

**Bear River Tri-State Water Quality Monitoring
Basin Wide Synoptic Sampling
Year One**

Bear River Water Quality Monitoring
June, July, and November 2006
April, June, and July 2007

**Prepared By:
Idaho Department of Environmental Quality
Pocatello Regional Office
444 Hospital Way, #300
Pocatello ID, 83201**

31 March 2008

Summary

Water quality monitoring was conducted in the Bear River Basin at 21 sites along the entire length of the Bear River in June, July and November, 2006 and in April, June, and July, 2007 as part of the coordinated monitoring effort amongst Wyoming, Idaho and Utah. Water chemistry monitoring was conducted over four two-day periods in July and November 2006 and April and June 2007 during defined hydrologic intervals as outlined in the Bear River/Malad Subbasin Assessment and Total Maximum Daily Load Plan (2005). There are distinct temporal and seasonal components to sediment and nutrients in the Bear River. Bacteria monitoring was performed over two two-day intervals in late June 2006 and early July 2007. *Escherichia coli* bacteria was monitored at all 21 sites two years in a row with an exceedance of Primary Contact Recreation (PCR) criterion of 406 colonies/100ml occurring one time at only one site.

Introduction

The Bear River Basin is a trans-boundary basin located in three states; Wyoming, Idaho and Utah, with the Bear River crossing state boundaries five times. The Bear River Water Quality Task Force, headed by water quality staff from the three states, determined that coordinated water quality monitoring was an essential component of a fully integrated watershed management scheme. In 2006 a Tri-State Water Quality Monitoring Plan was finalized and approved by the Bear River Water Quality Committee which acts underneath the umbrella of the Bear River Commission. As part of the plan, water quality monitoring is conducted on the Bear River five times a year at twenty-one different sites. Four of the five monitoring events are for water chemistry and the other event is for bacterial monitoring. Data collected in this tri-state monitoring effort will provide ongoing consistent and comparable water quality monitoring data for the entire length of the Bear River. It is anticipated that this monitoring will continue for an initial five year period.

Methods

Study Sites

Twenty-one (21) sites were monitored along the entire Bear River (Figure 1); eleven in Idaho, seven in Utah, and three in Wyoming. At each of the 21 sites, six water quality monitoring events took place in just over a year. Four of six events were for water chemistry and two for *E. coli*. Water chemistry monitoring occurred on: 1) 17-18 July 2006 (summer base flow), 2) 15-16 November 2006 (winter base flow), 3) 24-25 April 2007 (lower basin run-off), and 4) 20-21 June 2007 (upper basin run-off). Bacteria monitoring was conducted on 29-30 June 2006 and 5-6 July 2007. Water chemistry monitoring in July 2006, November 2006, and April 2006 consisted of two teams, one from Utah DEQ and one from Idaho DEQ, working towards each other from the bottom

and top of the watershed. The two *E. coli* events and the last water chemistry monitoring, in June 2007 were conducted with just one team, with a single representative from Idaho DEQ and Utah DEQ. In the approved monitoring plan (IDEQ 2006), the monitoring procedure prescribes depth integrated sampling across the river channel, however, due to time and resource constraints, the monitoring method was changed from that of depth integrated to grab (bucket-grab). One discreet bucket sample was collected in the centroid of stream flow to guarantee the most representative sample. The sample was then placed in sample containers, as outlined in the original monitoring plan. All bucket-grab sampling equipment (bucket and rope) were rinsed three times with the ambient water at each monitoring location prior to sampling. Stream grab samples were collected upstream of the bridge to avoid any influence bridge run-off might have on collecting a representative sample. Bacteria sampling was done either by direct grab or bucket grab, depending on whether or not containers could be filled away from the bank, away from backwater and stagnant pooled areas. A YSI multi-parameter monitoring system (model 6920 sonde, model 650 MDS display, Yellow Springs Instruments, Ohio) was used to acquire in-situ readings of dissolved oxygen, temperature, turbidity, conductivity, and pH concurrent with water sampling. Readings were taken at up to three locations perpendicular to the stream flow (middle, left third, right third). Physical measurements were also used to substantiate that water chemistry was longitudinally similar across the stream profile. All water chemistry samples were preserved with sulfuric acid, as necessary, stored at 4°C in coolers and shipped under chain of custody within holding times to Energy Laboratories, Billings, Montana. *E. coli* samples were analyzed in the field utilizing Utah DEQ's mobile bacterial testing unit.

Results

Physiochemical Measurements

Across the seasons and the subbasin, water temperature ranged from 0.02°C to 26.32°C. Specific conductance ranged from 124 to 4732 µs/cm. Dissolved oxygen measurements ranged from 5.15 to 14.95 mg/L. pH ranged from 7.70 to 8.99. Turbidity ranged from 1.2 to 88.2 NTU. Mean values for physicochemical parameters for all sample dates and at all sites are presented in Tables 1-4.

Bacteria

On 30 June 2006 *E. coli* counts ranged from four (4) colony forming units (cfu) below Cutler Dam (BR-20) to 326 (mean=93) cfu at BR-15 (above Oneida Reservoir). On 5 July 2007 *E. coli* ranged from zero cfu at BR-09 (Bear Lake Outlet) to 461 (mean=85) cfu at Stewart Dam (BR-07). Bacterial monitoring results are presented in Table 5.

Chemical Constituents

Total suspended sediment ranged from <10 mg/L to 155 (mean = 27) mg/L. Total dissolved solids ranged from 48 mg/L to 2590 (mean = 442) mg/L. Total alkalinity (total as CaCO₃) ranged from 56 mg/L to 358 (mean = 234) mg/L. Mean chloride was 82 mg/L (range = <1 to 1360 mg/L). Sulfate ranged from 3 mg/L to (mean = 51) 165 mg/L. Average nitrogen concentrations were 0.21 mg/L (range=<0.05 to 1.07) for nitrate +

nitrite, and 0.98 mg/L (range=0.4 to 3.0) for TKN. Ammonia was just above or at the MDL of 0.05 mg/L for all monitoring. Phosphorous ranged from <0.004 to 0.263 (mean=0.075) mg/L for total phosphorous and a range of <0.004 to 0.054 (mean=0.011) mg/L for dissolved ortho-phosphorous. All results for chemical constituents are found in Table 6.

Analyses of an equipment blank collected during field sampling on 21 June 2006 indicated low concentrations for TKN (0.2 mg/L, MDL=0.1 mg/L), ortho-phosphorous (0.008 mg/L, MDL=0.004 mg/L) and total phosphorous (0.015 mg/L, MDL=0.004 mg/L). Total suspended solids, total dissolved solids, alkalinity, chloride, sulfate, ammonia, and nitrate + nitrite were below method detection limits (Table 6). Duplicate samples were within 25% of each other for all constituents present, except for the 19 July 2006 duplicate concentrations of ortho-phosphorous and total suspended sediment, where reported levels were either at or just above the MDL and the percent difference cannot be computed. In those cases, all laboratory quality assurance criteria were met.

Discussion

Sample Sites

Eighteen (18) sites were monitored with a bucket in a well mixed portion of the river, from bridges. Bridge monitoring at Bear Lake Inlet (BR-08), Below Grace Dam (BR-13), and Corinne (BR-21) was not feasible due to site configurations so water samples were collected in a well mixed portion of the river from either the right or left bank. River water around Bear Lake is dependant on water storage and transport demands. In 2006 and 2007 Bear River water was not conveyed to Bear Lake in the summer months. Stagnant water was collected around Stewart Dam (BR-07) and Bear Lake Inlet (BR-08) in July 2006 and June 2007. Paris Dike was closed from October to May and water samples collected from the outlet canal (BR-10) in November 2006 and April 2007 were of stagnant water.

Physiochemical Measurements

The lowest water temperature recorded (0.02°C) was at BR-01 (above Evanston) on 15 November 2007 and the highest temperature recorded (26.32°C) was at Corinne (BR-21) on 21 June 2007. Specific conductance ranged from 124 to 4732 µs/cm, with the lowest conductivity at BR-01 (above Evanston) and the highest conductivity measured near the Great Salt Lake in Corinne (BR-21). Conductivity generally increases down river. Dissolved oxygen measurements ranged from 5.15 mg/L at BR-17 on 18 July 2006 to 14.95 mg/L at BR-03 on 15 November 2006. Dissolved oxygen measurements in the lower watershed (BR-18 to BR-21) were removed from the dataset due to faulty probe conditions and DO measurements were not taken below BR-13 and BR-15 in July 2006 and November 2006, respectively. pH ranged from 7.70 to 8.99 with the lowest measurements consistently below Oneida Reservoir (BR-16), irrespective of season. Turbidity ranged from 1.2 to 88.2 NTU. Turbidity measurements, basin wide, were lower during winter base flow (November 2006). Mean values for physicochemical parameters at all sites are presented in Tables 1-4.

Bacteria

E. coli water quality standards vary amongst the three states. The primary contact instantaneous maximum is 406 cfu in Idaho and 576 cfu in Utah. Wyoming has a fecal coliform standard, based on a geometric mean. There was only one exceedance of the Idaho criteria (most stringent) in July 2007 at Stewart Dam (BR-07) with a measurement of 461 cfu. This exceedance occurred when river water was not passing through the system to Bear Lake. The second highest *E. coli* measurement (308 cfu), in July 2007, was above Oneida Reservoir (BR-15), this is the same location where the highest measurement (326 cfu) was recorded in June 2006. *E. coli* counts tend to be highest above the reservoirs and Bear Lake (including Mud Lake) and then “reset” with the lowest readings consistently below the storage basins (Figure 2). Bacterial monitoring results are presented in Table 5 and Figure 2.

Chemical Constituents

Overall, total suspended sediment (TSS) ranged from <10 mg/L to 155 (mean = 27, median=13) mg/L (Figure 3). Looking at TSS seasonally, mean TSS measurements were lowest (range=<10 to 85 mg/L, mean=28 mg/L, median=5 mg/L) in November 2006 and highest in June 2007 (range=<10 to 155 mg/L, mean=29 mg/L, median=29). There was a variation in TSS concentrations based on location in the watershed. Total suspended sediment measurements were highest in the upper watershed (above BR-09, Bear Lake), during spring runoff (April 2007) and highest in the lower watershed (below BR-10, Paris Dike) during irrigation season (June 2007). Figures 4 to 8 depict TSS measurements by monitoring event. Concentrations of total dissolved solids ranged from 48 mg/L to 2590 (mean = 442) mg/L. There was a gradual increase in TDS through the basin from BR-01 to BR-20 and then there was a significant spike in TDS, at the lowermost monitoring site (BR-21), near the Great Salt Lake. TDS above Evanston (BR-01) ranged from 121 mg/L to 365 (mean=244) mg/L, below Cutler Reservoir (BR-20) ranged from 392 mg/L to 430 (mean=407) mg/L and at Corinne (BR-21) ranged from 484 mg/L to 2590 (mean=1133) mg/L. The most significant measurements of TDS at BR-21 occurred in July 2006 (2170 mg/L) and June 2007 (2590 mg/L). Chloride concentrations slowly increased through the watershed until the Utah-Idaho Border (BR-17), where there was a bump in chloride that remained relatively steady until Corinne (BR-21) where there was a significant spike in chloride. Chloride above Evanston (BR-01) ranged from <1 mg/L to 2 (mean=1.3) mg/L, at Utah-Idaho border (BR-17) ranged from 73 mg/L to 557 (mean=94) mg/L, and at Corinne (BR-21) ranged from 145 mg/L to 1360 (mean=693) mg/L. Nitrate + nitrite concentrations had two distinct patterns. First, nitrogen concentrations were at or just above the MDL in the upper watershed and then there was a significant increase in all nitrate + nitrite concentrations below Mud Lake. Nitrate + nitrite at BR-10 was below the MDL (0.05 mg/L) on all four monitoring events and nitrate + nitrite at BR-11 (Pescadero) was below the MDL in the summer and above the MDL in November 2006 (0.23 mg/L) and April 2007 (0.11 mg/L). Figure 8 shows the nitrate + nitrite concentrations for all sites for each monitoring event. The second major observation about nitrate + nitrite is a distinct seasonal component. Nitrate + nitrite concentrations were highest in November 2006 and second highest in April 2007. Nitrate + nitrite concentrations were lower during summer months. Figures 8 and 9 show the seasonal

component of nitrate + nitrite in the Bear River basin. Overall TP concentrations ranged from <0.004 mg/L to 0.263 (mean=0.075, median=0.56) mg/L. Looking at TP seasonally, mean TSS measurements were lowest (range=0.015 to 0.106 mg/L, mean=0.036 mg/L, median=0.03 mg/L) in November 2006 and highest in April 2007 (range=0.011 to 0.263 mg/L, mean=0.093 mg/L, median=0.081). There was a variation in TP concentration based on location in the watershed. Total phosphorous measurements were highest in the upper watershed (above BR-09, Bear Lake), during spring runoff (April 2007) and highest in the lower watershed (below BR-10, Paris Dike) during irrigation season (June 2007). Figures 4 to 8 depict TP measurements by monitoring event.

Recommendations

Continue to collect water chemistry samples quarterly at 21 sites on the main stem Bear River and attempt to schedule sampling in conjunction with defined hydrologic seasons; recognizing that logistical constraints may prevent this from occurring every monitoring event. Continue to incorporate an annual bacterial monitoring event during peak recreation season. Evaluate and determine the feasibility and benefit of substituting and/or eliminating sites around Bear Lake /Mud Lake to account for water conveyance changes due to water storage and irrigation demands. Consider moving Steward Dam (BR-07) upstream to Dingle Bridge and Paris Dike (BR-10) further downstream, near Bern when water is not moving through those sites. It is the intention of the Bear River Water Quality Committee that the Bear River tri-state water quality monitoring project continue for an initial five years. Continued monitoring and annual reporting is recommended to fulfill obligations outlined in the Bear River Tri-state Water Quality Monitoring Plan.

References

- IDEQ. 2005. Bear River/Malad Subbasin Assessment and Total Maximum Daily Load Plan: Pocatello, ID. 341 pp.
- IDEQ. 2006. Bear River Tri-State Water Quality Monitoring Plan. Idaho Department of Environmental Quality – Pocatello Regional Office: Pocatello, ID. 31 pp.

Bear River Water Quality Monitoring Locations



Figure 1. Bear River water quality monitoring locations.

Key to Figure 1 - Bear River water quality monitoring locations.

Monitoring Location	Name	Description	Location		
			Latitude	Longitude	Elevation
BR-01	Above Evanston	Above Evanston off of West of Hwy 150 where Hwy crosses Mill Creek	N 41.0044148°	W -110.936104°	7545
BR-02	Evanston	Above Woodruff Narrows below Evanston at Hwy 89 Rd Crossing	N 41.370982 °	W -111.021392 °	6545
BR-03	Below Narrows	Below Woodruff Narrows near Ut-Wy border	N 41.520202°	W -111.060211°	6341
BR-04	Randolph	East of Randolph	N 41.668790°	W -111.139145°	6240
BR-05	B- Dam	Above Pixley Dam	N 41.862688	W -111.009966°	6195
BR-06	Idaho-Wyoming Border	USGS gage station down river of border	N 42.211002°	W -111.053140°	6060
BR-07	Rainbow Canal	Rainbow Canal above Stewart Dam	N 42.250085°	W -111.288771°	5930
BR-08	Bear Lake Inlet @ Causeway	East of outlet near North Beach State Park	N 42.120056°	W -111.297429°	5927
BR-09	Bear Lake Outlet	Bear Lake outlet at Lifton pump station	N 42.122337°	W -111.314741°	5927
BR-10	Upper Outlet Canal @ Paris Dike	Outlet Canal beneath Mud Lake	N 42.208121°	W -111.339975°	5930
BR-11	Pescadero	USGS gage 10068500	N 42.400632°	W -111.354918°	5940
BR-12	Above Alexander Reservoir	Road crossing above Alexander Reservoir	N 42.648905°	W -111.617333°	5730
BR-13	Below Grace Dam @ Hwy 34	Between Last Chance and Grace Dam	N 42.586013°	W -111.730310°	5540
BR-14	Below Cove Power Plant	Road crossing below Cove power plant	N 42.494780°	W -111.790882°	4950
BR-15	Above Oneida Reservoir	Hwy 34 crossing above Oneida Narrows	N 42.346769°	W -111.713442°	4900
BR-16	Below Oneida Reservoir	Road crossing below Oneida station	N 42.263556°	W -111.752836°	4749
BR-17	Idaho-Utah Border	Road crossing near border, 3900 S Rd in Idaho	N 42.029354 °	W -111.922109°	4450
BR-18	Cub River	Below Cub River Confluence, on Rd Crossing in Amalga, Ut	N 41.833871°	W -111.893421°	4410
BR-19	Benson	Road Crossing up river of Benson, above Cutler Reservoir	N 41.800630°	W -111.909714°	4400
BR-20	Cutler Dam	Flow Gage below Cutler Dam	N 41.833916°	W -112.054800°	4390
BR-21	Corinne	USGS Real-time gage 10126000 up river from Corinne, Utah	N 41.545195°	W -112.095624°	4220

Table 1. Mean physical water parameters for Bear River water sampling 17-18 July 2006.

Site #	Site Description	T(°C)	SPC	DO%	DO (mg/L)	pH	Turbidity
BR-01	Above Evanston below UT-WY border	20.05	0.192	86.4	7.84	8.50	1.2
BR-02	Below Evanston above Woodruff Narrows	23.92	0.485	115.0	9.69	8.45	10.6
BR-03	Below Woodruff Narrows Reservoir	22.16	0.305	147.0	12.84	8.99	5.3
BR-04	East of Randolph	23.14	0.602	102.2	8.74	8.23	9.6
BR-05	B-Q Dam	23.12	0.676	68.9	5.88	8.17	43.4
BR-06	WY-ID border	23.32	0.672	106.0	9.02	8.43	30.5
BR-07	Steward Dam (Rainbow Canal)	20.33	0.713	72.6	6.55	8.31	42.9
BR-08	Bear Lake Inlet (Causeway)	23.84	0.650	91.7	7.73	8.61	14.6
BR-09	Bear Lake Outlet (Lifton Pump)	22.44	0.693	88.7	7.67	8.59	8.4
BR-10	Outlet Canal downstream of Paris Dike	22.74	0.706	72.1	6.19	8.33	64.8
BR-11	Pescadero	22.65	0.711	77.3	6.65	8.33	53.7
BR-12	Above Alexander Reservoir	22.50	0.688	87.4	7.55	8.32	39.5
BR-13	Below Grace Dam	21.30	0.670	94.1	8.27	8.25	17.8
BR-14	Below Black Canyon at Niter cheese plant	23.10	0.747	148.3	10.91	7.84	NA ¹
BR-15	Above Oneida Reservoir	22.32	0.705	95.3	7.12	8.18	NA ¹
BR-16	Below Oneida Reservoir	22.17	0.752	105.9	7.93	7.87	NA ¹
BR-17	ID-UT border	23.28	0.922	70.2	5.15	8.05	NA ¹
BR-18	Below Cub River in Amalga	25.25	0.939	102.9	7.27	8.44	NA ¹
BR-19	Above Cutler Reservoir in Benson	26.11	0.845	117.4	8.17	8.34	NA ¹
BR-20	Below Cutler Reservoir	23.20	1.316	79.8	5.85	8.16	NA ¹
BR-21	Corinne	25.92	4.153	175.5	12.28	8.10	NA ¹

¹Data not available for this parameter

Table 2. Mean physical water parameters for Bear River water sampling 15-16 November 2006.

Site #	Site Description	T(°C)	SPC	DO%	DO (mg/L)	pH	Turbidity
BR-01	Above Evanston below UT-WY border	0.02	0.203	92.0	13.39	8.07	7.1
BR-02	Below Evanston above Woodruff Narrows	0.25	0.380	93.1	13.50	8.29	12.1
BR-03	Below Woodruff Narrows Reservoir	1.58	0.558	107.0	14.95	8.77	4.9
BR-04	East of Randolph	2.40	0.624	93.9	12.84	8.20	6.6
BR-05	B-Q Dam	1.30	0.642	88.2	12.40	8.39	14.7
BR-06	WY-ID border	1.25	0.596	95.9	13.51	8.35	11.3
BR-07	Steward Dam (Rainbow Canal)	1.83	0.696	93.9	13.03	8.44	6.3
BR-08	Bear Lake Inlet (Causeway)	1.14	0.655	84.7	11.96	8.37	7.3
BR-09	Bear Lake Outlet (Lifton Pump)	2.68	0.649	86.6	11.71	8.25	5.7
BR-10	Outlet Canal downstream of Paris Dike	1.42	0.633	83.0	11.61	7.92	1.3
BR-11	Pescadero	0.60	0.646	91.6	13.14	8.33	7.5
BR-12	Above Alexander Reservoir	0.55	0.607	87.5	12.57	8.24	1.6
BR-13	Below Grace Dam	3.49	0.732	104.4	13.70	8.40	4.9
BR-14	Below Black Canyon at Niter cheese plant	5.03	0.763	104.5	13.35	8.48	5.1
BR-15	Above Oneida Reservoir	3.89	0.749	98.5	12.92	8.24	2.6
BR-16	Below Oneida Reservoir	5.61	0.541	NA ¹	9.41	7.70	NA ¹
BR-17	ID-UT border	4.35	0.617	NA ¹	10.35	8.22	NA ¹
BR-18	Below Cub River in Amalga	3.51	0.568	NA ¹	11.07	8.36	NA ¹
BR-19	Above Cutler Reservoir in Benson	3.51	0.568	NA ¹	11.07	8.36	NA ¹
BR-20	Below Cutler Reservoir	2.82	0.440	NA ¹	10.67	8.43	NA ¹
BR-21	Corinne	3.44	0.663	NA ¹	9.91	8.30	NA ¹

¹Data not available for this parameter, measurement not taken**Table 3. Mean physical water parameters for Bear River water sampling 24-25 April 2007.**

Site #	Site Description	T(°C)	SPC	DO%	DO (mg/L)	pH	Turbidity
BR-01	Above Evanston below UT-WY border	4.29	0.215	82.2	10.69	8.11	3.2
BR-02	Below Evanston above Woodruff Narrows	7.24	0.387	91.2	10.97	8.24	5.9
BR-03	Below Woodruff Narrows Reservoir	8.65	0.391	90.0	10.51	8.40	5.8
BR-04	East of Randolph	6.73	0.331	87.8	10.72	8.25	5.0
BR-05	B-Q Dam	10.86	0.505	78.1	8.63	8.15	32.4
BR-06	WY-ID border	8.75	0.409	85.3	9.95	8.27	14.4
BR-07	Steward Dam (Rainbow Canal)	9.07	0.636	85.0	9.79	8.38	28.0
BR-08	Bear Lake Inlet (Causeway)	11.01	0.630	79.7	8.77	8.04	88.2
BR-09	Bear Lake Outlet (Lifton Pump)	11.23	0.605	98.0	10.73	8.46	7.8
BR-10	Outlet Canal downstream of Paris Dike	9.67	1.153	82.4	9.32	8.36	15.6
BR-11	Pescadero	12.01	0.599	113.9	12.27	8.36	22.7
BR-12	Above Alexander Reservoir	12.50	0.560	111.4	11.90	8.41	14.7
BR-13	Below Grace Dam	10.09	0.698	98.2	11.02	8.32	10.1
BR-14	Below Black Canyon at Niter cheese plant	16.53	0.785	124.4	12.15	8.12	9.7
BR-15	Above Oneida Reservoir	14.75	0.694	110.4	11.18	8.14	16.4
BR-16	Below Oneida Reservoir	10.36	0.692	99.3	11.04	7.78	4.9
BR-17	ID-UT border	14.96	0.826	122.5	12.33	8.37	11.2
BR-18	Below Cub River in Amalga	14.22	0.699	101.3	10.37	8.33	34.3
BR-19	Above Cutler Reservoir in Benson	14.23	0.694	102.9	10.54	8.42	36.3
BR-20	Below Cutler Reservoir	13.87	0.842	103.0	10.61	8.30	31.7
BR-21	Corinne	14.78	0.991	127.3	12.87	8.62	52.2

Table 4. Mean physical water parameters for Bear River water sampling 20-21 June 2007.

	Site Description	T(°C)	SPC	DO%	DO (mg/L)	pH	Turbidity
BR-01	Above Evanston below UT-WY border	12.95	0.124	88.6	9.34	8.50	2.1
BR-02	Below Evanston above Woodruff Narrows	17.32	0.372	88.2	8.46	8.24	2.6
BR-03	Below Woodruff Narrows Reservoir	18.37	0.319	111.1	10.43	8.79	4.7
BR-04	East of Randolph	17.52	0.536	77.0	7.35	7.93	19.8
BR-05	B-Q Dam	21.15	0.866	65.5	5.81	8.09	31.7
BR-06	WY-ID border	20.48	0.760	97.4	8.75	8.34	18.6
BR-07	Steward Dam (Rainbow Canal)	20.23	0.754	93.7	8.45	8.40	36.6
BR-08	Bear Lake Inlet (Causeway)	20.03	0.725	102.4	9.25	8.72	14.1
BR-09	Bear Lake Outlet (Lifton Pump)	20.26	0.707	102.4	9.23	8.71	4.3
BR-10	Outlet Canal downstream of Paris Dike	20.59	0.719	99.43	8.89	8.65	53.1
BR-11	Pescadero	19.30	0.727	83.1	7.59	8.58	50.1
BR-12	Above Alexander Reservoir	18.87	0.732	81.9	7.60	8.57	68.2
BR-13	Below Grace Dam	18.43	0.752	86.0	8.06	8.46	12.2
BR-14	Below Black Canyon at Niter cheese plant	19.04	0.754	103.2	9.51	8.60	12.4
BR-15	Above Oneida Reservoir	18.59	0.771	65.5	6.11	8.30	35.2
BR-16	Below Oneida Reservoir	19.18	0.790	99.67	9.16	7.94	2.9
BR-17	ID-UT border	19.81	0.872	69.0	6.28	8.21	21.7
BR-18	Below Cub River in Amalga	21.78	0.862	NA ¹	NA ¹	8.28	65.4
BR-19	Above Cutler Reservoir in Benson	22.83	0.860	NA ¹	NA ¹	8.33	55.3
BR-20	Below Cutler Reservoir	25.58	1.850	NA ¹	NA ¹	8.65	11.4
BR-21	Corinne	26.32	4.732	NA ¹	NA ¹	8.79	56.0

¹DO measurements removed due to probe malfunction.

Table 5. Results of Bear River *E. coli* monitoring on 30 June 2006 and 5 July 2007.

Site #	Description	30-Jun-06	5-Jul-07
		<i>E. coli</i> cfu per 100 ml	<i>E. coli</i> MPN/100 ml
BR-01	Above Evanston at UT/WY border	13.1	204.6
BR-02	Below Evanston	39.3	93.3
BR-03	Below Woodruff Narrows Reservoir	12.2	20.3
BR-04	East of Randolph	131.3	30.5
BR-05	B-Q Dam	186	43.5
BR-06	ID/WY Border	133.3	74.4
BR-07	Rainbow Canal above Stewart Dam	201.4	461.1
BR-08	Bear Lake Inlet	27.8	7.4
BR-09	Bear Lake Outlet	25.9	0
BR-10	Outlet Canal @ Paris Dike	176.9	51.2
BR-11	Pescadero	178.9	105
BR-12	Above Alexander	86.2	38.8
BR-13	Grace	28.8	19.7
BR-14	Below Black Canyon	160.7	61.1
BR-15	Above Oneida Reservoir	325.5	307.6
BR-16	Below Oneida Reservoir	15.5	18.7
BR-17	ID/UT Border - 3900 S. road crossing	82.1	60.2
BR-18	Below Cub River inlet in Amalga	69.5	62
BR-19	Above Cutler	37.9	34.1
BR-20	Below Cutler	4.1	3.1
BR-21	Corrine	10.8	95.9

Table 6. Results of Bear River surface water quality sampling for July and November 2006 and April and June 2007. (All results in mg/L)

Description	Site #	Collection Date	Time	TSS ¹	TDS ²	Alkalinity, total as CaCO ₃ ³	Chloride ⁴	Sulfate ⁵	NH ₃ ⁶	NO ₂ +NO ₃ ⁷	TKN ⁸	Ortho-p ⁹	TP ¹⁰
Above Evanston at UT/WY border	BR-01	7/18/2006	1410	5 ¹¹	121	96	0.5 ¹¹	3	0.025 ¹¹	0.025 ¹¹	0.5	0.002 ¹¹	0.002 ¹¹
Above Woodruff Narrows Reservoir	BR-02	7/18/2006	1510	5 ¹¹	289	204	19	24	0.025 ¹¹	0.025 ¹¹	1.1	0.007	0.015
Below Woodruff Narrows Reservoir	BR-03	7/18/2006	1545	5 ¹¹	201	131	15	8	0.025 ¹¹	0.025 ¹¹	1.1	0.028	0.066
East of Randolph	BR-04	7/18/2006	1620	17	365	240	35	24	0.025 ¹¹	0.025 ¹¹	1.1	0.007	0.043
Pixley Dam	BR-05	7/18/2006	1705	35	396	267	43	26	0.025 ¹¹	0.025 ¹¹	1.3	0.011	0.106
ID/WY Border	BR-06	7/18/2006	1750	30	405	253	34	53	0.025 ¹¹	0.025 ¹¹	1.3	0.004	0.072
Bear River at Corrine	BR-21	7/19/2006	725	51	2170	250	1100	65	0.025 ¹¹	0.29	3	0.01	0.231
Below Cutler	BR-20	7/19/2006	825	21	692	230	245	34	0.025 ¹¹	0.06	1.2	0.05	0.141
Rainbow Canal above Stewart Dam	BR-07	7/19/2006	900	59	430	248	43	59	0.025 ¹¹	0.025 ¹¹	1	0.002 ¹¹	0.12
Above Cutler	BR-19	7/19/2006	900	53	497	245	94	47	0.025 ¹¹	0.12	1.4	0.006	0.112
Paris Dike	BR-10	7/19/2006	930	85	409	244	40	59	0.025 ¹¹	0.025 ¹¹	1	0.005	0.142
Below Cub River inlet in Amalga	BR-18	7/19/2006	930	45	529	263	112	49	0.025 ¹¹	0.26	1.3	0.01	0.13
Bear Lake Outlet at Lifton Pump Station	BR-09	7/19/2006	1000	12	391	237	43	66	0.025 ¹¹	0.025 ¹¹	0.5	0.005	0.014
Bear Lake Inlet	BR-08	7/19/2006	1005	5 ¹¹	396	203	47	60	0.05	0.025 ¹¹	1.6	0.007	0.044
ID/UT Border - 3900 S. road crossing	BR-17	7/19/2006	1015	10	522	244	113	53	0.025 ¹¹	0.07	0.9	0.015	0.042
Duplicate at BR-Outlet=BR-09	BR-22	7/19/2006	1025	5 ¹¹	397	238	43	66	0.025 ¹¹	0.025 ¹¹	0.6	0.002 ¹¹	0.016
Pescadero	BR-11	7/19/2006	1115	62	425	253	43	59	0.025 ¹¹	0.025 ¹¹	1.1	0.006	0.114
Below Oneida Reservoir	BR-16	7/19/2006	1115	5 ¹¹	450	274	45	56	0.06	0.23	1	0.015	0.048
Above Oneida Reservoir	BR-15	7/19/2006	1200	17	421	269	38	53	0.025 ¹¹	0.41	1	0.04	0.067
Above Alexander	BR-12	7/19/2006	1210	50	400	255	36	47	0.025 ¹¹	0.025 ¹¹	1.2	0.002 ¹¹	0.082
Grace	BR-13	7/19/2006	1235	5 ¹¹	402	250	36	49	0.025 ¹¹	0.12	1	0.014	0.04
Below Black Canyon	BR-14	7/19/2006	1255	11	437	277	39	54	0.025 ¹¹	0.25	0.9	0.009	0.041
Above Evanston at UT/WY border	BR-01	11/15/2006	1105	11	115	98	2	5	0.025 ¹¹	0.12	0.4	0.002 ¹¹	0.017
Above Woodruff Narrows Reservoir	BR-02	11/15/2006	1205	5 ¹¹	220	161	16	11	0.025 ¹¹	0.025 ¹¹	0.5	0.017	0.045
Below Woodruff Narrows Reservoir	BR-03	11/15/2006	1240	5 ¹¹	310	146	68	18	0.025 ¹¹	0.025 ¹¹	0.8	0.004	0.032
East of Randolph	BR-04	11/15/2006	1325	10	356	236	40	30	0.025 ¹¹	0.09	0.5	0.002 ¹¹	0.03
Pixley Dam	BR-05	11/15/2006	1355	12	374	239	35	45	0.025 ¹¹	0.025 ¹¹	0.4	0.002 ¹¹	0.034
ID/WY Border	BR-06	11/15/2006	1445	13	359	213	26	57	0.025 ¹¹	0.06	0.4	0.002 ¹¹	0.031
Rainbow Canal above Stewart Dam	BR-07	11/15/2006	1520	5 ¹¹	417	220	49	60	0.025 ¹¹	0.16	0.4	0.002 ¹¹	0.019
Bear Lake Inlet	BR-08	11/16/2006	925	5 ¹¹	388	220	38	61	0.025 ¹¹	0.025 ¹¹	0.5	0.002 ¹¹	0.02
Bear River at Corrine	BR-21	11/16/2006	927	16	596	256	167	45	0.025 ¹¹	0.88	1	0.049	0.106
Bear Lake Outlet at Lifton Pump Station	BR-09	11/16/2006	940	5 ¹¹	385	223	41	68	0.025 ¹¹	0.025 ¹¹	0.6	0.002 ¹¹	0.015
Paris Dike	BR-10	11/16/2006	1015	5 ¹¹	364	236	32	55	0.025 ¹¹	0.025 ¹¹	0.7	0.002 ¹¹	0.022

Below Cutler	BR-20	11/16/2006	1041	10	413	251	59	40	0.025 ¹¹	0.88	0.7	0.051	0.095
Pescadaro	BR-11	11/16/2006	1122	5 ¹¹	386	226	34	69	0.025 ¹¹	0.23	0.6	0.002 ¹¹	0.024
Above Cutler	BR-19	11/16/2006	1128	10	511	287	82	58	0.025 ¹¹	1.07	1.1	0.015	0.056
Below Cub River inlet in Amalga	BR-18	11/16/2006	1200	10	548	288	102	60	0.07	1.02	0.9	0.015	0.048
Above Alexander	BR-12	11/16/2006	1206	5 ¹¹	372	234	23	56	0.07	0.76	0.5	0.009	0.02
Grace	BR-13	11/16/2006	1240	11	439	275	28	65	0.025 ¹¹	0.52	0.7	0.004	0.035
ID/UT Border - 3900 S. road crossing	BR-17	11/16/2006	1246	5 ¹¹	557	288	99	69	0.025 ¹¹	0.79	0.8	0.005	0.021
Below Black Canyon	BR-14	11/16/2006	1310	11	471	293	34	68	0.025 ¹¹	0.78	0.6	0.008	0.034
Above Oneida Reservoir	BR-15	11/16/2006	1335	5 ¹¹	443	293	36	63	0.025 ¹¹	1.03	0.8	0.009	0.029
Below Oneida Reservoir	BR-16	11/16/2006	1341	5 ¹¹	479	294	49	71	0.07	0.85	0.9	0.002 ¹¹	0.024
Above Evanston at UT/WY border	BR-01	4/24/2007	1018	5 ¹¹	108	103	2	5	0.025 ¹¹	0.025 ¹¹	0.7	0.002 ¹¹	0.011
Above Woodruff Narrows Reservoir	BR-02	4/24/2007	1110	5 ¹¹	211	168	17	15	0.025 ¹¹	0.025 ¹¹	0.8	0.008	0.031
Below Woodruff Narrows Reservoir	BR-03	4/24/2007	1200	5 ¹¹	215	159	25	14	0.025 ¹¹	0.025 ¹¹	0.9	0.006	0.037
East of Randolph	BR-04	4/24/2007	1245	44	246	183	27	19	0.025 ¹¹	0.025 ¹¹	1	0.008	0.105
Pixley Dam	BR-05	4/24/2007	1330	32	275	202	32	24	0.025 ¹¹	0.025 ¹¹	1	0.007	0.097
ID/WY Border	BR-06	4/24/2007	1425	69	325	207	29	60	0.025 ¹¹	0.025 ¹¹	1	0.013	0.132
Bear River at Corrine	BR-21	4/25/2007	930	121	506	223	145	44	0.025 ¹¹	0.2	1.8	0.011	0.263
Rainbow Canal above Stewart Dam	BR-07	4/25/2007	1010	31	362	214	48	61	0.025 ¹¹	0.025 ¹¹	1	0.002 ¹¹	0.084
Below Cutler	BR-20	4/25/2007	1015	102	319	220	48	26	0.025 ¹¹	0.29	1.3	0.023	0.248
Paris Dike	BR-10	4/25/2007	1025	19	698	358	95	165	0.025 ¹¹	0.025 ¹¹	1.2	0.006	0.064
Above Cutler	BR-19	4/25/2007	1047	40	388	236	67	35	0.025 ¹¹	0.48	0.9	0.023	0.116
Bear Lake Outlet at Lifton Pump Station	BR-09	4/25/2007	1106	5 ¹¹	343	208	43	54	0.025 ¹¹	0.025 ¹¹	0.9	0.005	0.028
Below Cub River inlet in Amalga	BR-18	4/25/2007	1110	33	392	226	71	35	0.025 ¹¹	0.44	1	0.014	0.123
Bear Lake Inlet	BR-08	4/25/2007	1120	89	364	214	45	65	0.025 ¹¹	0.025 ¹¹	1.4	0.004	0.168
ID/UT Border - 3900 S. road crossing	BR-17	4/25/2007	1150	15	430	234	92	49	0.025 ¹¹	0.26	0.8	0.011	0.055
Pescadaro	BR-11	4/25/2007	1210	24	346	209	36	63	0.025 ¹¹	0.11	1.1	0.002 ¹¹	0.073
Above Alexander	BR-12	4/25/2007	1256	18	321	212	25	50	0.09	0.46	1.2	0.007	0.081
Below Oneida Reservoir	BR-16	4/25/2007	1300	12	400	264	39	54	0.09	0.49	1	0.009	0.045
Grace	BR-13	4/25/2007	1323	13	406	284	26	58	0.025 ¹¹	0.39	0.9	0.007	0.053
Above Oneida Reservoir	BR-15	4/25/2007	1337	25	407	281	35	54	0.025 ¹¹	0.74	1	0.015	0.083
Below Black Canyon	BR-14	4/25/2007	1350	19	413	262	33	62	0.025 ¹¹	0.75	1.2	0.012	0.061
Above Evanston at UT/WY border	BR-01	6/20/2007	1040	5 ¹¹	48	56	0.5 ¹¹	3	0.025 ¹¹	0.025 ¹¹	0.7	0.015	0.013
Above Woodruff Narrows Reservoir	BR-02	6/20/2007	1145	5 ¹¹	192	199	12	16	0.025 ¹¹	0.025 ¹¹	0.6	0.008	0.02
Below Woodruff Narrows Reservoir	BR-03	6/20/2007	1215	5 ¹¹	153	137	14	10	0.025 ¹¹	0.025 ¹¹	0.7	0.008	0.034
East of Randolph	BR-04	6/20/2007	1300	29	281	216	29	21	0.025 ¹¹	0.025 ¹¹	0.8	0.008	0.056
Duplicate at BR-Outlet=BR-09	BR-22	6/20/2007	1300	5 ¹¹	380	240	48	72	0.025 ¹¹	0.025 ¹¹	0.6	0.006	0.017
Pixley Dam	BR-05	6/20/2007	1340	35	504	353	59	36	0.025 ¹¹	0.025 ¹¹	1.6	0.015	0.095
ID/WY Border	BR-06	6/20/2007	1430	21	442	276	44	70	0.025 ¹¹	0.025 ¹¹	1.1	0.008	0.057

Rainbow Canal above Stewart Dam	BR-07	6/20/2007	1530	32	442	265	47	74	0.025 ¹¹	0.025 ¹¹	1	0.012	0.083
Bear Lake Inlet	BR-08	6/20/2007	1600	5 ¹¹	399	227	53	88	0.025 ¹¹	0.025 ¹¹	0.9	0.006	0.031
Bear Lake Outlet at Lifton Pump Station	BR-09	6/20/2007	1620	5 ¹¹	380	240	47	72	0.025 ¹¹	0.025 ¹¹	1.7	0.006	0.016
Paris Dike	BR-10	6/20/2007	1655	67	399	245	48	73	0.025 ¹¹	0.025 ¹¹	0.8	0.006	0.099
Below Oneida Reservoir	BR-16	6/20/2007	1803	5 ¹¹	457	282	51	74	0.11	0.12	0.8	0.019	0.046
Pescadero	BR-11	6/21/2007	920	70	402	246	48	74	0.025 ¹¹	0.025 ¹¹	0.8	0.007	0.252
Above Alexander	BR-12	6/21/2007	1013	98	383	251	48	74	0.025 ¹¹	0.025 ¹¹	1	0.007	0.155
Grace	BR-13	6/21/2007	1040	5 ¹¹	431	263	47	75	0.025 ¹¹	0.09	0.9	0.01	0.05
Blank	BR-23	6/21/2007	1100	5 ¹¹	5 ¹¹	1 ¹¹	0.5 ¹¹	0.5	0.025 ¹¹	0.025 ¹¹	0.2	0.008	0.015
Below Black Canyon	BR-14	6/21/2007	1114	12	440	266	47	75	0.025 ¹¹	0.13	0.9	0.007	0.057
Above Oneida Reservoir	BR-15	6/21/2007	1145	38	451	277	47	74	0.025 ¹¹	0.13	0.9	0.009	0.094
ID/UT Border - 3900 S. road crossing	BR-17	6/21/2007	1303	37	494	283	73	73	0.025 ¹¹	0.18	1	0.01	0.11
Below Cub River inlet in Amalga	BR-18	6/21/2007	1345	155	489	281	71	70	0.025 ¹¹	0.22	1.1	0.011	0.231
Above Cutler	BR-19	6/21/2007	1400	41	484	275	73	71	0.025 ¹¹	0.21	0.9	0.015	0.099
Below Cutler	BR-20	6/21/2007	1440	15	967	237	405	46	0.025 ¹¹	0.025 ¹¹	1	0.054	0.146
Bear River at Corrine	BR-21	6/21/2007	1540	59	2590	235	1360	83	0.025 ¹¹	0.18	2.3	0.018	0.174
Duplicate at BR-09	BR-22	7/19/06	1025	ND	397	238	43	66	ND	ND	0.6	ND	0.016
Duplicate at BR-09	BR-22	6/20/07	1300	ND	380	240	48	72	ND	ND	0.6	0.006	0.017
Blank	BR-23	6/21/07	1100	ND	ND	ND	ND	ND	ND	ND	0.2	0.008	0.015

¹TSS method detection limit (MDL)=10 mg/L

²TDS MDL =10 mg/L

³Alkalinity MDL =2 mg/L

⁴Chloride MDL =1 mg/L

⁵Sulfate MDL =1 mg/L

⁶Ammonia MDL =0.05 mg/L

⁷Nitrate+Nitrite MDL =0.05 mg/L

⁸TKN MDL =0.01 mg/L

⁹Ortho-phosphorous MDL =0.004 mg/L

¹⁰Total phosphorous MDL =0.004 mg/L

¹¹below MDL so values recorded as half the MDL.

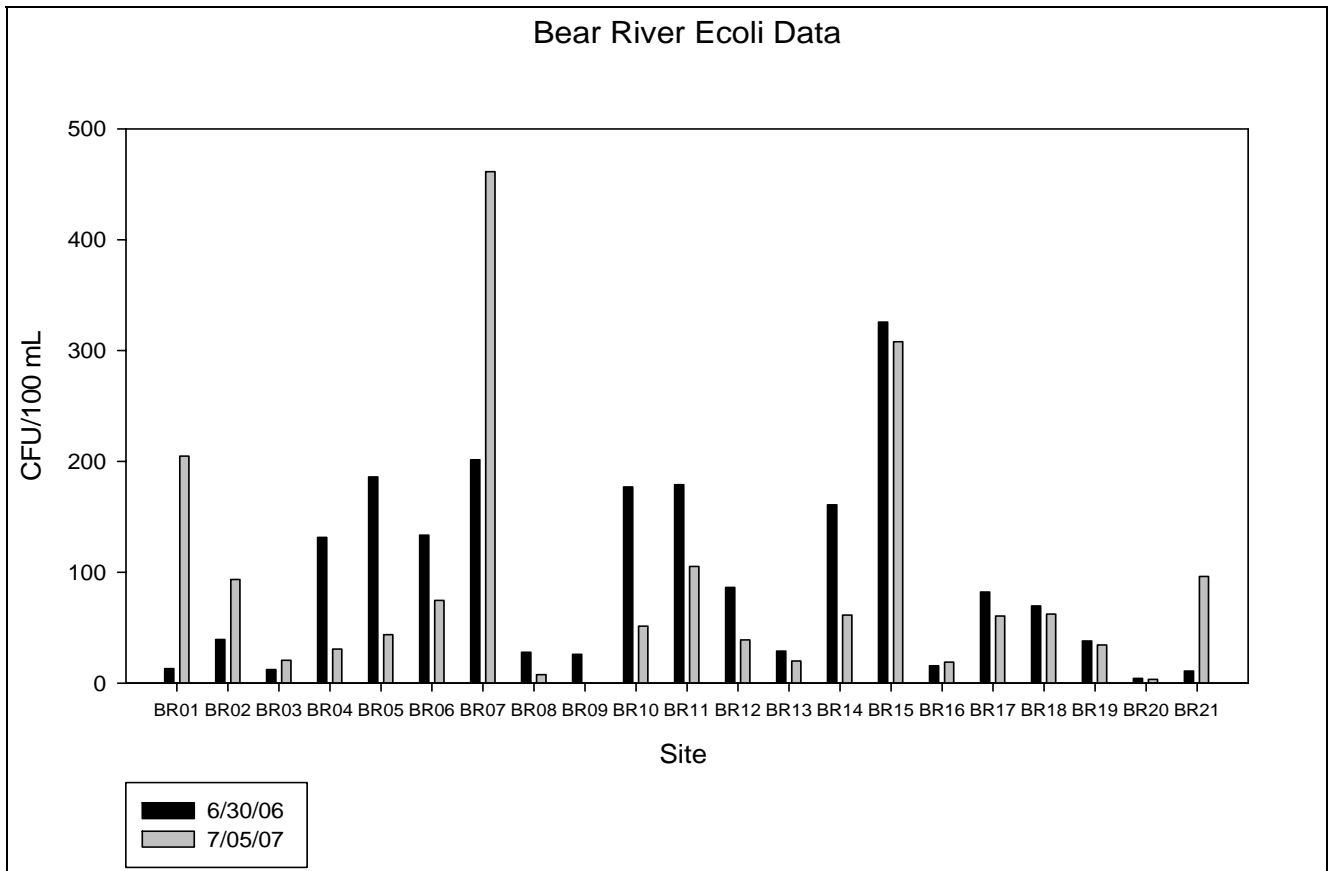


Figure 2. 2006 and 2007 Bear River *E. coli* data.

Bear River Total Suspended Sediment Summary

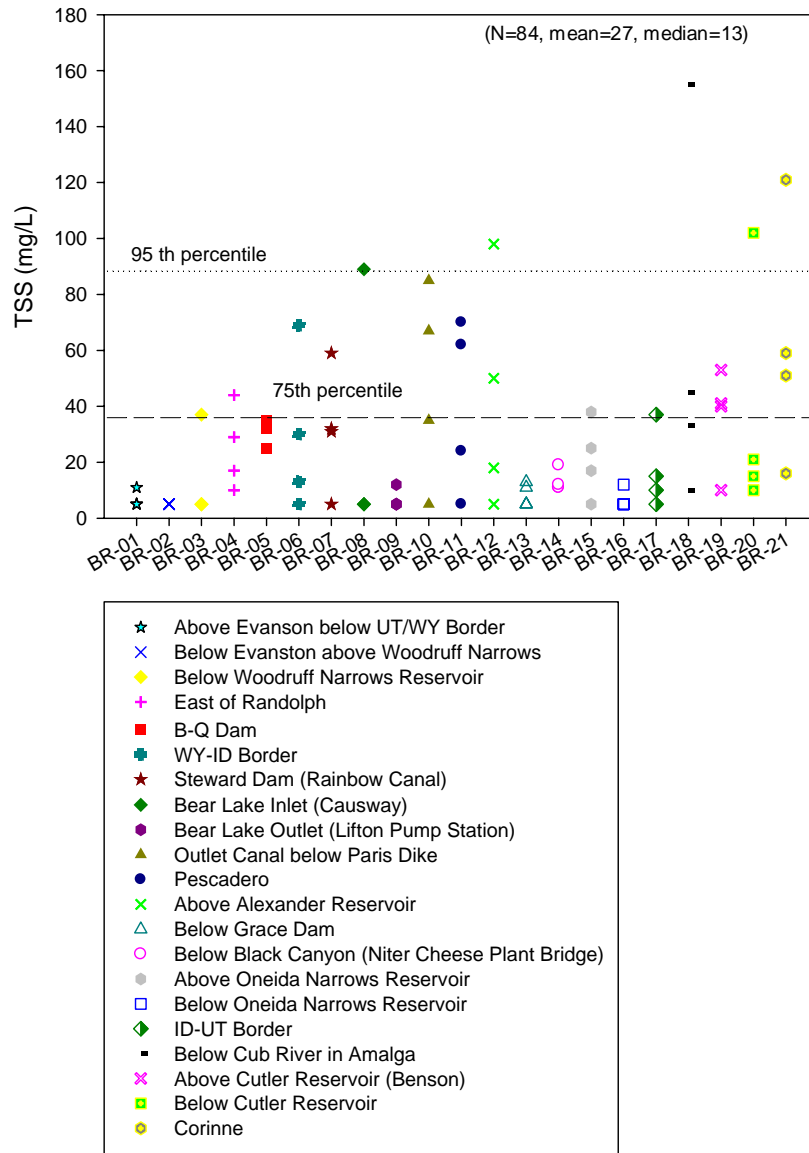


Figure 3. Bear River Total Suspended Sediment Summary.

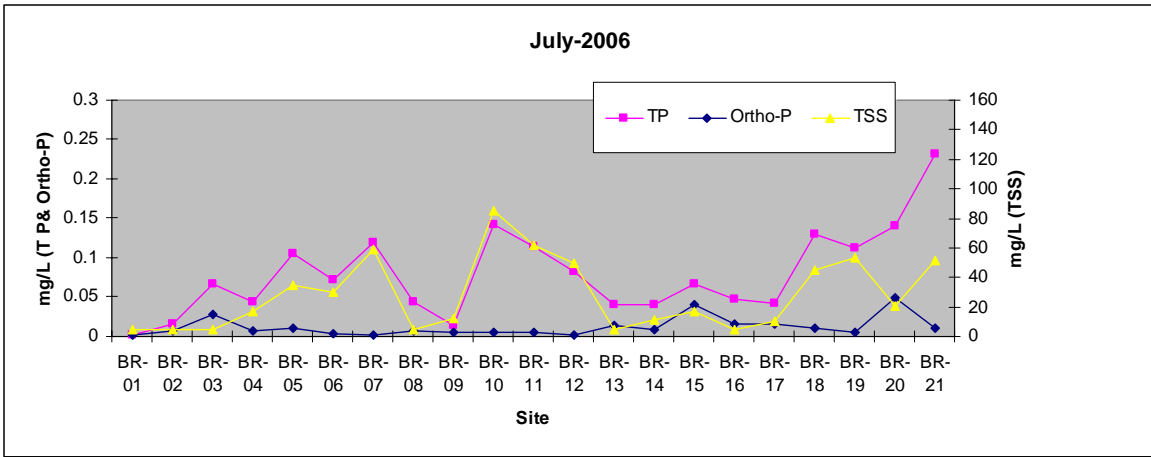


Figure 4. Bear River TSS, TP, and Ortho-P for all sites in July 2006.

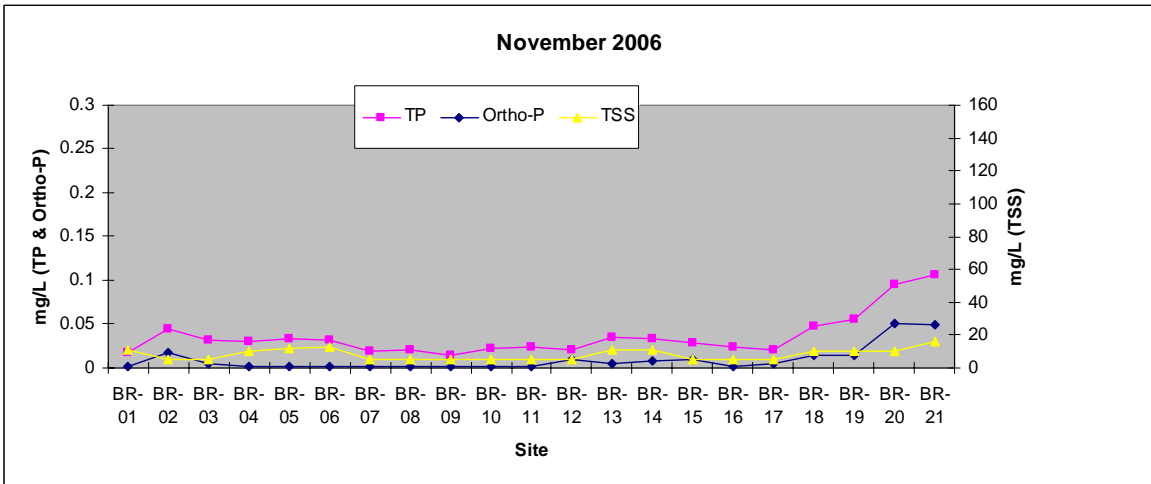


Figure 5. Bear River TSS, TP, and Ortho-P for all sites in November 2006.

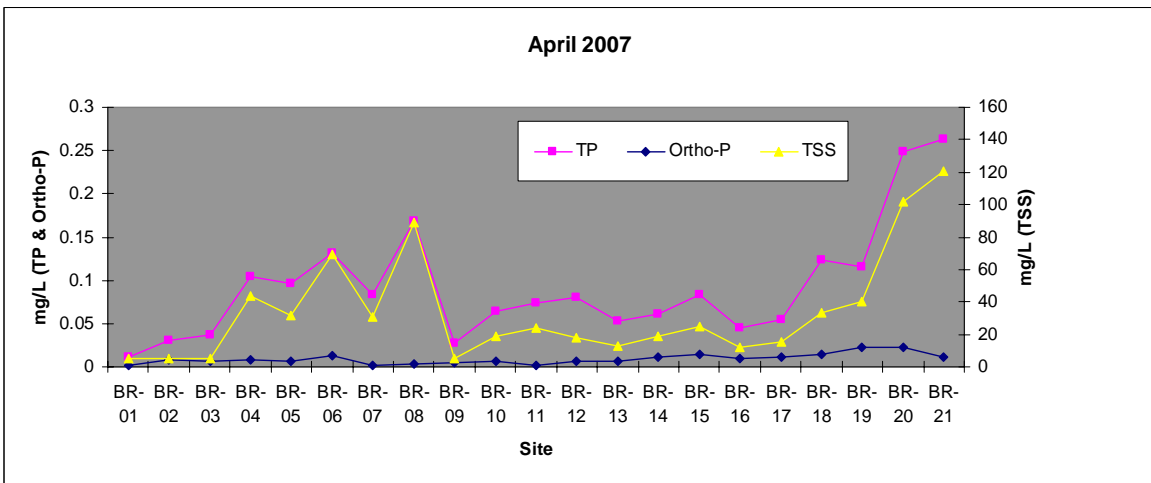


Figure 6. Bear River TSS, TP, and Ortho-P for all sites in April 2007.

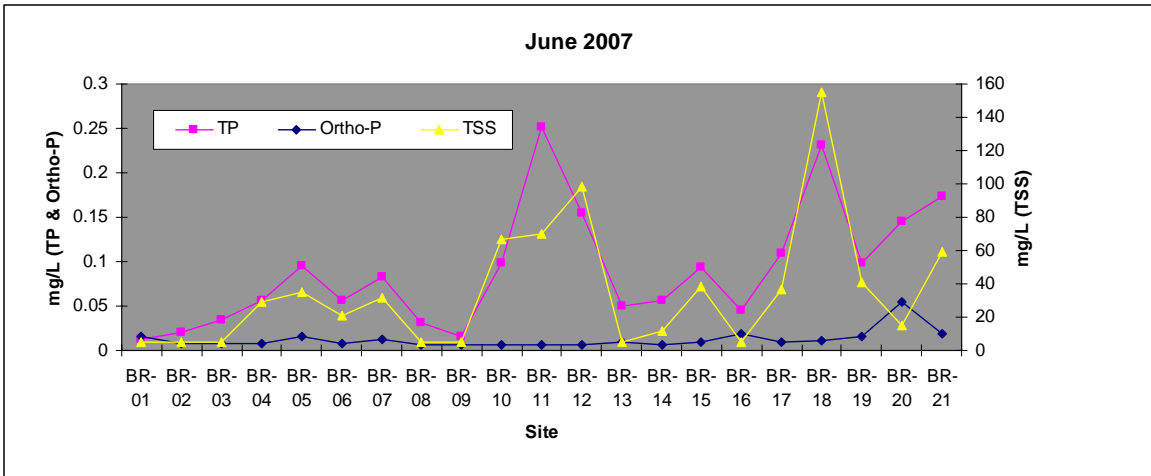


Figure 7. Bear River TSS, TP, and Ortho-P for all sites in June 2007.

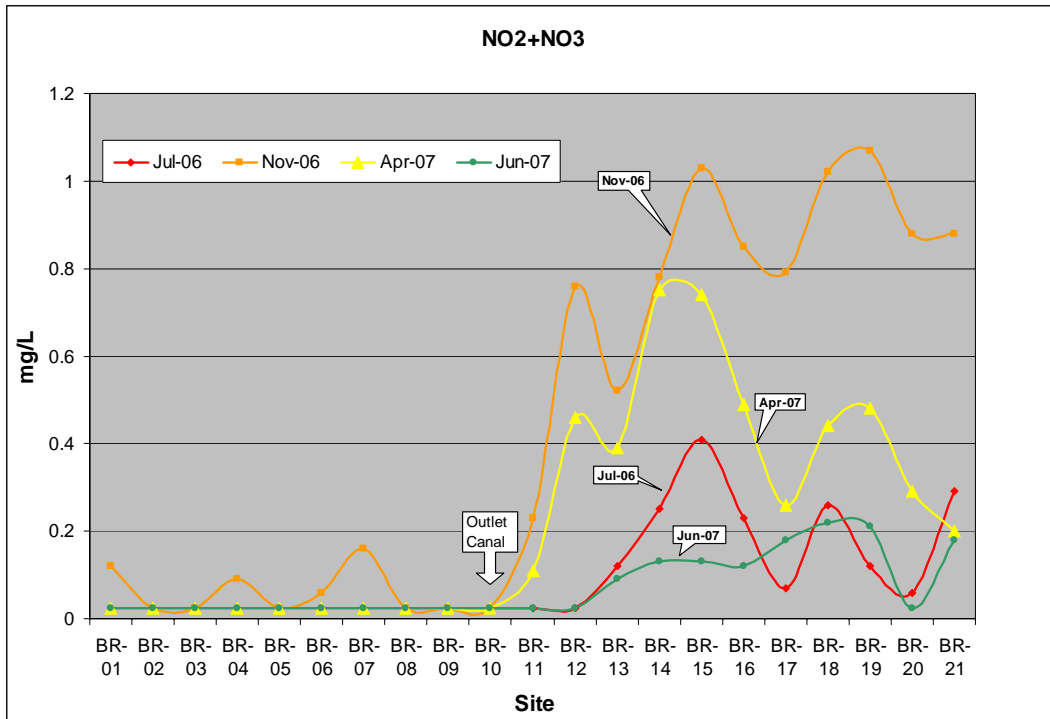


Figure 8. Bear River nitrate+nitrite for all sites for July 2006, November 2006, April 2007, and June 2007.

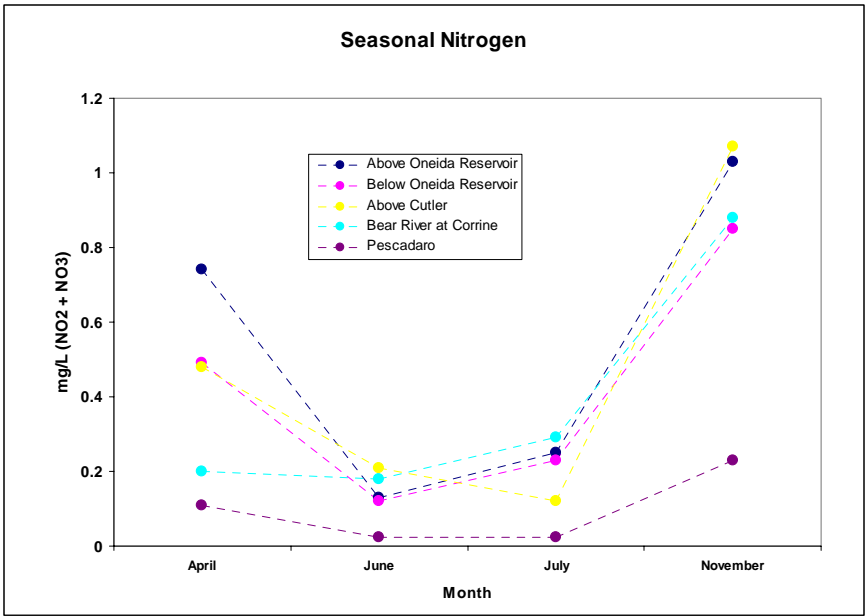


Figure 9. Bear River seasonal nitrate+nitrite for select sites in the basin.

Bear River Total Phosphorous Summary

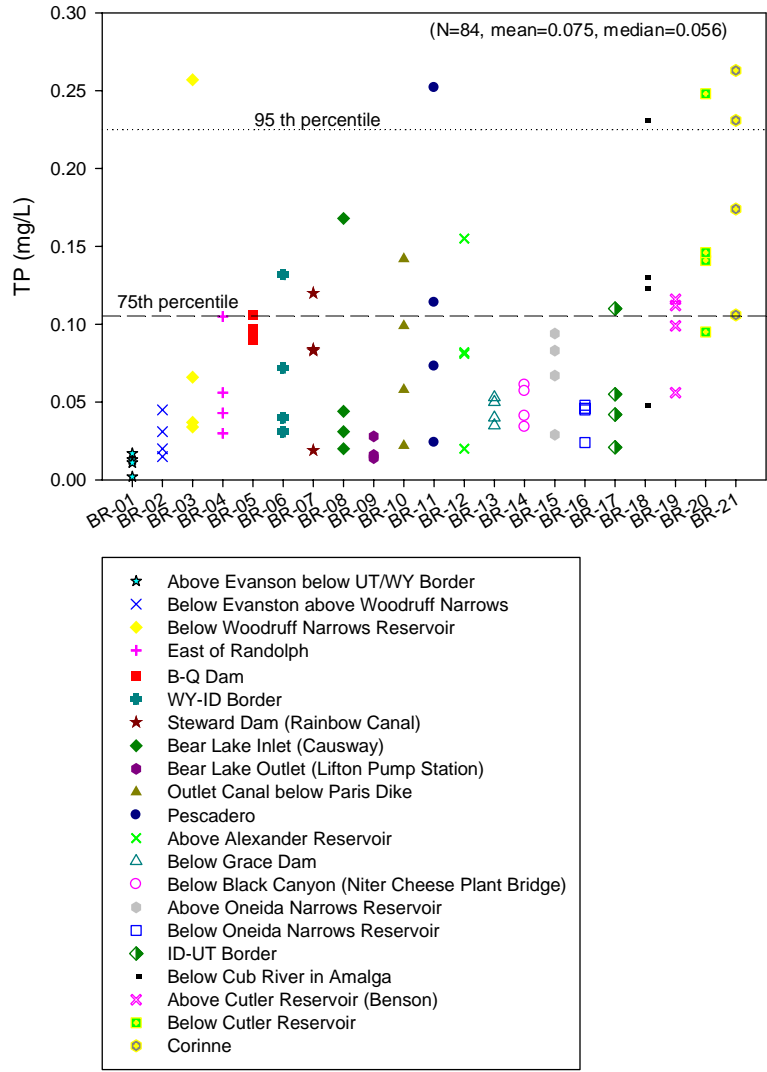


Figure 10. Bear River Total Phosphorous Summary.