MEMORANDUM

To: Big Dry Creek Watershed Association Board of Directors

From: Wright Water Engineers, Inc.
Jane Clary

Date: April 4, 2011

Re: Big Dry Creek Water Quality Summary for 2010

This memorandum summarizes the water quality monitoring program conducted by the Big Dry Creek Watershed Association (BDCWA) during 2010 and discusses these topics:

- Data summary and comparison to stream standards
- Key constituents of interest
    a. *E. coli*
    b. Selenium
    c. Nutrients (ammonia, nitrate, phosphorus)
    d. Temperature
- Flow conditions
    a. Standley Lake Release Patterns
    b. Summary of Colorado Division of Natural Resources Diversion Records
- Quality assurance/quality control

Data Summary and Comparison to Stream Standards

During 2010, the City and County of Broomfield and the cities of Northglenn, Thornton, and Westminster (Cities) worked together to collect water quality and flow data along the main stem of Big Dry Creek (Figure 1), consistent with the on-going BDCWA monitoring program (BDCWA 2003). The Cities and BDCWA also helped to fund operation of the U.S. Geological Survey (USGS) gauging station at Westminster behind Front Range Community College. A clear understanding of the hydrologic regime on Big Dry Creek is important due to its significant effect

on pollutant loading and instream concentrations. Figure 2 provides a conceptual summary of the key discharges and diversions along the creek, along with the USGS gauging station locations.

Water quality samples were collected and analyzed for a variety of constituents, resulting in over 3,600 records being added into the BDCWA water quality database. Metals were monitored on a quarterly basis with the exceptions of selenium, which was monitored monthly. All other constituents were monitored on a monthly basis. The Big Dry Creek monitoring program is an ambient-based program. During 2010, the May, June and July sampling events were influenced by wet weather conditions, with the May event including snowmelt. The June, July, August and September events were conducted during conditions when Standley Lake was releasing. Table 1 summarizes field conditions on sampling dates, as recorded at Standley Lake Dam.

Table 1. Summary of Field Conditions During 2010 Sampling Events

Date	Weather	Rain (in)	High Air Temp (F)	Standley Lake Release (cfs)	USGS West. Flow (cfs)	USGS Ft. Lupton Flow (cfs)
01/14/10	Partly cloudy, cooler	0	48	0	1.7	33
02/11/10	Mostly sunny, cool	0	48	0	2.3	33
03/11/10	Partly cloudy, mild, windy PM	0	52	0	2	32
04/08/10	Mostly sunny, mild	0	58	0	5.5	39
05/13/10*	Mostly cloudy, cool	0.30	60	0	24	99
06/10/10	Mostly sunny, hot, T-storms PM	0.20	90	26	31	23
07/08/10	Cloudy, warm, T-storms PM	0.55	72	8	49	43
08/12/10	Partly cloudy, hot	0	91	45	50	72
09/09/10	Mostly sunny, warm	0.05	93	32	32	32
10/14/10	Mostly sunny, warm	0	78	0	3.5	63
11/04/10	Mostly sunny, mild	0	61	0	3.1	22
12/09/10	Partly cloudy, mild, windy	0	58	0	1.9	20

General Notes: Weather-related data are values reported by the Standley lake dam tender and may differ from weather in other portions of the watershed. For 2011, this information is consistent with narrative observations of field staff. USGS flow data were obtained from the USGS NWIS website.
Other Notes: 5/13/10 sampling event was preceded by 1 inch of precipitation over previous two days.

An overview of samples collected is provided in these tables and attachments:

- Table 2 identifies the Colorado Water Quality Control Commission (CWQCC) stream standards on Segment 1 of Big Dry Creek, the frequency with which standards were exceeded and whether the stream attained the standard for each constituent.

- Table 3 provides a summary of the numbers of samples collected and the average, minimum and maximum concentrations for each constituent. The relevant regulatory statistic (e.g., 85th percentile as explained below) for constituents with stream standards is also provided.

- Attachment 1 provides a summary of the instream data collected during 2010 for each monitoring station.

- Attachment 2 provides a summary of grab samples for municipal wastewater treatment plant (WWTP) discharges to Big Dry Creek during 2010. These samples are collected to provide supplemental information on the quality of discharges to Big Dry Creek at the time of instream sample collection. During 2008, BDCWA decided to provide Discharge Monitoring Report (DMR) data for Colorado Discharge Permit (CDPS)-regulated constituents in lieu of grab samples; however, this change in the monitoring program was not fully implemented during 2009-2010 and is being re-evaluated in 2011. Since DMR reporting is more comprehensive than the grab samples collected as part of this program, only general review of the WWTP grab samples has been completed for purposes of this memorandum. Although Broomfield, Westminster and Northglenn are permitted to discharge to Big Dry Creek, Northglenn rarely discharges to the creek and did not discharge to Big Dry Creek at all during 2010.

- Attachment 3 provides a summary of quality assurance (QA) samples collected in accordance with the Big Dry Creek Sampling and Analysis Plan (BDCWA 2003).

Attainment of stream standards is evaluated based on comparison of specific statistical values to chronic stream standards and determining whether acute standards are exceeded in any samples. For most constituents, the relevant statistic for comparison to the chronic standard is the 85th percentile value. Exceptions include use of the 50th percentile value for metals with standards in the total recoverable form, the geometric mean[1] for *E. coli*, and the 15th percentile value for dissolved oxygen (DO) and the lower acceptable range for pH. More complex evaluation approaches are required for *E. coli*, selenium and temperature, as described further in this memorandum. (*It should be noted that from a regulatory perspective, five years of data would be used in such a comparison.*) The time periods evaluated in this memorandum vary, depending on the nature of the water quality and/or regulatory issue. For constituents with current or historic water quality concerns, five to ten years of data may be included in the discussion, whereas for most other constituents, new data collected during 2010 are the primary focus.

[1] The geometric mean is calculated as the nth root of the product of n values. The geometric mean is used for regulatory purposes because it lessens the impact of extremely high or low values, relative to the arithmetic mean.

To calculate hardness-based stream standards, a hardness value of 333 mg/L was used, consistent with the value used by the Colorado Water Quality Control Division (CWQCD) wastewater discharge permits for Broomfield, Westminster and Northglenn. The mean hardness value for the stream as a whole during 2010 was 356 mg/L, which is relatively consistent with previous analyses conducted by BDCWA. Hardness values have a significant effect on certain metals standards. For example, a hardness value of 250 mg/L results in a chronic zinc standard of 271 μg/L, whereas a hardness value of 350 mg/L results in a chronic zinc standard of 362 μg/L (i.e., the higher the hardness value, the less stringent the water quality standard is for certain metals.)

Segment 1 (the main stem) of Big Dry Creek is listed on the 2010 303(d) List for Colorado for non-attainment of stream standards for *E. coli* and selenium. (This was also the case for the 2008 303(d) List.) The 2010 Big Dry Creek data are consistent with these listings, showing attainment of all currently applicable standards with the exception of selenium and *E. coli*. A brief synopsis of these two issues includes:

- Selenium: At the December 2007 CWQCC Rulemaking Hearing, irrigation and non-irrigation season site-specific standards were assigned to Big Dry Creek. A specific standards assessment method was also developed that is to be based on data collected at monitoring locations bdc1.5, bdc2.0, and bdc4.0 (i.e., the instream locations upstream of the WWTP discharges). The 2010 Big Dry Creek data set meets the non-irrigation season (winter) chronic and acute standards and the irrigation season acute standard; however, the 2010 irrigation season data slightly exceed the chronic irrigation season standard. Attainment of the stream standard is based on evaluation of five years of data. When considering the last five years of data (2006-2010), the stream does not attain the chronic irrigation season standard by a small margin of 0.5 μg/L. Review of Standley Lake release patterns indicates that the "fringe" month of October is more comparable to the non-irrigation season. If October selenium data are analyzed with the non-irrigation season data set, then both the irrigation and non-irrigation standards would be obtained. (See the selenium discussion later in this memorandum for more information.)

- *E. coli:* Big Dry Creek does not meet the *E. coli* standard for 2010 using current CWQCD assessment procedures. *E. coli* exceeds the stream standard during the recreational season bimonthly evaluation periods of May-June, July-August and September-October. A Total Maximum Daily Load (TMDL) process has been initiated by the CWQCD and the U.S. Environmental Protection Agency (EPA) for Big Dry Creek with regard to *E. coli*. BDCWA is working cooperatively with the CWQCD and EPA to ensure that the most complete and scientifically sound data set and assumptions are used in this process. Special studies related to sources of *E. coli* in the watershed were conducted by Wright Water Engineers and BDCWA during 2007 and 2008 and provided to the CWQCD. A draft TMDL is anticipated during 2011.

More detailed discussion for selenium and *E. coli* follows, along with discussion of several other constituents of regulatory interest.

Table 2.
Comparison of 2010 Big Dry Creek Data to Stream Standards

PARAMETER	STANDARD TYPE	STREAM STANDARD	UNIT	# OF INSTREAM SAMPLES[1]	# OF VALUES GREATER THAN STD[3]	DOES 85th (or 50th) PERCENTILE VALUE FOR 2010 EXCEED STANDARD?[4]	% OF SAMPLES EXCEEDING STANDARD	# SAMPLE DAYS STANDARD EXCEEDED	COMMENT
PHYSICAL AND BIOLOGICAL									
DO		5	mg/L	92	0	NO	0%	0	
pH		6.5-9.0	SU	92	1	NO	1%	1	9-9-10 @bdc3.0 pH = 9.11
Temperature (WS-1)	Mar-Nov (DM)	24.2	C	92	0	NO	0%	0	
	Mar-Nov (MWAT)	29.0	C	92	0	NO	0%	0	
	Dec-Feb (DM)	12.1	C	92	0	NO	0%	0	
	Dec-Feb (MWAT)	14.5	C	92	0	NO	0%	0	
E. coli	(P=Potential Primary Contact)	205	#/100mL	92	62	N/A	67%	11	See monthly assessment periods below.
Jan-Feb		205	#/100mL	12	6	No	50%	-	Geomean = 161/100 mL
Mar-Apr		205	#/100mL	16	3	No	19%	-	Geomean = 46/100 mL
May-Jun		205	#/100mL	16	16	Yes	100%	-	Geomean = 481/100 mL
Jul-Aug		205	#/100mL	16	15	Yes	94%	-	Geomean = 967/100 mL
Sept-Oct		205	#/100mL	16	14	Yes	88%	-	Geomean = 487/100 mL
Nov-Dec		205	#/100mL	16	8	No	50%	-	Geomean = 168/100 mL
Ammonia	acute	TVS	mg/L	92	0	NO	0%	0	Temporary modification in place until 12/31/2011; however, when calculated using new standards, no exceedances.
Ammonia	chronic	0.1	mg/L	92	0	NO	0%	0	Temporary modification in place until 12/31/2011; however, when calculated using new standards, no exceedances.
Chlorine	acute	0.019	mg/L	N/A	N/A	N/A	N/A	N/A	
Chlorine	chronic	0.011	mg/L	N/A	N/A	N/A	N/A	N/A	
Cyanide		0.005	mg/L	32	0	NO	0%	0	
Sulfide		0.002	mg/L	N/A	N/A	N/A	N/A	N/A	
Boron		0.75	mg/L	32	0	NO	0%	0	
Nitrite		4.5	mg/L	92	0	NO	0%	0	
METALS (DISSOLVED UNLESS OTHERWISE NOTED)[2]									
Arsenic (Trec)	Acute	340	µg/L	32	0	NO	0%	0	
Arsenic (Trec)	Chronic	100	µg/L	32	0	NO	0%		
Beryllium	Chronic	100	µg/L	N/A	N/A	N/A	N/A	N/A	
Cadmium	Acute	7.8	µg/L	32	0	NO	0%	0	
Cadmium	Chronic	1.0	µg/L	32	0	NO	0%	0	
Chromium III	Acute	1526	µg/L	32	0	NO	0%	0	Analysis is total chromium.
Chromium III	Chronic	199	µg/L	32	0	NO	0%	0	Analysis is total chromium.
Chromium VI	Acute	16	µg/L	32	0	NO	0%	0	Analysis is total chromium.
Chromium VI	Chronic	11	µg/L	32	0	NO	0%	0	Analysis is total chromium.
Copper	Acute	42	µg/L	32	0	NO	0%	0	
Copper	Chronic	25	µg/L	32	0	NO	0%	0	
Iron (Trec)	Chronic	1000	µg/L	32	3	NO	0%	1	9-9-10 3 sites @ 1.14 to 1.15 mg/L
Lead	Acute	232	µg/L	32	0	NO	0%	0	
Lead	Chronic	9.1	µg/L	32	0	NO	0%	0	
Mercury (tot)	Acute	0.01	µg/L	10	0	NO	0%	0	
Manganese	Acute	4457	µg/L	32	0	NO	0%	0	
Manganese	Chronic	2463	µg/L	32	0	NO	0%	0	
Nickel	Acute	1296	µg/L	32	0	NO	0%	0	
Nickel	Chronic	144	µg/L	32	0	NO	0%	0	
Selenium (Irrigation 4/1-10/31)	Acute	18.4	µg/L	56	0	NO	0%	0	
Selenium (Irrigation)	Chronic	7.4	µg/L	56	2	Yes	4%	2	5-year 85th percentile = 7.9 ug/L
Selenium (Non-irrigation 11/1-3/31)	Acute	19.1	µg/L	36	0	NO	0%	0	
Selenium (Non-irrigation)	Chronic	15.0	µg/L	36	0	NO	0%	0	
Silver	Acute	16	µg/L	32	0	NO	0%	0	
Silver	Chronic	2.5	µg/L	32	0	NO	0%	0	
Zinc	Acute	400	µg/L	32	0	NO	0%	0	
Zinc	Chronic	347	µg/L	32	0	NO	0%	0	

[1]Based on data collected at all in-stream sampling locations along Segment 1 of Big Dry Creek.
[2]The hardness-based metal standards in this table are calculated using a hardness value of 333 mg/L.
[3]May include multiple exceedances that occurred on the same day at different stations for some parameters.
[4]The 85th percentile value is used by the CWQCD to assess whether streams attain most water quality standards. The 50th percentile value is used for metals with standards in the total form. Geometric mean is used for E. coli. For regulatory purposes, the last five years of data would be included to assess standards attainment.

Table 3. Big Dry Creek Instream Sample Summary 2010

Parameter	Units	Det. Limit	Count	min	max	mean	std dev.	5th%	15th %	25th%	50th %	75th%	85th%	95th%
ALKALINITY	mg/L	1	84	57.0	388.0	170.3	62.6	74.6	97.0	138.3	170.5	206.0	224.6	264.1
ARSENIC, Tot. Rec.	mg/L	0.001	32	<DL	0.002	0.001	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.002
BORON	mg/L	0.01	32	0.06	0.56	0.29	0.13	0.10	0.12	0.18	0.34	0.38	0.40	0.476
CADMIUM, D	mg/L	0.0003	32	< DL	< DL	< DL	NA	< DL	< DL	< DL	< DL	< DL	< DL	< DL
CALCIUM	mg/L	1	92	36.0	185.0	98.3	32.7	42.6	57.9	78.0	100.5	119.0	126.4	144.8
TOC	mg/L	0.2	92	2.0	9.3	6.5	1.8	2.4	4.4	5.8	7.0	7.7	8.0	8.6
CHLORIDE	mg/L	0.2	92	28.4	507.5	144.1	93.3	36.4	53.5	84.1	128.9	170.8	223.6	346.7
CHLOROPHYLL A, COR.	ug/L	0.1	92	0.1	73.3	10.1	10.3	2.6	3.6	4.4	6.7	11.6	17.6	28.0
CHLOROPHYLL A, UNCOR.	ug/L	0.1	92	0.1	51.6	7.7	8.1	1.2	2.1	2.8	5.0	9.3	13.6	22.5
CHROMIUM, D	mg/L	0.0004	32	< DL	< DL	< DL	NA	< DL	< DL	< DL	< DL	< DL	< DL	< DL
CONDUCTANCE, SPECIFIC	µS/cm		92	289	2996	1289	577	407	639	938	1263	1626	1716	2398
COPPER, D	mg/L	0.0007	32	0.0030	0.0130	0.0075	0.0026	0.0036	0.0050	0.0060	0.0070	0.0090	0.0104	0.0120
CYANIDE	mg/L	0.004	32	<DL	0.002	0.002	0.000	0.002	0.002	0.002	0.002	0.002	0.002	0.002
DO	mg/L		92	6.5	15.8	9.9	1.9	7.7	8.0	8.4	9.2	11.0	12.3	13.6
E. coli	#/100mL	1	92	6	2420	524	618	29	48	125	336	588	990	2420
HARDNESS	mg/L	calc	92	113	683	356	129	143	197	272	370	435	466	547
IRON, Tot. Rec.	mg/L	0.04	32	0.12	1.15	0.49	0.29	0.19	0.24	0.29	0.36	0.65	0.83	1.14
LEAD, D	mg/L	0.001	32	< DL	< DL	< DL	NA	< DL	< DL	< DL	< DL	< DL	< DL	< DL
MAGNESIUM	mg/L	0.1	92	5.7	59.1	26.8	12.2	8.4	12.8	18.4	27.6	33.9	37.5	47.2
MANGANESE, D	mg/L	0.0002	32	0.0100	0.6800	0.1130	0.1704	0.0141	0.0200	0.0300	0.0550	0.0889	0.1945	0.5325
MERCURY, Tot	ug/L		10	0.0016	0.0074	0.0040	0.0020	0.0018	0.0021	0.0022	0.0042	0.0049	0.0060	0.0070
AMMONIA, TOTAL	mg/L	0.05	92	<DL	1.01	0.12	0.18	<DL	<DL	<DL	0.07	0.11	0.16	0.57
AMMONIA, UNIONIZED	mg/L	calc	92	<DL	0.0382	0.0023	0.0053	<DL	<DL	<DL	0.0010	0.0025	0.0033	0.0060
NICKEL, D	mg/L	0.001	32	<DL	0.0040	0.0019	0.0010	0.0005	0.0005	0.0010	0.0020	0.0030	0.0030	0.0030
NITROGEN, NITRITE (NO2)	mg/L	0.005	92	<DL	0.281	0.042	0.064	0.003	0.007	0.010	0.020	0.036	0.054	0.221
NO3+NO2	mg/L	0.05	92	<DL	8.34	3.36	2.75	0.15	0.33	0.67	2.85	5.62	7.46	8.00
PH	SU		92	6.8	9.1	7.8	0.4	7.2	7.4	7.6	7.8	8.0	8.2	8.4
PHOSPHORUS, TOTAL	mg/L	0.05	92	<DL	1.56	0.29	0.30	0.03	0.07	0.10	0.19	0.34	0.59	0.82
PHOSPHORUS, ORTHOPHOSPHATE AS P	mg/L	0.01	92	<DL	1.49	0.17	0.26	0.01	0.01	0.01	0.06	0.18	0.38	0.66
POTASSIUM	mg/L	0.05	92	2.30	11.47	6.17	2.50	2.47	3.58	4.11	5.75	8.35	8.92	10.52
SELENIUM, D	mg/L	0.0008	92	<DL	0.0150	0.0045	0.0027	0.0004	0.0020	0.0030	0.0042	0.0060	0.0069	0.0095
SILVER, D	mg/L	0.0002	32	< DL	< DL	< DL	NA	< DL	< DL	< DL	< DL	< DL	< DL	< DL
SODIUM	mg/L	0.8	92	19.0	424.1	158.5	86.3	32.1	64.6	109.6	151.1	199.0	222.9	356.3
TDS	mg/L		92	186.0	1889.0	840.0	380.1	239.4	392.6	632.3	841.0	1031.3	1108.9	1572.5
SULFATE	mg/L	0.1	92	48.7	965.0	323.8	175.3	78.7	122.2	212.3	316.5	397.8	493.5	624.5
TEMPERATURE, WATER	°C		92	0.3	25.3	11.2	6.2	2.4	4.0	6.7	9.9	16.2	17.3	21.6
TSS	mg/L	2	92	1	700	48	92	6	10	13	22	45	67	160
TURBIDITY	NTU		92	3.5	438.0	34.4	64.1	5.2	7.4	9.0	16.3	32.0	47.1	94.0
ZINC, D	mg/L	0.001	32	<DL	0.047	0.014	0.014	0.001	0.001	0.002	0.007	0.024	0.029	0.039

SELENIUM

In December 2007, BDCWA, CWQCD and EPA worked together to develop an ambient-based site-specific standard for Big Dry Creek based on the "natural or irreversible human-induced conditions" related to selenium in the creek. As a result, the stream standards for selenium in Big Dry Creek changed from a chronic stream standard of 4.6 µg/L and acute standard of 18.4 µg/L to seasonal ambient-based standards. (The complete study on which this standard is based can be downloaded from the Big Dry Creek website www.bigdrycreek.org.) The new standards and method of assessing attainment of the standards are described in the Statement of Basis and Purpose in Regulation 38 (CWQCD 2008b) as:

> *The Big Dry Creek Cities presented evidence that the natural or irreversible human-induced ambient water quality levels for selenium in Big Dry Creek Segment 1 at times exceed the relevant table value standard, and an ambient quality based standard, calculated in a manner consistent with Basic Standards requirements, is adequate to protect classified uses. The Commission accepts the Big Dry Creek Cities' evidence as accurate. The Commission expressly finds that the natural or irreversible human-induced ambient water quality levels for selenium in Big Dry Creek Segment 1 exceed the relevant table value standard. Moreover, the proposed ambient quality based standard is adequate to protect classified uses and represents the highest reasonably attainable standard, based on analysis of available data that show elevated instream conditions are attributable to natural or irreversible human induced conditions.*
>
> *Strong seasonal variation associated with highly managed flow conditions (e.g., releases of irrigation water from Standley Lake) significantly influences selenium concentrations, particularly in the portion of the stream above the wastewater treatment plants. As a result, the Commission adopts seasonal ambient quality based site-specific standards for selenium applicable to Big Dry Creek Segment 1. During the irrigation season (April through October), ambient standards are 7.4 µg/L chronic (dis) and TVS µg/L acute (dis). Ambient-based non-irrigation season (November through March) standards are 15 µg/L chronic (dis) and 19.1 µg/L acute (dis). These calculations are based on the 85% (chronic) and the 95% (acute for the non-irrigation season) of the ambient selenium data collected at three specific instream monitoring locations (bdc1.5, bdc2.0 and bdc4.0) upstream of the three municipal wastewater treatment plant discharges, however, it is the Commission's intent that the existing spatial variability of selenium in Big Dry Creek be maintained. This composite approach was jointly developed by the Cities and the Water Quality Control Division as a reasonable method to establish the ambient based standards and to assess attainment of future stream standards for Segment 1 of Big Dry Creek. The ambient quality based site-specific standards for selenium (acute and chronic) shall apply to the entirety of Big Dry Creek Segment 1. The Commission also removes the temporary modification currently in place for selenium in Big Dry Creek Segment 1.*

Based on these revised standards, the 2010 data set attains the non-irrigation season (winter) standard for Big Dry Creek. The irrigation season data set for 2010 is slightly above the irrigation

season (summer) chronic standard, as was also the case in the summers of 2007, 2008 and 2009. WWTP grab samples collected during this time period were below chronic and acute stream standards. Statistically significant increases in selenium concentrations over time are not present in the data set.

Table 4 provides the most recent five-year period covering 2006-2010. Figure 3 provides the last five years of monthly data at bdc1.5, bdc2.0 and bdc4.0. Instream selenium concentrations are influenced by the flow regime at the time of sample collection, which is the basis for the irrigation and non-irrigation season standards. When Standley Lake is not releasing water to Big Dry Creek, instream flows at bdc1.5 are typically dominated by groundwater inflows, which are known to have high selenium concentrations due to the geology in the vicinity of bdc1.5. The months of April and October are "fringe" months with regard to irrigation releases from Standley Lake. For this five-year period, Standley Lake rarely released flows in October, which is believed to be the reason that the chronic irrigation season 85th percentile value of 7.9 ug/L slightly exceeds the chronic selenium standard of 7.4 ug/L. The non-irrigation season chronic standard and the acute standards for both the irrigation and non-irrigation seasons are attained. If the month of October is moved to the non-irrigation season month, then the acute and chronic stream standards would be attained for the 2006-2010 time period as shown in Table 4. Sampling locations bdc2.0 and bdc4.0 are less affected by releases from Standley Lake due to dilution of instream flows with WWTP discharges from Broomfield and Westminster. (See the Flow discussion at the end of this memorandum and Figure 19 for more information on Standley Lake release patterns.)

Table 4. Big Dry Creek Instream Selenium Data Summary (2006-2010)

	Irrigation Season			Non-irrigation Season			
	2006-2010 (per Reg. 38)	2006-2010 (w/out Oct.)	Dec. 2007 Standard		2006-2010 (per Reg. 38)	2006-2010 (w/Oct)	Dec. 2007 Standard
All Sites (85th %)	**6.5**	6.2	NA	All Sites (85th %)	**8.0**	7.9	NA
bdc1.5, 2.0, 4.0 (85th %)	7.9	7.3	7.4 (ch)	bdc1.5, 2.0, 4.0 (85th %)	12.7	13.4	15 (ch)
bdc1.5, 2.0, 4.0 (Max)	15.6	13.0	18.4 (ac)	bdc1.5, 2.0, 4.0 (95th%)	16.6	16.0	19.1 (ac)

Bacteria

BDCWA now has eleven years of *E. coli* data collected on a monthly basis at eight instream locations, as well as grab samples from the WWTPs (Tables 5 through 7 and Figures 4a-c & 5a-d). During 2009, the CWQCD changed its standards assessment procedure for *E. coli* to include an assessment of standards during the recreation season (May-October) in addition to the historically used annual assessment procedure. In 2010, additional refinement to the assessment methodology was adopted in the Basic Standards (CWQCC 2010a), which was subsequently integrated into 2012

303(d) Listing Methodology (CWQCD 2011). The new methodology assesses attainment of the stream standard in bimonthly time steps (e.g., January-February, July-August). If the geometric mean of a single two-month period exceeds the standard, then the stream does not attain recreational water quality standards. Essentially, these changes result in more stringent criteria, which will be very difficult to meet, given the open space corridor with abundant wildlife in the upper watershed and the agricultural uses in the lower watershed. Table 5 summarizes annual *E. coli* data, whereas Tables 6 and 7 summarize bimonthly data for the last five years and 2010 only, respectively. CWQCD prefers that five or more samples be collected in each bimonthly time period. When this sample frequency is not available, then a longer period of record for each bimonthly time period may be used. (Note: BDCWA conducted weekly E. coli monitoring in 2003, but has monitored E. coli on a monthly basis since that time.)

From a regulatory perspective, data collected from 2006 through 2010 would be considered in evaluating attainment of the *E. coli* stream standard. Historic data from 2000 through 2005 are provided in Table 5 to show the influence of the drought (which peaked in 2002) on *E. coli* concentrations. The historic data are also of interest to show significant reductions in the Broomfield WWTP's effluent concentrations following WWTP upgrades and expansion in the 2001-2004 time period. Significant reductions in Westminster's WWTP effluent concentrations are also apparent in 2008-2010, following plant upgrades including UV treatment and other operational changes.

Table 5
Summary of Big Dry Creek *E. coli* Data
(grey-shaded cells exceed the stream standard)

Geometric Mean *E. coli* (#/100 mL)										
Year	**bdc0.5**	**bdc1.0**	**bdc1.5**	**bdc10.0 (Broom. WWTP)**	**bdc2.0**	**bdc11.0 (West. WWTP)**	**bdc3.0 (I-25)**	**bdc4.0**	**bdc5.0**	**bdc6.0**
2000	212	151	389	--	**574**	--	294	500	212	323
2001	477	118	332	215	**649**	68	387	634	442	510
2002	858	230	363	364	**934**	16	536	441	451	572
2003	191	210	293	27	**615**	24	382	225	249	339
2004	279	181	217	18	346	28	205	187	156	**377**
2005	152	122	281	26	**328**	35	204	113	182	301
2006	76	241	316	20	309	48	214	163	179	**333**
2007	196	177	257	14	324	66	230	231	198	**364**
2008	266	197	267	10	**461**	6	439	376	290	380
2009	61	78	147	5	207	14	**251**	137	149	197
2010	111	191	193	12	**483**	16	376	280	235	368

Notes: Broom. = Broomfield; West. = Westminster; Northglenn excluded due to infrequent discharge. For consistency between sampling years, the 2003 weekly samples were converted to monthly geometric means prior to calculating the annual geometric mean for 2003. The 2009 Broomfield and Westminster geometric means are based on Discharge Monitoring Report (DMR) values.

Table 6
Bimonthly Summary of Instream Big Dry Creek *E. coli* Data
(Values are geometric means [#/100 mL] of 2006-2010 data set at each location)

			Recreation Season			
Station	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sept-Oct	Nov-Dec
bdc0.5	11	56	324	449	240	48
bdc1.0	40	87	366	**767**	215	29
bdc1.5	64	82	623	**964**	381	103
bdc2.0	223	96	493	**885**	526	283
bdc3.0	146	98	333	**728**	600	286
bdc4.0	96	55	335	**629**	437	249
bdc5.0	74	52	368	**641**	409	171
bdc6.0	136	169	**997**	584	473	146
All Sites	87	81	443	**688**	389	136

Note: Shaded values exceed the stream standard. Bold values are the highest bimonthly value per station.

Table 7. 2010 E. coli Data

					Recreation Season							
Station ID	Jan-Feb	#/100 mL	Mar-Apr	#/100 mL	May-Jun	#/100 mL	Jul-Aug	#/100 mL	Sept-Oct	#/100 mL	Nov-Dec	#/100 mL
bdc0.5	Jan	ice	Mar	6	May	687	Jul	1120	Sep	72	Nov	68
bdc0.5	Feb	ice	Apr	31	Jun	326	Aug	166	Oct	250	Dec	30
bdc1.0	Jan	ice	Mar	29	May	366	Jul	>2420	Sep	128	Nov	70
bdc1.0	Feb	ice	Apr	219	Jun	326	Aug	345	Oct	250	Dec	46
bdc1.5	Jan	32	Mar	14	May	580	Jul	>2420	Sep	366	Nov	366
bdc1.5	Feb	29	Apr	20	Jun	649	Aug	921	Oct	1204	Dec	76
bdc2.0	Jan	517	Mar	248	May	462	Jul	>2420	Sep	817	Nov	388
bdc2.0	Feb	613	Apr	40	Jun	1008	Aug	436	Oct	1047	Dec	312
bdc3.0	Jan	345	Mar	93	May	308	Jul	1987	Sep	1414	Nov	462
bdc3.0	Feb	285	Apr	52	Jun	518	Aug	326	Oct	687	Dec	366
bdc4.0	Jan	225	Mar	31	May	462	Jul	>2420	Sep	326	Nov	489
bdc4.0	Feb	116	Apr	40	Jun	313	Aug	489	Oct	1204	Dec	215
bdc5.0	Jan	147	Mar	19	May	548	Jul	>2420	Sep	199	Nov	152
bdc5.0	Feb	49	Apr	64	Jun	548	Aug	687	Oct	1120	Dec	192
bdc6.0	Jan	147	Mar	39	May	649	Jul	>2420	Sep	548	Nov	276
bdc6.0	Feb	387	Apr	462	Jun	388	Aug	518	Oct	981	Dec	130
G. Mean		161		46		**481**		**967**		**487**		168
Avg. Temp C		4.4		7.2		13.8		16.8		15.5		8.0

Based on review of the data, the following observations are noteworthy:

- Geometric mean concentrations for 2010 are within the range of annual geometric mean values observed for the period of record.

- Neither the 2010 data set nor the 2006-2010 data meet stream standards for the May-June, July-August and September-October assessment periods—essentially the entire May-October potential recreational season. This is true evaluating the stream as a whole, as well as at all individual monitoring locations. Additionally, bdc2.0, bdc3.0 and bdc4.0 (128th Avenue to York Street) exceed the standard November-December assessment period, although by a smaller margin than in the recreational season months. Station bdc2.0 also exceeds the January-February assessment period standard by a small margin.

- For 2006-2010, the highest *E. coli* concentrations for all stations are experienced during the July-August assessment period, with the exception of bdc6.0, which experiences the highest concentrations in May-June.

- Based on review of geometric mean concentrations from 2006-2010, *E. coli* concentrations are consistently the lowest in grab samples from the Broomfield and Westminster WWTP discharges (Table 5), which are well below the stream standard.

- Scatter plots of *E. coli* versus temperature (Figures 5a through 5d) suggests that *E. coli* may increase as a function of temperature. Statistically significant trends are difficult to determine for *E. coli* for a variety of reasons such as artificially truncated upper quantification limits at 2,490/100mL and multiple variables that are expected to influence persistence of *E. coli* organisms such as sunlight, temperature, turbidity, flow conditions, densities and life cycles of urban wildlife, bridge crossings providing bird nesting/perching areas, pet trail usage and other factors. Nonetheless, a trend is most strongly suggested between Standley Lake and Front Range Community College. The trend is also generally present in the broader reach from Standley Lake to I-25 (Figure 5b), and weaker in the agricultural portion of the watershed. Although both high and low *E. coli* concentrations can occur at low temperatures, it appears that very few samples attain the standard at any sampling location if the temperature is above approximately 16-18 C (Figure 5a-d). Available data indicate that attainment of the stream standard in the warm summer months, particularly the July-August timeframe is unlikely. This has potential implications for long-term attainment of standards under the forthcoming TMDL for *E. coli* on Big Dry Creek.

- Scatter plots of *E. coli* versus flow were previously examined (WWE 2009) and were again explored in preparation of this memorandum, but no clear relationship was present.

Metals (excluding selenium)

With the exception of selenium, Big Dry Creek attains instream standards for metals. A few specific observations regarding metals based on Tables 2 and 3 and Attachment 1 include:

- Total recoverable iron concentrations during 2010 attained the stream standard of 1 mg/L based on the 50th percentile value for the overall stream and at individual monitoring stations. In 2008, the CWQCD removed Segment 1 of Big Dry Creek from the Monitoring and Evaluation List for iron. The 50th percentile at all monitoring stations for the past five years continues to meet the iron standard.

- In 2008, BDCWA changed its monitoring approach for mercury and is now using the EPA 1631e analysis method at one monitoring location at 120th Avenue. This analysis method has much lower detection limits, providing more meaningful data, but is also much more costly, thus limiting analysis to one location. All samples collected at this location were below the stream standard.

- Dissolved cadmium, chromium, lead and silver were not detected in samples collected during 2010.

Nutrients

Nationally, statewide and locally, control of nutrient loading to streams is a significant issue. Water quality criteria and standards continue to emerge and are becoming more stringent. Although Big Dry Creek currently attains nutrient standards (i.e., ammonia) assigned in Regulation 38, it is likely to be affected by a downstream TMDL for Barr Lake and Milton Reservoir that is targeting reductions in phosphorus loading. Additionally, the initially proposed warm water nutrient criteria for Colorado streams as reported by the Colorado Nutrient Standards Work Group on February 2, 2011 include total phosphorus of 0.16 mg/L and 2 mg/L of total nitrogen for warm water streams. As currently envisioned, attainment of the standard would be based on the 50th percentile (median) value with an allowable exceedance of once every three years. Under current conditions, Big Dry Creek would not attain either of these standards. Big Dry Creek data for ammonia, nitrate and phosphorus are discussed further below.

Ammonia

Stream standards for ammonia on Big Dry Creek are undergoing changes. In June 2005, the CWQCC adopted revised ammonia criteria for the Basic Standards based on EPA's *1999 Update of Ambient Water Quality Criteria for Ammonia*. The new criteria are in the form of total ammonia and are more stringent for warm water streams than the previous standards. During the March 13, 2007 Rulemaking Hearing, the WQCD proposed temporary modifications to WWTP discharge permits, including the cities of Broomfield, Westminster and Northglenn to remain at the "old" ammonia standard until December 31, 2011. This proposal was based on the CWQCC's acknowledgement that there is substantial uncertainty regarding the appropriateness of and cost of compliance with the new criteria. The temporary modification allows time to reassess what

standards are appropriate on a site-specific basis and also provides dischargers additional time to address treatment facility modification that may be needed (CWQCD 2007).

For the currently applicable stream standards, unionized ammonia concentrations were well below the "old" chronic stream standard of 0.1 mg/L in 2010 with no exceedances of the acute standard. This is consistent with the data set for the past five years. The 85th percentile value was 0.0033 mg/L.

Total ammonia concentrations for Big Dry Creek are plotted in Figure 6, along with the chronic standards that will be in effect beginning in 2012. Both chronic and acute standards for total ammonia are calculated using a formula based on pH and temperature. During 2010, the stream attained both chronic and acute total ammonia standards.

Nitrate

Regulation 38 does not assign a nitrate standard to Big Dry Creek; however, Big Dry Creek nitrate concentrations are well below the agricultural nitrate standard of 100 mg/L identified in the Colorado Basic Standards (Regulation 31). Additionally, although Big Dry Creek does not have a drinking water classification (with a corresponding in-stream nitrate standard of 10 mg/L), the Middle South Platte River Segment 1 downstream of Big Dry Creek has a drinking water classification and a nitrate standard of 10 mg/L. This standard is applied based on a single day combined total of nitrite and nitrate at the point of intake to the domestic water supply. At bdc6.0, upstream of the confluence with the South Platte River, Figure 7 shows a maximum reported value of 7.4 mg/L. Nitrate concentrations in WWTP discharges to Big Dry Creek are typically higher than values at bdc6.0, but dilution from instream flows and natural losses associated with the nitrogen cycle result in lower nitrate concentrations by the time these flows reach the confluence with the South Platte River.

Total Nitrogen (Estimated)

Figure 8 plots the sum of nitrate/nitrite plus total ammonia for purposes of general comparison to the potential nutrient criteria currently being considered in Colorado. The initially proposed total nitrogen standard is 2 mg/L of total nitrogen, which includes ammonia, nitrate/nitrite, and organic nitrogen (which is not currently monitored on Big Dry Creek). Upstream of the WWTP discharges to Big Dry Creek, the median nitrate/nitrite plus total ammonia value is 0.46 mg/L during 2010 (comparable to 0.40 mg/L in 2009). For the stream as a whole, the median value was 2.9 mg/L in 2010, which was somewhat lower than the 4.0 mg/L median in 2009. Under current conditions, the total nitrogen standard would not be attained on Big Dry Creek from the Broomfield WWTP discharge to the South Platte River.

Phosphorus in Relation to Barr-Milton TMDL

The Barr-Milton Watershed Association (BMW) is addressing pH exceedances in the Barr-Milton reservoir system. These pH exceedances are attributed to excessive algal growth caused by nutrient loading. BMW has established a database for modeling conditions in the reservoirs and

has included water quality data from Big Dry Creek, as well as many other tributaries upstream of the Barr-Milton system. BDCWA representatives are participating in various aspects of the BMW effort. In August 2009, AECOM released the final report titled "Watershed and Lake Modeling for a TMDL Evaluation of Barr Lake and Milton Reservoir," which forms the underlying basis for ongoing work in development of a TMDL. As of December 2010, a draft TMDL was submitted to CDPHE. In this draft, Big Dry Creek was identified as contributing approximately 5.9 percent of the phosphorus loading to Milton Reservoir. Big Dry Creek has been targeted for a 20 percent total phosphorus load reduction from 2,301 kg/yr down to 1,840 kg/yr. Because Big Dry Creek is identified as a nonpoint source of loading, "application of BMPs to the greatest extent feasible" is the recommended approach for achieving these reductions.

As a result of the Barr Milton TMDL process, BDCWA reviewed phosphorus data collected along Big Dry Creek, with primary focus on monitoring station bdc6.0, which is the downstream-most instream monitoring location on Big Dry Creek in the agricultural portion of Weld County. Several key observations at bdc6.0 are summarized in Figures 9-12. Although instantaneous flow measurements are conducted by BDCWA on a monthly basis, the USGS Fort Lupton gauging station is combined with the bdc6.0 water quality data to estimate loads because the USGS gauge it is a more comprehensive data set. Several key observations at bdc6.0 include:

- As shown in Figures 9a&b, total instream phosphorus concentrations have decreased significantly since 2002, with the average 2010 concentration (0.5 mg/L) being less than one-third of the 2002 average concentration (1.57 mg/L). For purposes of the BMW modeling, 2003-2004 was used as a baseline. Average phosphorus concentrations at bdc6.0 in 2010 were approximately 65% lower than in 2004.

- Phosphorus loading has also decreased substantially. Pollutant loads are calculated based on pollutant concentration multiplied by flow volume (Figures 10a&b). During 2010, phosphorus loading at bdc6.0 decreased by approximately 45% relative to 2004. (Note: Load reductions were not evident during 2009 despite reductions in phosphorus concentrations due to higher flows that offset reductions in concentration.)

- Both Broomfield and Westminster WWTP discharges show substantial reductions in total phosphorus concentrations since 2004 (Figures 11a&b and Figures 12a&b, respectively). Both WWTPs have implemented major upgrades in recent years and have been in the process of optimizing plant operations following these upgrades. Westminster reports that its WWTP is designed to reduce total phosphorus below 1 mg/L, and Broomfield reports that eventually 0.5 mg/L of total phosphorus may be feasible. In 2010, average total phosphorus was 0.17 mg/L for Broomfield (down from 0.9 mg/L in 2009) and 1.03 mg/L for Westminster (up from 0.57 mg/L in 2009). The Westminster 2010 concentrations were higher than in 2009 for several reasons. First, Westminster collected a higher percentage (almost 50%) of its samples on Sundays in 2010 to confirm that concentrations tended to be higher on Sundays than weekdays (and they were). Secondly, phosphorus removal competes with other operational parameters that have permit limits; therefore, highest priority tends to focus on constituents regulated in permits. Although these two factors

may explain why the 2010 concentrations at the Westminster WWTP were higher, it is also possible that this variability and range of values may be normal and generally within the 1 mg/L total phosphorus design criterion for the WWTP. Since Westminster only has two fully complete years of data since the upgrades were implemented, additional monitoring will help to refine expectations regarding long-term effluent conditions from the plant (Personal Communication with David Meyer, City of Westminster, February 2011). For a relative sense of how these concentrations compare to other WWTP discharges in the metro Denver area, AECOM (2009) reports that total phosphorus concentrations in Littleton-Englewood and Metro effluent range between 2.5 and 3.0 mg/L. For purposes of a general frame of reference, WWTPs discharging to Front Range reservoirs such as Chatfield, Bear Creek and Cherry Creek have total phosphorus discharge permit limits ranging from 0.2 to 1 mg/L. *(Northglenn WWTP data were not provided at the time this memorandum was completed; however, historically, Northglenn has discharged infrequently to Big Dry Creek. During 2009, however, Northglenn discharged to Big Dry Creek during January-June due to temporary operational adjustments due to repairs being made to Bull Reservoir, with total phosphorus values in the BDCWA grab samples averaging 2.15 mg/L total phosphorus. Northglenn did not discharge to Big Dry Creek in 2010.)*

- In addition to phosphorus concentration reductions at the Broomfield and Westminster WWTPs, both cities have implemented significant reclaimed water programs. Figure 13 shows annual volumes discharged to Big Dry Creek for 2004-2010. Since 2004, Broomfield's annual discharges to Big Dry Creek have decreased by approximately 25 percent. Although Westminster's discharges have not decreased, they have also not increased to the extent that they would have due to growth in the absence of the reuse program. The current and future effects of reclaimed water programs have not been fully evaluated for purposes of this memorandum, but are important considerations should more in-depth analysis be conducted related to Big Dry Creek phosphorus loading to the South Platte River.

- As previously shown in Figure 2, the hydrology of Big Dry Creek is highly managed and complex. Future evaluation of measures to reduce phosphorus loading from Big Dry Creek must consider these complexities. Other hydrology-related considerations include:

    - It is important to be aware that bdc6.0 is located upstream from the USGS gauge. Instantaneous flow measurements at bdc6.0 and the average daily flow measurements at the USGS Fort Lupton gauge vary substantially. On average, flows at the USGS gauge are approximately 20 percent higher; however, there is large variation in the magnitude of the difference between individual pairs of flow measurements.

    - It is important that the water quality sample location used for modeling Big Dry Creek phosphorus contributions to the South Platte River be located upstream of the Lupton Bottoms discharge to Big Dry Creek. Sampling location bdc6.0 is

upstream of Lupton Bottoms, but Metro Wastewater Reclamation District has also collected some water quality samples below Lupton Bottoms ditch, which may be influenced by South Platte water discharged from the Lupton Bottoms ditch.

Phosphorus in Relation to CWQCD's Initially Proposed Total Phosphorus Standards

Total phosphorus concentrations in Big Dry Creek are also of interest with regard to nutrient criteria being developed in Colorado. The CWQCD's initially proposed total phosphorus standard for warm water streams in Colorado is 0.16 mg/L (CWQCD 2011). For comparison, Figure 14 shows that Big Dry Creek would have substantial difficulty meeting this proposed standard from I-25 to the South Platte River, with the median phosphorus concentration during 2010 ranging from 0.31 to 0.44 mg/L in this reach (also see Figure 9b for a longer period of record at bdc6.0). Nonetheless, the 2010 median value is approximately half of the five-year (2006-2010) median of 1.10 mg/L, showing substantial reductions in phosphorus concentrations due to recent phosphorus reductions in the Broomfield and Westminster WWTP discharges. Nonetheless, attainment of the initially proposed stream standard would not be achievable under current conditions.

Temperature

At the January 2007 CWQCC Rulemaking Hearing, the CWQCC adopted new temperature standards that became effective on July 1, 2007. Temporary modifications to this standard were also adopted for certain stream types, and these temporary modifications expired on December 31, 2009.

The currently applicable classification for temperature standards on Big Dry Creek is Warm Stream Tier I (WS-I), due to the presence of the Johnny darter in some locations in the upper portion of the stream. Attainment of standards is assessed based on comparison of the maximum weekly average temperature (MWAT) and Daily Maximum (DM) temperature to seasonal temperature standards established for March-November and December-February. Values above these standards are allowed under these conditions:

- The DM may exceed the acute temperature standard once every three years. The DM means the highest two-hour average water temperature recorded during a given 24-hour period.

- The MWAT may exceed the chronic standard once every three years (1E3). The MWAT is calculated as the largest mathematical mean of multiple, equally spaced, daily temperatures over a seven-day consecutive period, with a minimum of three data points spaced equally through the day.

- Values measured during conditions meeting air temperature or low-flow excursion criteria defined in Regulation 31 are not considered exceedances.

The WQCD determines whether temperature limits are to be included in permits in accordance with the Basic Standards 31.14 (14) "Integration into Discharge Permits." Currently, the municipal WWTP dischargers to Big Dry Creek are required to "report only" under terms of the current

permits. Additional instream monitoring data have been collected at several instream locations in support of this effort using HOBO data loggers recording temperature measurements at 15-minute intervals. These data sets have not been fully evaluated for purposes of this memorandum; however, the cities report that attainment of the standard will be challenging during certain time periods.

In lieu of evaluating the cities' daily temperature data, the comments provided below are based on the BDCWA monthly instream grab samples collected between 2006 through 2010, as summarized in Figures 15a&b. Key observations include:

- All monthly temperature measurements during the December-February timeframe were below the Daily Maximum (DM) limit of 14.5 C. In December 2010, one value at bdc3.0 (below Westminster WWTP) exceeded the Maximum Weekly Average Temperature (MWAT) of 12.1 C.

- During the March-November timeframe, all measurements were below the DM limit of 29.0 C and the MWAT of 24.2, with the exception of one value at bdc5.0 that slightly exceeded the MWAT.

For a more robust evaluation of temperatures on Big Dry Creek in the vicinities of the WWTP discharges, 15-minute incremental temperature data collected as part of CDPS DMRs should be reviewed.

Flow

The hydrology of Big Dry Creek is discussed below in terms of 1) annual streamflows relative to period of record, 2) release and diversion patterns, and 3) stormwater.

Streamflows

USGS flow data for the Westminster and Fort Lupton gauges are shown in Figures 16 through 18. During 2010, average daily flows at the Westminster gauge ranged from 0.55 cubic feet per second (cfs) to 185 cfs with an average of 14.0 cfs. Average daily flows for the Fort Lupton gauge data ranged from 11 cfs to 457 cfs with an average of 46.9 cfs. Flows during 2010 at Fort Lupton are lower than in 2009 due in part to the Northglenn WWTP not discharging to the creek, which is a resumption of normal operation for the WWTP. In 2009, Northglenn had discharged more frequently to Big Dry Creek because Bull Reservoir was being repaired and had to be drawn down and maintained at a low level until repairs were completed (Personal Communication with Shelley Stanley, City of Northglenn).

Figures 17a&b identify peak stream flows for the period of record at both gauges. Peak flows at both gauges were within previously observed ranges for the period of record.

Seasonal Flow Regime

As part of an on-going effort to update the Big Dry Creek Watershed Management Plan, more detailed evaluation of Standley Lake discharges, irrigation diversions and WWTP discharges was completed for the most recent five year period with complete annual records (2005-2009). Table 8 summarizes average monthly instream flows, major discharges/releases to the creek and ditch diversions.

Table 8. Summary of Measured Hydrologic Influences on Big Dry Creek (2005-2009 in average cfs/month)

Measured Flow	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Standley Release	Inflow	0.2	0.4	0.2	0.9	17.3	17.8	13.7	12.4	11.7	0.3	0.3	0.5
USGS West 6720820	Instream	**2.9**	**3.2**	**4.1**	**12.1**	**30.6**	**30.1**	**18.8**	**21.8**	**15.7**	**6.8**	**3.2**	**2.8**
Broom. WWTP	Inflow	6.2	6.2	7.1	7.9	7.5	6.2	5.4	6.2	6.2	6.7	5.6	6.0
Bull Canal Diversion[1]	Diversion	0.2	0.4	0.2	0.9	17.3	17.8	13.7	12.4	11.7	0.3	0.3	0.5
Whipple Ditch (@Bull Canal)	Diversion					5.0	4.5			2.4			
West. WWTP	Inflow	9.6	9.4	9.0	8.8	8.4	7.4	6.5	7.3	7.3	8.5	9.9	10.0
Thornton Golf Course	Diversion	0.1	0.4	0.4	0.5	0.5	0.7	0.9	0.7	0.4	0.4	0.3	
German Ditch	Diversion				9.3	6.4	5.5	6.9	5.9	3.3	3.5		
Big Dry Creek Ditch	Diversion				1.0	4.0	4.4	4.1	4.3	1.9	3.9		
Yoxall Ditch	Diversion				1.2	1.9	2.0	2.0	1.8	1.3	1.2		
Lupton Bottom Ditch[2]	Inflow/ Outflow			7.5	19.2	48.9	61.3	75.1	61.0	50.9	24.0	5.7	
USGS Ft. Lupton 6720990	Instream	**25.5**	**25.9**	**34.8**	**62.2**	**36.6**	**47.7**	**40.7**	**44.9**	**32.2**	**37.7**	**35.2**	**31.7**

[1]Bull Canal diversion is assumed to be equal to the Standley Lake discharge.
[2]Inflow/Outflow indicates that Lupton Bottom Flows are carried in Big Dry Creek and subsequently diverted upstream of the USGS Fort Lupton gauge. Although from a water quantity perspective, the net effect should not be significant, from a water quality perspective, this is a substantial flow volume of South Platte River water that mixes with Big Dry Creek water. This is important from a TMDL perspective.

Figure 19 illustrates the relative percentage of Standley Lake flows in Big Dry Creek at the USGS Westminster gauge. As would be expected, Table 6 and Figure 19 show significant seasonal variation in release patterns. During April through September, Standley Lake releases comprise 30 to 70 percent of the flows measured at the USGS gauge. October is a "fringe" month for irrigation, but is more similar to the non-irrigation season than the irrigation season. During October through March, Standley Lake releases comprise approximately 5-10 percent of the flows at the Westminster gauge.

Figure 20 shows the relative percentages of WWTP discharges at bdc6.0 from 2005-2009. During the winter months, WWTP flows comprise roughly half of the flows present at bdc6.0. During April to August, this relative balance decreases down to approximately 25 percent of the flows at bdc6.0, with the exception of May.

It is critically important to understand the relative water balance for the creek during different seasons. For example, in the absence of Standley Lake releases, the selenium standard is exceeded in the upper watershed. With regard to nutrient loading, it is important to recognize that winter months are dominated by wastewater contributions and relatively low flow conditions. Summer months have higher flows with lower relative contributions from wastewater.

Stormwater

During 2008, the Urban Drainage and Flood Control District, the cities of Westminster and Thornton, and Adams County initiated a master drainage plan update for the main stem of Big Dry Creek from Standley Lake dam to the Weld County line. This plan should be completed in 2011 and will be important for identifying measures to minimize flooding and stream degradation.

Quality Assurance/Quality Control

During 2010, quality assurance/quality control (QA/QC) procedures were followed using the guidelines set forth in the Big Dry Creek Sampling and Analysis Plan (BDCWA 2003). Under this program, field blanks are analyzed for the full suite of constituents in March, a full set of duplicate analyses are completed in September, and during June and December, field duplicates are analyzed at four locations (bdc1.5, bdc2.0, bdc3.0 and bdc5.0) for constituents of concern (selenium, *E. coli*, ammonia and iron) (Table 9).

Table 9. Field Quality Control Program (from 2004 monitoring plan)

Month	QC Sample Type	Site
March	Field blanks (complete set)	6.0 –maximum equip. use
June	Field duplicates for Constituents of Concern (Represents high flows)	1.5 – Selenium 2.0 – *E. coli* 3.0 – NH_3 5.0 – Fe (TRec)
September	Field duplicates, full set	5.0 –most constituents detected at this site
December	Field duplicates for Constituents of Concern (Represents low flows)	1.5–Selenium 2.0–*E.coli* 3.0–NH_3 5.0 – Fe (TRec)

During 2010, the minimum set of QA samples was collected. Additional field blank and replicate analyses were also conducted that went beyond the minimum requirements of the Sampling and Analysis Plan.

Attachment 3 summarizes analysis of field blank and replicate samples for 2010. Analysis of relative percent difference (RPD) for the sample replicates generally shows acceptable accuracy for most constituents. Several noteworthy comments for sample pairs with higher RPD values include:

- RPD values for *E. coli* are high relative to other constituents; however, this is not unusual for *E. coli* analysis. RPDs for the three replicate sets were 108%, 26%, and 49% with an average of 61%.

- Total recoverable iron had one relatively high RPD of 59%, averaging 24% for the three replicate pairs. Again, this is not unusual for iron, which is typically associated with sediment particles.

- Total phosphorus had an RPD of 67% in the one replicate sample collected at bdc5.0 (0.08 mg/L and 0.16 mg/L, with a detection limit of 0.05 mg/L). Phosphorus is also often sorbed to sediment, so may be affected by difference in sediment content of the samples. The TSS RPD on this sample date was 33%. The full suite of field replicates collected in September is at a bridge sampling location at bdc5.0, which is sampled by a bucket then divided into sample bottles, which may affect the characteristics of the replicate samples.

CONCLUSIONS

1. Water quality on Big Dry Creek attained stream standards for currently assigned stream standards, with the exceptions of E. coli and selenium.

2. Phosphorus concentrations and loads to Big Dry Creek are decreasing due to enhanced treatment processes at the Broomfield and Westminster WWTPs, along with reuse programs that continue to be implemented at these WWTPs.

3. Given the warmwater stream nitrogen and phosphorus standards currently proposed by the WQCD, Big Dry Creek would not attain either standard.

4. Sampling frequencies for E. coli are less frequent than desired by the WQCD for calculating bimonthly geometric mean concentrations. Given that the monitoring program is voluntary and includes a long period of record for comparison, BDCWA decided in 2010 not to modify it sampling frequency.

5. Attainment of the current site-specific selenium standard will likely require shifting the month of October to the non-irrigation season, since Standley Lake releases and instream flows during October are more similar to the non-irrigation season. (Alternatively, the standard could be slightly increased, as a result of a more complete data set than what was available at the time of the standard change.)

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Wright Water Engineers, Inc. 2009b. Overview of *E. coli* Source Characterization Efforts for Big Dry Creek (2006-2008). (Notebook compendium of special studies conducted from 2006-2008.) Prepared for the Big Dry Creek Watershed Association. March.

Wright Water Engineers, In. 2010. Technical Memorandum Regarding Big Dry Creek Water Quality Summary for 2009

FIGURES

Figure 1. Watershed Overview

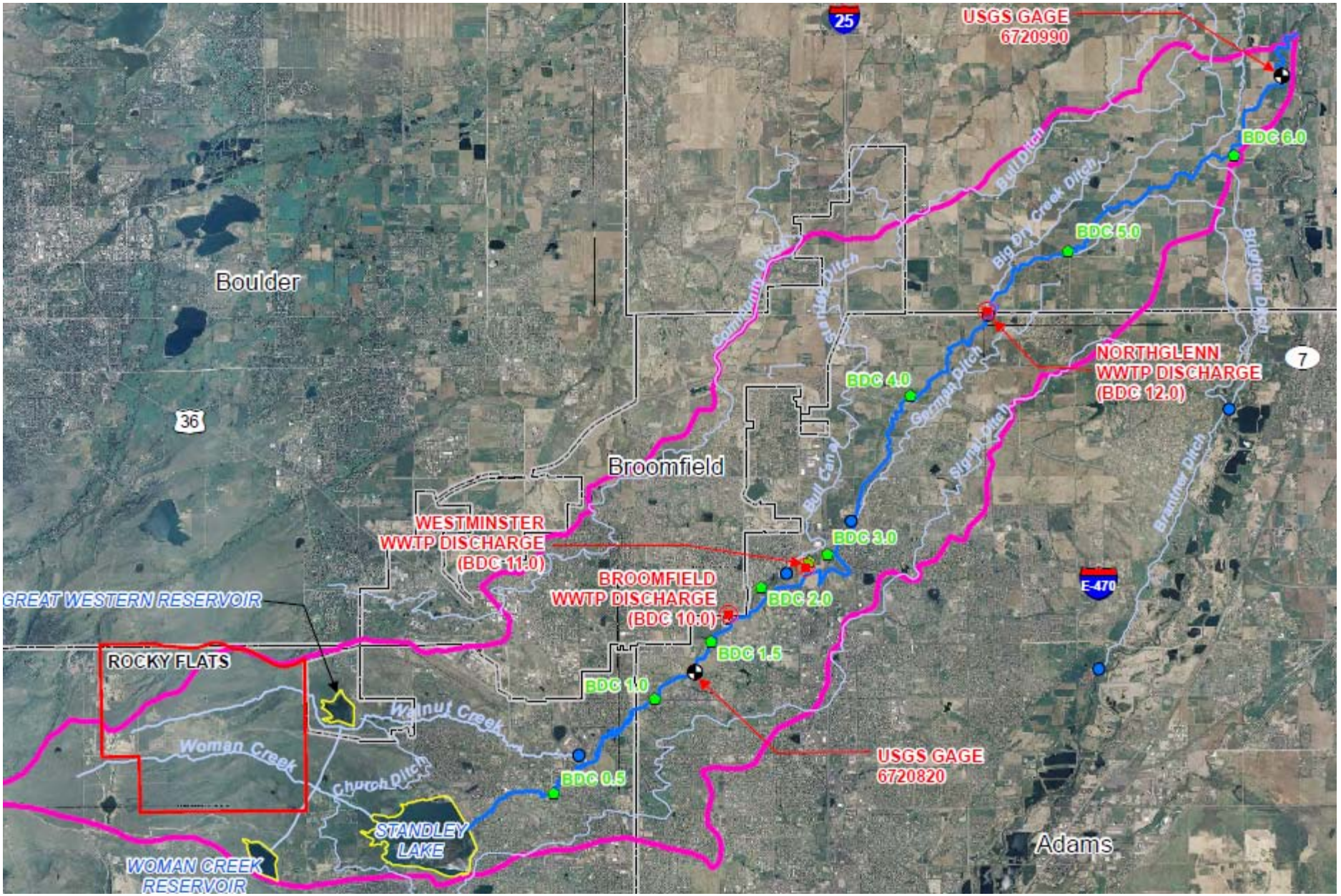


Figure 2. Hydrologic Influences on Big Dry Creek Flows (based on average AF/YR for 2005-2009)
(concept diagram; not to scale; important seasonal variations not reflected in this diagram)

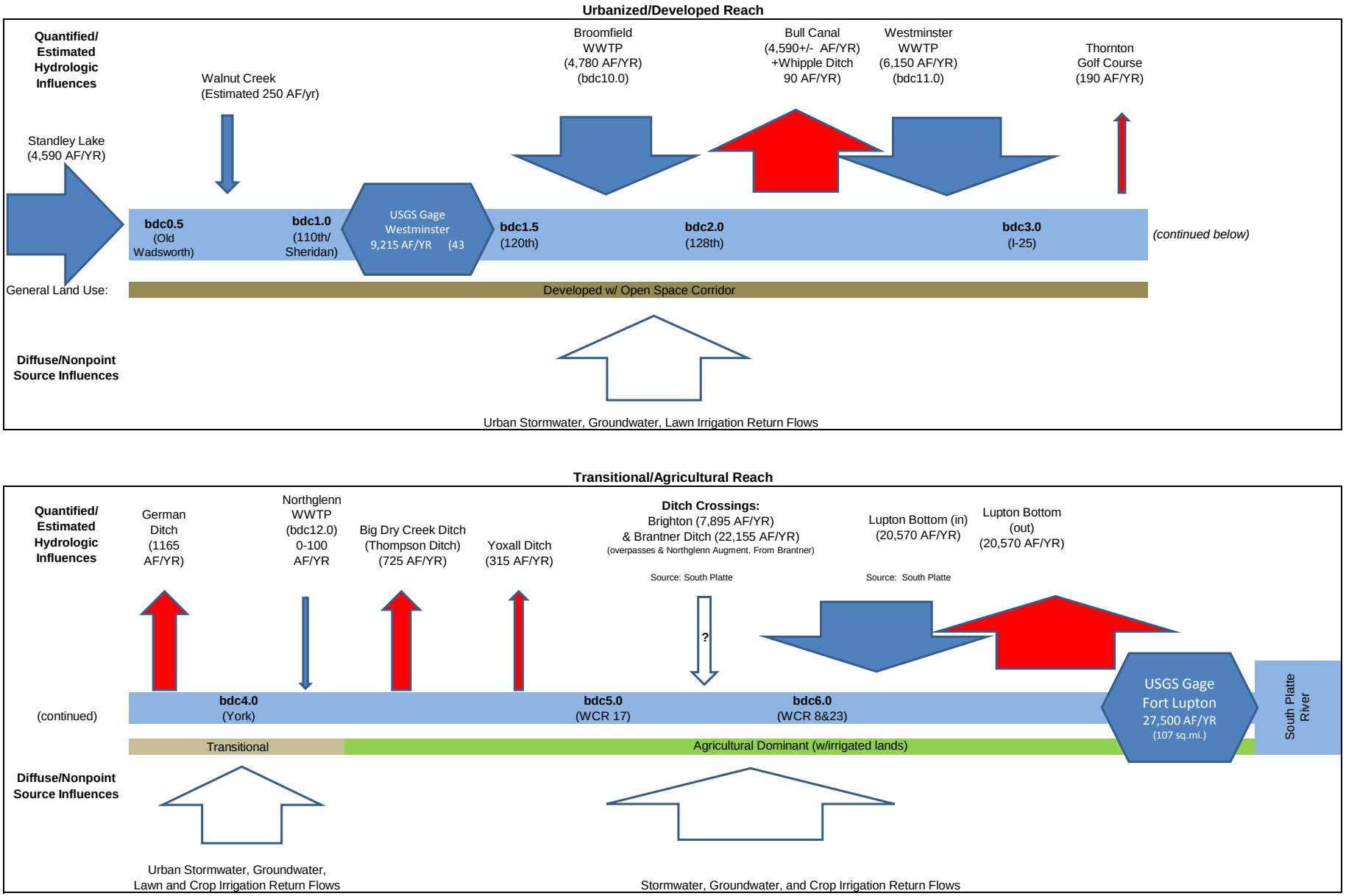


Figure 3. Big Dry Creek Selenium at bdc1.5, 2.0 and 4.0 (2006-2010)

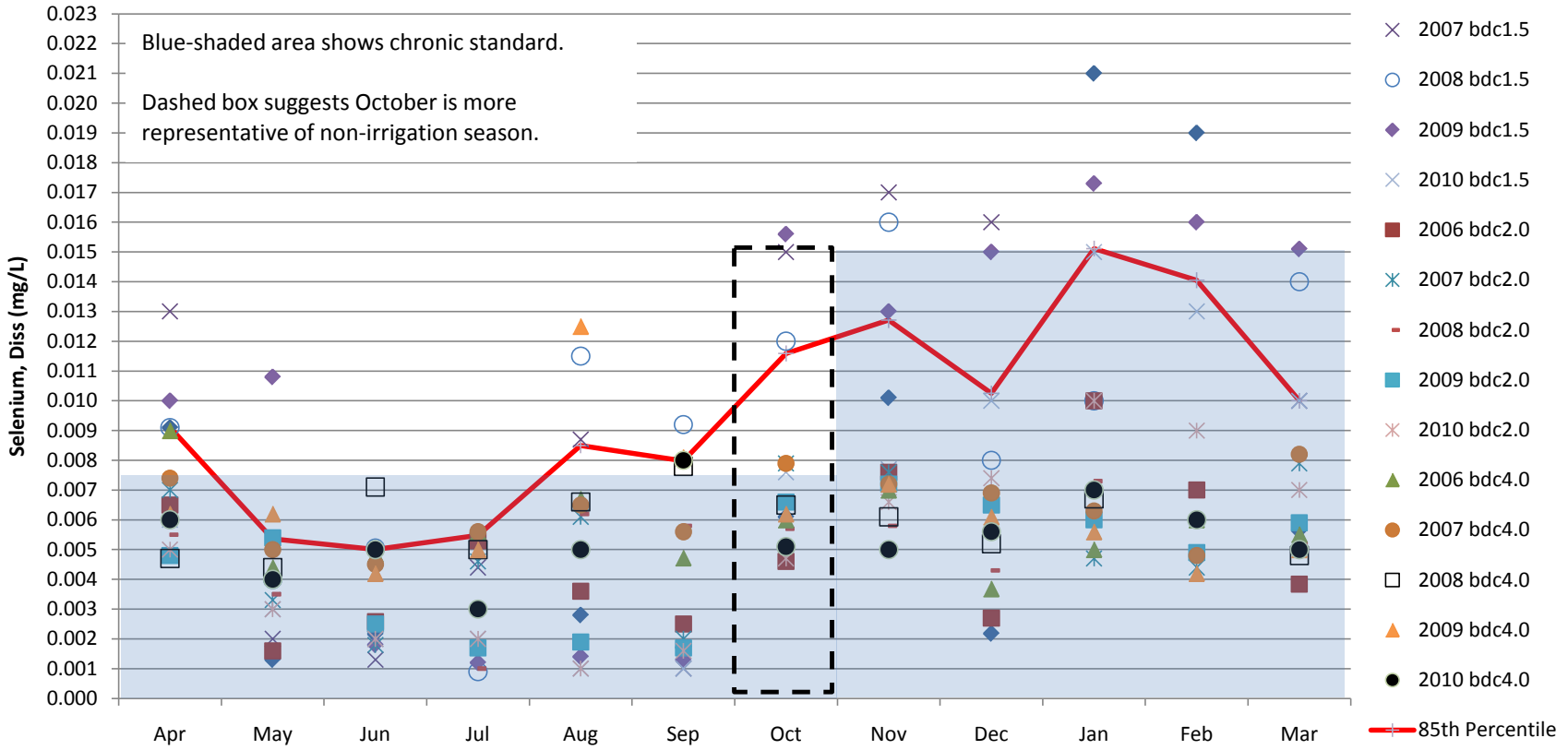


Figure 4a. 2010 Geometric Mean E. coli (#/100mL) at All Stations

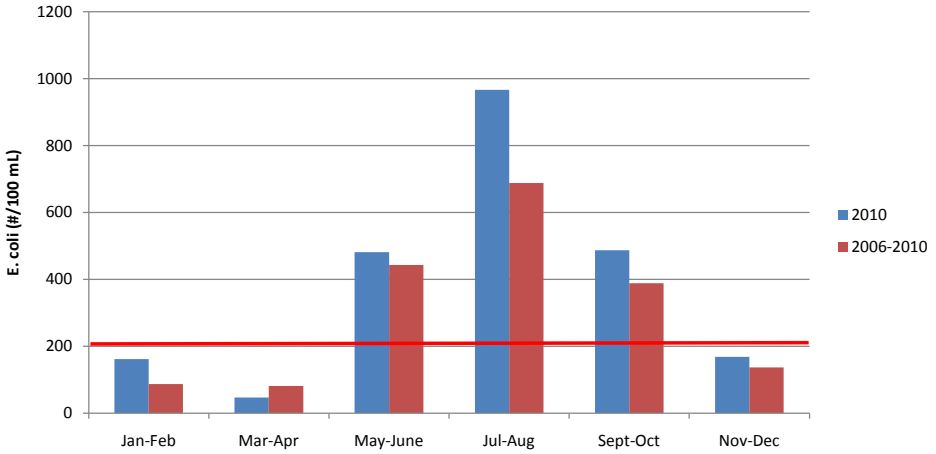


Figure 4b. Geometric Mean E. coli 2006-2010 by Month & Station

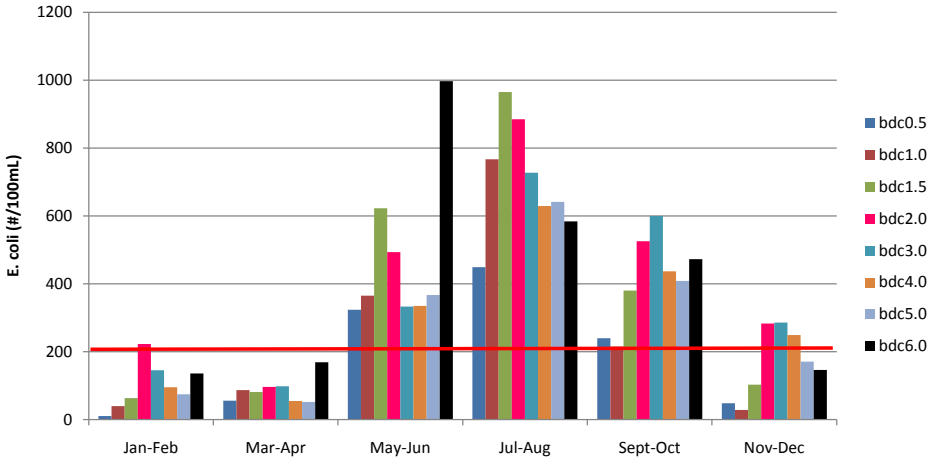


Figure 4c. Geometric Mean E. coli 2006-2010 by Station and Month

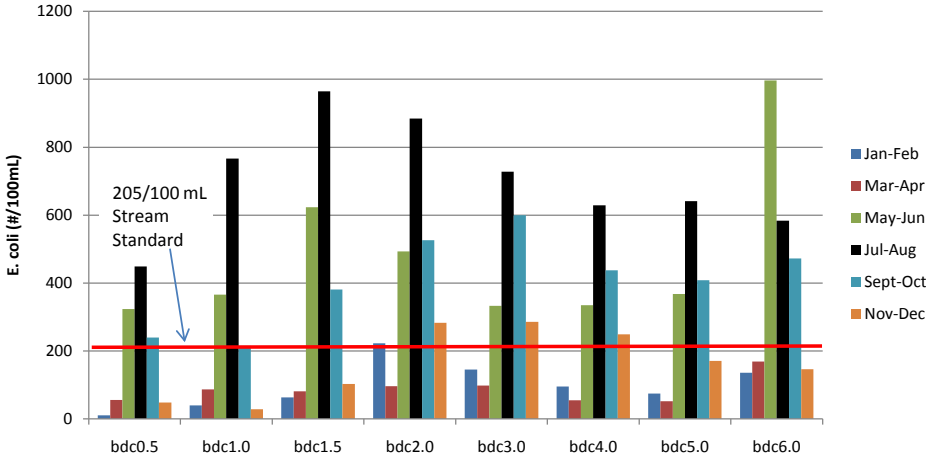


Figure 5a. E. coli vs. Temperature (all monitoring stations)

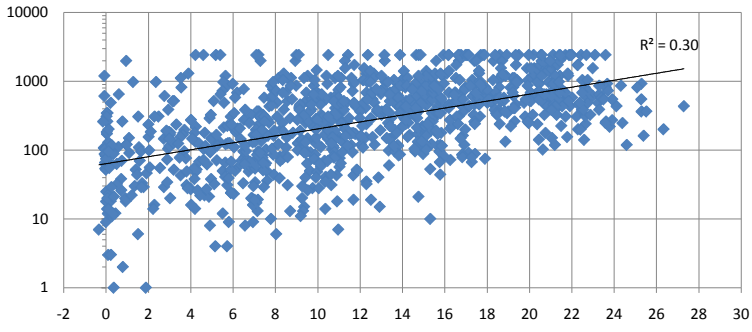


Figure 5b. E. coli vs. Temperature (Standley Lake to bdc1.5)

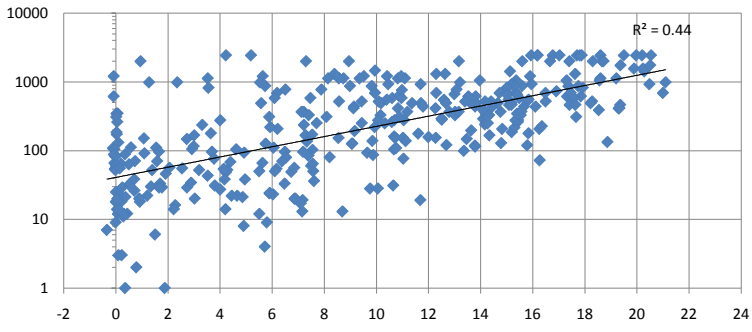


Figure 5c. E. coli vs. Temperature (Standley Lake to I-25)

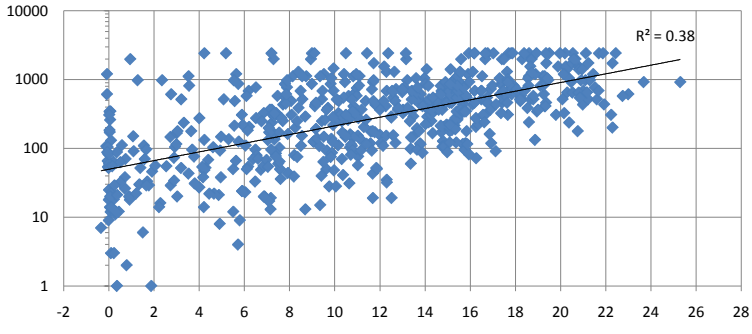


Figure 5d. E. coli vs. Temperature (York St. [bdc4.0] to Upstream of Confluence [bdc6.0])

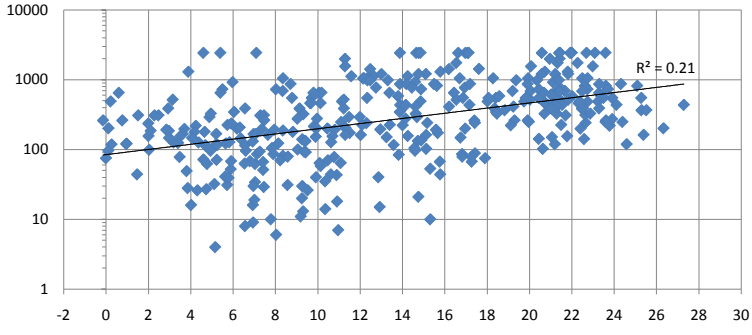


Figure 6. 2010 Big Dry Creek Instream Total Ammonia Compared to "New" Ammonia Standards

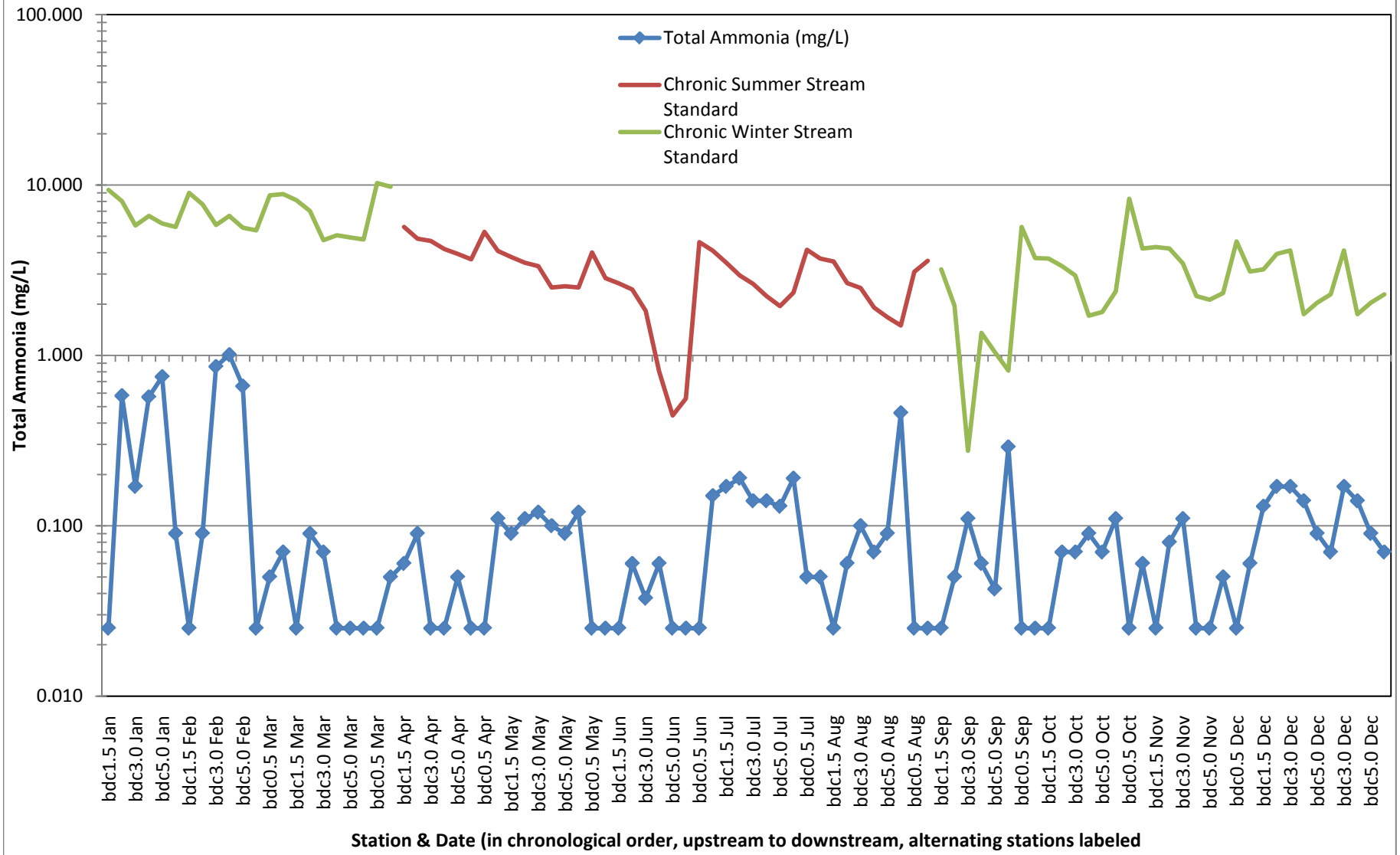


Figure 7. Big Dry Creek Average and Maximum Nitrate 2010

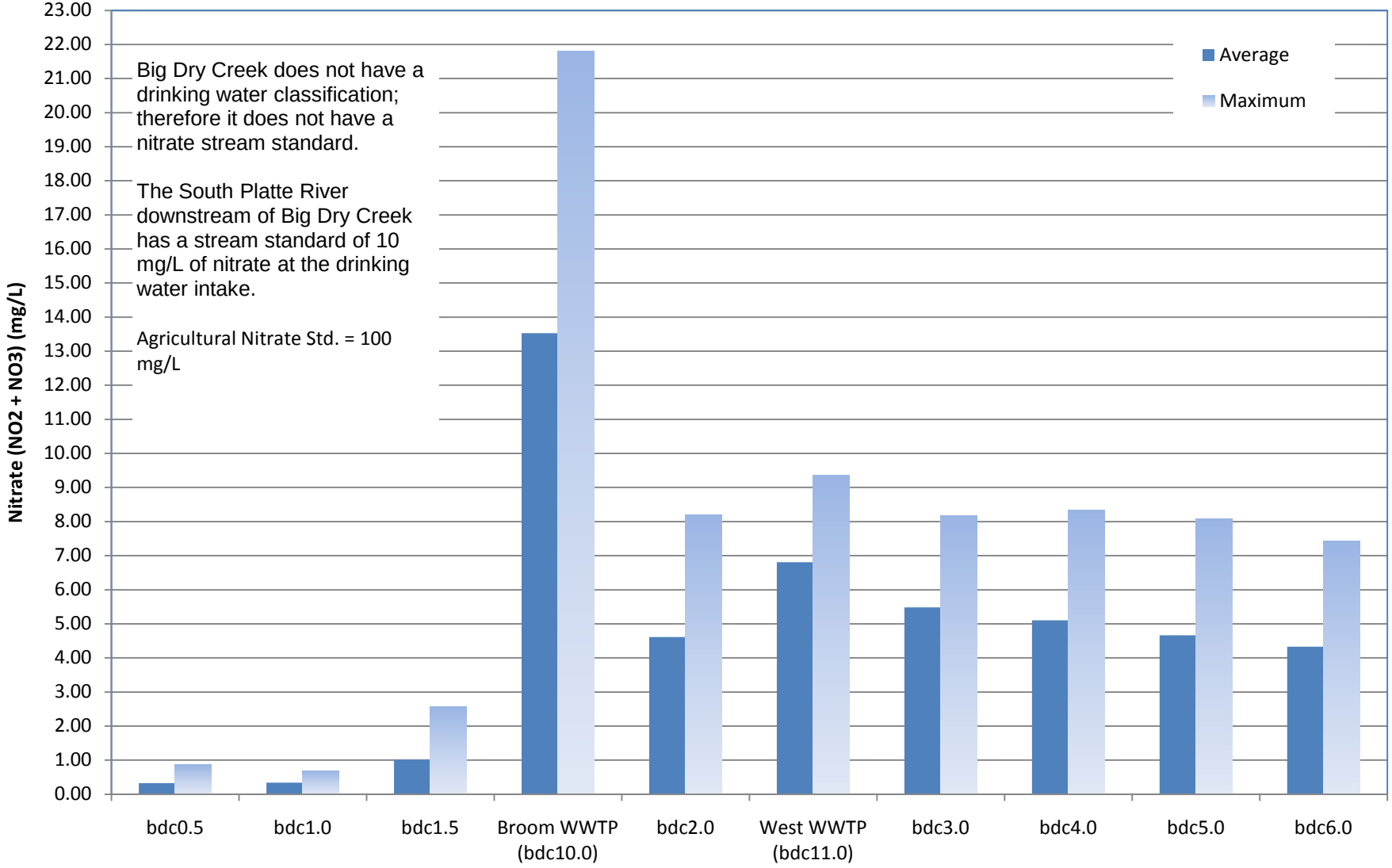


Figure 8. 2010 Big Dry Creek Total Ammonia + NO3/NO2

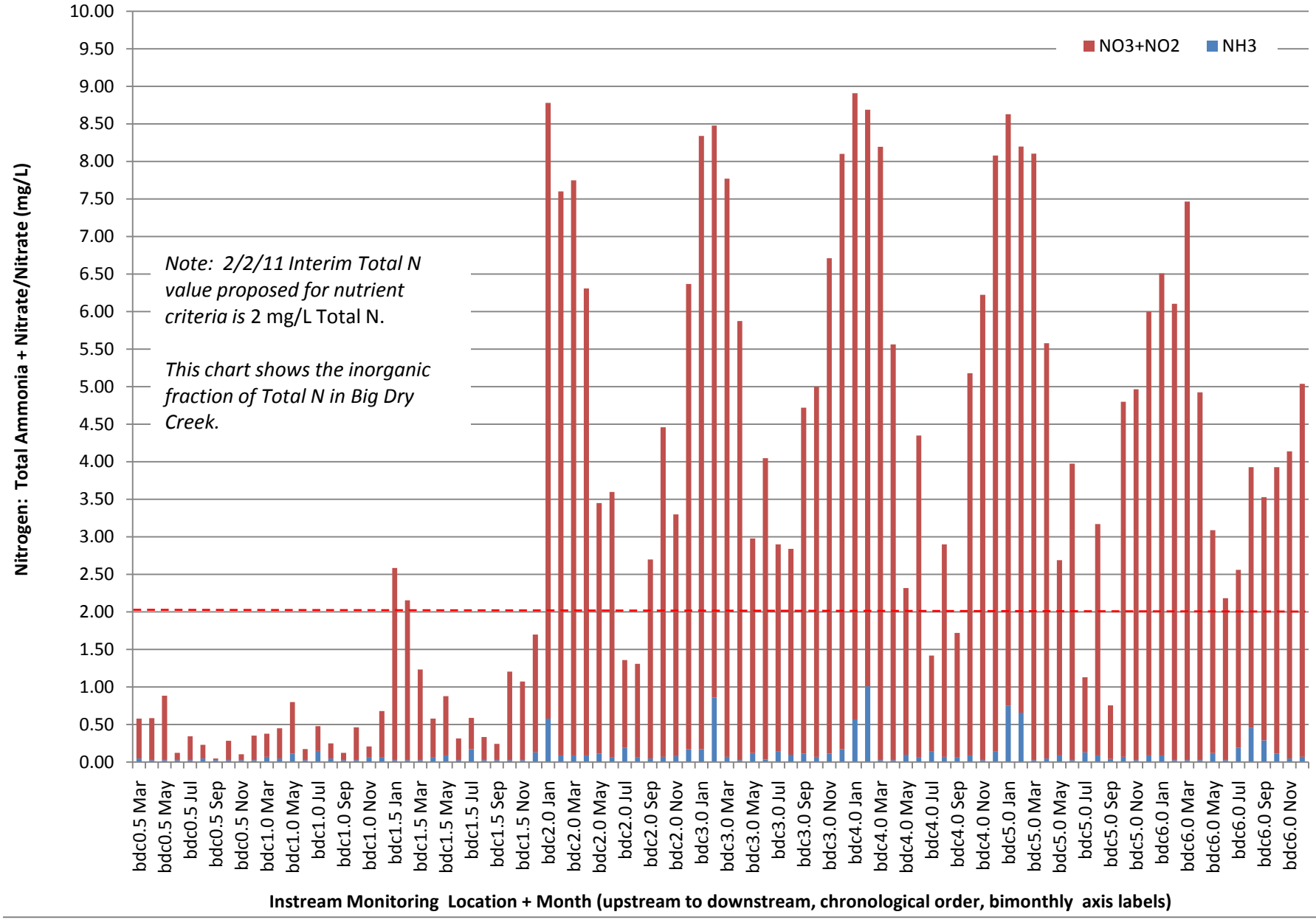


Figure 9a.
Big Dry Creek Instream Total Phosphorus at bdc6.0

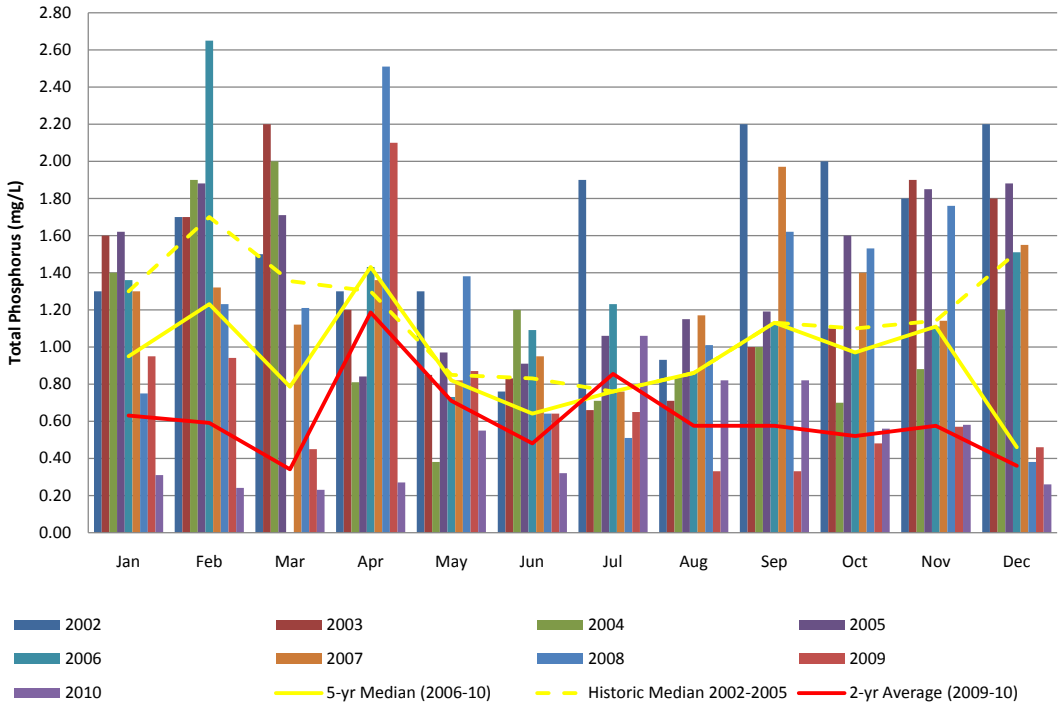


Figure 9b. Big Dry Creek Instream Total Phosphorus at bdc6.0 (2002-2010)

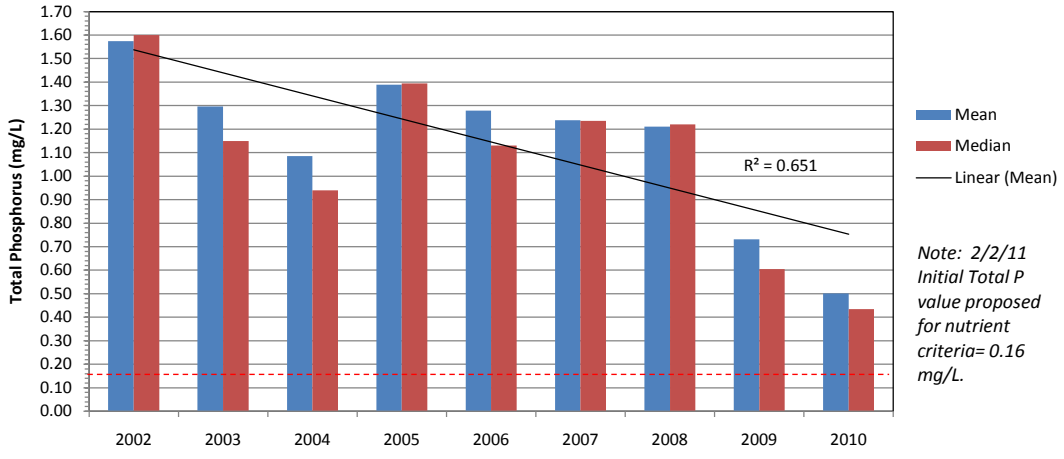


Figure 10a. Estimated Total P Loading at bdc6.0 (using Fort Lupton Gage & bdc6.0 Total P)

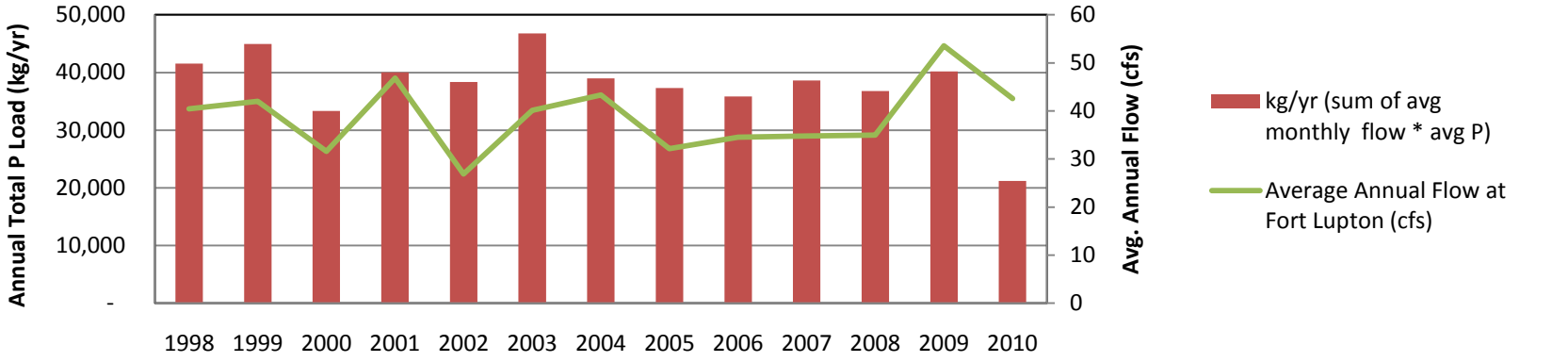


Figure 10b. Estimated Total P Loading at bdc6.0 (using Fort Lupton Gage & bdc6.0 Total P)

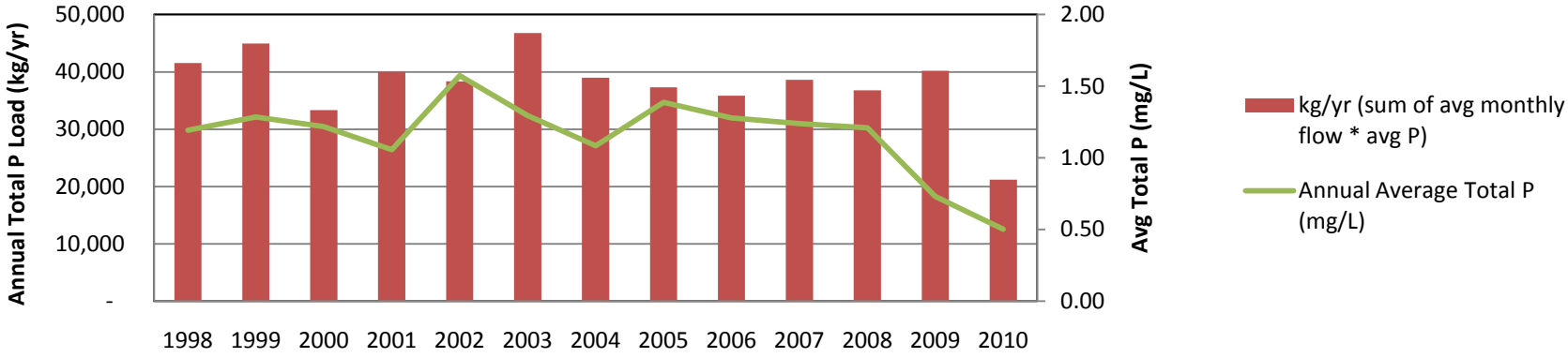


Figure 11a.
Total Phosphorus in Broomfield WWTP Discharge

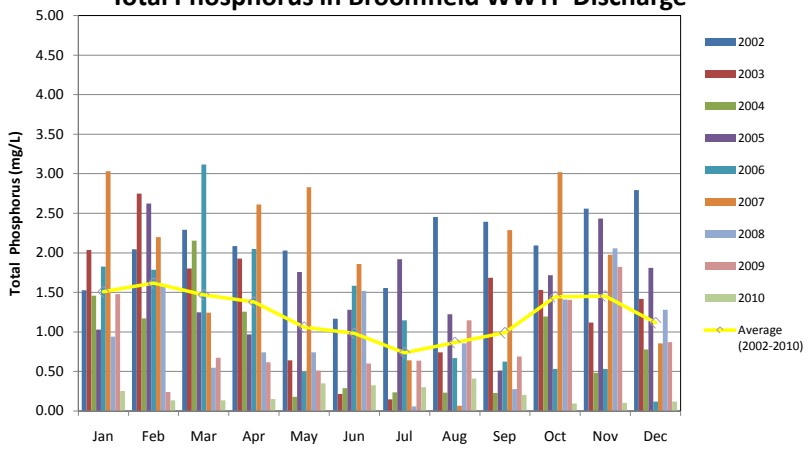


Figure 12a.
Total Phosphorus in Westminster WWTP Discharge

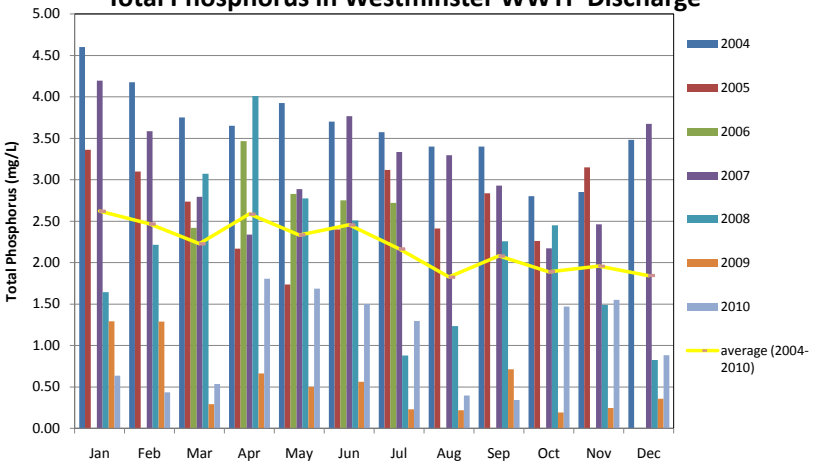


Figure 11b. Average Total Phosphorus Concentration in Broomfield WWTP Discharge

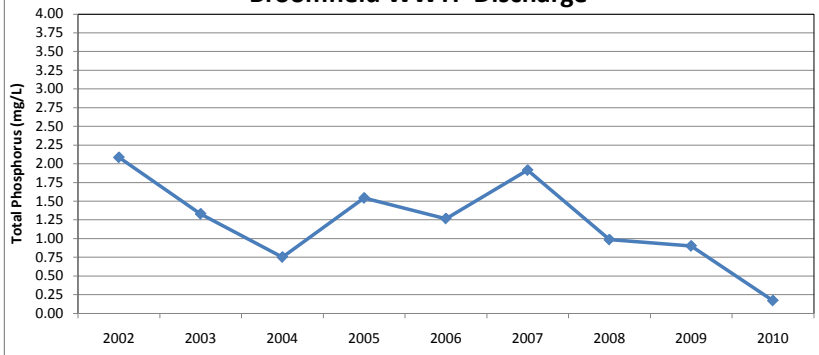
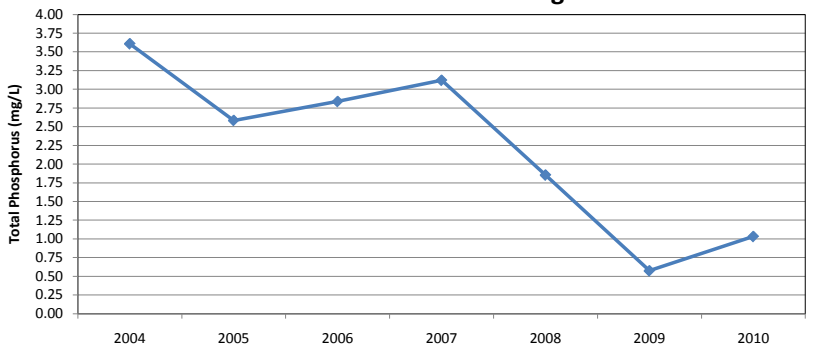


Figure 12b. Average Total Phosphorus Concentration in Westminster WWTP Discharge



Only 5 months available for 2007

Figure 13.
Total Broomfield and Westminster WWTP Discharges to Big Dry Creek

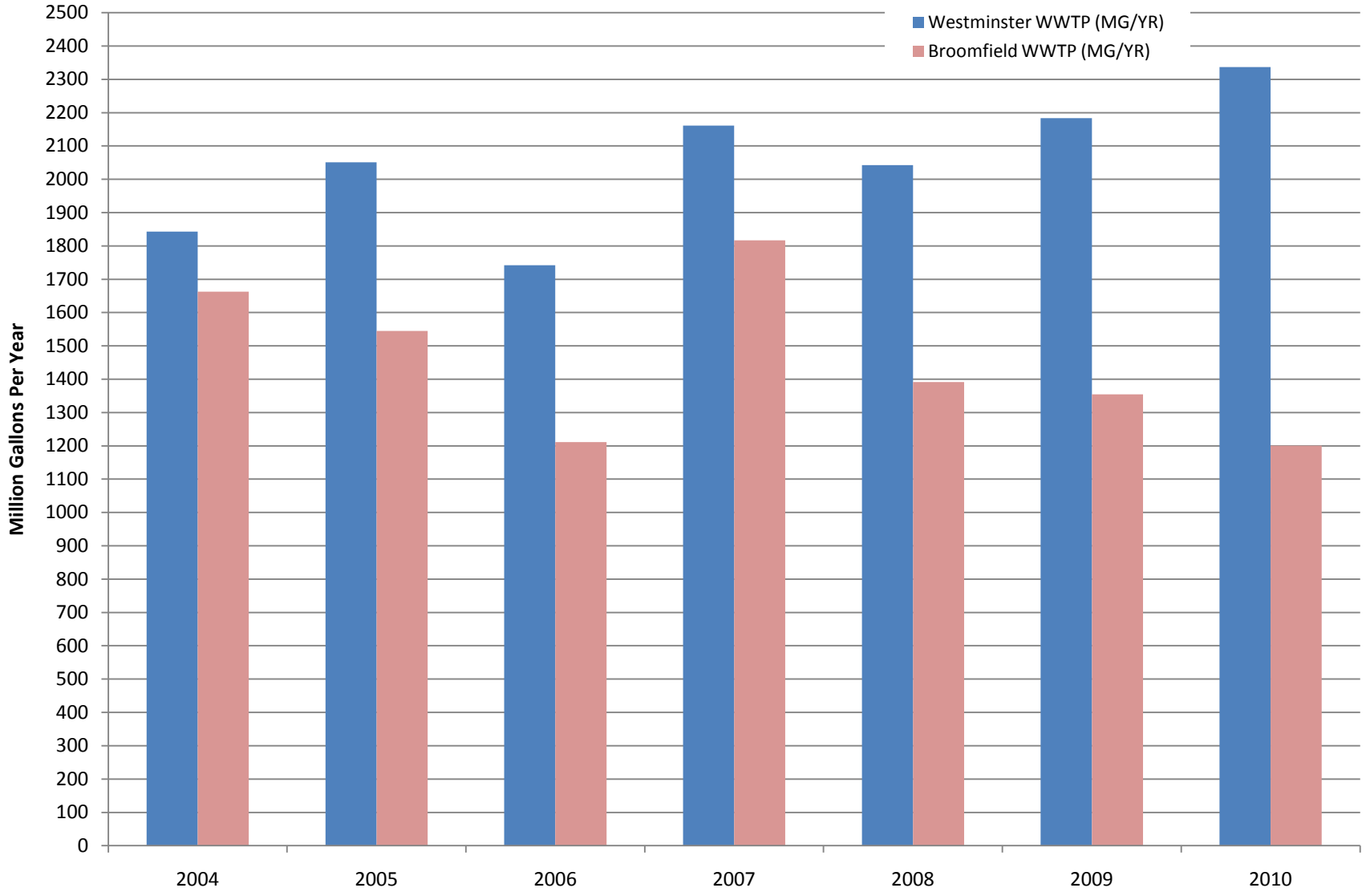


Figure 14. Big Dry Creek Median Total Phosphorus in 2010

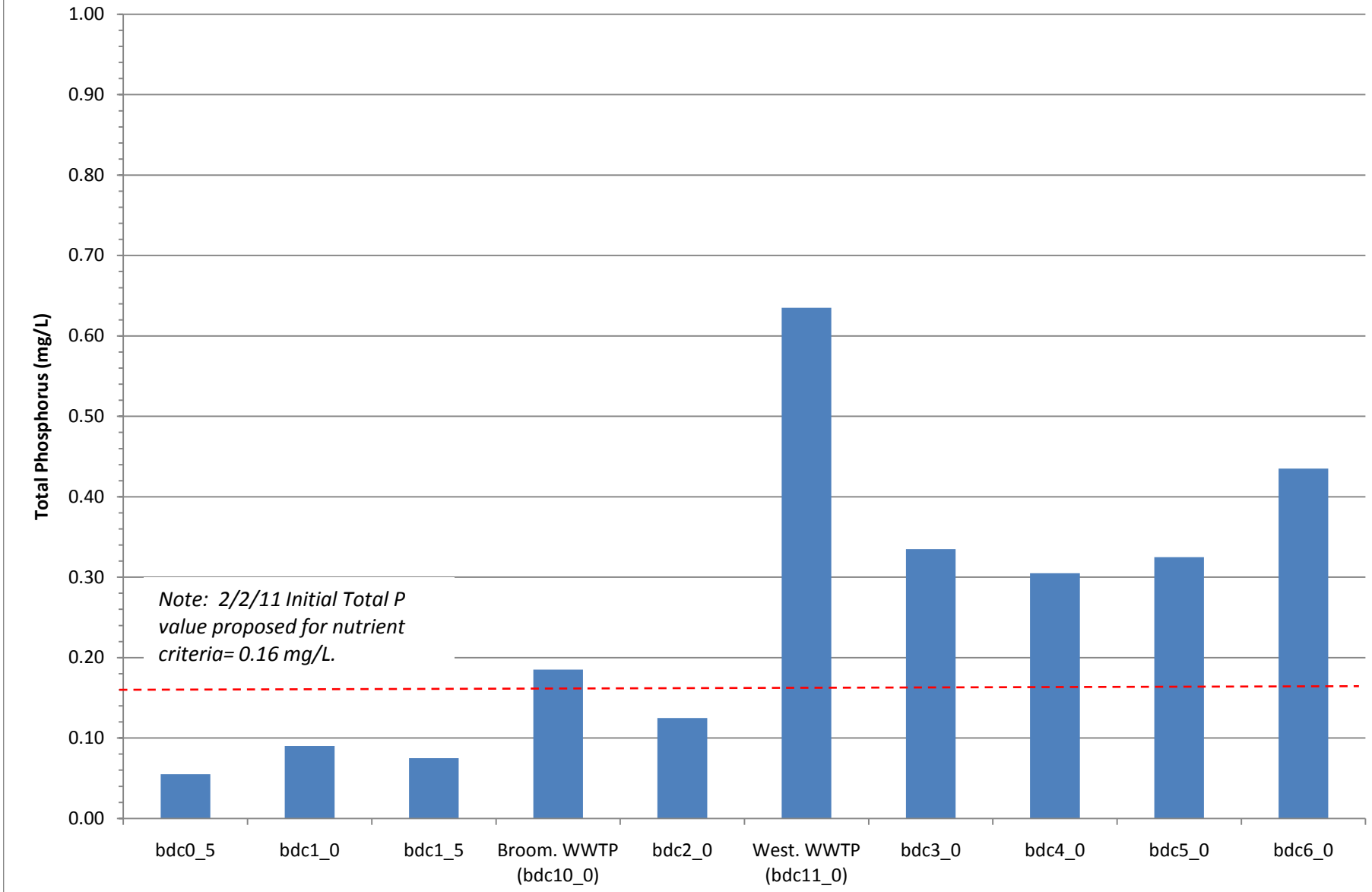


Figure 15a. Big Dry Creek
Instream Temperatures (Dec-Feb) 2005-2010

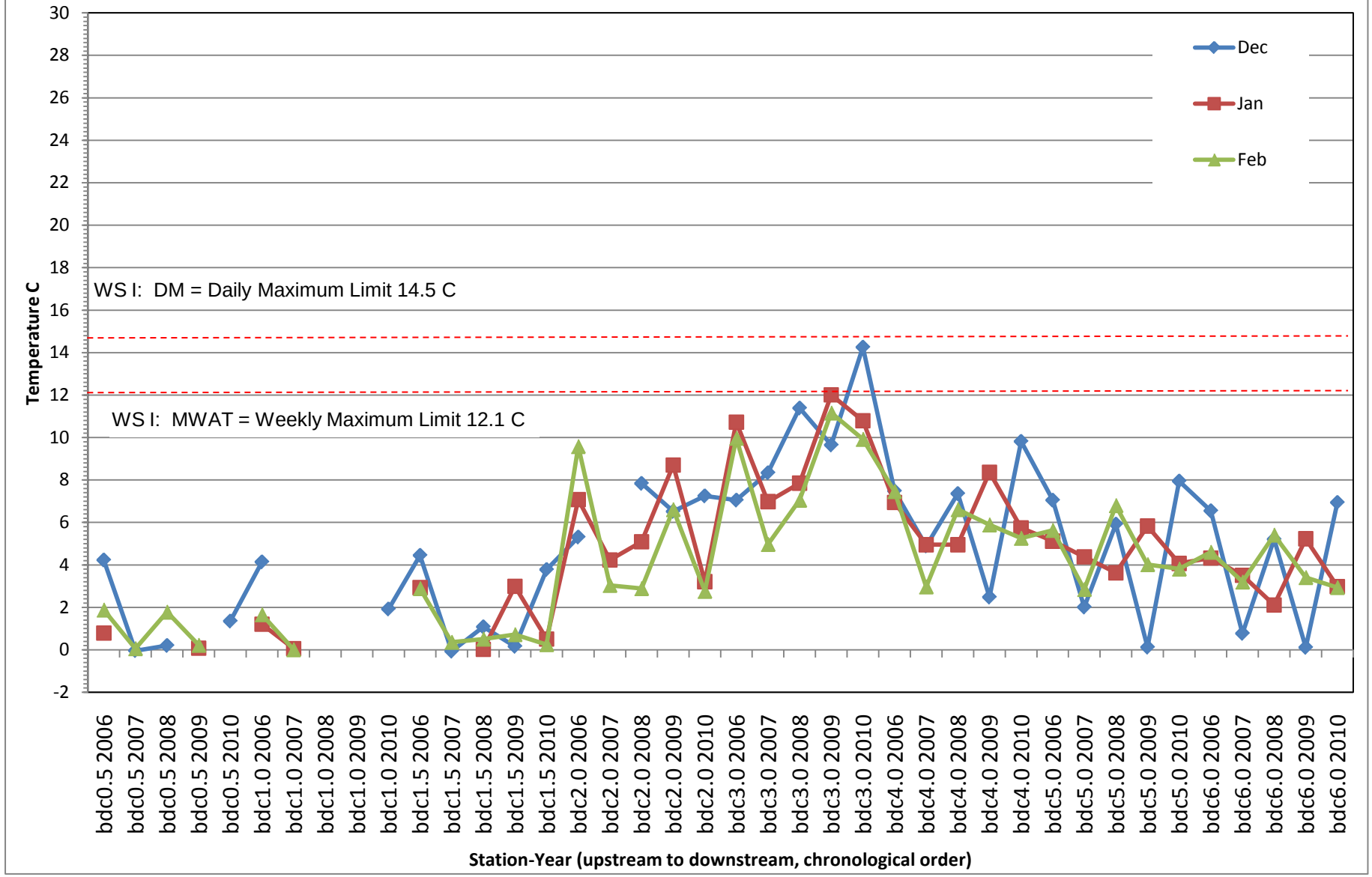
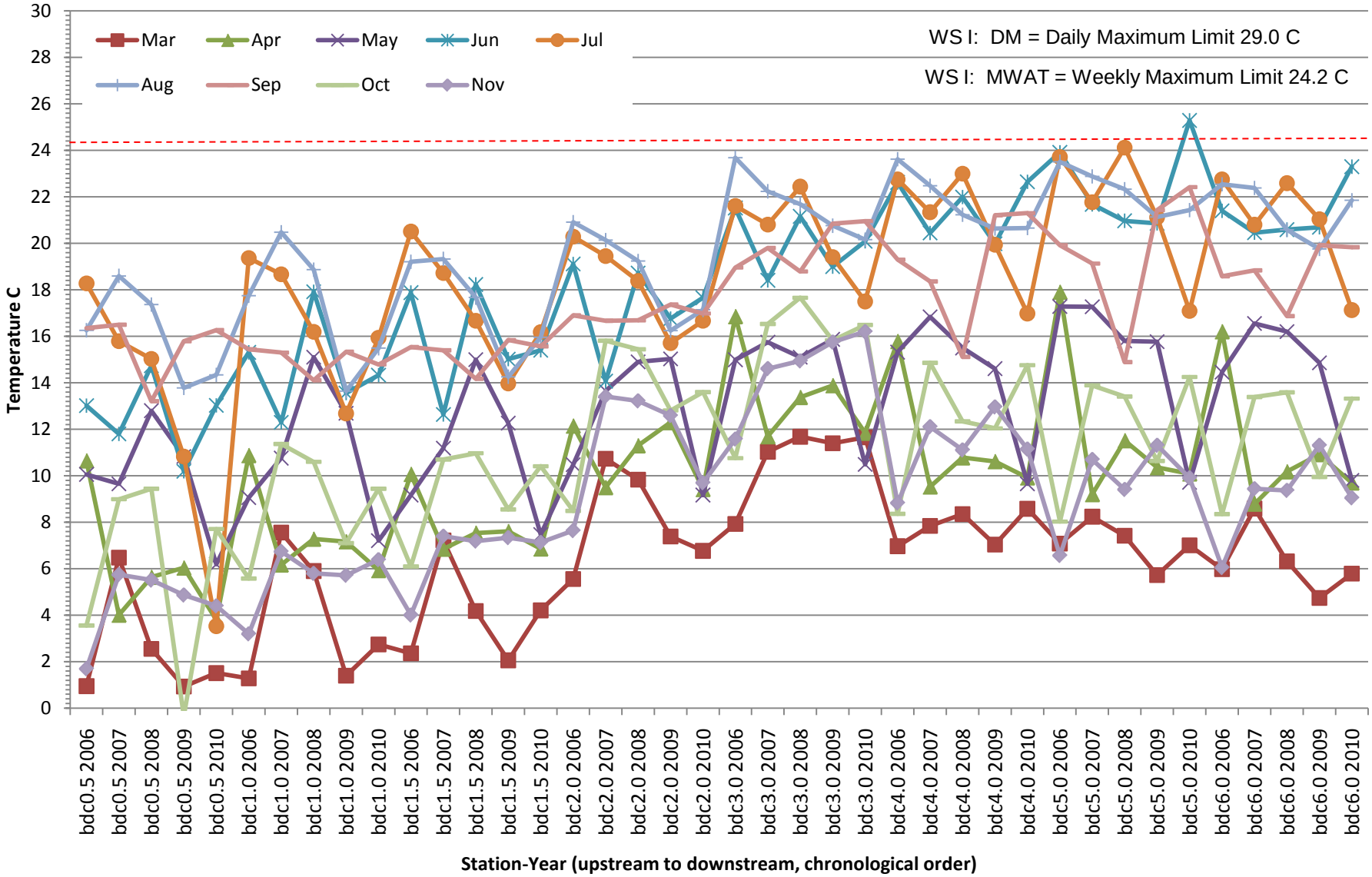
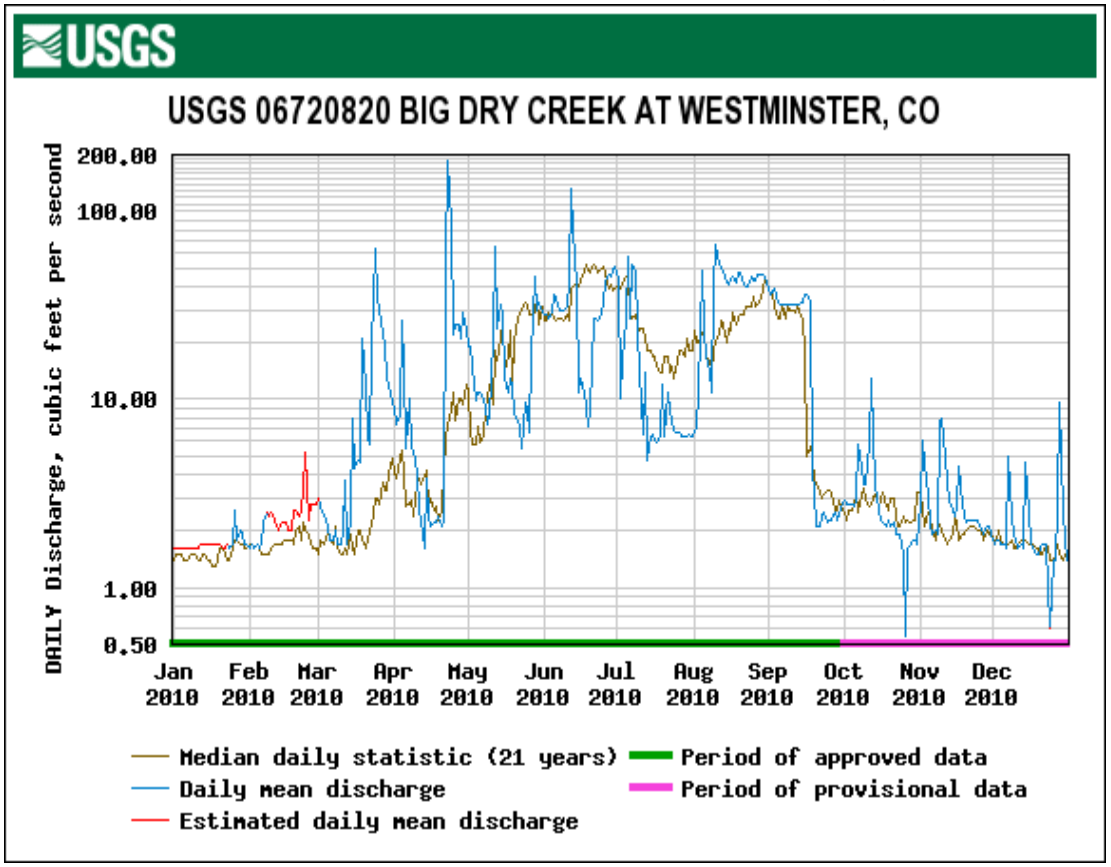
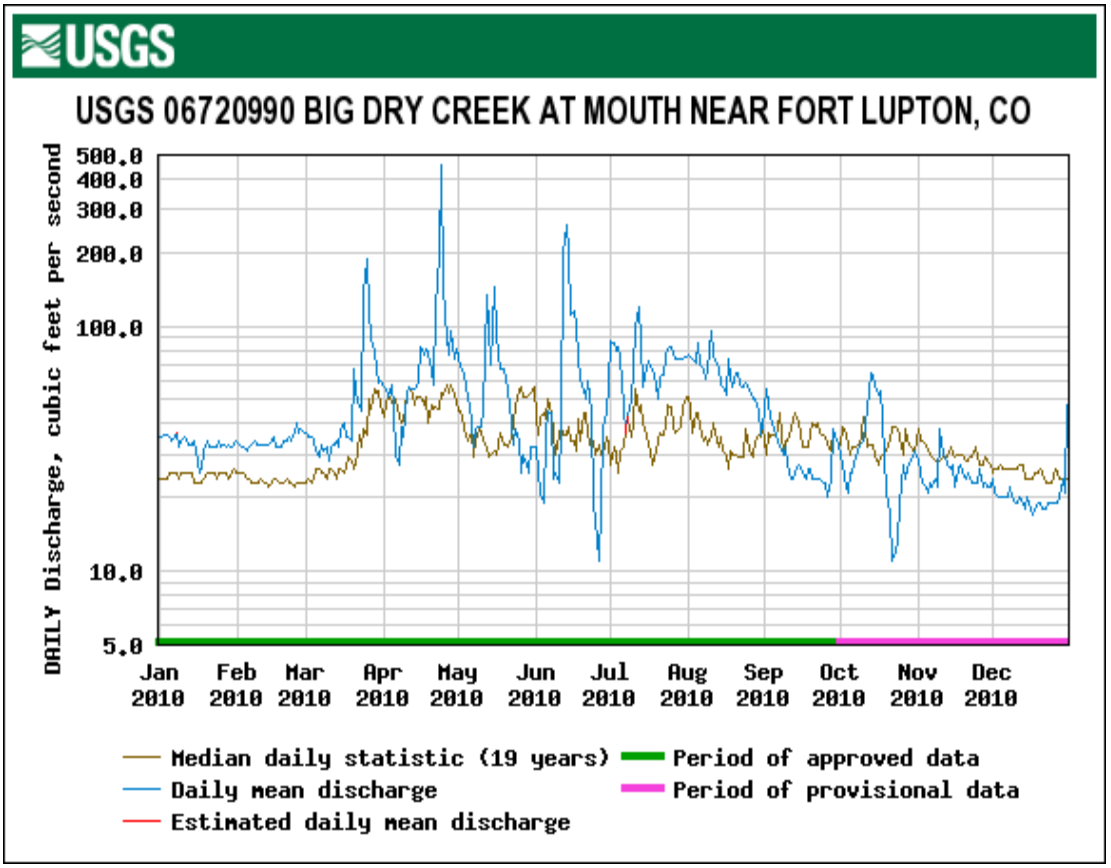


Figure 15b.
Big Dry Creek Instream Temperatures (Mar-Nov) 2006-2010

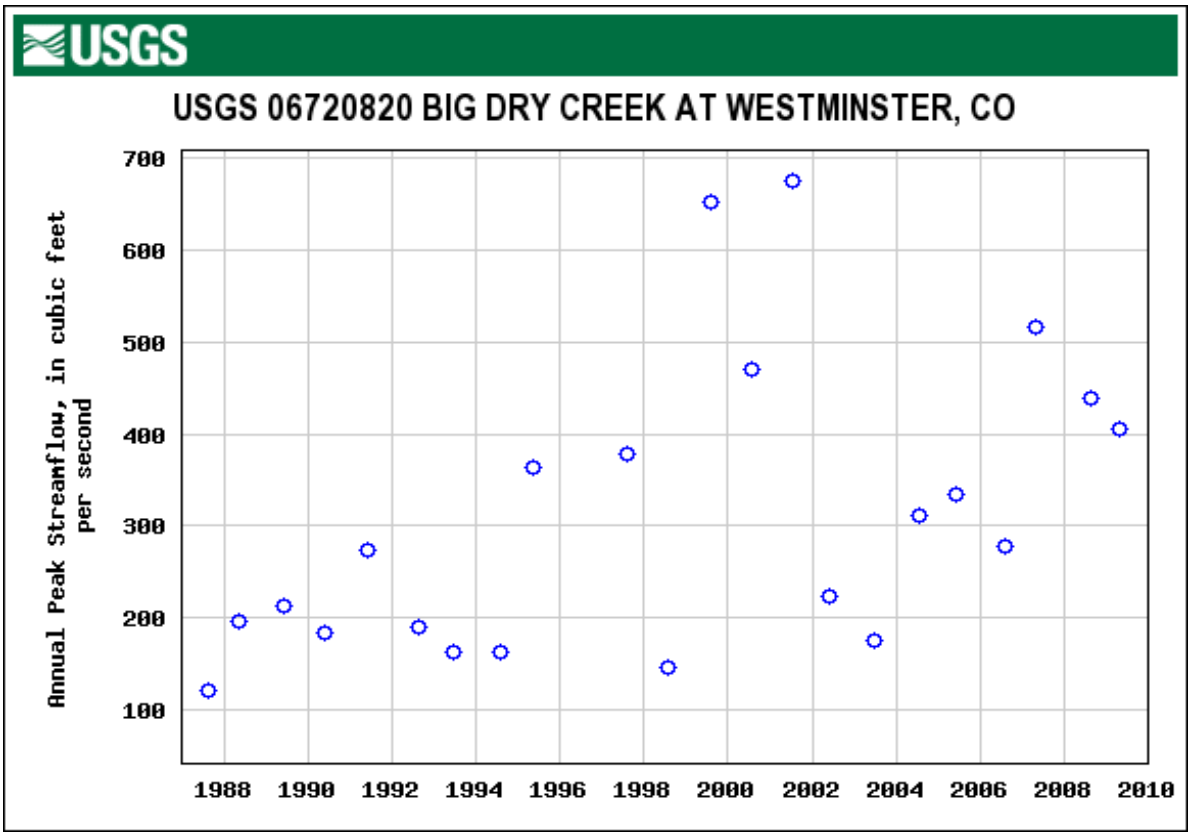


Figures 16 a & b. USGS 2009 Streamflows on Big Dry Creek





Figures 17 a & b. USGS Peak Annual Streamflows on Big Dry Creek



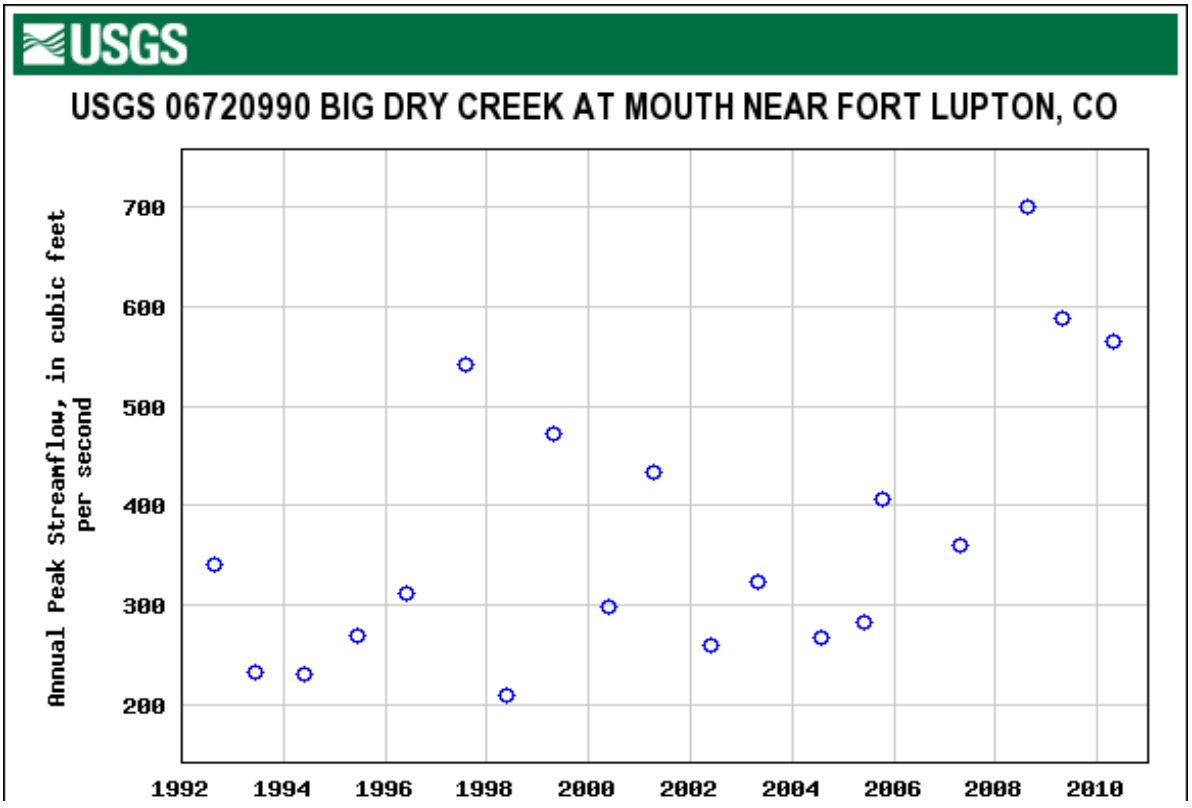


Figure 18.
Average Annual Flows on Big Dry Creek at USGS Westminster and Fort Lupton Gages
(plotted as calendar years)

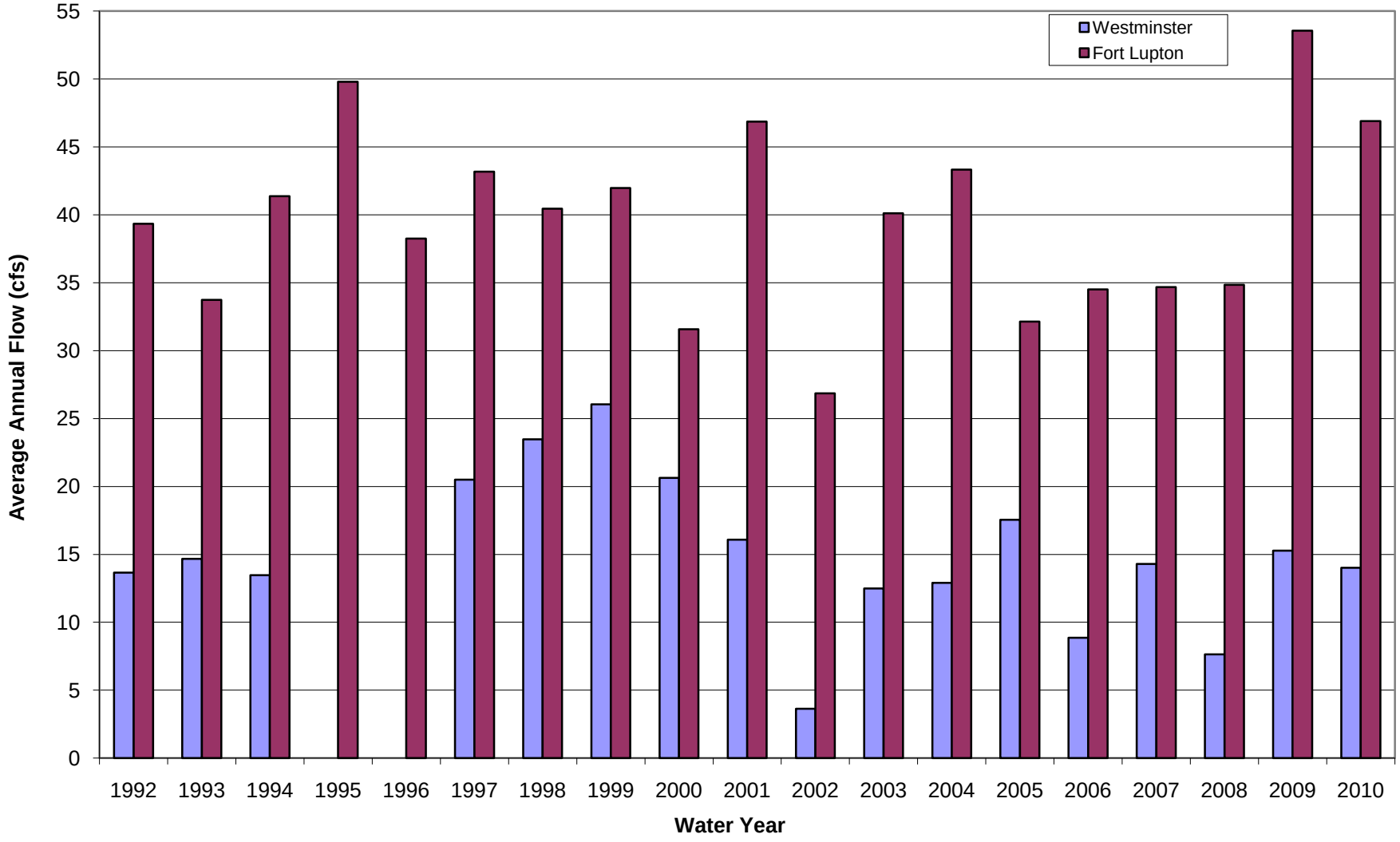


Figure 19. Average Percentage of Flows at USGS Westminster Gage from Standley Lake Releases (2006-2010)
(shown with average monthly flow at gauge)

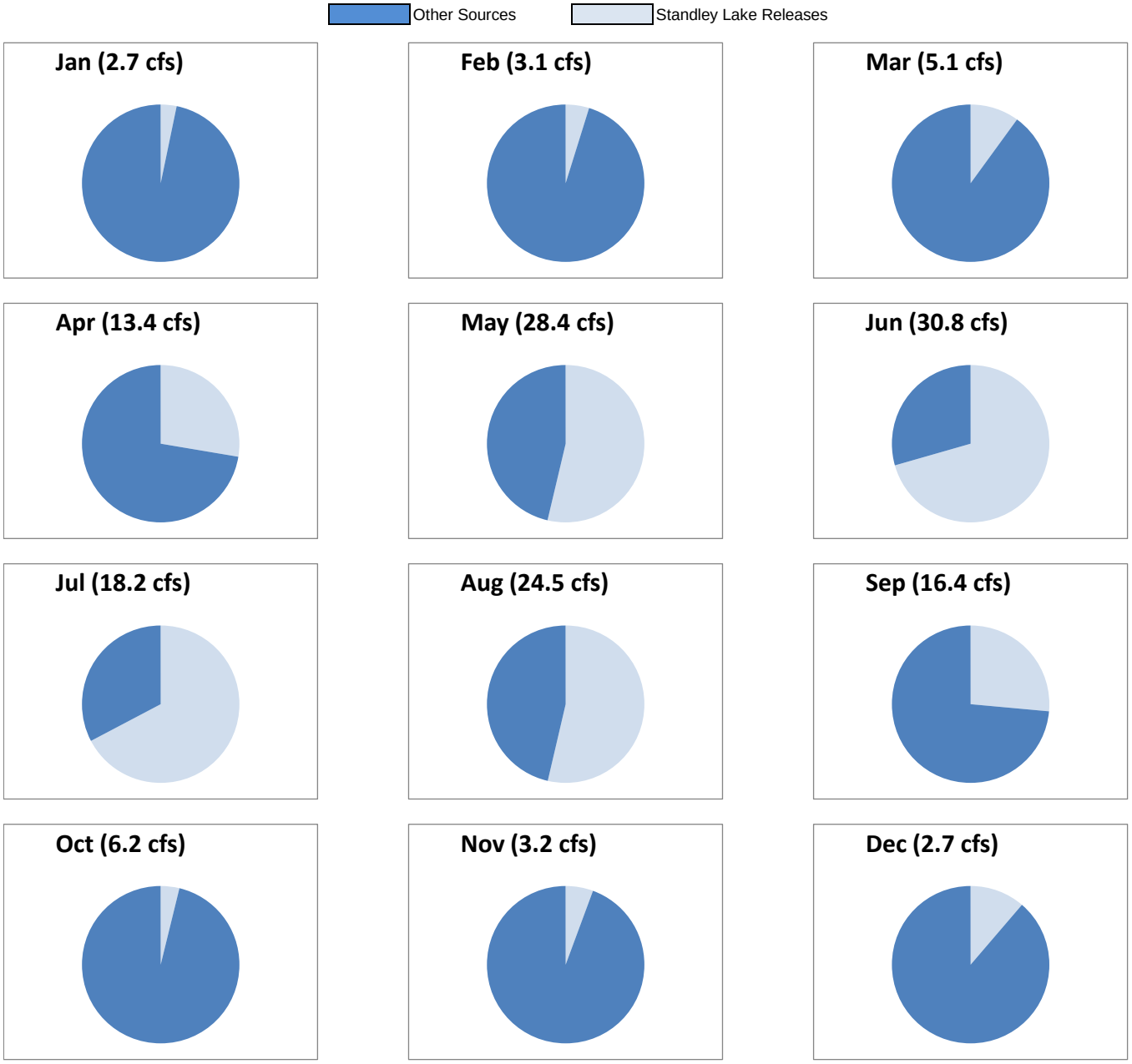
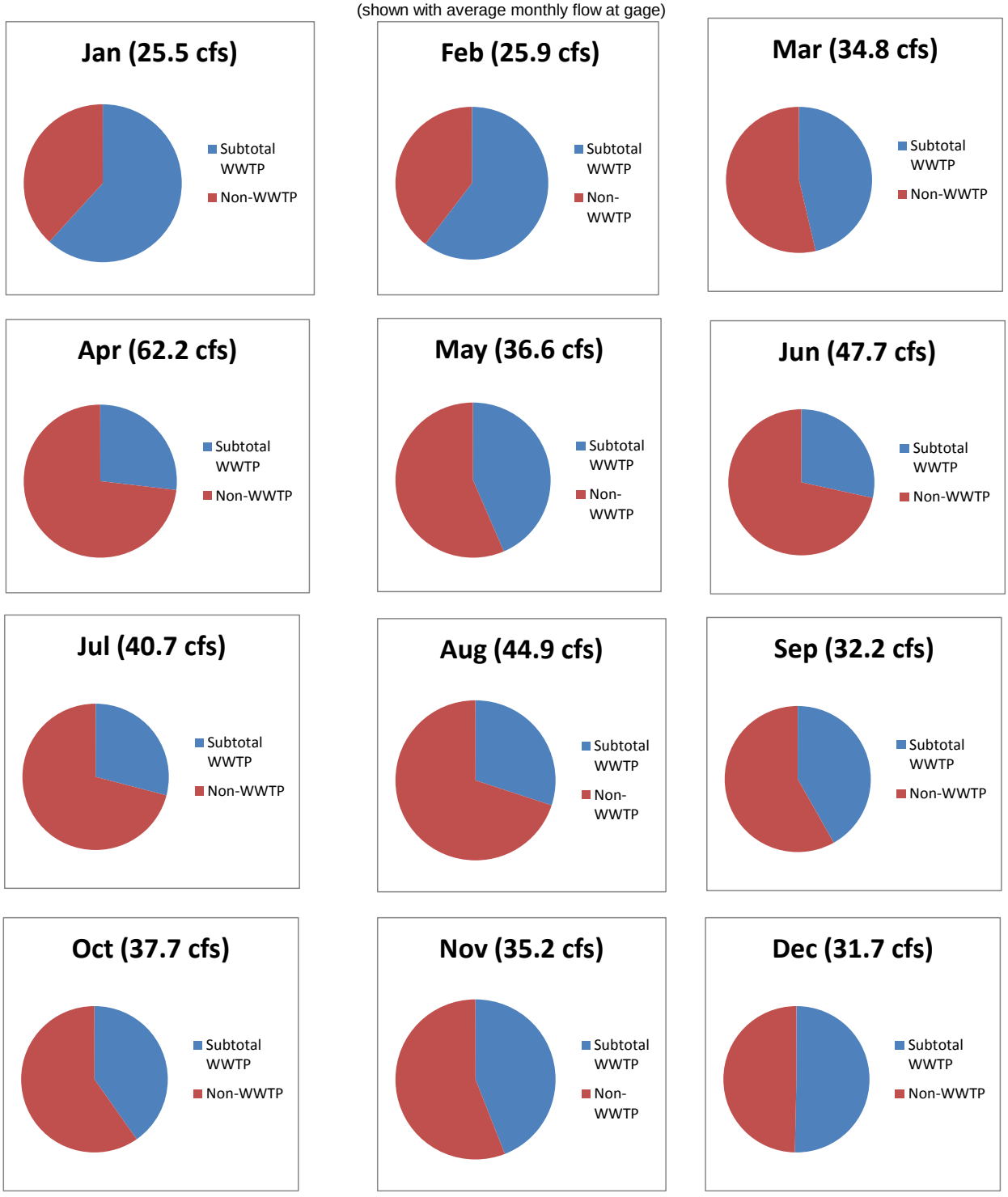


Figure 20. Average Percentage of Broomfield and Westminster WWTP Flows at USGS Fort Lupton Gage (2005-2009)
(shown with average monthly flow at gage)



ATTACHMENTS

Attachment 1. Big Dry Creek 2010
Instream Data

Trip Start Date	Station ID	QA Sample Flag	ALK-ALINITY	ARSENIC, Tot. Rec.	BORON	CADMIUM, D	CALCIUM	TOC	CHLORIDE	CHLOROPHYLL A, COR.	CHLOROPHYLL A, UNCOR.	CHROMIUM, D	CONDUCTANCE, SPECIFIC	COPPER, D	CYANIDE	DO	E. coli	FLOW	Hardness	IRON, Tot. Rec.	LEAD, D	MAG-NESIUM	MAN-GANESE, D	MERCURY, Tot
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	µS/cm	mg/L	mg/L	mg/L	#/100mL	cfs	mg/L	mg/L	mg/L	mg/L	mg/L	
14-Jan-10	bdc1.5		334				185	5.64	420	5.9	4.3		2894			13.77	32		683			53.69		
14-Jan-10	bdc2.0		265				142	6.51	288	4.1	1.7		2187			11.70	517		533			43.28		
14-Jan-10	bdc3.0		145				102	7.73	149	3	2.3		1380			10.42	345	6.59	345			21.86		
14-Jan-10	bdc4.0		178				124	7.33	190	4.9	3.8		1639			11.91	225		412			24.74		
14-Jan-10	bdc5.0		192				108	6.95	180	8.3	6.4		1648			12.47	147		391			29.57		
14-Jan-10	bdc6.0		207				122	6.46	173	*Non-detect	*Non-detect		1655			12.99	147	33	435			31.75		
11-Feb-10	bdc1.5		302				182	6.41	507.5	24.7	20.2		2996			12.91	29		656			48.95		
11-Feb-10	bdc2.0		230				130	7.05	344	5.6	3.8		2252			12.31	613		472			35.91		
11-Feb-10	bdc3.0		156				100	7.64	164.4	5.9	4.6		1385			11.36	285		347			23.51		
11-Feb-10	bdc4.0		190				118	7.93	222	7.4	5.9		1730			13.47	116		415			29.18		
11-Feb-10	bdc5.0		186				112	7.37	202	14.5	11.4		1717			13.62	49		403			29.88		
11-Feb-10	bdc6.0		220				127	7.09	194.4	31.5	22.9		1769			13.55	387	35	452			32.72		
11-Mar-10	bdc0.5		missing lab sheet	*Non-detect	0.24	*Non-detect	131	5.76	350	9.2	6.4	*Non-detect	2477	0.011	*Non-detect	11.33	6		515	0.367	*Non-detect	45.72	0.68	
11-Mar-10	bdc1.0		missing lab sheet	*Non-detect	0.27	*Non-detect	143	6.71	416	11.6	9	*Non-detect	2408	0.005	*Non-detect	12.42	29		513	0.333	*Non-detect	37.87	0.67	
11-Mar-10	bdc1.5		missing lab sheet	*Non-detect	0.37	*Non-detect	152	6.50	354	8.8	7	*Non-detect	2389	0.009	*Non-detect	12.22	14		564	0.593	*Non-detect	44.79	0.42	
11-Mar-10	bdc2.0		missing lab sheet	*Non-detect	0.33	*Non-detect	121	7.00	228	3.6	2.7	*Non-detect	1716	0.010	*Non-detect	11.54	248	1.28	435	0.386	*Non-detect	32.15	0.17	
11-Mar-10	bdc3.0		missing lab sheet	*Non-detect	0.36	*Non-detect	100	8.25	133	4.2	2.9	*Non-detect	1250	0.013	*Non-detect	10.93	93	5.86	344	0.322	*Non-detect	22.81	0.08	
11-Mar-10	bdc4.0		missing lab sheet	*Non-detect	0.38	*Non-detect	111	7.52	158.4	8.1	6	*Non-detect	1478	0.012	*Non-detect	13.72	31		391	0.348	*Non-detect	27.73	0.07	
11-Mar-10	bdc5.0		missing lab sheet	*Non-detect	0.38	*Non-detect	118	7.43	158.4	11.3	8.6	*Non-detect	1506	0.011	*Non-detect	13.35	19		414	0.449	*Non-detect	28.91	0.06	
11-Mar-10	bdc6.0		missing lab sheet	*Non-detect	0.41	*Non-detect	118	7.22	160.4	22.8	17.3	*Non-detect	1545	0.012	*Non-detect	13.03	39	34	421	0.676	*Non-detect	30.59	0.07	
08-Apr-10	bdc0.5		207				99	8.73	185.6	7.1	5.2		1626			10.72	31		390			34.74		
08-Apr-10	bdc1.0		185				101	9.23	238	6.7	5.5		1685			10.91	219		390			33.38		
08-Apr-10	bdc1.5		194				119	7.92	238	8.1	6		1654			11.19	20		431			32.60		
08-Apr-10	bdc2.0		150				103	8.16	176.4	6.1	4.8		1446			11.62	40	23.45	369			27.18		
08-Apr-10	bdc3.0		156				109	7.96	150.8	5.6	4.5		1432			10.43	52	39.77	385			27.51		
08-Apr-10	bdc4.0		186				113	8.09	164	8.3	7.1		1577			10.63	40		413			31.67		
08-Apr-10	bdc5.0		182				126	8.06	161.4	10.5	9.6		1593			10.44	64		448			32.27		
08-Apr-10	bdc6.0		175				129	7.67	170	13.6	9.8		1645			10.23	462	43	460			33.56		
13-May-10	bdc0.5		179				78	8.25	141.8	3	2.4		1213			9.65	687		304			26.55		
13-May-10	bdc1.0		130				74	8.03	112.4	6.7	5.5		901			9.23	366		250			15.82		
13-May-10	bdc1.5		139				77	7.85	130.2	9.3	7.3		1022			9.21	580	25.64	263			17.14		
13-May-10	bdc2.0		125				73	7.49	104.8	5.5	4.7		946			8.72	462	55.06	252			16.84		
13-May-10	bdc3.0		141				84	7.52	109.4	6.1	5.2		1072			8.65	308		288			19.00		
13-May-10	bdc4.0		141				86	7.68	104.2	7.5	5.4		1074			8.80	462		293			19.07		
13-May-10	bdc5.0		144				86	7.60	104.2	9.8	8.6		1060			8.69	548		293			19.03		
13-May-10	bdc6.0		144				80	7.52	97.8	11.8	9.2		1055			8.75	649		277			18.70		
10-Jun-10	bdc0.5		57	*Non-detect	0.09	*Non-detect	38	2.11	29.5	3.5	2.3	*Non-detect	340	0.006	*Non-detect	8.33	326	27.99	121	0.338	*Non-detect	6.32	0.05	
10-Jun-10	bdc1.0		78	*Non-detect	0.11	*Non-detect	44.8	2.42	40.4	5	3.3	*Non-detect	449	0.006	*Non-detect	8.86	326	30.92	146	0.643	*Non-detect	8.23	0.03	
10-Jun-10	bdc1.5		88	*Non-detect	0.13	*Non-detect	48	2.65	45.4	5.9	3.8	*Non-detect	522	0.005	*Non-detect	8.32	649	41.73	160	0.864	*Non-detect	9.73	0.03	
10-Jun-10	bdc2.0		103	*Non-detect	0.18	*Non-detect	57.6	3.89	59.4	5.2	2.8	*Non-detect	659	0.008	*Non-detect	7.56	462		194	0.901	*Non-detect	12.11	0.02	
10-Jun-10	bdc2.0	Field Replicate															1554							
10-Jun-10	bdc3.0		150	*Non-detect	0.25	*Non-detect	79.2	5.55	94.5	3.1	2.1	*Non-detect	1045	0.009	*Non-detect	9.24	518	18.39	272	0.281	*Non-detect	18.14	0.02	

Attachment 1. Big Dry Creek 2010
Instream Data

Trip Start Date	Station ID	QA Sample Flag	ALK-ALINITY	ARSENIC, Tot. Rec.	BORON	CADMIUM, D	CALCIUM	TOC	CHLORIDE	CHLOROPHYLL A, COR.	CHLOROPHYLL A, UNCOR.	CHROMIUM, D	CONDUCTANCE, SPECIFIC	COPPER, D	CYANIDE	DO	E. coli	FLOW	Hardness	IRON, Tot. Rec.	LEAD, D	MAG-NESIUM	MAN-GANESE, D	MERCURY, Tot
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	µS/cm	mg/L	mg/L	mg/L	#/100mL	cfs	mg/L	mg/L	mg/L	mg/L	mg/L	
10-Jun-10	bdc3.0	Field Replicate																						
10-Jun-10	bdc4.0		167	*Non-detect	0.32	*Non-detect	96.8	5.99	107	3.3	2.4	*Non-detect	1287	0.007	*Non-detect	10.95	313		372	0.204	*Non-detect	31.73	0.013	
10-Jun-10	bdc5.0		186	0.001	0.36	*Non-detect	101.6	5.64	114	2.6	1.6	*Non-detect	1377	0.007	*Non-detect	11.21	548		404	0.178	*Non-detect	36.40	0.02	
10-Jun-10	bdc5.0	Field Replicate																		0.183				
10-Jun-10	bdc6.0		160	0.001	0.29	*Non-detect	78.4	5.09	79.5	5.3	3.1	*Non-detect	1033	0.008	*Non-detect	9.02	388		272	0.805	*Non-detect	18.55	0.04	
08-Jul-10	bdc0.5		78				42	4.13	36.2	4.9	*Non-detect		425			8.83	1120	12.98	143			9.30		
08-Jul-10	bdc1.0		92				56	7.65	54.6	14.6	12.3		555			8.24	2420	28.56	189			12.04		
08-Jul-10	bdc1.5		104				58	8.40	57.1	20.6	17.4		616			8.56	2420	38.4	199			13.13		
08-Jul-10	bdc2.0		116				63	8.82	61.4	16.8	13.9		666			8.40	2420		218			14.65		
08-Jul-10	bdc3.0		136				75	8.01	68.8	15.7	13.3		835			8.83	1987		266			19.17		
08-Jul-10	bdc4.0		150				72	7.70	47.4	31.6	26.1		770			8.69	2420		252			17.48		
08-Jul-10	bdc5.0		136				65	6.80	47	43.5	32.1		651			8.64	2420		224			14.93		
08-Jul-10	bdc6.0		154				85	6.75	77.2	73.3	51.6		913			8.39	2420		304			22.24		
12-Aug-10	bdc0.5		60				36	2.01	28.9	3.1	1.8		326			8.13	166	44.25	119			7.16		
12-Aug-10	bdc1.0		72				43	2.44	34.2	6.4	4.3		388			7.93	345		142			8.48		
12-Aug-10	bdc1.5		82				48	2.69	36.5	7.5	4.1		443			7.88	921	45.31	161			10.03		
12-Aug-10	bdc2.0		90				51	3.28	43.5	9.8	4.3		514			7.52	436		174			11.41		
12-Aug-10	bdc3.0		134				78	5.25	72.1	7.6	3.9		891			7.24	326	17.85	277			20.04		
12-Aug-10	bdc4.0		161				90	5.61	87.5	7.7	5.9		1134			7.87	489		333			26.37		
12-Aug-10	bdc5.0		179				100	6.33	93.5	11.2	7.9		1211			7.84	687		371			29.52		
12-Aug-10	bdc6.0		170				84	5.68	85.3	19.4	16.4		967			6.45	518		297			21.30		
09-Sep-10	bdc0.5		59	*Non-detect	0.10	*Non-detect	36	2.11	28.4	2.6	1.9	*Non-detect	289	0.005	*Non-detect	7.98	72	33.8	113	0.535	*Non-detect	5.69	0.25	
09-Sep-10	bdc1.0		74	0.001	0.06	*Non-detect	37.2	2.35	39.5	5.8	3.3	*Non-detect	360	0.007	*Non-detect	8.22	128	31.35	122	1.149	*Non-detect	7.04	0.09	
09-Sep-10	bdc1.5		82	0.001	0.12	*Non-detect	48.4	2.55	38.5	5.2	3.1	*Non-detect	422	0.004	*Non-detect	8.13	366	30.27	156	1.140	*Non-detect	8.52	0.03	
09-Sep-10	bdc2.0		88	0.001	0.10	*Non-detect	48.8	3.52	51.5	4.7	2.7	*Non-detect	532	0.005	*Non-detect	7.77	817		164	1.143	*Non-detect	10.13	0.01	
09-Sep-10	bdc3.0		171	*Non-detect	0.36	*Non-detect	94	6.14	109	3.5	3.2	*Non-detect	1023	0.008	*Non-detect	8.02	1414	12.58	315	0.297	*Non-detect	19.46	0.03	
09-Sep-10	bdc4.0		224	0.002	0.52	*Non-detect	124.4	6.73	137	20.6	18.2	*Non-detect	1627	0.006	*Non-detect	14.31	326		496	0.117	*Non-detect	44.90	0.06	
09-Sep-10	bdc5.0		257	0.002	0.60	*Non-detect	112.8	6.22	159	17.8	16.4	*Non-detect	1854	0.003	*Non-detect	15.81	173		524	0.188	*Non-detect	58.90	0.09	
09-Sep-10	bdc5.0	Field Replicate	261	0.002	0.52	*Non-detect	119.2	6.07	158	21.9	20	*Non-detect	1859	0.003	*Non-detect	15.81	225			0.208	*Non-detect	58.85	0.087	
09-Sep-10	bdc6.0		246	0.002	0.44	*Non-detect	110	8.09	136	21.2	20.1	*Non-detect	1427	0.008	*Non-detect	10.58	548		429	0.197	*Non-detect	37.38	0.07	
14-Oct-10	bdc0.5		172				82	6.51	86.8	1.4	0.9		1042			7.88	250		273			16.66		
14-Oct-10	bdc1.0		181				115	9.07	145	25.2	22.2		1247			8.51	250		406			28.76		
14-Oct-10	bdc1.5		216				116	9.28	147	15.2	13.4		1447			8.59	1204		435			35.38		
14-Oct-10	bdc2.0		165				103	8.41	117.8	9.5	7.3		1106			7.67	1047	18.33	362			25.38		
14-Oct-10	bdc3.0		159				93	7.89	111.4	8.7	5.7		1131			7.97	687	29.05	310			18.93		
14-Oct-10	bdc4.0		173				98	7.74	111	7.7	6		1248			9.08	1204		365			29.10		
14-Oct-10	bdc5.0		185				108	7.55	127.6	13	10.1		1275			8.66	1120		394			30.22		
14-Oct-10	bdc6.0		206				133	7.26	117.8	19.2	12.1		1304			8.78	981		461			31.39		
04-Nov-10	bdc0.5		388				147	7.53	312.5	31.9	29.3		2503			8.72	68		610			59.07		
04-Nov-10	bdc1.0		229				119	8.46	270	11.6	9.9		1689			9.03	70		462			40.06		
04-Nov-10	bdc1.5		259				138	6.37	270.5	6.5	5.2		1769			9.39	366		526			44.06		
04-Nov-10	bdc2.0		245				126	6.53	226.5	4.5	3.8		1591			8.52	388	3.34	472			38.28		

Attachment 1. Big Dry Creek 2010
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Trip Start Date	Station ID	QA Sample Flag	ALK-ALINITY	ARSENIC, Tot. Rec.	BORON	CADMIUM, D	CALCIUM	TOC	CHLORIDE	CHLOROPHYLL A, COR.	CHLOROPHYLL A, UNCOR.	CHROMIUM, D	CONDUCTANCE, SPECIFIC	COPPER, D	CYANIDE	DO	E. coli	FLOW	Hardness	IRON, Tot. Rec.	LEAD, D	MAG-NESIUM	MAN-GANESE, D	MERCURY, Tot
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	µS/cm	mg/L	mg/L	mg/L	#/100mL	cfs	mg/L	mg/L	mg/L	mg/L	mg/L	
04-Nov-10	bdc3.0		159				100	7.32	144	3.9	3.2		1206			7.75	462	20.8	354			25.40		
04-Nov-10	bdc4.0		190				108	6.60	160	3.9	3.3		1035			9.78	489		399			31.52		
04-Nov-10	bdc5.0		206				124	6.17	164.75	3.9	1.4		1497			9.46	152		453			34.88		
04-Nov-10	bdc6.0		238				116	5.93	168.75	4.4	2.1		1554			9.71	276		445			37.71		
09-Dec-10	bdc0.5		161	*Non-detect	0.16	*Non-detect	84	3.81	80.5	4.3	2.7	*Non-detect	1110	0.010	*Non-detect	9.97	30		286	0.290	*Non-detect	18.43	0.24	
09-Dec-10	bdc1.0		185	*Non-detect	0.22	*Non-detect	99	4.56	99.7	4.3	0.5	*Non-detect	814	0.007	*Non-detect	10.46	46		364	0.314	*Non-detect	28.42	0.08	
09-Dec-10	bdc1.5		311	*Non-detect	0.38	*Non-detect	172	5.86	202	4.4	2.6	*Non-detect	2197	0.003	*Non-detect	9.38	76		654	0.262	*Non-detect	54.63	0.09	
09-Dec-10	bdc2.0		220	*Non-detect	0.35	*Non-detect	115	7.07	132	0.6	*Non-detect	*Non-detect	1535	0.007	*Non-detect	9.31	236	2.7	435	0.314	*Non-detect	35.80	0.04	
09-Dec-10	bdc2.0	Field Replicate															388							
09-Dec-10	bdc3.0		146	*Non-detect	0.35	*Non-detect	88	7.19	106	2.6	1.6	*Non-detect	1175	0.008	*Non-detect	8.32	366	17.74	318	0.289	*Non-detect	23.89	0.03	
09-Dec-10	bdc3.0	Field Replicate																						
09-Dec-10	bdc4.0		178	*Non-detect	0.38	*Non-detect	113	6.86	119	3.2	1.4	*Non-detect	1392	0.007	*Non-detect	10.17	215		408	0.376	*Non-detect	30.64	0.03	
09-Dec-10	bdc5.0		215	*Non-detect	0.40	*Non-detect	131	6.28	134	3.7	1.5	*Non-detect	1594	0.006	*Non-detect	9.91	192		481	0.475	*Non-detect	37.43	0.015	
09-Dec-10	bdc5.0	Field Replicate																		0.874				
09-Dec-10	bdc6.0		225	0.001	0.41	*Non-detect	124	6.11	125	5	3	*Non-detect	1528	0.007	*Non-detect	10.94	130		462	0.542	*Non-detect	36.99	0.02	

Note:

Metals monitored quarterly, except iron, selenium and mercury.

Trip Start Date	Station ID	Mercury Tot (ug/L)
03-Feb-10	bdc & 120th	0.00211
08-Apr-10	bdc & 120th	0.00229
05-May-10	bdc & 120th	0.00457
09-Jun-10	bdc & 120th	0.00404
09-Jul-10	bdc & 120th	0.00652
06-Aug-10	bdc & 120th	0.00504
01-Sep-10	bdc & 120th	0.00739
01-Oct-10	bdc & 120th	0.00162
10-Nov-10	bdc & 120th	0.00435
02-Dec-10	bdc & 120th	0.00212

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Trip Start Date	Station ID	QA Sample Flag	NH3, Ammonia	Unionized Ammonia	NICKEL, D	NITROGEN, NITRITE (NO2)	NO3+NO2	PH	Phosphorus	PHOSPHORUS, ORTHOPHOSPHATE AS P	POTASSIUM	SELENIUM, D	SILVER	SODIUM	TDS	SULFATE	TEMP.	TSS	TURBIDITY	ZINC, D
Units			mg/L	mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	NTU	mg/L
14-Jan-10	bdc1.5		*Non-detect	*Non-detect		0.02	2.56	7.06	*Non-detect	*Non-detect	4.05	0.015		380.1	1882	620.0	0.5	6.8	7.5	
14-Jan-10	bdc2.0		0.58	0.0014		0.18	8.20	7.34	0.19	0.07	7.50	0.010		282.8	1387	460.0	3.2	51	35.7	
14-Jan-10	bdc3.0		0.17	0.0009		0.10	8.17	7.45	0.79	0.50	11.01	0.005		156.4	845	279.0	10.8	16	9.6	
14-Jan-10	bdc4.0		0.57	0.0029		0.28	8.34	7.58	1.04	0.91	9.77	0.007		204.6	1058	373.0	5.7	20	14.4	
14-Jan-10	bdc5.0		0.75	0.0042		0.27	7.88	7.68	0.35	0.22	8.98	0.007		198.9	1055	381.0	4.1	30	21.5	
14-Jan-10	bdc6.0		0.09	0.0005		0.07	6.42	7.72	0.31	0.17	8.50	0.006		201.9	1069	391.0	3.0	52	35.8	
11-Feb-10	bdc1.5		*Non-detect	*Non-detect		0.02	2.13	7.15	0.07	*Non-detect	4.11	0.013		424.1	1889	602.5	0.3	44	26.1	
11-Feb-10	bdc2.0		0.09	0.0002		0.04	7.51	7.40	0.13	0.05	6.79	0.009		292.8	1391	456.0	2.8	36	22.6	
11-Feb-10	bdc3.0		0.86	0.0050		0.17	7.62	7.51	0.25	0.06	10.64	0.004		168.2	853	294.0	9.9	29	14.4	
11-Feb-10	bdc4.0		1.01	0.0049		0.22	7.68	7.58	0.22	0.13	9.38	0.006		224.5	1097	396.0	5.3	17	13.2	
11-Feb-10	bdc5.0		0.66	0.0040		0.27	7.54	7.73	0.19	0.08	9.07	0.006		219.5	1087	402.0	3.8	29	20.5	
11-Feb-10	bdc6.0		*Non-detect	*Non-detect		0.07	6.08	7.76	0.24	0.09	8.70	0.006		222.0	1131	432.0	2.9	68	44.4	
11-Mar-10	bdc0.5		0.05	0.0001	0.003	0.01	0.53	7.21	*Non-detect	*Non-detect	4.13	0.005	*Non-detect	386.2	1645	630.0	1.5	9.8	8.8	0.004
11-Mar-10	bdc1.0		0.07	0.0001	0.003	*Non-detect	0.31	7.18	*Non-detect	0.01	4.13	0.005	*Non-detect	359.9	1550	486.0	2.7	14	13.1	0.001
11-Mar-10	bdc1.5		*Non-detect	*Non-detect	0.003	0.01	1.21	7.32	0.06	*Non-detect	4.02	0.010	*Non-detect	355.4	1600	576.0	4.2	17	12.1	0.001
11-Mar-10	bdc2.0		0.09	0.0004	0.002	0.02	7.66	7.51	0.11	0.05	7.39	0.007	*Non-detect	246.7	1163	412.0	6.8	12	7.7	0.018
11-Mar-10	bdc3.0		0.07	0.0006	0.002	0.01	7.70	7.61	0.21	0.04	10.91	0.003	*Non-detect	146.2	824	292.0	11.7	14	7.6	0.047
11-Mar-10	bdc4.0		*Non-detect	*Non-detect	0.003	0.03	8.17	7.73	0.19	0.11	9.70	0.005	*Non-detect	197.2	995	384.0	8.6	11	6.1	0.035
11-Mar-10	bdc5.0		*Non-detect	*Non-detect	0.003	0.02	8.08	7.84	0.16	0.08	9.19	0.005	*Non-detect	200.5	1014	396.0	7.0	18	9.0	0.030
11-Mar-10	bdc6.0		*Non-detect	*Non-detect	0.003	0.04	7.44	7.86	0.23	0.15	8.76	0.005	*Non-detect	204.6	1047	414.0	5.8	29	15.1	0.028
08-Apr-10	bdc0.5		*Non-detect	*Non-detect		0.02	0.56	6.78	*Non-detect	*Non-detect	3.64	0.004		224.6	1026	356.0	3.8	9.6	8.8	
08-Apr-10	bdc1.0		0.05	0.0001		0.01	0.40	6.95	0.05	*Non-detect	3.78	0.005		227.8	1057	330.0	5.9	8	10.0	
08-Apr-10	bdc1.5		0.06	0.0001		0.01	0.52	7.10	0.07	*Non-detect	3.44	0.006		221.1	1020	308.0	6.9	19	15.3	
08-Apr-10	bdc2.0		0.09	0.0004		0.03	6.22	7.37	0.11	0.02	6.72	0.005		164.6	819	232.0	9.4	14	11.8	
08-Apr-10	bdc3.0		*Non-detect	*Non-detect		0.03	5.85	7.41	0.24	0.04	8.29	0.005		155.7	834	266.0	11.8	18	12.8	
08-Apr-10	bdc4.0		*Non-detect	*Non-detect		0.04	5.54	7.54	0.16	0.04	6.94	0.006		178.2	919	316.0	9.9	31	19.7	
08-Apr-10	bdc5.0		0.05	0.0004		0.02	5.53	7.61	0.2	0.06	7.02	0.006		185.4	933	324.0	10.1	56	34.8	
08-Apr-10	bdc6.0		*Non-detect	*Non-detect		0.02	4.90	7.68	0.27	0.09	6.73	0.006		191.1	965	334.0	9.7	86	52.0	
13-May-10	bdc0.5		*Non-detect	*Non-detect		0.01	0.86	7.23	0.06	0.01	4.72	0.003		161.8	792	250.0	6.2	4.4	6.7	
13-May-10	bdc1.0		0.11	0.0006		0.02	0.69	7.57	0.09	0.01	3.92	0.003		104.4	563	156.0	7.2	24	19.7	
13-May-10	bdc1.5		0.09	0.0006		0.02	0.79	7.65	0.14	0.02	3.95	0.003		124.9	654	190.8	7.5	66	34.1	
13-May-10	bdc2.0		0.11	0.0010		0.02	3.34	7.72	0.16	0.03	5.21	0.003		110.0	612	186.2	9.2	32	21.2	
13-May-10	bdc3.0		0.12	0.0013		0.02	2.86	7.76	0.22	0.07	5.78	0.004		125.4	696	238.0	10.5	34	21.1	
13-May-10	bdc4.0		0.10	0.0017		0.02	2.22	7.98	0.27	0.10	4.97	0.004		127.2	703	252.0	9.7	100	50.5	
13-May-10	bdc5.0		0.09	0.0015		0.02	2.60	7.97	0.37	0.16	5.15	0.004		127.2	717	254.0	9.7	160	85.1	
13-May-10	bdc6.0		0.12	0.0020		0.02	2.97	7.98	0.55	0.23	5.40	0.004		127.2	714	254.0	9.8	240	124.3	
10-Jun-10	bdc0.5		*Non-detect	*Non-detect	*Non-detect	*Non-detect	0.10	7.59	*Non-detect	*Non-detect	2.40	*Non-detect	*Non-detect	22.6	194	58.9	13.0	9.6	6.6	0.002
10-Jun-10	bdc1.0		*Non-detect	*Non-detect	*Non-detect	0.01	0.15	7.89	*Non-detect	0.01	2.45	*Non-detect	*Non-detect	35.2	261	81.3	14.3	19	13.3	0.001
10-Jun-10	bdc1.5		*Non-detect	*Non-detect	*Non-detect	0.01	0.29	7.90	0.06	0.01	2.54	0.002	*Non-detect	45.1	307	103.0	15.4	29	18.9	0.001
10-Jun-10	bdc2.0		0.06	0.0013	0.001	0.01	3.54	7.85	0.12	0.06	4.46	0.002	*Non-detect	64.8	394	133.0	17.7	28	19.6	0.006
10-Jun-10	bdc2.0	Field Replicate																		
10-Jun-10	bdc3.0		0.05	0.0013	0.002	0.02	4.01	7.95	0.42	0.35	7.40	0.003	*Non-detect	116.6	676	259.0	20.1	8.6	6.6	0.020

Attachment 1. Big Dry Creek 2010
Instream Data

Trip Start Date	Station ID	QA Sample Flag	NH3, Ammonia	Unionized Ammonia	NICKEL, D	NITROGEN, NITRITE (NO2)	NO3+NO2	PH	Phosphorus	PHOSPHORUS, ORTHOPHOSPHATE AS P	POTASSIUM	SELENIUM, D	SILVER	SODIUM	TDS	SULFATE	TEMP.	TSS	TURBIDITY	ZINC, D
Units			mg/L	mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	NTU	mg/L
10-Jun-10	bdc3.0	Field Replicate	*Non-detect																	
10-Jun-10	bdc4.0		0.06	0.0059	0.002	0.04	4.29	8.37	0.34	0.31	6.70	0.005	*Non-detect	149.9	853	368.0	22.7	6	5.3	0.010
10-Jun-10	bdc5.0		*Non-detect	*Non-detect	0.003	0.04	3.95	8.62	0.24	0.21	6.63	0.006	*Non-detect	163.4	936	397.0	25.3	6	4.4	0.014
10-Jun-10	bdc5.0	Field Replicate																		
10-Jun-10	bdc6.0		*Non-detect	*Non-detect	0.003	0.08	2.16	8.56	0.32	0.25	4.98	0.003	*Non-detect	115.0	664	274.0	23.3	25	17.4	0.009
08-Jul-10	bdc0.5		*Non-detect	*Non-detect		0.01	0.32	7.43	0.05	0.03	3.10	*Non-detect		38.6	249	73.1	3.5	6.6	8.2	
08-Jul-10	bdc1.0		0.15	0.0012		0.02	0.33	7.46	0.16	0.06	4.08	0.002		57.3	335	107.0	15.9	56	62.0	
08-Jul-10	bdc1.5		0.17	0.0020		0.02	0.42	7.62	0.18	0.06	4.03	0.002		64.1	390	117.0	16.2	73	81.0	
08-Jul-10	bdc2.0		0.19	0.0032		0.02	1.17	7.75	0.19	0.07	4.53	0.002		69.7	419	132.0	16.7	79	82.0	
08-Jul-10	bdc3.0		0.14	0.0028		0.02	2.76	7.80	0.59	0.44	5.89	0.003		91.4	541	170.0	17.5	73	64.0	
08-Jul-10	bdc4.0		0.14	0.0037		0.02	1.28	7.95	0.44	0.18	4.80	0.003		83.1	507	130.0	17.0	220	186.0	
08-Jul-10	bdc5.0		0.13	0.0043		0.02	1.00	8.04	0.73	0.16	4.47	0.002		71.4	437	125.0	17.1	460	395.0	
08-Jul-10	bdc6.0		0.19	0.0047		0.04	2.37	7.91	1.06	0.24	5.73	0.003		105.6	596	215.0	17.1	700	438.0	
12-Aug-10	bdc0.5		0.05	0.0004		0.01	0.18	7.55	0.08	0.03	2.49	*Non-detect		21.5	186	70.7	14.3	18	14.2	
12-Aug-10	bdc1.0		0.05	0.0006		*Non-detect	0.20	7.61	0.09	0.02	2.51	*Non-detect		29.1	224	98.9	15.5	55	28.2	
12-Aug-10	bdc1.5		*Non-detect	*Non-detect		*Non-detect	0.31	7.62	0.15	0.03	2.60	0.001		34.5	247	103.0	16.0	66	38.9	
12-Aug-10	bdc2.0		0.06	0.0012		*Non-detect	1.25	7.81	0.12	0.03	3.46	0.001		42.8	302	109.0	17.1	71	45.3	
12-Aug-10	bdc3.0		0.10	0.0019		0.02	2.74	7.70	0.19	0.10	6.33	0.003		93.1	557	204.0	20.2	38	23.4	
12-Aug-10	bdc4.0		0.07	0.0021		0.02	2.83	7.89	0.23	0.13	5.56	0.005		129.3	732	320.0	20.7	40	24.9	
12-Aug-10	bdc5.0		0.09	0.0033		0.05	3.08	7.95	0.3	0.17	6.82	0.004		144.6	797	317.0	21.4	49	37.1	
12-Aug-10	bdc6.0		0.46	0.0199		0.28	3.47	8.01	0.82	0.45	7.38	0.003		108.1	639	219.0	21.9	160	103.0	
09-Sep-10	bdc0.5		*Non-detect	*Non-detect	*Non-detect	0.01	*Non-detect	7.73	0.1	0.01	2.30	*Non-detect	*Non-detect	19.0	186	48.7	16.3	13	10.2	0.002
09-Sep-10	bdc1.0		*Non-detect	*Non-detect	*Non-detect	0.01	0.10	7.68	0.13	0.02	2.41	*Non-detect	*Non-detect	27.5	230	75.5	14.8	32	22.4	*Non-detect
09-Sep-10	bdc1.5		*Non-detect	*Non-detect	*Non-detect	*Non-detect	0.22	7.74	0.21	0.02	2.45	0.001	*Non-detect	35.9	264	85.5	15.6	34	24.0	0.001
09-Sep-10	bdc2.0		0.05	0.0016	0.001	0.01	2.65	8.04	0.15	0.03	4.53	0.002	*Non-detect	51.6	334	107.5	17.0	34	22.3	0.008
09-Sep-10	bdc3.0		0.11	0.0382	0.001	0.02	4.61	9.11	0.16	0.07	8.89	0.003	*Non-detect	133.2	763	290.0	21.0	10	6.3	0.024
09-Sep-10	bdc4.0		0.06	0.0030	0.003	0.04	1.66	8.10	0.15	0.04	6.63	0.008	*Non-detect	215.8	1168	542.0	21.3	6.2	3.5	0.006
09-Sep-10	bdc5.0		*Non-detect	0.0030	0.004	0.04	0.71	8.22	0.08	0.01	4.89	0.007	*Non-detect	261.2	1336	634.0	22.4	10	4.3	0.003
09-Sep-10	bdc5.0	Field Replicate	0.06		0.004	0.04	0.72	8.22	0.16	0.01	4.99	0.007	*Non-detect	264.1	1330	628.0	22.4	14	4.8	0.003
09-Sep-10	bdc6.0		0.29	0.0292	0.003	0.22	3.24	8.47	0.82	0.64	10.26	0.003	*Non-detect	178.3	964	370.0	19.8	11	5.0	0.006
14-Oct-10	bdc0.5		*Non-detect	*Non-detect		*Non-detect	0.26	7.68	0.07	*Non-detect	4.32	0.002		134.5	681	281.0	7.7	*Non-detect	4.1	
14-Oct-10	bdc1.0		*Non-detect	*Non-detect		*Non-detect	0.44	7.93	0.14	0.01	5.19	0.004		139.7	847	322.0	9.4	18	17.5	
14-Oct-10	bdc1.5		*Non-detect	*Non-detect		0.01	1.18	7.89	0.12	0.01	5.30	0.008		167.5	999	388.0	10.4	18	16.7	
14-Oct-10	bdc2.0		0.07	0.0011		0.02	4.39	7.81	0.15	0.04	8.02	0.005		123.7	749	284.0	13.6	18	15.9	
14-Oct-10	bdc3.0		0.07	0.0012		0.02	4.93	7.76	0.79	0.60	9.57	0.004		126.5	763	284.0	16.5	35	31.3	
14-Oct-10	bdc4.0		0.09	0.0037		0.04	5.09	8.22	0.6	0.44	8.83	0.005		146.0	837	330.0	14.8	36	34.1	
14-Oct-10	bdc5.0		0.07	0.0027		0.02	4.73	8.21	0.7	0.31	8.41	0.005		149.6	870	376.0	14.3	64	55.6	
14-Oct-10	bdc6.0		0.11	0.0029		0.06	3.82	8.07	0.56	0.48	8.33	0.005		152.2	886	340.0	13.3	98	86.6	
04-Nov-10	bdc0.5		*Non-detect	*Non-detect		*Non-detect	0.08	7.29	0.07	*Non-detect	5.21	0.004		357.5	1693	965.0	4.4	17	5.5	
04-Nov-10	bdc1.0		0.06	0.0007		*Non-detect	0.15	7.95	0.09	*Non-detect	4.98	0.003		191.8	1050	532.5	6.4	18	14.8	
04-Nov-10	bdc1.5		*Non-detect	*Non-detect		0.01	1.05	7.93	0.08	*Non-detect	4.18	0.008		199.2	1148	815.0	7.1	10	8.9	
04-Nov-10	bdc2.0		0.08	0.0009		0.03	3.22	7.82	0.12	0.03	6.64	0.007		181.3	1017	710.0	9.7	22	16.8	

Attachment 1. Big Dry Creek 2010
Instream Data

Trip Start Date	Station ID	QA Sample Flag	NH3, Ammonia	Unionized Ammonia	NICKEL, D	NITROGEN, NITRITE (NO2)	NO3+NO2	PH	Phosphorus	PHOSPHORUS, ORTHOPHOSPHATE AS P	POTASSIUM	SELENIUM, D	SILVER	SODIUM	TDS	SULFATE	TEMP.	TSS	TURBIDITY	ZINC, D
Units			mg/L	mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	NTU	mg/L
04-Nov-10	bdc3.0		0.11	0.0013		0.03	6.60	7.63	1.56	1.49	10.93	0.004		134.3	740	400.0	16.2	21	11.5	
04-Nov-10	bdc4.0		*Non-detect	*Non-detect		0.03	6.20	8.20	1.26	1.27	8.86	0.005		161.8	904	507.5	11.2	14	10.9	
04-Nov-10	bdc5.0		*Non-detect	*Non-detect		0.03	4.94	8.28	0.76	0.68	7.81	0.006		173.6	967	550.0	9.9	19	12.8	
04-Nov-10	bdc6.0		0.05	0.0015		0.03	4.09	8.26	0.58	0.50	7.75	0.005		182.0	1014	560.0	9.1	22	15.6	
09-Dec-10	bdc0.5		*Non-detect	*Non-detect	0.001	*Non-detect	0.33	7.88	*Non-detect	*Non-detect	3.17	0.002	*Non-detect	138.3	720	288.0	1.4	3.4	6.9	0.003
09-Dec-10	bdc1.0		0.06	0.0009	0.001	0.01	0.62	8.16	0.06	*Non-detect	3.35	0.004	*Non-detect	145.2	777	302.0	1.9	7.6	7.4	0.002
09-Dec-10	bdc1.5		0.13	0.0020	0.002	0.01	1.57	8.14	0.07	*Non-detect	3.89	0.010	*Non-detect	280.9	1521	590.0	3.8	9.6	10.2	0.004
09-Dec-10	bdc2.0		0.17	0.0024	0.002	0.06	6.20	7.99	0.1	0.03	8.26	0.007	*Non-detect	183.0	1024	352.0	7.3	8.6	8.6	0.021
09-Dec-10	bdc2.0	Field Replicate																		
09-Dec-10	bdc3.0		0.17	0.0016	0.001	0.03	7.81	7.58	0.64	0.50	11.47	0.004	*Non-detect	135.8	769	247.0	14.3	13	7.4	0.043
09-Dec-10	bdc3.0	Field Replicate	0.17				8.05													
09-Dec-10	bdc4.0		0.14	0.0061	0.002	0.05	7.94	8.40	0.76	0.71	10.43	0.006	*Non-detect	165.1	933	335.0	9.8	18	15.2	0.033
09-Dec-10	bdc5.0		0.09	0.0033	0.002	0.05	5.91	8.38	0.35	0.23	8.46	0.007	*Non-detect	186.0	1057	400.0	8.0	28	21.3	0.024
09-Dec-10	bdc5.0	Field Replicate																		
09-Dec-10	bdc6.0		0.07	0.0022	0.002	0.02	4.97	8.35	0.26	0.14	8.41	0.006	*Non-detect	178.4	1024	372.0	6.9	37	30.8	0.025

Note:

Metals monitored quarterly,
except iron, selenium and mercury.

Attachment 2. 2010 Big Dry Creek WWTP Grab Samples

Trip Start Date	Station ID	ALK-ALINITY	ARSENIC, Tot. Rec.	BORON	CADMIUM, D	CALCIUM	TOC	CHLORIDE	CHLOROPHYLL A, COR.	CHLOROPHYLL A, UNCOR.	CHROMIUM, D	CONDUCTANCE, SPECIFIC	COPPER, D	CYANIDE	DO	E. coli	Hardness	IRON, Tot. Rec.	LEAD, D	MAG-NESIUM
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	µS/cm	mg/L	mg/L	mg/L	#/100mL	mg/L	mg/L	mg/L	mg/L
bdc10.0	14-Jan-10	52				48.0	11.7	115	0.6	*Non-detect		882			8.1	24	176			13.6
bdc10.0	11-Feb-10	87				53.0	10.8	106	0.4	*Non-detect		835			9.6	30	178			11.1
bdc10.0	11-Mar-10	missing lab sheet	*Non-detect	0.28	*Non-detect	52.0	10.6	86.2	1	*Non-detect	*Non-detect	760	0.017	*Non-detect	9.1	11	178	0.2149	*Non-detect	11.8
bdc10.0	08-Apr-10	105				93.0	9.3	106	0.8	0.5		1186			7.7	15	309			18.6
bdc10.0	13-May-10	132				82.0	9.1	96.7	0.5	0.2		1049			7.2	9	312			26.0
bdc10.0	10-Jun-10	110	*Non-detect	0.37	*Non-detect	62.4	8.7	91.5	0.9	0.2	*Non-detect	968	0.010	*Non-detect	6.3	2	224	0.1366	*Non-detect	16.5
bdc10.0	08-Jul-10	122				76.0	9.3	86.9	0.8	0.7		935			7.2	7	278			21.5
bdc10.0	12-Aug-10	111				64.0	9.1	85.9	0.8	0.7		869			6.2	15	232			17.5
bdc10.0	09-Sep-10	97	*Non-detect	0.28	*Non-detect	55.6	7.8	88.2	0.7	0.5	*Non-detect	790	0.007	*Non-detect	6.1	33	191	0.1643	*Non-detect	12.6
bdc10.0	14-Oct-10	103				64.0	8.8	82.9	1.3	0.7		732			6.4	7	206			11.3
bdc10.0	04-Nov-10	100				48.0	8.8	82.9	1.2	0.8		705			6.9	11	159			9.6
bdc10.0	09-Dec-10	84	*Non-detect	0.26	*Non-detect	43.0	9.7	63.4	0.1	*Non-detect	*Non-detect	645	0.007	*Non-detect	7.0	11	148	0.2229	*Non-detect	9.8
bdc11.0	10-Jan-10																			
bdc11.0	11-Jan-10															33.6				
bdc11.0	12-Jan-10															37.2				
bdc11.0	13-Jan-10															28.5				
bdc11.0	**14-Jan-10**	115				84.0	9.1	118	2	1.8		1033			9.5	20	281			17.3
bdc11.0	07-Feb-10																			
bdc11.0	08-Feb-10															24				
bdc11.0	09-Feb-10															14.6				
bdc11.0	10-Feb-10															51.2				
bdc11.0	**11-Feb-10**	121				84.0	8.5	122	1.3	0.8		1037			9.4	13	268			14.1
bdc11.0	**11-Mar-10**	missing lab sheet	*Non-detect	0.36	*Non-detect	92.0	8.9	111	2.4	1	*Non-detect	1022	0.016	*Non-detect	11.0	3	290	0.1387	*Non-detect	14.7
bdc11.0	**08-Apr-10**	135				112.0	8.2	120	1.5	0.5		1279			8.1	35	354			18.0
bdc11.0	**13-May-10**	157				96.0	8.3	119	1.5	0.9		1146			7.1	30	344			25.2
bdc11.0	**10-Jun-10**	152	*Non-detect	0.37	*Non-detect	86.0	6.9	120	1.2	0.7	*Non-detect	1127	0.010	*Non-detect	6.5	8	285	0.0603	*Non-detect	17.1
bdc11.0	05-Jul-10																			
bdc11.0	06-Jul-10																			
bdc11.0	07-Jul-10																			
bdc11.0	**08-Jul-10**	148				96.0	7.5	114	1.5	1.4		1088			7.5	5	337			23.7
bdc11.0	12-Aug-10	152				86.0	7.4	113	1.7	1.5		1075			5.9	22	302			21.1
bdc11.0	**09-Sep-10**	143	*Non-detect	0.3	*Non-detect	88.0	7.2	117	1.5	1.1	*Non-detect	965	0.008	*Non-detect	6.1	11	279	0.0614	*Non-detect	14.4
bdc11.0	12-Oct-10																			
bdc11.0	13-Oct-10																			
bdc11.0	**14-Oct-10**	126				88.0	7.3	104	1.2	0.8		930			6.5	15	273			13.0
bdc11.0	15-Oct-10																			
bdc11.0	**04-Nov-10**	114				75.0	7.5	112	1.8	*Non-detect		964			6.3	15	240			12.7
bdc11.0	07-Dec-10																			
bdc11.0	08-Dec-10																			
bdc11.0	**09-Dec-10**	103	*Non-detect	0.31	*Non-detect	70.0	7.6	98.5	0.4	0.3	*Non-detect	918	0.009	*Non-detect	7.1	7	239	*Non-detect	*Non-detect	15.6

Attachment 2. 2010 Big Dry Creek WWTP Grab Samples

Trip Start Date	Station ID	MANGANESE, D	NH3	NICKEL, D	NITROGEN, NITRITE (NO2)	NO3+NO2	Phosphorus	PHOSPHORUS, ORTHOPHOSPHATE AS P	POTASSIUM	SELENIUM, D	SILVER	SODIUM	TDS	SULFATE	TEMP.	TSS	TURBIDITY	ZINC, D
Units		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	NTU	mg/L
bdc10.0	14-Jan-10		0.13		0.18	21.80	0.27	0.03	15.7	0.0020		102.9	557	104.0	14.0	4.0	2.8	
bdc10.0	11-Feb-10		*Non-detect		0.03	19.00	0.22	0.02	14.8	0.0010		95.7	510	101.0	13.2	5.8	3.1	
bdc10.0	11-Mar-10	0.009		0.002	0.01	18.90	0.24	0.02	14.5	0.0020	*Non-detect	91.7	500	117.0	13.7		2.8	0.045
bdc10.0	08-Apr-10				0.04	15.60	0.18	0.01	13.0	0.0040		125.9	694	198.0	13.7		3.5	
bdc10.0	13-May-10				0.02	12.40	0.15	0.02	11.5	0.0050		121.4	721	237.0	14.4		2.1	
bdc10.0	10-Jun-10	0.009		0.002	0.01	15.40	0.28	0.18	12.3	0.0020	*Non-detect	109.9	623	191.0	19.1		1.1	0.030
bdc10.0	08-Jul-10				0.01	9.56	0.23	0.12	12.0	0.0300		115.0	623	186.0	19.3		2.0	
bdc10.0	12-Aug-10				0.02	11.40	0.17	0.05	13.4	0.0030		101.6	553	161.0	21.8		1.0	
bdc10.0	09-Sep-10	0.005		0.002	0.02	11.40	0.17	0.06	14.2	0.0020	*Non-detect	93.4	522	143.0	21.6		1.0	0.036
bdc10.0	14-Oct-10				0.01	9.00	0.19	0.05	13.8	0.0020		85.9	464	129.0	19.4		3.5	
bdc10.0	04-Nov-10				0.02	7.70	0.13	0.02	14.5	0.0017		77.4	410	123.0	17.5		1.4	
bdc10.0	09-Dec-10	0.007		0.002	0.03	10.20	0.17	0.02	15.1	0.0016	*Non-detect	71.9	416	78.2	16.4		2.1	0.047
bdc11.0	10-Jan-10		0.25															
bdc11.0	11-Jan-10		0.22															
bdc11.0	12-Jan-10		0.52													7.4		
bdc11.0	13-Jan-10															8.0		
bdc11.0	**14-Jan-10**		0.09		0.06	7.56	1.01	0.59	12.1	0.0020		117.5	647	191.0	13.6	8.2	5.3	
bdc11.0	07-Feb-10		0.68															
bdc11.0	08-Feb-10		0.83															
bdc11.0	09-Feb-10		1.50													5.6		
bdc11.0	10-Feb-10															5.4		
bdc11.0	**11-Feb-10**		0.98		0.21	6.68	0.29	0.06	12.2	0.0020		118.5	634	208.0	12.0	5.2	3.2	
bdc11.0	**11-Mar-10**	0.020	0.08	0.002	0.01	8.06	0.25	0.03	12.8	0.0010	*Non-detect	119.5	658	217.0	12.6	4.6	4.1	0.050
bdc11.0	**08-Apr-10**		0.55		0.01	5.16	0.47	0.06	10.6	0.0030		133.6	749	249.0	13.8	7.3	6.8	
bdc11.0	**13-May-10**		0.08		0.01	5.50	0.49	0.25	10.5	0.0030		130.0	786	264.0	14.5	7.9	3.2	
bdc11.0	**10-Jun-10**	0.010	0.06	0.001	0.01	5.42	0.83	0.73	11.5	0.0020	*Non-detect	123.6	725	248.0	19.1	3.3	1.3	0.040
bdc11.0	05-Jul-10		0.19															
bdc11.0	06-Jul-10		0.10															
bdc11.0	07-Jul-10		0.12															
bdc11.0	**08-Jul-10**				0.02	9.35	2.11	1.71	11.8	0.0020		128.0	718	237.0	19.1	4.0	2.1	
bdc11.0	12-Aug-10		0.31		0.03	5.22	0.26	0.09	11.0	0.0013		116.5	698	233.0	21.1	5.0	1.7	
bdc11.0	**09-Sep-10**	0.005	0.08	0.001	0.01	5.90	0.19	0.07	12.1	0.0008	*Non-detect	110.1	635	201.0	21.4	2.6	1.3	0.038
bdc11.0	12-Oct-10															4.9		
bdc11.0	13-Oct-10		0.11															
bdc11.0	**14-Oct-10**				0.02	6.25	2.02	1.08	12.2	0.0020		103.3	604	193.0	19.9		2.6	
bdc11.0	15-Oct-10		0.17													4.2		
bdc11.0	**04-Nov-10**		0.12		0.02	7.66	2.43	1.71	12.8	0.0017		98.7	555	216.0	17.3	11.0	2.6	
bdc11.0	07-Dec-10															8.2		
bdc11.0	08-Dec-10															9.6		
bdc11.0	**09-Dec-10**	0.006	0.09	0.001	0.02	8.90	0.78	0.57	13.0	0.0016	*Non-detect	97.0	576	164.0	16.1		2.6	0.054

Attachment 3 Big Dry Creek 2010
Quality Assurance Data

Trip Start Date	Station ID	Sample Type	ALK-ALINITY	ARSENIC, Tot. Rec.	BORON	CADMIUM, D	CALCIUM	TOC	CHLORIDE	CHLOROPHYLL A, COR.	CHLOROPHYLL A, UNCOR.	CHROMIUM, D	CONDUCTANCE, SPECIFIC	COPPER, D	CYANIDE	DO	E. coli	IRON, Tot. Rec.	LEAD, D	MAG-NESIUM	MAN-GANESE, D	NH3, Ammonia
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	µS/cm	mg/L	mg/L	mg/L	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L
10-Jun-10	bdc2.0																462					
10-Jun-10	bdc2.0	Field Replicate															1554					
Relative % Difference																	**108%**					
10-Jun-10	bdc3.0																					0.05
10-Jun-10	bdc3.0	Field Replicate																				0.05
Relative % Difference																						**0%**
10-Jun-10	bdc5.0																	0.178				
10-Jun-10	bdc5.0	Field Replicate																0.183				
Relative % Difference																		**3%**				
09-Sep-10	bdc5.0		257	0.002	0.60	*Non-detect	112.8	6.22	159	17.8	16.4	*Non-detect	1854	0.003	*Non-detect	15.81	173	0.188	*Non-detect	58.90	0.09	0.05
09-Sep-10	bdc5.0	Field Replicate	261	0.002	0.52	*Non-detect	119.2	6.07	158	21.9	20	*Non-detect	1859	0.003	*Non-detect	15.81	225	0.208	*Non-detect	58.85	0.087	0.06
Relative % Difference			**2%**	**0%**	**14%**	**0%**	**6%**	**2%**	**1%**	**21%**	**20%**	**0%**	**0%**	**0%**	**0%**	**0%**	**26%**	**10%**	**0%**	**0%**	**3%**	**18%**
09-Dec-10	bdc2.0																236					
09-Dec-10	bdc2.0	Field Replicate															388					
Relative % Difference																	**49%**					
09-Dec-10	bdc3.0																					0.17
09-Dec-10	bdc3.0	Field Replicate																				0.17
Relative % Difference																						**0%**
09-Dec-10	bdc5.0																	0.475				
09-Dec-10	bdc5.0	Field Replicate																0.874				
Relative % Difference																		**59%**				

Note: Two NH3 values below detection limit were replaced with detection limit for purposes of calculations, as highlighted in yellow.

Average RPD			**2%**	**0%**	**14%**	**0%**	**6%**	**2%**	**1%**	**21%**	**20%**	**0%**	**0%**	**0%**	**0%**	**0%**	**61%**	**24%**	**0%**	**0%**	**3%**	**6%**

Trip Start Date	Station ID	Sample Type	ALK-ALINITY	ARSENIC, Tot. Rec.	BORON	CADMIUM, D	CALCIUM	TOC	CHLORIDE	CHLOROPHYLL A, COR.	CHLOROPHYLL A, UNCOR.	CHROMIUM, D	CONDUCTANCE, SPECIFIC	COPPER, D	CYANIDE	DO	E. coli	IRON, Tot. Rec.	LEAD, D	MAG-NESIUM	MAN-GANESE, D	NH3, Ammonia
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	ug/L	mg/L	µS/cm-1	mg/L	mg/L	mg/L	#/100mL	mg/L	mg/L	mg/L	mg/L	mg/L
11-Mar-10	Trip Blank	Trip Blank	missing lab sheet	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	1	*Non-detect	*Non-detect	7.07	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect

Attachment 3 Big Dry Creek 2010
Quality Assurance Data

Trip Start Date	Station ID	Sample Type	NICKEL, D	NITROGEN, NITRITE (NO2)	NO3+NO2	PH	Phosphorus	PHOSPHORUS, ORTHOPHOSPHATE AS P	POTASSIUM	SELENIUM, D	SILVER	SODIUM	TDS	SULFATE	TEMP.	TSS	TURBIDITY	ZINC, D
Units			mg/L	mg/L	mg/L	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	NTU	mg/L
10-Jun-10	bdc2.0																	
10-Jun-10	bdc2.0	Field Replicate																
Relative % Difference																		
10-Jun-10	bdc3.0																	
10-Jun-10	bdc3.0	Field Replicate																
Relative % Difference																		
10-Jun-10	bdc5.0																	
10-Jun-10	bdc5.0	Field Replicate																
Relative % Difference																		
09-Sep-10	bdc5.0		0.004	0.04	0.71	8.22	0.08	0.01	4.89	0.007	*Non-detect	261.2	1336	634.0	22.4	10	4.3	0.003
09-Sep-10	bdc5.0	Field Replicate	0.004	0.04	0.72	8.22	0.16	0.01	4.99	0.007	*Non-detect	264.1	1330	628.0	22.4	14	4.8	0.003
Relative % Difference			**0%**	**2%**	**1%**	**0%**	**67%**	**2%**	**2%**	**0%**	**0%**	**1%**	**0%**	**1%**	**0%**	**33%**	**13%**	**0%**
09-Dec-10	bdc2.0																	
09-Dec-10	bdc2.0	Field Replicate																
Relative % Difference																		
09-Dec-10	bdc3.0				7.81													
09-Dec-10	bdc3.0	Field Replicate			8.05													
Relative % Difference					**3%**													
09-Dec-10	bdc5.0																	
09-Dec-10	bdc5.0	Field Replicate																
Relative % Difference																		
Average RPD			**0%**	**2%**	**2%**	**0%**	**67%**	**2%**	**2%**	**0%**	**0%**	**1%**	**0%**	**1%**	**0%**	**33%**	**13%**	**0%**

Trip Start Date	Station ID	Sample Type	NICKEL, D	NITROGEN, NITRITE (NO2)	NO3+NO2	PH	Phosphorus	PHOSPHORUS, ORTHOPHOSPHATE AS P	POTASSIUM	SELENIUM, D	SILVER	SODIUM	TDS	SULFATE	TEMP.	TSS	TURBIDITY	ZINC, D
Units			mg/L	mg/L	mg/L	SU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	°C	mg/L	NTU	mg/L
11-Mar-10	Trip Blank	Trip Blank	*Non-detect	*Non-detect	*Non-detect	8.72	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	*Non-detect	17.9	*Non-detect	0.09	*Non-detect