UPPER OTTER CREEK WATERSHED COUNCIL
SUMMER 2004 WATER QUALITY MONITORING PROGRAM

Submitted by
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VT Department of Environmental Conservation
103 S. Main 10N Waterbury VT 05671-0408

2004 Upper Otter Creek Water Quality Monitoring Results

Sample Locations

All sampling sites monitored for this project were located in and around Rutland on significant tributaries to the Otter Creek. These waters are those that have been identified in the *2004EPA 303(d) List* as waters either consistently not meeting Vermont Water Quality Standards (2000) or waters in need of further assessment. The following table lists all of the sites monitored in 2004 and their location in the watershed.

Table 1: Sample names and locations for Upper Otter Creek Watershed Council summer 2004 water quality monitoring project.

Site	Location
Moon01	Moon Brook, adjacent to an old landfill (VT DEC has interest in measuring this site).
Moon02	Moon Brook at the recreation area off of B Street, about 0.3 miles above Rte 7.
Moon03	Moon Brook, below the Forest Street bridge.
Muss04	Mussey Creek, upstream from the Park Street bridge.
Clar05	On the Clarendon, about 50’ upstream of the confluence with Ira Brook.
Clar06	Clarendon River, 0.6 miles by road downstream from Ira Brook confluence.
East07	East Creek at the Meadow Street recreation area downstream of the CSO.
East08	East Creek, south of State Street and north of the railroad trestle.
East09	East Creek, upstream of McKinley Avenue bridge.
Tenn10	Tenney Brook, below Rte 7 in Rotary Park.
Tenn11	Tenney Brook, off of Rte 4 at northeast end of the Home Depot parking lot.
Mend12	Mendon Brook, Located 0.2 mi off Rte 4 on the west side of Meadowlake Rd, downstream of the bridge and above the intake for the Rutland Reservoir.

Methodology

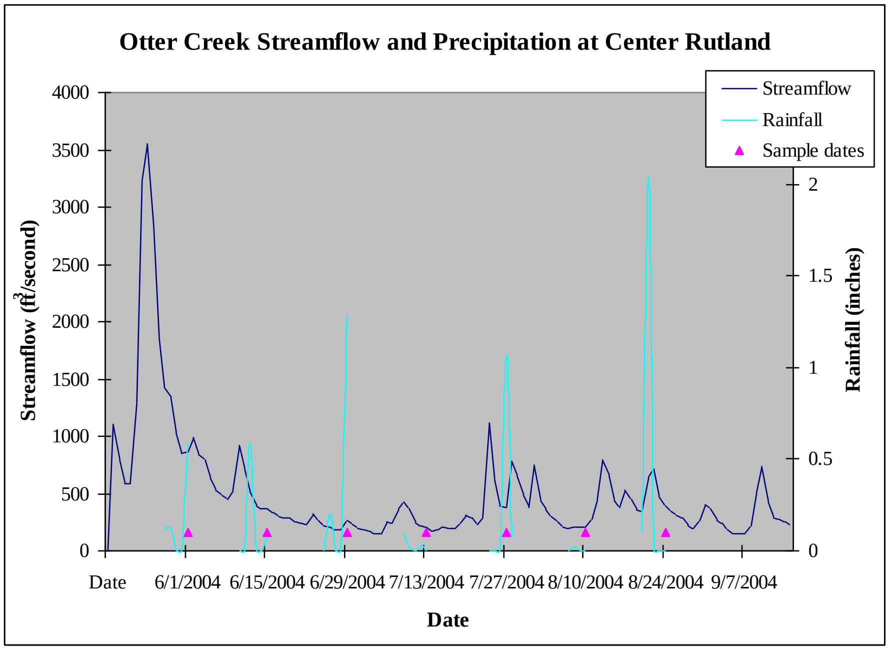
UOCWC followed all training, sample collection and sample transport protocols outlined in their June 2004 QAPP. The training schedule can be found in Appendix A.

Samples were collected at the above twelve locations at seven dates (every other Tuesday morning between June 1 and August 24, 2004) throughout the summer. Over 97% of the proposed samples were collected and analyzed. Most of the proposed QA/QC samples (field blanks, field duplicates and an extra phosphorus sample per batch for the matrix spike) were collected and are listed in Appendix B.

Results

Streamflow Data

Chart 1: Streamflow and precipitation data measured at the USGS gage station below Rutland Falls, Center Rutland.

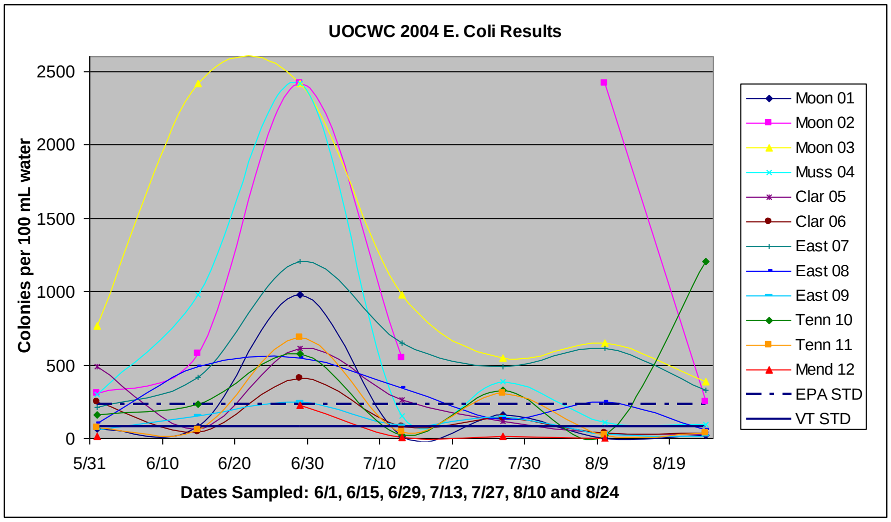


The above chart shows streamflow for the Otter Creek at Center Rutland between the dates of May 15 and September 15, 2004. The highest flow for this period occurred between May 29 and June 5. The samples collected during the first sample date should reflect these high streamflow conditions. In addition, it rained just over 0.5 inches in Rutland on June 1 and again on June 12, potentially causing contaminants to be carried in runoff on these dates. On June 29, when we correspondingly see some of our highest contaminant peaks, it rained almost 1.3 inches. There was very little precipitation preceding the July 13 or August 10 sampling dates. On July 27, it rained over an inch and on August 21 it rained over 2 inches, though there was no more rain in the days preceding the August 24 sampling date.

On a cautionary note, peaks seen in streamflow conditions in the Otter may appear less dramatic than changes seen on smaller tributaries and/or peak river flow may be delayed as compared to smaller tributaries located in steeper areas with shallower soils. In other words, sampling results from tributaries to the Otter may reflect storm-related conditions with increased nonpoint source (NPS) pollution from overland flow, though the Otter gauging station shows only a moderate or even a delayed peak. This may be true for the sample results collected on June 29, after a short, but heavy rain event. The results for these samples consistently showed high pollution results, though the streamflow data above does not indicate a significant peak in streamflow. The peaks in August on the Otter, for example, appear less significant than the peaks seen for the smaller Poultney River for this same time period.

E. Coli (Escherichia coli)

Chart 2: E. Coli results for Upper Otter Creek



E. coli counts measure one type of fecal coliform bacteria found in the digestive tracts of human and other warm-blooded animals. High *E. coli* levels indicate that fecal waste is being carried over land or through groundwater into streams. People exposed to fecal wastes of sick individuals can develop serious diseases or other health consequences. US EPA sets its recommended limits for *E. coli* levels in waters where swimming may occur at 235 colonies per 100mL of water, while the Vermont DEC sets their recommended limit for class B waters (current classification for most of the sites monitored) at 77 colonies per 100 ml of water.

E. coli results for Moon Brook (Moon02 and Moon03), Mussey Brook (Muss04) and East Creek near the Combined Sewer Overflow (CSO) (East07) were chronically high during the 2004 sampling season. The Clarendon River (Clar05 and Clar06), East Creek upstream of the CSO (East08), Moon Brook near the landfill (Moon01) and the Tenney Brook (Tenn10 and Tenn11) had high *E. coli* results during rain events, indicating that they receive *E. coli* pathogens via overland flow. Several sites remained relatively high during the two sampling dates, July13 and August 10, not associated with rain events. These include the lower sections of the Moon Brook (Moon02 and Moon03) East Creek near the CSO (East07) and to some degree East08 and Clar05. High *E. coli* levels during low-flow periods may indicate that these streams have some pathogenic bacteria contributions via groundwater sources such as failing septic systems in the area.

All of the creeks in the study area, except the site on the Mendon Brook, exceeded the Vermont Water Quality Standards multiple times and the US EPA standards at least once. Many creeks had multiple exceedances of state and federal standards. The Mendon Brook site, located above the intake for Rutland's drinking water facility consistently showed the lowest *E. coli* measurements in the study area.

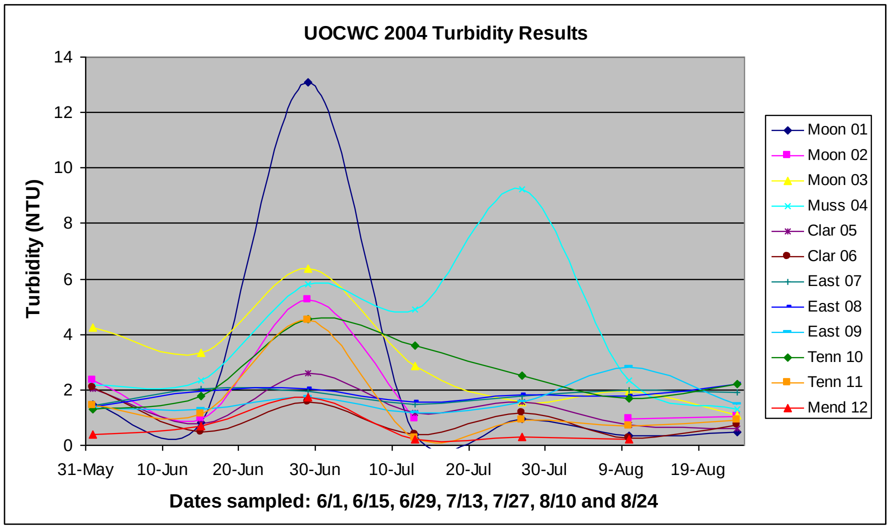
Turbidity and Suspended Solids

The amount of turbidity and/or total suspended solids (TSS) found in water serves to determine its relative clarity. Suspended solids in the water create turbid (murky) conditions and reduce the transmission of light. Suspended solids are varied, ranging from clay, silt and plankton, to industrial wastes and sewage.

Water containing high levels of sediment, loses its ability to support a diversity of aquatic organisms, becoming warmer as suspended particles absorb heat from the sunlight and cause depleted oxygen concentrations. Photosynthesis decreases because less light penetrates the water, resulting in even further drops in oxygen levels. The combination of warmer water, less light and oxygen depletion may make it impossible for some forms of aquatic life to survive.

Suspended solids affect aquatic life in other ways as well. Suspended solids can clog fish gills, reduce growth rates, decrease resistance to disease and prevent egg and larval development. Particles of silt, clay and organic materials settle to the bottom, especially in areas of a river or stream that are slow moving. These settled particles could smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Material that settles into the spaces between rocks makes these microhabitats unsuitable for mayfly and stonefly nymphs, caddisfly larvae and other aquatic insects living there (Above information from Richards, West River Report, 2004).

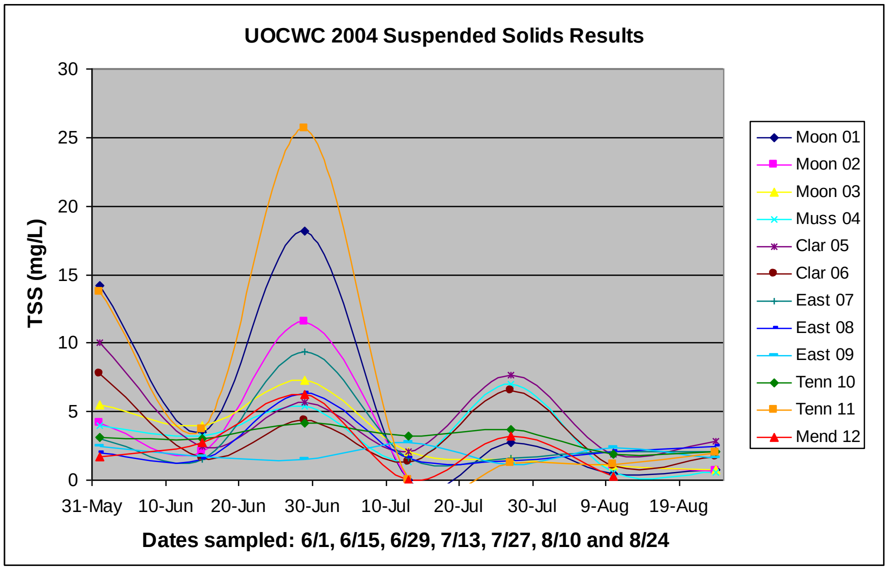
Chart 3: Turbidity Results for Upper Otter Creek



Turbidity is a measure of sediment levels in the water. High turbidity is often associated with sediments carried in stormwater runoff, though anthropogenic sources such as water from car washing, cleaning of sidewalks or buildings and leaking septic systems can cause increases in turbidity when runoff is low. Many of the creeks showed high turbidity results after the rain event on June 29. The Moon Brook site near the old landfill had extremely high turbidity results on this date. The lower Moon Brook (Moon03), the Mussey (Muss04) and Tenney Brook near Home Depot (Tenn10) tended to have relatively high turbidity results throughout the study period.

Total Suspended Solids

Chart 4: Total suspended solids results for Upper Otter Creek

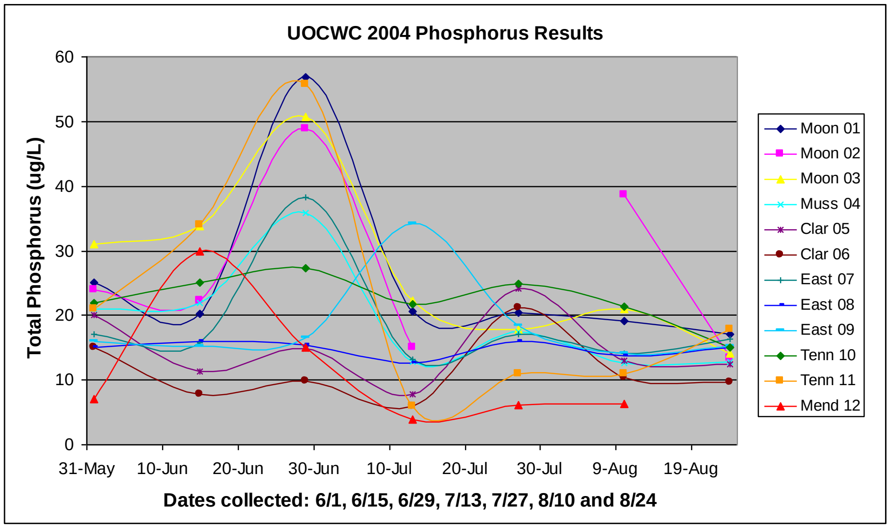


The total suspended solids results for Upper Otter Creek monitoring locations clearly demonstrated a link between high levels of sediment in the water and the occurrence of storm-related, overland runoff. Sites on the Moon Brook and Tenney Creek showed relatively high TSS results early in the summer, while the Mussey and Clarendon showed relatively high TSS levels late in the summer.

Total Phosphorus

Nitrogen and phosphorus are nutrients that, when above their natural levels in the environment can change the local ecologic balance. Phosphorus is often the nutrient that limits the amount of aquatic plant growth in our waterbodies. Excess phosphorus in water, thus, often contributes to the growth of algae and other plants. This accelerated plant growth may eventually damage stream ecosystems by changing the balance of plants growing, causing algal blooms and by draining the oxygen levels in the water when the plants decompose. Phosphorus is often introduced into the environment through human activities such as improper waste management, over-application of fertilizers, certain industrial wastes and human disturbance of the land and its vegetation. Phosphorus binds with soil and is often carried into streams during storms when TSS levels are high. Under certain conditions, phosphorus may disassociate from the soil and dissolve in the water column, where it may become biologically available for many seasons.

Chart 5: Total phosphorus results for Upper Otter Creek



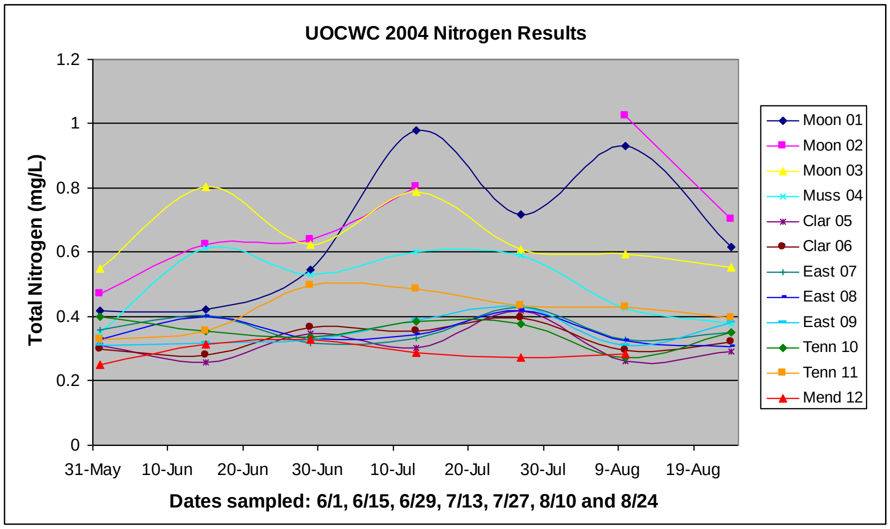
According to Vermont DEC Watershed Coordinator, Ethan Swift, there is no Vermont State numerical standard for total phosphorus concentrations in rivers and streams. The General Policy states that "in all water, total phosphorous loadings shall be limited so that they will not contribute to the acceleration of eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents the full support of uses." River Network information (Testing the Waters, Shannon Behar) states that phosphorous concentrations of 0.01 mg/L (10µg/L) or less may have measurable impact on nutrient poor upland streams, while larger rivers could be impacted when concentrations near 0.1 mg/L (100 µg/L). The phosphorus goal set by the Lake Champlain Basin Program for the Otter Creek outfall is 140 ug/L. While all of the results from this monitoring effort were below this level, Wetzel (Limnology) recommends that creeks draining to lakes not exceed 50 ug/L.

Our monitoring results were generally higher during storm events, though the Mussey showed a peak during a low-flow period. As with the E. coli, high phosphorus levels during dry periods may indicate failing septic systems as its source. The Mussey is an urban stream and may receive fertilizer in runoff from gardens and lawns.

Total Nitrogen

Pollutants such as sewage or manure contain high levels of nitrogen. Nitrogen may travel to groundwater or streams from fertilized fields, lawns, and golf courses, from septic system effluent or from runoff of manure.

Chart 6: Total nitrogen results for Upper Otter Creek



The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L); in the effluent of wastewater treatment plants, it can range up to 30 mg/L. The Vermont Water Quality Standard for Class B waters states that $N0_3$-N concentrations shall not exceed 5.0 mg/L during certain flow conditions. The UOCWC measured total nitrogen in the water. Total nitrogen includes all of the commonly-found forms of nitrogen in the environment. The nitrate concentration listed above does not apply to the type of nitrogen that we measured. All locations along the Moon Brook and the Mussey Brook had higher nitrogen levels than the other monitored sites. The Tenney Brook site in Lincoln Park showed moderately high nitrogen levels, as well.

Conclusions

In conclusion, the Moon Brook and the Mussey Brook showed consistently high nutrient, sediment and *E. coli* levels. Much of this pollution is carried to these urban creeks in stormwater. The City of Rutland has applied for a grant to build settling tanks within the stormwater conveyance system in the city. The UOCWC has partnered with the City to provide education and outreach about the program and how residents of Rutland can help keep pollutants out of the stormwater entering creeks.

Next year's proposal for water quality monitoring does not include the Clarendon River sites and proposes to only sample the Tenney Brook and Mendon Brook sites on a revolving basis. The Smokey House Center has agreed to partner with the UOCWC to collect water quality samples in the Danby area of the watershed. New sites will include a headwater site on the Wheatherby Brook, several sites bracketing farms, and a site on the Otter Creek at the confluence with Mill Brook in Danby. Additionally, the Wallingford Conservation Commissionttee has offered to sample several location in Wallingford along the Otter. These locations are up- and downstream from the Wallingford WWTFP.

The UOCWC has decided to add additional Otter Creek sites on Mill Brook and the mainstem of the Otter Creek.in? Other recommendations for next year's sampling include trying to sample directly after storm events, using rain gage data from Center Rutland and the Smokey House Center, creating a database that combines all data collected to date (chemical, buffer and geomorphic) and finally a way to quickly report E. coli results to the public.

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Appendix A

UOCWC 2004 Sample Collection Training Schedule

Sample Coordinator	Nanci McGuire
QA Officer	Hilary Solomon
Watershed Coordinator	Ethan Swift
3-May	UOCWC Site Location and Descriptions Ethan Swift Hilary Solomon Nanci McGuire Jennifer Durham Bob Drachman Homer Summers
30-Apr	Sample Collection and TransportationTraining at Vermont DEC Ethan Swift Hilary Solomon Bob Drachman Jennifer Durham Cindy Oas-kirk Homer Summers
26-May	UOCWC sample collection training Hilary Solomon Cindy Oas-Kirk Bob Drachman Homer Summers George Hooker Neil Jordan
	In-field Observations by QA Officer
26-May	George Hooker
13-Jul	Cindy Oas-Kirk
27-Jul	Bob and Homer
27-Jul	Mark Skakel
10-Aug	Neil Jordan

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Appendix B

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QAQC data

Table 3: Field duplicate data

Date	Site	Test	Sample	Field dups	Units	RPD
1-Jun	Moon01	E.coli	64	52	#col/100mL	21
15-Jun	Moon02	E.coli	579	411	#col/100mL	34
29-Jun	_	E.coli	2419	2419	#col/100mL	0
13-Jul	_	E.coli	152	201	#col/100mL	28
27-Jul	_	E.coli	118	199	#col/100mL	51
10-Aug	_	E.coli	40	44	#col/100mL	10
24-Aug	_	E.coli	1203	613	#col/100mL	65
1-Jun	Moon01	TN	0.42	0.38	mg/L	10
15-Jun	Moon02	TN	0.63	0.56	mg/L	12
29-Jun	_	TN	0.62	0.64	mg/L	3
13-Jul	_	TN	0.6	0.64	mg/L	6
27-Jul	_	TN	0.42	0.42	mg/L	0
10-Aug	_	TN	0.29	0.27	mg/L	7
24-Aug	_	TN	0.35	0.66	mg/L	61
1-Jun	Moon01	TP	25	28	ug/L	11
15-Jun	Moon02	TP	22.3	18.3	ug/L	20
29-Jun	_	TP	50.8	50.8	ug/L	0
13-Jul	_	TP	12.9	13.6	ug/L	5
27-Jul	_	TP	24.1	24.9	ug/L	3
10-Aug	_	TP	10.4	11.5	ug/L	10
24-Aug	_	TP	15	14.4	ug/L	4
1-Jun	Moon01	TSS	14.2	11.9	mg/L	18
15-Jun	Moon02	TSS	2.1	1.8	mg/L	15
29-Jun	_	TSS	7.3	8	mg/L	9
13-Jul	_	TSS	1.3	1.1	mg/L	17
27-Jul	_	TSS	7.6	7.5	mg/L	1
10-Aug	_	TSS	1.2	1.07	mg/L	11
24-Aug	_	TSS	2.1	2	mg/L	5
1-Jun	Moon01	Turb	1.48	1.34	NTU	10
15-Jun	Moon02	Turb	0.94	1.04	NTU	10
29-Jun	_	Turb	6.35	8.12	NTU	10
13-Jul	_	Turb	4.89	4.89	NTU	10
27-Jul	_	Turb	1.56	1.64	NTU	10
10-Aug	_	Turb	0.26	0.33	NTU	10
24-Aug	_	Turb	2.23	1.97	NTU	10

Table 4: Field Blank Data

Date	Test	Field blank	Units
1-Jun	TN	<0.1	mg/L
1-Jun	TP	<5	ug/L
1-Jun	TSS	<1	mg/L
1-Jun	Turb	0.06	NTU
15-Jun	TN	<0.1	mg/L
15-Jun	TP	0.655	ug/L
15-Jun	TSS	<1	mg/L
15-Jun	Turb	<0.2	NTU
29-Jun	TN	<0.1	mg/L
29-Jun	TP	<5?	ug/L
29-Jun	TSS	<1	mg/L
29-Jun	Turb	<0.2	NTU
13-Jul	TN	<0.1	mg/L
13-Jul	TP	0.678	ug/L
13-Jul	TSS	<1	mg/L
13-Jul	Turb	<0.2	NTU
27-Jul	TN	<0.1	mg/L
27-Jul	TP	1.36	ug/L
27-Jul	TSS	_	mg/L
27-Jul	Turb	<0.2	NTU
10-Aug	TN	<0.1	mg/L
10-Aug	TP	2.16	ug/L
10-Aug	TSS	0?	mg/L
10-Aug	Turb	<0.2	NTU
24-Aug	TN	<0.1	mg/L
24-Aug	TP	1.18	ug/L
24-Aug	TSS	<0.1	mg/L
24-Aug	Turb	<0.2	NTU