Chapter 7: Interpreting Results

State standards

Using guidance provided by the USEPA, states have developed standards for fecal coliform bacteria and/or E. coli. Compliance is often based on the arithmetic mean of three or more samples taken during the same sampling event at representative locations within a defined sampling area or on the geometric mean based on at least five samples taken over a 30-day period or a total number of samples collected over a specified monitoring period.

State	*E. coli or* Fecal coliform	Water Use	One-time Standard	30-day Geometric Mean
Indiana	*E. coli*	Primary bathing contact. This standard only applies April to October (the recreation season). From November to March, there is no standard.	235 colony forming units (cfu)/100ml	125cfu/100ml
Iowa	*E. coli*	Full contact recreation	235 cfu/100ml	126cfu/100ml
Michigan	*E. coli*	Full body contact recreation	300 cfu/100ml (3 or more samples)	130cfu/100ml
Minnesota	*E. coli**	Full body contact recreation	1260 cfu/100ml	126cfu/100ml
Ohio	*E. coli*	Primary bathing contact	298 cfu/100ml (not exceeded in more than 10% of samples)	126cfu/100ml
Wisconsin	Fecal coliform *E. coli***	Recreational Waters Beach Closures	400 cfu/100ml (not exceeded in more than 10% of samples) 235 cfu/100ml	200cfu/100 ml 126 cfu/100ml
YOUR STATE				

**Proposed in September 2007*

***EPA Guidelines* (see page 10 for other *E. coli* standards in fresh water bodies)

Determining the geometric mean

E. coli concentrations are reported as colony forming units (cfu) per 100 ml of water sample. When measuring *E. coli* concentrations over time, using the geometric mean is a useful reporting tool. The geometric mean takes into account that a few extreme counts may be found among many more closely grouped values. Calculating a geometric mean provides a number that is more representative of the median (or that number where half the samples are higher and half are lower) and helps reduce the effect of a few extreme values. Also, use of a geometric mean over time (often 30 days) minimizes fluctuations in the levels of bacteria in the water or one-time high counts. The 30-day geometric mean helps determine if a stream has a continually high level of *E. coli*.

The geometric mean (GM) can be calculated as follows:

$$GM= (s1 \text{ x } s2 \text{ x } s3 \text{ x } sn)^{1/N}$$

Where "s" is the number of *E. coli* colonies per 100 mls for samples 1, 2, 3, though the n^{th} sample, and N is the number of samples collected.

For example, let's say you have 5 samples and your counts of cfu/100ml at one site over a 30-day period were:

5, 10, 120, 20, 2600

The geometric mean would be determined by taking the 5th root of the product of the 5 readings:

$$(5 \text{ x } 10 \text{ x } 120 \text{ x } 20 \text{ x } 2600)^{1/5} = 50$$

If you had just taken an average of the five samples for the 30-day period, your answer would be:

$$(5 + 10 + 120 + 20 + 2600) = 2755$$

and

$$2755/5 = 551$$

The simple average does not reflect the typical value of the set of numbers as well as the geometric mean does, nor does it take into account the one result that is much higher than the others.

Note: The geometric mean can only be used with positive numbers greater than zero.

Getting "high" bacteria counts

If you find a "high" bacteria count (over your state's standard for a one-time sampling), it may be a one-time event or occurrence. This information is useful, but before taking further action, you should return to the site to take more samples. When you return, pay careful attention to anything out of the ordinary at the site. Look for the presence of animals and be alert for any unusual odors. Walk the banks again to look for obvious sources of pollution (see Chapter 2), and note past and current weather conditions. Continue to sample and contact your local health agency if numbers remain high. Be sure to wear long rubber gloves while sampling and wash your hands carefully afterwards.

If you do find a high *E. coli* count what steps should you take? Generally, you should:

- ❑ Continue to monitor the site. This will help identify if there is a chronic bacteria problem or a high count resulting from a one-time event.
- ❑ If you continue to find a high count, work through your volunteer monitoring program to alert your local agency.

You may wish to alert your local watershed group or local agency about your monitoring efforts and the results so far. These groups will likely have an interest in your results regardless of whether or not you have detected a problem. They may be able to work with you on determining the possible sources of *E. coli* pollution if a problem does exist.

Tracking, storing and retrieval of data

Keep track of your *E. coli* data on a spreadsheet (electronic, if possible) or data form (see Appendix B for a sample data sheet). An electronic spreadsheet may be advantageous in that it allows for easy calculations to show ranges, pollutant loads, or to make graphs. After entering the results on your data sheet, mail or fax this to your program leader as promptly as possible.

Alternatively, you can enter the data on the *E. coli* electronic database website developed as a part of this project. It can be accessed at www.iwr.msu.edu/cmb. The site is password protected; however, the password can be obtained by emailing any of the contacts listed near the beginning of this manual.

Source tracking

One method for determining sources of *E. coli* is called bacterial source tracking. Bacterial Source Tracking (BST) is a collective group of new methodologies being developed to determine sources of fecal pollution in environmental samples. Sources of fecal pollution may come from domestic pets, cows, deer, geese, hogs, other wild animals, and humans.

If used successfully, BST methodologies have the potential to turn nonpoint (diffuse) sources into point sources. Current BST research is being driven by the recent implementation of the Total Maximum Daily Load (TMDL) concept by EPA. BST methods represent the best tools available for determining sources of fecal pollution in water and should be an integral part of any project that involves TMDL development for fecal coliform. BST methods can also be used in the design and implementation of Best Management Practices to reduce fecal loading in water.

Currently, both molecular (genotypic) and biochemical (phenotype) BST methods are under development. DNA fingerprinting has received the greatest publicity, but numerous methods show potential. Most researchers believe that some combination of BST methods will be needed to provide the most accurate and reliable source identification answers. It is doubtful that any one BST method will emerge as the "best" method for all situations.

While this is not a procedure that the volunteers will be conducting, it is a procedure to be aware of, and a possible step that state agencies might take. At this point, it is still an emerging and costly technology, even for agencies, so it is not used routinely.

Pollution prevention actions you can take

Our valued streams and rivers are subject to pollution stress from land uses in the watershed. These pollutants come from many sources, including those around our own homes. You can practice certain activities that can help reduce water pollution risks from bacteria. Some examples may include:

- Planting any bare soil with native grasses, shrubs, or other plants. The roots of these plants will help contain the soil from running off into the nearest stream.
- Cleaning up after your pet. Pet wastes can be a source of *E. coli* and excess nutrient contamination in our waterways. Pet wastes can make their way from the lawn to a river, so dispose of wastes in the toilet or trash.
- Draining roof downspouts onto vegetated areas, not on the street or pavement, so that water can soak into the ground.
- Limiting paved surfaces; landscape with rocks, plants, or gravel.
- Supporting active interaction, communication, and education between technical advisors and land users.
- Encouraging community appreciation of watershed health through community events, e.g. outdoor sports, river cleaning, and other events.