An Overview and Management Plan for the Lake Powell Ecosystem, Bay & Walton Counties, Florida.

Prepared by: The Lake Powell Community Alliance, Inc. May 2006

Richard Bryon, President
Emily Ellis, Vice President
Christopher Foreman, Secretary-Treasurer

With Assistance From: Keppner Biological Services

Acknowledgements

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Lake Powell Community Alliance, Inc.

A group of citizens interested in the conditions in Lake Powell, Bay County Florida met in 2004 to discuss their ideas for the future of the Lake Powell drainage basin. The group formed the Lake Powell Community Alliance (LPCA). In 2005, the LPCA was recognized as a not-for–profit corporation by the State of Florida and is currently seeking 501(c)(3) status from the Internal Revenue Service. Through a Bay County sponsorship, the LPCA has received a $13,000 grant from the U.S. Fish and Wildlife Service Coastal Program to: gather information regarding the hydrology, tidal exchange and flushing capabilities, perform a shoreline survey, and prepare and disseminate a comprehensive ecosystem management plan for the Lake Powell drainage basin.

Article I of the bylaws of the LPCA states that the purpose of the corporation is the preservation, restoration, and management of the globally rare and imperiled Lake Powell ecosystem. Article IV of the Articles of Incorporation that: More particularly, to conduct programs and activities, sponsor research, sponsor promotions, raise funds, request and receive grants, gifts, contributions, dues, and bequests of money, real and personal property; or acquire, receive hold, invest and administer, in its own name, securities, funds, objects of value, or other property, real or personal; make expenditures and distributions for the benefits of the Lake Powell Watershed as set forth in the management plan of the corporation not inconsistent with these Articles of Incorporation and which may be amended from time to time.

The LPCA obtained a grant from the U.S. Fish and Wildlife Service’s Coastal Program to accomplish a number of tasks. One of the tasks was to produce a management plan for the Lake Powell ecosystem. This document completes that task. A second task was to conduct a shoreline survey of Lake Powell. That task has also been completed with emphasis on stormwater discharge points. The grant also included support for a study of the hydrology of Lake Powell and the investigation of the tidal exchange and flushing capabilities of the lake under the current inlet management regime. These tasks are included as Action Plans in this document. The LPCA expresses its appreciation for the support of the U.S. Fish and Wildlife Service in our efforts.

The LPCA also expresses appreciation to Bay County for its support in establishing the LPCA. The point person for the county that accomplished much in the development of the LPCA is Ms. Summer Water, Natural Resources Planner for Bay County. The support and efforts of the Choctawhatchee Bay Alliance and the Walton County Dune Lakes Advisory Committee is greatly appreciated. Mr. Phillip Ellis has given freely of his time to further the efforts of the LPCA.

Preface

The Lake Powell Ecosystem Management Plan is the product of the cooperation and joint efforts of the participants in the Lake Powell Community Alliance with the assistance of Keppner Biological Services. The preparation of the plan revealed the absence of information regarding Lake Powell many of the characteristics of Lake Powell and its drainage basin. It also revealed that much of the information regarding certain aspects of Lake Powell is anecdotal, and therefore, open to disagreement and contradiction. The absence of formal information in many areas of concern may lead to assumptions and conclusions that are difficult to support or resolve.

The LPCA believes that the management plan should be based on the existing facts. However, the LPCA considers anecdotal information as a value in the plan and that speculation is warranted in that it can lead to asking questions that can be placed in the document as Action Plans. The Action Plans included in the plan are used to obtain answers to questions in a formal manner.

An attempt was made to make the management plan as comprehensive as possible, but it is realized that some existing information may have been missed during its preparation or that additional analysis of existing data may be warranted in the future. The plan is open for revision, additions, and review at almost any time that the LPCA determines necessary to clarify information or update actions taken in the management area. Those who read the plan are encouraged to contact the LPCA and submit their recommendations.

Lake Powell Community Alliance May 31, 2006

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Purpose

The Lake Powell Community Alliance (LPCA) is interested in and concerned about the future of Lake Powell as development continues around the lake and within its drainage basin. The LPCA concluded that the best manner in which to approach the perceived problems and the expressed concerns that actually or potentially face Lake Powell is to prepare a management plan for Lake Powell with the goal of maintaining the excellent water quality in the lake and its exceptional recreational and ecological values as is required by its designation as an Outstanding Florida Water. In addition, the Alliance is interested in maintaining the biodiversity (both species and biotic community diversity) of the lake and the drainage basin. The LPCA believes that the plan should be based on the available information regarding the lake and its drainage basin.

The following plan is provided to aid in achieving that goal. The plan is intended to be modified when and where appropriate and includes Action Plans directed at obtaining information not currently available, supplementing the available information, and examining other issues. The LPCA will be responsible for implementing the management plan as resources to do so become available. Some of the information regarding the Lake Powell ecosystem is anecdotal and is therefore open to question. The LPCA believes that this anecdotal information can be of some value and should be included in the informational sections of the plan. Therefore some of these observations are included.

This plan is divided into Sections that address various aspects of the Lake Powell system. Section I is an overview of the Lake Powell ecosystem that is based on the information located regarding the ecosystem with emphasis on the terrestrial and freshwater habitats. It must be realized that Lake Powell itself is not an entity separate from the surrounding uplands, wetlands, creeks, streams, plants, animals, and the Gulf of Mexico. Section II is an overview of Lake Powell that emphasizes the lake and its physical, chemical, and biological characteristics. Section III is the proposed ecosystem management concept for the ecosystem to conserve and protect the quality, quantity, and seasonal distribution of freshwater to Lake Powell. Section IV contains the Action Plans developed by the LPCA to address the need for additional information necessary to better understand the lake and how it functions.

Introduction

One must define the area to be managed in order to attempt to develop a management plan for Lake Powell. The Lake Powell subdrainage basin of the St. Andrew Bay ecosystem is located in the southwest corner of Bay County, and the western arm of the lake extends into Walton County (Figure 1). Lake Powell is usually included as a part of the St. Andrew Bay ecosystem, but may be worthy of separate designation. The following definition of ecosystem appears to be relevant to the decision as to the area to be evaluated and managed in order to achieve the goals for Lake Powell and what to call the management area – a subdrainage basin of the St, Andrew Bay ecosystem or an ecosystem in its on right.

An ecosystem is any area of nature in which the biotic (living) and abiotic (non-living) components interact to form a clearly defined trophic (flow of energy) structure based upon the fixation of light energy, biodiversity, and biogeochemical cycles (Odum, 1971). An ecosystem develops under the influence of the climate and the geological history of an area and is then acted upon by plants and animals. The only source of energy needed by the ecosystem to sustain itself is sunlight. Both the biotic and abiotic components of an ecosystem influence one another, and both are necessary for the maintenance of the ecosystem in question. Ecosystem management, therefore, should be directed at maintaining and restoring the biodiversity, trophic structure, and biogeochemical cycles of the ecosystem in question.

The St. Andrew Bay ecosystem is defined geographically by its drainage basin in which all the flowing surface water and ground water movement is toward the St. Andrew Bay estuary and then to the Gulf of Mexico through East Pass (when open) and the West Pass (man-made navigation channel). A close examination of the Lake Powell subdrainage basin of the St. Andrew Bay ecosystem (designated the Phillips Inlet subdrainage basin by DEP) reveals that all of the water flowing in this subdrainage basin enters Lake Powell and is then discharged to the Gulf of Mexico (Figure 2) on an intermittent basis both naturally and artificially through human activity. Figure 2 also shows the tributaries or subdrainage basins entering Lake Powell.

The Lake Powell subdrainage basin of the St. Andrew Bay ecosystem agrees with the definition of ecosystem, agrees with a geographical delineation of an ecosystem by its drainage basin with subdrainage basins, does not, apparently, provide surface water or ground water to the St. Andrew Bay ecosystem, and discharges the waters originating in the drainage basin directly to the Gulf of Mexico. Therefore, Lake Powell can be and is considered to be an ecosystem separate from, rather than a minor part of, the larger St. Andrew Bay ecosystem for the purposes of this management plan.

Although the aquatic portion of the Lake Powell ecosystem is the major subject of interest by the residents of the Lake Powell ecosystem, one must realize that what happens on the uplands and wetlands within this ecosystem affects and determines what happens in the waters of Lake Powell to a great degree. Lake Powell is considered to be a Coastal Dune Lake by the Florida Natural Areas Inventory (FNAI). FNAI (2005) lists Coastal Dune Lakes (CDL) as S1 or imperiled in Florida. FNAI (1990) characterizes CDLs as shallow, irregularly shaped or elliptical depressions occurring in coastal biotic communities. They are generally permanent water bodies, although water levels may fluctuate substantially. They are typically lentic water bodies without significant surface inflows or outflows. The substrate is primarily composed of sand with organic deposits increasing with water depth. They characteristically have slightly acidic, hard water, with high mineral content, predominantly sodium and chloride. Salinity levels vary greatly. They are generally oligotrophic with low nutrient levels. Butera (2005) stated that the Panhandle's Coastal Dune Lakes are between 2,000 and 10,000 years old.

It may be well to note that the above definition or characteristics of a Coastal Dune Lake includes the phrase – without significant surface inflows or outflows. It should also be recognized that some people and documents refer to an "outlet" rather than an "inlet" as being associated with Coastal Dune Lakes. Traditionally, the water leaving or entering Lake Powell has been referred to as an "inlet", and this tradition will be followed in this document. However, the dynamics of the opening of Lake Powell to the Gulf of Mexico is more an outlet than an inlet in that the surface levels of the lake plays a significant role in determining when the sand barrier between the Gulf and the lake is breached. Storm events also play a role in opening and closing of the connections to the Gulf of Mexico.

The long history of human intervention in creating or enhancing the “inlet” to Lake Powell may be of importance in deciding whether or not Lake Powell can be considered a Coastal Dune Lake. The frequency of the opening and closing of the inlet from natural causes and/or human intervention may have been of a frequency sufficient to have altered the Coastal Dune Lake characteristics of the lake and preclude restoration of Lake Powell as a Coastal Dune Lake. This should be kept in mind as one proceeds through this document. Lake Powell deviates from some of the characteristics provided by FNAI, but the lake is in agreement with many of the characteristics listed by FNAI. The primary deviations are the connection between Lake Powell and the Gulf of Mexico and the number and size of the tributaries entering the lake.

In recognition of the excellent recreational values, ecological values, and water quality in Lake Powell, the lake was designated an Outstanding Florida Water (OFW) in 1991 by the Florida Department of Environmental Protection. This designation provides some protection through the regulatory programs of the State of Florida that is directed at maintaining the water quality of an OFW at the same quality as when established (ambient water quality). The primary goal of the plan is to attempt to maintain these values or restore them, if necessary and if possible.

In conclusion, it appears that the Lake Powell drainage basin can be easily viewed as an ecosystem by itself rather than a component of the St. Andrew Bay ecosystem. This approach is followed throughout the plan. The activities that occur on the uplands and freshwater wetlands have a great influence on the lake in terms of the quality, quantity, and seasonal distribution of freshwater to Lake Powell as well as the opening and closing of the inlet. The alteration of these areas is considered in this plan.

Literature

Keppner and Keppner (2000) provided a basic summary of the information pertaining to Lake Powell that was available to them at the time. The summary was requested by and submitted to Bay County Planning Department, and a copy can be obtained from that agency. The original documents, upon which the summary was based, are present at the U.S. Fish and Wildlife Service office in Panama City, and at the National Marine Fisheries Service library in Panama City Beach. Since the March 17, 2000 date of that summary, additional information has accumulated regarding Lake Powell, and the information provided and available since that date is included here. The specific information used in the document is cited in the appropriate places in the plan and listed in the literature cited.

Those interested in obtaining detailed information regarding the St. Andrew Bay drainage basin including Lake Powell can find information specific to both in a number of places such as local libraries. One excellent library for technical information is located at the National Marine Fisheries Service laboratory on Delwood Beach Road in Panama City Beach. This library maintains an extensive collection of articles, reports, journal publications, and other information that pertains to the St. Andrew Bay ecosystem (including Lake Powell) and the St. Andrew Bay estuary. The original bibliography for the ecosystem was prepared by Shaffer (1993), and she has updated the bibliography regularly. This bibliography can be searched at their website (www.aoml.noaa/ lib/sadl.html).

Section I. Overview of the Lake Powell Ecosystem

Lake Powell 1964

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The GIS data used to construct the figures in this plan is from a variety of sources, and the data is not a legal representation of the features depicted. Any conclusions drawn from the use of the information are the sole responsibility of the user.

Introduction. Tucked away in the southwestern corner of Bay County and included as a minor part of the St. Andrew Bay ecosystem, little was formally known regarding the ecology of Lake Powell or its ecosystem prior to the late 1960s, when the U.S. Army Corps of Engineers (COE) evaluated the construction of a permanent navigation inlet into Lake Powell from the Gulf of Mexico. There also was talk of connecting the north side of the lake to the Gulf Intracoastal Waterway. In 1971, the COE held a Public meeting on the proposed improvements to Phillips Inlet (COE 1971). Subsequently, the COE decided that the improvements were not cost beneficial, and the project was deactivated.

About 1983, a proposal for issuance of COE and Florida Department of Environmental Protection (DEP) permits to permanently open Lake Powell to the Gulf of Mexico was brought to the COE, Jacksonville District and the DEP by a group of property owners around Lake Powell. The result of this proposal was a year-long study of Lake Powell during which information was obtained and provided pertaining to many aspects of the lake. After a number of years of negotiation, the permit was eventually denied by the State of Florida based on concerns for public access to and along the Gulf front beach. The St. Andrew Bay Resource Management Association (RMA) petitioned the State of Florida to designate Lake Powell as an OFW in 1987. After a few years of delay and an Administrative Hearing, Lake Powell was designated an OFW by the DEP in 1991.

About 1995, the DEP issued a permit to their Division of Recreation and Parks to open the inlet to Lake Powell when the water level in the lake reached a certain elevation to avoid flooding of low-lying residential areas. Opening of the inlet to the specified elevation and width has occurred from about 1995 to the present. About 1999, a proposal to construct a golf course on the north side of Lake Powell was presented to the citizens and the regulatory agencies. In 2000, the Bay County Planning Department requested that a summary of the information regarding Lake Powell be prepared and the information gathered in one place. The summary was completed in March 2000 (Keppner and Keppner 2000). Since 2000, a number of water quality studies and other studies have been implemented and continued in the lake. These studies are added to the previous information in this Lake Powell Ecosystem Management Plan where appropriate.

Description of the Ecosystem. The Lake Powell ecosystem is located in the extreme southwestern portion of Bay County and the extreme southeastern portion of Walton County. It is about 13.2 square miles in area with about 10 square miles in Bay County and about 3.2 square miles in Walton County. The health of the ecosystem and its included Lake Powell is dependent on the maintenance of the functions of the ecosystem in as natural a state as possible. Some knowledge of the components of the ecosystem is essential to understanding and maintaining its functions.

Abiotic Components. The abiotic (non-living) components of the ecosystem determine the fauna and flora that will be supported within the ecosystem. Generally, the abiotic components of the ecosystem are not as easily subject to change as the biotic components. Changing the geology, climate, and soils is not considered to be as easily accomplished as altering the numbers and kinds of living things. However, the soils can be altered by filling with material imported from outside the ecosystem and the topography can be altered by a variety of construction techniques.

Physiography and Geology. A physiographic area or region provides information regarding the land form that has been established through time and provides general characteristics of the area such as topography and the influence of coastal processes.

Most of the reports pertaining to Camp Helen and the other areas specific to the Lake Powell drainage basin address these topics. Lake Powell is located in the Gulf Coastal Lowlands physiographic region. Barr and Wagner (1981) provide a summary of the physiography and geology of southwestern Bay County. Schmidt and Clark (1980) described the land forms in this region as being composed of barrier islands, coastal ridges, estuaries, lagoons, relict spits and bars, and sand dune ridges which are generally parallel to the present coast. These land forms were shaped by previous coastal environments. Chance and Ashley (1999) provide a brief description of the physiography of the Lake Powell area based on Brooks (1981). According to this classification, the Lake Powell area is within the Delta Plain and Coastal Strip physiographic regions of the Apalachicola Delta District. The Coastal Strip is a remnant of a lagoon-barrier island complex along the coast of the Gulf of Mexico. The Delta Plain consists of surface deposits of sand and silt that support poorly drained swamp forest and flatwoods.

Schmidt and Clark (1980) provided a detailed description of the geology and physiography of Bay County, and this document should be consulted for detailed information pertaining to the geology and stratigraphy of Bay County. Although Lake Powell is not specifically mentioned, Wolfe et al. (1988) provided a general description of the geology and physiography of the entire Panhandle area. The following has been excerpted from these two sources.

Bay County is included in the ancient Apalachicola Embayment, and Lake Powell is at the western boundary of that embayment. The Apalachicola Embayment is an ancient sea floor where sediments eroded from the uplands, were deposited, and sedimentary rocks were formed. Today we are concerned about a rising sea level, but from a geological time perspective, sea level has decreased since the Miocene, leaving terraces behind as the surface of the sea has fallen. These marine terraces are the former bottoms of ancient seas, and a number of these terraces have been identified in Bay County. The youngest terraces are closest to the present coast line (0-25 feet in elevation), and it is within this area, Silver Bluff and Pamlico terraces, that Lake Powell is located.

In about the last 2 million years, sea level has risen and fallen in association with climatic changes that resulted in the formation of glaciers and their regression. About 6000 years ago the present sea level was established. The rise and fall of the sea level prior to 6000 years ago resulted in the sediments in the Silver Bluff and Pamlico Terraces being subjected to erosion, wind action, deposition of sediments, and wave action. Coastal features such as dunes, sandbars, etc. became landlocked as the sea level decreased. Lake Powell was formed as a result of these events. The only speculation as to the time and method of formation of Lake Powell is that provided in the EPS (1985) study. It is stated in the report that the basin of Lake Powell has long been flooded by Gulf waters resulting from the last rise in sea level which occurred approximately 10,000 years ago. Tesar (1996) examined the archeological evidence and concluded that the area was visited by prehistoric people beginning by at least 4000 years ago. According to his interpretation, the archeological remains also reflect on the environmental status of Lake Powell during the same period. Lake Powell - except for a period from about 1000-1250 A. D., when sea level was about 18 inches (45-50 cm) higher than present - remained an essentially closed water body. This is reflected in the shellfish food remains found at prehistoric sites. Marsh clams (*Rangia cuneata*) have a low salinity tolerance, and they dominate the sites through time. The lone exception is the brief 250 year period in which oysters and *Mercenaria* clams occurred which is evidence of a shift to a tidally flushed, higher saline system. Even today - the most recent 200 years - the system continues to be primarily a closed freshwater system according to Tesar (1996). This interpretation would conform better to the definition of a Coastal Dune Lake as being mostly isolated from the Gulf of Mexico with storm surges providing the major, if only, seawater input to the Lake. However, the inlet to Lake Powell has been manipulated by humans for, apparently, some time in addition to natural openings and closings. Many of the long-time residents of the area are of the opinion that the inlet has been manipulated by humans for over 70 years, and some before that.

Topography. The Seminole Hills and Point Washington U.S.G.S. Quadrangle maps contain most or all of the Lake Powell drainage basin. The maps show the contour of the land in intervals of five feet. Examination of the maps reveals that the elevations vary from sea level to about 40 feet above sea level. The land closest to the lake varies from sea level to about 20 feet with the steepest slopes being along the shoreline and creeks entering the lake. Away from the shoreline and the creeks, the land has broad expanses of low areas designated as wetlands from the perspective of these maps. However, the definition of wetlands used in the construction of these maps may be different from that used for regulatory purposes or formal wetlands surveys.

Soils in the Ecosystem. The types of soil that exist in the ecosystem are a result of the interaction of the parent material, climate, topography, inundation by the Gulf of Mexico, erosion, and the plant and the biotic communities present. A biotic community is an assemblage of plants and animals that occupy a given area and interact to produce a flow of energy through food webs and food chains. The natural biotic communities present in an area are adapted to the physical and chemical characteristics of the soil, climatic conditions, and other natural events such as frequency of fire. The biotic communities act on the soil to alter its characteristics by adding organic material, reducing erosion, shading the soil, etc. The types of soil in an area, in conjunction with the types and coverage of vegetation, determine aspects of the quality of the water that enters the lake through surface runoff and groundwater. In addition, the types of soils in an area determine the degree of alteration or management necessary to achieve various desired goals.

Duffee et al. (1984) described the soils of Bay County, Florida, and the following is largely taken from that publication. The land around Lake Powell is a mosaic of soil types (Figure 3) using the soils map from the Bay County GIS Department. In general, the soils are acidic, sandy soils of recent origin. Appendix 1 provides some characteristics of the most abundant soil types in the Lake Powell drainage basin. Hudson et al. (1990) provided additional characteristics of the soil types in the Lake Powell drainage basin pertaining to the ability of the soils to support wastewater treatment facilities. The ecosystem consists of about 12 different soil types; Chipley Sand, Foxworth Sand 0-5% slope, Hurricane Sand, Kureb Sand, Lakeland Sand 0-5% slope, Leon Sand, Mandarin Sand, Centenary Sand, Pottsburg Sand, Rutlege Sand, and Resota Fine Sand 0-5% slope. Beach Sand is present along the Gulf of Mexico.

The soil types that are considered to be hydric soils are very important in determining the areas considered to be wetlands within the jurisdiction of various government agencies that regulate the alteration of wetlands. A hydric soil is a soil that has formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil profile. Figure 4 is a map showing the distribution of hydric soils in the Lake Powell drainage basin as listed for Bay County by Kriz (1995). The five hydric soils are Leon Sand, Mandarin Sand, Pottsburg Sand, and Rutlege Sand. The operative words in the definition of hydric soils are "saturated" and "ponded". Almost any soil type that is saturated or ponded for a sufficient length of time can develop the anaerobic conditions necessary to be called a hydric soil. Kriz (1995) should be consulted for the descriptions of those soils considered to be hydric soils.

A significant portion of Bay County and the land in the Lake Powell ecosystem is in silviculture or the growing of trees as a crop. The sand pines and slash pines that are planted as a crop are done so on soils to which these trees are naturally adapted, and, therefore, require a minimum of management. In other words, the desired product, wood, is produced without supplemental watering and a minimum of fertilizers, pesticides, and herbicides. However, if one desires to grow corn or any other vegetation not naturally adapted to the prevailing environmental conditions on these soils, management techniques to ensure success would increase. The type of soil in an area also affects construction methods, and can have an effect on sanitary facilities such as the efficiency of the operation of septic tanks (see Hudson et al, 1990).

Climate. Wolfe et al. (1988) provided a general description of the climate of the Florida Panhandle and Duffee et al. (1983) also provided a summary of the climate of Bay County. The following is excerpted from those reports. Bay County experiences a mild, subtropical climate which is modified by the proximity to the Gulf of Mexico. The closer one is to the Gulf of Mexico in Bay County, the greater is the modifying affect of that body of water on temperatures and wind direction. Summers are long, warm, and humid. Winters are cool with rather frequent large changes in temperature due to the passage of cold fronts. The official weather records for the county are recorded at the Bay County water treatment plant located on Transmitter Road just south of Highway 231.

Temperatures in the summer months of June, July, August and September reach into the 90's on almost a daily basis with a mean average temperature in these months of 80 degrees. Towards the end of September, temperatures begin to moderate as cold fronts reach the area. The average date of the first killing frost for the county is November 29th. The coldest months of the year are December, January, and February with daily normal maximum temperatures of about 60 degrees and daily normal minimum temperatures of about 40 degrees. The passage of cold fronts during these months can result in temperatures falling into the teens, but extreme cold is usually quite short-lived. The average date of the last killing frost is about March 3rd. The coastal location of

Lake Powell results in a greater effect of the adjacent Gulf waters on moderating temperature extremes.

The average annual rainfall in the county is about 58 inches per year and about 43% of that amount falls during the five months from December to April. About 16% of the total annual amount falls during May and June, and the remaining 24% falls in July and August. The driest months are October and November. Rainfall amounts in excess of eight inches per day occur about once in every 10 years, and amounts reaching 20 inches in a single month have been recorded. The passage of tropical storms during the hurricane season can alter the generalities greatly.

The prevailing winds are generally from the south and southwest from March to November. In November, there is a shift in the prevailing winds to the northwest. The annual mean wind speed is about 7.5 miles per hour with the lowest average monthly wind speed of 5.8 miles per hour occurring in August, and the highest average monthly wind speed of 9.0 miles per hour occurring in March. The closer one is to the coast in the county, the more one is affected by the onshore and offshore winds that occur due to the daily heating and cooling of the land above and below the temperature of the Gulf of Mexico water.

EPS (1985) included weather data for the Lake Powell area during the term of their study. An automatic weather data recorder was installed near Lake Powell in 1984 and provided information until February 1985. Wind roses (diagrams of wind speed and direction that look like flowers) are provided for the study period and rainfall is compared against the normal rainfall. During the study period, the rainfall greatly exceeded the normal during April of 1984 and again in July of 1984. Rainfall was below the normal during May of 1984, and below the normal from August to December of 1984. Rainfall data was provided for the months of the study from Panama City. Additional data for January 1984 to September 1984 was given for the West Bay fire tower, and data for Lake Powell was provided from July 1984 to December 1984. Data for all three places was provided for July through August 1984. During July 1984, there were 14.76 inches of rain at Panama City, 14.3 inches at the West Bay tower, and 16.9 inches at the Lake Powell station. In August 1984, there were 5.68 inches at Panama City, 8.5 inches at West Bay tower, and 4.3 inches at Lake Powell. In September 1984, the amounts were respectively 0.98 inches, 0.8 inches, and 0.2 inches. The average rainfall at Panama City for October through January 1985 was 3.06 inches while at Lake Powell, the average for the same period was 2.15 inches. Rainfall is, apparently, variable throughout the county.

The RMA reports for 1991, 1992, 1994, 1995, & 1997 (RMA) include climatological data provided by Tyndall Air Force Base. This information was obtained closer to the coast than that at the Bay County water treatment plant and may better reflect the conditions at Lake Powell. However, Tyndall Air Force Base is located at the eastern side of Bay County and may not accurately reflect rainfall amounts at Lake Powell. NMFS & FWS (1985) made the observation that on December 24, 1983 the temperature in Bay County fell to 11 degrees F. This agrees with the EPS (1985) study and appears to account for the low water temperatures recorded at the time. During the first week of April 1984, rainfall in excess of 11 inches in 24 hour period was recorded for Bay County.

Hudson et al. (1990) provide rainfall records from the Point Washington forest tower and from the Panama City Beach wastewater treatment plant for the period of their study of the shellfish harvesting status of Lake Powell. Their interest was in the amount of rainfall in relation to the levels of fecal coliform bacteria in Lake Powell. Management of some waters classified as shellfish harvesting involves temporary closure of harvesting when a certain amount of rain falls within a certain amount of time. This amount and duration of rainfall are related to the number of fecal coliform bacteria that enter a water body from runoff. They used the rainfall and duration figures from the Point Washington tower in the management plan for the shellfish harvesting areas in Lake Powell. However, shellfish harvesting was not approved following the studies.

Ms. Katherine Berryman, a consultant for the Wild Heron development provided daily climatic data from April 2003-August 2005 for the Wild Heron's Shark's Tooth Golf Club including minimum temperature, maximum temperature, relative humidity, rainfall, wind, and solar radiation (Appendix II). This appears to be the only existing data for the immediate Lake Powell area.

Air. Bay County is considered an attainment area for air quality by the U.S. Environmental Protection Agency.

In summary, the Lake Powell ecosystem is a complex physical and chemical environment in which alterations of the natural conditions can significantly alter the characteristics of the ecosystem and, therefore, Lake Powell itself during short and long time periods. Lake Powell's location within the Coastal Lowlands physiographic province means that wave action, wind, rainfall amounts, and storm surges all combine to make Lake Powell a dynamic body of water. One should not be surprised if the lake presents problems to those that expect consistency in its characteristics. The soils in the Lake Powell drainage basin are predominantly sandy and acidic, and support a variety of biotic communities. Hydric soils are abundant in the drainage basin. The climate of the Lake Powell area is subtropical with warm, humid summers and cool winters. The climatic conditions in conjunction with the soils in the area determine the plants and animals present. The plants and animals must be adapted to these conditions in order to survive in the area.

Biotic Components. The biotic components of the ecosystem include all living things within the ecosystem and their interrelationship with one another and the non-living part of the ecosystem as defined in the section on soils. The natural biotic communities present in an area are adapted to the physical and chemical characteristics of the soil, climatic conditions, and other natural events such as frequency of fire. Biotic communities are usually named for the dominant plants present such as hardwood swamp, pine flatwoods, seagrass bed, algal bed, etc., their appearance such as freshwater marsh, saltmarsh, bog, etc, or their place on the landscape such as floodplain swamp, seepage slope, tidal marsh, etc.

The biotic communities present in the Lake Powell ecosystem can be examined as upland types and wetland types. There are many definitions of upland versus wetland but all appear to include the type of soil present, hydrology, and species of plants that occur. Upland biotic communities generally occur on well-drained soils that are normally not inundated for any length of time and support species of plants that are not adapted to high water tables and inundation for significant periods of time. Wetland biotic communities generally occur on soils that are inundated for a significant period of time and support vegetation adapted to the period of inundation or high water table that result in anoxia in the surficial layer of the soils during inundation or ponding.

Upland Biotic Communities. Figure 5 is the Florida Fish and Wildlife Conservation Commission (FFWCC) map of vegetation types in the Lake Powell ecosystem. With the exception of the urban developed areas, there are fourteen vegetation types defined by the FFWCC. The system of naming and defining the vegetation types varies from that developed by FNAI, and the FNAI designations and definitions of biotic communities are followed herein.

The Lake Powell ecosystem supports both altered and natural upland biotic communities. Much of the interior uplands are devoted to pine silviculture, and most of the coastal uplands are the sites of potential or actual human development. The coastal areas support remnants of upland, natural biotic communities, some of which are considered to be imperiled to varying degrees by the Florida Natural Areas Inventory (FNAI) (2005).

Based on Figure 5, the biotic communities that are listed by FNAI as rare and/or imperiled are Scrub that exists on old dunes with fine sand substrate with the dominant vegetation being sand pine and scrub oaks such as laurel oak, Chapman's oak, and turkey oak and/or rosemary and lichens. The Scrub biotic community is listed as S2 or imperiled in Florida due to limited distribution and development. Another listed community is Coastal Strand that occurs on stabilized dunes near the coast with a sand substrate and is dominated by vines, grasses, and herbaceous plants with a few small trees or large shrubs. This community is strongly affected by wind and salt spray, and is considered to be S2 in Florida. Another community is Xeric Oak Scrub or Xeric Hammock which, by the FFWCC definition includes the Maritime Hammock of FNAI, is a community that is found on deep sand substrate and is dominated by sand live oak, live oak, other oaks, saw palmetto, and other shrubs. This community is considered to be S3 or imperiled primarily by development in the state. Another community is Beach Dune that consists of active coastal dunes vegetated primarily with sea oats other salt spray tolerant grasses and herbs, and is considered to be S2. In Bay County, this community is experiencing alteration due to development and the need for beach renourishment projects to protect the coastal construction and provide a beach for tourists.

DRP (1997) includes a list of the terrestrial habitats of Camp Helen. The communities listed in that report correspond to those listed in Lands Acquisition and Advisory Council and Florida Natural Areas Inventory (LAAC and FNAI 1994). LAAC and FNAI (1994) examined the natural upland communities on 3380 acres of land around Lake Powell. In that report, they consider about 32%, or 1097 acres of the tract examined, not to be a natural biotic community. Most of the 1097 acres consisted of recently harvested pine trees that have been replanted with sand pines. In other words the land is being used for silvicultural purposes. A table of the acreage of each community type and the FNAI tracking status is provided in the LAAC and FNAI (1994) report. The following is taken from that report.

Scrub: Scrub develops on well-drained soil and is found along most of the lake shore, and is dominated by sand pine (*Pinus clausa*) with an understory of shrubby oaks (*Quercus myrtifolia*, *Q. laevis*, and *Q. geminata*). It was considered to be a natural scrub community along the lake shore rather than an area of sand pine silviculture. The lichens, *Cladonia sp*. and *Cladina spp.* form 20-30% of the ground cover in this community.

Mesic flatwoods: Mesic flatwoods develop on moderately moist soils and are located around the northeast head of the westernmost drainage indentation in the lake shore, both north and south of the power line. The community is dominated by longleaf pine (*Pinus palustris*) with an understory of wiregrass (*Aristida stricta*), scattered shrubs such as wicky (*Kalmia hirsuta*), gallberry (*Ilex glabra*), and shiny lyonia (*Lyonia lucida*). Slightly higher areas contain turkey oak (*Quercus laevis*), sand pine (*Pinus clausa*), live oak (*Quercus virginianus*), and bluejack oak (*Quercus incana*). The mesic flatwoods located on the western border of the westernmost tributary is dominated by slash pine.

Xeric Hammock: A xeric hammock community develops on dry, sandy soils that are not as well drained as the soils that support scrub and is present on a few acres along the north shore at the “windmill house”. The canopy consists of 15-30' tall trees of sand live oak (*Quercus geminata*) with occasional Virginia live oaks (*Quercus virginiana*). Understory trees include buckthorn (*Bumelia lanuginosa*), and wild olive (*Osmanthus americana*). Shrubs present include yaupon (*Ilex vomitoria*), sparkleberry (*Vaccinium arboreum*), and myrtle oak (*Quercus myrtifolia*).

Maritime Hammock: A maritime hammock community is present on the east and west sides of Phillips Inlet which consists of a low (25') canopy of sand live oaks with scattered southern magnolias (*Magnolia grandiflora*) and pignut hickories (*Carya glabra*). On the eastern side of Phillips Inlet, this community grades into a salt spray pruned scrub near the coast. FNAI considers this community to be S2.
Beach Dune: A beach dune community is located west of Phillips Inlet and consists of sea oats (*Uniola paniculata*) near the beach with Gulf bluestem grass (*Schizachyrium maritimum*) with scattered shrubs of rosemary (*Conradina canescens*) and woody goldenrod (*Chrysoma pauciflosculosa*) on the more inland portions. Within this community are found the rare species, Godfrey’s goldenaster (*Chrysopsis godfreyi*) and Gulf lupine (*Lupinus westianus*). The Snowy Plover (*Charadrius alexandrinus*) and the Least Tern (*Sterna antillarum*) have been reported to nest in this area.

Wetland Biotic Communities. The wetland biotic communities in the Lake Powell ecosystem include those that are undeniably freshwater and those that are associated with the open water of Lake Powell. Figure 6 is the National Wetlands Inventory (NWI) depiction of the wetland communities present in the Lake Powell Drainage basin. The NWI maps show only wetland types with all others not considered to be wetlands designated as just uplands. In the legend, the “E” = estuarine, “PF” = palustrine forested, “PS” = palusrine shrub. One can break the categories down further if one wishes. The biotic communities associated with Lake Powell such as saltmarshes and seagrass beds will be discussed under Section II pertaining to Lake Powell itself. This is an artificial separation, because the freshwater wetlands and the Lake Powell wetlands are interconnected rather than separate from one another.

Creeks: Major creeks enter Lake Powell from the east side, west side, and north side (Figure 2). The soils maps and the wetland inventory maps indicate that these tributaries to the lake originate in marshes, swamps, and probably bogs. According to Wolfe et al. (1988) the most widely distributed type of stream in the Panhandle of Florida is the blackwater or swamp-and-bog stream. These streams are common in the Gulf Coastal Lowlands where they originate in herb and shrub bogs and swamps. These streams or creeks have sediments that are high in organic content, acid water, low turbidity, and relatively high color at times. The color of the water in these streams or creeks provides the name attributed to them, blackwater. The water draining from these streams is brown in color due to the organic materials that they carry.

This tannin stained water that enters Lake Powell from these creeks can turn the color of the surface waters of the lake brown yet clear. When the inlet is open and the lake is draining to the Gulf, a plume of brown colored, but clear water enters the Gulf and travels westward along the beach in response to the westward littoral drift. Refer to the section on marshes and swamps for additional information on the communities at the heads of the creeks and along the creeks that drain to the lake. LAAC and FNAI (1994) describe the communities along the drainages as wet flatwoods dominated by slash pine with occasional sweetbay (*Magnolia virginiana*) with a dense understory of titi (*Cliftonia monophylla* and *Cyrilla racemiflora*) and wax myrtle (*Myrica cerifera*). LAAC and FNAI (1994) provide a table with the acreage of each community type and the FNAI tracking status for the biotic communities in the drainage basin including swamps and marshes.

Freshwater Marshes: Fresh water marshes, according to the definitions provided by FNAI, come in a variety of types dependent on the soil characteristics, degree of saturation and/or inundation, and the dominant plants present. The dominant plants present in freshwater marshes are grasses, sedges, and other herbaceous vegetation. Trees and shrubs are absent or scattered. Information regarding the freshwater marshes in the ecosystem is restricted to information pertaining to the freshwater marshes found on the Camp Helen State Recreation Area. Information regarding the occurrence of freshwater marshes in the Lake Powell ecosystem other than Camp Helen was not located.
LAAC and FNAI (1994) did not describe the vegetation present in the freshwater marshes that they observed in the area studied but did provide an estimate of 25 acres of basin marsh in the area. Basin marsh is defined by FNAI as a “closed basin with [an] outlet usually only in time of high water, with peat substrate; seasonally inundated; frequent fire; sawgrass and/or cattail and/or buttonbush and/or mixed emergents”.

DRP (1997) includes a list of the terrestrial and aquatic habitats of Camp Helen. The communities listed correspond to those listed in the report discussed below (Wamer, 1991). Johnson et al. (1992) provided a description of the biotic communities on Camp Helen. They mention “a coastal grassland area that appeared to be an upper marsh area invaded by sand to form slightly higher flats dominated by coastal bluestem (*Schizachyrium maritimum*) with switchgrass (*Panicum virgatum*), beach cordgrass (*Spartina patens*), and broomsedge (*Andropogon virginicus*)”.

Wamer (1991) described the biotic communities present in the Camp Helen State Recreation Area. The freshwater marsh identified on the property was classified as a depression marsh which is defined by FNAI as a “small rounded depression in sand substrate with peat accumulating toward the center; seasonally inundated, still water; frequent or occasional fire; maidencane, fire flag, pickerelweed, and mixed emergents, may be in concentric bands”. This depression marsh exists on both sides of Highway 98 west of the entrance road and has been referred to locally as the “beaver pond”. A description of the vegetation was not provided.

Edmiston (1995) discussed the assessment provided by Wamer (1991), and provided interesting, general observations regarding the classification of the biotic communities located on Camp Helen property.

Swamps: Swamps are wetlands that are dominated by woody plants, trees and shrubs. According to the definition provided by FNAI, swamps also come in a variety of types dependent on the same physical characters of marshes. LAAC and FNAI (1994) describe the communities along the drainages that enter Lake Powell as "wet flatwoods dominated by slash pine (*Pinus elliottii*) with occasional sweetbay (*Magnolia virginiana*) with a dense understory of titi and wax myrtle (*Myrica cerifera*). The drainages themselves are lined with a bay-gall community dominated by sweet bay, swamp red bay (*Persia palustris*), bald cypress (*Taxodium distichum*), and in other places by the shrubs titi, sweet pepperbush (*Clethra alnifolia*), and azalea (*Rhododendron* sp.). The steeper, better drained creek slopes support red maple, (*Acer rubrum*), sourwood, (*Oxydendron arboreum*), and tuliptree (*Liriodendron tulipifera*)". In addition to the swamps that occur along the drainages, dome swamps dominated by bald cypress are found throughout the area surveyed by LAAC and FNAI (1994). Their report of the occurrence of Chapman's Butterwort (*Pinguicula planifolia*), a plant listed as threatened by Florida, is probably from one of these communities.

Another description of the wetlands around Lake Powell is provided by the U.S. Fish and Wildlife Service Wetlands Inventory map. The NWI maps show a preponderance of forested wetlands in the areas designated as wetlands on Figure 6. The nature of these swamp areas and freshwater marsh areas in the drainage basin combine to determine the quality of the water that is provided to Lake Powell by the creeks that enter the lake.

Summary. In summary, the terrestrial communities in the Lake Powell drainage basin are diverse and include a number of naturally occurring communities and communities that were previously managed for their agricultural value, namely silviculture. The terrestrial communities that exist in the drainage basin also determine, in part, the quality of the water that enters the lake through surface runoff, the creeks, and the groundwater. The alteration of the vegetation present in these communities and the number of acres of the communities that are changed to impervious surfaces or other types of vegetation should be limited if one is concerned about maintaining ambient water quality conditions in the lake.

The freshwater wetland communities of the Lake Powell drainage basin appear to be varied and extensive. These natural swamps, marshes, and bogs, play a large role in the determination of the quality of water that enters Lake Powell and the ground water. One characteristic of the water entering the lake and thence discharged to the Gulf of Mexico from these natural biotic communities is the color. Although some persons may find the "blackwater" color of Lake Powell aesthetically displeasing, it is a natural characteristic of the lake, and is an integral ingredient in the ambient water quality of the lake. The wetlands associated with the creeks entering the lake may have to be preserved or conserved in order to preserve this ambient water quality character of the lake in addition to the other characteristics that they influence.

Biodiversity. In its simplest form, biodiversity is the number of organisms that occupy a given area. In this case, the given area is the Lake Powell ecosystem. The species *known* from an area are those that are based on specimens collected in an area that are preserved and available for examination. Those species *reported* from an area are those species that are mentioned in reports that do not include statements as to where specimens of the species collected are deposited for examination or are considered to be present in an area based on range maps for species. It is, of course, recognized that the formal study of the vertebrate fauna of an area is time consuming and expensive. Nevertheless, formal studies yield the best results. It is most helpful if the lists of species reported from an area include how the lists were constructed and from where the information was obtained to construct the list.

Camp Helen State Park has received the most attention regarding the listing of species present within the confines of the Recreation Area. The species known from and reported from the Park form the basis for the following discussion of the species diversity of the drainage basin. These lists of species are found in DRP (1997), Wamer (1991) and Hudson et al. (1990) reports. The species listed in these three reports are supplemented with information from other reports cited below.

*Flora***.** The flora of the drainage basin is documented for Camp Helen State Park. Keppner and Keppner (1998) surveyed the vascular plants of Camp Helen and collected and preserved specimens of each species on the list. The report contains records of the occurrence of 274 species in 187 genera in 70 families from the various habitats on the Camp Helen property. The records are based on the preserved specimens that are located in the Camp Helen herbarium at the Division of Recreation and Parks, District I Office, located in St. Andrews State Park.

DRP (1997) contains a list of 154 species of vascular plants reported from Camp Helen. However, where, how, and when the species on the list were identified is not provided nor is there mention of specimens being collected, preserved, and archived. One of the species listed is listed twice. Deer tongue is listed as *Carphephorus odoratissima* and as *Trilisa odoratissima* which are synonyms. *Carphephorus* is the valid generic designation. Of the 154 species listed in DRP (1997), 72 are additions to the list provided by Keppner and Keppner (1998) that brings the total number of species of vascular plants known from Camp Helen to about 346. Additional observations of vascular plants occurring in the drainage basin are provided in the reports cited for the communities mentioned above. The lists of plants reported or known from the ecosystem is included in Appendix III as the Keppner and Keppner (1998) list and the DRP (1997) list.

Butera (2005) reported 27 taxa of vascular plants from Lake Powell including the following native species; seagrass (*Ruppia maritima),* a rush that was considered to be the dominant species throughout the lake (*Juncus effusus*), a cattail, (*Typha latifolia*), a cordgrass (*Spartina alternifolia*), and a fennel (*Eupatorium capillifolium*). He also reported the presence of the non-native and invasive Chinese tallow tree (*Sapium sebiferum*), mimosa tree (*Albizia julibrissin*), and torpedograss (*Panicum repens*). In addition, Butera (2005) reported that species found in previous surveys but were absent during his survey included the bay tree (*Persea palustris*), seagrass (*Halodule wrightii*), and the bulrush (*Scirpus americana*).

The conclusion that the dominant species marsh around the lake was *Juncus effusus* is interesting, because *J. effusus* is considered to be a freshwater species. Previous surveys in the lake in the 1980’s stated that the species present in Lake Powell is *Juncus roemerianus* that is the dominant species in coastal marshes with a great tolerance for salinity changes. Both species appear similar but differ in the size and shape of the achenes, the structure of the rhizomes, and the panicle. It is possible that there has been a drastic shift in species composition in 20 years, but it does not appear likely due to the persistence of *S. alterniflora* in the lake. This species grows almost exclusively in intertidal zones with significant salinity and its occurrence in the lake should be re-established by direct observation. Therefore, one can conclude that the dominant marsh species around the lake is needlerush (*J. roemerianus*).

Fauna. The diversity of finfish in the drainage basin will be discussed in Section II below because the knowledge of the species of finfish was obtained from the lake. Additional surveys of the lake and the freshwater ponds would probably add a significant number of species to those already reported, particularly in the freshwater parts of the streams and the isolated ponds along the lake shore. The diversity of benthic invertebrates is also discussed in Section II below. Additional study of the lake alone would, undoubtedly, reveal the presence of many more species of benthic invertebrates. Studies of other invertebrates in the drainage basin were not located.

The reports of amphibians, reptiles, birds, and mammals from the drainage basin appear to be based primarily on those species that might occur or could possibly occur. Formal studies of the vertebrates of the drainage basin were not located. Hudson et al. (1990) contains an extensive list of species of vertebrates that possibly occur in the drainage basin. The list was obtained from a report by Flood & Associates for south Escambia and Santa Rosa Counties. They list 15 species of amphibians, 31 species of reptiles, 126 species of birds, and 26 species of mammals including bottle-nosed dolphin. The methods by which these lists of species were obtained are not stated. However, the lists were constructed as part of a shellfish harvesting survey that places great emphasis on the actual or potential sources of enteric bacteria to a body of water. Therefore, it was probably necessary to list all possible animal sources of such bacteria to assess the situation rather than determine the species that actually occur in an area. Mr. Charles Fleming, Jr. stated in a letter dated April 14, 1988 (in DER, 1991) that he played with a dolphin in the lake in 1968. One version of this story is that the dolphin was some how brought into the lake.

DRP (1997) contains lists of vertebrates reported from Camp Helen and the habitats in which they might be found. The report contains a list of 14 species of amphibians, 24 species of reptiles, 95 species of birds, and 12 species of mammals. Wamer (1991) provided lists of vertebrate species likely to occur at Camp Helen including 8 species of amphibians, 28 species of reptiles, 186 species of birds, and 19 species of mammals. The methods used to construct the two lists mentioned above were not provided. Wamer (1991), however, uses the words “likely to occur”, but does not separate out those known to occur. See Edmiston (1995) for a discussion of these lists. Table 1 is a summary of the species known, reported, or listed from the Lake Powell drainage basin. Appendix IV is a list of vertebrate species that possibly occur in the Lake Powell drainage basin from DRP (1997). The Hudson et al. (1990) list of vertebrates is not included in Appendix IV, because the list was constructed for other counties as well as the Lake Powell area and it is not possible to determine which species were actually observed or thought to occur in the Lake Powell ecosystem.

Table 1. Biodiversity Summary for the Lake Powell Drainage Basin

Organisms	Number of Species
Vascular Plants	364
Lichens	2
Invertebrates	100
Finfish	79
Amphibians	DRP = 14. Hudson et al. =25
Reptiles	DRP = 24. Hudson et al. = 31
Birds	DRP = 95. Wamer = 186
Mammals	DRP = 12. Hudson = 26
Total Species	DRP = 683 Hudson et al. & Wamer = 804

The number of species known from or reported from the Lake Powell drainage basin depends on which figures for vertebrate species one chooses to support. The lesser value yields a total of 224 species of vertebrates, 91 species of benthic organisms, and 364 species of plants. The maximum number of species known or reported from the drainage basin is 679 species using the data for vertebrates from DRP (1997) or 802 using the information from Hudson et al. (1990) and Wamer (1991).

In comparison, Bay County is known to support over 1300 species of vascular plants (Keppner and Keppner, 2003). The known or reported plant species from the Lake Powell drainage basin is about 28% of those known from Bay County. A comparison of the total biodiversity can be made using the information provided in Keppner (2001) in which a total of, at least, 2530 species are known from or reported from the St. Andrew Bay estuarine system. Lake Powell has not been studied to anywhere near the degree that St. Andrew Bay has been studied, and it is about 100 times smaller than St. Andrew Bay. BEST and DEP (1998) estimated the St. Andrew Bay drainage basin covers about 1104 square miles and supports 4645 species of plants and animals known or reported from the system. Using the smaller total number of species known or reported for Lake Powell (681), Lake Powell has 14.6% of the species known from the St. Andrew Bay ecosystem. Using the larger number for the lake (804), Lake Powell has 17.3% of the number of species as the St. Andrew Bay ecosystem.

The biodiversity of the Lake Powell drainage basin is not well known or documented through actual surveys of species present, but could be impressive for a small drainage basin based on the number of species actually known and that could possibly occur there. Additional surveys of the flora and fauna of the basin would add appreciably to the understanding of the actual biodiversity of the system.

Protected Species. The species of plants and animals that are protected under the Federal Endangered Species Act are listed and managed by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. The plants that are protected under Florida law fall under the purview of the Florida Department of Agriculture and Consumer Services, and those on the protected list are determined by the Endangered Plant Advisory Council. The species of animals that are protected under Florida law are under the purview of the Florida Fish and Wildlife Commission. FNAI maintains records and lists of all species of plants and animals that receive protection under federal law and also tracks species and habitats that are considered of concern to FNAI. However, they do not track all the species of plants protected by State statute, but track some species that are neither listed by the state or the federal governments.

Figure 7 shows the FNAI elements of occurrence for protected species including the records provided by Keppner and Keppner (2005). Each place shown on the figure may list more than one species. One should notice that there are large areas in the Lake Powell ecosystem that have no records of protected and/or tracked species. The probability is quite high that protected and/or tracked species occur in the blank areas, but no one has surveyed the areas for such species, or if surveys have been completed, the results have not been forwarded to FNAI for inclusion in their database. Publications that are most helpful in gaining an understanding of the protected and tracked species and habitats of Florida include Coile and Garland (2003), FNAI (1990), FNAI (2005), Chafin (2000), Hipes et al. (2001), and FFWCC (2004), and the Federal Endangered Species Act that is available from the USFWS office in Panama City, Florida. The protected species lists are subject to change with species being deleted, added, or their ranking changed, so one should consult the most current list.

The U.S. Fish and Wildlife Service in Panama City provided the following information through personal communications. The federally and state protected subspecies of beach mice have not been reported from the Lake Powell ecosystem. FWS recommended that a survey be conducted in the appropriate habitats in accordance with their established methods. Snowy Plovers and Least Terns have been reported nesting in the area of the inlet in the past. Surveys for the nesting of these species should be conducted on a regular basis. The occurrence of Piping Plover along the beach area should also be re-established.

The list of protected or tracked species in the drainage basin includes eight plants known to occur (two species, Chapman's Crown Beard and Curtiss's Sandgrass have been reported only from the Walton County part of the ecosystem), two plants that possibly occur, one reptile reported to occur, eleven species of birds reported to occur, and an additional number of vertebrates possibly occurring. Table 2 is the list of protected species provided by LAAC and FNAI (1994) with the additions from DRP (1997). The only protected animal species reported from the drainage basin for which there is detailed data is that for the Loggerhead sea turtle, *Caretta caretta*. The The St. Andrew Bay Resource Management Association (RMA) has conducted an intensive survey of the nesting of this species on the beaches of Bay County and for a short distance into Walton County, from 1991 to the present. An annual report is furnished by the RMA to the State of Florida and the U.S. Fish and Wildlife Service. Mr. Kennard Watson of the RMA has directed the study since its inception. Watson (pers. comm., 2005) stated that during the period 1991 - 2005, 112 loggerhead nests and 49 false crawls were documented from Sunnyside Beach to the Walton County line by the RMA volunteers. In 1995, a group of volunteers in Walton County began a nesting survey. They have reported 29 loggerhead nests from the area from Phillips Inlet to a point one mile west of the inlet during the period 1995-1999. The two areas referenced are approximately the southern boundary of the Lake Powell ecosystem.

Table 2. Protected Species Reported from the Lake Powell Drainage Basin from LAAC and FNAI (1994) and DRP (1997)

Genus and Species	Common Name	FNAI	State	Federal
Plants				
Calamovilfa curtissii	Curtiss's Sandgrass	S3	LT	N
**Chrysopsis godfreyi*	Godfrey's Goldenaster	S2	N	N
***Chrysopsis gossypina cruiseana*	Cruise's Goldenaster	S2	LE	N
***Gentiana pennelliana*	Wiregrass Gentian	S3	LE	N
**Lupinus westianus*	Gulf Lupine	S2	LT	N
**Pinguicula planifolia*	Chapman's Butterwort	S2	LE	N
**Polygonella macrophylla*	Large-leaved Jointweed	S2	LT	N
**Sarracenia leucophylla*	White-top Pitcher Plant	S3	LE	N
Verbesina chapmanii	Chapman's Crownbeard	S3	LT	N
Reptiles				
**Caretta caretta*	Loggerhead Turtle	S3	LT	LT
***Alligator mississippiensis*	American Alligator	S4	SC	N
**Gopherus polyphemus*	Gopher Tortoise	S3	SC	N
Birds				
**Charadrius alexandrinus*	Snowy Plover	S2	LT	N
**Charadrius melodus*	Piping Plover	S2	LT	LT
***Egretta caerulea*	Little Blue Heron	S4	SC	N
***Egretta rufescens*	Reddish Egret	S2	SC	N
***Egretta thula*	Snowy Egret	S4	SC	N
***Egretta tricolor*	Tricolored Heron	S4	SC	N
Grus americana	Whooping Crane	SXC	SC	XN
Haliaeetus leucocephalus	Bald Eagle	S3	LT	LT
***Pelecanus occidentalis*	Brown Pelican	S3	SC	N
***Rynchops niger*	Black Skimmer	S3	SC	N
**Pandion haliatus*	Osprey	S3 S4	N	N
**Sterna antillarum*	Least Tern	S3	N	LT

Birds - not all species listed in reports are considered because there is no real basis for the lists as discussed above.
* = Listed by FNAI as occurring.
** = in DRP (1997) but not FNAI.

SC = Species of Special Concern
S2 = imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction from natural or man-made factor.
S3 = Very rare or local throughout range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or vulnerable to extinction from other factors.
S4 = apparently secure in Florida (may be rare in parts of range).
LT = Listed as threatened by the U.S. Fish and Wildlife Service and/or the Florida Fish and Wildlife Commission.
LE = Listed as endangered by the U.S. Fish and Wildlife Service and/or the Florida Fish and Wildlife Commission.
N = Not listed
SXC = Experimental Population of special concern
XN = Non-essential experimental population

Land Use in the Ecosystem. From a historic perspective, the land use around Lake Powell has changed considerably. Figures 8, 9 are from 1953; Figure 10 is from 1964; Figure 11 is from 1978; Figure 12 is from 1997, and Figure 13 is from 2004. These aerial photographs show a progression of development over the time period 1953 to 2004. Development has been greatest along the southeast shoreline in Bay County. Figure 13 appears to show the tannin stained water leaving the lake and forming a plume in the Gulf of Mexico at the time of the photograph. It also appears to show shallow areas that are not visible on aerial photographs from earlier times. However, the earlier photographs available are not true color and may not show the shallow areas by reason of the photos being black and white or infrared images.

It is evident from the photographs that the south shore of Lake Powell in Bay County and, to a lesser degree, the south shore of Walton County have been progressively developed. In Bay County, the development is currently rather dense. This development occurred in the absence of a central sewage treatment plant and drinking water facility. The septic tank locations in Bay County are shown on Figure 13 as provided by the Bay County GIS Department. The extent of septic ranks associated with development in the Walton County portion f the ecosystem was unavailable. The north shore of the lake remained undeveloped until the Wild Heron development with its conservation easements was constructed. A relatively small area of land owned by development companies and individuals is located west of Wild Heron.

The remainder of the land along the major tributaries extending east and west from the lake and the remaining lake shore is apparently owned by the St. Joe Company and is the subject of the Regional General Permit (RPG) issued by the COE and agreed with by the DEP through an Ecosystem Management Agreement (EMA). The RGP-EMA includes the set-aside of extensive conservation areas and includes agreements regarding restrictions on the dredging and/or filling of the high, medium, and low quality wetlands identified in the permit. However, the RGP has been challenged in court and an injunction has been issued preventing the implementation of the permit at the time of this writing. A summary of RGP-EMA is presented (page 56 below).

The Bay and Walton County Comprehensive Growth Management Plans (CGMP) have elements in them that pertain to the Lake Powell drainage basin. Presently, the compiler has access to the Bay County CGMP only. The Bay County CP designates the north shore of the lake as an ecosystem management area and the same area is listed as a conservation zone. The plan should be consulted for any requirements that Bay County place on the land in the drainage basin that is so designated.

Figure 8. Lake Powell 1953

Figure 9. Eastern Lake Powell 1953

Figure 10. Lake Powell 1964

Figure 11. Lake Powell 1978

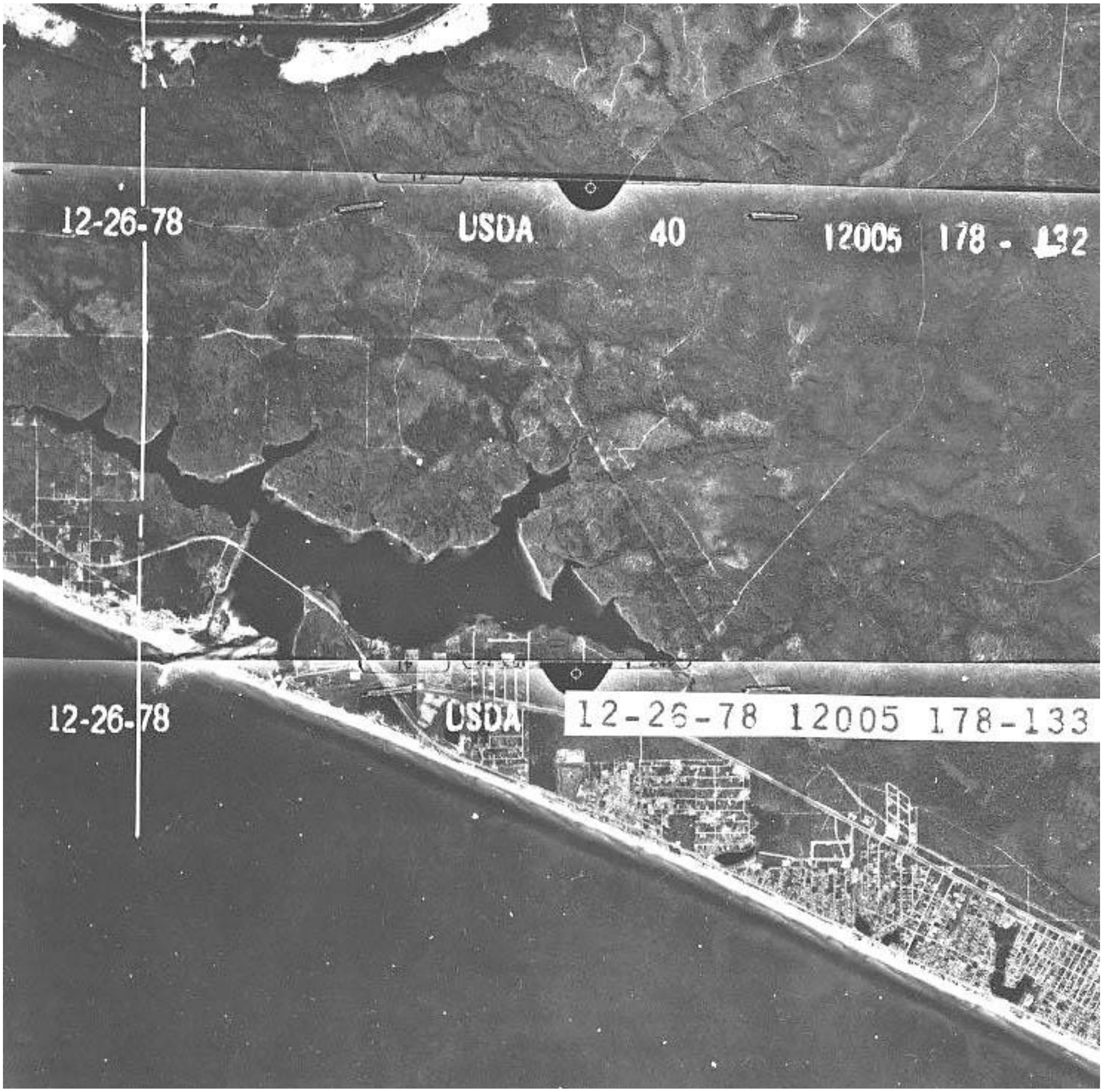


Figure 12. Lake Powell 1997

In summary, the species and biotic community diversity of the Lake Powell ecosystem is not well known, but indications are that the number of imperiled biotic communities is significant as is the number of protected species. Unfortunately, it appears that large areas of the ecosystem have not been systematically inventoried for species and biotic communities of concern. Land use in the ecosystem has changed through time mostly along the southeastern shore area of Bay County, but is now expanding to the north shore area of the lake and the Walton County portion of the lake.

Section II. Overview of the Lake Powell

Phillips Inlet from Camp Helen

Section II. Overview of Lake Powell

Description of Lake Powell. The long axis of Lake Powell is oriented in a southeast to northwest direction with creeks entering each arm on the east and west sides. Three creeks enter small embayments along the north side of the lake. The lake extends south of the U.S. Highway 98 Bridge toward the Gulf of Mexico, and the portion of Lake Powell south of this bridge is referred to as Phillips Inlet (Figure 13). Lake Powell drains to the Gulf of Mexico through what is presumed to be a natural, intermittently open outlet to the Gulf. However, as stated a number of times, the inlet has been and is presently being manipulated by humans.

Shoreline, Surface Area, and Volume. Environmental Protection Systems, Inc. (1985) estimated the surface area of Lake Powell to be 657 acres with a shoreline of about 10.2 miles and a volume of 5,205 acre feet. These calculations were made during a period of time when the inlet to Lake Powell was open on a regular basis and to a depth at least of the mean high tide mark of the Gulf of Mexico. Chance and Ashley (1999) stated that Lake Powell is about 737 acres (about 1.15 square miles) in surface area with about 32 acres of the surface area in Walton County and the remainder in Bay County. These calculations were made during a period of time when the lake was managed by the existing state and federal permits to open the inlet to a specified elevation and width. The shoreline is about 12.5 miles long with about 1.5 miles in Walton County and 11 miles in Bay County. If the calculated surface areas and shoreline estimates are comparable in method employed, it would appear that Lake Powell has increased in surface area and shore line length during the intervening 14 years. Presumably, the volume has also increased. One possible reason for this could be a result of the current manipulation of the lake through the permit that arbitrarily maintains the surface of the lake at a higher elevation.

Bathymetry. A detailed survey of the bathymetry of Lake Powell has not been accomplished in the past or recently. Two brief and incomplete surveys were performed in the past, but neither of the surveys produced a bathymetric map of the lake.

EPS (1985) examined the bathymetry of Lake Powell and stated that, with the exception of the shallow bars around the shoreline, the bathymetry was very uniform. The central body of the lake is flat and about 10-12 feet deep, shallowing to about 8-10 feet deep at inland extremities. There was an area about 16 feet deep near the northeast side of the Highway 98 Bridge. This particularly deep zone probably represents the last area to be filled by sediments coming downstream and from the Gulf of Mexico or a borrow area for construction of the first bridge.

The remainder of the lake probably contains deeper sediments that reach to the original valley floor that has been long flooded by Gulf and fresh waters. The shallow sand bars probably originated from erosion and deposition of materials from the present lake shoreline. Water depth over the sand bars varied from 2-7 feet deep with an average of 3 feet during the EPS (1985) study. The surface areas of the bars were estimated to be about 195 acres. It is on these shallow bar areas that seagrass beds were observed to occur. Figure 14 is a map of the seagrass beds and the sand bars on which they occurred taken from the information provided by EPS (1985). Their information shows that during the survey, seagrass beds and the sand bars upon which they were growing form an almost continuous band along the northern and southern shore of Lake Powell. They were absent from the southern shore of the west arm of the lake. The increase in volume and surface area mentioned above may have increased the depth of water over the sand bars and the depth of the lake in general.

The National Marine Fisheries Service and Fish and Wildlife Service (NMFS & FWS) (1985) survey of various characteristics of the lake was conducted during 1984 and described the lake as having a shallow, gently sloping shelf which supports submerged aquatic vegetation. The shelf terminates rather abruptly and depths increase rapidly to 10-12 feet. The bottom is mostly flat with decreases in depth at the mouths of the east, west, and north arms, and a shallow shoal was present along the north shore opposite the Highway 98 Bridge. The greatest depth recorded was 16 feet just north and east of the east end of the Highway 98 Bridge. It is stated that the creek entering the west (this is an error, it should read east) arm of the lake and above the wooden bridge on Kelly Street had areas at each bend of the creek with depths of 6-9 feet. Personal communication with residents revealed that there is an area 8-9 feet deep in the one of the north feeder streams to the lake.

Sediments in Lake Powell. The material that makes up the bottom of a water body consists of the minerals and soil that was present at the time of inundation and the accumulation of the materials that have been carried into the water body by surface runoff, groundwater, and the tributaries to the water body. The chemical and physical characteristics (quality) of the sediment are determined by the material that enters from the surrounding land and settles to the bottom.

EPS (1985) provided information pertaining to the particle size and heavy metals in the sediment of Lake Powell. It is mentioned in their materials and methods section that pesticides were also looked for, but there is no further discussion or mention of this in their report. The samples were obtained at the same stations in the lake as the samples for the analysis of macrobenthic infauna (animals living in the sediment). The analysis for heavy metals was achieved by two methods, the elutriate method which indicates the amount of each metal that is readily released into the water upon disturbance of the sediments, and the total metals analysis which indicates the total amount of the metals in the sediment.

EPS (1985) concluded that most of the metals analyzed were present in low concentrations. Lead, barium, and zinc concentrations were somewhat greater than background, and they concluded that this was probably associated with motorboat activity. The concentrations of chromium, copper, cadmium, nickel, and silver were equal to background concentrations. Station C that was located near the center of the Highway 98 Bridge had the highest metal concentrations. Station B located near the Pinnacle Port dock also had relatively high metal concentrations. Station A located nearest the Gulf of Mexico had the lowest concentration of metals. Particle size analysis at the sampling stations revealed that the sediment, in general, was predominantly sand with some silts and clays.

NMFS and FWS (1985) provided a brief description of the sediment at the stations sampled. The shallow water sediments were described as fine sand and silt, and the deep water sediments were described as a brown, gelatin-like material with a high organic content. It was noticed at the time of sampling, but not recorded, that the deep water sediment also had a strong odor of hydrogen sulphide.

Brim (2000) provided data regarding the particle size analysis at three sediment stations in Lake Powell. The stations were in deep water and selected for their high organic content to obtain contaminants data from sediments susceptible to retaining the contaminants. The means for each parameter for the three stations were; 6.2% total organic carbon, 54.7% sand, 24.7% silt, and 20.6% clay.

Payne and Butts (2000) provided grain size and organic matter data from stations in Lake Powell at depths of 2 meters to 4 meters. They reported that the sediments examined contained 0.63% organic carbon. Silt/clay (<0.063 mm) was 7.64%, very fine sand (0.063-0.125 mm) 1.06%, fine sand (0.125-0.250) 19.6%, medium sand (0.25-0.50 mm) 60.8%, coarse to very coarse sand (0.50-2.00 mm) 10.9%, and gravel (>2.00 mm) 0.48%.

Butera (2005) reported that the data obtained in 2003 demonstrated that the bottom was almost entirely composed of mud/muck/silt with noticeable anaerobic activity. He concluded that the particle size classes had drastically shifted to smaller grain size since 2000, because in 2003, the sediment particles less than 0.063 mm were the dominant size class at 65.7% of the sediment samples. Conversely, the dominant class size in 2000 (0.25-0.50 mm) accounted for only 6.77% of the samples in 2003, and the percent organic fraction had increased from 0.63% in 2000 to 11% in 2003. This exceeds the 6.2% organic matter reported by Brim (2000) for his deep water stations.

In summary, it appears that the sediment in Lake Powell may be changing in that organic material is increasing and grain size is decreasing in the deeper areas of Lake Powell. The changes, if real, can lead to a change in the biotic community present in these sediments and a possible increase in the anaerobic conditions in the deeper waters of the lake under certain conditions. The cause of these changes is unknown. The inlet to the lake has been manipulated by humans for some time to varying degrees and development has increased around the lake. It appears that the manipulation prior to the issuance of the permit for flood control in 1995 may have been significantly different than manipulations that occurring under the permitted management decision. These two factors may play a significant role in any real changes observed in the sediments of the lake.

Brim (2000) also provided data from three stations in Lake Powell which were analyzed for a list of heavy metals and chemicals of human origin (pesticides, herbicides, and their degradation molecules). The three stations were in deep water and had organic containing sediments that usually hold the organic molecules and heavy metals much better than sandy sediments. The chemicals analyzed provide an extensive list of the contaminants and heavy metals found in the sampled sediments. Appendix V provides the data taken directly from the reports for the sediment quality parameters measured by EPS (1985) and Brim (2000).

For those individuals who may be interested in “what does this all mean?”, one can obtain detailed information regarding the adverse biological effects of some of the chemicals listed in Appendix V by consulting Long et al. (1995) for the methods used in determining the sediment quality guidelines. This research paper describes the methods used to determine the effects range-low (ERL) and the effects range-medium (ERM) for a number of chemicals in sediments. Concentrations of the chemicals measured that are equal to or above the ERL number but below the ERM number represent a range of concentrations (possible-effects range) of that chemical in the sediment within which adverse effects on the biotic community would occasionally occur. Concentrations equal to or above the ERM number represent a range of concentration (probable-effects range) within which adverse effects on the biotic community would frequently occur. Concentrations below the ERL number represent a minimal effects range in which adverse effects on the biotic community would rarely be observed. The data from Brim (2000) has two chemicals that exceeded the ERL. Lead concentrations exceeded the ERL at two of the three stations in Lake Powell and anthracene exceeded the ERL at one of the three stations in the lake. Brim (1998) provides a summary of the sediment quality guidelines and the calculation of toxicity equivalents. This document also provides the results of an extensive survey of the sediments of St. Andrew Bay for anyone interested in comparing Lake Powell with St. Andrew Bay.

Brim (2000) analyzed the three sediment samples from Lake Powell for 70 organic chemicals. The concentrations of 13 of these chemicals exceed the dry weight detection limit indicating that they are present in the sediment. The samples were also analyzed for the presence of 21 inorganic metals present in the sediment. The data indicates that there is little to be concerned about regarding sediment quality at this time. The manner in which the drainage basin is developed and the quality of the storm water entering the lake should be monitored for increases in those chemicals in the sediment that are of possible concern. The Brim (2000) data is presented as both dry weight and wet weight with the detection limit for both data sets. EPS presented their metals data as wet weight and performed an elutriate test whereas Brim (2000) did not perform an elutriate test.

Brim (2000) also analyzed a single sample of sediment from Lake Powell for 14 chemical compounds associated with the degradation of dioxin. The analysis yielded data for the presence of 11 of the compounds. The chemistry of dioxin in the environment is complex and each of the chemicals has a toxicity level of its own with 2,3,7,8-TCDD considered to be the most toxic. The toxicity factor for each of the 14 chemicals associated with the degradation of dioxin is the toxicity of that chemical in relation to the 2,3,7,8-TCDD. A factor of one is given to 2,3,7,8-TCDD, and the others are a fraction of one. The 2,3,7,8,-TCDD toxicity equivalents for the chemicals present were calculated by Brim (2000) and are provided directly from that report in Appendix VI. The source of the dioxin compounds in the sediments of Lake Powell is not known. The finding of dioxin in the sediments of Lake Powell was somewhat surprising, and a possible source for this chemical in the sediments has not been identified. However, data in Hemming et al. (2003) for Panhandle estuaries and Hemming et al. (2005) for Choctawhatchee Bay support the supposition that the level of dioxin in Lake Powell is at or near the background level for Panhandle estuaries.

In summary, these surveys indicate that the chemical properties of the sediment in Lake Powell have not been significantly degraded by human activities to the year 2000. The key word is significantly. The lake sediments do contain some chemicals associated with pesticides and herbicides and other man made chemicals. Additional studies of the chemicals in the sediments in Lake Powell should be conducted and the analysis expanded to include man made compounds as well as the concentration of heavy metals in the sediment. The conclusion by Butera (2005) that the sediments are changing toward finer and more organic material is of concern as to why this is occurring.

Hydrology. DRP (1997) described the water flows in the 183.5 acre Camp Helen State Recreation Area including the surface water flows both to the Phillips Inlet area and to the lake proper. Flow to the lake proper originates in a freshwater marsh south of Highway 98 and is carried by a culvert and ditch to the north side of the highway and then to Lake Powell. The opening of the ditch to the lake is on Camp Helen State Recreation Area land. The volume of flow was not determined, and measurements of water quality were obtained.

Data regarding the movement of water into and out of the lake and within the lake itself has not been located except for some information pertaining to the inlet and its stabilization. Fresh water enters Lake Powell from direct surface runoff to the lake from the land along the shore, from surface runoff to and accumulation in the wetlands at the heads of and along the creeks entering the lake, direct input from rain falling on the lake surface, and probably from ground water movement. The amount of fresh water entering the lake from all sources is dependent on the precipitation that falls in the drainage basin in a given amount of time. The amount of stormwater runoff from developed areas appears unknown. Salt water from the Gulf of Mexico enters the lake when the inlet is open to a sufficient depth to allow Gulf waters to enter the lake. At these times, the lake is presumably influenced by the tide to some unknown point in the lake depending on the depth and width of the opening and the volume of freshwater entering the lake from the ecosystem. Data regarding the volume of water flows from each source was not located but should be obtained. Data of the amount of freshwater entering Lake Powell and the sources of that water have not been located.

Wolfe et al. (1988) describe the area from the eastern side of Bay County westward as an area of net westward littoral drift. This means that the longshore currents along the Gulf of Mexico in this region are predominantly to the west. These currents transport sand and sediment from the eastern part of Bay County westward. The net transport of sediment along the coast at Lake Powell is westward, and this westward littoral drift has an important effect on the location of the inlet to Lake Powell, and the direction that water takes when leaving the lake.

Freshwater Inflow (Ground & Surface). The quality of the water in Lake Powell is determined primarily by the quality of the freshwater entering the lake through the tributary streams that originate in wetlands, the movement of ground water, and the influence of the waters of the Gulf of Mexico when the inlet is open and Gulf waters can enter the lake. Rainfall amounts determine the amount of water flowing in the streams and the action of the soil and biotic communities on that rainwater determines the quality, quantity, and seasonal distribution to the lake.

Data pertaining to the amount of fresh water that enters the lake through surface runoff, creeks, or ground water was not located. This is an area that should be investigated and a water budget (how much water enters and leaves the lake on an average annual basis) for the lake should be established. Knowledge of these fresh water inputs is important to maintaining the water quality in the lake. EPS (1985) did measure the surface elevations of the lake during the term of their study. The measurements were obtained from gauges placed south of the Highway 98 Bridge. The results show that when the inlet is closed, the water level rises in the lake. The rate of rise depends upon the amount of fresh water entering the lake. Over the course of the study, the lake averaged 0.9 feet higher than the Gulf of Mexico when the inlet was closed and 0.7 feet above the Gulf when the inlet was open. However, it is stated in another section of the study that the average water level in the lake was 1.6 feet mean sea level. The highest water level recorded (3.1 feet mean sea level) during the study occurred on February 12-15, 1985 after the inlet had been closed for 40 days. When the inlet reopened, the water level in the lake rapidly fell to about 2.5 feet mean sea level according to the study. The lowest water level recorded during the study was 0.2 feet mean sea level which occurred on March 1, 1985 when the inlet was open.

Currently, the DEP's Division of Recreation and Parks and Bay County manipulate the water level of Lake Powell to prevent flooding of certain properties around the lake. The permit allows restricted opening of a channel 3-6 feet wide and 3-6 inches below the water level in the lake to drain the flooding water from the lake and provide an opportunity for the lake to cut the inlet channel as deep and as wide as the natural conditions in the lake allow.

Barr and Wagner (1981) provided a summary of the then known characteristics of the ground water in southwestern Bay County. They described the general characteristics of the three aquifers in the subsurface of the county, and provide information pertaining to the quality of water in each aquifer. They describe the nonartesian aquifer or water table aquifer as composed primarily of unconsolidated sand locally containing discontinuous clay and peat beds. Recharge to the nonartesian aquifer is almost entirely from rainfall. Once the infiltrating water reaches the water table, the path it follows depends largely on the thickness and permeability of the underlying Intracoastal Formation. Where the Intracoastal Formation is thick, such as in southwestern Bay County, virtually all of the water that enters the nonartesian aquifer is lost to evapotranspiration (evaporation from plants) or moves laterally toward streams, St. Andrew Bay, the Gulf of Mexico, or the Intracoastal Waterway. In southwestern Bay County where the water table is within a few feet of the land surface, most of the nonartesian water flow occurs as local flow systems associated with surface drainage and topography. The volume of this noartesian flow that enters Lake Powell was not addressed, but the report indicates that the lake receives water from the nonartesian aquifer and from surface run-off to the creeks and lake directly. They also discussed the water quality in the nonartesian aquifer. They characterized the water as of good chemical quality except for low pH and high iron concentrations.

The LAAC and FNAI, (1994) included a general paragraph regarding the ground water resources in the area that they surveyed. They stated that the sandy soils allow rainfall to infiltrate rapidly into the aquifers underlying the surveyed area. They also addressed possible potable water supplies, ground water recharge, and threat of ground water contamination in the area. Ground water or surface water movement to Lake Powell was not mentioned.

The Inlet and Inlet Management. The most complex issue for the public and the ecology of Lake Powell is the inlet from the Gulf of Mexico to Lake Powell. It is complex because the inlet has been manipulated by humans for a significant period of time and in an inconsistent manner. The area of Lake Powell south of the Highway 98 Bridge is referred to as Phillips Inlet. Water from the Gulf of Mexico enters Phillips Inlet when the inlet is open through the low sandy area along the Gulf of Mexico to a depth sufficient to allow the water in Lake Powell to be discharges to the Gulf of Mexico. If the inlet opening is deep enough, it allows water from the Gulf to enter the lake during a normal tidal cycle. Under natural conditions, it appears that the inlet opens and closes in relation to the amount of freshwater entering the lake, the influence of storm surges, and wave action driven by wind in the Gulf of Mexico and, to a lesser degree in the lake. The shape of Lake Powell results in a fetch of significant length only from northwest to southeast and vice versa.

It appears that under natural conditions the amount of freshwater entering the lake plays a significant role in the opening of the inlet in conjunction with severe storm events that result in opening due to wave action or storm surges in the Gulf of Mexico. When the inlet is closed and the water in the lake, due to freshwater inflows, reaches an elevation sufficient for it to breach the sand area that is separating the lake from the Gulf of Mexico, the water in the lake will begin to leave the lake and enter the Gulf. This may be enhanced by wind action on the lake. The width and depth to which the inlet is opened by this action varies with the amount of water entering the lake, the location of the breach, and the elevation of the sand that has accumulated between the Gulf and the lake. Storm events that bring a surge of Gulf water over the barrier area can also open the inlet. The closing of the inlet appears to result from the gradual accumulation of sand and littoral drift after the water level of the lake approaches or equals the level of high tide.

Each study of the various characteristics of the lake that has been conducted in Lake Powell has been accomplished under the conditions imposed by the status of the inlet during the study period and immediately prior to the study period. The variation in these conditions results in difficulty in interpreting or comparing the various studies that have been conducted in the lake. The conditions in the lake during the EPS studies were probably much different than those conducted during the present regimen of inlet opening and closing. The difference in the size of the lake and the estimated volume of water in the lake between the 1984 and 1999 estimates points directly to the differences between the characteristics of the lake under different inlet opening schedules. The EPS (1985) data and the conditions of opening in the DEP permit since 1995 speak to this issue.

During periods when the inlet is open to a sufficient depth and width, a variety of saltwater organisms enter the lake from the Gulf of Mexico including species of fish, ichthyoplankton, zooplankton, and phytoplankton that are known to enter bays. When the inlet closes those remaining in Lake Powell are trapped and their fate is unknown. The saltwater that enters the lake can settle in the deeper areas of the lake resulting in stratification of the water column with the heavier saltwater along the bottom and the lighter freshwater above. The presumed natural opening and closing of the inlet results in a variable set of physical, chemical, and biological conditions in the lake. The studies conducted during the 1980s in the lake were accomplished under conditions of a fairly regularly open inlet of sufficient depth to permit the entrance of Gulf of Mexico water. Those studies conducted since the issuance of the DEP permit in 1995 occurred under varying conditions of inlet opening.

The opening of the inlet is not “natural” due to human influence which complicates the understanding of the lake and the application of the definition of Dune Lake to Lake Powell. It also complicates the identification and meaning of “ambient water quality” at the time of Lake Powell’s designation as an OFW. The assisted opening of the inlet by humans may extend back to the early 1900s or before. Many statements have been made by long-time residents and users of the lake that the inlet has been opened on a regular basis by residents over the past 70 years at least. A summary history of the inlet was provided in a FAX to the District 1 of the Division of Recreation and Parks dated December 16, 1996. This history begins in 1945 and brings the history to 1996. Examination of historical photographs reveals that the inlet has migrated westward, probably under the influence of the westward littoral drift.

Since about 1995, Camp Helen State Park has opened the inlet under a DEP permit and subsequent COE permit under specific conditions to alleviate flooding of private property along the lake shore. Opening of the inlet is evidently determined by the surface elevation of the lake to prevent this flooding. The opening is permitted for a width of 40 feet to a depth of 3 feet at a constant location. The possible effects of this on Lake Powell are numerous depending on how deep and wide the inlet becomes due to the water leaving the lake and the time it remains open. One possible effect is that the artificial opening may drain only the surface water from the lake in an amount equal to the final depth of the cut. This would severely impede or prevent the inflow of Gulf water and the flushing of the bottom water. If there is sufficient water in the lake to open the inlet wider and deeper, the effects may be quite different. The actions under this permit may be stabilizing the characteristics of the lake more toward a freshwater system or may be having little effect, but this remains to be proven or disproved. If the current opening and closing of the inlet is stabilizing the lake toward a more freshwater system, one would expect the loss or collapse toward the inlet of those biotic communities dependent on a certain range of salinity. Detailed examination of the water quality data may demonstrate or refute this hypothesis. Explanations and opinions will be variable and extensive regarding the effects of this situation on the lake.

Discussions will arise no matter which speculative outcome is proposed. For the sake of initiating discussion, one could view the management of the lake since 1995 as stabilizing the surface elevation of the lake; increasing the depth and volume of the lake; increasing the area and depth of freshwater in the lake at certain times; increasing the siltation and organic content of the sediments; increasing the depth of water and affecting the quality of the water over the sand bars that once supported seagrass beds; and changing the entire biotic composition of the lake to a more freshwater communities.

At the other extreme, a permanent inlet wide enough and deep enough to allow the entrance of Gulf waters, expand the area of tidal influence, lower the surface elevation of the lake with its attendant volume and shoreline, allow the ingress and egress of marine organisms, decrease the depth of water over the sandbars, increase the salinity, etc. would push the lake to a more estuarine or bay-like condition that appears evident during the studies conducted in 1984.

The extent of tidal influence in Lake Powell under various conditions of depth and width of the open inlet is unknown. The EPS (1985) study did not address this. Those who were involved in the review of the permit during the 1980s recall that a request was made to determine the extent of tidal influence on Lake Powell under the conditions of a permanently open inlet about 40 feet wide and a depth of about -4 feet mean sea level. An oceanographer or hydrologist from the University of Florida calculated that, under these circumstances, the tidal influence in the lake would not extend very far north of the Highway 98 Bridge. A copy of that letter has not been found.

However, at least two facts remain to be addressed that involve the future of the lake. The management of the inlet will, presumably, determine how fresh the lake becomes in the future, and at what point in time can one justify “ambient water quality” for the OFW status. The "ambient water quality" in Lake Powell was a combination of the freshwater entering from the ecosystem and the saltwater entering from the Gulf of Mexico. The amount of saltwater entering the lake appears to depend on the frequency and size of inlet openings. The arbitrary date for ambient water quality is the date of designation of the lake as an OFW (1991). This may no longer be realistic in view of the variation in the opening of the inlet from 1984 to 1994 and the conditions imposed on the lake since 1995.

It has been suggested by a member of the LPCA that a management approach for the inlet that addresses flooding of residences, ambient water quality, restoration of seagrass beds, and Lake Powell's designation as a Coastal Dune Lake could satisfy several concerns. The management of the inlet would continue to be by humans on an intermittent basis. The artificial openings of the inlet could be designed and timed to prevent flooding and also to promote a return toward the ambient water quality and biotic communities in the lake. The intermittent openings could be a straighter opening deep enough and wide enough for improvement of water quality, transfer of some fine sediment accumulations, and provide opportunities for the exchange of marine life between the lake and the Gulf of Mexico. A somewhat simple modification of the present artificial openings of the inlet, which are directed only at flooding, may accomplish these goals. For example, inlet opening could be scheduled every month or two. The design openings could include some flexibility to protect the lake, such as opening to prevent flood damage to residences in the flood prone areas and avoid opening as much as possible during periods of red tide.

Just before approval of that current DEP permit for opening the inlet, a letter from Mr. Gary Shaffer of the DEP indicated that the proposed permit could address problems such as seagrass losses and a declining fishery in Lake Powell when it is considered for renewal.

In summary, the management of the inlet to Lake Powell remains undetermined. It appears that considerable thought and additional data will be required before a management plan for the inlet and all that the management plan will mean for Lake Powell will become a reality. Each scenario has its advantages and disadvantages, but consistent and long-term management of the inlet to the lake will allow the lake to respond and establish itself in relationship the management imposed on it.

Aquatic Habitats. The aquatic habitats of the Lake Powell drainage basin include the open water of the lake itself and the wetlands, both freshwater and saltwater, that exist in the drainage basin. The most intensively studied communities in the system are the open water habitat and the benthic (sediment) habitat of Lake Powell. The information regarding the biodiversity of the open water and benthic habitats of Lake Powell is primarily embodied in the surveys performed by EPS (1985), NMFS and FWS (1985), and Payne and Butts (2000). The following discussion of the open water and benthic habitats is based primarily on these three reports. The wetland habitats of the Lake Powell include the salt marsh, seagrass, brackish marsh, and freshwater wetland habitats at the heads of the streams entering the lake. These habitats have been examined in the above referenced reports and form the basis of the following discussion of each habitat type. Some of the biotic communities that have not been investigated in the lake itself are identified.

Emergent and Submerged Vegetated Communities. The emergent vegetated biotic communities consist of the marsh areas around the lake that have plants that extend above the water's surface. Submerged vegetated biotic communities consist of plants that are submerged below the surface. Salt marshes are emergent marshes and seagrass and algal beds are submerged communities often referred to as SAV (submerged aquatic vegetation).

Salt Marshes. Salt marshes or tidal marshes are defined by FNAI as expansive intertidal or supratidal areas occupied by rooted emergent vascular macrophytes (e.g. cord grass, needlerush, sawgrass, saltwort, saltgrass, and glasswort); and may include various epiphytes and epifauna. The NMFS and FWS (1985) provided a brief description of the major vascular plants in the salt marshes of Lake Powell. The major creeks entering the lake were described as passing through extensive marsh systems vegetated primarily with sawgrass (*Cladium jamaicense*) and needlerush (*Juncus roemerianus*). The shoreline of the lake supported marshes consisting of primarily sawgrass and needlerush with narrow, patches of smooth cordgrass (*Spartina alterniflora*) south of the Highway 98 bridge and along the northeast shore. Needlerush usually is found at or above the mean high water mark. This species was the most prevalent plant in the salt marsh around the lake. Sawgrass usually grows landward of the needlerush where salinity is lower. Smooth cordgrass usually grows in the intertidal zone with higher salinity. The extent of the intertidal zone usually determines the prevalence of smooth cordgrass in an area.

The report by Butera (2005) that the dominant emergent marsh species is *Juncus effusus* rather than *Juncus roemerianus* should probably be discounted, because this change from one dominant species to another would be a significant observation of change to more freshwater conditions in Lake Powell. However, *J*. *roemerianus* is a euryhaline species that has been observed in almost freshwater, if not totally freshwater, conditions in some areas.

EPS (1985) mapped the salt marsh around Lake Powell but did not discuss the species composition of the marshes mapped. Refer to EPS (1985) for the drawings to scale of the salt marsh areas and shallow areas around the lake. The value of these marshes to the adjacent aquatic system has been established in numerous publications and reports, and little can be added regarding their importance to Lake Powell. Their presence is additional evidence that Lake Powell was an estuarine system during the surveys, and that the marshes observed correspond to the FNAI definition of saltmarsh at the time of the EPS survey. These marshes are evident at the mouths of the streams entering Lake Powell and in areas of low elevation along the shoreline.

LAAC and FNAI (1994) appear to have relied on the information in the EPS (1985) and NMFS and FWS (1985) reports in the description of the salt marshes around the lake. The report mentions the presence of *Scirpus* sp. as a component plant of the saltmarshes of the lake. See Keppner and Keppner (1998) for the species collected from the wetlands present on the Camp Helen State Park. The DEP, Division of Recreation and Parks (DRP) prepared a management plan for Camp Helen in 1997. The plan includes a list of the terrestrial habitats and wetland habitats on Camp Helen.

Seagrass Beds. The NMFS and FWS (1985) survey mentioned the presence of two species of seagrass in Lake Powell, Cuban shoalgrass (*Halodule wrightii*) and widgeongrass (*Ruppia maritima*). The determination that some of the specimens collected were, in fact, widgeongrass was debated among the investigators. However, specimens were confirmed as

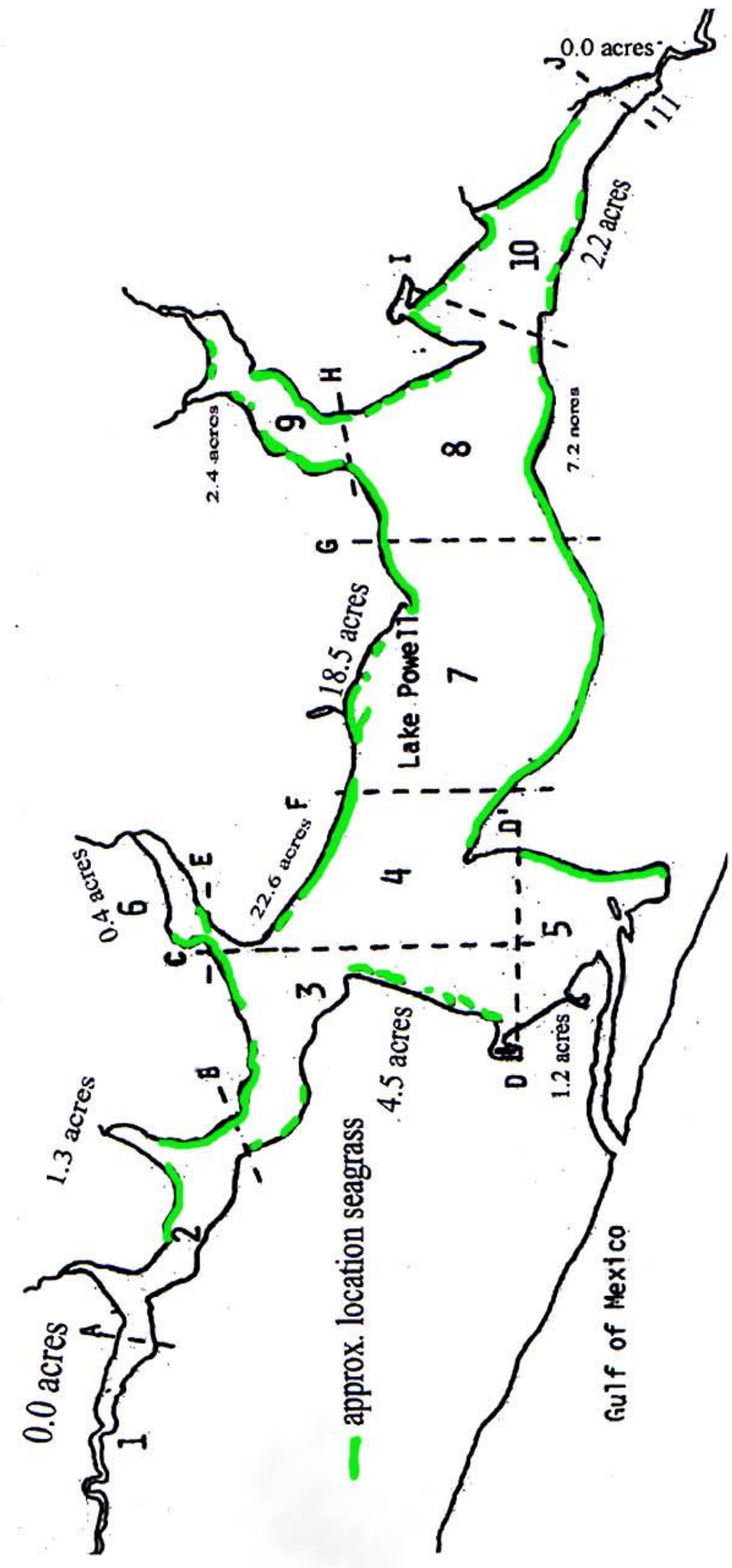
Halodule wrightii by seagrass experts at the NMFS laboratory in Beaufort, North Carolina. The EPS (1985) study mentions, but does not cite, a report by William Young of the Florida Department of Environmental Regulation that widgeongrass was growing in the lake in 1980. Based on the NMFS and FWS (1985) survey, it is not certain that widgeongrass was actually present during the survey period, and this survey did not map or otherwise determine the extent of seagrass habitat in Lake Powell.

EPS (1985) identified only Cuban shoalgrass (*Halodule wrightii*) as growing in the sediments in Lake Powell, and it is mentioned that turtlegrass (*Thalassia testudinum*) was often observed floating in the lake. Neither survey observed any turtlegrass growing in the lake, and the source of this observation is suspect. The floating leaves, if they were turtlegrass and not leaves of sawgrass (*Cladium jamaicense*) washed into the lake from the major tributaries, may have been carried into the lake with incoming tides. However, Mr. Eric Padgett (pers. comm. 2000), a long time resident of the lake, mentioned that he called the thick-bladed seagrass where he found scallops in Lake Powell scallop grass. This could be interpreted that turtlegrass (*Thalassia testudinum*) was once present in Lake Powell during the 1950s and that he harvested scallops in this vegetation in the lake. He stated that the scallops and the scallop grass disappeared, and that he went back to harvesting clams. The presence of turtlegrass and scallops in Lake Powell, if real, indicates that the salinity was higher and that the clarity of the water was sufficient to support this climax seagrass community. Widgeongrass was not observed growing in the lake during the EPS survey period. EPS (1985) also mapped the seagrass beds and calculated the area of seagrass beds in the lake.

Extent of Seagrass in Lake Powell. The U.S. Fish and Wildlife Service obtain aerial photography of St. Andrew Bay as a continuing assessment of the trend in seagrass bed distribution and density in the estuary. Examination of the recent digitized aerial photography does not include Lake Powell. The large scale maps prepared by the EPS survey are present in their final report and are too large to be reproduced here. Approximately 60 acres of Cuban shoalgrass were present in the lake during the study period. The location of the seagrass beds corresponds to the location of the shallow, sandy areas mapped by EPS (1985). Figure 14 is an approximate composite of the maps prepared by EPS showing the location of the seagrass beds in the lake. The green represents the approximate location of the beds and is not to scale. Refer to EPS (1985) for the drawings to scale of the seagrass beds and shallow water areas in the lake.

Environmental Services, Inc. (2005) provided a survey of the seagrass beds in portions of Lake Powell during 2002. The species of seagrass observed was not mentioned. In a letter transmitting the report, they state that seagrass was present in an area during the first survey but was absent during a survey of the same area several years later. Based on an interpretation of the drawing included with the letter, it appears that the seagrass beds waterward of the Wild Heron development were continuous in shallow water and patchy as the depth increased when they were present. The failure to observe seagrasses several years following the first observation of their presence is unexplained.

Figure 14. Seagrass Beds on sand bars in Lake Powell, EPS 1985.



The Land Acquisition Advisory Counsel (LAAC) and FNAI (1994) prepared a project assessment report in which the biotic communities on 3187 acres of land on the north side and southeast side of Lake Powell were described. Although not referenced, it appears that the information regarding the seagrass beds was obtained from the EPS (1985) report.
It is apparent that there has been a significant loss of seagrass beds in Lake Powell.

Comments from a number of resident observers of the lake may lead to the conclusion that about 60 acres of seagrass beds have been lost from the lake. This is the total amount of seagrass estimated by the EPS study. The most cited time frame is that from 1995 to 1998. However, the seagrass beds were not formally monitored since they were mapped by EPS (1985). Therefore, the time to loss and amount of loss is not well established. However, residents are certain that a loss occurred. In the absence of formal surveys, it is difficult to determine the extent of the loss of seagrasses or the length of time during which the seagrass beds declined and were lost. More importantly, the cause(s) of the decline and loss is unknown. The beds that were present off-shore of the County Park on the south side of the lake have been lost since about 1986 when this seagrass bed was a sampling station for a qualitative survey of the marine nematodes of Lake Powell.

The ecological value of seagrass beds has been well established in numerous studies and reports. Cuban shoalgrass and widgeongrass are considered to be the species of seagrasses with the greatest tolerance to changes in environmental factors such as salinity, etc. The present concern over the perceived decline of seagrass beds in Lake Powell is justified from an ecological point of view. The possible causes of the observed decline in seagrass beds in the lake are numerous, any one of which singly or in combination with one or more other factors, may be the reason for the decline. Detailed studies will probably be required to accurately determine the cause or causes of the observed decline.

The seagrass beds in Lake Powell exist on the shallow shelf and sand bars around the lake where they are exposed to variations in water level, salinity, temperature, physical disturbance, etc. Possible causes for the decline include, but are not limited to changes in depth of the water over the suitable areas; changes in any single water quality factor; a combination of changes in water quality factors; increased wave action, if it can be documented; increased sediment disturbance, if it can be documented; or a combination of many factors. The increase in the size of the lake from that of the EPS (1985) estimate to that of the estimate by Chance and Ashley (1999) is about 80 acres. This means that the surface elevation of the lake has increased somewhat. The seagrass beds growing at their lowest depth would be covered by more water. Even if there has been no change in water color or turbidity, the increase in depth of water over the beds may reduce their size due to light attenuation. If one adds changes in turbidity and/or water color to the increased depth, there could be a synergism of all changed parameters with a more drastic decrease in seagrass beds than could be attributable to the change in only one factor (see Kirschenfeld comments below).

Sargent et al. (1995) discussed the problem of propeller scarring of seagrass beds in Florida. They identified prop scarring as a significant factor in the loss of seagrass beds. Propeller dredging occurs when propellers or other methods of propulsion disturb the sediment in seagrass beds sufficiently to expose or damage the roots and rhizomes of the seagrass. Prop scarring and prop dredging activities in shallow areas may disturb fine grained sediments and suspend them.

This may increase the turbidity and the sediments can settle on the seagrass blades thereby reducing the quantity and quality of the light impinging on the plants. Discovering the cause of seagrass loss in Lake Powell will not be easy, because the loss is probably a result of a combination of factors acting synergistically.

Restoration of seagrass beds is not an easy undertaking in most instances. Fonseca (1994) and Fonseca et al. (1998) recommend that the first two steps in a program of seagrass restoration are first to determine whether or not seagrass existed at the site and then determine the cause of the loss at the site. One then corrects the cause of the loss followed by the planting of the appropriate seagrass species. The Florida Department of Environmental Protection began an attempt in 1999 to establish widgeon grass in the lake by transplanting seedlings to selected areas at the southeastern end of the lake that once supported seagrass. In a letter to Mr. Joe Gant of the LPCA, Mr. Taylor Kirschenfeld of the Watershed Assessment and Management Institute, Inc. stated that it appears that success can be achieved with widgeongrass in water less than two feet deep. He stated that he was not successful in restoring SAV (submerged aquatic vegetation) in depths greater than two feet.

Mr. Kirschenfeld also stated that there could be multiple explanations for this lack of restoration success in deeper waters. He state that he believed the major problem in Lake Powell is light attenuation and reduced photosynthetically active radiation that is preventing the grasses from receiving the minimum threshold quantity of light (we add quality of light also) that they require for growth and survival. He listed a number of factors that produce the attenuation of the light reaching the bottom of the lake in deeper waters. Each of these possible cause could be investigated; increased turbidity from stormwater runoff, resuspension of fine materials from the bottom sediments, algal blooms, resulting from increased nutrient loading, or changes in water color during significant periods of time that alter the quality of light reaching the bottom. Examination of the existing water quality data does not appear to support these causes. Water color in Lake Powell has regularly been altered naturally by tannins entering the lake from the wetlands in the drainage basin. The cause is probably a combination of factors acting together (synergistically) that are not strikingly evident in the data.

The success of seagrass restoration and the species that will probably be most successful will depend on the salinity, light penetration, and quality of light reaching the bottom in the areas conducive to transplanting. This, of course, brings us back to the question of the management of the inlet.

Open Water. The quality of the open water habitat of Lake Powell is determined by the water quality parameters discussed in the section on water quality below. The organisms that live in the water column must be adapted to those parameters. When the inlet is open sufficiently, organisms can actively and passively enter and leave the lake to and from the Gulf of Mexico if water quality conditions are favorable to them. What happens to them if the inlet closes and they become trapped in the lake probably depends to a great degree on changes in salinity and the species trapped. Larval organisms that enter from the Gulf when the inlet is open and use the lake as a nursery are also trapped if the inlet closes at the time that they must migrate back to the Gulf of Mexico.

Phytoplankton. The phytoplankton is those microscopic plants that are present in the water column and are passively carried by currents. These organisms are adapted to the chemical and physical conditions of the water column. A single taxonomic study of the species of phytoplankton that inhabit the waters of Lake Powell was located. Payne and Butts (2002) provided a list of 13 species of phytoplankters with a total density of 129 per mL of lake water in samples taken at a depth of 30 cm. The densities of *Cryptomonas* spp. (49/mL) and Cryptophyceae (47/mL) were the densest. They reported the following from Lake Powell; *Cyclotella* spp., *Pennales* spp., *Chlorella* spp., Chlorophyceae, Chrysophyceae, *Chroomonas* spp., *Crytptomonas* spp., Cryptophyceae, *Anabaena* spp., *Synechococcus* spp., *Gymnodium* sp., *Glenodinium* spp., *Prorocentrum* spp. Another method of obtaining indirect information regarding the density of phytoplankton present is to measure the chlorophyll a content of water samples. The chlorophyll a levels were undetectable during the survey. This is an indication of low nutrient levels in the lake water.

Zooplankton. The zooplankton present in the lake has not been studied except for the very general identification of a few major groups of animals present in the NMFS and FWS (1985) survey. That survey mentions the presence of larval crabs, arrow worms, comb jellyfish, mysid shrimp, gastropod (snail) larvae, isopods, and copepods. Studies of the zooplankton in the lake should accompany phytoplankton studies to gain an additional understanding of the lake and its water quality.

Ichthyoplankton. The EPS (1985) and NMFS and FWS (1985) did survey the lake for ichthyoplankton (fish eggs and larvae), a special group of the zooplankton. Samples obtained during both studies were preserved in the field and identification and measurements were made in the laboratory. There are species of animals that spawn offshore, and their eggs and/or larvae are carried by currents into inlets to estuaries in which they find the required conditions to grow rapidly. After a period of growth and development, they return to the open offshore waters. Ichthyoplankton are larvae of various species of finfish and shellfish that are present in, and transported in, the water column.

EPS (1985) found that the highest density of fish eggs and larvae were collected from the lake in August 1984, and that the numbers dropped drastically in September 1984. They attributed this drop in numbers to seasonal spawning activities of the species captured and to the closing of the inlet in early October. The inlet opened again in January 1985, and the number and diversity of fish eggs and larvae were again high. The bay anchovy (*Anchoa mitchilli*) was by far the most abundant species recovered in the ichthyoplankton samples. The NMFS and FWS (1985) mention only the occurrence of larval fish in their survey. The ichthyoplankters and groups of zooplankton recovered from the lake attest to the estuarine conditions in the lake during the period of study. This, of course, is related to the presence of an open inlet of sufficient depth to allow the tide to influence the lake and bring saltwater carrying the animals into the lake. A list of species identified from Lake Powell is provided in Appendix VII.

Finfish. EPS (1985) sampled finfish with beach seines, minnow seines, gill nets, and an otter trawl at various stations in Lake Powell and provided notes on the biology of some of the finfish captured and provided measurements of some of the species captured during the survey. All the species collected were estuarine or marine with the exception of a single specimen of large-mouth bass (*Micropterus salmoides*) and one specimen of longnose gar (*Lepisosteus* *osseus*). The survey captured 15,888 individual fish that contained 67 species in 32 families. The seven most abundant species of finfish accounted for 98.8% of the total catch. These seven species were bay anchovy (*Anchoa mitchelli*), spot (*Leiostomus xanthurus*), tidewater silverside (*Menidia peninsulae*), pinfish (*Lagodon rhomboides*), striped mullet (*Mugil cephalus*), gulf menhaden (*Brevoortia patronus*), and spotfin mojarra (*Eucinostomus argenteus*).

The NMFS & FWS (1985) survey employed beach seines, gill nets, and an otter trawl to obtain specimens of finfish from various areas of the lake. In addition, this survey included measurements and weights of some of the species caught. A total of 40 species in 37 genera were collected. Two of the species were considered freshwater; spotted gar (*Lepisosteus oculatus*) and longnose gar (*Lepisosteus osseus*). Appendix VIII is a combined list of the species of finfish taken by the two surveys.

The two surveys combined yielded 79 species of finfish in 59 genera for the year of sampling. Published literature regarding the species of finfish in Lake Powell was not located. In comparison, Keppner (2002) listed 309 species of finfish in 184 genera for all of the St. Andrew Bay estuarine system based on a review of the literature for the St. Andrew Bay estuary from the opening of the ship channel to the limit of the normal tides. The number of species reported from Lake Powell in a single year of sampling is 25 % of that in the St. Andrew Bay system which is 100 times larger and has been studied for many years. The list from Lake Powell contains a few species not reported from St. Andrew Bay system.

LAAC and FNAI (1994) state that 67 species of finfish representing 32 families have been reported from the lake and state that three of these species - largemouth bass, bream, and gar are considered freshwater. A reference for this information or the method by which it was obtained is not stated. If the report of the bream is factual, then another species would be added to the combined list of finfish based upon the EPS (1985) and NMFS and FWS (1985) surveys. However, it was not added to the list because there are many species of bream. As an aside, at a public meeting held by the Corps of Engineers, Mobile District in 1972 regarding the possible federal project for Phillips Inlet (COE, 1972), a representative of the Florida Game and Freshwater Fish Commission made the comment that Lake Powell supported an excellent freshwater fishery. No data could be located to support this statement.

Mr. Eric Padgett has stated that he showed the EPS survey team the largemouth bass that he had caught on a day during the EPS (1985) study period. He showed them where the bass and bream could be caught. These areas are ponds along the north shore that are not visible except on an aerial photograph. The ponds appear to be isolated from the lake during low water levels and minimally connected at high water levels. The freshwater characteristics of the ponds, evidently, are not influenced by the salt water during high water levels in the lake. This is probably due to the freshwater being on the surface of the lake during these periods. During the NMFS and FWS survey, fisherman reported catching largemouth bass and bream in the creeks entering Lake Powell. Both sources said that one must know where to go to catch them. The two survey teams obviously did not know where to go, so these fish were not caught during the studies and are not listed as a result. Nevertheless, the finfish captured at the stations in the lake support the estuarine nature of Lake Powell during the period of the surveys. The anecdotal reports support the freshwater characteristics of the creeks entering the lake which would not be unexpected.

Lake Powell is a complex aquatic system with its many parts interacting to produce the overall character of the lake.

Ultimately, the species of all plants and animals in Lake Powell will be determined by the management of the inlet due to the historical human manipulation in an inconsistent manner until recently (1995).

Benthic Habitat. The benthos are those animals that live on or in submerged sediments. The benthic habitats of Lake Powell are the submerged sediments of the lake in which certain plants and animals live. Animals live in or on the sediments throughout the lake and the shallow water sediments provide a place where submerged aquatic vegetation can root. The quality of the sediments, particularly the oxygen available below the surface of the sediment and the composition of the sediment, determines the kinds and numbers of animals present. The algae associated with the sediments of Lake Powell have not been studied. The seagrasses present in Lake Powell are discussed above. The animals present in the sediment have been examined in the surveys performed by EPS (1985) and NMFS, FWS (1985), and Payne and Butts (2000).

The benthic infauna, or those animals that live in the sediment, are studied by obtaining samples of the sediment with a variety of tools that extract a core or grab a sample from the bottom. The animals in the sediment can be separated by size using screens with a varying mesh size. Macrobenthic infauna (large animals that live in the sediment) are those organisms that are retained on a 0.5 mm mesh screen. Meiobenthic and microbenthic infauna (smaller animals) will pass through this size screen so a smaller meshed screen is needed to retain them. To collect the animals, the sediment is placed on the screen and washed. The animals that remain on the screen are preserved and identified in the laboratory. If one knows the area of the sampling device, one can express the data obtained in terms of unit area such as number per square meter. If one wishes to compare benthic infauna data between studies, one must know the mesh size of the screen used to wash the sediment. The larger the openings in the screen, the fewer the animals collected.

Macrobenthic Infauna. EPS (1985) sampled the macrobenthic infauna at five original stations in the lake that were located in rather deep water. An additional six stations were added in shallow water to obtain a better understanding of the distribution and diversity of these animals in the lake. There was a dramatic difference between the numbers and variety of benthic macroinvertebrates recovered from the original five deep water stations and the supplementary six shallow water stations. The deeper water stations were located in fine grained mostly anoxic sediments while the shallow water stations were located in sandy sediments and seagrass beds. This is not unexpected, because many studies have demonstrated a greater diversity and density of these organisms in seagrass beds and sandy sediments over that of anaerobic, fine grained sediments.

The EPS (1985) study collected 87 species of benthic macroinvertebrates representing 10 phyla. The polychaetous annelid worms (related to earthworms) were the most diverse group recovered as would be expected. Included among the species recovered were blue crabs and pink shrimp. The study did not express the data obtained as species per unit area. All species collected are representative of marine or estuarine environments. Payne and Butts (2001) added an additional 13 species to the list to bring the total number of species of macrobenthic invertebrates to 100.

The EPS (1985) study used a Ponar dredge of unspecified sample area and a 1.0 mm mesh screen, or a screen about twice the size of the standard screen. The NMFS and FWS (1985) survey used a 1/64 square meter sampling device and a 0.7 mm mesh screen that is significantly larger than the standard. Therefore, the results of the two studies are not comparable, and they are not comparable with studies performed with a standard 0.5 mm mesh screen. The NMFS and FWS (1985) survey did not identify the animals collected below the level of the phylum. All this renders both surveys inadequate for comparison with benthic surveys conducted in other areas.

The NMFS and FWS (1985) survey samples were taken from deeper water areas off of the shallow shelf, and the numbers and diversity of organisms collected reflected those of the EPS stations in deeper water. The NMFS and FWS survey did not provide identification of the benthic animals below the phylum level except for the reported occurrence of the epibenthic species; blue crab, pink shrimp, and species of grass shrimp (*Palaemonetes*). However the data was expressed as animals per unit area. The density of animals was low and no specimens were taken during the July 1984 and October 1984 samples. This reflects the low level of oxygen in the bottom waters and sediment during the sampling period. Appendix IX is a list of the species reported by the above referenced studies along with the stations from which they were reported in the studies.

Payne and Butts (2000) provided information regarding the species of macrobenthos in the sublittoral zone in Lake Powell during a late winter sampling time. At this time, benthic infaunal communities are generally most diverse due to the oxygen content and supposedly due to decreased predation. They stated that all macroinvertebrates recovered from Lake Powell were estuarine forms common in brackish waters and tide pools. The identified 27 plus species with 51.4% of the benthic community sample consisting of the species of *Anomalocardia auberiana* (clam). The species reported by them that are not included in the above studies is appended to Appendix IX.

Payne and Butts (2000) reported density of 4,914 organisms per square meter of substrate with a Shannon-Weaver diversity index of 2.48. The density and diversity are high for this community. The DEP has a biological integrity standard associated with the classification of waterbodies. The standard is applied to Class I, II, and III waterbodies. It states that the Shannon-Weaver diversity index of benthic macroinvertebrates shall not be reduced to less than 75% of background levels as measured using organisms retained by a U.S. Standard No. 30 sieve and collected and composited from a minimum of three Hester-Dendy type artificial substrate samplers of 0.10 to 0.25 square meters in area each. It is not known if this standard is applicable to the ambient water quality standard for OFW's. If it is applicable, then a survey of the macrobenthic infauna of Lake Powell could be accomplished using the equipment and procedures required by the DEP.

In summary, some of the studies cited above were flawed, but did demonstrate that the benthos in Lake Powell is typical of estuaries during the period of sampling and under the conditions of the inlet. The studies could be repeated using the DEP required methods to gain a more complete understanding of this component of the lake's fauna. The NMFS and FWS survey (1985) did not collect oysters but the investigators did note the presence of an occasional clump of oysters in shallow water in the embayments on the north side of the lake. During a trip to Lake Powell with Mr. Eric Padgett (1999) an abundance of clumps of oysters were observed in the shallow water of one of the north side embayments. Numerous clumps of mussels were also observed along the shoreline. The species were identified as the American Oyster, *Crassostrea virginica*, and the ribbed mussel, *Geukensia demissa* (= *Modiolus demissus*).

Meiobenthic infauna. These animals are usually not studied as part of environmental assessments performed as part of the regulatory process. The reason is that the taxonomy of most of the groups of animals in this group is not well known, and it is difficult to find a person able to identify these animals. The meiobenthic infaunal organisms are those that pass through a 0.5 mm mesh screen. They are the most abundant organisms in estuarine and marine sediments, but little is known about their function in the ecosystem. Keppner (1986, 1987, 1988, and 1994) described new species of free-living marine nematodes from Lake Powell. The nematodes known from Lake Powell were typical of estuarine and marine areas and are essentially the same as those reported from St. Andrew Bay by Keppner (1996). The samples were obtained primarily from shallow water vegetated and non-vegetated sediments at the Bay County park on the south shore of the lake. The list is not reproduced here, but suffice it to say that the species obtained from the sediments of Lake Powell during the collection period from 1983-1990 were typical marine and estuarine species.

Summary. The aquatic habitats of the Lake Powell drainage basin were and are varied and support a number of biotic communities depending on the condition of the inlet. This renders comparisons difficult if not impossible and each survey becomes one unto itself because of the inlet question primarily. The biodiversity of these habitats appear to be about average based upon the present knowledge. However, additional surveys would increase the number of species known from the drainage basin greatly (less the lake). The open water and benthic communities were typical of an estuary, at least, at the time of the surveys. The seagrass beds appear to have varied over time in both in terms of the species present and their coverage of the shallow water areas of the lake. Saltmarshes do not appear to have been adversely impacted in extent since 1984, if one compares the EPS (1985) data with the current aerial photographs of the lake. However, the change in dominant saltmarsh species as discussed above could be significant. These communities play a role in the water quality of the lake and define its biological character. However, the dominant species in these saltmarshes may have changed. Conservation and preservation of these communities would aid in maintaining the water quality and biological characteristics of the lake.

Water Quality. The quality, quantity, and seasonal distribution of the freshwater entering Lake Powell determine, to great degree, the quality of the open water and sediments of the lake. Particulate matter carried by the surface water entering the lake settles in the lake and provides the characteristics of the sediments. At times this water is stained brown with humic acids derived from the upstream wetlands and is a natural condition in the lake. As construction activities occur around the lake and along its tributaries, the opportunity exists for an increase of pollutants being discharged to the lake. An example is the recent sediment influx due to construction at a site within the Lake Powell ecosystem in Walton County. Figure 15 contains two photographs taken from a dock along the western arm of Lake Powell following the discharge. Shoreline construction resulted in an influx of sediment that was carried toward Lake Powell by the major western tributary. Such events as this can alter the water and sediment quality in portions of Lake Powell depending on the frequency and volume of such discharges.

Figure 15. Sedimentation Event in Western Tributary to Lake Powell

Classification and Rankings. The DEP provides a classification of water quality based upon its ultimate use. Class I waterbodies are those designated as drinking water supplies and have the most stringent criteria, Class II waterbodies are those approved for shellfish harvesting, Class III waterbodies are for propagation and maintenance of healthy, well balanced populations of fish and wildlife has less stringent criteria. Lake Powell, though designated a Class III waterbody, demonstrated many of the characteristics of a Class II waterbody at the time of its designation as an OFW. However, Class II is directed at shellfish harvesting, the lake did not meet the coliform bacteria standards for unrestricted harvest of shellfish.
Lake Powell was described by Hand et al. (1990) as ecologically interesting in that it has characteristics of both fresh and salt water lakes. They found Lake Powell to have good water quality that supports its designated use as a Class III waterbody. It was stated that it is also in relatively pristine condition from the point of view of water quality. There are some who take issue with this statement due to the human manipulation of the inlet, however. Hudson et al. (1990) reported on samples obtained from February 1985 through August 1989. Huber et al. (1982) ranked 573 lakes in Florida according to their trophic state. In that report, they ranked Lake Powell 45th in this group, found that Lake Powell had better water quality than the Bay County average, and ranked Lake Powell as 36th out of 651 lakes in terms of recreational user occasions.

Water Quality Sampling. Water quality studies began with the report by EPS (1985) for their November 1983 samples followed by their monthly sampling period from March 1984 to May 1985. The St. Andrew Bay Resource Management Association (RMA) began sampling in 1990 and their sampling program continues to this day. ESI (1999) conducted a water quality survey on a day in May of 1999. Bay County initiated a water quality survey in November of 2004 that will continue, and Butera (2005) provided water quality information at eight sampling stations in Lake Powell directed at assessing the observed spike in nutrients in the lake. Interpretation of the data from these surveys and comparisons are difficult due to the varying conditions of the inlet management and absence of knowledge of the effects of opening of the inlet to varying depths and widths. Even a trend analysis of the continuous data obtained by the RMA is open to question due to the variability of the inlet opening and manipulation by humans. Probably the most significant data is that obtained from 1995, the date of the DEP permit, to the present. Figure 16 shows the locations of the various sampling stations in Lake Powell by data gathering organization.

Another variable in the data is that the data from the RMA sampling and the Bay County sampling are both at the top and the bottom. The bottom depth at which the samples were taken varies with some stations in the Bay County data and presumably, also varies with the RMA data, because depth of the bottom samples was not recorded. It is difficult to remain on station, and sampling stations in an area of varying depths results in samples being taken at varying bottom depths. The data referred to as the Poundstone data is data taken from the western arm of the lake and contains notes as to whether the inlet was opened or closed and notes on rainfall events. The RMA and Bay County data does not include these observations.

Water Quality. All the available data regarding water quality is available from the LPCA should anyone wish to conduct additional analyses. Only a few stations are examined here, because one could write an entire report in an attempt to analyze all of the existing data.

Salinity. It does not appear of value to go over all of this data and attempt to compare it. However, a cursory examination of the RMA data from for their station 89 just south of the bridge shows that salinity at the surface and bottom to be variable and shows a slight downward trend in the surface and bottom salinities. If this is real, then the salinity in the lake is very gradually becoming more freshwater (Figures 17 & 18). However, if one looks at the Poundstone data for their Station 1 in the western arm of the lake (Figures 19 & 20), the salinity at the surface and bottom appears to be increasing. However, the surface salinity is greater than the bottom salinity which is anamolous considering that saline water is more dense than freshwater. However, there may be an explanation if the data is correct. There is a possibility that the numbers became transposed somewhere along the line. An Action Plan is proposed below to attempt to understand all of the existing water quality data for Lake Powell.

Nitrogen, Phosphorus, Chlorophyll, Secchi Depth, and Turbidity. These chemicals in proper proportion and concentration provide the basic substances for the growth of green plants, particularly phytoplankton when in the water column. An excessive amount of nutrients in a clear water lake may result in algae blooms as the phytoplankton use the excess nutrients to increase their population densities. High concentrations of phytoplankton in the water column can reduce the quality and quantity of light reaching the depths at which seagrasses may grow. In extreme cases, the algae can die in a short period of time. Their decomposition can result in the depletion of oxygen from the water column and result in fish kills.

Figure 21 is a summary of the RMA data provided by the Lake Watch program in Gainesville and Figure 22 is a summary of the nutrients at the surface and bottom provided by Butera 2005. This information appears to indicate a very slight trend toward increasing phosphorus levels and decreasing nitrogen levels in Lake Powell. However, Figure 22 shows spikes in nutrients that did not persist. The cause of this spike has been of much interest. Payne and Butts (2001) attempted to obtain data regarding ammonia, nitrite-nitrate, total phosphorus, orthophosphate, and total Kjeldahl-nitrogen. All were undetectable. One could conclude from the data that there has been little if any significant change throughout the years of sampling.

The amount of chlorophyll in the water column provides an indication of the phytoplankton population density in that the more chlorophyll the denser the phytoplankton populations. The Data for chlorophyll in Figure 21 shows a decreasing trend in the total amount of chlorophyll.

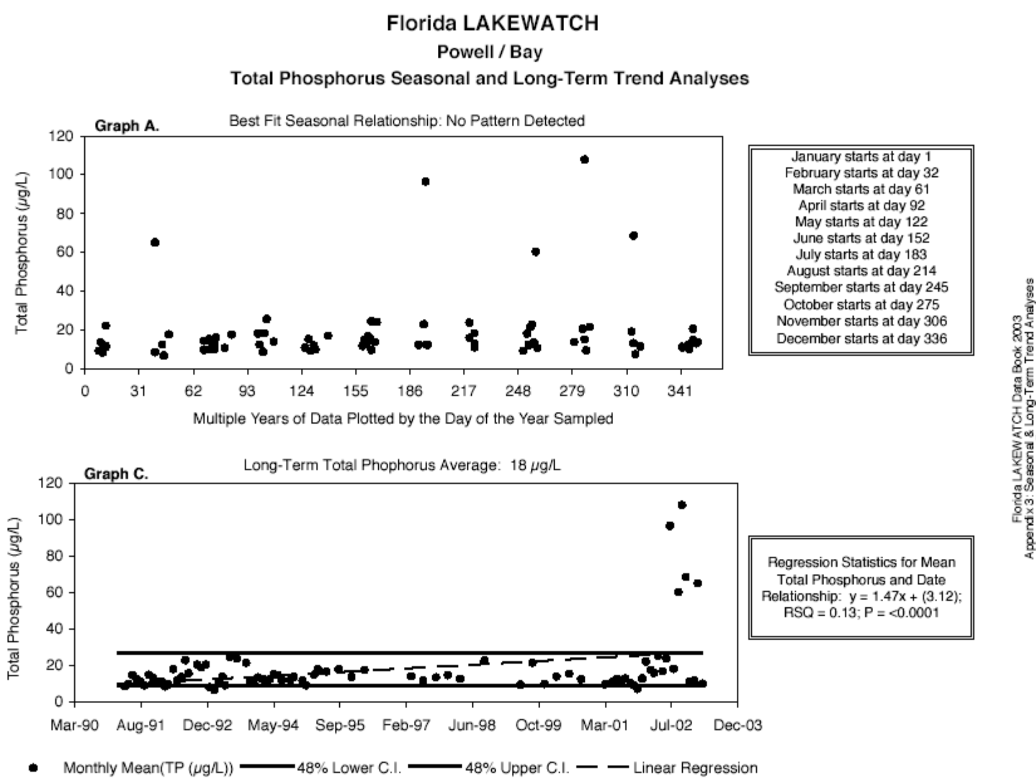
Secchi depth is the depth at which a standard secchi disk is not observable and provides data on the depth of light penetration into the water or clarity of the water. Figure 21 shows that the depth at which the observation of the secchi disk is extinguished is increasing. This indicates that light penetration (clarity) is increasing.

Turbidity is also a measure of water clarity and light penetration. Figure 23 is from Butera 2005 and indicates that, during the period of sampling, there did not appear to be a trend toward increasing turbidity although certain sampling stations showed peaks during isolated sampling events.

Figure 24 shows the measurement of oxygen concentrations in the lake at various stations and dates of sampling. The amount of oxygen that water can contain varies with the salinity and temperature of the water. As the temperature and salinity of the water increases, it can hold less and less oxygen in solution. One would expect the highest oxygen concentrations in cold freshwater and the lowest oxygen concentrations in warm saline water.

Summary. The complexity of the existing water quality data requires an in depth analysis that is beyond the limits of this summary part of the Lake Powell Ecosystem Management Plan. However, the importance of a thorough examination of the water quality data is considered essential to the development of the inlet management plan as well as the protection of the tributaries to the lake. To achieve the goal of a thorough analysis of the existing and water quality data, an Action Plan has been included in the section of this plan directed at obtaining that analysis. Completion of the water quality Action Plan should assist in answering the question of what the citizens want the lake to be – more freshwater versus more saltwater and every variation between. The LPCA will have to address their desires for the lake and arrive at a position that all can be comfortable with if not in total agreement.

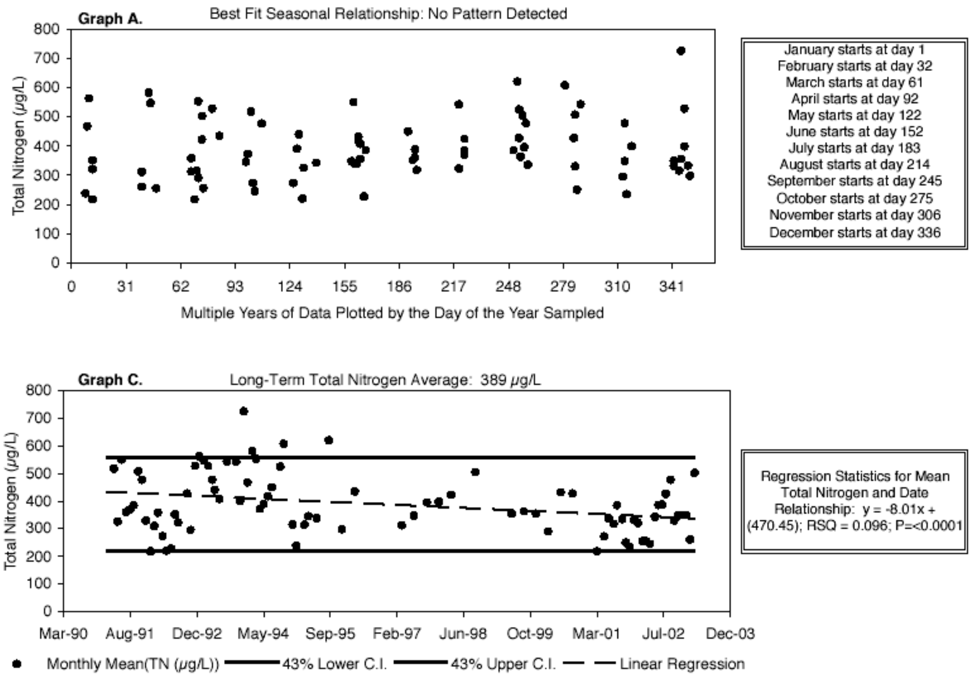
Figure 21. Summary Data from Lake Watch/Bay Watch



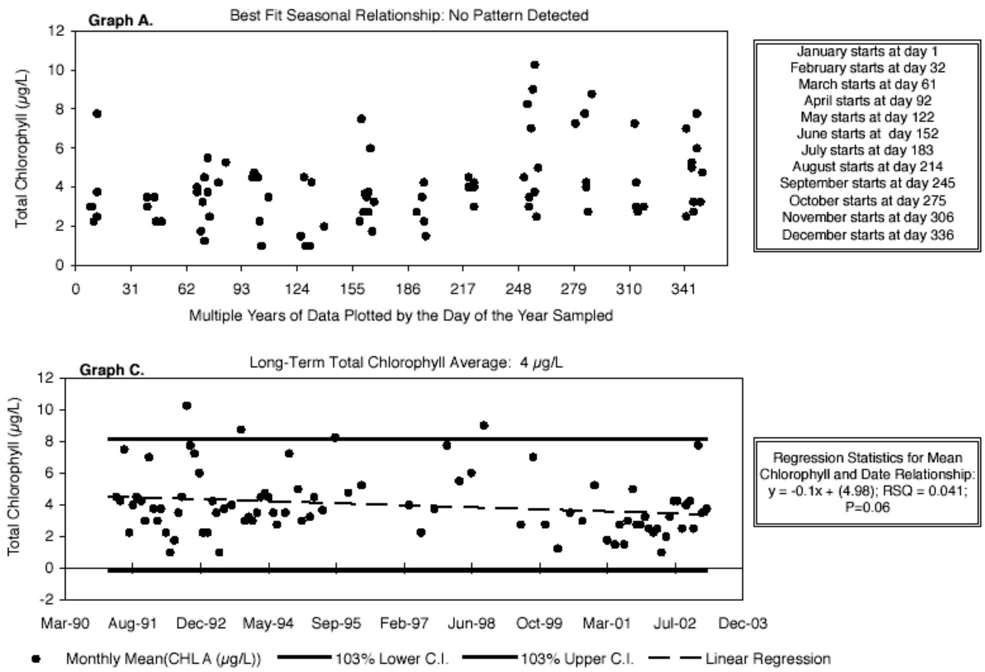
Florida LAKEWATCH

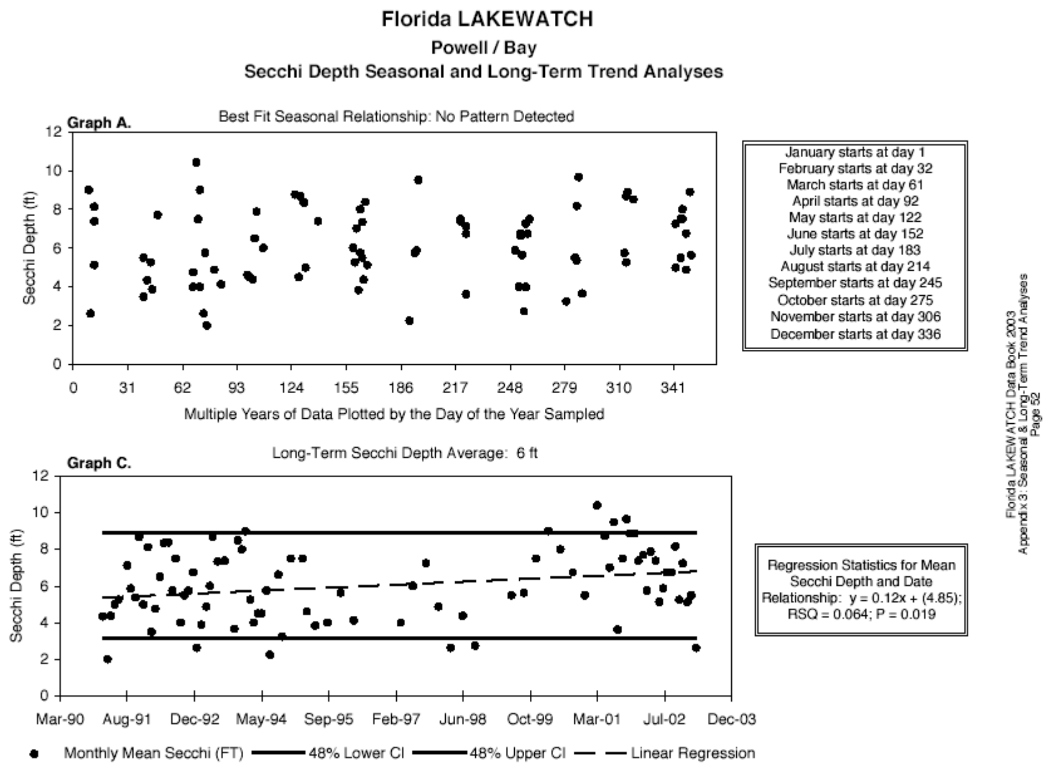
Powell / Bay

Total Nitrogen Seasonal and Long-Term Trend Analyses



Florida LAKEWATCH
Powell / Bay
Total Chlorophyll Seasonal and Long-Term Trend Analyses





Outstanding Florida Water. Lake Powell officially became an OFW in 1991 (DER 1991) following the completion of all the steps necessary to receive such designation (refer to sections below). The DER (1991) report to the Environmental Regulation Commission included a map of the Lake Powell Outstanding Florida Water Boundary. Figure 25 is a rendition of the map included in the proposed designation document by the DER (1991). It follows range and township lines. Although the OFW Boundary does not include the entire Lake Powell ecosystem, it includes the majority of the ecosystem. Presumably, the OFW boundary has some regulatory or management meaning. It appears the OFW Boundary includes the major tributaries, all or in part, and their sustaining wetlands.

The decision to designate Lake Powell as an OFW was based on its exceptional recreational and ecological values. Therefore, it appears that the goal of the DEP is to maintain these values and water quality as defined by the appropriate regulations. This may be a difficult task considering the conditions at the time of designation. This could be achieved by taking actions to return the management of the inlet to a similar condition and protect the remaining part of the ecosystem to ensure the maintenance of the quality, quantity, and seasonal distribution of freshwater entering the lake. Appendix XI is a copy of the Appendix G of the DER (1991) document that provides answers to questions and the applicable Florida Statutes.

Non-Point Source Discharges (stormwater). A shoreline survey directed at locating stormwater entrance points has been conducted by members of the LPCA. The results of that survey will be incorporated in this plan upon its completion. Concern has been expressed regarding the number and location of septic tanks surrounding Lake Powell. Figure 13 provides the Bay County data regarding septic tank locations around the Bay County portion of the lake obtained from the Bay County GIS Department.

Septic Tanks. Figure 13 shows the locations of septic tanks in the Bay County portion of the Lake Powell ecosystem. The data is from the Bay County GIS Department for the year 2003, and data from Walton County is unavailable at this writing. The septic tanks are clustered along the southeastern shore of Lake Powell between the lake and Highway 98. Whether or not septic tank effluent reaches the lake through ground water is unknown. Each county in Florida issues permit for the placement of septic tanks, so, presumably all of the septic tanks meet the criteria for their placement. The method of treatment of sewage by Wild Heron is unknown and the method of sewage treatment for the proposed development of St. Joe Company land is also unknown. Septic tank concerns are directed at the possible migration of the effluent through the ground water to the lake. If this occurs, there is a possibility that nutrient levels in the lake would increase. Both Bay and Walton Counties have required septic tank set-backs from the water designed to address the concerns.

Point Source Discharges. Point source discharges to Lake Powell have not been identified, and there may be no existing point source discharges to Lake Powell.

Threats to the Lake Powell Ecosystem. The threats to the Lake Powell ecosystem and Lake Powell itself are due to the development of the area and the manner in which it is developed or will be developed. Stormwater discharges, point source discharges (if any actual or future), sheetflow from developed areas, etc. are major concerns as development proceeds. Existing and any new septic tanks have often been identified as problems to water quality in other areas and could be examined in this ecosystem regarding their possible effects. The armoring of the shoreline may become an issue as may the number of docks, boat houses, and other lake front human amenities. User issues may also arise such as the number of motor driven boats and personal watercraft on the lake. Development consistent with a plan to maintain the functioning of the ecosystem components that directly affect the lake may help preserve the recreational values, ecological values, and water quality of the lake. Action plans will be developed in discussion with the LPCA members.

Comprehensive Growth Management Plans and OFW Restrictions.

Walton County. The Growth Management Plan for Walton County defines a Coastal Dune Lake Protection Zone as all land within an area beginning at the mean or ordinary high water line of coastal dune lakes and their tributaries and extending 300 feet landward. Development within the Coastal Dune Lake Protection Zone is allowed subject the following restrictions:

1. ***Septic Tanks:*** drain fields must be located at least 100 feet from the ordinary or mean high water line whichever applies;

2. ***Stormwater management:*** New lots shall be graded to ensure untreated stormwater runoff from lawn fertilizers, pesticides, or patios, driveways, etc. do not enter the lake. If regional stormwater facilities will not provide this standard, the lot shall utilize a vegetated swale and berm system, underground seepage system or other stormwater treatment method between the developed area and the lake to hold and treat runoff, consistent with the level of service standard for drainage facilities adopted in this plan.

3. ***Erosion Control:*** Specific erosion control measures shall be utilized during construction activity, such as staked and staggered hay bales, siltation barriers, floating silt and filter berms. Further, erosion and sedimentation controls shall be left in place until the disturbed areas are stabilized with permanent vegetation that will prevent transport of sediment of site. In addition, erosion control during construction, stabilization of the shoreline shall be provided by limiting clearing of natural vegetation within 100 feet of the mean or ordinary high water line of the shoreline to 2 percent of the site.

4. ***Hazardous Wastes:*** No land use shall be allowed within the zone which stores, handles, or generates hazardous wastes.

5. ***Sea Walls, bulkheads, revetments and rip-rap*** are not permitted.

6. ***Endangered Species:*** Native vegetative communities, including habitat for listed species, in this zone shall be protected in accordance with policy C-3.2.7 of the Comprehensive Plan.

7. ***Point and Non-point Source Discharges:*** No new point or non-point sources of pollution shall be discharged into the lakes, such as treated wastewater effluent or untreated stormwater runoff.

8. ***Open Space:*** All new development and redevelopment shall preserve at least 75 percent of the portion of the parcel within the 300-foot protection zone in open space. Vegetative clearing within this preserved area shall be limited to that which is necessary to accomplish the 25 percent development that is permitted, plus a 10 foot cleared buffer immediately adjacent to buildings.

9. ***Outlet.*** No new construction or disturbance will be allowed in the natural outlet from a coastal dune lake. A buffer of not less than fifty (50) feet of vegetated area will be left undisturbed along either side of the natural outlet from the lake.

Bay County. The Bay County Comprehensive Growth Management Plan does not address Coastal Dune Lakes as a separate entity. Lake Powell is the only Coastal Dune Lake in Bay County jurisdiction. It is included in the designated "Ecosystem Management Area". The Bay County Plan includes a Shoreline Setback that states that;

"All principle and accessory structures shall be located no closer than thirty (30) feet from the mean high water or ordinary high water line or within thirty (30) feet of any Department of Environmental Protection jurisdictional line, whichever is more restrictive. Piers, docks or similar structures and an attendant ten (10) foot wide cleared path for purposes of providing access to such structure shall be allowed. All natural vegetation if any exists will be preserved within the 30-foot setback area. The purpose of the setback is to provide a buffer between surface waters and development, preserve quality, limit sediment discharges, erosion, and uncontrolled stormwater discharges, and provide wildlife habitat".
The Ecosystem Management Areas, of which Lake Powell is one, has development restrictions attached to the designation. These restrictions apply unless it can be demonstrated that no locally significant natural resources exist on a parcel of land subject to development or a developer can

design and construct his development project such that locally significant natural resources are preserved, or impact minimized.

1. All stormwater runoff will be treated to Outstanding Florida Water (OFW) standards or greater as specified by state regulations.

2. Any new point source discharges of sewage effluent into surface waters are prohibited.

3. All on site disposal systems will be located at least 100 feet upland of the U.S. Army Corps of Engineers or the DEP wetland jurisdiction line, whichever is more restrictive.

4. Development will be undertaken so as to avoid activities that would destroy wetlands or natural functions of wetlands except for activities or permits issued by state and federal agencies.

5. No building or structure can be located closer than thirty (30) feet mean high water or ordinary high water line or within thirty (30) feet of any Department of Environmental Protection jurisdictional line whichever is more restrictive except for piers, docks or similar structures and an attendant ten (10) foot wide cleared path through the wetland for purposes of providing access to such structure, or wetland crossings required to connect dry, upland parcels. All native vegetation, if any exists, will be preserved within the 30-foot setback area, with exception to the allowed attendant path.

6. No development will be permitted that can reasonably be expected to cause short term or long term violations of state or federal water quality standards.

7. The requirements of this subsection will not apply to bona fide agricultural or silvicultural activities whenever established “Best Management Practices” are used, as published by the Florida Department of Agriculture and Consumer Services, most recent edition.

8. Development projects may be clustered to avoid or preserve significant natural resources.

9. For development projects in Ecosystem Management Areas, conservation zones or Coastal High Hazard Areas or a site with jurisdictional wetlands, the Planning Official may require an environmental impact analysis to determine potential impact on locally significant natural resources. Any such analysis shall be at the expense of the developer, and shall follow the requirements of Section 1915.

Section III. Proposed Ecosystem Management Concepts

Phillips Inlet from Camp Helen looking south

Section III. Proposed Ecosystem Management Concepts

The goal of the management plan is to conserve/protect the Lake Powell Dune Lake in as natural a condition as possible whatever that is decided to be. To achieve this goal it appears that two characteristics of the lake must be examined. The first is the maintenance of the quality, quantity, and seasonal distribution of the freshwater entering the lake from the drainage basin. The second is the inlet from the Gulf of Mexico into Lake Powell. There are a number of ways to address each issue.

These two interrelated management aspects must be addressed regarding the Lake Powell ecosystem. The first aspect for management is the maintenance of the quality, quantity, and seasonal distribution of the freshwater entering the lake from the ecosystem. The second aspect for management is the the quantity and timing of the entrance of water from the Gulf of Mexico into Lake Powell. It is the combined effects of both water inflows that determine what the lake will be in the future.

A management plan for the freshwater inflows is presented for consideration first. Of the possible plans to achieve the goals, the one discussed here appears to provide the most benefits in that it addresses the freshwater inflows, protection of habitats, species diversity, and interconnectivity of habitats to avoid fragmentation of the ecosystem. It provides for the movement of animals, aquatic, amphibian, and terrestrial, as well as maintenance of physical and chemical aspects of the freshwater entering Lake Powell.

The second management consideration is the entrance and timing of the inflows of water from the Gulf of Mexico into Lake Powell. This is a more difficult management endeavor because of the history of the connection between Lake Powell and the Gulf of Mexico and the future condition of the lake as peceived by different individuals and groups.

Management of Freshwater Inflows to Lake Powell

The current status of the ecosystem is one of being developed and poised for additional development. The degree of alteration of habitats, fragmentation of habitats, and effects on the quantity, quality, and seasonal distribution of freshwater to the ecosystem is unknown but could range from mild with good planning to severe with poor planning. The manner in which the ecosystem is developed for human use will be important to Lake Powell. A management plan for development should be considered that will conserve and protect riparian wetlands and wetlands at the head waters of the creeks and streams that enter Lake Powell along with adequate buffers to ensure the maintenance of the quality, quantity, and seasonal distribution of freshwater to the lake. In addition, the plan should include methods to prevent additional fragmentation of the ecosystem and consider the preservation of imperiled biotic communities and species. There are a variety of ways to achieve these goals. The following concept has been adopted for this plan. It can be modified as need be.

Linear Flow of Ecological Materials. The concept of the maintenance of the linear flow of ecological materials within a drainage basin is not new. This concept was discussed in a paper by Puth and Wilson (2001), and their discussion of this concept is detailed and should be consulted by those wishing to understand the details. The application of the basic tenets of this concept to the Lake Powell drainage basin may provide a significant benefit to the lake's water quality.

Essentially, the concept attempts to protect the quality, quantity, and seasonal distribution of the water flowing in the streams, creeks, and rivers in a drainage basin by conservation/preservation of the streams and their adjacent wetlands in conjunction with a border or buffer of wetlands where present and an additional buffer of uplands. The width of these riparian buffers and upland buffers (discussed below) varies with the size of the stream and width of adjacent wetlands and upland buffer. In addition, the wetlands connected to the corridors are conserved such as cypress ponds, apparently isolated swamps, marshes, lakes, and ponds. It would appear that this would require the conservation/preservation of every acre of "wetland" in the drainage basin, but this is not necessarily so. This conserves habitats, provides migratory routes for animals, dispersion routes for plants, and aids in maintaining species diversity. Upland or wetland connections between riparian areas also provide connectivity in the ecosystem and lessen the fragmentation that often results from development. Planning is the key to developing a balance between development activities and conservation/preservation activities.

As stated above, the concept of the maintenance of the linear flow of ecological materials and riparian buffer zones is not new. It was proposed for application in the Optional Sector Planning process in Duval County at about the time Bay County was deciding to use this process to plan development in the area north of West Bay. It is not known if the Duval County process was successful. It was also used in the form of Noah's Ark, with modification, in the Optional Sector Planning process in Bay County with some success in the planning stages.

Primary Tributaries to Lake Powell. Figure 26 shows the Bay County portion of the Lake Powell drainage basin as it was in 1995 at the time that the aerial photographs were obtained, and shows the tributaries and wetlands that one could consider for conservation/preservation to maintain the linear flow of ecological materials to the lake. The width of the corridors along the tributaries and around supposed wetland areas are **rough** estimates and should be adjusted to include buffers where necessary. This would require working at a higher resolution and would require field visits to ground truth the estimated corridors and wetland inclusions.

Riparian Buffers. The conservation/preservation of the open water around the shoreline of the lake itself is not sufficient to maintain the linear flow of ecological materials in the drainage basin that provides freshwater to the lake, because the quality and quantity of flowing materials are primarily derived from the surrounding uplands and freshwater vegetated wetlands. In addition, the open water in the lake and the tributaries to the lake are intimately associated with the adjacent biotic communities in terms of living things that move up and down or around the open water via wetlands, transition zones (ecotones) and/or uplands. Therefore, it is necessary to consider the conservation/preservation of adjacent habitats that affect the quality, quantity, and seasonal distribution of water in the riparian area and the plants and animals associated with these habitats. In addition, the advantage of the Riparian Buffer to the flowing water corridor is that it protects the stream from a variety of human disturbances, provides a semblance of natural interactions of the different biotic communities, provides a means of movement for plants and animals both up and down the stream corridor, and provides a variety of habitats for many species.

Riparian areas are biotic communities or parts of biotic communities that are adjacent to or near open water such as rivers, creeks, streams, lakes, and vegetated wetlands. Most of these riparian areas are transition zones (ecotones) between the open water aquatic environment and upland biotic communities. These ecotonal areas exhibit gradients in environmental conditions, ecological processes, and living organisms (The Environmental Law Institute 2003). Riparian Buffers are areas protected from alteration that reduce the negative impacts of development near the riparian areas. Buffers are usually zones parallel to (creeks and streams) or around (lakes, ponds, and wetlands) that are vegetated with native species and that are placed between the open water or wetlands and the areas of human alteration. The water body or wetland conserved by the use of riparian buffers can be further enhanced by the use of an upland buffer zone or area adjacent to the upland limit of the riparian buffer that extends into the adjacent upland biotic community. The ecological functions of riparian and upland buffers are numerous (see The Environmental Law Institute, 2003) for a summary.

One method of measuring Riparian Buffer widths is to begin at the top of the bank or elevation of bankfull discharge of running water or the high water level of a lake or pond and measure outward. For example a 30 foot wide stream with a 50 foot buffer would have 50 feet of buffer on each side of the stream for of a total width of 130 feet (50 feet on one side + 30 feet of stream width + 50 feet on the other side). This raises the question of whether a uniform buffer width (X feet on each side) will be used for the length of the running water body or will the Riparian Buffer vary in width along the length of the stream. The same is true for a lake or pond.

1. Managing Adequate Buffer Width. The Environmental Law Institute (2003) provided the following summary. Riparian Buffer widths can be determined by using two general methods or one could add a third by choosing to use the habitat requirements of a particular species of animal as a method of arriving at a buffer width. The two general methods for consideration of buffer width are presented here are uniform width versus variable width buffers. Uniform width buffers (X feet on either side) are often based on a single resource protection goal such as water quality. They are easier to enforce, require less specialized knowledge, and provide for easier regulatory enforcement. The second method is the variable width Riparian Buffer in which the width of the buffer is adjusted for multiple ecological functions and adjacent land use, but variable width buffers are not as easily determined or as easily enforced. However, since the purpose is to maintain ecological functions that protect Lake Powell, the variable width buffer appears to be the preferred method. The above referenced document, in Appendix E, provides a summary of the scientific literature regarding the recommended buffer widths based on a number of factors and species. There is no ideal buffer width for all circumstances. A recommended round number that provides for water quality protection and some wildlife habitat protection is at least 300 feet. The Bay County CP has a buffer width of 30 feet and Walton County has a buffer width of X feet.

2. Riparian Buffers – Extent and Protection. Again the reader is referred to the above referenced document for details. Ideally, the Riparian Buffers should extend along the entire length of perennial and intermittent flowing waters, around lakes and ponds, and around or along adjacent wetlands. The establishment of Riparian Buffers in these areas can be accomplished by planning development activities that may come to these areas now rather than wait until the development is in place and nothing can be done but to provide fragmented Riparian Buffer Areas, if any at all. Of course, one could assume that the CP buffer will be required by the county in issuing development documents and enforced during and after construction.

Protection of the Riparian Buffer involves the exclusion from the buffer of activities that may or will alter the functioning of the buffer. In some instances restoration or enhancement of the designated buffer area may be required to provide the needed ecological characteristics. How the Riparian Buffer is conserved will determine what can be accomplished within the buffer area. A conservation easement may allow certain activities that would not be allowed under a designation of preservation if the buffer area is owned by a public or private conservation entity. Consideration of how the Riparian Buffer will be established and conserved is crucial to what may or may not be allowed in the buffer area. Passive human use such as walking, bird watching, etc. is often not regarded as detrimental to buffer function.

The above is within the context of the maintenance of linear flow of ecological materials that, hopefully, will protect and maintain the characteristics of the lake. People of knowledge have stated that the management of these narrow corridors is not practicable and may be impossible if the surrounding areas are developed. They favor large tracts of land and water that can be managed, monitored, and the conditions establishing the tracts enforced. This would, of course, be preferred if these areas also protect the stream corridors. Large conservation/preservation areas that are easily managed may not offer protection downstream or upstream of these areas, and they may not be connected. All in all, one faces many problems in deciding which way to proceed. However, given the human mind’s ability to solve problems, one can be fairly certain that this problem could be solved with enough thought and cooperation.

In summary, the tributaries, ponds, and wetland areas at the heads of the tributaries to Lake Powell could be conserved/protected using the above discussed corridors and buffers. The decision to use buffers, and the width of the buffers should be decided by the Management Committee. It is recommended that the variable width buffer be used to accommodate large wetland areas and narrow where it is appropriate if the Committee decides to use buffers as a conservation/preservation method. However, a minimum width should be examined as one travels along each corridor.

Existing Conservation/preservation Areas. Camp Helen State Recreation Area occupies about 182 acres of land north and south of highway 98 and west of Phillips Inlet. Currently, the Area is not heavily used, but this will change as the population of the counties grows. The plans for the development to support increasing use of Camp Helen are not known to me. The future use of Camp Helen should be investigated and assessment of the planned activities could be made regarding possible adverse impacts to Lake Powell.

Planning Activities to Fulfill the Goal. The protection of riparian areas as described above is a daunting exercise if one must depend on purchase of property or the acquisition of conservation easements in order to adequately protect the riparian areas. A program is not in place that would be capable of addressing the needs and then obtaining the land and water necessary to maintain the water quality in the lake at any level of government.

Government Activity to Fulfill the Goals. One could rely on the regulatory programs of the State and Federal Governments to provide protection for the riparian areas. However, this method of case by case permit issuance does not provide for the over view planning for the entire ecosystem and is dependent on the case by case determination of jurisdiction over wetland areas and the piece by piece mitigation activities. It is doubtful if the case by case permitting could fulfill the goals necessary to protect and maintain the Lake Powell ecosystem and Lake Powell itself.

There are various State level programs for the purchase of land by the State, but these programs require justification for purchase. A significant amount of time would be required to develop the background information required to enter the State land purchase programs. The background information may be difficult to obtain considering the fact that the land is in private ownership and is poised for development. The State of Florida had an opportunity to purchase almost, if not all of the land, on the north side of the lake in the early 1990s and failed to do so. It appears less likely now than then that the State would purchase the land and wetlands necessary to fulfill the goal.

County comprehensive plans could provide adequate buffers to the riparian areas including upland buffers and then enforce them. This would require amending existing comprehensive plans to include adequate buffers and connectivity within the ecosystem. This approach appears to be one of long term political activism for the Lake Powell ecosystem. Development will occur during the time it will take to obtain the necessary ordinances and money to fulfill the goal, but it may be a required endeavor.

Existing Planning Activities. Fortunately or unfortunately, depending on one's point of view, there may be a more immediate alternative to fulfill the goals of ecosystem maintenance, and therefore, the protection of Lake Powell. The St. Joe Company owns the vast majority of the land in the Lake Powell ecosystem that is undeveloped and which they wish to develop. St. Joe has worked with an interagency task force to develop a plan of development for their property that will conserve significant areas of the Lake Powell ecosystem that participate in determining the quality, quantity, and seasonal distribution of freshwater to Lake Powell, serve as habitat for many species, and will conserve significant biotic communities in the ecosystem. The result of the regulatory task force was a Federal permit pursuant to the Clean Water Act, Section 404 and a State Ecosystem Management Agreement. The issuance of the Federal permit was challenged in federal court, and the judge has stopped the use of the permit. However, it is rumored that the involved parties are attempting to negotiate some kind of settlement. In spite of the fact that the court has ruled against the use of the Federal permit, it is informative to examine the conditions of the permit to evaluate its ability to fulfill the goals of this management plan and to demonstrate what is necessary to achieve should this permit be rendered mute by the judge.

The U.S. Army Corps of Engineers (COE) has issued a Regional General Permit (RGP) and the Florida Department of Environmental Protection (DEP) has issued an Ecosystem Management Permit (EMP) that encompasses the Lake Powell ecosystem, some of the adjacent subdrainage basins of the St. Andrew Bay ecosystem, and portions of the Choctawhatchee Bay ecosystem. These permits place about 13,000 acres of land in conservation units according to a formula with additional agreements regarding the treatment of high, medium, and low quality wetlands on the St. Joe Company property. Figure 27 is the exhibit from the RGP showing the locations of the conservation units that would have or may conserve/protect a significant area of interconnected land south of the Gulf Intracoastal Waterway extending from Walton County to the shore of West Bay. **The indicated conservation areas have not been surveyed so one must take care in interpreting the indicated limits as final and accurate**.

Figure 27 also contains the FNAI Potential Natural Areas as drafted in 2001, FNAI Conservation Lands (Camp Helen), and the arbitrary tributaries concept of conservation/preservation developed above. Figure 27 shows that the RGP-EMP included all of the areas under the ownership of the St. Company that were FNAI Potential Natural Areas as well as including most of the riparian corridors recommended in this plan for conservation/ preservation. Figure 28 is the Wild Heron Conservation Easements and the tributary conservation/preservation concept. The Wild Heron Easements include the majority of the riparian areas considered for conservation/preservation in this area. One must remember that the concept riparian areas have not been examined in the field and all that is included may not be justifiable. Conversely, additional areas for conservation may also be justified, particularly upland buffers.

Should the RGP be eliminated entirely, the conservation areas identified in the RGP remain essential to the achievement of the goal stated above. It is not within the scope of this document to address the philosophical questions such as “does the end justify the means?”, “can an illegal action produce a legal result?” or “does one modify the rule to fit the individual circumstance or modify the circumstance to fit the rule?” However, one answers these questions; the fact is that, in the absence of the RGP-EMP, a different method of placing these areas within the Lake Powell ecosystem in a conservation/preservation status must be found. The RGP provided a significant contribution to the conservation/preservation of the St. Andrew Bay ecosystem. It connects to the West Bay Preservation Area that will be realized should the relocation of the airport be approved. Again, readers can draw their own conclusions.

It appears that the RGP conservation units were large, conserve/protect more than the FNAI designated potential natural areas, and somewhat more than the rough conceptual delineation of corridors, and may have been adequate to protect water quality in the lake for a significant period of time depending on the intensity of development and the development of infrastructure to address stormwater, sewerage disposal, and drinking water concerns.

Should the RGP become functional again, the entire permit and conditions should be read by the Management Committee members to become familiar with the intricacies of the permit conditions, because they include such conditions as the 30 foot buffer around the lake shore measured from the ordinary high water line in Bay County, and conditions on the number of acres of high quality wetlands that can be altered for specific purposes, conditions on the alteration of medium quality wetlands, the timing and placement of mitigation requirements, etc. The Management Committee can draw its own conclusions.

It appears that the RGP-EMP was an excellent example of how the permitting process should proceed with a long-term view and with conservation/preservation as an integral part of the process. There appears to be little if any fragmentation except for the appearance of the isolation of the South American Swamp from the other conservation units. However, if one agrees that the Lake Powell drainage basin is an entity unto itself, then connection with the St. Andrew Bay ecosystem may be sufficient through the one obvious connector north of Wild Heron.

Fragmentation of an Ecosystem. Fragmentation refers to the breaking up of the originally interconnected ecosystem or drainage basin into a mosaic of unconnected areas of varying sizes referred to as patches. The size of a patch, in general, determines the level of ecosystem function realized within the patch. The larger the patch size, the greater the value to ecosystem function, in general. The Environmental Law Institute (2003) provides an excellent understandable summary of the effects of fragmentation and the relationship of habitat patch size to ecological functions and species needs. It also lists the applicable literature for those interested in a detailed account of habitat patches. The point to be made here is that any isolated patches of habitat be examined for connection to other patches, riparian conservation/preservation areas, and existing public and private lands in conservation/preservation status.

The Lake Powell ecosystem has experienced rather significant development along the southern shoreline of Lake Powell, and in the Wild Heron area of development. The remainder of the ecosystem is poised for development with or without the RGP-EMP in effect. The manner in which this development continues will, to a large degree, shape the future of Lake Powell and the ecosystem. Fragmentation of biotic communities and ecosystems is one of the greatest dangers to the maintenance of a functioning Lake Powell drainage basin. The breaking up of biotic communities into isolated patches on the landscape significantly degrades the flow of materials with the system and the movement of numerous species of plants and animals

In order to protect the characteristics of the lake, the above discussed concept is adopted for discussion purposes. However, the use of that concept by itself can lead to fragmentation of habitats and biotic communities that will lead to decreased species diversity and impaired ecological functions provided by the upland portion of the ecosystem. Connectivity of habitats can be incorporated into the above discussed rough concept by connecting the riparian conservation/preservation areas to one another with land bridges. The negative aspect of connecting land bridges is that they can be more difficult to manage, monitor, and protect than large contiguous areas of the ecosystem. Development will occur, and that development will occur on the uplands and through permitted alteration of wetlands. It may be easier, in the long run to establish land bridges between riparian areas now rather than to seek to obtain or designate large areas for conservation/preservation in the future.

The existing Wild Heron conservation easements in Phase I appear to adequately protect wetland corridors within the development provided that stormwater is being handled and treated in a manner conducive to maintaining the ambient water quality of Lake Powell. Fragmentation of the conservation easements may or may not be a matter for concern. The Management Committee could examine this in more detail. The RGP-EMP conservation units are interconnected to form a quite wide corridor that begins in Walton County and extends eastward to the western shore of West Bay where it connects with the West Bay Preservation area depicted in the Bay County Optional Sector Plan. It would place significant connected areas of land in conservation status in the Lake Powell ecosystem and appears to be sufficient to protect Lake Powell.

Sheet Flow and Stormwater Runoff and Treatment. Sheet flow is that surface water that runs off the land directly to Lake Powell rather than being conducted to a tributary. Whether or not this is a concern given the sandy soils of the area is a matter for further examination. Bay County has a requirement for a buffer of 30 feet along the shoreline of surface water bodies. The adequacy of this buffer to protect Lake Powell water quality could be examined in more detail by the LPCA Management Committee. A buffer 30 feet wide along the shoreline of the lake in addition to wider buffers along the tributaries to the lake may protect water quality to a sufficient degree over all. However, the buffer does not appear to have been applied to the south shoreline of the lake as it was developed. Therefore, flow off of this developed land and the presence of septic tanks could be examined in more detail by the Management Committee.

Summary. The chosen plan for the management of the Lake Powell ecosystem is directed at the maintenance of the quality, quantity, and seasonal distribution of the freshwater inflows to Lake Powell, the maintenance of connectivity between riparian areas by land corridors, and the examination of actual and potential development pressure. The methods by which the goals of the plan could be achieved were examined from the point of views of the State government, Federal and State permit programs, and local government actions. The RGP-EMA permits issued by the COE and the DEP were examined for their applicability to achieving the goals of the plan.

Inlet Management

The implementation of the Management plan for freshwater inflows would be a major achievement in conserving Lake Powell. However, in the absence of a well thought through inlet management plan, the achievement will be only partially successful or completely successful depending on the goal set for the future condition of Lake Powell. The fact is that the development of low-lying areas around the lake will require managing the lake to prevent flooding. Although this has little to do with conserving the quality of the recreational and biological characteristics of the lake, it will be, and presently is, the driving force. With this in mind, one must decide what they want Lake Powell to be in the future – what it is now, what it was in 1985, what it was in 1900. Does one wish it to be a more freshwater lake or a more saltwater lake? If one wishes it to be what it is now, then little needs to be done regarding the inlet and emphasis shiftes to maintaing freshwater inflows as decribed above.

If one wishes it to be other than it is now, then a plan should be developed based on as factual assessment of what the results of the proposed alterations may ultimately be. Permanently opening and maintaining the inlet to width and depth sufficient to increase the salinity in the lake and possibly increase the flushing of the lake would also mitigate the flooding of private property. On the other extreme, the current manipulation of the lake level to prevent flooding will not achieve the same results and the lake will be as it is now. Closing the inlet and letting it open and close naturall where it wants to open and close does not appear to be an option because it would not mitigate the flooding of private property.

A number of plans have been mentioned in discussions. The following is a plan that was brought for inclusion in this document for consideration of the LPCA and the interested public. “A management approach that addresses flooding of residences, ambient water quality, restoration of seagrass beds, and Lake Powell’s designation as a Coastal Dune Lake could satisfy several concerns. First, such an approach would not include a permanentopening of the inlet. The inlet would continue to be opened intermittently. However, any artificial openings of the inlet could be designed not just to prevent flooding but alos to promote ambient water quality. The intermittent openings should be designed deep enough, wide enough, and straight enough for improvement of water quality, transfer of sediments acculations, and some opportunity for various marine life exchanges between the lake and the Gulf. A somewhat simple modification of the present artificial openings of the inlet which are directed at only flooding seemed to accomplish these objectives for decreased flooding before 1995. For example, the inlet openings could be scheduled every month or two. The LPCA design could also include some flexibility to protect the lake such as avoiding openings as much as possible when red tides could enter the lake. Just before approving permit BA-295 datred 8/7/95, a letter from Gary Shaffer of DEP indicates that the proposed permit could address problems such as dying seagrasses and declining fishery in Lake Powell."

This is one approach that appears to have some merit because it addresses the fact of flood control as well as other impacts on the charaqcteristics of the lake. Of course, other people have other ideas regarding the management of the inlet to achieve their perceived goals. It does appear to be an efficient use of time, to seek and include all the alternative plans that are being discussed. This job is better completed through presentation and discussion of the plans at LPCA meetings or a workshop devoted to the development of plans. That is the approach recommended here.

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Section IV. Action Plans

The action plans are general statements of the actions that the LPCA believe necessary to better understand the Lake Powell ecosystem, monitor various characteristics of the ecosystem, and to provide informed recommendations regarding the fate of the ecosystem to local, state, and federal entities responsible for the ecosystem. The action plans are not in a prioritized list either generally or specifically. As the means or interest in completing the individual action plans become available, those interested or with means to complete them can do so. The format of the Actions Plans includes brief statements regarding Action, Background, and Strategy.

Many of the action plans are surveys that will provide current conditions from information can be used to develop an inlet management plan or can be used as baseline surveys for assessment of the effects of the implementation of the inlet management plan and the management plan for the Lake Powell ecosystem of which the inlet plan is a part.

Action Plan – Organization of the Lake Powell Citizens Alliance

Action Plan O1. IRS 501(c)(3) Status

Action. Obtain the 501(c)(3) designation from the Internal Revenue Service.

Background. The LPCA has obtained status as a Florida not-for-profit corporation and now is LPCA, Inc. The Board of Directors currently consists of three members, President, Vice President, and Secretary-Treasurer.

Strategy. In order to obtain funding or grants from most grantors, the LPCA will require a determination from the IRS regarding the corporation's status as a 501(c)(3) tax exempt corporation. The required documents have been submitted to the IRS. Status of the requested determination should be tracked until received.

Action Plan O2. Number of the LPCA, Inc. Board of Directors

Action. Increase the number of members of the Board of Directors to at least five

Background. The Board of Directors of the LPCA currently consists of three members; President, Vice President, and a Secretary-Treasurer. The opinion has been expressed that the number of Board members be increase to provide a better division of labor and efficiency of operation.

Strategy. In accordance with the by-laws increase the number of Board members to at least five and elect a separate Secretary and Treasurer. This would provide for four officers; President, Vice President, Secretary, and Treasurer. The fifth and additional members if deemed appropriate would serve as Board Members at large.

Action Plan O3. Committees

Action. Provide increased structure to the LPCA through the formation of Committees to oversee and provide the work of the LPCA.

Background. Membership in the LPCA is expected to increase as the membership drive commences. Increased membership provides an opportunity (or necessity) to provide a division of labor in the organization directed at achieving the goals of the LPCA. The standing committees could include a Growth Management Committee, Education/Outreach Committee (including newsletter development), and a Natural Resources Committee to implement the action plans pertaining to the natural resources of the ecosystem. The Chairpersons of the committees could serve as members of the LPCA, Inc. Board of Directors if desired.

Strategy. Develop the committee structure and provide principles, policies, and procedures to guide the work of the committees. Recruit volunteers to serve as chairpersons of the committees.

Action Plans – Physical and Chemical Characteristics

The gaps in the information regarding the physical and chemical characteristics of the ecosystem will provide the data for an increased understanding of the ecosystem. Long-term monitoring is also advantageous in identifying changes that may occur in the ecosystem particularly Lake Powell.

Action Plan PC1. Bathymetry

Action. Obtain an accurate bathymetric map of Lake Powell.

Background. The bathymetry of Lake Powell is mapped and is not well understood. Obtaining an accurate map of the bottom contours of the lake in 3 foot increments would provide information to better calculate the volume of discharge of water from the lake to the Gulf of Mexico, provide information regarding potential areas for seagrass restoration, and provide increased understanding of the flow of water in the lake.

Strategy. Seek funding to contract with a qualified business to perform the survey and provide bottom contour maps of the lake and its major tributaries, and embayments.

Action Plan PC 2. Analysis of Existing Water Quality Data

Action. Obtain the services of someone who can provide a detailed analysis of the existing water quality data for Lake Powell from which reasonably valid conclusions can be drawn.

Background. The discussion of the water quality in Lake Powell provided above is not sufficient to draw reasonable, long-term conclusions. The abundance of data is such that an in depth analysis requires the efforts of someone who is familiar with this kind of data and its analysis. There may be much that can be concluded from such an analysis that will be of importance in determining how the inlet will managed and the predicted results of the management plan.

Strategy. Approach the DEP and Possibly the federal Environmental Protection Agency regarding the accomplishment of this Action Plan by them or through funds that may be obtained from them individually or jointly. Another source of possible funding is the U.S. Fish and Wildlife Service Coastal Program.

Action Plan PC 3. Water Budget and Hydrology.

Action. Determine the seasonal flows of freshwater into the lake from its tributaries, the effects of precipitation in the ecosystem, and the volume of discharge of water to the Gulf of Mexico when the inlet is open. This information is important to maintaining the quantity and seasonal distribution of freshwater to the lake and understanding the movement of water within the lake basin.

Background. There is no data available as to the amount of water entering Lake Powell from direct precipitation and from the tributaries and no information as the volume of water leaving the lake when the inlet is open under the current inlet management regime. The information is important to maintaining the water quality in the lake and understanding the outflows under different inlet management plans.

Strategy. Obtain funds to perform the work or request the services of a state and/or federal agency to perform the analysis. Included in the work should be ground water and surface water inflows, examination of flushing rates under various inlet opening strategies, and quantification of the change in water levels.

Action Plan PC 4. Sediment Survey

Action. Initiate a regular, long-term sediment survey including organic content, grain size analysis, and chemical constituents to build upon the existing data pertaining to sediment quality. This information can be used to track the quality of the sediment in Lake Powell and identify significant changes, if any occur.

Background. Several sediment quality surveys have been conducted in Lake Powell. The last survey provided information that the sediments in Lake Powell may be experiencing an increase in organic content and decrease in grain size. Data is needed to confirm or refute this, because if the latest data is accurate for the majority of the sediments in the lake, the water quality and near the bottom may be adversely affected.

Strategy. Included here are the mapping of sediment layers in the lake and an attempt to identify sources of silt and clay that may be entering the lake. The U.S. Fish and Wildlife Service has conducted a number of sediment surveys in Panhandle estuaries and could be approached to develop and implement a long-term sediment survey in Lake Powell using trained volunteers. The same is true of the DEP.

Action Plan PC 5. Water Quality Monitoring

Action. Continue the existing water quality monitoring activities in Lake Powell.

Background. Long-term water quality monitoring activities in Lake Powell by the RMA Bay Watch/Lake Watch program should be continued. Bay County's monitoring activities should also be continued. There are some questions about some of the data such as the consistency of the depth of bottom samples in both monitoring activities at a few stations. If possible, the ability to sample at the same bottom depth each sample period should be improved.

Strategy. Encourage the RMA to continue sampling efforts. If the funding currently being sought by RMA should not be realized, RMA should be assisted in obtaining the necessary funds to continue the program. The same applies to the effort by Bay County. Consistent water quality data with adequate quality control procedures is important to assessing the condition of Lake Powell under the active management of the inlet and the freshwater inflows to the lake.

Action Plan PC 6. Shoreline Survey.

Action. Expand the recently conducted shoreline survey to include number of docks and shoreline hardening activities.

Background. LPCA has completed a preliminary shoreline survey directed primarily at the location of stormwater runoff concerns and invasive exotic species. The results of that survey should be prepared in a report form to the LPCA or wait for additional surveys to be completed.

Strategy. Expand the recent shoreline survey to include the factors mention in the Action section. This could be achieved by LPCA volunteers after the development of procedure to complete the survey. A complete stormwater assessment could be made a part of this plan.

Action Plan PC 8. LPCA Inlet Management Plan

Action. The LPCA will discuss and obtain consensus (if possible) on a plan for management of the inlet that will reasonable fulfill the LPCA's perception of what Lake Powell should become in the future. The development and discussion of the plan should be based on the information obtained from the bathymetric survey, hydrological study, and annual water budget added to the existing water quality data and a detailed analysis of that data.

Background. There appears to be differences in opinions as to what Lake Powell should be and how to achieve the various goals for the lake. The various opinions for the future of the lake should be discussed completely by the LPCA and then brought to the citizens who will be affected by the proposals.

Strategy. Once the studies mentioned in the Action Plan section above area completed, the LPCA will conduct a series of workshops in which the members will be presented the results and conclusion from the studies will be discussed. The members can them discuss and agree upon the direction they wish to pursue with some data to support that decision. LPCA could then conduct a public workshop with all agencies attending to present the information and the conclusion that the LPCA has reached after examination of the information.

Action Plan PC 9. Beach Nourishment and Dune Restoration

Action. Obtain information regarding the beach nourishment process along the beaches in the Lake Powell inlet vicinity, and the restoration and stabilization of the dune system. Particularly, information regarding the possible effects on the inlet opening and closing should be sought.

Background. Beach nourishment projects have become the rule in Bay and Walton Counties due to the effects of storms and coastal development. The projects may or may not require reconstruction and stabilization of the dunes.

Strategy. Approach the Tourist Development Council and the U.S. Army Corps of Engineers for information regarding the federal-state beach nourishment project. Contact Pinnacle Port regarding any beach nourishment that they may have planned independent of the public project. Approach Camp Helen regarding their participation in the projects. The same should be accomplished for Walton County within a reasonable distance from the inlet area.

Action Plan PC 10. Dogfly Spray Effects

Action. Contact the Arthropod Laboratory in Panama City and obtain information regarding the seasonal spraying of the beaches to control dogflies. The necessity for spraying, threshold for spraying, chemical used and its effects on non-target marine arthropod species and humans should be obtained.

Background. The State of Florida uses aerial spraying to control dogflies along Panhandle beaches. The Mulrennan Arthopod Laboratory in Panama City provides the aircraft and performs the spraying during the fall of the year. The laboratory also conducts studies on the effects of various pesticides on non-target species and droplet dispersion and concentrations at the target areas.

Strategy. Obtain an understanding of this activity and its possible effects on freshwater and brackish water species in Lake Powell and along the beaches fronting Lake Powell. Discuss the pros and cons of this activity.

Action Plans – Biological Characteristics

The actions developed under Biological Characteristics are directed at obtaining a better understanding of the existing species and biotic community diversity with the goal of providing recommendations for the conservation or preservation of the identified areas in the ecosystem to maintain species and community diversity.

Action Plan BC 1. List of Birds

Action. Perform a detailed survey of the birds that utilize the various habitats of the Lake Powell ecosystem on a seasonal basis. Use of the area by migratory species, particularly Neotropical Migrants should be obtained for the various habitats. In addition, nesting species and those species present during all seasons and their habitat should be identified.
Background. The birds that inhabit the Lake Powell ecosystem are not well known except, possibly, for those reported from Camp Helen. Coastal habitats are often important for birds migrating across the Gulf of Mexico and serve as resting and feeding places for them before they continue their journey north.

Strategy. The LPCA could encourage birders from the area and local Audubon Chapters such as the Choctawhatchee and Bay County Chapters to make regular visits to the area and catalogue the species of birds observed and the habitats in which they were observed. A checklist could be created and the area considered, if appropriate, for a Florida Birding Trail or Important Bird Area.

Action Plan BC 2. Protected Species – Plants and Animals

Action. Initiate surveys for protected birds such as the snowy plover, piping plover, bald eagle, and others in the Lake Powell ecosystem. This could be a part of Action Plan BC1. If feasible and with appropriate permission perform a survey for the federally and state protected subspecies of beach mouse along the dunes fronting Lake Powell. The beachmouse survey should be conducted in accordance with FWS methods. FWS has delineated critical habitat areas for the subspecies of beach mouse along the northern coast of the Gulf of Mexico from Alabama to Bay County. The closet unit is at Deer Lake State Park. A FWS approved survey for the beach mouse in the vicinity of the Lake Powell inlet has not been conducted. Support the turtle watch programs in Bay and Walton Counties.

Strategy. Include the birds in the overall bird survey or initiate a separate survey for protected species. Contact the U.S. Fish and Wildlife Service to obtain the required procedures to conduct the survey and seek someone to conduct the survey. Support or volunteer for the turtle watch programs active in the area.

Action Plan BC 3. Seagrass Survey

Action. Initiate a long-term and planned annual seagrass survey in Lake Powell. The information obtained can be used in assessing the effectiveness of the inlet management plan.

Background. The importance of seagrasses to water quality, aquatic productivity, and species diversity is well established. It is apparent that the seagrass beds in Lake Powell have declined drastically over the years since the original observations in the 1980s. The cause of the loss is unknown.

Strategy. Consult with seagrass experts to develop a systematic monitoring plan of seagrass in Lake Powell to include investigations into possible causes of the loss. The plan could involve monitoring stations at areas that previously supported seagrasses and areas that appear to be conducive to seagrass recruitment. Obtain funding to retain the services of those with expertise or an approach and organization with the expertise and experience to conduct the survey in accordance with the plan.

Action Plan BC 4. Saltmarsh Mapping.

Action. Conduct field work to establish the location, dominant vegetation and area covered by the salt and brackish marsh biotic communities around Lake Powell.

Background. The value of marshes to aquatic systems is well known. The maintenance of the extent and types of marshes associated with Lake Powell is important to maintaining the quality and species diversity of the lake.

Strategy. Plan a survey that includes mapping the location, acreage and dominant species of marsh vegetation around the lake. The baseline survey should be followed by a sequence of resurveys every three years to track the health and coverage of the areas. The areas should be monitored on an occasional basis in conjunction with recreational activities or other sampling activities by members of the LPCA for any encroachment by development into the marshes or other actions that reduce the extent of these marshes.

Action Plan BC 5. Finfish Survey of Lake Powell.

Action. Initiate a survey of the finfish of Lake Powell to obtain understanding of the species of finfish that currently inhabit Lake Powell.

Background. The only previously located surveys of the finfish known from Lake Powell are those from 1984. Knowledge of the species currently present in the lake can be compared against the species previously reported to provide information regarding changes that may have occurred in Lake Powell in the past 20+ years.

Strategy. Obtain funding to initiate the survey of the finfish in Lake Powell. Use the information obtained to compare against the previous lists of finfish from the lake. The survey can serve as the current baseline conditions for future finfish surveys following implementation of the inlet manage plan.

Action Plan BC 6. Macrobenthic Infaunal Survey

Action. Develop a Macrobenthic infaunal survey with permanent stations to determine the macrobenthic infaunal communities in various parts of Lake Powell. These communities reflect the conditions of the sediment and the water quality in the lake.

Background. The two previous surveys of macrobenthic infauna in Lake Powell should be supplemented with a systematic survey of the current infaunal communities for comparison with previous surveys and to provide current baseline conditions.

Strategy. Obtain funding to initiate the survey and establish permanent sampling stations for future monitoring of macrobenthic infaunal communities as another method of assessing the effects of the inlet management plan and overall ecosystem management plan.

Action Plan - History of Lake Powell

Action Plan H 1. Inlet History

Action. Compile a history of the opening and closing of the inlet including paleo-cores to obtain a history of the lake conditions in the past. Define the flood prone areas and residences and develop Environmental Impact scenarios for various inlet opening concepts. Prepare a document that provides the history of the Lake Powell ecosystem from the time of the earliest known archeological sites in the ecosystem to the present. Appendix X is the list of the cultural resource sites in the Lake Powell area.

Background. The historical conditions in Lake Powell, including the frequency of inlet opening and closing both artificially and naturally, has not been formally compiled. The presettlement condition of the lake is unknown. A management plan for the inlet should be based on all information obtainable. There is not a single source that one can refer to regarding the history of the Lake Powell ecosystem. Gathering the information into one historical document would benefit an understanding of the ecosystem and Lake Powell as well as being a quite interesting document to read.

Strategy. Obtain funding or volunteers to carry out a systematic compliation of information regarding the conditions in the lake and the inlet from long-term residents of the area. Obtain the services of a qualified person to obtain and analize the paleo-core information.

Action Plans-Education/Outreach

Action Plan E 1. Establish an Education/Outreach Committee within the LPCA

Action. Form an Education/Outreach Committee of the LPCA to develop and provide educational materials, workshops, and meetings to bring the activities of the LPCA to the public. Formulate the policies and procedures under which this committee shall work.

Background. The LPCA is a growing organization that is accomplishing goals. These activites should be enhanced and coordinated by a committee.

Strategy. Approach or recruit members of the LPCA to serve on the committee and provide them with the guidance and information to achieve the goals of the committee and organization.

Appendix I. Characteristics of Soils in the Lake Powell Ecosystem

The ecosystem consists of about 12 different soil types; Chipley Sand, Foxworth Sand 0-5% slope, Hurricane Sand, Kureb Sand, Lakeland Sand 0-5% slope, Leon Sand, Mandarin Sand, Pamilco-Dorovan Complex, Pottsburg Sand, Rutlege Sand, and Resota Fine Sand 0-5% slope. Beach Sand is present along the Gulf of Mexico beach area.

Appendix 2. Common Soil Types and Some Characteristics in the Lake Powell Drainage Basin.

Soil Name	Characteristics
Hurricane Sand	Somewhat poorly drained, nearly level, occurring between the uplands and lower lying flatwoods. Water table is at a depth of 40-60 inches for 3-6 months and a depth of 20-40 inches for 1-3 months in a normal year. Natural vegetation is slash and longleaf pines, turkey, bluejack, and post oak, with an understory of saw palmetto, gallberry, bluestem, and pineland threeawn.
Lakeland Sand	0-5% slopes, excessively drained, permeability very rapid, natural fertility and organic content low. Natural vegetation; longleaf pine, bluejack, turkey, & post oaks.
Leon Sand	0-2% slopes, poorly drained, water table at 10" or less 1-4 months, permeability rapid in surface and subsurface. Natural vegetation; longleaf , pond, slash pines, water oak, wax myrtle.
Foxworth Sand	0-5% slopes, well drained, rapid permeability, low fertility. Natural vegetation; slash & longleaf pines, live, post, bluejack, red oaks.
Chipley Sand	0-5% slopes, poorly drained, rapid permeability. Natural vegetation; slash & longleaf pines, post, bluejack, & turkey oaks.
Centenary Sand	0-5% slopes, moderately well drained, very rapid permeability in surface and subsurface layers, low fertility. Natural vegetation; slash & longleaf pines, live, post, bluejack, & red oaks.
Mandarin Sand	0-2% slopes, somewhat poorly drained, available water capacity very low, permeability rapid. Natural vegetation; longleaf & slash pines, bluejack, turkey, post oaks, & wax myrtle.
Rutlege Sand	0-2% slopes, very poorly drained, water table at or near surface for 4-6 months and ponded for 4-6 months, available water capacity low, permeability rapid, fertility medium, organic content high. Natural vegetation; titi, sweetbay, blackgum, cypress, wax myrtle, herbs.
Pottsburg Sand	
Resota Fine Sand	0-5% slopes, medium well drained, very low available water capacity, permeability rapid, fertility & organic content low. Natural vegetation; sand, slash & longleaf pines.
Beach Sand	Bare sand subject to movement by tides, wave action, wind, water table above surface or within 10", salt content of ground water high.
Kureb Sand	0-5% slopes, excessively drained, low available water capacity, permeability rapid, fertility and organic content very low. Natural vegetation; sand pine, longleaf pine, dwarf live, turkey, bluejack oaks, and rosemary.

Appendix II. Climate Data from Wild Heron

The data consists of 28 pages and is considered too voluminous to be included in its entirety. For those interested, the data can be obtained from the LPCA data files for this report.

Appendix III. Vascular Plants Known from Camp Helen State Recreation Area Prepared by Keppner and Keppner (1998)

FAMILY	*GENUS & SPECIES*	COMMON NAME	#	LOCATION
Aceraceae	*Acer rubrum*	Red Maple	282	NW Boundary
Agavaceae	*Yucca flacida*	Weak-leaved Yucca	126	S Lake Slope
Aizoaceae	*Sesuvium portulacastrum*	Sea Purslane		
Alismataceae	*Sagittaria graminea*	Arrowhead	73	SW canal
Alismataceae	*Sagittaria graminea*	Arrowhead	141	FW Marsh S
Alismataceae	*Sagittaria lancifolia*	Arrowhead		
Amaranthaceae	*Amaranthus spinosus*	Spiny Amaranth	156	SW HWY 98 ROW
Amaranthaceae	*Froelichia floridana*	Cottonweed	191	S Lake Slope
Anacardiaceae	*Rhus copalina*	Winged Sumac	279	Entrance Hammock
Anacardiaceae	*Toxicodendron radicans*	Poison Ivy		
Annonaceae	*Asimina parviflora*	Small-friuted Pawpaw		
Apiaceae	*Centella erecta*		155	FW Marsh S
Apiaceae	*Chaerophyllum tainturieri*	Wild Chervil	39	SW Lawn
Apiaceae	*Eryngium yuccafolium*	Rattlesnake Master		
Apiaceae	*Hydrocotyle bonariensis*	Water Pennywort	80	S. Lake Slope
Apiaceae	*Hydrocotyle umbellata*	Marsh Pennywort	59	S Canal Edge
Apiaceae	*Ptilimnium capillaceum*	Mock Bishop's-weed	150	FW Marsh S
Apiaceae	*Spermolepis echinata*	Scale-seed	114	Brush Pile N
Aquifoliaceae	*Ilex ambigua*	Carolina Holly; Sand Holly	117	Hammock N
Aquifoliaceae	*Ilex cassine*	Dahoon Holly; Florida Holly	249	FW Marsh N
Aquifoliaceae	*Ilex coriacea*	Large Gallberry		
Aquifoliaceae	*Ilex glabra*	Gallberry	118	Pine Flatwood N
Aquifoliaceae	*Ilex myrtifolia*	Myrtle Leaf Holly		
Aquifoliaceae	*Ilex opaca*	American Holly		
Aquifoliaceae	*Ilex vomitoria*	Yaupon	116	Lake Shore N
Aracaceae (= Palmae)	*Serenoa repens*	Saw Palmetto	49	Pine Flatwoods N
Arecaceae	*Sabal palmetto*	Cabbage Palm		
Asclepiadaceae	*Asclepias humistrata*	Purple Milkweed	122	Scrub N
Asclepiadaceae	*Asclepias lanceolata*		233	Fw Marsh S
Asclepiadaceae	*Asclepias tuberosa*	Butterfly weed	189	Scrub N
Asclepiadaceae	*Cynanchum angustifolium*		197	Brackish Marsh S
Asteraceae	*Ambrosia artemisiifolia*	Common Ragweed	213	Hwy 98 ROW S
Asteraceae	*Baccharis halimifolia*	Salt Bush	277	Beach Path S
Asteraceae	*Balduina angustifolia*	Yellow Buttons	270	Dune Edge SW
Asteraceae	*Bidens alba*	Spanish Needle	99	Lawn
Asteraceae	*Bidens bipinnata*	Spanish Needles	247	FW Marsh S
Asteraceae	*Bidens mitis*	Burr Marigold	140	FW Marsh S
Asteraceae	*Bidens mitis*	Burr Marigold	248	FW Marsh S
Asteraceae	*Bidens mitis*	Burr Marigold	302	FW Marsh S
Asteraceae	*Borrichia frutescens*	Sea Oxeye Daisy		
Asteraceae	*Carphephorus odoratissimus*	Deer's Tongue		
Asteraceae	*Chrysoma pauciflosculosa*	Bush or Woody Goldenrod	269	Dune Edge SW
Asteraceae	*Chrysopsis godfreyi*	Golden Aster	51	Scrub Edge S
Asteraceae	*Chrysopsis godfreyi*	Golden Aster	272	Beach Path S
Asteraceae	*Chrysopsis godfreyi*	Golden Aster	293	Dune S

Asteraceae	*Chrysopsis godfreyi*	Golden Aster	295	Bridge to Beach S
Asteraceae	*Chrysopsis gossypina cruiseana*	Cruise's Golden Aster		
Asteraceae	*Chrysopsis gossypina trichophylla*	Golden Aster	294	Beach Path S
Asteraceae	*Chrysopsis lanuginosa*	Golden Aster	273	Lake Path S
Asteraceae	*Conoclinum coelestinum*	Mist Flower	292	Cabin Area S
Asteraceae	*Conyza canadensis*	Horseweed	211	Hwy 98 ROW S
Asteraceae	*Elephantopus elatus*	Florida Elephants-foot	207	Hammock Trail S
Asteraceae	*Erechtites hieracifolia*	Fireweed	218	FW Marsh S
Asteraceae	*Erigeron strigosus*	White-tops	216	FW Marsh S
Asteraceae	*Erigeron strigosus*	White-tops; Daisy Fleabane	133	Lawn
Asteraceae	*Erigeron vernuus*	Daisy Fleabane		
Asteraceae	*Eupatorium compositifolium*	Dog Fennel	278	Beach Path S
Asteraceae	*Eupatorium serotinum*		275	Beach Path S
Asteraceae	*Euthamia minor*		291	Beach Path S
Asteraceae	*Gaillardia pulchella*	Blanketflower	65	S Lake Slope
Asteraceae	*Gnaphalium obtusifolium*	Sweet Everlasting	276	S Lake Path
Asteraceae	*Gnaphalium pensilvanicum*	Rabbit Tobacco	31	Brush Pile N
Asteraceae	*Haplopappus divaricatus*	Scratch Daisy	260	Lake Trail N
Asteraceae	*Helenium amarum*	Bitterweed	203	Hwy 98 ROW S
Asteraceae	*Helianthus debilis*	Cucumber-leaved Sunflower	172	Hwy 98 ROW S
Asteraceae	*Helianthus radula*	Rayless Sunflower		
Asteraceae	*Helianthus simulans*	Sunflower	145	Hwy 98 ROW S
Asteraceae	*Heterotheca subaxillaris*	Camphorweed	19	Lake Road S
Asteraceae	*Heterotheca subaxillaris*	Camphorweed	245	Hwy 98 ROW S
Asteraceae	*Heterotheca subaxillaris*	Camphorweed	274	Lake Path N
Asteraceae	*Hypochoeris brasiliensis*	Cat's-ears	107	Lawn
Asteraceae	*Iva imbricata*	Seashore Elder		
Asteraceae	*Krigia virginica*	Dwarf Dandelion	4	Lawn
Asteraceae	*Liatris tenuifolia*	Blazing Star	262	Scrub N
Asteraceae	*Pityopsis graminifolia*	Golden Aster	271	Lawn
Asteraceae	*Pluchea odorata*	Salt Marsh Fleabane		
Asteraceae	*Pyrrhopappus carolinianus*	False Dandelion	147	Hwy 98 ROW
Asteraceae	*Solidago chapmanii*	Seaside Goldenrod		
Asteraceae	*Solidago odora*	Sweet Goldenrod	259	Lake Trail N
Asteraceae	*Solidago sempervirens*	Seaside Goldenrod	70	Lake Shore S
Asteraceae	*Sonchus asper*	Spiny-leaved Sow Thistle	25	Lawn
Asteraceae	*Taraxacum officinale*	Dandelion	9	Lawn
Asteraceae	*Youngia japonica*	Youngia	24	Entrance Area
Brassicaceae	*Cakile constricta*	Sea Rocket	23	Inlet S
Brassicaceae	*Cakile constricta*	Sea Rocket	100	Inlet S
Brassicaceae	*Descurainia pinnata*	Tansy Mustard	11	Lawn
Brassicaceae	*Lepidium virginicum*	Peppergrass	72	Hwy 98 ROW S
Brassicaceae	*Raphanus raphanistrum*	Wild Radish	38	Hwy 98 Bridge
Bromeliaceae	*Tillandsia usneoides*	Spanish Moss	2	Entrance Area
Cactaceae	*Opuntia stricta*	Prickly Pear Cactus		
Callitrichaceae	*Callitriche peploides*	Water Starwort	60	FW Marsh S
Campanulaceae	*Triodanis biflora*	Venus' Looking Glass		
Campanulaceae	*Triodanis perfoliata*	Venus' Looking-glass	74	Lawn
Campanulaceae	*Wahlenbergia marginata*		61	Hwy 98 ROW N
Caprifoliaceae	*Lonicera sempervirens*	Coral Honeysuckle	43	Hammock Trail S

Caryophyllaceae	*Cerastium glomeratum*	Mouse-ear Chickweed	32	Brush Pile N
Caryophyllaceae	*Paronychia erecta*	Whitlow-wort	136	Back Dune S
Caryophyllaceae	*Paronychia erecta*	Whitlow-wort	129	Lake Slope S
Carypohyllaceae	*Paronychia rugellii*	Sandsquares		
Chenopodiaceae	*Atriplex pentandra*	Seabeach Atriplex		
Chrysobalanaceae	*Licania michauxii*	Gopher Apple		
Cistaceae	*Helianthemum arenicola*	Rockrose	17	Lake Slope S
Cistaceae	*Helianthemum corymbosum*	Rock Rose		
Clethraceae	*Clethra alnifolia*	Sweet Pepper Bush		
Commelinaceae	*Commelina erecta*	Dayflower	181	Lake Slope S
Commelinaceae	*Tradescantia hirsutiflora*	Spiderwort	28	Lake Shore N
Commelinaceae	*Tradescantia ohiensis*	Common Spiderwort	7	Entrance Area
Convolvulaceae	*Calystegia sepium*	Hedge Bindweed	206	Path to Beach S
Convolvulaceae	*Cuscuta sp.*	Dodder	127	Lake Shore S
Convolvulaceae	*Ipomoea imperati*	Beach Morning-glory	171	Lake Slope S
Convolvulaceae	*Ipomoea quamoclit*	Cypress Vine	217	FW Marsh S
Convolvulaceae	*Ipomoea sagittata*		205	Path to Beach S
Convolvulaceae	*Ipomoea trichocarpa*	Morning-glory	149	Wet ditch S
Convolvulaceae	*Jacquemontia tamnifolia*		214	Hwy 98 ROW S
Cupressaceae	*Juniperus salicicola*	Southern Red Cedar		
Cyperaceae	*Bulbostylis ciliatifolia*		242	FW Marsh S
Cyperaceae	*Carex albolutescens*		157	FW Marsh S
Cyperaceae	*Carex glaucescens*		84	West Boundary S
Cyperaceae	*Cladium jamaicense*	Sawgrass	192	Lake Shore N
Cyperaceae	*Cyperus erythrorhizos*		224	FW Marsh S
Cyperaceae	*Cyperus globulosus*		184	Lake Shore S
Cyperaceae	*Cyperus lecontei*		124	Lake Shore S
Cyperaceae	*Cyperus odoratus*		298	Path to Lake N
Cyperaceae	*Cyperus polystachyos*		201	Path to Beach S
Cyperaceae	*Cyperus retrorsus*		241	Hammock Trail S
Cyperaceae	*Cyperus surinamensis*		163	FW Marsh S
Cyperaceae	*Dichromena latifolia*	White top Sedge		
Cyperaceae	*Eleocharis cellulosa*		222	FW Marsh S
Cyperaceae	*Eleocharis olivacea*		180	FW Marsh S
Cyperaceae	*Eleocharis robbinsii*		223	FW Marsh S
Cyperaceae	*Fimbristylis autumnalis*		200	FW Marsh S
Cyperaceae	*Fimbristylis castanea*		182	Lake Shore S
Cyperaceae	*Fimbristylis dichotoma*		237	Beach Path S
Cyperaceae	*Fuirena scirpoidea*	Umbrellagrass	86	FW Pond S
Cyperaceae	*Psilocarya nitens*	Baldrush	232	FW Marsh S
Cyperaceae	*Rhynchospora chalarocephala*	Beakrush	229	FW Marsh S
Cyperaceae	*Rhynchospora inundata*	Beakrush	164	FW Marsh S
Cyperaceae	*Rhynchospora megalocarpa*	Beakrush	138	Hammock Trail S
Cyperaceae	*Rhynchospora microcephala*	Beakrush	228	FW Marsh S
Cyperaceae	*Rhynchospora tracyi*	Beakrush	252	FW Marsh S
Cyperaceae	*Scleria reticularis*	Nutrush	225	FW Marsh S
Cyperaceae	*Scleria triglomerata*	Nutrush	130	Lawn
Cyrillaceae	*Cliftonia monophylla*	Black Titi		
Cyrillaceae	*Cyrilla racemiflora*	Ti-ti	285	NW Boundary
Droseraceae	*Drosera capillaris*	Pink Sundew	56	Canal N

Droseraceae	*Drosera filiformis*	Dew-threads		
Ebenaceae	*Diospyros virginiana*	Persimmon	185	Scrub NW
Empetraceae	*Ceratiola ericoides*	Rosemary	50	Scrub N
Ericaceae	*Gaylussacia dumosa*	Dwarf Huckleberry		
Ericaceae	*Gaylussacia mosieri*	Huckleberry		
Ericaceae	*Kalmia angustifolia (is hirsuta)*	Little Wicky		
Ericaceae	*Lyonia ferruginea*	Staggerbush	83	Boundary SW
Ericaceae	*Lyonia lucida*	Fetterbush	53	Scrub N
Ericaceae	*Vaccinium arboreum*	Sparkleberry	69	Hammock Trail S
Ericaceae	*Vaccinium corymbosum*	Highbush Blueberry	287	Boundary NW
Ericaceae	*Vaccinium darrowii*	Glaucous Blueberry		
Ericaceae	*Vaccinium myrsinites*	Shiny Blueberry		
Ericaceae	*Vaccinium stamineum*	Deerberry	44	Scrub S
Eriocaulaceae	*Eriocaulon compressum*	Hat Pins		
Eriocaulaceae	*Eriocaulon decangulare*	Hat Pins		
Eriocaulaceae	*Lachnocaulon engleri*	Engler's Bogbutton		FW Marsh S
Euphorbiaceae	*Acalypha gracilens*	Three-seeded Mercury	210	Hwy 98 ROW S
Euphorbiaceae	*Chamaecysce ammannioides*	Sand-dune Spurge	268	Beach Path S
Euphorbiaceae	*Chamaesysce hyssopifolia*	Eyebane	151	Hwy 98 ROW S
Euphorbiaceae	*Cnidoscolus stimulosus*	Tread Softly	78	Beach Dune S
Euphorbiaceae	*Croton argyranthemus*	Silver Croton	195	Lake Path S
Euphorbiaceae	*Croton capitatus*	Wolly Croton	267	Lake Path N
Euphorbiaceae	*Croton glandulosus*		194	Lake Path N
Euphorbiaceae	*Croton punctatus*	Beach Tea	193	Beach S
Euphorbiaceae	*Euphorbia cyathophora*		152	Hwy 98 ROW S
Euphorbiaceae	*Euphorbia floridana*	Spurge	54	Lake Shore N
Euphorbiaceae	*Sapium sebiferum*	Chinese Tallow Tree		
Fabaceae	*Albizia julibrissin*	Silk Tree; Mimosa	128	Lake Slope S
Fabaceae	*Baptisia lanceolata*	False Indigo		
Fabaceae	*Cassia nictitans*	Wild Sensitive Plant		
Fabaceae	*Cassia obtusifolia*	Coffe Weed; Sicklepod	246	Hwy 98 ROW S
Fabaceae	*Cassia obtusifolia*	Coffe Weed; Sicklepod	220	Hwy 98 ROW S
Fabaceae	*Cassia occidentalis*	Coffee Senna	266	Hwy 98 ROW S
Fabaceae	*Centrosema virginianum*	Butterfly-pea	135	Back Dune S
Fabaceae	*Cercis canadensis*	Redbud	3	Entrance Area
Fabaceae	*Chamaecrista fasciculata*	Partridge-pea	174	Lake Slope S
Fabaceae	*Crotalaria pallida*		208	FW Marsh S
Fabaceae	*Crotalaria rotundifolia*	Rabbit-bells	196	Lake Path N
Fabaceae	*Desmodium tortuosum*	Florida Beggarweed	257	Hwy 98 ROW S
Fabaceae	*Erythrina herbacea*	Cherokee Bean; Coral Bean	79	Lake Slope S
Fabaceae	*Galactia macreei*	Milk-pea	212	Hammock Trail S
Fabaceae	*Galactia microphylla*	Eastern Milkpea	303	Sand Dune
Fabaceae	*Indigofera hirsuta*	Hairy Indigo	252	Hwy 98 ROW S
Fabaceae	*Lupinus westianus*		103	Beach S
Fabaceae	*Rhynchosia cystisoides*	Pine Barren Pea	173	Lake Slope S
Fabaceae	*Schrankia microphylla*	Sensitive Briar		
Fabaceae	*Sesbania vesicaria*	Sesbania		
Fabaceae	*Strophosyles helvola*	Sand Bean	146	Hwy 98 ROW S
Fabaceae	*Trifolium campestre*	Low Hop Cloveer	5	Lawn
Fabaceae	*Trifolium incarnatum*	Crimson Clover	63	Hwy 98 ROW s

Fabaceae	*Vicia sativa*	Common Vetch	26	Entrance Area
Fagaceae	*Quercus chapmanii*	Chapman Oak	111	Scrub N
Fagaceae	*Quercus chapmanii*	Chapman Oak	289	Scrub N
Fagaceae	*Quercus falcata*	Southern Red Oak	110	Scrub N
Fagaceae	*Quercus falcata*	Southern Red Oak	190	Scrub N
Fagaceae	*Quercus geminata*	Sand Live Oak	112	Entrance Area
Fagaceae	*Quercus myrtifolia*	Myrtle Oak	288	Boundary NW
Fagaceae	*Quercus nigra*	Water Oak		
Fagaceae	*Quercus virginiana*	Live Oak	301	Hammock S
Gentianaceae	*Gentianna pennelliana*	Wiregrass Gentian		
Gentianaceae	*Sabatia stellaris*	Marsh Pink	167	Lake Shore S
Geraniaceae	*Geranium carolinianum*	Cranebill	20	Lawn
Guttiferae	*Hypericum crux-andreae*	St. Andrew's Cross		
Guttiferae	*Hypericum galioides*	St. John's-wort	168	FW Marsh S
Guttiferae	*Hypericum reductum*	St. John's-wort		
Guttiferae	*Hypericum tetrapetalum*	St. John's-wort	76	Path to Hammock S
Guttiferae	*Triadenum virginicum*	Marsh St. John's-wort	250	FW Marsh S
Haemodoraceae	*Lachnanthes caroliniana*	Redroot	202	FW Marsh S
Iridaceae	*Sisyrinchium atlanticum*	Blue-eyed Grass	66	Lake Shore N
Iridaceae	*Sisyrinchium rosulatum*	Blue-eyed Grass		
Juglandaceae	*Carya glabra*	Pignut Hickory	121	Entrance Area
Juncaceae	*Juncus acuminatus*		230	FW Marsh S
Juncaceae	*Juncus coriaceus*		45	FW Marsh S
Juncaceae	*Juncus dichotomus*		85	Path to Beach S
Juncaceae	*Juncus diffusissimus*		161	FW Marsh S
Juncaceae	*Juncus marginatus*		158	FW Marsh S
Juncaceae	*Juncus megacephalus*		162	FW Marsh S
Juncaceae	*Juncus polycephalus*		227	FW Marsh S
Juncaceae	*Juncus roemarianus*	Needlerush; Blackrush	22	Path to Beach S
Juncaceae	*Juncus scirpoides*		226	FW Marsh S
Juncaceae	*Juncus scirpoides*		240	Beach Path S
Lamiaceae	*Calamintha coccinea*	Wild Sage		
Lamiaceae	*Conradina canescens*	Rosemary	6	Entrance Area
Lamiaceae	*Lamium amplexicaule*	Henbit	12	Lawn
Lamiaceae	*Salvia lyrata*	Lyre-leaved Sage	15	Lawn
Lamiaceae	*Stachys floridana*	Hedge Nettle	41	Cabin Area SW
Lamiaceae	*Teucrium canadense*	Wood Sage	175	Path to Bridge S
Lamiaceae	*Trichostema dichotomum*	Blue Curls	134	Path to Bridge S
Lauraceae	*Persea palustris*	Swamp Redbay	187	Edge of Scrub NW
Lauraceae	*Persea palustris*	Swamp Redbay	264	Edge of Scrub NW
Lauraceae	*Persia borbonia*	Red Bay		
Lauraceae	*Sassafras albidum*	Sassafras	186	Scrub NW
Lentibulariaceae	*Utricularia biflora*	Bladderwort	71	FW Marsh S
Lentibulariaceae	*Utricularia cornuta*	Horned Bladderwort	243	FW Marsh S
Lentibulariaceae	*Utricularia purpurea*	Purple Bladderwort		
Lentibulariaceae	*Utricularia subulata*	Bladderwort	55	Canal Edge N
Liliaceae	*Allium canadense*	Wild Onion	95	Hwy 98 ROW S
Loganiaceae	*Mitreola angustifolia*	Mitrewort	178	FW Marsh S
Loganiaceae	*Mitreola petiolata*	Mitrewort	221	FW Marsh S
Loganiaceae	*Polypremum procumbens*	Rustweed; Copperweed	153	Hwy 98 ROW S

Lythraceae	*Ammannia latifolia*	Toothcups	238	Path to Beach S
Lythraceae	*Lythrum lineare*	Wand Loosestrife		Brackish Marsh S
Magnoliaceae	*Magnolia grandiflora*	Southern Magnolia	119	Hammock N
Magnoliaceae	*Magnolia virginiana*	Sweet Bay		
Malvaceae	*Hibiscus grandiflorus*	Swamp Hibiscus	204	Cabin Area SW
Malvaceae	*Kosteletzkya virginica*	Virginia Saltmarsh Mallow		Lake Shore S
Malvaceae	*Sida rhombifolia*	Indian Hemp	160	FW Marsh S
Melastomataceae	*Rhexia alifanus*	Meadowbeauty		
Melastomataceae	*Rhexia cubensis*	Meadow Beauty	215	FW Marsh S
Melastomataceae	*Rhexia lutea*	Yellow Meadowbeauty		
Menyanthaceae	*Nymphoides aquatica*	Floating Hearts		
Myricaceae	*Myrica cerifera*	Wax Myrtle	35	Lake Shore N
Myricaceae	*Myrica heterophylla*	Bayberry		
Nymphaeaceae	*Nuphar luteum*	Spatterdock		
Nymphaeaceae	*Nymphaea odorata*	White Water-lily	82	Pond, Beach Path
Oleaceae	*Osmanthus americanus*	Wild Olive	1	Entrance Area
Onagraceae	*Gaura angustifolia*	Southern Gaura	142	Hwy 98 ROW S
Onagraceae	*Ludwigia leptocarpa*		170	FW Marsh S
Onagraceae	*Ludwigia maritima*		169	FW Marsh S
Onagraceae	*Ludwigia microcarpa*		179	FW Marsh S
Onagraceae	*Ludwigia octovalvis*		148	FW Marsh S
Onagraceae	*Oenothera humifusa*	Seaside Evening-primrose	98	Foredune S
Onagraceae	*Oenothera laciniata*	Cut-leaved Evening-primrose	36	Trail to Lake N
Orchidaceae	*Habenaria repens*	Water Spider Orchid	251	FW Marsh S
Osmundaceae	*Osmunda cinnamomea*	Cinnamon Fern		
Osmundaceae	*Osmunda regalis*	Royal Fern	42	Canal SW
Oxalidaceae	*Oxalis corniculata*	Lady's Wood-sorrel	13	Lawn
Oxalidaceae	*Oxalis rubra*	Wood -sorrel	34	Brush Pile N
Phytolaccaceae	*Phytolacca americana*	Pokeweed; Pokeberry	125	Lake Slope S
Pinaceae	*Pinus clausa*	Sand Pine	104	Entrance Area
Pinaceae	*Pinus elliottii*	Slash Pine	286	Boundary NW
Plantaginaceae	*Plantago lanceolata*	English Plantain	108	Lawn
Plantaginaceae	*Plantago virginica*	Hoary Plantain	29	Brush Pile N
Plantaginaceae	*Plantago wrightiana*	Plantain	94	Hwy 98 ROW S
Poaceae	*Andropogon brachystachus*			
Poaceae	*Andropogon glomeratus*	Bushy Beardgrass		
Poaceae	*Andropogon virginicus*	Broomsedge		
Poaceae	*Aristida purpurescens*	Arrowfeather	263	Scrub N
Poaceae	*Aristida stricta*	Wiregrass		
Poaceae	*Arundinaria gigantea*	Cane	297	Lodge lawn
Poaceae	*Axonopus affinis*	Common Carpetgrass	137	Hammock Trail S
Poaceae	*Briza minor*	Little Quaking Grass	64	Hwy 98 ROW S
Poaceae	*Bromus unioloides*	Rescuegrass	88	Lake Shore S
Poaceae	*Cenchrus echinatus*	Southern Sandspur	299	Lake Shore S
Poaceae	*Cenchrus incertus*	Coast Sandspur	97	Lake Slope S
Poaceae	*Chasmanthium sessiliflorum*		283	Hammock S
Poaceae	*Chloris petraea*		10	Lawn
Poaceae	*Dactyloctenium aegypticum*	Crowfoot Grass	256	Hwy 98 ROW S
Poaceae	*Danthonia sericea*		101	Hammock Trail S
Poaceae	*Digitaria ciliaris*	Southern Crabgrass	113	Lake Shore Path S

Poaceae	*Echinochloa walteri*	Coastal Cockspur	165	FW Marsh S
Poaceae	*Eragrostis elliottii*	Elliott Lovegrass	280	Beach Path S
Poaceae	*Eragrostis secundiflora*	Red Lovegrass	209	Lake Shore Path S
Poaceae	*Eragrostis spectabilis*	Purple Lovegrass	236	Beach Path S
Poaceae	*Festuca arundinacea*	Tall Fescue	131	Entrance Area
Poaceae	*Festuca sp.*		132	Entrance Area
Poaceae	*Hordeum pusillum*	Little Barley	68	Lake Shore S
Poaceae	*Panicum (D.) oligosanthes*		67	Path to Bridge S
Poaceae	*Panicum (D.) oligosanthes*		102	Hammock Trail S
Poaceae	*Panicum (D.) oligosanthes*		46	Scrub N
Poaceae	*Panicum (D.) sp.*		47	Scrub N Slope
Poaceae	*Panicum (P.) amarum*	Beachgrass	235	Beach Path S
Poaceae	*Panicum (P.) repens*	Torpedo Grass	123	Lake Shore S
Poaceae	*Panicum (P.) virgatum*	Switchgrass	234	Beach Path S
Poaceae	*Panicum dichotomiflorum*	Fall Panicum		
Poaceae	*Paspalum notatum*	Bahiagrass	115	Lake Shore Path S
Poaceae	*Paspalum urvillei*	Vaseygrass	144	FW Marsh S
Poaceae	*Phragmites australis (communis)*	Common Reed	284	Lake Shore S
Poaceae	*Sacciolepis striata*	American Cupscale	159	FW Marsh S
Poaceae	*Schizachryrium maritima*	Gulf Bluestem		
Poaceae	*Setaria geniculata*	Knotroot Foxtail	183	Lake Shore S
Poaceae	*Spartina alterniflora*	Smooth Cordgrass		
Poaceae	*Spartina bakerti*	Sand Cordgrass	198	Lake Shore N
Poaceae	*Spartina patens*	Saltmeadow Cordgrass	199	Path to Beach S
Poaceae	*Sphenopholis obtusata*	Prairie Wedgescale	87	Lake Shore S
Poaceae	*Sporobolus indicus*	Smutgrass	21	Lake Shore S
Poaceae	*Sporobolus virginicus*	Coastal Dropseed		
Poaceae	*Stipa avenacea*	Blackseed Needlegrass	14	Lawn
Poaceae	*Uniola paniculata*	Sea Oats	239	Path to Beach S
Poaceae	*Vulpia octoflora*	Common Sixweeksgrass	89	Lake Slope S
Polygalaceae	*Polygala lutea*	Yellow Thimbles		
Polygalaceae	*Polygala nana*	Wild Bachelor's Button		
Polygonaceae	*Polygonella macrophylla*	Large-leaved Jointweed	281	Hammock Trail S
Polygonaceae	*Polygonella polygama*	October Flower	300	Hammock Trail S
Polygonaceae	*Polygonum hydropiperoides*	Wild Water-pepper	81	FW Pond, Beach S
Polygonaceae	*Rumex hastatulus*	Sourdock	8	Lawn
Polypodiaceae	*Polypodium polypodioides*	Resurrection Fern		
Polypodiaceae	*Pteridium aquilinum*	Bracken Fern	188	Scrub N
Pontedariaceae	*Pontedaria cordata*	Pickerel Weed		
Portulacaceae	*Portulaca pilosa*	Pink Purslane	219	FW Marsh S
Rosaceae	*Crataegus flava*	Hawthorne		
Rosaceae	*Rubus cuniefolius*	Sand Blackberry		
Rosaceae	*Rubus trivialis*	Dewberry	16	Lawn
Rubiaceae	*Cephalanthus occidentalis*	Buttonbush		
Rubiaceae	*Diodia teres*	Poor Joe	176	Lake Slope S
Rubiaceae	*Galium aparine*	Goosegrass; Spring Cleavers	40	Lawn
Rubiaceae	*Galium hispidulum*	Bedstraw	177	Lawn
Rubiaceae	*Galium tinctorium*	Cleavers	58	FW Marsh S
Rubiaceae	*Hedyotis procumbens*	Innocence	52	Scrub S
Rubiaceae	*Mitchella repens*	Partridge Berry	75	Hammock S

Rubiaceae	*Richardia brasiliensis*		154	Hwy 98 ROW S
Rutaceae	*Zanthoxylum clava-herculis*	Hercule's-club	92	Hammock Trail S
Salicaceae	*Salix caroliniana*	Coastal Plain Willow		
Salicaceae	*Salix niger*	Black Willow		FW Marsh S
Sapotaceae	*Bumelia lanuginosa*	Gum Bumelia	93	Hammock Trail S
Sarraceniaceae	*Sarracenia leucophylla*	White-top Pitcher Plant		
Saxifragaceae	*Itea virginica*	Virginia Willow	296	Boundary NW
Scrophulariaceae	*Bacopa monnieri*		244	FW Marsh S
Scrophulariaceae	*Linaria floridana*		18	Lawn
Scrophulariaceae	*Linaria floridana*		33	Lake Trail N
Scrophulariaceae	*Linaria texana*		57	Hwy 98ROW N
Scrophulariaceae	*Seymaria cassioides*	Black Senna	261	Lake Trail N
Scrophulariaceae	*Seymeria pectinata*		265	Scrub N
Scrophulariaceae	*Veronica arvensis*	Corn Speedwell	30	Brush Pile N
Smilacaceae	*Smilax auriculata*	Greenbriar	120	Brush Pile N
Smilacaceae	*Smilax bona-nox*	Catbrier		
Solanaceae	*Physalis angulata*	Ground-cherry	258	Hwy 98 ROW S
Solanaceae	*Physalis angustifolia*	Ground-cherry	27	Lake Shore N
Solanaceae	*Solanum nigrescens*	Black Nightshade	62	Hwy 98 ROW S
Typhaceae	*Typha latifolia*	Common Cattail	166	FW Marsh S
Valerianaceae	*Valerianella radiata*	Corn Salad	37	Hwy 98 ROW N
Verbenaceae	*Callicarpa americana*	Beauty Berry	290	Hammock Trail S
Verbenaceae	*Lantana camara*	Lantana	231	Cabin Area SW
Verbenaceae	*Phyla nodiflora*	Cape-weed; Carpet Weed	96	Cabin Area SW
Verbenaceae	*Verbena halei*	Vervain	48	Lake Trail N
Violaceae	*Viola lanceolata*	Bog White Violet		
Violaceae	*Viola primulifolia*	Primrose-leaved Violet	77	Lawn
Vitaceae	*Ampelopsis arborea*	Pepper Vine		
Vitaceae	*Parthenocissus quinquefolia*	Virginia Creeper	105	Entrance Area
Vitaceae	*Vitis aestivalis*	Summer Grape	109	Scrub N
Vitaceae	*Vitis aestivalis*	Summer Grape	139	Scrub N
Vitaceae	*Vitis aestivalis*	Summer Grape	90	Hammock Trail S
Vitaceae	*Vitis aestivalis*	Summer Grape	91	Hammock Trail S
Vitaceae	*Vitis rotundifolia*	Muscadine Grape	106	Scrub N
Xyridaceae	*Xyris baldwinii*	Yellow-eyed Grass		
Xyridaceae	*Xyris iridifolia*	Yellow-eyed Grass	143	FW Marsh S
Xyridaceae	*Xyris jupacai*	Common Yellow-eyed Grass	254	FW Marsh S
Xyridaceae	*Xyris smalliana*	Yellow-eyed Grass	255	FW Marsh S

\# = specimen number in the Camp Helen herbarium.

Plants without a specimen number are from the Unit Management Plan

Compilation of Vascular Plants in Addition to Those Reported by Keppner and Keppner 1998 from DRP.

Genus and Species	Common Name
Andropogon brachystachus	Andropogon (= Shortspike Bluestem)
Andropogon glomeratus	Bushy Beardgrass
Andropogon virginicus	Broomsedge
Ampelopsis arborea	Pepper Vine
Aristida stricta	Wiregrass
Asimina parviflora	Small-friuted Pawpaw
Atriplex pentandra	Seabeach Atriplex
Baptisia lanceolata	False Indigo
Borrichia frutescens	Sea Oxeye Daisy
Carphephorus odoratissimus	Deer's Tongue
Cassia nictitans	Wild Sensitive Plant
Cephalanthus occidentalis	Buttonbush
Chrysopsis gossypina ssp. cruiseana	Cruise's Golden Aster
Clethra alnifolia	Pepperbush
Cliftonia monophylla	Black Titi
Crataegus flava	Hawthorne
Dichromena latifolia	White Top Sedge
Drosera filiformis	Drosera (= Threadleaf Sundew)
Erigeron quercifolius	Southern Fleabane
Eriocaulon decangulare	Hat Pins
Eriocaulon compressum	Hat Pins
Eriogonum tomentosum	Buckwheat
Galactia microphylla	Milk-pea
Gaylussacia dumosa	Dwarf Huckleberry
Gaylussacia moserei	Huckleberry
Gentianella penneliana	Wiregrass Gentian
Halodule wrightii	Cuban Shoalgrass
Helianthemum corymbosum	Rockrose
Helianthus radula	Rayless Sunflower
Hypericum crux-andreae	St. Andrews Cross
Hypericum reductum	Hypericum (= Atlantic St. John's-wort)
Ilex coriacea	Large Gallberry
Ilex myrtifolia	Myrtleleaf Holly

Genus and Species	**Common Name**
Ilex opaca	American Holly
Iva imbricata	Seashore Elder
Juniperus salicicola	Southern Red Cedar
Kalmia hirsuta	Wicky (DRP lists *K. angustifolia*, but no such species could be located in the taxonomic literature available)
Licania michauxii	Gopher Apple
Liriodendron tulipifera	Tuliptree
Magnolia virginiana	Sweetbay
Myrica heterophylla	Bayberry
Nupharis lutreum (probably means Nuphar luteum)	Spatterdock
Nymphoides aquatica	Floating Hearts
Opuntia stricta	Prickly Pear Cactus
Oxydendron arboreum	Sourwood
Panicum dichotomiflorum	Fall Panicum
Paronychia rugelii	Sand Squares
Pinguicula planifolia	Chapman's Butterwort
Pinus palustris	Longleaf Pine
Persia borbonia	Red Bay
Pluchea odorata	Salt Marsh Fleabane
Polygala lutea	Yellow Thimbles
Polygala nana	Wild Bachelor's Button
Polygonella gracilis	Jointweed
Pontedaria cordata	Pickeral Weed
Quercus incana	Bluejack Oak
Quercus laevis	Turkey Oak
Quercus niger	Water Oak
Rhexia alifanus	Meadowbeauty
Rhexia lutea	Yellow Meadowbeauty
Rhododendron sp.	Azalea
Rhynchospora melanocarpa	Black rush
Rubus cuneifolius	Sand Blackberry
Ruppia maritima	Widgeongrass
Sabal palmetto	Cabbage Palm
Sagittaria lancifolia	Arrowhead
Salix caroliniana	Coastal Plain Willow

Genus and Species	**Common Name**
Sapium sebiferum	Chinese Tallow Tree
Sarrecenia leucophylla	White-top Pitcher Plant
Schizachyrium maritimum	Gulf Bluestem
Shrankia microphylla	Sensitive Briar
Sesbania versicaria	Sesbania
Sesuvium portulacastrum	Sea Purslane
Sisyrinchium rosulatum	Blue-eyed Grass
Solidago chapmanii	Goldenrod
Spartina alterniflora	Smooth Cordgrass
Taxodium distichum	Bald Cypress
Triodanis biflora	Venus' Looking Glass
Utricularia purpurea	Purple Bladderwort
Vaccinium darrowii	Glaucous Blueberry
Vaccinium myrsinites	Shiny Blueberry
Viola lanceolata	Bog White Violet
Xyris baldwinii	Yellow-eyed Grass

Appendix IV. Vertebrates Known from the Lake Powell Ecosystem

Appendix 13. List of Vertebrates that Possibly Occur in the Lake Powell Drainage Basin (DRP, 1997)

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
	BIRDS	
Spotted sandpiper	*Actitis macularia*	1
Red-winged blackbird	*Agelaius phoeniceus*	8,63
Wood duck	*Aix sponsa*	29,63
Anhinga	*Anhinga anhinga*	29,63
Great blue heron	*Ardea herodias*	29,63
Cedar waxwing	*Bombycilla cedrorum*	7,8,14
Red-shouldered hawk	*Buteo lineatus*	7,8,14
Red-tailed hawk	*Buteo jamaicensis*	7,8,14
Cattle egret	*Bubulcus ibis*	ALL
Green-backed heron	*Butorides striatus*	29,63
Sanderling	*Calidris alba*	1
Dunlin	*Calidris alpina*	1
Semipalmated sandpiper	*Calidris pusilla*	1
Chuck-will's widow	*Caprimulgus carolinensis*	8,81
Whip-poor-will	*Caprimulgus vociferus*	8,81
Northern cardinal	*Cardinalis cardinalis*	8,81
Great egret	*Casmerodius albus*	29,66
Turkey vulture	*Cathartes aura*	ALL
Hermit thrush	*Catharus guttatus*	7,8
Belted kingfisher	*Ceryle alcyon*	29,63
Chimney swift	*Chaetura pelagica*	81
Snowy plover	*Charadrius alexandrinus*	1,63

* = Non-Native Species

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
Piping plover	*Charadrius melodus*	1,63
Semipalmated plover	*Charadrius semipalmatus*	1
Killdeer	*Charadrius vociferus*	1
Northern harrier	*Circus cyaneus*	29,63
Yellow-billed cuckoo	*Coccyzus americanus*	8,81,82
Northern flicker	*Colaptes auratus*	7,8,14
Fish crow	*Corvus ossifragus*	29,63
Blue jay	*Cyanocitta cristata*	7,8,81
Yellow-rumped warbler	*Dendroica coronata*	8,14
Yellow-throated warbler	*Dendroica dominica*	8
Pine warbler	*Dendroica pinus*	8
Palm warbler	*Dendroica palmarum*	8,14
Gray catbird	*Dumetella carolinensis*	81,82
Pileated woodpecker	*Dryocopus pileatus*	8
Little blue heron	*Egretta caerulea*	29,63
Reddish egret	*Egretta rufescens*	63
Snowy egret	*Egretta thula*	29,63
Tricolored heron	*Egretta tricolor*	29,63
Acadian flycatcher	*Empidonax virescens*	8
American kestrel	*Falco sparverius*	8,25
Common loon	*Gavia immer*	63
Common yellowthroat	*Geothlypis trichas*	8
Bald eagle	*Haliaeetus leucocephalus*	ALL

* = Non-Native Species

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
Wood thrush	*Hylocichla mustelina*	8
Mississippi kite	*Ictinia mississippiensis*	ALL
Orchard oriole	*Icterus spurius*	8,81
Herring gull	*Larus argentatus*	1,63
Laughing gull	*Larus atricilla*	1,63
Ring-billed gull	*Larus delawarensis*	1,63
Bonaparte's gull	*Larus phiadelphia*	1,63
Red-bellied woodpecker	*Melanerpes carolinus*	8,81
Red-breasted merganser	*Mergus serrator*	29,63
Wild turkey	*Meleagris gallopavo*	8
Mockingbird	*Mimus polyglottos*	81,82
Black and white warbler	*Mniotilta varia*	8,14
Brown-headed cowbird	*Molothrus ater*	81,82
Great crested flycatcher	*Myiarchus crinitus*	8,14
Osprey	*Pandion haliaetus*	63
Northern parula	*Parula americana*	8,14
Carolina chickadee	*Parus carolinensis*	8,14
Tufted titmouse	*Parus bicolor*	8,14
Indigo bunting	*Passerina cyanea*	8,14
American white pelican	*Pelecanus erythrorhynchos*	63
Brown pelican	*Pelecanus occidentalis*	1,63
Double-crested cormorant	*Phalacrocorax auritus*	63
Rufous-sided towhee	*Pipilo erythrophthalmus*	8,14

* = Non-Native Species

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
Scarlet tanager	*Piranga olivacea*	7,8,14
Summer tanager	*Piranga rubra*	7,8,14
Blue-gray gnatcatcher	*Polioptila caerulea*	8,14
Sora	*Porzana carolina*	63
Purple martin	*Progne subis*	81
Prothonotary warbler	*Protonotaria citrea*	7,8,14
Boat-tailed grackle	*Quiscalus major*	63
Common grackle	*Quiscalus quiscalus*	81,82
Ruby-crowned kinglet	*Regulus calendula*	8,14
Black skimmer	*Rynchops niger*	1,63
Least tern	*Sterna antillarum*	1,63
Common tern	*Sterna hirundo*	1,63
Royal tern	*Sterna maxima*	1,63
Barred owl	*Strix varia*	8
Yellow-bellied sapsucker	*Sphyrapicus varius*	8,81
Chipping sparrow	*Spizella passerina*	81
Eastern phoebe	*Sayornis phoebe*	8
Greater yellowlegs	*Tringa melanoleuca*	1,63
Tree swallow	*Tachycineta bicolor*	1,29,63
Carolina wren	*Thryothorus ludovicianus*	7,8,14,81
American robin	*Turdus migratorius*	7,8,14,25,29,81
Brown thrasher	*Toxostoma rufum*	81,82
White-eyed vireo	*Vireo griseus*	7,8,14

* = Non-Native Species

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
Solitary vireo	*Vireo solitarius*	7,8,14
Red-eyed vireo	*Vireo olivaceus*	7,8,14
Hooded warbler	*Wilsonia citrina*	7,8,14
Mourning dove	*Zenaida macroura*	7,8,14,25,29,63,81
	MAMMALS	
Nine-banded armadillo	*Dasypus novemcinctus*	8,81
Oppossum	*Didelphis marsupialis*	8,81
Eastern woodrat	*Neotoma floridana*	8
White-tailed deer	*Odocoileus virginianus*	8,14
Cotton mouse	*Peromyscus gossypinus*	8,81
Raccoon	*Procyon lotor*	All
Gray fox	*Urocyon cinereoargenteus*	7,8,14
Eastern mole	*Scalopus aquaticus*	8
Eastern gray squirrel	*Sciurus carolinensis*	7,8,14,81
Hispid cotton rat	*Sigmodon hispidus*	8,81
Eastern cottontail	*Sylvilagus floridanus*	8,81
Marsh rabbit	*Sylvilagus palustris*	8,29,63
	REPTILES	
Florida cottonmouth	*Agkistrodon piscivorus*	8,63
American alligator	*Alligator mississippensis*	29,63
Green anole	*Anolis carolinensis*	7,8,14,81
Atlantic loggerhead turtle	*Caretta caretta*	1
Florida cooter	*Chrysemys floridana*	25,29,63

* = Non-Native Species

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
Six-lined racerunner	*Cnemidophorus sexlineatus*	ALL
Southern black racer	*Coluber constrictor*	7,8,81
Eastern diamondback rattlesnake	*Crotalus adamanteus*	8
Eastern chicken turtle	*Deirochelys reticularia*	29
Southern ringneck snake	*Diadophis punctatus*	7,8,14
Red rat, Corn snake	*Elaphe guttata*	8,14
Gray rat, Oak snake	*Elaphe obsoleta*	8,14
Southeastern five-lined skink	*Eumeces inexpectatus*	8,14
Broad-headed skink	*Eumeces laticeps*	ALL
Eastern mud snake	*Farancia abacura*	29
Eastern mud turtle	*Kinosternon subrubrum*	29,63
Banded water snake	*Nerodia fasciata*	29,63
Eastern glass lizard	*Ophisaurus ventralis*	8,14
Southern fence lizard	*Sceloporus undulatus*	8,81
Ground skink	*Scincella lateralis*	ALL
Gulf coast box turtle	*Terrapene carolina*	8,14,63
Dusky pygmy rattlesnake	*Sistrurus miliarius*	8,14
Eastern ribbon snake	*Thamnophis sauritus*	8,81
Eastern garter snake	*Thamnophis sirtalis*	8,81
	AMPHIBIANS	
Southern toad	*Bufo terrestris*	7,8,14,25,29,63
Eastern narrow-mouthed frog	*Gastrophryne carolinensis*	7,8,14,25,29
Gray treefrog	*Hyla chrysocelis*	25,29

* = Non-Native Species

COMMON NAME	SCIENTIFIC NAME	PRIMARY HABITAT (for all species)
Green treefrog	*Hyla cinerea*	25,29
Southern spring peeper	*Hyla crucifer*	25,29
Pine-woods treefrog	*Hyla femoralis*	8,81
Squirrel treefrog	*Hyla squirella*	8,25,29,81
Southeastern slimy salamander	*Pletodon glutinosus*	7,8,29
Southen chorus frog	*Pseudacris nigrita*	25,29
Little grass frog	*Pseudacris ocularis*	25,29
Bullfrog	*Rana catesbeiana*	25,29
Bronze frog	*Rana clamitans*	25,29
Southern leopard frog	*Rana utricularia*	25,29
Eastern spadefoot toad	*Scaphiopus holbrooki*	25,29

FNAI HABITAT CODES

1 = BEACH DUNE
7 = MARITIME HAMMOCK
8 = MESIC FLATWOODS
14 = SCRUB
25 = BASIN SWAMP
29 = DEPRESSION MARSH
63 = ESTUARINE TIDAL MARSH
81 = RUDERAL
82 = DEVELOPED
ALL = ALL COMMUNITY TYPES

* = Non-Native Species

Appendix V. Sediment Quality Data from Lake Powell

Summary of Sediment Quality Data. Means for each Parameter for all Stations.

Chemical	Brim (2000) actual ppm (dry weight)	Brim (2000) detect ppm	EPS (1985) total mg/kg wet weight	EPS (1985) elutriate mg/l
Acid volatile sulfides	130	30		
Aluminum	23,133.3	4		
Arsenic	7.5	0.2		
Boron	67.3	10.3		
Barium	19.4 (3.54)	0.05 (0.009)	12.1	<detect
Beryllium	0.64	0.12		
Cadmium	0.50 (0.09)	0.09 (0.037)	0.18	<detect
Chromium	35 (6.4)	1 (0.2)	3.0	<detect
Copper	15.0 (2.73)	1 (0.2)	1.95	--
Iron	16900	0.87		
Mercury	0.08	0.05	--	<detect
Magnesium	81.66	0.06		
Manganese	71.7	0.3		
Molybdemum	6.83	0.5		
Nickel	12.3 (2.27)	0.8 (0.17)	2.26	--
Lead*****	55.3 (9.93)	3.0 (0.57)	7.57	<detect
Selenium	1.47	0.1		
Silver			<detect	<detect
Strontium	81.5	0.02		
Vanadium	32.0	0.6		
Zinc	57.2 (10.4)	0.2 (0/037)	12.05	<detect
2.6.-dimethylnaphthalene	0.0717792	0.0539395		
C2-naphthalenes	0.0573759	0.0539395		
anthracene******	0.1358025	0.0617284		
benzo(b)fluoranthene	0.1908625	0.0539395		
benzo(e)pyrene	0.0921469	0.0551361		
benzo(g,h,i)perylene	0.0800694	0.0539395		

benzo(k)fluoranthene	0.0740741	0.0617284		
chrysene	0.0970874	0.0485437		
fluoranthene	0.1699029	0.0485437		
indeno(1,2,3,-cd)pyrene	0.4132322	0.0539395		
perylene	0.0989485	0.0539395		
phenanthrene	0.1296296	0.0617384		
pyrene	0.1893204	0.0485437		

< = below detection limit
* = exceeds the effects range low (ERL) sediment quality guideline in Long et al. (1995) at 2 stations.
** = exceeds the effects range low (ERL) sediment quality guidelines in Long et al. (1995) at one station.

Appendix VI. Dioxin Data from Lake Powell Sediments

Table 4. Calculation of Dioxin TCDD Toxicity Equivalents for Single Sediment Sample from Lake Powell in 1997 from Brim (2000).

Analyte	Parts per Trillion	Toxicity Factor	Toxicity Equivalent
2378-TCDD	0.5	1	0.5
12378-PeCDD	0	0	0
123478-HxCdd	3.9	0.1	0.39
123678-HxCDD	5.8	0.1	0,58
123789-HxCdd	16	0.1	1.6
1234678-HpCDD	188	0.01	1.88
OCDD	2490	0.001	2.49
2378-TCDF	3/7	0.1	0.37
12378-PeCDF	0	0	0
23478-PeCDF	0.66	0.5	0.33
123478-HxCDF	1.3	0.1	0.13
123678-HxCDF	0.65	0.1	0.065
234678-HxCDF	1.3	0.1	0.13
123789-HxCDF	0	0	0
1234678-HpCDF	8.7	0.01	0.087
1234789-HpCDF	0	0	0
OCDF	10.9	0.001	0.0109
Total 2378-TCDD Equivalents			8.5629

Appendix VII. Icthyoplankton Known from Lake Powell

Appendix 8. Ichthyoplankton Summary from EPS (1985).

Common Name	Genus and Species	Average number/10 min. Trawl
Gulf Menhaden	*Brevoortia patronus*	0.06
Bay Anchovy	*Anchoa mitchelli*	2677.1
Tidewater Silverside	*Menidia peninsulae*	1.16
Gulf Pipefish	*Syngnathus scovelli*	0.13
Silver Perch	*Bairdiella chrysura*	0.15
N/A	*Menticirrus sp.*	0.34
N/A	Sciaenidae	0.29
Spotted Seatrout	*Cynoscion nebulosus*	0.84
Pinfish	*Lagodon rhomboides*	0.13
N/A	Blennidae	18.95
Frillfin Goby	*Bathygobius soporata*	21.20
Code Goby	*Gobiosoma robustum*	9.28
Clown Goby	*Microgobius gulosus*	1,88
N/A	Gobiidae	2.97
Lined Sole	*Achirus lineatus*	0.10
Unidentified	*N/A*	25.60

Appendix VIII. Finfish Known from Lake Powell

Combined List of Finfish Caught in Lake Powell
(EPS, 1985 & NMFS & FWS (1985).

Common Name	Scientific Name	Study
Lined Sole	*Achirus lineatus*	EPS
Alabama Shad	*Alosa alabamae*	NF
Skipjack Herring	*Alosa chrysochloris*	EPS
Unicorn Filefish	*Aluterus monoceros*	EPS
Orange Filefish	*Aluterus schoepfi*	EPS
Bay Anchovy	*Anchoa mitchilli*	EPS, NF
Flat Anchovy	*Anchoviella perfasciata*	EPS
American Eel	*Anguilla rostrata*	NF
Sheepshead	*Archosargus probatocephalus*	EPS
Sea Catfish	*Arius felis*	EPS, NF
Silver Perch	*Bairdiella chrysura*	EPS, NF
Frillfin Goby	*Bathygobius soporator*	EPS (ichthyoplankton)
Gulf Menhaden	*Brevoortia patronus*	EPS, NF
Atlantic Menhaden	*Brevoortia tyrannus*	NF
Yellow Jack	*Caranx bartholomaei*	NF
Jack Crevalle	*Caranx hippos*	EPS, NF
Horse-eye Jack	*Caranx latus*	EPS, NF
Atlantic Bumper	*Chloroscombrus chrysurus*	EPS
Sand Seatrout	*Cynoscion arenarius*	EPS
Spotted Seatrout	*Cynoscion nebulosus*	EPS, NF
Sheepshead Minnow	*Cyprinodon variegatus*	NF
Atlantic Stingray	*Dasyatis sabine*	EPS
Spinycheek Sleeper	*Eleotris pisonis*	EPS
Ladyfish	*Elops saurus*	EPS, NF
Fringed Flounder	*Etropis crossotus*	EPS

Common Name	Scientific Name	Study
Spotfin Mojarra	*Eucinostomus argenteus*	EPS, NF
Silver Blenny	*Eucinostomus gula*	EPS, NF
Longnose Killifish	*Fundulus similis*	EPS, NF
Gulf Killifish	*Fundulus grandis*	EPS, NF
Mosquitofish	*Gambusia affinis*	EPS
Darter Goby	*Gobioellus boleosoma*	EPS
Naked Goby	*Gobiosoma boscii*	EPS
Code Goby	*Gobiosoma robustum*	EPS
Scaled Sardine	*Harengula jaguana*	EPS
Pinfish	*Lagodon rhomboides*	EPS, NF
Spot	*Leiostomus xanthurus*	EPS, NF
Spotted Gar	*Lepisosteus oculatus*	NF
Longnose Gar	*Lepisosteus osseus*	EPS
Rainwater Killifish	*Lucania parva*	EPS, NF
Gray Snapper	*Lutjanus griseus*	EPS, NF
Tidewater Silverside	*Menidia peninsulae*	EPS, NF
Clown Goby	*Microgobius gulosus*	EPS
Atlantic Croaker	*Micropogon undulatus*	EPS, NF
Largemouth Bass	*Micropterus salmoides*	EPS
Planehead Filefish	*Monacanthus hispidus*	EPS
Striped Mullet	*Mugil cephalus*	EPS, NF
Silver Mullet	*Mugil curema*	EPS
Leather Jacket	*Oligoplites saurus*	EPS, NF
Gulf Toadfish	*Opsanus beta*	EPS
Atlantic Threadfin Herring	*Opisthonema oglinum*	NF
Pigfish	*Orthopristis chrysoptera*	EPS, NF
Gulf Flounder	*Paralichthys albigutta*	EPS, NF
Southern Flounder	*Paralichthys lethostigma*	EPS
Broad Flounder	*Paralichthys squamilentus*	EPS

Common Name	Scientific Name	Study
Gulf Butterfish	*Paprilus burti*	EPS
Sailfin Molly	*Poecilla latipinna*	EPS
Black Drum	*Pogonis cromis*	EPS
Atlantic Threadfin	*Polydactylus octonemus*	EPS
Spanish Sardine	*Sardinella anchovia*	EPS
Red Drum	*Sciaenops ocellata*	EPS, NF
Chub Mackerel	*Scomber japonicus*	EPS
Spanish Mackerel	*Scomberomorus maculatus*	EPS
Cero Mackerel	*Scomberomorus regalis*	NF
Lookdown	*Selene vomer*	EPS
Barracuda	*Sphryaena barracuda*	EPS, NF
Northern Sennet	*Sphyraena borealis*	NF
Guachancho	*Sphyraena guachancho*	EPS
Atlantic Needlefish	*Strongylura marina*	EPS, NF
Redfin Needlefish	*Strongylura notata*	NF
Timuca Needlefish	*Strongylura timuca*	NF
Blackcheek Tonguefish	*Symphurus plagiusa*	EPS, NF
Dusky Pipefish	*Syngnathus floridae*	NF
Chain Pipefish	*Syngnathus louisianae*	EPS
Gulf Pipefish	*Syngnathus scovelii*	EPS
Inshore Lizardfish	*Synodus foetens*	EPS, NF
Florida Pompano	*Trachinotus carolinus*	EPS, NF
Permit	*Trachinotus falcatus*	EPS
Hogchoker	*Trinectes maculatus*	EPS
Southern Hake	*Urophycis floridanus*	EPS, NF

Total of 79 species in 59 genera.

Appendix IX. Macrobenthic Infauna from Lake Powell

Macrobenthic Infauna from EPS (1985). A Compilation of Tables 11 & 12 from EPS, 1985.

Station Designations

Species	**Total specimens**	A	B	C	D	E	G1	G2	G3	G4	G5	G6
Oligochaeta	183						X	X	X	X	X	X
Polychaeta:												
Amphictereis gunneri floridus	162		X		X	X	X	X	X	X	X	X
Arenicola cristata	340		X		X	X	X	X	X	X	X	X
Armandia agilis	11	X							X			
Armandia maculata	6			X				X	X	X		
Branchioasychis americana	2							X	X			
Brania clavata	262						X	X	X	X	X	X
Capitella capitata	140	X	X		X		X	X	X	X	X	X
Capitellides jonesi	2 (Not in Table 12)											
Cistenides gouldii	25	X		X	X	X	X	X	X	X	X	X
Diopatra cuprea	1											X
Eteone heteropoda	12	X				X		X	X	X	X	X
Fabricia sp.	409						X	X	X	X	X	X
Glycinde solitaria	1							X				
Haploscoloplos foliosus	100			X			X	X	X	X	X	X
Haploscoloplos fragilis	3	X										
Haploscolplos robustus	1							X				
Heteromastus filiformis	13	X				X	X	X		X		X
Hydroides dianthus	1											X
Laeonereis culveri	31	X				X	X	X			X	
Loandalia fauveli	24	X				X	X			X	X	X
Magelona pettiboneae	8	X				X		X				X
Mediomastus californiensis	1							X				
Melinna maculata	23						X	X	X		X	X

Species	**Total specimens**	A	B	C	D	E	G1	G2	G3	G4	G5	G6
Neanthes succinea	186	X			X		X		X	X	X	X
Ophelia sp.	1	X										
Parahesione luteola	12							X		X		
Paraonis fulgens	1	X										
Phyllodoce arenae	3				X					X		
Polydora ligni	103	X			X		X			X	X	X
Polydora websteri	29											X
Prionospio heterbranchia	506	X				X	X	X	X	X	X	X
Scolelepis texana	2	X										
Sigambra bassi	12				X	X	X	X		X	X	X
Spio pettiboneae	2								X			
Spiochaetopterus costarum oculatus	17				X	X	X	X	X	X		
Streblospio benedicti	334	X	X	X	X		X	X	X	X	X	X
Syllides verrilli	37	X										
Crustacea:												
Amphipoda												
Ampelisca cf. abdita	12					X	X	X	X			
Amphilochus sp.	15						X					
Corophium sp.	2											
Cymadusa compta	80						X			X		X
Gammarus cf. mucronatus	171			X			X	X	X	X	X	X
Grandidierella bonneroides	257						X	X		X		X
Lepidactylus sp.	1								X			
Listriella sp.	1											X
Melita longisetosa	4						X					
Cumacea												
Almyracuma sp.	1							X				
Cyclapsis sp.	2							X				
Decapoda												
Callinectes sapidus	6						X					
Hippolyte pleuracantha	5						X					
Palemon floridanus	1									X		

Penaeus duorarum	2						X					
Processa vicina	1						X					
Isopoda												
Edotea triloba	2					X		X				
Erichsonella attenuata	119											
Mysidacea							X	X		X	X	X
Bowmaniella floridana	9				X			X	X		X	X
Mysidopsis bahia	8		X			X		X	X		X	
Taphromysis bowmani	1	X					X					
Tanaidacea												
Hargeria rapax	152						X			X	X	X
Chaetognatha undetermined	1							X				
Chordata:												
Branchiostoma floridae	24	X	X						X			
Echinodermata:												
Holothuroidea												
Leptosynapta sp.	30	X						X	X			
Mollusca:												
Gastropoda												
Acteocina canaliculata	97	X	X	X	X		X	X	X	X		X
Diastoma varium	163							X		X	X	X
Melanella sp.	1							X				
Mitrella lunata	3						X					
Nassarius vibex	1									X		
Neritina reclivata	6						X			X		
Nudibranchia undeterm.	3					X	X	X				
Odostomia sp.	65		X			X	X	X		X		X
Sayella hemphilli	1									X		
Pelecypoda:												
Amygdalum papyrium	86					X	X	X		X	X	X
Anomalocardia auberiana	377	X				X	X	X	X	X		X
Chione cancellata	3						X	X		X		
Ensis minor	1								X			

Laevicardium mortoni	16						X	X	X		X	X
Macoma tenta	1											X
Macoma sp.	4	X	X									
Musculus lateralis	1						X					
Parvalucina multilineata	14							X	X			
Tagelus plebeius	14	X				X	X					X
Tellina versicolor	9						X		X	X		X
Tellina sp.	18	X				X	X	X		X		X
Nematoda undetermined*	74						X	X		X	X	X
Nemertinea undetermined	78	X	X		X	X	X	X	X	X	X	X
Phoronida:												
Phoronis architecta	18					X			X	X		X
Platyhelminthes undetermined.	19	X					X		X	X		
Vertebrata:												
Pisces												
Microgobius gulosus	6						X			X	X	X

* There are a number of species of nematodes known from Lake Powell that have not been published. New species were described by Keppner from Lake Powell in a number of journals from 1986-1994. This list is included in Keppner (2002).

Payne and Butts (2001) added the Amphipods – *Haustorius* spp., *Ampelisca vadorum*,; the Annelida - *Leitoscolopios fragilis, Mediomastus ambiseta*, *Sigambra tentaculata, Pectinaria gouldi, Parandelia Americana, Hobsonia florida*; the isopod – *Edotea montosa*; the Mysidacean – *Mysidopsis almyra*; the Cumacean - *Oxyurostylis smithi*, the –; and the Pelecypods – *Rangia cuneata* and *Solen viridis*. Added February 2000 were the pelecypods - American Oyster, *Crassostrea virginica*, and the ribbed mussel, *Geukensia demissa*.

Appendix X. Cultural Resource Sites in the Lake Powell Area.

Site Name	Type of Site	General Location
Phillips Inlet Mound	prehistoric	Camp Helen
Camp Helen	**prehistoric**	**Camp Helen**
Camp Helen	**prehistoric**	**Camp Helen**
Courtney shell midden	**prehistoric**	**Sunset Pass**
Phillips Inlet Bridge West Bluff	**prehistoric**	**Camp Helen**
Lake Powell North Shore	**prehistoric**	**Medallist**
Bear Grass Midden	prehistoric	Medallist
Pork Chop Midden	prehistoric	Medallist
Fisherman's Bluff	20th century & prehistoric	Medallist
Petone Ridge	prehistoric	Medallist
Red Bug Pond	prehistoric	Medallist
Lake Powell Hotel	early 20th century	Medallist
Los Ninos Cementary	early 20th century	Medallist
(Camp Helen just north of bridge)	prehistoric	Camp Helen
Camp Helen #10	**prehistoric**	**Camp Helen**
The Lodge	**early 20th century**	**Camp Helen**
Guest Apartment	**early 20th century**	**Camp Helen**
Stable	**early 20th century**	**Camp Helen**
Maid & Butler House	**early 20th century**	**Camp Helen**
Kitchen	**early 20th century**	**Camp Helen**
4 Guest Cottages	**early 20th century**	**Camp Helen**
Old Codgers Pond	prehistoric	Medallist
Sea Witch	prehistoric	Medallist
Catface Trail	prehistoric	Medallist
Sandy Cut	prehistoric	Medallist
Mossy Knoll	prehistoric	Medallist
Heron Midden	prehistoric	Medallist
Middle of the Road	prehistoric	Medallist
Carhop	20th century & prehistoric	Medallist
Windmill House	early 20th century	Medallist
Deptford Beach (may = 796)	prehistoric	Medallist
(unknown)	prehistoric	Sunset Pass
Water tower & Pump House	early 20th century	Camp Helen
Shelter (overlook)	early 20th century	Camp Helen
Cook's Cottage	early 20th century	Camp Helen
Cathouse	early 20th century	Camp Helen

Appendix XI. DER Regulations and Questions and Answers from the 1991 OFW Document

Florida Department of Environmental Regulation

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Bob Martinez, Governor Dale Twachtmann, Secretary John Shearer, Assistant Secretary

FACTSHEET ABOUT OUTSTANDING FLORIDA WATERS

Authority: Section 403.061(27), Florida Statutes, grants DER the power to:

Establish rules which provide for a special category of water bodies within the state, to be referred to as "Outstanding Florida Waters", which shall be worthy of special protection because of their natural attributes.

Implementing Agency: All state water quality standards are adopted by the Environmental Regulation Commission for use by the Department of Environmental Regulation (DER). The Environmental Regulation Commission is a seven-member citizens' body appointed by the Governor.

Regulatory Significance: In general, DER cannot issue permits for direct pollutant discharges to OFWs which would lower ambient (existing) water quality or for indirect discharges which would significantly degrade the Outstanding Florida Water. Permits for new dredging and filling must be clearly in the public interest.

Factors Determining The Public Interest:

1. Whether the project will adversely affect the public health, safety, or welfare or property of others;

2. Whether the project will adversely affect the conservation of fish and wildlife, including endangered or threatened species, or their habitats;

3. Whether the project will adversely affect navigation or the flow of water or cause harmful erosion or shoaling;

4. Whether the project will adversely affect the fishing or recreational values of marine productivity in the vicinity of the project;

5. Whether the project will be of a temporary or permanent nature;

6. Whether the project will adversely affect or enhance significant historical and archaeological resources under the provisions of Sec. 267.061; and

7. The current condition and relative value of functions being performed by areas affected by the proposed activity. (Sec. 403.918(2), F.S.)

Some Exceptions to OFW Standards:

1. Permitted activities existing on the date of designation, which are "grandfathered" (except activities with Temporary Operating Permits).

2. Activities not regulated by DER, such as fishing, river setback ordinances, and boat speeds.

3. Restoration of seawalls at previous locations.

4. Non-commercial boat docks, on pilings, of less than 500 square feet.

5. Temporary lowering of water quality during construction activities (with special restrictions).

6. Activities to allow or enhance public usage, or to maintain pre-existing activities (with certain safeguards).

Waters in OFW Designation:

National Parks
National Wildlife Refuges
National Seashores
National Preserves
National Marine Sanctuaries and Estuarine Research Reserves
National Forests (certain waters)
State Parks & Recreation Areas
State Preserves and Reserves
State Ornamental Gardens and Botanical Sites
Environmentally Endangered Lands Program, Conservation and Recreation Lands Program, and Save Our Coast Program Acquisitions
State Aquatic Preserves
Scenic and Wild Rivers (both National and State)
"Special Waters"

"Special Waters" OFWs include 28 of Florida's 1700 rivers, several lakes and lake chains, several estuarine areas, and the Florida Keys:

Apalachicola River
Aucilla River
Blackwater River
Butler Chain of Lakes
Chipola River
Choctawhatchee River
Clermont Chain of Lakes
Crooked Lake
Crystal River
Estero Bay Tributaries
Florida Keys
Kingsley Lake & Black Creek (North Fork)
Lemon Bay Estuarine System
Little Manatee River
Lochloosa Lake
Myakka River (lower part)
Ochlockonee River
Oklawaha River
Orange Lake, the River Styx, and Cross Creek
Perdido River
Rainbow River
St. Marks River
Santa Fe River System
Sarasota Bay Estuarine System
Shoal River
Silver River
Suwannee River
Wacissa River
Wakulla River
Wekiva River
Withlacoochee Riverine and Lake System

Note: Actual rule language describing above water bodies is more complex. For further information, refer to Section 17-302.700(9)(i), Florida Administrative Code.

Requirements For a "Special Water" OFW Designation:

1. Rulemaking procedures pursuant to Chapter 120, F.S., and Chapter 17-102, F.A.C. shall be followed;

2. At least one fact-finding workshop shall be held in the affected area;

3. All local county or municipal governments and state legislators whose districts or jurisdictions include all or part of a water body proposed for Special Water designation shall be notified at least 60 days prior to the workshop in writing by the Secretary of DER;

4. A prominent public notice shall be placed in a newspaper of general circulation in the area of the proposed Special Water at least 60 days prior to the workshop;

5. An economic impact analysis, consistent with Chapter 120, shall be prepared which provides a general analysis of the impact on growth and development including such factors as impacts on planned or potential industrial, agricultural or other development or expansion; and

6. The Environmental Regulation Commission may designate a water of the State as a Special Water after making a finding that the waters are of exceptional recreational or ecological significance and a finding that the environmental, social, and economic benefits of the action outweigh the environmental, social, and economic costs (Section 17-302.700(5), Florida Administrative Code).

For More Information Contact:	Department of Environmental Regulation, Bureau of Surface Water Management at (904)487-0505 or SUNCOM 277-0505.

November 30, 1990

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Bob Martinez, Governor Dale Twachtmann, Secretary John Shearer, Assistant Secretary

OUTSTANDING FLORIDA WATERS

QUESTIONS AND ANSWERS

Some common questions about an Outstanding Florida Water (OFW) designation are answered here. For more information, please contact Eric Shaw, Janet Klemm, Marge Coombs, or Tom Swihart in Tallahassee (904/487-0505).

What is the basic intent of an OFW designation?

To prevent the lowering of existing water quality.

Does the present classification of the proposed waters already prevent the lowering of water quality?

No. For current water quality classifications such as Class II (Shellfish Propagation or Harvesting) and Class III (Recreation, Fish, and Wildlife), DER can legally issue permits to lower water quality down to the minimum standards for that classification, provided that such degradation is necessary or desirable under federal standards and under circumstances which are clearly in the public interest (Section 17-302.300(7), F.A.C.). The general minimum standards are intended to protect these uses but may not protect all species or be adequate for all water bodies. Class III and II waters have a smaller "safety margin" than Outstanding Florida Waters.

What activities would be affected by an OFW designation?

Only activities that require a DER permit would be affected, such as dredge and fill and pollutant discharge activities.

Would regulatory activities of all state and federal agencies be affected?

No. Only DER permitting activities are affected with the exception of some permits required by Water Management Districts that have been delegated stormwater management authority from DER.

What types of activities are not affected by an OFW designation?

Activities not regulated by DER, such as fishing, boating, diving, and river setback ordinances, are not affected. However, some indirectly associated activities, such as dredging and filling for new marinas, are subject to OFW standards.

Some activities, such as those for maintenance of existing facilities, activities to allow or enhance public usage, and temporary lowering of water quality during construction activities, are exempted from regular OFW criteria, if special safeguards are used.

Is an additional application needed to obtain a permit for an activity in an OFW?

No. An OFW designation affects only the criteria used in permitting decisions. It is not a new or separate permit process.

What effect does an OFW designation have on a pollutant discharge that currently has a DER permit?

Existing legal discharges are "grandfathered" and may continue without any new OFW requirements.

Some activities are exempt from DER permitting. Would exemptions still be possible with an OFW designation?

Yes. An OFW designation affects only activities which require a DER permit. Activities eligible for an exemption from DER permitting do not have any new requirements placed on them.

What regulations would new pollutant discharges be subject to?

There are separate requirements which must be met for direct and indirect discharges:

New direct pollutant discharges must not lower existing ambient water quality.

New indirect pollutant discharges (discharges to waters which influence OFWs, although not placed directly into an OFW) must not significantly degrade nearby Outstanding Florida Waters.

Permitted activities must also be "clearly in the public interest".

Are there stricter stormwater controls for OFWs?

Yes. Some activities which directly discharge stormwater to OFWs are required to retain or treat a larger amount of stormwater than facilities which discharge to non-OFW waters. Some Water Management Districts have been delegated stormwater permitting authority.

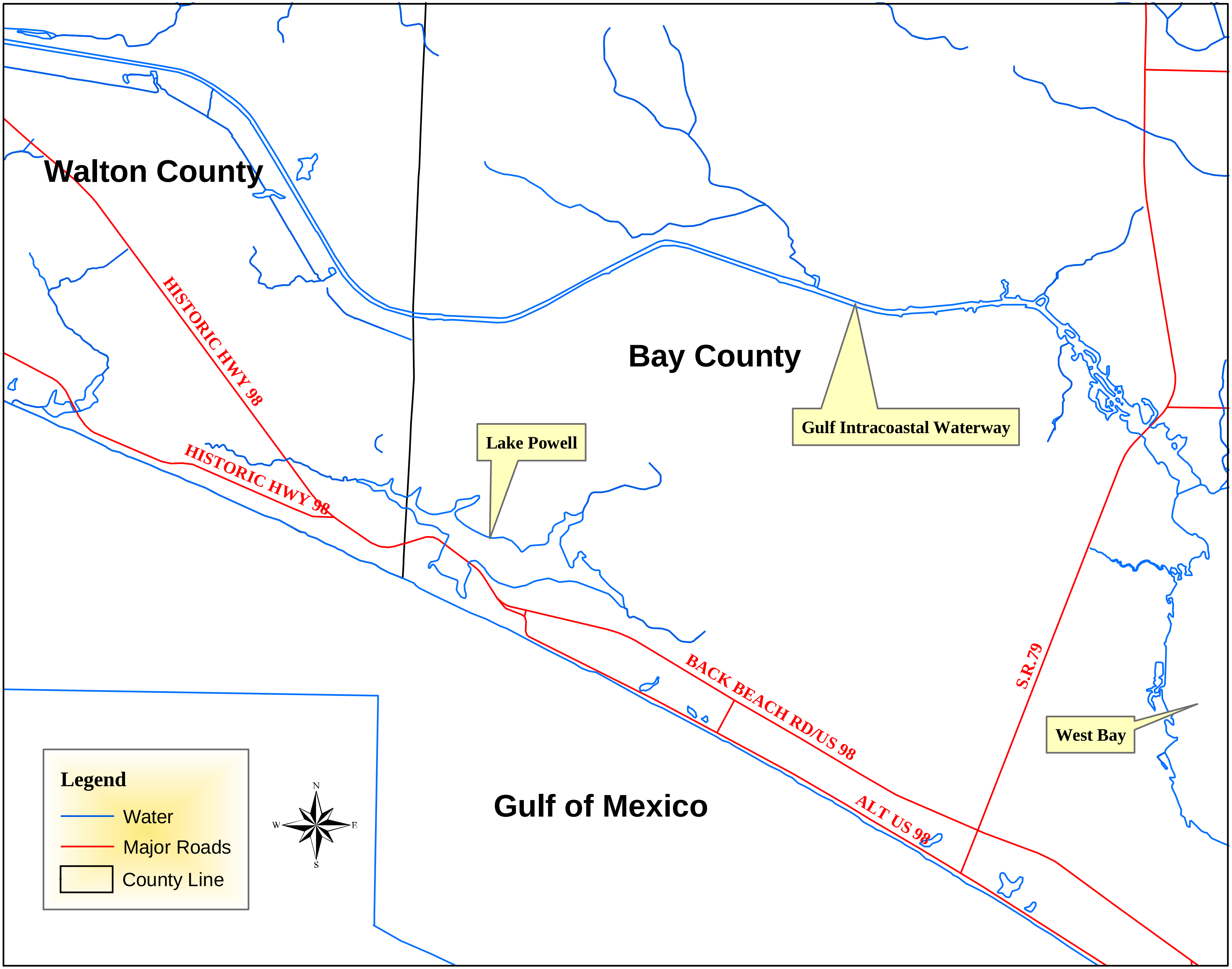
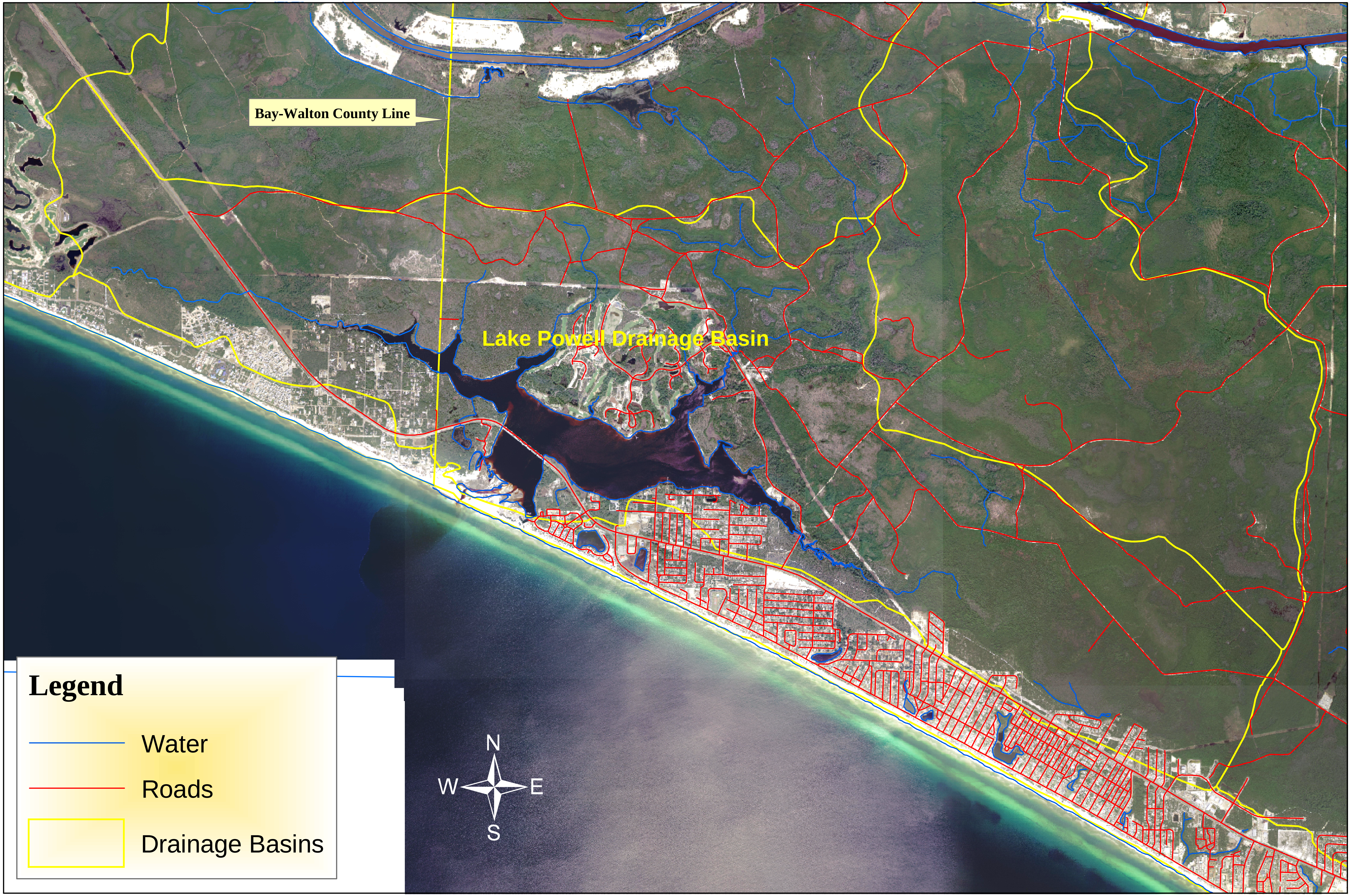


Figure 1. Location of Lake Powell

Figure 2. Lake Powell Drainage Basin (Ecosystem)



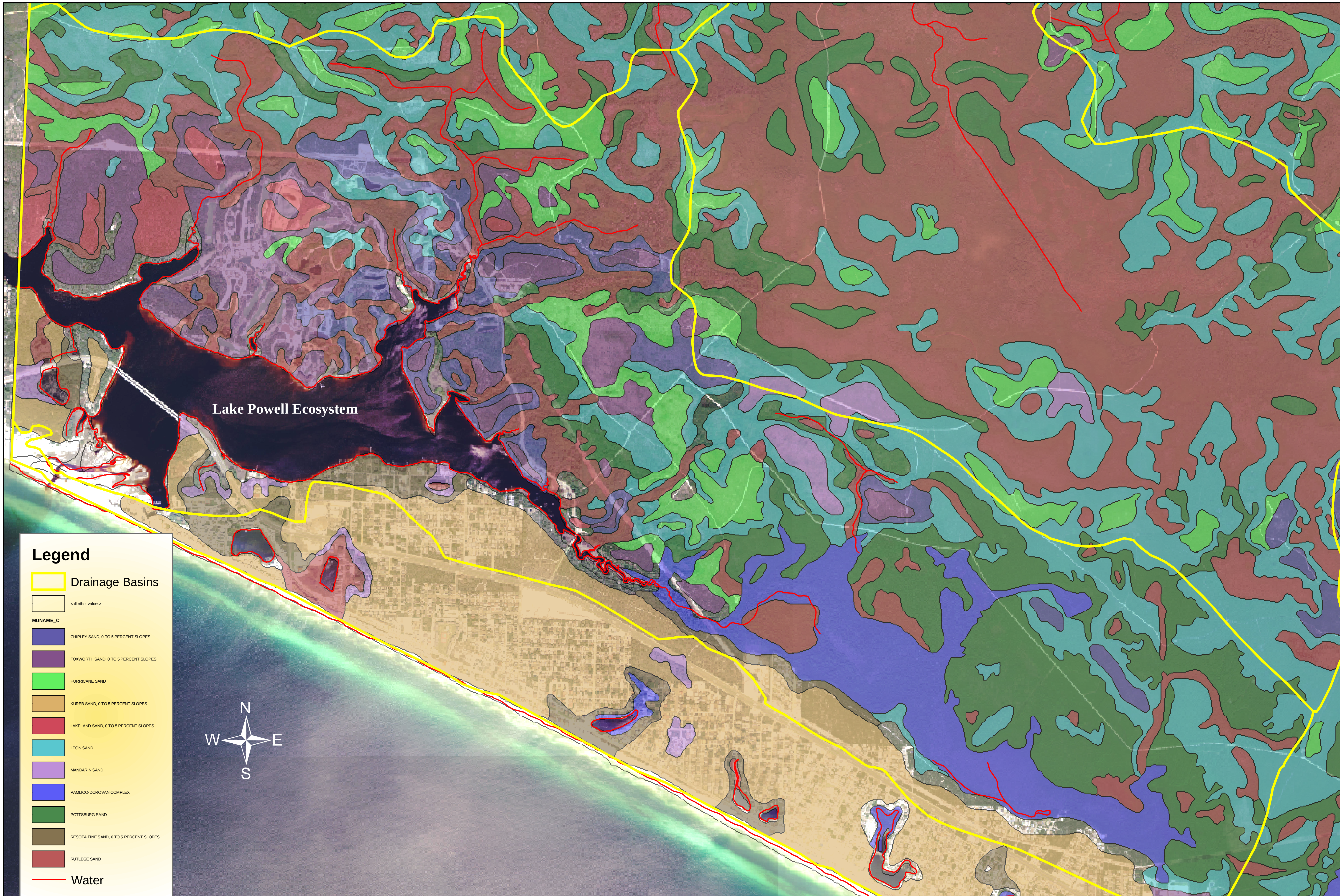


Figure 3. Lake Powell Ecosystem Soil Types, Bay County

Figure 4. Lake Powell Ecosystem Wetland (Hydric) Soil Types, Bay County

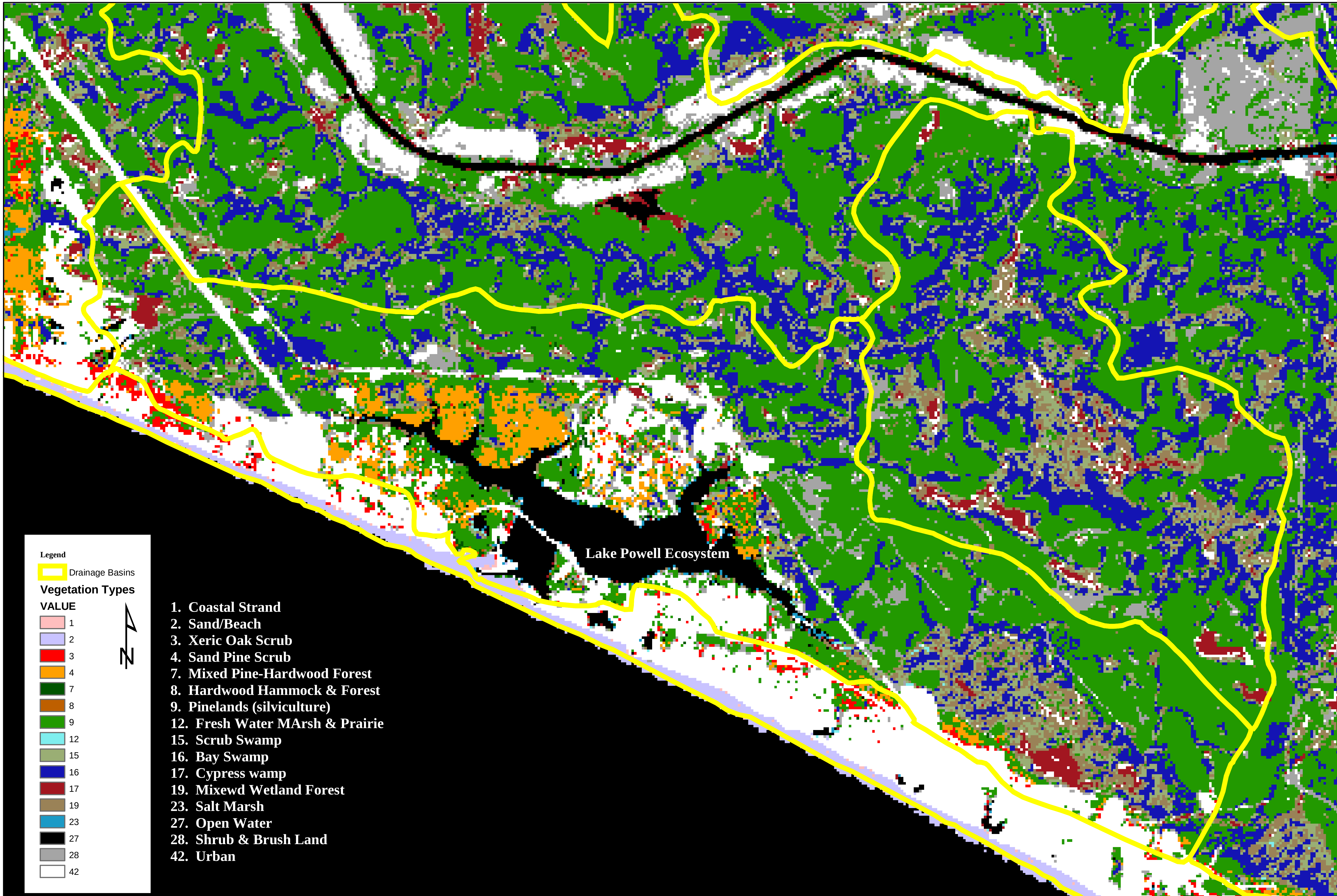


Figure 5. Vegetative Communities in the Lake Powell Ecosystem, FFWCC.

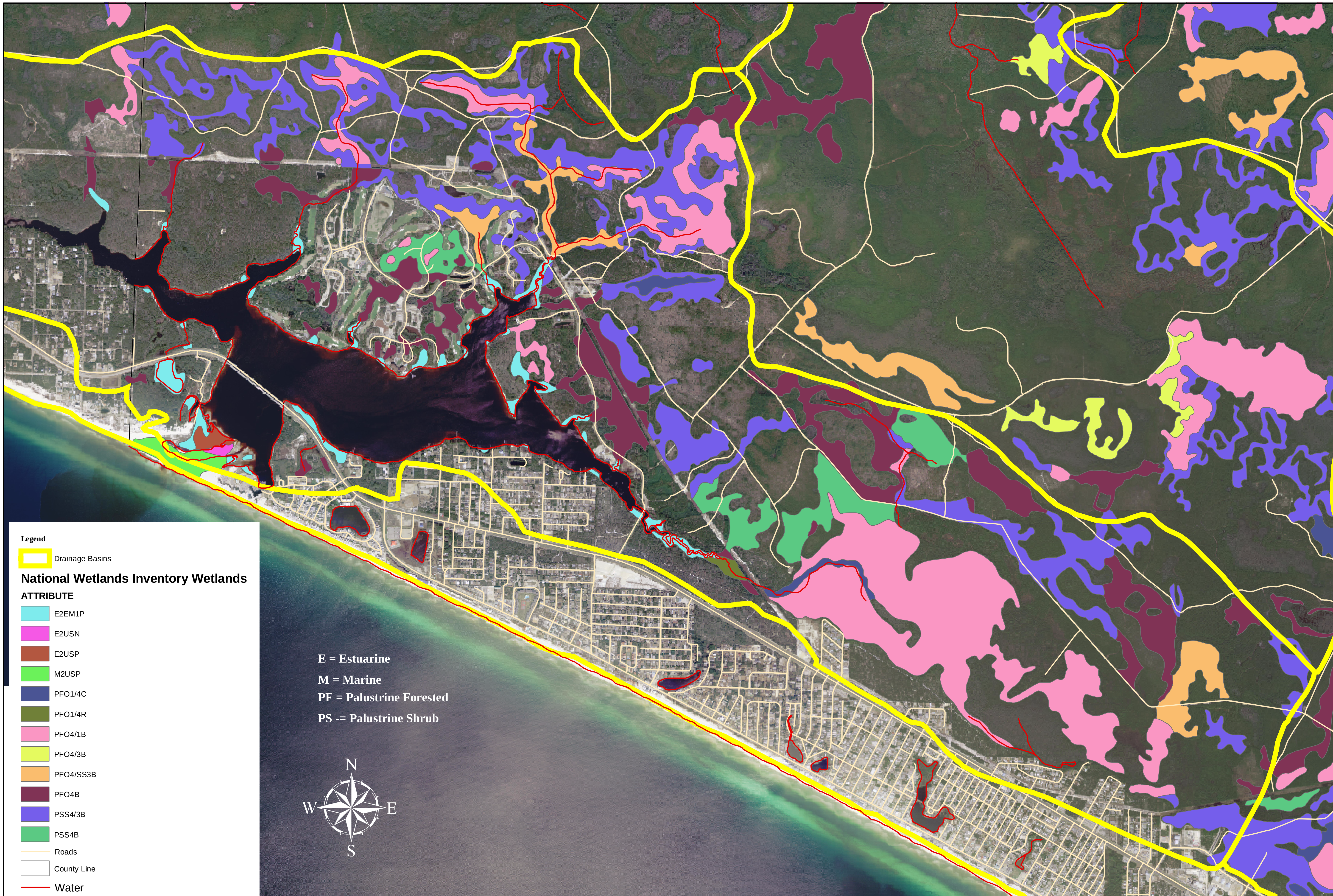


Figure 6. National Wetlands Inventory Communities, Lake Powell Ecosystem

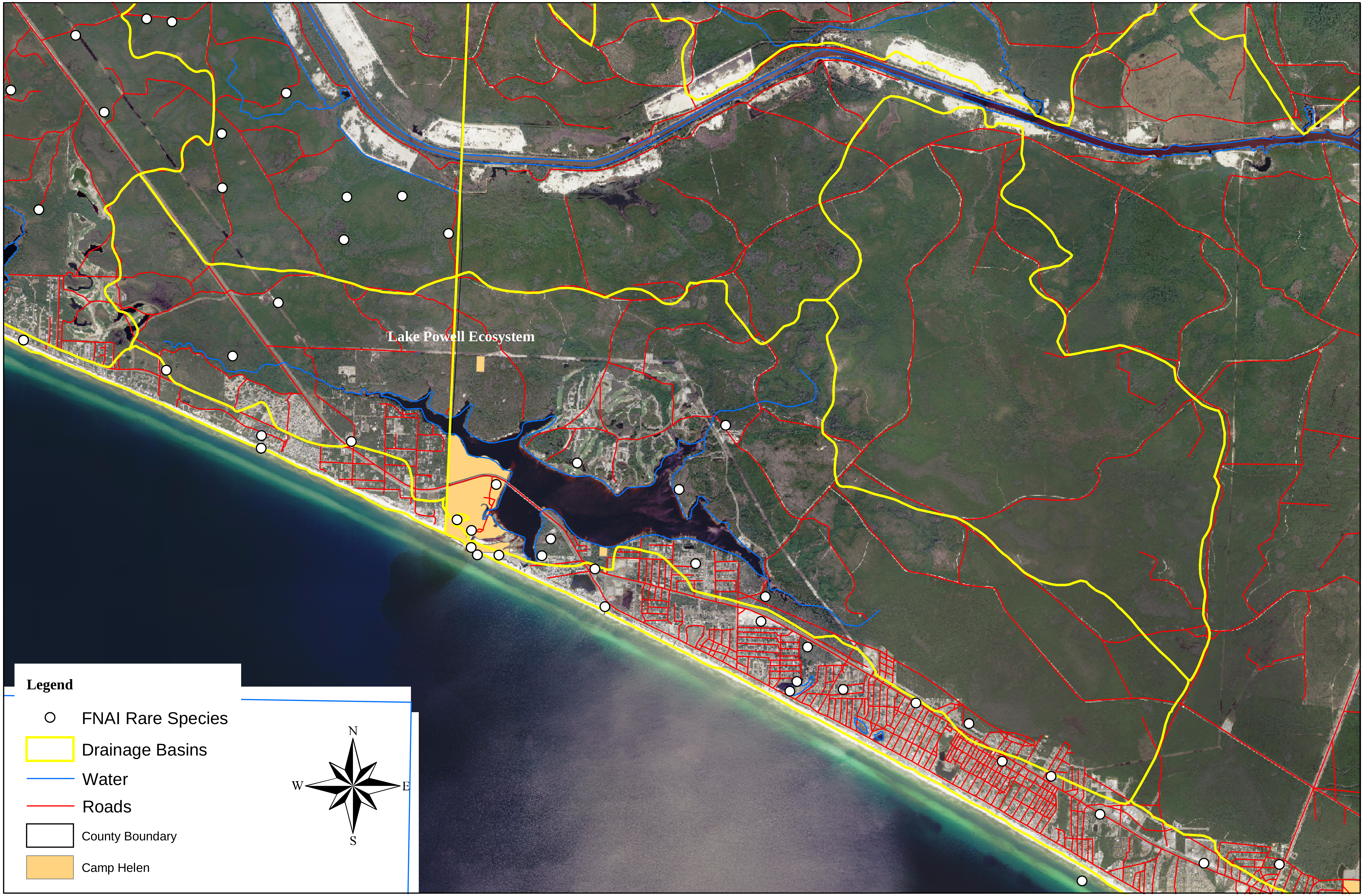


Figure 7. Florida Natural Areas Inventory Elements of Occurrence, Lake Powell Ecosystem

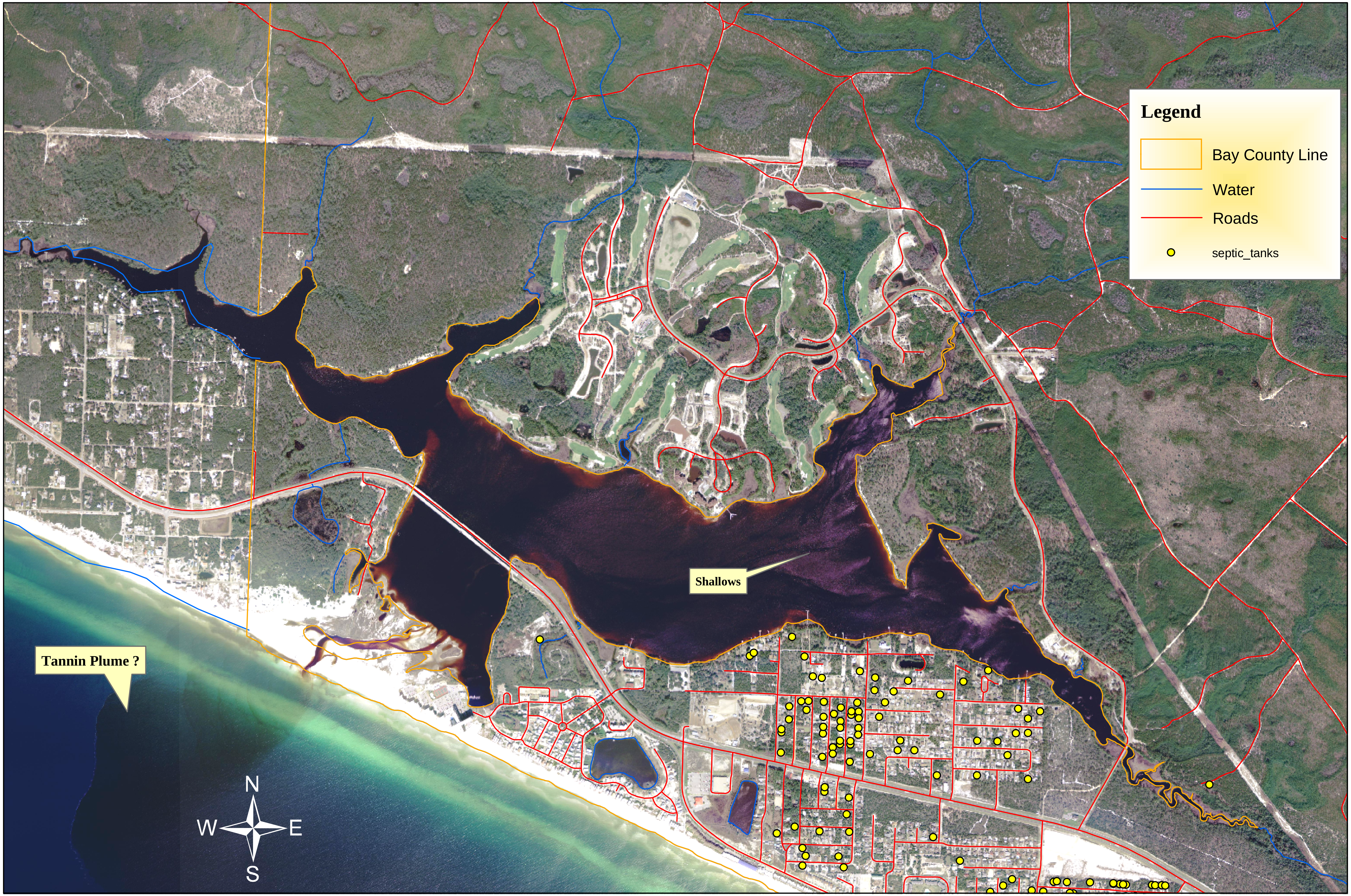
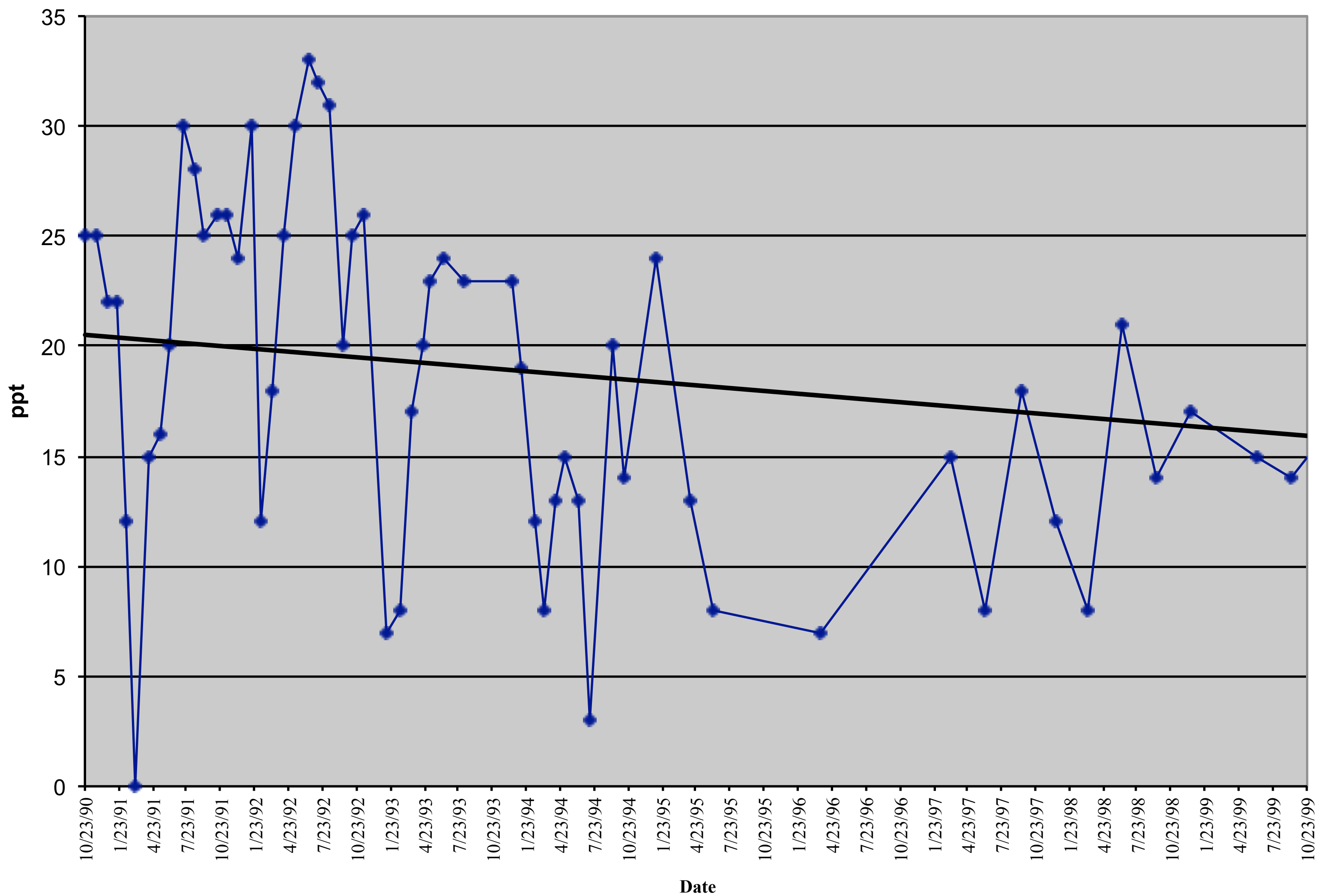


Figure 13. Lake Powell, 2004

Figure 16. Major Water Quality Sampling Stations

Figure 17. Surface Salinity Station 89, RMA



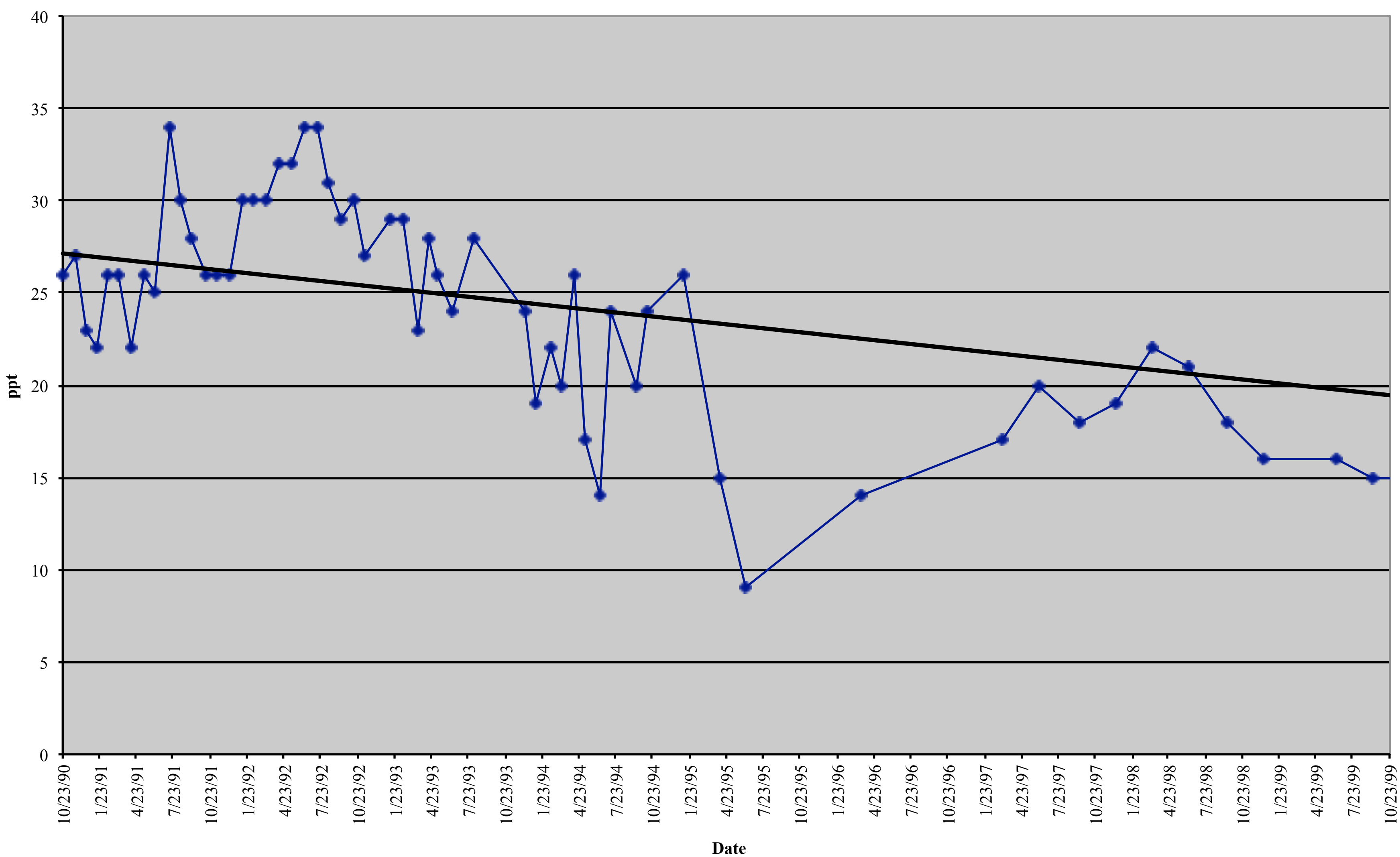
Lake Powell RMA Station 89, Salinity

Date	Surface Salinty	Bottom Salinity
10/23/90	25	26
11/21/90	25	27
12/20/90	22	23
1/14/91	22	22
2/11/91	12	26
3/7/91	0	26
4/12/91	15	22
5/12/91	16	26
6/9/91	20	25
7/14/91	30	34
8/11/91	28	30
9/8/91	25	28
10/13/91	26	26
11/10/91	26	26
12/8/91	24	26
1/12/92	30	30
2/9/92	12	30
3/8/92	18	30
4/12/92	25	32
5/10/92	30	32
6/14/92	33	34
7/12/92	32	34
8/9/92	31	31
9/13/92	20	29
10/11/92	25	30
11/8/92	26	27
12/13/02	25	28
1/10/93	7	29
2/14/93	8	29
3/21/93	17	23
4/18/93	20	28
5/9/93	23	26
6/13/93	24	24
8/8/93	23	28
10/16/03	21	25
11/14/03	23	24
12/12/93	23	24

Lake Powell RMA Station 89, Salinity

1/9/94	19	19
2/13/94	12	22
3/13/94	8	20
4/10/94	13	26
5/8/94	15	17
6/12/94	13	14
7/10/94	3	24
9/11/94	20	20
10/9/94	14	24
1/8/95	24	26
4/9/95	13	15
6/11/95	8	9
3/24/96	7	14
3/9/97	15	17
6/8/97	8	20
9/14/97	18	18
12/14/97	12	19
3/15/98	8	22
6/14/98	21	21
9/13/98	14	18
12/13/98	17	16
6/13/99	15	16
9/12/99	14	15
12/12/99	16	15

Figure 18. Bottom Salinity, Station 89, RMA



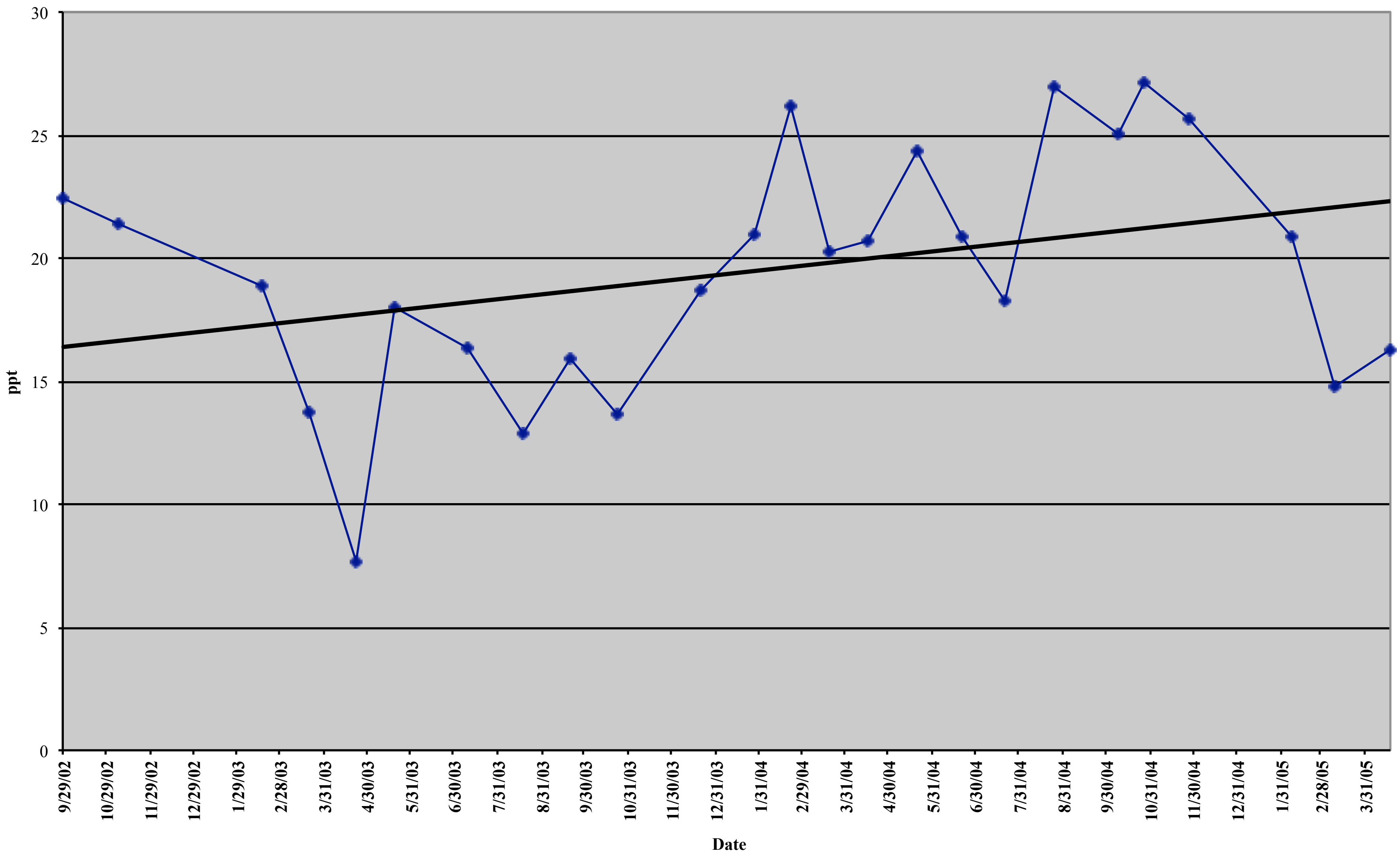
Lake Powell RMA Station 89, Salinity

Date	Bottom Salinity	Surface Salinty
10/23/90	26	25
11/21/90	27	25
12/20/90	23	22
1/14/91	22	22
2/11/91	26	12
3/7/91	26	0
4/12/91	22	15
5/12/91	26	16
6/9/91	25	20
7/14/91	34	30
8/11/91	30	28
9/8/91	28	25
10/13/91	26	26
11/10/91	26	26
12/8/91	26	24
1/12/92	30	30
2/9/92	30	12
3/8/92	30	18
4/12/92	32	25
5/10/92	32	30
6/14/92	34	33
7/12/92	34	32
8/9/92	31	31
9/13/92	29	20
10/11/92	30	25
11/8/92	27	26
12/13/02	28	25
1/10/93	29	7
2/14/93	29	8
3/21/93	23	17
4/18/93	28	20
5/9/93	26	23
6/13/93	24	24
8/8/93	28	23
10/16/03	25	21
11/14/03	24	23
12/12/93	24	23

Lake Powell RMA Station 89, Salinity

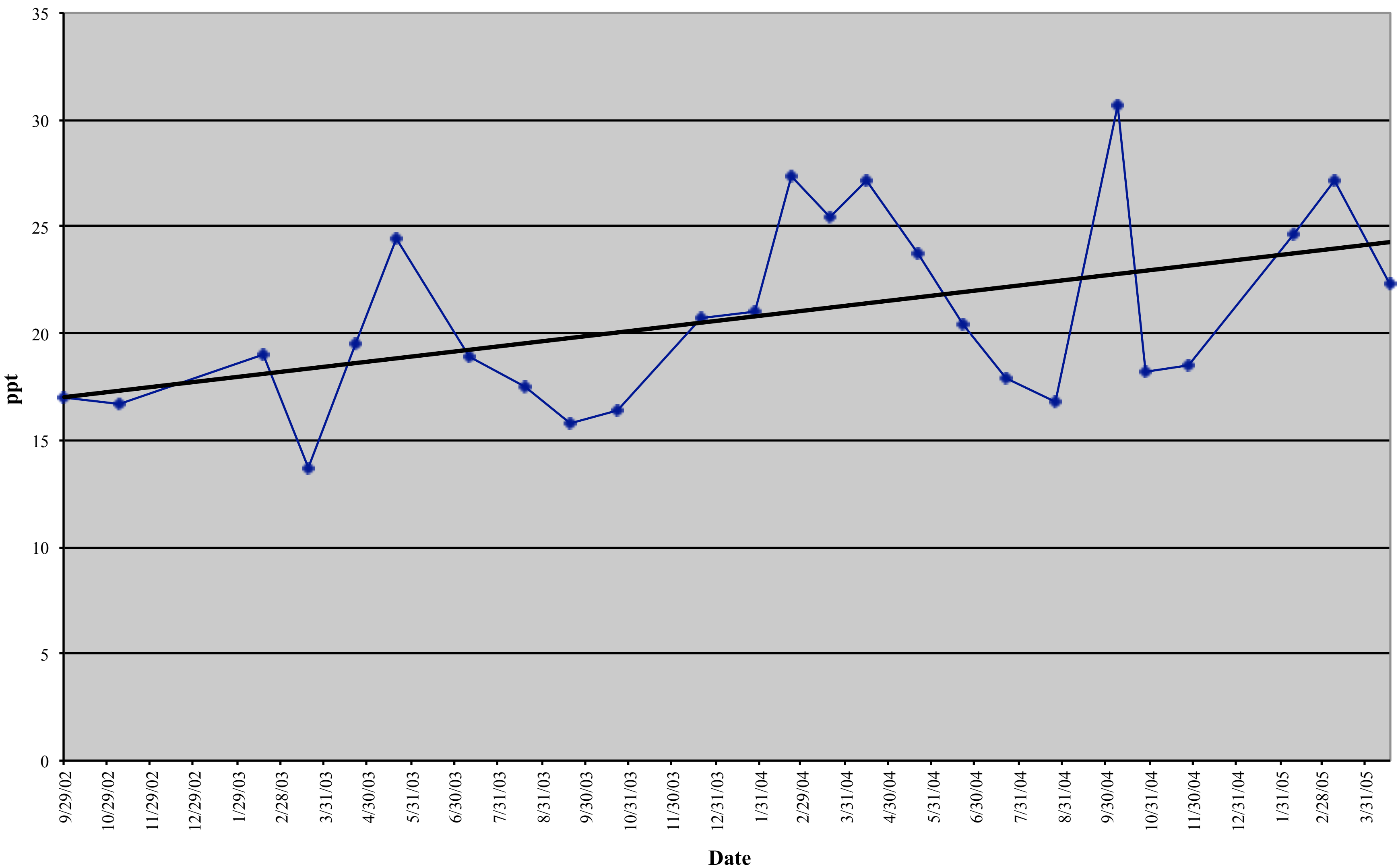
1/9/94	19	19
2/13/94	22	12
3/13/94	20	8
4/10/94	26	13
5/8/94	17	15
6/12/94	14	13
7/10/94	24	3
9/11/94	20	20
10/9/94	24	14
1/8/95	26	24
4/9/95	15	13
6/11/95	9	8
3/24/96	14	7
3/9/97	17	15
6/8/97	20	8
9/14/97	18	18
12/14/97	19	12
3/15/98	22	8
6/14/98	21	21
9/13/98	18	14
12/13/98	16	17
6/13/99	16	15
9/12/99	15	14
12/12/99	15	16

Figure 19. Pondstone Station 1, Surface Salinity



Date									Powell
8/8/02	Salin T	Salin B	DO% T	DO% B	Turb T	Turb B	Outlet	*Comments*	Station
9/29/02	22	17	89.0	86.5	9.2	8.9			1
11/7/02	21	17	94.6	49.8	7.4	8.6	Open	*high after tropical storm Isabel*	1
2/15/03	19	19	85.0	23.3	3.2	5.6	Open	*Heavy storms this last month*	1
3/20/03	14	14	95.9	91.0	1.1	1.4	Closed		1
4/22/03	8	20	78.7	37.1	5.8	32.3	Closed	*Heavy storm the previous night*	1
5/20/03	18	24	74.2	30.6	7.0	14.4	Open	*Gusty winds.*	1
7/10/03	16	19	87.2	32.9	9.1	7.2	Closed		1
8/18/03	13	17	81.7	7.5	13.5	58.5	Open	*Hvy rain wk prior; none last 4 days.*	1
9/20/03	16	16	86.1	8.5	14.1	13.8	Open	*Heavy rains days prior to monitoring.*	1
10/23/03	14	16	76.8	6.3	4.8	39.6	Open	*Lake level higher than normal.*	1
12/21/03	19	21	81.5	27.5	5.4	12.1	Open		1
1/27/04	21	21	111.7	103.4			Open	*Temp high 20's; ice on lake morning.*	1
2/21/04	26	27	99.6	58.3	1.5	3.7	Open		1
3/20/04	20	25	83.3	18.1	16.3	1.7	Open	*Down about 2 ft;opened 6 days ago.*	1
4/15/04	21	27	96.2	63.4	0.6	11.5	Open		1
5/20/04	24	24	86.1	81.5	2.3	4.5	Open	*Rain 3 days prior to monitoring.*	1
6/21/04	21	20	96.3	76.4	4.8	4.9	Closed		1
7/21/04	18	18	79.8	41.6	30.5	40.2	Open		1
8/25/04	27	17	97.3	37.3	28.0	24.2	Closed		1
10/8/04	25	31	65.1	4.9	7.6	8.2	Open		1
10/27/04	27	18	86.6	48.5	0.0	7.4	Closed	*1st monitoring since Hurricane Ivan.*	1
11/27/04	26	18	97.7	53.9	0.0	0.0	Open		1
2/8/05	21	25	85.2	60.0	0.0	0.0	Closed	*Lake level is very high.*	1
3/9/05	15	27	108.5	33.3	0.0	0.0	Closed	*Outlet open for past two weeks.*	1
4/17/05	16	22	101.0	83.9	0.0	0.0	Closed		1
	12	22	100.8	28.5	0.0	9.3	Open		1
Average									
	19	**21**	**89.5**	**45.9**	**6.9**	**12.7**			

Figure 20. Poundstone Station 1, Bottom Salinity



Date								Powell	
8/8/02	Salin B	DO% T	DO% B	Turb T	Turb B	Outlet	*Comments*	Station	Salin T
9/29/02	17	89.0	86.5	9.2	8.9			1	22
11/7/02	17	94.6	49.8	7.4	8.6	Open	*high after tropical storm Isabel*	1	21
2/15/03	19	85.0	23.3	3.2	5.6	Open	*Heavy storms this last month*	1	19
3/20/03	14	95.9	91.0	1.1	1.4	Closed		1	14
4/22/03	20	78.7	37.1	5.8	32.3	Closed	*Heavy storm the previous night*	1	8
5/20/03	24	74.2	30.6	7.0	14.4	Open	*Gusty winds.*	1	18
7/10/03	19	87.2	32.9	9.1	7.2	Closed		1	16
8/18/03	17	81.7	7.5	13.5	58.5	Open	*Hvy rain wk prior; none last 4 days.*	1	13
9/20/03	16	86.1	8.5	14.1	13.8	Open	*Heavy rains days prior to monitoring.*	1	16
10/23/03	16	76.8	6.3	4.8	39.6	Open	*Lake level higher than normal.*	1	14
12/21/03	21	81.5	27.5	5.4	12.1	Open		1	19
1/27/04	21	111.7	103.4			Open	*Temp high 20's; ice on lake morning.*	1	21
2/21/04	27	99.6	58.3	1.5	3.7	Open		1	26
3/20/04	25	83.3	18.1	16.3	1.7	Open	*Down about 2 ft;opened 6 days ago.*	1	20
4/15/04	27	96.2	63.4	0.6	11.5	Open		1	21
5/20/04	24	86.1	81.5	2.3	4.5	Open	*Rain 3 days prior to monitoring.*	1	24
6/21/04	20	96.3	76.4	4.8	4.9	Closed		1	21
7/21/04	18	79.8	41.6	30.5	40.2	Open		1	18
8/25/04	17	97.3	37.3	28.0	24.2	Closed		1	27
10/8/04	31	65.1	4.9	7.6	8.2	Open		1	25
10/27/04	18	86.6	48.5	0.0	7.4	Closed	*1^{st} monitoring since Hurricane Ivan.*	1	27
11/27/04	18	97.7	53.9	0.0	0.0	Open		1	26
2/8/05	25	85.2	60.0	0.0	0.0	Closed	*Lake level is very high.*	1	21
3/9/05	27	108.5	33.3	0.0	0.0	Closed	*Outlet open for past two weeks.*	1	15
4/17/05	22	101.0	83.9	0.0	0.0	Closed		1	16
	22	100.8	28.5	0.0	9.3	Open		1	12
Average									
	21	**89.5**	**45.9**	**6.9**	**12.7**				**19**

Figure 22. Nutient Data, Lake Powell from Ellis et al. 2005

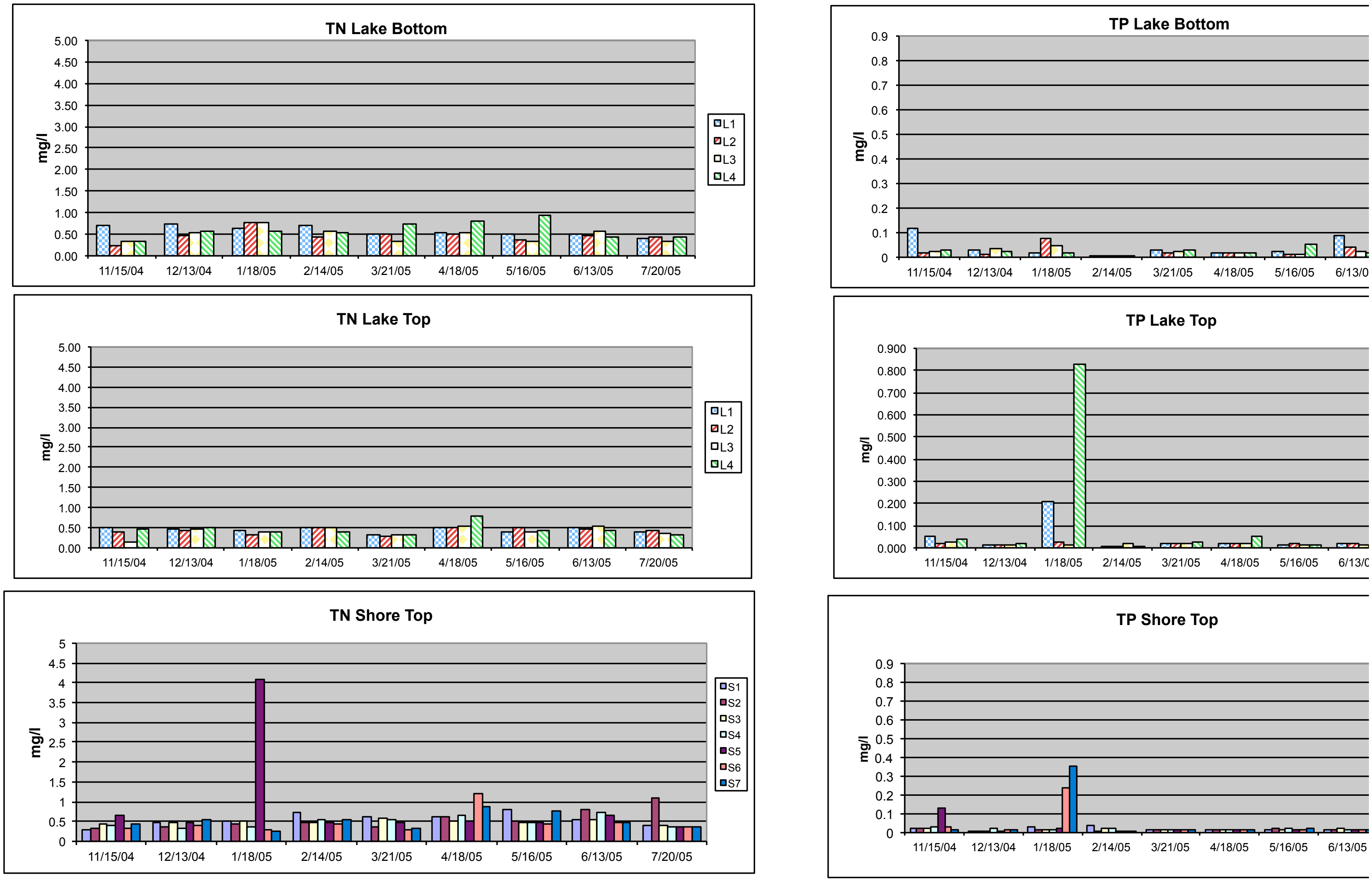
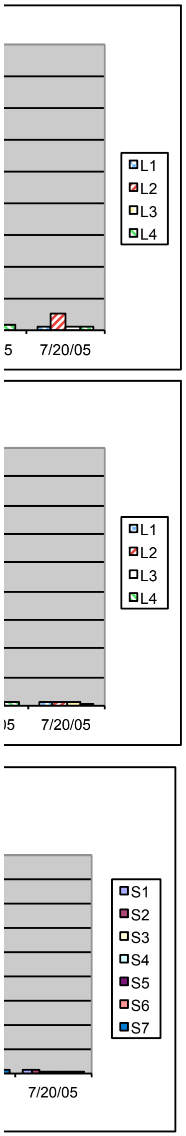
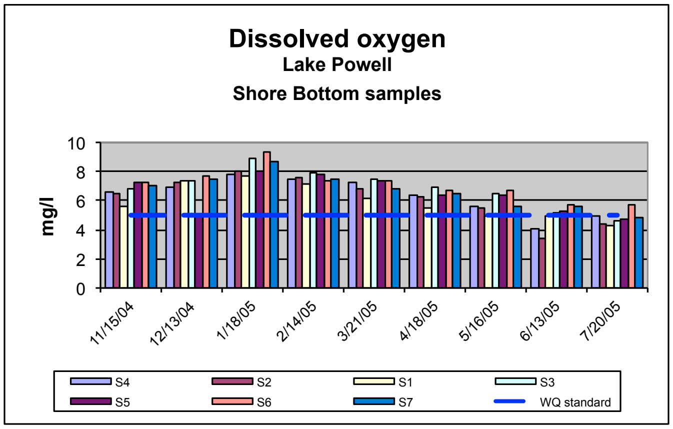
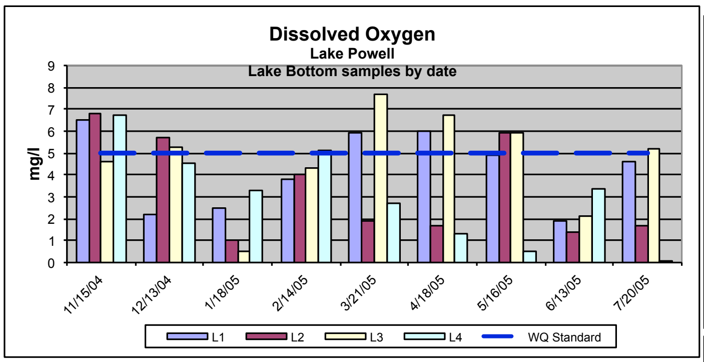


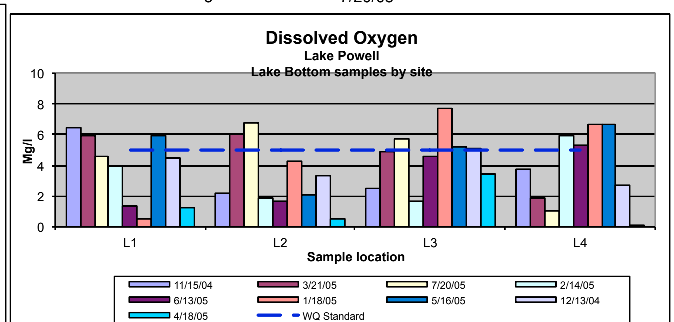
Figure 22. Nutient Data, Lake Powell from Ellis et al. 2005

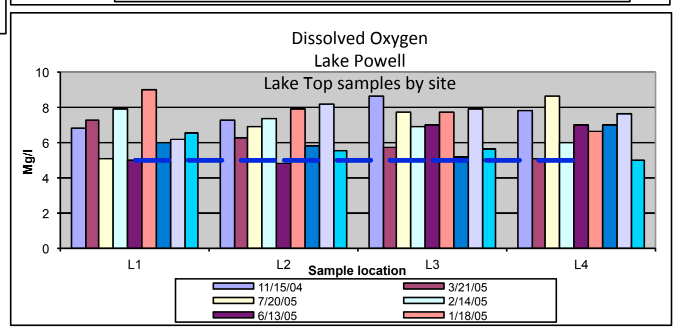


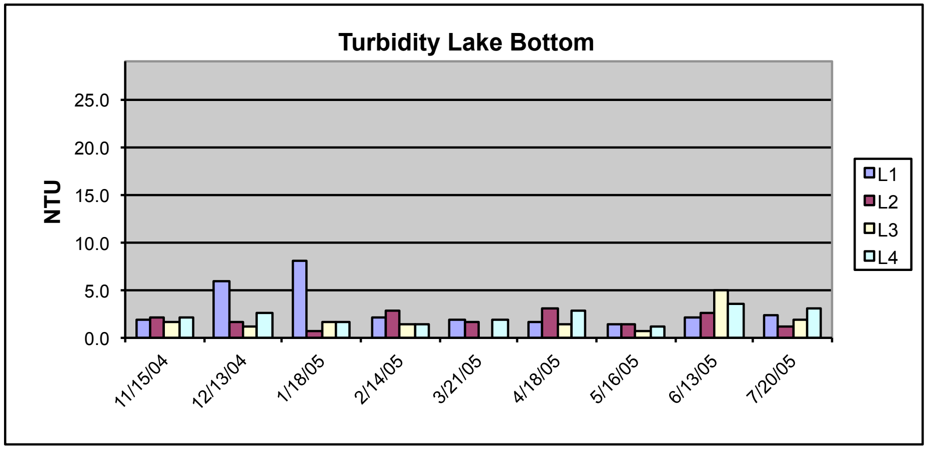


5		
5	11/15/04	L1
5	12/13/04	L2
5	1/18/05	L3
5	2/14/05	L4
5	3/21/05	
5	4/18/05	
5	5/16/05	
5	6/13/05	
5	7/20/05	

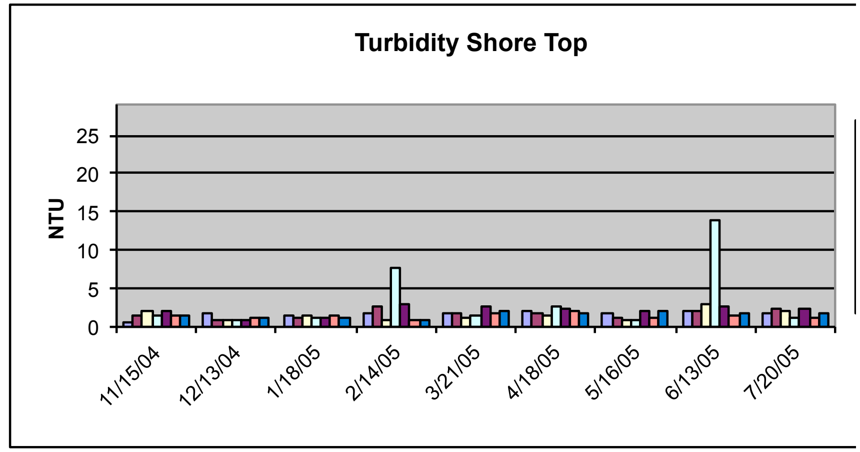




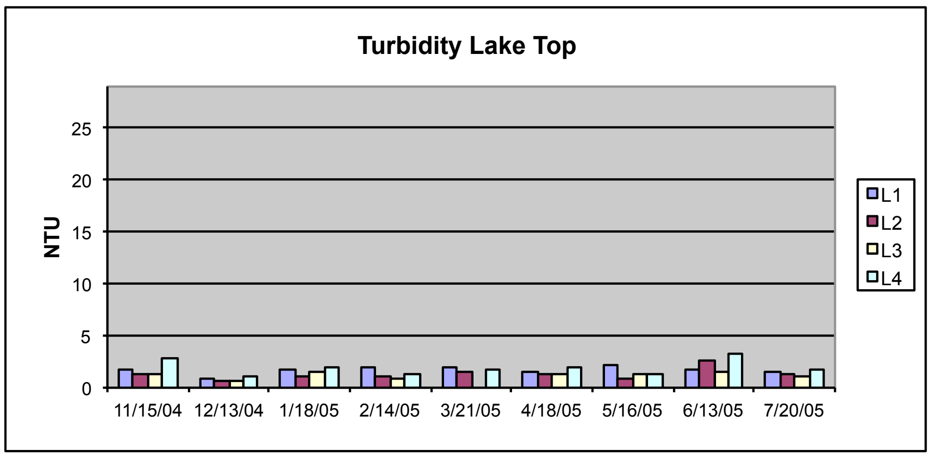




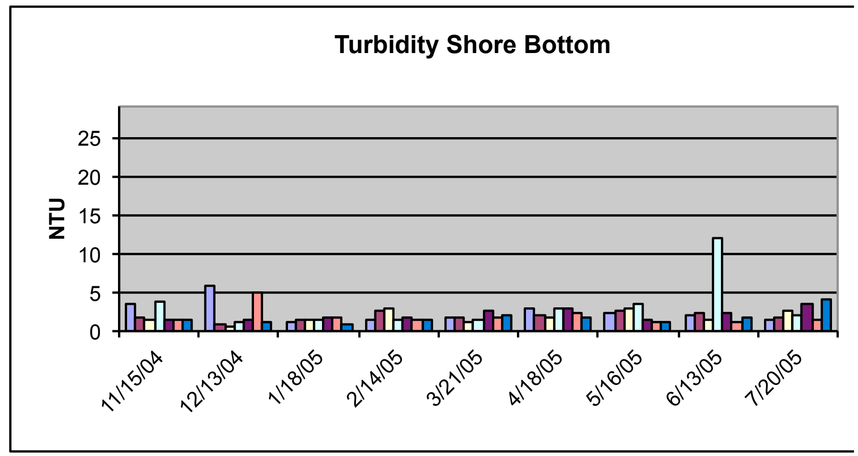
Turbidity Lake Bottom
NTU
25.0
20.0
15.0
10.0
5.0
0.0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4



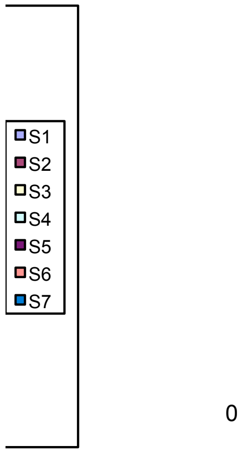
Turbidity Shore Top
NTU
25
20
15
10
5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05

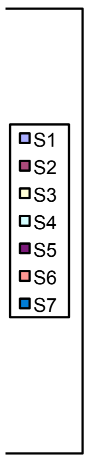


Turbidity Lake Top
NTU
25
20
15
10
5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4



Turbidity Shore Bottom
NTU
25
20
15
10
5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05


S1
S2
S3
S4
S5
S6
S7
0


S1
S2
S3
S4
S5
S6
S7

Station	Date	Depth relative	Depth ft.	Temp. °C	pH	D.O. mg/l	Specific Conduct. Mmho/cm	Turbidity ntu
S1	11/15/04	Top	1	20.7	7.8	5.6	39.1	0.65
S1	12/13/04	Top	1	17.3	7.5	7.4	22.3	1.9
S1	1/18/05	Top	1.0	13.2	6.9	7.7	24.0	1.6
S1	2/14/05	Top	1	16.5	7.7	7.1	37	1.9
S1	3/21/05	Top	0.8	19.3	7.5	6.1	25.3	1.8
S1	4/18/05	Top	1	24.1	7.5	5.5	23.1	2.0
S1	5/16/05	Top	1.5	29.4	7.6	5	29.4	1.9
S1	6/13/05	Top	1	29.3	7.9	5.0	32.7	2.1
S1	7/20/05	Top	1.0	32.4	7.6	4.3	40.8	1.8
S2	11/15/04	Top	1	19.3	8.0	6.5	38.9	1.6
S2	12/13/04	Top	1	17.9	7.8	7.2	33.2	1.0
S2	1/18/05	Top	1.0	13.7	7.2	8.0	25.4	1.2
S2	2/14/05	Top	1	18	7.6	7.6	29.6	2.7
S2	3/21/05	Top	0.9	20.6	7.5	6.8	23.6	1.7
S2	4/18/05	Top	1	22.7	7.6	6.3	22.7	1.7
S2	5/16/05	Top	1	28.3	7.8	5.5	29	1.3
S2	6/13/05	Top	1	28.7	6.4	3.4	21.9	2.2
S2	7/20/05	Top	1.1	32.2	7.8	4.4	40.9	2.5
S3	11/15/04	Top	1	18.8	8.1	6.8	39.4	2.0
S3	12/13/04	Top	1	17.8	8.0	7.4	37.7	0.8
S3	1/18/05	Top	1.2	11.8	7.6	8.9	25.2	1.5
S3	2/14/05	Top	1	17.9	7.8	7.9	31.4	0.95
S3	3/21/05	Top	0.9	19.9	7.6	7.5	21.9	1.1
S3	4/18/05	Top	1.0	23.1	7.8	6.9	22.4	1.6
S3	5/16/05	Top	1	27.0	8.0	6.5	28.7	0.85
S3	6/13/05	Top	0.7	29.9	7.2	5.2	21.9	2.9
S3	7/20/05	Top	1.1	31.5	7.8	4.6	39.2	2.0
S4	11/15/04	Top	1	19.8	8.1	6.6	39.0	1.6
S4	12/13/04	Top	1	17.7	8.0	6.9	36.9	0.95
S4	1/18/05	Top	1.0	13.8	7.5	7.8	27.0	1.2
S4	2/14/05	Top	1	18.2	7.7	7.5	30.0	7.8
S4	3/21/05	Top	1	20.7	7.5	7.3	20.6	1.4
S4	4/18/05	Top	1	24.2	7.6	6.4	20.7	2.6
S4	5/16/05	Top	0.8	29.0	7.9	5.6	29.3	0.95
S4	6/13/05	Top	0.9	29.9	7.0	4.1	20.7	14
S4	7/20/05	Top	0.9	32.5	7.9	4.9	39.3	1.1
S5	11/15/04	Top	1	19.1	8.0	7.2	37.2	2.1
S5	12/13/04	Top	1	20.1	7.9	4.9	41.1	0.90
S5	1/18/05	Top	1.2	14.3	7.5	8.0	27.0	1.1
S5	2/14/05	Top	1	16.5	7.7	7.8	29.9	2.9
S5	3/21/05	Top	0.9	20.2	7.3	7.4	14.6	2.6
S5	4/18/05	Top	1	23.7	7.6	6.4	20.5	2.5
S5	5/16/05	Top	0.9	29.4	7.9	6.4	27.5	2.0
S5	6/13/05	Top	1	29.8	7.1	5.3	23.8	2.6
S5	7/20/05	Top	1	32.9	7.8	4.7	34.3	2.5
S6	11/15/04	Top	1	18.5	8.2	7.3	38.3	1.4
S6	12/13/04	Top	1	17.6	8.1	7.7	38.3	1.3
S6	1/18/05	Top	1.1	10.7	7.6	9.3	23.8	1.6
S6	2/14/05	Top	1	16.8	7.8	7.4	36	0.9
S6	3/21/05	Top	0.9	19.2	7.5	7.4	21.3	1.8

S6	4/18/05	Top	1	22.9	7.8	6.7	23.0	2.2
S6	5/16/05	Top	0.8	27.8	8.0	6.7	27.4	1.3
S6	6/13/05	Top	0.9	30.6	8.1	5.7	31.3	1.5
S6	7/20/05	Top	0.8	31.6	7.9	5.7	38.9	1.1
S7	11/15/04	Top	1	18.8	7.8	7.0	39.5	1.5
S7	12/13/04	Top	1	17.5	7.8	7.5	35.9	1.3
S7	1/18/05	Top	1.5	11.2	7.1	8.7	19.8	1.2
S7	2/14/05	Top	1	16.6	7.6	7.5	35.2	0.8
S7	3/21/05	Top	1	19.9	7.5	6.8	24.3	2.0
S7	4/18/05	Top	1	21.4	7.1	6.5	22.5	1.8
S7	5/16/05	Top	1.1	27.6	7.7	5.6	28.7	2.1
S7	6/13/05	Top	1	29.9	7.8	5.6	32.8	1.7
S7	7/20/05	Top	0.9	31.5	7.8	4.8	39.6	1.7
S1	11/15/04	Bottom	3.9	20.6	8.0	6.3	40.1	3.5
S1	12/13/04	Bottom	2.2	19.3	7.4	6.1	33.7	6.0
S1	1/18/05	Bottom	5.0	16.8	7.3	5.5	27.5	1.2
S1	2/14/05	Bottom	4	16.3	7.7	6.4	38.3	1.5
S1	3/21/05	Bottom	3.2	19.6	7.5	4.7	29.1	1.8
S1	4/18/05	Bottom	2	24.5	7.4	3.8	26.4	3.0
S1	5/16/05	Bottom	2.5	32.6	7.4	2.9	32.6	2.2
S1	6/13/05	Bottom	3.6	27.8	7.4	1.7	35.5	2.1
S1	7/20/05	Bottom	2.2	32.7	7.8	4.5	41.7	1.4
S2	11/15/04	Bottom	7	18.4	8.1	6.5	39.5	1.8
S2	12/13/04	Bottom	5	16.9	8.0	7.3	36.3	0.85
S2	1/18/05	Bottom	9.0	18.3	7.4	2.1	40.0	1.4
S2	2/14/05	Bottom	7	16.4	7.7	4.1	42.8	2.7
S2	3/21/05	Bottom	5.3	19.4	7.5	2.6	32.4	1.7
S2	4/18/05	Bottom	4	22.7	7.6	4.9	25.1	2.1
S2	5/16/05	Bottom	6	25.7	7.6	2.4	38.5	2.7
S2	6/13/05	Bottom	3	28.2	7.2	1.8	31.4	2.3
S2	7/20/05	Bottom	3	32.4	7.8	3.8	42.6	1.9
S3	11/15/04	Bottom	5.2	18.8	8.1	6.5	39.4	1.4
S3	12/13/04	Bottom	3	17.7	8.0	7.3	37.6	0.7
S3	1/18/05	Bottom	4.3	11.9	7.6	8.7	26.1	1.5
S3	2/14/05	Bottom	3	16.9	7.9	8.9	39.5	2.9
S3	3/21/05	Bottom	2.5	19.9	7.6	7.5	21.9	1.1
S3	4/18/05	Bottom	2.0	23.1	7.8	6.8	22.4	1.7
S3	5/16/05	Bottom	2.1	27.5	8.2	6.3	29.0	2.9
S3	6/13/05	Bottom	2.7	29.0	7.6	4.4	31.5	1.6
S3	7/20/05	Bottom	2.1	31.6	7.8	4.9	39.5	2.7
S4	11/15/04	Bottom	9.8	18.9	8.1	6.3	39.3	3.8
S4	12/13/04	Bottom	6.6	19.6	7.9	4.0	43.8	1.1
S4	1/18/05	Bottom	9.0	18.3	7.4	3.4	36.1	1.6
S4	2/14/05	Bottom	7	16.6	7.8	5.1	43.2	1.4
S4	3/21/05	Bottom	6.8	19.1	7.4	2.7	29.6	1.4
S4	4/18/05	Bottom	4	22.9	7.5	3.8	25.5	2.8
S4	5/16/05	Bottom	7.5	23.4	7.5	0.7	40.2	3.6
S4	6/13/05	Bottom	6.9	27.5	7.6	0.2	40.3	12
S4	7/20/05	Bottom	6	30.8	7.7	3.2	44.2	2.1
S5	11/15/04	Bottom	9.7	19.4	8.0	6.4	38.9	1.4
S5	12/13/04	Bottom	7	19.5	8.0	4.0	44.5	1.5
S5	1/18/05	Bottom	8.9	18.5	7.4	3.0	35.0	1.8
S5	2/14/05	Bottom	7	16.7	7.9	4.9	44.4	1.9

S5	3/21/05	Bottom	7	18.9	7.4	3.6	29.1	2.6
S5	4/18/05	Bottom	6.5	21.0	7.5	1.0	36.7	2.8
S5	5/16/05	Bottom	2	28.3	7.9	4.9	29.0	1.5
S5	6/13/05	Bottom	7.5	27.7	7.7	2.0	38.7	2.2
S5	7/20/05	Bottom	7.9	29.8	7.6	1.5	45.8	3.5
S6	11/15/04	Bottom	3.5	17.9	8.1	8.4	38.6	1.4
S6	12/13/04	Bottom	4	17.7	8.1	8.1	38.3	5.0
S6	1/18/05	Bottom	3.6	10.3	7.6	9.3	24.6	1.8
S6	2/14/05	Bottom	3	16.8	7.9	7.9	39.6	1.4
S6	3/21/05	Bottom	2.7	18.2	7.5	7.2	22.4	1.8
S6	4/18/05	Bottom	1.7	22.7	7.9	6.2	23.2	2.2
S6	5/16/05	Bottom	1.5	27.7	8.1	7.5	27.4	1.2
S6	6/13/05	Bottom	2.3	29.7	8.1	6.8	32.6	1.1
S6	7/20/05	Bottom	1.6	31.4	7.9	6.0	39.0	1.5
S7	11/15/04	Bottom	5.8	18.7	7.9	6.5	39.6	1.5
S7	12/13/04	Bottom	5	17.1	7.8	7.5	36.1	1.1
S7	1/18/05	Bottom	5	12.2	7.4	8.3	26.5	0.9
S7	2/14/05	Bottom	6	16.5	7.6	5.2	41.6	1.4
S7	3/21/05	Bottom	6	19.1	7.6	4.1	32.6	2.0
S7	4/18/05	Bottom	7.2	20.7	7.3	1.1	38.0	1.9
S7	5/16/05	Bottom	5.5	23.0	7.5	1.8	40.1	1.3
S7	6/13/05	Bottom	7	27.9	7.5	1.7	41.4	1.7
S7	7/20/05	Bottom	5.2	30.5	7.8	4.1	44.7	4.1
		Max						
		Min						

Qualifier	Secchi depth ft.	Total N mg/l	TKN mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l		Ortho P mg/l
J	>4	0.28	0.28	0.010 M	0.082 U	0.023		0.010 M
	6	0.48	0.45	0.034	0.082 U	0.011		0.010 M
	4	0.52	0.50	0.015	0.082 U	0.032		0.010 M
	>4	0.74		0.041	0.082 U	0.041		0.010 M
	>4	0.63		0.013	0.082 U	0.018		0.010 M
	>3	0.63		0.030	0.082 U	0.018		0.010 M
	3	0.8		0.027	0.082 U	0.017		0.010 M
	3.5	0.56		0.010 M	0.082 U	0.018		0.010
	>2.6	0.39		0.0053 U	0.082 U	0.013		0.010 M
	5	0.32	0.32	0.010 M	0.082 U	0.023		0.010 M
	6	0.38	0.34	0.037	0.082 U	0.011		0.010 M
	5	0.42	0.39	0.030	0.082 U	0.014		0.010 M
	5	0.49		0.053	0.082 U	0.006		0.010 M
	3.75	0.38		0.012	0.082 U	0.018		0.010 M
	2	0.62		0.065	0.082 U	0.018		0.010 M
	2.5	0.50		0.015	0.082 U	0.025		0.010 M
	1	0.80		0.024	0.082 U	0.017		0.011
	>4	1.1		0.0053 U	0.082 U	0.019		0.010 M
	5	0.42	0.40	0.022	0.082 U	0.021		0.016
	>3.5	0.48	0.46	0.018	0.082 U	0.011		0.010 M
	5	0.50	0.38	0.12	0.082 U	0.017		0.010 M
J	>4	0.48		0.043	0.082 U	0.024		0.010 M
	3	0.57		0.016	0.082 U	0.018		0.010 M
	>3	0.50		0.047	0.082 U	0.018		0.014
J	>3	0.46		0.012	0.082 U	0.018		0.010 M
	1	0.55		0.010 M	0.082 U	0.025		0.011
	>3	0.39		0.0053 U	0.082 U	0.01	M	0.010 M
	5	0.41	0.41	0.010 M	0.082 U	0.027		0.010 M
	7	0.33	0.29	0.036	0.082 U	0.022		0.010 M
	6	0.35	0.32	0.032	0.082 U	0.017		0.010 M
	6	0.53		0.096	0.082 U	0.021		0.012
	3.5	0.56		0.075	0.082 U	0.018	U	0.010 M
	2.5	0.67		0.10	0.082 U	0.018	U	0.014
J	4.5	0.48		0.037	0.082 U	0.023		0.010 M
	1	0.73		0.070	0.082 U	0.018		0.018
	5.5	0.35		0.0053 U	0.082 U	0.006	U	0.010 M
	5.5	0.66	0.60	0.065	0.082 U	0.13		0.010 M
	6	0.47	0.46	0.014	0.082 U	0.011		0.010 M
	5	4.1	4.1	0.034	0.082 U	0.021		0.010 M
	6	0.49		0.076	0.082 U	0.006	U	0.010 M
	2	0.47		0.10	0.082 U	0.018	U	0.010 M
	>2	0.52		0.075	0.082 U	0.018	U	0.011
	>3	0.49		0.068	0.082 U	0.014		0.010 M
	1	0.64		0.055	0.082 U	0.017		0.010 M
	5	0.38		0.060	0.082 U	0.01	M	0.010 M
	4	0.32	0.49 J4	0.010 M	0.082 U	0.03		0.010 M
	>5	0.41	0.39	0.024	0.082 U	0.018		0.010 M
	4	0.31	0.28	0.028	0.082 U	0.24		0.010 M
J	>4	0.42		0.039	0.082 U	0.006	U	0.010 M
	2	0.30		0.013	0.082 U	0.018	U	0.010 M

	>2	1.2		0.048	0.082 U	0.018	U	0.013
	>2.5	0.44		0.0053 U	0.082 U	0.013		0.010 M
	2	0.47		0.0053 U	0.082 U	0.018		0.010 M
	>3	0.35		0.0053 U	0.082 U	0.01	M	0.010 M
	5	0.44	0.44	0.010 M	0.082 U	0.019		0.010 M
	>6	0.54	0.50	0.040	0.082 U	0.019		0.010 M
	4	0.27	0.23	0.037	0.082 U	0.35		0.010 M
J	>6	0.54		0.044	0.082 U	0.006	U	0.010 M
	4.5	0.34		0.016	0.082 U	0.018	U	0.010 M
	3.5	0.89		0.039	0.082 U	0.018	U	0.0026 U
	4.5	0.76		0.010 M	0.082 U	0.021		0.010 M
	4	0.46		0.010 M	0.082 U	0.016		0.010 M
	6	0.37		0.0053 U	0.082 U	0.01	M	0.010 M
J								

J

4.1
0.27

TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
14.2	100	3 B		1.8
3.8				
7.2	50	84	2.7	3.4
18.3	175	24B		1.2
5.0		2 B		2.4
54.8	80	500	1.4	6.2
23.9		58		1.6
12.4	100	94	1.3	1.6
8.8				
10.9	140	17 B		3.4
4.7				
15.8		4 B		3.0
5.1	15	12 B	3.1	5.8
10.9	100	7B		2.2
7.4		10 B		2.0
9.6	30	2B	1.4	4.8
11.4	125	<2 B		3.0
11.6				
15.5	300	31	1.0 J3	3.8
5.8		3 B		
13.3		12 B		2.4
4.9	20 J5	13 B	2.7	1.4 J5
9.7	75	3B	no sample	3.0
6.9	60	<2 B	3.4 J3	4.2
6.4				
10.8		2 B		2.4
17.5		64		2.8
13.2	60	70		1.8
7.2	60	3 B	4.7 J3	4.0
5.5		<1		
11.0		2 B	5.3	3.7
6.5				
7.5	60	<2 B	4.1 J3	2.2
5.6				
4.4		12 B		3.6
10.8	100	<2B	2.3	3.4
24		300		2.4
10.4	120	100		3.0
7.7	70	5 B	3.8 J3	3.9
12.2	125	58		3.0
7.6				
5.2	20	33 B	2.9	4.0

10.7	140	<3B		3.2
5.3		2 B		1.2
7.8	40	8B	2.1	4.4
8.5		17	4.4	2.5
6.2		2 B		3.6
5.7				
15.5		130		3.6
28.6		25 B		
10.6		2 B		4.4
10.8	50	570	2.9	2.0
11	100	11B		2.6
5.7		12 B	1.6 J3	4.4
10.7	100	17B		2.0
3.7				
10.7		3 B		2.2
4.8				
13.8	125	25B		2.2
10.6				
11.1		<2 B		3.6
6.2				
7.5	60	2 B	4.3 J3	2.0
11.3				
9.2		8.0		3.2
7.2				
8.3	70	4 B	4.8 J3	2.2

11.9		
9.1 5.4	17	2.4
5.1 4.3	<2 B	4

Station	Date	Depth relative	Depth ft.	Temp. °C	pH	D.O. mg/l	Specific Conduct. Mmho/cm	Turbidity ntu
L1	11/15/04	Bottom	12	18.5	8.0	6.5	39.7	1.8
L1	12/13/04	Bottom	9	19.5	7.8	2.2	44.5	6.0
L1	1/18/05	Bottom	9.5	17.7	7.4	2.5	41.2	8.0
L1	2/14/05	Bottom	11	16.9	7.8	3.8	46.2	2.1
L1	3/21/05	Bottom	3.3	19.6	7.6	5.9	27.7	1.9
L1	4/18/05	Bottom	2	23.0	7.6	6.0	22.5	1.6
L1	5/16/05	Bottom	3	27.1	7.8	4.9	31.9	1.4
L1	6/13/05	Bottom	4.5	27.9	7.4	1.9	34.8	2.1
L1	7/20/05	Bottom	5.0	31.3	7.9	4.6	43.9	2.3
L2	11/15/04	Bottom	11.5	18.4	8.1	6.8	39.5	2.2
L2	12/13/04	Bottom	9	18.0	8.1	5.7	45.8	1.7
L2	1/18/05	Bottom	10.8	17.3	7.4	1.0	43.6	0.7
L2	2/14/05	Bottom	11	16.6	7.9	4.0	46.7	2.8
L2	3/21/05	Bottom	6.8	18.9	7.6	1.9	37.3	1.6
L2	4/15/05	Bottom	10.1	20.8	7.7	1.7	40.7	3.1
L2	5/16/05	Bottom	2.5	27.0	7.9	5.9	29.1	1.5
L2	6/13/05	Bottom	5.5	27.4	7.6	1.4	38.9	2.5
L2	7/20/05	Bottom	11	28.7	7.7	1.7	39.2	1.2
L3	11/15/04	Bottom	12.6	19.2	8.0	4.6	39.3	1.7
L3	12/13/04	Bottom	10	18.7	8.2	5.3	46.5	1.1
L3	1/18/05	Bottom	11.2	17.2	7.4	0.5	44	1.6
L3	2/14/05	Bottom	11	16.7	7.9	4.3	46.7	1.4
L3	3/21/05	Bottom	2.1	19.2	7.6	7.7	21.8	
L3	4/18/05	Bottom	2	22.9	7.8	6.7	22.5	1.5
L3	5/16/05	Bottom	2.6	26.6	7.9	5.9	28.9	0.75
L3	6/13/05	Bottom	7.8	27.4	7.9	2.1	42.0	4.9
L3	7/20/05	Bottom	3.2	31.1	7.9	5.2	39.8	1.9
L4	11/15/04	Bottom	11	18.8	8.1	6.7	39.0	2.2
L4	12/13/04	Bottom	8	19.2	8.0	4.5	44.9	2.5
L4	1/18/05	Bottom	9.0	18.2	7.5	3.3	35.5	1.6
L4	2/14/05	Bottom	9	16.9	7.9	5.1	45.6	1.5
L4	3/21/05	Bottom	7.9	19.1	7.5	2.7	33.2	1.8
L4	4/18/05	Bottom	8	20.8	7.6	1.3	38.7	2.8
L4	5/16/05	Bottom	9.1	22.4	7.5	0.5	42.3	1.1
L4	6/13/05	Bottom	7.1	27.8	7.9	3.4	38.2	3.6
L4	7/20/05	Bottom	8.4	29.4	7.4	0.1	36.0	3.1
L1	11/15/04	Mid	6	18.6	8.0	6.5	39.6	1.7
L1	12/13/04	Mid	5.5	16.6	8.0	7.3	37.0	1
L1	1/18/05	Mid	4.7	13.0	7.5	8.2	26.5	1.0
L1	2/14/05	Mid	5	16.4	7.7	5.4	41.4	1.9
L1	3/21/05	Mid	2	19.5	7.6	7.2	22.9	1.9
L1	4/18/05	Mid	1.5	23.1	7.6	5.9	22.5	1.8
L1	5/16/05	Mid	2	27.4	7.8	5.7	29.5	1.8
L1	6/13/05	Mid	2.4	29.7	7.7	4.5	30.8	2.0

L1	7/20/05	Mid	2.4	31.1	7.9	5.1	40.3	1.4
L2	11/15/04	Mid	6.6	18.5	8.1	6.7	39.4	1.4
L2	12/13/04	Mid	5.5	16.6	8.0	7.4	37.8	0.7
L2	1/18/05	Mid	5.5	12.2	7.5	8.0	26.5	1.4
L2	2/14/05	Mid	5.6	16.5	7.8	5.4	42	1.4
L2	3/21/05	Mid	3.2	19.6	7.6	7.2	22.3	1.6
L2	4/15/05	Mid	5.5	21.2	7.7	3.0	36.8	1.5
L2	5/16/05	Mid	1.6	27.0	7.9	6.0	29	1.0
L2	6/13/05	Mid	3.3	28.6	7.8	3.7	34.1	1.8
L2	7/20/05	Mid	6	29.9	8.0	4.5	39.1	1.3
L3	11/15/04	Mid	6.2	18.8	6.7	8.1	39.2	1.3
L3	12/13/04	Mid	5.5	17.6	8.0	6.9	38.1	0.7
L3	1/18/05	Mid	5.8	12.0	7.6	7.8	26.5	1.2
L3	2/14/05	Mid	6	16.2	7.9	6.4	42.1	1
L3	3/21/05	Mid	1.5	19.3	7.6	7.6	21.8	1.4
L3	4/18/05	Mid	1.5	23.0	7.8	6.2	22.5	1.6
L3	5/16/05	Mid	1.8	26.9	8.0	6.1	28.8	1.0
L3	6/13/05	Mid	3.6	29.3	7.8	5.4	30.0	2.9
L3	7/20/05	Mid	2	31.1	7.9	5.2	38.9	1.0
L4	11/15/04	Mid	5.6	18.9	8.1	6.7	38.8	2.2
L4	12/13/04	Mid	5	19.0	8.0	4.5	44.5	1.4
L4	1/18/05	Mid	5.1	13	7.5	7.1	27.1	0.95
L4	2/14/05	Mid	4.5	16.5	7.8	6.4	42.3	1.1
L4	3/21/05	Mid	4	19.0	7.6	6.9	20.8	1.8
L4	4/18/05	Mid	4	22.2	7.6	4.0	28.2	1.7
L4	5/16/05	Mid	4.5	25.8	7.8	2.8	37.4	1.5
L4	6/13/05	Mid	3.5	29.3	7.9	4.7	28.8	2.9
L4	7/20/05	Mid	4.1	32.2	7.9	4.8	35.2	0.9
L1	11/15/04	Top	1	18.7	8.0	6.8	39.6	1.7
L1	12/13/04	Top	1	17.5	7.9	7.3	35.3	1
L1	1/18/05	Top	1	12.5	7.5	8.6	26.4	1.7
L1	2/14/05	Top	1	17.2	7.7	7.8	32.4	2
L1	3/21/05	Top	1	19.6	7.6	7.3	22.8	1.9
L1	4/18/05	Top	1	23.1	7.6	6.3	22.4	1.6
L1	5/16/05	Top	1	27.9	7.8	5.7	28.9	2.2
L1	6/13/05	Top	0.8	29.8	7.7	5.1	30.4	1.8
L1	7/20/05	Top	0.9	31.4	7.9	5.1	40.1	1.5
L2	11/15/04	Top	1	18.7	8.1	6.9	39.4	1.3
L2	12/13/04	Top	1	17.2	7.9	7.7	36.3	0.75
L2	1/18/05	Top	1	12.2	7.6	8.6	26.5	1.1
L2	2/14/05	Top	1	17.4	7.8	7.9	32	1.1
L2	3/21/05	Top	1.1	19.6	7.6	7.4	22.3	1.6
L2	4/15/05	Top	1	22.4	7.8	6.9	22.6	1.4
L2	5/16/05	Top	1	27.3	7.9	6.0	28.9	0.95
L2	6/13/05	Top	0.9	29.2	7.4	5.0	27.7	2.7
L2	7/20/05	Top	0.9	31.2	7.9	4.8	39.9	1.2
L3	11/15/04	Top	1	18.9	8.1	7.0	39.1	1.2

L3	12/13/04	Top	1	17.6	8.0	7.0	38.6	0.75
L3	1/18/05	Top	1.4	11.2	7.5	9.0	24.5	1.6
L3	2/14/05	Top	1	18.1	7.8	7.9	31.6	0.95
L3	3/21/05	Top	1	19.3	7.6	7.7	21.7	
L3	4/18/05	Top	1	22.9	7.8	6.6	22.5	1.4
L3	5/16/05	Top	0.8	29.2	7.9	6.0	28.8	1.2
L3	6/13/05	Top	1.1	30.2	8.0	5.8	29.4	1.6
L3	7/20/05	Top	1	31.3	7.9	5.2	38.9	1.0
L4	11/15/04	Top	1	19.6	8.1	7.0	38.4	2.9
L4	12/13/04	Top	1	19.7	8.0	6.2	40.8	1.1
L4	1/18/05	Top	1.0	13.1	7.5	8.2	27.0	2.0
L4	2/14/05	Top	1	17.1	7.8	7.9	30.4	1.4
L4	3/21/05	Top	1.1	20.4	7.5	7.6	19.5	1.8
L4	4/18/05	Top	1	23.1	7.7	6.5	21.2	2.0
L4	5/16/05	Top	1.2	28.2	7.9	5.5	28.7	1.4
L4	6/13/05	Top	0.8	30.9	7.6	5.6	23.6	3.2
L4	7/20/05	Top	0.9	32.9	7.8	5	35.3	1.8
		Max						
		Min						

Qualifier	Secchi depth ft.	Total N mg/l	Qualifier	TKN mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Qualifier
		0.72		0.70	0.015	0.082 U	0.12	
		0.73		0.72	0.011	0.082 U	0.029	
		0.64	J4	0.63 J4	0.011	0.19	0.019	
		0.70			0.012	0.13	0.006	U
		0.49			0.028	0.082U	0.030	
		0.53			0.084	0.082 U	0.018	U
		0.51			0.0053 U	0.082U	0.022	
		0.51			0.0053 U	0.082U	0.090	
		0.39			0.0053 U	0.082U	0.011	
		0.22		0.22	0.010 M	0.082 U	0.019	
		0.47		0.46	0.011	0.082 U	0.011	
J		0.78		0.77	0.011	0.30	0.076	
		0.42			0.014	0.082 U	0.006	U
		0.50			0.010 M	0.22	0.018	U
		0.52			0.0053 U	0.21	0.018	U
		0.36			0.0053 U	0.082 U	0.011	
		0.47			0.0053 U	0.082 U	0.043	
		0.45			0.0053 U	0.082 U	0.052	
		0.34		0.33	0.011	0.082 U	0.021	
		0.55		0.54	0.013	0.082 U	0.035	
		0.77		0.74	0.030	0.33	0.048	
		0.58			0.013	0.10 M	0.006	U
NA		0.32			0.014	0.082 U	0.025	
		0.55			0.052	0.082 U	0.018	U
J		0.35			0.0053 U	0.082 U	0.01	M
		0.56			0.0053 U	0.082 U	0.022	
		0.34			0.0053 U	0.082 U	0.01	M
		0.35		0.31 J4	0.14	0.082 U	0.029	
		0.57		0.56	0.013	0.082 U	0.021	U
		0.57		0.55	0.017	0.13	0.019	
		0.53			0.016	0.010 M	0.006	U
		0.75			0.0053U	0.39	0.028	
		0.80			0.012	0.28	0.02	M
		0.94			0.010 M	0.27	0.050	
		0.45			0.0053 U	0.082U	0.017	
		0.44			0.011	0.082 U	0.012	
J								

J							
J							
J							
	5.5	0.50	0.49	0.012	0.082 U	0.050	
J	8	0.47	0.45	0.019	0.082 U	0.011	
	6	0.42	0.38	0.035	0.082 U	0.21	
	6	0.49		0.044	0.082U	0.006	U
	3.5	0.33		0.012	0.082U	0.018	U
	>3	0.50		0.043	0.082 U	0.02	M
	>4	0.38		0.0053 U	0.082U	0.011	
	3.0	0.49		0.0053 U	0.082U	0.017	
	>7	0.40		0.0053 U	0.082U	0.01	M
	6	0.40	0.40	0.010 M	0.082 U	0.018	
J	8	0.44	0.42	0.022	0.10 M J4	0.011	
	6	0.34	0.31	0.034	0.082 U	0.028	
	6	0.52		0.044	0.082 U	0.006	U
	4	0.30		0.017	0.082 U	0.018	U
	2.5	0.51		0.044	0.082 U	0.018	U
J	>3.5	0.52		0.019	0.082 U	0.019	
	3.5	0.46		0.0053 U	0.082 U	0.020	
	4	0.44		0.0053 U	0.082 U	0.01	M
	5.5	0.13	0.13	0.010 M	0.082 U	0.026	

J	8	0.47	0.45	0.016	0.082 U	0.016	
	5	0.40	0.40	0.010 M	0.082 U	0.016	
J	8	0.52		0.041	0.082 U	0.018	
NA	3	0.34		0.013	0.082 U	0.018	U
	>3	0.53		0.033	0.082 U	0.018	U
	>3.5	0.39		0.0053 U	0.082 U	0.01	M
	3	0.54		0.0053 U	0.082 U	0.015	
	>4.5	0.35		0.0053 U	0.082 U	0.01	M
	5.5	0.48	0.45	0.026	0.082 U	0.039	
	8	0.52	0.51	0.014	0.082 U	0.018	
	5	0.39	0.36	0.030	0.082 U	0.83	
	6	0.41		0.071	0.082 U	0.006	U
	2	0.32		0.044	0.11	0.023	
	2	0.79		0.059	0.082 U	0.050	
	4	0.42		0.010 M	0.082 U	0.013	
	2	0.44		0.0053 U	0.082 U	0.016	
	7	0.33		0.0053 U	0.082 U	0.006	U
		0.94				0.83	
		0.13				0.01	

Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
0.018	4.9				
0.018					
0.010 M	28.4	20	15 B	3.2	3.0
0.010 M	5.4				
0.012					
0.010 M					
0.010 M	18.5		100		2.8
0.010 M	8.9	60	28 B		2.8
0.010 M	7.5	60	3.2	3.8 J3	3.2
0.010 M	3.7				
0.010 M					
0.010 M	4.7		5 B		
0.010 M	4.6				
0.010 M					
0.010 M	21.8	125	550	1.0 M	2.0
0.010 M					
0.010 M					
0.010 M					
0.010 M	4.3				
0.010 M					
0.010 M	10.1	80	64		2.8
0.010 M	5.6				
0.010 M	20.4	100	79		3.2
0.017	7.5	150	<2B	4.9 J3	3.0
0.012	5.9		240		
0.013	10.8		13 B		3.4
0.010 M	4.5	15	8 B	3.7	6.0
0.010 M	5.3				
0.010 M					
0.010 M	6.5	40	10 B	3.3	2.8
0.010 M	5.0				
0.020					
0.010 M					
0.013					
0.010 M					
0.010 M					
	4.4	20	64 B	3.2	6.0
	2.9				
	8.5		7 B		1.2
	9.6	100	7 B		3.6

	5.2	30	2 B		3.0
	4.7				
	15.1	20	74	4.2	6.5
	5.4		<2 B		2.8
	13	90	710B	1.5	3.8
	8.3		32		3.4
	8.9	60	50		3.8
	3.7				
	6.4	40	<2B	2.7	2.4
	4.0				
	18.7	50	380	1.6	7.0
	37.9		100		1.6
	8.2	60	50		1.8
	7.8	70	35 B	7.5 J3	4.0
	5.4		2 B		
0.010 M	4.8	15	12 B	3.6	1.6
0.42 J6	3.7				
0.010 M					
0.010 M	5.6		2 B		3.2
0.010 M	12.9				
0.014					
0.010 M	6.9	70	<2B	3.3 J3	3.6
0.010 M	5.5		10 B		
0.010 M	14.7		4 B		5.2
0.010 M	5.6		9 B		
0.010 M	6.0				
0.010 M					
0.010 M	4.4	15	12 B	3.3	3.0
0.010 M	4.0				
0.010 M	11.0	80	44		2.6
0.010 M					
0.013					
0.010 M					
0.71 J6	9.2	60	60		3.2

0.010 M	3.4				
0.010 M					
0.010 M	4.3		110		
0.010 M	8.8		45		
0.010 M	10.2		3 B		3.8
0.012	4.0	15	20 B	3.7	4.2
0.010 M	15.1	175	110		2.0
0.010 M	6.6		1 B		2.2
0.010 M	6.4	40	<2 B	2.0	2.8
0.010 M	6.1				
0.010 M					
0.010 M	8.3	60	42		2.6
0.010 M					
0.010 M					
0.010 M					
0.010 M					
0.010 M					

Station	Date	Depth ft.	Depth relative	Time	Sampler	Temp. °C	pH	D.O. mg/l	Specific Conduct. Mmho/cm	Turbidity ntu
L1	11/15/04	1	Top	11:14	RH	18.7	8.0	6.8	39.6	1.7
L1	11/15/04	6	Mid	11:24	RH	18.6	8.0	6.5	39.6	1.7
L1	11/15/04	12	Bottom	11:19	RH	18.5	8.0	6.5	39.7	1.8
L1	12/13/04	1	Top	10:51	RH	17.5	7.9	7.3	35.3	0.85 J
L1	12/13/04	5.5	Mid	10:56	RH	16.6	8.0	7.3	37.0	0.85 J
L1	12/13/04	9	Bottom	11:01	RH	19.5	7.8	2.2	44.5	6.0
L1	1/18/05	1	Top	11:15	RH	12.5	7.5	8.6	26.4	1.7
L1	1/18/05	4.7	Mid	11:22	RH	13.0	7.5	8.2	26.5	1.0
L1	1/18/05	9.5	Bottom	11:19	RH	17.7	7.4	2.5	41.2	8.0
L1	2/14/05	1	Top	11:30		17.2	7.7	7.8	32.4	2
L1	2/14/05	5	Mid	11:40		16.4	7.7	5.4	41.4	1.9
L1	2/14/05	11	Bottom	11:36		16.9	7.8	3.8	46.2	2.1
L1	3/21/05	1	Top	11:29		19.6	7.6	7.3	22.8	1.9
L1	3/21/05	2	Mid	11:37		19.5	7.6	7.2	22.9	1.9
L1	3/21/05	3.3	Bottom	11:36		19.6	7.6	5.9	27.7	1.9
L1	4/18/05	1	Top	11:31		23.1	7.6	6.3	22.4	1.6
L1	4/18/05	1.5	Mid	11:37		23.1	7.6	5.9	22.5	1.8
L1	4/18/05	2	Bottom	11:35		23.0	7.6	6.0	22.5	1.6
L1	5/16/05	1	Top	11:49		27.9	7.8	5.7	28.9	2.2
L1	5/16/05	2	Mid	11:54		27.4	7.8	5.7	29.5	1.8
L1	5/16/05	3	Bottom	11:55		27.1	7.8	4.9	31.9	1.4
L1	6/13/05	0.8	Top	9:47		29.8	7.7	5.1	30.4	1.8
L1	6/13/05	2.4	Mid	9:54		29.7	7.7	4.5	30.8	2.0
L1	6/13/05	4.5	Bottom	9:49		27.9	7.4	1.9	34.8	2.1
L1	7/20/05	0.9	Top	10:19		31.4	7.9	5.1	40.1	1.5
L1	7/20/05	2.4	Mid	10:24		31.1	7.9	5.1	40.3	1.4
L1	7/20/05	5.0	Bottom	10:21		31.3	7.9	4.6	43.9	2.3
L2	11/15/04	1	Top	11:45	RH	18.7	8.1	6.9	39.4	1.3
L2	11/15/04	6.6	Mid	11:52	RH	18.5	8.1	6.7	39.4	1.4
L2	11/15/04	11.5	Bottom	11:49	RH	18.4	8.1	6.8	39.5	2.2
L2	12/13/04	1	Top	11:25	RH	17.2	7.9	7.7	36.3	0.75 J
L2	12/13/04	5.5	Mid	11:29	RH	16.6	8.0	7.4	37.8	0.70 J
L2	12/13/04	9	Bottom	11:33	RH	18.0	8.1	5.7	45.8	1.7
L2	1/18/05	1	Top	11:40	RH	12.2	7.6	8.6	26.5	1.1
L2	1/18/05	5.5	Mid	11:47	RH	12.2	7.5	8.0	26.5	1.4
L2	1/18/05	10.8	Bottom	11:43	RH	17.3	7.4	1.0	43.6	0.70 J
L2	2/14/05	1	Top	11:59		17.4	7.8	7.9	32	1.1
L2	2/14/05	5.6	Mid	12:07		16.5	7.8	5.4	42	1.4
L2	2/14/05	11	Bottom	12:02		16.6	7.9	4.0	46.7	2.8
L2	3/21/05	1.1	Top	11:58		19.6	7.6	7.4	22.3	1.6
L2	3/21/05	3.2	Mid	12:06		19.6	7.6	7.2	22.3	1.6

L2	3/21/05	6.8	Bottom	12:04		18.9	7.6	1.9	37.3	1.6
L2	4/15/05	1	Top	11:59		22.4	7.8	6.9	22.6	1.4
L2	4/15/05	5.5	Mid	12:02		21.2	7.7	3.0	36.8	1.5
L2	4/15/05	10.1	Bottom	12:05		20.8	7.7	1.7	40.7	3.1
L2	5/16/05	1	Top	12:12		27.3	7.9	6.0	28.9	0.95J
L2	5/16/05	1.6	Mid	12:28		27.0	7.9	6.0	29	1.0
L2	5/16/05	2.5	Bottom	12:23		27.0	7.9	5.9	29.1	1.5
L2	6/13/05	0.9	Top	10:18		29.2	7.4	5.0	27.7	2.7
L2	6/13/05	3.3	Mid	10:26		28.6	7.8	3.7	34.1	1.8
L2	6/13/05	5.5	Bottom	10:21		27.4	7.6	1.4	38.9	2.5
L2	7/20/05	0.9	Top	10:48		31.2	7.9	4.8	39.9	1.2
L2	7/20/05	6	Mid	10:45		29.9	8.0	4.5	39.1	1.3
L2	7/20/05	11	Bottom	10:41		28.7	7.7	1.7	39.2	1.2
L3	11/15/04	1	Top	12:14	RH	18.9	8.1	7.0	39.1	1.2
L3	11/15/04	6.2	Mid	12:22	RH	18.8	6.7	8.1	39.2	1.3
L3	11/15/04	12.6	Bottom	12:20	RH	19.2	8.0	4.6	39.3	1.7
L3	12/13/04	1	Top	11:53	RH	17.6	8.0	7.0	38.6	0.75 J
L3	12/13/04	5.5	Mid	11:56	RH	17.6	8.0	6.9	38.1	0.70 J
L3	12/13/04	10	Bottom	11:58	RH	18.7	8.2	5.3	46.5	1.1
L3	1/18/05	1.4	Top	12:03	RH	11.2	7.5	9.0	24.5	1.6
L3	1/18/05	5.8	Mid	12:10	RH	12.0	7.6	7.8	26.5	1.2
L3	1/18/05	11.2	Bottom	12:07	RH	17.2	7.4	0.5	44	1.6
L3	2/14/05	1	Top	12:35		18.1	7.8	7.9	31.6	0.95J
L3	2/14/05	6	Mid	12:41		16.2	7.9	6.4	42.1	1
L3	2/14/05	11	Bottom	12:38		16.7	7.9	4.3	46.7	1.4
L3	3/21/05	1	Top	12:21		19.3	7.6	7.7	21.7	NA
L3	3/21/05	1.5	Mid	12:28		19.3	7.6	7.6	21.8	1.4
L3	3/21/05	2.1	Bottom	12:23		19.2	7.6	7.7	21.8	NA
L3	4/18/05	1	Top	12:24		22.9	7.8	6.6	22.5	1.4
L3	4/18/05	1.5	Mid	12:26		23.0	7.8	6.2	22.5	1.6
L3	4/18/05	2	Bottom	12:28		22.9	7.8	6.7	22.5	1.5
L3	5/16/05	0.8	Top	12:47		29.2	7.9	6.0	28.8	1.2
L3	5/16/05	1.8	Mid	12:54		26.9	8.0	6.1	28.8	1.0
L3	5/16/05	2.6	Bottom	12:52		26.6	7.9	5.9	28.9	0.75J
L3	6/13/05	1.1	Top	10:42		30.2	8.0	5.8	29.4	1.6
L3	6/13/05	3.6	Mid	10:54		29.3	7.8	5.4	30.0	2.9
L3	6/13/05	7.8	Bottom	10:49		27.4	7.9	2.1	42.0	4.9
L3	7/20/05	1	Top	11:06		31.3	7.9	5.2	38.9	1.0
L3	7/20/05	2	Mid	11:04		31.1	7.9	5.2	38.9	1.0
L3	7/20/05	3.2	Bottom	11:02		31.1	7.9	5.2	39.8	1.9
L4	11/15/04	1	Top	12:50	RH	19.6	8.1	7.0	38.4	2.9
L4	11/15/04	5.6	Mid	12:59	RH	18.9	8.1	6.7	38.8	2.2
L4	11/15/04	11	Bottom	12:55	RH	18.8	8.1	6.7	39.0	2.2
L4	12/13/04	1	Top	12:20	RH	19.7	8.0	6.2	40.8	1.1
L4	12/13/04	5	Mid	12:22	RH	19.0	8.0	4.5	44.5	1.4
L4	12/13/04	8	Bottom	12:26	RH	19.2	8.0	4.5	44.9	2.5
L4	1/18/05	1.0	Top	12:32	RH	13.1	7.5	8.2	27.0	2.0
L4	1/18/05	5.1	Mid	12:37	RH	13	7.5	7.1	27.1	0.95 J
L4	1/18/05	9.0	Bottom	12:35	RH	18.2	7.5	3.3	35.5	1.6
L4	2/14/05	1	Top	13:02		17.1	7.8	7.9	30.4	1.4

L4	2/14/05	4.5	Mid	13:10		16.5	7.8	6.4	42.3	1.1
L4	2/14/05	9	Bottom	13:05		16.9	7.9	5.1	45.6	1.5
L4	3/21/05	1.1	Top	12:47		20.4	7.5	7.6	19.5	1.8
L4	3/21/05	4	Mid	12:55		19.0	7.6	6.9	20.8	1.8
L4	3/21/05	7.9	Bottom	12:53		19.1	7.5	2.7	33.2	1.8
L4	4/18/05	1	Top	12:50		23.1	7.7	6.5	21.2	2.0
L4	4/18/05	4	Mid	12:52		22.2	7.6	4.0	28.2	1.7
L4	4/18/05	8	Bottom	12:54		20.8	7.6	1.3	38.7	2.8
L4	5/16/05	1.2	Top	13:18		28.2	7.9	5.5	28.7	1.4
L4	5/16/05	4.5	Mid	13:25		25.8	7.8	2.8	37.4	1.5
L4	5/16/05	9.1	Bottom	13:21		22.4	7.5	0.5	42.3	1.1
L4	6/13/05	0.8	Top	11:21		30.9	7.6	5.6	23.6	3.2
L4	6/13/05	3.5	Mid	11:34		29.3	7.9	4.7	28.8	2.9
L4	6/13/05	7.1	Bottom	11:26		27.8	7.9	3.4	38.2	3.6
L4	7/20/05	0.9	Top	11:29		32.9	7.8	5	35.3	1.8
L4	7/20/05	4.1	Mid	11:26		32.2	7.9	4.8	35.2	0.9
L4	7/20/05	8.4	Bottom	11:24		29.4	7.4	<0.10	36.0	3.1
S1	11/15/04	1	Top	10:51	RH	20.7	7.8	5.6	39.1	0.65 J
S1	11/15/04	3.9	Bottom	10:57	RH	20.6	8.0	6.3	40.1	3.5
S1	12/13/04	1	Top	10:32	RH	17.3	7.5	7.4	22.3	1.9
S1	12/13/04	2.2	Bottom	10:36	RH	19.3	7.4	6.1	33.7	6.0
S1	1/18/05	1.0	Top	10:59	RH	13.2	6.9	7.7	24.0	1.6
S1	1/18/05	5.0	Bottom	11:03	RH	16.8	7.3	5.5	27.5	1.2
S1	2/14/05	1	Top	11:17		16.5	7.7	7.1	37	1.9
S1	2/14/05	4	Bottom	11:17		16.3	7.7	6.4	38.3	1.5
S1	3/21/05	0.8	Top	11:14		19.3	7.5	6.1	25.3	1.8
S1	3/21/05	3.2	Bottom	11:18		19.6	7.5	4.7	29.1	1.8
S1	4/18/05	1	Top	11:16		24.1	7.5	5.5	23.1	2.0
S1	4/18/05	2	Bottom	11:18		24.5	7.4	3.8	26.4	3.0
S1	5/16/05	1.5	Top	11:31		29.4	7.6	5	29.4	1.9
S1	5/16/05	2.5	Bottom	11:36		32.6	7.4	2.9	32.6	2.2
S1	6/13/05	1	Top	9:31		29.3	7.9	5.0	32.7	2.1
S1	6/13/05	3.6	Bottom	9:35		27.8	7.4	1.7	35.5	2.1
S1	7/20/05	1.0	Top	10:00		32.4	7.6	4.3	40.8	1.8
S1	7/20/05	2.2	Bottom	10:04		32.7	7.8	4.5	41.7	1.4
S2	11/15/04	1	Top	11:33	RH	19.3	8.0	6.5	38.9	1.6
S2	11/15/04	7	Bottom	11:40	RH	18.4	8.1	6.5	39.5	1.8
S2	12/13/04	1	Top	11:11	RH	17.9	7.8	7.2	33.2	1.0
S2	12/13/04	5	Bottom	11:14	RH	16.9	8.0	7.3	36.3	0.85 J
S2	1/18/05	1.0	Top	11:30	RH	13.7	7.2	8.0	25.4	1.2
S2	1/18/05	9.0	Bottom	11:33	RH	18.3	7.4	2.1	40.0	1.4
S2	2/14/05	1	Top	11:48		18	7.6	7.6	29.6	2.7
S2	2/14/05	7	Bottom	11:52		16.4	7.7	4.1	42.8	2.7
S2	3/21/05	0.9	Top	11:44		20.6	7.5	6.8	23.6	1.7
S2	3/21/05	5.3	Bottom	11:46		19.4	7.5	2.6	32.4	1.7
S2	4/18/05	1	Top	11:46		22.7	7.6	6.3	22.7	1.7
S2	4/18/05	4	Bottom	11:48		22.7	7.6	4.9	25.1	2.1
S2	5/16/05	1	Top	12:06		28.3	7.8	5.5	29	1.3
S2	5/16/05	6	Bottom	12:11		25.7	7.6	2.4	38.5	2.7
S2	6/13/05	1	Top	10:02		28.7	6.4	3.4	21.9	2.2
S2	6/13/05	3	Bottom	10:06		28.2	7.2	1.8	31.4	2.3
S2	7/20/05	1.1	Top	10:32		32.2	7.8	4.4	40.9	2.5
S2	7/20/05	3	Bottom	10:34		32.4	7.8	3.8	42.6	1.9

S3	11/15/04	1	Top	11:59	RH	18.8	8.1	6.8	39.4	2.0
S3	11/15/04	5.2	Bottom	12:05	RH	18.8	8.1	6.5	39.4	1.4
S3	12/13/04	1	Top	11:41	RH	17.8	8.0	7.4	37.7	0.8
S3	12/13/04	3	Bottom	11:46	RH	17.7	8.0	7.3	37.6	0.7
S3	1/18/05	1.2	Top	11:53	RH	11.8	7.6	8.9	25.2	1.5
S3	1/18/05	4.3	Bottom	11:56	RH	11.9	7.6	8.7	26.1	1.5
S3	2/14/05	1	Top	12:25		17.9	7.8	7.9	31.4	0.95J
S3	2/14/05	3	Bottom	12:27		16.9	7.9	8.9	39.5	2.9
S3	3/21/05	0.9	Top	12:12		19.9	7.6	7.5	21.9	1.1
S3	3/21/05	2.5	Bottom	12:14		19.9	7.6	7.5	21.9	1.1
S3	4/18/05	1.0	Top	12:15		23.1	7.8	6.9	22.4	1.6
S3	4/18/05	2.0	Bottom	12:16		23.1	7.8	6.8	22.4	1.7
S3	5/16/05	1	Top	12:35		27.0	8.0	6.5	28.7	0.85J
S3	5/16/05	2.1	Bottom	12:39		27.5	8.2	6.3	29.0	2.9
S3	6/13/05	0.7	Top	10:35		29.9	7.2	5.2	21.9	2.9
S3	6/13/05	2.7	Bottom	10:39		29.0	7.6	4.4	31.5	1.6
S3	7/20/05	1.1	Top	10:50		31.5	7.8	4.6	39.2	2.0
S3	7/20/05	2.1	Bottom	10:55		31.6	7.8	4.9	39.5	2.7
S4	11/15/04	1	Top	12:35	RH	19.8	8.1	6.6	39.0	1.6
S4	11/15/04	9.8	Bottom	12:40	RH	18.9	8.1	6.3	39.3	3.8
S4	12/13/04	1	Top	12:08	RH	17.7	8.0	6.9	36.9	0.95
S4	12/13/04	6.6	Bottom	12:12	RH	19.6	7.9	4.0	43.8	1.1
S4	1/18/05	1.0	Top	12:18	RH	13.8	7.5	7.8	27.0	1.2
S4	1/18/05	9.0	Bottom	12:25	RH	18.3	7.4	3.4	36.1	1.6
S4	2/14/05	1	Top	12:50		18.2	7.7	7.5	30.0	7.8
S4	2/14/05	7	Bottom	12:54		16.6	7.8	5.1	43.2	1.4
S4	3/21/05	1	Top	12:38		20.7	7.5	7.3	20.6	1.4
S4	3/21/05	6.8	Bottom	12:42		19.1	7.4	2.7	29.6	1.4
S4	4/18/05	1	Top	12:37		24.2	7.6	6.4	20.7	2.6
S4	4/18/05	4	Bottom	12:39		22.9	7.5	3.8	25.5	2.8
S4	5/16/05	0.8	Top	13:02		29.0	7.9	5.6	29.3	0.95J
S4	5/16/05	7.5	Bottom	13:07		23.4	7.5	0.7	40.2	3.6
S4	6/13/05	0.9	Top	11:04		29.9	7.0	4.1	20.7	14
S4	6/13/05	6.9	Bottom	11:09		27.5	7.6	0.2	40.3	12
S4	7/20/05	0.9	Top	11:13		32.5	7.9	4.9	39.3	1.1
S4	7/20/05	6	Bottom	11:11		30.8	7.7	3.2	44.2	2.1
S5	11/15/04	1	Top	13:05	RH	19.1	8.0	7.2	37.2	2.1
S5	11/15/04	9.7	Bottom	13:10	RH	19.4	8.0	6.4	38.9	1.4
S5	12/13/04	1	Top	12:34	RH	20.1	7.9	4.9	41.1	0.90
S5	12/13/04	7	Bottom	12:36	RH	19.5	8.0	4.0	44.5	1.5
S5	1/18/05	1.2	Top	12:45	RH	14.3	7.5	8.0	27.0	1.1
S5	1/18/05	8.9	Bottom	12:48	RH	18.5	7.4	3.0	35.0	1.8
S5	2/14/05	1	Top	13:17		16.5	7.7	7.8	29.9	2.9
S5	2/14/05	7	Bottom	13:20		16.7	7.9	4.9	44.4	1.9
S5	3/21/05	0.9	Top	13:00		20.2	7.3	7.4	14.6	2.6
S5	3/21/05	7	Bottom	13:06		18.9	7.4	3.6	29.1	2.6
S5	4/18/05	1	Top	13:00		23.7	7.6	6.4	20.5	2.5
S5	4/18/05	6.5	Bottom	13:03		21.0	7.5	1.0	36.7	2.8
S5	5/16/05	0.9	Top	13:38		29.4	7.9	6.4	27.5	2.0
S5	5/16/05	2	Bottom	13:41		28.3	7.9	4.9	29.0	1.5
S5	6/13/05	1	Top	11:34		29.8	7.1	5.3	23.8	2.6
S5	6/13/05	7.5	Bottom	11:38		27.7	7.7	2.0	38.7	2.2
S5	7/20/05	1	Top	11:39		32.9	7.8	4.7	34.3	2.5

S5	7/20/05	7.9	Bottom	11:37		29.8	7.6	1.5	45.8	3.5
S6	11/15/04	1	Top	13:26	RH	18.5	8.2	7.3	38.3	1.4
S6	11/15/04	3.5	Bottom	13:26	RH	17.9	8.1	8.4	38.6	1.4
S6	12/13/04	1	Top	13:26	RH	17.6	8.1	7.7	38.3	1.3
S6	12/13/04	4	Bottom	13:29	RH	17.7	8.1	8.1	38.3	5.0
S6	1/18/05	1.1	Top	12:58	RH	10.7	7.6	9.3	23.8	1.6
S6	1/18/05	3.6	Bottom	13:01	RH	10.3	7.6	9.3	24.6	1.8
S6	2/14/05	1	Top	13:37		16.8	7.8	7.4	36	0.9J
S6	2/14/05	3	Bottom	13:40		16.8	7.9	7.9	39.6	1.4
S6	3/21/05	0.9	Top	13:20		19.2	7.5	7.4	21.3	1.8
S6	3/21/05	2.7	Bottom	13:24		18.2	7.5	7.2	22.4	1.8
S6	4/18/05	1	Top	13:19		22.9	7.8	6.7	23.0	2.2
S6	4/18/05	1.7	Bottom	13:23		22.7	7.9	6.2	23.2	2.2
S6	5/16/05	0.8	Top	13:55		27.8	8.0	6.7	27.4	1.3
S6	5/16/05	1.5	Bottom	13:58		27.7	8.1	7.5	27.4	1.2
S6	6/13/05	0.9	Top	11:48		30.6	8.1	5.7	31.3	1.5
S6	6/13/05	2.3	Bottom	11:53		29.7	8.1	6.8	32.6	1.1
S6	7/20/05	0.8	Top	11:59		31.6	7.9	5.7	38.9	1.1
S6	7/20/05	1.6	Bottom	11:55		31.4	7.9	6.0	39.0	1.5
S7	11/15/04	1	Top	10:35	RH	18.8	7.8	7.0	39.5	1.5
S7	11/15/04	5.8	Bottom	10:38	RH	18.7	7.9	6.5	39.6	1.5
S7	12/13/04	1	Top	10:13	RH	17.5	7.8	7.5	35.9	1.3
S7	12/13/04	5	Bottom	10:18	RH	17.1	7.8	7.5	36.1	1.1
S7	1/18/05	1.5	Top	10:37	RH	11.2	7.1	8.7	19.8	1.2
S7	1/18/05	5	Bottom	10:47	RH	12.2	7.4	8.3	26.5	0.90 J
S7	2/14/05	1	Top	11:00		16.6	7.6	7.5	35.2	0.8J
S7	2/14/05	6	Bottom	11:10		16.5	7.6	5.2	41.6	1.4
S7	3/21/05	1	Top	10:57		19.9	7.5	6.8	24.3	2.0
S7	3/21/05	6	Bottom	11:02		19.1	7.6	4.1	32.6	2.0
S7	4/18/05	1	Top	10:58		21.4	7.1	6.5	22.5	1.8
S7	4/18/05	7.2	Bottom	11:00		20.7	7.3	1.1	38.0	1.9
S7	5/16/05	1.1	Top	11:11		27.6	7.7	5.6	28.7	2.1
S7	5/16/05	5.5	Bottom	11:16		23.0	7.5	1.8	40.1	1.3
S7	6/13/05	1	Top	9:15		29.9	7.8	5.6	32.8	1.7
S7	6/13/05	7	Bottom	9:18		27.9	7.5	1.7	41.4	1.7
S7	7/20/05	0.9	Top	9:47		31.5	7.8	4.8	39.6	1.7
S7	7/20/05	5.2	Bottom	9:41		30.5	7.8	4.1	44.7	4.1

Secchi depth ft.	Total N mg/l	TKN mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml
5.5	0.50	0.49	0.012	0.082 U	0.050	0.010 M	4.8	15	12 B
	0.72	0.70	0.015	0.082 U	0.12	0.018	4.9		
8	0.47	0.45	0.019	0.082 U	0.011	0.42 J6	3.7		
							4.4	20	64 B
	0.73	0.72	0.011	0.082 U	0.029	0.018			
6	0.42	0.38	0.035	0.082 U	0.21	0.010 M			
							2.9		
	0.64 J4	0.63 J4	0.011	0.19	0.019	0.010 M	28.4	20	15 B
6	0.49		0.044	0.082U	0.006 U	0.010 M	5.6		2 B
	0.70		0.012	0.13	0.006 U	0.010 M	5.4		
3.5	0.33		0.012	0.082U	0.018 U	0.010 M	12.9		
							8.5		7 B
	0.49		0.028	0.082U	0.030	0.012			
>3	0.50		0.043	0.082 U	0.020 M	0.014			
							9.6	100	7 B
	0.53		0.084	0.082 U	0.018 U	0.010 M			
>4	0.38		0.0053 U	0.082U	0.011	0.010 M	6.9	70	<2B
	0.51		0.0053 U	0.082U	0.022	0.010 M	18.5		100
3.0	0.49		0.0053 U	0.082U	0.017	0.010 M	5.5		10 B
	0.51		0.0053 U	0.082U	0.090	0.010 M	8.9	60	28 B
>7	0.40		0.0053 U	0.082U	0.010 M	0.010 M	14.7		4 B
	0.39		0.0053 U	0.082U	0.011	0.010 M	7.5	60	3.2
6	0.40	0.40	0.010 M	0.082 U	0.018	0.010 M	5.6		9 B
	0.22	0.22	0.010 M	0.082 U	0.019	0.010 M	3.7		
8	0.44	0.42	0.022	0.10 M J4	0.011	0.010 M	6.0		
							5.2	30	2 B
	0.47	0.46	0.011	0.082 U	0.011	0.010 M			
6	0.34	0.31	0.034	0.082 U	0.028	0.010 M			
							4.7		
	0.78	0.77	0.011	0.30	0.076	0.010 M	4.7		5 B
6	0.52		0.044	0.082 U	0.006 U	0.010 M	4.4	15	12 B
	0.42		0.014	0.082 U	0.006 U	0.010 M	4.6		
4	0.30		0.017	0.082 U	0.018 U	0.010 M	4.0		
							15.1	20	74

	0.50		0.010 M	0.22	0.018 U	0.010 M			
2.5	0.51		0.044	0.082 U	0.018 U	0.010 M	11.0	80	44
	0.52		0.0053 U	0.21	0.018 U	0.010 M	21.8	125	550
>3.5	0.52		0.019	0.082 U	0.019	0.010 M			
							5.4		<2 B
	0.36		0.0053 U	0.082 U	0.011	0.010 M			
3.5	0.46		0.0053 U	0.082 U	0.020	0.013			
							13	90	710B
	0.47		0.0053 U	0.082 U	0.043	0.010 M			
4	0.44		0.0053 U	0.082 U	0.010 M	0.010 M			
							8.3		32
	0.45		0.0053 U	0.082 U	0.052	0.010 M			
5.5	0.13	0.13	0.010 M	0.082 U	0.026	0.71 J6	9.2	60	60
	0.34	0.33	0.011	0.082 U	0.021	0.010 M	4.3		
8	0.47	0.45	0.016	0.082 U	0.016	0.010 M	3.4		
							8.9	60	50
	0.55	0.54	0.013	0.082 U	0.035	0.010 M			
5	0.40	0.40	0.010 M	0.082 U	0.016	0.010 M			
							3.7		
	0.77	0.74	0.030	0.33	0.048	0.010 M	10.1	80	64
8	0.52		0.041	0.082 U	0.018	0.010 M	4.3		110
	0.58		0.013	0.10 M	0.006U	0.010 M	5.6		
3	0.34		0.013	0.082 U	0.018U	0.010 M	8.8		45
	0.32		0.014	0.082 U	0.025	0.010 M	20.4	100	79
>3	0.53		0.033	0.082 U	0.018 U	0.010 M	10.2		3 B
	0.55		0.052	0.082 U	0.018 U	0.017	7.5	150	<2B
>3.5	0.39		0.0053 U	0.082 U	0.010 M	0.012	4.0	15	20 B
	0.35		0.0053 U	0.082 U	0.010 M	0.012	5.9		240
3	0.54		0.0053 U	0.082 U	0.015	0.010 M	15.1	175	110
	0.56		0.0053 U	0.082 U	0.022	0.013	10.8		13 B
>4.5	0.35		0.0053 U	0.082 U	0.010 M	0.010 M	6.6		1 B
	0.34		0.0053 U	0.082 U	0.010 M	0.010 M	4.5	15	8 B
5.5	0.48	0.45	0.026	0.082 U	0.039	0.010 M	6.4	40	<2 B
	0.35	0.31 J4	0.14	0.082 U	0.029	0.010 M	5.3		
8	0.52	0.51	0.014	0.082 U	0.018	0.010 M	6.1		
							6.4	40	<2B
	0.57	0.56	0.013	0.082 U	0.021 U	0.010 M			
5	0.39	0.36	0.030	0.082 U	0.83	0.010 M			
							4.0		
	0.57	0.55	0.017	0.13	0.019	0.010 M	6.5	40	10 B
6	0.41		0.071	0.082 U	0.006 U	0.010 M	8.3	60	42

	0.53		0.016	0.010 M	0.006 U	0.010 M	5.0		
2	0.32		0.044	0.11	0.023	0.010 M			
							18.7	50	380
	0.75		0.0053U	0.39	0.028	0.020			
2	0.79		0.059	0.082 U	0.050	0.010 M			
							37.9		100
	0.80		0.012	0.28	0.020 M	0.010 M			
4	0.42		0.010 M	0.082 U	0.013	0.010 M			
							8.2	60	50
	0.94		0.010 M	0.27	0.050	0.013			
2	0.44		0.0053 U	0.082 U	0.016	0.010 M			
							7.8	70	35 B
	0.45		0.0053 U	0.082U	0.017	0.010 M			
7	0.33		0.0053 U	0.082 U	0.006U	0.010 M			
							5.4		2 B
	0.44		0.011	0.082 U	0.012	0.010 M			
>4	0.28	0.28	0.010 M	0.082 U	0.023	0.010 M	14.2	100	3 B
6	0.48	0.45	0.034	0.082 U	0.011	0.010 M	3.8		
							10.7	100	17B
4	0.52	0.50	0.015	0.082 U	0.032	0.010 M			
							3.7		
>4	0.74		0.041	0.082 U	0.041	0.010 M	7.2	50	84
>4	0.63		0.013	0.082 U	0.018 U	0.010 M	18.3	175	24B
>3	0.63		0.030	0.082 U	0.018 U	0.010 M	5.0		2 B
3	0.8		0.027	0.082 U	0.017	0.010 M	54.8	80	500
3.5	0.56		0.010 M	0.082 U	0.018	0.010	23.9		58
>2.6	0.39		0.0053 U	0.082 U	0.013	0.010 M	12.4	100	94
5	0.32	0.32	0.010 M	0.082 U	0.023	0.010 M	8.8		
							10.7		3 B
6	0.38	0.34	0.037	0.082 U	0.011	0.010 M			
							4.8		
5	0.42	0.39	0.030	0.082 U	0.014	0.010 M	10.9	140	17 B
5	0.49		0.053	0.082 U	0.006 U	0.010 M	4.7		
							13.8	125	25B
3.75	0.38		0.012	0.082 U	0.018 U	0.010 M	15.8		4 B
2	0.62		0.065	0.082 U	0.018 U	0.010 M	5.1	15	12 B
2.5	0.50		0.015	0.082 U	0.025	0.010 M	10.9	100	7B
1	0.80		0.024	0.082 U	0.017	0.011	7.4		10 B
>4	1.1		0.0053 U	0.082 U	0.019	0.010 M	9.6	30	2B

5	0.42	0.40	0.022	0.082 U	0.021	0.016	10.6		
>3.5	0.48	0.46	0.018	0.082 U	0.011	0.010 M	11.4	125	<2 B
5	0.50	0.38	0.12	0.082 U	0.017	0.010 M	11.6 11.1		<2 B
>4	0.48		0.043	0.082 U	0.024	0.010 M	6.2		
3	0.57		0.016	0.082 U	0.018 U	0.010 M	15.5	300	31
>3	0.50		0.047	0.082 U	0.018 U	0.014	5.8		3 B
>3	0.46		0.012	0.082 U	0.018	0.010 M	13.3		12 B
1	0.55		0.010 M	0.082 U	0.025	0.011	4.9	20 J5	13 B
>3	0.39		0.0053 U	0.082 U	0.010 M	0.010 M	9.7	75	3B
5	0.41	0.41	0.010 M	0.082 U	0.027	0.010 M	6.9	60	<2 B
7	0.33	0.29	0.036	0.082 U	0.022	0.010 M	6.4 7.5	60	2 B
6	0.35	0.32	0.032	0.082 U	0.017	0.010 M	11.3		
6	0.53		0.096	0.082 U	0.021	0.012	10.8		2 B
3.5	0.56		0.075	0.082 U	0.018 U	0.010 M	17.5		64
2.5	0.67		0.10	0.082 U	0.018 U	0.014	13.2	60	70
4.5	0.48		0.037	0.082 U	0.023	0.010 M	7.2	60	3 B
1	0.73		0.070	0.082 U	0.018	0.018	5.5		<1
5.5	0.35		0.0053 U	0.082 U	0.006 U	0.010 M	11.0		2 B
5.5	0.66	0.60	0.065	0.082 U	0.13	0.010 M	6.5 9.2		8.0
6	0.47	0.46	0.014	0.082 U	0.011	0.010 M	7.2		
5	4.1	4.1	0.034	0.082 U	0.021	0.010 M	7.5	60	<2 B
6	0.49		0.076	0.082 U	0.006 U	0.010 M	5.6 8.3	70	4 B
2	0.47		0.10	0.082 U	0.018 U	0.010 M	4.4		12 B
>2	0.52		0.075	0.082 U	0.018 U	0.011	10.8	100	<2B
>3	0.49		0.068	0.082 U	0.014	0.010 M	24		300
1	0.64		0.055	0.082 U	0.017	0.010 M	10.4	120	100
5	0.38		0.060	0.082 U	0.010M	0.010 M	7.7	70	5 B

4	0.32	0.49 J4	0.010 M	0.082 U	0.03	0.010 M	11.9		
>5	0.41	0.39	0.024	0.082 U	0.018	0.010 M	12.2	125	58
4	0.31	0.28	0.028	0.082 U	0.24	0.010 M	7.6 9.1		17
>4	0.42		0.039	0.082 U	0.006 U	0.010 M	5.4		
2	0.30		0.013	0.082 U	0.018 U	0.010 M	5.2	20	33 B
>2	1.2		0.048	0.082 U	0.018 U	0.013	10.7	140	<3B
>2.5	0.44		0.0053 U	0.082 U	0.013	0.010 M	5.3		2 B
2	0.47		0.0053 U	0.082 U	0.018	0.010 M	7.8	40	8B
>3	0.35		0.0053 U	0.082 U	0.010 M	0.010 M	8.5		17
5	0.44	0.44	0.010 M	0.082 U	0.019	0.010 M	6.2		2 B
>6	0.54	0.50	0.040	0.082 U	0.019	0.010 M	5.7 5.1		<2 B
4	0.27	0.23	0.037	0.082 U	0.35	0.010 M	4.3		
>6	0.54		0.044	0.082 U	0.006 U	0.010 M	15.5		130
4.5	0.34		0.016	0.082 U	0.018 U	0.010 M	28.6		25 B
3.5	0.89		0.039	0.082 U	0.018 U	0.0026 U	10.6		2 B
4.5	0.76		0.010 M	0.082 U	0.021	0.010 M	10.8	50	570
4	0.46		0.010 M	0.082 U	0.016	0.010 M	11	100	11B
6	0.37		0.0053 U	0.082 U	0.010 M	0.010 M	5.7		12 B

Chlorophyll A ug/l	TSS mg/l
3.6	1.6
3.2	6.0
3.2	3.0
	3.2
	1.2
	3.6
3.3 J3	3.6
	2.8
	2.8
	5.2
3.8 J3	3.2
	3.0
3.3	3.0
4.2	6.5

	2.6
1.0 M	2.0
	2.8
1.5	3.8
	3.4
	3.2
	3.8
	2.8
	3.2
	3.8
4.9 J3	3.0
3.7	4.2
	2.0
	3.4
	2.2
3.7	6.0
2.0	2.8
2.7	2.4
3.3	2.8
	2.6

1.6	7.0
	1.6
	1.8
7.5 J3	4.0
	1.8
	2.0
2.7	3.4
	1.2
	2.4
1.4	6.2
	1.6
1.3	1.6
	2.2
	3.4
	2.2
	3.0
3.1	5.8
	2.2
	2.0
1.4	4.8

	3.0
	3.6
1.0 J3	3.8
	2.4
2.7	1.4 J5
no sample	3.0
3.4 J3	4.2
4.3 J3	2.0
	2.4
	2.8
	1.8
4.7 J3	4.0
5.3	3.7
	3.2
4.1 J3	2.2
4.8 J3	2.2
	3.6
2.3	3.4
	2.4
	3.0
3.8 J3	3.9

	3.0
	2.4
2.9	4.0
	3.2
	1.2
2.1	4.4
4.4	2.5
	3.6
	4
	3.6
	4.4
2.9	2.0
	2.6
1.6 J3	4.4

L1						Specific		Secchi								Fecal	Chlorophyll	
Date	Depth	Time	Temp.	pH	D.O.	Conduct.	Turbidity	depth	Total N	NO2NO3	Ammonia	Total P	Ortho P	TOC	Color	coliform	A	TSS
	ft		°C		mg/l	mmho/cm	ntu	feet	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pcu	#/100ml	ug/l	mg/l
11/15/04	1	11:14	18.7	8.0	6.8	39.6	1.7	5.5	0.50	0.012	0.082 U	0.050	0.010 M	4.8	15	12 B	3.6	1.6
11/15/04	6	11:24	18.6	8.0	6.5	39.6	1.7											
11/15/04	12	11:19	18.5	8.0	6.5	39.7	1.8		0.72	0.015	0.082 U	0.12	0.018	4.9				
12/13/04	1	10:51	17.5	7.9	7.3	35.3	0.85 J	8	0.47	0.019	0.082 U	0.011	0.42 J6	5.6		9 B		
12/13/04	5.5	10:56	16.6	8.0	7.3	37.0	0.85 J											
12/13/04	9	11:01	19.5	7.8	2.2	44.5	6.0		0.73	0.011	0.082 U	0.029	0.018	3.7				
1/18/05	1	11:15	12.5	7.5	8.6	26.4	1.7	6	0.42	0.035	0.082 U	0.21	0.010 M	9.2	60	60		3.2
1/18/05	4.7	11:22	13.0	7.5	8.2	26.5	1.0											
1/18/05	9.5	11:19	17.7	7.4	2.5	41.2	8.0		0.64 J4	0.011	0.19	0.019	0.010 M	4.3				
2/14/05	1	11:30	17.2	7.7	7.8	32.4	2	6	0.49	0.044	0.082U	0.006 U	0.010 M	6.4	40	<2 B	2.0	2.8
2/14/05	5	11:40	16.4	7.7	5.4	41.4	1.9											
2/14/05	11	11:36	16.9	7.8	3.8	46.2	2.1		0.70	0.012	0.13	0.006 U	0.010 M	5.3				
3/21/05	1	11:29	19.6	7.6	7.3	22.8	1.9	3.5	0.33	0.012	0.082U	0.018 U	0.010 M	14.2	100	3 B		1.8
3/21/05	2	11:37	19.5	7.6	7.2	22.9	1.9											
3/21/05	3.3	11:36	19.6	7.6	5.9	27.7	1.9		0.49	0.028	0.082U	0.030	0.012	8.8				
4/18/05	1	11:31	23.1	7.6	6.3	22.4	1.6	>3	0.50	0.043	0.082 U	0.020 M	0.014	10.7		3 B		2.2
4/18/05	1.5	11:37	23.1	7.6	5.9	22.5	1.8											
4/18/05	2	11:35	23.0	7.6	6.0	22.5	1.6		0.53	0.084	0.082 U	0.018 U	0.010 M	10.6				
5/16/05	1	11:49	27.9	7.8	5.7	28.9	2.2	>4	0.38	0.0053 U	0.082U	0.011	0.010 M	6.9	60	<2 B	3.4 J3	4.2
5/16/05	2	11:54	27.4	7.8	5.7	29.5	1.8											
5/16/05	3	11:55	27.1	7.8	4.9	31.9	1.4		0.51	0.0053 U	0.082U	0.022	0.010 M	6.5				
6/13/05	0.8	9:47	29.8	7.7	5.1	30.4	1.8	3.0	0.49	0.0053 U	0.082U	0.017	0.010 M	9.2		8.0		3.2
6/13/05	2.4	9:54	29.7	7.7	4.5	30.8	2.0											
6/13/05	4.5	9:49	27.9	7.4	1.9	34.8	2.1		0.51	0.0053 U	0.082U	0.090	0.010 M	11.9				
7/20/05	0.9	10:19	31.4	7.9	5.1	40.1	1.5	>7	0.40	0.0053 U	0.082U	0.010 M	0.010 M	6.2		2 B		3.6
7/20/05	2.4	10:24	31.1	7.9	5.1	40.3	1.4											
7/20/05	5.0	10:21	31.3	7.9	4.6	43.9	2.3		0.39	0.0053 U	0.082U	0.011	0.010 M	3.7				

B = Results based on colony counts outside the acceptable range.
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M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J4 = The matrix interfered with the ability to make an accurate determination.
J5 = the data is questionable because of improper laboratory or field protocols
J6 = Result is suspect because the TP is lower than the OP result

L2 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	11:45	18.7	8.1	6.9	39.4	1.3	6	0.40	0.010 M	0.082 U	0.018	0.010 M	4.4	20	64 B	3.2	6.0
	6.6	11:52	18.5	8.1	6.7	39.4	1.4											
	11.5	11:49	18.4	8.1	6.8	39.5	2.2		0.22	0.010 M	0.082 U	0.019	0.010 M	6.0				
12/13/04	1	11:25	17.2	7.9	7.7	36.3	0.75 J	8	0.44	0.022	0.10 M J4	0.011	0.010 M	5.2	30	2 B		3.0
	5.5	11:29	16.6	8.0	7.4	37.8	0.70 J											
	9	11:33	18.0	8.1	5.7	45.8	1.7		0.47	0.011	0.082 U	0.011	0.010 M	3.4				
1/18/05	1	11:40	12.2	7.6	8.6	26.5	1.1	6	0.34	0.034	0.082 U	0.028	0.010 M	8.9	60	50		3.8
	5.5	11:47	12.2	7.5	8.0	26.5	1.4											
	10.8	11:43	17.3	7.4	1.0	43.6	0.70 J		0.78	0.011	0.30	0.076	0.010 M	6.1				
2/14/05	1	11:59	17.4	7.8	7.9	32	1.1	6	0.52	0.044	0.082 U	0.006 U	0.010 M	6.4	40	<2B	2.7	2.4
	5.6	12:07	16.5	7.8	5.4	42	1.4											
	11	12:02	16.6	7.9	4.0	46.7	2.8		0.42	0.014	0.082 U	0.006 U	0.010 M	3.8				
3/21/05	1.1	11:58	19.6	7.6	7.4	22.3	1.6	4	0.30	0.017	0.082 U	0.018 U	0.010 M	10.7	100	17B		2.0
	3.2	12:06	19.6	7.6	7.2	22.3	1.6											
	6.8	12:04	18.9	7.6	1.9	37.3	1.6		0.50	0.010 M	0.22	0.018 U	0.010 M	4.8				
4/15/05	1	11:59	22.4	7.8	6.9	22.6	1.4	2.5	0.51	0.044	0.082 U	0.018 U	0.010 M	11.4	125	<2 B		3.0
	5.5	12:02	21.2	7.7	3.0	36.8	1.5											
	10.1	12:05	20.8	7.7	1.7	40.7	3.1		0.52	0.0053 U	0.21	0.018 U	0.010 M	6.4				
5/16/05	1	12:12	27.3	7.9	6.0	28.9	0.95J	>3.5	0.52	0.019	0.082 U	0.019	0.010 M	7.5	60	2 B	4.3 J3	2.0
	1.6	12:28	27.0	7.9	6.0	29	1.0											
	2.5	12:23	27.0	7.9	5.9	29.1	1.5		0.36	0.0053 U	0.082 U	0.011	0.010 M	7.2				
6/13/05	0.9	10:18	29.2	7.4	5.0	27.7	2.7	3.5	0.46	0.0053 U	0.082 U	0.020	0.013	12.2	125	58		3.0
	3.3	10:26	28.6	7.8	3.7	34.1	1.8											
	5.5	10:21	27.4	7.6	1.4	38.9	2.5		0.47	0.0053 U	0.082 U	0.043	0.010 M	5.7				
7/20/05	0.9	10:48	31.2	7.9	4.8	39.9	1.2	4	0.44	0.0053 U	0.082 U	0.010 M	0.010 M	5.1		<2 B		4
	6	10:45	29.9	8.0	4.5	39.1	1.3											
	11	10:41	28.7	7.7	1.7	39.2	1.2		0.45	0.0053 U	0.082 U	0.052	0.010 M	2.9				

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

L3

Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	12:14	18.9	8.1	7.0	39.1	1.2	5.5	0.13	0.010 M	0.082 U	0.026	0.71 J6	28.4	20	15 B	3.2	3.0
	6.2	12:22	18.8	6.7	8.1	39.2	1.3											
	12.6	12:20	19.2	8.0	4.6	39.3	1.7		0.34	0.011	0.082 U	0.021	0.010 M	4.7				
12/13/04	1	11:53	17.6	8.0	7.0	38.6	0.75 J	8	0.47	0.016	0.082 U	0.016	0.010 M	4.7		5 B		
	5.5	11:56	17.6	8.0	6.9	38.1	0.70 J											
	10	11:58	18.7	8.2	5.3	46.5	1.1		0.55	0.013	0.082 U	0.035	0.010 M	3.7				
1/18/05	1.4	12:03	11.2	7.5	9.0	24.5	1.6	5	0.40	0.010 M	0.082 U	0.016	0.010 M	10.1	80	64		2.8
	5.8	12:10	12.0	7.6	7.8	26.5	1.2											
	11.2	12:07	17.2	7.4	0.5	44	1.6		0.77	0.030	0.33	0.048	0.010 M	4.0				
2/14/05	1	12:35	18.1	7.8	7.9	31.6	0.95J	8	0.52	0.041	0.082 U	0.018	0.010 M	6.5	40	10 B	3.3	2.8
	6	12:41	16.2	7.9	6.4	42.1	1											
	11	12:38	16.7	7.9	4.3	46.7	1.4		0.58	0.013	0.10 M	0.006U	0.010 M	3.7				
3/21/05	1	12:21	19.3	7.6	7.7	21.7	NA	3	0.34	0.013	0.082 U	0.018U	0.010 M	10.9	140	17 B		3.4
	1.5	12:28	19.3	7.6	7.6	21.8	1.4											
	2.1	12:23	19.2	7.6	7.7	21.8	NA		0.32	0.014	0.082 U	0.025	0.010 M	11.6				
4/18/05	1	12:24	22.9	7.8	6.6	22.5	1.4	>3	0.53	0.033	0.082 U	0.018 U	0.010 M	11.1		<2 B		3.6
	1.5	12:26	23.0	7.8	6.2	22.5	1.6											
	2	12:28	22.9	7.8	6.7	22.5	1.5		0.55	0.052	0.082 U	0.018 U	0.017	11.3				
5/16/05	0.8	12:47	29.2	7.9	6.0	28.8	1.2	>3.5	0.39	0.0053 U	0.082 U	0.010 M	0.012	7.5	60	<2 B	4.1 J3	2.2
	1.8	12:54	26.9	8.0	6.1	28.8	1.0											
	2.6	12:52	26.6	7.9	5.9	28.9	0.75J		0.35	0.0053 U	0.082 U	0.010 M	0.012	7.6				
6/13/05	1.1	10:42	30.2	8.0	5.8	29.4	1.6	3	0.54	0.0053 U	0.082 U	0.015	0.010 M	9.1		17		2.4
	3.6	10:54	29.3	7.8	5.4	30.0	2.9											
	7.8	10:49	27.4	7.9	2.1	42.0	4.9		0.56	0.0053 U	0.082 U	0.022	0.013	4.3				
7/20/05	1	11:06	31.3	7.9	5.2	38.9	1.0	>4.5	0.35	0.0053 U	0.082 U	0.010 M	0.010 M	5.6		2 B		3.2
	2	11:04	31.1	7.9	5.2	38.9	1.0											
	3.2	11:02	31.1	7.9	5.2	39.8	1.9		0.34	0.0053 U	0.082 U	0.010 M	0.010 M	5.4				

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M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols
J6 = Result is suspect because the TP is lower than the OP result

L4 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	12:50	19.6	8.1	7.0	38.4	2.9	5.5	0.48	0.026	0.082 U	0.039	0.010 M	4.4	15	12 B	3.3	3.0
	5.6	12:59	18.9	8.1	6.7	38.8	2.2											
	11	12:55	18.8	8.1	6.7	39.0	2.2		0.35	0.14	0.082 U	0.029	0.010 M	4.6				
12/13/04	1	12:20	19.7	8.0	6.2	40.8	1.1	8	0.52	0.014	0.082 U	0.018	0.010 M	4.3		110		
	5	12:22	19.0	8.0	4.5	44.5	1.4											
	8	12:26	19.2	8.0	4.5	44.9	2.5		0.57	0.013	0.082 U	0.021 U	0.010 M	5.6				
1/18/05	1.0	12:32	13.1	7.5	8.2	27.0	2.0	5	0.39	0.030	0.082 U	0.83	0.010 M	8.3	60	42		2.6
	5.1	12:37	13	7.5	7.1	27.1	0.95 J											
	9.0	12:35	18.2	7.5	3.3	35.5	1.6		0.57	0.017	0.13	0.019	0.010 M	5.0				
2/14/05	1	13:02	17.1	7.8	7.9	30.4	1.4	6	0.41	0.071	0.082 U	0.006 U	0.010 M	7.2	50	84	2.7	3.4
	4.5	13:10	16.5	7.8	6.4	42.3	1.1											
	9	13:05	16.9	7.9	5.1	45.6	1.5		0.53	0.016	0.010 M	0.006 U	0.010 M	4.7				
3/21/05	1.1	12:47	20.4	7.5	7.6	19.5	1.8	2	0.32	0.044	0.11	0.023	0.010 M	13.8	125	25B		2.2
	4	12:55	19.0	7.6	6.9	20.8	1.8											
	7.9	12:53	19.1	7.5	2.7	33.2	1.8		0.75	0.0053U	0.39	0.028	0.020	6.2				
4/18/05	1	12:50	23.1	7.7	6.5	21.2	2.0	2	0.79	0.059	0.082 U	0.050	0.010 M	10.8		2 B		2.4
	4	12:52	22.2	7.6	4.0	28.2	1.7											
	8	12:54	20.8	7.6	1.3	38.7	2.8		0.80	0.012	0.28	0.020 M	0.010 M	5.6				
5/16/05	1.2	13:18	28.2	7.9	5.5	28.7	1.4	4	0.42	0.010 M	0.082 U	0.013	0.010 M	8.3	70	4 B	4.8 J3	2.2
	4.5	13:25	25.8	7.8	2.8	37.4	1.5											
	9.1	13:21	22.4	7.5	0.5	42.3	1.1		0.94	0.010 M	0.27	0.050	0.013	5.4				
6/13/05	0.8	11:21	30.9	7.6	5.6	23.6	3.2	2	0.44	0.0053 U	0.082 U	0.016	0.010 M	15.5		130		3.6
	3.5	11:34	29.3	7.9	4.7	28.8	2.9											
	7.1	11:26	27.8	7.9	3.4	38.2	3.6		0.45	0.0053 U	0.082U	0.017	0.010 M	12.9				
7/20/05	0.9	11:29	32.9	7.8	5	35.3	1.8	7	0.33	0.0053 U	0.082 U	0.006U	0.010 M	8.5		7 B		1.2
	4.1	11:26	32.2	7.9	4.8	35.2	0.9											
	8.4	11:24	29.4	7.4	<0.10	36.0	3.1		0.44	0.011	0.082 U	0.012	0.010 M	4.0				

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J4 = Estimated result. The sample matrix interfered with the ability to make an accurate measurement.
J5 = the data is questionable because of improper laboratory or field protocols

S1						Specific		Secchi								Fecal	Chlorophyll	
Date	Depth	Time	Temp.	pH	D.O.	Conduct.	Turbidity	depth	Total N	NO2NO3	Ammonia	Total P	Ortho P	TOC	Color	coliform	A	TSS
	ft		°C		mg/l	mmho/cm	ntu	feet	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pcu	#/100ml	ug/l	mg/l
11/15/04	1	10:51	20.7	7.8	5.6	39.1	0.65 J	>4	0.28	0.010 M	0.082 U	0.023	0.010 M	15.1	20	74	4.2	6.5
	3.9	10:57	20.6	8.0	6.3	40.1	3.5											
12/13/04	1	10:32	17.3	7.5	7.4	22.3	1.9	6	0.48	0.034	0.082 U	0.011	0.010 M	8.8		45		
	2.2	10:36	19.3	7.4	6.1	33.7	6.0											
1/18/05	1.0	10:59	13.2	6.9	7.7	24.0	1.6	4	0.52	0.015	0.082 U	0.032	0.010 M	20.4	100	79		3.2
	5.0	11:03	16.8	7.3	5.5	27.5	1.2											
2/14/05	1	11:17	16.5	7.7	7.1	37	1.9	>4	0.74	0.041	0.082 U	0.041	0.010 M	18.7	50	380	1.6	7.0
	4	11:17	16.3	7.7	6.4	38.3	1.5											
3/21/05	0.8	11:14	19.3	7.5	6.1	25.3	1.8	>4	0.63	0.013	0.082 U	0.018 U	0.010 M	18.3	175	24B		1.2
	3.2	11:18	19.6	7.5	4.7	29.1	1.8											
4/18/05	1	11:16	24.1	7.5	5.5	23.1	2.0	>3	0.63	0.030	0.082 U	0.018 U	0.010 M	15.8		4 B		3.0
	2	11:18	24.5	7.4	3.8	26.4	3.0											
5/16/05	1.5	11:31	29.4	7.6	5	29.4	1.9	3	0.8	0.027	0.082 U	0.017	0.010 M	15.5	300	31	1.0 J3	3.8
	2.5	11:36	32.6	7.4	2.9	32.6	2.2											
6/13/05	1	9:31	29.3	7.9	5.0	32.7	2.1	3.5	0.56	0.010 M	0.082 U	0.018	0.010	17.5		64		2.8
	3.6	9:35	27.8	7.4	1.7	35.5	2.1											
7/20/05	1.0	10:00	32.4	7.6	4.3	40.8	1.8	>2.6	0.39	0.0053 U	0.082 U	0.013	0.010 M	4.4		12 B		3.6
	2.2	10:04	32.7	7.8	4.5	41.7	1.4											

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S2						Specific		Secchi								Fecal	Chlorophyll	
Date	Depth	Time	Temp.	pH	D.O.	Conduct.	Turbidity	depth	Total N	NO2NO3	Ammonia	Total P	Ortho P	TOC	Color	coliform	A	TSS
	ft		°C		mg/l	mmho/cm	ntu	feet	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pcu	#/100ml	ug/l	mg/l
11/5/04	1	11:33	19.3	8.0	6.5	38.9	1.6	5	0.32	0.010 M	0.082 U	0.023	0.010 M	5.2	20	33 B	2.9	4.0
	7	11:40	18.4	8.1	6.5	39.5	1.8											
12/13/04	1	11:11	17.9	7.8	7.2	33.2	1.0	6	0.38	0.037	0.082 U	0.011	0.010 M	28.6		25 B		
	5	11:14	16.9	8.0	7.3	36.3	0.85 J											
1/18/05	1.0	11:30	13.7	7.2	8.0	25.4	1.2	5	0.42	0.030	0.082 U	0.014	0.010 M	11.0	80	44		2.6
	9.0	11:33	18.3	7.4	2.1	40.0	1.4											
2/14/05	1	11:48	18	7.6	7.6	29.6	2.7	5	0.49	0.053	0.082 U	0.006 U	0.010 M	21.8	125	550	1.0 M	2.0
	7	11:52	16.4	7.7	4.1	42.8	2.7											
3/21/05	0.9	11:44	20.6	7.5	6.8	23.6	1.7	3.75	0.38	0.012	0.082 U	0.018 U	0.010 M	9.6	100	7 B		3.6
	5.3	11:46	19.4	7.5	2.6	32.4	1.7											
4/18/05	1	11:46	22.7	7.6	6.3	22.7	1.7	2	0.62	0.065	0.082 U	0.018 U	0.010 M	10.2		3 B		3.8
	4	11:48	22.7	7.6	4.9	25.1	2.1											
5/16/05	1	12:06	28.3	7.8	5.5	29	1.3	2.5	0.50	0.015	0.082 U	0.025	0.010 M	7.5	150	<2B	4.9 J3	3.0
	6	12:11	25.7	7.6	2.4	38.5	2.7											
6/13/05	1	10:02	28.7	6.4	3.4	21.9	2.2	1	0.80	0.024	0.082 U	0.017	0.011	37.9		100		1.6
	3	10:06	28.2	7.2	1.8	31.4	2.3											
7/20/05	1.1	10:32	32.2	7.8	4.4	40.9	2.5	>4	1.1	0.0053 U	0.082 U	0.019	0.010 M	5.0		2 B		2.4
	3	10:34	32.4	7.8	3.8	42.6	1.9											

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S3 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	11:59	18.8	8.1	6.8	39.4	2.0	5	0.42	0.022	0.082 U	0.021	0.016	5.1	15	12 B	3.1	5.8
	5.2	12:05	18.8	8.1	6.5	39.4	1.4											
12/13/04	1	11:41	17.8	8.0	7.4	37.7	0.8	>3.5	0.48	0.018	0.082 U	0.011	0.010 M	5.8		3 B		
	3	11:46	17.7	8.0	7.3	37.6	0.7											
1/18/05	1.2	11:53	11.8	7.6	8.9	25.2	1.5	5	0.50	0.12	0.082 U	0.017	0.010 M	13.2	60	70		1.8
	4.3	11:56	11.9	7.6	8.7	26.1	1.5											
2/14/05	1	12:25	17.9	7.8	7.9	31.4	0.95J	>4	0.48	0.043	0.082 U	0.024	0.010 M	10.8	100	<2B	2.3	3.4
	3	12:27	16.9	7.9	8.9	39.5	2.9											
3/21/05	0.9	12:12	19.9	7.6	7.5	21.9	1.1	3	0.57	0.016	0.082 U	0.018 U	0.010 M	10.7	140	<3B		3.2
	2.5	12:14	19.9	7.6	7.5	21.9	1.1											
4/18/05	1.0	12:15	23.1	7.8	6.9	22.4	1.6	>3	0.50	0.047	0.082 U	0.018 U	0.014	10.6		2 B		4.4
	2.0	12:16	23.1	7.8	6.8	22.4	1.7											
5/16/05	1	12:35	27.0	8.0	6.5	28.7	0.85J	>3	0.46	0.012	0.082 U	0.018	0.010 M	6.9	70	<2B	3.3 J3	3.6
	2.1	12:39	27.5	8.2	6.3	29.0	2.9											
6/13/05	0.7	10:35	29.9	7.2	5.2	21.9	2.9	1	0.55	0.010 M	0.082 U	0.025	0.011	18.5		100		2.8
	2.7	10:39	29.0	7.6	4.4	31.5	1.6											
7/20/05	1.1	10:50	31.5	7.8	4.6	39.2	2.0	>3	0.39	0.0053 U	0.082 U	0.010 M	0.010 M	5.4		<2 B		2.8
	2.1	10:55	31.6	7.8	4.9	39.5	2.7											

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S4						Specific		Secchi								Fecal	Chlorophyll	
Date	Depth	Time	Temp.	pH	D.O.	Conduct.	Turbidity	depth	Total N	NO2NO3	Ammonia	Total P	Ortho P	TOC	Color	coliform	A	TSS
	ft		°C		mg/l	mmho/cm	ntu	feet	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pcu	#/100ml	ug/l	mg/l
11/15/04	1	12:35	19.8	8.1	6.6	39.0	1.6	5	0.41	0.010 M	0.082 U	0.027	0.010 M	4.0	15	20 B	3.7	4.2
	9.8	12:40	18.9	8.1	6.3	39.3	3.8											
12/13/04	1	12:08	17.7	8.0	6.9	36.9	0.95	7	0.33	0.036	0.082 U	0.022	0.010 M	5.9		240		
	6.6	12:12	19.6	7.9	4.0	43.8	1.1											
1/18/05	1.0	12:18	13.8	7.5	7.8	27.0	1.2	6	0.35	0.032	0.082 U	0.017	0.010 M	8.2	60	50		1.8
	9.0	12:25	18.3	7.4	3.4	36.1	1.6											
2/14/05	1	12:50	18.2	7.7	7.5	30.0	7.8	6	0.53	0.096	0.082 U	0.021	0.012	54.8	80	500	1.4	6.2
	7	12:54	16.6	7.8	5.1	43.2	1.4											
3/21/05	1	12:38	20.7	7.5	7.3	20.6	1.4	3.5	0.56	0.075	0.082 U	0.018 U	0.010 M	10.9	100	7B		2.2
	6.8	12:42	19.1	7.4	2.7	29.6	1.4											
4/18/05	1	12:37	24.2	7.6	6.4	20.7	2.6	2.5	0.67	0.10	0.082 U	0.018 U	0.014	13.3		12 B		2.4
	4	12:39	22.9	7.5	3.8	25.5	2.8											
5/16/05	0.8	13:02	29.0	7.9	5.6	29.3	0.95J	4.5	0.48	0.037	0.082 U	0.023	0.010 M	7.2	60	3 B	4.7 J3	4.0
	7.5	13:07	23.4	7.5	0.7	40.2	3.6											
6/13/05	0.9	11:04	29.9	7.0	4.1	20.7	14	1	0.73	0.070	0.082 U	0.018	0.018	24		300		2.4
	6.9	11:09	27.5	7.6	0.2	40.3	12											
7/20/05	0.9	11:13	32.5	7.9	4.9	39.3	1.1	5.5	0.35	0.0053 U	0.082 U	0.006 U	0.010 M	5.3		2 B		1.2
	6	11:11	30.8	7.7	3.2	44.2	2.1											

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S5						Specific		Secchi								Fecal	Chlorophyll	
Date	Depth	Time	Temp.	pH	D.O.	Conduct.	Turbidity	depth	Total N	NO2NO3	Ammonia	Total P	Ortho P	TOC	Color	coliform	A	TSS
	ft		°C		mg/l	mmho/cm	ntu	feet	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pcu	#/100ml	ug/l	mg/l
11/15/04	1	13:05	19.1	8.0	7.2	37.2	2.1	5.5	0.66	0.065	0.082 U	0.13	0.010 M	10.8	50	570	2.9	2.0
	9.7	13:10	19.4	8.0	6.4	38.9	1.4											
12/13/04	1	12:34	20.1	7.9	4.9	41.1	0.90	6	0.47	0.014	0.082 U	0.011	0.010 M	5.5		10 B		
	7	12:36	19.5	8.0	4.0	44.5	1.5											
1/18/05	1.2	12:45	14.3	7.5	8.0	27.0	1.1	5	4.1	0.034	0.082 U	0.021	0.010 M	8.9	60	28 B		2.8
	8.9	12:48	18.5	7.4	3.0	35.0	1.8											
2/14/05	1	13:17	16.5	7.7	7.8	29.9	2.9	6	0.49	0.076	0.082 U	0.006 U	0.010 M	13	90	710B	1.5	3.8
	7	13:20	16.7	7.9	4.9	44.4	1.9											
3/21/05	0.9	13:00	20.2	7.3	7.4	14.6	2.6	2	0.47	0.10	0.082 U	0.018 U	0.010 M	15.1	175	110		2.0
	7	13:06	18.9	7.4	3.6	29.1	2.6											
4/18/05	1	13:00	23.7	7.6	6.4	20.5	2.5	>2	0.52	0.075	0.082 U	0.018 U	0.011	10.8		13 B		3.4
	6.5	13:03	21.0	7.5	1.0	36.7	2.8											
5/16/05	0.9	13:38	29.4	7.9	6.4	27.5	2.0	>3	0.49	0.068	0.082 U	0.014	0.010 M	7.8	70	35 B	7.5 J3	4.0
	2	13:41	28.3	7.9	4.9	29.0	1.5											
6/13/05	1	11:34	29.8	7.1	5.3	23.8	2.6	1	0.64	0.055	0.082 U	0.017	0.010 M	23.9		58		1.6
	7.5	11:38	27.7	7.7	2.0	38.7	2.2											
7/20/05	1	11:39	32.9	7.8	4.7	34.3	2.5	5	0.38	0.060	0.082 U	0.010M	0.010 M	7.4		10 B		2.0
	7.9	11:37	29.8	7.6	1.5	45.8	3.5											

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S6 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	13:26	18.5	8.2	7.3	38.3	1.4	4	0.32	0.010 M	0.082 U	0.03	0.010 M	4.9	20 J5	13 B	2.7	1.4 J5
	3.5	13:26	17.9	8.1	8.4	38.6	1.4											
12/13/04	1	13:26	17.6	8.1	7.7	38.3	1.3	>5	0.41	0.024	0.082 U	0.018	0.010 M	5.5		<1		
	4	13:29	17.7	8.1	8.1	38.3	5.0											
1/18/05	1.1	12:58	10.7	7.6	9.3	23.8	1.6	4	0.31	0.028	0.082 U	0.24	0.010 M	10.4	120	100		3.0
	3.6	13:01	10.3	7.6	9.3	24.6	1.8											
2/14/05	1	13:37	16.8	7.8	7.4	36	0.9J	>4	0.42	0.039	0.082 U	0.006 U	0.010 M	7.8	40	8B	2.1	4.4
	3	13:40	16.8	7.9	7.9	39.6	1.4											
3/21/05	0.9	13:20	19.2	7.5	7.4	21.3	1.8	2	0.30	0.013	0.082 U	0.018 U	0.010 M	11	100	11B		2.6
	2.7	13:24	18.2	7.5	7.2	22.4	1.8											
4/18/05	1	13:19	22.9	7.8	6.7	23.0	2.2	>2	1.2	0.048	0.082 U	0.018 U	0.013	14.7		4 B		5.2
	1.7	13:23	22.7	7.9	6.2	23.2	2.2											
5/16/05	0.8	13:55	27.8	8.0	6.7	27.4	1.3	>2.5	0.44	0.0053 U	0.082 U	0.013	0.010 M	7.5	60	3.2	3.8 J3	3.2
	1.5	13:58	27.7	8.1	7.5	27.4	1.2											
6/13/05	0.9	11:48	30.6	8.1	5.7	31.3	1.5	2	0.47	0.0053 U	0.082 U	0.018	0.010 M	8.3		32		3.4
	2.3	11:53	29.7	8.1	6.8	32.6	1.1											
7/20/05	0.8	11:59	31.6	7.9	5.7	38.9	1.1	>3	0.35	0.0053 U	0.082 U	0.010 M	0.010 M	6.6		1 B		2.2
	1.6	11:55	31.4	7.9	6.0	39.0	1.5											

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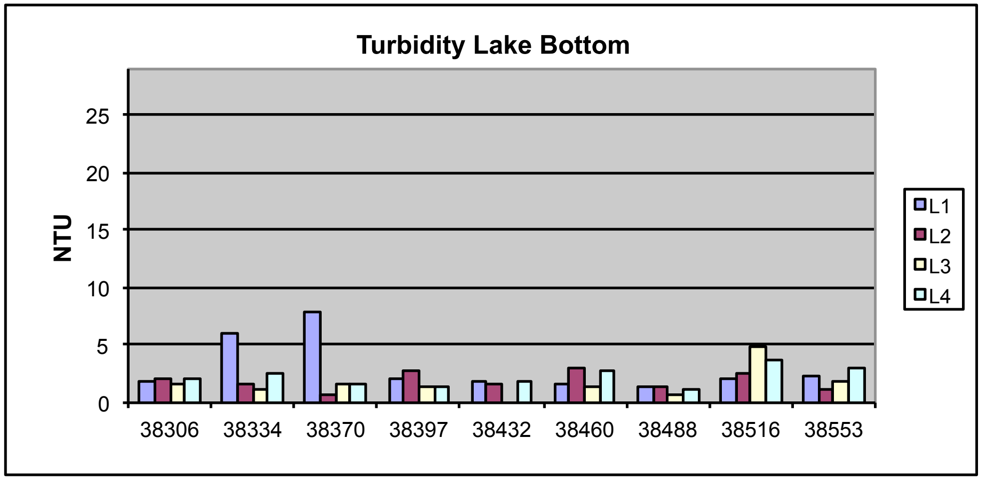
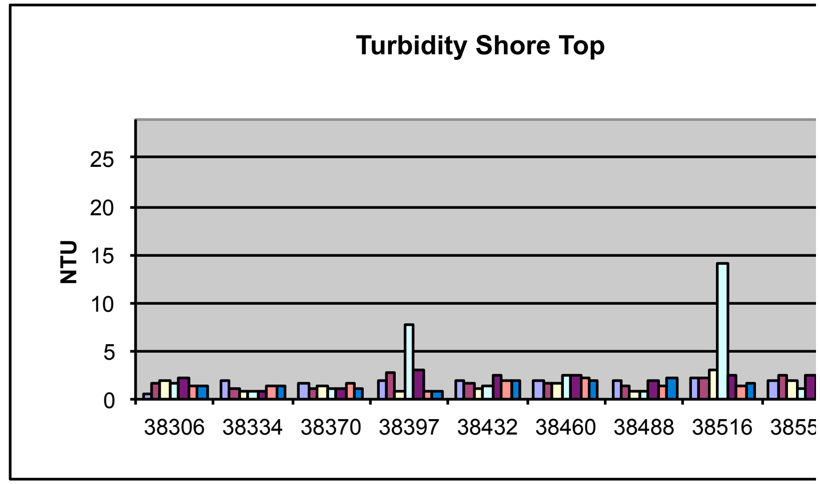
M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J4 = Estimated result. The sample matrix interfered with the ability to make an accurate measurement.
J5 = the data is questionable because of improper laboratory or field protocols

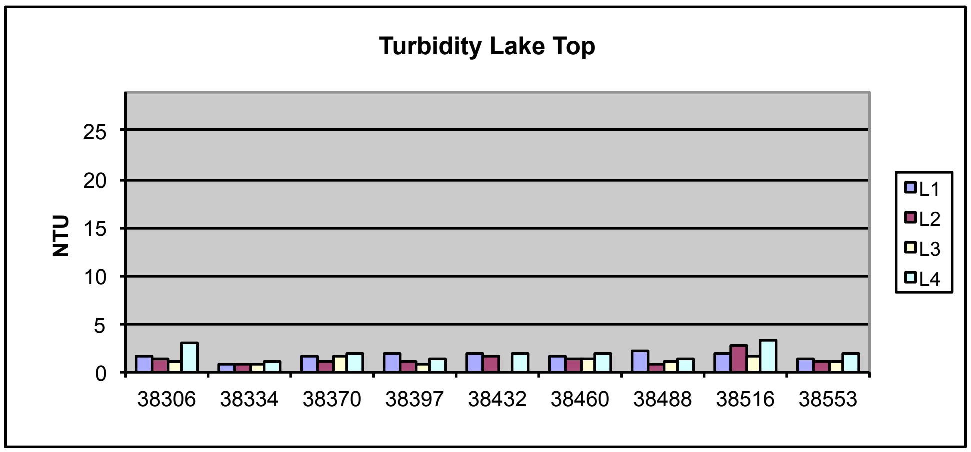
S7						Specific		Secchi								Fecal	Chlorophyll	
Date	Depth	Time	Temp.	pH	D.O.	Conduct.	Turbidity	depth	Total N	NO2NO3	Ammonia	Total P	Ortho P	TOC	Color	coliform	A	TSS
	ft		°C		mg/l	mmho/cm	ntu	feet	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	pcu	#/100ml	ug/l	mg/l
11/15/04	1	10:35	18.8	7.8	7.0	39.5	1.5	5	0.44	0.010 M	0.082 U	0.019	0.010 M	4.5	15	8 B	3.7	6.0
	5.8	10:38	18.7	7.9	6.5	39.6	1.5											
12/13/04	1	10:13	17.5	7.8	7.5	35.9	1.3	>6	0.54	0.040	0.082 U	0.019	0.010 M	5.4		2 B		
	5	10:18	17.1	7.8	7.5	36.1	1.1											
1/18/05	1.5	10:37	11.2	7.1	8.7	19.8	1.2	4	0.27	0.037	0.082 U	0.35	0.010 M	12.4	100	94	1.3	1.6
	5	10:47	12.2	7.4	8.3	26.5	0.90 J											
2/14/05	1	11:00	16.6	7.6	7.5	35.2	0.8J	>6	0.54	0.044	0.082 U	0.006 U	0.010 M	9.6	30	2B	1.4	4.8
	6	11:10	16.5	7.6	5.2	41.6	1.4											
3/21/05	1	10:57	19.9	7.5	6.8	24.3	2.0	4.5	0.34	0.016	0.082 U	0.018 U	0.010 M	9.7	75	3B	no sample	3.0
	6	11:02	19.1	7.6	4.1	32.6	2.0											
4/18/05	1	10:58	21.4	7.1	6.5	22.5	1.8	3.5	0.89	0.039	0.082 U	0.018 U	0.0026 U	11.0		2 B	5.3	3.7
	7.2	11:00	20.7	7.3	1.1	38.0	1.9											
5/16/05	1.1	11:11	27.6	7.7	5.6	28.7	2.1	4.5	0.76	0.010 M	0.082 U	0.021	0.010 M	7.7	70	5 B	3.8 J3	3.9
	5.5	11:16	23.0	7.5	1.8	40.1	1.3											
6/13/05	1	9:15	29.9	7.8	5.6	32.8	1.7	4	0.46	0.010 M	0.082 U	0.016	0.010 M	8.5		17	4.4	2.5
	7	9:18	27.9	7.5	1.7	41.4	1.7											
7/20/05	0.9	9:47	31.5	7.8	4.8	39.6	1.7	6	0.37	0.0053 U	0.082 U	0.010 M	0.010 M	5.7		12 B	1.6 J3	4.4
	5.2	9:41	30.5	7.8	4.1	44.7	4.1											

B = Results based on colony counts outside the acceptable range.
U = Analyte not detected. The reported result is the laboratory method detection limit.
M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

Figure 23. Turbidity from Butera 2005







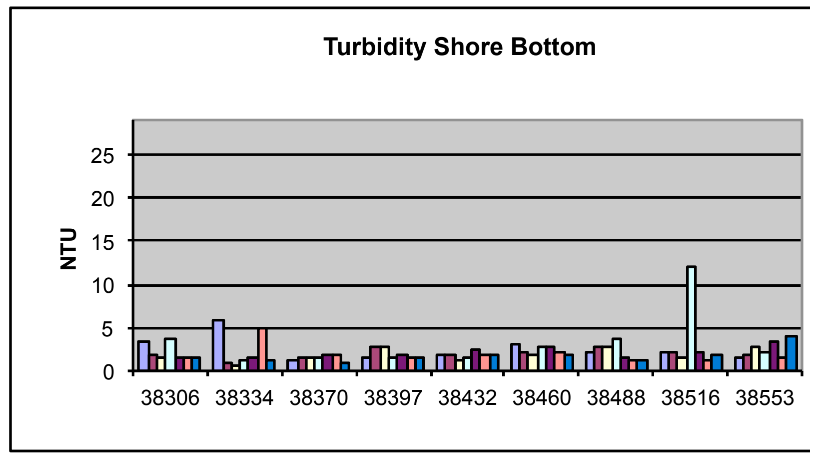
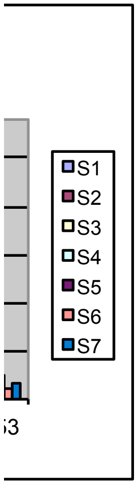
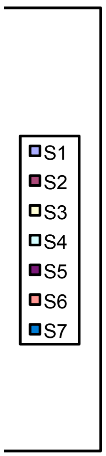
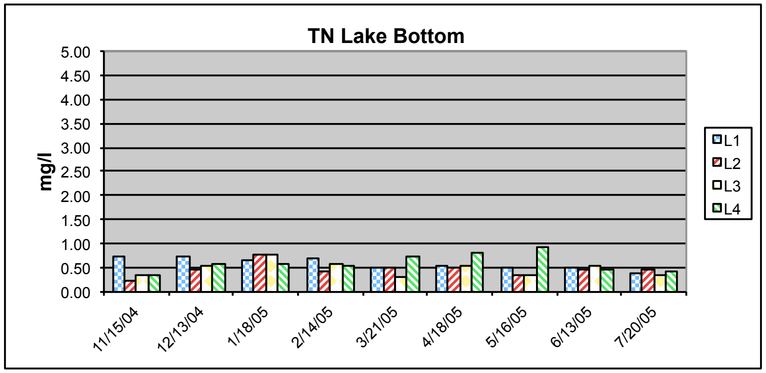
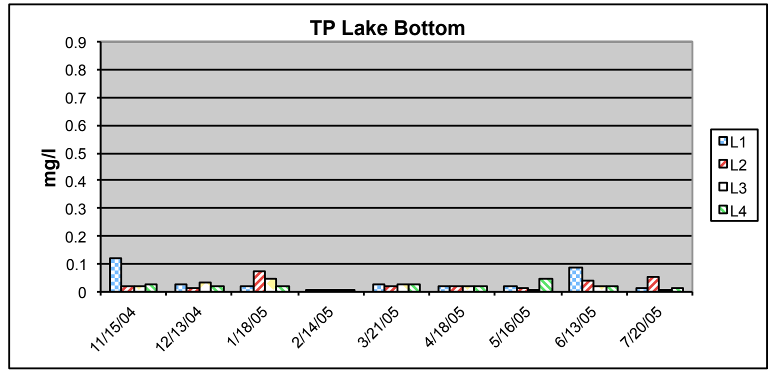


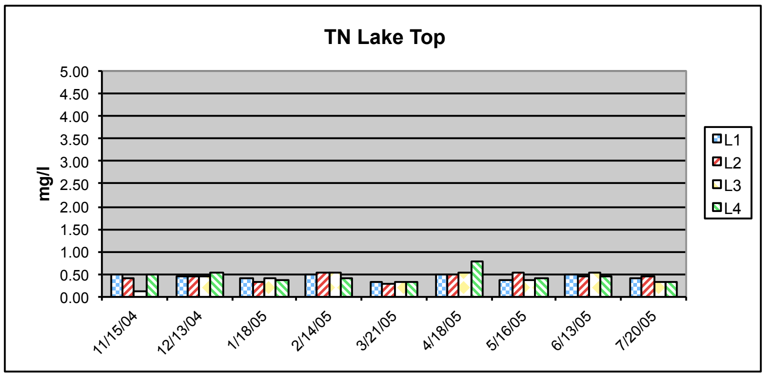
Figure 23. Turbidity from Butera 2005

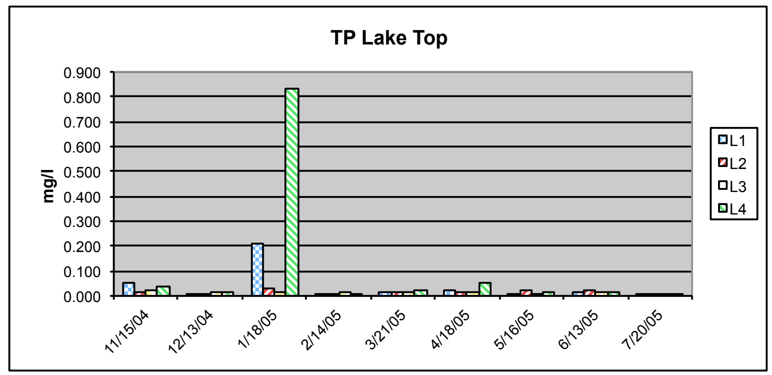


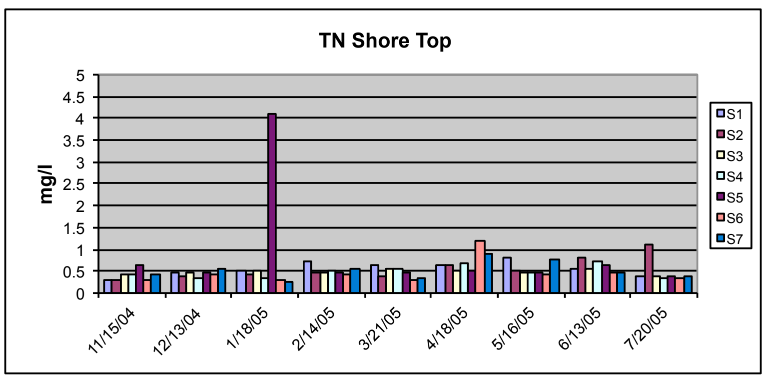



TN Lake Bottom
mg/l
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4


TP Lake Bottom
mg/l
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4


TN Lake Top
mg/l
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4


TP Lake Top
mg/l
0.900
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4


TN Shore Top
mg/l
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
S1
S2
S3
S4
S5
S6
S7

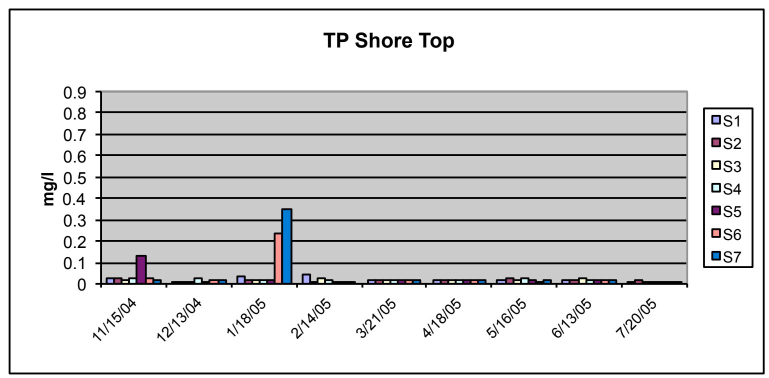

TP Shore Top
mg/l
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
S1
S2
S3
S4
S5
S6
S7

Figure 24. Oxygen Levels, Butera 2005

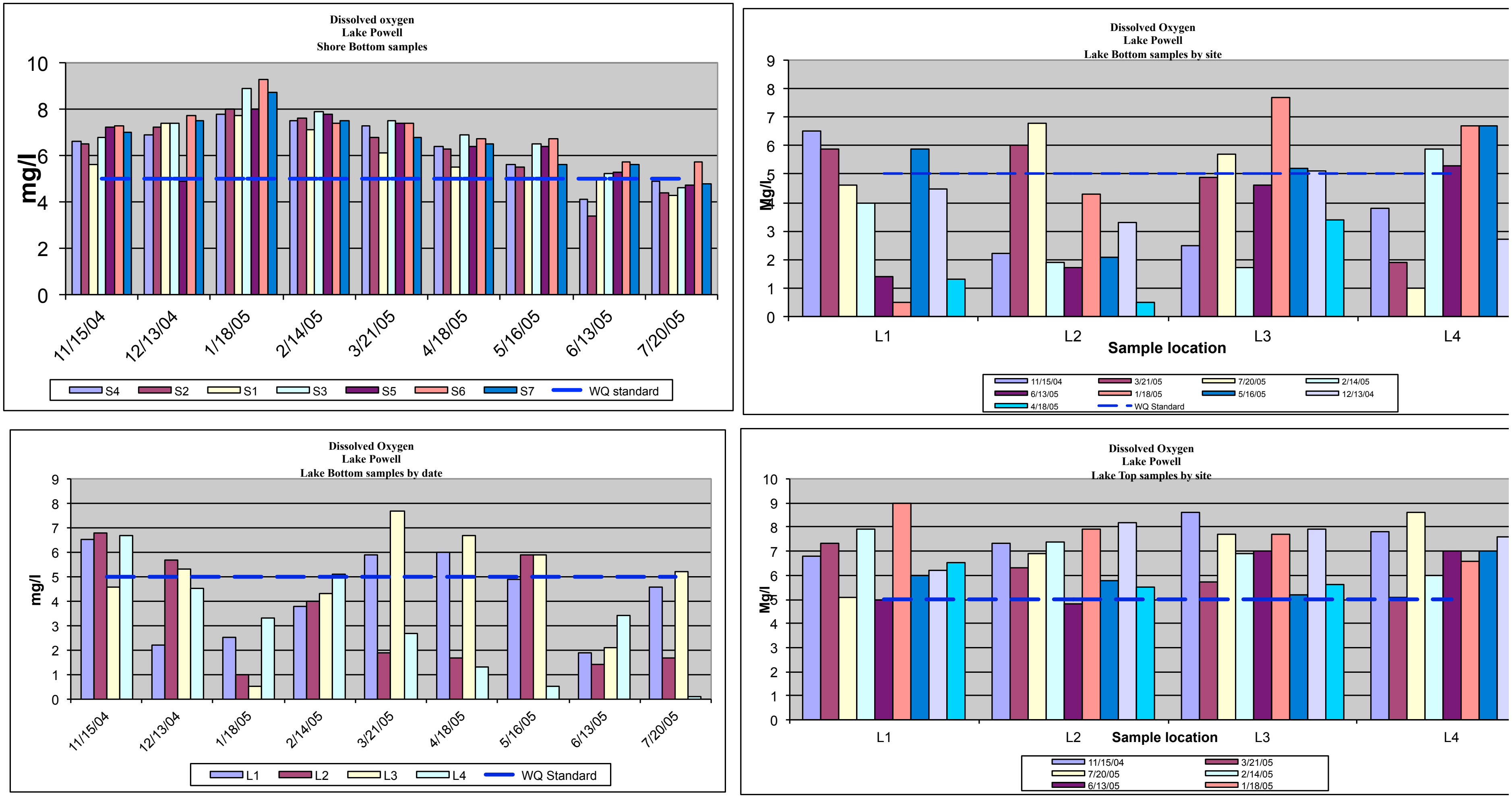
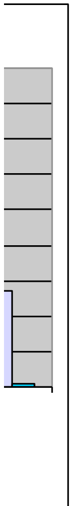
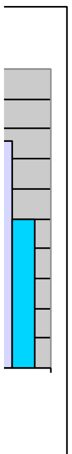
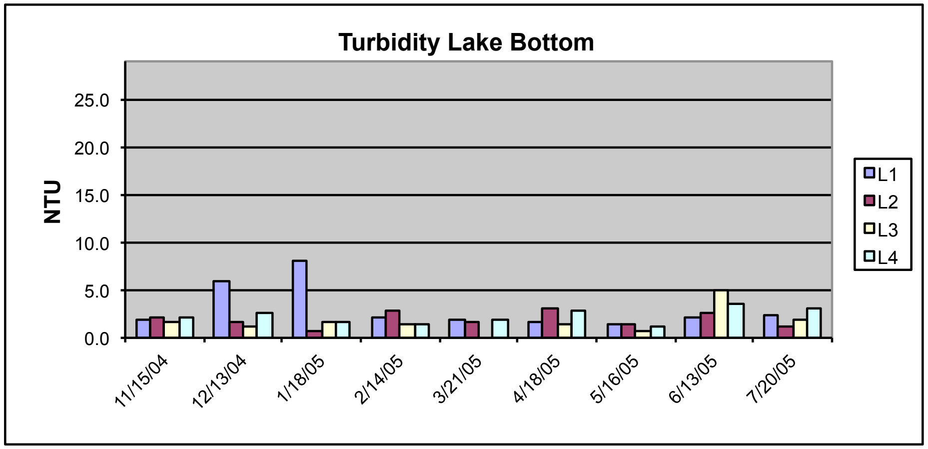
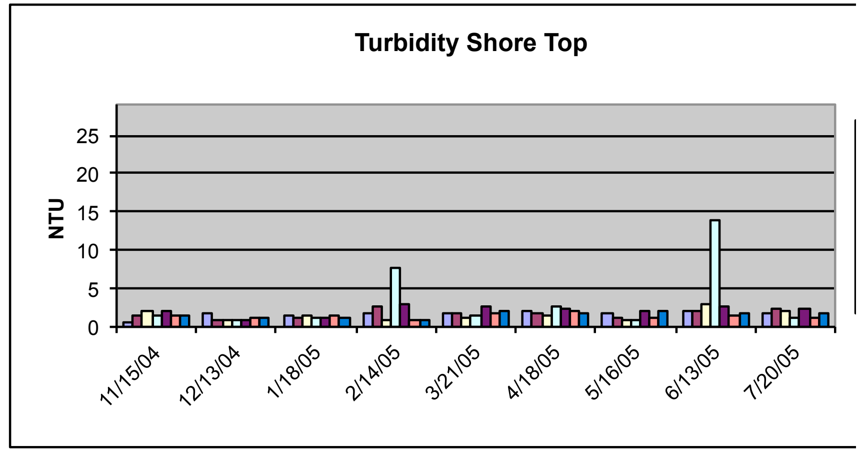


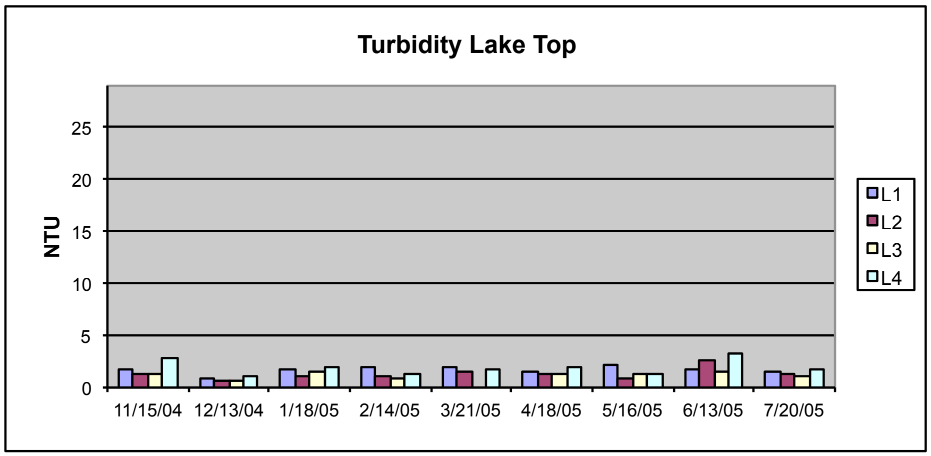
Figure 24. Oxygen Levels, Butera 2005

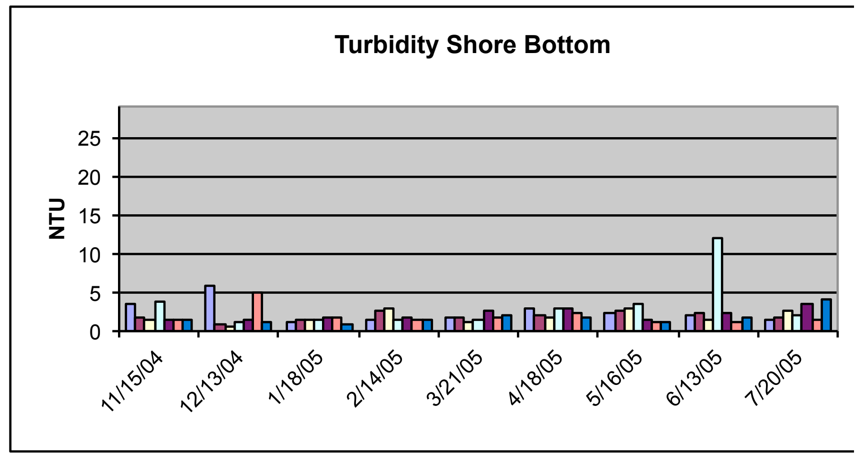


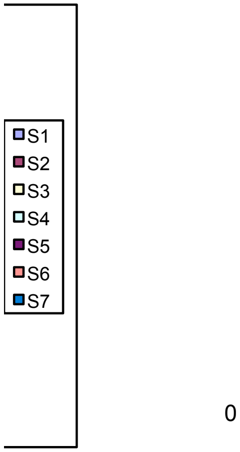


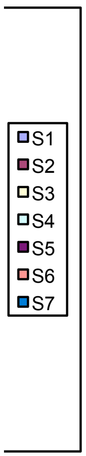

Turbidity Lake Bottom
NTU
25.0
20.0
15.0
10.0
5.0
0.0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4


Turbidity Shore Top
NTU
25
20
15
10
5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05


Turbidity Lake Top
NTU
25
20
15
10
5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05
L1
L2
L3
L4


Turbidity Shore Bottom
NTU
25
20
15
10
5
0
11/15/04
12/13/04
1/18/05
2/14/05
3/21/05
4/18/05
5/16/05
6/13/05
7/20/05


S1
S2
S3
S4
S5
S6
S7
0


S1
S2
S3
S4
S5
S6
S7

Station	Date	Depth relative	Depth ft.	Temp. °C	pH	D.O. mg/l	Specific Conduct. Mmho/cm	Turbidity ntu
S1	11/15/04	Top	1	20.7	7.8	5.6	39.1	0.65
S1	12/13/04	Top	1	17.3	7.5	7.4	22.3	1.9
S1	1/18/05	Top	1.0	13.2	6.9	7.7	24.0	1.6
S1	2/14/05	Top	1	16.5	7.7	7.1	37	1.9
S1	3/21/05	Top	0.8	19.3	7.5	6.1	25.3	1.8
S1	4/18/05	Top	1	24.1	7.5	5.5	23.1	2.0
S1	5/16/05	Top	1.5	29.4	7.6	5	29.4	1.9
S1	6/13/05	Top	1	29.3	7.9	5.0	32.7	2.1
S1	7/20/05	Top	1.0	32.4	7.6	4.3	40.8	1.8
S2	11/15/04	Top	1	19.3	8.0	6.5	38.9	1.6
S2	12/13/04	Top	1	17.9	7.8	7.2	33.2	1.0
S2	1/18/05	Top	1.0	13.7	7.2	8.0	25.4	1.2
S2	2/14/05	Top	1	18	7.6	7.6	29.6	2.7
S2	3/21/05	Top	0.9	20.6	7.5	6.8	23.6	1.7
S2	4/18/05	Top	1	22.7	7.6	6.3	22.7	1.7
S2	5/16/05	Top	1	28.3	7.8	5.5	29	1.3
S2	6/13/05	Top	1	28.7	6.4	3.4	21.9	2.2
S2	7/20/05	Top	1.1	32.2	7.8	4.4	40.9	2.5
S3	11/15/04	Top	1	18.8	8.1	6.8	39.4	2.0
S3	12/13/04	Top	1	17.8	8.0	7.4	37.7	0.8
S3	1/18/05	Top	1.2	11.8	7.6	8.9	25.2	1.5
S3	2/14/05	Top	1	17.9	7.8	7.9	31.4	0.95
S3	3/21/05	Top	0.9	19.9	7.6	7.5	21.9	1.1
S3	4/18/05	Top	1.0	23.1	7.8	6.9	22.4	1.6
S3	5/16/05	Top	1	27.0	8.0	6.5	28.7	0.85
S3	6/13/05	Top	0.7	29.9	7.2	5.2	21.9	2.9
S3	7/20/05	Top	1.1	31.5	7.8	4.6	39.2	2.0
S4	11/15/04	Top	1	19.8	8.1	6.6	39.0	1.6
S4	12/13/04	Top	1	17.7	8.0	6.9	36.9	0.95
S4	1/18/05	Top	1.0	13.8	7.5	7.8	27.0	1.2
S4	2/14/05	Top	1	18.2	7.7	7.5	30.0	7.8
S4	3/21/05	Top	1	20.7	7.5	7.3	20.6	1.4
S4	4/18/05	Top	1	24.2	7.6	6.4	20.7	2.6
S4	5/16/05	Top	0.8	29.0	7.9	5.6	29.3	0.95
S4	6/13/05	Top	0.9	29.9	7.0	4.1	20.7	14
S4	7/20/05	Top	0.9	32.5	7.9	4.9	39.3	1.1
S5	11/15/04	Top	1	19.1	8.0	7.2	37.2	2.1
S5	12/13/04	Top	1	20.1	7.9	4.9	41.1	0.90
S5	1/18/05	Top	1.2	14.3	7.5	8.0	27.0	1.1
S5	2/14/05	Top	1	16.5	7.7	7.8	29.9	2.9
S5	3/21/05	Top	0.9	20.2	7.3	7.4	14.6	2.6
S5	4/18/05	Top	1	23.7	7.6	6.4	20.5	2.5
S5	5/16/05	Top	0.9	29.4	7.9	6.4	27.5	2.0
S5	6/13/05	Top	1	29.8	7.1	5.3	23.8	2.6
S5	7/20/05	Top	1	32.9	7.8	4.7	34.3	2.5
S6	11/15/04	Top	1	18.5	8.2	7.3	38.3	1.4
S6	12/13/04	Top	1	17.6	8.1	7.7	38.3	1.3
S6	1/18/05	Top	1.1	10.7	7.6	9.3	23.8	1.6
S6	2/14/05	Top	1	16.8	7.8	7.4	36	0.9
S6	3/21/05	Top	0.9	19.2	7.5	7.4	21.3	1.8

S6	4/18/05	Top	1	22.9	7.8	6.7	23.0	2.2
S6	5/16/05	Top	0.8	27.8	8.0	6.7	27.4	1.3
S6	6/13/05	Top	0.9	30.6	8.1	5.7	31.3	1.5
S6	7/20/05	Top	0.8	31.6	7.9	5.7	38.9	1.1
S7	11/15/04	Top	1	18.8	7.8	7.0	39.5	1.5
S7	12/13/04	Top	1	17.5	7.8	7.5	35.9	1.3
S7	1/18/05	Top	1.5	11.2	7.1	8.7	19.8	1.2
S7	2/14/05	Top	1	16.6	7.6	7.5	35.2	0.8
S7	3/21/05	Top	1	19.9	7.5	6.8	24.3	2.0
S7	4/18/05	Top	1	21.4	7.1	6.5	22.5	1.8
S7	5/16/05	Top	1.1	27.6	7.7	5.6	28.7	2.1
S7	6/13/05	Top	1	29.9	7.8	5.6	32.8	1.7
S7	7/20/05	Top	0.9	31.5	7.8	4.8	39.6	1.7
S1	11/15/04	Bottom	3.9	20.6	8.0	6.3	40.1	3.5
S1	12/13/04	Bottom	2.2	19.3	7.4	6.1	33.7	6.0
S1	1/18/05	Bottom	5.0	16.8	7.3	5.5	27.5	1.2
S1	2/14/05	Bottom	4	16.3	7.7	6.4	38.3	1.5
S1	3/21/05	Bottom	3.2	19.6	7.5	4.7	29.1	1.8
S1	4/18/05	Bottom	2	24.5	7.4	3.8	26.4	3.0
S1	5/16/05	Bottom	2.5	32.6	7.4	2.9	32.6	2.2
S1	6/13/05	Bottom	3.6	27.8	7.4	1.7	35.5	2.1
S1	7/20/05	Bottom	2.2	32.7	7.8	4.5	41.7	1.4
S2	11/15/04	Bottom	7	18.4	8.1	6.5	39.5	1.8
S2	12/13/04	Bottom	5	16.9	8.0	7.3	36.3	0.85
S2	1/18/05	Bottom	9.0	18.3	7.4	2.1	40.0	1.4
S2	2/14/05	Bottom	7	16.4	7.7	4.1	42.8	2.7
S2	3/21/05	Bottom	5.3	19.4	7.5	2.6	32.4	1.7
S2	4/18/05	Bottom	4	22.7	7.6	4.9	25.1	2.1
S2	5/16/05	Bottom	6	25.7	7.6	2.4	38.5	2.7
S2	6/13/05	Bottom	3	28.2	7.2	1.8	31.4	2.3
S2	7/20/05	Bottom	3	32.4	7.8	3.8	42.6	1.9
S3	11/15/04	Bottom	5.2	18.8	8.1	6.5	39.4	1.4
S3	12/13/04	Bottom	3	17.7	8.0	7.3	37.6	0.7
S3	1/18/05	Bottom	4.3	11.9	7.6	8.7	26.1	1.5
S3	2/14/05	Bottom	3	16.9	7.9	8.9	39.5	2.9
S3	3/21/05	Bottom	2.5	19.9	7.6	7.5	21.9	1.1
S3	4/18/05	Bottom	2.0	23.1	7.8	6.8	22.4	1.7
S3	5/16/05	Bottom	2.1	27.5	8.2	6.3	29.0	2.9
S3	6/13/05	Bottom	2.7	29.0	7.6	4.4	31.5	1.6
S3	7/20/05	Bottom	2.1	31.6	7.8	4.9	39.5	2.7
S4	11/15/04	Bottom	9.8	18.9	8.1	6.3	39.3	3.8
S4	12/13/04	Bottom	6.6	19.6	7.9	4.0	43.8	1.1
S4	1/18/05	Bottom	9.0	18.3	7.4	3.4	36.1	1.6
S4	2/14/05	Bottom	7	16.6	7.8	5.1	43.2	1.4
S4	3/21/05	Bottom	6.8	19.1	7.4	2.7	29.6	1.4
S4	4/18/05	Bottom	4	22.9	7.5	3.8	25.5	2.8
S4	5/16/05	Bottom	7.5	23.4	7.5	0.7	40.2	3.6
S4	6/13/05	Bottom	6.9	27.5	7.6	0.2	40.3	12
S4	7/20/05	Bottom	6	30.8	7.7	3.2	44.2	2.1
S5	11/15/04	Bottom	9.7	19.4	8.0	6.4	38.9	1.4
S5	12/13/04	Bottom	7	19.5	8.0	4.0	44.5	1.5
S5	1/18/05	Bottom	8.9	18.5	7.4	3.0	35.0	1.8
S5	2/14/05	Bottom	7	16.7	7.9	4.9	44.4	1.9

S5	3/21/05	Bottom	7	18.9	7.4	3.6	29.1	2.6
S5	4/18/05	Bottom	6.5	21.0	7.5	1.0	36.7	2.8
S5	5/16/05	Bottom	2	28.3	7.9	4.9	29.0	1.5
S5	6/13/05	Bottom	7.5	27.7	7.7	2.0	38.7	2.2
S5	7/20/05	Bottom	7.9	29.8	7.6	1.5	45.8	3.5
S6	11/15/04	Bottom	3.5	17.9	8.1	8.4	38.6	1.4
S6	12/13/04	Bottom	4	17.7	8.1	8.1	38.3	5.0
S6	1/18/05	Bottom	3.6	10.3	7.6	9.3	24.6	1.8
S6	2/14/05	Bottom	3	16.8	7.9	7.9	39.6	1.4
S6	3/21/05	Bottom	2.7	18.2	7.5	7.2	22.4	1.8
S6	4/18/05	Bottom	1.7	22.7	7.9	6.2	23.2	2.2
S6	5/16/05	Bottom	1.5	27.7	8.1	7.5	27.4	1.2
S6	6/13/05	Bottom	2.3	29.7	8.1	6.8	32.6	1.1
S6	7/20/05	Bottom	1.6	31.4	7.9	6.0	39.0	1.5
S7	11/15/04	Bottom	5.8	18.7	7.9	6.5	39.6	1.5
S7	12/13/04	Bottom	5	17.1	7.8	7.5	36.1	1.1
S7	1/18/05	Bottom	5	12.2	7.4	8.3	26.5	0.9
S7	2/14/05	Bottom	6	16.5	7.6	5.2	41.6	1.4
S7	3/21/05	Bottom	6	19.1	7.6	4.1	32.6	2.0
S7	4/18/05	Bottom	7.2	20.7	7.3	1.1	38.0	1.9
S7	5/16/05	Bottom	5.5	23.0	7.5	1.8	40.1	1.3
S7	6/13/05	Bottom	7	27.9	7.5	1.7	41.4	1.7
S7	7/20/05	Bottom	5.2	30.5	7.8	4.1	44.7	4.1
		Max						
		Min						

Qualifier	Secchi depth ft.	Total N mg/l	TKN mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l		Ortho P mg/l
J	>4	0.28	0.28	0.010 M	0.082 U	0.023		0.010 M
	6	0.48	0.45	0.034	0.082 U	0.011		0.010 M
	4	0.52	0.50	0.015	0.082 U	0.032		0.010 M
	>4	0.74		0.041	0.082 U	0.041		0.010 M
	>4	0.63		0.013	0.082 U	0.018		0.010 M
	>3	0.63		0.030	0.082 U	0.018		0.010 M
	3	0.8		0.027	0.082 U	0.017		0.010 M
	3.5	0.56		0.010 M	0.082 U	0.018		0.010
	>2.6	0.39		0.0053 U	0.082 U	0.013		0.010 M
	5	0.32	0.32	0.010 M	0.082 U	0.023		0.010 M
	6	0.38	0.34	0.037	0.082 U	0.011		0.010 M
	5	0.42	0.39	0.030	0.082 U	0.014		0.010 M
	5	0.49		0.053	0.082 U	0.006		0.010 M
	3.75	0.38		0.012	0.082 U	0.018		0.010 M
	2	0.62		0.065	0.082 U	0.018		0.010 M
	2.5	0.50		0.015	0.082 U	0.025		0.010 M
	1	0.80		0.024	0.082 U	0.017		0.011
	>4	1.1		0.0053 U	0.082 U	0.019		0.010 M
	5	0.42	0.40	0.022	0.082 U	0.021		0.016
	>3.5	0.48	0.46	0.018	0.082 U	0.011		0.010 M
	5	0.50	0.38	0.12	0.082 U	0.017		0.010 M
J	>4	0.48		0.043	0.082 U	0.024		0.010 M
	3	0.57		0.016	0.082 U	0.018		0.010 M
	>3	0.50		0.047	0.082 U	0.018		0.014
J	>3	0.46		0.012	0.082 U	0.018		0.010 M
	1	0.55		0.010 M	0.082 U	0.025		0.011
	>3	0.39		0.0053 U	0.082 U	0.01	M	0.010 M
	5	0.41	0.41	0.010 M	0.082 U	0.027		0.010 M
	7	0.33	0.29	0.036	0.082 U	0.022		0.010 M
	6	0.35	0.32	0.032	0.082 U	0.017		0.010 M
	6	0.53		0.096	0.082 U	0.021		0.012
	3.5	0.56		0.075	0.082 U	0.018	U	0.010 M
	2.5	0.67		0.10	0.082 U	0.018	U	0.014
J	4.5	0.48		0.037	0.082 U	0.023		0.010 M
	1	0.73		0.070	0.082 U	0.018		0.018
	5.5	0.35		0.0053 U	0.082 U	0.006	U	0.010 M
	5.5	0.66	0.60	0.065	0.082 U	0.13		0.010 M
	6	0.47	0.46	0.014	0.082 U	0.011		0.010 M
	5	4.1	4.1	0.034	0.082 U	0.021		0.010 M
	6	0.49		0.076	0.082 U	0.006	U	0.010 M
	2	0.47		0.10	0.082 U	0.018	U	0.010 M
	>2	0.52		0.075	0.082 U	0.018	U	0.011
	>3	0.49		0.068	0.082 U	0.014		0.010 M
	1	0.64		0.055	0.082 U	0.017		0.010 M
	5	0.38		0.060	0.082 U	0.01	M	0.010 M
	4	0.32	0.49 J4	0.010 M	0.082 U	0.03		0.010 M
	>5	0.41	0.39	0.024	0.082 U	0.018		0.010 M
	4	0.31	0.28	0.028	0.082 U	0.24		0.010 M
J	>4	0.42		0.039	0.082 U	0.006	U	0.010 M
	2	0.30		0.013	0.082 U	0.018	U	0.010 M

	>2	1.2		0.048	0.082 U	0.018	U	0.013
	>2.5	0.44		0.0053 U	0.082 U	0.013		0.010 M
	2	0.47		0.0053 U	0.082 U	0.018		0.010 M
	>3	0.35		0.0053 U	0.082 U	0.01	M	0.010 M
	5	0.44	0.44	0.010 M	0.082 U	0.019		0.010 M
	>6	0.54	0.50	0.040	0.082 U	0.019		0.010 M
	4	0.27	0.23	0.037	0.082 U	0.35		0.010 M
J	>6	0.54		0.044	0.082 U	0.006	U	0.010 M
	4.5	0.34		0.016	0.082 U	0.018	U	0.010 M
	3.5	0.89		0.039	0.082 U	0.018	U	0.0026 U
	4.5	0.76		0.010 M	0.082 U	0.021		0.010 M
	4	0.46		0.010 M	0.082 U	0.016		0.010 M
	6	0.37		0.0053 U	0.082 U	0.01	M	0.010 M
J								

J

4.1
0.27

TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
14.2	100	3 B		1.8
3.8				
7.2	50	84	2.7	3.4
18.3	175	24B		1.2
5.0		2 B		2.4
54.8	80	500	1.4	6.2
23.9		58		1.6
12.4	100	94	1.3	1.6
8.8				
10.9	140	17 B		3.4
4.7				
15.8		4 B		3.0
5.1	15	12 B	3.1	5.8
10.9	100	7B		2.2
7.4		10 B		2.0
9.6	30	2B	1.4	4.8
11.4	125	<2 B		3.0
11.6				
15.5	300	31	1.0 J3	3.8
5.8		3 B		
13.3		12 B		2.4
4.9	20 J5	13 B	2.7	1.4 J5
9.7	75	3B	no sample	3.0
6.9	60	<2 B	3.4 J3	4.2
6.4				
10.8		2 B		2.4
17.5		64		2.8
13.2	60	70		1.8
7.2	60	3 B	4.7 J3	4.0
5.5		<1		
11.0		2 B	5.3	3.7
6.5				
7.5	60	<2 B	4.1 J3	2.2
5.6				
4.4		12 B		3.6
10.8	100	<2B	2.3	3.4
24		300		2.4
10.4	120	100		3.0
7.7	70	5 B	3.8 J3	3.9
12.2	125	58		3.0
7.6				
5.2	20	33 B	2.9	4.0

10.7	140	<3B		3.2
5.3		2 B		1.2
7.8	40	8B	2.1	4.4
8.5		17	4.4	2.5
6.2		2 B		3.6
5.7				
15.5		130		3.6
28.6		25 B		
10.6		2 B		4.4
10.8	50	570	2.9	2.0
11	100	11B		2.6
5.7		12 B	1.6 J3	4.4
10.7	100	17B		2.0
3.7				
10.7		3 B		2.2
4.8				
13.8	125	25B		2.2
10.6				
11.1		<2 B		3.6
6.2				
7.5	60	2 B	4.3 J3	2.0
11.3				
9.2		8.0		3.2
7.2				
8.3	70	4 B	4.8 J3	2.2

11.9		
9.1 5.4	17	2.4
5.1 4.3	<2 B	4

Station	Date	Depth relative	Depth ft.	Temp. °C	pH	D.O. mg/l	Specific Conduct. Mmho/cm	Turbidity ntu
L1	11/15/04	Bottom	12	18.5	8.0	6.5	39.7	1.8
L1	12/13/04	Bottom	9	19.5	7.8	2.2	44.5	6.0
L1	1/18/05	Bottom	9.5	17.7	7.4	2.5	41.2	8.0
L1	2/14/05	Bottom	11	16.9	7.8	3.8	46.2	2.1
L1	3/21/05	Bottom	3.3	19.6	7.6	5.9	27.7	1.9
L1	4/18/05	Bottom	2	23.0	7.6	6.0	22.5	1.6
L1	5/16/05	Bottom	3	27.1	7.8	4.9	31.9	1.4
L1	6/13/05	Bottom	4.5	27.9	7.4	1.9	34.8	2.1
L1	7/20/05	Bottom	5.0	31.3	7.9	4.6	43.9	2.3
L2	11/15/04	Bottom	11.5	18.4	8.1	6.8	39.5	2.2
L2	12/13/04	Bottom	9	18.0	8.1	5.7	45.8	1.7
L2	1/18/05	Bottom	10.8	17.3	7.4	1.0	43.6	0.7
L2	2/14/05	Bottom	11	16.6	7.9	4.0	46.7	2.8
L2	3/21/05	Bottom	6.8	18.9	7.6	1.9	37.3	1.6
L2	4/15/05	Bottom	10.1	20.8	7.7	1.7	40.7	3.1
L2	5/16/05	Bottom	2.5	27.0	7.9	5.9	29.1	1.5
L2	6/13/05	Bottom	5.5	27.4	7.6	1.4	38.9	2.5
L2	7/20/05	Bottom	11	28.7	7.7	1.7	39.2	1.2
L3	11/15/04	Bottom	12.6	19.2	8.0	4.6	39.3	1.7
L3	12/13/04	Bottom	10	18.7	8.2	5.3	46.5	1.1
L3	1/18/05	Bottom	11.2	17.2	7.4	0.5	44	1.6
L3	2/14/05	Bottom	11	16.7	7.9	4.3	46.7	1.4
L3	3/21/05	Bottom	2.1	19.2	7.6	7.7	21.8	
L3	4/18/05	Bottom	2	22.9	7.8	6.7	22.5	1.5
L3	5/16/05	Bottom	2.6	26.6	7.9	5.9	28.9	0.75
L3	6/13/05	Bottom	7.8	27.4	7.9	2.1	42.0	4.9
L3	7/20/05	Bottom	3.2	31.1	7.9	5.2	39.8	1.9
L4	11/15/04	Bottom	11	18.8	8.1	6.7	39.0	2.2
L4	12/13/04	Bottom	8	19.2	8.0	4.5	44.9	2.5
L4	1/18/05	Bottom	9.0	18.2	7.5	3.3	35.5	1.6
L4	2/14/05	Bottom	9	16.9	7.9	5.1	45.6	1.5
L4	3/21/05	Bottom	7.9	19.1	7.5	2.7	33.2	1.8
L4	4/18/05	Bottom	8	20.8	7.6	1.3	38.7	2.8
L4	5/16/05	Bottom	9.1	22.4	7.5	0.5	42.3	1.1
L4	6/13/05	Bottom	7.1	27.8	7.9	3.4	38.2	3.6
L4	7/20/05	Bottom	8.4	29.4	7.4	0.1	36.0	3.1
L1	11/15/04	Mid	6	18.6	8.0	6.5	39.6	1.7
L1	12/13/04	Mid	5.5	16.6	8.0	7.3	37.0	1
L1	1/18/05	Mid	4.7	13.0	7.5	8.2	26.5	1.0
L1	2/14/05	Mid	5	16.4	7.7	5.4	41.4	1.9
L1	3/21/05	Mid	2	19.5	7.6	7.2	22.9	1.9
L1	4/18/05	Mid	1.5	23.1	7.6	5.9	22.5	1.8
L1	5/16/05	Mid	2	27.4	7.8	5.7	29.5	1.8
L1	6/13/05	Mid	2.4	29.7	7.7	4.5	30.8	2.0

L1	7/20/05	Mid	2.4	31.1	7.9	5.1	40.3	1.4
L2	11/15/04	Mid	6.6	18.5	8.1	6.7	39.4	1.4
L2	12/13/04	Mid	5.5	16.6	8.0	7.4	37.8	0.7
L2	1/18/05	Mid	5.5	12.2	7.5	8.0	26.5	1.4
L2	2/14/05	Mid	5.6	16.5	7.8	5.4	42	1.4
L2	3/21/05	Mid	3.2	19.6	7.6	7.2	22.3	1.6
L2	4/15/05	Mid	5.5	21.2	7.7	3.0	36.8	1.5
L2	5/16/05	Mid	1.6	27.0	7.9	6.0	29	1.0
L2	6/13/05	Mid	3.3	28.6	7.8	3.7	34.1	1.8
L2	7/20/05	Mid	6	29.9	8.0	4.5	39.1	1.3
L3	11/15/04	Mid	6.2	18.8	6.7	8.1	39.2	1.3
L3	12/13/04	Mid	5.5	17.6	8.0	6.9	38.1	0.7
L3	1/18/05	Mid	5.8	12.0	7.6	7.8	26.5	1.2
L3	2/14/05	Mid	6	16.2	7.9	6.4	42.1	1
L3	3/21/05	Mid	1.5	19.3	7.6	7.6	21.8	1.4
L3	4/18/05	Mid	1.5	23.0	7.8	6.2	22.5	1.6
L3	5/16/05	Mid	1.8	26.9	8.0	6.1	28.8	1.0
L3	6/13/05	Mid	3.6	29.3	7.8	5.4	30.0	2.9
L3	7/20/05	Mid	2	31.1	7.9	5.2	38.9	1.0
L4	11/15/04	Mid	5.6	18.9	8.1	6.7	38.8	2.2
L4	12/13/04	Mid	5	19.0	8.0	4.5	44.5	1.4
L4	1/18/05	Mid	5.1	13	7.5	7.1	27.1	0.95
L4	2/14/05	Mid	4.5	16.5	7.8	6.4	42.3	1.1
L4	3/21/05	Mid	4	19.0	7.6	6.9	20.8	1.8
L4	4/18/05	Mid	4	22.2	7.6	4.0	28.2	1.7
L4	5/16/05	Mid	4.5	25.8	7.8	2.8	37.4	1.5
L4	6/13/05	Mid	3.5	29.3	7.9	4.7	28.8	2.9
L4	7/20/05	Mid	4.1	32.2	7.9	4.8	35.2	0.9
L1	11/15/04	Top	1	18.7	8.0	6.8	39.6	1.7
L1	12/13/04	Top	1	17.5	7.9	7.3	35.3	1
L1	1/18/05	Top	1	12.5	7.5	8.6	26.4	1.7
L1	2/14/05	Top	1	17.2	7.7	7.8	32.4	2
L1	3/21/05	Top	1	19.6	7.6	7.3	22.8	1.9
L1	4/18/05	Top	1	23.1	7.6	6.3	22.4	1.6
L1	5/16/05	Top	1	27.9	7.8	5.7	28.9	2.2
L1	6/13/05	Top	0.8	29.8	7.7	5.1	30.4	1.8
L1	7/20/05	Top	0.9	31.4	7.9	5.1	40.1	1.5
L2	11/15/04	Top	1	18.7	8.1	6.9	39.4	1.3
L2	12/13/04	Top	1	17.2	7.9	7.7	36.3	0.75
L2	1/18/05	Top	1	12.2	7.6	8.6	26.5	1.1
L2	2/14/05	Top	1	17.4	7.8	7.9	32	1.1
L2	3/21/05	Top	1.1	19.6	7.6	7.4	22.3	1.6
L2	4/15/05	Top	1	22.4	7.8	6.9	22.6	1.4
L2	5/16/05	Top	1	27.3	7.9	6.0	28.9	0.95
L2	6/13/05	Top	0.9	29.2	7.4	5.0	27.7	2.7
L2	7/20/05	Top	0.9	31.2	7.9	4.8	39.9	1.2
L3	11/15/04	Top	1	18.9	8.1	7.0	39.1	1.2

L3	12/13/04	Top	1	17.6	8.0	7.0	38.6	0.75
L3	1/18/05	Top	1.4	11.2	7.5	9.0	24.5	1.6
L3	2/14/05	Top	1	18.1	7.8	7.9	31.6	0.95
L3	3/21/05	Top	1	19.3	7.6	7.7	21.7	
L3	4/18/05	Top	1	22.9	7.8	6.6	22.5	1.4
L3	5/16/05	Top	0.8	29.2	7.9	6.0	28.8	1.2
L3	6/13/05	Top	1.1	30.2	8.0	5.8	29.4	1.6
L3	7/20/05	Top	1	31.3	7.9	5.2	38.9	1.0
L4	11/15/04	Top	1	19.6	8.1	7.0	38.4	2.9
L4	12/13/04	Top	1	19.7	8.0	6.2	40.8	1.1
L4	1/18/05	Top	1.0	13.1	7.5	8.2	27.0	2.0
L4	2/14/05	Top	1	17.1	7.8	7.9	30.4	1.4
L4	3/21/05	Top	1.1	20.4	7.5	7.6	19.5	1.8
L4	4/18/05	Top	1	23.1	7.7	6.5	21.2	2.0
L4	5/16/05	Top	1.2	28.2	7.9	5.5	28.7	1.4
L4	6/13/05	Top	0.8	30.9	7.6	5.6	23.6	3.2
L4	7/20/05	Top	0.9	32.9	7.8	5	35.3	1.8
		Max						
		Min						

Qualifier	Secchi depth ft.	Total N mg/l	Qualifier	TKN mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Qualifier
		0.72		0.70	0.015	0.082 U	0.12	
		0.73		0.72	0.011	0.082 U	0.029	
		0.64	J4	0.63 J4	0.011	0.19	0.019	
		0.70			0.012	0.13	0.006	U
		0.49			0.028	0.082U	0.030	
		0.53			0.084	0.082 U	0.018	U
		0.51			0.0053 U	0.082U	0.022	
		0.51			0.0053 U	0.082U	0.090	
		0.39			0.0053 U	0.082U	0.011	
		0.22		0.22	0.010 M	0.082 U	0.019	
		0.47		0.46	0.011	0.082 U	0.011	
J		0.78		0.77	0.011	0.30	0.076	
		0.42			0.014	0.082 U	0.006	U
		0.50			0.010 M	0.22	0.018	U
		0.52			0.0053 U	0.21	0.018	U
		0.36			0.0053 U	0.082 U	0.011	
		0.47			0.0053 U	0.082 U	0.043	
		0.45			0.0053 U	0.082 U	0.052	
		0.34		0.33	0.011	0.082 U	0.021	
		0.55		0.54	0.013	0.082 U	0.035	
		0.77		0.74	0.030	0.33	0.048	
		0.58			0.013	0.10 M	0.006	U
NA		0.32			0.014	0.082 U	0.025	
		0.55			0.052	0.082 U	0.018	U
J		0.35			0.0053 U	0.082 U	0.01	M
		0.56			0.0053 U	0.082 U	0.022	
		0.34			0.0053 U	0.082 U	0.01	M
		0.35		0.31 J4	0.14	0.082 U	0.029	
		0.57		0.56	0.013	0.082 U	0.021	U
		0.57		0.55	0.017	0.13	0.019	
		0.53			0.016	0.010 M	0.006	U
		0.75			0.0053U	0.39	0.028	
		0.80			0.012	0.28	0.02	M
		0.94			0.010 M	0.27	0.050	
		0.45			0.0053 U	0.082U	0.017	
		0.44			0.011	0.082 U	0.012	
J								

J							
J							
J							
	5.5	0.50	0.49	0.012	0.082 U	0.050	
J	8	0.47	0.45	0.019	0.082 U	0.011	
	6	0.42	0.38	0.035	0.082 U	0.21	
	6	0.49		0.044	0.082U	0.006	U
	3.5	0.33		0.012	0.082U	0.018	U
	>3	0.50		0.043	0.082 U	0.02	M
	>4	0.38		0.0053 U	0.082U	0.011	
	3.0	0.49		0.0053 U	0.082U	0.017	
	>7	0.40		0.0053 U	0.082U	0.01	M
	6	0.40	0.40	0.010 M	0.082 U	0.018	
J	8	0.44	0.42	0.022	0.10 M J4	0.011	
	6	0.34	0.31	0.034	0.082 U	0.028	
	6	0.52		0.044	0.082 U	0.006	U
	4	0.30		0.017	0.082 U	0.018	U
	2.5	0.51		0.044	0.082 U	0.018	U
J	>3.5	0.52		0.019	0.082 U	0.019	
	3.5	0.46		0.0053 U	0.082 U	0.020	
	4	0.44		0.0053 U	0.082 U	0.01	M
	5.5	0.13	0.13	0.010 M	0.082 U	0.026	

J	8	0.47	0.45	0.016	0.082 U	0.016	
	5	0.40	0.40	0.010 M	0.082 U	0.016	
J	8	0.52		0.041	0.082 U	0.018	
NA	3	0.34		0.013	0.082 U	0.018	U
	>3	0.53		0.033	0.082 U	0.018	U
	>3.5	0.39		0.0053 U	0.082 U	0.01	M
	3	0.54		0.0053 U	0.082 U	0.015	
	>4.5	0.35		0.0053 U	0.082 U	0.01	M
	5.5	0.48	0.45	0.026	0.082 U	0.039	
	8	0.52	0.51	0.014	0.082 U	0.018	
	5	0.39	0.36	0.030	0.082 U	0.83	
	6	0.41		0.071	0.082 U	0.006	U
	2	0.32		0.044	0.11	0.023	
	2	0.79		0.059	0.082 U	0.050	
	4	0.42		0.010 M	0.082 U	0.013	
	2	0.44		0.0053 U	0.082 U	0.016	
	7	0.33		0.0053 U	0.082 U	0.006	U

0.94	0.83
0.13	0.01

Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
0.018	4.9				
0.018					
0.010 M	28.4	20	15 B	3.2	3.0
0.010 M	5.4				
0.012					
0.010 M					
0.010 M	18.5		100		2.8
0.010 M	8.9	60	28 B		2.8
0.010 M	7.5	60	3.2	3.8 J3	3.2
0.010 M	3.7				
0.010 M					
0.010 M	4.7		5 B		
0.010 M	4.6				
0.010 M					
0.010 M	21.8	125	550	1.0 M	2.0
0.010 M					
0.010 M					
0.010 M					
0.010 M	4.3				
0.010 M					
0.010 M	10.1	80	64		2.8
0.010 M	5.6				
0.010 M	20.4	100	79		3.2
0.017	7.5	150	<2B	4.9 J3	3.0
0.012	5.9		240		
0.013	10.8		13 B		3.4
0.010 M	4.5	15	8 B	3.7	6.0
0.010 M	5.3				
0.010 M					
0.010 M	6.5	40	10 B	3.3	2.8
0.010 M	5.0				
0.020					
0.010 M					
0.013					
0.010 M					
0.010 M					
	4.4	20	64 B	3.2	6.0
	2.9				
	8.5		7 B		1.2
	9.6	100	7 B		3.6

	5.2	30	2 B		3.0
	4.7				
	15.1	20	74	4.2	6.5
	5.4		<2 B		2.8
	13	90	710B	1.5	3.8
	8.3		32		3.4
	8.9	60	50		3.8
	3.7				
	6.4	40	<2B	2.7	2.4
	4.0				
	18.7	50	380	1.6	7.0
	37.9		100		1.6
	8.2	60	50		1.8
	7.8	70	35 B	7.5 J3	4.0
	5.4		2 B		
0.010 M	4.8	15	12 B	3.6	1.6
0.42 J6	3.7				
0.010 M					
0.010 M	5.6		2 B		3.2
0.010 M	12.9				
0.014					
0.010 M	6.9	70	<2B	3.3 J3	3.6
0.010 M	5.5		10 B		
0.010 M	14.7		4 B		5.2
0.010 M	5.6		9 B		
0.010 M	6.0				
0.010 M					
0.010 M	4.4	15	12 B	3.3	3.0
0.010 M	4.0				
0.010 M	11.0	80	44		2.6
0.010 M					
0.013					
0.010 M					
0.71 J6	9.2	60	60		3.2

0.010 M	3.4				
0.010 M					
0.010 M	4.3		110		
0.010 M	8.8		45		
0.010 M	10.2		3 B		3.8
0.012	4.0	15	20 B	3.7	4.2
0.010 M	15.1	175	110		2.0
0.010 M	6.6		1 B		2.2
0.010 M	6.4	40	<2 B	2.0	2.8
0.010 M	6.1				
0.010 M					
0.010 M	8.3	60	42		2.6
0.010 M					
0.010 M					
0.010 M					
0.010 M					
0.010 M					

Station	Date	Depth ft.	Depth relative	Time	Sampler	Temp. °C	pH	D.O. mg/l	Specific Conduct. Mmho/cm	Turbidity ntu
L1	11/15/04	1	Top	11:14	RH	18.7	8.0	6.8	39.6	1.7
L1	11/15/04	6	Mid	11:24	RH	18.6	8.0	6.5	39.6	1.7
L1	11/15/04	12	Bottom	11:19	RH	18.5	8.0	6.5	39.7	1.8
L1	12/13/04	1	Top	10:51	RH	17.5	7.9	7.3	35.3	0.85 J
L1	12/13/04	5.5	Mid	10:56	RH	16.6	8.0	7.3	37.0	0.85 J
L1	12/13/04	9	Bottom	11:01	RH	19.5	7.8	2.2	44.5	6.0
L1	1/18/05	1	Top	11:15	RH	12.5	7.5	8.6	26.4	1.7
L1	1/18/05	4.7	Mid	11:22	RH	13.0	7.5	8.2	26.5	1.0
L1	1/18/05	9.5	Bottom	11:19	RH	17.7	7.4	2.5	41.2	8.0
L1	2/14/05	1	Top	11:30		17.2	7.7	7.8	32.4	2
L1	2/14/05	5	Mid	11:40		16.4	7.7	5.4	41.4	1.9
L1	2/14/05	11	Bottom	11:36		16.9	7.8	3.8	46.2	2.1
L1	3/21/05	1	Top	11:29		19.6	7.6	7.3	22.8	1.9
L1	3/21/05	2	Mid	11:37		19.5	7.6	7.2	22.9	1.9
L1	3/21/05	3.3	Bottom	11:36		19.6	7.6	5.9	27.7	1.9
L1	4/18/05	1	Top	11:31		23.1	7.6	6.3	22.4	1.6
L1	4/18/05	1.5	Mid	11:37		23.1	7.6	5.9	22.5	1.8
L1	4/18/05	2	Bottom	11:35		23.0	7.6	6.0	22.5	1.6
L1	5/16/05	1	Top	11:49		27.9	7.8	5.7	28.9	2.2
L1	5/16/05	2	Mid	11:54		27.4	7.8	5.7	29.5	1.8
L1	5/16/05	3	Bottom	11:55		27.1	7.8	4.9	31.9	1.4
L1	6/13/05	0.8	Top	9:47		29.8	7.7	5.1	30.4	1.8
L1	6/13/05	2.4	Mid	9:54		29.7	7.7	4.5	30.8	2.0
L1	6/13/05	4.5	Bottom	9:49		27.9	7.4	1.9	34.8	2.1
L1	7/20/05	0.9	Top	10:19		31.4	7.9	5.1	40.1	1.5
L1	7/20/05	2.4	Mid	10:24		31.1	7.9	5.1	40.3	1.4
L1	7/20/05	5.0	Bottom	10:21		31.3	7.9	4.6	43.9	2.3
L2	11/15/04	1	Top	11:45	RH	18.7	8.1	6.9	39.4	1.3
L2	11/15/04	6.6	Mid	11:52	RH	18.5	8.1	6.7	39.4	1.4
L2	11/15/04	11.5	Bottom	11:49	RH	18.4	8.1	6.8	39.5	2.2
L2	12/13/04	1	Top	11:25	RH	17.2	7.9	7.7	36.3	0.75 J
L2	12/13/04	5.5	Mid	11:29	RH	16.6	8.0	7.4	37.8	0.70 J
L2	12/13/04	9	Bottom	11:33	RH	18.0	8.1	5.7	45.8	1.7
L2	1/18/05	1	Top	11:40	RH	12.2	7.6	8.6	26.5	1.1
L2	1/18/05	5.5	Mid	11:47	RH	12.2	7.5	8.0	26.5	1.4
L2	1/18/05	10.8	Bottom	11:43	RH	17.3	7.4	1.0	43.6	0.70 J
L2	2/14/05	1	Top	11:59		17.4	7.8	7.9	32	1.1
L2	2/14/05	5.6	Mid	12:07		16.5	7.8	5.4	42	1.4
L2	2/14/05	11	Bottom	12:02		16.6	7.9	4.0	46.7	2.8
L2	3/21/05	1.1	Top	11:58		19.6	7.6	7.4	22.3	1.6
L2	3/21/05	3.2	Mid	12:06		19.6	7.6	7.2	22.3	1.6

L2	3/21/05	6.8	Bottom	12:04		18.9	7.6	1.9	37.3	1.6
L2	4/15/05	1	Top	11:59		22.4	7.8	6.9	22.6	1.4
L2	4/15/05	5.5	Mid	12:02		21.2	7.7	3.0	36.8	1.5
L2	4/15/05	10.1	Bottom	12:05		20.8	7.7	1.7	40.7	3.1
L2	5/16/05	1	Top	12:12		27.3	7.9	6.0	28.9	0.95J
L2	5/16/05	1.6	Mid	12:28		27.0	7.9	6.0	29	1.0
L2	5/16/05	2.5	Bottom	12:23		27.0	7.9	5.9	29.1	1.5
L2	6/13/05	0.9	Top	10:18		29.2	7.4	5.0	27.7	2.7
L2	6/13/05	3.3	Mid	10:26		28.6	7.8	3.7	34.1	1.8
L2	6/13/05	5.5	Bottom	10:21		27.4	7.6	1.4	38.9	2.5
L2	7/20/05	0.9	Top	10:48		31.2	7.9	4.8	39.9	1.2
L2	7/20/05	6	Mid	10:45		29.9	8.0	4.5	39.1	1.3
L2	7/20/05	11	Bottom	10:41		28.7	7.7	1.7	39.2	1.2
L3	11/15/04	1	Top	12:14	RH	18.9	8.1	7.0	39.1	1.2
L3	11/15/04	6.2	Mid	12:22	RH	18.8	6.7	8.1	39.2	1.3
L3	11/15/04	12.6	Bottom	12:20	RH	19.2	8.0	4.6	39.3	1.7
L3	12/13/04	1	Top	11:53	RH	17.6	8.0	7.0	38.6	0.75 J
L3	12/13/04	5.5	Mid	11:56	RH	17.6	8.0	6.9	38.1	0.70 J
L3	12/13/04	10	Bottom	11:58	RH	18.7	8.2	5.3	46.5	1.1
L3	1/18/05	1.4	Top	12:03	RH	11.2	7.5	9.0	24.5	1.6
L3	1/18/05	5.8	Mid	12:10	RH	12.0	7.6	7.8	26.5	1.2
L3	1/18/05	11.2	Bottom	12:07	RH	17.2	7.4	0.5	44	1.6
L3	2/14/05	1	Top	12:35		18.1	7.8	7.9	31.6	0.95J
L3	2/14/05	6	Mid	12:41		16.2	7.9	6.4	42.1	1
L3	2/14/05	11	Bottom	12:38		16.7	7.9	4.3	46.7	1.4
L3	3/21/05	1	Top	12:21		19.3	7.6	7.7	21.7	NA
L3	3/21/05	1.5	Mid	12:28		19.3	7.6	7.6	21.8	1.4
L3	3/21/05	2.1	Bottom	12:23		19.2	7.6	7.7	21.8	NA
L3	4/18/05	1	Top	12:24		22.9	7.8	6.6	22.5	1.4
L3	4/18/05	1.5	Mid	12:26		23.0	7.8	6.2	22.5	1.6
L3	4/18/05	2	Bottom	12:28		22.9	7.8	6.7	22.5	1.5
L3	5/16/05	0.8	Top	12:47		29.2	7.9	6.0	28.8	1.2
L3	5/16/05	1.8	Mid	12:54		26.9	8.0	6.1	28.8	1.0
L3	5/16/05	2.6	Bottom	12:52		26.6	7.9	5.9	28.9	0.75J
L3	6/13/05	1.1	Top	10:42		30.2	8.0	5.8	29.4	1.6
L3	6/13/05	3.6	Mid	10:54		29.3	7.8	5.4	30.0	2.9
L3	6/13/05	7.8	Bottom	10:49		27.4	7.9	2.1	42.0	4.9
L3	7/20/05	1	Top	11:06		31.3	7.9	5.2	38.9	1.0
L3	7/20/05	2	Mid	11:04		31.1	7.9	5.2	38.9	1.0
L3	7/20/05	3.2	Bottom	11:02		31.1	7.9	5.2	39.8	1.9
L4	11/15/04	1	Top	12:50	RH	19.6	8.1	7.0	38.4	2.9
L4	11/15/04	5.6	Mid	12:59	RH	18.9	8.1	6.7	38.8	2.2
L4	11/15/04	11	Bottom	12:55	RH	18.8	8.1	6.7	39.0	2.2
L4	12/13/04	1	Top	12:20	RH	19.7	8.0	6.2	40.8	1.1
L4	12/13/04	5	Mid	12:22	RH	19.0	8.0	4.5	44.5	1.4
L4	12/13/04	8	Bottom	12:26	RH	19.2	8.0	4.5	44.9	2.5
L4	1/18/05	1.0	Top	12:32	RH	13.1	7.5	8.2	27.0	2.0
L4	1/18/05	5.1	Mid	12:37	RH	13	7.5	7.1	27.1	0.95 J
L4	1/18/05	9.0	Bottom	12:35	RH	18.2	7.5	3.3	35.5	1.6
L4	2/14/05	1	Top	13:02		17.1	7.8	7.9	30.4	1.4

L4	2/14/05	4.5	Mid	13:10		16.5	7.8	6.4	42.3	1.1
L4	2/14/05	9	Bottom	13:05		16.9	7.9	5.1	45.6	1.5
L4	3/21/05	1.1	Top	12:47		20.4	7.5	7.6	19.5	1.8
L4	3/21/05	4	Mid	12:55		19.0	7.6	6.9	20.8	1.8
L4	3/21/05	7.9	Bottom	12:53		19.1	7.5	2.7	33.2	1.8
L4	4/18/05	1	Top	12:50		23.1	7.7	6.5	21.2	2.0
L4	4/18/05	4	Mid	12:52		22.2	7.6	4.0	28.2	1.7
L4	4/18/05	8	Bottom	12:54		20.8	7.6	1.3	38.7	2.8
L4	5/16/05	1.2	Top	13:18		28.2	7.9	5.5	28.7	1.4
L4	5/16/05	4.5	Mid	13:25		25.8	7.8	2.8	37.4	1.5
L4	5/16/05	9.1	Bottom	13:21		22.4	7.5	0.5	42.3	1.1
L4	6/13/05	0.8	Top	11:21		30.9	7.6	5.6	23.6	3.2
L4	6/13/05	3.5	Mid	11:34		29.3	7.9	4.7	28.8	2.9
L4	6/13/05	7.1	Bottom	11:26		27.8	7.9	3.4	38.2	3.6
L4	7/20/05	0.9	Top	11:29		32.9	7.8	5	35.3	1.8
L4	7/20/05	4.1	Mid	11:26		32.2	7.9	4.8	35.2	0.9
L4	7/20/05	8.4	Bottom	11:24		29.4	7.4	<0.10	36.0	3.1
S1	11/15/04	1	Top	10:51	RH	20.7	7.8	5.6	39.1	0.65 J
S1	11/15/04	3.9	Bottom	10:57	RH	20.6	8.0	6.3	40.1	3.5
S1	12/13/04	1	Top	10:32	RH	17.3	7.5	7.4	22.3	1.9
S1	12/13/04	2.2	Bottom	10:36	RH	19.3	7.4	6.1	33.7	6.0
S1	1/18/05	1.0	Top	10:59	RH	13.2	6.9	7.7	24.0	1.6
S1	1/18/05	5.0	Bottom	11:03	RH	16.8	7.3	5.5	27.5	1.2
S1	2/14/05	1	Top	11:17		16.5	7.7	7.1	37	1.9
S1	2/14/05	4	Bottom	11:17		16.3	7.7	6.4	38.3	1.5
S1	3/21/05	0.8	Top	11:14		19.3	7.5	6.1	25.3	1.8
S1	3/21/05	3.2	Bottom	11:18		19.6	7.5	4.7	29.1	1.8
S1	4/18/05	1	Top	11:16		24.1	7.5	5.5	23.1	2.0
S1	4/18/05	2	Bottom	11:18		24.5	7.4	3.8	26.4	3.0
S1	5/16/05	1.5	Top	11:31		29.4	7.6	5	29.4	1.9
S1	5/16/05	2.5	Bottom	11:36		32.6	7.4	2.9	32.6	2.2
S1	6/13/05	1	Top	9:31		29.3	7.9	5.0	32.7	2.1
S1	6/13/05	3.6	Bottom	9:35		27.8	7.4	1.7	35.5	2.1
S1	7/20/05	1.0	Top	10:00		32.4	7.6	4.3	40.8	1.8
S1	7/20/05	2.2	Bottom	10:04		32.7	7.8	4.5	41.7	1.4
S2	11/15/04	1	Top	11:33	RH	19.3	8.0	6.5	38.9	1.6
S2	11/15/04	7	Bottom	11:40	RH	18.4	8.1	6.5	39.5	1.8
S2	12/13/04	1	Top	11:11	RH	17.9	7.8	7.2	33.2	1.0
S2	12/13/04	5	Bottom	11:14	RH	16.9	8.0	7.3	36.3	0.85 J
S2	1/18/05	1.0	Top	11:30	RH	13.7	7.2	8.0	25.4	1.2
S2	1/18/05	9.0	Bottom	11:33	RH	18.3	7.4	2.1	40.0	1.4
S2	2/14/05	1	Top	11:48		18	7.6	7.6	29.6	2.7
S2	2/14/05	7	Bottom	11:52		16.4	7.7	4.1	42.8	2.7
S2	3/21/05	0.9	Top	11:44		20.6	7.5	6.8	23.6	1.7
S2	3/21/05	5.3	Bottom	11:46		19.4	7.5	2.6	32.4	1.7
S2	4/18/05	1	Top	11:46		22.7	7.6	6.3	22.7	1.7
S2	4/18/05	4	Bottom	11:48		22.7	7.6	4.9	25.1	2.1
S2	5/16/05	1	Top	12:06		28.3	7.8	5.5	29	1.3
S2	5/16/05	6	Bottom	12:11		25.7	7.6	2.4	38.5	2.7
S2	6/13/05	1	Top	10:02		28.7	6.4	3.4	21.9	2.2
S2	6/13/05	3	Bottom	10:06		28.2	7.2	1.8	31.4	2.3
S2	7/20/05	1.1	Top	10:32		32.2	7.8	4.4	40.9	2.5
S2	7/20/05	3	Bottom	10:34		32.4	7.8	3.8	42.6	1.9

S3	11/15/04	1	Top	11:59	RH	18.8	8.1	6.8	39.4	2.0
S3	11/15/04	5.2	Bottom	12:05	RH	18.8	8.1	6.5	39.4	1.4
S3	12/13/04	1	Top	11:41	RH	17.8	8.0	7.4	37.7	0.8
S3	12/13/04	3	Bottom	11:46	RH	17.7	8.0	7.3	37.6	0.7
S3	1/18/05	1.2	Top	11:53	RH	11.8	7.6	8.9	25.2	1.5
S3	1/18/05	4.3	Bottom	11:56	RH	11.9	7.6	8.7	26.1	1.5
S3	2/14/05	1	Top	12:25		17.9	7.8	7.9	31.4	0.95J
S3	2/14/05	3	Bottom	12:27		16.9	7.9	8.9	39.5	2.9
S3	3/21/05	0.9	Top	12:12		19.9	7.6	7.5	21.9	1.1
S3	3/21/05	2.5	Bottom	12:14		19.9	7.6	7.5	21.9	1.1
S3	4/18/05	1.0	Top	12:15		23.1	7.8	6.9	22.4	1.6
S3	4/18/05	2.0	Bottom	12:16		23.1	7.8	6.8	22.4	1.7
S3	5/16/05	1	Top	12:35		27.0	8.0	6.5	28.7	0.85J
S3	5/16/05	2.1	Bottom	12:39		27.5	8.2	6.3	29.0	2.9
S3	6/13/05	0.7	Top	10:35		29.9	7.2	5.2	21.9	2.9
S3	6/13/05	2.7	Bottom	10:39		29.0	7.6	4.4	31.5	1.6
S3	7/20/05	1.1	Top	10:50		31.5	7.8	4.6	39.2	2.0
S3	7/20/05	2.1	Bottom	10:55		31.6	7.8	4.9	39.5	2.7
S4	11/15/04	1	Top	12:35	RH	19.8	8.1	6.6	39.0	1.6
S4	11/15/04	9.8	Bottom	12:40	RH	18.9	8.1	6.3	39.3	3.8
S4	12/13/04	1	Top	12:08	RH	17.7	8.0	6.9	36.9	0.95
S4	12/13/04	6.6	Bottom	12:12	RH	19.6	7.9	4.0	43.8	1.1
S4	1/18/05	1.0	Top	12:18	RH	13.8	7.5	7.8	27.0	1.2
S4	1/18/05	9.0	Bottom	12:25	RH	18.3	7.4	3.4	36.1	1.6
S4	2/14/05	1	Top	12:50		18.2	7.7	7.5	30.0	7.8
S4	2/14/05	7	Bottom	12:54		16.6	7.8	5.1	43.2	1.4
S4	3/21/05	1	Top	12:38		20.7	7.5	7.3	20.6	1.4
S4	3/21/05	6.8	Bottom	12:42		19.1	7.4	2.7	29.6	1.4
S4	4/18/05	1	Top	12:37		24.2	7.6	6.4	20.7	2.6
S4	4/18/05	4	Bottom	12:39		22.9	7.5	3.8	25.5	2.8
S4	5/16/05	0.8	Top	13:02		29.0	7.9	5.6	29.3	0.95J
S4	5/16/05	7.5	Bottom	13:07		23.4	7.5	0.7	40.2	3.6
S4	6/13/05	0.9	Top	11:04		29.9	7.0	4.1	20.7	14
S4	6/13/05	6.9	Bottom	11:09		27.5	7.6	0.2	40.3	12
S4	7/20/05	0.9	Top	11:13		32.5	7.9	4.9	39.3	1.1
S4	7/20/05	6	Bottom	11:11		30.8	7.7	3.2	44.2	2.1
S5	11/15/04	1	Top	13:05	RH	19.1	8.0	7.2	37.2	2.1
S5	11/15/04	9.7	Bottom	13:10	RH	19.4	8.0	6.4	38.9	1.4
S5	12/13/04	1	Top	12:34	RH	20.1	7.9	4.9	41.1	0.90
S5	12/13/04	7	Bottom	12:36	RH	19.5	8.0	4.0	44.5	1.5
S5	1/18/05	1.2	Top	12:45	RH	14.3	7.5	8.0	27.0	1.1
S5	1/18/05	8.9	Bottom	12:48	RH	18.5	7.4	3.0	35.0	1.8
S5	2/14/05	1	Top	13:17		16.5	7.7	7.8	29.9	2.9
S5	2/14/05	7	Bottom	13:20		16.7	7.9	4.9	44.4	1.9
S5	3/21/05	0.9	Top	13:00		20.2	7.3	7.4	14.6	2.6
S5	3/21/05	7	Bottom	13:06		18.9	7.4	3.6	29.1	2.6
S5	4/18/05	1	Top	13:00		23.7	7.6	6.4	20.5	2.5
S5	4/18/05	6.5	Bottom	13:03		21.0	7.5	1.0	36.7	2.8
S5	5/16/05	0.9	Top	13:38		29.4	7.9	6.4	27.5	2.0
S5	5/16/05	2	Bottom	13:41		28.3	7.9	4.9	29.0	1.5
S5	6/13/05	1	Top	11:34		29.8	7.1	5.3	23.8	2.6
S5	6/13/05	7.5	Bottom	11:38		27.7	7.7	2.0	38.7	2.2
S5	7/20/05	1	Top	11:39		32.9	7.8	4.7	34.3	2.5

S5	7/20/05	7.9	Bottom	11:37		29.8	7.6	1.5	45.8	3.5
S6	11/15/04	1	Top	13:26	RH	18.5	8.2	7.3	38.3	1.4
S6	11/15/04	3.5	Bottom	13:26	RH	17.9	8.1	8.4	38.6	1.4
S6	12/13/04	1	Top	13:26	RH	17.6	8.1	7.7	38.3	1.3
S6	12/13/04	4	Bottom	13:29	RH	17.7	8.1	8.1	38.3	5.0
S6	1/18/05	1.1	Top	12:58	RH	10.7	7.6	9.3	23.8	1.6
S6	1/18/05	3.6	Bottom	13:01	RH	10.3	7.6	9.3	24.6	1.8
S6	2/14/05	1	Top	13:37		16.8	7.8	7.4	36	0.9J
S6	2/14/05	3	Bottom	13:40		16.8	7.9	7.9	39.6	1.4
S6	3/21/05	0.9	Top	13:20		19.2	7.5	7.4	21.3	1.8
S6	3/21/05	2.7	Bottom	13:24		18.2	7.5	7.2	22.4	1.8
S6	4/18/05	1	Top	13:19		22.9	7.8	6.7	23.0	2.2
S6	4/18/05	1.7	Bottom	13:23		22.7	7.9	6.2	23.2	2.2
S6	5/16/05	0.8	Top	13:55		27.8	8.0	6.7	27.4	1.3
S6	5/16/05	1.5	Bottom	13:58		27.7	8.1	7.5	27.4	1.2
S6	6/13/05	0.9	Top	11:48		30.6	8.1	5.7	31.3	1.5
S6	6/13/05	2.3	Bottom	11:53		29.7	8.1	6.8	32.6	1.1
S6	7/20/05	0.8	Top	11:59		31.6	7.9	5.7	38.9	1.1
S6	7/20/05	1.6	Bottom	11:55		31.4	7.9	6.0	39.0	1.5
S7	11/15/04	1	Top	10:35	RH	18.8	7.8	7.0	39.5	1.5
S7	11/15/04	5.8	Bottom	10:38	RH	18.7	7.9	6.5	39.6	1.5
S7	12/13/04	1	Top	10:13	RH	17.5	7.8	7.5	35.9	1.3
S7	12/13/04	5	Bottom	10:18	RH	17.1	7.8	7.5	36.1	1.1
S7	1/18/05	1.5	Top	10:37	RH	11.2	7.1	8.7	19.8	1.2
S7	1/18/05	5	Bottom	10:47	RH	12.2	7.4	8.3	26.5	0.90 J
S7	2/14/05	1	Top	11:00		16.6	7.6	7.5	35.2	0.8J
S7	2/14/05	6	Bottom	11:10		16.5	7.6	5.2	41.6	1.4
S7	3/21/05	1	Top	10:57		19.9	7.5	6.8	24.3	2.0
S7	3/21/05	6	Bottom	11:02		19.1	7.6	4.1	32.6	2.0
S7	4/18/05	1	Top	10:58		21.4	7.1	6.5	22.5	1.8
S7	4/18/05	7.2	Bottom	11:00		20.7	7.3	1.1	38.0	1.9
S7	5/16/05	1.1	Top	11:11		27.6	7.7	5.6	28.7	2.1
S7	5/16/05	5.5	Bottom	11:16		23.0	7.5	1.8	40.1	1.3
S7	6/13/05	1	Top	9:15		29.9	7.8	5.6	32.8	1.7
S7	6/13/05	7	Bottom	9:18		27.9	7.5	1.7	41.4	1.7
S7	7/20/05	0.9	Top	9:47		31.5	7.8	4.8	39.6	1.7
S7	7/20/05	5.2	Bottom	9:41		30.5	7.8	4.1	44.7	4.1

Secchi depth ft.	Total N mg/l	TKN mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml
5.5	0.50	0.49	0.012	0.082 U	0.050	0.010 M	4.8	15	12 B
	0.72	0.70	0.015	0.082 U	0.12	0.018	4.9		
8	0.47	0.45	0.019	0.082 U	0.011	0.42 J6	3.7		
							4.4	20	64 B
	0.73	0.72	0.011	0.082 U	0.029	0.018			
6	0.42	0.38	0.035	0.082 U	0.21	0.010 M			
							2.9		
	0.64 J4	0.63 J4	0.011	0.19	0.019	0.010 M	28.4	20	15 B
6	0.49		0.044	0.082U	0.006 U	0.010 M	5.6		2 B
	0.70		0.012	0.13	0.006 U	0.010 M	5.4		
3.5	0.33		0.012	0.082U	0.018 U	0.010 M	12.9		
							8.5		7 B
	0.49		0.028	0.082U	0.030	0.012			
>3	0.50		0.043	0.082 U	0.020 M	0.014			
							9.6	100	7 B
	0.53		0.084	0.082 U	0.018 U	0.010 M			
>4	0.38		0.0053 U	0.082U	0.011	0.010 M	6.9	70	<2B
	0.51		0.0053 U	0.082U	0.022	0.010 M	18.5		100
3.0	0.49		0.0053 U	0.082U	0.017	0.010 M	5.5		10 B
	0.51		0.0053 U	0.082U	0.090	0.010 M	8.9	60	28 B
>7	0.40		0.0053 U	0.082U	0.010 M	0.010 M	14.7		4 B
	0.39		0.0053 U	0.082U	0.011	0.010 M	7.5	60	3.2
6	0.40	0.40	0.010 M	0.082 U	0.018	0.010 M	5.6		9 B
	0.22	0.22	0.010 M	0.082 U	0.019	0.010 M	3.7		
8	0.44	0.42	0.022	0.10 M J4	0.011	0.010 M	6.0		
							5.2	30	2 B
	0.47	0.46	0.011	0.082 U	0.011	0.010 M			
6	0.34	0.31	0.034	0.082 U	0.028	0.010 M			
							4.7		
	0.78	0.77	0.011	0.30	0.076	0.010 M	4.7		5 B
6	0.52		0.044	0.082 U	0.006 U	0.010 M	4.4	15	12 B
	0.42		0.014	0.082 U	0.006 U	0.010 M	4.6		
4	0.30		0.017	0.082 U	0.018 U	0.010 M	4.0		
							15.1	20	74

	0.50		0.010 M	0.22	0.018 U	0.010 M			
2.5	0.51		0.044	0.082 U	0.018 U	0.010 M	11.0	80	44
	0.52		0.0053 U	0.21	0.018 U	0.010 M	21.8	125	550
>3.5	0.52		0.019	0.082 U	0.019	0.010 M			
							5.4		<2 B
	0.36		0.0053 U	0.082 U	0.011	0.010 M			
3.5	0.46		0.0053 U	0.082 U	0.020	0.013			
							13	90	710B
	0.47		0.0053 U	0.082 U	0.043	0.010 M			
4	0.44		0.0053 U	0.082 U	0.010 M	0.010 M			
							8.3		32
	0.45		0.0053 U	0.082 U	0.052	0.010 M			
5.5	0.13	0.13	0.010 M	0.082 U	0.026	0.71 J6	9.2	60	60
	0.34	0.33	0.011	0.082 U	0.021	0.010 M	4.3		
8	0.47	0.45	0.016	0.082 U	0.016	0.010 M	3.4		
							8.9	60	50
	0.55	0.54	0.013	0.082 U	0.035	0.010 M			
5	0.40	0.40	0.010 M	0.082 U	0.016	0.010 M			
							3.7		
	0.77	0.74	0.030	0.33	0.048	0.010 M	10.1	80	64
8	0.52		0.041	0.082 U	0.018	0.010 M	4.3		110
	0.58		0.013	0.10 M	0.006U	0.010 M	5.6		
3	0.34		0.013	0.082 U	0.018U	0.010 M	8.8		45
	0.32		0.014	0.082 U	0.025	0.010 M	20.4	100	79
>3	0.53		0.033	0.082 U	0.018 U	0.010 M	10.2		3 B
	0.55		0.052	0.082 U	0.018 U	0.017	7.5	150	<2B
>3.5	0.39		0.0053 U	0.082 U	0.010 M	0.012	4.0	15	20 B
	0.35		0.0053 U	0.082 U	0.010 M	0.012	5.9		240
3	0.54		0.0053 U	0.082 U	0.015	0.010 M	15.1	175	110
	0.56		0.0053 U	0.082 U	0.022	0.013	10.8		13 B
>4.5	0.35		0.0053 U	0.082 U	0.010 M	0.010 M	6.6		1 B
	0.34		0.0053 U	0.082 U	0.010 M	0.010 M	4.5	15	8 B
5.5	0.48	0.45	0.026	0.082 U	0.039	0.010 M	6.4	40	<2 B
	0.35	0.31 J4	0.14	0.082 U	0.029	0.010 M	5.3		
8	0.52	0.51	0.014	0.082 U	0.018	0.010 M	6.1		
							6.4	40	<2B
	0.57	0.56	0.013	0.082 U	0.021 U	0.010 M			
5	0.39	0.36	0.030	0.082 U	0.83	0.010 M			
							4.0		
	0.57	0.55	0.017	0.13	0.019	0.010 M	6.5	40	10 B
6	0.41		0.071	0.082 U	0.006 U	0.010 M	8.3	60	42

	0.53		0.016	0.010 M	0.006 U	0.010 M	5.0		
2	0.32		0.044	0.11	0.023	0.010 M			
							18.7	50	380
	0.75		0.0053U	0.39	0.028	0.020			
2	0.79		0.059	0.082 U	0.050	0.010 M			
							37.9		100
	0.80		0.012	0.28	0.020 M	0.010 M			
4	0.42		0.010 M	0.082 U	0.013	0.010 M			
							8.2	60	50
	0.94		0.010 M	0.27	0.050	0.013			
2	0.44		0.0053 U	0.082 U	0.016	0.010 M			
							7.8	70	35 B
	0.45		0.0053 U	0.082U	0.017	0.010 M			
7	0.33		0.0053 U	0.082 U	0.006U	0.010 M			
							5.4		2 B
	0.44		0.011	0.082 U	0.012	0.010 M			
>4	0.28	0.28	0.010 M	0.082 U	0.023	0.010 M	14.2	100	3 B
6	0.48	0.45	0.034	0.082 U	0.011	0.010 M	3.8		
							10.7	100	17B
4	0.52	0.50	0.015	0.082 U	0.032	0.010 M			
							3.7		
>4	0.74		0.041	0.082 U	0.041	0.010 M	7.2	50	84
>4	0.63		0.013	0.082 U	0.018 U	0.010 M	18.3	175	24B
>3	0.63		0.030	0.082 U	0.018 U	0.010 M	5.0		2 B
3	0.8		0.027	0.082 U	0.017	0.010 M	54.8	80	500
3.5	0.56		0.010 M	0.082 U	0.018	0.010	23.9		58
>2.6	0.39		0.0053 U	0.082 U	0.013	0.010 M	12.4	100	94
5	0.32	0.32	0.010 M	0.082 U	0.023	0.010 M	8.8		
							10.7		3 B
6	0.38	0.34	0.037	0.082 U	0.011	0.010 M			
							4.8		
5	0.42	0.39	0.030	0.082 U	0.014	0.010 M	10.9	140	17 B
5	0.49		0.053	0.082 U	0.006 U	0.010 M	4.7		
							13.8	125	25B
3.75	0.38		0.012	0.082 U	0.018 U	0.010 M	15.8		4 B
2	0.62		0.065	0.082 U	0.018 U	0.010 M	5.1	15	12 B
2.5	0.50		0.015	0.082 U	0.025	0.010 M	10.9	100	7B
1	0.80		0.024	0.082 U	0.017	0.011	7.4		10 B
>4	1.1		0.0053 U	0.082 U	0.019	0.010 M	9.6	30	2B

5	0.42	0.40	0.022	0.082 U	0.021	0.016	10.6		
>3.5	0.48	0.46	0.018	0.082 U	0.011	0.010 M	11.4	125	<2 B
5	0.50	0.38	0.12	0.082 U	0.017	0.010 M	11.6 11.1		<2 B
>4	0.48		0.043	0.082 U	0.024	0.010 M	6.2		
3	0.57		0.016	0.082 U	0.018 U	0.010 M	15.5	300	31
>3	0.50		0.047	0.082 U	0.018 U	0.014	5.8		3 B
>3	0.46		0.012	0.082 U	0.018	0.010 M	13.3		12 B
1	0.55		0.010 M	0.082 U	0.025	0.011	4.9	20 J5	13 B
>3	0.39		0.0053 U	0.082 U	0.010 M	0.010 M	9.7	75	3B
5	0.41	0.41	0.010 M	0.082 U	0.027	0.010 M	6.9	60	<2 B
7	0.33	0.29	0.036	0.082 U	0.022	0.010 M	6.4 7.5	60	2 B
6	0.35	0.32	0.032	0.082 U	0.017	0.010 M	11.3		
6	0.53		0.096	0.082 U	0.021	0.012	10.8		2 B
3.5	0.56		0.075	0.082 U	0.018 U	0.010 M	17.5		64
2.5	0.67		0.10	0.082 U	0.018 U	0.014	13.2	60	70
4.5	0.48		0.037	0.082 U	0.023	0.010 M	7.2	60	3 B
1	0.73		0.070	0.082 U	0.018	0.018	5.5		<1
5.5	0.35		0.0053 U	0.082 U	0.006 U	0.010 M	11.0		2 B
5.5	0.66	0.60	0.065	0.082 U	0.13	0.010 M	6.5 9.2		8.0
6	0.47	0.46	0.014	0.082 U	0.011	0.010 M	7.2		
5	4.1	4.1	0.034	0.082 U	0.021	0.010 M	7.5	60	<2 B
6	0.49		0.076	0.082 U	0.006 U	0.010 M	5.6 8.3	70	4 B
2	0.47		0.10	0.082 U	0.018 U	0.010 M	4.4		12 B
>2	0.52		0.075	0.082 U	0.018 U	0.011	10.8	100	<2B
>3	0.49		0.068	0.082 U	0.014	0.010 M	24		300
1	0.64		0.055	0.082 U	0.017	0.010 M	10.4	120	100
5	0.38		0.060	0.082 U	0.010M	0.010 M	7.7	70	5 B

4	0.32	0.49 J4	0.010 M	0.082 U	0.03	0.010 M	11.9		
>5	0.41	0.39	0.024	0.082 U	0.018	0.010 M	12.2	125	58
4	0.31	0.28	0.028	0.082 U	0.24	0.010 M	7.6 9.1		17
>4	0.42		0.039	0.082 U	0.006 U	0.010 M	5.4		
2	0.30		0.013	0.082 U	0.018 U	0.010 M	5.2	20	33 B
>2	1.2		0.048	0.082 U	0.018 U	0.013	10.7	140	<3B
>2.5	0.44		0.0053 U	0.082 U	0.013	0.010 M	5.3		2 B
2	0.47		0.0053 U	0.082 U	0.018	0.010 M	7.8	40	8B
>3	0.35		0.0053 U	0.082 U	0.010 M	0.010 M	8.5		17
5	0.44	0.44	0.010 M	0.082 U	0.019	0.010 M	6.2		2 B
>6	0.54	0.50	0.040	0.082 U	0.019	0.010 M	5.7 5.1		<2 B
4	0.27	0.23	0.037	0.082 U	0.35	0.010 M	4.3		
>6	0.54		0.044	0.082 U	0.006 U	0.010 M	15.5		130
4.5	0.34		0.016	0.082 U	0.018 U	0.010 M	28.6		25 B
3.5	0.89		0.039	0.082 U	0.018 U	0.0026 U	10.6		2 B
4.5	0.76		0.010 M	0.082 U	0.021	0.010 M	10.8	50	570
4	0.46		0.010 M	0.082 U	0.016	0.010 M	11	100	11B
6	0.37		0.0053 U	0.082 U	0.010 M	0.010 M	5.7		12 B

Chlorophyll A ug/l	TSS mg/l
3.6	1.6
3.2	6.0
3.2	3.0
	3.2
	1.2
	3.6
3.3 J3	3.6
	2.8
	2.8
	5.2
3.8 J3	3.2
	3.0
3.3	3.0
4.2	6.5

	2.6
1.0 M	2.0
	2.8
1.5	3.8
	3.4
	3.2
	3.8
	2.8
	3.2
	3.8
4.9 J3	3.0
3.7	4.2
	2.0
	3.4
	2.2
3.7	6.0
2.0	2.8
2.7	2.4
3.3	2.8
	2.6

1.6	7.0
	1.6
	1.8
7.5 J3	4.0
	1.8
	2.0
2.7	3.4
	1.2
	2.4
1.4	6.2
	1.6
1.3	1.6
	2.2
	3.4
	2.2
	3.0
3.1	5.8
	2.2
	2.0
1.4	4.8

	3.0
	3.6
1.0 J3	3.8
	2.4
2.7	1.4 J5
no sample	3.0
3.4 J3	4.2
4.3 J3	2.0
	2.4
	2.8
	1.8
4.7 J3	4.0
5.3	3.7
	3.2
4.1 J3	2.2
4.8 J3	2.2
	3.6
2.3	3.4
	2.4
	3.0
3.8 J3	3.9

	3.0
	2.4
2.9	4.0
	3.2
	1.2
2.1	4.4
4.4	2.5
	3.6
	4
	3.6
	4.4
2.9	2.0
	2.6
1.6 J3	4.4

L1

Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	11:14	18.7	8.0	6.8	39.6	1.7	5.5	0.50	0.012	0.082 U	0.050	0.010 M	4.8	15	12 B	3.6	1.6
11/15/04	6	11:24	18.6	8.0	6.5	39.6	1.7											
11/15/04	12	11:19	18.5	8.0	6.5	39.7	1.8		0.72	0.015	0.082 U	0.12	0.018	4.9				
12/13/04	1	10:51	17.5	7.9	7.3	35.3	0.85 J	8	0.47	0.019	0.082 U	0.011	0.42 J6	5.6		9 B		
12/13/04	5.5	10:56	16.6	8.0	7.3	37.0	0.85 J											
12/13/04	9	11:01	19.5	7.8	2.2	44.5	6.0		0.73	0.011	0.082 U	0.029	0.018	3.7				
1/18/05	1	11:15	12.5	7.5	8.6	26.4	1.7	6	0.42	0.035	0.082 U	0.21	0.010 M	9.2	60	60		3.2
1/18/05	4.7	11:22	13.0	7.5	8.2	26.5	1.0											
1/18/05	9.5	11:19	17.7	7.4	2.5	41.2	8.0		0.64 J4	0.011	0.19	0.019	0.010 M	4.3				
2/14/05	1	11:30	17.2	7.7	7.8	32.4	2	6	0.49	0.044	0.082U	0.006 U	0.010 M	6.4	40	<2 B	2.0	2.8
2/14/05	5	11:40	16.4	7.7	5.4	41.4	1.9											
2/14/05	11	11:36	16.9	7.8	3.8	46.2	2.1		0.70	0.012	0.13	0.006 U	0.010 M	5.3				
3/21/05	1	11:29	19.6	7.6	7.3	22.8	1.9	3.5	0.33	0.012	0.082U	0.018 U	0.010 M	14.2	100	3 B		1.8
3/21/05	2	11:37	19.5	7.6	7.2	22.9	1.9											
3/21/05	3.3	11:36	19.6	7.6	5.9	27.7	1.9		0.49	0.028	0.082U	0.030	0.012	8.8				
4/18/05	1	11:31	23.1	7.6	6.3	22.4	1.6	>3	0.50	0.043	0.082 U	0.020 M	0.014	10.7		3 B		2.2
4/18/05	1.5	11:37	23.1	7.6	5.9	22.5	1.8											
4/18/05	2	11:35	23.0	7.6	6.0	22.5	1.6		0.53	0.084	0.082 U	0.018 U	0.010 M	10.6				
5/16/05	1	11:49	27.9	7.8	5.7	28.9	2.2	>4	0.38	0.0053 U	0.082U	0.011	0.010 M	6.9	60	<2 B	3.4 J3	4.2
5/16/05	2	11:54	27.4	7.8	5.7	29.5	1.8											
5/16/05	3	11:55	27.1	7.8	4.9	31.9	1.4		0.51	0.0053 U	0.082U	0.022	0.010 M	6.5				
6/13/05	0.8	9:47	29.8	7.7	5.1	30.4	1.8	3.0	0.49	0.0053 U	0.082U	0.017	0.010 M	9.2		8.0		3.2
6/13/05	2.4	9:54	29.7	7.7	4.5	30.8	2.0											
6/13/05	4.5	9:49	27.9	7.4	1.9	34.8	2.1		0.51	0.0053 U	0.082U	0.090	0.010 M	11.9				
7/20/05	0.9	10:19	31.4	7.9	5.1	40.1	1.5	>7	0.40	0.0053 U	0.082U	0.010 M	0.010 M	6.2		2 B		3.6
7/20/05	2.4	10:24	31.1	7.9	5.1	40.3	1.4											
7/20/05	5.0	10:21	31.3	7.9	4.6	43.9	2.3		0.39	0.0053 U	0.082U	0.011	0.010 M	3.7				

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M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J4 = The matrix interfered with the ability to make an accurate determination.
J5 = the data is questionable because of improper laboratory or field protocols
J6 = Result is suspect because the TP is lower than the OP result

L2

Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	11:45	18.7	8.1	6.9	39.4	1.3	6	0.40	0.010 M	0.082 U	0.018	0.010 M	4.4	20	64 B	3.2	6.0
	6.6	11:52	18.5	8.1	6.7	39.4	1.4											
	11.5	11:49	18.4	8.1	6.8	39.5	2.2		0.22	0.010 M	0.082 U	0.019	0.010 M	6.0				
12/13/04	1	11:25	17.2	7.9	7.7	36.3	0.75 J	8	0.44	0.022	0.10 M J4	0.011	0.010 M	5.2	30	2 B		3.0
	5.5	11:29	16.6	8.0	7.4	37.8	0.70 J											
	9	11:33	18.0	8.1	5.7	45.8	1.7		0.47	0.011	0.082 U	0.011	0.010 M	3.4				
1/18/05	1	11:40	12.2	7.6	8.6	26.5	1.1	6	0.34	0.034	0.082 U	0.028	0.010 M	8.9	60	50		3.8
	5.5	11:47	12.2	7.5	8.0	26.5	1.4											
	10.8	11:43	17.3	7.4	1.0	43.6	0.70 J		0.78	0.011	0.30	0.076	0.010 M	6.1				
2/14/05	1	11:59	17.4	7.8	7.9	32	1.1	6	0.52	0.044	0.082 U	0.006 U	0.010 M	6.4	40	<2B	2.7	2.4
	5.6	12:07	16.5	7.8	5.4	42	1.4											
	11	12:02	16.6	7.9	4.0	46.7	2.8		0.42	0.014	0.082 U	0.006 U	0.010 M	3.8				
3/21/05	1.1	11:58	19.6	7.6	7.4	22.3	1.6	4	0.30	0.017	0.082 U	0.018 U	0.010 M	10.7	100	17B		2.0
	3.2	12:06	19.6	7.6	7.2	22.3	1.6											
	6.8	12:04	18.9	7.6	1.9	37.3	1.6		0.50	0.010 M	0.22	0.018 U	0.010 M	4.8				
4/15/05	1	11:59	22.4	7.8	6.9	22.6	1.4	2.5	0.51	0.044	0.082 U	0.018 U	0.010 M	11.4	125	<2 B		3.0
	5.5	12:02	21.2	7.7	3.0	36.8	1.5											
	10.1	12:05	20.8	7.7	1.7	40.7	3.1		0.52	0.0053 U	0.21	0.018 U	0.010 M	6.4				
5/16/05	1	12:12	27.3	7.9	6.0	28.9	0.95J	>3.5	0.52	0.019	0.082 U	0.019	0.010 M	7.5	60	2 B	4.3 J3	2.0
	1.6	12:28	27.0	7.9	6.0	29	1.0											
	2.5	12:23	27.0	7.9	5.9	29.1	1.5		0.36	0.0053 U	0.082 U	0.011	0.010 M	7.2				
6/13/05	0.9	10:18	29.2	7.4	5.0	27.7	2.7	3.5	0.46	0.0053 U	0.082 U	0.020	0.013	12.2	125	58		3.0
	3.3	10:26	28.6	7.8	3.7	34.1	1.8											
	5.5	10:21	27.4	7.6	1.4	38.9	2.5		0.47	0.0053 U	0.082 U	0.043	0.010 M	5.7				
7/20/05	0.9	10:48	31.2	7.9	4.8	39.9	1.2	4	0.44	0.0053 U	0.082 U	0.010 M	0.010 M	5.1		<2 B		4
	6	10:45	29.9	8.0	4.5	39.1	1.3											
	11	10:41	28.7	7.7	1.7	39.2	1.2		0.45	0.0053 U	0.082 U	0.052	0.010 M	2.9				

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

L3

Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	12:14	18.9	8.1	7.0	39.1	1.2	5.5	0.13	0.010 M	0.082 U	0.026	0.71 J6	28.4	20	15 B	3.2	3.0
	6.2	12:22	18.8	6.7	8.1	39.2	1.3											
	12.6	12:20	19.2	8.0	4.6	39.3	1.7		0.34	0.011	0.082 U	0.021	0.010 M	4.7				
12/13/04	1	11:53	17.6	8.0	7.0	38.6	0.75 J	8	0.47	0.016	0.082 U	0.016	0.010 M	4.7		5 B		
	5.5	11:56	17.6	8.0	6.9	38.1	0.70 J											
	10	11:58	18.7	8.2	5.3	46.5	1.1		0.55	0.013	0.082 U	0.035	0.010 M	3.7				
1/18/05	1.4	12:03	11.2	7.5	9.0	24.5	1.6	5	0.40	0.010 M	0.082 U	0.016	0.010 M	10.1	80	64		2.8
	5.8	12:10	12.0	7.6	7.8	26.5	1.2											
	11.2	12:07	17.2	7.4	0.5	44	1.6		0.77	0.030	0.33	0.048	0.010 M	4.0				
2/14/05	1	12:35	18.1	7.8	7.9	31.6	0.95J	8	0.52	0.041	0.082 U	0.018	0.010 M	6.5	40	10 B	3.3	2.8
	6	12:41	16.2	7.9	6.4	42.1	1											
	11	12:38	16.7	7.9	4.3	46.7	1.4		0.58	0.013	0.10 M	0.006U	0.010 M	3.7				
3/21/05	1	12:21	19.3	7.6	7.7	21.7	NA	3	0.34	0.013	0.082 U	0.018U	0.010 M	10.9	140	17 B		3.4
	1.5	12:28	19.3	7.6	7.6	21.8	1.4											
	2.1	12:23	19.2	7.6	7.7	21.8	NA		0.32	0.014	0.082 U	0.025	0.010 M	11.6				
4/18/05	1	12:24	22.9	7.8	6.6	22.5	1.4	>3	0.53	0.033	0.082 U	0.018 U	0.010 M	11.1		<2 B		3.6
	1.5	12:26	23.0	7.8	6.2	22.5	1.6											
	2	12:28	22.9	7.8	6.7	22.5	1.5		0.55	0.052	0.082 U	0.018 U	0.017	11.3				
5/16/05	0.8	12:47	29.2	7.9	6.0	28.8	1.2	>3.5	0.39	0.0053 U	0.082 U	0.010 M	0.012	7.5	60	<2 B	4.1 J3	2.2
	1.8	12:54	26.9	8.0	6.1	28.8	1.0											
	2.6	12:52	26.6	7.9	5.9	28.9	0.75J		0.35	0.0053 U	0.082 U	0.010 M	0.012	7.6				
6/13/05	1.1	10:42	30.2	8.0	5.8	29.4	1.6	3	0.54	0.0053 U	0.082 U	0.015	0.010 M	9.1		17		2.4
	3.6	10:54	29.3	7.8	5.4	30.0	2.9											
	7.8	10:49	27.4	7.9	2.1	42.0	4.9		0.56	0.0053 U	0.082 U	0.022	0.013	4.3				
7/20/05	1	11:06	31.3	7.9	5.2	38.9	1.0	>4.5	0.35	0.0053 U	0.082 U	0.010 M	0.010 M	5.6		2 B		3.2
	2	11:04	31.1	7.9	5.2	38.9	1.0											
	3.2	11:02	31.1	7.9	5.2	39.8	1.9		0.34	0.0053 U	0.082 U	0.010 M	0.010 M	5.4				

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols
J6 = Result is suspect because the TP is lower than the OP result

L4 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	12:50	19.6	8.1	7.0	38.4	2.9	5.5	0.48	0.026	0.082 U	0.039	0.010 M	4.4	15	12 B	3.3	3.0
	5.6	12:59	18.9	8.1	6.7	38.8	2.2											
	11	12:55	18.8	8.1	6.7	39.0	2.2		0.35	0.14	0.082 U	0.029	0.010 M	4.6				
12/13/04	1	12:20	19.7	8.0	6.2	40.8	1.1	8	0.52	0.014	0.082 U	0.018	0.010 M	4.3		110		
	5	12:22	19.0	8.0	4.5	44.5	1.4											
	8	12:26	19.2	8.0	4.5	44.9	2.5		0.57	0.013	0.082 U	0.021 U	0.010 M	5.6				
1/18/05	1.0	12:32	13.1	7.5	8.2	27.0	2.0	5	0.39	0.030	0.082 U	0.83	0.010 M	8.3	60	42		2.6
	5.1	12:37	13	7.5	7.1	27.1	0.95 J											
	9.0	12:35	18.2	7.5	3.3	35.5	1.6		0.57	0.017	0.13	0.019	0.010 M	5.0				
2/14/05	1	13:02	17.1	7.8	7.9	30.4	1.4	6	0.41	0.071	0.082 U	0.006 U	0.010 M	7.2	50	84	2.7	3.4
	4.5	13:10	16.5	7.8	6.4	42.3	1.1											
	9	13:05	16.9	7.9	5.1	45.6	1.5		0.53	0.016	0.010 M	0.006 U	0.010 M	4.7				
3/21/05	1.1	12:47	20.4	7.5	7.6	19.5	1.8	2	0.32	0.044	0.11	0.023	0.010 M	13.8	125	25B		2.2
	4	12:55	19.0	7.6	6.9	20.8	1.8											
	7.9	12:53	19.1	7.5	2.7	33.2	1.8		0.75	0.0053U	0.39	0.028	0.020	6.2				
4/18/05	1	12:50	23.1	7.7	6.5	21.2	2.0	2	0.79	0.059	0.082 U	0.050	0.010 M	10.8		2 B		2.4
	4	12:52	22.2	7.6	4.0	28.2	1.7											
	8	12:54	20.8	7.6	1.3	38.7	2.8		0.80	0.012	0.28	0.020 M	0.010 M	5.6				
5/16/05	1.2	13:18	28.2	7.9	5.5	28.7	1.4	4	0.42	0.010 M	0.082 U	0.013	0.010 M	8.3	70	4 B	4.8 J3	2.2
	4.5	13:25	25.8	7.8	2.8	37.4	1.5											
	9.1	13:21	22.4	7.5	0.5	42.3	1.1		0.94	0.010 M	0.27	0.050	0.013	5.4				
6/13/05	0.8	11:21	30.9	7.6	5.6	23.6	3.2	2	0.44	0.0053 U	0.082 U	0.016	0.010 M	15.5		130		3.6
	3.5	11:34	29.3	7.9	4.7	28.8	2.9											
	7.1	11:26	27.8	7.9	3.4	38.2	3.6		0.45	0.0053 U	0.082U	0.017	0.010 M	12.9				
7/20/05	0.9	11:29	32.9	7.8	5	35.3	1.8	7	0.33	0.0053 U	0.082 U	0.006U	0.010 M	8.5		7 B		1.2
	4.1	11:26	32.2	7.9	4.8	35.2	0.9											
	8.4	11:24	29.4	7.4	<0.10	36.0	3.1		0.44	0.011	0.082 U	0.012	0.010 M	4.0				

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J4 = Estimated result. The sample matrix interfered with the ability to make an accurate measurement.
J5 = the data is questionable because of improper laboratory or field protocols

S1 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	10:51	20.7	7.8	5.6	39.1	0.65 J	>4	0.28	0.010 M	0.082 U	0.023	0.010 M	15.1	20	74	4.2	6.5
	3.9	10:57	20.6	8.0	6.3	40.1	3.5											
12/13/04	1	10:32	17.3	7.5	7.4	22.3	1.9	6	0.48	0.034	0.082 U	0.011	0.010 M	8.8		45		
	2.2	10:36	19.3	7.4	6.1	33.7	6.0											
1/18/05	1.0	10:59	13.2	6.9	7.7	24.0	1.6	4	0.52	0.015	0.082 U	0.032	0.010 M	20.4	100	79		3.2
	5.0	11:03	16.8	7.3	5.5	27.5	1.2											
2/14/05	1	11:17	16.5	7.7	7.1	37	1.9	>4	0.74	0.041	0.082 U	0.041	0.010 M	18.7	50	380	1.6	7.0
	4	11:17	16.3	7.7	6.4	38.3	1.5											
3/21/05	0.8	11:14	19.3	7.5	6.1	25.3	1.8	>4	0.63	0.013	0.082 U	0.018 U	0.010 M	18.3	175	24B		1.2
	3.2	11:18	19.6	7.5	4.7	29.1	1.8											
4/18/05	1	11:16	24.1	7.5	5.5	23.1	2.0	>3	0.63	0.030	0.082 U	0.018 U	0.010 M	15.8		4 B		3.0
	2	11:18	24.5	7.4	3.8	26.4	3.0											
5/16/05	1.5	11:31	29.4	7.6	5	29.4	1.9	3	0.8	0.027	0.082 U	0.017	0.010 M	15.5	300	31	1.0 J3	3.8
	2.5	11:36	32.6	7.4	2.9	32.6	2.2											
6/13/05	1	9:31	29.3	7.9	5.0	32.7	2.1	3.5	0.56	0.010 M	0.082 U	0.018	0.010	17.5		64		2.8
	3.6	9:35	27.8	7.4	1.7	35.5	2.1											
7/20/05	1.0	10:00	32.4	7.6	4.3	40.8	1.8	>2.6	0.39	0.0053 U	0.082 U	0.013	0.010 M	4.4		12 B		3.6
	2.2	10:04	32.7	7.8	4.5	41.7	1.4											

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S2 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/5/04	1	11:33	19.3	8.0	6.5	38.9	1.6	5	0.32	0.010 M	0.082 U	0.023	0.010 M	5.2	20	33 B	2.9	4.0
	7	11:40	18.4	8.1	6.5	39.5	1.8											
12/13/04	1	11:11	17.9	7.8	7.2	33.2	1.0	6	0.38	0.037	0.082 U	0.011	0.010 M	28.6		25 B		
	5	11:14	16.9	8.0	7.3	36.3	0.85 J											
1/18/05	1.0	11:30	13.7	7.2	8.0	25.4	1.2	5	0.42	0.030	0.082 U	0.014	0.010 M	11.0	80	44		2.6
	9.0	11:33	18.3	7.4	2.1	40.0	1.4											
2/14/05	1	11:48	18	7.6	7.6	29.6	2.7	5	0.49	0.053	0.082 U	0.006 U	0.010 M	21.8	125	550	1.0 M	2.0
	7	11:52	16.4	7.7	4.1	42.8	2.7											
3/21/05	0.9	11:44	20.6	7.5	6.8	23.6	1.7	3.75	0.38	0.012	0.082 U	0.018 U	0.010 M	9.6	100	7 B		3.6
	5.3	11:46	19.4	7.5	2.6	32.4	1.7											
4/18/05	1	11:46	22.7	7.6	6.3	22.7	1.7	2	0.62	0.065	0.082 U	0.018 U	0.010 M	10.2		3 B		3.8
	4	11:48	22.7	7.6	4.9	25.1	2.1											
5/16/05	1	12:06	28.3	7.8	5.5	29	1.3	2.5	0.50	0.015	0.082 U	0.025	0.010 M	7.5	150	<2B	4.9 J3	3.0
	6	12:11	25.7	7.6	2.4	38.5	2.7											
6/13/05	1	10:02	28.7	6.4	3.4	21.9	2.2	1	0.80	0.024	0.082 U	0.017	0.011	37.9		100		1.6
	3	10:06	28.2	7.2	1.8	31.4	2.3											
7/20/05	1.1	10:32	32.2	7.8	4.4	40.9	2.5	>4	1.1	0.0053 U	0.082 U	0.019	0.010 M	5.0		2 B		2.4
	3	10:34	32.4	7.8	3.8	42.6	1.9											

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
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S3

Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	11:59	18.8	8.1	6.8	39.4	2.0	5	0.42	0.022	0.082 U	0.021	0.016	5.1	15	12 B	3.1	5.8
	5.2	12:05	18.8	8.1	6.5	39.4	1.4											
12/13/04	1	11:41	17.8	8.0	7.4	37.7	0.8	>3.5	0.48	0.018	0.082 U	0.011	0.010 M	5.8		3 B		
	3	11:46	17.7	8.0	7.3	37.6	0.7											
1/18/05	1.2	11:53	11.8	7.6	8.9	25.2	1.5	5	0.50	0.12	0.082 U	0.017	0.010 M	13.2	60	70		1.8
	4.3	11:56	11.9	7.6	8.7	26.1	1.5											
2/14/05	1	12:25	17.9	7.8	7.9	31.4	0.95J	>4	0.48	0.043	0.082 U	0.024	0.010 M	10.8	100	<2B	2.3	3.4
	3	12:27	16.9	7.9	8.9	39.5	2.9											
3/21/05	0.9	12:12	19.9	7.6	7.5	21.9	1.1	3	0.57	0.016	0.082 U	0.018 U	0.010 M	10.7	140	<3B		3.2
	2.5	12:14	19.9	7.6	7.5	21.9	1.1											
4/18/05	1.0	12:15	23.1	7.8	6.9	22.4	1.6	>3	0.50	0.047	0.082 U	0.018 U	0.014	10.6		2 B		4.4
	2.0	12:16	23.1	7.8	6.8	22.4	1.7											
5/16/05	1	12:35	27.0	8.0	6.5	28.7	0.85J	>3	0.46	0.012	0.082 U	0.018	0.010 M	6.9	70	<2B	3.3 J3	3.6
	2.1	12:39	27.5	8.2	6.3	29.0	2.9											
6/13/05	0.7	10:35	29.9	7.2	5.2	21.9	2.9	1	0.55	0.010 M	0.082 U	0.025	0.011	18.5		100		2.8
	2.7	10:39	29.0	7.6	4.4	31.5	1.6											
7/20/05	1.1	10:50	31.5	7.8	4.6	39.2	2.0	>3	0.39	0.0053 U	0.082 U	0.010 M	0.010 M	5.4		<2 B		2.8
	2.1	10:55	31.6	7.8	4.9	39.5	2.7											

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S4 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	12:35	19.8	8.1	6.6	39.0	1.6	5	0.41	0.010 M	0.082 U	0.027	0.010 M	4.0	15	20 B	3.7	4.2
	9.8	12:40	18.9	8.1	6.3	39.3	3.8											
12/13/04	1	12:08	17.7	8.0	6.9	36.9	0.95	7	0.33	0.036	0.082 U	0.022	0.010 M	5.9		240		
	6.6	12:12	19.6	7.9	4.0	43.8	1.1											
1/18/05	1.0	12:18	13.8	7.5	7.8	27.0	1.2	6	0.35	0.032	0.082 U	0.017	0.010 M	8.2	60	50		1.8
	9.0	12:25	18.3	7.4	3.4	36.1	1.6											
2/14/05	1	12:50	18.2	7.7	7.5	30.0	7.8	6	0.53	0.096	0.082 U	0.021	0.012	54.8	80	500	1.4	6.2
	7	12:54	16.6	7.8	5.1	43.2	1.4											
3/21/05	1	12:38	20.7	7.5	7.3	20.6	1.4	3.5	0.56	0.075	0.082 U	0.018 U	0.010 M	10.9	100	7B		2.2
	6.8	12:42	19.1	7.4	2.7	29.6	1.4											
4/18/05	1	12:37	24.2	7.6	6.4	20.7	2.6	2.5	0.67	0.10	0.082 U	0.018 U	0.014	13.3		12 B		2.4
	4	12:39	22.9	7.5	3.8	25.5	2.8											
5/16/05	0.8	13:02	29.0	7.9	5.6	29.3	0.95J	4.5	0.48	0.037	0.082 U	0.023	0.010 M	7.2	60	3 B	4.7 J3	4.0
	7.5	13:07	23.4	7.5	0.7	40.2	3.6											
6/13/05	0.9	11:04	29.9	7.0	4.1	20.7	14	1	0.73	0.070	0.082 U	0.018	0.018	24		300		2.4
	6.9	11:09	27.5	7.6	0.2	40.3	12											
7/20/05	0.9	11:13	32.5	7.9	4.9	39.3	1.1	5.5	0.35	0.0053 U	0.082 U	0.006 U	0.010 M	5.3		2 B		1.2
	6	11:11	30.8	7.7	3.2	44.2	2.1											

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J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S5 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	13:05	19.1	8.0	7.2	37.2	2.1	5.5	0.66	0.065	0.082 U	0.13	0.010 M	10.8	50	570	2.9	2.0
	9.7	13:10	19.4	8.0	6.4	38.9	1.4											
12/13/04	1	12:34	20.1	7.9	4.9	41.1	0.90	6	0.47	0.014	0.082 U	0.011	0.010 M	5.5		10 B		
	7	12:36	19.5	8.0	4.0	44.5	1.5											
1/18/05	1.2	12:45	14.3	7.5	8.0	27.0	1.1	5	4.1	0.034	0.082 U	0.021	0.010 M	8.9	60	28 B		2.8
	8.9	12:48	18.5	7.4	3.0	35.0	1.8											
2/14/05	1	13:17	16.5	7.7	7.8	29.9	2.9	6	0.49	0.076	0.082 U	0.006 U	0.010 M	13	90	710B	1.5	3.8
	7	13:20	16.7	7.9	4.9	44.4	1.9											
3/21/05	0.9	13:00	20.2	7.3	7.4	14.6	2.6	2	0.47	0.10	0.082 U	0.018 U	0.010 M	15.1	175	110		2.0
	7	13:06	18.9	7.4	3.6	29.1	2.6											
4/18/05	1	13:00	23.7	7.6	6.4	20.5	2.5	>2	0.52	0.075	0.082 U	0.018 U	0.011	10.8		13 B		3.4
	6.5	13:03	21.0	7.5	1.0	36.7	2.8											
5/16/05	0.9	13:38	29.4	7.9	6.4	27.5	2.0	>3	0.49	0.068	0.082 U	0.014	0.010 M	7.8	70	35 B	7.5 J3	4.0
	2	13:41	28.3	7.9	4.9	29.0	1.5											
6/13/05	1	11:34	29.8	7.1	5.3	23.8	2.6	1	0.64	0.055	0.082 U	0.017	0.010 M	23.9		58		1.6
	7.5	11:38	27.7	7.7	2.0	38.7	2.2											
7/20/05	1	11:39	32.9	7.8	4.7	34.3	2.5	5	0.38	0.060	0.082 U	0.010M	0.010 M	7.4		10 B		2.0
	7.9	11:37	29.8	7.6	1.5	45.8	3.5											

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J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

S6 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	13:26	18.5	8.2	7.3	38.3	1.4	4	0.32	0.010 M	0.082 U	0.03	0.010 M	4.9	20 J5	13 B	2.7	1.4 J5
	3.5	13:26	17.9	8.1	8.4	38.6	1.4											
12/13/04	1	13:26	17.6	8.1	7.7	38.3	1.3	>5	0.41	0.024	0.082 U	0.018	0.010 M	5.5		<1		
	4	13:29	17.7	8.1	8.1	38.3	5.0											
1/18/05	1.1	12:58	10.7	7.6	9.3	23.8	1.6	4	0.31	0.028	0.082 U	0.24	0.010 M	10.4	120	100		3.0
	3.6	13:01	10.3	7.6	9.3	24.6	1.8											
2/14/05	1	13:37	16.8	7.8	7.4	36	0.9J	>4	0.42	0.039	0.082 U	0.006 U	0.010 M	7.8	40	8B	2.1	4.4
	3	13:40	16.8	7.9	7.9	39.6	1.4											
3/21/05	0.9	13:20	19.2	7.5	7.4	21.3	1.8	2	0.30	0.013	0.082 U	0.018 U	0.010 M	11	100	11B		2.6
	2.7	13:24	18.2	7.5	7.2	22.4	1.8											
4/18/05	1	13:19	22.9	7.8	6.7	23.0	2.2	>2	1.2	0.048	0.082 U	0.018 U	0.013	14.7		4 B		5.2
	1.7	13:23	22.7	7.9	6.2	23.2	2.2											
5/16/05	0.8	13:55	27.8	8.0	6.7	27.4	1.3	>2.5	0.44	0.0053 U	0.082 U	0.013	0.010 M	7.5	60	3.2	3.8 J3	3.2
	1.5	13:58	27.7	8.1	7.5	27.4	1.2											
6/13/05	0.9	11:48	30.6	8.1	5.7	31.3	1.5	2	0.47	0.0053 U	0.082 U	0.018	0.010 M	8.3		32		3.4
	2.3	11:53	29.7	8.1	6.8	32.6	1.1											
7/20/05	0.8	11:59	31.6	7.9	5.7	38.9	1.1	>3	0.35	0.0053 U	0.082 U	0.010 M	0.010 M	6.6		1 B		2.2
	1.6	11:55	31.4	7.9	6.0	39.0	1.5											

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U = Analyte not detected. The reported result is the laboratory method detection limit.
M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J4 = Estimated result. The sample matrix interfered with the ability to make an accurate measurement.
J5 = the data is questionable because of improper laboratory or field protocols

S7 Date	Depth ft	Time	Temp. °C	pH	D.O. mg/l	Specific Conduct. mmho/cm	Turbidity ntu	Secchi depth feet	Total N mg/l	NO2NO3 mg/l	Ammonia mg/l	Total P mg/l	Ortho P mg/l	TOC mg/l	Color pcu	Fecal coliform #/100ml	Chlorophyll A ug/l	TSS mg/l
11/15/04	1	10:35	18.8	7.8	7.0	39.5	1.5	5	0.44	0.010 M	0.082 U	0.019	0.010 M	4.5	15	8 B	3.7	6.0
	5.8	10:38	18.7	7.9	6.5	39.6	1.5											
12/13/04	1	10:13	17.5	7.8	7.5	35.9	1.3	>6	0.54	0.040	0.082 U	0.019	0.010 M	5.4		2 B		
	5	10:18	17.1	7.8	7.5	36.1	1.1											
1/18/05	1.5	10:37	11.2	7.1	8.7	19.8	1.2	4	0.27	0.037	0.082 U	0.35	0.010 M	12.4	100	94	1.3	1.6
	5	10:47	12.2	7.4	8.3	26.5	0.90 J											
2/14/05	1	11:00	16.6	7.6	7.5	35.2	0.8J	>6	0.54	0.044	0.082 U	0.006 U	0.010 M	9.6	30	2B	1.4	4.8
	6	11:10	16.5	7.6	5.2	41.6	1.4											
3/21/05	1	10:57	19.9	7.5	6.8	24.3	2.0	4.5	0.34	0.016	0.082 U	0.018 U	0.010 M	9.7	75	3B	no sample	3.0
	6	11:02	19.1	7.6	4.1	32.6	2.0											
4/18/05	1	10:58	21.4	7.1	6.5	22.5	1.8	3.5	0.89	0.039	0.082 U	0.018 U	0.0026 U	11.0		2 B	5.3	3.7
	7.2	11:00	20.7	7.3	1.1	38.0	1.9											
5/16/05	1.1	11:11	27.6	7.7	5.6	28.7	2.1	4.5	0.76	0.010 M	0.082 U	0.021	0.010 M	7.7	70	5 B	3.8 J3	3.9
	5.5	11:16	23.0	7.5	1.8	40.1	1.3											
6/13/05	1	9:15	29.9	7.8	5.6	32.8	1.7	4	0.46	0.010 M	0.082 U	0.016	0.010 M	8.5		17	4.4	2.5
	7	9:18	27.9	7.5	1.7	41.4	1.7											
7/20/05	0.9	9:47	31.5	7.8	4.8	39.6	1.7	6	0.37	0.0053 U	0.082 U	0.010 M	0.010 M	5.7		12 B	1.6 J3	4.4
	5.2	9:41	30.5	7.8	4.1	44.7	4.1											

B = Results based on colony counts outside the acceptable range.
U = Analyte not detected. The reported result is the laboratory method detection limit.
M = Analyte detected but could not be quantified. The reported result is the laboratory practical quantitation limit.
J = Estimated result. The reported result is below the lowest calibration standard.
J3 = Estimated result. The reported result failed to meet the established criteria for accuracy or precision.
J5 = the data is questionable because of improper laboratory or field protocols

Figure 25. Lake Powell Outstanding Florida Water Boundary

Figure 26. Lake Powell Tributaries

Figure 27. RGP Conservation Units, FNAI Potential Natural Areas, and Tributaries

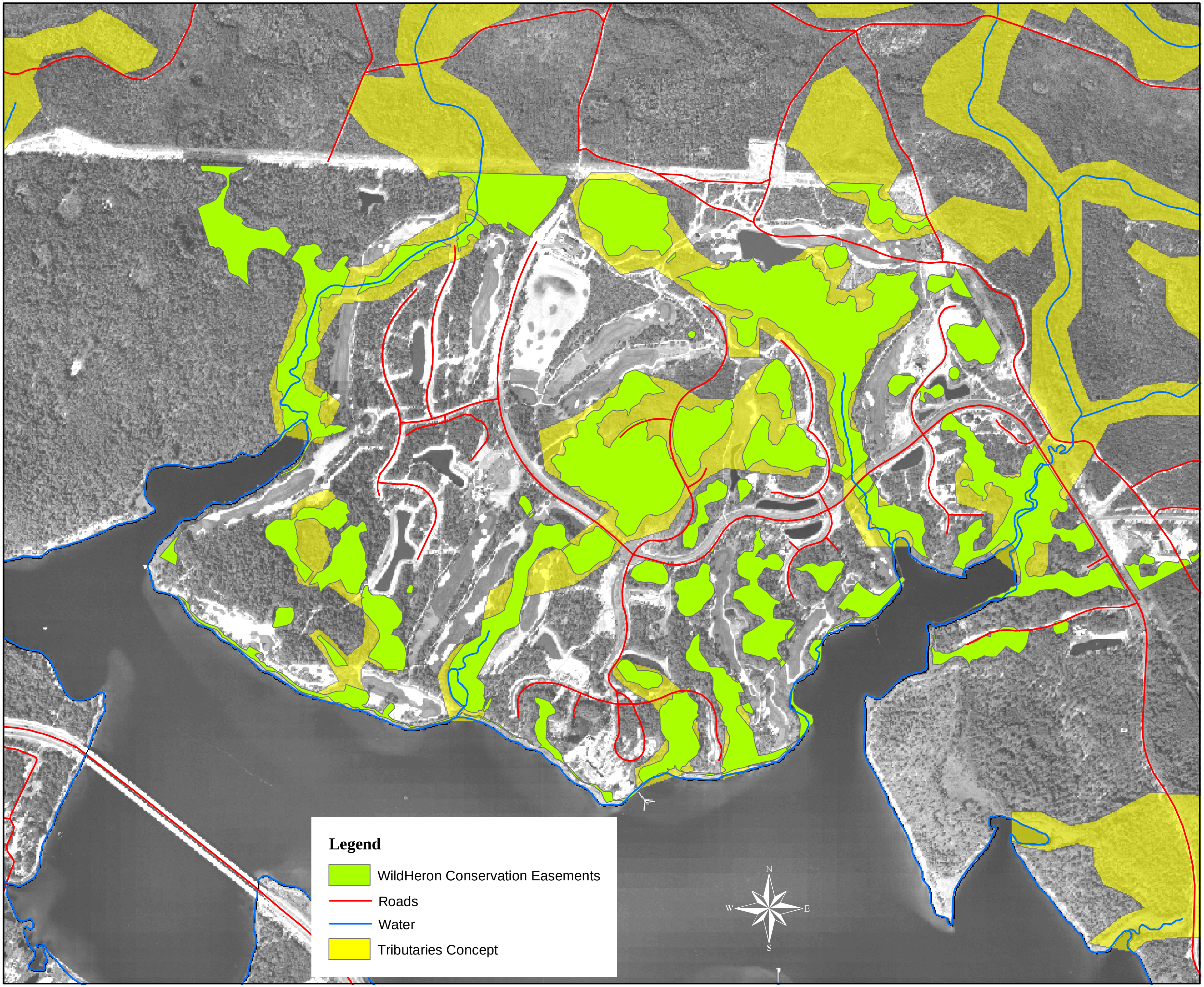

Figure 28. Wild Heron and Tributary Conservation Concept