



# Friends of Corte Madera Creek Watershed

P.O. Box 415 • Larkspur • California 94977

[info@friendsofcortemaderacreek.org](mailto:info@friendsofcortemaderacreek.org) (415) 456-5052 [www.friendsofcortemaderacreek.org](http://www.friendsofcortemaderacreek.org)

## *E. coli* and *Enterococcus* Testing Corte Madera Creek Watershed 2003 - 2006

Between summer 2003 and summer 2006, Friends conducted multiple water quality sampling campaigns. Multiple locations in Corte Madera Creek and its tributaries were tested both during summer and winter. The objective of the testing was to measure concentrations of the bacteria *E. coli* and *Enterococcus*, indicators of water quality contamination, which are found only in the digestive tracts of warm-blooded animals, including humans. Epidemiological studies demonstrate that, while not necessarily pathogenic themselves, these bacteria correlate with gastrointestinal illness in swimmers.

To ensure quality assurance and quality control, Friends used EPA Standard Operating Procedure for Volunteer Monitoring of Surface Waters for Bacteria (#1106). With the exception of summer of 2004, samples were tested for total coliform bacteria, *E. coli* and *Enterococcus*. *E. coli* was used as an indicator in freshwater reaches of creek while *Enterococcus*, more tolerant of saline conditions, was measured in tidal sections near San Francisco Bay. Test results were evaluated using the following federal contact recreational criteria: saltwater concentrations of *Enterococcus* must not exceed 35 MPN/100ml, and freshwater concentrations of *E. coli* must not exceed 126 MPN/100ml. MPN stands for Most Probable Number. MPN is used in standard testing methods to account for the variability in the distribution of bacteria in a sample, and is expressed as a number of bacteria per milliliter. Freshwater test results were also evaluated using the state non-contact recreation standard of less than 2000 fecal coliform/100 ml.)

Sampling results are highly variable. This variability may be attributed to many factors. Bacteria concentrations change in response to changes in temperature and rainfall, they come from unpredictable and variable sources, and due to complicated mixing processes in the estuary, and the presence of isolated pools in the tributaries, concentrations have a tendency to be unevenly distributed.

The following narrative describes each season's testing sites and a summary of the results. All the sites are listed in the table of results and shown on the maps, which can be downloaded separately.

**Summer of 2003:** Staff of the Environmental Protection Agency Region 9 Laboratory in Richmond helped Friends' volunteers collect water samples and then tested the samples and analyzed the results. Samples were taken at nine sites throughout the watershed. Tests showed that all creeks in the watershed, with the exception of Deer Park Creek, met the California standard for non-contact recreation. Deer Park Creek, a series of isolated shallow pools in summer, with a concentration of 2600 MPN, may have been contaminated with *E. coli* from a leaking sewage system or by bacteria containing sediment that was inadvertently stirred up at the bottom of pools during sample collection. Samples taken in Larkspur Creek exceeded the EPA full-body contact criterion for saltwater with a concentration of 77 MPN.

**Winter 2004:** The EPA laboratory tested samples collected by Friends' volunteers at thirteen sites. Typically more sites are tested in the winter simply because most creeks are flowing in that season. All freshwater sites had concentrations that met state standards for non-contact recreation. All tested areas immediately downstream of stables met state and federal criteria for bathing standards and were among six of the eleven areas with the lowest concentrations of bacteria. In the tidal section of creek, results were less favorable than those from the freshwater sections. At Larkspur Creek the mean winter concentration of *Enterococcus* was 690 MPN, higher than in summer of 2003 and greatly exceeding the EPA standard for contact recreation of 35 MPN. Likewise on Corte Madera Creek at Bon Air Bridge, the concentration was 59 MPN, indicating that there may be impacts from non-point bacterial sources such as geese or dogs adjacent to the site or possibly from leaking sewers.

**Summer 2004:** We tested eleven sites, four in saltwater and seven in freshwater. This campaign was designed to attempt to identify sources of *E. coli* in the tidally influenced section of creek (locations where the highest concentrations of bacteria had been observed during previous test periods). Of the three Corte Madera Creek sites, the site below Bon Air Bridge had the highest concentrations of bacteria. The mean concentration of *E. coli* was 290 MPN, exceeding the state contact standard of 200 MPN. Along Larkspur Creek, the Doherty site was also high, with a concentration of 140 MPN. We compared concentrations during incoming and outgoing tides at the Corte Madera Creek and Larkspur Creek sites and found that when the tide ebbs, concentrations of *E. coli* are generally higher. No freshwater sites exceeded the state's non-contact standard of 2000 MPN; however Sorich Creek was right at the limit, and Sleepy Hollow Creek followed behind with concentrations of 650 MPN.

**Winter 2005:** EPA Region 9 Laboratory tested samples from twelve sites. Overall, we found that the results at all freshwater sites met state standards of fecal coliform for non-contact recreation and were consistent with trends seen in other communities: downstream sites on the main stem and tributaries generally had higher concentrations of *E. coli* than upstream sites. Corte Madera Creek in Ross at 450 MPN had higher concentrations of *E. coli* than at other freshwater sites, although samples were still within the state non-contact recreation standards. Concentrations from Larkspur Creek were also relatively high at 440 MPN, but were within acceptable standards. A dry sampling season (with only one rainy day) had an impact on our results. When we compared results of the wet-day sampling to those of dry days, we found that on the wet-day *E. coli* concentrations at most sites were considerably higher. Two sites had much higher concentrations than all other sites, Sleepy Hollow Creek just downstream of San Domenico stables and Larkspur Creek downstream of Cane Street. Testing on Corte Madera Creek well downstream of Bon Air Bridge revealed low *E. coli* and *Enterococcus* concentrations.

**Summer 2005:** The Marin County Public Health Lab tested samples during this season. To best characterize pollutant contributions from tributaries and side channels, samples were collected when the tide ranged from 0.9 ft to 2.0 ft, (a fairly low tide at the mouth of Corte Madera Creek). Of fourteen sites tested, twelve were located between the lower boundary of the concrete flood control channel in Kentfield and the Marin Rowing Association dock in Larkspur; two sites were located upstream in the freshwater section of creek, one in Ross behind the town hall and the other in the County's Cascade Canyon Open Space area. Concentrations of bacteria from Ross Town Hall and from eight downstream sites (the Concrete Channel, Tamalpais Creek Culvert, College of Marin Field, Hillview Gardens, Lower Creekside Park, Posts and Pipes Bon Air and Bon Air Road Cypress), all on Corte Madera Creek, were not within contact standards. Only results from the four sites nearest the mouth of the creek, where the creek is diluted by bay water, and results from Cascade Canyon were within acceptable safe limits for contact recreation. Although the site at Hillview Gardens showed the highest concentrations of *Enterococcus* and the site directly downstream of Bon Air Bridge showed the second highest mean concentration, we cannot identify the source.

**Summer 2006:** The Marin County Public Health Lab tested samples during this season. Of thirteen sites tested, eleven were located between the lower boundary of the concrete flood control channel in Kentfield and the Marin Rowing Association dock in Larkspur; two sites were located upstream in the freshwater section of creek, one in Ross behind the town hall and the other in the County's Cascade Canyon Open Space area. Concentrations of bacteria from eight downstream sites (College of Marin Field, Tamalpais Creek, King Mountain Creek, Wolfe Grade Creek, Bon Air Bridge, Larkspur Boardwalk One, Corte Real, and Larkspur), all on Corte Madera Creek, were not within body contact standards. Only results from the two freshwater sites and within the concrete flood control channel were within acceptable safe limits for contact recreation.