Community Clean Water Institute
Lower Russian River Water Quality Monitoring Project
Special Study:
Bacteriological Testing of the Russian River- Monte Rio Beach Area

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Introduction

The Community Clean Water Institute (CCWI) is a non-profit 501(c)(3) organization, based in Sebastopol, California. CCWI has received funding from the Nonpoint Source Pollution Control Program (Prop 13) of the State Water Resources Control Board. This special study is part of the Lower Russian River Water Quality Monitoring Project, consisting of public education using water quality monitoring, citizen monitoring data collection and community outreach along Dutch Bill Creek and the Lower Russian River's final six miles to coastal outlet.

This report summarizes the results of a Special Study undertaken by CCWI in the Monte Rio Beach area over the course of the weekend of August 14-16, 2004. This study provides a snap-shot of the bacterial levels in the Monte Rio Beach area on an average weekend in the summer. Monte Rio Beach receives the greatest amount of human use in the late summer weekends, when tourism is at its peak. This study is designed to answer the following question: what are the potential sources of E. coli to the Russian River in Monte Rio area beaches in the summer?

Historical Background of Study Area

From 1996 to 2003, the North Coast Regional Water Quality Control Board performed periodic bacterial analysis on several beaches along the Russian River in Sonoma County, California between Memorial Day and Labor Day. The Monte Rio Beach area in the Lower Russian River has exhibited high bacteria counts, as noted in monitoring performed by the Regional Water Quality Control Board from 1996-2003.[1] On June 11, 2003, testing revealed a coliform spike at Monte Rio beach, which exceeded the California Department of Health Services guidelines for E. coli by about 300% (Figure 5).

The Lower Russian River has been listed on the EPA list as 303(d) impaired for pathogens. However, due to lack of funding, the Regional Water Board did not perform testing in 2004. The Sonoma County Water Agency did perform testing along the Lower Russian River as part of a requirement for a modification of its 2004 water allocation from the State Water Board.

The Sonoma County Water Agency plans to install a sewer system along the Russian River in the Monte Rio area due to concerns about failing septic systems. The town of Camp Meeker along Dutch Bill Creek is also planning a large retrofit to connect aging septic systems to a sewer system.

[1] http://www.swrcb.ca.gov/rwqcb1/sampling/russ_river.html

Materials and Methods

Appendix A shows the site locations. The sites are named from downstream to upstream as follows: RUS039-Villa Grande; RUS040-Monte Rio Beach; RUS045-50 yards upstream of Monte Rio Beach; and RUS048-200 yards upstream from Monte Rio Beach. RUS039 is near houses therefore septic systems on the south side of the river. RUS040 is located at Monte Rio Beach where human use, such as swimming, is concentrated. RUS045 and RUS048 are a short distance upstream of Monte Rio Beach.

Table 1 shows site locations and GPS coordinates.

Site Locations & GPS Coordinates (Table 1)

Site Name	Site Description	GPS Points
RUS039	Villa Grande	W 123°01.031'123, N 38°28.244'
RUS040	Monte Rio Beach	W 123°00.553', N 38°27.979'
RUS045	Upstream of Monte Rio Beach	123°00.501', 38°28.012'N
RUS048	200 yards upstream from Monte Rio Beach	123°00.410', N 38°28.138'

Table 2 describes the parameters tested and the methods used.

Parameters & Methods (Table 2)

Parameters:	**Tested in field by**	**Field equipment:**	
Conductivity (Ions)	CCWI staff	Oakton Conductivity Tester Low	
Temperature	CCWI staff	pocket thermometer	
Parameters:	**Tested in Lab by:**	**Sampling container:**	**Lab Equipment:**
Ammonia	Sample brought to CCWI, tested by CCWI	Sample collected by Whirl Pak bag	Hach Stream Survey Kit with Ammonia reagents
Total Coliform and E.coli (Quantitray method)	Sample collected by CCWI, tested by CCWI	100 ml cylindrical bottle	IDEXX colilert media, quantitrays, sealer, and incubator
Flow measurements	Data collected by Sonoma County Water Agency-online and the USGS		

Total coliform and E. coli were the constituents of primary concern. Conductivity and ammonia were monitored as indicators of failing septic systems, or presence of additional contaminants. Temperature and flow were monitored as background characteristics.

CCWI staff completed a practice run on August 3, 2004. CCWI staff visited each site, and collected samples. Staff then returned to the CCWI office and performed tests. The purpose of the practice run was to confirm that laboratory supplies were adequate and to determine the appropriate dilution factor. Staff also incorporated quality controls during the practice run such as a Lab Blank for coliform testing.

Trip Schedule:

Trip 1: Friday August 13, 2004 at 1:00PM
Trip 2 and 3: Saturday August 14, 2004 at 11:00am and 6:00pm
Trips 4 and 5: Sunday, August 15, 2004 at 11:00am and at 6:00pm
Trip 6: Monday, August 16, 2004 at 1:00PM

Collection methods:

Samples at RUS040 and RUS045 were collected at knee depth, facing upstream. 100 ml sterile vessels were used for coliform and E. coli. Whirl-Pak bags were used to collect samples which were brought back to the CCWI lab for Ammonia testing. Samples at RUS039 and RUS048 were collected by kayak, collected upstream of the kayak, about 1 foot below the water surface. Areas with high densities of birds, ducks, and other wildlife were avoided.

After collecting the samples in the field, sample vessels were placed in an iced cooler and taken to the CCWI office in Occidental. Dilutions of 10ml of sample H2O to 90ml of deionized H20 were mixed with Colilert 24hr media (R), poured into Quantitrays, sealed the Quantitray sealer and placed in the incubator at 35 degrees Celsius. All dilution water was taken from a single specially marked 2.5 gallon Arrowhead Distilled Water container. After 24 hours, the Quantitrays were removed from the incubator and immediately analyzed. All of the Quantitrays were analyzed by Tuesday, August 17, 2004. Ammonia tests were performed within an hour of collection using the Hach multiparameter stream survey kit with reagents.

For quality assurance, during each trip into the field, one blank of DI water was tested for coliform for a total of 6 blanks. One duplicate sample was taken at RUS040 on Saturday at 6PM. Two lab replicates were performed, one at RUS039 on Saturday at 11AM, and one on Sunday at 11AM.

Results

A. Total Coliform

The standard limit for total coliform in fresh water streams on a given day for recreational use is 10,000 MPN/100ml (State Department of Health)[2]. The standard limit for E. coli for a given day for recreational use is 235 MPN/100ml (State Department of Health). Overall, none of the sites tested exceeded the standards for total coliform or E. coli.

Figure 1

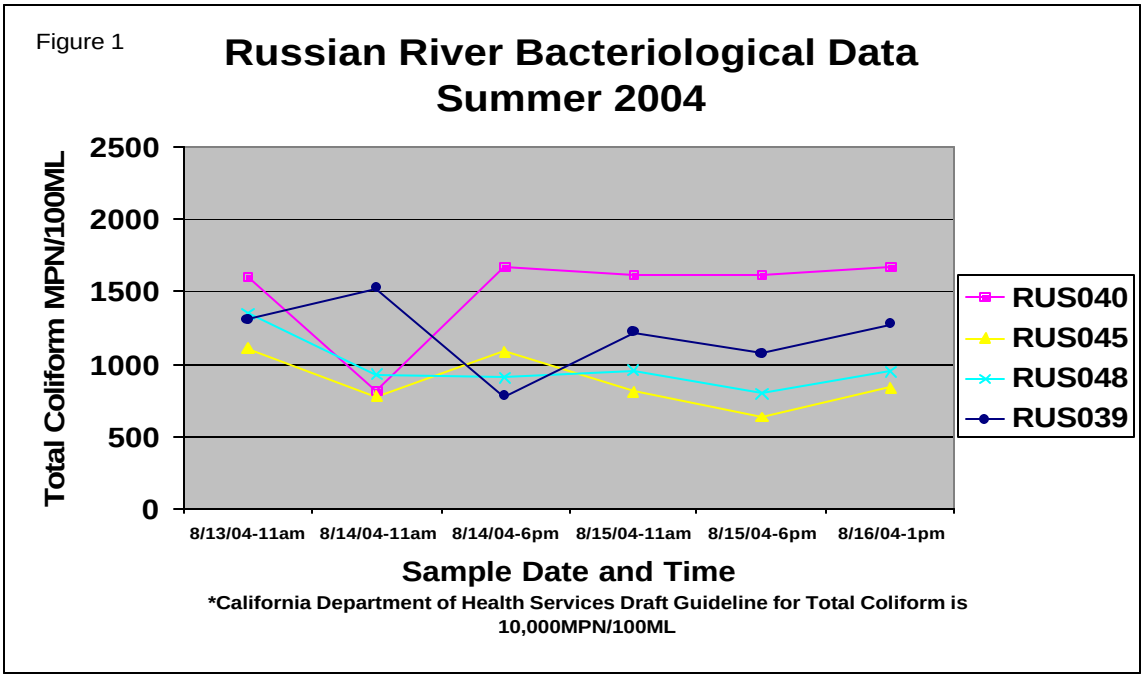


Figure 1 shows that total coliform levels are consistently greater at site RUS040 than at any of the other sites, with the exception of August 14, 2004 at 11:00 a.m. Generally, RUS039 and RUS040, which are the 2 downstream sites, were higher in total coliform than RUS045 and RUS048, the 2 upstream sites. RUS040 is at the mouth of the Dutch Bill Creek Tributary.

Figure 2, Figure 3 and Figure 4 refer to the data collected by the California State Regional Water Quality Control Board. The data collected by CCWI in 2004 (Figure 1) is consistent with the data collected by the State Regional Water Quality Control Board in the summer of 2002 and in the summer of 2003. In 2002, total coliform levels in the Monte Rio Beach area were approximately 2000MPN/100ml and slowly decreased over the next couple of weeks. In the end of July 2002 and the beginning of August 2002, the levels of total coliform fluctuate between 500-1000MPN/100ml without increasing above 1000MPN/100ml.

[2] http://www.waterboards.ca.gov/northcoast/sampling/sampling.html

Figure 2

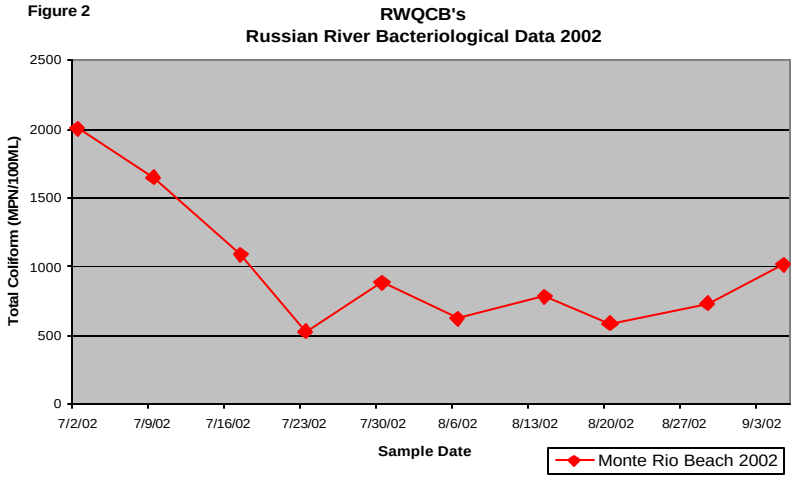


Figure 3

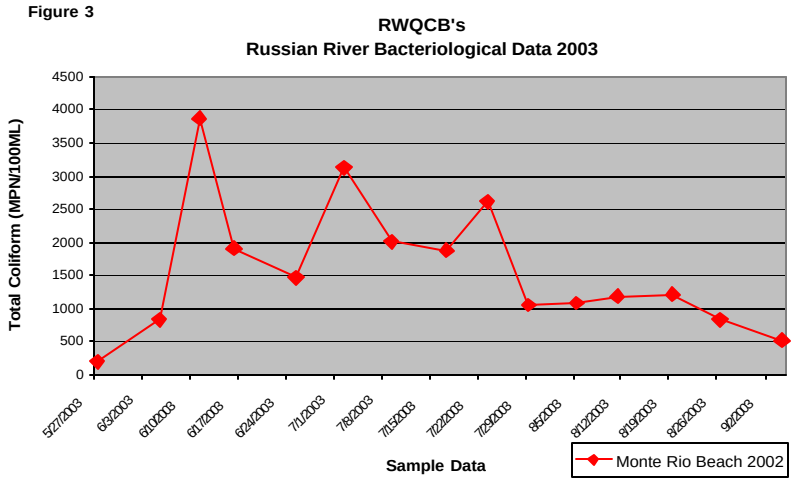


Figure 4

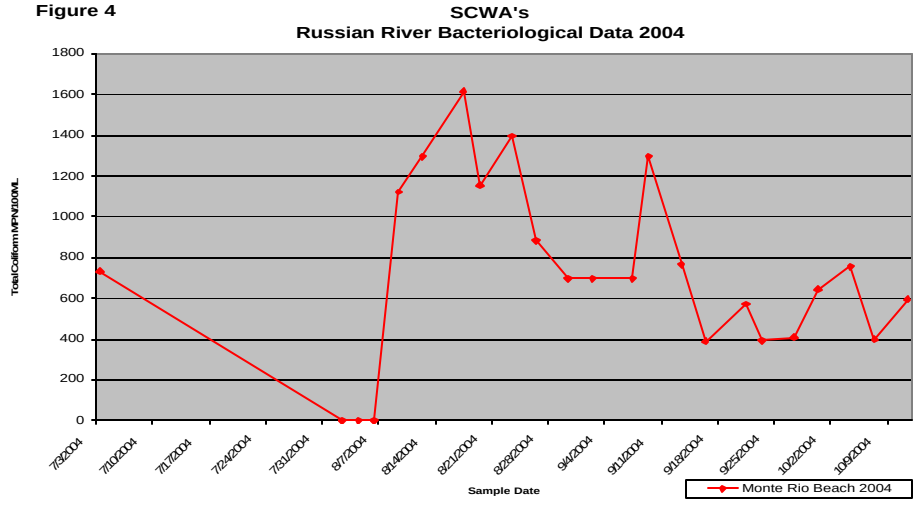


Figure 4 shows the data collected by the Sonoma County Water Agency from July 2004 through the middle of October 2004. Coliform levels decline in July 2004 to the beginning of August 2004. This is consistent with the data from 2002 and 2003. Then, the levels of total coliform increased to levels above 1000 MPN/100ml. Finally, the levels reached their peak on August 17, 2004 at 1616 MPN/100ml. This very close to CCWI's data where the levels of total coliform peaked on August 16, 2004 at 1669 MPN/100ml.

In both 2002 and 2003, the levels of total coliform were highest during the months of June and July; by the end of July the levels of total coliform decrease to levels far below the health draft guidelines. Although we do not have data from the May 2004, we have data beginning in July of 2004. At this time the levels of total coliform decreased from 750 MPN/100ml on July 3, 2004 to almost 0 MPN/100ml on August 7, 2004. Then the levels of total coliform continue to fluctuate between 1500 MPN/100ml and 800 MPN/100ml as they slowly decrease to levels below 800 MPN/100ml in October.

B. E. coli

Figure 5 shows that the total E. coli levels at the four sites varied. The level of E. coli on Friday, August 13, 2004 at site RUS039 was 20 MPN/100ml. On Saturday, August 14, 2004 at 11:00 am it was 72 MPN/100ml at site RUS039. The next sample level of E. coli at site RUS039 was 52 MPN/100ml. For the duration of the weekend, levels of E. coli fluctuated between 41 and 61 MPN/100ml.

The levels of E. coli at site RUS040 fluctuated between 31 and 41 MPN/100ml at each of the first three samples taken. The last three samples fluctuated between 0 MPN/100ml and 20 MPN/100ml of E. coli.

Site RUS045, in three out of six samples had E. coli levels higher than 100 MPN/100ml. On August 15, 2004 at 6:00p.m., the level of E. coli was 148 MPN/100ml. The other samples taken at site RUS045 were near 50 MPN/100ml.

The sample from site RUS048 on August 15, 2004 at 11:00 a.m. had E. coli levels of 146 MPN/100ml. It should be noted that RUS045 is downstream of RUS048. The other samples from site RUS048 remained near 50 MPN/100ml. The results for downstream sites, RUS039 and RUS040, were not higher than results for upstream sites RUS045 and RUS048.

Figure 5

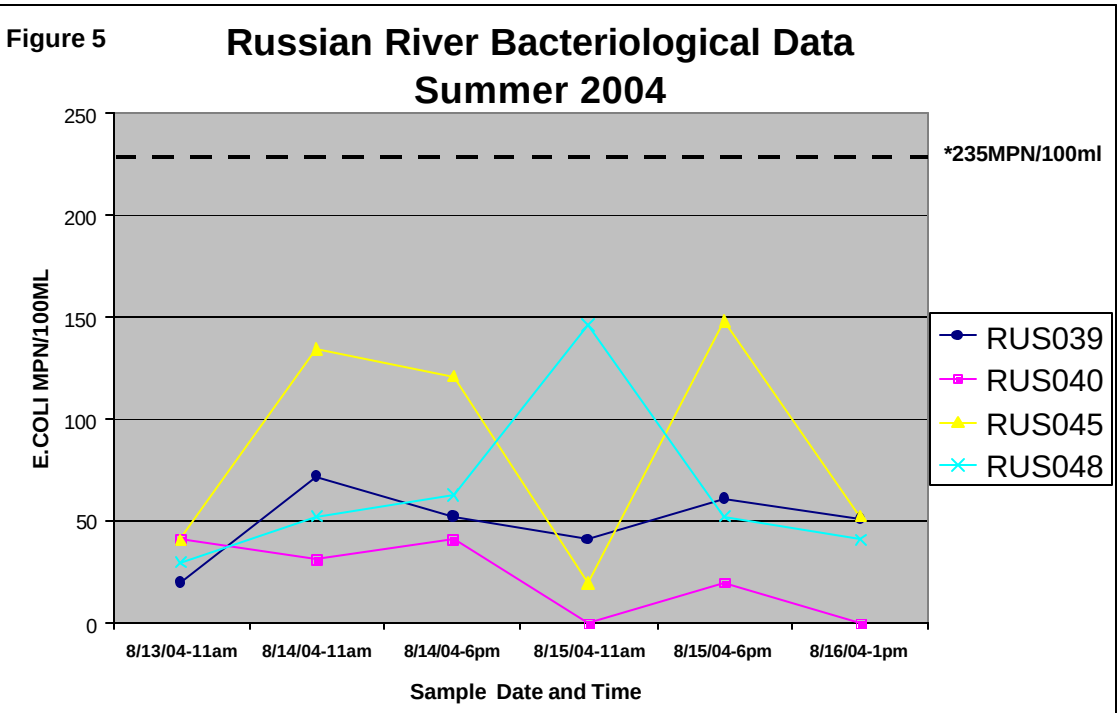


Figure 6, Figure 7 and Figure 8 are the data collected by the Regional Water Quality Control Board in the summer of 2002 and 2003 for E. coli levels. In 2002 (Figure 6), the E. coli levels are highest in June and July and then decrease dramatically in mid July and remain at low levels through August. In 2003 (Figure 7), the highest levels of E. coli exist in June. However, for the remainder of the testing period, the levels of E. coli remain far below the Health Department Guidelines of 235 MPN/100ml. The levels of E. coli present during the weekend of August 13, 2004 through August 16, 2004, are consistent with the levels found in mid-August in 2002 and 2003.

Figure 8 shows E. coli levels at 20MPN/100ml on August 12, 2004 and on August 17, 2004. These levels are consistent with the levels of E. coli on August 13, 2004 and on August 16, 2004 as shown in Figure 5. E. coli levels increased to 213MPN/100ml on August 23, 2004 (Figure 8).

Figure 6

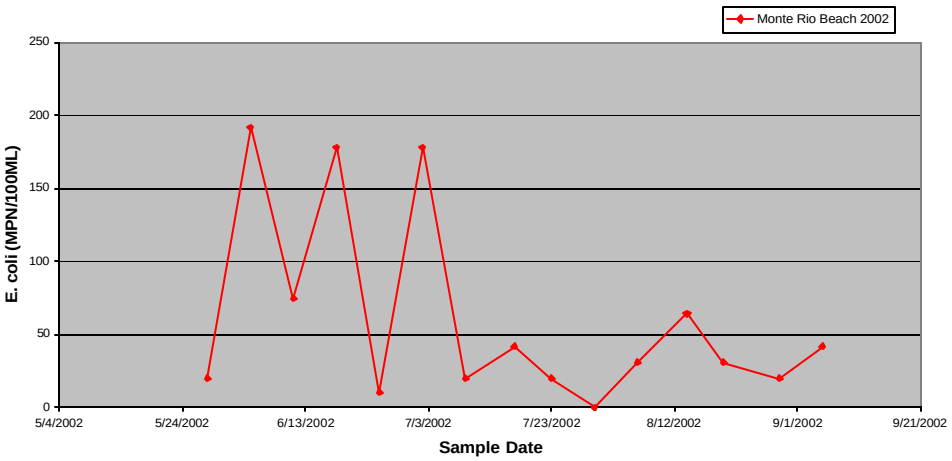


Figure 7

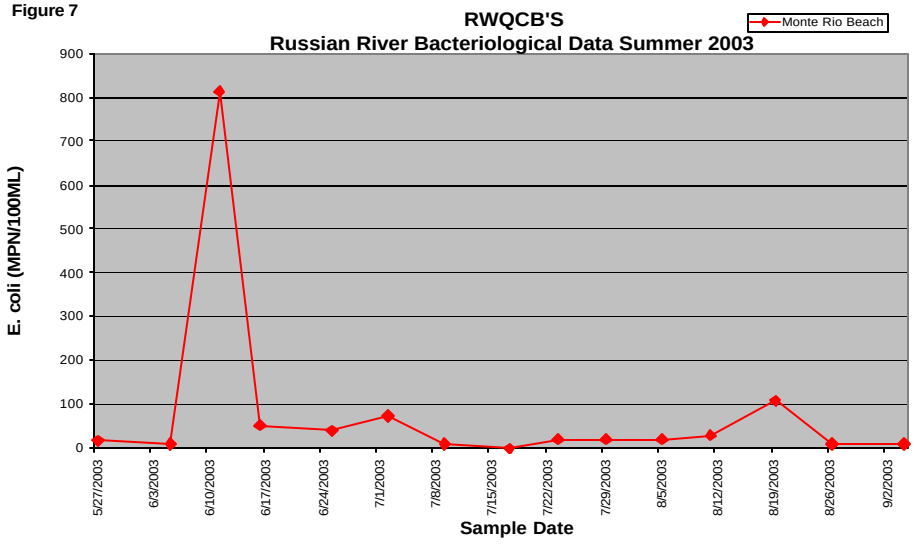
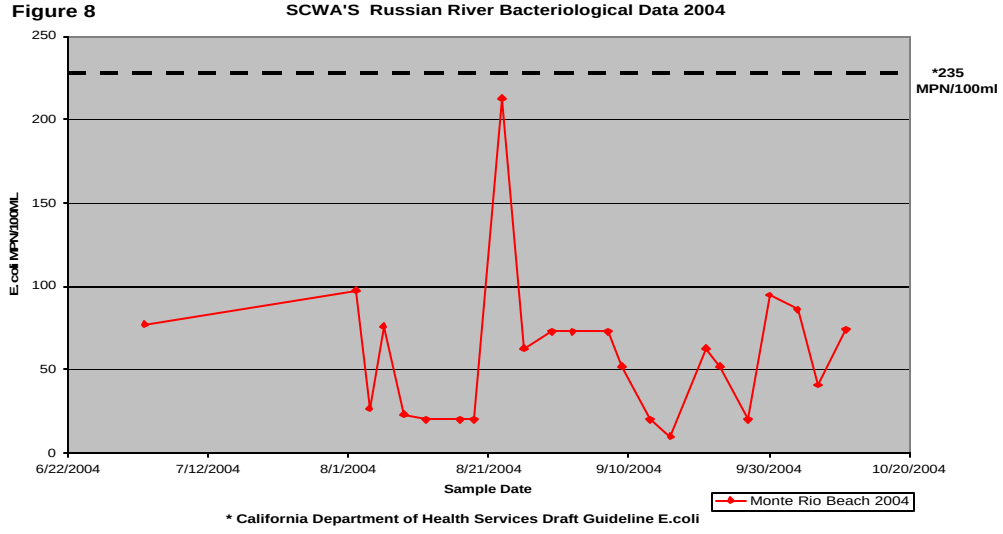


Figure 8

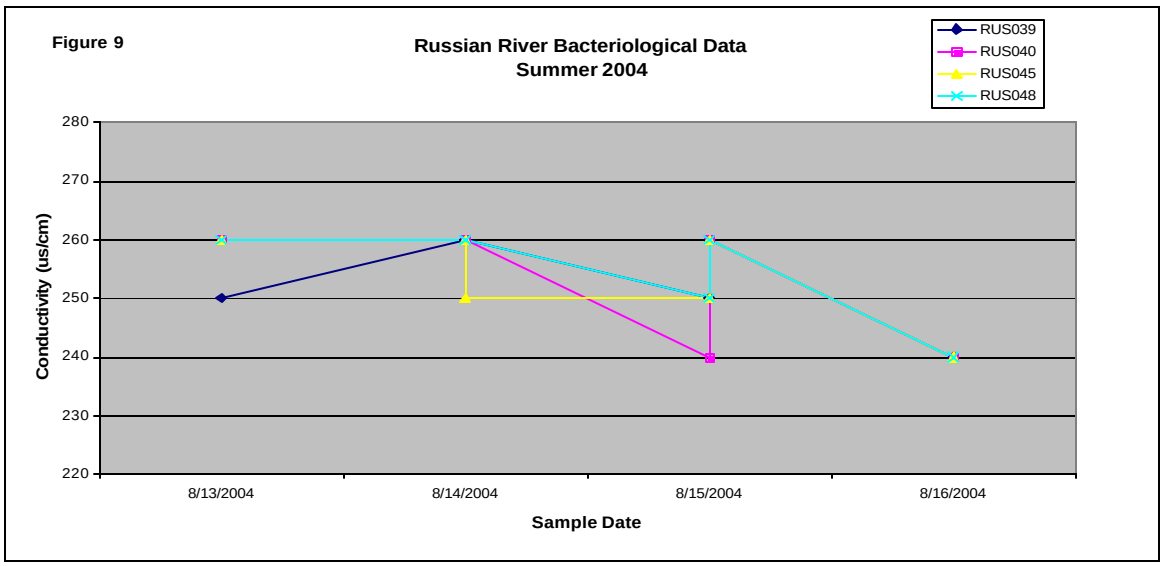


* California Department of Health Services Draft Guideline E.coli

C. Conductivity

Conductivity measures the ability of water to conduct an electric current. The conductivity is primarily affected by geology that the stream or river runs through. Streams that flow through granite and bedrock tend to have lower conductivity than streams that pass through clay and silt. Another characteristic of the stream that affects conductivity is temperature-as the temperature increases the conductivity of the stream increases.

Figure 9 shows the conductivity of the Russian River by site location. The conductivity in the river was generally between 240 microsiemens and 260 microsiemens at all sites. Conductivity in rivers throughout the United States ranges from 50uS to 1500uS (U.S.E.P.A., 1997). In addition, healthy streams and rivers' conductivity ranges between 150 and 500 uS (U.S.E.P.A., 1997).



D. Temperature

The temperature in a stream or river is vital to the health of the ecosystems it supports. The following table shows the temperature of the Russian throughout our study. The temperature varied between 20 to 30 degrees Celsius throughout this study weekend.

Temperature (Table 3)

STATION ID	DATE	TIME	TEMPERATURE (C)
RUS040	8/14/2004	11:15PM	20
RUS040	814/2004	11:30AM	23
RUS045	8/14/2004	6:15PM	26
RUS045	8/15/2004	11:10AM	27
RUS045	8/15/2004	7:10PM	27
RUS045	8/16/2004	1:00PM	27
RUS045	8/16/2004	1:15PM	30

E. Flow

The Water Agency on June 28 asked the state for permission to reduce river flows this summer so cold water can be stored in Lake Mendocino and released in the fall when spawning Chinook salmon need a cool river. The State Water Resources Control Board approved the Sonoma County Water Agency's (SCWA) petition to reclassify the 2004 water year from a normal year to a dry year. According to the U.S.G.S., the mean flow in August over the past 64 years is 169 cfs[3]. In August, the mean flow was 109.2 cfs.

At the beginning of August, the Sonoma County Water Agency lowered the flow in the Russian River below 150 cfs. The following table (Table 4) shows the U.S. Geological Survey's data for discharge during our study measured in Guerneville. This data can be found as footnoted.

Flow (Table 4)

Date	Discharge (cfs) (daily mean value)
8/13/2004	94.3
8/14/2004	101.6
8/15/2004	91.4
8/16/2004	100.6

F. Ammonia

In addition to Coliform and E. coli, ammonia is an indicator of sewage pollution and manure in streams and rivers. Ammonia can be toxic to aquatic life. The natural level of ammonia in surface water is typically less than 1mg/L; in wastewater, the level of ammonia ranges from 1mg/L to 30mg/L. Using the reagent kit from Hach Company, no samples were found to have ammonia within the detection limit. This result is denoted "ND" for "Non Detect." Table 5 shows the data for Ammonia.

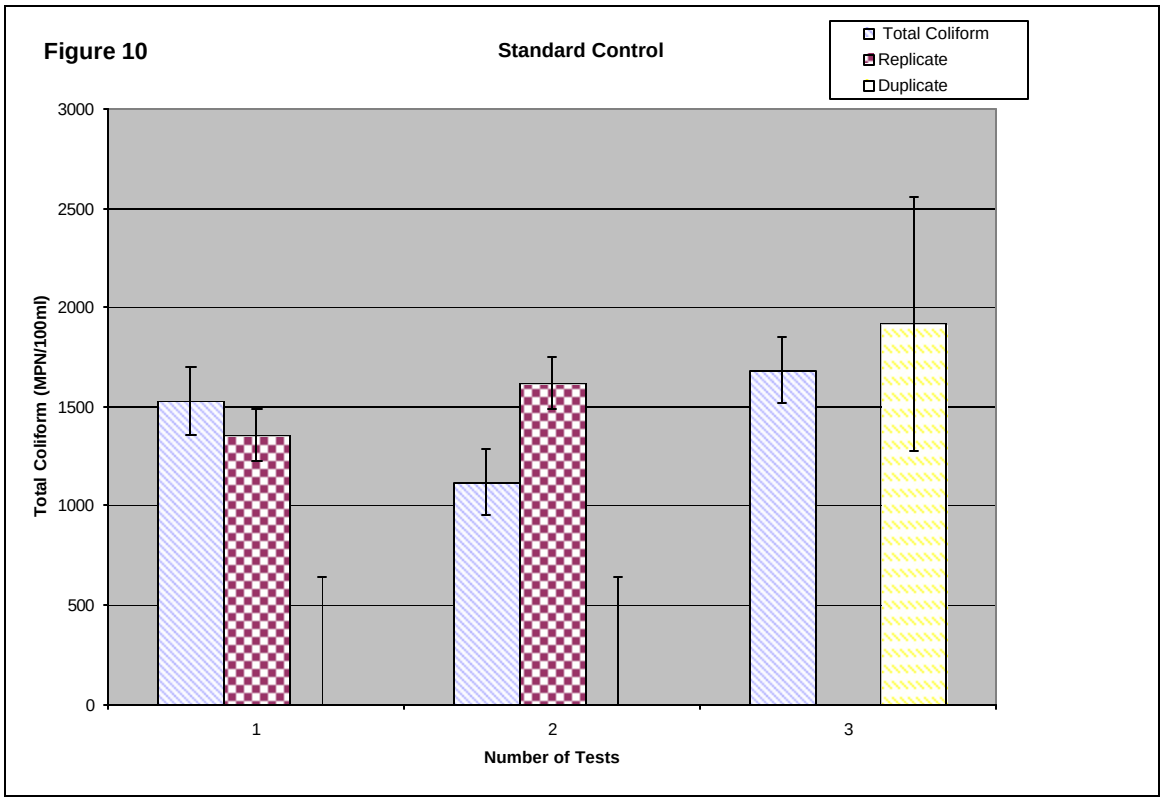
Ammonia (Table 5)

STATION ID	DATE	TIME	AMMONIA
RUS039	8/13/2004	1:30PM	ND
RUS039	8/14/2004	11:45AM	ND
RUS039	8/15/2004	7:25PM	ND
RUS039	8/16/2004	1:45PM	ND
RUS040	8/13/2004	1:25PM	ND
RUS040	8/14/2004	11:30AM	ND
RUS040	8/14/2004	6:30PM	ND
RUS040	8/15/2004	11:25PM	ND
RUS045	8/13/2004	1:35PM	ND
RUS045	8/14/2004	11:15PM	ND
RUS048	8/13/2004	1:50PM	ND
RUS048	8/14/2004	11:25PM	ND

[3] http://nwis.waterdata.usgs.gov/ca/nwis/monthly

G. Quality Assurance

Figure 10 shows the lab replicates and field duplicates that were taken for quality assurance. With a 95% confidence interval, bars show a 5% margin of error. Where bars over lap, the quality control test was within 5% error. Test Number 1 is a replicate; with a 5 % margin of error, there is no statistical difference between the actual total coliform sample and the replicate. However, in test 2, the error bars do not overlap. This indicates that there a statistical difference between the actual coliform sample and the replicate. Test 3 shows total coliform and a duplicate. Within a 5% margin of error, the difference between the actual sample and the duplicate is negligible.



Discussion and Conclusions

This study was designed to focus on potential sources of E. coli to the Russian River in Monte Rio area beaches in the summer. These data show no significant increase in total coliform or E. coli throughout the study weekend. However, this does not prove that tourism and/or recreational use of the Lower Russian River does not affect the levels of total coliform and/or E. coli. This study was a "snap shot" of the levels of coliform and E. coli throughout one weekend in August 2004.

Total coliform levels were higher at the two downstream sites (RUS039, RUS040) than at the two upstream sites (RUS045, RUS048). The results show increased total coliform downstream of site RUS045, coinciding with the confluence of Dutch Bill Creek. Further studies could compare coliform counts from Lower Dutch Bill Creek with those around Monte Rio Beach. Weekend swimming at the beach or impacts related to tourism could be other factors for the "downstream" sites' slightly higher total coliform count. A comparison of coliform counts on weekdays and weekends could resolve this question, since there are generally more swimmers on the weekends

E. coli showed no significant difference above or below Dutch Bill Creek. Dutch Bill Creek's contribution to E. coli in the Russian River was not significant in this study. This does not rule out the potential for contribution, which could be a topic for future study.

No ammonia was detected. Ammonia was tested in order to see if leaky septic systems in the immediate area could be detected. Non-detects showed that this is not the case. However, future studies may wish to conduct sampling over a larger area of the Lower Russian River.

A long-term study comparing data from the weekdays and the weekends throughout the summer would better indicate whether or not the levels of total coliform and E.coli increase on the weekends when tourism and recreational use are at their peak. In addition, this study did not include data showing how the human population increased over the weekend. If human population increases with the levels of coliform and E. coli throughout the weekend, then the increase of coliform and E. coli would directly relate to the human population increase.

Based on the results of this study, we recommend future studies incorporating the following:

1. A comparison of coliform counts on weekdays and weekends;
2. Dutch Bill Creek's contribution to E. coli in the Russian River;

3. Seasonal variations in total coliform and E. coli. Differences include: high flows in the winter; potential for more septic system malfunctions, offset by dilution from rainwater; decreased tourism and swimming in the winter; and
4. Monitor "low flow" conditions: The Sonoma County Water Agency has been advocating a "low flow" regime for reducing flows in the Lower Russian River by over 50%. Even in 2004, they applied to the State Water Board for the reduced flows for a "drought year" despite having had rains close to 100% of average.

CCWI encourages agencies, citizen groups, and nonprofit organizations to continue monitoring of the Lower Russian River and to make data available to the public.

Appendix A

Station ID	Date Collected	Time Collected	MPN Total coliform in sample	MPN E.coli in sample
RUS039	8/13/2004	1:30 PM	1313	20
RUS039	8/14/2004	11:45 AM	1529	72
RUS039	8/14/2004	6:40 PM	776	52
RUS039	8/15/2004	11:40 AM	1223	41
RUS039	8/15/2004	7:25 PM	1076	61
RUS039	8/16/2004	1:45 PM	1281	51
RUS039rep	8/14/2004	2:00 PM	1354	62
RUS039rep	8/15/2004	11:40 AM	1119	52
RUS040	8/13/2004	1:25 PM	1607	41
RUS040	8/14/2004	11:30 AM	816	31
RUS040	8/14/2004	6:30 PM	1684	41
RUS040	8/15/2004	11:25 AM	1616	0
RUS040	8/15/2004	7:15 PM	1616	20
RUS040	8/16/2004	1:00 PM	1669	0
RUS040dup	8/14/2004	6:30 PM	1918	20
RUS045	8/13/2004	1:35 PM	1112	41
RUS045	8/14/2004	11:15 AM	776	134
RUS045	8/14/2004	6:15 PM	1086	121
RUS045	8/15/2004	11:10 AM	813	20
RUS045	8/15/2004	7:10 PM	637	148
RUS045	8/16/2004	1:15 PM	839	52
RUS048	8/13/2004	1:50 PM	1354	30
RUS048	8/14/2004	11:25 AM	932	52
RUS048	8/14/2004	6:25 PM	907	63
RUS048	8/15/2004	11:15 AM	959	146
RUS048	8/15/2004	7:00 PM	794	52
RUS048	8/16/2004	1:35 PM	950	41
Trip Blank	8/13/2004	1:00 PM	0	0
Trip Blank	8/14/2004	11:00 AM	0	0
Trip Blank	8/14/2004	6:00 PM	0	0
Trip Blank	8/15/2004	11:00 AM	0	0

Appendix B