Water Quality and Chemistry Above and Below the Effluent Discharges of Twenty Wastewater Treatment Facilities in Vermont

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Background:

The treatment of wastewater became a common practice during the 19th century. Untreated water polluted waterways and spread disease. These problems occurred particularly in cities where increasingly higher concentrations of people were living and the outbreak of life-threatening diseases was traced to pathogenic bacteria in polluted water. By 1965, 21 wastewater treatment facilities had been completed in Vermont, serving 65% of the state's population. Passage of the Clean Water Act, improving technology and increased support from state and federal grants for the construction of wastewater treatment facilities resulted in more and better facilities being built during the 1960s and '70s. By 1992, Vermont was one of only two states to complete all its planned treatment facilities, offering at least a secondary level of waste treatment. Currently there are 91 municipal and 81 industrial effluent discharges in the state of Vermont. Wastewater treatment facilities (WWTF) reduce and/or remove organic matter, solids, nutrients, disease-causing organisms and other pollutants from the wastewater before it is discharged to a body of water such as a river or lake.

This report provides results from a field data collection effort designed to improve Vermont's information that is of relevance in the computation of WWTF effluent discharge limitations. Previous monitoring of WWTF effects on receiving waters in the state has focused on the biological integrity of the receiving waters to determine if there is reasonable potential for the discharge to cause or contribute to water quality violations. Water quality data used for these efforts may be limited to a single grab sample at the time of biological sampling.

Objectives:

The goals and objectives of this project are to collect quality assured water quality data under "base flow" conditions for use during the permit reauthorization process to assist the DEC in assessing the potential that each WWTF effluent has to contribute to surface water quality. The project documents water quality attributes both upstream and downstream of the discharge point at 20 chosen WWTFs with relatively high instream waste concentrations. This data will help the VTDEC incorporate effluent limits in part based on receiving water conditions for the reissuance of National Pollutant Discharge Elimination System (NPDES) permits for these 20 facilities.

Project Description:

VTDEC received supplemental funding from the USEPA under Section 106 of the Clean Water Act; this funding was used to increase the level of ambient water quality sampling and information to support the "reasonable potential to cause or contribute" analyses in the NPDES permit renewal process. Data was

collected during the late summer and fall of 2010 by VTDEC, which conducted dedicated upstream and downstream water quality assessments at each of 20 WWTF **(Table 1)** due for permit reauthorization within the next three years. The selection of sites took into account four prioritization ranking factors: 1- the location of the facility within the 2010 or 2011 rotational water quality planning basins, 2- the permit reauthorization date, 3- the prior availability of proximal monitoring data, and 4- the facility priority as established in the Vermont Toxic Discharge Control Strategy (TDCS).

The goal of the Vermont TDCS, implemented by VTDEC, is to quantify the toxicity potential of all National Pollutant Discharge Elimination System (NPDES) discharges in the state, assist in developing numerical water quality criteria and establishing discharge permit limits used to regulate discharges in a manner that will assure that the state water quality standards and receiving water classification goals are met. The Wastewater Management Division (WWMD) Direct Discharge Permit Section administers the NPDES permit program under federal delegation for discharges from individual, municipal, and industrial wastewater treatment facilities to state surface waters. Discharge permit limits are determined using a three tiered effluent characterization for assessing the toxic nature of discharge effluents.

One component of the prioritization ranking is based on the calculated in-stream waste concentration (IWC), calculated at effluent flow of average daily design (ADDF), and receiving water flow of 7Q10 (lowest 7-day average flow that occurs once every 10 years). **Table 2** provides the WWTF design flows and hydrology of the receiving waters. Tier I screening, conducted by the VTDEC, serves as an initial screening of all existing discharges to waters of the state resulting in a priority ranking of all VT NPDES permitted discharges based on the potential to discharge toxic substances in toxic amounts.

The subsequent two tiers, II and III, can be characterized as definitive data generating tiers which refine and expand upon data generated by the preceding tier. Tier II may be conducted by the VTDEC or the discharger/permitee. Tier III is undertaken by the discharger to decrease uncertainty associated with the development of characterization data. The tier structure of the effluent characterization process is thought to be the most cost-effective means available to the Department to assess the toxic nature of discharge effluents, since the process is designed to suspend data collection once adequate effluent characterization data has been generated to determine the need for water-quality based permit limits.

Collection and Analytical Methods:

Twenty WWTF receiving waters were sampled upstream and downstream of their effluent outfall. Three water quality sampling events were conducted approximately tri-weekly, during periods of low-median monthly flow (LMMF). Most sampled facilities discharged to wadeable receiving waters. Samples were collected using manual grab technique during field visits, while a few non-wadeable stream water quality samples (i.e. lower Winooski River) were collected by manual grab from a canoe at the middle of the river. Water samples were analyzed for pH, dissolved oxygen, turbidity, alkalinity, conductivity, color, chlorides, sulfates, and nutrients, total phosphorus (TP), dissolved phosphorus (TDP), total nitrogen (TN), nitrate + nitrite (NOX) and ammonia (NH3). Water samples were also tested for the following total metals: calcium, magnesium, sodium, potassium, aluminum, antimony, arsenic, beryllium, cadmium chromium, copper, manganese, nickel, iron, lead, selenium, silver, thallium, zinc and total hardness (VTDEC Biological Assessments of Running Waters in Vermont Quality Assurance Project Plan 2010).

Measurement performance criteria were calculated following methods provided by the VTDEC Laboratory's Quality Assurance Plan (VTDEC 2011). Precision was assessed based on calculated relative percent differences (RPD) of field and laboratory duplicates. Accuracy was assessed based on calculated percent matrix spike recoveries or bias for analytical analyses. Representativeness was assured by sampling the same segment of each river under similar climatic conditions. The Quality Assurance Plan referenced above provides specific details.

Coordinates and river mile (distance from mouth) for each site and outfall locations and sites that had bioassessments conducted during this study are shown in **Table 1**, approximate locations are illustrated in **Figure 1**. The most proximal USGS gauge was used to determine suitability of flows for monitoring. Sample collection sites were established at the most logistically feasible locations upstream and downstream of the outfall, and at previously established biological monitoring points if exist. If possible the downstream sites were located below the "mixing zone", which is established in the VT WQS as 200 feet below the discharge point and at locations where no additional influences were expected, and where complete downstream mixing was likely. If complete mixing was not achieved at the optimal sampling location 200 feet below the outfall, the site was relocated further downstream below a riffle or rapid where the effluent discharge and receiving stream water had fully mixed.

Table 1: Sampling Locations of the 20 Wastewater Treatment Facilities -Above, Below and Outfall (latitude and longitude are in decimal degrees, NAD83) also indicated are the 2010 bioassessments.

Wastewater Treatment Facility	Receiving Water and River Mile (RM)	Latitude	Longitude	Bioassessment
Barre Above	Steven's Branch 3.3	44.21056	72.51813	Yes
Barre Below	Steven's Branch 2.8	44.21188	72.52542	Yes
Barre Outfall		44.210498	72.52110	
Burlington - North Above	Winooski River 2.3	44.52755	73.26740	No
Burlington - North Below	Winooski River 2.2	44.52916	73.26684	No
Burlington – North Outfall		44.52815	73.26740	
Burlington - Riverside Above	Winooski River 9.4	44.48801	73.19271	No
Burlington - Riverside Below	Winooski River 9.3	44.48883	73.19562	No
Burlington - Riverside Outfall		44.48825	73.19382	
Castleton Above	Castleton River 6.5	43.60357	73.20940	No
Castleton Below	Castleton River 6.2	43.6028	73.21251	No
Castleton Outfall		43.603648	73.21029	
Chelsea Above	1st Branch White River 17.2	43.98079	72.44572	No
Chelsea Below	1st Branch White River 17.1	43.97892	72.44594	Yes
Chelsea Outfall		43.98079	72.44595	
Danville Above	Water Andric 6.6	44.41307	72.12964	No
Danville Below	Water Andric 6.5	44.41238	72.12876	Yes
Danville Outfall		44.41296	72.12968	
EHV Weidmann Above	Passumpsic River 14.3	44.48191	72.01202	No
EHV Weidmann Below	Passumpsic River 14.0	44.479	72.01609	No
EHV Outfall		44.48186	72.01216	
Hartford - Quechee Above	Ottauquechee River 5.9	43.64508	72.41634	No
Hartford - Quechee Below	Ottauquechee River 5.7	43.64729	72.41348	No
Hartford - Quechee Outfall		43.64552	72.41573	
Hinesburg Above	LaPlatte River 12.5	44.3335	73.12593	No
Hinesburg Below	LaPlatte River 12.0	44.33304	73.12704	No
Hinesburg Outfall		44.33322	73.12603	
Lyndon Above	Passumpsic River 18.5	44.52835	72.00350	No
Lyndon Below	Passumpsic River 18.3	44.52557	72.00246	Yes
Lyndon Outfall		44.52826	72.00325	
Montpelier Above	Winooski River 54.7	44.25638	72.59891	No
Montpelier Below	Winooski River 54.3	44.25827	72.60659	Yes
Montpelier Above	Dog River 0.1	44.25629	72.60118	No
Montpelier Outfall		44.25617	72.60034	

Table 1 (cont'd): Sampling Locations of the 20 Wastewater Treatment Facilities -Above, Below and Outfall (Latitude and Longitude are in decimal degrees, NAD83) also indicated are the 2010 bioassessments.

Wastewater Treatment Facility	Receiving Water and River Mile (RM)	Latitude	Longitude	Bioassessment
Poultney Above	Poultney River 23.1	43.52309	73.24799	Yes
Poultney Below	Poultney River 23.0	43.52462	73.24713	Yes
Poultney Outfall		43.52324	73.24788	
Randolph Above	3rd Branch White River 9.7	43.92444	72.65666	Yes
Randolph Below	3rd Branch White River 9.5	43.92707	72.65467	Yes
Randolph Outfall		43.92596	72.66760	
St Johnsbury Above	Passumpsic River 8.6	44.41085	72.01358	Yes
St Johnsbury Below	Passumpsic River 6.7	44.39303	72.02190	Yes
St. Johnsbury Outfall		44.409481	72.01577	
Sherburne FD#1 Above	Ottauquechee River 34.4	43.65948	72.77076	No
Sherburne FD#1 Below	Ottauquechee River 34.3	43.65857	72.77005	Yes
Sherburne FD#1 Outfall		43.65925	72.77066	
West Rutland Above	Clarendon River 1.8	43.5913	73.03752	No
West Rutland Below	Clarendon River 1.7	43.59213	73.03771	Yes
West Rutland Outfall		43.59117	73.03780	
Williamstown Above	Steven's Branch Trib. 0.4	44.12838	72.53175	Yes
Williamstown Below	Steven's Branch Trib. 0.3	44.129	72.53193	Yes
Williamstown Outfall		44.12834	72.53185	
Winooski Above	Winooski River 9.3	44.48883	73.19562	No
Winooski Below	Winooski River 9.0	44.48998	73.20068	No
Winooski Outfall		44.4897	73.19894	
Woodstock - Main Above	Ottauquechee River 14.9	43.62909	72.50751	Yes
Woodstock - Main Below	Ottauquechee River 14.8	43.63043	72.50967	Yes
Woodstock – Main Outfall		43.62979	72.50765	
Woodstock - South Above	Kedron Brook 5.3	43.56505	72.52895	Yes
Woodstock - South Below	Kedron Brook 5.2	43.56548	72.52724	Yes
Woodstock - South Outfall		43.56532	72.52811	

Figure 1: Location of the Twenty Wastewater Treatment Facilities Sampled in Vermont.

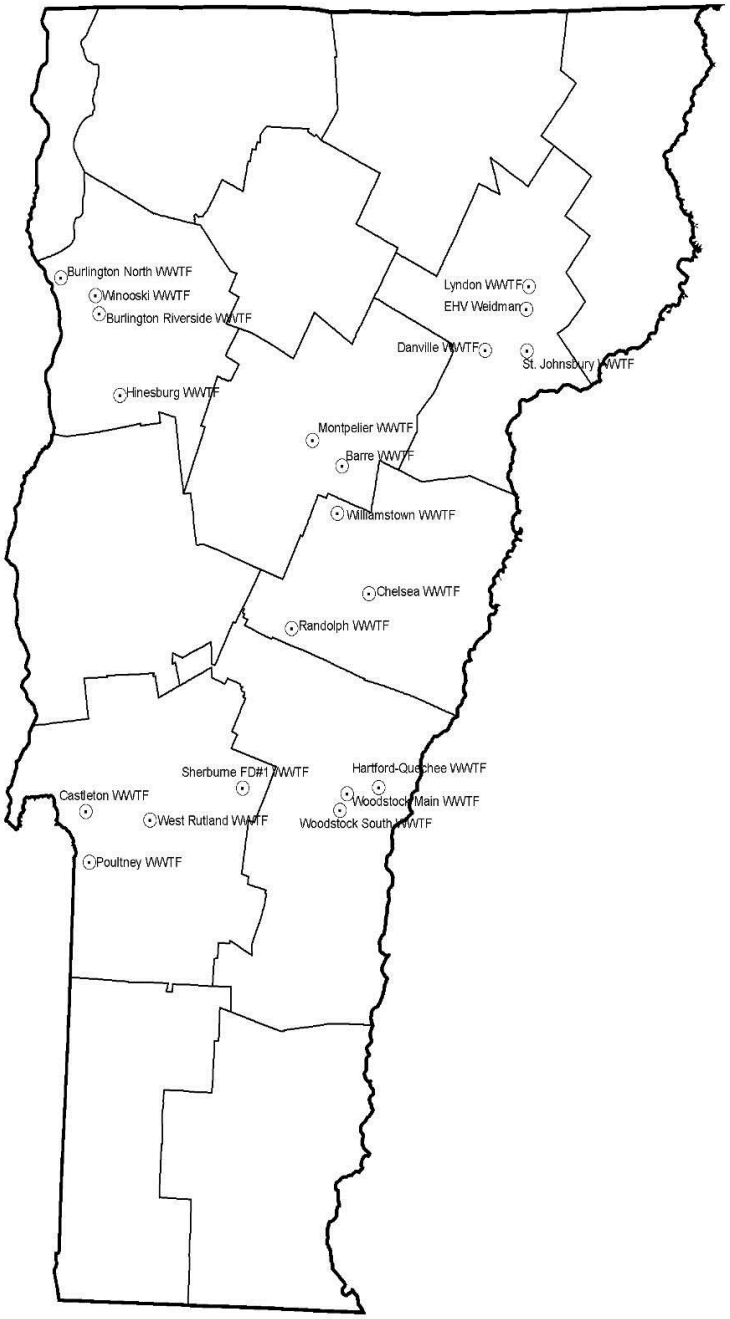

Table 2: WWTF design flows and hydrology of receiving water. WWTFs with IWC>10% at LMMF or 7Q10 are bolded.

Wastewater Treatment Facility	Receiving Water	Design Flow MGD	Design Flow CFS	Drainage Area SQ Mile	**** 7Q10 CFS	IWC 7Q10 %	Low Mo Med CFS	IWC LMMF %	Annual Med CFS	IWC Annual %
Barre	Steven's Branch	4.0000	6.192	93	9.0	**40.7**	36.9	**14.36**	74.5	7.7
Burlington - North	Winooski River	2.0000	3.096	1070	170.1	1.79	482.0	0.64	975	0.3
Burlington - Riverside	Winooski River	1.2000	1.858	1053	167.4	1.10	474.0	0.39	959	0.2
Castleton	Castleton River	0.4800	0.743	90	4.3	**14.68**	35.6	2.04	111	0.7
Chelsea	1st Branch White River	0.0550	0.085	19	1.0	7.80	5.1	1.63	5.2	1.6
Danville	Water Andric	0.0600	0.093	2.05	0.1	**48.04**	0.8	**10.65**	-	-
EHV Weidmann	Passumpsic River	0.3500	0.542	233	45.9	1.17	124.9	0.43	227	0.2
Hartford - Quechee	Ottauquechee River	0.3000	0.464	207	20.7	2.19	70.8	-	-	-
Hinesburg	LaPlatte River	0.2500	0.387	17.8	1.7	**18.31**	2.0	**16.50**	8.4	4.4
Lyndon	Passumpsic River	0.7500	1.161	198	39.0	2.89	106.2	1.08	193	0.6
Montpelier	Winooski River	3.9700	6.146	492	75.8	7.50	183.4	3.24	394	1.5
Poultney	Poultney River	0.5000	0.774	41	2.0	**27.81**	8.9	7.99	29.2	2.6
Randolph	3rd Branch White River	0.4000	0.619	109	6.4	8.78	29.1	2.09	89.7	0.7
St Johnsbury	Passumpsic River	1.6000	2.477	430	86.0	2.80	132.0	1.84	334	0.7
Sherburne FD#1	Ottauquechee River	0.3000	0.464	20	1.1	**29.69**	6.6	6.58	-	-
West Rutland	Clarendon River	0.4500	0.697	47	7.0	9.05	25.7	2.64	51.1	1.3
Williamstown	Steven's Branch Trib.	0.1500	0.232	3.55	0.2	**55.24**	0.4	**34.67**	2.0	10.5
Winooski	Winooski River	1.4000	2.167	1053	167.4	1.28	475.0	0.45	959	0.2
Woodstock - Main	Ottauquechee River	0.4500	0.697	150	15.0	4.44	51.3	1.34	136	0.5
Woodstock - South	Kedron Brook	0.0500	0.077	7.8	0.4	**16.29**	2.7	2.81	7.1	1.1

Results:

Results of water chemistry measures pH, dissolved oxygen, turbidity, alkalinity, conductivity, color, chlorides, sulfates, and nutrients: total phosphorus (TP), dissolved phosphorus (TDP), total nitrogen (TN), nitrate + nitrite (NOX) and ammonia (NH3) are summarized in **Table 4**. Water samples were also tested for total metals (**Tables 5 and 6),** provide results for the following metals: calcium, magnesium, sodium, potassium, aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, manganese, nickel, iron, lead, selenium, silver, thallium, zinc and total hardness.

Of the twenty WWTF receiving waters sampled, seven were found to have minimal measurable effect on the receiving waters. These WWTFs are Chelsea, Hartford-Quechee, Lyndon, Poultney, St. Johnsbury, and West Rutland. One of the most noticeable patterns showed an increased level of pollutants phosphorus and nitrogen. This was a result of effluent being discharged from older, less modernized facilities. Many of these facilities use aerated lagoons as their primary treatment process **(Table 3).** Additionally as one might expect, receiving waters with high instream waste concentrations (>10% IWC @ 7Q10) were more likely to show higher levels of nutrients; albeit this was also dependent on the WWTF process and the receiving water flow at the time of sampling.

Phosphorus

VTDEC Proposed Nutrient Criteria for Vermont Lakes and Wadeable Streams (VTDEC 2009) include values for total phosphorus and total nitrogen. Separate criteria were derived for each of three stream ecotypes: 1) small, high-gradient streams (SHG), (2) medium, high-gradient streams (MHG), and (3) warm-water, medium-gradient streams (WWMG). Phosphorus concentrations exceeded VTDEC proposed nutrient criteria (.035 - .044 mg /l) at eight of the twenty WWTFs sampled **(Figure 2).** The proposed nutrient criteria values are used here for illustrative purposes and should not be taken as indications of legally binding criteria. The proposed criteria are in fact proposed as guidance values with demonstrated instream impairment of aquatic life support (ALS) or aesthetics needed before VTWQS impairment is declared. Low Median Monthly Flow (LMMF) is the hydrologic condition which these proposed draft nutrient criteria are intended to be applied.

Wastewater treatment facilities that discharge directly to Lake Champlain or to one of its tributaries are held to a higher standard of phosphorous removal. State law limits effluent phosphorus concentrations to 0.8 mg/l at certain types of plants in the basin, and similar phosphorus limits apply at several other facilities. The Lake Champlain total maximum daily load (TMDL) recommends extending the 0.8 mg/l phosphorus limit to five aerated lagoon type municipal treatment plants in Vermont that are now exempt

from phosphorus removal requirements. WWTFs that are not in the Lake Champlain Basin (LCB) do not have effluent limits for total phosphorus.

There were seven WWTF receiving waters sampled that are within the LCB, three of these WWTFs; Hinesburg, Williamstown and Barre exceeded the proposed total phosphorus criteria. Additionally there were six WWTFs outside of the LCB that exceeded the proposed total phosphorus nutrient criteria: Woodstock Main, Woodstock South, Sherburne FD#1, Randolph, West Rutland, and Danville.

Nitrogen

Total nitrogen levels exceeding the VTDEC proposed nutrient criteria of 0.75 mg-TN/L were observed at 8 of the 20 sites **(Figure 3).** The larger warm water moderate gradient (WWMG) streams and low gradient (LG) rivers (e.g.. lower Winooski R.) had elevated total nitrogen values (>0.75 mg/L) above and below the outfall, indicating that the WWTF effluent was likely not a significant factor in the observed total nitrogen exceedance. The small high-gradient (SHG) and medium-sized high-gradient (MHG) streams with elevated nitrogen levels showed significantly higher levels below the outfall, indicating upstream nitrogen levels were not a significant contributing factor.

WWTFs with High Instream Waste Concentration

The receiving waters at the WWTF in Danville showed elevated levels of total nitrogen, decreased levels of dissolved oxygen, a significant increase in turbidity and color, and a total phosphorus value of 786 ug/L, more than 22 times the proposed nutrient criteria of 35 ug/L. This WWTF discharges into Water Andric, a small high-gradient stream (SHG) with a drainage area of just over two square miles. At 7Q10 flow, the instream waste concentration (IWC) at design capacity is 48% and is also greater than >10% at LMMF.

The Williamstown WWTF discharges to Stevens Branch Tributary #23 and at 7Q10 flow and LMMF the IWC at design capacity is very high, 55% and 34% respectively. Nutrient values below the outfall were above proposed criteria for nitrogen and phosphorous. Additionally the chronic ammonia criteria (1.2 mg/L) were exceeded. One of the upstream water samples exceeded the chronic aluminum criteria (87 ug/L); the source of this exceedance will be examined further. This plant was in the process of upgrading their lagoons and wastewater processing system during the sampling period. This facility should be reassessed next season to determine the extent to which upgrades have had a positive effect on the receiving water quality.

The Hinesburg WWTF discharges to the Laplatte River and at 7Q10 flow the IWC at design capacity is 18%. This stream is classified as a slow winder (SW) and is dominated by a sandy bottom. The total nitrogen measurement (1.14 mg-N/L) does exceed the proposed nutrient criteria of 0.75 mg-N/L; however the proposed criteria would not be applied to this slow winder stream type since there are currently no biocriteria established for this stream type.

Ammonia values of 0.82 mg-N/L and 0.29 mg-N/L were observed below the outfall, these ammonia values do not exceed the current chronic criteria of 1.2 mg-N/L (early life stages of fish present).

Table 3: Treatment plant type, inputs, ecotype and receiving water details

Wastewater Treatment Facility	Treatment Process*	Eco-Type**	Wadeable	Input Characterization	Population Served	Design Capacity (mgd)
Barre	Activated Sludge	MHG	Y	Comm/Res	8,818	4.000
Burlington North	Activated Sludge	LG	N	Res/Comm	11,100	2.000
Burlington Riverside	Activated Sludge	LG	N	Urb/Comm/Univ/Hosp	11,000	1.200
Castleton	SBR, UV	MHG	Y	Univ/Res	4,500	0.480
Chelsea	Extended Aeration	MHG	Y	Res/Comm	1,206	0.055
Danville	Aerated Lagoon	SHG	Y	Res	2,364	0.060
EHV Weidmann	Industrial Solids Removal	WWMG	Y	Comm		0.350
Hartford-Quechee	Aerated Lagoon	WWMG	N	Res	627	0.300
Hinesburg	Aerated Lagoon	SW	Y	Res	4,633	0.250
Lyndon	Extended Aeration	WWMG	Y	Univ/Res	5,500	0.750
Montpelier	Activated Sludge	WWMG	Y	Comm/Resident	8,663	3.970
Poultney	SBR, UV	MHG	Y	Univ/Res	4,400	0.500
Randolph	Extended Aeration	MHG	Y	Res/Comm	5,108	0.400
St. Johnsbury	RBC	WWMG	Y	Urb/Res/Comm	7,674	1.600
Sherburne FD#1	RBC	MHG	Y	Res	1,098	0.300
West Rutland	Extended Aeration	MHG	Y	Res	2,251	0.450
Williamstown	Aerated Lagoon	SHG	Y	Res	3,206	0.150
Winooski	Activated Sludge	LG	N	Urb/Res/Comm	6,561	1.400
Woodstock Main	Extended Aeration	MHG	Y	Res	3,286	0.450
Woodstock South	Extended Aeration	MHG	Y	Res	291	0.050

*SBR=Sequencing Batch Reactor, RBC=Rotating Biological Contractor

**MHG= Medium-sized High Gradient, SHG=Small High Gradient, WWMG= Warm Water Moderate Gradient, SW= Slow Winder, LG=Low Gradient

Other chemical constituents

Conductivity values ranged from 51 – 581 umhos/cm, the highest observed value was observed below the outfall of the Barre WWTF. Conductivity values can provide some insight to the dilution of effluent and current stream flow when comparing samples collected at the same location over time. Generally the highest observed TP values are associated with the highest observed conductivity value at the site. Most

turbidity values were low, < 2.0 NTU which is reflective of the sampling strategy avoiding recent rain events and freshet flows. The highest turbidity of 5.56 NTU was observed below the Hinesburg WWTF outfall, turbidity was also elevated above the outfall. These turbidity values are likely associated with the "slow winder" character of the Laplatte River.

Dissolved oxygen ranged from 5.96 mg/L- 8.3 mg/L, with the lowest values being observed below the Hartford-Quechee WWTF outfall and below the Danville WWTF outfall, 5.96mg/L and 5.98 mg/L respectively. These values are just below the Vermont Water Quality Standard of 6.0 mg/l for Cold Water Fish Habitat.

Aside from the earth metals calcium and magnesium, and manganese and iron very few metals were observed above the detection limits. Aluminum was one metal detected at most WWTFs and exceeded the chronic criteria (87 ug/L) at the Williamstown WWTF above the outfall. It was also elevated at the Hinesburg WWTF below the outfall (81 ug/L); however results indicate Al was elevated above the WWTF outfall also. The highest iron concentration (806 mg/L) was also observed at the Williamstown WWTF below the outfall. The chronic criterion for iron is 1000 mg/L. The fact that all of the EPA priority metals analyzed were below detection underscores the efficacy of WWTF treatment processes, and reflects well on the TSDC **(Tables 5 & 6)**.

Figure 2: Total phosphorus levels at 8 WWTFs with exceedances of the proposed nutrient criteria of 35 ug/L for SHG and MHG streams and 44 ug/L for WWMG streams. Proposed criteria represented by solid line near bottom of figure. BL=Below, AB=Above effluent discharge.

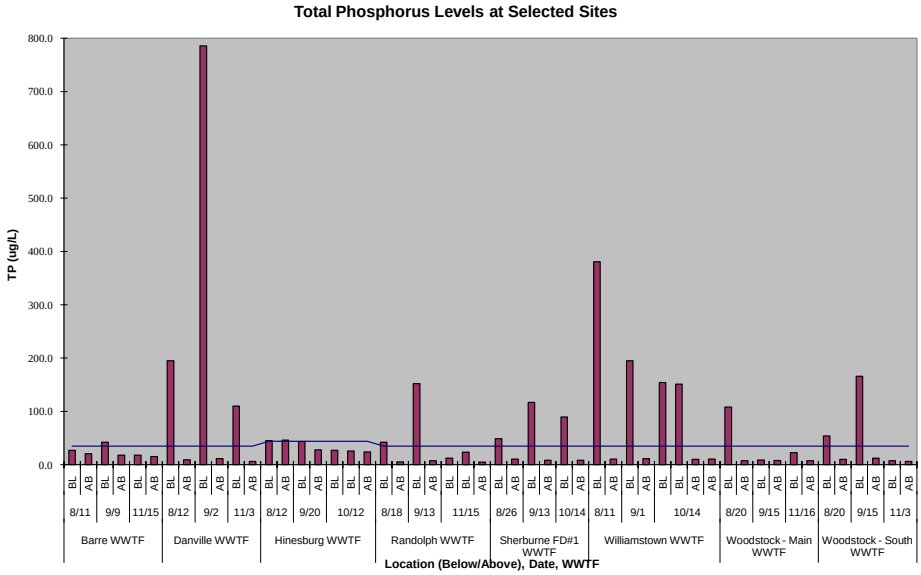

Figure 3: Total nitrogen levels at 8 WWTFs with exceedances of proposed nutrient criteria of 0.75 mg/L for SHG, MHG, or WWMG streams. Proposed criteria represented by solid line near bottom of figure. BL=Below, AB=Above effluent discharge.

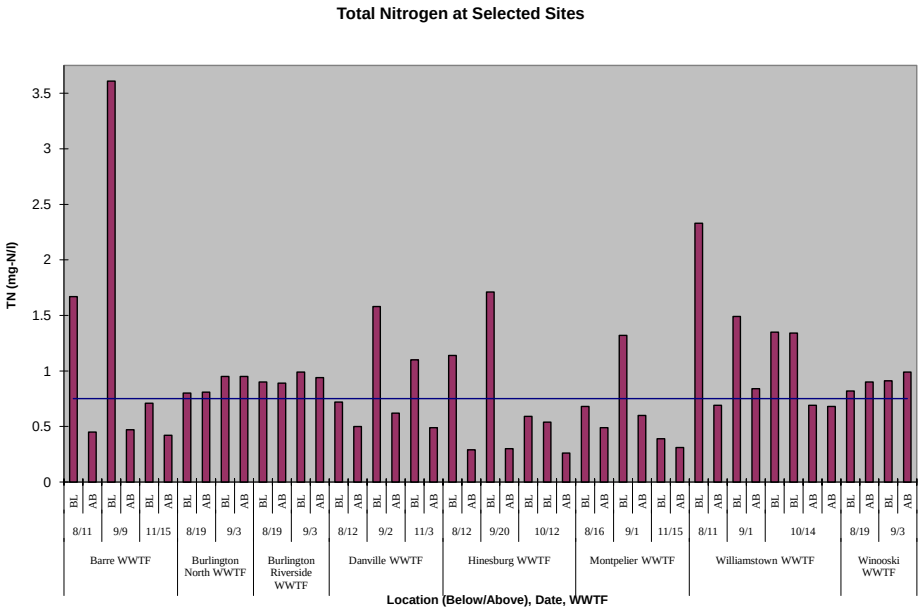

Table 4: Concentrations of surface-water chemistry above and below 20 wastewater treatment plant discharges in Vermont.
Data shown in **Bold** indicates an exceedance of proposed nutrient criteria, VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Water Temp C	pH	Alk mg/L	Cond umhos	Color	DO mg/L	DO %	Turb NTU	TP ug/L	TDP ug/L	Chloride mg/L	TSO4 mg/L	TN mg-N/l	TNOX mg-N/l	TNH3 mg-N/l
Barre WWTF	8/11/2010	2.8	22.4	8.5	139	442	20	9.9	114.2	1.52	27.2	18.5	46.9	11.7	**1.67**	1.5	0.06
		3.3	21.93	8.48	136	398	15	9.2	112	1.39	20.7	13.5	44	10.5	0.45	0.28	0.07
	9/9/2010	2.8	16.4	8.11	158	579	25	10.1	108	1.19	**42.1**	35.5	74.9	16.8	**3.61**	2.37	0.64
		3.3	16.27	8.27	154	507	15	10.3	107.2	1.02	17.9	15.9	61	14.9	0.47	0.36	<0.05
	11/15/2010	2.8	5.8	7.84	115	332	20	11	90.3	2.12	18.1	13.4	23.2	10	0.71	0.58	<0.05
		3.3	5.71	7.87	112	306	12.5	10.1	83.1	1.8	15.4	10.8	18.5	9.9	0.42	0.32	<0.05
Burlington North WWTF	8/19/2010	2.2	24.35	7.61	59.3	221	22.5	6.9	83.1	2.83	15.6	7.62	23.1	10.5	**0.8**	0.67	<0.05
		2.3	24.55	7.58	59.1	221	17.5	7.2	86.9	2.06	16.3	10	23	10.1	**0.81**	0.71	<0.05
	9/3/2010	2.2	25.49	7.85	66.3	252	20	7.7	96.3	1.95	17.5	9.08	26.7	11.8	**0.95**	0.85	<0.05
		2.3	25.69	7.9	66.5	250	15	7.9	99	1.91	18.1	9.81	26.4	11.9	**0.95**	0.82	<0.05
Burlington Riverside WWTF	8/19/2010	9.3	24.76	8.15	64.3	239	20	8.0	97.4	1.74	16.2	9.87	25.7	10.3	**0.9**	0.78	<0.05
		9.4	24.68	8.15	64.4	238	20	8.1	98.1	1.85	16.5	11.7	25.6	10.4	**0.89**	0.74	<0.05
	9/3/2010	9.3	25.6	8.1	68.2	258	17.5	8.3	103.6	1.43	19.5	12.6	27.8	11.7	**0.99**	0.74	<0.05
		9.4	25.6	8.12	69.2	258	15	8.7	108	1.37	18.6	15.6	27.6	11.5	**0.94**	0.84	<0.05
Castleton WWTF	8/26/2010	6.2	15.48	7.53	114	310	20	7.4	75.6	0.53	17.3	11.9	26.4	9.91	0.27	0.23	<0.05
		6.5	15.33	7.53	115	302	12.5	7.3	74.4	0.39	13.7	12.3	22.7	9.14	0.24	0.18	<0.05
	10/14/2010	6.2	9.61	7.54	97.2	280	15	9.0	83.6	1.3	13.3	12	20.1	10.3	**0.94**	0.77	<0.05
		6.5	9.04	7.58	97.4	266	17.5	8.8	82.3	0.98	11.7	7.72	18.3	9.21	0.38	0.26	<0.05
	11/16/2010	6.2	8.22	7.35	85.3	247	12.5	7.4	**65.4**	1.26	11.5	8.51	14.5	8.45	0.31	0.22	<0.05
		6.5	8.24	7.4	85	234	12.5	8.1	**67**	0.61	11.2	7.64	14.2	8.7	0.28	0.2	<0.05
Chelsea WWTF	8/11/2010	17.1	18.07	8.24	150	308	15	8.7	94.4	0.58	16.8	16.3	5.27	6.97	0.12	0.08	<0.05
		17.2	17.94	8.2	152	309	15	8.6	92.9	0.22	7.2	16.5	5.18	7.05	0.11	0.08	<0.05
	8/31/2010	17.1	17.14	8.22	163	341	12.5	8.0	85.7	< 0.2	18.7	20.5	6.78	8.08	0.16	0.11	<0.05
		17.2	18.99	8.29	161	335	7.5	7.6	84.9	< 0.2	7.5	10.2	6.45	8.12	0.15	0.11	<0.05
	10/13/2010	17.1	9.97	8.17	134	284	12.5	9.5	87.5	0.5	11.1	9.37	3.44	8.01	0.15	0.08	<0.05
		17.1			135	284				0.51	10.9	10.9	3.94	8.21	0.14	0.08	<0.05
		17.2	10.02	8.18	135	280	7.5	9.3	85.5	0.2	8.68	6.34	3.4	7.88	0.12	0.08	<0.05
Danville WWTF	8/12/2010	6.5	18.83	8.19	156	470	10	8.0	91.3	1.31	**316**	195	43.9	16	0.72	0.51	0.05
		6.6	18.73	8.27	155	457	10	8.2	92.3	0.26	11.3	9.29	43.3	15.3	0.5	0.48	<0.05
	9/2/2010	6.5	20.96	7.97	170	581	17.5	**5.9**	70.9	1.7	**786**	750	65.2	21.8	**1.58**	1.08	0.32
		6.6	20.7	8.21	173.0	563	5	7.0	80.9	0.27	11.5	11.3	65.1	20	0.62	0.58	<0.05
	11/3/2010	6.5	2.45	7.7	115.0	343	17.5	8.5	**64**	0.43	**110**	110	22.4	14.6	**1.1**	0.46	0.33
		6.6	2.53	7.87	114.0	334	15	10.8	84.2	0.37	5.99	5.07	21.6	13.9	0.49	0.41	<0.05

Table 4 (cont'd): Concentrations of surface-water chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates exceedance of proposed nutrient criteria, VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Water Temp C	pH	Alk mg/L	Cond umhos	Color	DO mg/L	DO %	Turb NTU	TP ug/L	TDP ug/L	Chloride mg/L	TSO4 mg/L	TN mg-N/l	TNOX mg-N/l	TNH3 mg-N/l
EHV Weidmann WWTF	8/13/2010	14	21.01	8.12	94.6	246	20	8.5	97.9	0.63	11.7	5.08	13.8	8.61	0.26	0.17	<0.05
		14.3	20.69	8.12	93.3	245	15	8.1	93.1	0.44	11.6	16.9	13.9	8.5	0.27	0.17	<0.05
	9/8/2010	14	18.33	8.23	106	287	20	7.4	83	0.48	12.7	8.95	18.5	11.1	0.31	0.18	<0.05
		14.3	18.37	8.23	107	291	20	7.8	86.5	0.85	12.4	10.3	18.5	10.8	0.35	0.23	<0.05
	11/15/2010	14	3.81	7.54	74.2	201	20	10.8	85.3	0.86	11.1	11.2	8.57	7.46	0.4	0.25	<0.05
		14.3	3.75	7.54	104	205	17.5	9.7	75.9	0.69	6.95	5.56	7.92	7.48	0.34	0.24	<0.05
Hartford - Quechee WWTF	8/20/2010	5.7	21.13	7.92	72.9	221	15	5.9	**68.9**	1.67	13.8	6.25	20.6	6	0.26	0.09	<0.05
		5.9	20.86	7.81	72.7	219	12.5	7.6	87.1	1.81	13.8	8.45	19.5	6.09	0.24	0.09	<0.05
	9/16/2010	5.7	15.1	7.94	72.9	234	20	-	-	1.05	14.2	8.32	23.5	7.01	0.31	0.18	<0.05
		5.9	14.2	7.42	75.1	234	17.5			0.76	14.1	7.57	21.7		0.3	0.19	<0.05
	11/16/2010	5.7	6.9	7.98	53.3	146	12.5	7.7	**64.6**	0.46	8.27	6.03	8.69	6.26	0.2	0.13	<0.05
		5.9	6.9	7.98	53.2	146	10	8.6	72.3	0.35	8.47	6.17	8.1	6.18	0.18	0.13	<0.05
Hinesburg WWTF	8/12/2010	12	19.52	7.59	122	375	30	5.8	64.9	5.56	**45.3**	33.3	37.4	9.99	**1.14**	0.09	**0.82**
		12.5	19.86	7.6	115	319	30	6.7	75.7	4.93	**46.3**	26.9	28.8	4.94	0.29	0.05	<0.05
	9/20/2010	12	12.37	7.65	125	414	25	9.2	87.2	4.52	**43.4**	22.6	45.8	16.4	**1.71**	0.14	1.04
		12.5	13.64	7.81	116	331	25	10.5	103.6	3.58	27.8	33.2	30.2	9.55	0.3	0.05	<0.05
	10/12/2010	12	10.38	7.4	83.3	264	20	9.2	85.4	2	27.2	19.4	23.6	9.76	0.59	0.05	**0.29**
		12			81.7	259				1.95	25.9	19.8	24	9.57	0.54	0.05	**0.29**
		12.5	10.42	7.53	79.9	242	17.5	9.1	84.4	2.36	24.1	16.5	21.1	8.62	0.26	0.05	<0.05
Lyndon WWTF	8/13/2010	18.3	19.49	7.81	90.7	236	20	7.6	86	0.57	14.7	9.7	13.1	7.94	0.3	0.19	<0.05
		18.5	18.9	7.82	90.1	232	15	7.6	84.4	0.37	9.42	6.43	12.3	7.89	0.28	0.19	<0.05
	9/8/2010	18.3	16.81	7.75	103	268	20	8.7	93.1	1.71	25.5	29.3	16	9.52	0.48	0.22	0.14
		18.5	16.95	7.8	100	259	15	7.6	82.2	0.9	9.62	9.89	14.3	9.02	0.31	0.22	<0.05
	11/15/2010	18.3	3.75	7.28	72.9	192	15	9.9	77.8	1.52	8.45	6.99	8.77	7.95	0.33	0.25	<0.05
		18.5	3.79	7.27	73.6	191	15	9.6	75.2	1.23	7.83	n/a	9.26	8.15	0.34	0.26	<0.05
Montpelier WWTF	8/16/2010	54.3	20.14	7.7	85.8	276	15	7.6	85.1	1.51	18.8	15	28.9	8.09	0.68	0.56	<0.05
		54.7	20.5	7.85	97.4	302	15	7.4	83.8	1.66	14.6	12.5	30.6	8.36	0.49	0.36	<0.05
	9/1/2010	54.3	25.5	8.53	91.2	317	12.5			0.79	24.3	19.1	48.5	9.39	**1.32**	1.2	<0.05
		54.7	26.5	8.59	104	332	20			1.08	15.1	10.3	35.4	9.2	0.6	0.46	<0.05
	11/15/2010	54.3	5.21	7.59	64.3	187	15	10.8	88.3	2.37	11.9	6.93	12.1	7.01	0.39	0.28	<0.05
		54.7	4.97	7.57	58.8	170	20	10.1	81.6	2.42	11.9	7.9	10.9	6.23	0.31	0.19	<0.05
Montpelier WWTF	8/16/2010	0.1	18.84	7.33	51.6	182	10	7.8	85.5	0.61	8.5	7.67	18.3	7.61	0.34	0.28	<0.05
	9/1/2010	0.1	22.5	7.95	53.2	197	12.5	-	-	0.43	11.3	12.3	21.3	8.97	0.42	0.36	<0.05
	11/15/2010	0.1	6.07	7.17	38.6	124	12.5	10.4	86.7	2.61	8.86	5	7.99	6.53	0.29	0.19	<0.05

Table 4 (cont'd): Concentrations of surface-water chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of proposed nutrient criteria, VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Water Temp C	pH	Alk mg/L	Cond umhos	Color	DO mg/L	DO %	Turb NTU	TP ug/L	TDP ug/L	Chloride mg/L	TSO4 mg/L	TN mg-N/l	TNOX mg-N/l	TNH3 mg-N/l
Poultney WWTF	8/17/2010	23	21.46	7.69	84.3	220	10	7.5	87.6	0.86	11.6	11.9	13.7	7.86	0.33	0.27	<0.05
		23.1	21.48	7.63	84.8	219	7.5	6.6	76.5	0.55	10.2	11.5	11.6	7.33	0.32	0.27	<0.05
	9/30/2010	23	16.42	7.14	94.5	271	-	-	-	0.48	13.2	13.2	6.95	9.29	0.28	0.18	<0.05
		23.1	16.2	7.14	91.8	251				1.48	9.72	9.72	5.88	9.07	0.21	0.15	<0.05
	10/14/2010	23	11.02	7.34	72.5	215	15	8.9	82.9	0.32	12.4	9.11	19.1	10.1	0.68	0.56	<0.05
		23.1	10.42	7.44	65.8	185	15	9.3	85.2	0.2	7.41	6.22	9.29	9.49	0.44	0.37	<0.05
Randolph WWTF	8/18/2010	9.5	15.9	7.34	24.4	87.2		8.7	90.1	< 0.2	**55.8**	42.3	7.45	4.53	0.46	0.46	<0.05
		9.7	15.63	7.31	22.9	77.2	7.5	8.3	86.1	< 0.2	5.34	5.08	5.77	4.06	0.23	0.22	<0.05
	9/13/2010	9.5	13.8	7.88	31.2	135	10	-	-	1.24	**152**	**150**	14.2	6.94	**1.41**	1.51	<0.05
		9.7	13.7	8.17	29.6	109	5			2.47	7.62	6.01	10.5	5.6	0.35	0.31	<0.05
	11/15/2010	9.5	7.17	6.91	16.2	51	7.5	10.4	89.5	0.52	12.4	9.62	3.41	3.88	0.31	0.26	<0.05
		9.5			16.6	-	-	-	-	0.9	23.5	9.64	3.47	4.13	0.31	0.26	<0.05
		9.7	7.17	6.91	16.2	51	7.5	10.4	89.5	0.67	5	5	2.93	3.78	0.27	0.22	<0.05
Sherburne FD#1 WWTF	8/26/2010	34.3	17.67	7.15	37.5	190	40	6.6	70.3	0.46	**48.8**	33	28.4	4.95	0.6	0.51	<0.05
		34.4	17.65	7.07	37.1	176	25	6.6	71.4	0.51	10.3	9.12	27.6	4.15	0.24	0.15	<0.05
	9/13/2010	34.3	14.4	6.65	42.8	228	20	-	-	1.33	**117**	**75.2**	44.1	5.94	0.45	0.68	<0.05
		34.4	14.3	6.65	42.0	229	15			1.04	8.18	7.03	39	4.99	0.28	0.2	<0.05
	10/14/2010	34.3	6.87	7.07	32.3	212	20	9.2	79.9	0.64	**89.3**	62.5	32.7	6.08	0.68	0.54	<0.05
		34.4	6.52	7.03	30.9	152	20	9.2	83.8	0.47	8.33	5.11	20.2	4.77	0.28	0.16	<0.05
St Johnsbury WWTF	8/13/2010	6.7	20.56	8.03	84.5	222	30	7.2	82.8	0.99	14.9	13.4	12.5	8.37	0.26	0.11	<0.05
		8.6	20.39	8.41	80.7	212	20	8.6	98.2	0.64	12.6	7.25	12.2	7.1	0.24	0.11	<0.05
	9/8/2010	6.7	18.92	8	101	287	20	7.2	81.2	1.8	30.5	21	20	11.8	0.43	0.26	<0.05
		8.6	19.36	8.28	92.0	256	20	7.3	83	1.25	13.6	9.71	17.2	10.1	0.25	0.11	<0.05
	11/15/2010	6.7	3.61	7.42	68.7	187	17.5	11.1	86.8	1.29	11.5	8.76	8.15	8.28	0.34	0.23	<0.05
		8.6	3.74	7.55	63.5	168	17.5	13.5	105	1.19	8.79	7.85	7.69	7.49	0.31	0.2	<0.05
West Rutland WWTF	8/17/2010	1.7	18.16	7.96	172	352	-	7.2	78.2	1.99	18.1	13.8	10.2	3.84	0.27	0.1	<0.05
		1.8	18.45	7.98	172	352		7.5	82.8	0.66	15.7	13.1	10.1	3.81	0.25	0.1	<0.05
	9/30/2010	1.7	15.57	7.54	176	392	25	-	-	1.02	**38.5**	**17.8**	19	7.34	0.2	0.05	<0.05
		1.8	15.12	7.71	170	360	17.5			1.04	8.9	6.56	12.2	5.3	0.1	0.05	<0.05
	11/16/2010	1.7	7.07	7.61	133	324	17.5	7.4	62.7	1.38	17.6	11.6	10.8	7.42	0.34	0.24	<0.05
		1.8	6.93	7.81	135	309	12.5	7.4	62.1	0.72	8	6.34	8.32	6.69	0.24	0.16	<0.05

Table 4 (cont'd): Concentrations of surface-water chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of proposed nutrient criteria, VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Water Temp C	pH	Alk mg/L	Cond umhos	Color	DO mg/L	DO %	Turb NTU	TP ug/L	TDP ug/L	Chloride mg/L	TSO4 mg/L	TN mg-N/l	TNOX mg-N/l	TNH3 mg-N/l
Williamstown WWTF	8/11/2010	0.3	14.4	7.74	167	462	20	11	110	1.89	**381**	100	35.5	16.2	**2.33**	0.69	**1.25**
		0.4	14	7.76	157	423	10	12.2	124	0.23	10.4	22.7	29.5	14.8	0.69	0.71	<0.05
	9/1/2010	0.3	13.4	8.11	189	529	12.5	-	-	1.28	**195**	119	42.5	17.5	**1.49**	0.85	0.6
		0.4	13.4	7.98	186	513	7.5			< 0.2	11.4	12.7	51.8	16.8	0.84	0.82	<0.05
	10/14/2010	0.3	8.77	7.78	126	377	17.5	8.5	**64**	0.84	**154**	132	24.4	15.7	**1.35**	0.92	0.21
		0.3			133	378				1.35	**151**	127	24.4	17	**1.34**	1.03	0.21
		0.4	8.64	7.78	134	364	12.5	9.0	79.7	0.25	10.1	8.65	22.6	15.1	0.69	0.62	<0.05
		0.4			132	364				0.27	10.3	8.92	22.9	16.3	0.68	0.71	<0.05
Winooski WWTF	8/19/2010	9	24.91	8.16	64.7	240	20	9.2	99.9	1.47	19.8	12.5	25.6	9.35	**0.82**	0.8	<0.05
		9.3	24.76	8.15	64.3	239	20	8.0	97.4	1.74	16.2	9.87	25.7	10.3	**0.9**	0.78	<0.05
	9/3/2010	9	25.55	8.07	69.0	258	17.5	8.3	103.4	1.46	18.9	16.6	36.3	11.4	**0.91**	0.74	<0.05
		9.3	25.6	8.1	68.2	258	17.5	8.3	103.6	1.43	19.5	12.6	27.8	11.7	**0.99**	0.74	<0.05
Woodstock - Main WWTF	8/20/2010	14.8	21.27	8.05	55.5	199	12.5	8.2	94.3	0.93	**108**	101	22.3	6.19	0.67	0.7	<0.05
		14.9	21.34	7.97	53.8	183	12.5	8.1	93.8	0.95	7.6	5.16	20.4	5.8	0.1	0.11	<0.05
	9/15/2010	14.8	14.74	8.21	50.7	181	17.5	10.7	110.7	0.98	8.88	22.4	20.1	6.31	0.22	0.13	<0.05
		14.9	14.57	8.02	55.5	183	12.5	10.2	103.8	0.45	8.1	7.35	20.7	6.32	0.21	0.12	<0.05
	11/16/2010	14.8	7.08	7.64	40.4	120	12.5	7.3	**61.4**	1.2	22.8	21.8	9.03	5.79	0.28	0.19	<0.05
		14.9	7.11	7.6	40.3	120	10	8.4	71.1	0.88	7.64	6.25	8.54	5.76	0.17	0.12	<0.05
Woodstock - South WWTF	8/20/2010	5.2	18.46	8.03	152	347	10	7.6	83.5	1.29	**53.7**	59.2	13.4	8.58	0.38	0.48	<0.05
		5.3	18.25	8.03	148	333	10	7.7	83.7	0.72	10.2	8.48	12.2	7.83	0.15	0.22	<0.05
	9/15/2010	5.2	12.17	7.94	164	380	15	10.1	100.4	0.89	**166**	**145**	16	9.79	**0.95**	0.92	<0.05
		5.3	12.35	7.93	163	362	5	10.1	100	0.6	12.2	9.78	13.6	8.75	0.2	0.15	<0.05
	11/3/2010	5.2	4.64	7.93	99.4	239	15	8.5	69.6	0.97	7.31	5	5.5	8.77	0.22	0.18	<0.05
		5.3	4.91	7.93	101	238	15	7.8	**63**	0.73	6.1	5	5.28	8.84	0.22	0.18	<0.05

Summary Statistics																
	Minimum	2.45	6.65	16.2	51.40	5	5.8	61.4	0.2	5	5	2.93	3.78	0.1	0.05	0.05
	Maximum	26.5	8.59	189	581	40	13.5	124	5.56	786	750	74.9	21.8	3.61	2.37	1.25
	Median	15.9	7.84	91.0	258	15	8.3	85.35	1.02	13.8	10.9	19.75	8.61	0.34	0.24	0.29

Table 5: Concentrations of surface-water metal chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminum (ug/L)	Total Arsenic (ug/l)	Total Cadmium ug/l	Total Silver (ug/l)
Barre WWTF	8/11/2010	2.8	51.7	5	2.76	28.4	39.6	<1	<1	<1
		3.3	50.8	4.86	2.05	21.6	29	<1	<1	<1
	9/9/2010	2.8	64.1	6.7	4.49	44.6	33	<1	<1	<1
		3.3	64.8	6.5	2.55	33.2	10.9	<1	<1	<1
Burlington North WWTF	8/19/2010	2.2	21.1	3.24	1.4	15.1	37.8	<1	<1	<1
		2.3	21.5	3.21	1.32	15	34.1	<1	<1	<1
	9/3/2010	2.2	25.2	3.64	1.58	17.5	31.8	<1	<1	<1
		2.3	25	3.66	1.52	17.7	29.2	<1	<1	<1
Burlington Riverside WWTF	8/19/2010	9.3	23.6	3.32	1.49	16.7	40.6	<1	<1	<1
		9.4	23.9	3.32	1.52	16.6	40.5	<1	<1	<1
	9/3/2010	9.3	25.8	3.84	1.53	17.9	32.7	<1	<1	<1
		9.4	26	3.85	1.55	17.8	33.6	<1	<1	<1
Castleton WWTF	8/26/2010	6.2	35.5	7.4	1.05	15.6	20	<1	<1	<1
		6.5	36	7.38	1	15.2	<10	<1	<1	<1
	10/14/2010	6.2	33.9	6.67	1.35	14.5	17.2	<1	<1	<1
		6.5	33.1	6.53	1.07	12.6	13.1	<1	<1	<1
Chelsea WWTF	8/11/2010	17.1	54.5	2.55	2.48	5.83	18.2	<1	<1	<1
		17.2	53.6	2.55	2.51	5.71	15.1	<1	<1	<1
	8/31/2010	17.1	60.2	2.87	2.97	7.98	<10	<1	<1	<1
		17.2	59.6	2.83	2.94	7.59	<10	<1	<1	<1
Danville WWTF	8/12/2010	6.5	59.7	2.51	4.14	29.8	35.3	<1	<1	<1
		6.6	59.9	2.41	3.63	28.6	23.2	<1	<1	<1
	9/2/2010	6.5	67.4	2.98	6.19	44	32	<1	<1	<1
		6.6	67.8	2.84	4.72	43.6	16.3	<1	<1	<1
EHV Weidman WWTF	8/13/2010	14	37.9	1.75	1.77	8.74	41.3	<1	<1	<1
		14.3	37.8	1.73	1.78	8.63	40.2	<1	<1	<1
	9/8/2010	14	41.9	2.07	2.24	11.1	17	<1	<1	<1
		14.3	41.2	2.06	2.33	11.3	25.6	<1	<1	<1
Hartford-Quechee WWTF	8/20/2010	5.7	24	3.56	1.4	13.4	27	<1	<1	<1
		5.9	23.9	3.56	1.21	12.6	23.5	<1	<1	<1
	9/16/2010	5.7	25.6	3.87	1.51	15.3	16.8	<1	<1	<1
		5.9	26.7	4.09	1.43	14.6	11	<1	<1	<1

Table 5(cont'd): Concentrations of surface-water metal chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminum (ug/L)	Total Arsenic (ug/l)	Total Cadmium (ug/l)	Total Silver (ug/l)
Hinesburg WWTF	8/12/2010	12	35.6	9.68	1.78	23.9	81.6	<1	<1	<1
		12.5	33.6	8.74	1.18	17.2	65.3	<1	<1	<1
	9/20/2010	12	36.3	10.9	2.27	27.7	63.6	<1	<1	<1
		12.5	34.4	9.73	1.23	17.9	72.8	<1	<1	<1
Lyndon WWTF	8/13/2010	18.3	37.4	1.66	1.7	8.55	46.1	<1	<1	<1
		18.5	36.8	1.64	1.62	8.1	31.2	<1	<1	<1
	9/8/2010	18.3	39	1.83	2.03	9.92	18.9	<1	<1	<1
		18.5	38.6	1.78	1.88	8.83	17.5	<1	<1	<1
Montpelier WWTF	8/16/2010	54.3	32	3.46	1.45	18.1	34.1	<1	<1	<1
		54.7	36.3	3.68	1.61	18.8	36.1	<1	<1	<1
	9/1/2010	54.3	36.2	3.98	1.9	22.2	29.1	<1	<1	<1
		54.7	40.1	4.16	1.84	21.6	36.1	<1	<1	<1
Montpelier WWTF	8/16/2010	0.1	17.9	2.64	0.7	12.5	<10	<1	<1	<1
(Dog River)	9/1/2010	0.1	19.1	2.85	0.91	14.4	<10	<1	<1	<1
Poultney WWTF	8/17/2010	23	26.6	4.57	1.26	8.58	13.5	<1	<1	<1
		23.1	27.7	4.58	1.2	8.47	<10	<1	<1	<1
	9/30/2010	23	30.3	5	1.93	15.6	11.9	<1	<1	<1
		23.1	30.5	5	1.22	11.8	10	<1	<1	<1
Randolph WWTF	8/18/2010	9.5	8.44	1.61	0.58	5.26	<10	<1	<1	<1
		9.7	7.9	1.51	0.44	4.3	<10	<1	<1	<1
	9/13/2010	9.5	11.9	2.34	1.18	9.18	14.7	<1	<1	<1
		9.7	10.8	1.95	0.7	7.05	22.4	<1	<1	<1
Sherburne FD#1 WWTF	8/26/2010	34.3	14.6	2.72	1.14	18	16.6	<1	<1	<1
		34.4	13.7	2.6	0.93	15.5	15.9	<1	<1	<1
	9/13/2010	34.3	18.1	3.33	1.19	19.5	11.9	<1	<1	<1
		34.4	18.1	3.35	1.17	19.1	10.4	<1	<1	<1
St Johnsbury WWTF	8/13/2010	6.7	34.5	1.79	1.8	8.25	51.4	<1	<1	<1
		8.6	32.8	1.7	1.64	8.02	45.6	<1	<1	<1
	9/8/2010	6.7	33.5	1.91	2.28	11.1	24.1	<1	<1	<1
		8.6	36.5	2.05	2.24	10.2	28.2	<1	<1	<1
West Rutland WWTF	8/17/2010	1.7	46.6	13.8	0.98	6.92	24.5	<1	<1	<1
		1.8	46.7	13.8	0.94	6.88	<10	<1	<1	<1
	9/30/2010	1.7	42.9	12.9	2.22	15.3	13.3	<1	<1	<1
		1.8	36	11	0.91	6.55	10	<1	<1	<1

Table 5(cont'd): Concentrations of surface-water metal chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of VT Water Quality Standards or EPA Water Quality Standards

Wastewater Treatment Facility	Date	River Mile	Total Calcium (mg/L)	Total Magnesium (mg/L)	Total Potassium (mg/L)	Total Sodium (mg/L)	Total Aluminum (ug/L)	Total Arsenic (ug/l)	Total Cadmium (ug/l)	Total Silver (ug/l)
Williamstown WWTF	8/11/2010	0.3	58.8	6.34	3.23	23	13.7	<1	<1	<1
		0.4	58.2	5.7	2.47	18.6	<10	<1	<1	<1
	9/1/2010	0.3	70.1	7.6	2.98	26.3	<10	<1	<1	<1
		0.4	70.7	7.31	2.52	24.2	**146**	<1	<1	<1
Winooski WWTF	8/19/2010	9	24	3.33	1.43	16.9	40.8	<1	<1	<1
		9.3	23.6	3.32	1.49	16.7	40.6	<1	<1	<1
	9/3/2010	9	26	3.83	1.55	17.9	31.2	<1	<1	<1
		9.3	25.8	3.84	1.53	17.9	32.7	<1	<1	<1
Woodstock Main WWTF	8/20/2010	14.8	17.9	3.54	1.36	14.9	14.2	<1	<1	<1
		14.9	17	3.46	1.07	13	12.3	<1	<1	<1
	9/15/2010	14.8	16.8	3.52	0.98	12.3	<10	<1	<1	<1
		14.9	16.8	3.52	1	12.6	<10	<1	<1	<1
Woodstock South WWTF	8/20/2010	5.2	52.4	4.55	1.99	12.2	10.8	<1	<1	<1
		5.3	50.4	4.36	1.79	11.2	<10	<1	<1	<1
	9/15/2010	5.2	57.6	5	2.35	14.8	<10	<1	<1	<1
		5.3	56.3	4.79	1.98	12.4	<10	<1	<1	<1
	Summary Statistics	Minimum:	7.9	1.51	0.44	4.3	10	<1	<1	<1
		Maximum:	70.7	13.8	6.19	44.6	146	<1	<1	<1
		Median:	34.45	3.55	1.55	14.95	27.6	<1	<1	<1

Table 6: Concentrations of surface-water metal chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Total Antimony ug/L	Total Chromium ug/L	Total Copper ug/L	Total Iron ug/L	Total Lead ug/L	Total Manganese ug/L	Total Nickel ug/L	Total Selenium ug/L	Total Zinc ug/L	Total Hardness (mg/L)
Barre WWTF	8/11/2010	2.8	< 10	< 5	< 10	94.4	< 1	31.2	< 5	< 5	< 50	150
		3.3	< 10	< 5	< 10	112	< 1	34.3	< 5	< 5	< 50	147
	9/9/2010	2.8	< 10	< 5	< 10	103	< 1	37.8	< 5	< 5	< 50	188
		3.3	< 10	< 5	< 10	90	< 1	38.7	< 5	< 5	< 50	188
Burlington North WWTF	8/19/2010	2.2	< 10	< 5	< 10	194	< 1	52.8	< 5	< 5	< 50	66.1
		2.3	< 10	< 5	< 10	158	< 1	47.1	< 5	< 5	< 50	67
	9/3/2010	2.2	< 10	< 5	< 10	142	< 1	51.3	< 5	< 5	< 50	77.9
		2.3	< 10	< 5	< 10	158	< 1	46.7	< 5	< 5	< 50	77.5
Burlington Riverside WWTF	8/19/2010	9.3	< 10	< 5	< 10	122	< 1	46.5	< 5	< 5	< 50	72.6
		9.4	< 10	< 5	< 10	115	< 1	48.1	< 5	< 5	< 50	73.3
	9/3/2010	9.3	< 10	< 5	< 10	117	< 1	56.1	< 5	< 5	< 50	80.1
		9.4	< 10	< 5	< 10	135	< 1	51	< 5	< 5	< 50	80.8
Castleton WWTF	8/26/2010	6.2	< 10	< 5	< 10	232	< 1	60.2	< 5	< 5	< 50	119
		6.5	< 10	< 5	< 10	132	< 1	41.1	< 5	< 5	< 50	120
	10/14/2010	6.2	< 10	< 5	< 10	92.9	< 1	27.7	< 5	< 5	< 50	112
		6.5	< 10	< 5	< 10	89.7	< 1	25	< 5	< 5	< 50	110
Chelsea WWTF	8/11/2010	17.1	< 10	< 5	< 10	<50	< 1	15.8	< 5	< 5	< 50	147
		17.2	< 10	< 5	< 10	<50	< 1	15.1	< 5	< 5	< 50	144
	8/31/2010	17.1	< 10	< 5	< 10	<50	< 1	15.5	< 5	< 5	< 50	162
		17.2	< 10	< 5	< 10	<50	< 1	15.4	< 5	< 5	< 50	161
Danville WWTF	8/12/2010	6.5	< 10	< 5	< 10	82.4	< 1	29.3	< 5	< 5	< 50	159
		6.6	< 10	< 5	< 10	<50	< 1	15	< 5	< 5	< 50	160
	9/2/2010	6.5	< 10	< 5	< 10	114	< 1	43.4	< 5	< 5	< 50	181
		6.6	< 10	< 5	< 10	<50	< 1	13.6	< 5	< 5	< 50	181
EHV Weidman WWTF	8/13/2010	14	< 10	< 5	< 10	82.7	< 1	44.1	< 5	< 5	< 50	102
		14.3	< 10	< 5	< 10	82.9	< 1	43.3	< 5	< 5	< 50	101
	9/8/2010	14	< 10	< 5	< 10	73	< 1	44.6	< 5	< 5	< 50	113
		14.3	< 10	< 5	< 10	91.2	< 1	45.6	< 5	< 5	< 50	111

Table 6(cont'd): Concentrations of surface-water metal chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Total Antimony ug/L	Total Chromium ug/L	Total Copper ug/L	Total Iron ug/L	Total Lead ug/L	Total Manganese ug/L	Total Nickel ug/L	Total Selenium ug/L	Total Zinc ug/L	Total Hardness (mg/L)
Hartford-Quechee WWTF	8/20/2010	5.7	< 10	< 5	< 10	162	< 1	62.7	< 5	< 5	< 50	74.5
		5.9	< 10	< 5	< 10	159	< 1	59.4	< 5	< 5	< 50	74.2
	9/16/2010	5.7	< 10	< 5	< 10	114	< 1	25.7	< 5	< 5	< 50	80
		5.9	< 10	< 5	< 10	110	< 1	20.9	< 5	< 5	< 50	84
Hinesburg WWTF	8/12/2010	12	< 10	< 5	< 10	481	< 1	172	< 5	< 5	< 50	129
		12.5	< 10	< 5	< 10	476	< 1	168	< 5	< 5	< 50	120
	9/20/2010	12	< 10	< 5	< 10	327	< 1	87.6	< 5	< 5	< 50	136
		12.5	< 10	< 5	< 10	322	< 1	81	< 5	< 5	< 50	126
Lyndon WWTF	8/13/2010	18.3	< 10	< 5	< 10	102	< 1	37.2	< 5	< 5	< 50	100
		18.5	< 10	< 5	< 10	84.2	< 1	35.7	< 5	< 5	< 50	98.7
	9/8/2010	18.3	< 10	< 5	< 10	86.7	< 1	47.5	< 5	< 5	< 50	105
		18.5	< 10	< 5	< 10	79.7	< 1	41.4	< 5	< 5	< 50	104
Montpelier WWTF	8/16/2010	54.3	< 10	< 5	< 10	201	< 1	41.3	< 5	< 5	< 50	94.1
		54.7	< 10	< 5	< 10	206	< 1	46.8	< 5	< 5	< 50	106
	9/1/2010	54.3	< 10	< 5	< 10	142	< 1	41.7	< 5	< 5	< 50	107
		54.7	< 10	< 5	< 10	164	< 1	51.5	< 5	< 5	< 50	117
Montpelier WWTF	8/16/2010	0.1	< 10	< 5	< 10	170	< 1	25	< 5	< 5	< 50	55.7
(Dog River)	9/1/2010	0.1	< 10	< 5	< 10	169	< 1	28.4	< 5	< 5	< 50	59.5
Poultney WWTF	8/17/2010	23	< 10	< 5	< 10	76.5	< 1	31.7	< 5	< 5	< 50	85.2
		23.1	< 10	< 5	< 10	61.2	< 1	29.4	< 5	< 5	< 50	88.1
	9/30/2010	23	< 10	< 5	< 10	66.1	< 1	48.4	< 5	< 5	< 50	96
		23.1	< 10	< 5	< 10	86.8	< 1	48.4	< 5	< 5	< 50	97
Randolph WWTF	8/18/2010	9.5	< 10	< 5	< 10	61.6	< 1	14.2	< 5	< 5	< 50	27.7
		9.7	< 10	< 5	< 10	<50	< 1	12.4	< 5	< 5	< 50	25.9
	9/13/2010	9.5	< 10	< 5	< 10	61.6	< 1	21.2	< 5	< 5	< 50	39
		9.7	< 10	< 5	< 10	74.4	< 1	18.3	< 5	< 5	< 50	35
Sherburne FD#1	8/26/2010	34.3	< 10	< 5	< 10	375	< 1	51	< 5	< 5	< 50	47.7
		34.4	< 10	< 5	< 10	316	< 1	42.2	< 5	< 5	< 50	44.9
	9/13/2010	34.3	< 10	< 5	< 10	414	< 1	70.2	< 5	< 5	< 50	59
		34.4	< 10	< 5	< 10	390	< 1	65	< 5	< 5	< 50	59

Table 6(cont'd): Concentrations of surface-water metal chemistry above and below 20 wastewater treatment plant discharges in Vermont. Data shown in **Bold** indicates an exceedance of VT Water Quality Standards or EPA Water Quality Standards.

Wastewater Treatment Facility	Date	River Mile	Total Antimony ug/L	Total Chromium ug/L	Total Copper ug/L	Total Iron ug/L	Total Lead ug/L	Total Manganese ug/L	Total Nickel ug/L	Total Selenium ug/L	Total Zinc ug/L	Total Hardness (mg/L)
St Johnsbury WWTF	8/13/2010	6.7	< 10	< 5	< 10	136	< 1	43.4	< 5	< 5	< 50	93.5
		8.6	< 10	< 5	< 10	126	< 1	34.7	< 5	< 5	< 50	88.9
	9/8/2010	6.7	< 10	< 5	< 10	143	< 1	57.3	< 5	< 5	< 50	91.4
		8.6	< 10	< 5	< 10	121	< 1	39.1	< 5	< 5	< 50	99.7
West Rutland WWTF	8/17/2010	1.7	< 10	< 5	< 10	279	< 1	27.4	< 5	< 5	< 50	173
		1.8	< 10	< 5	< 10	191	< 1	19.9	< 5	< 5	< 50	173
	9/30/2010	1.7	< 10	< 5	< 10	< 50	< 1	15.8	< 5	< 5	< 50	160
		1.8	< 10	< 5	< 10	77.1	< 1	20.2	< 5	< 5	< 50	135
Williamstown WWTF	8/11/2010	0.3	< 10	< 5	< 10	<50	< 1	9.17	< 5	< 5	< 50	173
		0.4	< 10	< 5	< 10	<50	< 1	< 5	< 5	< 5	< 50	169
	9/1/2010	0.3	< 10	< 5	< 10	<50	< 1	6.41	< 5	< 5	< 50	206
		0.4	< 10	< 5	< 10	806	< 1	22.6	< 5	< 5	< 50	207
Winooski WWTF	8/19/2010	9	< 10	< 5	< 10	124	< 1	48.3	< 5	< 5	< 50	73.6
		9.3	< 10	< 5	< 10	117	< 1	46.5	< 5	< 5	< 50	72.6
	9/3/2010	9	< 10	< 5	< 10	122	< 1	52.6	< 5	< 5	< 50	80.6
		9.3	< 10	< 5	< 10	135	< 1	56.1	< 5	< 5	< 50	80.1
Woodstock - Main WWTF	8/20/2010	14.8	< 10	< 5	< 10	110	< 1	25.6	< 5	< 5	< 50	59.4
		14.9	< 10	< 5	< 10	107	< 1	25.2	< 5	< 5	< 50	59.6
	9/15/2010	14.8	< 10	< 5	< 10	62.7	< 1	14.2	< 5	< 5	< 50	56
		14.9	< 10	< 5	< 10	73.1	< 1	16	< 5	< 5	< 50	56
Woodstock - South WWTF	8/20/2010	5.2	< 10	< 5	< 10	76.2	< 1	15.1	< 5	< 5	< 50	150
		5.3	< 10	< 5	< 10	66.7	< 1	10.7	< 5	< 5	< 50	144
	9/15/2010	5.2	< 10	< 5	< 10	< 50	< 1	12.3	< 5	< 5	< 50	164
		5.3	< 10	< 5	< 10	< 50	< 1	5.3	< 5	< 5	< 50	160
Summary Statistics	Minimum		<10	<5	<10	61.2	<1	5.3	<5	<5	<50	25.9
	Maximum		<10	<5	<10	806	<1	172	<5	<5	<50	207
	Median		<10	<5	<10	123	<1	39.1	<5	<5	<50	99.7

Table 7 provides a summary of the WWTFs with water quality concerns, primarily instances where receiving waters exceeded the proposed nutrient criteria. Eight WWTFs exceeded the proposed TP criteria; the number of exceedances observed at each site are also included in the table. Three of the WWTFs exceeded the TP criteria for each of the three sampling events, these WWTFs were Danville, Sherburne FD#1 and Williamstown. Instream waste concentrations (IWC) for these three WWTFs range from 29% - 55% at 7Q10, and 6% - 34% at LMMF. Two out of three use aerated lagoons the most primitive treatment process **(Table 7).**

The proposed TN criteria were exceeded at 8 WWTFs (**Table 4**). The WWTFs on the lower Winooski River; Burlington North, Winooski and Burlington Riverside had TN values above the proposed criteria, but since these receiving waters are non wadeable, the proposed nutrient criteria do not apply. Noteworthy is that the upstream TN values at these three sites was also elevated, very similar to downstream values.

Although ammonia exceeded the current chronic criteria (1.2 mg/L-N) at only the Williamstown WWTF, it was elevated at the Barre and Hinesburg WWTFs, 0.64 mg/L-N and 0.82 mg/L-N respectively. This study was limited in that it represents only three sampling events and it only reflects warm weather scenarios. Ammonia levels would likely be considerably higher during cold weather sampling due to the cold temperatures impeding the nitrogen removal at the WWTFs, especially for aerated lagoons.

Table 7: Summary of WWTFs with Water Quality Exceedances. **Bold** indicates WWTF with IWC>10% @LMMF or 7Q10 are bolded. Proposed nutrient criteria does not apply to nonwadeable receiving waters.

Wastewater Treatment Facility	Receiving Water	IWC@ 7Q10	IWC @LMMF	Process	Ecotype	Proposed Nutrient Criteria Exceeded		Water Quality Criteria Exceeded
						TP	TN	NH3
Barre	Steven's Branch	**40.7**	**14.3**	Activated Sludge	MHG	1	2	
Burlington North*	Winooski River	1.79	0.64	Activated Sludge	LG	NA	NA	
Burlington Riverside*	Winooski River	1.10	0.39	Activated Sludge	LG	NA	NA	
Castleton	Castleton River	**14.68**	2.04	SBR, UV	MHG		1	
Chelsea	1st Branch White River	7.80	1.63	Extended Aeration	MHG			
Danville	Water Andric	**48.04**	**10.65**	Aerated Lagoon	SHG	3	1	
EHV Weidmann	Passumpsic River	1.17	0.43	Industrial Solids Removal	WWMG			
Hartford-Quechee	Ottauquechee River	2.19		Aerated Lagoon	WWMG			
Hinesburg	LaPlatte River	**18.31**	**16.5**	Aerated Lagoon	SW	NA	NA	
Lyndon	Passumpsic River	2.89	1.08	Extended Aeration	WWMG			
Montpelier	Winooski River	7.50	3.24	Activated Sludge	WWMG		1	
Poultney	Poultney River	**27.81**	7.99	SBR, UV	MHG			
Randolph	3rd Branch White River	8.78	2.09	Extended Aeration	MHG	2	1	
St. Johnsbury	Passumpsic River	2.80	1.84	RBC	WWMG			
Sherburne FD#1	Ottauquechee River	**29.69**	6.58	RBC	MHG	3		
West Rutland	Clarendon River	9.05	2.64	Extended Aeration	MHG	1		
Williamstown	Steven's Branch Trib.	**55.24**	**34.6**	Aerated Lagoon	SHG	3	1	1
Winooski*	Winooski River	1.28	0.45	Activated Sludge	LG	NA	NA	
Woodstock Main	Ottauquechee River	4.44	1.34	Extended Aeration	MHG	1		
Woodstock South	Kedron Brook	**16.29**	2.81	Extended Aeration	MHG	2	1	
No. WWTFs with Water Quality Exceedances						**8**	**7**	**1**

Discussion:

It is clear that as hydrologic condition changes, so does the instream waste concentration (IWC) below WWTF outfalls. The data presented here illustrates this point well; some samples were collected during periods of flow above the low median monthly flow (LMMF) and some well below the LMMF, near the 7Q10 flow. The design of this project was to collect samples while flows were +/- 10% of the LMMF, which is the hydrologic condition which the proposed draft nutrient criteria are intended to be applied. This requirement was difficult to meet when sampling extended past September; LMMF is often reached during July, August or February. Although the flows were elevated for some samples, the trends remained fairly similar. Overall the first sampling did well at capturing LMMF, the second sampling at many sites was well below LMMF (more reflective of 7Q10 flows) and the third sampling at most sites was well above LMMF. With a high IWC at the Danville WWTF, the TP data from below the outfall illustrates these varying flow conditions and associated dilutions well. TP values for the three sampling events were 316 ug/L, 786 ug/L and 110ug/L respectively; reflecting LMMF, 7Q10 flow and a flow significantly above LMMF. This hydrologic variability needs to be considered when reviewing the water quality data and applying the proposed nutrient criteria. USGS hydrologic tables (**Appendix A)** show approximate daily flows during sampling at sites with USGS gages located nearby.

As discussed above, the lowest flows observed at most sites occurred during the second sampling event in September. These flows were reflective of 7Q10 flows and several sites showed exceedances of the proposed TP criteria only during this flow. Technically these would not be considered exceedances of the proposed criteria, since the criteria are intended to be applied at LMMF. The operations of the WWTFs and discharge rates can greatly affect the quality and the quantity of the effluent and VTDEC recognizes that the quality and quantity of effluent may change for varying reasons. Though this is a very small snap shot of effluent quality from these 20 WWTFs, the data presented here suggest this variability to be true. It is also noteworthy that many if not all of the WWTFs sampled are not currently operating at full design capacity; some are operating at one half design capacity. This would indicate that the data set presented would be the best case scenario for the water quality below the outfalls. For instance if the Randolph WWTF is currently operating at one half design capacity now, an increase in effluent discharge up to full design capacity would in turn double the amount of TP and other constituents in the discharge, likely causing a significant change in the water quality of the receiving water.

The goals and objectives of this project have been met and this data will help to determine if there is reasonable potential for the discharge to cause or contribute to water quality violations. The application of the proposed nutrient criteria for wadeable streams is described in detail within the proposed nutrient criteria document (VTDEC 2009). In order to prevent false-positive assessments of use impairment based on phosphorus or nitrogen concentrations alone, it is recommended that causal variables (total phosphorus or nitrogen concentrations) be superseded by response variables (stream biological condition) which provide more direct indications of use impairment. Under this hierarchy, phosphorus or nitrogen concentrations would be used to judge compliance with the Water Quality Standards if no other data existed (as in the case of predictive modeling for a new discharge), but if response variable data were available, the actual response measurements would be used to determine compliance with the Standards.

Biological assessments (macroinvertebrate and/or fish) have been conducted above and below the outfall at many of these wastewater treatment facilities in past years. Most recently, biological assessments were conducted at 13 of the wadeable sites **(Table 1)**, coincident with this study. Data analysis for these 13 biological assessments show that many sites that exceeded the proposed TP criteria below the outfall have met or exceeded Class B expectations for the stream type (SHG, MHG, WWMG). These sites include the Barre, Danville, Randolph, Sherburne FD1, West Rutland, Woodstock Main and Woodstock South WWTFs. One exception thus far is the Williamstown WWTF bioassessment that did not meet Class B expectations for the stream type (SHG).

Recommendations:

It is recommended that these studies continue targeting other WWTFs for water quality assessments based on permit reauthorization dates, instream waste concentration (IWC), prior monitoring data and the location of the facility within the current rotational water quality planning basins. Additionally some WWTFs that were sampled during this project may require additional monitoring to assure that state water quality standards and receiving water classification criteria are maintained.

References:

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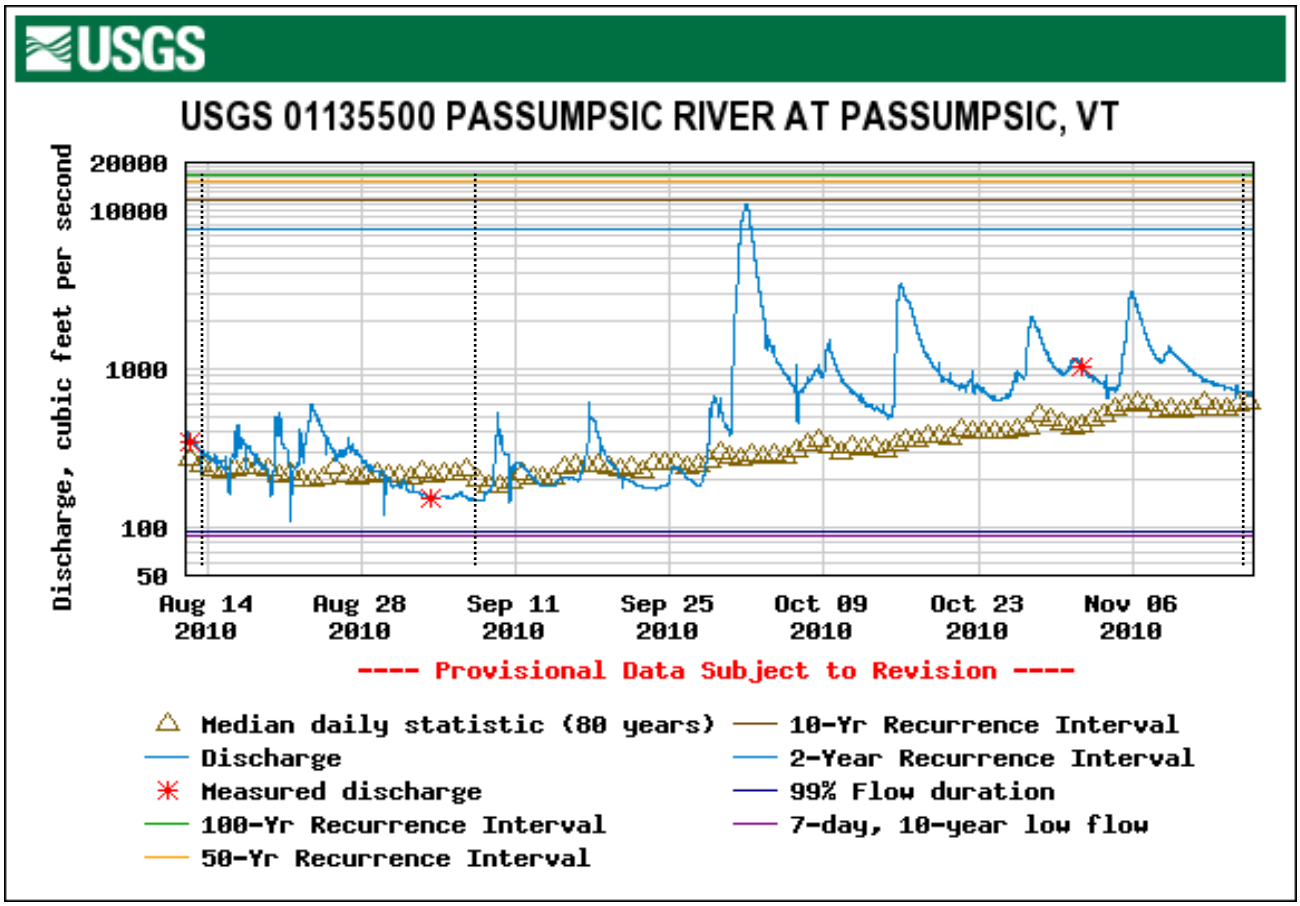
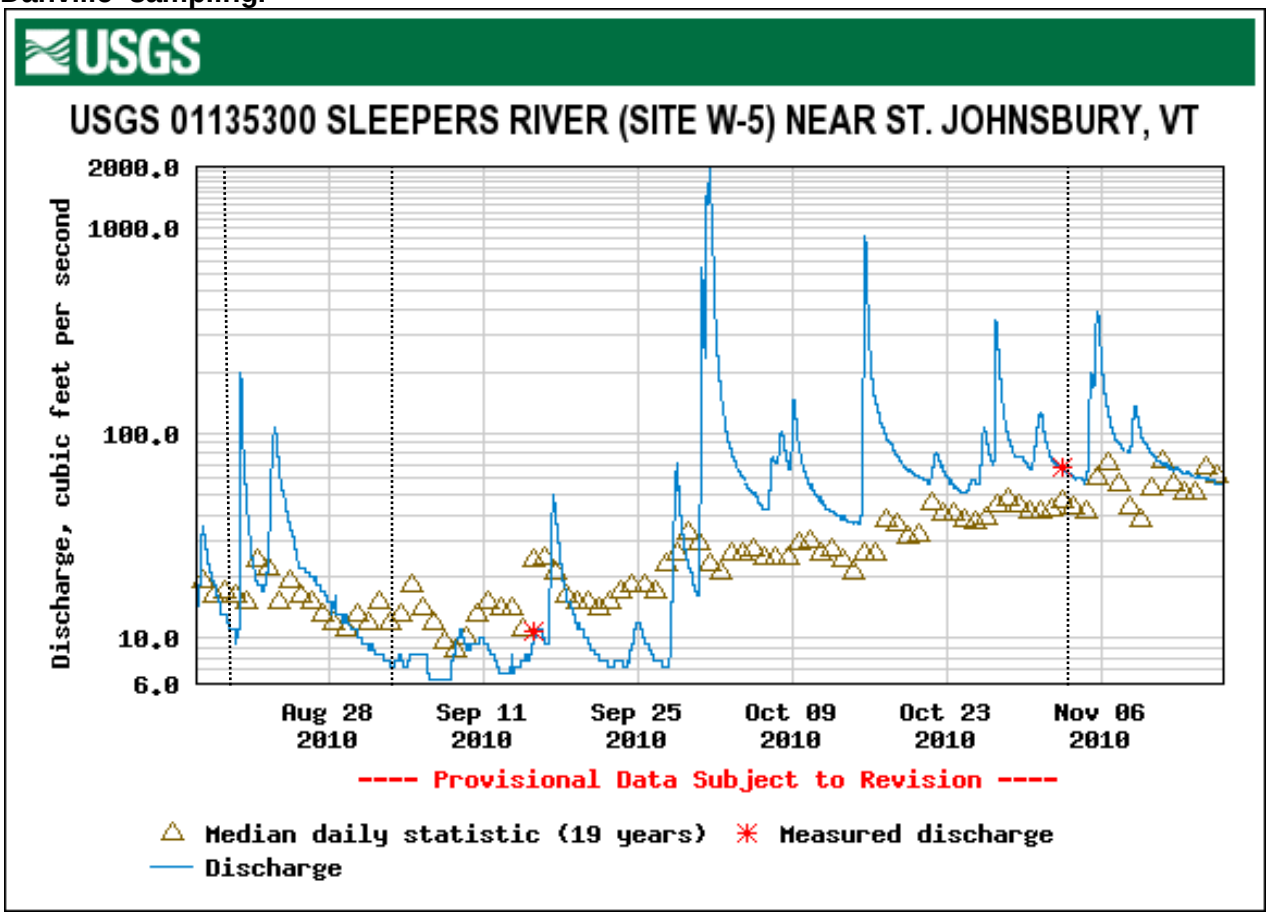
Appendix A: USGS flow tables showing flows on streams that were sampled or are the most proximal USGS gauging station to sites we sampled. Black dashed lines represent the approximate date of sampling in the vicinity. Flow at sites that did not have a USGS gauge close by were evaluated by best professional judgment.

***Lyndon, EHV and St Johnsbury sampling.**

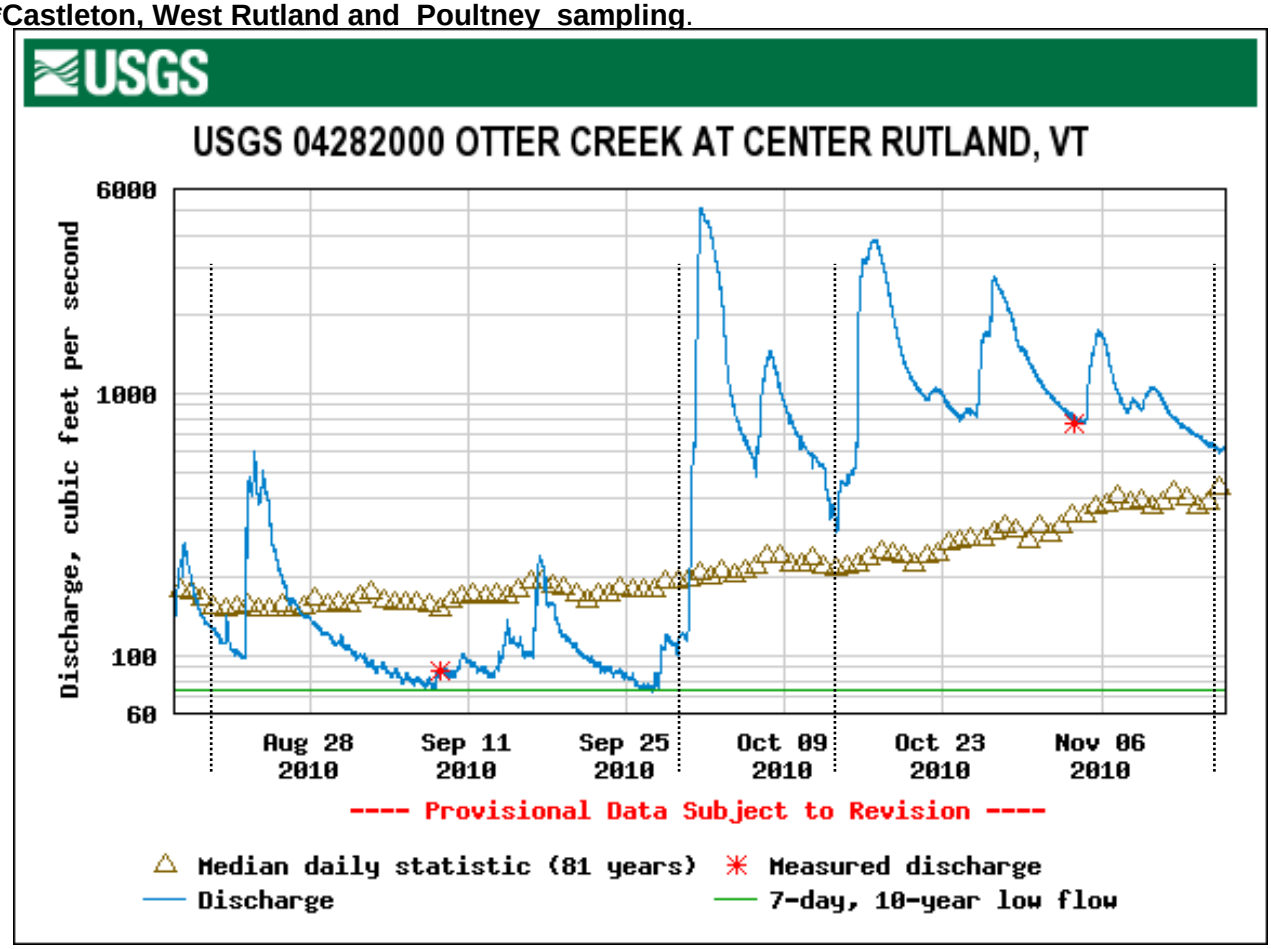


Appendix A (cont'd):

***Danville sampling.**

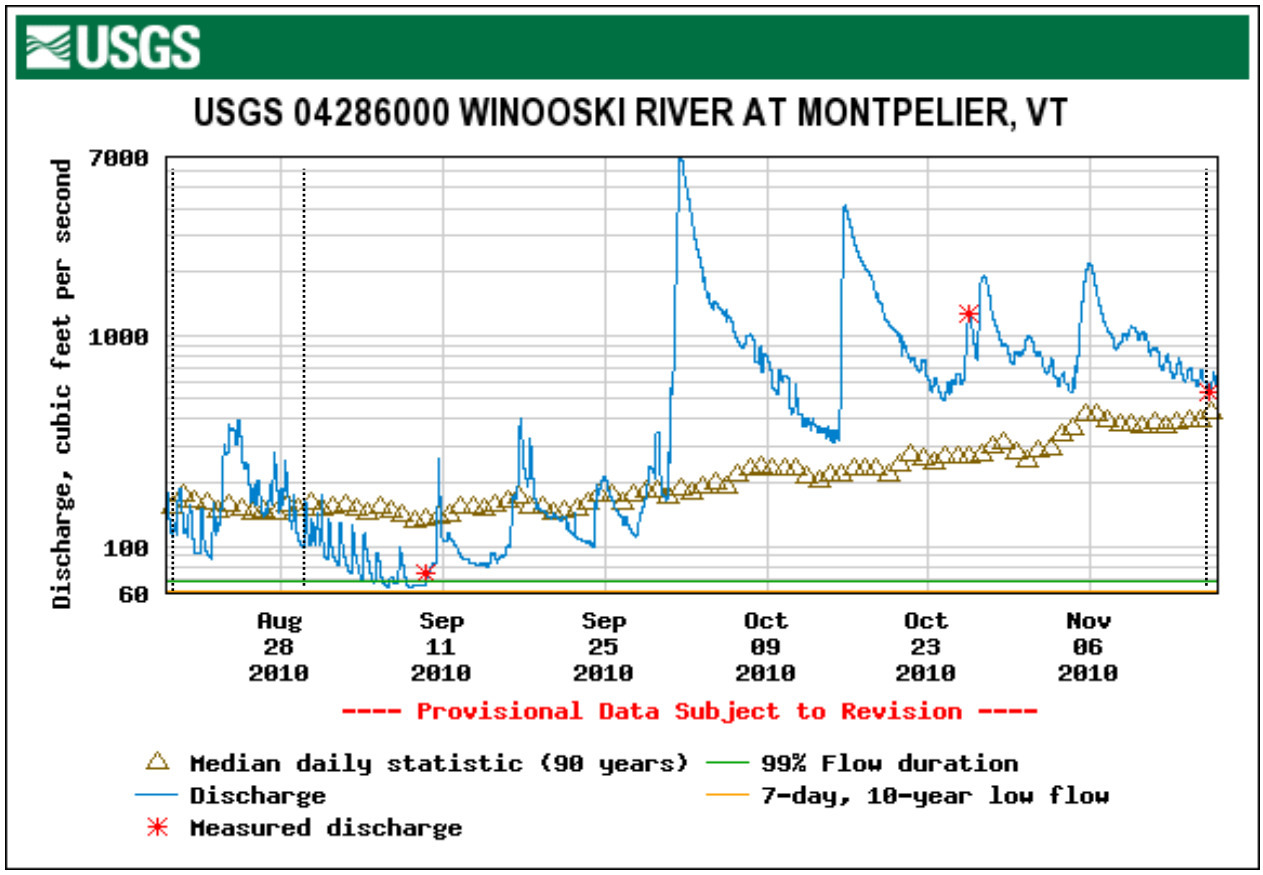


Appendix A (cont'd):
***Castleton, West Rutland and Poultney sampling.**



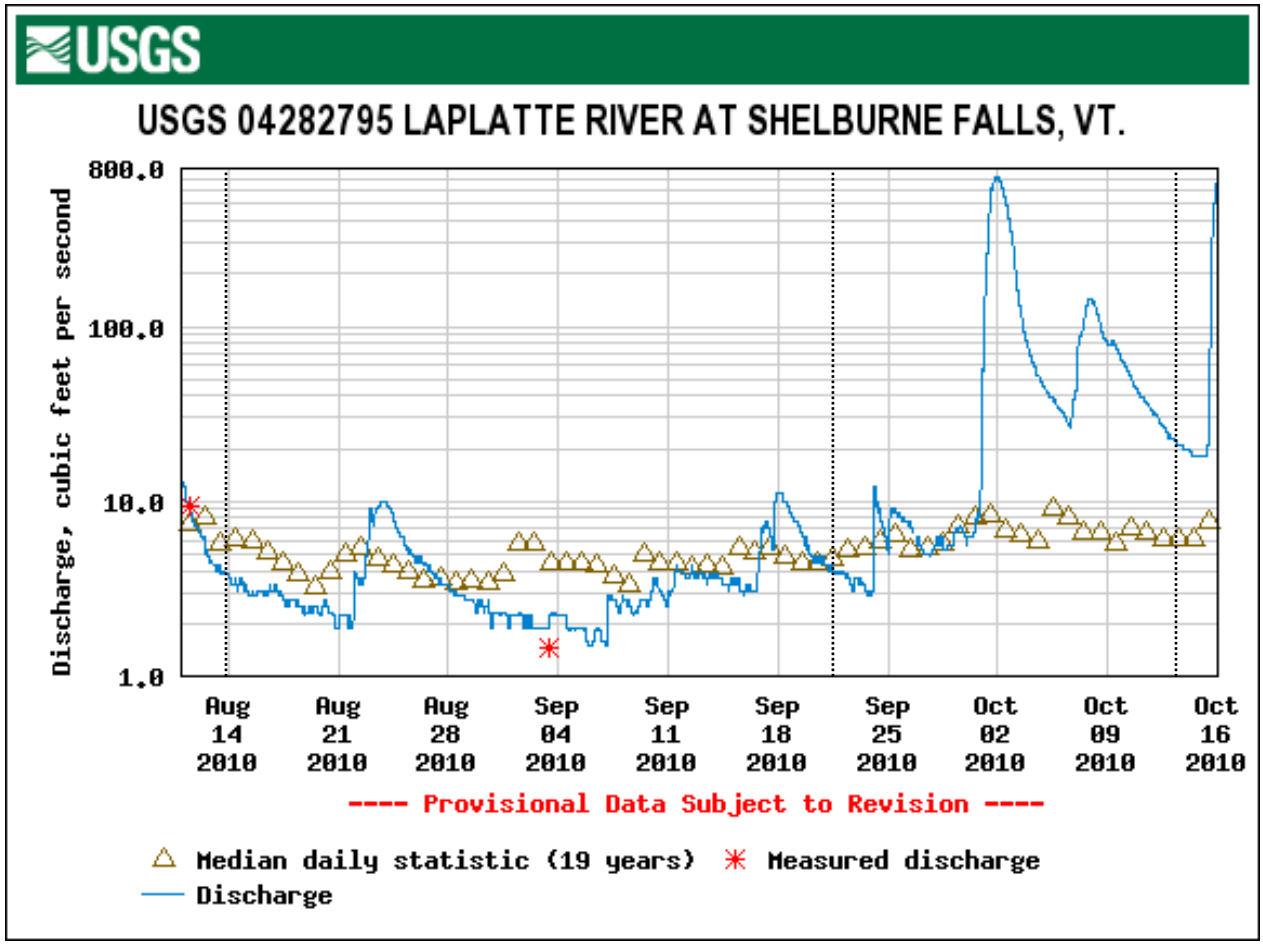
Appendix A (cont'd):

***Montpelier River sampling.**



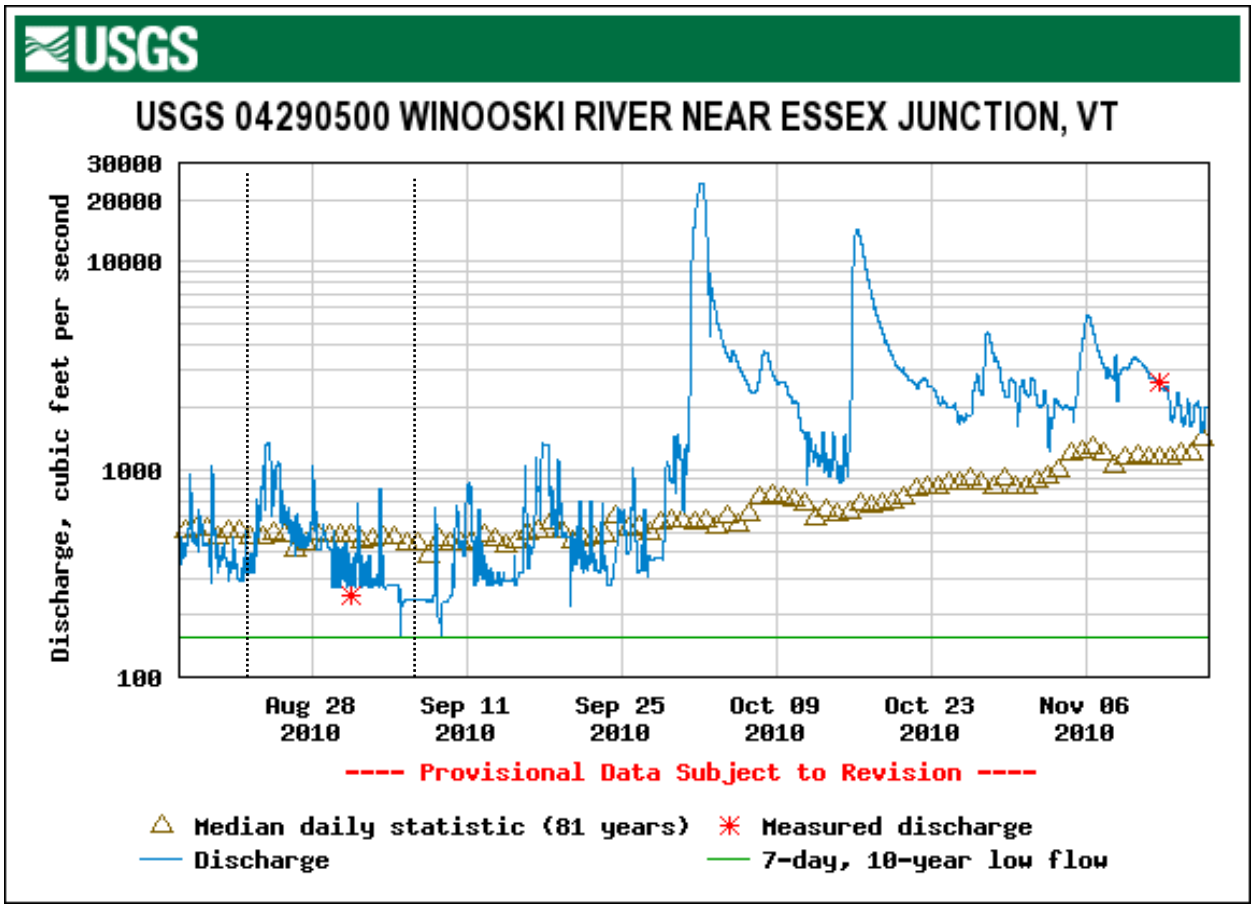
Appendix A (cont'd):

***Hinesburg Sampling.**



Appendix (cont'd):

***Burlington North, Burlington Riverside and Winooski sampling.**



Appendix A (cont'd):

***Poultney River sampling.**