

Introduction

This water quality monitoring fact sheet was prepared by the Irrigated Agriculture Program of the Central Coast Regional Water Quality Control Board (Water Board) and made available on November 30, 2008. The data were delivered by Central Coast Water Quality Preservation, Inc. (CCWQP) to the Water Board as part of the monitoring and reporting requirements for all dischargers enrolled under *Conditional Waiver of Waste Discharge Requirements for Discharge from Irrigated Lands, Order No. R3-2004-0117*. Monitoring stations were selected to represent water quality in predominantly agricultural areas, but in some cases reflect mixed land uses upstream of the sites.

312BCC Bradley Channel at Culvert

The Cooperative Monitoring Program sampled Bradley Channel at Culvert 30 times (approximately one sample per month) between January 2005 and July 2007, excluding six sampling dates that were recorded as dry.

Summary of Water Quality Data

Notable Measured Analytes for Water Quality Monitoring

Analyte/Parameter	Average	Range	Water Quality Criteria (WQC) or Guideline ¹	Percent Outside WQC or Guideline
Ammonia as N, Unionized	0.077 mg/L	0.000–0.679 mg/L	<0.025 mg/L ⁺	42%
Nitrate/Nitrite as N	28.2 mg/L	4.3–112 mg/L	<10.0 mg/L*	62%
Orthophosphate as P	1.77 mg/L	0.004–12.1 mg/L	<0.12 mg/L*	95%
Turbidity (NTU)	728 NTU	11–3000 NTU	<25 NTU*	79%
Conductivity	1.38 mmho/cm	0.00–2.09 mmho/cm	Ranges: * <0.75 No Problem 0.75–3.0 Increasing >3.0 Severe	10% 90% 0%
pH	8.1	7.3–9.2	7.0–8.5 ⁺	10%
Annual Median Dissolved Oxygen (% Saturation)	2005: 97% 2006: 65% 2007: 71%	31–180%	>85% annual median ⁺	Std met Std not met Std not met
Dissolved Oxygen	8.12 mg/L	2.75 –15.18 mg/L	>5.0 mg/L (GEN/WARM) ⁺ >7.0 mg/L (COLD/SPWN)*	15% 30%
Chlorophyll a	3.0 µg/L	0.005–9.8 µg/L	<40 µg/L*	0%
Water Temperature	19.3°C	12.1–31.3°C	Water Basin Specific	--

+ Indicates standard defined in the Water Quality Control Plan, Central Coast Basin (Basin Plan)

* Indicates guideline not described in the Basin Plan or not specifically stated as applicable to the beneficial uses of the site. Origin of the guideline is described in the individual discussion of the analyte/parameter.

The present and potential beneficial uses for **Bradley Channel** are not specified in the Basin Plan. General Basin Plan water quality objectives will apply. Any analytes not specified under the general objectives in the Basin Plan are compared to a different water quality guideline to create a better understanding of the site's condition.

Unionized Ammonia (as N)

Unionized ammonia (as N) is a calculated value based on water temperature, pH, and total ammonium concentration. Ammonia can be toxic in water. With high water temperature and/or high pH, ammonia becomes unionized and is toxic at

¹ Water Quality Criteria (WQC) are defined in the Water Quality Control Plan, Central Coast Basin (also referred to as the "Basin Plan") to protect beneficial uses such as drinking water, fish habitat, irrigation water, etc. WQC include general water quality standards for some analytes as well as specific criteria based on the defined beneficial uses. Other water quality guidelines were compiled to provide a standard in order to compare sites. Bold indicates beneficial uses that apply to this watershed.

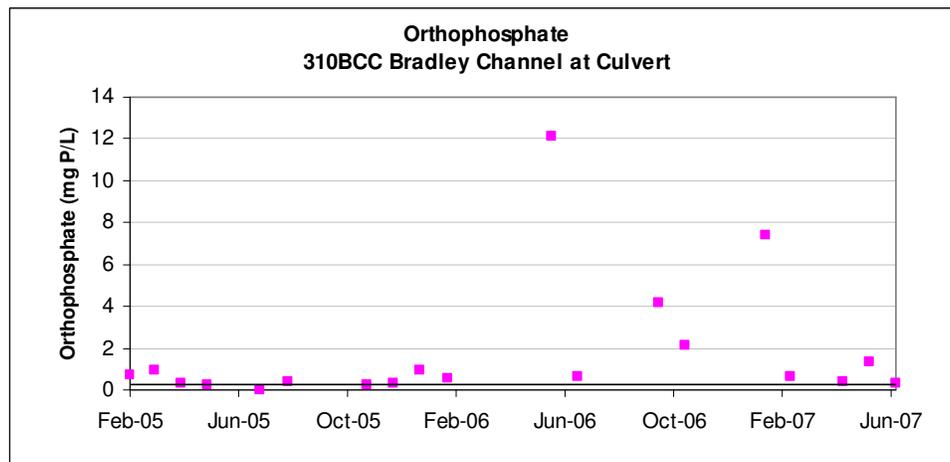
much lower levels. The Basin Plan general water quality objectives state that unionized ammonia should not exceed 0.025 mg/L. Over time, ammonia should reduce to nitrate, so long-lasting levels of ammonia may indicate continuous discharges of waste. **Eight of 19 of samples (42%) exceeded the standard. The average unionized ammonia concentration was 0.077 mg/L. However, the standard deviation was 0.162 mg/L, indicating extreme (high and low) samples.**

Nitrate/Nitrite as N

The Municipal and Domestic Supply (MUN) objective states in Table 3-2 of the Basin Plan that nitrate as NO₃ shall not exceed 45 mg/L. This value is equivalent to 10 mg/L of nitrate as N. Nitrite accounts for a small percent of total nitrate/nitrite, and therefore, nitrate as N criterion was used as a guideline for nitrate/nitrite. **Eight of 13 nitrate/nitrite samples (62%) exceeded the guideline. The average concentration was 28.2 mg/L (nearly 3 times the guideline). However, the standard deviation was over 30, indicating extreme (high and low) readings.**

Orthophosphate as P

The Basin Plan does not contain orthophosphate standards. The Central Coast Ambient Monitoring Program (CCAMP) non-regulatory guideline for general water quality objectives states that orthophosphate concentrations shall not exceed 0.12 mg/L. **Orthophosphate concentration levels exceed the guideline in 18 of 19 samples (95%); one sample exceeded the guideline by over 100 times (June 2006 – 12.1 mg/L). The average concentration was 1.77 mg/L. The standard deviation was 3.06 mg/L, indicating extreme (high and low) readings. Orthophosphate concentrations increased dramatically after months of dry conditions, as shown in the following chart.**

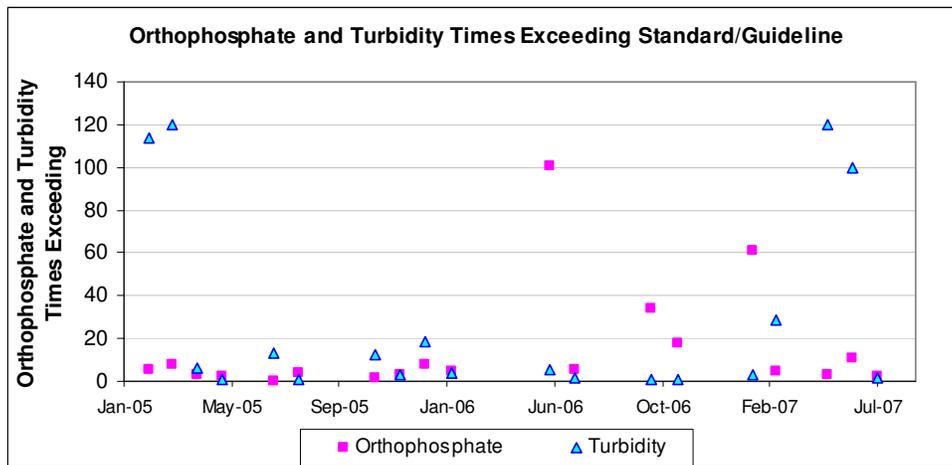


Turbidity

The Basin Plan states: “Water shall be free of changes in turbidity that cause nuisance or adversely affect beneficial uses.” Sigler et al.² shows that turbidity levels of 25 NTU or greater caused reduction in juvenile salmonid growth due to interference with their ability to find food. Turbidity is often affected by suspended material in runoff. **Fifteen of 19 turbidity readings (79%) exceeded the guideline. Turbidity levels in Bradley Channel at Culvert averaged 728 NTU over the almost three years sampled. However, the standard deviation was 1135 NTU, indicating extreme (high and low) readings. Turbidity increased dramatically with increased flow; two of the three highest turbidities (all three over 3000 NTU) correlate with the two highest recorded flows.**

The following graph shows the times that orthophosphate as P concentration and turbidity exceeded the given standard or guideline (shall not exceed 0.12 mg/L concentration of P for orthophosphate and 25 NTU for turbidity) (e.g. if the turbidity reading was 75, the times exceeding would be 3).

² Sigler, J.W., T.C. Bjornn, & F.H. Everst. (1984). *Effects of chronic turbidity on density and growth of steelhead and coho salmon*. Transactions of the American Fisheries Society. 113:142-150.



Conductivity

Conductivity is measured from a water sample. Based on Table 3-3 of the Basin Plan showing Guidelines for Interpretation of Quality of Water for Irrigation, conductivity below 0.75 mmho/cm causes no problems to irrigation, between 0.75 and 3 mmho/cm causes increasing problems, and conductivity above 3 mmho/cm causes severe problems. The conductivity level can be greatly affected by geologic and biological influences and is not necessarily related to agricultural activities. **Two of 20 conductivity samples (10%) indicated no problems to irrigation water; 18 samples (90%) indicated increasing problems; no samples indicated severe problems.**

pH

Multiple beneficial uses have objectives for pH. The Basin Plan general water quality objective for pH is between 7.0 and 8.5; MUN, AGR, REC-1, and REC-2 pH objectives are between 6.5 and 8.3. The standard, therefore, is 7.0-8.3 if one or more of MUN, AGR, REC-1, and REC-2 is defined as a beneficial use. pH above 9 can cause skin irritant to humans and makes water inhospitable to many species. **Seven of 20 pH samples (35%) exceeded the MUN, AGR, REC-1, REC-2 standard for pH, and two pH samples (10%) exceeded the GEN standard for pH. Samples ranged from 7.33 to 9.17. Salts can cause high pH. However, as shown above, the conductivity and salinity in Bradley Channel at Culvert is not extremely high. This may indicate anthropogenic influence.**

Dissolved Oxygen Concentration and Dissolved Oxygen Saturation

The Basin Plan general water quality objectives state annual median dissolved oxygen shall remain above 85% saturation. General and WARM objectives state that the dissolved oxygen concentration must remain above 5.0 mg/L at all times, and SPWN and COLD objectives state that the dissolved oxygen concentration must remain above 7.0 mg/L at all times. **Three of 20 samples (15%) did not meet the general and WARM concentration standard, and six samples (30%) did not meet the COLD and SPWN concentration standard. Dissolved oxygen did not meet the saturation standard during 2006 or 2007, with median annual values of 65 and 71% saturation, respectively. The median annual values for 2005 (97%) met the standard for dissolved oxygen saturation.**

Though no standards have been set in the Basin Plan regarding dissolved oxygen supersaturation (>100%), studies have shown that supersaturation of gases may cause gas bubble trauma in fish³. Dissolved gas saturation levels were not collected at this site; however, oxygen levels reached 180% saturation which may indicate dissolved gas supersaturation.

Chlorophyll a

Healthy and appropriate Chlorophyll a levels are not defined in the Basin Plan. Chlorophyll a indicates phytoplankton growth, a necessary component of healthy water bodies. Because turbidity causes interference for the Chlorophyll a probe, measurements of Chlorophyll a may not be accurate when turbidity is above 1000 NTU. Chlorophyll a levels over 40 µg/L are considered problematic by North Carolina Administrative Code (NCAC). **No readings exceeded the guideline. The Chlorophyll a readings averaged 3.0 µg/L.**

³ Mesa, M.G., L.K. Weiland, & A.G. Maule. (2000). *Progression and severity of gas bubble trauma in juvenile salmonids*. Transactions of the American Fisheries Society. 129:174-185.

Temperature

Sullivan et al.⁴ state that the maximum weekly average temperatures for protection of steelhead or rainbow trout, and coho salmon are 19.6 and 19.7°C, respectively. **The temperature averaged 19.3°C and ranged from 12.1 to 31.3°C. Though weekly averages were not taken, the temperatures taken at this site indicate averages that may regularly exceed these maximum temperatures for fish protection. The high, 31.3°C, is extremely warm, even for a warm-water habitat. Because Bradley Channel lacks a stable and constant streambed and flow, the temperature may change more drastically with weather or soil conditions than other water bodies would.**

Summary of Toxicity Data

Species with Significant Mortality

	Feb-05	Mar-05	Apr-05	Jul-05	Feb-06	May-06	Feb-07	Mar-07
Invertebrate (Water Column)	Yes [#]	Yes		No*	Yes ⁺		Yes	Yes
Invertebrate (Sediment)			No			Yes		
Fish (Water Column)	No	No			No		No	No
Algae (Water Column)	No	No			No		Yes	Yes

⁺Indicates complete mortality within 24 hours of test initiation

[#]Indicates complete mortality within 5 days of test initiation

*Indicates significant effect on growth or reproduction (even though mortality did not have a significant effect)

Significant effect is determined by statistically significant rates of mortality, growth, or reproduction compared to a control sample and provides an indication that something is affecting plant or animal life in the stream. Invertebrates show significant sensitivity to organophosphates and pesticides. Significant effect to algae often indicates the presence of herbicides and metals such as copper. Fish are less sensitive to organophosphates but can be impacted by other pollutants such as ammonia and pyrethroid pesticides.

Photos of Site



February 2006



July 2006

⁴ Sullivan, K., D.J. Martin, R.D. Cardwell, T.E. Toll, & S. Duke. (2000). *An analysis of the effects of temperature on salmonids of the Pacific Northwest with implications for selecting temperature criteria*. Portland, OR: Sustainable Ecosystems Institute.

QAQC

The data in this water quality monitoring fact sheets meet the quality assurance and quality control requirements of the Water Board's Surface Water Ambient Monitoring Program (SWAMP). Additional surface water monitoring data are available at the Water Board's Central Coast Ambient Monitoring Program website <http://www.ccamp.org>. Any questions regarding the data or analysis should be directed to either **Peter Meertens** at pmeertens@waterboards.ca.gov (805) 549-3869 or **Amanda Bern** at abern@waterboards.ca.gov (805) 594-6197.

Attachment: Monitoring Data

Site Tag	Bradley Channel at Culvert														
312 BCC	Beneficial Uses: Not Specified														
		Ammonia as N, Ionized	Chlorophyll a	Conductivity	Instantaneous Flow	Nitrate/Nitrite as N	N / STD	Orthophosphate as P	OP / STD	Oxygen, Dissolved	Oxygen, Saturation	pH	Turbidity	T / STD	Water Temp
Units		mg/L	µg/L	mmho/cm	CFS	mg/L	none	mg/L	none	mg/L	%		NTU	none	°C
	Jan-05	No Flow													
2/21/2005	Feb-05	0.0035	9.82	0.4295	17.1			0.671	5.59	9.88	93	7.91	2839	114	12.1
3/22/2005	Mar-05	0.0483	6.77	0.9122	4.1	22.9	2.29	0.95	7.92	7.34	75	7.83	3000	120	16.4
4/20/2005	Apr-05	0.0389	1.06	1.352	0.2			0.351	2.93	15.18	170	8.87	147	6	21.0
5/24/2005	May-05	0.0125	0.89	1.863	0.3			0.27	2.25	13.2	180	9.17	17	1	31.3
7/26/2005	Jul-05	0.0125	6.65	1.394	0.8			0.004	0.03	8.07	96	8.38	330	13	23.5
8/31/2005	Aug-05	0.0335	2.83	1.375	0.1			0.419	3.49	10.57	131	8.32	21	1	25.9
9/27/2005	Sep-05				0.0										
10/25/2005	Oct-05	Dry													
11/29/2005	Nov-05	0.0037	2.11	1.68	2.5			0.222	1.85	9.62	97	8.37	300	12	15.8
12/15/2005	Dec-05	0.0079	3.18	1.629	0.4	4.26	0.43	0.337	2.81	10.27	98	8.23	85	3	13.1
1/25/2006	Jan-06	0.2058	2.29	1.361	0.0	9.15	0.92	0.929	7.74	7.6	77	8.19	468	19	14.8
2/22/2006	Feb-06	0.0088		1.589	0.2	14.8	1.48	0.561	4.68	11.47	120	8.33	99	4	17.0
3/30/2006	Mar-06				0.0										
4/27/2006	Apr-06				0.0										
5/15/2006	May-06		3.44	1.949	0.0					8.37	90	8.49			18.2
6/27/2006	Jun-06	0.6788	4.47	1.473	0.4	20.7	2.07	12.1	####	3.64	45	7.67	142	6	25.2
7/26/2006	Jul-06	0.007	1.2	1.431	0.4	8.64	0.86	0.621	5.18	3.76	47	7.65	42	2	25.5
8/22/2006	Aug-06				0.0										
9/26/2006	Sep-06				0.0										
10/25/2006	Oct-06	0.0021	0.005	1.4	0.0	18.6	1.86	4.13	34.42	6.16	65	7.94	11	0	17.3
11/15/2006	Nov-06	0.001	1.35	2.093	0.0	63.4	6.34	2.135	17.80	6.09	62	7.41	13	1	15.9
	Dec-06	No Flow													
1/30/2007	Jan-07	Dry													
2/13/2007	Feb-07	0.0964	1.21	1.282	0.5	5.53	0.55	7.359	61.32	7.02	71	7.76	86	3	15.6
3/20/2007	Mar-07	0.029	4.53	1.523	0.9	60.1	6.01	0.5999	5.00	8.84	88	7.86	709	28	15.0
4/10/2007	Apr-07	Standing pools			0.0										
5/29/2007	May-07	0.2576	2.49	1.382	0.1	19.2	1.92	0.383	3.19	7.31	82	8.05	3000	120	21.0
6/26/2007	Jun-07	0.0151	2.06	0.0013	0.4	112	11.2	1.332	11.10	5.24	61	7.43	2487	99	22.3
7/25/2007	Jul-07	0.0002	0.48	1.475	0.5	7.6	0.76	0.289	2.41	2.75	31	7.33	30	1	20.3
Average		0.077	3.0	1.38	1.1	28.2		1.77		8.1	Below	8.1	728		19.3
Standard Deviation		0.162	2.5	0.48	3.4	31.6		3.06		3.2		0.5	1135		5.0
Minimum		0.000	0.0	0.00	0.0	4.3		0.00		2.8	31	7.3	11		12.1
Maximum		0.679	9.8	2.09	17.1	112		12.10		15.2	180	9.2	3000		31.3
Standard		<0.025	<40	<0.75		<10		<0.12		>7		7-8.5	<25		
%Outside		42%	0%	10%		62%		95%		30%		10%	79%		
Standard 2				3						>5		7-8.3			
%Outside				0%						15%		35%			
								Median Annual DO %							
								Year	Median	Meet Criteria					
								2005	97%	Yes					
								2006	65%	No					
								2007	71%	No					