Section 5-7
Penjajawoc Stream (Penjajawoc Stream Team)

Refer to Chapter 4 of this document for information about sampling methods, sampling sites, and quality assurance.

Overview

In the fall of 2007, the City of Bangor and the Maine DEP VRMP Program organized a Volunteer Monitoring Team to monitor water quality in Penjajawoc Stream. Penjajawoc Stream is a small urban stream located partially in Bangor and partially in Veazie, Maine. Penjajawoc has a watershed area of 8.57 square miles, with headwaters in a vast marsh system north of Bangor. The stream then flows through the Bangor Mall before passing under highway I-95, then past Eastern Maine Community College (a vocational college), the Dorothea Dix Mental Health Center complex, and past a number of auto dealerships before it passes through a residential area and drains into the Penobscot River. Two principal tributaries, Meadow Brook and Cemetery Brook, join the stream in the lower watershed. Penjajawoc Stream is 5.2 miles long, while the tributaries – Meadow and Cemetery Brooks – are 1.5 and 2.2 miles respectively. Penjajawoc Stream and Meadow Brook are listed as impaired due to urban non-point source pollution, hydraulic alterations due to development, and habitat degradation. Specific problems include seasonally low dissolved oxygen, seasonally warm water, and impaired aquatic macroinvertebrate communities. Bacterial contamination has been documented, but it is still unclear at this time if it is from human or wildlife origins. The statutory water class of the Penjajawoc and Meadow Brook are Class B. As recently as 2009, a DEP biomonitoring assessment and a more inclusive assessment in 2008 showed that all sites failed to attain Class B standards.

The Volunteer Monitoring Team was established to assess water quality and to monitor progress as the City of Bangor makes stormwater retrofits in order to improve water quality. Eventually, the goal is for these streams to meet their water quality classification standards. The Penjajawoc Sampling and Analysis Plan states that the objectives of monitoring are to: (1) develop baseline data; (2) provide information on current watershed conditions; and (3) monitor progress during the restoration process.

Methods

Since the first monitoring in the fall of 2007, the Penjajawoc Volunteer Monitoring Team have monitored seven historical stations on the main stem and one station each on the lower reaches of Meadow and Cemetery Brooks (Table 5-7-1 and Figure 5-7-1). In 2011, four main stem sites and two tributary sites were monitored, and the monitoring group became known as the Penjajawoc Stream Team. In the spring and fall, stream sampling was timed to coincide with stormwater episodes. Specific conductance (or total dissolved solids, TDS), water temperature, and turbidity were measured in the field. In the summer, volunteers took baseflow measurements of water temperature, specific conductance, and dissolved oxygen. Sampling

began with one sample in May and then sampling switched to twice a month at two week intervals in June, July, and August. All of the Penjajawoc Stream Team sites are VRMP approved sites.

Table 5-7-1: Penjajawoc Stream Team monitoring sites.

VRMP Site ID	Organization Site Code	Sample Location	Class
Cemetery Brook-PPJCB02-VRMP	CB1	Cemetery Brook	B
Penjajawoc Stream-PPJ01-VRMP	PJS1	Young Street	B
Penjajawoc Stream-PPJ08-VRMP	PJS2	Evergreen Woods	B
Penjajawoc Stream-PPJ16-VRMP	PJS3	Staples	B
Penjajawoc Stream-PPJ21-VRMP	PJS4B	Penn Plaza	B
Meadow Brook (Bangor)-PPJME01	MB1	Meadow Brook	B

Monitoring was conducted from February 26 through August 23. Spring samples were timed to catch stormwater events. Summer samples were essentially once a month to twice a month during baseflow conditions. At each site, the monitors made direct measurements of water temperature and dissolved oxygen using a LaMotte all-liquid Winkler titration kit. Conductivity was directly measured at the freshwater sites using an Oakton EC 11+ Testr conductivity pen (or some volunteers had Oakton TDS Testr 11 pens, TDS was converted to specific conductance for reporting). Grab samples were collected for turbidity analysis at the Bangor DEP office. DEP used a Hach 2100 P meter for assessing turbidity.

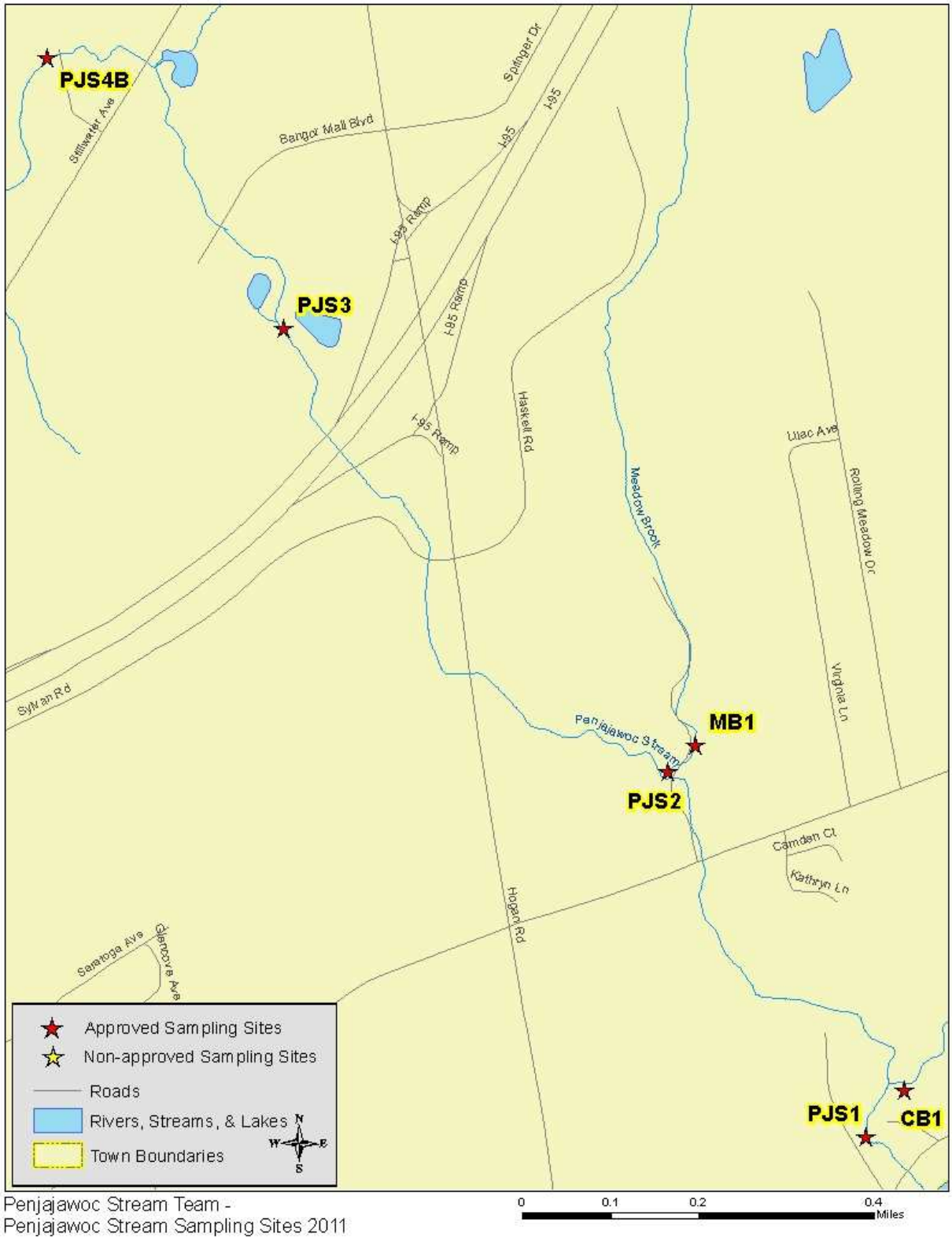

Figure 5-7-1: Map of Penjajawoc Stream Team sampling sites on the Penjajawoc Stream.

Results

Refer to Appendices A-1 and A-2 in discussion of individual site data and trends, as well as graphed data (5-7-2 through 5-7-6), at the end of this section of the report.

Dissolved Oxygen

Dissolved oxygen (DO) was measured once in mid- to late-May and then twice a month from June 15 through August 23 (Table 5-7-2 and Table 5-7-3). Class B standards for dissolved oxygen are a minimum of 7 mg/l (milligrams/liter) or 75% saturation, whichever is higher.

Table 5-7-2: A summary of minimum, maximum, and average dissolved oxygen concentration values (mg/l) at Penjajawoc Stream Team sites on the Penjajawoc Stream.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average
PJS1	Y	8	7.6	8.9	8
PJS2	Y	7	6.6	8.7	7.7
PJS3	Y	8	6	8.6	7.6
PJS4b	Y	8	5.6	7.9	6.4
MB1	Y	9	5.7	8.7	7.3
CB1	Y	8	7.4	9.2	7.7

Table 5-7-3: A summary of minimum, maximum, and average dissolved oxygen saturation values (%) at Penjajawoc Stream Team sites on the Penjajawoc Stream.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average
PJS1	Y	7	77	90.6	87.4
PJS2	Y	6	74	90.6	82.2
PJS3	Y	7	67.3	94.6	82.6
PJS4b	Y	7	63.4	73.3	69.2
MB1	Y	7	60.8	82.6	73.5
CB1	Y	7	75.5	91.2	83

Dissolved oxygen concentrations measured at main stem and tributary sites ranged from 5.6 mg/l at Penn Plaza on July 12th to 9.2 mg/l in Cemetery Brook during an algal bloom on July 26th (soon after the hottest day of the year). Photosynthesis from the algal bloom is responsible for the high DO value on this date (the sample is probably supersaturated for oxygen, but we cannot tell for sure since water temperature was not recorded for this day). All DO samples from the lower watershed (the Penjajawoc at Young's Street and Cemetery Brook) met the state Class B standard. However, all the other sites had some DO concentrations that were below the Class B standard of 7.0 mg/l. Dissolved oxygen percent saturation ranged from 60.8% to 94.6%. Again,

Penjajawoc Stream at Young's Street and Cemetery Brook met the Class B standard of 75% saturation for all samples, while other sites all had some values below that threshold. All of the measurements below 75% saturation occurred on summer days when water temperature was equal to or exceeded 18ºC (64.4ºF), except for Meadow Brook which had some low values down to 15ºC (59ºF). A DO concentration of 4.0 mg/l of oxygen is mentioned in fisheries literature as a threshold for survival for many fish and invertebrates. No values that low were observed this year. Dissolved oxygen is strongly influenced by temperature and flow conditions. Warm water has less capacity to carry dissolved gasses (i.e., gasses are less soluble). Also, during high flow conditions, oxygen is renewed in streams by turbulent mixing of water and air. If summer flows are rainy and cooler than normal, then this will affect the dissolved oxygen. The summer of 2011 was especially wet from August through the end of the year.

Penn Plaza generally has the lowest DO (Figure 5-7-2) – in 2011, only one measurement met state DO standards. This may be due to the proximity of this site to Penjajawoc Marsh, which is only 0.25 miles away. Most of the stream habitat from the Marsh to Penn Plaza is rocky riffles and is expected to be a good aerator for the stream water. However, the aeration may not be very efficient at low flows and during high summer temperatures. The decomposition of peat in the marsh can reduce oxygen levels in the stream to very low levels.

Meadow Brook also often has low DO values even though it has the coldest water. This may indicate an organic load in this sub-watershed. For instance, Birch Stream, which drains much of Bangor International Airport, had an organic load that turned out to be antifreeze from winter de-icing of aircraft; this runoff has now been diverted to the city wastewater treatment plant. The nature of the organic load (if any) in Meadow Brook is not clear; sometimes this comes from a peaty stream bottom like in Penjajawoc Marsh, but this stream has a rock and clay bottom.

Cemetery Brook and the Penjajawoc at Young's Street have the best DO concentrations. Cemetery Brook has more green space, including the partially wooded Mount Hope Cemetery and undeveloped forested areas in the upper watershed. The lower Penjajawoc is also less intensively developed, transitioning from urban to partially wooded suburban residential in the lower watershed. The lower stream is also dominated by rocky riffle habitat and steeper gradients than the upper watershed, which promote turbulent mixing. In a good water year like 2011, this appears to be enough to keep the water aerated.

Water Temperature

Temperature was measured at least 6 times for all sampling sites (Table 5-7-4). Monitoring for temperature occurred from February through August (note: graphed water temperature data does not include early season data). Maine's Regulations Relating to Temperature (06-096 CMR Chapter 582) require that discharge of pollutants not raise the temperature of any river and stream above the EPA criteria for indigenous species (23°C maximum and 19°C weekly average) or 0.3°C (0.5°F) above the temperature that would naturally occur outside a mixing zone established by the Board of Environmental Protection. A "pollutant" is defined in statute as many things including dirt, excess heat, and toxic chemicals.

Table 5-7-4: A summary of minimum, maximum, and average temperature values (°C) at Penjajawoc Stream Team sites on the Penjajawoc Stream.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average
PJS1	Y	7	16	22	19.5
PJS2	Y	6	15.5	22	18.8
PJS3	Y	7	15.5	22	19.6
PJS4b	Y	7	15.5	21.5	19
MB1	Y	9	15	20	15.8
CB1	Y	7	16.5	22	19.1

Temperatures measured during the summer at four Penjajawoc Stream sites ranged from 15.5˚C to 22˚C. Meadow Brook site MB1 was consistently colder than other sites. The lower main stem site PJS2 was the warmest with temperatures as high as 22ºC. The warmest day of the year was on July 21st. The warmest temperatures of the year were down substantially from last year when the highest values were 27ºC (a lethal 80.6ºF for coldwater fishes). No temperature exceedances were observed, although temperature varied through the day and we cannot tell from single measurements what the real maximum or weekly averages were.

Meadow Brook is consistently the coldest, and is obviously influenced by spring inputs. Cemetery Brook has the least developed watershed, but the Mount Hope Cemetery has some small ponds that are part of Cemetery Brook. Ponds act like solar collectors and can counter the benefits of forested headwaters.

Specific Conductance

Specific conductance was measured at all six sites (Table 5-7-5). Monitoring occurred from February through August (note: graphed specific conductance data does not include early season data). Specific conductance is a measure of the amount of dissolved materials in the water (and it is inter-convertible with total dissolved solids, or TDS). While there are no numerical standards for specific conductance, in urban settings a relationship exists between conductivity and chloride which does have numerical criteria. In general, streams located in urban areas tend to have high specific conductance due to polluted urban stormwater runoff. This is due in part to salt contamination of surface water and groundwater from road maintenance practices.

Meadow Brook has the highest average specific conductance. Lab tests have confirmed that sodium chloride (road salt) is the dominant dissolved substance. However, even if our highest conductivity values are converted to chloride, there would be no exceedances this year.

In past years, there were weeks at a time in the spring when both chronic and acute State water quality standards for chloride were exceeded due to road salt contamination. Because the minimum value is also high, it is apparent that groundwater has been contaminated by road salt. Based on historic measurements in the Penjajawoc Marsh (the upper watershed), the normal

specific conductance for this watershed appears to be around 115 µS/cm. This value could be used as a baseline for when there was no major development in the middle and lower watersheds. Cemetery Brook has the lowest average specific conductance and is similar to this hypothetical baseline. The Cemetery Brook watershed is dominated by the Mount Hope Cemetery and has forested headwaters. It also has the least impermeable cover (buildings and roads) and appears to have much less contamination from road salt.

Table 5-7-5: A summary of minimum, maximum, and average specific conductance values (µS/cm) at Penjajawoc Stream Team sites on the Penjajawoc Stream.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average
PJS1	Y	7	120	544	261
PJS2	Y	8	106	453	291
PJS3	Y	6	99	779	486
PJS4b	Y	6	129	684	315
MB1	Y	11	297	791	492
CB1	Y	7	99	156	136

It is surprising that the middle site on the Penjajawoc (below Staples on the Bangor Mall) has the highest specific conductance. Usually a drop in conductance at a lower site is due to dilution by a tributary, but there is no tributary between this site and Evergreen Woods. Meadow Brook enters Penjajawoc Stream below the Evergreen Woods site and is more contaminated with road salt than the main stem is. The dilution in the main stem could to be due to groundwater from springs and seeps, but the steady temperature in the mid to lower watershed (Table 5-7-4) does not appear to support that possibility. Usually groundwater in Maine is about 4ºC (40ºF), but urban groundwater can be warmer due to the amount of pavement and urban heat-island effect. Another issue is that averages are strongly influenced by very large or very small values that pull the average one way or the other. It is likely the average was pulled off by a large value from the middle watershed that was not matched by a lower site on the same date. Volunteers often take their samples hours or even days apart, and there are usually some missing samples when someone was not able to make a measurement.

Turbidity

Turbidity was primarily measured in the late winter and early spring (February and March) or in the fall (October to December) during high flows, or at any other time when cloudiness was observed in the water (Table 5-7-6). Maine has no statutory criteria for turbidity, but streams are supposed to support native wildlife, including native fishes. The impacts of turbidity are measured by a combination of intensity (measured in nephelometric turbidity units, NTU) and duration (hours, days or weeks). Negative impacts on aquatic organisms are expected when the intensity is greater than 10 NTU and the conditions last for weeks, or if the intensity is higher than about 100 NTU for many hours at a time. There were not many samples taken for turbidity, only six measurements, in 2011.

Table 5-7-6: A summary of minimum, maximum, and average turbidity values (NTU) at Penjajawoc Stream Team sites on the Penjajawoc Stream.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average
PJS1	Y	0			
PJS2	Y	3	16	62	39
PJS3	Y	0			
PJS4b	Y	0			
MB1	Y	3	84	765	328
CB1	Y	0			

Turbidity remains an issue and Meadow Brook was observed to have the worst (as has been the case in previous years). Our data is from volunteer grab samples and does not provide information about the duration of the problem. However, based previous year's experience, the observed turbidities are high enough, occur over a long enough period, and are repeated frequently enough to be harmful for aquatic plants and animals.

Total solids is a measure of dissolved solids plus suspended and settable solids in water and, in stream water, consist of minerals, ion particles, humics, and tannins (Figure 5-7-6). Volunteer monitors collect water samples, and results are analyzed by a certified lab.

Discussion and Recommendations

There are numerous sources of pollution and other stresses to the Penjajawoc sites monitored by the Penjajawoc Volunteer Monitoring Team that could potentially have an impact on water quality. Some of those sources of pollution and stress may include:

- Non-point source pollution (e.g., eroded soil, fertilizers, pesticides, heavy metals, petroleum residues, road salt, septic systems, wildlife, and pet feces) and polluted stormwater originating from urban sources
- Impervious surfaces (e.g., streets, parking lots, driveways, rooftops), agriculture, and forestry
- Ponds and impoundments (which often create more pond-like aquatic habitat conditions that may have higher water temperatures and lower dissolved oxygen concentrations than free-flowing waters)
- Natural effects of wetlands (such as contributing waters to a stream/river that have low dissolved oxygen levels due to the decomposition of large amounts of organic matter, respiration of abundant plant matter, and low re-aeration rates that is characteristic of many wetlands).

Some of the objectives of the Penjajawoc Volunteer Monitoring Team have been achieved to date. Since 2008, the first full year of monitoring, the VRMP program has established a good baseline and has been able to accurately characterize the current water quality conditions. A

number of problems have been identified. The remaining mission of the Monitoring Team is to document changes as the stormwater collection system is up-graded and modernized. There were important stormwater upgrades in 2010 and again in 2011. Hopefully, the changes will be reflected in improved water quality in 2012.

The following are recommendations for future monitoring:

- Monitoring should include some early morning (before 8:00 am) sampling to document potential dissolved oxygen problems. Over a 24 hour period, the lowest readings occur in the early morning and highest readings in mid to late afternoon. This occurs because oxygen is used up during the night due to plant respiration and during the day, plant life is photosynthesizing. This is particularly important during the summer months of July to early September when temperatures are warmest and dissolved oxygen tends to be at the lowest levels.
- If very high specific conductance values are found again, the monitors may want to do some specific conductance readings in the river above the high values to see if a source can be found.
- Further study of the high bacteria may be warranted.
- The Volunteer Monitoring Team may do some macroinvertebrate monitoring to see if indicator species, such as stoneflies, will establish themselves. The Izaak Walton League Save our Streams Program has some appropriate protocols for volunteer groups.

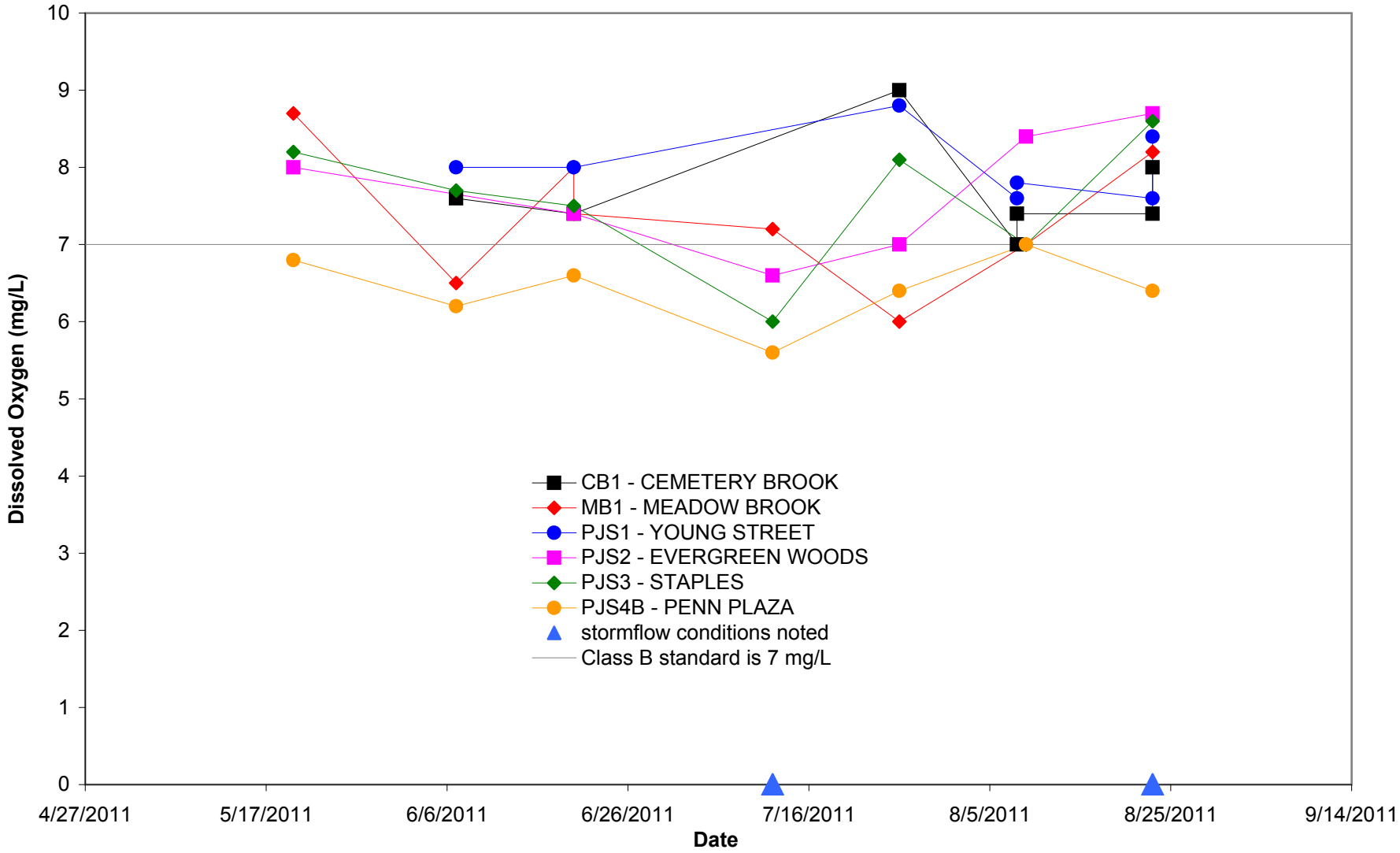

Figure 5-7-2. Dissolved oxygen concentrations at Penjajawoc Stream Team monitoring sites on Penjajawoc Stream, Cemetery Brook, and Meadow Brook for 2011.

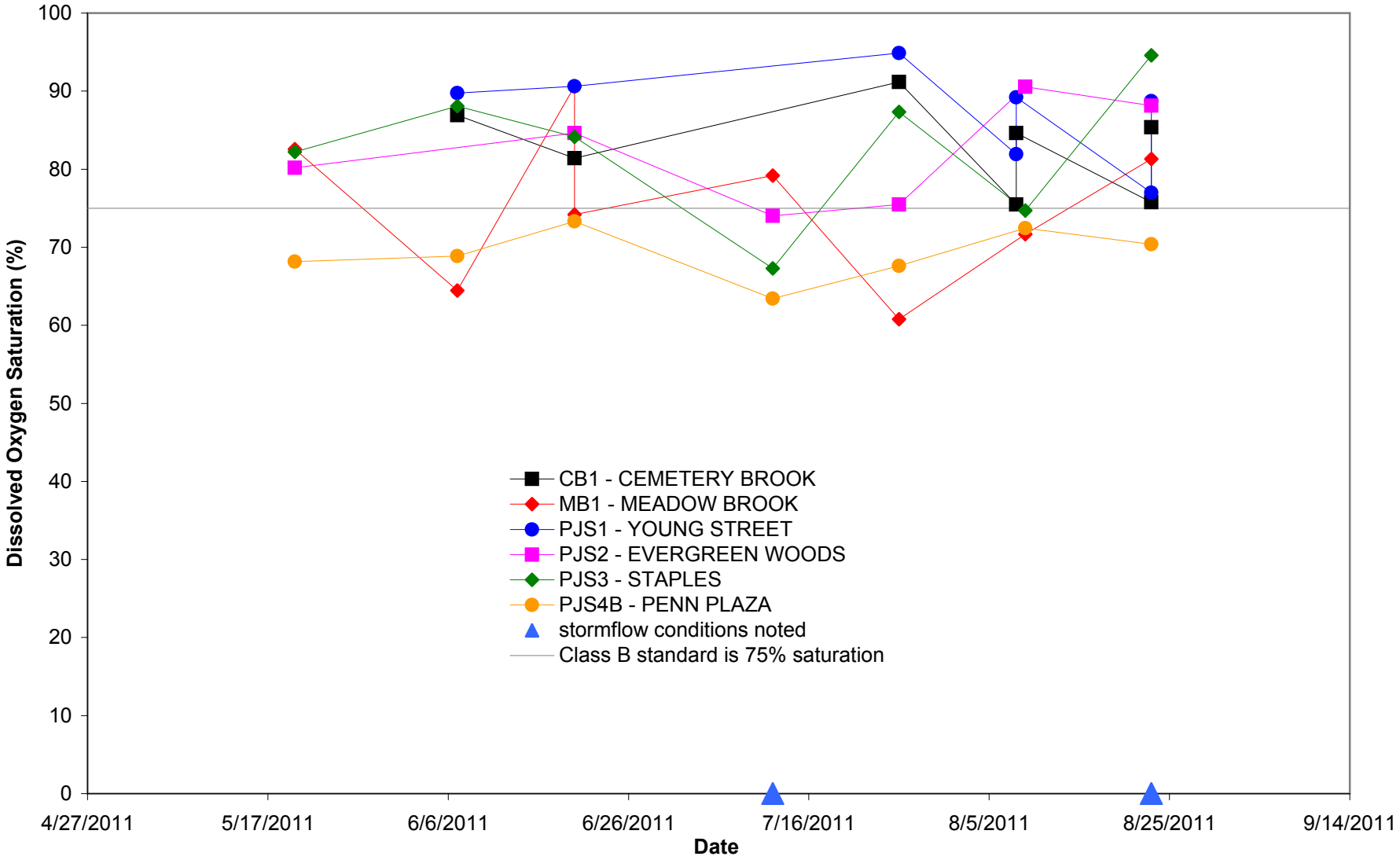

Figure 5-7-3. Dissolved oxygen % saturation at Penjajawoc Stream monitoring sites on Penjajawoc Stream, Cemetery Brook, and Meadow Brook for 2011.

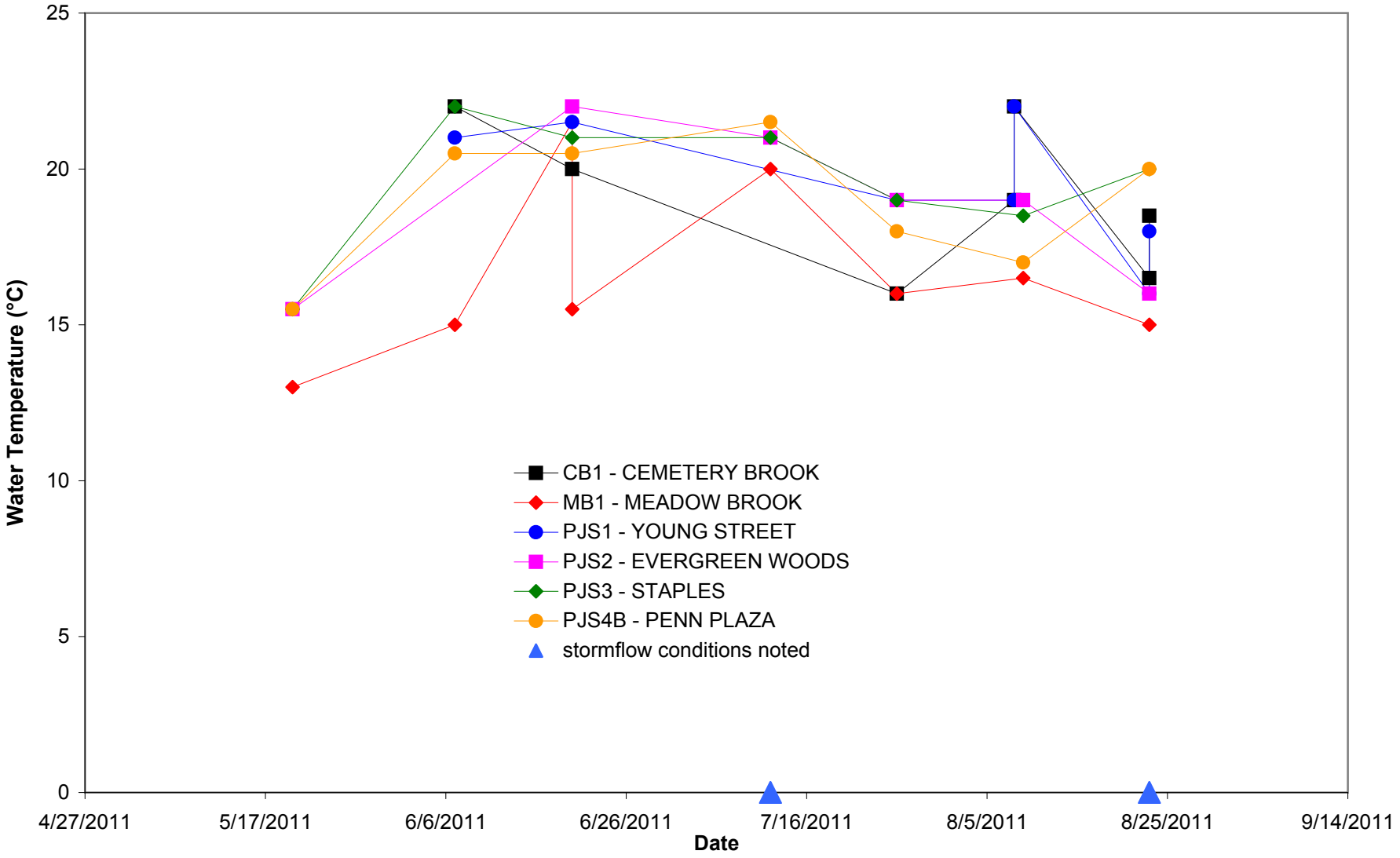

Figure 5-7-4. Water temperatures at Penjajawoc Stream Team monitoring sites on Penjajawoc Stream, Cemetery Brook, and Meadow Brook for 2011.

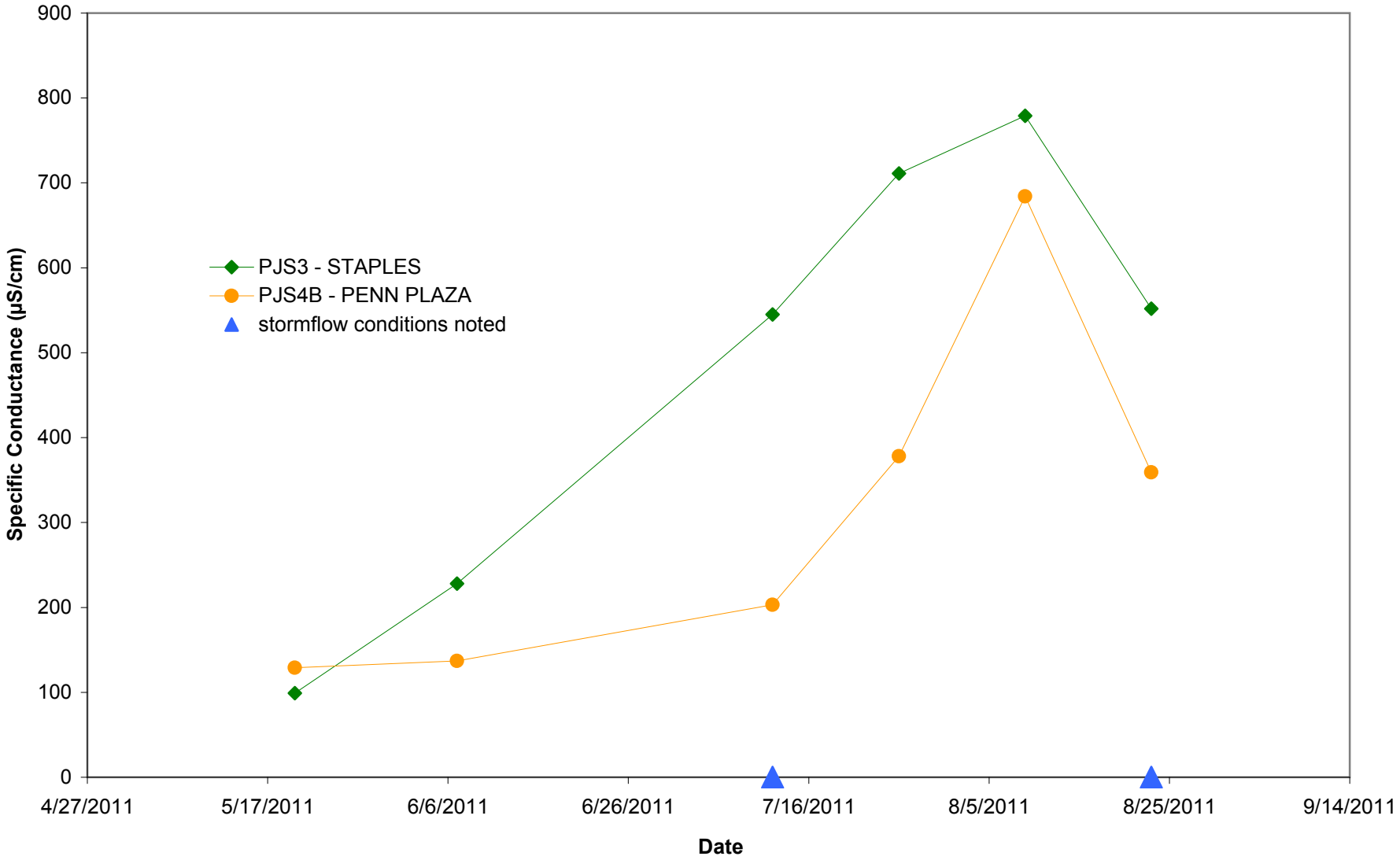

Figure 5-7-5. Specific conductance at Penjajawoc Stream Team monitoring sites on Penjajawoc Stream for 2011.

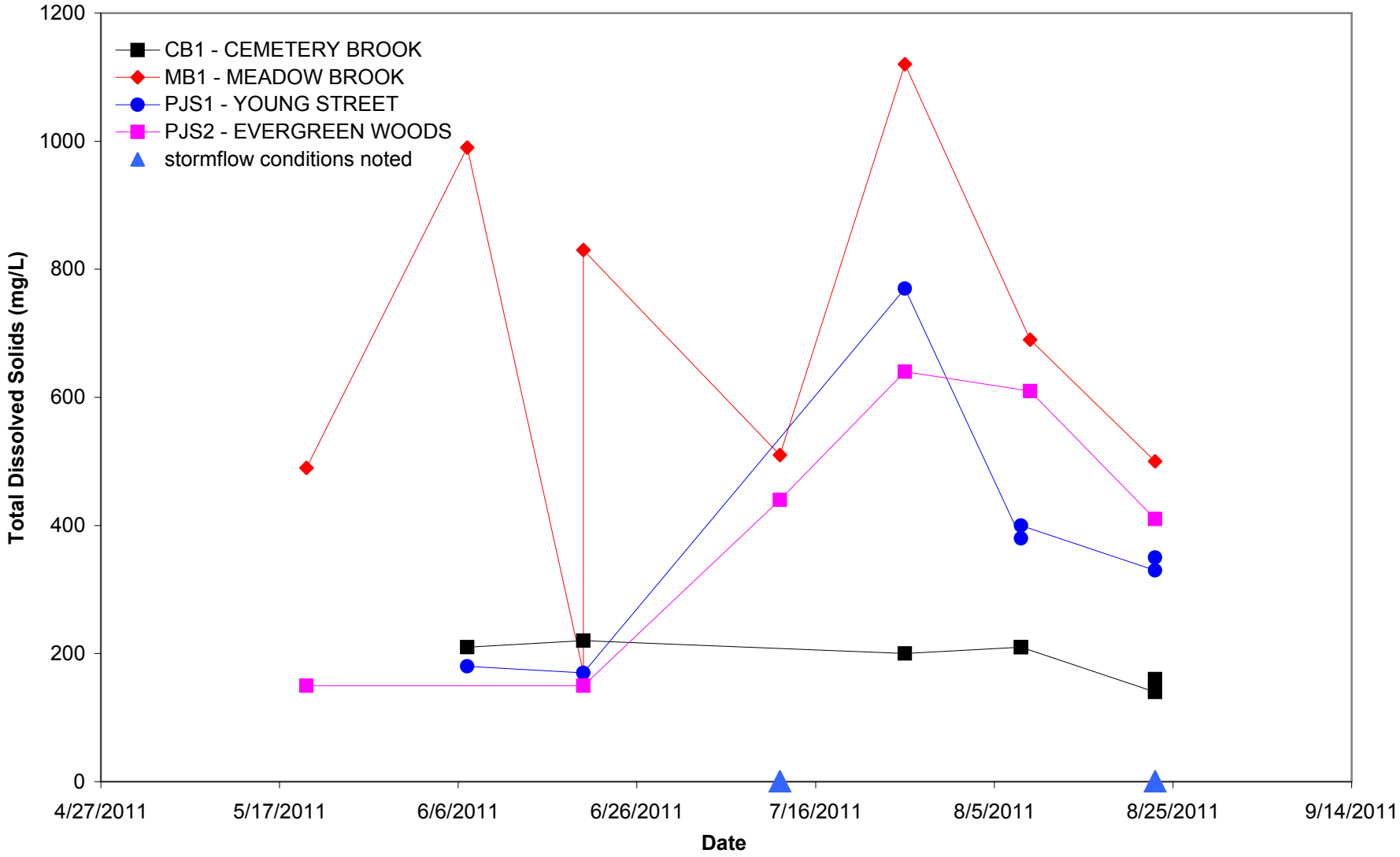

Figure 5-7-6. Total dissolved solids at Penjajawoc Stream Team monitoring sites on Penjajawoc Stream, Cemetery Brook, and Meadow Brook for 2011.

Appendix A-1. 2011 water quality data for "Approved" and "Non-Approved" sites. Non-Approved sites do not yet meet official VRMP sample location criteria and/or require further inspection and review.
* Sampling depths are only reported for Tier 1 VRMP sites.
** "N" = normal environmental sample ; "D" = field duplicate; "D.O." = dissolved oxygen; "Spec. Cond" = specific conductance; "TSS" = total suspended solids"
Refer to Appendix A-2 for observational data and quality assurance/quality control (QA/QC) notes.

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	* Sample Depth	Depth Unit	Water Temp (DEG C)	** D.O. Sat. (%)	** D.O. (MG/L)	** Spec. Cond. (US/CM)	Salinity (PPTH)	Turb-idity (NTU)	Total Diss. Solids (MG/L)	** TSS (MG/L)	E Coli Bacteria (MPN/ 100ML)
Penjajawoc Stream - Penjajawoc Stream Team (Approved Sites)															
CB1 - CEMETERY BROOK	CEMETERY BROOK - PPJCB02	6/7/2011	4:50 PM	N			22	86.92	7.6				210		
CB1	CEMETERY BROOK - PPJCB02	6/20/2011	3:45 PM	N			20	81.39	7.4				220		
CB1	CEMETERY BROOK - PPJCB02	7/26/2011	2:40 PM	N			16	91.18	9				200		
CB1	CEMETERY BROOK - PPJCB02	7/26/2011	2:40 PM	D					9.2						
CB1	CEMETERY BROOK - PPJCB02	8/8/2011	8:00 AM	N			19	75.46	7				210		
CB1	CEMETERY BROOK - PPJCB02	8/8/2011	3:09 PM	N			22	84.63	7.4				210		
CB1	CEMETERY BROOK - PPJCB02	8/23/2011	8:40 AM	N			16.5	75.77	7.4				140		
CB1	CEMETERY BROOK - PPJCB02	8/23/2011	3:00 PM	N			18.5	85.37	8				160		
PJS1 - YOUNG STREET	PENJAJAWOC STREAM - PPJ0	6/7/2011	4:30 PM	N			21	89.74	8				180		
PJS1	PENJAJAWOC STREAM - PPJ0	6/20/2011	3:20 PM	N			21.5	90.61	8				170		
PJS1	PENJAJAWOC STREAM - PPJ0	7/26/2011	3:00 PM	N			19	94.87	8.8				770		
PJS1	PENJAJAWOC STREAM - PPJ0	7/26/2011	3:00 PM	D					8.9						
PJS1	PENJAJAWOC STREAM - PPJ0	8/8/2011	8:20 AM	N			19	81.93	7.6				380		
PJS1	PENJAJAWOC STREAM - PPJ0	8/8/2011	3:20 PM	N			22	89.21	7.8				400		
PJS1	PENJAJAWOC STREAM - PPJ0	8/23/2011	9:00 AM	N			16	77	7.6				330		
PJS1	PENJAJAWOC STREAM - PPJ0	8/23/2011	3:30 PM	N			18	88.73	8.4				350		
PJS2 - EVERGREEN WOODS	PENJAJAWOC STREAM - PPJ0	2/26/2011	5:10 PM	N			0					16	320		
PJS2	PENJAJAWOC STREAM - PPJ0	2/26/2011	5:10 PM	D								19			
PJS2	PENJAJAWOC STREAM - PPJ0	3/11/2011	3:30 PM	N			0					62	570		
PJS2	PENJAJAWOC STREAM - PPJ0	5/20/2011	6:40 PM	N			15.5	80.19	8				150		
PJS2	PENJAJAWOC STREAM - PPJ0	6/20/2011	4:00 PM	N			22	84.63	7.4				150		
PJS2	PENJAJAWOC STREAM - PPJ0	7/12/2011	7:40 AM	N			21	74.03	6.6				440		
PJS2	PENJAJAWOC STREAM - PPJ0	7/12/2011	7:40 AM	D					6.6						
PJS2	PENJAJAWOC STREAM - PPJ0	7/26/2011	5:54 PM	N			19	75.46	7				640		
PJS2	PENJAJAWOC STREAM - PPJ0	8/9/2011	9:30 AM	N			19	90.55	8.4				610		
PJS2	PENJAJAWOC STREAM - PPJ0	8/23/2011	7:50 AM	N			16	88.14	8.7				410		

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	* Sample Depth	Depth Unit	Water Temp (DEG C)	** D.O. Sat. (%)	** D.O. (MG/L)	** Spec. Cond. (US/CM)	Salinity (PPTH)	Turb-idity (NTU)	Total Diss. Solids (MG/L)	** TSS (MG/L)	E Coli Bacteria (MPN/ 100ML)
PJS3 - STAPLES	PENJAJAWOC STREAM - PPJ1	5/20/2011	5:00 PM	N			15.5	82.2	8.2	99					
PJS3	PENJAJAWOC STREAM - PPJ1	6/7/2011	4:05 PM	N			22	88.06	7.7	228					
PJS3	PENJAJAWOC STREAM - PPJ1	6/20/2011	4:10 PM	N			21	84.13	7.5						
PJS3	PENJAJAWOC STREAM - PPJ1	7/12/2011	8:30 AM	N			21	67.3	6	545					
PJS3	PENJAJAWOC STREAM - PPJ1	7/12/2011	8:30 AM	D					6.3						
PJS3	PENJAJAWOC STREAM - PPJ1	7/26/2011	4:20 PM	N			19	87.32	8.1	711					
PJS3	PENJAJAWOC STREAM - PPJ1	8/9/2011	9:02 AM	N			18.5	74.7	7	779					
PJS3	PENJAJAWOC STREAM - PPJ1	8/23/2011	4:10 PM	N			20	94.58	8.6	552					
PJS4B - PENN PLAZA	PENJAJAWOC STREAM - PPJ2	5/20/2011	4:20 PM	N			15.5	68.16	6.8	129					
PJS4B	PENJAJAWOC STREAM - PPJ2	6/7/2011	3:45 PM	N			20.5	68.87	6.2	137					
PJS4B	PENJAJAWOC STREAM - PPJ2	6/20/2011	5:10 PM	N			20.5	73.31	6.6						
PJS4B	PENJAJAWOC STREAM - PPJ2	7/12/2011	8:05 AM	N			21.5	63.43	5.6	203					
PJS4B	PENJAJAWOC STREAM - PPJ2	7/12/2011	8:05 AM	D					5.6						
PJS4B	PENJAJAWOC STREAM - PPJ2	7/26/2011	3:55 PM	N			18	67.6	6.4	378					
PJS4B	PENJAJAWOC STREAM - PPJ2	8/9/2011	8:25 AM	N			17	72.43	7	684					
PJS4B	PENJAJAWOC STREAM - PPJ2	8/23/2011	3:44 PM	N			20	70.39	6.4	359					
MB1 - MEADOW BROOK	MEADOW BROOK (BANGOR) -	2/26/2011	5:00 PM	N			0					135	420		
MB1	MEADOW BROOK (BANGOR) -	2/26/2011	5:00 PM	D								138			
MB1	MEADOW BROOK (BANGOR) -	3/11/2011	3:30 PM	N			-1					765	710		
MB1	MEADOW BROOK (BANGOR) -	5/20/2011	6:25 PM	N			13	82.57	8.7				490		
MB1	MEADOW BROOK (BANGOR) -	5/20/2011	6:25 PM	D									490		
MB1	MEADOW BROOK (BANGOR) -	6/7/2011	3:45 PM	N			15	64.46	6.5				990		
MB1	MEADOW BROOK (BANGOR) -	6/20/2011	3:20 PM	N			21.5	90.61	8				170		
MB1	MEADOW BROOK (BANGOR) -	6/20/2011	3:35 PM	N			15.5	74.18	7.4				830		
MB1	MEADOW BROOK (BANGOR) -	6/20/2011	3:35 PM	D			15.5								
MB1	MEADOW BROOK (BANGOR) -	7/12/2011	7:04 AM	N			20	79.19	7.2			84	510		
MB1	MEADOW BROOK (BANGOR) -	7/12/2011	7:04 AM	D					6.9						
MB1	MEADOW BROOK (BANGOR) -	7/26/2011	5:24 PM	N			16	60.79	6				1120		
MB1	MEADOW BROOK (BANGOR) -	7/26/2011	5:24 PM	D			16		5.7				1110		
MB1	MEADOW BROOK (BANGOR) -	8/9/2011	9:10 AM	N			16.5	71.67	7				690		
MB1	MEADOW BROOK (BANGOR) -	8/23/2011	7:30 AM	N			15	81.32	8.2				500		

Appendix A-2. 2011 observational data and quality assurance/quality control (QA/QC) notes for "approved" and "non-approved" sites.
** "N" = normal environmental sample; "D" = field duplicate; "D.O." = dissolved oxygen; "Spec. Cond" = specific conductance; "TSS" = total suspended solids
Refer to Appendix A-1 for water quality data

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	Flow	Stage	Air Temp (° C)	Sample Location	Current Weather	Air Condition	Past 24HR Weather	Habitat	Tide Stage	Water Appearance	Comments
Penjajawoc Stream - Penjajawoc Stream Team (Approved Sites)															
CB1 - CEMETERY BROOK	CEMETERY BROOK -	6/7/2011	4:50 PM	N	BASE FLOW	LOW	23.9	WADING	CLOUDY		CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
CB1	CEMETERY BROOK -	6/20/2011	3:45 PM	N	BASE FLOW	HIGH	25.6	WADING	CLOUDY		CLEAR	RUN		CLEAR	MUGGY WEATHER WADEABLE/MID-DEPTH
CB1	CEMETERY BROOK -	7/26/2011	2:40 PM	N	BASE FLOW	LOW	21.1	WADING	CLOUDY		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		CLEAR	LOTS OF ALGAE PRESENT WADEABLE/MID-DEPTH
CB1	CEMETERY BROOK -	7/26/2011	2:40 PM	D				WADING							LOTS OF ALGAE PRESENT WADEABLE/MID-DEPTH
CB1	CEMETERY BROOK -	8/8/2011	8:00 AM	N	BASE FLOW	LOW	18.3	WADING	CLOUDY, SHOWERS		MOSTLY CLOUDY, RAIN, SHOWERS	RIFFLE		CLEAR	WATER STILL LOW IN SPITE OF SHOWERS, BUT UP A BIT, LOTS OF PURPLE LOOSESTRIFE WADEABLE/MID-DEPTH
CB1	CEMETERY BROOK -	8/8/2011	3:09 PM	N	BASE FLOW	LOW	27.2	WADING	CLOUDY, SHOWERS		MOSTLY CLOUDY, RAIN, SHOWERS	RIFFLE		CLEAR	WATER LEVEL STILL LOW, BUT UP A BIT WADEABLE/MID-DEPTH
CB1	CEMETERY BROOK -	8/23/2011	8:40 AM	N	BASE FLOW	LOW	14.4	WADING	CLEAR		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		OPAQUE	HEAVY RAIN SAT-MONDAY WADEABLE/MID-DEPTH MORNING AND AFTERNOON SAMPLES TAKEN FOR DO COMPARISONS
CB1	CEMETERY BROOK -	8/23/2011	3:00 PM	N	BASE FLOW	LOW	24.4	WADING	CLEAR		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		OPAQUE	HEAVY RAIN SAT-MONDAY WADEABLE/MID-DEPTH MORNING AND AFTERNOON SAMPLES TAKEN FOR DO COMPARISONS
PJS1 - YOUNG STREET	PENJAJAWOC STREA	6/7/2011	4:30 PM	N	BASE FLOW	MEDIUM	23.9	WADING	CLOUDY		CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	6/20/2011	3:20 PM	N	BASE FLOW	MEDIUM	25.6	WADING	CLOUDY		CLEAR	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	7/26/2011	3:00 PM	N	BASE FLOW	LOW	21.1	WADING	CLOUDY		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	7/26/2011	3:00 PM	D				WADING							WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	8/8/2011	8:20 AM	N	BASE FLOW	LOW	18.3	WADING	CLOUDY, SHOWERS		MOSTLY CLOUDY, RAIN, SHOWERS	RIFFLE		OPAQUE	WATER LEVEL STILL LOW, BUT UP A BIT WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	8/8/2011	3:20 PM	N	BASE FLOW	LOW	27.2	WADING	CLOUDY, SHOWERS		MOSTLY CLOUDY, RAIN, SHOWERS	RIFFLE		OPAQUE	WATER LEVEL STILL LOW, BUT UP A BIT WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	8/23/2011	9:00 AM	N	BASE FLOW	LOW	14.4	WADING	CLEAR		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		OPAQUE	HEAVY RAIN SAT-MONDAY WADEABLE/MID-DEPTH
PJS1	PENJAJAWOC STREA	8/23/2011	3:30 PM	N	BASE FLOW	LOW	24.4	WADING	CLEAR		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		OPAQUE	HEAVY RAIN SAT-MONDAY WADEABLE/MID-DEPTH MORNING AND AFTERNOON SAMPLES TAKEN FOR DO COMPARISONS
PJS2 - EVERGREEN WOODS	PENJAJAWOC STREA	2/26/2011	5:10 PM	N	STRM FLOW	HIGH		BANK	CLOUDY, LIGHT RAIN	CALM	HEAVY RAIN, OVERCAST, SHOWERS	RUN		TURBID	WADEABLE/1.5 FT BELOW SURFACE
PJS2	PENJAJAWOC STREA	2/26/2011	5:10 PM	D				BANK							WADEABLE/1.5 FT BELOW SURFACE

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	Flow	Stage	Air Temp (° C)	Sample Location	Current Weather	Air Condition	Past 24HR Weather	Habitat	Tide Stage	Water Appearance	Comments
PJS2	PENJAJAWOC STREA	3/11/2011	3:30 PM	N		HIGH		BANK	CLOUDY, LIGHT RAIN		OVERCAST	RUN		TURBID	WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	5/20/2011	6:40 PM	N	BASE FLOW	HIGH		WADING	CLOUDY	CALM	LIGHT RAIN, OVERCAST, SHOWERS	RUN		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	6/20/2011	4:00 PM	N	BASE FLOW	MEDIUM	22.8	BANK	PARTLY CLOUDY		CLEAR, PARTLY CLOUDY	RUN		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	7/12/2011	7:40 AM	N	STRM FLOW	HIGH	21.1	BANK	LIGHT RAIN		CLEAR, LIGHT RAIN	RUN		CLEAR	WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	7/12/2011	7:40 AM	D				BANK							WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	7/26/2011	5:54 PM	N	BASE FLOW	MEDIUM	22.2	WADING	CLOUDY		OVERCAST, RAIN, SHOWERS	RIFFLE		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	8/9/2011	9:30 AM	N	BASE FLOW	MEDIUM	22.2	WADING	CLEAR		CLEAR, LIGHT RAIN, MOSTLY CLOUDY	RIFFLE		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS2	PENJAJAWOC STREA	8/23/2011	7:50 AM	N	STRM FLOW	MEDIUM	21.1	WADING	CLEAR		LIGHT RAIN, PARTLY CLOUDY	RUN		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS3 - STAPLES	PENJAJAWOC STREA	5/20/2011	5:00 PM	N	BASE FLOW	HIGH		WADING	CLOUDY	CALM	LIGHT RAIN, OVERCAST, SHOWERS	RUN		CLEAR	WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	6/7/2011	4:05 PM	N	BASE FLOW	MEDIUM		WADING				RIFFLE		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	6/20/2011	4:10 PM	N	BASE FLOW	MEDIUM	22.2	WADING	PARTLY CLOUDY		CLEAR, PARTLY CLOUDY	RIFFLE		FOAMY	DID NOT HAVE HANNA COND PEN WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	7/12/2011	8:30 AM	N	BASE FLOW	LOW	22.2	WADING	CLOUDY, LIGHT RAIN		CLEAR, LIGHT RAIN, PARTLY CLOUDY	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	7/12/2011	8:30 AM	D				WADING							WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	7/26/2011	4:20 PM	N		LOW		WADING	CLOUDY		LIGHT RAIN, SHOWERS	RIFFLE		CLEAR	WATER VERY LOW AND SLOW WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	8/9/2011	9:02 AM	N	BASE FLOW	LOW		WADING	CLOUDY		MOSTLY CLOUDY, RAIN	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS3	PENJAJAWOC STREA	8/23/2011	4:10 PM	N	BASE FLOW	MEDIUM		WADING	PARTLY CLOUDY		OVERCAST	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS4B - PENN PLAZA	PENJAJAWOC STREA	5/20/2011	4:20 PM	N	BASE FLOW	HIGH		WADING	CLOUDY	CALM	LIGHT RAIN, OVERCAST, SHOWERS	RUN		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS4B	PENJAJAWOC STREA	6/7/2011	3:45 PM	N	BASE FLOW	MEDIUM		WADING				RIFFLE		MEDIUM STAINED	WADEABLE/MID-DEPTH
PJS4B	PENJAJAWOC STREA	6/20/2011	5:10 PM	N	BASE FLOW	MEDIUM	28.9	WADING	PARTLY CLOUDY		CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	DID NOT HAVE HANNA COND PEN WADEABLE/MID-DEPTH
PJS4B	PENJAJAWOC STREA	7/12/2011	8:05 AM	N	BASE FLOW	LOW	22.2	WADING	CLOUDY, LIGHT RAIN		CLEAR, LIGHT RAIN, PARTLY CLOUDY	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS4B	PENJAJAWOC STREA	7/12/2011	8:05 AM	D				WADING							WADEABLE/MID-DEPTH
PJS4B	PENJAJAWOC STREA	7/26/2011	3:55 PM	N		LOW		WADING	CLOUDY		LIGHT RAIN, SHOWERS	RIFFLE		CLEAR	WATER LEVEL VERY LOW AND SLOW WADEABLE/MID-DEPTH

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	Flow	Stage	Air Temp (° C)	Sample Location	Current Weather	Air Condition	Past 24HR Weather	Habitat	Tide Stage	Water Appearance	Comments
PJS4B	PENJAJAWOC STREA	8/9/2011	8:25 AM	N	BASE FLOW	LOW		WADING	CLOUDY		MOSTLY CLOUDY, RAIN	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
PJS4B	PENJAJAWOC STREA	8/23/2011	3:44 PM	N	BASE FLOW	MEDIUM		WADING	PARTLY CLOUDY		LIGHT RAIN	RIFFLE		CLEAR	MINNOWS AND CRAYFISH NOTED WADEABLE/MID-DEPTH
MB1 - MEADOW BROOK	MEADOW BROOK (BA	2/26/2011	5:00 PM	N	STRM FLOW	HIGH		BANK	CLOUDY, LIGHT RAIN	CALM	HEAVY RAIN, OVERCAST, SHOWERS	RUN		TURBID	WADEABLE/1.5 FT BELOW SURFACE
PPJME01	MEADOW BROOK (BA	2/26/2011	5:00 PM	D				BANK							WADEABLE/1.5 FT BELOW SURFACE
MB1	MEADOW BROOK (BA	3/11/2011	3:30 PM	N		HIGH		BANK	CLOUDY, LIGHT RAIN		OVERCAST	RUN		TURBID	WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	5/20/2011	6:25 PM	N	BASE FLOW	HIGH		BANK	CLOUDY	CALM	LIGHT RAIN, OVERCAST, SHOWERS	RIFFLE		MEDIUM STAINED	WADEABLE/1.5 FT BELOW SURFACE
MB1	MEADOW BROOK (BA	5/20/2011	6:25 PM	D				BANK							WADEABLE/1.5 FT BELOW SURFACE
MB1	MEADOW BROOK (BA	6/7/2011	3:45 PM	N	BASE FLOW	LOW	21.1	WADING	CLOUDY	BREEZE	CLEAR	RUN		CLEAR	DID NOT DO PENJAJWOC, NO BOOTS WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	6/20/2011	3:20 PM	N	BASE FLOW	MEDIUM	25.6	WADING	CLOUDY		CLEAR	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	6/20/2011	3:35 PM	N	BASE FLOW	LOW	22.8	BANK	PARTLY CLOUDY		CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	6/20/2011	3:35 PM	D				BANK							WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	7/12/2011	7:04 AM	N	STRM FLOW	HIGH	21.1	BANK	LIGHT RAIN		CLEAR, LIGHT RAIN	RIFFLE		MILKY	WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	7/12/2011	7:04 AM	D				BANK							WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	7/26/2011	5:24 PM	N	BASE FLOW	HIGH	22.2	WADING	CLOUDY		LIGHT RAIN, MOSTLY CLOUDY, SHOWERS	RIFFLE		CLEAR	WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	7/26/2011	5:24 PM	D				WADING							WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	8/9/2011	9:10 AM	N	BASE FLOW	MEDIUM	22.2	BANK	CLEAR		CLEAR, LIGHT RAIN, MOSTLY CLOUDY	RIFFLE		MEDIUM STAINED	WADEABLE/MID-DEPTH
MB1	MEADOW BROOK (BA	8/23/2011	7:30 AM	N	STRM FLOW	MEDIUM	21.1	BANK	CLEAR		LIGHT RAIN, PARTLY CLOUDY	RIFFLE		MILKY	WADEABLE/MID-DEPTH