Wolf Creek Bacterial Impact on Maumee Bay State Park Beach

Summary Report
June 2003

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Conducted by
University of Toledo
Lake Erie Center
6200 Bayshore Rd
Oregon, Ohio 43618

Summary Prepared by
Toledo Metropolitan Area Council of Governments
300 Dr Martin Luther King Dr
PO Box 9508
Toledo OH 43697-9508

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WOLF CREEK BACTERIAL IMPACT ON MAUMEE BAY STATE PARK BEACH SUMMARY REPORT

Introduction

Maumee Bay State Park is one of Lake Erie's premier recreation facilities. It provides swimming, fishing, and boating opportunities to the public, and draws people from across Ohio, Michigan, and the Midwest. The beaches at the park, however, have a history of high fecal bacteria (*E. coli*) levels. The beaches were posted for high bacteria levels a total of 216 days from 1986 through 2001. This problem raises two key questions:

- Where are the bacteria coming from?
- What needs to be done to meet water quality standards at the beaches and assure safe bathing at Maumee Bay State Park?

The Wolf Creek project was conceived by members of the Maumee Bay Bacteria Task Force to help answer these questions. Wolf Creek is about 9-1/2 miles long, starting at Woodville Mall in Northwood, and flowing through Oregon and Jerusalem Township into Maumee Bay. Originally the mouth of Wolf Creek was near Little Cedar Point (Reno Beach) in eastern Jerusalem Township. Today, the stream is cut off at North Curtice Road. The cutoff ditch that short-cuts Wolf Creek to the Bay is called Berger Ditch.

Previous Studies

The Maumee Bay Bacteria Task Force, a coalition of governmental agencies, has worked to answer these questions since 1995. The primary projects of the Task Force and other area researches are summarized below. Maumee Bay State Park and its beaches are shown in Figure 1.

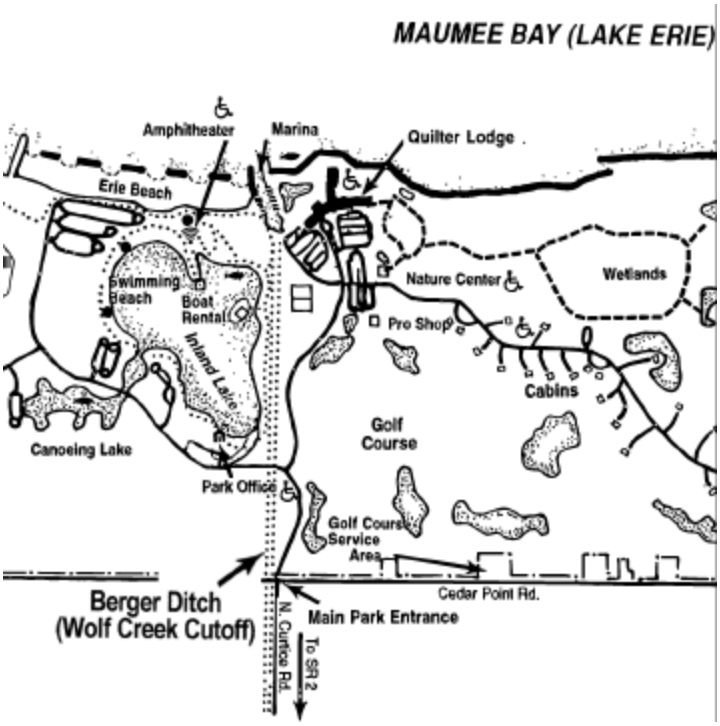

Figure 1: Berger Ditch and the beaches at Maumee Bay State Park

- Early studies analyzed sediments and water from the Inland Lake, the Maumee Bay nearshore area, and ditches flowing into the Bay in Oregon and Jerusalem Township within a few miles of the park. These studies concluded that stream sediments may have high bacterial levels even when the water does not. This suggests that the bacteria are surviving in sediments.

- The University of Toledo studied DNA fingerprinting techniques to identify the sources of *E. coli* impacting the beaches. Although the technique did not link specific sources with *E. coli,* but it did confirm birds (particularly gulls and geese) as an important source, especially for the Inland Lake. As a result, Maumee Bay State Park began programs to frighten birds away from the beach areas, and posted warnings against feeding the birds.

- In 1996, Ohio EPA sampled water in the bay. The results showed substantially lower concentrations of *E. coli* offshore than at the beaches and in the ditches. This indicates that high *E. coli* levels are a nearshore phenomenon.

- The Lake Erie beaches are divided into five coves. In 1996, Maumee Bay State Park and the City of Toledo studied *E. coli* levels at each cove. Wolf Creek/Berger Ditch enters the bay at the east end of the beaches. *E. coli* levels declined moving west, away from the creek. This study led to the hypothesis that Wolf Creek may be a significant source of *E. coli* impacting the Lake Erie beaches. This study had several results:

    - The Toledo/Lucas County Health Department tested septic systems in the area, particularly the Wolf Creek watershed. Many failed septic systems were identified and upgraded.

    - This study supported extension of sanitary sewer service to the area, presently under construction.

    - Indications that Wolf Creek/Berger Ditch may be an important source of bacteria at the beaches led to the present study.

- More recent studies show correlations between water turbidity and *E. coli*, between rain events and turbidity, and wind direction and *E. coli.* Highest *E. coli* levels were found when winds are from the north, northeast, or northwest. This study confirmed findings from beach studies in other areas that high *E. coli* levels are weather-related, and that high *E. coli* levels may be due to resuspension of sediments.

- UT studies in 2000 revealed that *E. coli* concentrations remain high for several months, especially in clay-rich sediments. This supports the hypothesis that sediment resuspension by storms may indeed cause high bacterial levels. It also implies that it is necessary to control the input of *E.coli*-bearing sediments to the Bay.

- In 2001, Oregon studied *E. coli* concentrations in Maumee Bay waters and potential sources. In offshore sampling, *E. coli* concentrations were highest closest to the mouth of the Maumee River and lowest offshore. The ditches that flow into the bay had higher *E. coli* concentrations than the ditch/lake mixing zones. At Maumee Bay State Park, high *E. coli* levels occurred in the summer under northerly winds, when the lake was turbid, or following half an inch or more of rain. The study suggests multiple sources of *E. coli,* and that storms resuspend bacteria from the sediments. Figure 2 shows Wolf Creek and other streams that flow into Maumee Bay.

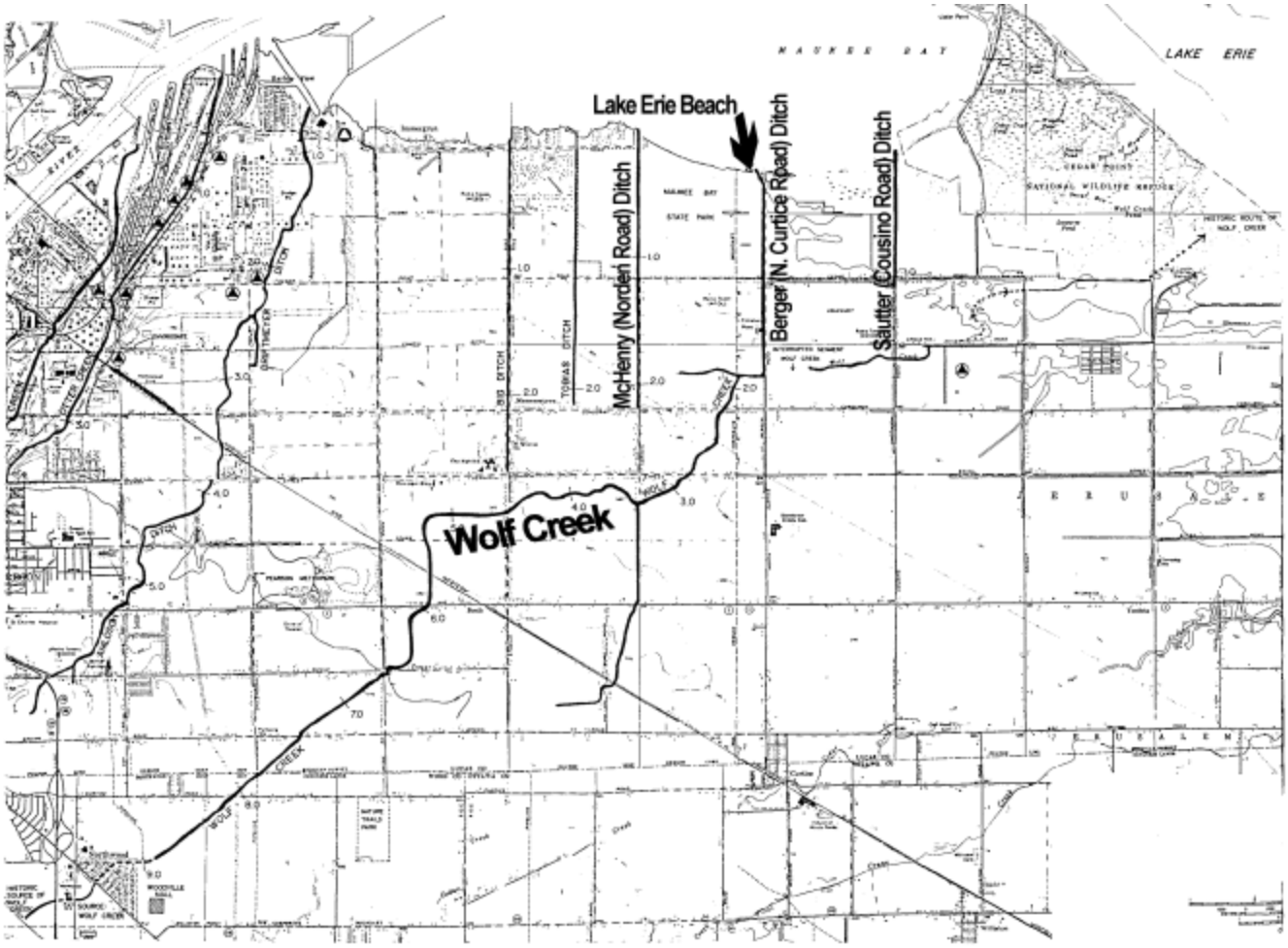

Figure 2 The Wolf Creek watershed and ditches that flow into Maumee Bay.

Project Goals

Wolf Creek flows into Maumee Bay via Berger Ditch at the Maumee Bay State Park marina. Past studies indicated multiple sources of *E. coli* impacting the Lake Erie Beaches, and that *E. coli* levels at the beaches are highest near the marina (Berger Ditch). The Maumee Bay Bacteria Task Force decided to study Wolf Creek in more detail, and answer these questions:

- Are the sediments of Wolf Creek/Berger Ditch a reservoir of bacteria contributing to high counts at the Lake Erie beaches?
- Are there "hot spots" of bacteria in the sediments of Wolf Creek?
- How long do bacteria survive in the stream sediments?

Study Method

Both the water and the sediments of Wolf Creek and Berger Ditch were sampled and tested for *E. coli*.

Water Samples

Water was tested at Site "B" in Maumee Bay State Park, shown in Figure 3. An automatic sampler was used to collect timed samples for 16 hours after a rainstorm. Water sampling was conducted on August 24th 2001.

Sediment Samples

Sediments were collected at sampling points along the entire length of Berger Ditch and Wolf Creek, shown in Figure 3. The sites were tested for *E. coli* as follows:

- During dry weather to show "background" levels. These samples were taken on July 10th and August 8th 2001 following several weeks of no significant rainfall
- On June 24th 2002, three days after a 0.09" rain
- On September 3rd, eleven days after another 0.09" rain*

The hypothesis for this study is that fine sediments (clay and silt), carrying *E. coli*, are an important source of bacteria at the Maumee Bay State Park Lake Erie beaches. If this is correct, the *E. coli* sediment levels should be at their highest between flushing rain events. They should drop significantly following a rainstorm that stirs up and flushes sediments out of the creeks. Sediment samples taken three days after a rainstorm should show this. Afterward, *E. coli* levels should gradually rise again as they accumulate between flushing rainstorms. Sediment samples taken eleven days after a rainstorm should show this.

Sediment was also studied in the lab to determine how long *E. coli* survive in these clays and silts.

The sediment samples may show a pattern of contamination, whether there are "hot spots" of *E. coli* in the sediments; and if so, where.

* Rainfall measurements at the Oregon Water Treatment Plant; NOAA satellite photos had indicated 0.5" or greater rainfall. Lack of rainfall during this drought summer was a difficulty for the study.

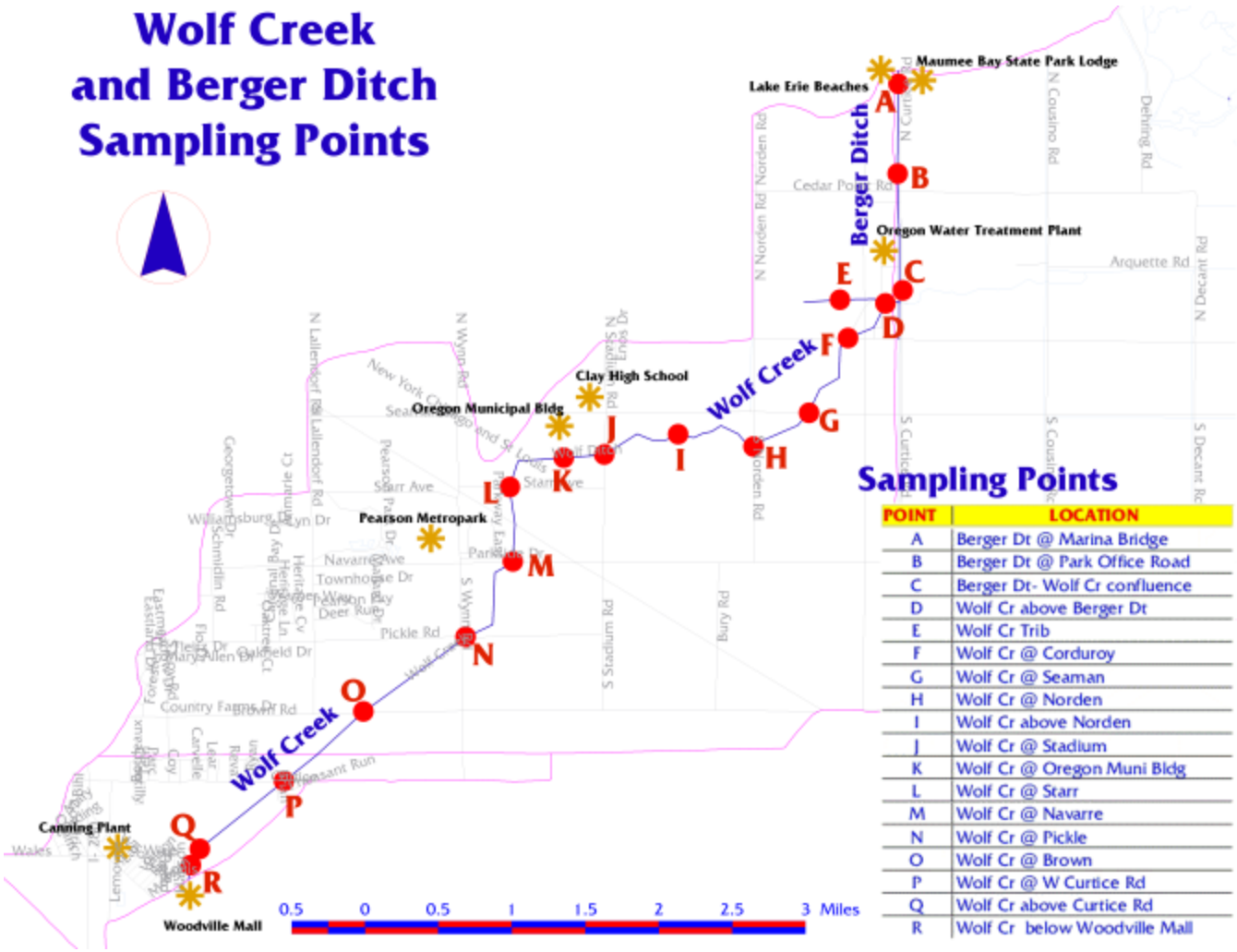

Figure 3 Berger Ditch and Wolf Creek sampling points

Conclusions

1. *E. coli* levels in sediment were high throughout Wolf Creek and Berger Ditch, but variable from site to site and from one sample to the next. Generally they were highest between Corduroy and Brown Roads, with lower levels near the mouth of Berger Ditch and in the headwaters of Wolf Creek in Northwood.

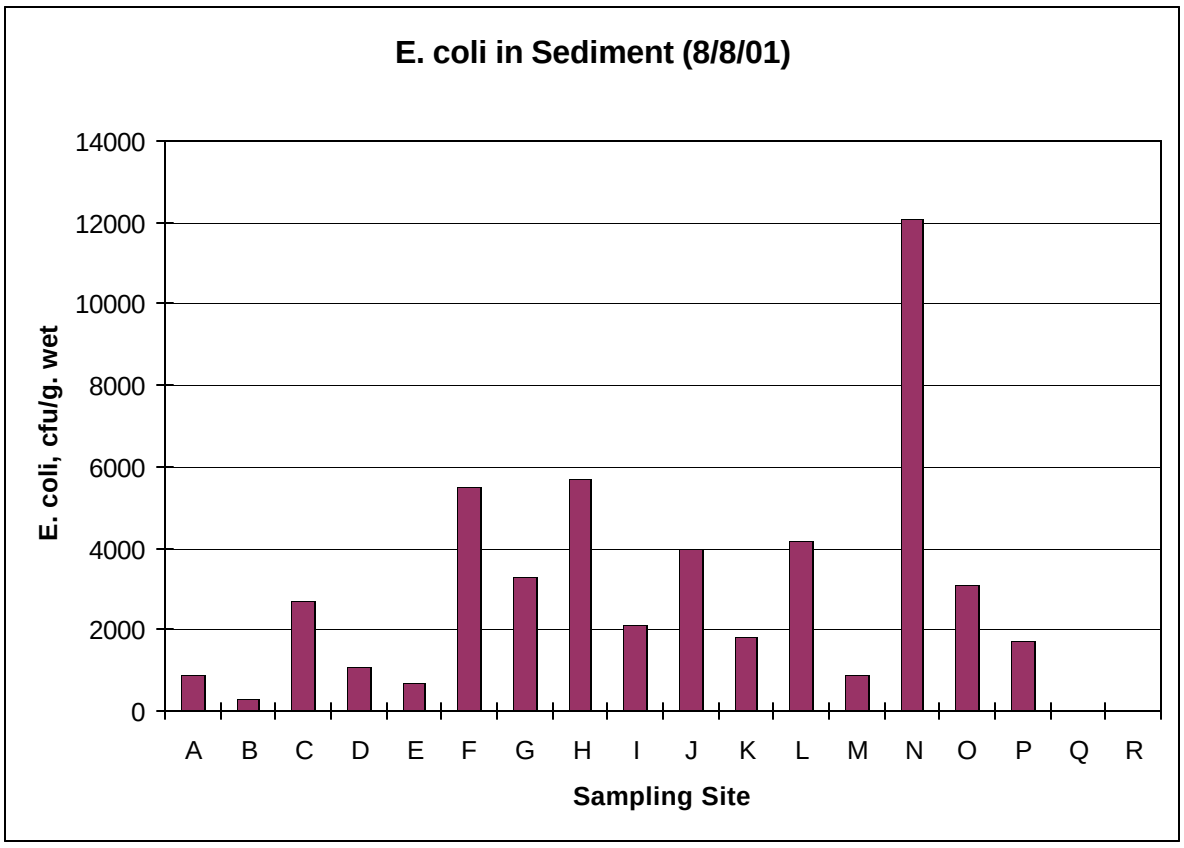

Figure 4 E. coli in Wolf Creek/Berger Ditch Sediments on August 8, 2001

2. *E.. coli* levels in sediment are quite variable. Two adjacent sites may differ widely. The same site may show very different results from one month to the next. Figure 4 shows the results on August 8, 2001.

3. Rainstorms stir up a vast volume of sediment and bacteria from Wolf Creek and Berger Ditch, and flush them out to the bay. The storm flush of August 24, 2001 showed a 250-fold increase over dry weather flow. (See figure 5)

4. During a rainstorm flush, the peak *E coli* level of 46,000 was 105 minutes after the rainstorm. Levels decreased; after sixteen hours, the level was 4,200. By comparison, the health standard for surface water is 126. *E coli* returned to "background" levels within five dry days after a storm. Figure 5 shows the *E coli* levels in the water column following the storm in red, and post-storm (background) levels in green.

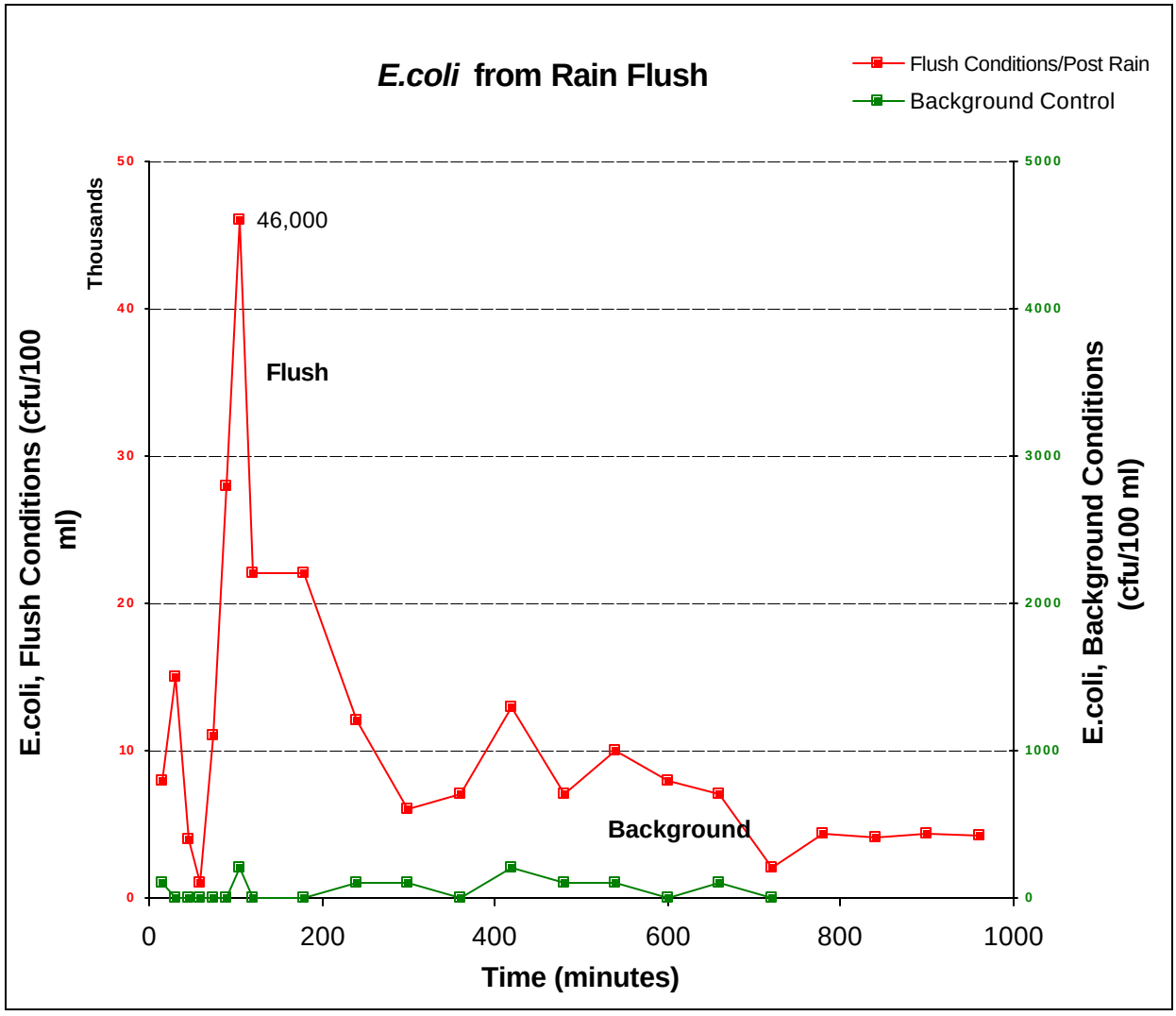

Figure 5 E. coli in Berger Ditch at Maumee Bay State Park following the flushing rainstorm of August 24, 2001

5. Lab studies showed that *E coli* survive in Wolf Creek sediments for a month with a population drop of 97%. This sounds like a substantial die-off of bacteria, but with the start population in the billions, 3% survival is enough to pose a human health risk.

6. Because bacteria do die-off, but their numbers remain high in the sediments, there must be ongoing sources.

7. Even under drought conditions, fecal contamination remains in the sediments as long as they are under water or moist.

8. The rainstorm flush of sediment and *E. coli* from Wolf Creek and Berger Ditch show that this is likely a source of bacterial contamination affecting the Maumee Bay State Park Lake Erie beaches. Previous studies indicate there are other sources as well.

9. No specific *E. coli* hot spots were identified in Wolf Creek/Berger Ditch; levels were high but variable at many sites over time.

10. High *E. coli* levels were consistently found in sediments upstream of areas impacted by the seiche — water flowing into the stream from Lake Erie under northeasterly winds. *E. coli* in

these sediments must therefore be attributed to sources from the watershed, not sources in Lake Erie.

Recommendations

1. Monitor the water column of Wolf Creek on a continuing basis to determine whether it meets OEPA water quality standards.
2. Continue monitoring and repair of septic systems in the Wolf Creek watershed, and other ditches draining into Maumee Bay.
3. Install sanitary sewers where economically feasible
4. Conduct research to determine to what extent the Wolf Creek *E. coli* are from human sources versus animal sources.
5. Conduct studies of *E. coli* in surface runoff water in the Wolf Creek watershed.
6. Check Health Department and sewer tap records to assure that all houses in sewered areas are connected. It is believed that some houses have a sewer available, but have not tapped.
7. Evaluate the feasibility of projects at Maumee Bay State Park
    a. A wetland that stormwater would flow through, to serve as a filter and reduce bacteria reaching the bay. Locations to consider should be near the downstream end of Berger Ditch, either in or near the Park.
    b. A breakwall extension from the western edge of the marina into Lake Erie. Such a breakwall may direct *E. coli* from Berger Ditch out into Bay, and help protect the beaches.
8. Repeat this study after the planned sewers in Oregon are completed (over the next two years), and allowing for die-off of bacteria in the sediments. If all buildings are tapped into available sewers, the results will show to what extent the *E. coli* problems were septic systems versus surface runoff.

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