1995 LAKE POWELL WATER QUALITY MONITORING REPORT

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INTRODUCTION

The National Park Service at Glen Canyon National Recreation Area (NRA) collects water samples for fecal coliform bacteria analysis from beach locations around Lake Powell. This water quality monitoring program is performed to ensure public health and safety and compliance with state and federal water quality standards, to evaluate visitor impacts upon water quality, and to conduct resource protection and management activities. Bacterial monitoring began in 1988 with the program gaining emphasis, expansion and expertise each year. Visitation to Lake Powell has increased steadily for several years; this has resulted in increased use and impacts to water quality.

The 1995 season proved to be a very challenging year for the water quality monitoring program. Water surface elevation for Lake Powell rose from a minimum of 3644 feet above mean sea level on March 4, 1995 to a maximum of 3694 feet on August 3, 1995. Beach and camping zones that were normally dry were inundated for the first time in ten years. These physical factors in combination with increased visitation and elevated levels of bacterial contamination contributed to a record number of beaches closed to swimming. The large number of resample events necessary this year led to considerable logistical difficulties and added to costs incurred. Cooperation of all divisions at Glen Canyon NRA was appreciated and necessary to accomplish all the required work for 1995.

The Water Resource Division (WRD) of the National Park Service (NPS) provided technical assistance by analyzing and interpreting bacterial water quality data from Glen Canyon NRA (Long and Smith, 1995). One of the objectives for these analyses was to develop a predictive model based on the data collected at each site during field sampling that could forecast potential health risks due to elevated bacterial contamination. The results of these analyses suggest a bacterial contamination problem does exist at some beaches, but statistical correlations between high bacteria counts and site characteristics, such as visitor use patterns and lake levels, were not significant.

In addition to the bacteriological monitoring, Glen Canyon NRA was involved in a cooperative sampling effort with the Utah Division of Water Quality (UDWQ), coordinated through Richard Denton. All UDWQ samples were filtered at the Wahweap lab by Glen Canyon NRA personnel. The filters and filtered water samples were then sent to the state lab for chlorophyll and nutrient analysis. This is a valuable effort that will provide baseline water quality and biological productivity data on Lake Powell. Other cooperative efforts were also mutually beneficial. Utah Division of Wildlife Resources (UDWR) continued to use the NPS Wahweap lab for nitrate analysis. The reverse osmosis unit provided by Glen Canyon NRA to the Arizona Game and Fish (AGF) lab performed adequately and provided both the Wahweap and Bullfrog labs with a reliable source of purified deionized water.

LAB FACILITIES

Two lab facilities continued to operate at Glen Canyon NRA in 1995, one uplake at Bullfrog, UT. and one downlake at Wahweap, AZ. Facilities at the downlake lab were upgraded including renovation of the electrical system and installation of a new autoclave sterilizer and countertops. Through funding provided through the Water Resources Division, Glen Canyon NRA was able to purchase a new autoclave sterilizer, a new pH/conductivity/selective ion meter and two new Hydrolab multi-parameter water quality probes. These instruments greatly increased the ability to maintain sufficient quality assurance/ quality control (QA/QC) standards for the water quality

program. Although an on site inspection did not occur in 1995, both NPS labs maintained the Utah Department of Health certification for environmental testing. The QA/QC plan developed in 1993 at Glen Canyon NRA was revised (Dodson, 1995) and adhered to for the 1995 season.

METHODOLOGY

During the peak visitation season, May through September, a total of 54 sites were sampled lakewide on every other Monday (table 1 & fig. 1). These sites included 19 in the Wahweap area, 16 in the Dangling Rope area, 15 in the Bullfrog area, and 4 in the Hite area. During the winter months (October through April) sampling was decreased to once a month at 7 sites uplake (Bullfrog and Hite) and 7 sites downlake (Wahweap). The Dangling Rope sites were not done during the winter months due to distance and time involved. Water quality sampling on Lake Powell required a great deal of logistical planning due to scheduling of personnel, boat availability and plane transportation (Table 2). For each sample day, four separate efforts were required: 1) Hite District (2 people, 1 boat), 2) Bullfrog District (2 people, 1 boat), 3)Dangling Rope District (2 people, 1 boat), and 4) Wahweap District (2 people, 1 boat). The Hite samples were sent by park plane to the Bullfrog lab and processed along with the Bullfrog samples. The Wahweap and Dangling Rope samples were processed at the water lab at the Wahweap maintenance area.

Samples were collected by boat in near shore environments where the water depth was 4 feet deep. A Van Dorn water sampler was used to collect a sample 4 inches below the surface. Duplicate 100 ml. subsamples were taken at each site from the Van Dorn sampler using pre-sterilized, disposable bottles and immediately packed on ice. Other data collected at each site include water and air temperature, time of collection count of boats, people, vehicles and sanitation facilities, location condition, weather condition, pH, and conductivity. When all field work was accomplished the samples were transported back to the lab and processed within the recommended 6 hour holding time limit (APHA, 1992).

All lab work at both NPS labs followed the procedures described in Standard Methods for the Examination of Water and Wastewater (APHA, 1992) for the analysis of fecal coliform bacteria using the membrane filter technique (MF). At the labs, replicate samples were processed as 100 ml and 50 ml aliquots for each site. In the case of a resample event, additional dilution samples were run in order to produce a countable plate. Depending on the expected bacterial concentration, additional dilutions were run at 25, 10, 5, 1, or 0.1 ml dilutions (e.g., a 10 ml dilution sample equals 10 ml of sample + 90 ml of sterile buffer, results were reported as #CFU/100 ml). Each sample was filtered through a Millipore funnel apparatus that was presterilized by the autoclave or ultraviolet light exposure, followed by three 20 ml rinses with sterile buffer solution. The filters were then removed and placed in a petri dish with an absorbent pad saturated in a bacterial growth medium (mFC broth). Petri dishes were sealed in a plastic ziploc bag and placed upside down in a water bath incubator held at 44.5 $\pm$ 5°C for 24 hours. At the end of the incubation period the coliform colonies were counted for each of the 100 ml and 50 ml sample dilution. Counts from the 2 replicate samples were averaged and results were reported as the number of colony forming units per 100 ml sample (#CFU/100 ml).

If the average coliform counts for a site exceeded 200 CFU/100 ml the site was resampled as soon as possible. Resampling of the site continued until the counts decreased. When the geometric mean of at least 5 samples in a 30 day period exceeded 200 CFU/100 ml or if 10% of samples exceed 400 CFU/100 ml the Superintendent issued a closure to swimming for that site. The closed sites were monitored on a daily basis until the coliform counts dropped and a 5 sample geometric mean

was less than 200 CFU/100 ml at which point the beach was reopened. Only sites that exceeded the allowable standard were resampled. However, because of the logistics involved in sampling Lake Powell (i.e., boat and personnel scheduling, plane transportation, distance to sites, lab prep, etc.) resample days usually took nearly as long as regularly scheduled sample days.

Results from the lab, including coliform counts from both the 100 ml and 50 ml dilution samples, and any field data collected were entered in to the park water quality database. For resample events, all sample dilutions were counted for bacterial colonies and recorded on the data sheets. The lab technician denoted the two plates that best met the counting criteria as specified in the QA/QC plan (a countable plate between 20 and 80 colonies). Coliform counts from the two selected plates were entered into the database. The average value of the two selected plates were used for analysis purposes or for decisions regarding resampling or beach closures.

BEACH CLOSURE AND REOPENING POLICY

Lake Powell encompasses areas in both Utah and Arizona. Inconsistencies in water quality standards between the two states led to differences in interpretation regarding application of water quality standards to beach closures at Lake Powell. Arizona Division of Water Quality states a maximum level of 200 CFU/100 ml based on a 30 day geometric mean with a 5 sample minimum or if 10% of the samples exceed 400 CFU/100 ml or if a single sample exceeds 800 CFU/100 ml. Utah Division of Water Quality also states a maximum level of 200 CFU/100 ml based on a 30 day geometric mean but does not require a 5 sample minimum. Prior to 1995 Glen Canyon NRA used results from both dilution samples (100 ml and 50 ml) in the 5 sample geometric mean calculation. Therefore, only 2 days of high count results would produce 4 of 5 values necessary for the geometric mean calculation. In 1995 the NPS Water Resource Division advised Glen Canyon NRA to average both dilution samples to obtain one daily result from each site. This required collecting 5 days of samples to use for the geometric mean calculation. Management implications of this include a lag time of several days from the first elevated counts until enough high numbers were obtained to raise the geometric mean to justify a beach closure. Conversely, when the counts fell to acceptable levels the reopening is delayed until 4 to 5 average daily values were low enough to bring down the geometric mean. The state specified procedures were problematic when applied to Lake Powell due to the fact that most episodes of high bacterial counts are sporadic and brief, usually a high peak followed by a rapid decline. Application of the state procedures would result in sites with elevated counts not being posted at all, or being posted when the worst is over and the levels have already dropped.

During the 1995 season, Glen Canyon NRA policy was to apply the geometric mean to the most current 5 sample days within a 30 day period. This practice enabled us to apply the most recent data available within a 30 day period to initiate beach swimming closures. By using this procedure we have been able to avoid "false alarms" that would result in excess closures based on a geometric mean of less than 5 days but still allow for timely closures based on the most recent data. Glen Canyon NRA also closed beaches to swimming if coliform concentrations at a site are in excess of 400 CFU/100 ml (i.e., for greater than 10% of samples).

When the decision had been made to close a beach the Chief Ranger was notified and the beach was posted to restrict swimming. Ranger patrols were increased to the closed beach areas in an effort to enforce and interpret the restrictions. Interpretive Rangers were also involved in initiating contact with visitors at the posted sites and educating them as to reasons behind the closures. Once the beach was closed to swimming the site was sampled on a daily basis. Recommendation to

terminate closure was made when the geometric mean of the most recent 5 sample days dropped below 200 CFU/100 ml.

RESULTS

The 1995 season saw a large fluctuation in lake surface elevation and a record number of swimming beach closures. Eleven sites were closed to swimming due to bacterial contamination in 1995. Six of the eleven sites are accessible by vehicle and have bathroom facilities (table 3).

1995 LAKE POWELL BEACH CLOSURES

SITE	VEHICLE ACCESSIBLE?	RESTROOMS AVAILABLE?	CLOSURE DATES
Farley Canyon	yes	yes	7/29-8/8
Forgotton Canyon	no	no	7/9-14
Hansen Creek	no	no	7/9-14
Hobi Cat Beach	yes	yes	7/9-26
Moqui Canyon	no	no	6/26-7/3
Stanton Creek	yes	yes	7/9-21;7/28-8/8
Upper Bullfrog Bay	yes	yes	7/28-8/8
Lone Rock Beach	yes	yes	7/9-14
Warm Creek Beach	no	no	7/27-29
Wahweap Picnic Beach	no	no	7/27-31
Wahweap Marina	yes	yes	6/14-15

Table 3: 1995 Lake Powell Beach Closures

Resampling events due to high bacterial counts resulted in 25 extra sample days necessary in addition to the 7 normally scheduled days from June through August.

Water surface elevation for Lake Powell rose from a minimum of 3644 feet above mean sea level on March 4 to a maximum of 3694 feet on August 3 (Fig. 2). This 50 foot rise in surface elevation inundated beach and camping areas for the first time in 10 years. Areas of accessible shoreline at many popular beach spots were decreased or disappeared altogether under the rising water, crowding visitor use at some sites to relatively small areas.

There were a total of 895 site samples analyzed for fecal coliform bacteria. Of these samples, 102 resulted in coliform counts over 200 CFU/100 ml. There were 7 sites (AP1, BFMAR1, CHA2, HCMAR1&2, HIMAR1&2,OAK3,WCCA, see site ID key in appendix) that experienced brief periods of high coliform counts exceeding the 200 CFU/100 ml threshold, but swimming closure action was never taken because the counts decreased immediately. Many of the uplake sites had repeated problems with high counts in 1995. Farley Canyon had sporadic high counts starting after July 4 resulting in beach swimming closures from 7/29 through 8/8. The maximum count was

1447 CFU/ 100 ml on 7/30. High counts were also observed at Hite Marina in July but NPS regulations prohibit swimming in marina areas so beach closure restrictions were unnecessary.

The Bullfrog/ Halls Creek area had numerous sites with elevated counts and required swimming restrictions. Hansen Creek and Upper Bullfrog Bay beach sites had high counts with maximum values reaching 1975 CFU/100 ml and 1230 CFU/100 ml, respectively (fig. 4 and 5). Hansen Creek sites were closed to swimming 7/9 - 14 and Upper Bullfrog Bay sites were closed to swimming 7/28 - 8/8. Hobi Cat Beach reached a maximum coliform count of 1765 CFU/100 ml and was closed to swimming 7/9 - 26 (fig. 6). Stanton Creek reached a maximum count of 1970 CFU/100 ml and was closed to swimming twice, 7/9 - 21 and 7/28 - 8/8 (fig. 7). Both Bullfrog Marina and Halls Creek Marina also had high counts this year but restrictions were not enforced due to the NPS no swimming policy at the marinas. Moqui Canyon had a maximum count of 716 CFU/100 ml and was closed to swimming 6/26 - 7/3 (fig. 8). Forgotton Canyon had a maximum count of 1852 CFU/100 ml and was closed to swimming 7/9 - 14 (fig. 9). Four of the downlake sites had elevated counts and required swimming closures: Lone Rock Beach with a maximum count of 801 CFU/100 ml was closed 7/9 - 14, Warm Creek Beach with a maximum count of 545 CFU/100 ml was closed 7/27 - 29, Wahweap Picnic Beach with a high count of 1159 CFU/100 ml was closed 7/27 - 31, and Wahweap Marina with a maximum count of 304 CFU/100 ml was closed 6/14-15. Figures 3-15 are plots of the 1995 coliform counts for all of the sites requiring closures this season.

QA/QC RESULTS

In order to maintain a high level of confidence in the microbiological data collected at Glen Canyon NRA, procedures described in the QA/QC plan were rigorously adhered to. The following controls were processed with each sample batch.

Duplicates: 100 ml and 50 ml dilutions were processed for each sample site.

Positive Control: 100 ml of sterile buffer dilution water was inoculated with *Escherichia Coli* (EC) and processed as normal to insure media and incubation temperature were conducive to fecal coliform growth.

Negative Control: 100 ml of sterile buffer dilution water was inoculated with *Enterobacter Aerogenes* (EA) and processed as normal to insure incubator temperature was correct. EA growth is inhibited at 44.5 °C.

UV Control: A positive control sample was prepared and exposed to UV light for 3 minutes to insure proper operation of the UV sterilizer. A UV control was processed every 10 samples. A 99% kill rate indicates proper UV operation.

Blank: 100 ml of sterile buffer dilution water was processed as normal to insure sterility of equipment, buffer solution, and lack of cross contamination between samples. Blanks were run every 10 samples.

Media Control: A sterile membrane in a petri dish was processed as normal to insure the media was not contaminated. One control was run with each sample batch.

Pre-rinse: 100 ml of sterile buffer dilution water was run through the unsterilized filter apparatus that was used for the positive control. This step determines the efficiency of the triple rinse step done as each sample was filtered. One control was run with each sample batch.

Final Rinse: 100 ml of sterile buffer dilution water was run through the sterilized filter apparatus used for the positive control. This control was the last sample processed.

Quality control practices worked well through the 1995 season. There was one incident of contamination of the blank controls at the Bullfrog lab on May 18 resulting in invalid data. Upon further investigation it was determined that the autoclave fuse blew, interrupting the sterilization cycle. There were numerous times at the Wahweap lab when the UV controls had coliform colonies, but a 99% kill rate was still achieved at all times. There were 3 instances of elevated counts in the pre-rinse control at the Wahweap lab. Beginning in mid to late July the EA culture became contaminated at both NPS labs. Due to this problem, negative controls were invalid at both labs for the latter half of the summer season. New EA cultures were obtained from the Coconino County Health Lab in Flagstaff in October.

ACTION TAKEN

When bacterial contamination exceeded one of the specified maximum levels the site was closed to swimming and resampling was scheduled every day until the counts decreased. Law enforcement rangers posted signs and buoys during beach closures and increased patrols to enforce any swimming restrictions and human waste disposal regulations. Interpretive rangers were posted at launch ramps, roamed popular beach spots initiating visitor contacts in an effort to educate the public on the water quality issues at Lake Powell and to inform them as to proper disposal of human waste. Informational bulletins were developed and distributed from the visitor center and concessionaire locations. There were several media outreach efforts done to inform the public regarding water quality issues, swimming restrictions and other appropriate actions.

In 1994 the park expanded pumpout docks to accommodate more boats at Wahweap, Bullfrog, Halls Crossing, and Hite Marinas. In 1995 new restrooms were constructed at Wahweap Picnic Beach and the Coves area. Future planned activities include expansion of the Stateline pumpout docks, development of floating pumpout docks/dump stations and port-a-potty dump stations installed at launch ramps.

During periods of high bacterial levels, Glen Canyon NRA comes under increased public scrutiny. There were two Freedom of Information Act requests for water quality data, one from the Deseret News in Salt Lake City and another from a private individual. All information requested was forwarded to the interested parties. No further response was received.

DISCUSSION

Lake Powell covers approximately 163,000 acres with nearly 2000 miles of shoreline. A high runoff late in the spring of 1995 resulted in a dramatic rise in lake elevation amounting to 50 vertical feet inundating beach areas that had not been covered in over 10 years. A number of the beach sites with elevated coliform levels are accessible to vehicles with RV's and tents routinely camping on the beach at the waterline. There is concern about improper human waste disposal and illegal dumping of sewage holding tanks by RV's parked in close proximity to the waterline. When

the lake level is rising rapidly these sites are quickly covered with water. Many of the sites that are historically problem spots are beaches where visitors are allowed to camp right at the waterline (see table 3). Bathroom facilities have been installed at many of these sites but remain unused at times due to the distance to the waterline when the lake level is low.

Many beach sites are in remote locations accessible only by boat. Human waste buried at the waterline or illegal dumping are suspected at these sites. Contamination problems can be persistent in narrow canyons due to the minimal water exchange and the increased water temperature.

There were two known incidents of sewage spills at pumpout facilities. On June 6, Wahweap Marina had a high coliform count of 304 CFU/100 ml. Although swimming is prohibited in marina areas the decision was made to officially restrict swimming at the Wahweap Marina site due to its' close proximity to the Wahweap Lodge. Starting July 7, a series of elevated coliform levels were detected at Halls Creek Marina with a maximum count of 1650 CFU/100 ml. Elevated bacterial contamination at both marinas were traced to improper connections at the pumpout facility. Both deficiencies were promptly corrected and the high counts quickly subsided. Through much of July, Hite Marina experienced sporadic high bacterial levels. The cause of these elevated levels was not determined. Sewage spills at the pumpout facility or illegal dumping from the nearby buoy field were suspected but not confirmed.

Data from 1988-1993 were analyzed to determine trends and statistical correlations between high coliform counts and other chemical and physical characteristics at the beach sites (Long and Smith, 1995). Although correlations were not statistically significant there are other observed beach use patterns that are likely impacting the sites. Inspection of the time series plots for the sites that required swimming closures reveals common characteristics at several locations (see figs. 3-15). Many sites typically displayed an increased frequency of high coliform levels with increased water temperature and lake elevation. Figures 14 and 15 display coliform counts at Lone Rock beach along with water temperature and lake elevation. These trends of increasing coliform counts in conjunction with rising water temperature and lake elevation were observed at most of the problem spots during the 1995 season. Also, many sites show a high spike immediately after the fourth of July weekend. These common characteristics suggest some correlation between physical factors (water temperature and rising lake levels) and increasing visitor use with high bacterial contamination.

Recently, Colorado State University completed a study of human waste management issues at Lake Powell (Wallace, et.al., 1994). In 1994 there were 2.3 million visitor nights at Glen Canyon NRA, with 95% of the visitors experiencing Lake Powell with a watercraft of some sort (i.e., houseboat, runabout, etc.). Of this portion, approximately one third (682,000 people for one night) do not carry a marine sanitation device on board. Findings also show that only 46% of the sampled population were aware of current regulations regarding proper disposal of human waste. Other issues identified were ease of use and distance to pumpout/port-a-potty dump stations, inadequate information about proper disposal of human waste, and inadequate enforcement of current regulations.

RECOMMENDATIONS

Due to the record number of resample events, high coliform counts and beach closures in 1995, the Resource Management Division was faced with situations that had never been addressed before. Initially, there was some confusion on the proper application of the water quality standards that, at

times, differed between Arizona and Utah. These issues have been addressed in the revised QA/QC plan. In the future, it will be important to maintain a standardized application of the water quality criteria in order to convey consistent information to the public. It is crucial that the water quality data is checked for accuracy and entered into the park computer database system in a timely manner to allow immediate assessment of the data. This database management should become a regular part of the sampling schedule to ensure current water quality information is archived.

The quality of analysis at both NPS labs has increased over the years. One problem that appears to be recurring each year at the labs is contamination of the EA bacteria culture. This has been pointed out in previous reports and is likely caused by changing personnel inexperienced in the practice of aseptic technique. The changing personnel will continue as new seasonals arrive each year. To alleviate this problem, there should be 2 culture tubes re-inoculated approximately every 2 weeks for both the EA and EC cultures. For example, 2 test tubes of LST broth would be inoculated with EA culture and labeled EA and EA_b. The EA tube can always be used to inoculated 100 ml buffer solutions for positive controls. The EA_b tube is only used to re-inoculate a new tube of LST broth. In this way there will always be one uncontaminated tube of bacterial culture.

There have been a number of incidents of skin rash associated with swimming. This may indicate the presence of other pathogens in the water that the NPS labs do not have the capacity to test for. Some individuals in the medical field have expressed interest in doing research into this problem. The EPA has also suggested funding may be available for a pathogen study at Lake Powell. The park should pursue this and determine if this type of pathogen analysis is feasible.

Glen Canyon NRA and UDWQ are in the process of developing a coordinated plan for water quality monitoring. This effort will promote an efficient use of combined resources for the purpose of data collection. In the future, it will be necessary to promote collaboration among all agencies involved in water quality data collection on Lake Powell (NPS, GCES, USGS, UDWQ) in order to avoid redundant data collection efforts.

Volunteers and/or NPS personnel are needed at launch ramps and marinas to inform and educate the public regarding human waste disposal regulations and water quality issues at Lake Powell. This is especially necessary during peak visitation weekends such as Fourth of July and Labor Day.

APPENDIX

Figures and Tables

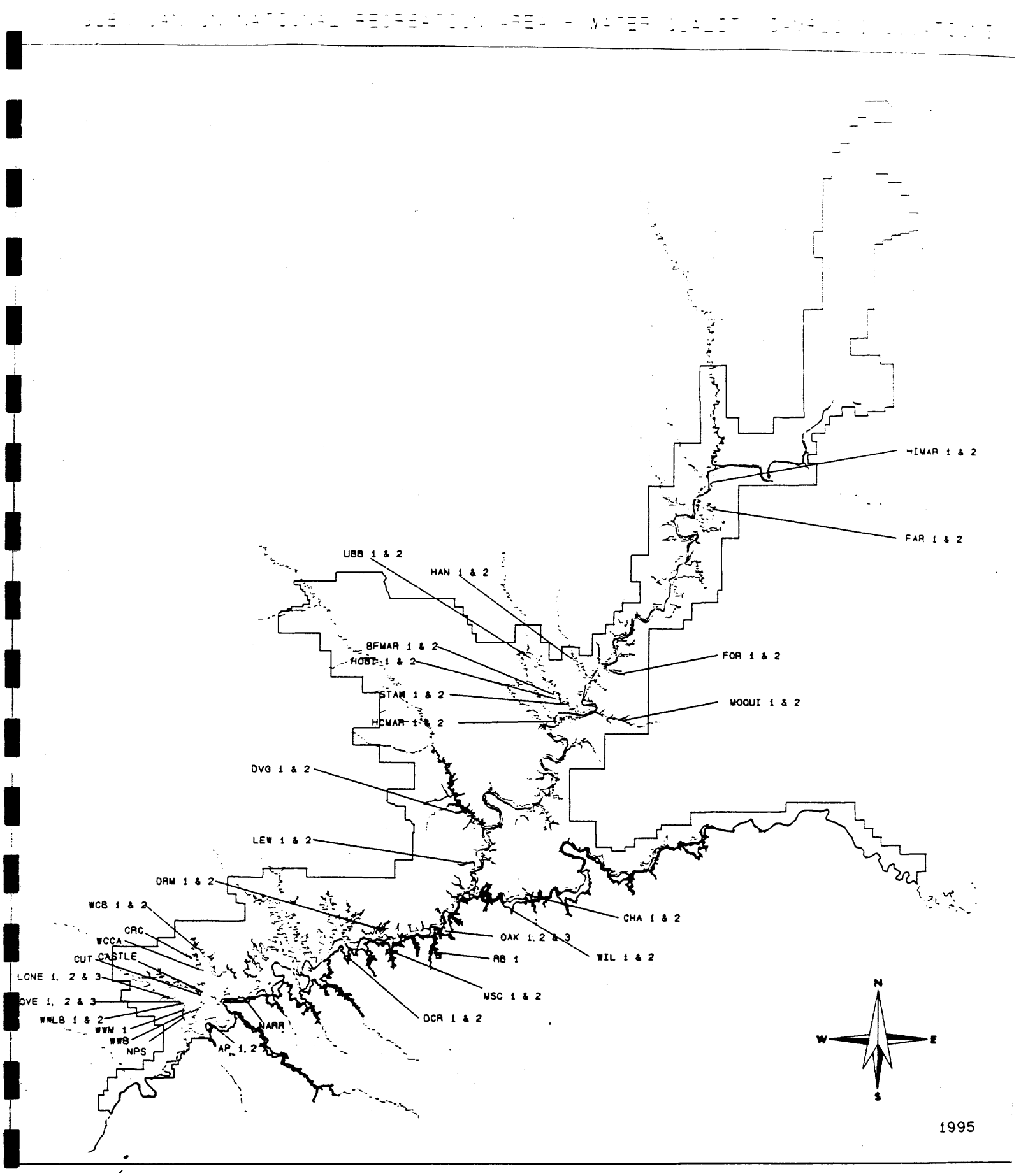

Figure 1: 1995 Lake Powell Water Sampling Locations

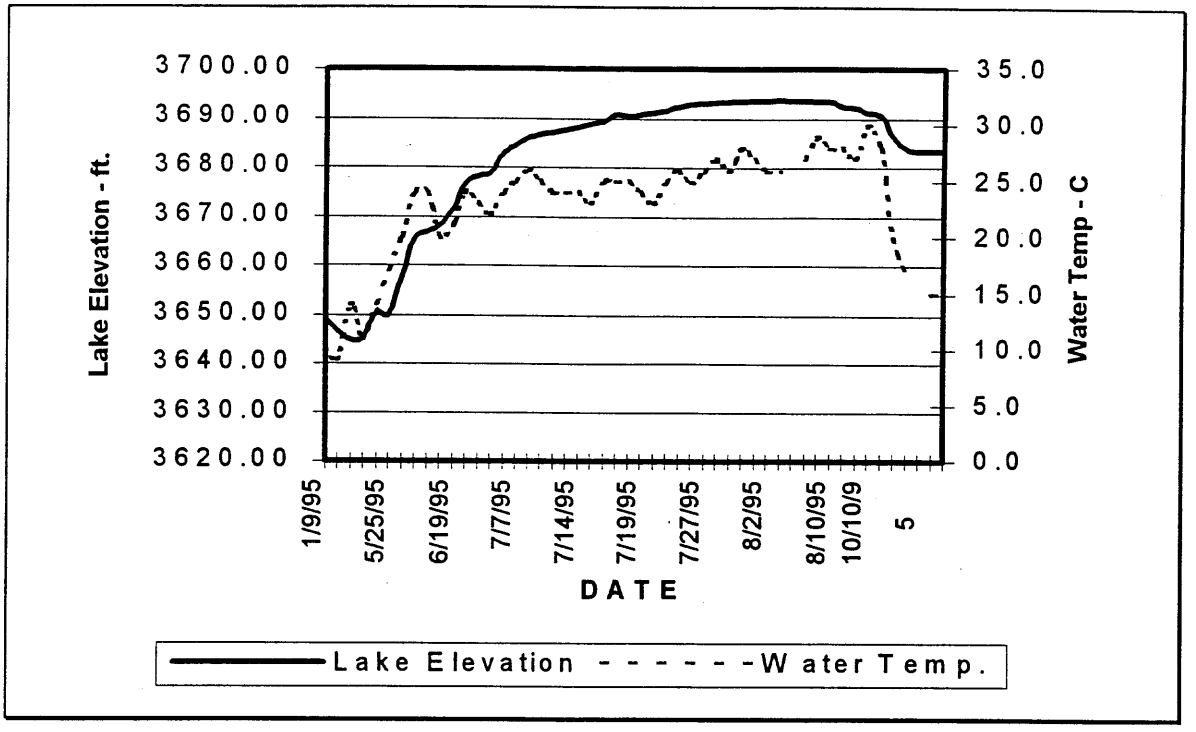

Figure 2: 1995 Lake Powell Surface Elevation and Water Temperature

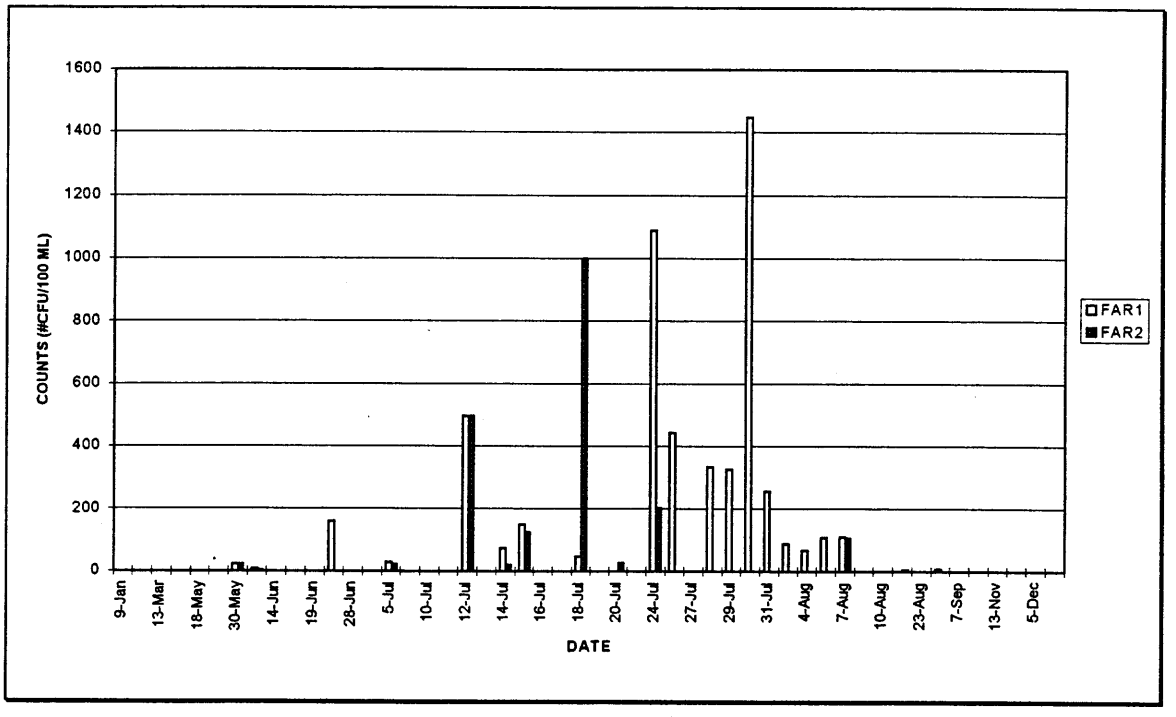

Figure 3: 1995 Fecal Coliform Counts at Farley Canyon Sites 1 and 2

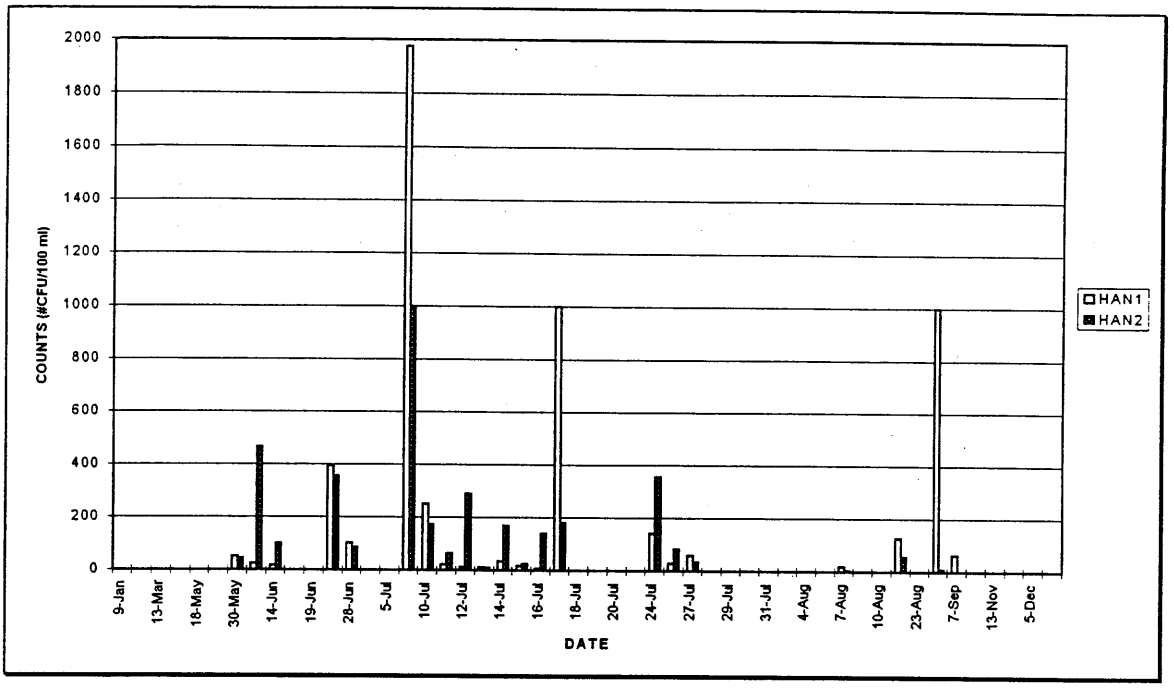

Figure 4: 1995 Fecal Coliform Counts at Hansen Creek sites 1 and 2

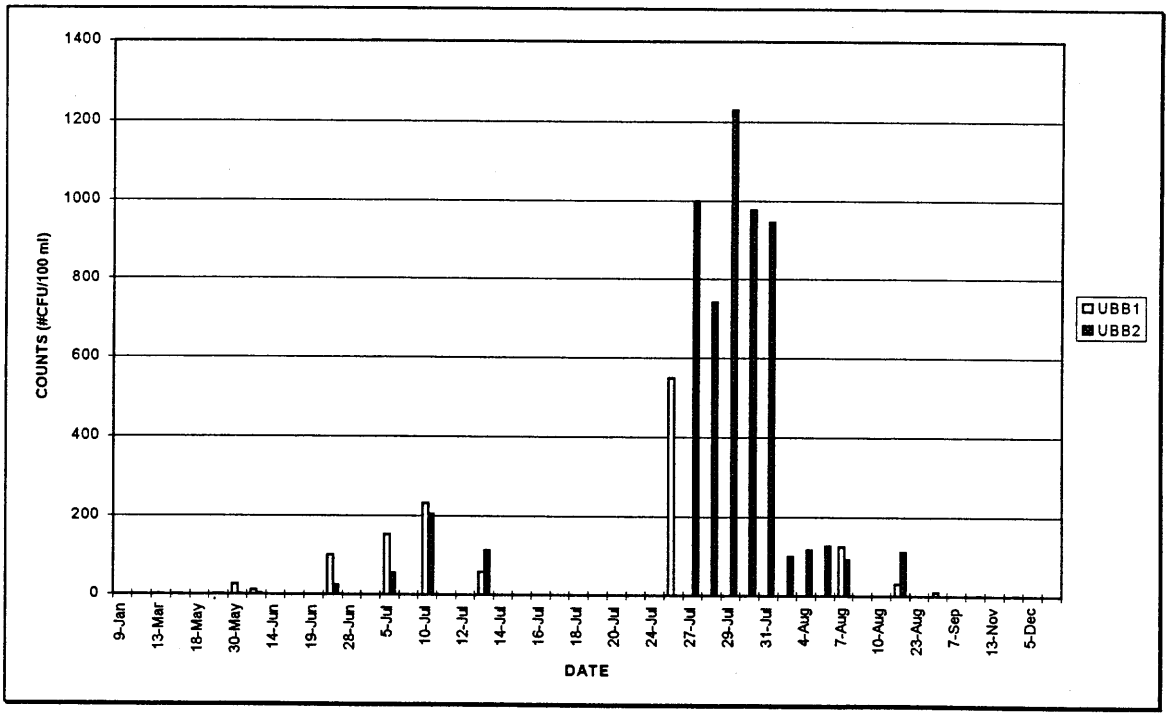

Figure 5: 1995 Fecal Coliform Counts at Upper Bullfrog Bay sites 1 and 2

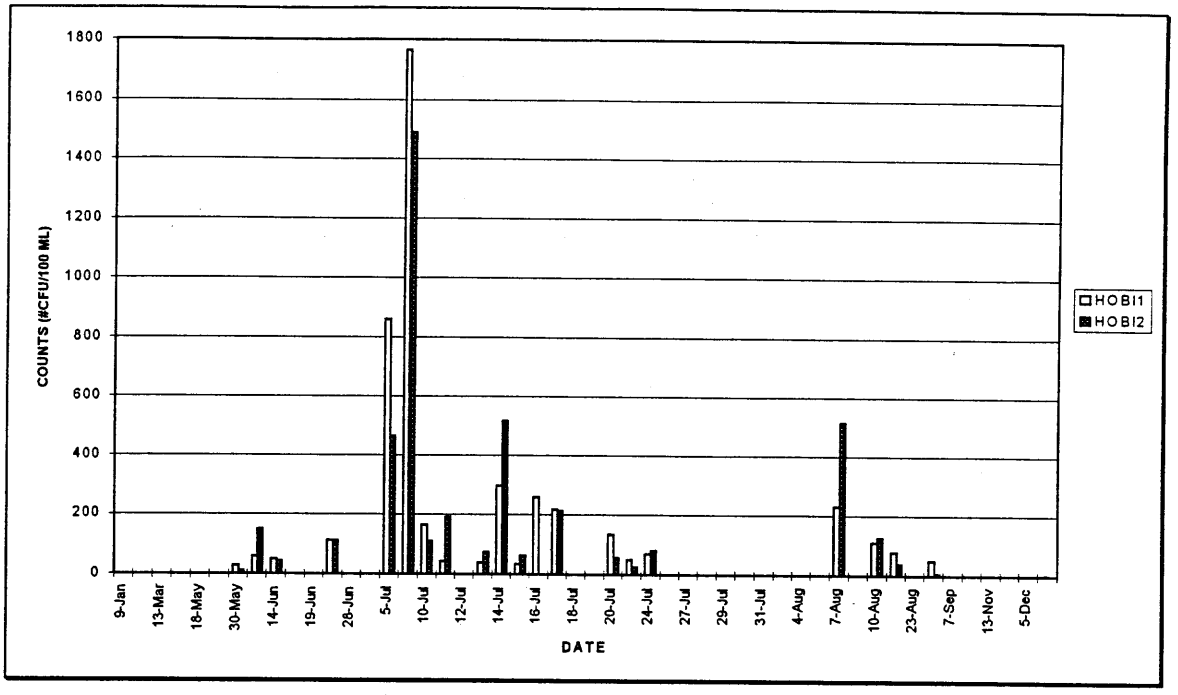

Figure 6: 1995 Fecal Coliform Counts at Hobi Cat Beach sites 1 and 2

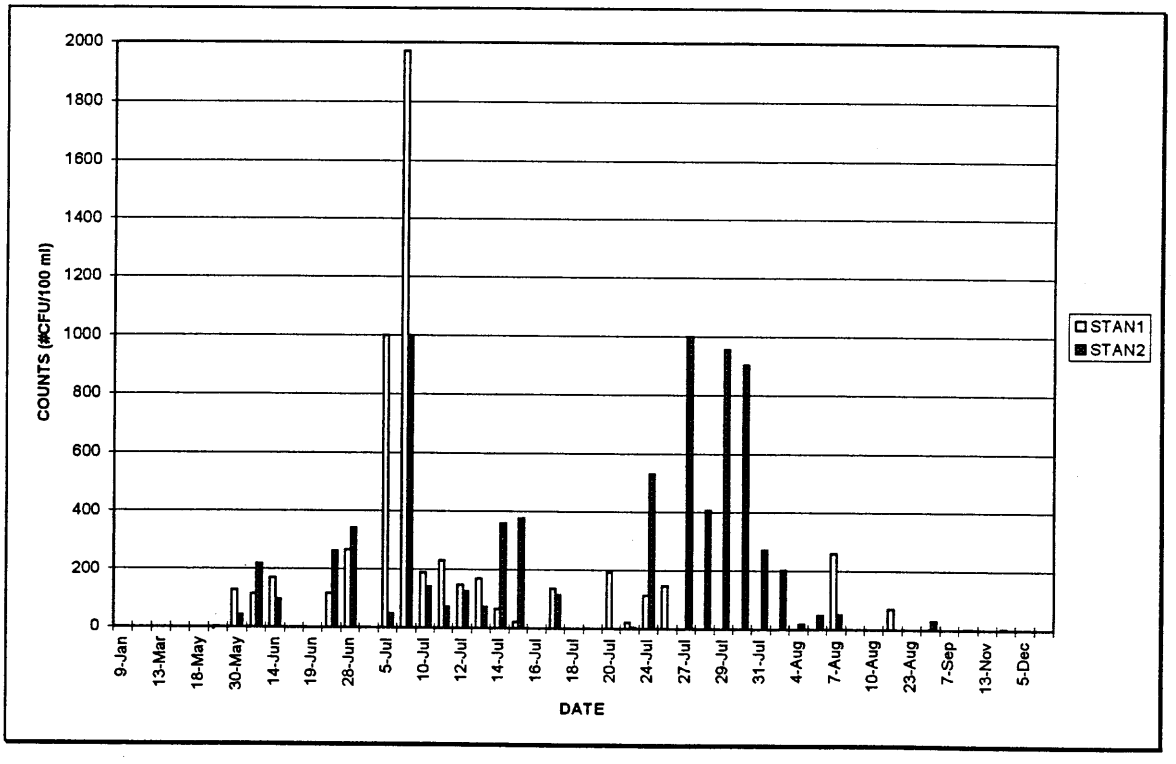

Figure 7: 1995 Fecal Coliform Counts at Stanton Creek sites 1 and 2

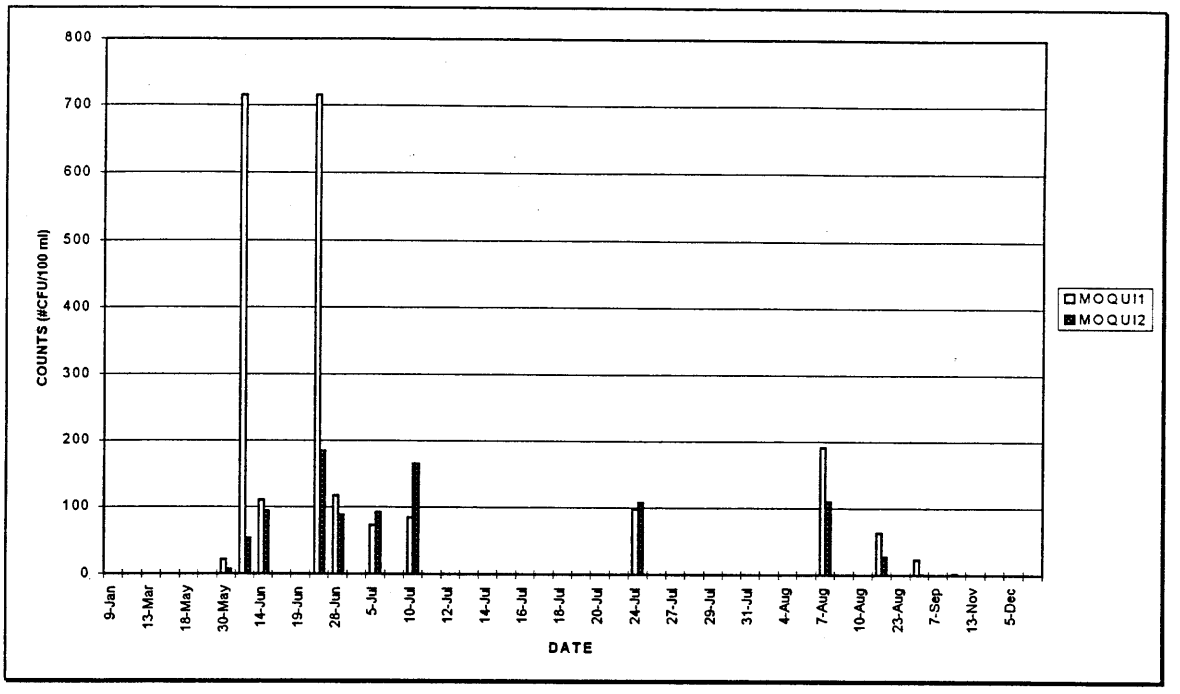

Figure 8: 1995 Fecal Coliform Counts at Moqui Canyon sites 1 and 2

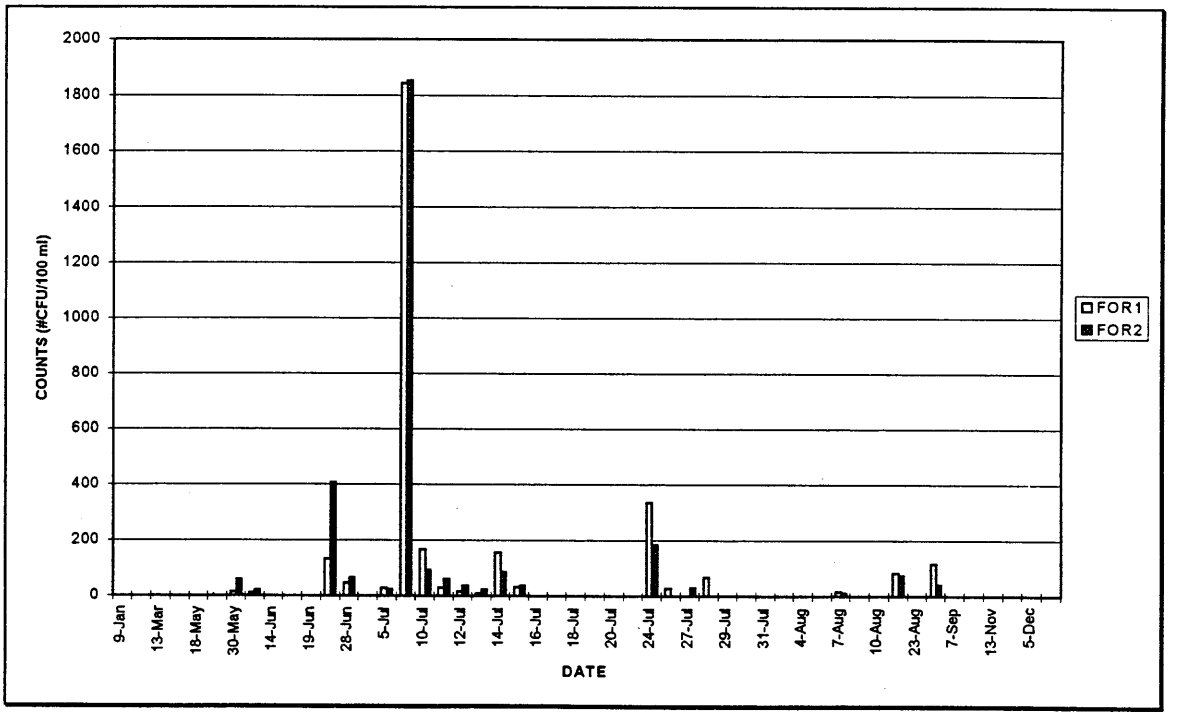

Figure 9: 1995 Fecal Coliform Counts at Forgotten Canyon sites 1 and 2

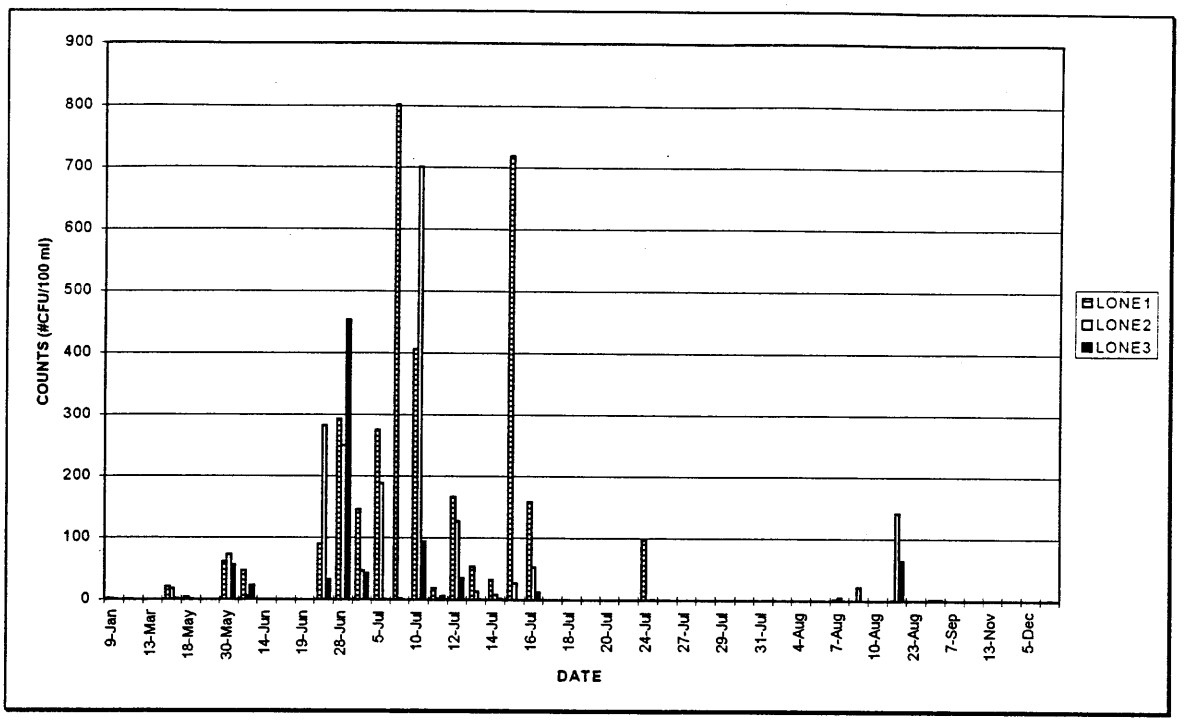

Figure 10: 1995 Fecal Coliform Counts at Lone Rock Beach sites 1,2, and 3

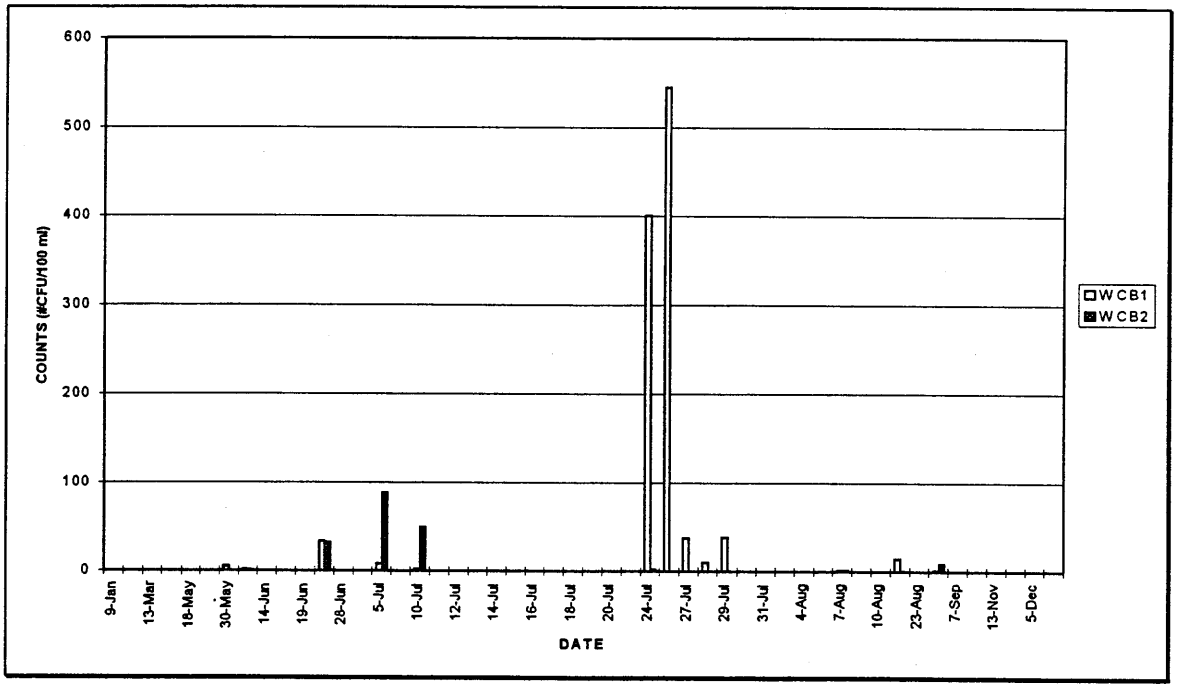

Figure 11: 1995 Fecal Coliform Counts at Warm Creek Beach sites 1 and 2

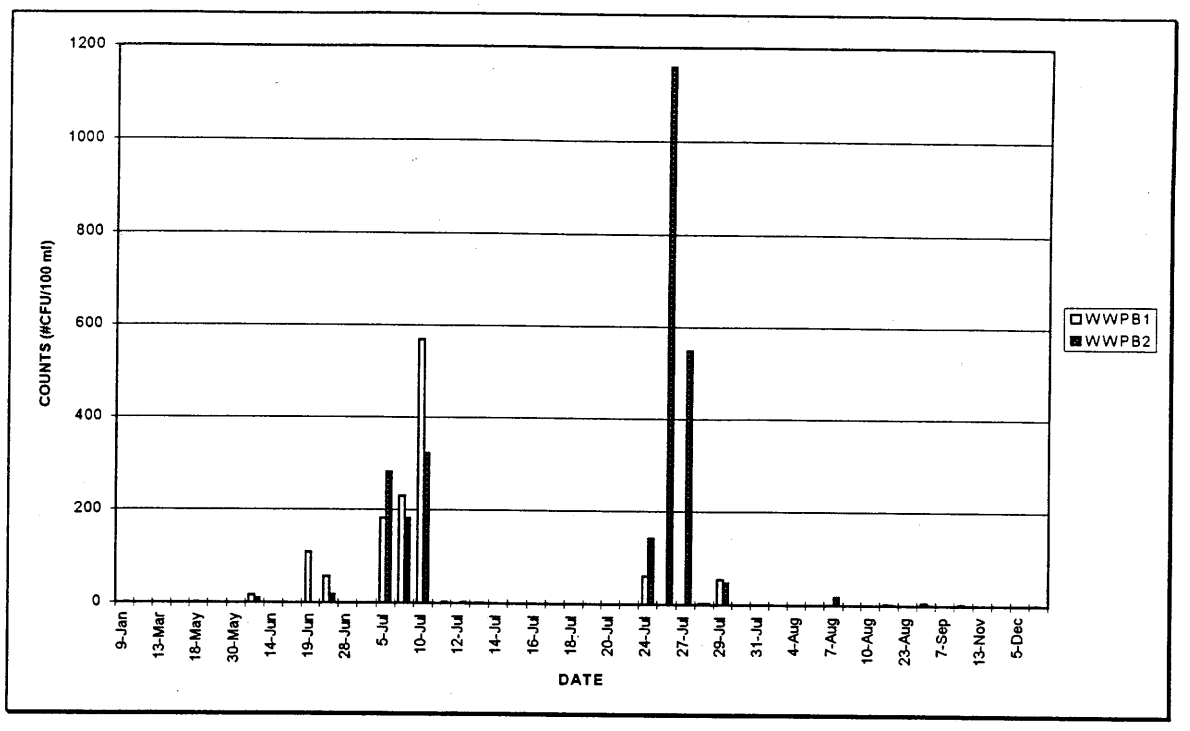

Figure 12: 1995 Fecal Coliform Counts at Wahweap Picnic Beach sites 1 and 2

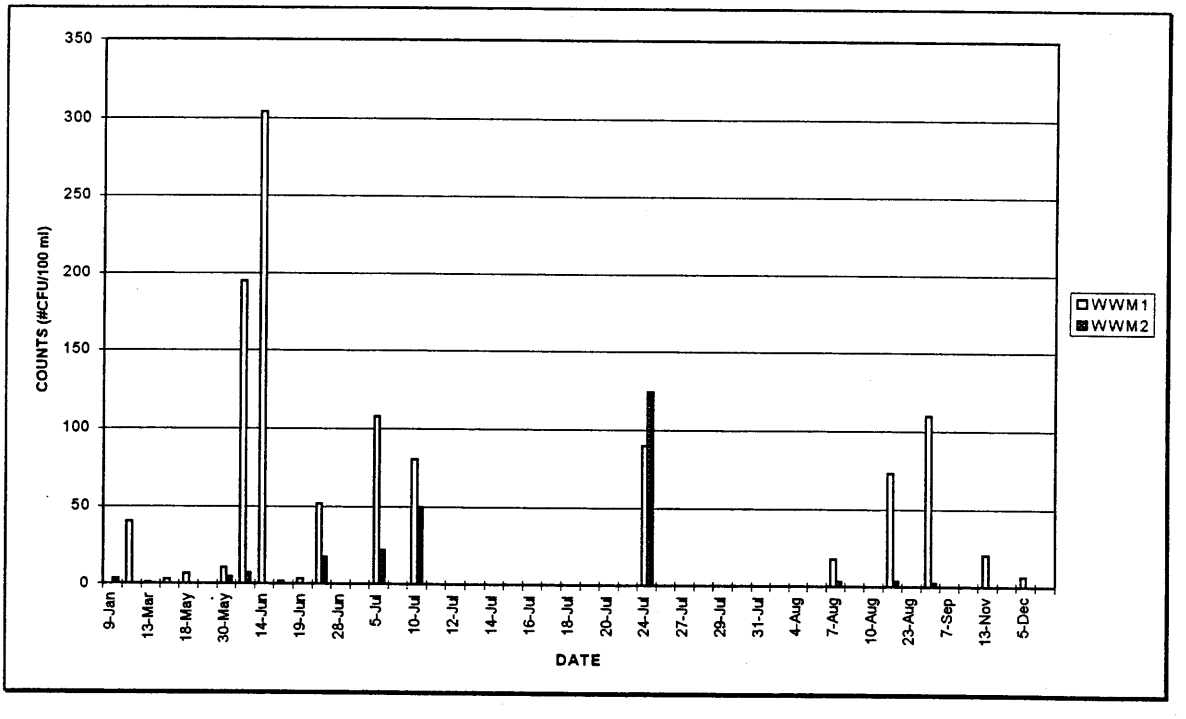

Figure 13: 1995 Fecal Coliform Counts at Wahweap Marina sites 1 and 2

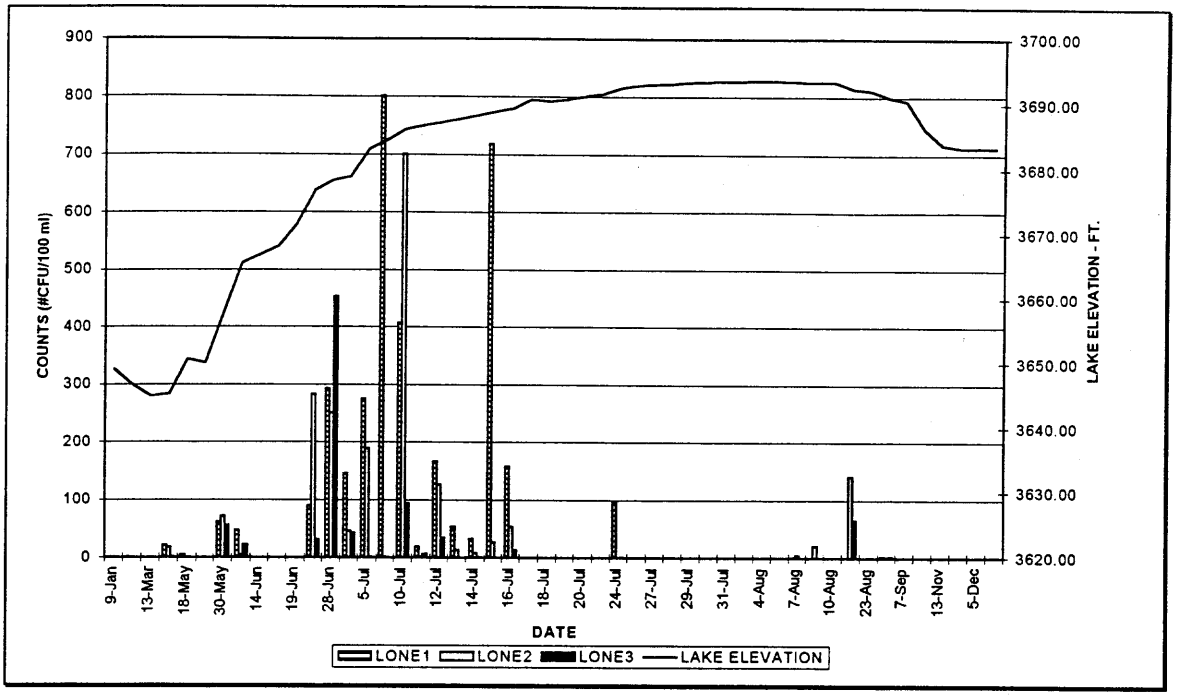

Figure 14: 1995 Fecal Coliform Counts and Lake Surface Elevation at Lone Rock Beach

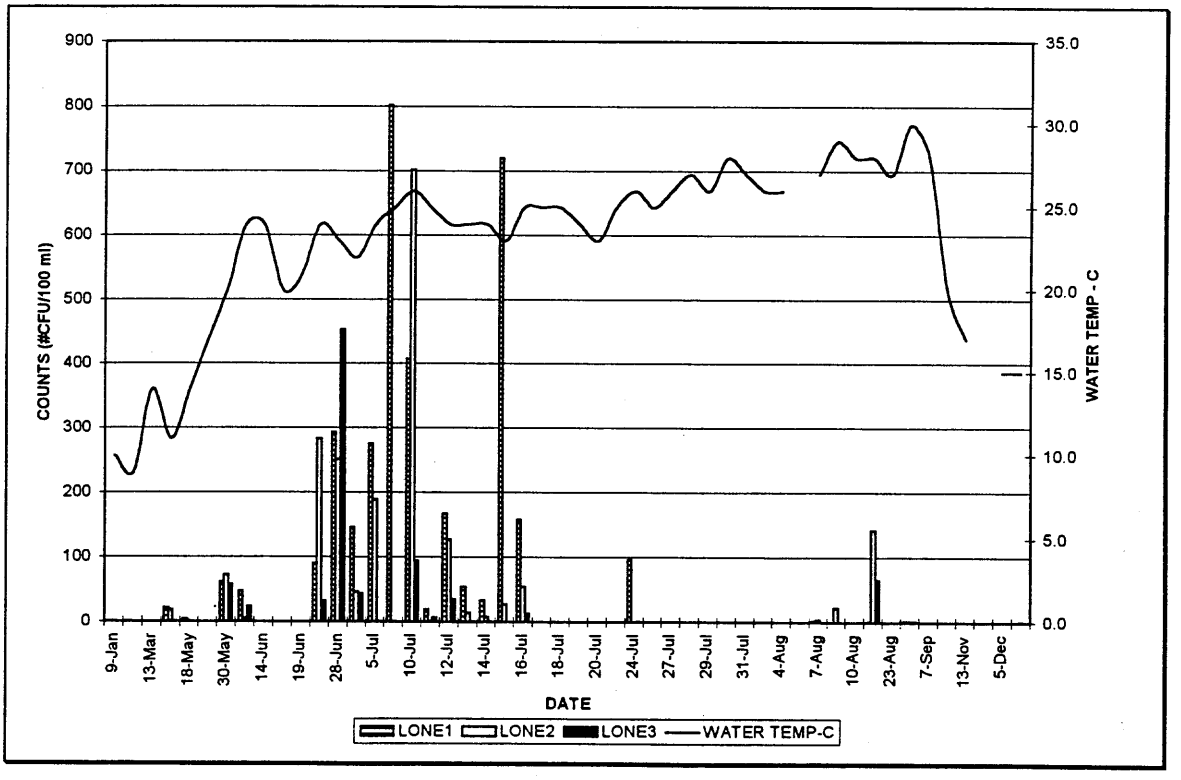

Figure 15: 1995 Fecal Coliform Counts and Water Temperature at Lone Rock

GLEN CANYON NATIONAL RECREATION AREA

1995 WATER QUALITY SCHEDULE

SITE	# SAMPLES TAKEN	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPT	OCT	NOV
WAHWEAP BAY	1	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
WAHWEAP LODGE BEACH	2	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
GOVERMENT HOUSING AREA	1	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
ANTELOPE POINT BEACH	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
ANTELOPE PT NGS INTAKE	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
LONEROCK BEACH	(3)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
WAHWEAP MARINA	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
WARM CREEK CATTLE AREA	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
WARM CREEK BEACH	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
THE COVES	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
CROSBY CANYON	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
CASTLE ROCK	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
THE CUT	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
THE NARROWS	(1)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
DANGLING ROPE MARINA	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
RAINBOW BRIDGE	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
MOUNTIAN SHEEP CANYON	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
OAK CANYON	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
WILSON CANYON	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
DUNGEON CREEK	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
LLEWELLYN GULCH	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
DAVIS GULCH	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
UPPER BULLFROG BAY	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
HOBI CAT BEACH	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
STANTON CREEK	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
HALLS CROSSING MARINA	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
MOQUI CANYON	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
FORGOTTEN CANYON	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
HANSEN CREEK	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
FARLEY CANYON	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13
WHITE MARINA	(2)	9	6	13	10	15.30	12.26	10.24	7.21	5.18	10	13

Table 1: 1995 Lake Powell Sampling Schedule

GLEN CANYON NATIONAL RECREATION AREA

LAKE POWELL SAMPLING REQUIREMENTS

SAMPLE DAY PREPARATION

* Personnel: 1 person
* Time: 1 day
* Collect necessary equipment for sampling day
* Prepare necessary solutions, label bottles, schedule boat use and plane transport
* Autoclave sterile buffer and utensils. Check sterility of solutions by inoculation and incubation overnight, no growth indicates sterility.

SAMPLE DAY

* Personnel: 8 people
* Time: 1 day
* Equipment: 4 boats, transport samples from Hite to Bullfrog on plane
* Collect water samples at 54 sites lakewide for bacteriological testing at Wahweap and Bullfrog labs
* Collect samples for Utah Division of Water Quality at 17 sites lakewide
* Lab work-filter and incubate samples for 24 hours in water bath incubator

POST SAMPLE DAYS

* Personnel: 1 person
* Time: 2 days
* Count coliform colonies
* Clean and re-sterilize all instruments used during lab work
* Transport UDWQ samples from Bullfrog to Wahweap on plane
* Process UDWQ samples at Wahweap lab and ship to state lab
* Prepare any necessary solutions
  Rosalic acid, sterile buffer, KH_2PO_4, MgCl, NaOH
  Re-inoculate EA and EC stock bacterial cultures
* Restock any necessary material
  DI water, bottles, etc.
* Perform any necessary QA/QC procedures
  Heterotrophic plate counts for DI water, sterile buffer solution
  Periodic checks of autoclave, UV sterilizer for proper sterilization

Table 2: Typical Lake Powell Sampling Effort

GLEN CANYON NATIONAL RECREATION AREA

Water Quality ID Key

Site Name	Site ID
Antelope Point Beach	AP1
Antelope Point Intake	AP2
Bullfrog Bay	BB
Bullfrog Marina	BFMAR1, BFMAR2
Bullfrog	BFNOTCH
Bullfrog	BFSB1, BFSB2
Castle Rock	CASTLE1
Cha Canyon	CHA1, CHA2
Copper Canyon	COPPCAN1, COPPCAN2
The Coves	COVE1,COVE2
Crosby Canyon	CRC1,CRC2
The Cut	CUT1,CUT2
The Dam	DAM1
Dungeon Creek	DCR1,DCR2
Dangling Rope Marina	DRM1,DRM2
Davis Gulch	DVG1,DVG2
Farley Canyon	FAR1,FAR2
Forgotten Canyon	FOR1,FOR2
Halls Creek Bay	HACR1,HACR2
Hansen Creek	HAN1,HAN2, HAN3
Halls Crossing Marina	HCMAR1,HCMAR2
Hite Marina	HIMAR1, HIMAR2, HIMAR3
Hobi Cat Beach	HOBIL, HOBI2, HOBI3
Llewellyn Gulch	LEW1, LEW2
Lone Rock North	LONE1
Lone Rock Middle	LONE2
Lone Rock South	LONE3
Moqui Canyon	MOQUIL, MOQUI2, MOQUI3
Mt. Sheep Canyon	MSC1, MSC2
The Narrows	NARR1, NARR2
Neskahi Canyon	NESCAN1, NESCAN2
Government Housing	NPS1, NPS2
Oak Canyon	OAK1, OAK2, OAK3
Paiute Farms	PAIUTE1, PAIUTE2
Rainbow Bridge	RBI, RB2
Spencer Camp	SPENCER1, SPENCER2
Stanton Creek	STAN1, STAN2, STAN3
Upper Bullfrog Bay	UBBI, UBB2
Warm Creek Beach	WCB1, WCE2
Warm Creek Cattle Area	WCCA1, WCCA2
Wilson Creek	WILL, WIL2
Wahweap Bay	WWB
Wahweap Lodge Beach	WWLB1, WWLB2
Wahweap Marina	WWM1, WWM2, WWM3NPS

1995 LAKE POWELL FECAL COLIFORM DATA SUMMARY

	AP1	AP2	BFMAR1	BFMAR2	BUOY110	BUOY120	BUOY130	BUOY140	CASTLE	CASTLE1	CASTLE2	CHA1	CHA2	CHA2A	CHA2B	CHA3	COLO R	COVE1	
Mean	35	22	41	67	1	0	3	13	0	4	8	5	40	0	18	35	164	20	
Range	526	147	215	578	0	0	0	6	0	39	17	22	305	1	34	71	0	186	
Minimum	0	0	0	0	1	0	3	10	0	0	0	0	0	0	1	0	164	0	
Maximum	526	147	215	578	1	0	3	16	0	39	17	22	305	1	35	71	164	186	
Sum	598	336	579	801	1	0	3	26	0	54	17	46	363	1	36	71	164	343	
Count	17	15	14	12	1	1	1	2	1	13	2	10	9	2	2	2	1	17	

	COVEA	COVEB	CRC1	CRC2	CRCA	CRCA2	CSBY	CUT1	DCR1	DCR2	DIRDEV	DRM1	DRM2	DRM3	DVG1	DVG2	FAR1	FAR2	FAR3
Mean	4	33	21	0	6	0	0	1	14	24	2	14	15	0	4	7	250	169	40
Range	0	0	65	0	0	0	0	8	61	63	0	91	37	0	12	18	1447	1000	67
Minimum	4	33	0	0	6	0	0	0	0	1	2	0	0	0	0	1	0	0	18
Maximum	4	33	65	0	6	0	0	8	61	64	2	91	37	0	12	19	1447	1000	84
Sum	4	33	232	0	6	0	0	17	110	195	2	109	106	0	31	41	5255	2023	120
Count	1	1	11	1	1	1	1	13	8	8	1	8	7	1	7	6	21	12	3

	FAR4	FOR1	FOR2	HAN1	HAN2	HC HBOAT	HCMAR1	HCMAR2	HIMAR1	HIMAR2	HOBI1	HOBI2	LEW1	LEW2	LEW3	LEW4	LONE1	LONE2	LONE3
Mean	5	164	172	244	174	138	132	83	157	238	166	214	4	12	20	1	126	76	39
Range	0	1844	1852	1975	999	0	1660	814	1020	1171	1765	1490	13	63	0	0	801	702	453
Minimum	5	1	1	1	1	138	0	0	0	0	0	0	0	0	20	1	0	0	0
Maximum	5	1844	1852	1975	1000	138	1660	814	1020	1171	1765	1490	13	63	20	1	801	702	453
Sum	5	3125	3099	5370	3647	138	2915	1497	3145	4045	4657	4286	29	81	20	1	3399	1971	829
Count	1	19	18	22	21	1	22	18	20	17	28	20	8	7	1	1	27	26	21

	MOQUI1	MOQUI2	MOQUI3	MSC1	MSC2	NARCYN	NARR1	NPS1	OAK1	OAK2	OAK3	RB1	RB2	STAN1	STAN2	UBB1	UBB2	WCB1	WCB2
Mean	184	84	216	5	1	96	21	19	30	2	73	2	3	191	256	81	244	55	12
Range	714	183	0	16	2	0	82	69	165	5	210	5	11	1970	1000	549	1230	545	89
Minimum	2	2	216	0	0	96	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum	716	184	216	16	2	96	82	69	165	5	210	5	11	1970	1000	549	1230	545	89
Sum	2214	927	216	37	2	96	270	250	330	6	514	16	12	5551	7689	1298	5850	1099	183
Count	12	11	1	8	3	1	13	13	11	3	7	9	4	29	30	16	24	20	15

	WCCA	WIL1	WIL2	WWB	WWPB1	WWPB2	WWLBP	WWM1	WWM2
Mean	40	7	24	3	56	124	1	56	17
Range	522	29	150	25	570	1159	1	304	125
Minimum	0	0	0	0	0	0	0	0	0
Maximum	522	29	150	25	570	1159	1	304	125
Sum	674	62	212	48	1296	2738	1	1127	240
Count	17	9	9	15	23	22	2	20	14

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	AP1	AP2	AP3	BFMAR1	BFMAR2	BOAT321	BUOY110	BUOY120	BUOY130	BUOY140
1/9/95	0	0	---	1	0	---	---	---		
2/6/95	0	0	---	0	0	---	---	---		
3/13/95	---	---	---	0	0	---	---	---		
4/10/95	0	0	0	1	0	---	---	---		
5/18/96	0	0	0	---	---	---	---	---		
5/25/95	---	---	---	---	---	---	---	---		
5/30/95	2	1	---	---	---	---	---	---		
6/12/95	3	2	---	9	19	---	---	---		
6/14/95	---	---	---	---	---	1	---	---		
6/15/95	---	---	---	---	---	---	---	---		
6/19/95	---	---	---	---	---	---	---	---		
6/26/95	23	0	---	---	---	---	---	---		
6/28/95	---	---	---	---	---	---	---	---		
6/29/95	---	---	---	---	---	---	---	---		
7/5/95	7	9	---	159	---	---	---	---		
7/7/95	---	---	---	---	---	---	---	---		
7/10/95	12	118	---	40	93	---	---	---		
7/11/95	---	---	---	---	---	---	---	---		
7/12/95	---	---	---	---	---	---	---	---		
7/13/95	---	---	---	---	---	---	---	---		
7/14/96	---	---	---	---	---	---	---	---		
7/15/95	---	---	---	---	---	---	---	0	3	10
7/16/95	---	---	---	---	---	---	---	---		
7/17/95	---	---	---	---	---	---	---	---		
7/18/96	---	---	---	---	---	---	---	---		
7/19/95	---	---	---	---	---	---	---	---		
7/20/95	---	---	---	---	---	---	---	---		
7/21/95	---	---	---	---	---	---	---	---		
7/24/95	19	25	---	43	578	---	---	---		
7/26/95	---	---	---	---	---	---	---	---		
7/27/95	---	---	---	---	---	---	---	---		
7/28/95	---	---	---	---	---	---	---	---		
7/29/96	---	---	---	---	---	---	---	---		16
7/30/95	---	---	---	---	---	---	---	---		
7/31/95	---	---	---	---	---	---	---	---		
8/2/95	---	---	---	---	---	---	---	---		
8/4/96	---	---	---	---	---	---	---	---		
8/5/95	---	---	---	---	---	---	---	---		
8/7/95	526	1	---	60	109	---	---	---		
8/9/96	5	---	---	---	---	---	---	---		
8/10/95	---	---	---	---	---	---	---	---		
8/21/95	3	147	---	21	1	---	---	---		
8/23/95	---	19	---	---	---	---	---	---		
9/5/95	0	16	---	215	0	---	---	---		
9/7/96	---	---	---	31	---	---	---	---		
10/10/95	0	0	---	---	---	---	---	---		
11/13/96	0	---	---	---	---	---	---	---		
11/14/95	---	---	---	1	2	---	---	---		
12/5/95	---	---	---	---	---	---	---	---		
12/11/95	1	---	---	1	1	---	---	---		
COUNT	17	15	2	14	12	1	0	1	1	2
CNT > 200	1	0	0	1	1	0	0	0	0	0
TOTAL CNT > 200		102								
TOTAL #SAMPLES TAKEN		895								

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	CASTLE	CASTLE1	CASTLE2	CHA1	CHA2	CHA2A	CHA2B	CHA3	COLO R	COVE1
1/9/95	---	0	---	---	---	---	---	---	---	0
2/6/95	---	0	---	---	---	---	---	---	---	0
3/13/95	---	0	---	---	---	---	---	---	---	---
4/10/95	---	0	---	0	0	---	---	---	---	---
5/18/95	---	0	---	---	---	---	---	---	---	1
5/25/95	---	---	---	---	---	---	---	---	---	39
5/30/95	---	39	---	0	0	---	---	---	---	---
6/12/95	---	0	---	0	0	---	---	---	---	0
6/14/95	---	---	---	---	---	---	---	---	---	1
6/15/95	---	---	---	---	---	---	---	---	---	---
6/19/95	---	---	---	---	---	---	---	---	---	---
6/26/95	---	14	---	3	305	---	---	---	---	---
6/28/95	---	---	---	9	18	0	35	---	---	47
6/29/95	---	---	---	9	3	1	1	---	---	---
7/5/95	---	---	0	0	---	---	---	71	---	---
7/7/95	---	---	---	---	---	---	---	---	---	6
7/10/95	---	---	17	---	---	---	---	---	---	---
7/11/95	---	---	---	---	---	---	---	---	---	186
7/12/95	---	---	---	---	---	---	---	---	---	---
7/13/95	---	---	---	---	---	---	---	---	164	---
7/14/95	---	---	---	---	---	---	---	---	---	---
7/15/95	---	---	---	---	---	---	---	---	---	---
7/16/95	---	---	---	---	---	---	---	---	---	---
7/17/95	---	---	---	---	---	---	---	---	---	---
7/18/95	---	---	---	---	---	---	---	---	---	---
7/19/95	---	---	---	---	---	---	---	---	---	---
7/20/95	---	---	---	---	---	---	---	---	---	52
7/21/95	---	---	---	---	---	---	---	---	---	---
7/24/95	---	0	---	0	---	---	---	---	---	---
7/26/95	---	---	---	---	---	---	---	0	---	10
7/27/95	---	---	---	---	---	---	---	---	---	---
7/28/95	---	---	---	---	---	---	---	---	---	---
7/29/95	---	---	---	---	---	---	---	---	---	---
7/30/95	---	---	---	---	---	---	---	---	---	---
7/31/95	---	---	---	---	---	---	---	---	---	---
8/2/95	---	---	---	---	---	---	---	---	---	---
8/4/95	---	---	---	---	---	---	---	---	---	---
8/5/95	---	---	---	---	---	---	---	---	---	---
8/7/95	---	0	---	22	18	---	---	---	---	---
8/9/95	---	---	---	---	---	---	---	---	---	2
8/10/95	---	---	---	---	---	---	---	---	---	---
8/21/95	---	1	---	---	5	---	---	---	---	---
8/23/95	---	---	---	---	---	---	---	---	---	0
9/5/95	---	1	---	6	15	---	---	---	---	---
9/7/95	---	---	---	---	---	---	---	---	---	1
10/10/95	0	---	---	---	---	---	---	---	---	---
11/13/95	---	0	---	---	---	---	---	---	---	1
11/14/95	---	---	---	---	---	---	---	---	---	0
12/5/95	---	---	---	---	---	---	---	---	---	---
12/11/95	---	---	---	---	---	---	---	---	---	---
										1
COUNT	1	13	2	10	9	2	2	2	1	17
CNT> 200	0	0	0	0	1	0	0	0	0	0
TOTAL CNT > 20										
TOTAL #SAMPLE										

[redacted] 1[redacted]LAKE[redacted]VELL[redacted]AL C[redacted]ORM[redacted]TA

DATE	COVEA	COVEB	CRC1	CRC2	CRCA	CRCA2	CSBY	CUT1	DCR1	DCR2
1/9/95	---	---	---	---	---	---	---	---	---	---
2/6/95	---	---	---	---	---	---	---	---	---	---
3/13/95	---	---	---	---	---	---	---	---	---	---
4/10/95	---	---	0	---	---	---	---	0	---	---
5/18/95	---	---	21	0	---	---	---	0	---	---
5/25/95	---	---	---	---	---	---	---	---	---	---
5/30/95	---	---	1	---	---	---	---	1	0	1
6/12/95	---	---	47	---	---	---	---	1	7	50
6/14/95	---	---	---	---	---	---	---	---	---	---
6/15/95	---	---	---	---	---	---	---	---	---	---
6/19/95	---	---	---	---	---	---	---	---	---	---
6/26/95	---	---	65	---	---	---	---	8	8	64
6/28/95	---	---	---	---	---	---	---	---	---	---
6/29/95	---	---	---	---	---	---	---	---	---	---
7/6/95	---	---	5	---	---	---	---	2	2	5
7/7/95	---	---	---	---	---	---	---	---	---	---
7/10/95	---	---	10	---	---	---	---	1	---	---
7/11/95	---	---	---	---	---	---	---	---	---	---
7/12/95	---	---	---	---	---	---	---	---	---	---
7/13/95	---	---	---	---	---	---	---	---	---	---
7/14/95	---	---	---	---	---	---	---	---	---	---
7/15/95	---	---	---	---	---	---	---	---	---	---
7/16/95	---	---	---	---	---	---	---	---	---	---
7/17/95	---	33	---	---	---	---	---	---	---	---
7/18/95	---	---	---	---	---	---	---	---	---	---
7/19/95	4	---	---	---	---	---	---	---	---	---
7/20/95	---	---	---	---	---	---	---	---	---	---
7/21/95	---	---	---	---	---	---	---	---	---	---
7/24/95	---	---	61	---	---	---	---	1	61	18
7/26/95	---	---	---	---	---	---	---	---	---	---
7/27/95	---	---	---	---	---	---	---	---	---	---
7/28/95	---	---	---	---	---	---	---	---	---	---
7/29/95	---	---	---	---	---	---	---	---	---	---
7/30/95	---	---	---	---	---	---	---	---	---	---
7/31/95	---	---	---	---	---	---	---	---	---	---
8/2/95	---	---	---	---	---	---	---	---	---	---
8/4/95	---	---	---	---	---	---	---	---	---	---
8/6/95	---	---	---	---	---	---	---	---	---	---
8/7/95	---	---	16	---	---	---	---	5	2	1
8/9/95	---	---	---	---	---	---	---	---	---	---
8/10/95	---	---	---	---	---	---	---	---	---	---
8/21/95	---	---	5	---	6	---	---	0	21	53
8/23/95	---	---	---	---	---	---	---	---	---	---
9/5/95	---	---	4	---	---	0	---	0	10	5
9/7/95	---	---	---	---	---	---	---	---	---	---
10/10/95	---	---	---	---	---	---	0	0	---	---
11/13/95	---	---	---	---	---	---	---	---	---	---
11/14/95	---	---	---	---	---	---	---	---	---	---
12/5/95	---	---	---	---	---	---	---	---	---	---
12/11/95	---	---	---	---	---	---	---	---	---	---
COUNT	1	1	11	1	1	1	1	13	8	8
CNT > 200	0	0	0	0	0	0	0	0	0	0
TOTAL CNT > 20										
TOTAL #SAMPLE										

[redacted] TS[redacted]AKE[redacted]VELL[redacted]AL C[redacted]DRM[redacted]A

DATE	DIRDEV	DRM1	DRM2	DRM3	DVG1	DVG2	FAR1	FAR2	FAR3	FAR4
1/9/95	---	---	---	---	---	---	---	---	---	---
2/6/95	---	---	---	---	---	---	---	---	---	---
3/13/95	---	---	---	---	---	---	---	---	---	---
4/10/95	---	---	---	---	---	---	---	---	---	---
5/18/95	---	---	---	---	---	---	---	---	---	---
5/26/95	---	---	---	---	---	---	---	---	---	---
5/30/95	---	0	0	---	12	2	22	22	---	---
6/12/95	---	0	2	0	5	4	7	3	---	---
6/14/95	---	---	---	---	---	---	---	---	---	---
6/16/95	---	---	---	---	---	---	---	---	---	---
6/19/95	---	---	---	---	---	---	---	---	---	---
6/26/95	---	0	---	---	5	12	159	---	---	---
6/28/95	---	---	---	---	---	---	---	---	---	---
6/29/95	---	---	---	---	---	---	---	---	---	---
7/5/95	---	1	3	---	4	5	28	23	---	---
7/7/95	---	---	---	---	---	---	---	---	---	---
7/10/95	---	---	---	---	---	---	---	---	---	---
7/11/96	---	---	---	---	---	---	---	---	---	---
7/12/95	---	---	---	---	---	---	496	496	---	---
7/13/95	---	---	---	---	---	---	---	---	---	---
7/14/95	---	---	---	---	---	---	74	19	---	---
7/15/95	2	---	---	---	---	---	150	124	---	---
7/16/96	---	---	---	---	---	---	---	---	---	---
7/17/95	---	---	---	---	---	---	---	---	---	---
7/18/95	---	---	---	---	---	---	47	1000	84	---
7/19/95	---	---	---	---	---	---	---	---	---	---
7/20/95	---	---	---	---	---	---	---	26	---	---
7/21/95	---	---	---	---	---	---	---	---	---	---
7/24/96	---	6	22	---	3	1	1087	202	19	---
7/26/95	---	---	---	---	---	---	442	---	---	---
7/27/95	---	---	---	---	---	---	---	---	---	---
7/28/95	---	---	---	---	---	---	335	---	---	---
7/29/95	---	---	---	---	---	---	326	---	---	---
7/30/95	---	---	---	---	---	---	1447	---	---	---
7/31/95	---	---	---	---	---	---	256	---	---	---
8/2/95	---	---	---	---	---	---	88	---	---	---
8/4/95	---	---	---	---	---	---	67	---	---	---
8/6/95	---	---	---	---	---	---	109	---	---	---
8/7/95	---	11	37	---	---	---	110	107	18	---
8/9/95	---	---	---	---	---	---	---	---	---	---
8/10/95	---	---	---	---	---	---	---	---	---	---
8/21/95	---	91	28	---	0	---	1	4	---	---
8/23/95	---	---	---	---	---	---	---	---	---	---
9/5/96	---	0	15	---	3	19	7	---	---	5
9/7/95	---	---	---	---	---	---	---	---	---	---
10/10/95	---	---	---	---	---	---	0	0	---	---
11/13/95	---	---	---	---	---	---	---	---	---	---
11/14/95	---	---	---	---	---	---	---	---	---	---
12/5/95	---	---	---	---	---	---	---	---	---	---
12/11/95	---	---	---	---	---	---	---	---	---	---
COUNT	1	8	7	1	7	6	21	12	3	1
CNT > 200	0	0	0	0	0	0	7	3	0	0
TOTAL CNT > 20										
TOTAL #SAMPLE										

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	FOR1	FOR2	HAN1	HAN2	HC HBOAT	HCMAR1	HCMAR2	HIMAR1	HIMAR2	HOBI1
1/9/95	---	---	---	---	---	0	0	---	---	0
2/6/95	---	---	---	---	---	0	0	---	---	0
3/13/95	---	---	---	---	---	0	0	---	---	0
4/10/95	---	---	---	---	---	4	0	---	---	0
5/18/95	---	---	---	---	---	---	---	---	---	---
5/25/95	---	---	---	---	---	---	---	---	---	---
5/30/95	13	58	53	46	---	15	21	23	---	0
6/12/95	12	21	26	466	---	72	49	15	---	28
6/14/95	---	---	18	99	---	---	---	---	---	58
6/15/95	---	---	---	---	---	---	---	---	---	50
6/19/95	---	---	---	---	---	---	---	---	---	---
6/26/95	132	407	396	356	---	229	90	41	---	113
6/28/95	45	66	102	85	---	---	---	---	---	---
6/29/95	---	---	---	---	---	---	---	---	---	---
7/5/95	28	23	---	---	---	226	139	16	---	862
7/7/95	1844	1852	1976	1000	---	1660	814	---	---	1765
7/10/95	168	93	252	173	---	39	88	---	---	166
7/11/95	30	60	22	63	---	24	---	---	---	44
7/12/95	17	37	14	291	---	41	14	82	273	---
7/13/95	9	22	14	10	---	75	---	---	---	39
7/14/95	155	86	35	167	---	24	27	26	79	298
7/15/95	32	38	17	26	---	122	168	178	137	35
7/16/95	---	---	8	141	---	---	---	---	---	260
7/17/95	---	---	1000	182	---	---	---	---	---	217
7/18/95	---	---	---	---	---	---	---	419	65	---
7/19/95	---	---	---	---	---	---	---	---	---	---
7/20/95	---	---	---	---	---	---	---	---	331	135
7/21/95	---	---	---	---	138	---	---	---	---	50
7/24/95	336	183	143	365	---	117	40	48	242	69
7/26/95	28	---	30	83	---	---	---	245	---	---
7/27/95	---	29	58	34	---	---	---	---	---	---
7/28/95	67	---	---	---	---	---	---	---	491	---
7/29/95	---	---	---	---	---	---	---	1020	1171	---
7/30/95	---	---	---	---	---	---	---	615	734	---
7/31/95	---	---	---	---	---	---	---	174	165	---
8/2/95	---	---	---	---	---	---	---	69	143	---
8/4/95	---	---	---	---	---	---	---	121	4	---
8/6/95	---	---	---	---	---	---	---	28	89	---
8/7/95	15	10	21	6	---	56	26	11	5	229
8/9/95	---	---	---	---	---	---	---	---	---	---
8/10/95	---	---	---	---	---	---	---	---	---	111
8/21/95	82	73	126	56	---	192	3	0	80	79
8/23/95	---	---	---	---	---	---	---	---	---	---
9/6/95	115	43	1000	9	---	20	18	17	37	50
9/7/95	---	---	63	---	---	---	---	---	---	---
10/10/95	1	1	1	1	---	1	1	0	0	1
11/13/95	---	---	---	---	---	---	---	---	---	---
11/14/95	---	---	---	---	---	0	---	---	---	0
12/5/95	---	---	---	---	---	---	---	---	---	---
12/11/95	---	---	---	---	---	0	---	---	---	2
COUNT	19	18	22	21	1	22	18	20	17	28
CNT > 200	2	2	5	5	0	3	1	4	6	6
TOTAL CNT > 20										
TOTAL #SAMPLE										

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	HOBI2	LEW1	LEW2	LEW3	LEW4	LONE1	LONE2	LONE3	MOQUI1	MOQUI2
1/9/95	---	---	---	---	---	2	1	0	.	.
2/6/95	---	---	---	---	---	1	0	0	.	.
3/13/96	---	---	---	---	---	0	---	---	.	.
4/10/96	---	0	0	---	---	21	18	2	.	.
5/18/95	---	---	---	---	---	4	1	0	.	.
5/25/95	0	---	---	---	---	---	---	---	.	.
5/30/95	12	0	3	---	---	62	73	57	21	7
6/12/95	150	3	0	---	---	47	5	23	716	54
6/14/95	43	---	---	---	---	---	---	---	110	94
6/15/95	---	---	---	---	---	---	---	---	.	.
6/19/95	---	---	---	---	---	---	---	---	.	.
6/26/95	114	4	14	---	---	90	283	32	716	184
6/28/95	---	---	---	---	---	293	251	453	117	88
6/29/95	---	---	---	---	---	146	47	43	.	.
7/5/95	466	---	---	20	1	276	189	1	73	92
7/7/95	1490	---	---	---	---	801	2	---	.	.
7/10/95	111	---	---	---	---	407	702	94	85	165
7/11/95	192	---	---	---	---	19	2	7	---	.
7/12/95	---	---	---	---	---	167	127	35	---	---
7/13/95	73	---	---	---	---	54	14	1	---	.
7/14/95	517	---	---	---	---	33	9	2	---	.
7/15/95	63	---	---	---	---	719	27	---	---	---
7/16/95	---	---	---	---	---	158	54	13	---	---
7/17/95	212	---	---	---	---	---	---	---	---	---
7/18/95	---	---	---	---	---	---	---	---	---	---
7/19/95	---	---	---	---	---	---	---	---	---	.
7/20/95	57	---	---	---	---	---	---	---	---	.
7/21/95	26	---	---	---	---	---	---	---	---	.
7/24/95	80	1	0	---	---	97	---	1	98	107
7/26/95	---	---	---	---	---	---	---	---	---	---
7/27/95	---	---	---	---	---	---	---	---	---	---
7/28/95	---	---	---	---	---	---	---	---	---	---
7/29/95	---	---	---	---	---	---	---	---	---	---
7/30/95	---	---	---	---	---	---	---	---	---	---
7/31/95	---	---	---	---	---	---	---	---	---	---
8/2/95	---	---	---	---	---	---	---	---	---	---
8/4/95	---	---	---	---	---	---	---	---	---	---
8/5/95	---	---	---	---	---	---	---	---	---	---
8/7/95	516	13	63	---	---	2	5	0	191	109
8/9/95	---	---	---	---	---	---	22	---	.	.
8/10/95	125	---	---	---	---	---	---	---	.	.
8/21/95	38	0	1	---	---	1	142	65	64	27
8/23/95	---	---	---	---	---	---	0	---	.	.
9/6/95	6	8	---	---	---	3	2	3	23	2
9/7/95	---	---	---	---	---	---	---	---	.	.
10/10/95	---	---	---	---	---	0	0	0	2	.
11/13/96	---	---	---	---	---	0	0	.	.	.
11/14/95	---	---	---	---	---	---	---	---	.	.
12/5/95	---	---	---	---	---	0	---	---	.	.
12/11/95	---	---	---	---	---	0	1	---	.	.
COUNT	20	8	7	1	1	27	26	21	12	11
CNT > 200	5	0	0	0	0	5	3	1	2	0
TOTAL CNT > 20										
TOTAL #SAMPLE										

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	MOQUI3	MSC1	MSC2	NARCYN	NARR1	NPS1	OAK1	OAK2	OAK3	RB1
1/9/95	---	---	---	---	---	---	---	---	---	---
2/6/95	---	---	---	---	0	---	---	---	---	---
3/13/95	---	---	---	---	---	---	---	---	---	---
4/10/95	---	---	---	---	0	0	0	0	---	0
5/18/95	---	---	---	---	0	0	---	---	---	---
5/25/95	---	---	---	---	---	---	---	---	---	---
5/30/95	---	0	0	---	15	12	0	1	---	5
6/12/95	---	0	0	---	45	38	9	---	9	1
6/14/95	---	---	---	---	---	---	---	---	---	---
6/15/95	---	---	---	---	---	---	---	---	---	---
6/19/95	---	---	---	---	---	---	---	---	---	---
6/26/95	---	7	---	---	59	33	40	---	174	0
6/28/95	---	---	---	---	---	---	13	---	71	---
6/29/95	---	---	---	---	---	---	165	---	210	---
7/5/95	---	5	2	---	40	69	1	---	0	2
7/7/95	---	---	---	---	---	---	---	---	---	---
7/10/95	---	---	---	---	82	3	---	---	---	---
7/11/95	---	---	---	---	---	---	---	---	---	---
7/12/95	---	---	---	---	---	---	---	---	---	---
7/13/95	---	---	---	---	---	---	---	---	---	---
7/14/95	---	---	---	---	---	---	---	---	---	---
7/15/95	---	---	---	96	---	---	---	---	---	---
7/16/95	---	---	---	---	---	---	---	---	---	---
7/17/95	---	---	---	---	---	---	---	---	---	---
7/18/95	---	---	---	---	---	---	---	---	---	---
7/19/95	---	---	---	---	---	---	---	---	---	---
7/20/95	---	---	---	---	---	---	---	---	---	---
7/21/95	---	---	---	---	---	---	---	---	---	---
7/24/95	216	4	---	---	29	44	70	---	43	1
7/26/95	---	---	---	---	---	---	---	---	---	---
7/27/95	---	---	---	---	---	---	---	---	---	---
7/28/95	---	---	---	---	---	---	---	---	---	---
7/29/95	---	---	---	---	---	---	---	---	---	---
7/30/95	---	---	---	---	---	---	---	---	---	---
7/31/95	---	---	---	---	---	---	---	---	---	---
8/2/95	---	---	---	---	---	---	---	---	---	---
8/4/96	---	---	---	---	---	---	---	---	---	---
8/6/96	---	---	---	---	---	---	---	---	---	---
8/7/96	---	4	---	---	1	45	11	---	8	2
8/9/96	---	---	---	---	---	---	---	---	---	---
8/10/96	---	---	---	---	---	---	---	---	---	---
8/21/95	---	16	---	---	1	4	0	---	---	3
8/23/95	---	---	---	---	---	---	---	---	---	---
9/6/96	---	3	---	---	1	2	23	5	---	3
9/7/96	---	---	---	---	---	---	---	---	---	---
10/10/95	---	---	---	---	0	0	---	---	---	---
11/13/95	---	---	---	---	---	1	---	---	---	---
11/14/95	---	---	---	---	---	---	---	---	---	---
12/6/95	---	---	---	---	---	---	---	---	---	---
12/11/95	---	---	---	---	---	---	---	---	---	---
COUNT	1	8	3	1	13	13	11	3	7	9
CNT > 200	1	0	0	0	0	0	0	0	1	0
TOTAL CNT > 20										
TOTAL #SAMPLE										

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	RB2	STAN1	STAN2	UBB1	UBB2	WCB1	WCB2	WCCA	WIL1	WIL2
1/9/95	---	0	---	0	0	0	0	0	---	---
2/6/95	---	0	---	0	0	0	0	0	---	---
3/13/95	---	0	---	1	0	0	0	0	---	---
4/10/95	0	0	---	2	0	0	0	0	---	---
5/18/95	---	---	---	---	---	0	0	0	0	0
5/25/95	---	2	0	2	1	---	---	---	---	---
6/30/95	1	128	41	27	1	5	0	0	1	1
6/12/95	11	116	217	11	4	1	1	0	1	4
6/14/95	---	170	96	---	---	---	---	---	---	---
6/15/95	---	---	---	---	---	---	---	---	---	---
6/19/95	---	---	---	---	---	---	---	---	---	---
6/26/95	0	116	262	101	24	34	32	1	19	16
6/28/95	---	267	341	---	---	---	---	---	---	---
6/29/95	---	---	---	---	---	---	---	---	---	---
7/6/95	---	1000	48	152	55	8	89	522	29	1
7/7/95	---	1970	1000	---	---	---	---	22	---	---
7/10/95	---	191	141	233	206	2	50	84	---	---
7/11/95	---	231	72	---	---	---	---	---	---	---
7/12/95	---	149	126	---	---	---	---	---	---	---
7/13/95	---	170	74	59	115	---	---	---	---	---
7/14/95	---	67	358	---	---	---	---	---	---	---
7/15/95	---	23	376	---	---	---	---	---	---	---
7/16/95	---	---	---	---	---	---	---	---	---	---
7/17/95	---	137	114	---	---	---	---	---	---	---
7/18/95	---	---	---	---	---	---	---	---	---	---
7/19/95	---	---	---	---	---	---	---	---	---	---
7/20/95	---	194	1	---	---	---	---	---	---	---
7/21/95	---	23	6	---	---	---	---	---	---	---
7/24/95	---	116	532	---	---	401	3	34	3	23
7/26/95	---	147	---	549	---	545	---	---	---	---
7/27/95	---	---	1000	---	1000	38	---	---	---	---
7/28/95	---	---	407	---	742	10	---	---	---	---
7/29/95	---	---	955	---	1230	39	---	---	---	---
7/30/95	---	---	904	---	976	---	---	---	---	---
7/31/95	---	---	270	---	946	---	---	---	---	---
8/2/95	---	---	202	---	100	---	---	---	---	---
8/4/95	---	---	17	---	117	---	---	---	---	---
8/6/95	---	---	48	---	126	---	---	---	---	---
8/7/95	---	260	52	124	93	1	1	12	5	150
8/9/95	---	---	---	---	---	---	---	---	---	---
8/10/95	---	---	---	---	---	---	---	---	---	---
8/21/95	---	71	0	31	113	15	1	0	6	8
8/23/95	---	---	---	---	---	---	---	---	---	---
9/6/95	---	3	31	9	---	1	9	1	1	12
9/7/95	---	---	---	---	---	---	---	---	---	---
10/10/95	---	2	2	0	2	0	0	0	---	---
11/13/95	---	---	---	---	---	0	---	0	---	---
11/14/95	---	5	---	---	2	---	---	---	---	---
12/5/95	---	---	---	---	---	---	---	---	---	---
12/11/95	---	1	---	---	0	---	---	---	---	---
COUNT	4	29	30	16	24	20	15	17	9	9
CNT > 200	0	5	13	2	6	2	0	1	0	0
TOTAL CNT > 20										
TOTAL #SAMPLE										

1995 LAKE POWELL FECAL COLIFORM DATA

DATE	WWB	WWPB1	WWPB2	WWLBP	WWM1	WWM2	
1/9/95	---	0	1	---	0	4	
2/6/95	0	0	0	---	41	0	
3/13/95	0	---	---	---	1	0	
4/10/95	0	0	0	---	3	0	
5/18/95	0	1	0	---	7	0	
5/25/95	---	---	---	---	---	---	
5/30/95	0	0	0	---	11	5	
6/12/95	1	17	10	---	195	8	
6/14/95	---	---	---	---	304	---	
6/15/95	---	---	---	---	2	---	
6/19/95	---	108	---	---	4	---	
6/26/95	2	67	19	---	52	18	
6/28/95	---	---	---	---	---	---	
6/29/95	---	---	---	---	---	---	
7/5/95	7	182	282	---	108	22	
7/7/95	---	231	183	---	---	---	
7/10/95	25	670	322	---	81	50	
7/11/95	---	0	2	---	---	---	
7/12/95	---	0	2	1	---	---	
7/13/95	---	2	1	---	---	---	
7/14/95	---	---	---	---	---	---	
7/15/95	---	---	---	---	---	---	
7/16/95	---	---	---	---	---	---	
7/17/95	---	---	---	---	---	---	
7/18/95	---	---	---	---	---	---	
7/19/95	---	---	---	---	---	---	
7/20/95	---	---	---	---	---	---	
7/21/95	---	---	---	---	---	---	
7/24/95	0	61	142	---	90	125	
7/26/95	---	---	1159	---	---	---	
7/27/95	---	---	549	---	---	---	
7/28/95	---	3	2	0	---	---	
7/29/95	---	54	47	---	---	---	
7/30/95	---	---	---	---	---	---	
7/31/95	---	---	---	---	---	---	
8/2/95	---	---	---	---	---	---	
8/4/95	---	---	---	---	---	---	
8/5/95	---	---	---	---	---	---	
8/7/95	8	1	18	---	18	4	
8/9/95	---	---	---	---	---	---	
8/10/95	---	---	---	---	---	---	
8/21/95	6	3	1	---	73	4	
8/23/95	---	---	---	---	---	---	
9/6/95	0	6	1	---	110	3	
9/7/95	---	---	---	---	---	---	
10/10/95	0	2	0	---	1	---	
11/13/95	0	0	---	---	21	---	
11/14/95	---	---	---	---	---	---	
12/5/95	---	---	---	---	7	---	
12/11/95	---	1	---	---	---	---	
COUNT	15	23	22	2	20	14	895
CNT > 200	0	2	4	0	1	0	102
TOTAL CNT > 20							
TOTAL #SAMPLE							