

**FINAL**

**2009 Water Quality Monitoring  
Mill River  
Hamden and New Haven, CT**

**MAY 2010**

*Prepared for*

**Regional Water Authority**

*Prepared by*



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# 2009 Mill River Water Quality Monitoring

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## Introduction

This report presents the results of continuing studies by the Regional Water Authority (RWA) to document dissolved oxygen (DO) and salinity concentrations in the Mill River downstream of the Lake Whitney water supply reservoir. The objective of these studies, which began in 1998, is to monitor DO and salinity in the Mill River as they relate to potential impacts from reactivating Lake Whitney as a public water supply. The lake served as a water supply from 1862 until 1991, when its use was temporarily discontinued. The RWA resumed water withdrawals from the reservoir during the summer of 2005, concurrent with completion of the new Lake Whitney Water Treatment Plant (WTP).

As part of a comprehensive environmental assessment of the WTP project, studies of DO and salinity patterns in the lower Mill River were conducted in 1998 and then annually since 2000. DO and salinity were both recognized as important parameters to be considered in developing an environmental management plan for the Lake Whitney water withdrawals (Lake Whitney WTP Environmental Evaluation Team, 1999).

Based on the analysis of data collected from 1998 to 2003, 7.0 milligrams per liter (mg/L) was selected as a reasonable DO target level for the plunge pool in the Mill River immediately below the Lake Whitney Dam (CH2M HILL, 2003). That data indicated that, under most circumstances, this level will result in surface water DO concentration above 5.0 mg/L at the Orange Street Bridge during dry weather conditions. However, DO concentrations slightly below 5.0 mg/L were occasionally observed before water withdrawals from the lake resumed in 2005.

Past monitoring has identified negative effects on Orange Street Bridge DO concentrations during wet weather, believed to be from input of organic matter from urban stormwater runoff and combined sewer overflows (CSOs). To evaluate the effects of lake withdrawals more directly, DO and salinity have been regularly monitored farther upstream, at the footbridge in East Rock Park, since the summer of 2003. At this location, the influence of stormwater runoff, CSOs, and tidal flows are presumed to be lesser factors.

DO and salinity sampling was performed every week between July 3 and September 25, 2009, as part of the continuing monitoring and assessment effort. Because of low DO concentrations encountered during the late summer in previous years, the normal monitoring period of July through August has been extended through the last week of September.

Spells of persistent rainfall of long duration and low intensity were prevalent throughout spring and early summer of 2009 (Figure 1). Precipitation during much of July followed suit, but August and September experienced markedly less rainfall. The recorded precipitation from June to September was 25.8 inches at the Lake Whitney rain gauge. The total rainfall amount from 2009 was slightly in excess of 2008, which had been the wettest summer since monitoring began in the river and the second wettest in the RWA's 97-year Lake Whitney rain

gauge record. The average precipitation from June to September over the 5-year sampling period since the WTP has been in operation is 17.7 inches.

Figure 2 presents the rainfall amounts in the 72 hours preceding each sampling event. When analyzing the DO data, it is important to note influences from stormwater runoff. Rainfall accumulation greater than 0.12 inch was considered as a wet-weather measurement event. Rainfall of less than or equal to 0.12 inch was considered a dry-weather event (in the 72 hours preceding each sampling event). Wet-weather measurements were taken on July 24, July 31, August 21, August 28 and September 11, with rainfall ranging from 0.20 to 2.24 inches. The remaining sampling events had no rainfall (July 2, July 10, July 17, August 7, August 14, September 4, September 18, and September 25) before measurements.

The WTP was first operational in April 2005 and continued operation through 2009. During 2009 there was a significant reduction in demand at the plant. As a result of the reduced demand, the plant only operated one day a week, averaging about 8.7 percent of its maximum registered daily diversion (Figure 3).

Figure 4 presents estimated Lake Whitney Dam downstream flows to the Mill River from January 2009 to October 2009. Spillway flows ranged from an estimated 36 to 341 million gallons per day (MGD), with an average flow of 96.6 MGD. Flows are calculated based on the lake level at the spillway and when applicable using metered flows of downstream releases via the artificial waterfall and/or estimates of water released through the blowoff. The Management Plan specifies the initial minimum release as 4.2 MGD when the lake level falls below spillway elevation. Because of the high flows in 2009, there was no need to conduct downstream releases. Figure 5 presents the estimated flow in the Mill River for each of the sampling dates in 2009. Sampling date flows ranged from 40 MGD on September 11 to 327 MGD on July 24.

The 2009 sampling is the fifth annual DO and salinity monitoring and assessment effort at Mill River since the new WTP has gone on line. This report discusses a historical review of DO data, which was undertaken to establish a relationship between flow conditions and DO at the Footbridge and Orange Street stations.

## Monitoring Methods

From July 2 to September 25, 2009, the RWA conducted weekly dawn DO and salinity monitoring at and below the Lake Whitney dam (i.e., the spillway, plunge pool, the footbridge, the Orange Street Bridge, and both sides of the tidegates) (Figure 6). The measurements were conducted at dawn to reflect the diurnal oxygen sag that typically occurs in a lake or stream because of overnight respiration and lack of oxygen, producing photosynthesis. Table 1 presents a summary of the 2009 Mill River measurements.

As in the previous several years, the weekly data were collected using a Hydrolab Quanta multi-parameter meter that was calibrated before each set of water quality measurements. Measurements were collected at one depth at the spillway and plunge pool. At the footbridge, Orange Street Bridge, and the tidegates, measurements were taken near the surface (0.1- to 0.2-meter depth) and near the bottom to account for the possible presence of distinct water layers caused by salinity intrusion from Long Island Sound. All weekly monitoring data are presented in the Attachment.

**TABLE 1**  
Mill River Monitoring Data Collected in 2009

Frequency/Dates	Locations	Parameters
Weekly – July 2 through September 25 (early morning)	Spillway	Temperature, DO, salinity, pH, estimated flow
	Plunge Pool	
	Footbridge	
	Orange St.	
	Tidegates (North and South)	

## Monitoring Results

### Salinity

The weekly salinity monitoring data are presented in Figure 7 (surface layer) and Figure 8 (bottom layer). In general, increasing salinity at tidally influenced monitoring stations (footbridge and downstream) occurs during periods of lower freshwater flow from Lake Whitney. Elevated flows from historically high precipitation in 2009 resulted in relatively low salinities at these stations, particularly early in the sampling period. Salinity was higher at Orange Street in August and September of 2009 earlier in the monitoring period. In the bottom layer at Orange Street, no measurements exceeded 5 parts per thousand (ppt). The highest salinity measurements at Orange Street were observed between August 28 and September 25. During this time, the average daily river flows, as estimated at the spillway, ranged from 40 to 48 MGD. There was no measurable tidal influx of saline waters at the footbridge station in 2009, with all measurements at this location not significantly different from upstream freshwater monitoring stations.

As expected, compared to upstream locations, salinity levels were elevated at the tide gates, with concentrations ranging from 0.2 to 24 ppt in the bottom waters and from 0.2 to 22 ppt at the surface.

Figure 9 presents surface salinities at Orange Street and the footbridge, with river flow as measured at Lake Whitney Dam (spillway overflow). The salinity at Orange Street increased as the flow gradually decreased from the end of August to the end of September.

### Dissolved Oxygen

Weekly surface layer DO measurements from Mill River at the spillway, the plunge pool, the footbridge, Orange Street Bridge, and the tide gates are shown in Figure 10. Bottom layer measurements are shown in Figure 11. Table 2 summarizes all of the 2009 DO concentrations at the spillway, plunge pool, footbridge, Orange Street Bridge, and tidegates, including average, minimum, and maximum DO concentrations. Average DO readings for all weekly monitoring from 2001 to 2009 are presented in Table 3.

**TABLE 2**

## Weekly Dissolved Oxygen Concentrations

	Spillway	Plunge Pool	Footbridge Surface	Footbridge Bottom	Orange Ave. Surface	Orange Ave. Bottom	North Tidegate Surface	North Tidegate Bottom	South Tidegate Surface	South Tidegate Bottom
7/2/2009	10.15	8.24	7.22	7.12	6.42	6.20	6.22	6.11	6.12	5.85
7/10/2009	6.94	7.94	7.11	7.14	6.51	6.34	6.76	6.61	6.89	6.76
7/17/2009	8.69	7.99	7.33	7.29	6.82	6.74	5.10	<b>4.85</b>	6.12	<b>4.12</b>
7/24/2009	6.61	7.86	7.75	7.73	7.50	7.43	6.94	7.04	7.45	7.05
7/31/2009	8.11	7.32	5.95	6.00	5.33	5.21	5.84	5.80	5.92	5.56
8/7/2009	7.21	7.96	7.01	6.85	6.20	6.19	6.48	6.39	6.96	6.93
8/14/2009	7.90	7.49	6.23	6.22	5.92	5.73	<b>4.57</b>	<b>4.04</b>	<b>4.04</b>	<b>3.02</b>
8/21/2009	7.76	6.99	5.30	5.31	5.64	5.43	5.61	5.42	6.45	6.34
8/28/2009	7.00	6.10	5.80	5.70	8.50	7.60	<b>4.60</b>	<b>4.10</b>	<b>3.90</b>	<b>3.50</b>
9/4/2009	7.85	7.70	6.15	6.13	7.16	6.74	6.17	5.55	6.93	6.86
9/11/2009	7.49	7.64	5.59	5.63	7.47	5.59	5.65	<b>4.85</b>	<b>4.59</b>	<b>4.08</b>
9/18/2009	7.52	7.58	6.33	6.38	6.72	6.55	6.14	6.11	6.90	6.74
9/25/2009	8.34	7.87	5.47	5.48	6.75	6.02	5.11	<b>4.82</b>	5.67	<b>4.40</b>
Average	7.81	7.59	6.40	6.38	6.69	6.29	5.78	5.51	6.00	5.48
Min	6.61	6.10	5.30	5.31	5.33	5.21	4.57	4.04	3.90	3.02
Max	10.15	8.24	7.75	7.73	8.50	7.60	6.94	7.04	7.45	7.05

## Notes:

**Bold** represents DO concentrations less than the Connecticut Department of Environmental Protection water quality standard of 5.0 mg/L.

**TABLE 3**  
Average Mill River Surface Dissolved Oxygen, 2001 – 2008 Weekly Measurements

Station	2001	2002	2003	2004*	2005	2006	2007	2008	2009
Spillway	8.0	8.0	8.0	8.2	7.6	8.4	7.3	8.8	7.81
Plunge Pool	7.7	7.9	7.9	4.1	7.5	7.7	7.4	7.6	7.59
Footbridge	NA	NA	6.5	6.0	5.2	5.5	5.0	5.5	6.40
Orange St. Bridge	5.9	6.2	6.4	6.8	5.3	6.7	5.9	5.7	6.69
Tide Gates Upstream	NA	NA	6.2	6.2	5.1	6.1	5.5	5.0	5.78
Tide Gates Downstream	NA	NA	6.6	6.1	5.6	5.8	5.6	5.1	6.00

Notes:

- \*Flow bypassed around plunge pool July 6 - August 27, 2004 for lake drawdown.
- Average represents only weeks sampled during the summer—not the entire year. The number of weeks per year varied depending on weather patterns.

NA = No data available

Figure 12 presents the DO concentrations at the plunge pool, Orange Street (surface and bottom), and the footbridge (surface and bottom), along with the flow in the river as measured at the Lake Whitney spillway. The DO at the plunge pool always measured 7.0 mg/L or greater. In general, DO concentrations near the bottom of the water column were not substantially different from DO concentrations near the surface at the Orange Street monitoring location. This is likely attributable to the lack of salinity stratification at this location in 2009. At Orange Street, surface DO never dropped below 5.0 mg/L, and bottom DO was never below 5.0 mg/L. Surface and bottom DO concentrations at the footbridge never dipped below 5.0 mg/L.

The lowest surface DO values observed at the footbridge in the 2009 monitoring period was 5.3 mg/L, which followed a period of about 3 weeks with little or no rain and lower river flows .

## Historical Review

Five years of Mill River DO monitoring following activation of the new Whitney WTP, at the footbridge and Orange Street Bridge sampling stations were examined to better understand the relationship between DO in the Mill River and flow over the spillway (Figure 13). The historical data show that, between the beginning of July and end of September, occurrences of surface DO lower than 5.0 mg/L at both the footbridge and Orange Street dropped off substantially when the flow over the spillway was greater than 30 mgd, which corresponds to a lake level of 0.17 feet.

The statistical analysis of the surface DO readings reiterates that the likelihood of surface DO readings of less than 5 mg/L drops to near zero once the flow over the spillway is greater than

30 MGD (Figure 14). The analysis also showed that, based on the historical record, if the flow over the spillway is less than 30 MGD there is an average 70 percent chance that a measurement of surface DO of less than 5 mg/L will occur at the footbridge and, similarly, a 44 percent chance at Orange Street Bridge.

## Conclusions

This report summarizes the information obtained from the fifth year of data collection during operation of the new Lake Whitney WTP. Rainfall in 2009 primarily occurred in prolonged rainfall events at the beginning of the sampling period, followed by several 3-4 week periods of dry weather later in the year. This was the wettest summer since monitoring began in 1998. The following conclusions can be drawn from the data collected in 2009:

- Record-high precipitation in 2009 resulted in lower salinities at the Orange Street Bridge and footbridge stations. The highest salinities at Orange Street in 2009 occurred at lower river flows in late summer, but were well below historical levels. At the footbridge station, freshwater conditions prevailed for the entire monitoring period.
- DO levels were always above the target value of 5 mg/L at the tidally influenced stations (footbridge and Orange Street). The lowest DO values were recorded during brief periods of lower river flow. DO readings at Orange Street in summer 2009 were comparable to those in 2008, which was also a wet summer. Unlike the previous 2 years, no DO measurements were less than 5 mg/L during the June through September monitoring period.
- During the 2009 monitoring period, the WTP was operating only one day a week, with low withdrawals (Figure 3) as dictated by operational needs.
- Data over multiple years show surface DO concentrations at the Orange Street and footbridge stations of less than 5 mg/L have been associated with spillway flows less than 30 MGD, which corresponds to a lake level of 0.17 feet.

## Literature Cited

Lake Whitney WTP Environmental Evaluation Team. 1999. *Lake Whitney Water Treatment Plant Environmental Evaluation, Vol. 1: Environmental Evaluation Team Final Report*. Report prepared for the South Central Connecticut Regional Water Authority, New Haven, CT.

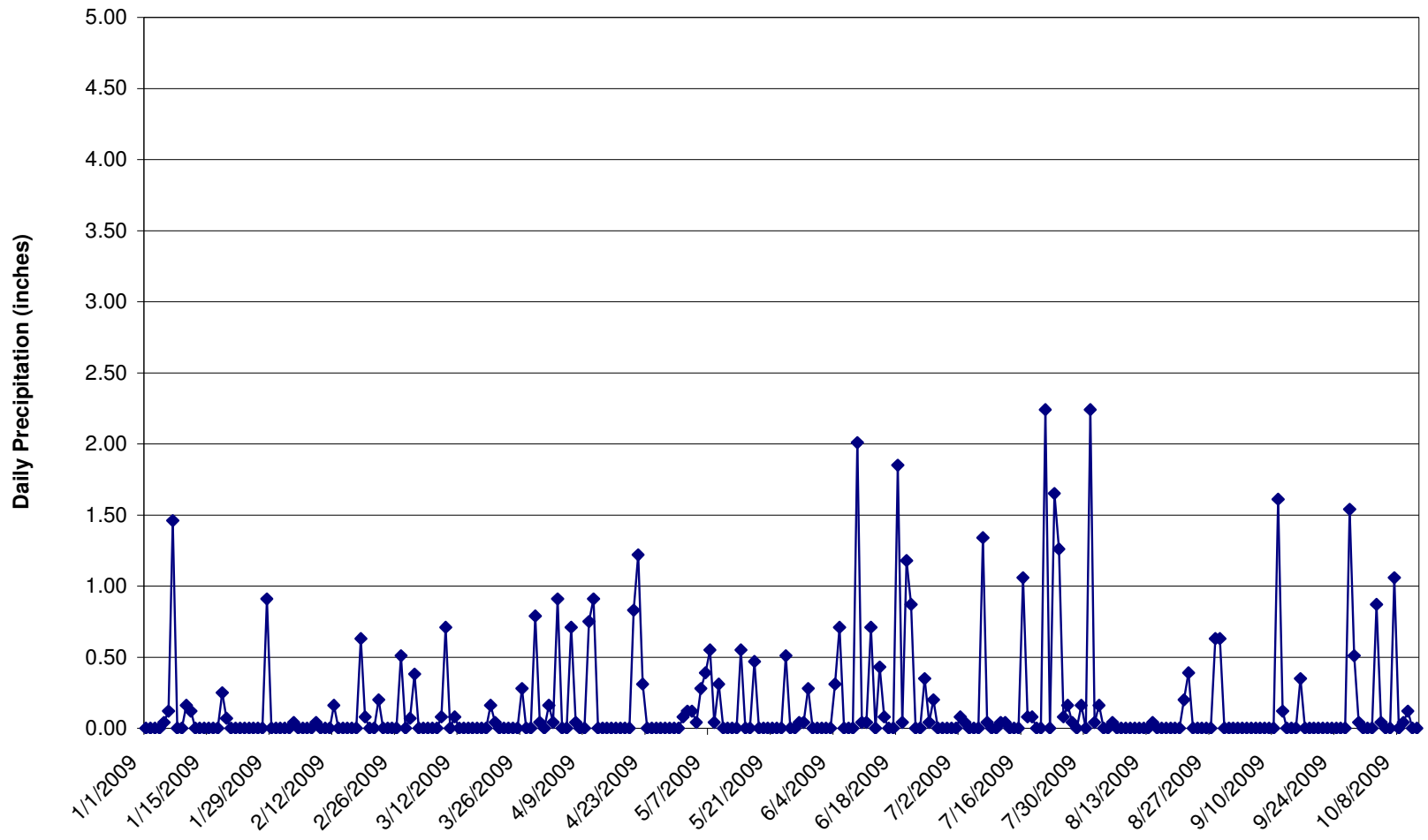
CH2M HILL. 2003. *1998-2003 Comprehensive Dissolved Oxygen Monitoring in the Lower Mill River, Hamden and New Haven, CT*. Report prepared for the South Central Connecticut Regional Water Authority, New Haven, CT.



## Figures

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**Figure 1 - Precipitation at Lake Whitney  
January - October 2009**



**Figure 2: 2009 Sampling Event Precipitation (72 hours Prior to each Sampling Event)**

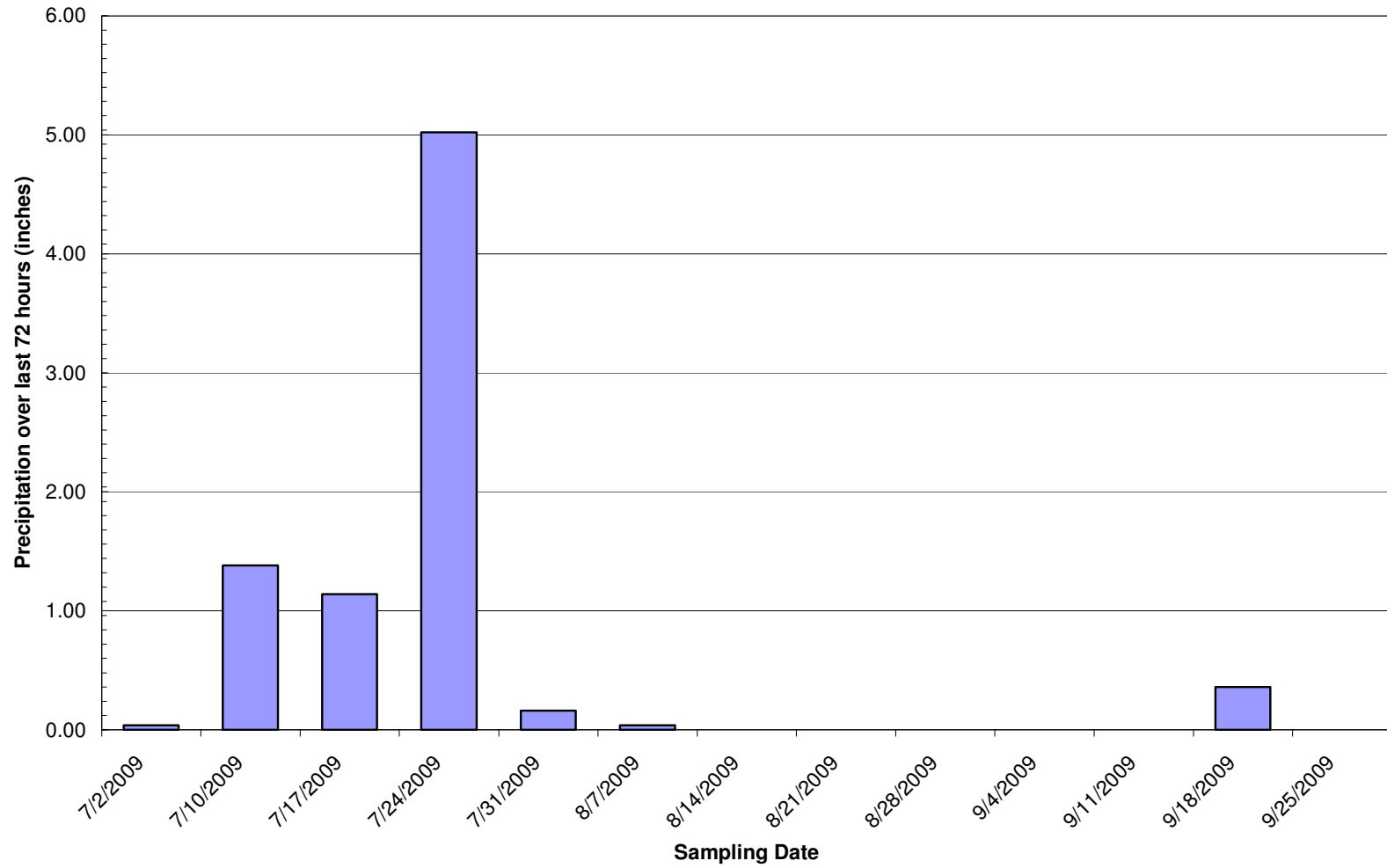


Figure 3: Lake Whitney Water Treatment Plant Withdrawals

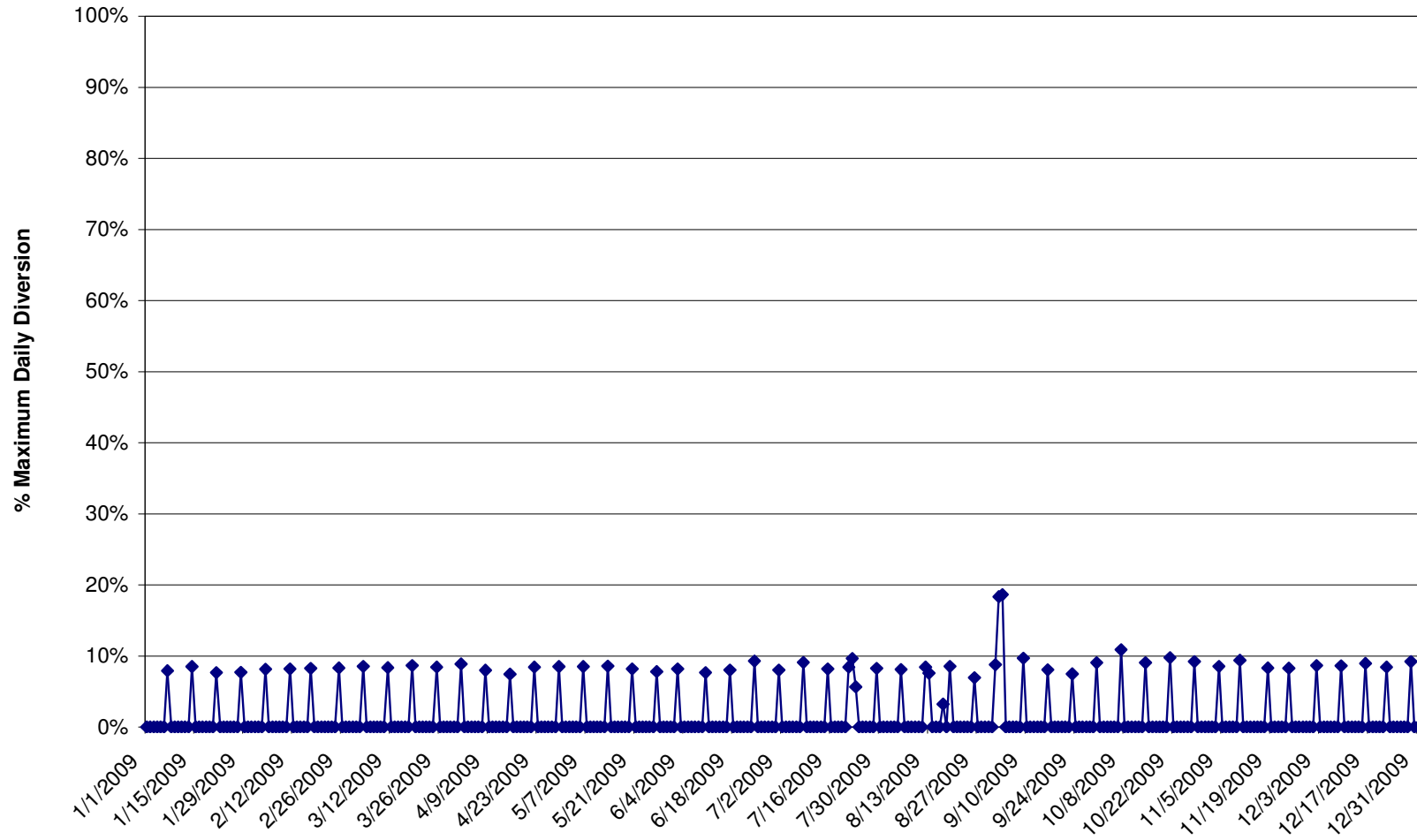
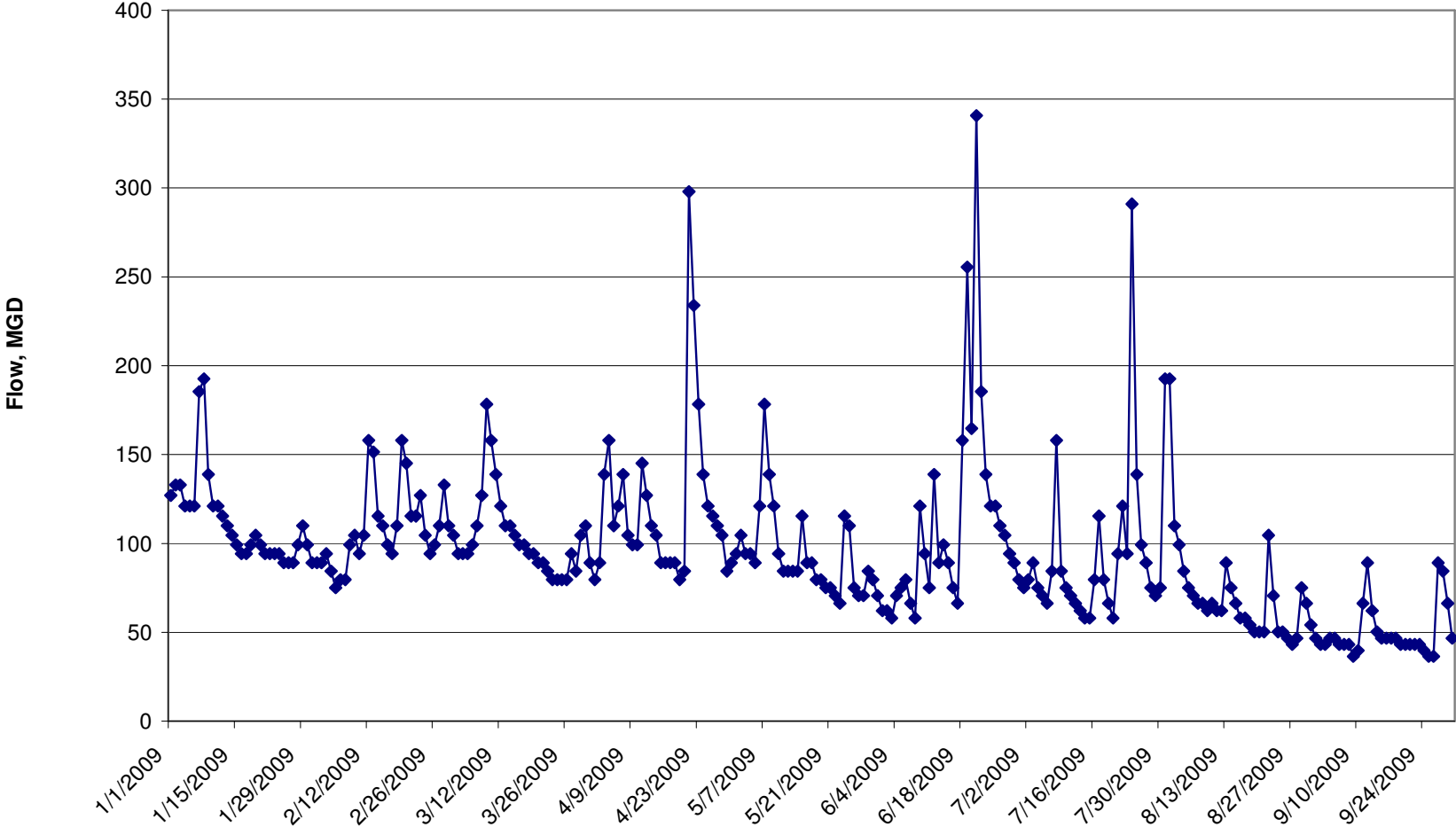
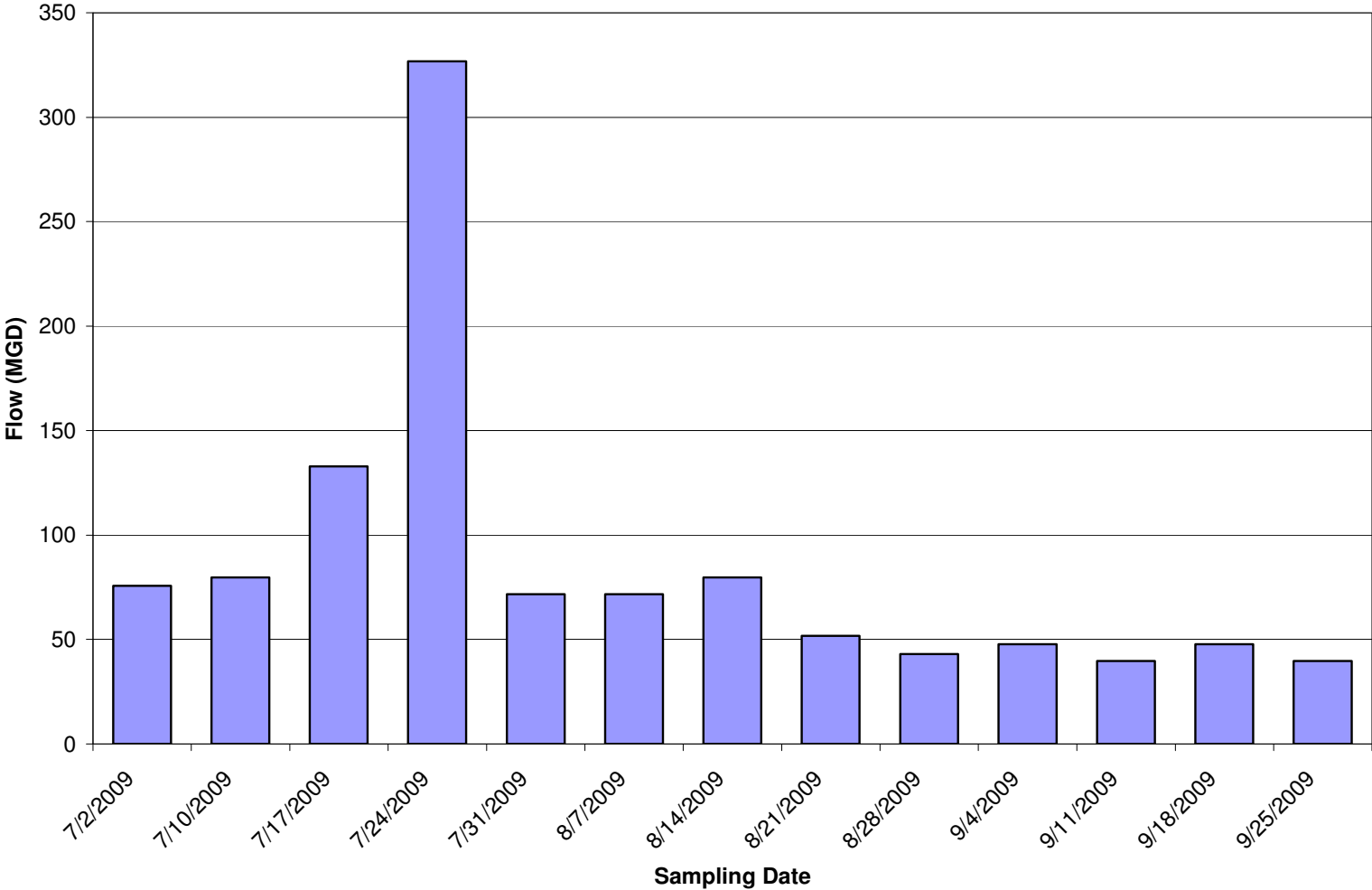


Figure 4: Lake Whitney Dam Downstream Flow  
January - September 2009



**Figure 5: 2009 Mill River Sampling Event Daily Average Flow**



**FIGURE 6**  
Locations Sampled During Mill River Monitoring



Figure 7: 2009 Mill River Surface Salinity

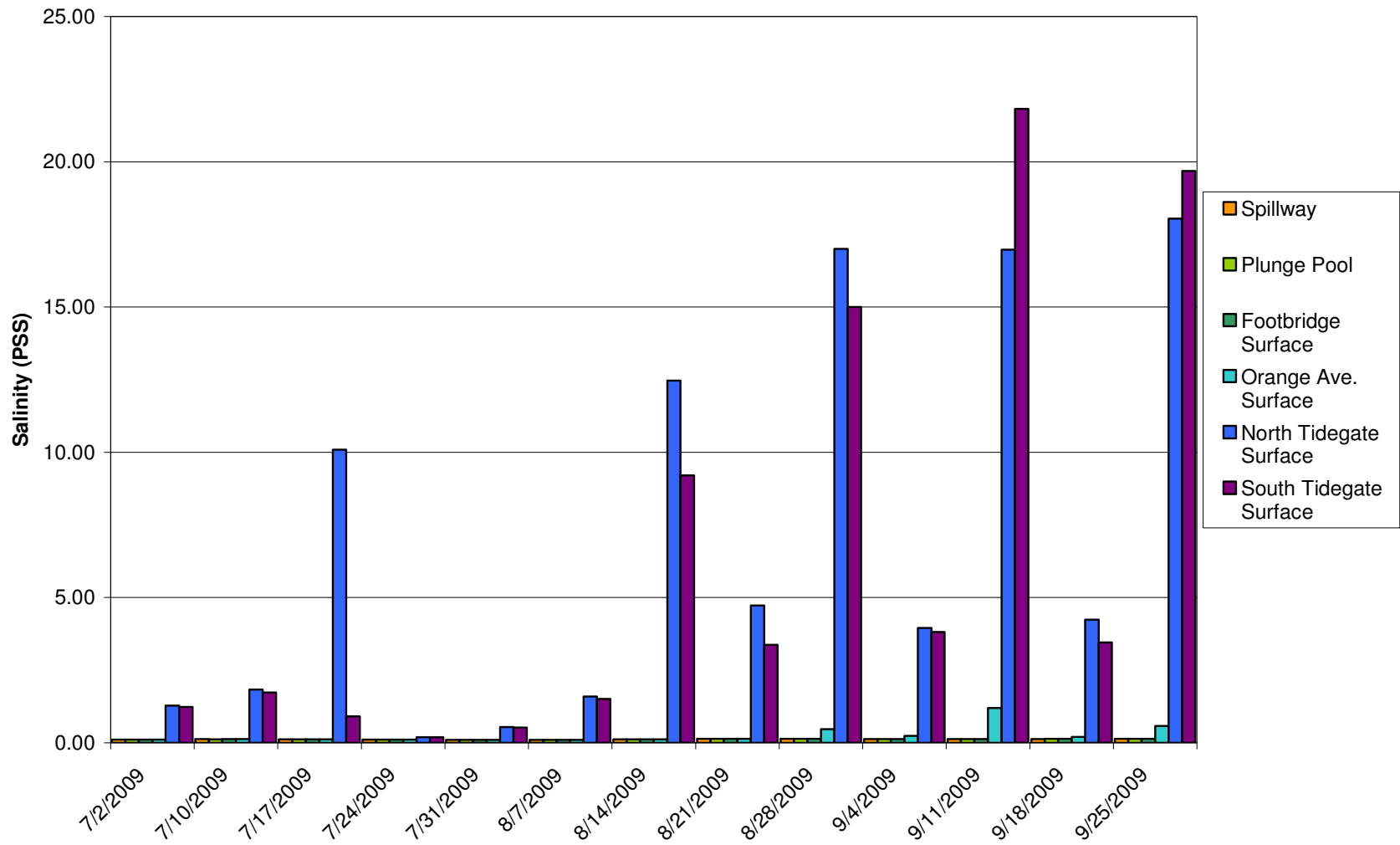
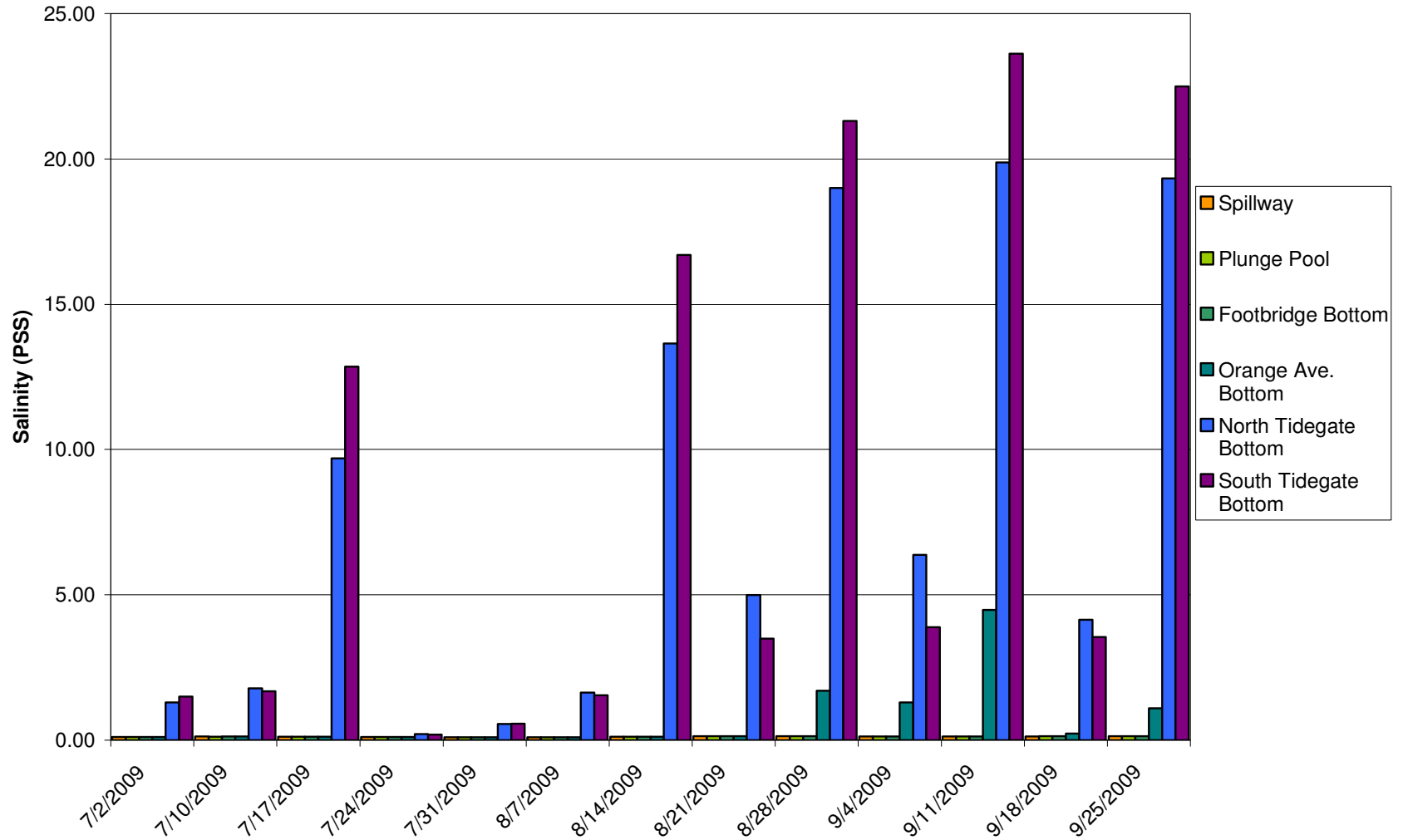




Figure 8: 2009 Mill River Bottom Salinity



**Figure 9: Mill River Downstream Surface Salinity with Flow**

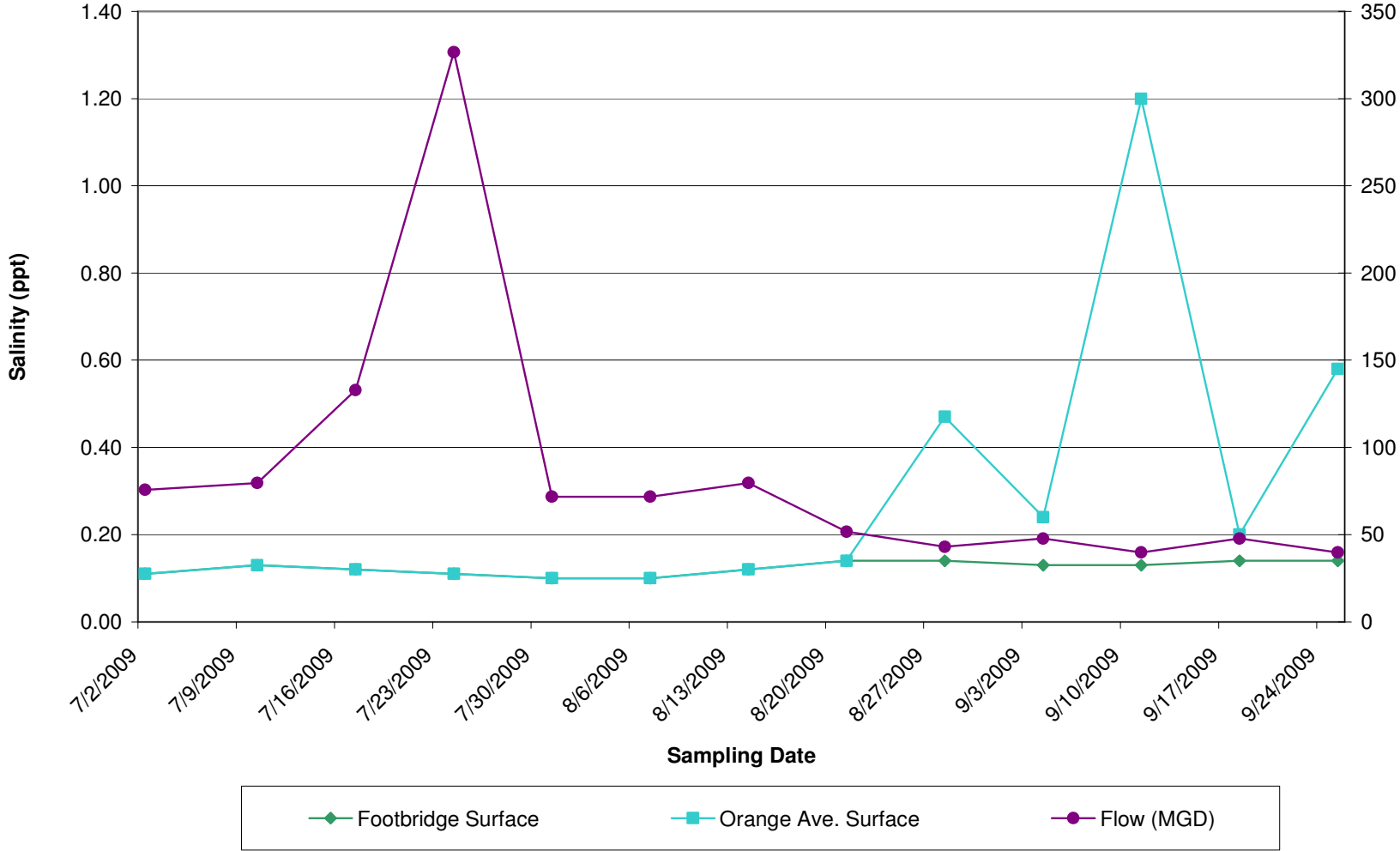


Figure 10: 2009 Mill River Surface Dissolved Oxygen

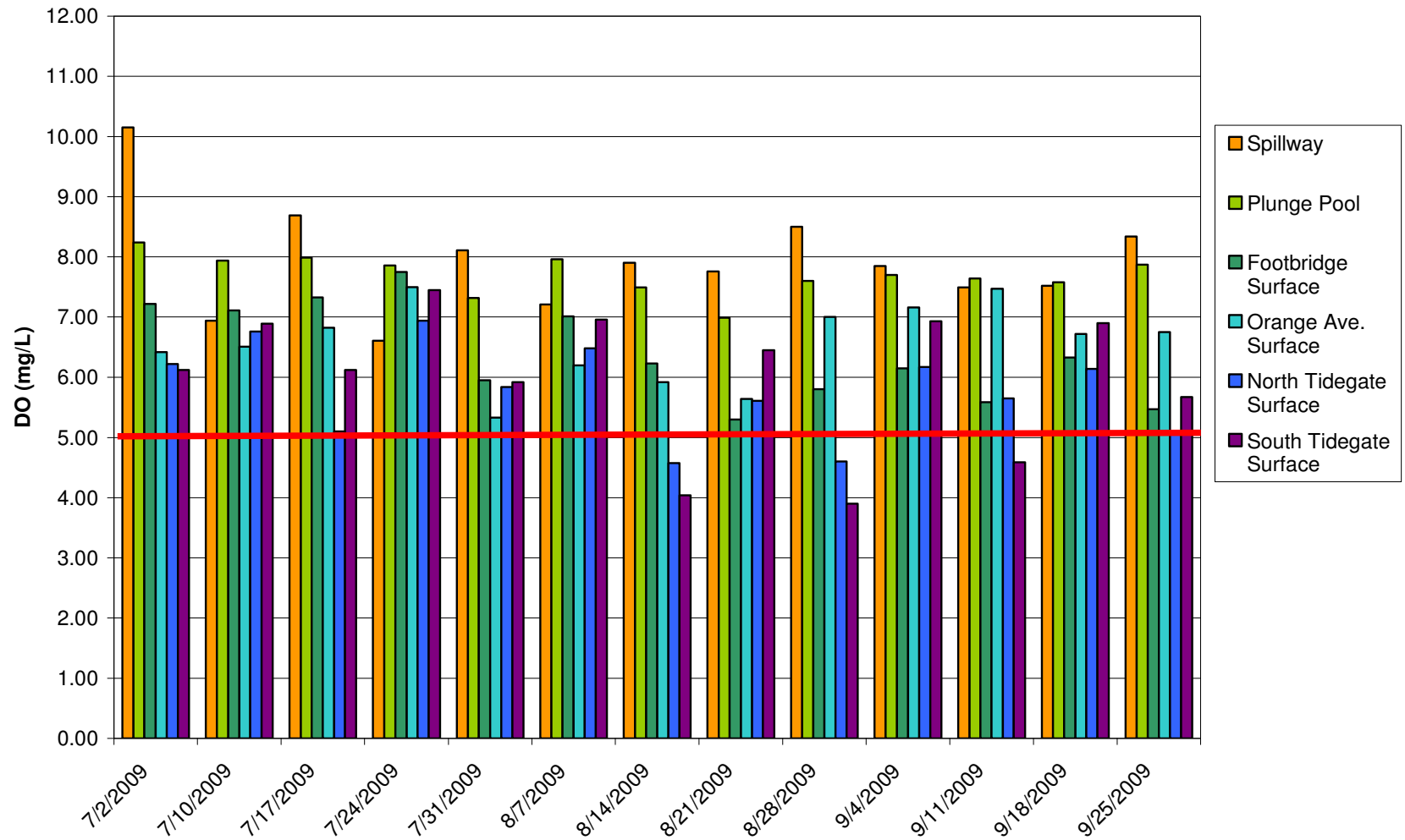


Figure 11: 2009 Mill River Bottom Dissolved Oxygen

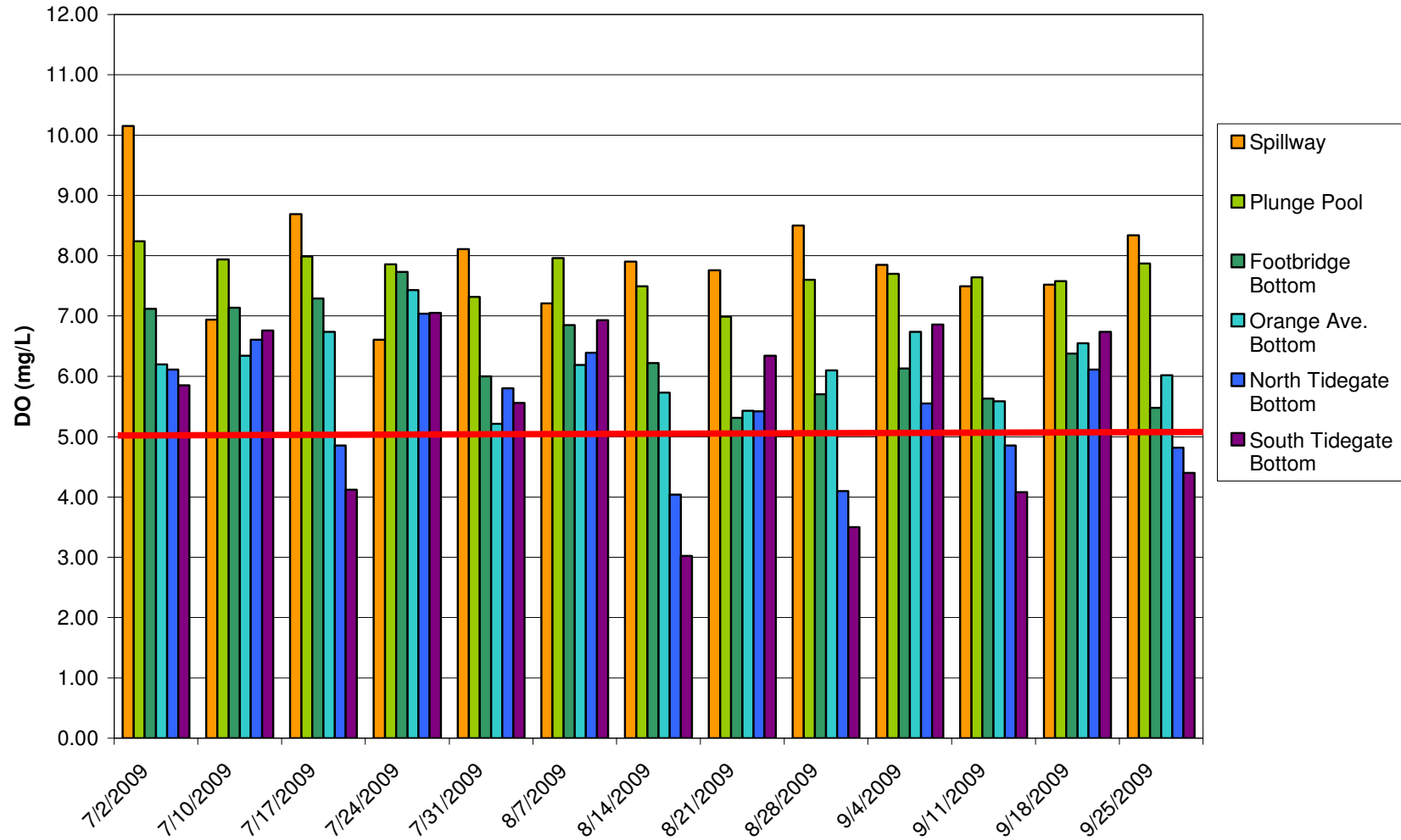


Figure 12: Mill River Downstream DO With Flow

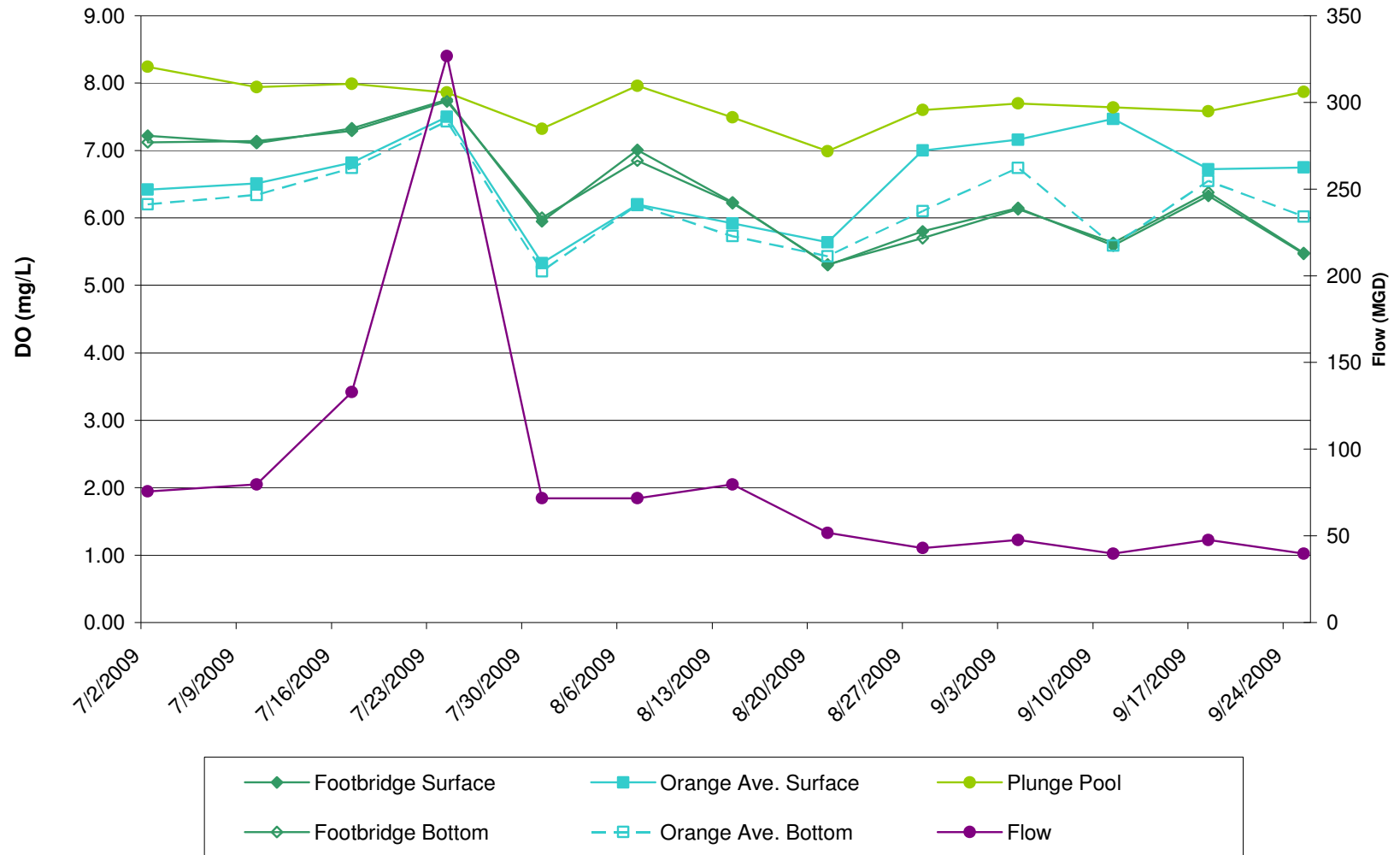


Figure 13: Mill River Surface DO Readings 2005-2009

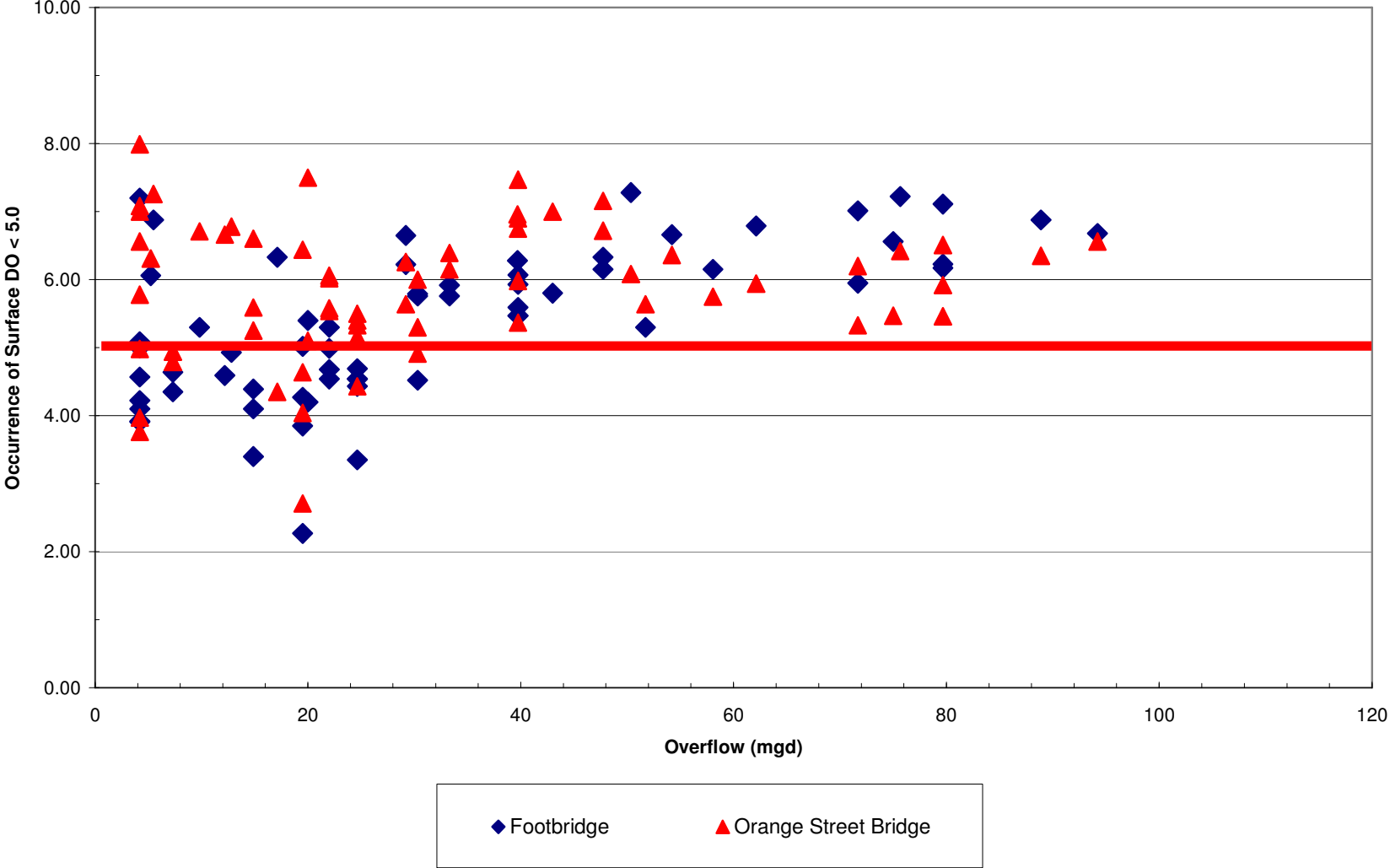
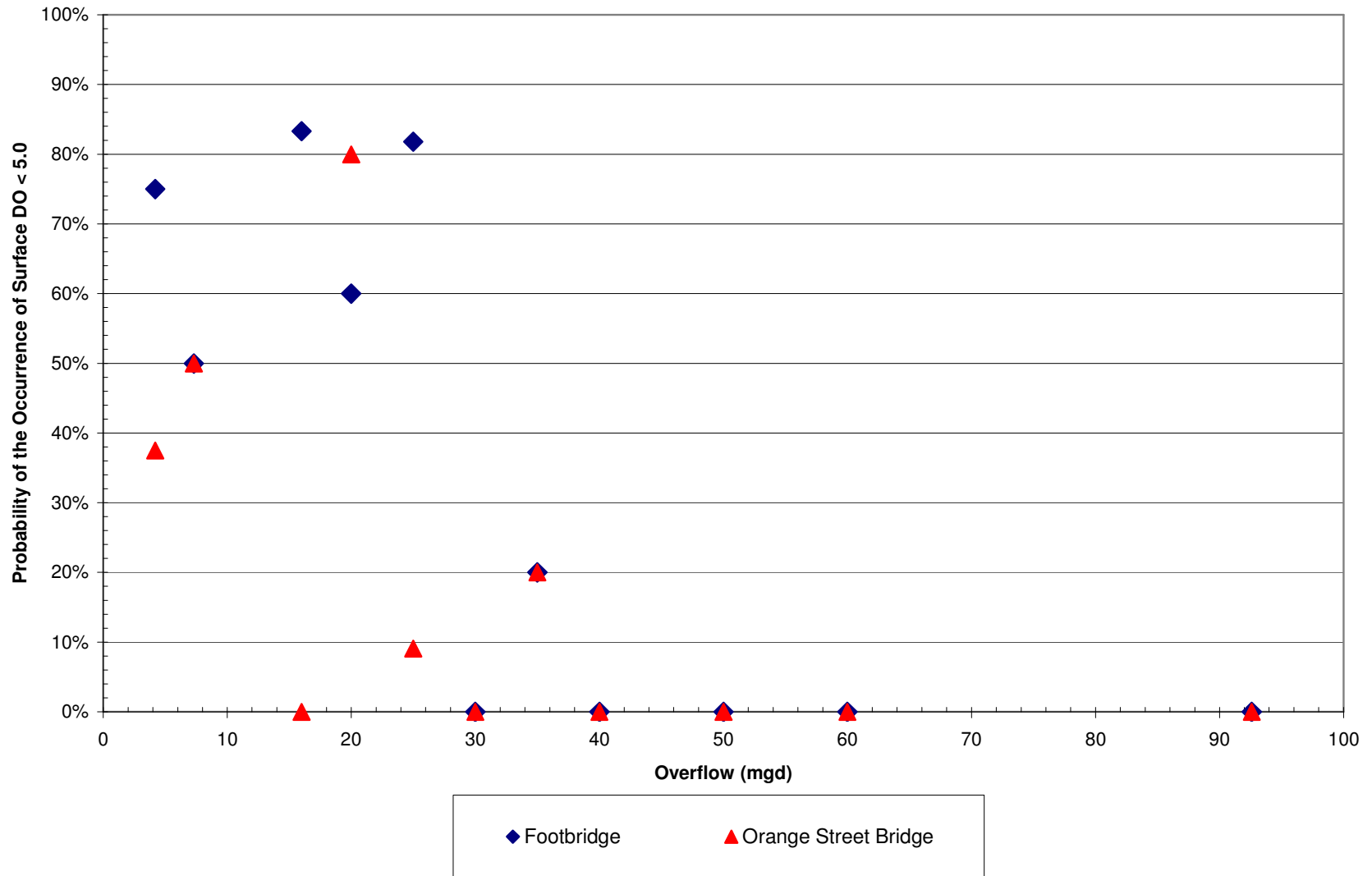


Figure 14: Mill River Occurrences of Surface DO < 5.0 mg/L, 2005-2009



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**Attachment**  
**Weekly Monitoring Data**

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DATE	Station	Time	Depth (m)	Temp (C)	Salinity (ppt)	DO (mg/l)	DO%	pH	Estimate flow (mgd)	Dry or Wet	Tide Stage	Comments
7/2/2009	6	5:15	0.20	22.01	0.11	6.42	73.60	7.59	75.67	Wet	Low	flow is south
7/2/2009	6	5:20	1.00	22.00	0.11	6.20	70.90	7.57	75.67	Wet	Low	
7/2/2009	4	5:30	0.20	22.19	0.11	7.22	82.90	7.99	75.67	Wet	Low	
7/2/2009	4	5:40	0.90	22.17	0.11	7.12	81.80	7.96	75.67	Wet	Low	
7/2/2009	0	5:50	0.40	22.45	0.11	10.15	117.20	8.36	75.67	Wet	Low	
7/2/2009	1	5:55	0.30	22.22	0.11	8.24	94.60	8.27	75.67	Wet	Low	
7/2/2009	7	6:05	0.20	22.25	1.28	6.22	72.20	7.39	75.67	Wet	Low	all tidegates are unobstructed
7/2/2009	7	6:10	1.00	22.25	1.29	6.11	71.00	7.38	75.67	Wet	Low	
7/2/2009	8	6:20	0.20	22.24	1.23	6.12	70.90	7.43	75.67	Wet	Low	
7/2/2009	8	6:25	1.10	22.25	1.50	5.85	67.90	7.34	75.67	Wet	Low	
7/10/2009	6	5:10	0.30	20.33	0.13	6.51	72.10	7.37	79.66	Wet	High	flow is south @ Orange St
7/10/2009	6	5:20	1.10	20.33	0.13	6.34	70.30	7.43	79.66	Wet	High	
7/10/2009	4	5:25	0.30	20.34	0.13	7.11	78.80	7.56	79.66	Wet	High	
7/10/2009	4	5:30	1.20	20.35	0.13	7.14	79.20	7.57	79.66	Wet	High	
7/10/2009	0	5:40	0.30	20.91	0.13	6.94	77.70	7.50	79.66	Wet	High	
7/10/2009	1	5:45	0.40	20.58	0.12	7.94	88.40	7.76	79.66	Wet	High	
7/10/2009	7	5:55	0.20	20.61	1.83	6.76	76.30	7.43	79.66	Wet	High	all tidegates are unobstructed
7/10/2009	7	6:00	0.90	20.61	1.78	6.61	74.40	7.44	79.66	Wet	High	
7/10/2009	8	6:05	0.30	20.58	1.73	6.89	77.60	7.45	79.66	Wet	High	
7/10/2009	8	6:10	0.80	20.58	1.68	6.76	76.10	7.45	79.66	Wet	High	
7/17/2009	6	5:18	0.20	22.17	0.12	6.82	79.20	7.64	132.90	Wet	Low	flow is south
7/17/2009	6	5:21	0.80	22.73	0.12	6.74	78.30	7.63	132.90	Wet	Low	
7/17/2009	4	5:37	0.20	22.75	0.12	7.33	85.10	7.86	132.90	Wet	Low	
7/17/2009	4	5:40	1.00	22.75	0.12	7.29	84.80	7.85	132.90	Wet	Low	
7/17/2009	0	5:54	0.20	23.05	0.12	8.69	101.50	8.06	132.90	Wet	Low	

DATE	Station	Time	Depth (m)	Temp (C)	Salinity (PSS)	DO (mg/l)	DO%	pH	Estimate flow (mgd)	Dry or Wet	Tide Stage	Comments
7/17/2009	7	6:33	0.20	22.28	10.08	5.10	62.50	7.08	132.90	Wet	Low	all tidegates are unobstructed
7/17/2009	7	6:36	1.10	22.30	9.70	4.85	59.30	7.08	132.90	Wet	Low	
7/17/2009	8	6:39	0.20	22.58	0.91	6.12	71.30	7.55	132.90	Wet	Low	
7/17/2009	8	6:42	1.30	22.14	12.85	4.12	51.20	7.03	132.90	Wet	Low	
7/24/2009	6	5:10	0.30	21.36	0.11	7.50	84.80	7.51	326.70	Wet	High	flow is south
7/24/2009	6	5:15	0.90	21.36	0.11	7.43	84.00	7.51	326.70	Wet	High	
7/24/2009	4	5:25	0.20	21.46	0.11	7.75	87.80	7.64	326.70	Wet	High	
7/24/2009	4	5:30	1.60	21.45	0.11	7.73	87.40	7.63	326.70	Wet	High	
7/24/2009	0	5:40	0.40	21.53	0.11	6.61	75.00	7.39	326.70	Wet	High	
7/24/2009	1	5:45	0.10	21.45	0.11	7.86	89.10	7.68	326.70	Wet	High	
7/24/2009	7	5:55	0.10	21.30	0.19	6.94	78.40	7.48	326.70	Wet	High	all tidegates are unobstructed
7/24/2009	7	6:05	0.60	21.30	0.20	7.04	79.60	7.46	326.70	Wet	High	
7/24/2009	8	6:10	0.20	21.29	0.19	7.45	84.20	7.53	326.70	Wet	High	
7/24/2009	8	6:25	0.60	21.29	0.19	7.05	79.70	7.46	326.70	Wet	High	
7/31/2009	6	5:15	0.30	25.21	0.10	5.33	64.80	7.42	71.68	Wet	Low	flow is south
7/31/2009	6	5:20	0.80	25.20	0.10	5.21	63.30	7.41	71.68	Wet	Low	
7/31/2009	4	5:30	0.20	25.02	0.10	5.95	72.10	7.59	71.68	Wet	Low	
7/31/2009	4	5:35	0.90	24.91	0.10	6.00	72.60	7.57	71.68	Wet	Low	
7/31/2009	0	5:45	0.40	25.69	0.10	8.11	99.40	8.05	71.68	Wet	Low	
7/31/2009	1	5:55	0.20	25.36	0.10	7.32	89.20	8.07	71.68	Wet	Low	
7/31/2009	7	6:05	0.30	25.86	0.54	5.84	72.10	7.47	71.68	Wet	Low	all tidegates are unobstructed
7/31/2009	7	6:10	0.90	25.86	0.55	5.80	71.50	7.46	71.68	Wet	Low	
7/31/2009	8	6:15	0.30	25.79	0.52	5.92	72.90	7.49	71.68	Wet	Low	
7/31/2009	8	6:20	1.00	25.84	0.57	5.56	68.70	7.42	71.68	Wet	Low	
8/7/2009	6	5:20	0.30	22.59	0.10	6.20	71.70	7.30	71.68	Wet	Mid	flow is south @ Orange St

DATE	Station	Time	Depth (m)	Temp (C)	Salinity (PSS)	DO (mg/l)	DO%	pH	Estimate flow (mgd)	Dry or Wet	Tide Stage	Comments
8/7/2009	4	5:35	0.30	22.59	0.10	7.01	81.10	7.43	71.68	Wet	Mid	
8/7/2009	4	5:40	0.90	22.61	0.10	6.85	79.30	7.41	71.68	Wet	Mid	
8/7/2009	0	5:45	0.30	23.40	0.10	7.21	84.80	7.37	71.68	Wet	Mid	
8/7/2009	1	5:55	0.30	22.90	0.10	7.96	92.70	7.67	71.68	Wet	Mid	
8/7/2009	7	6:05	0.30	23.09	1.59	6.48	76.50	7.24	71.68	Wet	Mid	all gates are unobstructed
8/7/2009	7	6:10	0.80	23.11	1.63	6.39	75.50	7.22	71.68	Wet	Mid	
8/7/2009	8	6:15	0.30	23.09	1.51	6.96	82.20	7.24	71.68	Wet	Mid	
8/7/2009	8	6:20	0.70	23.09	1.55	6.93	81.90	7.24	71.68	Wet	Mid	
8/14/2009	6	5:20	0.20	23.11	0.12	5.92	69.20	7.49	79.66	Dry	High	flow is south @ Orange St
8/14/2009	6	5:30	0.70	23.10	0.12	5.73	67.00	7.48	79.66	Dry	High	
8/14/2009	4	5:40	0.30	23.11	0.12	6.23	72.90	7.58	79.66	Dry	High	
8/14/2009	4	5:45	1.00	23.08	0.12	6.22	72.70	7.59	79.66	Dry	High	
8/14/2009	0	5:55	0.30	23.66	0.12	7.90	93.40	7.81	79.66	Dry	High	
8/14/2009	1	6:00	0.30	23.34	0.12	7.49	87.90	7.92	79.66	Dry	High	
8/14/2009	7	6:10	0.30	23.03	12.47	4.57	58.10	7.09	79.66	Dry	High	all gates are unobstructed
8/14/2009	7	6:15	1.10	23.02	13.64	4.04	51.30	7.06	79.66	Dry	High	
8/14/2009	8	6:20	0.30	23.29	9.20	4.04	50.30	7.11	79.66	Dry	High	
8/14/2009	8	6:25	1.10	22.94	16.69	3.02	39.10	7.00	79.66	Dry	High	
8/21/2009	6	5:15	0.30	26.53	0.14	5.64	70.40	7.54	51.72	Dry	Mid	flow is south @ Orange St
8/21/2009	6	5:25	0.80	26.50	0.14	5.43	67.60	7.52	51.72	Dry	Mid	
8/21/2009	4	5:35	0.20	26.19	0.14	5.30	65.70	7.58	51.72	Dry	Mid	
8/21/2009	4	5:41	0.80	26.17	0.14	5.31	65.70	7.57	51.72	Dry	Mid	
8/21/2009	0	5:50	0.30	26.95	0.14	7.76	97.50	8.03	51.72	Dry	Mid	
8/21/2009	1	6:00	0.30	26.72	0.14	6.99	87.40	8.08	51.72	Dry	Mid	
8/21/2009	7	6:10	0.20	26.84	4.72	5.61	72.30	7.21	51.72	Dry	Mid	all tidegates are unobstructed
8/21/2009	7	6:15	0.70	26.84	4.99	5.42	70.10	7.19	51.72	Dry	Mid	

DATE	Station	Time	Depth (m)	Temp (C)	Salinity (PSS)	DO (mg/l)	DO%	pH	Estimate flow (mgd)	Dry or Wet	Tide Stage	Comments
8/21/2009	8	6:25	0.40	26.88	3.50	6.34	81.20	7.30	51.72	Dry	Mid	
8/28/2009	0	6:10	0.20	25.40	0.14	8.50	104.40	8.20	43.00	Dry	Mid	
8/28/2009	1	6:16	0.20	24.30	0.14	7.60	91.30	8.20	43.00	Dry	Mid	
8/28/2009	4	6:31	0.20	23.60	0.14	5.80	68.30	7.60	43.00	Dry	Mid	
8/28/2009	4	6:33	1.00	23.60	0.14	5.70	66.90	7.60	43.00	Dry	Mid	
8/28/2009	6	6:43	0.20	24.00	0.47	7.00	83.30	7.90	43.00	Dry	Mid	
8/28/2009	6	6:46	0.90	25.00	1.70	6.10	75.00	7.40	43.00	Dry	Mid	
8/28/2009	7	6:59	0.20	24.10	17.00	4.60	60.50	6.90	43.00	Dry	Mid	
8/28/2009	7	7:00	1.00	24.20	19.00	4.10	55.10	6.90	43.00	Dry	Mid	
8/28/2009	8	7:04	0.20	24.50	15.00	3.90	51.50	7.00	43.00	Dry	Mid	
8/28/2009	8	7:05	1.10	24.30	21.30	3.50	47.50	6.90	43.00	Dry	Mid	
9/4/2009	6	5:25	0.30	20.91	0.24	7.16	80.30	7.60	47.73	Dry	Low	flow is south @ Orange St
9/4/2009	6	5:30	0.90	21.25	1.30	6.74	76.70	7.41	47.73	Dry	Low	
9/4/2009	4	5:40	0.30	20.07	0.13	6.15	67.80	7.52	47.73	Dry	Low	
9/4/2009	4	5:45	0.80	20.01	0.13	6.13	67.50	7.49	47.73	Dry	Low	
9/4/2009	0	5:55	0.30	21.46	0.13	7.85	89.00	7.75	47.73	Dry	Low	
9/4/2009	1	6:05	0.30	20.85	0.13	7.70	86.20	7.87	47.73	Dry	Low	
9/4/2009	7	6:15	0.20	20.77	3.95	6.17	70.80	7.17	47.73	Dry	Low	all gates are unobstructed
9/4/2009	7	6:20	0.70	21.19	6.37	5.55	65.20	7.05	47.73	Dry	Low	
9/4/2009	8	6:25	0.20	20.68	3.81	6.93	79.20	7.22	47.73	Dry	Low	
9/4/2009	8	6:30	0.30	20.71	3.89	6.86	78.70	7.22	47.73	Dry	Low	
9/11/2009	6	5:20	0.30	18.94	1.20	7.47	81.20	7.82	39.75	Dry	High	flow is south @ Orange St
9/11/2009	6	5:30	0.70	20.15	4.48	5.59	63.50	7.35	39.75	Dry	High	
9/11/2009	4	5:40	0.30	18.89	0.13	5.59	60.20	7.55	39.75	Dry	High	
9/11/2009	4	5:45	1.00	18.87	0.13	5.63	60.60	7.54	39.75	Dry	High	
9/11/2009	0	5:55	0.20	20.63	0.13	7.49	83.50	7.76	39.75	Dry	High	
9/11/2009	1	6:05	0.30	19.89	0.13	7.64	83.90	7.90	39.75	Dry	High	

DATE	Station	Time	Depth (m)	Temp (C)	Salinity (PSS)	DO (mg/l)	DO%	pH	Estimate flow (mgd)	Dry or Wet	Tide Stage	Comments
9/11/2009	7	6:20	1.00	20.56	19.88	4.85	61.10	6.96	39.75	Dry	High	
9/11/2009	8	6:25	0.20	21.08	21.82	4.59	59.00	6.93	39.75	Dry	High	
9/11/2009	8	6:30	30.80	21.10	23.62	4.08	53.10	6.92	39.75	Dry	High	
9/18/2009	6	5:25	0.30	17.72	0.20	6.72	70.80	7.76	47.73	Wet	Low	flow is south @ Orange St
9/18/2009	6	5:35	0.70	17.76	0.23	6.55	68.90	7.73	47.73	Wet	Low	
9/18/2009	4	5:45	0.20	17.83	0.14	6.33	66.50	7.67	47.73	Wet	Low	
9/18/2009	4	5:55	0.80	17.73	0.14	6.38	67.10	7.65	47.73	Wet	Low	
9/18/2009	0	6:05	0.30	19.37	0.13	7.52	81.80	7.80	47.73	Wet	Low	
9/18/2009	1	6:15	0.20	18.68	0.14	7.58	81.20	7.90	47.73	Wet	Low	
9/18/2009	7	6:25	0.20	18.21	4.23	6.14	67.00	7.18	47.73	Wet	Low	all gates are unobstructed
9/18/2009	7	6:30	0.70	18.18	4.14	6.11	66.60	7.19	47.73	Wet	Low	
9/18/2009	8	6:35	0.20	17.98	3.45	6.90	74.50	7.26	47.73	Wet	Low	
9/18/2009	8	6:40	0.40	18.00	3.55	6.74	73.00	7.28	47.73	Wet	Low	
9/25/2009	6	5:30	0.20	19.83	0.58	6.75	74.20	7.71	39.75	Dry	High	flow is south @ Orange St.
9/25/2009	6	5:40	0.70	20.34	1.10	6.02	67.20	7.56	39.75	Dry	High	
9/25/2009	4	5:45	0.20	19.16	0.14	5.47	59.20	7.61	39.75	Dry	High	
9/25/2009	4	5:55	0.80	19.14	0.14	5.48	59.30	7.60	39.75	Dry	High	
9/25/2009	0	6:00	0.20	20.46	0.14	8.34	92.60	8.08	39.75	Dry	High	
9/25/2009	1	6:10	0.20	19.60	0.14	7.87	86.00	8.06	39.75	Dry	High	
9/25/2009	7	6:20	0.20	20.16	18.04	5.11	63.10	7.04	39.75	Dry	High	all tidegates are unobstructed
9/25/2009	7	6:30	0.80	20.27	19.33	4.82	60.10	7.04	39.75	Dry	High	
9/25/2009	8	6:35	0.10	20.59	19.68	5.67	71.30	7.05	39.75	Dry	High	
9/25/2009	8	6:40	0.80	20.51	22.49	4.40	56.20	7.02	39.75	Dry	High	