Bacteria Contamination of Surface Waters Due to Livestock Grazing in the Stanislaus National Forest, California

(Seventh Year of Study)

Summary of 2015 Results

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Surface waters were tested for pathogenic bacteria indicators (i.e., *E. coli*, fecal coliform bacteria, and total coliform bacteria) for the seventh consecutive year within commercial cattle grazing allotments in the Stanislaus National Forest. The sample sites from the first three years of sampling, 2009 through 2011, focused on comparative sampling done at a specific site before cattle presence and then at the same site after the arrival of cattle. The results showed that individual and average concentrations of fecal coliform bacteria in surface waters were consistently below regulatory thresholds at all sites before cattle presence or where no livestock grazed during the season. Shortly after cattle were released into the national forest to graze in allotments, fecal coliform concentrations were much higher, and in places exceeded state standards. *E. coli* and total coliform concentrations followed the same pattern. Reports at the end of study field seasons in 2009 and again in 2010 focused on documenting the violations of state standards for fecal coliform concentrations in recreational contact waters. The 2011 report highlighted the difference in *E. coli* and fecal coliform concentrations detected in waters when cattle were not present compared to the *E. coli* and fecal coliform concentrations detected when cattle were present in the Stanislaus National Forest. The report for 2012 and 2013 discusses results from sampling that specifically focused on water quality in streams within grazed areas in national forest roadless areas and wilderness areas. The potential is high in those areas for back-country recreational users to drink the contaminated stream water.

Water samples were collected from six sites in four grazing allotments in 2014. The winter of 2013/2014 was by far the driest winter since this study commenced in the summer of 2009. The results from 2014 were more variable than other years of this study. The results from 2009-2013 consistently showed that there were low levels of fecal coliform found in creeks before cattle arrived. After cattle presence, the concentration of fecal coliform would rise and remain elevated until cattle left the area. In 2014 some sample sites had extremely high levels of fecal coliform while cattle were present, while the fecal coliform levels at other sites remained relatively low throughout the summer. The trend from the last six years is that the overall highest levels of fecal contamination have been found during the wetter years and lower levels of fecal contamination are found during the drier years.

In 2015, water samples were collected from five sites in five grazing allotments. The winter of 2014/2015 was even dryer than the previous winter with less accumulated snowpack according to the CA Department of Water Resources at (http://www.water.ca.gov/waterconditions/waterconditions.cfm). Due to the extended drought and minimal snowpack, many creeks went dry that normally have good flow all yearlong. Since there were fewer water sources available, the cattle appeared to spend more time near the remaining larger volume creeks that still had relatively good flow. As the cattle spent more time near the creeks with water, the level of fecal contamination was correspondingly high.

Field Site Selection for 2015

Four sites that were exposed to commercial livestock grazing during the summer of 2015 and one site that was not exposed to grazing were sampled within the Stanislaus NF. One of these sites has also been sampled in 2009 and 2010, another site was also sampled in 2014, and the ungrazed site had only "after" samples collected in 2010 and 2011. These sites are described below, and Table 1 provides location (i.e., latitude, longitude) coordinates for each site, using datum NAD 83.

Anderson Valley (AV)
Sample site: 1,024 meters (3,360 feet) elevation
Samples were collected from the Bull Creek in the Anderson Valley area (within the Bull Creek Range Allotment) in the Groveland Ranger District. Bull Creek is within the Merced River watershed and flows into the Merced River via the North Fork Merced. No "before livestock" samples were collected. Eight "after livestock arrival" samples were collected between May 11 and June 15, 2015.

Hunter Creek (HC)
Sample site: 938 meters (3,077 feet) elevation
Samples were collected from Hunter Creek (within the Hunter Creek Range Allotment). Hunter Creek is within the Tuolumne River watershed and flows into the Tuolumne River via the North Fork Tuolumne. No "before livestock" samples were collected. Eight "after livestock arrival" samples were collected between July 16 and August 4, 2015.

Rose Creek – sample site: 1,145 meters (3,756 feet) elevation
Samples were collected from Rose Creek in an area accessed by Forest Service Road 3N59Y, which spurs off road 4N16 (which is within the Rushing Range Allotment). Rose Creek is entirely within the Stanislaus River watershed and flows into the Lower Middle Fork of the Stanislaus River. Six "before livestock" water samples were collected between April 23, 2015 and April 28, 2015. Twelve "after livestock arrival" water samples were collected between May 4, 2015 and August 9, 2015. Samples were also collected from Rose Creek in 2009 and 2010.

Bell Creek (BC) – sample site: 1,991 meters (6,532 feet) elevation
Samples were collected from Bell Creek, where it flows through Middle Bell Meadow (within the Bell Meadow/Bear Lake Range Allotment). Bell Creek is within the

Tuolumne River watershed and flows into the Tuolumne River via the Clavey River. Three "before livestock" samples were collected between May 4 and July 17, 2015. Twelve "after livestock arrival" samples were collected between August 5 and September 14, 2015. Samples were also collected from Bell Creek in 2014.

Bull Meadow Creek (BM) – sample site: 1,145 meters (3,757 feet) elevation
The samples were collected from Bull Meadow Creek a short distance below Bull Meadow (which is within the Jawbone Range Allotment). Bull Meadow Creek is entirely within the Tuolumne River watershed and flows into the Tuolumne River via the Clavey River. This was an unexpected control site, as cows did not graze this area while samples were being collected in 2015. Six "before livestock" samples were collected between May 12, and June 22, 2015. Bull Meadow Creek was also sampled in 2010 and 2011 with all samples collected after cattle presence.

Table 1. List of water sample sites (lat/long datum NAD 83).

Site name	County	Latitude	Longitude
Anderson Valley	Mariposa	37.735869	-119.912805
Hunter Creek	Tuolumne	37.928052	-120.146363
Rose Creek	Tuolumne	38.141955	-120.199114
Bell Creek	Tuolumne	38.165198	-119.941107
Bull Meadow Creek	Tuolumne	37.893694	-120.057889

Methods

Field Water Collection

A Quality Assurance Project Plan (QAPP) was prepared for this water-monitoring project and all procedures specified in the QAPP were followed.

Water samples that were collected for bacteriological testing were collected while wearing sterile gloves and collected in sample bottles sterilized and provided by AquaLab Water Analysis (which has ELAP certification). The bacteriological samples were collected before any other work was performed at the site. The sterilized Nalgene bottles hold 125mL of liquid. They were filled to 100 mL with sample water taken directly from flowing water approximately 0.1 m below the surface.

The sample containers were marked with a unique 3-digit identifying number with an indelible marker so that the markings would not "run" or otherwise become illegible when collecting the sample. The collection date, time and samplers' names were recorded on the field datasheets, which are retained at the CSERC office; they are also recorded on the Chain-of-Custody form that was transmitted to AquaLab along with each sample. No sampling bottles were contaminated during sampling or transit.

All water samples collected for bacteriological analyses were delivered to AquaLab within six hours from the time the samples were collected. The sample bottles were placed in Zip-loc plastic bags (to avoid any potential contamination from the ice water) on ice in a cooler until delivered into the custody of AquaLab.

While collecting the water samples, the relative flow of the stream being sampled was recorded on a field datasheet along with other observations about the sample area.

Laboratory Analyses

Water samples were delivered at Twain Harte, CA, to AquaLab, a State-certified analytical laboratory. All water samples were tested for *E. coli,* total coliform, and fecal coliform bacteria within the 6-hour holding time specified in the QAPP, using Multiple Tube Fermentation (Most Probable Number/100 mL). The detection limit using this method of analysis is two fecal coliform organisms/100 mL of water. The detection maximum using this method of analysis is 16,000 fecal coliform organism/100 mL of water.

A copy of AquaLab's Quality Assurance SOP for Multiple Tube Fermentation is on file at the CSERC office and included in appendix 5. The analytical methods utilized by this laboratory are specified in *Standard Methods For the Examination of Water and Wastewater* (19th Edition).

Data Analysis for Comparison to State Standards

The bacteria results were compared to the relevant water quality standards contained in the Central Valley Regional Water Quality Control Board's *Water Quality Control Plan for the Sacramento and San Joaquin River Basins* ("Basin Plan"). Water contact recreation is a designated beneficial use of the receiving waters included in this study. To protect that beneficial use, the Basin Plan specifies (in part) the following numeric objectives (i.e., standards):

> *In waters designated for contact recreation (REC-1), the fecal coliform concentration based on a minimum of not less than five samples for any 30-day period shall not exceed a geometric mean of 200/100 ml, nor shall more than ten percent of the total number of samples taken during any 30-day period exceed 400/100 ml. (Basin Plan at III-3)*

Data were compiled whenever five or more samples were collected within a 30-day period, and results were judged as a "Type 1 Violation" whenever the geometric mean of five samples collected over a 30-day period exceeded 200 fecal coliform colonies per 100 ml of water. Results were judged as a "Type 2 Violation" whenever more than ten percent of the samples collected over a 30-day period exceeded 400 fecal coliform colonies per 100 ml of water. In effect, a Type 2 Violation exists for this study any time there are at least five samples during a 30-day period for which any single sample exceeded 400 fecal coliform colonies per 100 ml of water.

For this study, reporting periods were tabulated only when five or more samples were collected within a 30-day period. This conservative method of data analysis documented 134 violations of the above state water quality standards for fecal coliform bacteria. A more comprehensive analysis (i.e., tabulating all possible 30-day periods by re-starting the 30-day calendar each day) would produce additional violations.

Results

Comparison of Data From Sites with "Before vs. After Livestock" Data

At Anderson Valley, no before cattle presence samples were collected. The average *E. coli* concentration after cattle presence was 225 (n=8), with one sample of 500 and one of 900 [mean FC=313, n=8]. See Figure 1 for a comparison of the mean fecal coliform results to the state standard.

At Hunter Creek, no before cattle presence samples were collected. The average *E. coli* concentration with cattle presence was 686 (n=8), with five samples over 500 [mean FC=790, n=8]. See Figure 1 for a comparison of the mean fecal coliform results to the state standard.

At Rose Creek, the average *E. coli* concentration before cattle presence was <5 (n=6) [mean FC= <5, n=6]. The average *E. coli* concentration after cattle presence was 458 (n=12), with five samples of 500 or more [mean FC=600, n=12]. See Figure 2 for a comparison of the average "before livestock" fecal coliform results to the average "after livestock" results for Rose Creek.

At Bell Creek, the average *E. coli* concentration before cattle presence was <3 (n=3) [mean FC= 3, n=3]. The average *E. coli* concentration after cattle presence was 7,961 (n=12), with all but one sample in the thousands ranging from 2,400 to >16,000 [mean FC=9,044, n=12]. See Figure 3 for a comparison of the average "before livestock" fecal coliform results to the average "after livestock" results for Bell Creek.

At Bull Meadow Creek, the average *E. coli* concentration before cattle presence was 3 (n=6) [mean FC= 3, n=3], with three samples of 2 or less.

Comparison to Previous Year Results at Rose Creek (2009 & 2010), Bell Creek (2014) Sample Sites, and Bull Meadow Creek (2010 & 2011)

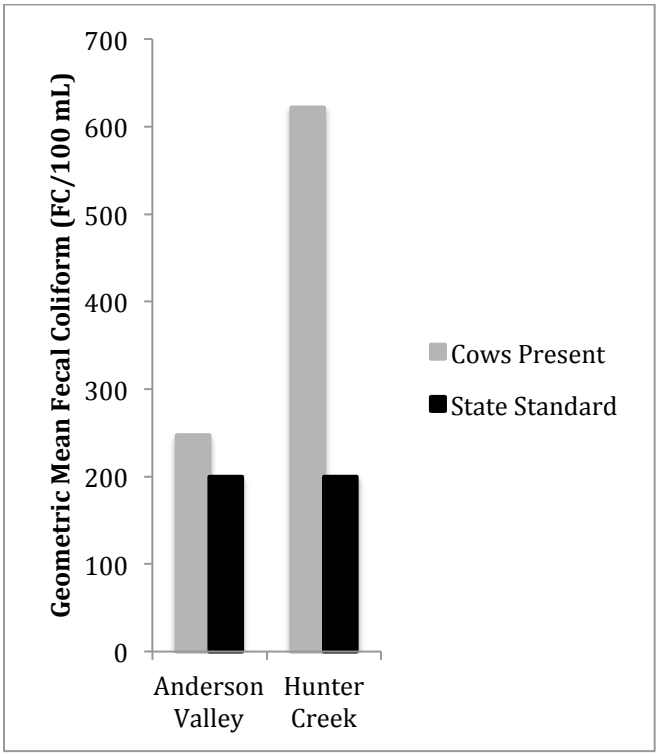
At Rose Creek in 2009, cows were already present at the time of the first visit so no "before" grazing samples were collected this year. Six "after cattle arrival" samples were collected between August 27, 2009 and September 23, 2009. The average *E. coli* concentration after cattle presence was 667 (n=6), with five samples of 300 or above [mean FC=853, n=10].
At Rose Creek in 2010, three "before" water samples were collected between May 4, 2010 and May 7, 2010. Nineteen "after livestock arrival" water samples were collected between May 12, 2010 and August 13, 2010. The average *E. coli* concentration before cattle presence was <3 (n=3) [mean FC= <3, n=3]. The average *E. coli* concentration after cattle presence was 493 (n=19), with seven samples of 500 or above [mean FC=558, n=19]. See Figure 2 for a comparison of the average "before livestock" fecal coliform results to the average "after livestock" results for Rose Creek for 2009, 2010, and 2015.

At Bell Creek in 2014, three "before livestock" samples were collected between June 19 and July 14, 2014. Ten "after livestock arrival" samples were collected between August

8 and September 9, 2014. The average *E. coli* concentration before cattle presence was 9 (n=3) [mean FC= 18, n=4]. The average *E. coli* concentration after cattle presence was 9,570 (n=10), with five samples of 16,000 or above [mean FC=9,970, n=10]. See Figure 3 for a comparison of the average "before livestock" fecal coliform results to the average "after livestock" results for Bell Creek in 2014 and 2015.

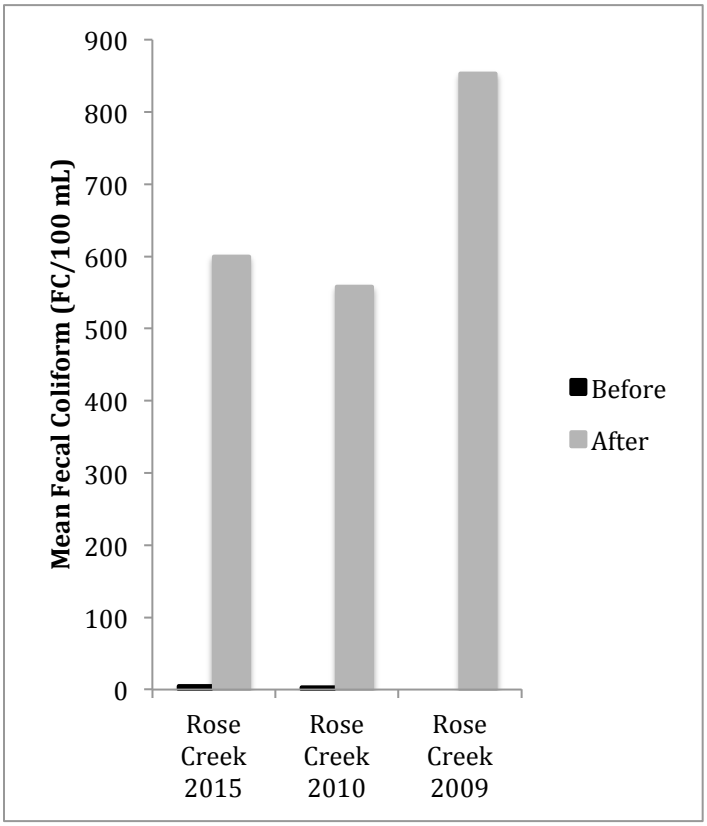
At Bull Meadow Creek in 2010, cows were already present at the time of the first visit to this site. Accordingly, no "before" grazing samples were collected. Seven "after cattle arrival" samples were collected between June 16, 2010 and July 21, 2010. The average *E. coli* concentration after cattle presence was 1,122 (n=9), with all samples of 500 or above [mean FC=1,200, n=9].
At Bull Meadow Creek in 2011, cows were already present at the time of the first visit to this site. Accordingly, no "before" grazing samples were collected. Sixteen "after cattle arrival" samples were collected between May 25, 2011 and October 3, 2011. The average *E. coli* concentration after cattle presence was 443 (n=16), with six samples of 500 or above [mean =476, n=16]. See Figure 4 for a comparison of the average "before livestock/control" fecal coliform results from 2015 to the average "after livestock" fecal coliform results from 2010 and 2011.

Figure 1. The graph depicts the geometric mean "after livestock" fecal coliform results for Anderson Valley and Hunter Creek to the State Standard (no "before livestock" samples were collected for these sites):



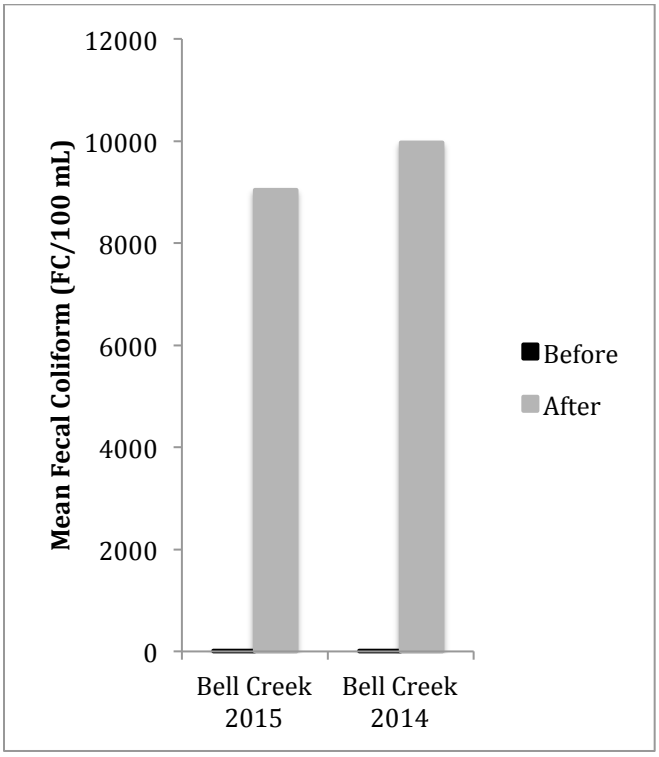
Note: The bar chart above shows the geometric mean for the "after livestock arrival" fecal coliform results for the two sites compared to the State Standard for Rec-1 water.

Figure 2. The graph depicts the results for the average fecal coliform concentrations for the "before grazing" and "after livestock arrival" at Rose Creek in 2015, 2010, and the "after livestock arrival" results for 2009 only (as no "before" samples were collected):



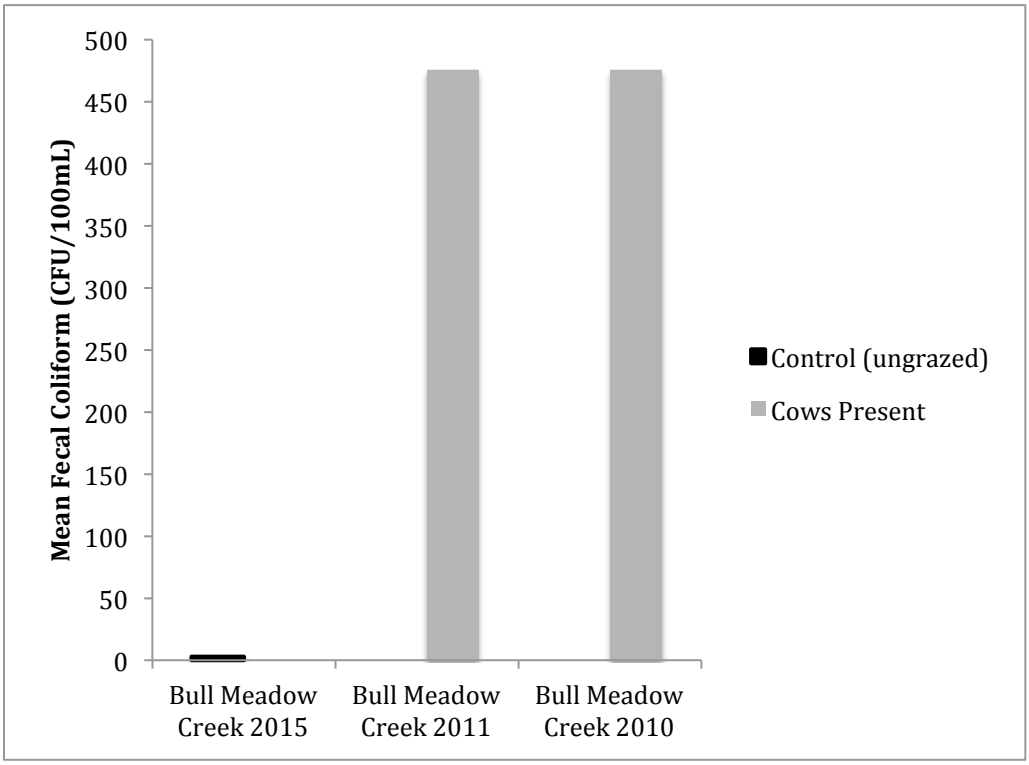
Note: The bar chart above shows the average fecal coliform concentrations "before" and "after" the commencement of grazing for 2015, 2010, and the "after" results for 2009 only for water samples collected at Rose Creek.

Figure 3. The graph depicts the results for the average fecal coliform concentrations for the "before grazing" and "after livestock arrival" at Bell Creek in 2015 and 2014:



Note: The bar chart above shows the average fecal coliform concentration "before" and "after" the commencement of grazing for samples collected in 2014 and 2015 at Bell Creek.

Figure 4. The graph depicts the results for the average fecal coliform concentrations for the "before grazing/control" samples collected in 2015 to the "after livestock arrival" only samples collected in 2011 and 2010 at Bull Meadow Creek:



Note: The bar chart above shows the average "before/control" fecal coliform results from 2015 and the "after livestock arrival" fecal coliform results for 2011 and 2010 at Bull Meadow Creek.

2015 Results Compared to State Standards

Below are tables that provide results for each of the 134 documented violations of state water quality standards. [A "(1, 2, or 3)" next to a date below indicates that more than one sample was collected that date with the same results (samples taken 5 minutes apart).]

Violation #1 (Type 1 Violation) — Site: Anderson Valley (AV)
Sampling dates: May 11, 2015 – May 27, 2015

Date	FC / 100ml
5/11/15	130
5/21/15	110
5/21/15	80
5/27/15	1600
5/27/15	500
Geo Mean	**247**

Violation #2 (Type 2 Violation*) — Site: Anderson Valley (AV)
Sampling dates: May 11, 2015 – May 27, 2015

Date	FC / 100ml
5/11/15	130
5/21/15	110
5/21/15	80
5/27/15*	1600
5/27/15	500

Violation #3 (Type 2 Violation*) — Site: Anderson Valley (AV)
Sampling dates: May 11, 2015 – May 27, 2015

Date	FC / 100ml
5/11/15	130
5/21/15	110
5/21/15	80
5/27/15	1600
5/27/15*	500

Violation #4 (Type 2 Violation*) — Site: Anderson Valley (AV)
Sampling dates: May 21, 2015 – June 15, 2015

Date	FC / 100ml
5/21/15	110
5/21/15	80
5/27/15*	1600
5/27/15	500
6/15/15	30

Violation #5 (Type 2 Violation*) — Site: Anderson Valley (AV)
Sampling dates: May 21, 2015 – June 15, 2015

Date	FC / 100ml
5/21/15	110
5/21/15	80
5/27/15	1600
5/27/15*	500
6/15/15	30

Violation #6 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 4, 2015 – May 13, 2015

Date	FC / 100ml
5/4/15	70
5/4/15	30
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
Geo Mean	**386**

Violation #7 (Type 2 Violation*) — Site: Rose Creek
Sampling dates: May 4, 2015 – May 13, 2015

Date	FC / 100ml
5/4/15	70
5/4/15	30
5/13/15* (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600

Violation #8 (Type 2 Violation*) — Site: Rose Creek
Sampling dates: May 4, 2015 – May 13, 2015

Date	FC / 100ml
5/4/15	70
5/4/15	30
5/13/15 (1)	1600
5/13/15* (2)	1600
5/13/15 (3)	1600

Violation #9 (Type 2 Violation*) — Site: Rose Creek
Sampling dates: May 4, 2015 – May 13, 2015

Date	FC / 100ml
5/4/15	70
5/4/15	30
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15* (3)	1600

Violation #10 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
Geo Mean	**663**

Violation #11 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15 (1)	240
5/26/15 (2)	240
Geo Mean	**749**

Violation #12 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (2)	240
Geo Mean	**663**

Violation #13 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
Geo Mean	**559**

Violation #14 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
Geo Mean	**453**

Violation #15 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
Geo Mean	**453**

Violation #16 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
Geo Mean	**453**

Violation #17 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15* (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240

Violation #18 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15* (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240

Violation #19 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15* (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240

Violation #20 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/1/15	50
6/1/15	240
Geo Mean	**547**

Violation #21 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15 (1)	240
6/1/15	240
Geo Mean	**749**

Violation #22 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15 (2)	240
6/1/15	240
Geo Mean	**749**

Violation #23 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
6/1/15	240
Geo Mean	**663**

Violation #23 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
6/1/15	50
Geo Mean	**484**

Violation #24 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15 (1)	240
6/1/15	50
Geo Mean	**547**

Violation #25 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15 (2)	240
6/1/15	50
Geo Mean	**547**

Violation #26 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 1, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
6/1/15	50
6/1/15	240
Geo Mean	**372**

Violation #27 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15* (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/1/15	240
6/1/15	50

Violation #28 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15* (2)	1600
5/13/15 (3)	1600
6/1/15	240
6/1/15	50

Violation #29 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – May 26, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15* (3)	1600
6/1/15	240
6/1/15	50

Violation #30 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
6/1/15	50
6/1/15	240
6/9/15	500
6/9/15	900
Geo Mean	**419**

Violation #31 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 26, 2015 – June 9, 2015

Date	FC / 100ml
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
6/1/15	50
6/1/15	240
6/9/15	500
6/9/15	900
Geo Mean	**236**

Violation #32 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/1/15	50
6/1/15	240
6/9/15	500
6/9/15	900
Geo Mean	**580**

Violation #33 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
5/26/15	130
5/26/15 (1)	240
5/26/15 (2)	240
6/9/15	500
6/9/15	900
Geo Mean	**585**

Violation #34 (Type 1 Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/9/15	500
6/9/15	900
Geo Mean	**1130**

Violation #35 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15* (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/9/15	500
6/9/15	900

Violation #36 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15* (2)	1600
5/13/15 (3)	1600
6/9/15	500
6/9/15	900

Violation #37 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15* (3)	1600
6/9/15	500
6/9/15	900

Violation #38 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/9/15*	500
6/9/15	900

Violation #39 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 13, 2015 – June 9, 2015

Date	FC / 100ml
5/13/15 (1)	1600
5/13/15 (2)	1600
5/13/15 (3)	1600
6/9/15	500
6/9/15*	900

Violation #40 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 26, 2015 – June 9, 2015

Date	FC / 100ml
5/26/15	130
5/26/15 (1)	240
5/23/15 (2)	240
6/9/15*	500
6/9/15	900

Violation #41 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 26, 2015 – June 9, 2015

Date	FC / 100ml
5/26/15	130
5/26/15 (1)	240
5/23/15 (2)	240
6/9/15	500
6/9/15*	900

Violation #42 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 26, 2015 – June 9, 2015

Date	FC / 100ml
5/26/15	130
5/26/15 (1)	240
5/23/15 (2)	240
6/1/15	240
6/1/15	50
6/9/15*	500
6/9/15	900

Violation #43 (Type 2* Violation) — Site: Rose Creek
Sampling dates: May 26, 2015 – June 9, 2015

Date	FC / 100ml
5/26/15	130
5/26/15 (1)	240
5/23/15 (2)	240
6/1/15	240
6/1/15	50
6/9/15	500
6/9/15*	900

Violation #44 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – July 28, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
Geo Mean	**543**

Violation #45 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**615**

Violation #46 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 24, 2015 – August 4, 2015

Date	FC / 100ml
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**651**

Violation #47 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**492**

Violation #48 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
8/4/15	500
8/4/15	1600
Geo Mean	**823**

Violation #49 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**583**

Violation #50 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**681**

Violation #51 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**583**

Violation #52 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**536**

Violation #53 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	300
8/4/15	500
8/4/15	1600
Geo Mean	**713**

Violation #54 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
8/4/15	500
8/4/15	1600
Geo Mean	**682**

Violation #55 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	1600
Geo Mean	**634**

Violation #56 (Type 1 Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
Geo Mean	**537**

Violation #57 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – July 28, 2015

Date	FC / 100ml
7/16/15*	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300

Violation #58 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – July 28, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15*	900
7/24/15	1600
7/28/15	220
7/28/15	300

Violation #59 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – July 28, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15*	1600
7/28/15	220
7/28/15	300

Violation #60 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15*	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #61 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15*	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #62 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15*	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #63 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15*	500
8/4/15	1600

Violation #64 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15*	1600

Violation #65 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 24, 2015 – August 4, 2015

Date	FC / 100ml
7/24/15*	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #66 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 24, 2015 – August 4, 2015

Date	FC / 100ml
7/24/15	900
7/24/15*	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #67 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 24, 2015 – August 4, 2015

Date	FC / 100ml
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15*	500
8/4/15	1600

Violation #68 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 24, 2015 – August 4, 2015

Date	FC / 100ml
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15*	1600

Violation #69 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15*	900
7/16/15	300
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #70 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/28/15	220
7/28/15	300
8/4/15*	500
8/4/15	1600

Violation #71 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15*	1600

Violation #72 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15*	900
7/16/15	300
7/24/15	900
7/24/15	1600
8/4/15	500
8/4/15	1600

Violation #73 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15*	900
7/24/15	1600
8/4/15	500
8/4/15	1600

Violation #74 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15*	1600
8/4/15	500
8/4/15	1600

Violation #75 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
8/4/15*	500
8/4/15	1600

Violation #76 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/16/15	300
7/24/15	900
7/24/15	1600
8/4/15	500
8/4/15*	1600

Violation #77 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	300
7/24/15*	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #78 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	300
7/24/15	900
7/24/15*	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #79 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15*	500
8/4/15	1600

Violation #80 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	300
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15*	1600

Violation #81 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15*	900
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #82 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/24/15*	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #83 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/24/15	900
7/24/15*	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15	1600

Violation #84 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15*	500
8/4/15	1600

Violation #85 (Type 2* Violation) — Site: Hunter Creek (HC)
Sampling dates: July 16, 2015 – August 4, 2015

Date	FC / 100ml
7/16/15	900
7/24/15	900
7/24/15	1600
7/28/15	220
7/28/15	300
8/4/15	500
8/4/15*	1600

Violation #86 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**8381**

Violation #87 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
Geo Mean	**7593**

Violation #88 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**6288**

Violation #89 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**12503**

Violation #90 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**8825**

Violation #91 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**8825**

Violation #92 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**9498**

Violation #93 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**8825**

Violation #94 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**7856**

Violation #95 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**8322**

Violation #96 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**7856**

Violation #97 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**7856**

Violation #98 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (2)	9000
9/14/15	16000
Geo Mean	**8322**

Violation #99 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15	16000
Geo Mean	**8322**

Violation #100 (Type 1 Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15	9000
Geo Mean	**7856**

Violation #101 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15* (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #102 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15* (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #103 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15*	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #104 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15* (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #105 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15* (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #106 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15*	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #107 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15* (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #108 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15* (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #109 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15* (1)	9000
9/14/15 (2)	9000
9/14/16	16000

Violation #110 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15* (2)	9000
9/14/15	16000

Violation #111 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15*	16000

Violation #112 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15* (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000

Violation #113 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15*(2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000

Violation #114 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15*	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000

Violation #115 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15* (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000

Violation #116 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15* (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000

Violation #117 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15*	9000
9/10/15 (2)	16000
9/10/15 (3)	16000

Violation #118 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15* (2)	16000
9/10/15 (3)	16000

Violation #119 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 10, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15* (3)	16000

Violation #120 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15* (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #121 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15* (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #122 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15*	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #123 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15* (3)	5000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #124 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15* (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #125 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15* (2)	9000
9/14/15	16000

Violation #126 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15* (2)	9000
9/14/15	16000

Violation #127 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 3, 2015 – September 14, 2015

Date	FC / 100ml
9/3/15 (1)	5000
9/3/15 (2)	5000
9/3/15	2400
9/3/15 (3)	5000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15*	16000

Violation #128 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15* (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #129 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15*	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #130 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15	9000
9/10/15* (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #131 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15* (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #132 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15* (1)	9000
9/14/15 (2)	9000
9/14/15	16000

Violation #133 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15* (2)	9000
9/14/15	16000

Violation #134 (Type 2* Violation) — Site: Bell Creek
Sampling dates: September 10, 2015 – September 14, 2015

Date	FC / 100ml
9/10/15 (1)	16000
9/10/15	9000
9/10/15 (2)	16000
9/10/15 (3)	16000
9/14/15 (1)	9000
9/14/15 (2)	9000
9/14/15*	16000

Conclusion

The results from 2015 continue to document significant pollution of surface waters that is resulting from cattle grazing as currently permitted and regulated on National Forest System lands. After seven years of collecting water samples for bacteriological testing at sites scattered throughout the Stanislaus National Forest, the results remain consistent. The concentration of indicator bacteria detected in the forest waters is only detectable at very low levels until cattle are released into summer grazing allotments. Shortly after cattle arrive within a stream sample area, the concentration of indicator bacteria often rises rapidly and remains high as long as the cattle are present. Many violations were documented in 2015 with many "after livestock" bacteriological sample results in the thousands.

The results presented here document 134 individual violations of California's regulatory water quality standards for bacteria within range allotments where water sampling was performed during the 2015 summer season.

The 134 individual violations, combined with CSERC's previous water quality sampling studies done during the 2009, 2010, 2011, 2012, 2013, and 2014 grazing seasons, provide persistent evidence of the failure of Best Management Practices (BMPs) to produce results that comply with state water quality standards. This study documents that BMPs as currently applied by the Stanislaus NF are not achieving water quality objectives in livestock-affected streams in a manner consistent with state water quality standards. This study also documents that, even with implementation of BMPs, significant pollution of surface waters is still resulting from cattle grazing as currently regulated and permitted on National Forest System lands.

Further, the levels and methods of livestock grazing in the sampled areas are not unlike practices throughout the Stanislaus NF and other public lands where livestock grazing

occurs in the Sierra Nevada. These latest findings confirm earlier studies indicating that widespread pollution of surface waters is occurring due to livestock presence on National Forest System lands in the Sierra Nevada. The findings demonstrate the need for consideration of: (1) appropriate changes in permitted livestock grazing activities in order to eliminate or reduce contamination of surface waters, (2) increased water quality monitoring of high-use livestock sites where prolonged or concentrated presence of cattle increases the potential for violations of water quality standards, and (3) removal of livestock from known areas where current livestock management techniques (such as fencing and herding) have not resulted in compliance with water quality standards (Derlet et al, 2008 and 2010).

This is the seventh year where "before cows" and "cows present" water sampling has detected high levels of fecal coliform, total coliform, and *E. coli* in national forest areas used by varying numbers of recreational visitors. One obvious consideration for reducing the risk of exposing recreational visitors (swimmers, hikers, campers, backpackers) to pathogens or indicators of pathogens in national forest water is to evaluate where the areas with the highest levels of backcountry recreational use occur within each national forest. Keeping livestock out of those high-use recreational areas would appear to be one effective strategy to avoid, in those specific areas, recreational visitors exposure to water that fails to meet State standards for recreational contact and public health.

References:

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Derlet, R.W., Goldman, C.R., Connor, M.J. 2010 Reducing the impact of summer cattle grazing on water quality in the Sierra Nevada Mountains of California: a proposal. *Journal of Water and Health*, 08.2