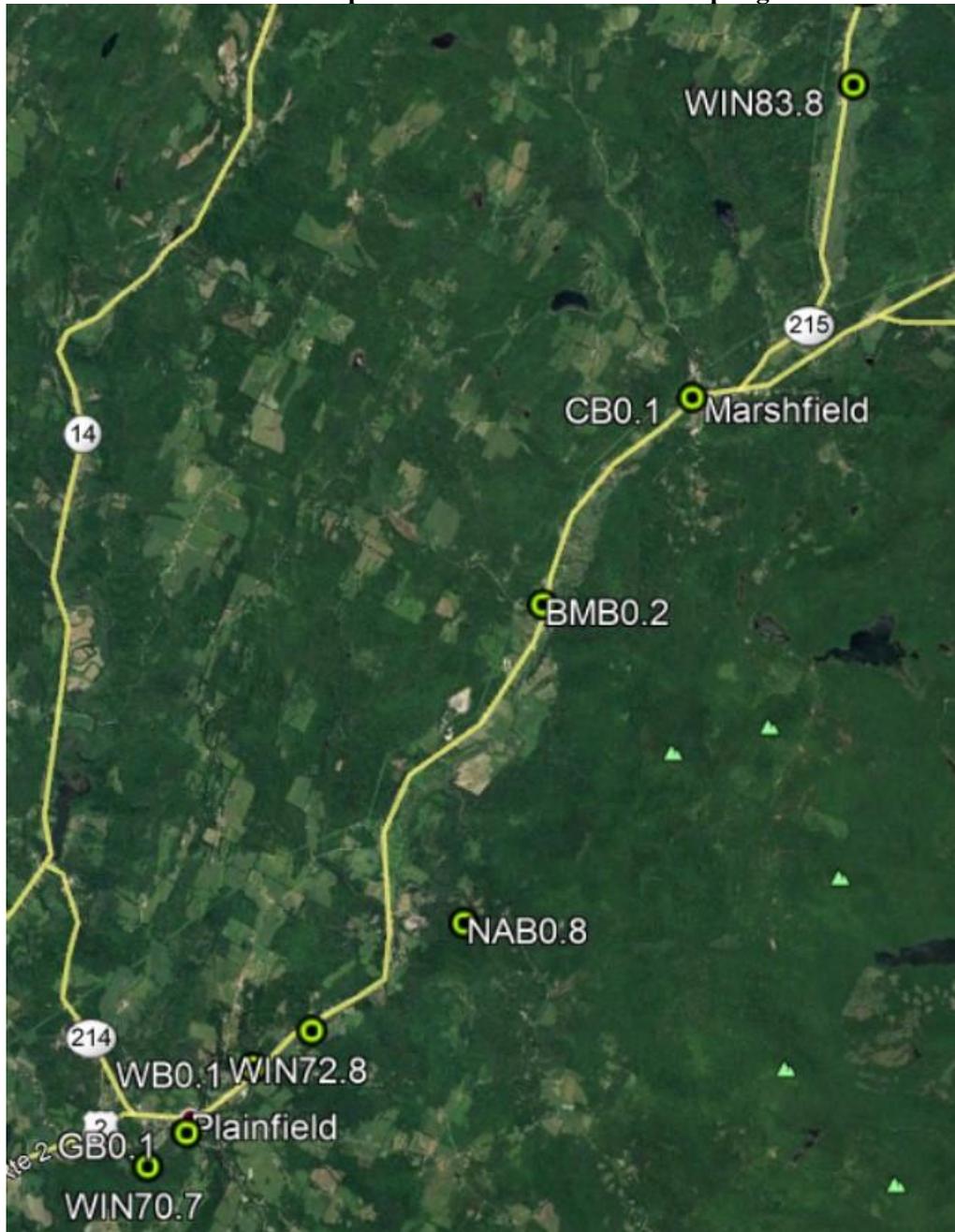
Upper Winooski Headwaters water quality monitoring sites in 2019 (15 total). Main stem sites are in **bold** and are listed upstream to downstream. Tributaries are listed as they enter main stem.

<b>Stream</b>	<b>Site ID</b>	<b>Lat</b>	<b>Long</b>	<b>Description</b>
<b>Winooski River</b>	WIN 86.9	44.40651	72.30995	Above Cabot Plains Brook, adjacent to Cabot Rec Fields
Goat Farm Trib	GFT 0.1	44.42794	72.32381	Above Houston Hill Road lower site
Goat Farm Trib	GFT 0.6	44.43248	72.32624	Below Houston Hill road upper site
Rec Field Trib	RECFIELD TRIB0.1	44.4064	72.3084	Rec Field trib. Adjacent to Cabot rec fields
Rec Field Trib	RECFIELD TRIB1.4	44.41203	72.2888	Below Menard Road
<b>Winooski River</b>	WIN85.5	44.3984	72.3244	Winooski R by Larry's Ball field below Cabot village
Jug Brook	JB0.1	44.3923	72.331	Jug Brook immediately below Rt 215 in lower Cabot
<b>Winooski River</b>	WIN83.8	44.3829	72.3325	Winooski at storage bldg in Durrant Cemetery bl WWTF
Creamery Brook	CB 0.1	44.35129	72.35524	Creamery Brook at Rt 2 crossing
Beaver Meadow	BMB 0.2	44.33032	72.37639	Beaver Meadow Brook above first town bridge.
Nasmith Brook	NAB0.8	44.29811	72.387455	At Paradise swimming hole, below RR bed
Wells Brook	WB0.1	44.28341	72.41726	Wells Brook at Rt 2 crossing, Mouth
<b>Winooski River</b>	WIN72.8	44.2871	72.409	Winooski R @ Martin Bridge in Marshfield;
Great Brook	GB0.1	44.2767	72.4267	Great Brook just above confluence with Winooski
<b>Winooski River</b>	WIN70.7	44.1624	72.2556	Winooski R below the Plainfield WWTF.

Headwaters Partnership Cabot, VT Sampling Sites for 2019



Headwaters Partnership Marshfield & Plainfield Sampling Sites 2019



**Appendix B:** 2019 total phosphorus concentration results for each site and date. RPD= relative percent difference between duplicate samples collected same date at a site. Data set includes 10% duplicate samples for quality control. Blanks were also collected along with duplicates on two dates, but missing on 9/12 and either contaminated or another duplicate sample on 8/17.

Lab ID	Sample ID	Collected On (Date, Time)	Total phosphorus (ug/L)	Flow Level from field sheets	RPD (%)	Precision for Field Duplicates (RPD)
1900700-007	BMB0.2	07/13/19 09:50:	19	not recorded		≤30%
1900763-010	BMB0.2	08/09/19 10:56:	38	medium		
1900765-010	BMB0.2	09/12/19 00:00:	11	medium		
1900765-016	BMB0.2-BLANK	09/12/19 00:00:	<5	medium		
1900765-015	BMB0.2-DUP	09/12/19 00:00:	10	medium	9.5	
1900700-006	CB0.1	07/13/19 09:35:	10	medium		
1900763-009	CB0.1	08/09/19 10:45:	37	medium		
1900765-009	CB0.1	09/12/19 00:00:	7	medium		
1900700-010	GB0.1	07/13/19 09:25:	10	high		
1900763-014	GB0.1	08/09/19 11:49:	34	not recorded		
1900700-012	GB0.1-BLANK	07/13/19 09:25:	<5	high		
1900700-011	GB0.1-DUP	07/13/19 09:25:	10	high	0	≤30%
1900700-001	GFT0.1	07/13/19 10:30:	40	high		
1900763-001	GFT0.1	08/17/19 08:30:	26	medium		
1900765-001	GFT0.1	09/12/19 00:00:	9	medium		
1900700-002	GFT0.6	07/13/19 10:35:	12	medium		
1900763-002	GFT0.6	08/17/19 08:50:	38	medium		
1900765-002	GFT0.6	09/12/19 00:00:	19	medium		
1900700-005	JB0.1	07/13/19 11:05:	8	medium		
1900763-007	JB0.1	08/17/19 10:20:	36	medium		
1900765-007	JB0.1	09/12/19 00:00:	10	medium		
1900700-008	NAB0.8	07/13/19 09:10:	16	high		
1900763-011	NAB0.8	08/09/19 11:04:	43	medium		
1900765-012	NAB0.8	09/12/19 00:00:	15	medium		
1900700-003	RECFIELDTRIB0.1	07/13/19 11:00:	10	medium		
1900763-004	RECFIELDTRIB0.1	08/17/19 09:00:	37	low		
1900765-004	RECFIELDTRIB0.1	09/12/19 00:00:	7	low		
1900700-004	RECFIELDTRIB1.4	07/13/19 10:45:	26	medium		
1900763-005	RECFIELDTRIB1.4	08/17/19 04:45:	42	medium		
1900765-005	RECFIELDTRIB1.4	09/12/19 00:00:	8	medium		
1900765-018	RECFIELDTRIB1.4-DUP	09/12/19 00:00:	8	medium	0	≤30%
1900700-009	WB0.1	07/13/19 09:15:	11	medium		
1900763-013	WB0.1	08/09/19 11:30:	37	medium		
1900765-013	WB0.1	09/12/19 00:00:	7	medium		
1900763-015	WIN70.7	08/09/19 12:00:	49	medium		
1900765-014	WIN70.7	09/12/19 00:00:	25	high		
1900763-012	WIN72.8	08/09/19 11:25:	50	medium		
1900765-011	WIN72.8	09/12/19 00:00:	20	high		

1900763-008	WIN83.8	08/09/19 10:30:	44	medium		
1900765-008	WIN83.8	09/12/19 00:00:	8	medium		
1900763-006	WIN85.5	08/17/19 10:10:	39	medium		
1900765-006	WIN85.5	09/12/19 00:00:	8	medium		
1900763-003	WIN86.9	08/17/19 09:00:	43	medium		
1900765-003	WIN86.9	09/12/19 00:00:	13	low		
1900763-017	WIN86.9-BLANK	08/17/19 09:00:	31*	medium		
1900763-016	WIN86.9-DUP	08/17/19 09:00:	42	medium	2.4	≤30%

\*The value of this blank is similar to the duplicates, and so is probably another duplicate mistakenly collected by the sampler.