

**Swim Beach Bacterial Monitoring Report  
Acadia National Park, 2003**



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## SUMMARY

Monitoring of bacterial densities at selected recreational swim beaches within Acadia National Park in 2003, closely followed the 2002 program (Breen, 2003). The bacterial sampling program was conducted in accordance with National Park Service (NPS) Director's Order #83: Public Health, to reduce the risk to park visitors of contracting a waterborne disease. Freshwater beaches sampled included the "life-guarded" beach at Echo Lake and the unguarded beach at Lake Wood; marine waters were sampled at the guarded beach at Sand Beach and in the ephemeral lagoon area at the east-end of Sand Beach. Freshwater samples were analyzed for *Escherichia coli*, marine and estuarine waters for *Enterococci* bacteria. The Health and Environmental Testing Laboratory, Maine Department of Human Services performed sample analysis. Sampling was conducted weekly from June 2, to September 2. Bacterial levels at all locations remained well within United States Environmental Protection Agency guidelines throughout the sampling season.

## INTRODUCTION

Director's Order #83: Public Health (National Park Service, 1999) requires that bacterial monitoring be conducted at all designated bathing beaches. A designated beach is defined as any beach identified by the park (signs, brochures, maps etc.) as "available to the public for contact recreational water activities." Designated bathing beaches at Acadia National Park (ANP) are Sand Beach and Echo Lake Beach. DO #83 states that the operation, maintenance and monitoring of bathing beaches should be in accordance with applicable state or local regulations, or in the absence of state regulations follow NPS policy. The Maine Department of Human Services (MDHS) has responsibility for protecting human health and establishing bathing beach monitoring standards in the state. At the present time Maine does not have an approved policy for bacterial monitoring at state bathing beaches (John Chandler, MDHS, personal communication). Therefore, the policy and guidance outlined in DO #83 were used to develop the bacterial monitoring program adopted in 2002.

Specific bacterial monitoring requirements outlined in DO #83 include:

- (a) Conducting a sanitary survey;
- (b) Preparing a bathing beach monitoring protocol;
- (c) Sampling for enterococcus or *Escherichia coli*; and
- (d) Issuing swimming advisories when bathing beach waters exceed bacterial standards.

Prior to beginning the monitoring program, park resource management staff prepared a standard operating procedure for bacterial monitoring, and conducted a sanitary survey of each beach to be monitored. The procedures and sanitary survey were reviewed by the Regional Public Health Consultant and approved by the Superintendent (Acadia National Park, 2002). The approved monitoring procedures identify *enterococci* as the bacterial indicator to be analyzed for at marine beaches (Sand Beach and the Lagoon), and *E. coli* as the indicator at freshwater beaches (Echo Lake, Lake Wood).

## BACTERIAL STANDARDS

The following bacterial indicators and standards, recommended by DO #83 as well as the MDHS and USEPA, have been adopted in the Acadia National Park bacterial monitoring program:

1. Marine Water Bathing Beaches
  - a. Enterococci
    - 1) **35 colonies/100 ml.** (Geometric Mean)  
**Or**
    - 2) **104 colonies/100 ml.** (Not to be exceeded by any one sample).
2. Freshwater Bathing Beaches
  - a. Enterococci
    - 1) **33 colonies/100 ml.** (Geometric Mean)  
**Or**
    - 2) **61 colonies/100 ml.** (Not to be exceeded by any one sample).
  - b. *E. coli*
    - 1) **126 colonies/100 ml.** (Geometric Mean).  
**Or**
    - 2) **235 colonies/100 ml.** (Not to be exceeded by any one sample).

## METHODS

Bacterial monitoring procedures implemented in 2003 are outlined in detail in the Acadia National Park standard operating procedure for "Bacterial Monitoring of Recreational Bathing Beaches" (Acadia National Park, 2002).

Water samples were collected from the park's two designated bathing beaches, Echo Lake and Sand Beach, and from the non-designated beach at Lake Wood (figure 1.). Sampling was also conducted at the Sand Beach lagoon when there was enough water present to justify sampling. The lagoon is an ephemeral pond that forms along an intermittent stream that flows into the ocean at the east-end of Sand Beach. The lagoon forms when beach accretion builds up and plugs the stream outlet. The lagoon often dries up in late summer due to drought. Two samples were collected each week at Sand Beach and Echo Lake, and one sample at Lake Wood and Sand Beach Lagoon.

Bacterial monitoring was conducted weekly from June 2 through September 2, following designated sample collection procedures (Figure 2.). Samples were collected Monday or Tuesday (if Monday was a holiday) morning using sample bottles provided by the Health and Environmental Testing Laboratory (HETL) at the Maine Department of Human Services. The

HETL is the state's primary health testing lab and is certified to conduct bacterial analysis in compliance with US Environmental Protection Agency methods (USEPA, 1986).

Samples were collected by wading into the water approximately thigh deep and submerging the sample bottle about one foot below the surface. Care was taken to keep fingers from touching the lid or inside of the sample bottle thus avoiding contamination. The date, time of sampling, location, weather conditions and surface water temperature were recorded. In addition, rainfall data (taken from ANP National Atmospheric Deposition Program rain gage) for 24 and 72 hours prior to sampling were also recorded.

Samples were mailed to the lab the same day using special mailing labels and insulated shipping containers provided by the HETL.

## RESULTS

Bacterial results for 2003 are presented in Table 1. At all locations, Echo Lake, Lakewood, Sand Beach, and Sand Beach Lagoon, bacterial densities remained well below EPA standards throughout the summer. Samples collected on June 23 arrived late to the lab and were not analyzed because they exceeded the HETL holding time limit. The highest single sample *E. coli* densities at Echo Lake and Lake Wood respectively were counts of 38 and 16 colonies per 100 milliliters. The highest single *enterococci* density at Sand Beach was a count of less than 10, which was the minimum detection limit. Sand Beach Lagoon had a maximum *enterococci* count of less than 20 colonies/100ml.

## DISCUSSION

The bacterial monitoring program conducted in 2003 successfully met all program objectives. For the most part, resource management staff, with assistance from park life-guards, were able to collect water samples and mail them to the state lab each week without any contamination, mailing delays, or other major problems. The only exception was the delayed arrival to the HETL lab of the June 23 samples. Results were faxed to the park by the HETL lab by Friday each week, so that notification, if necessary, of unhealthful conditions could have been initiated.

The results of monitoring conducted in 2003 indicate that bacterial densities at all ANP sampling locations were well within DO #83 and EPA bacterial guidelines. Because of the consistently low bacterial densities observed at Echo Lake beach in both 2002 and 2003, no additional sampling was deemed necessary at other less densely used swimming areas (i.e. Ike's point or the ledges) on Echo lake. The park plans to continue bacterial sampling at Sand Beach, Sand Beach Lagoon, Echo Lake and Lake Wood swim beach areas in 2004.

## **LITERATURE CITED**

Acadia National Park. 2002. Standard Operating Procedure: Bacterial Monitoring of Recreational Bathing Beaches. Bar Harbor, ME.

Breen, R., 2003. Swim Beach Bacterial Monitoring Report, Acadia National Park, 2002. Acadia National Park Natural Resources Report 2003-07.

National Park Service, 1999. Director's Order #83: Public Health. U.S. Department of Interior. National Park Service, Washington D.C.

United States Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria. EPA440-5-84-002. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C.

Figure 1.

2002 ANP Bacteriological Monitoring Sites

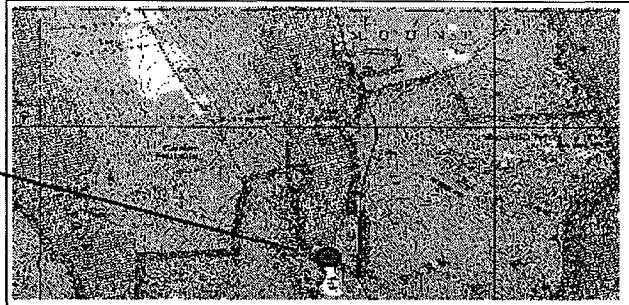
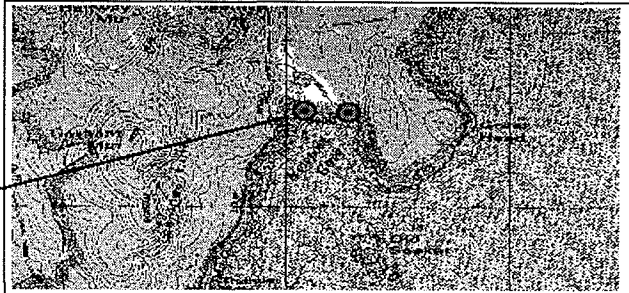
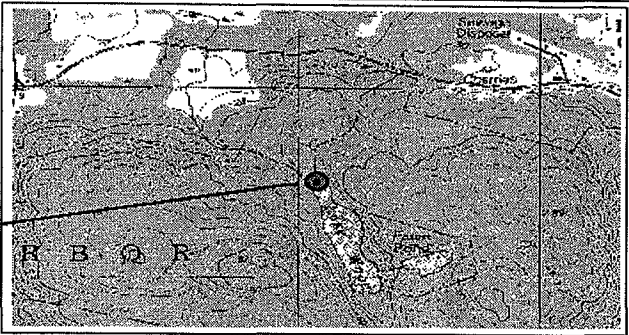
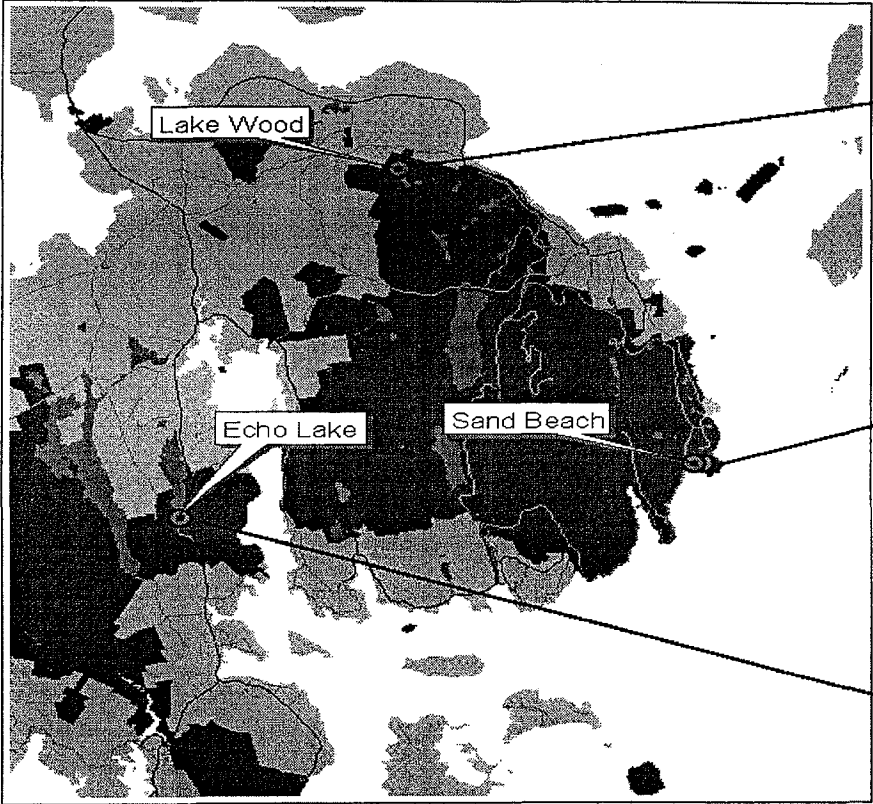


**Figure 2.**

## **RECOMMENDED SAMPLING PROCEDURES**

1. Collect samples on Monday morning (or Tuesday, if Monday is a Holiday) using bottles provided by the Maine DHS laboratory.
2. Collect samples as early as possible in the morning before visitors begin using the beach at the following locations (see figure 1.):
  - Sand Beach (east and west), 2 samples, approximately 1/3 and 2/3 the length of beach
  - Sand Beach Lagoon, 1 sample, near center of lagoon area
  - Echo Lake (east and west), 2 samples approximately 1/3 and 2/3 the length of beach
  - Lake Wood, 1 sample, near center of beach at north end of lake.
3. Wade out into the surf/lake about thigh deep and face into the current/wind.
4. Collect the water sample from an incoming wave, taking care to avoid getting sediment or debris into the sample.
5. The object is to avoid capturing surface water, and to collect from at least 1-foot depth. Grasp the bottle near the base with one hand and remove the cap with the other. Be careful to avoid touching the inside of the cap or rim of the bottle. Rotate your wrist so the mouth of the bottle is pointing downward at about a 45-degree angle. Rapidly plunge the bottle to a depth of about one foot. Rotate your wrist so the mouth of the bottle points up, loses its air bubble, and fills with water. Replace the cap while still underwater.
6. Lift the capped bottle out of the water. Remove the cap and carefully pour out enough water to leave a 1/2 inch air space. Replace the cap. Be careful to not touch the inside of the bottle or the inside of the cap.
7. Immediately place the bottle in an upright position in a covered cooler containing sufficient ice to keep the samples cool until they can be mailed to the laboratory. Park lifeguards may assist in collecting water samples at guarded beaches. Resource Management staff will collect samples at Lake Wood, and from the lifeguards, then prepare samples for mailing to the lab.
8. Record the sample bottle number, station name, date and time of sampling, sampler's name and other appropriate information on the field data sheet (Appendix C.).
9. Within 6 hours of sampling mail samples via regular mail to the Health and Environmental Testing Laboratory, Maine Department of Human Services, using the form, insulated shipping container, and mailing label provided by the Laboratory (Appendix D.).

**Table 1. Swim Beach Bacterial Monitoring Results, 2003**

| SAMPLE #      | SITE              | DATE    | COLLECTOR | TIME | TEMP | Rain (in<br>24h) | Rain (in<br>72h) | LAB | ECOLI | ENT |
|---------------|-------------------|---------|-----------|------|------|------------------|------------------|-----|-------|-----|
| 03E-WTR-06024 | Echo Lake East    | 6/2/03  | Sheehan   | 1118 | 15   | 1.25             | 1.25             | DHS | 34    |     |
| 03E-WTR-06023 | Echo Lake West    | 6/2/03  | Sheehan   | 1115 | 15   | 1.25             | 1.25             | DHS | 6     |     |
| 03E-WTR-06022 | Lake Wood         | 6/2/03  | Sheehan   | 1040 | 14.9 | 1.25             | 1.25             | DHS | 11    |     |
| 03E-WTR-06047 | Sand Beach Lagoon | 6/2/03  | Breen     | 1000 |      | 1.25             | 1.25             | DHS |       | 10  |
| 03E-WTR-06047 | Sand Beach West   | 6/2/03  | Breen     | 1000 |      | 1.25             | 1.25             | DHS |       | 10  |
| 03E-WTR-06036 | Echo Lake East    | 6/9/03  | Sheehan   | 1125 | 15.2 | 0                | 0                | DHS | 38    |     |
| 03E-WTR-06037 | Echo Lake West    | 6/9/03  | Sheehan   | 1127 | 15.2 | 0                | 0                | DHS | 11    |     |
| 03E-WTR-06047 | Lake Wood         | 6/9/03  | Sheehan   | 1050 | 16.6 | 0                | 0                | DHS | 0     |     |
| 03E-WTR-06048 | Sand Beach East   | 6/9/03  | Sheehan   | 1330 |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06065 | Sand Beach Lagoon | 6/9/03  | Sheehan   | 1333 |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06064 | Sand Beach West   | 6/9/03  | Sheehan   | 1327 |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06029 | Echo Lake East    | 6/16/03 | Sheehan   | 1410 | 19   | 0.05             | 0.9              | DHS | 0     |     |
| 03E-WTR-06027 | Echo Lake West    | 6/16/03 | Sheehan   | 1415 | 19   | 0.05             | 0.9              | DHS | 0     |     |
| 03E-WTR-06028 | Lake Wood         | 6/16/03 | Sheehan   | 1010 |      | 0.05             | 0.9              | DHS | 0     |     |
| 03E-WTR-06068 | Sand Beach East   | 6/16/03 | Sheehan   | 920  |      | 0.05             | 0.9              | DHS |       | 10  |
| 03E-WTR-06067 | Sand Beach Lagoon | 6/16/03 | Sheehan   | 925  |      | 0.05             | 0.9              | DHS |       | 10  |
| 03E-WTR-06069 | Sand Beach West   | 6/16/03 | Sheehan   | 915  | 15.2 | 0.05             | 0.9              | DHS |       | 10  |

**Table 1. (page 2.)**

| SAMPLE #      | SITE              | DATE    | COLLECTOR | TIME | TEMP | Rain (in<br>24h) | Rain (in<br>72h) | LAB | ECOLI | ENT |
|---------------|-------------------|---------|-----------|------|------|------------------|------------------|-----|-------|-----|
| 03E-WTR-06040 | Echo Lake East    | 6/30/03 | Sheehan   | 940  | 20.8 | 0                | 0                | DHS | 0     |     |
| 03E-WTR-06039 | Echo Lake West    | 6/30/03 | Sheehan   | 942  | 20.8 | 0                | 0                | DHS | 0     |     |
| 03E-WTR-06041 | Lake Wood         | 6/30/03 | Sheehan   | 910  | 23.4 | 0                | 0                | DHS | 2     |     |
| 03E-WTR-06063 | Sand Beach East   | 6/30/03 | Sheehan   | 1039 |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06061 | Sand Beach Lagoon | 6/30/03 | Sheehan   | 1041 |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06062 | Sand Beach West   | 6/30/03 | Sheehan   | 1030 |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06032 | Echo Lake East    | 7/7/03  | Sheehan   | 1103 | 24.7 | 0                | 0                | DHS | 3     |     |
| 03E-WTR-06033 | Echo Lake West    | 7/7/03  | Sheehan   | 1100 | 24.7 | 0                | 0                | DHS | 1     |     |
| 03E-WTR-06031 | Lake Wood         | 7/7/03  | Sheehan   | 1015 | 25.7 | 0                | 0                | DHS | 0     |     |
| 03E-WTR-06051 | Sand Beach East   | 7/7/03  | Sheehan   | 932  | 13.9 | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06050 | Sand Beach Lagoon | 7/7/03  | Sheehan   | 934  | 22.2 | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06049 | Sand Beach West   | 7/7/03  | Sheehan   | 928  | 13.9 | 0                | 0                | DHS |       | 10  |
| 03E-WTR-06030 | Echo Lake East    | 7/14/03 | Seger     | 947  | 21.4 | 0                | 0.7              | DHS | 1     |     |
| 03E-WTR-06038 | Echo Lake West    | 7/14/03 | Seger     | 945  | 21.4 | 0                | 0.7              | DHS | 0     |     |
| 03E-WTR-06045 | Lake Wood         | 7/14/03 | Seger     | 910  | 23.1 | 0                | 0.7              | DHS | 3     |     |
| 03E-WTR-06066 | Sand Beach East   | 7/14/03 | Seger     | 814  | 10.5 | 0                | 0.7              | DHS |       | 10  |
| 03E-WTR-06054 | Sand Beach Lagoon | 7/14/03 | Seger     | 819  | 17.8 | 0                | 0.7              | DHS |       | 10  |
| 03E-WTR-06057 | Sand Beach West   | 7/14/03 | Seger     | 805  | 10.5 | 0                | 0.7              | DHS |       | 10  |

**Table 1 (page 3.)**

| SAMPLE #      | SITE              | DATE    | COLLECTOR | TIME | TEMP | Rain (in<br>24h) | Rain (in<br>72h) | LAB | ECOLI | ENT |
|---------------|-------------------|---------|-----------|------|------|------------------|------------------|-----|-------|-----|
| 03E-WTR-06044 | Echo Lake East    | 7/21/03 | Seger     | 1000 | 20.8 | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-06043 | Echo Lake West    | 7/21/03 | Seger     | 1000 | 20.8 | 0                | 0.05             | DHS | 3     |     |
| 03E-WTR-06042 | Lake Wood         | 7/21/03 | Breen     | 1030 | 23.5 | 0                | 0.05             | DHS | 2     |     |
| 03E-WTR-06055 | Sand Beach East   | 7/21/03 | Breen     | 915  | 12.7 | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-06053 | Sand Beach Lagoon | 7/21/03 | Breen     | 915  | 20.5 | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-06052 | Sand Beach West   | 7/21/03 | Breen     | 915  | 12.7 | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-09043 | Echo Lake East    | 7/28/03 | Sheehan   | 1120 | 22.4 | 0                | 0                | DHS | 2     |     |
| 03E-WTR-09042 | Echo Lake West    | 7/28/03 | Sheehan   | 1125 | 22.4 | 0                | 0                | DHS | 5     |     |
| 03E-WTR-09049 | Lake Wood         | 7/28/03 | Sheehan   | 1050 | 23.7 | 0                | 0                | DHS | 0     |     |
| 03E-WTR-09070 | Sand Beach East   | 7/28/03 | Sheehan   | 930  | 12   | 0                | 0                | DHS |       | 10  |
| 03E-WTR-09067 | Sand Beach Lagoon | 7/28/03 | Sheehan   | 937  | 19.7 | 0                | 0                | DHS |       | 10  |
| 03E-WTR-09066 | Sand Beach West   | 7/28/03 | Sheehan   | 945  | 12   | 0                | 0                | DHS |       | 10  |
| 03E-WTR-09041 | Echo Lake East    | 8/4/03  | Sheehan   | 736  | 21   | 0                | 0.6              | DHS | 1     |     |
| 03E-WTR-09047 | Echo Lake West    | 8/4/03  | Sheehan   | 735  | 21   | 0                | 0.6              | DHS | 5     |     |
| 03E-WTR-09045 | Lake Wood         | 8/4/03  | Sheehan   | 750  | 22.3 | 0                | 0.6              | DHS | 0     |     |
| 03E-WTR-09063 | Sand Beach East   | 8/4/03  | Sheehan   | 824  | 11.9 | 0                | 0.6              | DHS |       | 10  |
| 03E-WTR-09064 | Sand Beach Lagoon | 8/4/03  | Sheehan   | 825  | 20.2 | 0                | 0.6              | DHS |       | 10  |
| 03E-WTR-09065 | Sand Beach West   | 8/4/03  | Sheehan   | 822  | 11.9 | 0                | 0.6              | DHS |       | 10  |

**Table 1. (page 4.)**

| SAMPLE #      | SITE              | DATE    | COLLECTOR | TIME | TEMP | Rain (in<br>24h) | Rain (in<br>72h) | LAB | ECOLI | ENT |
|---------------|-------------------|---------|-----------|------|------|------------------|------------------|-----|-------|-----|
| 03E-WTR-09050 | Echo Lake East    | 8/11/03 | Sheehan   | 823  | 21   | 0                | 0.08             | DHS | 2     |     |
| 03E-WTR-09057 | Echo Lake West    | 8/11/03 | Sheehan   | 825  | 21   | 0                | 0.08             | DHS | 3     |     |
| 03E-WTR-09051 | Lake Wood         | 8/11/03 | Sheehan   | 905  | 23.9 | 0                | 0.08             | DHS | 1     |     |
| 03E-WTR-09079 | Sand Beach East   | 8/11/03 | Sheehan   | 940  | 13.9 | 0                | 0.08             | DHS |       | 10  |
| 03E-WTR-09072 | Sand Beach Lagoon | 8/11/03 | Sheehan   | 940  | 21.3 | 0                | 0.08             | DHS |       | 10  |
| 03E-WTR-09071 | Sand Beach West   | 8/11/03 | Sheehan   | 945  | 13.9 | 0                | 0.08             | DHS |       | 10  |
| 03E-WTR-09039 | Echo Lake East    | 8/18/03 | Sheehan   | 856  |      | 0                | 0.05             | DHS | 0     |     |
| 03E-WTR-09040 | Echo Lake West    | 8/18/03 | Sheehan   | 900  |      | 0                | 0.05             | DHS | 1     |     |
| 03E-WTR-09052 | Lake Wood         | 8/18/03 | Sheehan   | 932  | 24.1 | 0                | 0.05             | DHS | 0     |     |
| 03E-WTR-09075 | Sand Beach East   | 8/18/03 | Sheehan   | 1015 | 14.1 | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-09068 | Sand Beach Lagoon | 8/18/03 | Sheehan   | 1010 | 23   | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-09069 | Sand Beach West   | 8/18/03 | Sheehan   | 1020 | 14.1 | 0                | 0.05             | DHS |       | 10  |
| 03E-WTR-09061 | Echo Lake East    | 8/25/03 | Sheehan   | 920  | 21.4 | 0                | 0                | DHS | 1     |     |
| 03E-WTR-09054 | Echo Lake West    | 8/25/03 | Sheehan   | 925  | 21.4 | 0                | 0                | DHS | 1     |     |
| 03E-WTR-09053 | Lake Wood         | 8/25/03 | Sheehan   | 1000 | 22.6 | 0                | 0                | DHS | 2     |     |
| 03E-WTR-09084 | Sand Beach East   | 8/25/03 | Sheehan   | 1040 | 14.6 | 0                | 0                | DHS |       | 10  |
| 03E-WTR-09081 | Sand Beach Lagoon | 8/25/03 | Sheehan   | 1030 | 23.6 | 0                | 0                | DHS |       | 10  |
| 03E-WTR-09083 | Sand Beach West   | 8/25/03 | Sheehan   | 1035 | 14.6 | 0                | 0                | DHS |       | 10  |

**Table 1. (page 5.)**

| SAMPLE #      | SITE              | DATE   | COLLECTOR | TIME | TEMP | Rain (in<br>24h) | Rain (in<br>72h) | LAB | ECOLI | ENT |
|---------------|-------------------|--------|-----------|------|------|------------------|------------------|-----|-------|-----|
| 03E-WTR-09056 | Echo Lake East    | 9/2/03 | Seger     | 934  | 19.2 | 0                | 0                | DHS | 35    |     |
| 03E-WTR-09059 | Echo Lake West    | 9/2/03 | Seger     | 930  | 19.2 | 0                | 0                | DHS | 18    |     |
| 03E-WTR-09055 | Lake Wood         | 9/2/03 | Seger     | 1000 | 20.5 | 0                | 0                | DHS | 16    |     |
| 03E-WTR-09073 | Sand Beach East   | 9/2/03 | Seger     | 811  |      | 0                | 0                | DHS |       | 10  |
| 03E-WTR-09080 | Sand Beach Lagoon | 9/2/03 | Seger     | 815  |      | 0                | 0                | DHS |       | 20  |
| 03E-WTR-09078 | Sand Beach West   | 9/2/03 | Seger     | 808  |      | 0                | 0                | DHS |       | 10  |