Evaluation of Hydrologic and Nutrient Loadings from Groundwater Seepage to Lake Jesup

Final Report

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SECTION 1

INTRODUCTION

1.1 Background

Lake Jesup is a 10,660-acre shallow, hypereutrophic lake located in northern-central Seminole County. A general location map for Lake Jesup is given on Figure 1-1. The lake is currently included on the Verified List, developed by the Florida Department of Environmental Protection (FDEP), as impaired for nutrients and unionized ammonia. Lake Jesup (WBID 2981) is also a priority waterbody as part of the State of Florida's Surface Water Improvement and Management (SWIM) Program. The lake is hydraulically connected to the St. Johns River at the northern end by a narrow outlet channel near the SR 46 bridge and causeway. The SR 417 bridge, completed in 1993, crosses the lake near the western end. A small island, commonly referred to as Bird Island, is located near the center of Lake Jesup.

Lake Jesup is an extremely shallow waterbody with a mean depth ranging from approximately 3-4 ft, depending upon water elevation. The average water stage in Lake Jesup is approximately 1.8-2.0 ft (NGVD). In general, net water movement occurs from Lake Jesup into the St. Johns River, although flow reversal occurs periodically during periods of differential rainfall in adjacent sub-basin areas.

The drainage basin for Lake Jesup covers an area of approximately 87,331 acres. An overview of the Lake Jesup watershed and sub-basin areas is given on Figure 1-2. The vast majority of the watershed is located within Seminole County, with a small portion of the southwest end extending into Orange County. The watershed area includes 11 separate municipalities, including Sanford, Lake Mary, Oviedo, Winter Springs, Longwood, Casselberry, Altamonte Springs, Maitland, Winter Park, Eatonville, and Orlando. Large portions of the watershed are highly urbanized, consisting of a combination of residential, commercial, and transportation land uses. The mean hydraulic residence time for Lake Jesup has been estimated from 82-99 days, depending upon the source.

A final TMDL report for Lake Jesup was issued by FDEP on April 14, 2006 which establishes total maximum daily loads (TMDLs) for nutrients and unionized ammonia in Lake Jesup. The TMDL report provides estimates of annual total phosphorus loadings from various sources into Lake Jesup, calibrated for the period from 1995-2002, which include surface runoff, baseflow, septic tanks, artesian input, atmospheric deposition, and inflow from the St. Johns River. Phosphorus inputs from septic tanks are included based upon the number of septic tanks and proximity to the lake. The input referred to as "artesian inputs" reflect contributions from upwelling of the Floridan Aquifer which is separate from shallow groundwater seepage.

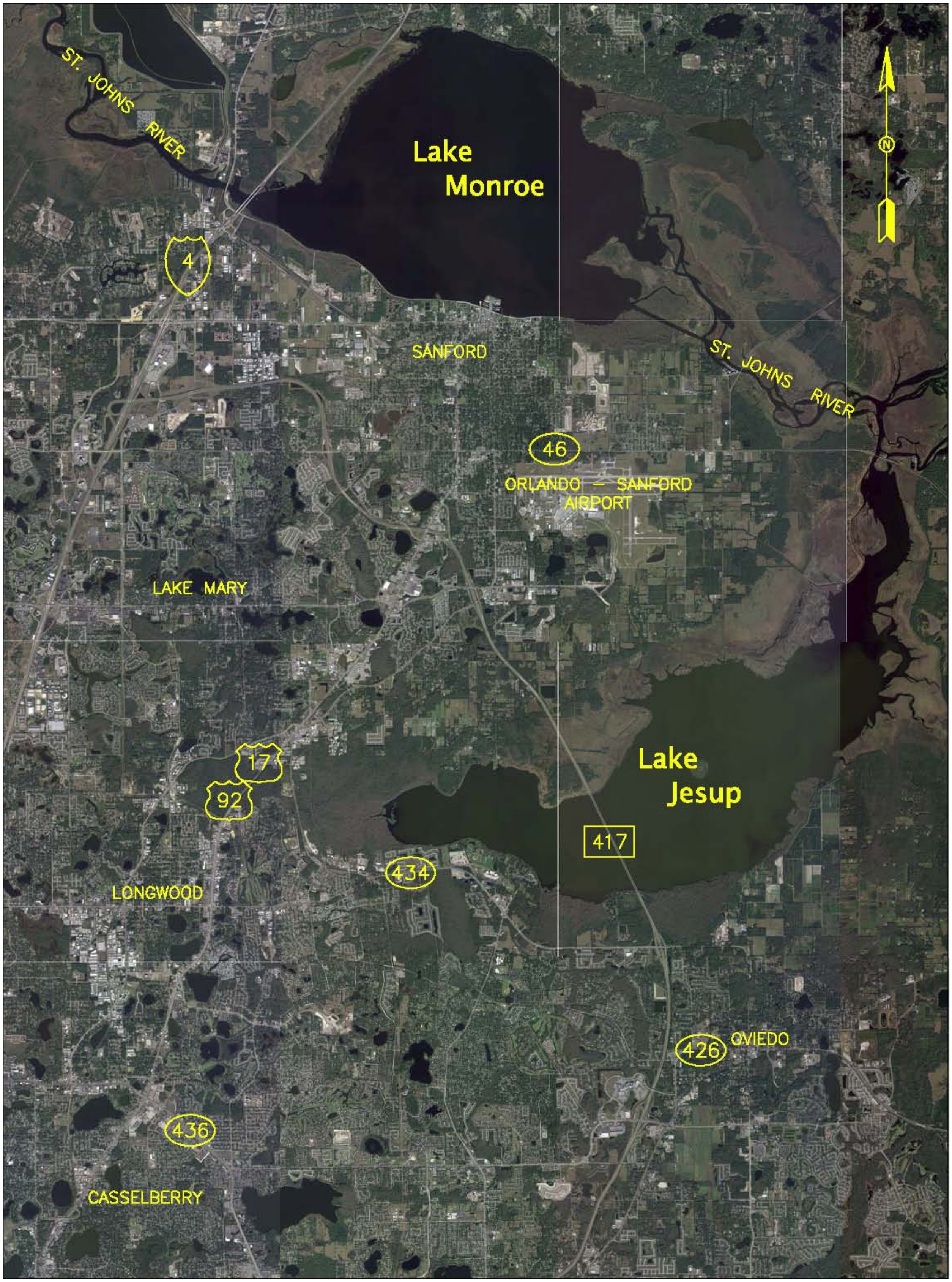

Figure 1-1. Location Map for Lake Jesup.

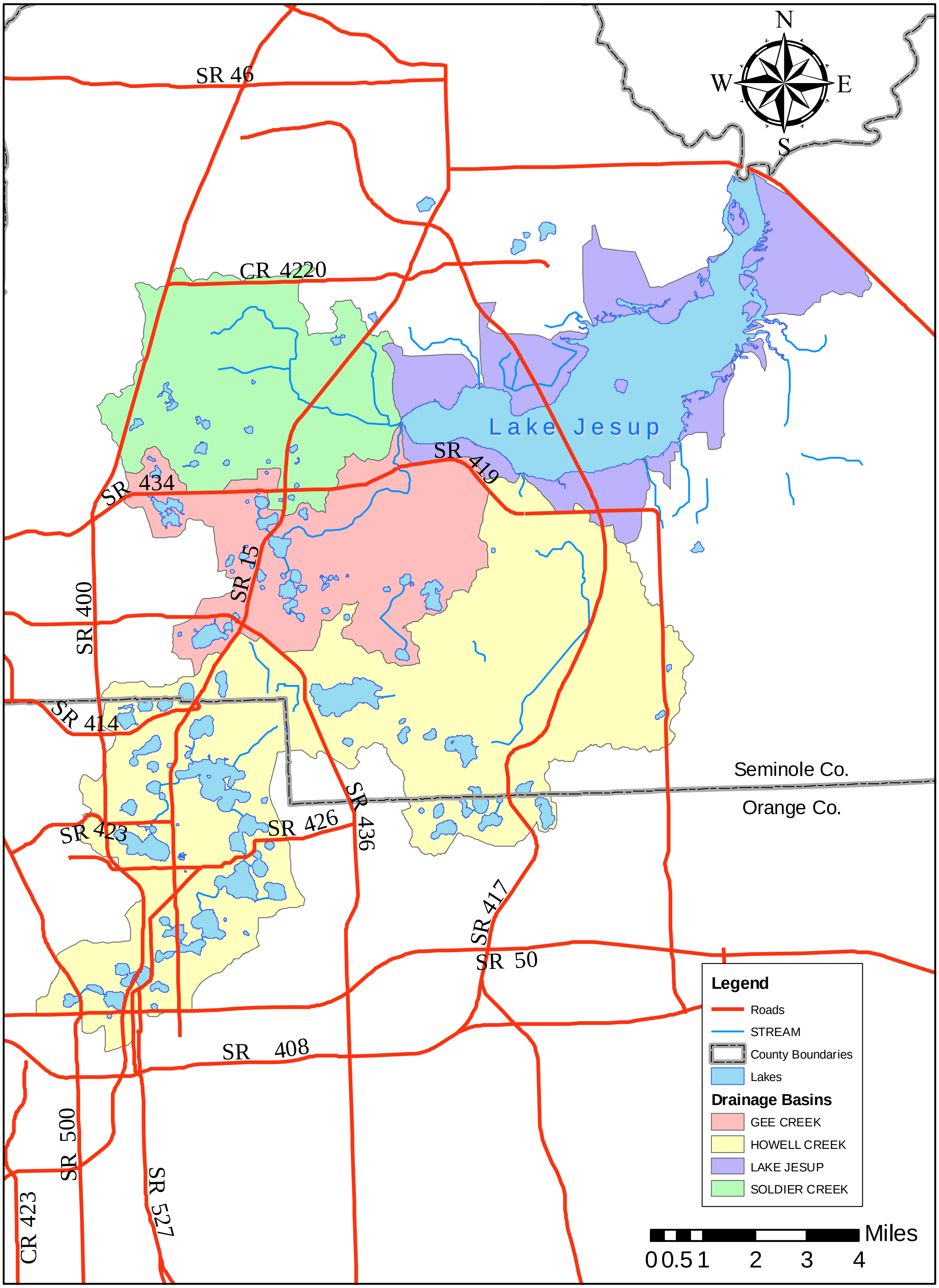

Figure 1-2. Lake Jesup Watershed and Sub-basin Areas.
(SOURCE: Final FDEP TMDL Report, 2006)

According to FDEP, estimation of hydrologic and nutrient loadings from shallow groundwater into Lake Jesup is also included in the TMDL report. The percentage of the total stream flow that was baseflow, estimated using the measured dry weather flow in gauged streams, is also applied to the ungauged stream areas, as well as perimeter areas immediately adjacent to the lake to reflect the shallow groundwater entering around the perimeter of the lake. The average total amount of baseflow discharging through tributaries and around the perimeter of the lake, based on the data from 1995-2002, was estimated to be 17,513 ac-ft/yr.

The work efforts discussed in this document provide a summary of field and laboratory monitoring conducted by Environmental Research & Design, Inc. (ERD) for Seminole County (County) to evaluate hydrologic and nutrient inputs into Lake Jesup resulting from shallow groundwater seepage. This information will be used to complement the existing hydrologic and nutrient budget for Lake Jesup with respect to shallow groundwater seepage, a component which has been only partially addressed in previous evaluations.

1.2 Work Efforts Conducted by ERD

Field monitoring was conducted by ERD over the period from June 2009-August 2010 to evaluate the hydrologic and water quality characteristics of shallow groundwater seepage inflows to Lake Jesup. Groundwater seepage meters were installed at 40 locations within Lake Jesup, and 9 separate monitoring events were conducted at each monitoring site over a 14-month field monitoring program. During each monitoring event, field measurements of seepage volume were conducted at each site, and a filtered water sample was collected for laboratory analyses.

This report has been divided into four separate sections for presentation of the work efforts conducted by ERD. Section 1 contains an introduction to the report, background information on Lake Jesup and phosphorus loadings, and a general overview of the work efforts performed by ERD. A discussion of field and laboratory activities is given in Section 2. Section 3 contains a discussion of the results of the field and laboratory activities. A summary is presented in Section 4. Appendices are also attached which contain technical data and analyses used to support the information contained within the report.

SECTION 2

FIELD AND LABORATORY ACTIVITIES

2.1 Introduction

Field investigations were performed by ERD to evaluate the quantity and quality of shallow groundwater seepage entering Lake Jesup. Seepage inflow into the lake was quantified using a series of underwater seepage meters installed at locations throughout the lake. Seepage meters provide a mechanism for direct measurement of groundwater inflow into a lake by isolating a portion of the lake bottom so that groundwater seeping up through the bottom sediments into the lake can be collected and characterized. Use of the direct seepage meter measurement technique avoids errors, assumptions, and extensive input data required when indirect techniques are used, such as the Gross Water Budget or Subtraction Method, as well as computer modeling and flow net analyses.

With installation of adequate numbers and proper placement, seepage meters can be a very effective tool to estimate groundwater-surface water interactions. Seepage inflow is generally greatest along the perimeter of a waterbody, and the majority of seepage meters are typically placed in shallow shoreline areas. Seepage inflow generally decreases with distance from the shoreline, and fewer seepage meters are placed in central portions of a lake. Placement of seepage meters should also consider variability in upland land uses, topography, and sewage disposal techniques to properly characterize groundwater inflows to a lake. The seepage meter technique has been recommended by the U.S. Environmental Protection Agency (EPA) and has been established as an accurate and reliable technique in field and tank test studies (Lee, 1977; Erickson, 1981; Cherkauer and McBride, 1988; Belanger and Montgomery, 1992). One distinct advantage of seepage meters is that seepage meters can provide estimates of both water quantity and quality entering a lake system, whereas estimated or modeling-based methods can only provide information on water quantity. ERD has conducted seepage monitoring in over 40 lakes within the State of Florida.

2.2 Field Activities

2.2.1 Seepage Meter Construction and Installation

A schematic of a typical seepage meter installation used in Lake Jesup is given on Figure 2-1. Seepage meters were constructed from a 2-ft diameter aluminum cylinder with a closed top and open bottom and a height of 36 inches. Each seepage meter isolated a sediment area of approximately 3.14 ft^2. The seepage meters used in Lake Jesup were also equipped with a 4-ft diameter flange which was welded to the outside of the aluminum cylinder to help stabilize the meters in areas of unconsolidated sediments, particularly in central portions of Lake Jesup, and to minimize settling of the meters over time. A photograph of a typical seepage meter used in Lake Jesup is given in Figure 2-2. The seepage meters were inserted into the lake sediments to the metal flange, resulting in a sediment penetration of approximately 18-24 inches, with approximately 8-12 inches of water trapped inside the seepage meter above the lake bottom. A large concrete weight (~75 lbs) was placed on top of each seepage meter.

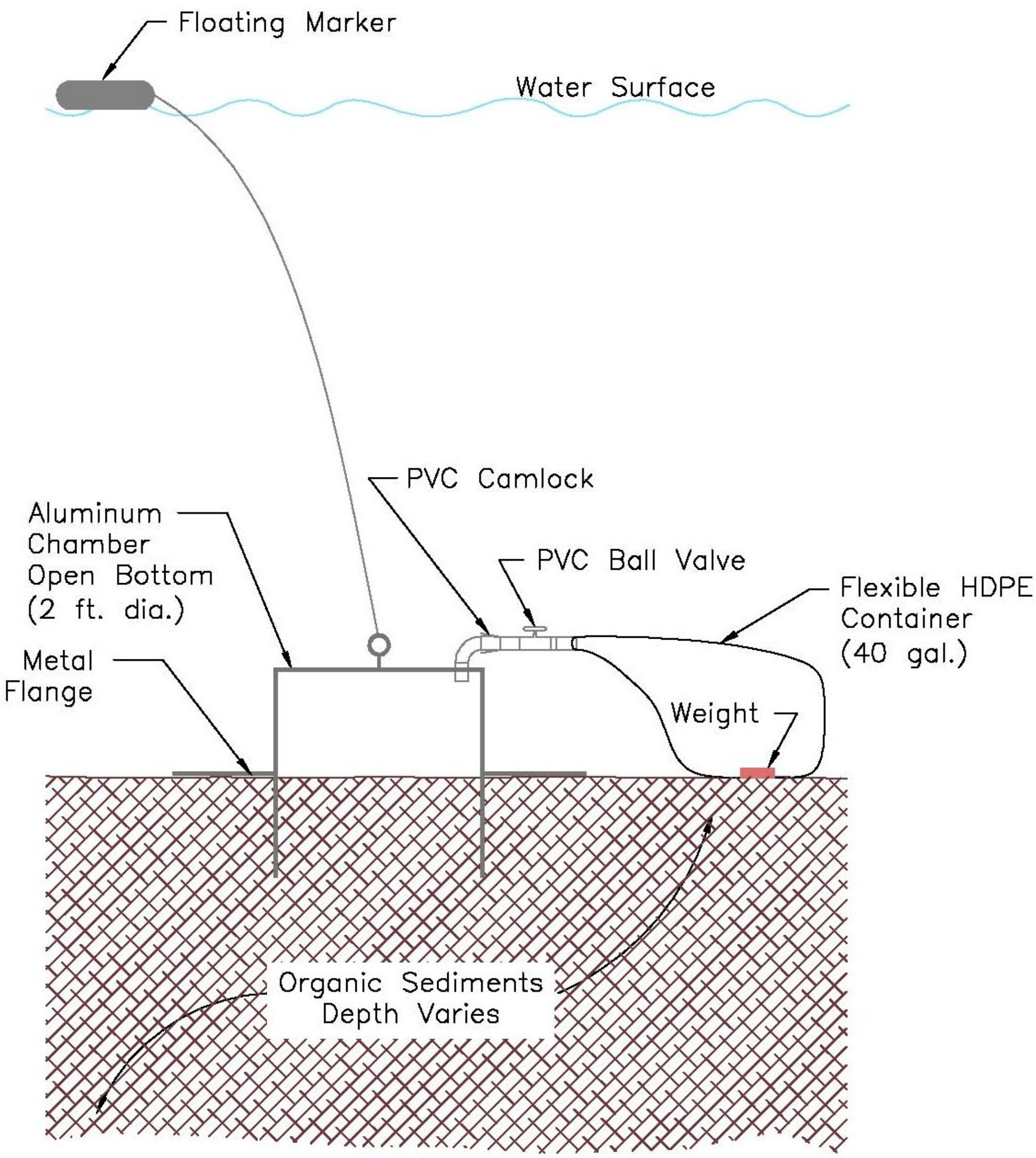

Figure 2-1. Typical Seepage Meter Installation.

In general, seepage meters installed around the perimeter of the lake were inserted through the unconsolidated sediment layer into either consolidated sediments or the sandy parent material. The seepage meters were inserted by repeatedly pounding around the perimeter of the meter using a 20-pound hammer weight until the seepage meter met significant resistance from the sediment material, and no additional movement of the meter was observed. Seepage meters installed in these areas were extremely stable, and additional settling of the seepage meters during the monitoring program is very unlikely. In central portions of the lake where the muck accumulations were deeper, the seepage meters were inserted through the surficial unconsolidated sediments into the layer of consolidated sediments. If possible, the flange was extended to the top of the consolidated sediment layer to achieve maximum stability for the seepage meter.

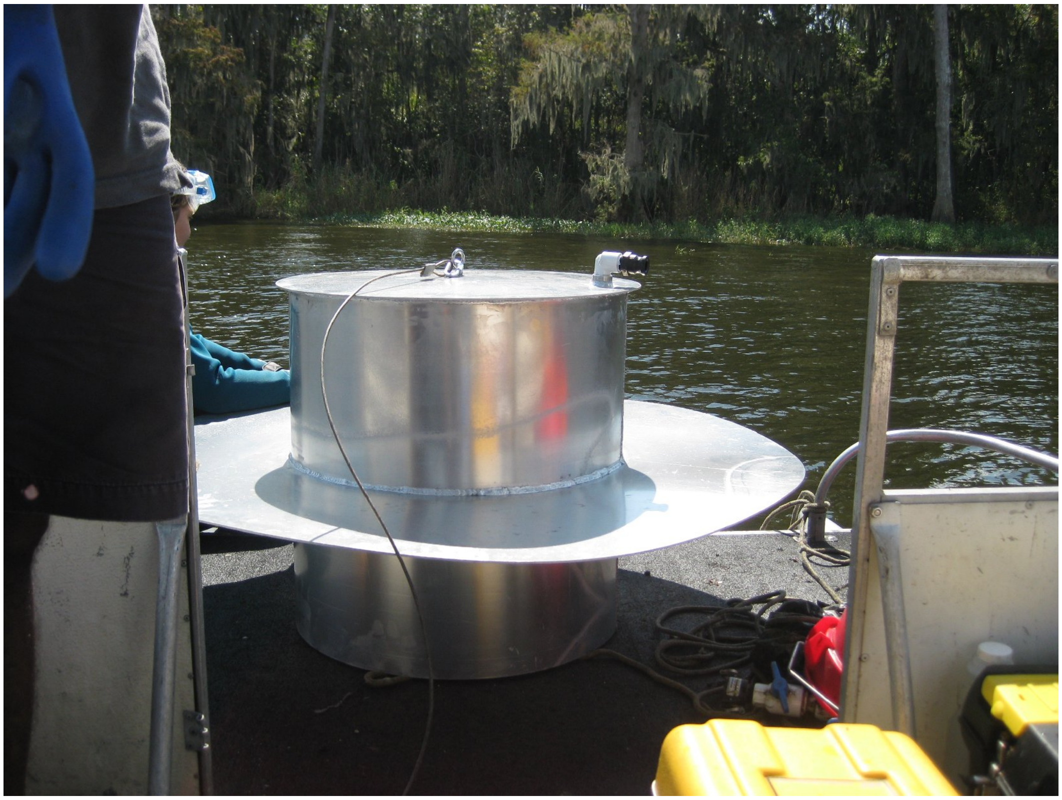

Figure 2-2. Typical Seepage Meter Used in Lake Jesup.

The seepage meters in central portions of the lake were less stable than the shoreline meters since the parent bottom material could not be reached. However, all of the central meters penetrated into the consolidated sediment layer, which generally provided a stable platform, particularly if the outer flange was resting on top of the consolidated layer.

A 0.75-inch PVC fitting was threaded into the top of each cylinder. The 0.75-inch PVC fitting was attached to a female quick-disconnect PVC camlock fitting. A flexible polyethylene bag, with an approximate useable volume of 40 gallons (150 liters), was attached to the seepage meters using a quick-disconnect PVC male camlock fitting with a terminal ball valve. Each of the collection bags was constructed of 3-mil black polyethylene to prevent light penetration into the bag. Light could potentially stimulate photosynthetic activity within the sample prior to collection and result in an alteration of the chemical characteristics of the sample.

Prior to attachment to the seepage meter, all air was removed from inside the polyethylene collection bag, and the PVC ball valve was closed so that lake water would not enter the collection bag prior to attachment to the seepage meter. A diver then connected the collection bag to the seepage meter using the PVC camlock fitting. After attaching the collection bag to the seepage meter, the PVC ball valve was then opened, allowing seepage to enter the bag. Groundwater influx into the open bottom of the seepage meter is collected inside the flexible polyethylene bag.

Each seepage meter was installed with a slight tilt toward the outlet point so that any gases which may be generated inside the seepage meter would exit into the collection bag, preventing buoyant conditions from developing inside the meter. Two 10-ounce plastic-coated fishing weights were placed inside each of the collection bags to prevent the bags from floating up towards the water surface as a result of trapped gases. The location of each seepage meter was indicated by a floating marker in the lake which was attached to the seepage meter using a coated wire cable. An example of the floating buoy used to identify seepage monitoring sites is given on Figure 2-3. A secondary solid dense Styrofoam float was also attached to allow location of seepage monitoring sites in the event that the larger air-filled buoy became punctured by wildlife, primarily alligators. Evidence of alligator bites into the floats was observed on virtually all monitoring dates. An example of bite marks on one of the Styrofoam floats is shown on Figure 2-4.

Forty (40) seepage meters were installed in Lake Jesup during June 2009. Locations for the seepage meters are indicated on Figure 2-5. Since seepage inflow is often most variable around the perimeter of a lake, the majority of the seepage meters were installed around the perimeter of the lake at a water depth of approximately 3 ft. Seepage meters were also installed in the central portions of the lake.

2.2.2 Seepage Meter Monitoring

Polyethylene collection bags were attached to each seepage meter at the time of installation. The initial seepage monitoring event was conducted during July 2009, approximately 3 weeks following installation. During this event, the volume of seepage collected at each site was measured and recorded. However, the collected sample was discarded since the initial sample represents a combination of seepage and lake water trapped inside the seepage meter at the time of installation. Beginning with the second monitoring event, samples were retained for laboratory analyses. Each of the 40 seepage meters was monitored on approximately a monthly to bi-monthly basis from July 2009-July 2010, with monthly events conducted during wet season conditions and bi-monthly samples collected during dry season conditions. Seepage monitoring events were conducted during the months of July, August, September, October, November, March, May, and July. Eight (8) separate seepage monitoring events were conducted for evaluation of quantity and quality at each of the monitoring sites. The seepage meters were removed at the end of the monitoring program.

During the collection process, a diver was used to close the PVC ball valve and remove the collection bag from the seepage meter using the quick-disconnect camlock fitting. The collection bag was placed onto the boat and the contents were emptied into a polyethylene container. The volume of seepage collected in the container was measured using either a 4-liter graduated cylinder or a 20-liter graduated polyethylene bucket, depending on the collected volume.

During some of the initial monitoring events, seepage meter samples were found to contain turbidity or particles originating from the sediments isolated within the seepage meter. Since these suspended contaminants are not part of the seepage flow, all seepage meter samples collected for chemical analyses were field-filtered using a 0.45 micron disposable glass fiber filter typically used for filtration of groundwater samples. A new filter was used for each seepage sample. Seepage samples were filtered immediately following collection using a battery operated peristaltic pump at a flow rate of approximately 0.25 liter/minute. The filtered seepage sample was placed in ice for return to the ERD laboratory for further chemical analyses.

Figure 2-3. Floating Buoy Used to Identify Seepage Monitoring Sites.

Figure 2-4. Example of Bite Marks on Seepage Meter Floats.

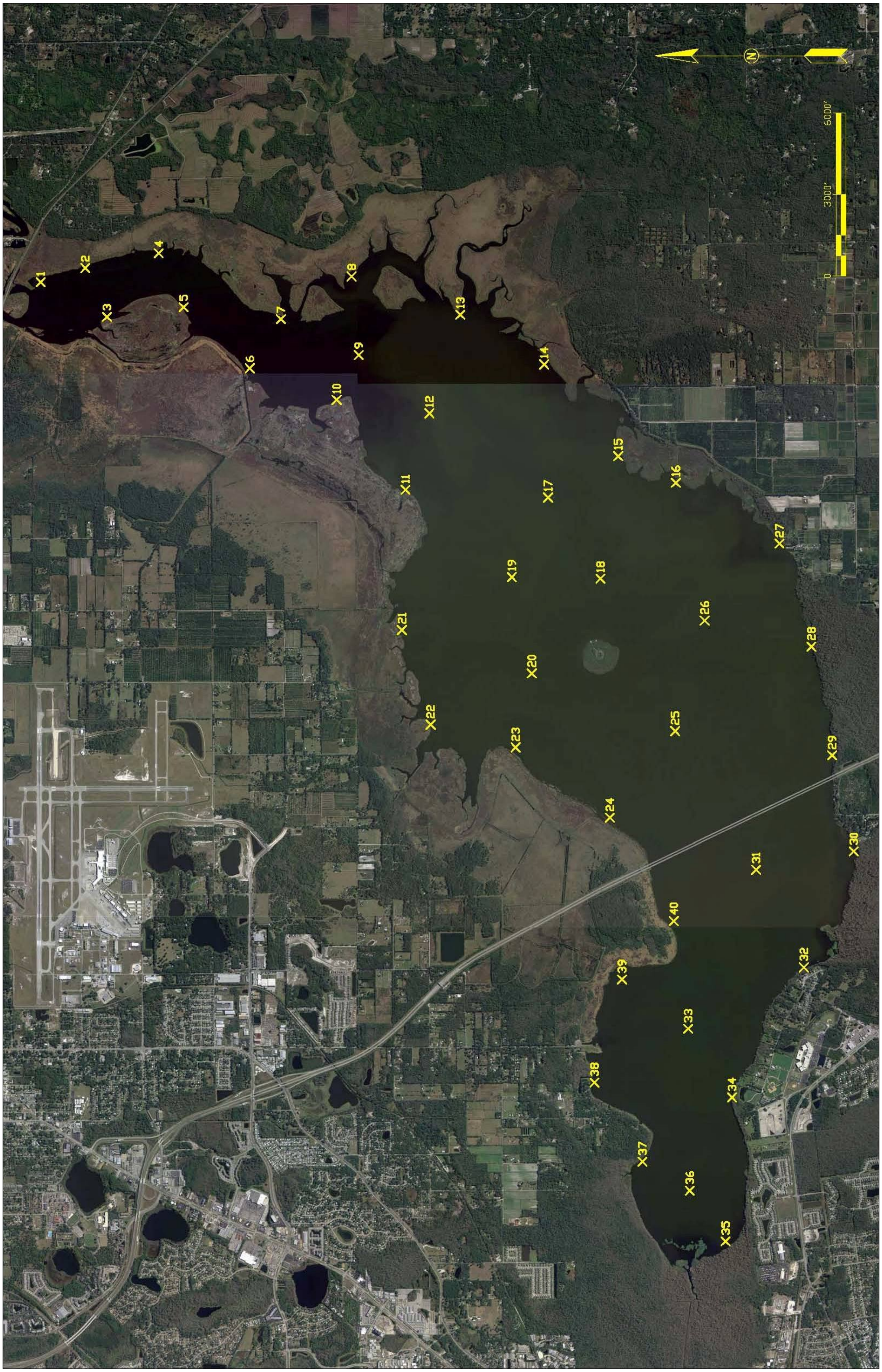

Figure 2-5. Groundwater Seepage Monitoring Sites in Lake Jesup.

During collection of the seepage samples, information was recorded on the time of sample collection, the total volume of seepage collected at each site, and general observations regarding the condition of the seepage collection bags and replacement/repair details. The seepage flow rate at each location is calculated by dividing the total collected seepage volume (liters) by the area of the seepage meter and the time (days) over which the seepage sample was collected.

2.3 Laboratory Analyses

Each of the collected seepage samples was evaluated in the ERD Laboratory for general parameters and nutrients. A summary of laboratory methods and MDLs for analyses conducted on water samples collected during this project is given in Table 2-1. The ERD Laboratory is NELAC-certified (No. 1031026). Additional details on field operations, laboratory procedures, and quality assurance methodologies are provided in the ERD Comprehensive Quality Assurance Plan.

TABLE 2-1

ANALYTICAL METHODS AND DETECTION LIMITS FOR LABORATORY ANALYSES

MEASUREMENT PARAMETER		METHOD	METHOD DETECTION LIMITS (MDLs)[1]
General Parameters	Hydrogen Ion (pH)	SM-21, Sec. 4500-H^+ B[2]	NA
	Specific Conductivity	SM-21, Sec. 2510 B	0.2 µmho/cm
	Alkalinity	SM-21, Sec. 2320 B	0.5 mg/l
Nutrients	Ammonia-N (NH_3-N)	SM-21, Sec. 4500-NH_3 G	0.005 mg/l
	Nitrate + Nitrite (NO_x-N)	SM-21, Sec. 4500-NO_3 F	0.005 mg/l
	Total Nitrogen	SM-21, Sec. 4500-N C	0.01mg/l
	Orthophosphorus (SRP)	SM-21, Sec. 4500-P F	0.001 mg/l
	Total Phosphorus	SM-21, Sec. 4500-P B.5	0.001 mg/l

1. MDLs are calculated based on the EPA method of determining detection limits
2. Standard Methods for the Examination of Water and Wastewater, 21st Ed., 2005.

SECTION 3

RESULTS

A discussion of the field and laboratory activities conducted by ERD to evaluate the quantity and quality of shallow groundwater seepage entering Lake Jesup is given in the following sections. These sections include a discussion of the quantity of data collected, seepage inflow rates, chemical characteristics of groundwater seepage, and estimated annual seepage influx of nitrogen and phosphorus.

3.1 Data Collection

Seepage influx into Lake Jesup was monitored over a 421-day period from June 11, 2009-August 5, 2010. Nine separate seepage monitoring events were conducted to evaluate the quantity of shallow seepage entering Lake Jesup, with laboratory analysis of the seepage samples conducted during eight of the monitoring events.

During the field monitoring program, 162 seepage samples were collected to measure volumetric inflow rates at the 40 monitoring sites. This value represents approximately 45% of the 360 potential seepage samples which would have been generated by conducting nine monitoring events at each of the 40 sites. A graphical illustration of the number of samples collected at each of the seepage monitoring sites in Lake Jesup is given on Figure 3-1. None of the seepage sites had useable data during all nine of the potential events. Only one of the seepage monitoring sites produced useable samples during eight monitoring dates, with six sites producing useable samples during seven monitoring events, and three sites producing useable samples during six monitoring events. Three of the seepage monitoring sites generated no useable samples at all. The most vulnerable sites were located in central portions of the lake where the marker floats were most visible.

The principle causes for the low percentage of useable seepage samples are theft and vandalism of the seepage meters along with damage caused by wildlife. Of the original 40 seepage meters installed in Lake Jesup during June 2009, at least 24 were stolen on at least one occasion during the monitoring program. These missing seepage meters were replaced by ERD during routine monitoring events. In addition, many of the seepage meters experienced accidental or intentional damage which either overturned the seepage meter or broke the PVC fittings attached to the sample collection bag. If possible, minor repairs were made in the field without removing the seepage meter. For larger repairs, the meter was removed from the lake and replaced with a new meter.

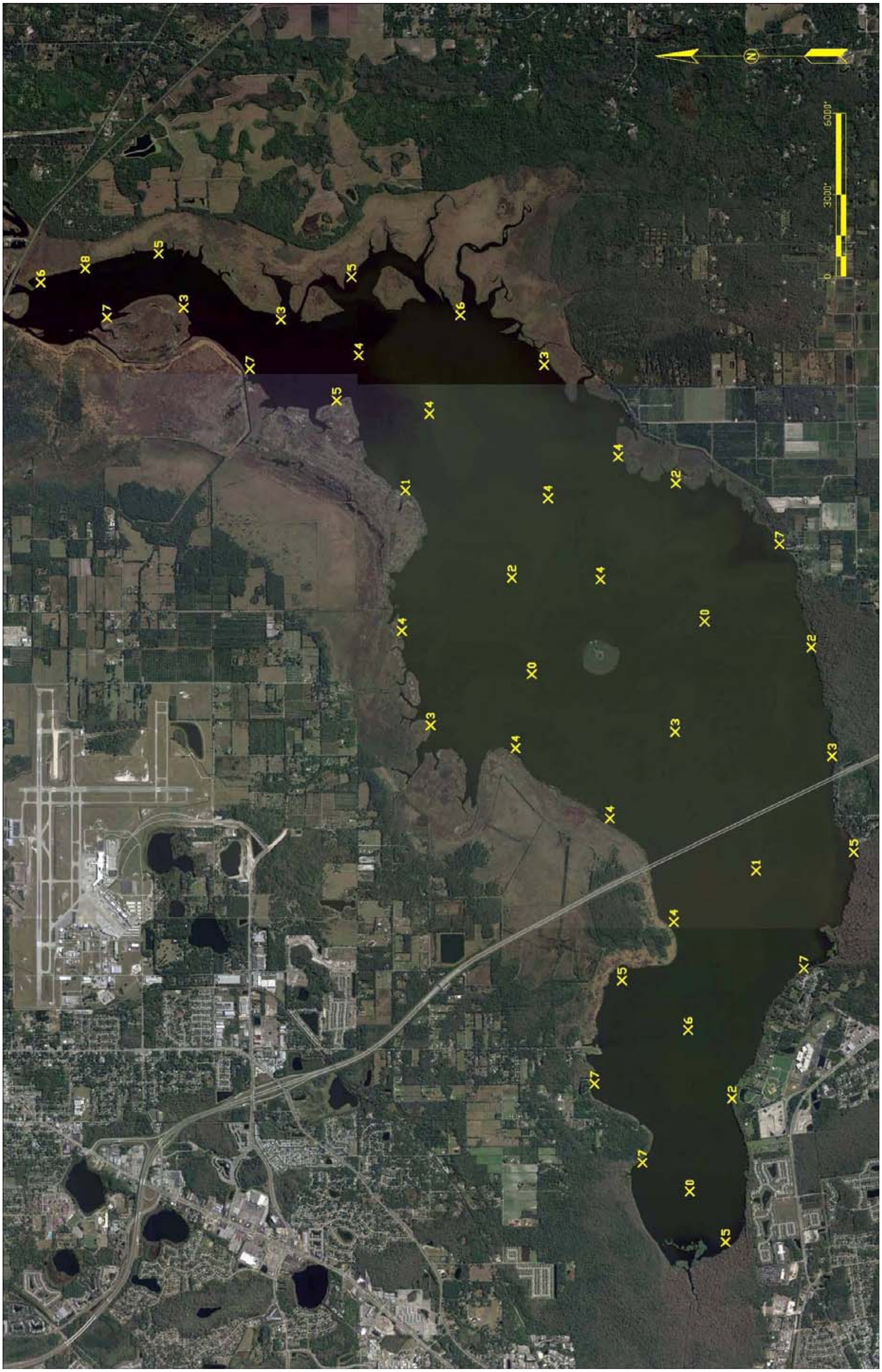

Figure 3-1. Number of Useable Seepage Inflow Samples Collected in Lake Jesup by Site.

Damage to the seepage meter collection system, particularly the collection bag, was a common occurrence. This damage usually consisted of large holes or tears in the collection bag, presumably from wildlife, which rendered any collected samples useless. An example of a damaged collection bag is given in Figure 3-2.

Figure 3-2. Example of Damaged Seepage Collection Bag.

The surficial sediments in Lake Jesup are extremely unconsolidated and easily disturbed. The process of retrieving the collected seepage samples using a diver stirred up plumes of flocculent sediment material which created a large area of elevated turbidity near the sampling location. A photograph of sediment resuspension during collection of seepage samples is given in Figure 3-3. These resuspended sediments had no impact on the seepage samples and is mentioned only to illustrate conditions within the lake.

Figure 3-3. Resuspended Sediments During Collection of Seepage Samples.

3.2 Hydrologic Inputs from Groundwater Seepage

3.2.1 Rainfall

Shallow groundwater seepage originates primarily as rainfall which infiltrates into shallow soils and migrates down gradient within a watershed until reaching a surface waterbody, channel, river, or stream. As a result, rainfall has a significant impact on the quantity of shallow groundwater seepage entering the lake.

A review of available rainfall recording stations in the vicinity of Lake Jesup was conducted to identify potential sources for estimation of historical rainfall characteristics in the general area of Lake Jesup as well as measured rainfall during the field monitoring program from June 2009-August 2010. Two separate National Climatic Data Center (NCDC) rainfall recording stations were identified in the general vicinity of Lake Jesup. One site is identified as "Sanford Experimental Station" (NCDC Station No. 87982) which is located south of Lake Monroe, west of downtown Sanford. Rainfall data at this site are available from June 1956-present. A second NCDC rainfall recording station, identified as "Sanford Airport", is located approximately 2.5 miles northwest of Lake Jesup. However, meteorological data at this station are available only from 1995-present. Since the purpose of the historical rainfall station is to provide estimates of "normal" monthly rainfall in the vicinity of Lake Jesup, the Sanford Experimental Station is selected as the source of these data so that a longer historical period of record could be included. Monthly rainfall records were obtained for this site over the period from 1971-2000, and these data are used to reflect "normal" rainfall in the general vicinity of Lake Jesup. The location of the Sanford Experimental Station site is indicated on Figure 3-4.

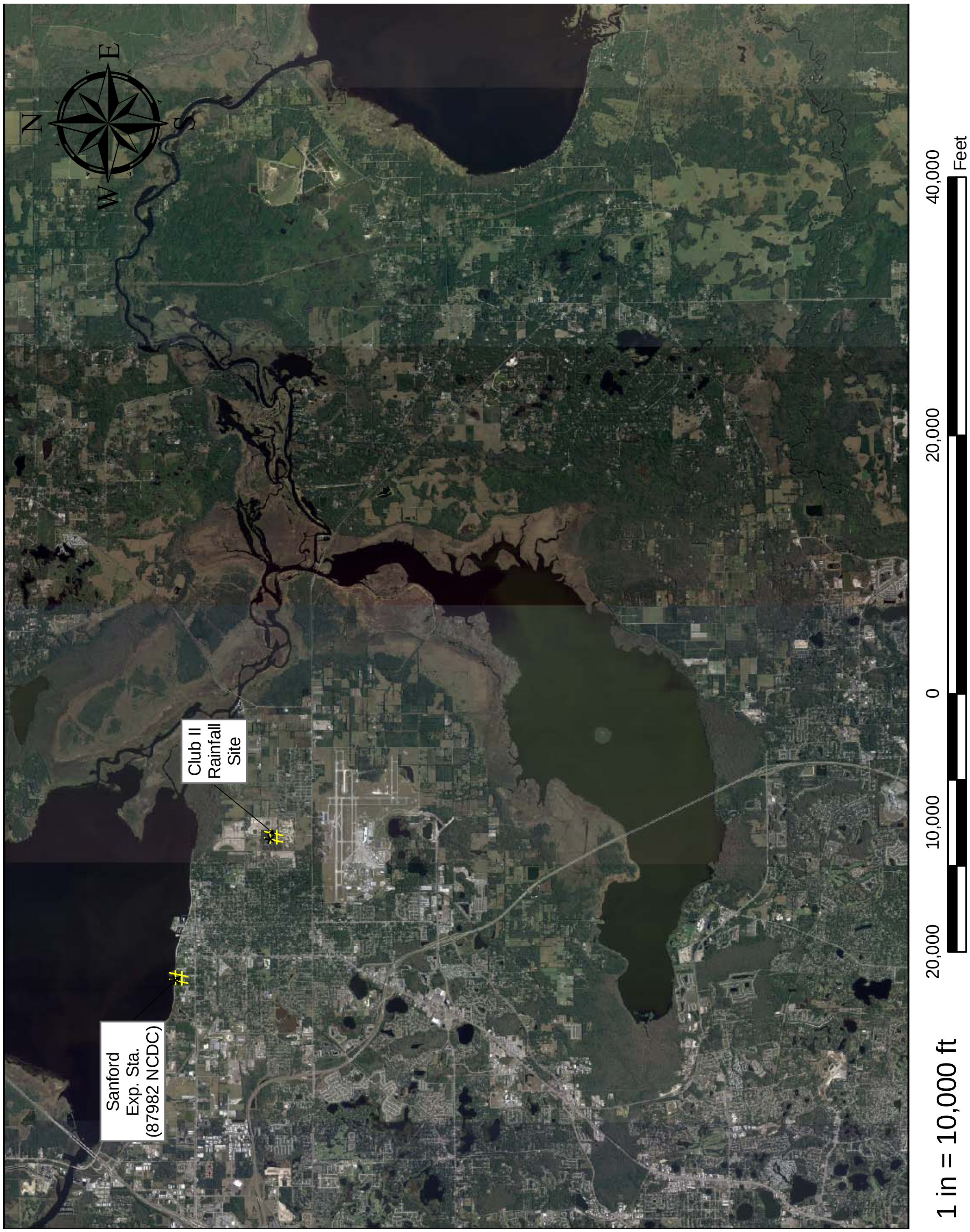

Figure 3-4. Locations of Identified Rainfall Recording Stations in the Vicinity of Lake Jesup.

Rainfall characteristics during the field monitoring program from June 2009-August 2010 were obtained from the rainfall recorder installed at the Club II Regional Stormwater Facility (RSF) as part of a long-term monitoring project conducted at this site by ERD for the County. Detailed rainfall records are available at this site from December 2008-November 2010 which encompasses the field monitoring program for the seepage evaluation project. Therefore, rainfall recorded at the Club II site is used to reflect rainfall in the vicinity of Lake Jesup during the field monitoring program. The location of the Club II site is also given on Figure 3-4.

A comparison of long-term “normal” rainfall in the vicinity of Lake Jesup (based upon the historical data at the Sanford Experimental Station site) and measured rainfall during the field monitoring program from June 2009-August 2010 (based upon rainfall records collected at the Club II RSF site) is given in Table 3-1. During the 14-month monitoring program, a total of approximately 58.89 inches of rainfall fell in the general vicinity of Lake Jesup. The long-term historical (normal) rainfall during the 14-month monitoring program is approximately 66.00 inches. The measured rainfall of 58.89 inches during the field monitoring program is approximately 11% less than the long-term annual mean of 66.00 inches.

TABLE 3-1

SUMMARY OF MEASURED AND HISTORICAL RAINFALL IN THE VICINITY OF LAKE JESUP

MONTH	RAINFALL AT THE CLUB II SITE (June 2009-July 2010)	MEAN RAINFALL AT THE SANFORD EXPERIMENTAL STATION (87982 NCDC) (1971-2000)
June 2009	9.16	6.31
July 2009	5.74	7.39
August 2009	2.62	7.53
September 2009	3.19	6.00
October 2009	0.50	3.82
November 2009	0.87	2.63
December 2009	4.44	2.71
January 2010	2.35	2.93
February 2010	6.41	2.98
March 2010	9.26	3.57
April 2010	0.60	2.84
May 2010	1.77	3.59
June 2010	7.60	6.31
July 2010	4.38	7.39
TOTALS:	**58.89**	**66.00**

A graphical comparison of measured and historical rainfall in the vicinity of Lake Jesup is given on Figure 3-5. Rainfall measured in the vicinity of Lake Jesup during July 2009, January 2010, and June 2010 appears to be approximately normal compared with long-term rainfall characteristics. Substantially lower than normal rainfall occurred in the vicinity of Lake Jesup during the period from August-November 2009, April-May 2010, and July 2010. Substantially higher than normal rainfall was observed during June and December 2009 and February-March 2010.

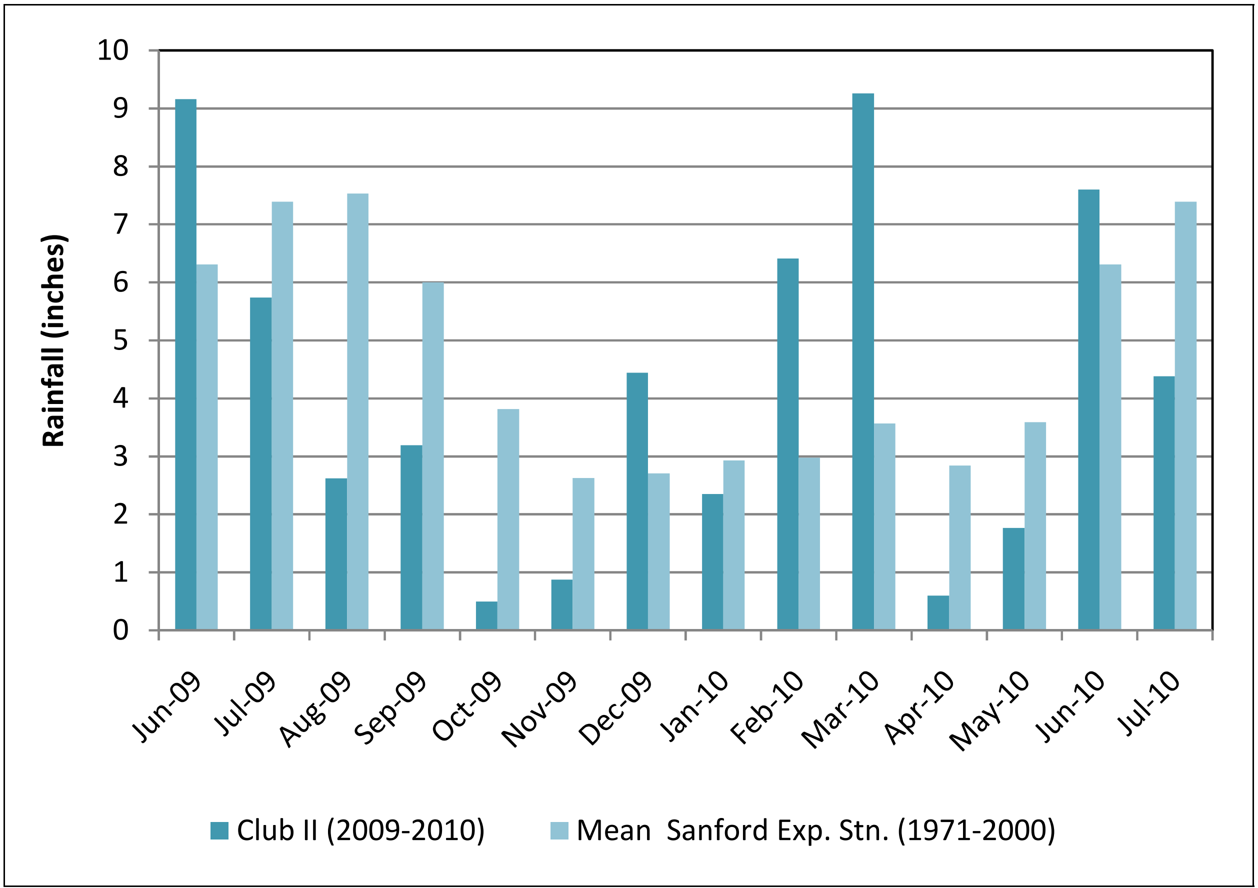

Figure 3-5. Comparison of Measured and Historical Rainfall in the Vicinity of Lake Jesup.

3.2.2 <u>Seepage Inflow</u>

3.2.2.1 <u>Field Measurements</u>

A complete listing of individual seepage measurements conducted at each of the 40 monitoring sites during each of the monitoring events is given in Appendix A. Information is provided on the date and time of installation for each of the seepage meters, along with date and times for each of the field monitoring events. Information is also provided on the volume of seepage collected during each event, along with the calculated seepage time and seepage rate. General comments and observations concerning the condition of the seepage meter and sample collection system are also provided.

A summary of measured seepage inflows to Lake Jesup from June 2009-August 2010 is given in Table 3-2. Information is provided for the mean seepage inflow measured at each site, the measured minimum and maximum inflow rates, and the number of samples collected at each site. The majority of seepage inflow rates range from approximately 0.5-2.0 liters/m^2-day. The mean seepage inflow rates listed on Table 3-2 and in Appendix A reflect weighted inflow rates rather than the mean of the individual measured inflow rates since the monitoring events are not evenly spaced. The mean inflow rate for each site is calculated according to the following equation:

$$\textit{Mean Inflow Rate} = \frac{\textit{Total Seepage Volume Collected}}{\textit{Number of Days Included in Collected Samples}}$$

TABLE 3-2

SUMMARY OF MEASURED SEEPAGE INFLOWS TO LAKE JESUP FROM JUNE 2009-AUGUST 2010

SITE	MEAN SEEPAGE INFLOW (liters/m^2-day)	MINIMUM VALUE (liters/m^2-day)	MAXIMUM VALUE (liters/m^2-day)	SITE	MEAN SEEPAGE INFLOW (liters/m^2-day)	MINIMUM VALUE (liters/m^2-day)	MAXIMUM VALUE (liters/m^2-day)
1	0.46	0.15	1.32	21	1.09	0.54	1.54
2	0.98	0.54	1.98	22	0.44	0.29	1.22
3	0.58	0.15	1.30	23	5.14	1.08	23.70
4	0.62	0.21	1.52	24	1.14	0.72	2.01
5	1.16	0.67	1.45	25	1.01	0.75	1.48
6	0.68	0.25	1.47	26	--	--	--
7	0.69	0.14	1.75	27	1.29	0.52	3.09
8	0.42	0.09	1.75	28	4.21	2.43	4.83
9	0.80	0.22	3.34	29	2.79	0.64	4.83
10	0.53	0.12	2.55	30	0.99	0.52	1.71
11	0.69	0.69	0.69	31	2.79	2.79	2.79
12	0.46	0.17	1.00	32	0.89	0.21	3.38
13	0.86	0.24	2.18	33	0.94	0.20	2.42
14	0.44	0.32	0.48	34	5.65	2.71	7.14
15	0.93	0.25	2.28	35	0.71	0.35	1.53
16	1.68	1.48	1.99	36	--	--	--
17	0.99	0.67	1.92	37	0.67	0.34	1.24
18	0.66	0.49	1.09	38	1.78	0.75	6.23
19	2.47	2.26	2.69	39	1.73	0.71	2.82
20	--	--	--	40	1.37	0.46	3.43
				MEAN:	**1.37**	**0.68**	**2.92**

3.2.2.2 Volumetric Inputs

The mean seepage inflow rates summarized on Table 3-2 were combined with geographic coordinates for each site to generate an isopleth contour map for mean seepage inflow into Lake Jesup using ARC GIS 9.0. Isopleths of mean seepage inflow into Lake Jesup over the period from June 2009-August 2010 are given on Figure 3-6. Isopleth lines indicated on this figure range from 0.75-2.25 liters/m^2-day. Seepage inflow into central portions of Lake Jesup ranges from approximately 0.75-1.0 liters/m^2-day. Areas of more elevated seepage inflow were observed in the northeastern portion of the lake, the southwestern portion, and northeast of Bird Island. Seepage inflow rates in these areas reached as high as 2.25 liters/m^2-day. The area of elevated seepage inflow on the northwestern portion of the lake is adjacent to developed sub-basin areas with relatively permeable soils and a moderate topography which enhances the potential for migration of groundwater into the lake. The area of elevated seepage observed along the southwest corner of the lake is adjacent to an agricultural area with a lower degree of topography than exists for the urban areas discharging into the northeastern portion of the lake.

The seepage isopleths indicated on Figure 3-6 were graphically integrated to obtain estimates of the mean daily seepage influx into the lake. A summary of estimated seepage inflow into Lake Jesup is given in Table 3-3. The mean area weighted seepage inflow into Lake Jesup over the period from June 2009-August 2010 is approximately 1.18 liters/m^2-day or approximately 41.3 ac-ft/day. If this value is extrapolated over a 365-day period, seepage inflow contributes approximately 15,074 ac-ft/yr.

TABLE 3-3

ESTIMATED SEEPAGE INFLOW TO LAKE JESUP

PARAMETER	VALUE
Lake Area	10,660 acres
Mean Seepage Inflow	1.18 liters/m^2-day 41.3 ac-ft/day 15,074 ac-ft/year
Seepage/Surface Area Ratio	1.41 ft

A calculated seepage/surface area ratio for Lake Jesup is provided at the bottom of Table 3-3. This value reflects an estimate of seepage inflow in terms of a depth over the entire lake surface and provides a mechanism for comparing relative seepage inflow between lakes without consideration of lake area. Seepage inflow to Lake Jesup contributes approximately 1.41 ft/yr over the entire lake surface. ERD has conducted measurements of seepage inflow rates for 34 lakes within the State of Florida, and the mean seepage inflow rate for these lakes is 1.97 ft/yr over the lake surface. Therefore, seepage inflow into Lake Jesup appears to be less than average compared with seepage inflow rates monitored by ERD in other Florida lakes.

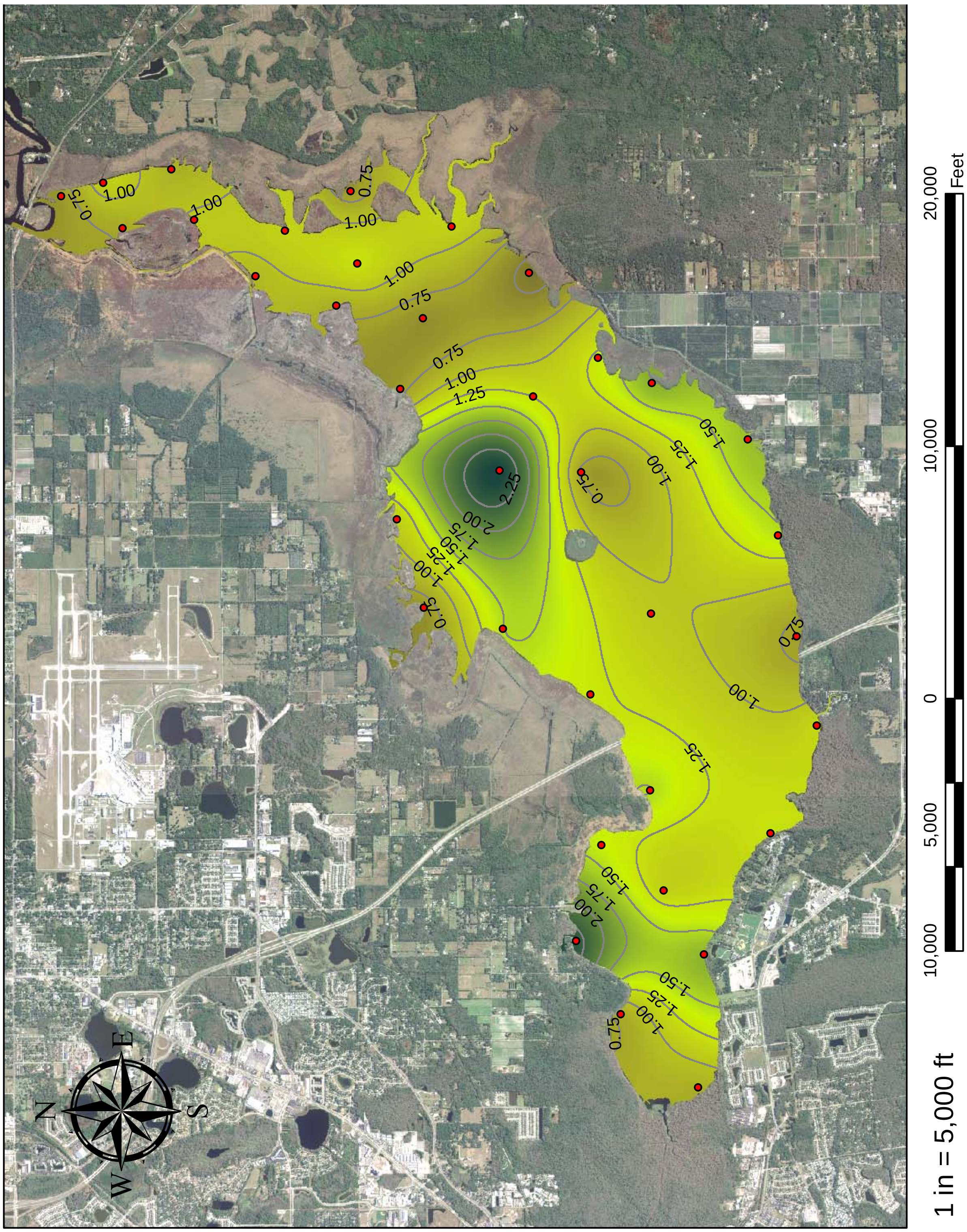

Figure 3-6. Isopleths of Mean Seepage Inflow (liters/m^2-day) to Lake Jesup from June 2009-August 2010.

3.2.2.3 Seasonal Variability in Seepage Rates

As discussed in Section 3.2.1, rainfall in the vicinity of Lake Jesup was approximately 11% less than normal during the field monitoring program. Assuming a positive relationship between rainfall and seepage inflow, seepage inflow to Lake Jesup should be higher during periods of frequent rainfall or following significant rain events.

A summary of mean seepage inflows to Lake Jesup for each of the nine collection dates is given on Table 3-4. The mean values summarized in this table reflect the log-normal mean value for all seepage inflow data collected on each collection date. The values summarized in Table 3-4 appear to exhibit a seasonal pattern, with more elevated seepage inflow rates during wet season conditions and reductions in seepage inflow observed during dry season conditions.

A graphical comparison of mean event seepage inflow rates to Lake Jesup during the field monitoring program is given on Figure 3-7. Measured event rainfall depths are also included for comparison purposes. In general, seepage inflow appears to be correlated with rainfall in the adjacent sub-basin areas, with more elevated seepage during periods of higher rainfall.

3.2.2.4 Error Evaluation

Volumetric measurements of seepage inflow using the seepage meter method are subject to several potential sources of error. First, a loss of seepage could occur as a result of an incomplete seal between the perimeter of the seepage meter and the bottom sediments. If this seal is not intact, seepage inflow may escape from the seepage meter into the lake without being collected in the sample bag. This type of error is generally limited to lakes with sandy sediments which typically do not exist within Lake Jesup. In fact, consolidated muck sediments, such as those found in Lake Jesup, provide an excellent seal with the seepage apparatus. As a result, error resulting from loss of seepage does not appear to be a concern in Lake Jesup.

A second potential for error exists if additional settling of the seepage meters occurs during the field monitoring program. As the seepage meter settles, the displaced water volume is forced into the seepage bag and is included in the seepage field measurements. This type of error is generally minimized by inserting the seepage meters until the original parent bottom material is reached. This was possible for virtually all of the shoreline seepage meters installed in Lake Jesup, and error from additional settling of the seepage meters is not a concern in these portions of the lake. The seepage meters installed in more central portions of the lake were generally located in areas with deeper muck accumulations. All of the seepage meters were installed at least into the consolidated sediment layer and were pounded into the sediments until no additional movement of the seepage meter occurred. Although additional settling of the seepage meters cannot be ruled out in these areas, any additional movement should be very minimal. No changes in seepage meter profiles were observed by the field crew at any of the monitoring sites. Errors in seepage measurements created by settling in central portions of the lake are possible but thought to be relatively minimal.

TABLE 3-4

**MEAN SEEPAGE INFLOWS TO
LAKE JESUP BY COLLECTION DATE**

DATE	MEAN SEEPAGE INFLOW (liters/m^2-day)
7/7/09	1.71
8/4/09	3.00
8/31/09	1.56
10/6/09	1.16
11/30/09	1.28
3/15/10	0.88
5/4/10	0.97
7/7/10	0.80
8/5/10	0.94

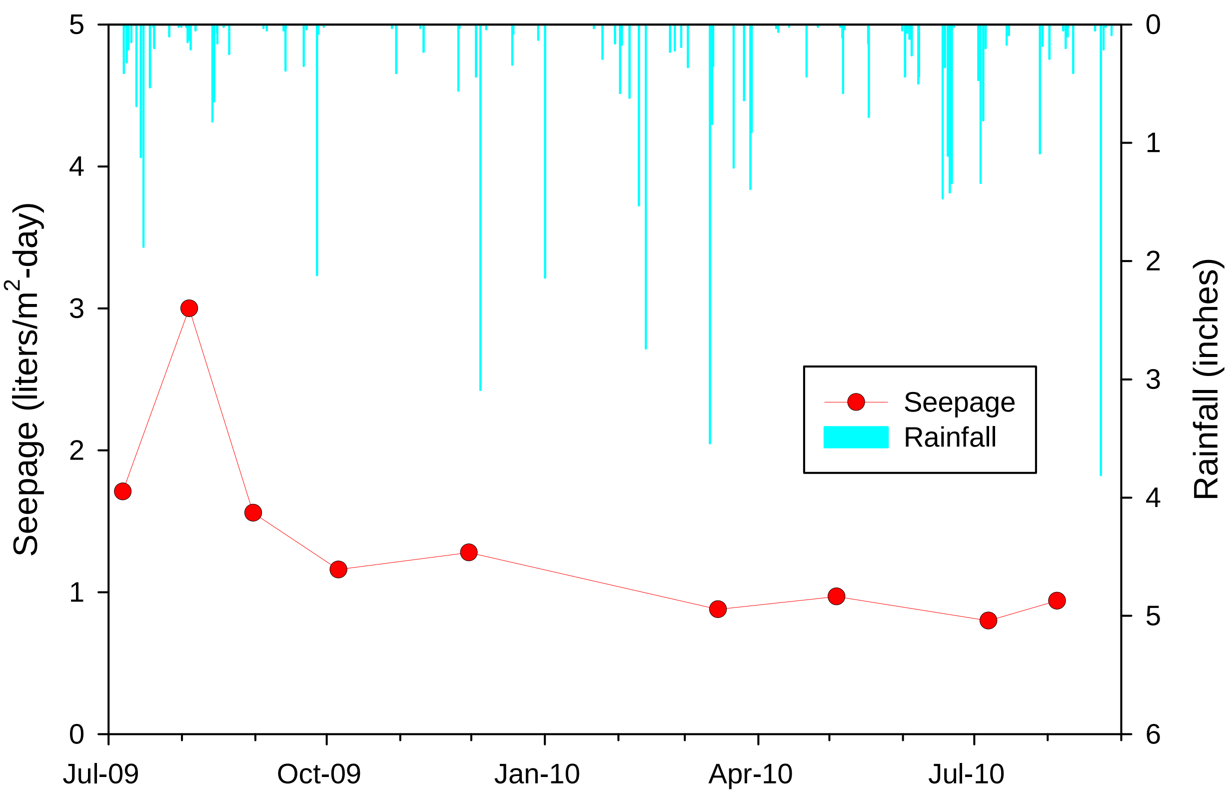

Figure 3-7. Mean Event Seepage Inflow Rates to Lake Jesup During the Field Monitoring Program.

3.3 Chemical Characteristics

Seepage samples collected during the final 8 of 9 seepage monitoring events in Lake Jesup were submitted for laboratory analyses. A complete listing of laboratory measurements conducted on individual seepage samples collected at each of the 40 monitoring sites is given in Appendix B. During the field monitoring program, samples for laboratory analyses were collected during the final 8 seepage monitoring events. A total of 152 seepage samples was collected during the field monitoring program for laboratory analyses. This value reflects approximately 48% of the number of potential samples for laboratory analyses which would have been generated by conducting 8 monitoring events at each of the 40 monitoring sites.

A summary of mean chemical characteristics of seepage samples collected entering Lake Jesup from June 2009-August 2010 is given in Table 3-5. The data summarized in this table reflect log-normal mean values for the available laboratory data collected at each site.

Groundwater seepage entering Lake Jesup was found to be approximately neutral in pH, with relatively elevated conductivity values. The majority of seepage inflow was well buffered, with mean measured alkalinity values at most sites in excess of 100 mg/l.

Measured ammonia concentrations in groundwater seepage were highly variable throughout the lake, ranging from approximately 100-8000 µg/l. A lower degree of variability was observed for measured concentrations of NO_x (nitrite + nitrate), with mean values for this parameter ranging from approximately 200-1,200 µg/l. Measured values of organic nitrogen appear to be relatively similar in many portions of the lake. In general, the majority of mean total nitrogen concentrations within the lake ranged from approximately 2,000-5,000 µg/l, although total nitrogen concentrations in excess of 10,000 µg/l were observed at several sites. Measured SRP (soluble reactive phosphorus) concentrations in groundwater seepage were highly variable, with mean concentrations ranging from approximately 20-1,400 µg/l. A similar degree of variability was observed for measured total phosphorus concentrations throughout the lake. SRP comprised approximately 75-80% of the measured total phosphorus in seepage entering the lake.

Overall mean seepage characteristics entering Lake Jesup over the period from June 2009-August 2010 are summarized at the bottom of Table 3-5. Groundwater seepage entering Lake Jesup was characterized by a mean total nitrogen concentration of approximately 4,179 µg/l, with a mean total phosphorus concentration of 334 µg/l. These values are substantially higher than the mean nutrient concentrations of 2,760 µg/l for total nitrogen and 137 µg/l for total phosphorus measured by ERD in groundwater seepage throughout the State of Florida.

Mean isopleths of pH in groundwater seepage entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-8 based upon the log-normal mean values summarized in Table 3-5. Areas of more elevated pH values were observed along the western, southern, and northern portions of the lake in the general vicinity of the areas of elevated seepage inflow rates indicated on Figure 3-6. The lowest seepage pH values appear to occur in the vicinity of Salt Creek and the constricted portion of the lake which intersects with the St. Johns River.

TABLE 3-5

MEAN SEEPAGE CHARACTERISTICS IN LAKE JESUP BY SITE

SITE	PARAMETER									
	pH (s.u.)	Cond. (μmho/cm)	Alkalinity (mg/l)	NH_3 (μg/l)	NO_x (μg/l)	Org. N (μg/l)	Total N (μg/l)	SRP (μg/l)	Org. P (μg/l)	Total P (μg/l)
1	6.91	928	80	906	362	1,207	2,608	241	84	340
2	7.42	1,010	105	1,189	624	1,241	3,553	227	42	275
3	7.27	773	81	500	193	1,284	2,093	75	28	116
4	7.22	788	83	928	525	1,383	2,983	171	45	230
5	7.54	832	100	160	1,206	1,423	3,763	90	22	135
6	7.32	735	84	363	571	1,176	2,459	132	50	211
7	7.40	820	102	810	569	1,619	3,384	113	50	168
8	7.25	1,945	160	8,128	153	3,491	12,212	1,394	184	1,698
9	7.38	772	91.0	369	900	1,362	2,848	195	24	226
10	7.22	782	100	583	127	1,199	2,515	207	46	276
11	7.83	1,297	180	5,532	523	1,398	7,453	245	245	490
12	7.45	1,714	163	873	420	1,486	5,040	1,033	530	1,843
13	7.29	1,108	116	2,493	253	1,902	5,148	406	25	473
14	7.39	863	110	1,469	440	1,590	3,565	316	70	440
15	7.45	1,007	124	2,375	223	1,303	4,025	285	99	385
16	7.51	1,205	195	4,543	976	2,832	8,351	1,295	177	1,472
17	7.55	722	94.8	378	1,188	1,478	3,832	135	25	165
18	7.46	692	103	940	103	1,057	3,132	211	49	269
19	7.56	608	83.7	702	1,505	940	3,827	222	66	296
20	--	--	--	--	--	--	--	--	--	--
21	7.39	740	106	1,353	204	1,708	3,401	71	21	106
22	7.59	909	125	1,152	683	2,135	5,647	335	16	359
23	7.38	656	77.6	319	414	1,018	2,030	21	7	33
24	7.51	720	97.6	112	1,225	921	2,567	54	19	73
25	7.77	1,050	188	3,263	859	2,430	7,098	664	180	911
26	--	--	--	--	--	--	--	--	--	--
27	7.38	672	90.1	468	537	972	2,379	77	35	133
28	7.86	1,000	230	5,888	631	1,678	10,118	1,219	20	1,241
29	7.43	655	120	2,552	637	888	5,182	249	15	277
30	7.24	561	108	2,210	229	990	4,340	421	58	488
31	--	--	--	--	--	--	--	--	--	--
32	7.35	590	116	2,507	754	789	7,528	734	21	788
33	7.45	640	118	2,522	320	1,449	5,509	260	127	536
34	7.48	622	111	5,141	212	1,026	7,011	424	196	651
35	7.63	632	167	2,842	231	995	5,069	1,342	67	1,525
36	--	--	--	--	--	--	--	--	--	--
37	7.41	654	112	1,249	997	1,034	5,314	286	100	469
38	7.41	1,125	135	5,250	140	1,124	7,128	364	89	591
39	7.50	623	78.3	200	102	1,195	1,751	26	13	49
40	7.77	778	139	874	650	997	3,589	348	20	370
MEAN:	**7.44**	**829**	**114**	**1,194**	**427**	**1,328**	**4,179**	**243**	**49**	**334**

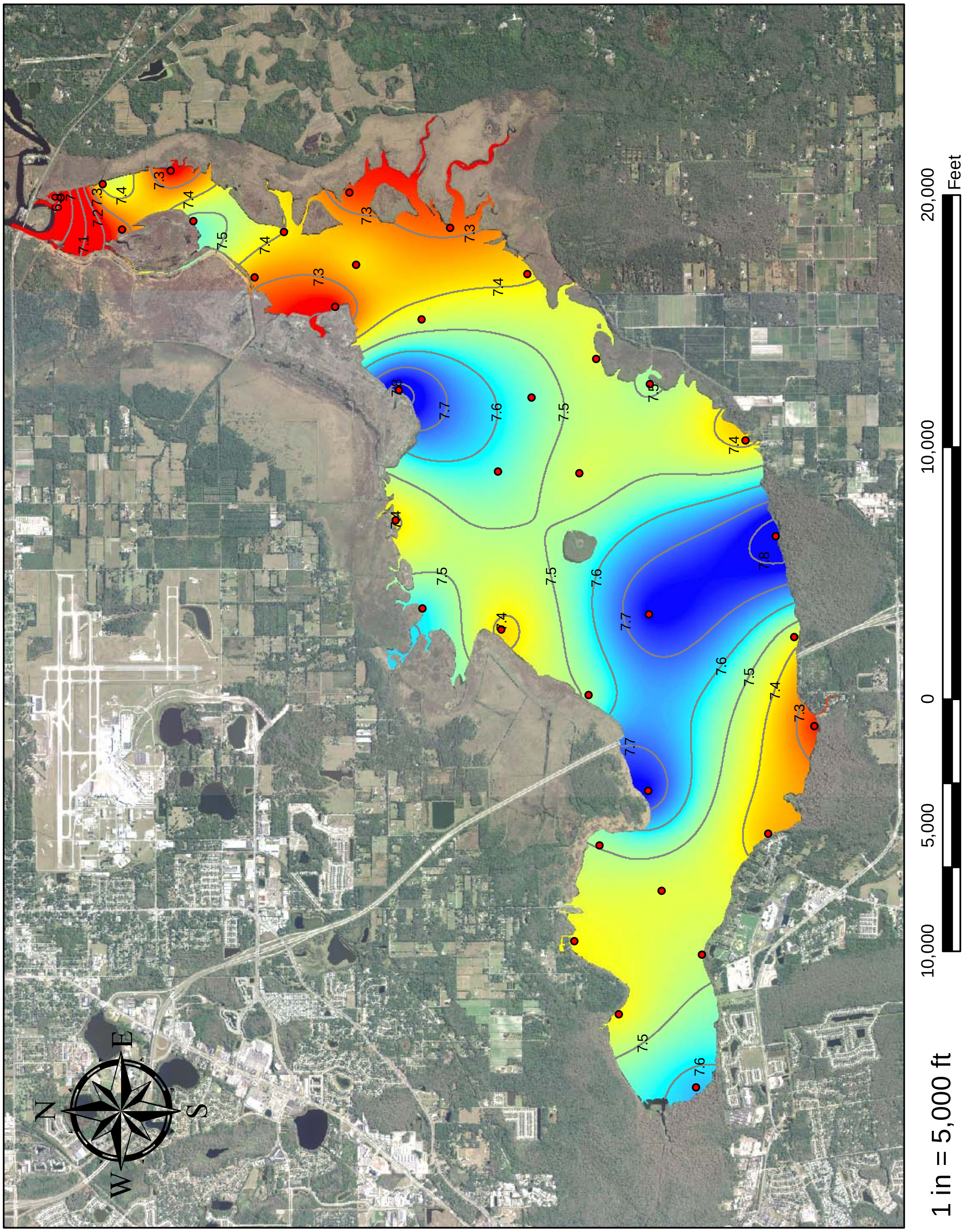

Figure 3-8. Mean Isopleths of pH (s.u.) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

Mean isopleths of conductivity measurements in groundwater samples entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-9. The most elevated conductivity measurements within the lake were observed in the general vicinity of Salt Creek where conductivity measurements as high as 1,945 μmho/cm were observed. Measured conductivity values in the remaining portions of the lake typically range from approximately 600-1,000 μmho/cm.

Mean isopleths of alkalinity in groundwater samples entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-10. Elevated alkalinity values in groundwater seepage were observed in western, southern, and northeastern portions of the lake in the general vicinity of the areas of elevated pH values indicated on Figure 3-8. Mean alkalinity concentrations in excess of 200 mg/l were observed in southern portions of the lake. Alkalinity values of approximately 160 mg/l were observed in western and northeastern portions of the lake, with the remaining areas typically exhibiting alkalinity values ranging from 80-120 mg/l.

Mean isopleths of ammonia concentrations in groundwater seepage entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-11. Elevated levels of ammonia concentrations, exceeding 4,000 μg/l, were observed in the same general areas which exhibited elevated levels of pH and alkalinity. The most elevated levels of ammonia in groundwater seepage were observed in the general vicinity of Salt Creek. Ammonia concentrations in seepage in other portions of the lake typically range from 1,000-2,000 μg/l.

Mean isopleths of NO_x concentrations in groundwater seepage entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-12. An area of relatively elevated NO_x concentrations was observed in the northeastern portion of the lake, with NO_x concentrations in remaining areas typically ranging from 200-800 μg/l.

Mean isopleths of total nitrogen concentrations in groundwater seepage entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-13. Elevated total nitrogen concentrations were observed in the same general areas which exhibited elevated levels of ammonia, alkalinity, and pH.

Mean isopleths of total phosphorus concentrations in groundwater seepage entering Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-14. In general, elevated concentrations of total phosphorus appear to occur in the same general areas which exhibited elevated concentrations for total nitrogen, ammonia, alkalinity, and pH. Total phosphorus concentrations in these elevated areas range from approximately 800-1,000 μg/l, with concentrations in remaining portions of the lake ranging from 200-600 μg/l.

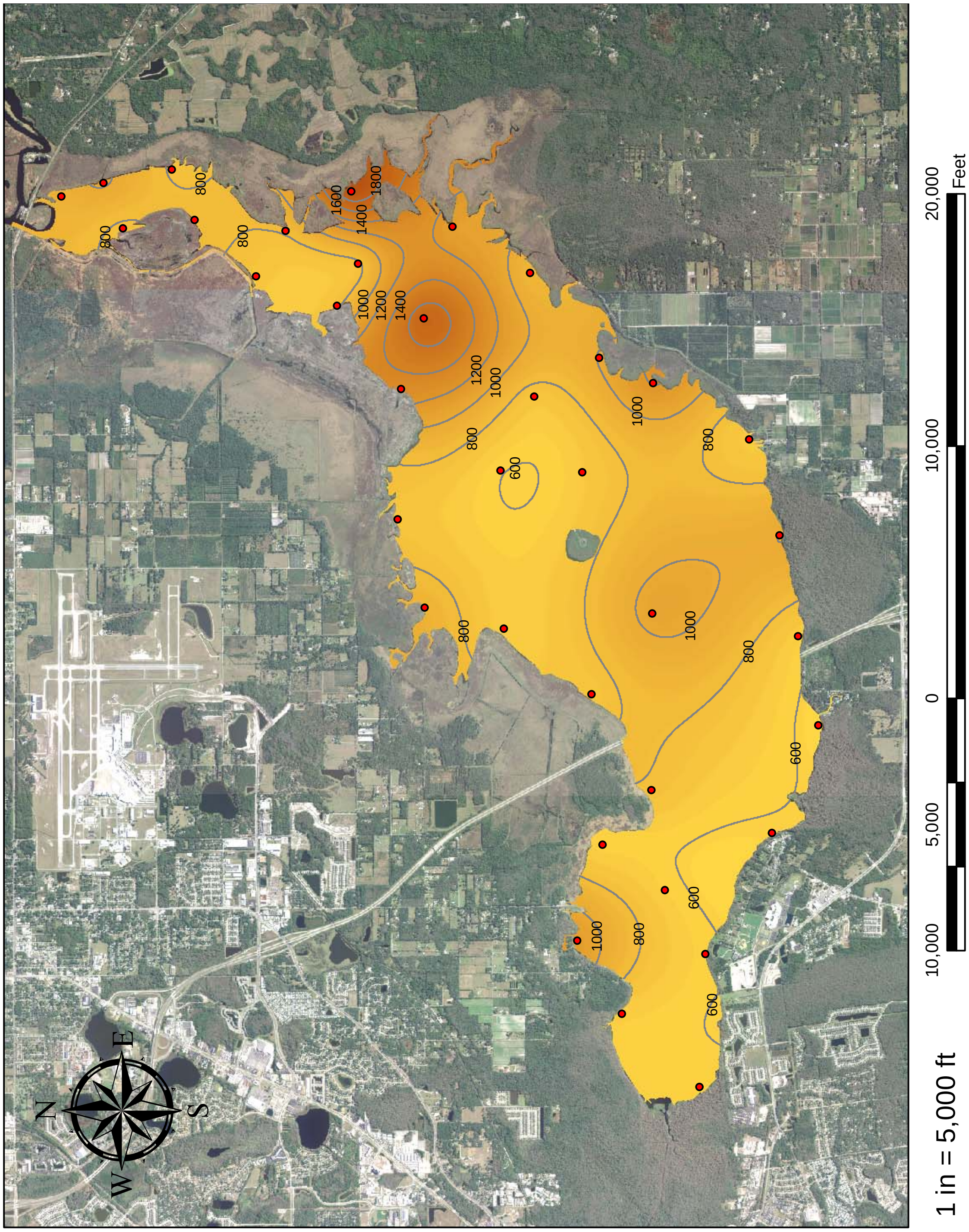

Figure 3-9. Mean Isopleths of Conductivity (µmho/cm) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

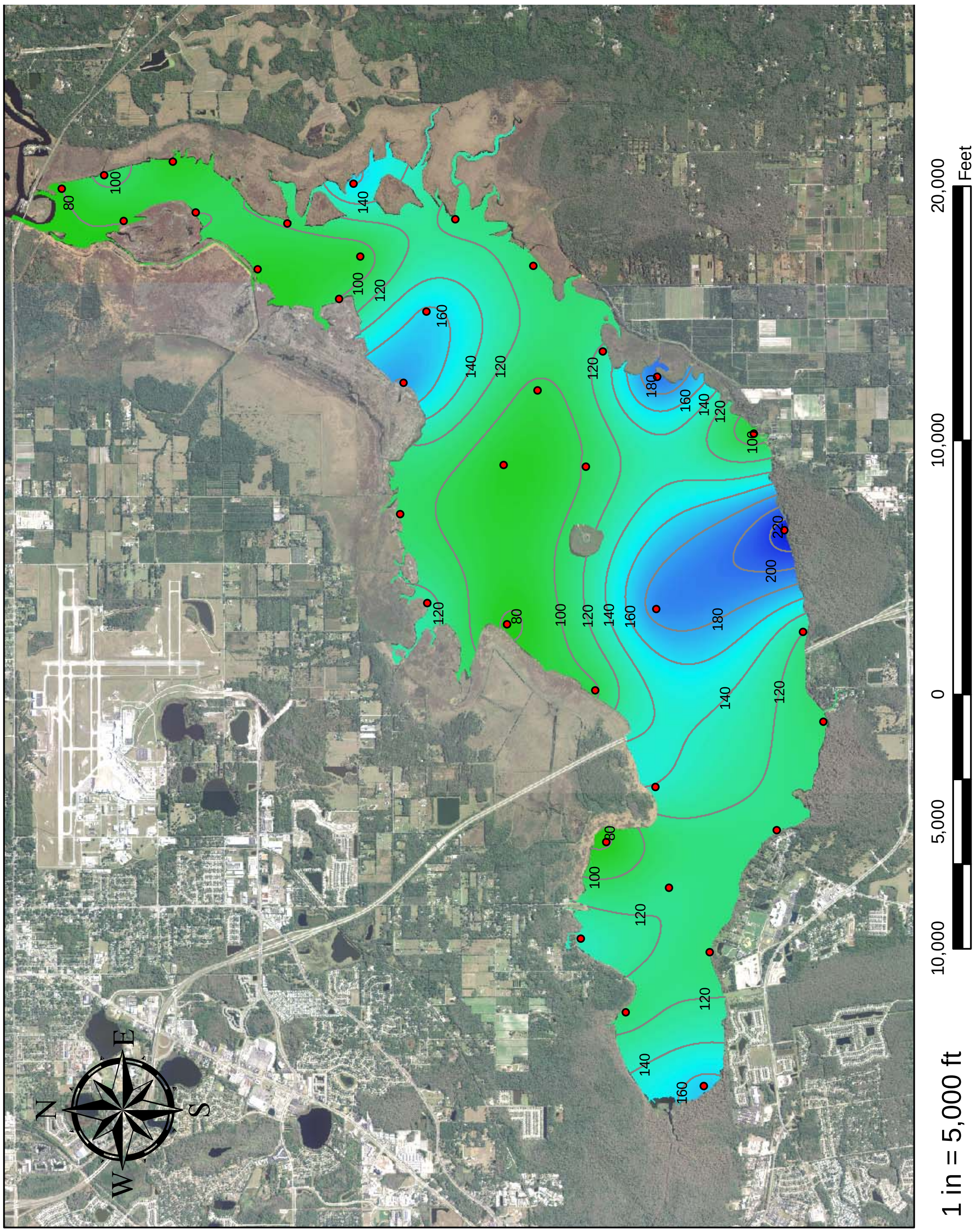

Figure 3-10. Mean Isopleths of Alkalinity (mg/l) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

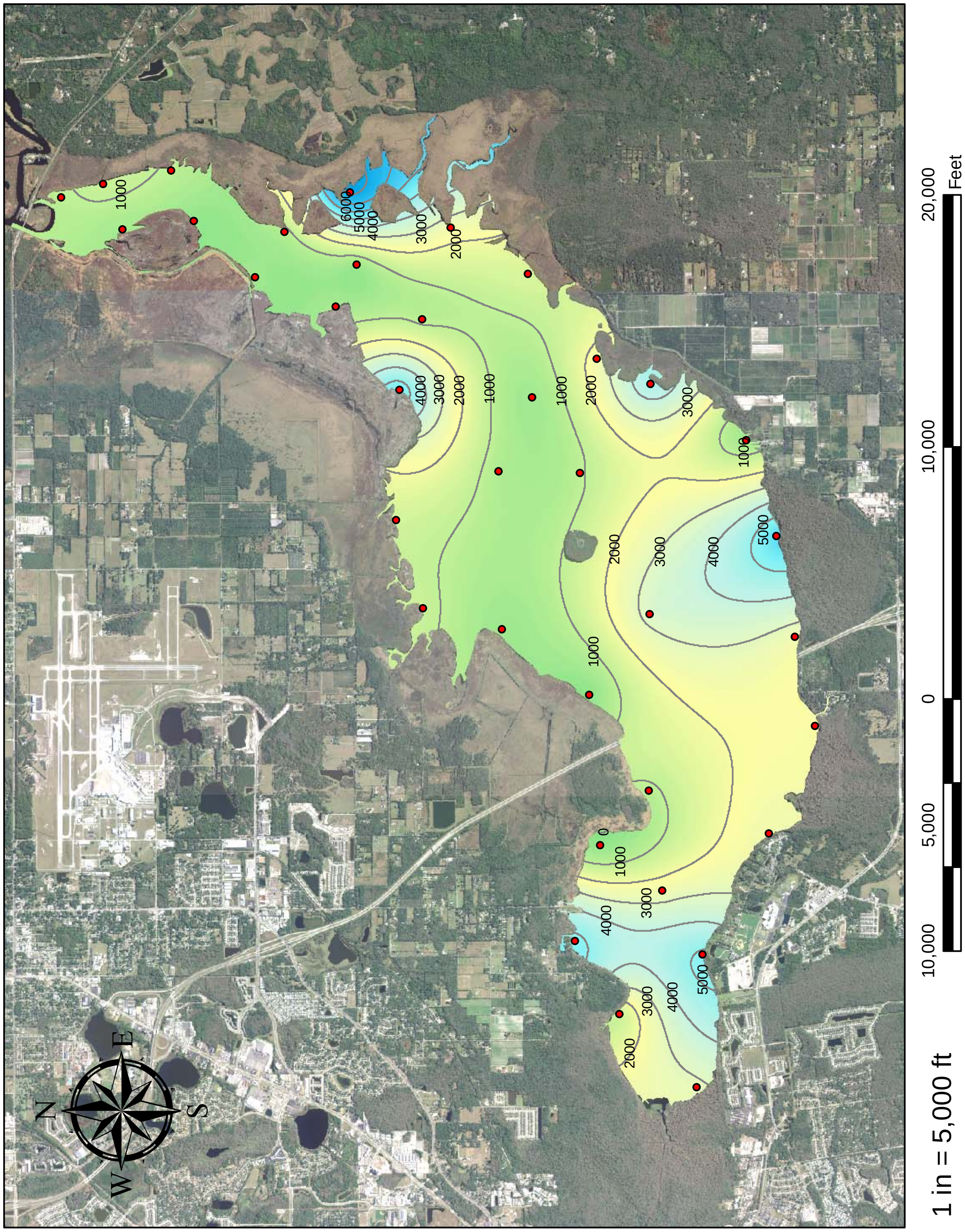

Figure 3-11. Mean Isopleths of Ammonia (µg/l) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

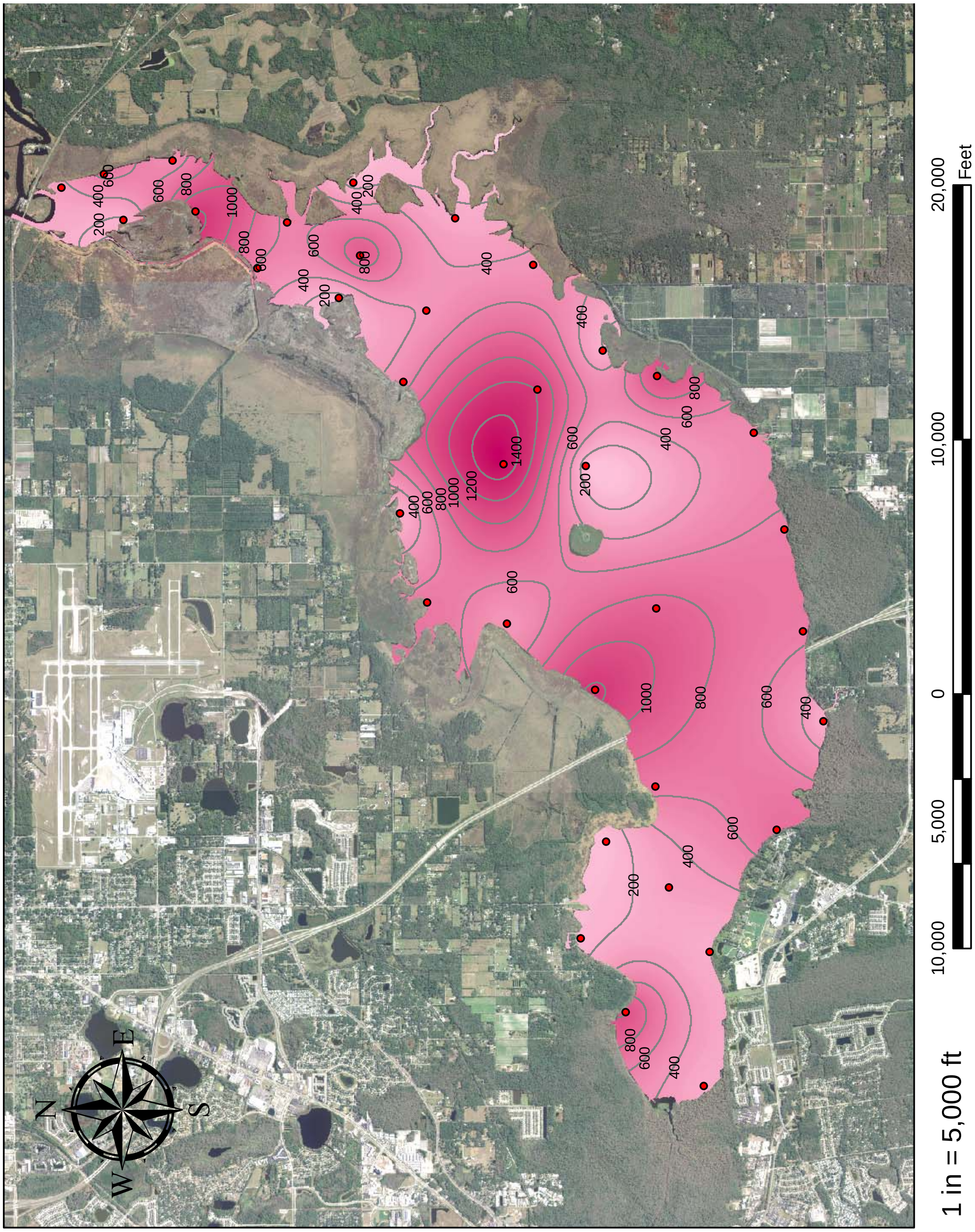

Figure 3-12. Mean Isopleths of NO_x (µg/l) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

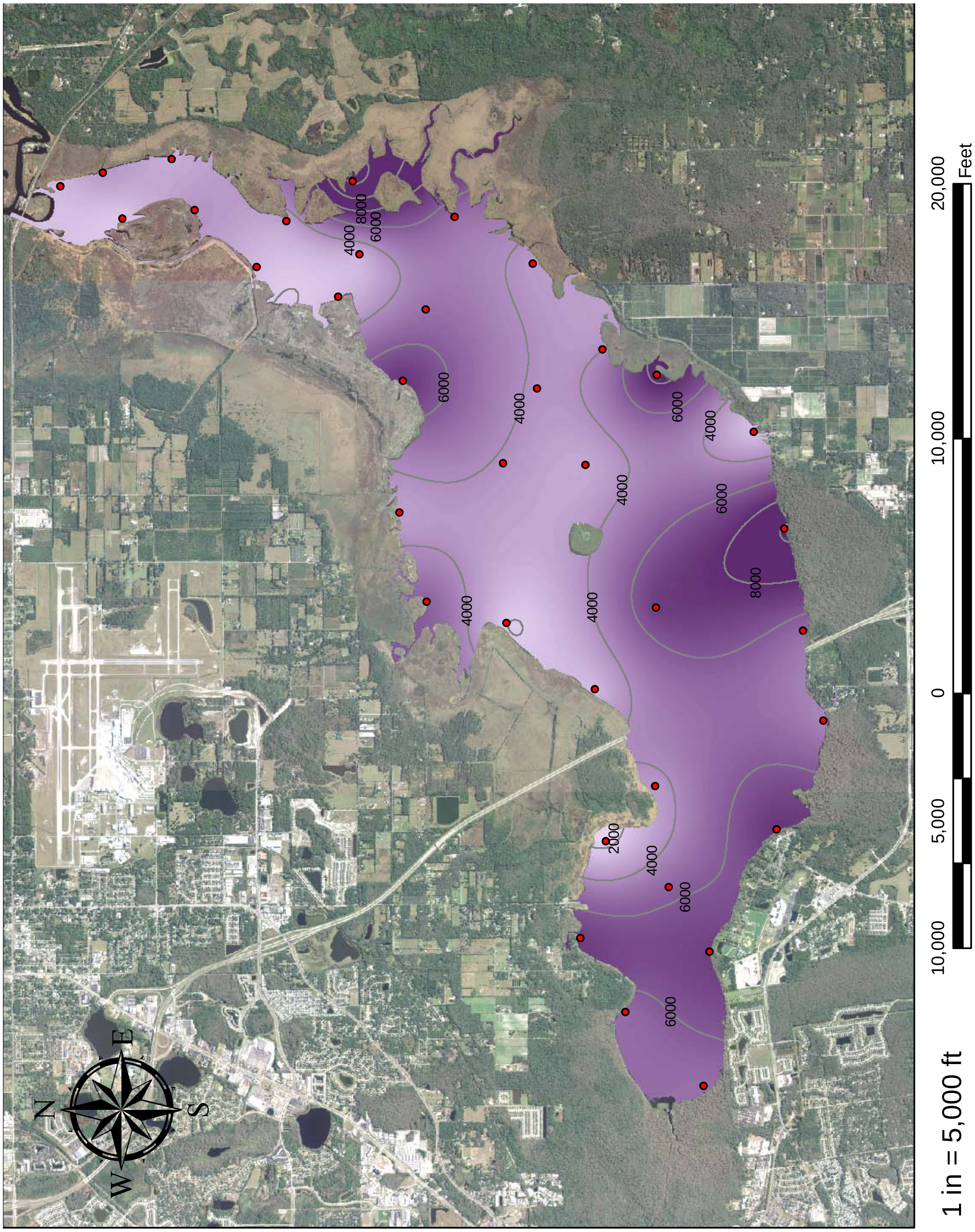

Figure 3-13. Mean Isopleths of Total Nitrogen (μg/l) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

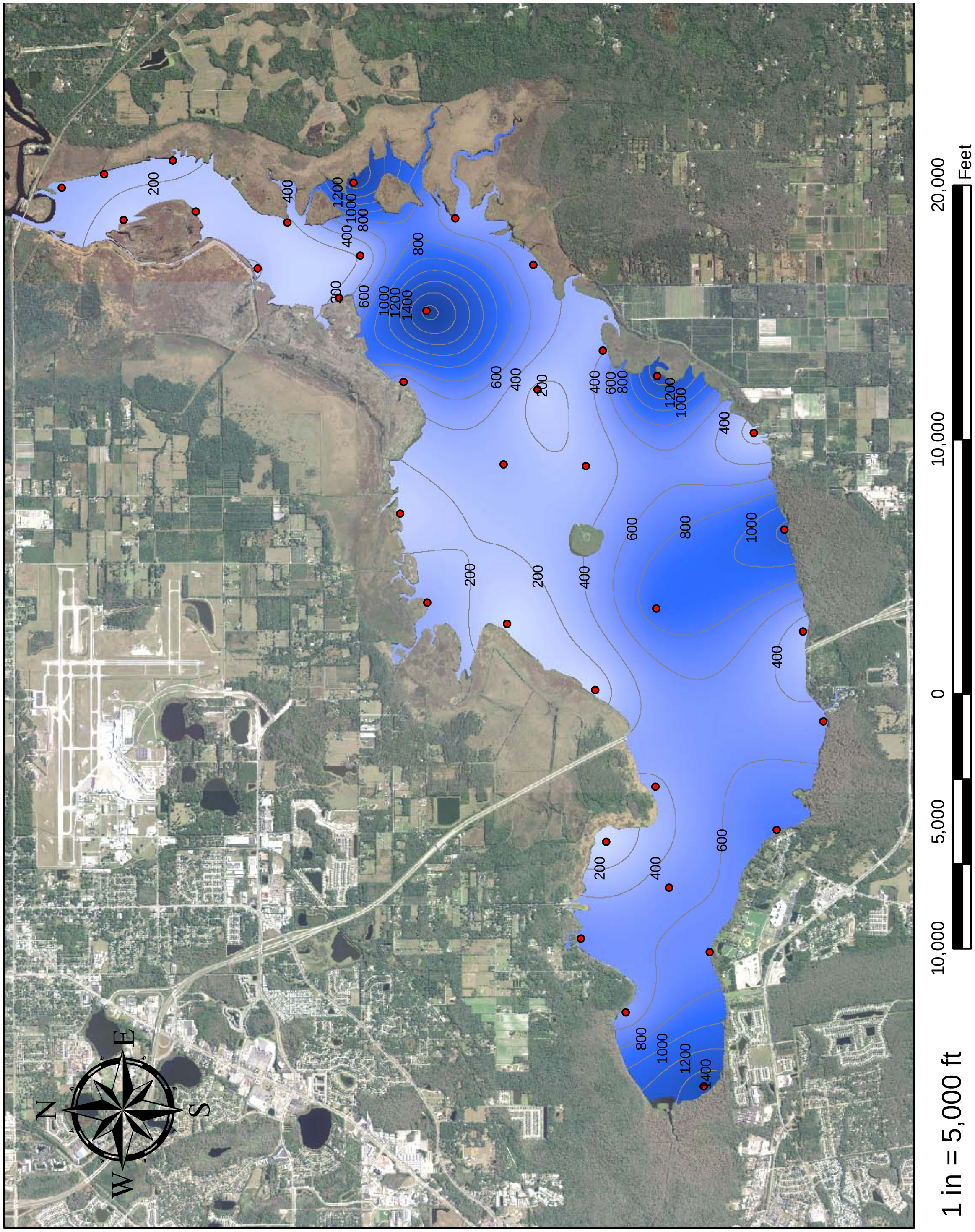

Figure 3-14. Mean Isopleths of Total Phosphorus (µg/l) in Groundwater Seepage Entering Lake Jesup from June 2009-August 2010.

3.4 Seepage Influx

3.4.1 Influx Estimates

Mean seepage isopleths for nitrogen and phosphorus were generated by combining the concentration isopleths for total nitrogen and total phosphorus (given in Figures 3-13 and 3-14, respectively) with the hydrologic isopleths for groundwater seepage (summarized on Figure 3-6). This procedure generates estimates of influx of nitrogen and phosphorus in terms of mass per square meter of lake surface per day. For purposes of this analysis, the term "influx" or "flux" is defined as the areal mass input or loading per unit of time.

Isopleths of mean seepage influx of total nitrogen into Lake Jesup are illustrated on Figure 3-15. In general, nitrogen influx from groundwater seepage ranges from approximately 4,000-10,000 $\mu g/m^2$-day within the lake. Elevated levels of nitrogen influx were observed along the western, southern, and northern portions of the lake, with seepage influx values ranging from approximately 6,000-10,000 $\mu g/m^2$-day in these areas. The remaining portions of the lake appear to exhibit nitrogen influx ranging from 2,000-4,000 $\mu g/m^2$-day.

Mean isopleths of total phosphorus influx into Lake Jesup from June 2009-August 2010 are illustrated on Figure 3-16. In general, phosphorus influx into Lake Jesup ranges from approximately 500-2,000 $\mu g/m^2$-day. These values appear to be somewhat greater than phosphorus influx previously observed by ERD within the State of Florida. Areas of elevated phosphorus influx are similar to the areas indicated for total nitrogen on Figure 3-15. Elevated phosphorus influx is apparent along the western, southern, and northeastern portions of Lake Jesup, with lower levels of phosphorus influx in the remaining portions of the lake.

The isopleths summarized in Figures 3-15 and 3-16 were integrated to develop estimates of the total influx of nitrogen and phosphorus from groundwater seepage into Lake Jesup. A summary of estimated influx of total nitrogen and total phosphorus from groundwater seepage to Lake Jesup from June 2009-August 2010 is given in Table 3-6. During the field monitoring program, groundwater seepage contributed approximately 5,661 μg TN/m^2-day. Assuming a lake surface area of 10,660 acres, this influx rate is equivalent to approximately 244 kg TN/day or 89,183 kg TN/yr.

During the field monitoring program, groundwater seepage contributed approximately 602 μg TP/m^2-day to Lake Jesup. Assuming a lake surface area of 10,660 acres, this equates to a daily influx of 26.0 kg TP/day or 9,484 kg TP/yr. Increases in seepage inflow resulting from higher annual rainfalls will likely increase the estimated influx of total nitrogen and total phosphorus.

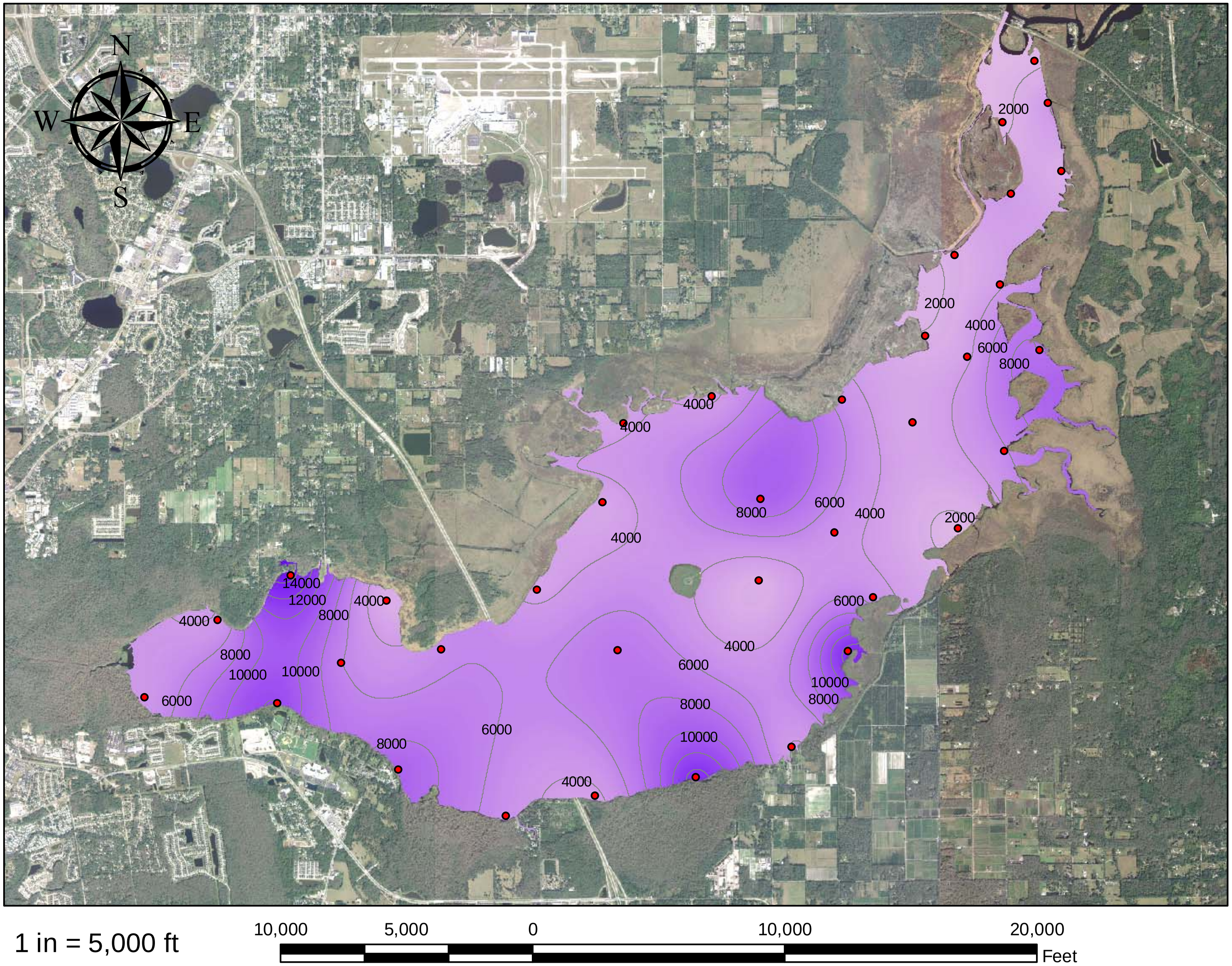

Figure 3-15. Isopleths of Total Nitrogen Flux (μg/m^2-day) into Lake Jesup from June 2009-August 2010.

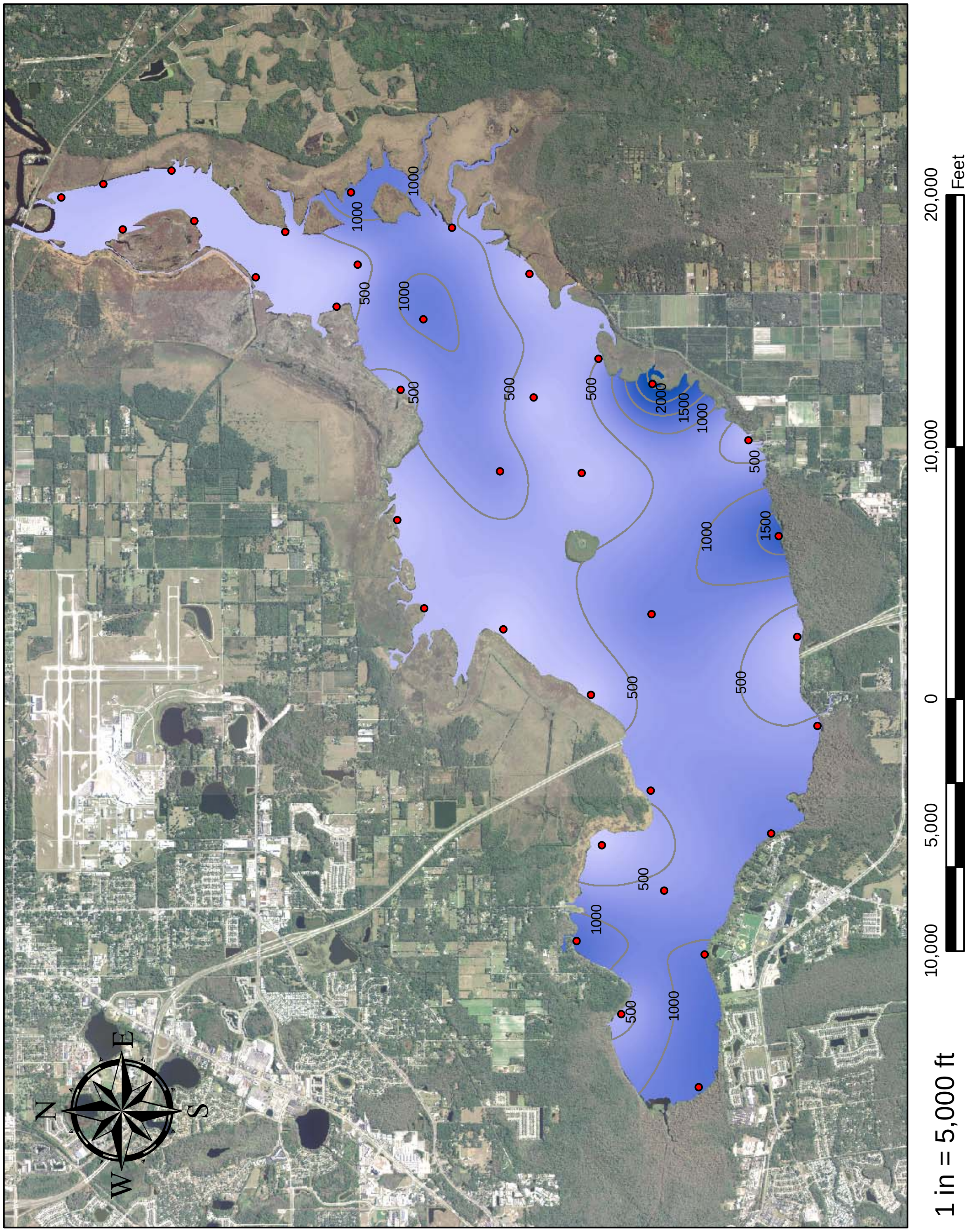

Figure 3-16. Isopleths of Total Phosphorus Flux ($\mu g/m^2$-day) into Lake Jesup from June 2009-August 2010.

TABLE 3-6

CALCULATED INFLUX OF TOTAL NITROGEN AND TOTAL PHOSPHORUS FROM GROUNDWATER SEEPAGE TO LAKE JESUP FROM JUNE 2009-AUGUST 2010

PARAMETER		VALUE
Total Nitrogen	Mean Influx	5,661 $\mu g/m^2$-day
	Daily Influx[1]	244 kg/day
	Annual Influx[1]	89,183 kg/yr
Total Phosphorus	Mean Influx	602 $\mu g/m^2$-day
	Daily Influx[1]	26.0 kg/day
	Annual Influx[1]	9,484 kg/yr

1. Based on an assumed lake surface area of 10,660 acres

3.4.2 Seepage or Sediments?

One of the most commonly discussed issues related to seepage measurements is the impact of sediment accumulations within the lake on seepage characteristics. Groundwater seepage originates in upland watershed areas as a result of rainfall which infiltrates into the shallow groundwater table. This groundwater then migrates laterally until reaching the receiving waterbody. During migration through the watershed, the groundwater assumes characteristics which are impacted to a large degree by activities and land uses within the watershed. When this seepage reaches the bottom of Lake Jesup, it then migrates through multiple feet of consolidated and unconsolidated sediments before reaching the water column. It is likely that the chemical characteristics of the seepage water which actually enters Lake Jesup is substantially different than the characteristics of the original groundwater seepage generated within the sub-basin areas as a result of contact with the sediments. It is then sometimes argued that seepage measured under these conditions reflects more of an internal loading rather than an external input.

However, it should be noted that the hydrologic component of seepage originates within the watershed areas, so the driving force for the inflow is clearly an external source, although the chemical characteristics of this influx may be altered by contact with the organic sediments. The measured seepage influx may also include a portion of sediment phosphorus release which is commonly referred to as internal recycling. However, regardless of how the sources of the influx are viewed, the measured seepage influx reflects a real and continuous loading of phosphorus into Lake Jesup.

The question of whether phosphorus loadings in seepage influx originate from watershed areas or lake sediments can be addressed relatively easily through additional field monitoring. This type of evaluation has been conducted by ERD in several previous projects by performing side-by-side seepage measurements in areas with and without the organic sediment. A large aluminum ring is inserted through the sediments to the parent sand material. The organic muck is then removed from the enclosed area using a hydraulic pump. Seepage meters are then installed inside the ring on the parent lake bottom and outside the ring at the existing sediment surface. Seepage monitoring is conducted over a period of time, and the volumes and chemical characteristics monitored at the two sites are compared to quantify the impacts of existing sediments on seepage quality. This information can be useful in targeting water quality improvement projects since it will be known whether the elevated phosphorus inflow originates within watershed areas, which might be improved perhaps by improving land management techniques, or originates internally within the lake. This type of evaluation has been used previously by ERD to evaluate changes in hydrologic budgets and seepage loadings as a result of proposed dredging projects on Lake Maggiore in St. Petersburg, FL and on the Winter Haven Chain-of-Lakes.

Another concern which has been expressed in the use of seepage meters is that the isolation of the water column and sediment layer by installation of the seepage meter will alter the chemistry at the sediment-water interface, resulting in sediment release of nutrients which would not occur if the seepage meter had not been installed. If this phenomenon were to occur, it could lead to artificially elevated concentrations of nutrients in the collected seepage samples. This process may be a concern in lakes where aerobic conditions are normally maintained at the water-sediment interface. However, it is highly unlikely that aerobic conditions occur at the water-sediment interface in Lake Jesup for more than a brief period of time, even in relatively shallow areas. Even if aerobic conditions are maintained in upper portions of the water column in Lake Jesup, dissolved oxygen drops rapidly at the water-sediment interface, quickly converting to reduced conditions at a very short distance into the sediments. Since these conditions exist virtually year-round in Lake Jesup, installation of the seepage meters likely had little impact on chemical conditions at the water-sediment interface.

3.5 Comparison of Measured Seepage Influx with TMDL Estimates

An attempt was made to compare the field measured influx from groundwater seepage with previous estimates generated as part of the TMDL process. Information for this comparison was obtained from the final TMDL report titled "Nutrient and Unionized Ammonia TMDLs for Lake Jesup, WBIDs 2981 and 2981A", dated April 14, 2006. The TMDL report does not include a specific input identified as groundwater seepage, although FDEP indicates that seepage is included in the baseflow estimate. The baseflow input included in the TMDL includes baseflow in gauged and ungauged tributaries and estimated seepage inflows around the perimeter of the lake. Separate mass loadings are also included for septic tanks around the perimeter of the lake, with the hydrologic loadings included in the baseflow estimates.

The TMDL report also includes, as a separate category, artesian inflow from two springs which were not evaluated as part of this project. The volumetric inflows from the artesian inputs in the TMDL report were calculated using modeling techniques based upon the calculated hydraulic gradient between the potentiometric surface of the Floridan Aquifer and the water level in Lake Jesup. Estimates of the chemical characteristics of the artesian input were obtained from data collected in five surficial aquifer background water quality monitoring wells located within or adjacent to the Lake Jesup watershed. The assumed total nitrogen concentration for the artesian input is 483 µg/l, with an average total phosphorus concentration of 155 µg/l.

A comparison of assumed and measured influx of total nitrogen and total phosphorus into Lake Jesup from groundwater seepage is given in Table 3-7. According to FDEP, baseflow from gauged and ungauged tributaries and seepage around the perimeter of the lake is assumed to contribute approximately 17,513 ac-ft/yr compared with a field measured value of 15,074 ac-ft/yr for groundwater seepage through the lake bottom over the period from June 2009-August 2010.

TABLE 3-7

COMPARISON OF ASSUMED AND MEASURED INFLUX OF TOTAL NITROGEN AND TOTAL PHOSPHORUS INTO LAKE JESUP FROM GROUNDWATER SEEPAGE

PARAMETER		UNITS	TMDL ESTIMATE[1]	FIELD MEASURED VALUE
Volume Input		ac-ft/yr	17,513	15,074
Total Nitrogen	Concentration	µg/l	1,264[2]	4,179
	Mass Loading	kg/yr	27,302	89,183
Total Phosphorus	Concentration	µg/l	252[2]	334
	Mass Loading	kg/yr	5,442	9,484

1. Mean value for the period from 1995-2002, includes combined inputs from baseflow in tributaries, seepage around the lake perimeter, and septic tanks

2. Listed values reflect total mass loadings from baseflow and septic tanks divided by the assumed baseflow volume

The TMDL estimated loadings of total nitrogen from baseflow, groundwater seepage, and septic tanks around the perimeter of the lake are approximately 27,302 kg/yr which equates to a mean inflow nitrogen concentration of 1,264 µg/l. The field measured influx of total nitrogen from groundwater seepage during the field monitoring program is approximately 89,183 kg/yr, with a measured mean inflow concentration of 4,179 µg/l. Based upon this comparison, the field measured total nitrogen loadings from groundwater seepage are approximately 3.3 times greater than the combined mass loadings of total nitrogen from baseflow, perimeter seepage, and septic tanks assumed in the TMDL. The field measured concentration for total nitrogen in groundwater seepage is approximately 3.3 times greater than the assumed mean concentration from baseflow, perimeter seepage, and septic tanks in the TMDL report.

The TMDL estimated mass loading of total phosphorus from baseflow, perimeter seepage, and septic tanks is 5,442 kg/yr which equates to a mean total phosphorus concentration of 252 μg/l. The field measured phosphorus loading from groundwater seepage is approximately 9,484 kg/yr, with a mean inflow concentration of 334 μg/l. The field measured total phosphorus loadings are approximately 3.3 times higher than mass loadings from baseflow, perimeter seepage, and septic tanks estimated in the TMDL. The comparison summarized in Table 3-7 suggests that hydrologic and nutrient loadings from groundwater seepage into Lake Jesup may be substantially more significant than previously estimated.

A comparison of measured seepage influx with estimated total hydrologic and nutrient inputs to Lake Jesup is given on Table 3-8. The estimated total hydrologic and nutrient inputs were obtained from Table 4-21 of the 2006 TMDL report. The hydrologic inputs from groundwater seepage measured during this project represent approximately 8% of the total annual hydrologic inputs to Lake Jesup summarized in the TMDL report. Nitrogen inputs from groundwater seepage reflect approximately 33% of the estimated total annual nitrogen inputs from all sources, with approximately 36% of the total annual phosphorus inputs contributed by groundwater seepage.

TABLE 3-8

COMPARISON OF MEAUSRED SEEPAGE INFLUX WITH ESTIMATED TOTAL HYDROLOGIC AND NUTRIENT INPUTS TO LAKE JESUP

PARAMETER	UNITS	ANNUAL TOTAL FROM ALL SOURCES[1]	GROUNDWATER SEEPAGE[2]	PERCENT OF TOTAL (%)
Hydrologic Inputs	ac-ft/yr	186,884	15,074	8
Total Nitrogen Inputs	kg/yr	274,195	89,183	33
Total Phosphorus Inputs	kg/yr	26,122	9,484	36

1. Values obtained from Final TMDL Report and reflect mean of 1995-2002
2. Field measured values from June 2009-August 2010

3.6 Quality Assurance

Supplemental samples (such as equipment blanks and duplicate samples) were collected during the field monitoring program for quality assurance purposes. In addition, a number of supplemental laboratory analyses were performed to evaluate precision and accuracy of the collected data. A summary of QA data collected as part of this project is given in Appendix C.

SECTION 4

SUMMARY

4.1 Project Summary

Lake Jesup is a 10,660 acre shallow, hypereutrophic lake located in north-central Seminole County. The lake is currently identified as impaired for nutrients and unionized ammonia. Lake Jesup is extremely shallow, with mean depths ranging from approximately 3-4 ft depending upon water elevation. A Final TMDL Report for Lake Jesup was issued by FDEP on April 14, 2006 which provides estimates of annual hydrologic and nutrient loadings from various sources into Lake Jesup, calibrated for the period from 1995-2002.

Field monitoring was conducted by ERD over the period from June 2009-August 2010 to evaluate the hydrologic and water quality characteristics of shallow groundwater seepage inflows to Lake Jesup. Groundwater seepage meters were installed at 40 locations within Lake Jesup and nine separate monitoring events were conducted at each site over the 14-month field monitoring program. Total rainfall during the field monitoring program was approximately 18% less than the long-term normal average.

The mean measured seepage inflow into Lake Jesup was 1.18 liters/m^2-day, equivalent to 41.3 ac-ft/day or 15,074 ac-ft/yr, which equates to approximately 1.41 ft/yr over the entire lake surface. This value is somewhat lower than seepage inflow rates observed by ERD in Florida lakes.

Seepage inflow to Lake Jesup is characterized by elevated levels of both total nitrogen and total phosphorus. Nitrogen influx from groundwater seepage contributes approximately 244 kg/day or 89,183 kg/yr. Phosphorus influx from groundwater seepage contributes approximately 26.0 kg/day or 9,484 kg/yr.

The Final TMDL Report for Lake Jesup does not include a separate loading category for groundwater seepage. Seepage is included as a sub-set in the Baseflow component which includes baseflow from tributaries and seepage around the perimeter of the lake. Therefore, the field measured seepage influx can only be compared with the broader category of Baseflow included in the TMDL. The field measured hydrologic input of 15,074 ac-ft/yr is slightly lower in value than the Baseflow component annual input of 17,513 ac-ft/yr. However, the field measured seepage influx of nutrients is substantially higher than the Baseflow category values used in the TMDL report calculations. The field measured seepage nitrogen influx of 89,183 kg/yr and 9,484 kg/yr for total phosphorus are approximately 3 times greater than the influx of 27,302 kg/yr of total nitrogen and 5,442 kg/yr for the combined categories of Baseflow and Septic Tanks in the TMDL report.

The measured seepage inflows contribute approximately 8% of the total hydrologic inputs estimated in the TMDL report, along with 33% of the total annual nitrogen inputs and 36% of the total phosphorus inputs. It appears that both hydrologic and nutrient contributions from groundwater seepage into Lake Jesup may be substantially larger than previously estimated.

4.2 Additional Research Needs

The study outlined in this report provided estimates for the hydrologic and nutrient inputs contributed to Lake Jesup as a result of groundwater seepage. This study was designed to determine the significance of groundwater seepage into Lake Jesup in comparison with the estimated hydrologic and nutrient budgets. However, this study did not address the ultimate source of the nutrient loadings entering the lake through groundwater seepage or the significance of existing sediments in regulating seepage characteristics.

Additional field monitoring is recommended to further identify the source of the elevated nutrient concentrations observed in groundwater seepage entering Lake Jesup. The impact of sediments can be best evaluated by conducting side-by-side comparisons of seepage meters installed in areas with and without existing sediments. These paired combinations would be conducted at multiple locations throughout the lake to include an evaluation of horizontal variability in characteristics throughout the lake. This analysis would also be valuable if dredging is ever considered as a lake management option since this will provide estimates of seepage characteristics in the absence of the existing sediments which would be valuable data for predicting ultimate water quality improvements.

APPENDICES

APPENDIX A

FIELD MEASUREMENTS OF SEEPAGE INFLOW VOLUMES IN LAKE JESUP FROM JUNE 2009 – AUGUST 2010

Seepage Meter Field Measurements

Location: Lake Jessup — Site: 1

Date Installed: 6/11/09 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	8:40	-----	-----	-----	-----	-----	Bags Installed
7/7/09	9:41	9.3	6/11/09	8:40	26.0	1.32	Sample collected, bag in good condition
8/4/09	10:08	4.3	7/7/09	9:41	28.0	0.56	Sample collected, bag in good condition
8/31/09	10:39	-----	8/4/09	10:08	27.0	-----	No sample collected, meter disturbed, replaced
10/6/09	10:10	-----	8/31/09	10:39	36.0	-----	No sample collected, meter disturbed, replaced
11/30/09	10:06	-----	10/6/09	10:10	55.0	-----	No sample collected, bag damaged, bag replaced
3/15/10	10:42	4.3	11/30/09	10:06	105.0	0.15	Sample collected, bag in good condition
5/4/10	10:25	3.3	3/15/10	10:42	50.0	0.24	Sample collected, bag in good condition
7/7/10	9:50	7.0	5/4/10	10:25	64.0	0.41	Sample collected, bag in good condition
8/5/10	11:29	9.8	7/7/10	9:50	29.1	1.24	Sample collected, bag in good condition
					Mean:	**0.46**	

Seepage Meter Field Measurements

Location: Lake Jessup — Site: 2

Date Installed: 6/11/09 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	9:05	-----	-----	-----	-----	-----	Bags Installed
7/7/09	9:47	9.0	6/11/09	9:05	26.0	1.28	Sample collected, bag in good condition
8/4/09	10:14	12.5	7/7/09	9:47	28.0	1.65	Sample collected, bag in good condition
8/31/09	10:45	-----	8/4/09	10:14	27.0	-----	No sample collected, fitting broken, system repaired
10/6/09	10:17	5.3	8/31/09	10:45	36.0	0.54	Sample collected, bag in good condition
11/30/09	10:11	8.5	10/6/09	10:17	55.0	0.57	Sample collected, bag in good condition
3/15/10	10:46	27.3	11/30/09	10:11	105.0	0.96	Sample collected, bag in good condition
5/4/10	10:29	12.8	3/15/10	10:46	50.0	0.94	Sample collected, bag in good condition
7/7/10	9:54	13.5	5/4/10	10:29	64.0	0.78	Sample collected, bag in good condition
8/5/10	11:21	15.5	7/7/10	9:54	29.1	1.98	Sample collected, bag in good condition
					Mean:	**0.98**	

Seepage Meter Field Measurements

Location: Lake Jessup — Site: 3

Date Installed: 6/11/09 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	9:26	-----	-----	-----	-----	-----	Bags Installed
7/7/09	9:54	5.5	6/11/09	9:26	26.0	0.78	Sample collected, bag in good condition
8/4/09	10:01	-----	7/7/09	9:54	28.0	-----	No sample collected, meter disturbed, replaced
8/31/09	10:33	9.5	8/4/09	10:01	27.0	1.30	Sample collected, bag in good condition
10/6/09	10:05	11.8	8/31/09	10:33	36.0	1.21	Sample collected, bag in good condition
11/30/09	9:59	-----	10/6/09	10:05	55.0	-----	No sample collected, bag damaged, bag replaced
3/15/10	10:31	4.3	11/30/09	9:59	105.0	0.15	Sample collected, bag in good condition
5/4/10	10:20	10.5	3/15/10	10:31	50.0	0.78	Sample collected, bag in good condition
7/7/10	9:44	13.0	5/4/10	10:20	64.0	0.75	Sample collected, bag in good condition
8/5/10	11:12	3.8	7/7/10	9:44	29.1	0.48	Sample collected, bag in good condition
					Mean:	**0.58**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 4

Date Installed: 6/11/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	9:40	-----	-----	-----	-----	-----	Bags Installed
7/7/09	9:59	-----	6/11/09	9:40	26.0	-----	No sample collected, meter disturbed, replaced
8/4/09	10:21	11.5	7/7/09	9:59	28.0	1.52	Sample collected, bag replaced
8/31/09	10:51	-----	8/4/09	10:21	27.0	-----	No sample collected, bag missing, bag replaced
10/6/09	10:21	13.0	8/31/09	10:51	36.0	1.34	Sample collected, bag in good condition
11/30/09	10:17	7.0	10/6/09	10:21	55.0	0.47	Sample collected, bag in good condition
3/15/10	10:54	6.0	11/30/09	10:17	105.0	0.21	Sample collected, bag in good condition
5/4/10	10:33	8.5	3/15/10	10:54	50.0	0.63	Sample collected, bag in good condition
7/7/10	10:00	-----	5/4/10	10:33	64.0	-----	No sample collected, meter missing, replaced
8/5/10	11:05	-----	7/7/10	10:00	29.0	-----	No sample collected, meter missing
					Mean:	**0.62**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 5

Date Installed: 6/11/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	9:55	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:04	-----	6/11/09	9:55	26.0	-----	No sample collected, bag damaged, bag replaced
8/4/09	9:57	7.5	7/7/09	10:04	28.0	0.99	Sample collected, bag in good condition
8/31/09	10:24	-----	8/4/09	9:57	27.0	-----	No sample collected, bag damaged, bag replaced
10/6/09	9:59	-----	8/31/09	10:24	36.0	-----	No sample collected, meter disturbed, replaced
11/30/09	9:53	-----	10/6/09	9:59	55.0	-----	No sample collected, meter disturbed, replaced
3/15/10	10:26	-----	11/30/09	9:53	105.0	-----	No sample collected, bag damaged, bag replaced
5/4/10	10:14	-----	3/15/10	10:26	50.0	-----	No sample collected, bag damaged, bag replaced
7/7/10	9:39	25.0	5/4/10	10:14	64.0	1.45	Sample collected, bag replaced
8/5/10	10:56	5.3	7/7/10	9:39	29.1	0.67	Sample collected, bag in good condition
					Mean:	**1.16**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 6

Date Installed: 6/16/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	8:58	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:10	-----	6/16/09	8:58	21.0	-----	No sample collected, bag missing, bag replaced
8/4/09	9:51	10.0	7/7/09	10:10	28.0	1.32	Sample collected, bag in good condition
8/31/09	10:18	10.8	8/4/09	9:51	27.0	1.47	Sample collected, bag in good condition
10/6/09	9:54	5.0	8/31/09	10:18	36.0	0.51	Sample collected, bag in good condition
11/30/09	9:46	12.5	10/6/09	9:54	55.0	0.84	Sample collected, bag in good condition
3/15/10	10:20	7.0	11/30/09	9:46	105.0	0.25	Sample collected, bag in good condition
5/4/10	10:09	18.5	3/15/10	10:20	50.0	1.37	Sample collected, bag in good condition
7/7/10	9:33	9.5	5/4/10	10:09	64.0	0.55	Sample collected, bag replaced
8/5/10	10:49	-----	7/7/10	9:33	29.1	-----	No sample collected, meter missing
					Mean:	**0.68**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 7

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:07	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:16	-----	6/11/09	10:07	26.0	-----	No sample collected, meter disturbed, replaced
8/4/09	10:30	-----	7/7/09	10:16	28.0	-----	No sample collected, meter disturbed, replaced
8/31/09	11:04	-----	8/4/09	10:30	27.0	-----	No sample collected, meter disturbed, replaced
10/6/09	10:28	17.0	8/31/09	11:04	36.0	1.75	Sample collected, bag in good condition
11/30/09	10:24	-----	10/6/09	10:28	55.0	-----	No sample collected, bag damaged, bag replaced
3/15/10	11:02	4.0	11/30/09	10:24	105.0	0.14	Sample collected, bag in good condition
5/4/10	10:40	20.0	3/15/10	11:02	50.0	1.48	Sample collected, bag in good condition
7/7/10	10:04	-----	5/4/10	10:40	64.0	-----	No sample collected, meter missing, replaced
8/5/10	10:42	-----	7/7/10	10:04	29.0	-----	No sample collected, meter missing
					Mean:	**0.69**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 8

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:13	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:24	-----	6/11/09	10:13	26.0	-----	No sample collected, meter disturbed, replaced
8/4/09	10:39	13.3	7/7/09	10:24	28.0	1.75	Sample collected, bag in good condition
8/31/09	11:14	-----	8/4/09	10:39	27.0	-----	No sample collected, meter disturbed, replaced
10/6/09	10:34	10.3	8/31/09	11:14	36.0	1.06	Sample collected, bag in good condition
11/30/09	10:32	-----	10/6/09	10:34	55.0	-----	No sample collected, meter missing, replaced
3/25/10	9:27	3.0	11/30/09	10:32	115.0	0.10	Sample collected, bag in good condition
5/4/10	10:46	1.0	3/25/10	9:27	40.1	0.09	Sample collected, bag in good condition
7/7/10	10:11	4.5	5/4/10	10:46	64.0	0.26	Sample collected, bag in good condition
8/5/10	12:10	-----	7/7/10	10:11	29.1	-----	No sample collected, meter missing
					Mean:	**0.42**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 9

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:21	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:31	-----	6/11/09	10:21	26.0	-----	No sample collected, meter disturbed, replaced
8/4/09	10:46	25.3	7/7/09	10:31	28.0	3.34	Sample collected, bag replaced
8/31/09	10:06	5.5	8/4/09	10:46	27.0	0.76	Sample collected, bag in good condition
10/6/09	9:42	-----	8/31/09	10:06	36.0	-----	No sample collected, meter disturbed, replaced
11/30/09	9:35	-----	10/6/09	9:42	55.0	-----	No sample collected, meter disturbed, replaced
3/15/10	10:07	6.3	11/30/09	9:35	105.0	0.22	Sample collected, bag replaced
5/4/10	9:58	8.3	3/15/10	10:07	50.0	0.61	Sample collected, bag in good condition
7/7/10	9:25	-----	5/4/10	9:58	64.0	-----	No sample collected, meter missing, replaced
8/5/10	8:26	-----	7/7/10	9:25	29.0	-----	No sample collected, bag damaged
					Mean:	**0.80**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 10

Date Installed: 6/11/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:28	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:39	-----	6/11/09	10:28	26.0	-----	No sample collected, meter disturbed, replaced
8/4/09	9:44	19.3	7/7/09	10:39	28.0	2.55	Sample collected, bag replaced
8/31/09	10:12	-----	8/4/09	9:44	27.0	-----	No sample collected, meter disturbed, replaced
10/6/09	9:48	8.5	8/31/09	10:12	36.0	0.87	Sample collected, bag in good condition
11/30/09	9:41	3.5	10/6/09	9:48	55.0	0.24	Sample collected, bag in good condition
3/15/10	10:12	3.5	11/30/09	9:41	105.0	0.12	Sample collected, bag in good condition
5/4/10	10:02	4.5	3/15/10	10:12	50.0	0.33	Sample collected, bag in good condition
7/7/10	9:27	-----	5/4/10	10:02	64.0	-----	No sample collected, meter disturbed, replaced
8/5/10	10:38	-----	7/7/10	9:27	29.0	-----	No sample collected, bag damaged
					Mean:	**0.53**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 11

Date Installed: 6/11/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:37	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:50	-----	6/11/09	10:37	26.0	-----	No sample collected, bag damaged, bag replaced
8/4/09	9:32	-----	7/7/09	10:50	27.9	-----	No sample collected, bag damaged, bag replaced
8/31/09	9:56	-----	8/4/09	9:32	27.0	-----	No sample collected, bag damaged, bag replaced
10/6/09	9:29	-----	8/31/09	9:56	36.0	-----	No sample collected, bag missing, bag replaced
11/30/09	9:16	-----	10/6/09	9:29	55.0	-----	No sample collected, meter flipped, meter replaced
3/15/10	9:53	19.5	11/30/09	9:16	105.0	0.69	Sample collected, bag in good condition
5/4/10	9:47	-----	3/15/10	9:53	50.0	-----	No sample collected, meter missing, replaced
7/7/10	9:16	-----	5/4/10	9:47	64.0	-----	No sample collected, meter missing, replaced
8/5/10	10:26	-----	7/7/10	9:16	29.0	-----	No sample collected, meter missing
					Mean:	**0.69**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 12

Date Installed: 6/11/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:48	-----	-----	-----	-----	-----	Bags Installed
7/7/09	10:56	-----	6/11/09	10:48	26.0	-----	No sample collected, bag damaged, bag replaced
8/4/09	10:52	-----	7/7/09	10:56	28.0	-----	No sample collected, meter disturbed, replaced
8/31/09	10:00	7.3	8/4/09	10:52	27.0	1.00	Sample collected, bag in good condition
10/6/09	9:36	-----	8/31/09	10:00	36.0	-----	No sample collected, bag damaged, bag replaced
11/30/09	9:26	11.5	10/6/09	9:36	55.0	0.77	Sample collected, bag in good condition
3/15/10	10:00	4.8	11/30/09	9:26	105.0	0.17	Sample collected, bag in good condition
5/4/10	9:53	6.0	3/15/10	10:00	50.0	0.44	Sample collected, bag in good condition
7/7/10	9:21	-----	5/4/10	9:53	64.0	-----	No sample collected, meter missing, replaced
8/5/10	8:31	-----	7/7/10	9:21	29.0	-----	No sample collected, bag damaged
					Mean:	**0.46**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 13

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	10:56	-----	-----	-----	-----	-----	Bags Installed
7/7/09	11:15	-----	6/11/09	10:56	26.0	-----	No sample collected, bag damaged, bag replaced
8/4/09	10:58	16.5	7/7/09	11:15	28.0	2.18	Sample collected, bag in good condition
8/31/09	11:21	9.5	8/4/09	10:58	27.0	1.30	Sample collected, bag in good condition
10/6/09	10:41	-----	8/31/09	11:21	36.0	-----	No sample collected, bag damaged, bag replaced
11/30/09	10:40	10.3	10/6/09	10:41	55.0	0.69	Sample collected, bag in good condition
3/25/10	9:35	7.5	11/30/09	10:40	115.0	0.24	Sample collected, bag in good condition
5/4/10	10:43	11.3	3/25/10	9:35	40.0	1.04	Sample collected, bag in good condition
7/7/10	10:20	21.5	5/4/10	10:43	64.0	1.24	Sample collected, bag in good condition
8/6/10	8:08	-----	7/7/10	10:20	29.9	-----	No sample collected, bag damaged
					Mean:	**0.86**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 14

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:05	-----	-----	-----	-----	-----	Bags Installed
7/7/09	11:24	-----	6/11/09	11:05	26.0	-----	No sample collected, meter missing, replaced
8/4/09	11:03	-----	7/7/09	11:24	28.0	-----	No sample collected, meter missing, replaced
8/31/09	11:29	3.3	8/4/09	11:03	27.0	0.45	Sample collected, bag in good condition
10/6/09	10:47	-----	8/31/09	11:29	36.0	-----	No sample collected, meter missing, replaced
11/30/09	10:46	-----	10/6/09	10:47	55.0	-----	No sample collected, meter disturbed, replaced
3/25/10	9:41	15.0	11/30/09	10:46	115.0	0.48	Sample collected, bag in good condition
5/4/10	10:59	3.5	3/25/10	9:41	40.1	0.32	Sample collected, bag in good condition
7/7/10	10:31	-----	5/4/10	10:59	64.0	-----	No sample collected, bag damaged, bag replaced
8/6/10	8:22	-----	7/7/10	10:31	29.9	-----	No sample collected, bag damaged
					Mean:	**0.44**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 15

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:13	-----	-----	-----	-----	-----	Bags Installed
7/7/09	11:36	16.0	6/11/09	11:13	26.0	2.28	Sample collected, bag in good condition
8/4/09	11:13	13.5	7/7/09	11:36	28.0	1.79	Sample collected, bag in good condition
8/31/09	11:34	-----	8/4/09	11:13	27.0	-----	No sample collected, meter disturbed, replaced
10/6/09	11:07	-----	8/31/09	11:34	36.0	-----	No sample collected, bag damaged, bag replaced
11/30/09	10:56	-----	10/6/09	11:07	55.0	-----	No sample collected, meter missing, replaced
3/25/10	9:50	7.8	11/30/09	10:56	115.0	0.25	Sample collected, bag in good condition
5/4/10	11:05	-----	3/25/10	9:50	40.1	-----	No sample collected, fitting broken, system repaired
7/7/10	10:37	15.5	5/4/10	11:05	64.0	0.90	Sample collected, bag in good condition
8/6/10	8:36	-----	7/7/10	10:37	29.9	-----	No sample collected, fitting broken
					Mean:	**0.93**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 16

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:21	-----	-----	-----	-----	-----	Bags Installed
7/7/09	11:41	14.0	6/11/09	11:21	26.0	1.99	Sample collected, bag in good condition
8/4/09	11:20	-----	7/7/09	11:41	28.0	-----	No sample collected, meter missing, replaced
8/31/09	11:41	-----	8/4/09	11:20	27.0	-----	No sample collected, meter disturbed, replaced
10/6/09	11:16	-----	8/31/09	11:41	36.0	-----	No sample collected, meter missing, replaced
11/30/09	11:23	-----	10/6/09	11:16	55.0	-----	No sample collected, meter missing, replaced
3/25/10	9:56	-----	11/30/09	11:23	114.9	-----	No sample collected, bag damaged, bag replaced
5/4/10	11:22	16.0	3/25/10	9:56	40.1	1.48	Sample collected, bag in good condition
7/7/10	10:56	-----	5/4/10	11:22	64.0	-----	No sample collected, bag damaged, bag replaced
8/6/10	8:43	-----	7/7/10	10:56	29.9	-----	No sample collected, bag damaged
					Mean:	**1.68**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 17

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:30	-----	-----	-----	-----	-----	Bags Installed
7/7/09	11:51	13.5	6/11/09	11:30	26.0	1.92	Sample collected, bag in good condition
8/4/09	11:41	-----	7/7/09	11:51	28.0	-----	No sample collected, meter disturbed, replaced
8/31/09	11:52	12.5	8/4/09	11:41	27.0	1.71	Sample collected, bag in good condition
10/6/09	10:56	-----	8/31/09	11:52	36.0	-----	No sample collected, meter missing, replaced
11/30/09	11:08	-----	10/6/09	10:56	55.0	-----	No sample collected, meter missing, replaced
3/25/10	9:16	21.5	11/30/09	11:08	114.9	0.69	Sample collected, bag in good condition
5/4/10	11:10	-----	3/25/10	9:16	40.1	-----	No sample collected, meter disturbed, replaced
7/7/10	10:44	-----	5/4/10	11:10	64.0	-----	No sample collected, meter disturbed, replaced
8/5/10	8:42	5.3	7/7/10	10:44	28.9	0.67	Sample collected, bag in good condition
					Mean:	**0.99**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 18

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:38	-----	-----	-----	-----	-----	Bags Installed
7/7/09	12:00	-----	6/11/09	11:38	26.0	-----	No sample collected, meter disturbed, reinstalled
8/4/09	11:34	8.3	7/7/09	12:00	28.0	1.09	Sample collected, bag in good condition
8/31/09	11:48	-----	8/4/09	11:34	27.0	-----	No sample collected, meter missing, replaced
10/6/09	10:51	-----	8/31/09	11:48	36.0	-----	No sample collected, meter missing, replaced
11/30/09	11:16	-----	10/6/09	10:51	55.0	-----	No sample collected, meter missing, replaced
3/25/10	9:08	-----	11/30/09	11:16	114.9	-----	No sample collected, meter disturbed, reinstalled
5/4/10	11:15	7.3	3/25/10	9:08	40.1	0.67	Sample collected, bag in good condition
7/7/10	10:50	8.5	5/4/10	11:15	64.0	0.49	Sample collected, bag in good condition
8/5/10	8:49	4.5	7/7/10	10:50	28.9	0.58	Sample collected, bag in good condition
					Mean:	**0.66**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 19

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:45	-----	-----	-----	-----	-----	Bags Installed
7/10/09	9:35	-----	6/11/09	11:45	28.9	-----	No sample collected, meter disturbed, reinstalled
8/4/09	11:48	18.3	7/10/09	9:35	25.1	2.69	Sample collected, bag in good condition
8/31/09	11:57	16.5	8/4/09	11:48	27.0	2.26	Sample collected, bag in good condition
10/6/09	11:01	-----	8/31/09	11:57	36.0	-----	No sample collected, meter missing, replaced
11/30/09	11:12	-----	10/6/09	11:01	55.0	-----	No sample collected, meter missing, replaced
3/15/10	9:42	-----	11/30/09	11:12	104.9	-----	No sample collected, meter missing, replaced
5/4/10	11:49	-----	3/15/10	9:42	4.51	-----	No sample collected, meter missing, replaced
7/7/10	11:24	-----	5/4/10	11:49	3.57	-----	No sample collected, meter missing, replaced
8/5/10	8:55	-----	7/7/10	11:24	2.90	-----	No sample collected, meter missing
					Mean:	**2.47**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 20

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	11:52	-----	-----	-----	-----	-----	Bags Installed
7/7/09	9:44	-----	6/11/09	11:52	25.9	-----	No sample collected, meter disturbed, reinstalled
8/4/09	11:54	-----	7/7/09	9:44	28.1	-----	No sample collected, meter disturbed, reinstalled
8/31/09	12:05	-----	8/4/09	11:54	27.0	-----	No sample collected, meter missing, replaced
10/6/09	-----	-----	8/31/09	-----	-----	-----	Site Eliminated
11/30/09	-----	-----	10/6/09	-----	-----	-----	Site Eliminated
3/25/10	-----	-----	11/30/09	-----	-----	-----	Site Eliminated
5/4/10	-----	-----	3/25/10	-----	-----	-----	Site Eliminated
7/7/10	-----	-----	5/4/10	-----	-----	-----	Site Eliminated
8/6/10	-----	-----	7/7/10	-----	-----	-----	Site Eliminated
					Mean:	-----	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 21

Date Installed: 6/11/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	12:00	-----	-----	-----	-----	-----	Bags Installed
7/10/09	9:23	-----	6/11/09	12:00	28.9	-----	No sample collected, meter missing, replaced
8/4/09	9:25	-----	7/10/09	9:23	25.0	-----	No sample collected, meter disturbed, reinstalled
8/31/09	9:50	11.3	8/4/09	9:25	27.0	1.54	Sample collected, bag in good condition
10/6/09	9:12	-----	8/31/09	9:50	36.0	-----	No sample collected, fitting broken, system repaired
11/30/09	9:07	12.3	10/6/09	9:12	55.0	0.82	Sample collected, bag in good condition
3/15/10	9:46	-----	11/30/09	9:07	105.0	-----	No sample collected, bag damaged, bag replaced
5/4/10	9:39	19.5	3/15/10	9:46	50.0	1.44	Sample collected, bag replaced
7/7/10	9:07	-----	5/4/10	9:39	64.0	-----	No sample collected, bag damaged, bag replaced
8/5/10	10:52	4.3	7/7/10	9:07	29.1	0.54	Sample collected, bag in good condition
					Mean:	**1.09**	

Seepage Meter Field Measurements

Location: Lake Jessup Site: 22

Date Installed: 6/11/09 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/11/09	12:11	-----	-----	-----	-----	-----	Bags Installed
7/10/09	9:15	-----	6/11/09	12:11	28.9	-----	No sample collected, meter disturbed, reinstalled
8/4/09	9:17	8.3	7/10/09	9:15	25.0	1.22	Sample collected, bag replaced
8/31/09	9:37	-----	8/4/09	9:17	27.0	-----	No sample collected, meter missing, replaced
10/6/09	8:57	-----	8/31/09	9:37	36.0	-----	No sample collected, fitting broken, system repaired
11/30/09	8:58	4.3	10/6/09	8:57	55.0	0.29	Sample collected, bag in good condition
3/15/10	9:39	9.5	11/30/09	8:58	105.0	0.34	Sample collected, bag in good condition
5/4/10	9:34	-----	3/15/10	9:39	50.0	-----	No sample collected, fitting broken, system repaired
7/7/10	9:03	-----	5/4/10	9:34	64.0	-----	No sample collected, meter missing
8/5/10	9:46	-----	7/7/10	9:03	29.0	-----	`
					Mean:	**0.44**	

Seepage Meter Field Measurements

Location: Lake Jessup Site: 23

Date Installed: 6/12/09 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	7:49	-----	-----	-----	-----	-----	Bags Installed
7/10/09	9:03	-----	6/12/09	7:49	28.1	-----	No sample collected, fitting broken, system repaired
8/4/09	9:07	160	7/10/09	9:03	25.0	23.7	Sample collected, bag in good condition
8/31/09	9:28	-----	8/4/09	9:07	27.0	-----	No sample collected, meter missing, replaced
10/6/09	8:50	10.5	8/31/09	9:28	36.0	1.08	Sample collected, bag in good condition
11/30/09	8:51	80.0	10/6/09	8:50	55.0	5.39	Sample collected, bag replaced
3/15/10	9:33	56.0	11/30/09	8:51	105.0	1.97	Sample collected, bag in good condition
5/4/10	9:30	-----	3/15/10	9:33	50.0	-----	No sample collected, meter missing, replaced
7/7/10	8:52	-----	5/4/10	9:30	64.0	-----	No sample collected, bag damaged, bag replaced
8/5/10	9:36	-----	7/7/10	8:52	29.0	-----	No sample collected, bag damaged
					Mean:	**5.14**	

Seepage Meter Field Measurements

Location: Lake Jessup Site: 24

Date Installed: 6/12/09 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	8:08	-----	-----	-----	-----	-----	Bags Installed
7/10/09	8:53	-----	6/12/09	8:08	28.0	-----	No sample collected, meter missing, replaced
8/4/09	8:52	-----	7/10/09	8:53	25.0	-----	No sample collected, meter missing, replaced
8/31/09	8:54	-----	8/4/09	8:52	27.0	-----	No sample collected, fitting broken, system repaired
10/6/09	8:43	19.5	8/31/09	8:54	36.0	2.01	Sample collected, bag in good condition
11/30/09	8:43	23.0	10/6/09	8:43	55.0	1.55	Sample collected, bag replaced
3/15/10	9:20	20.5	11/30/09	8:43	105.0	0.72	Sample collected, bag in good condition
5/4/10	9:21	12.5	3/15/10	9:20	50.0	0.93	Sample collected, bag in good condition
7/7/10	8:44	-----	5/4/10	9:21	64.0	-----	No sample collected, meter missing, replaced
8/5/10	9:25	-----	7/7/10	8:44	29.0	-----	No sample collected, meter missing
					Mean:	**1.14**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 25

Date Installed: 6/12/09 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	8:31	-----	-----	-----	-----	-----	Bags Installed
7/10/09	9:57	-----	6/12/09	8:31	28.1	-----	No sample collected, meter disturbed, reinstalled
8/4/09	12:05	10.0	7/10/09	9:57	25.1	1.48	Sample collected, bag in good condition
8/31/09	12:16	5.5	8/4/09	12:05	27.0	0.75	Sample collected, bag in good condition
10/6/09	11:43	8.5	8/31/09	12:16	36.0	0.88	Sample collected, bag in good condition
11/30/09	11:46	-----	10/6/09	11:43	55.0	-----	No sample collected, bag damaged, bag replaced
3/15/10	9:28	-----	11/30/09	11:46	104.9	-----	No sample collected, meter missing, replaced
5/4/10	-----	-----	3/15/10	9:28	-----	-----	No sample collected, meter missing, replaced
7/7/10	-----	-----	5/4/10	-----	-----	-----	No sample collected, meter missing, replaced
8/5/10	9:00	-----	7/7/10	-----	-----	-----	No sample collected, bag damaged
					Mean:	**1.01**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 26

Date Installed: 6/12/09 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	8:42	-----	-----	-----	-----	-----	Bags Installed
7/10/09	10:04	-----	6/12/09	8:42	28.1	-----	No sample collected, meter missing, replaced
8/4/09	7:41	-----	7/10/09	10:04	24.9	-----	No sample collected, meter missing, replaced
8/31/09	12:22	-----	8/4/09	7:41	27.2	-----	No sample collected, meter missing, replaced
10/6/09	-----	-----	8/31/09	12:22	-----	-----	Site Eliminated
11/30/09	-----	-----	10/6/09	-----	-----	-----	Site Eliminated
3/15/10	-----	-----	11/30/09	-----	-----	-----	Site Eliminated
5/4/10	-----	-----	3/15/10	-----	-----	-----	Site Eliminated
7/7/10	-----	-----	5/4/10	-----	-----	-----	Site Eliminated
8/5/10	-----	-----	7/7/10	-----	-----	-----	Site Eliminated
					Mean:	-----	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 27

Date Installed: 6/12/09 Chamber Diameter: 0.58 m Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	8:53	-----	-----	-----	-----	-----	Bags Installed
7/10/09	10:09	10.5	6/12/09	8:53	28.1	1.39	Sample collected, bag replaced
8/4/09	12:14	15.5	7/10/09	10:09	25.1	2.29	Sample collected, bag in good condition
8/31/09	12:29	22.5	8/4/09	12:14	27.0	3.09	Sample collected, bag in good condition
10/6/09	11:21	19.0	8/31/09	12:29	36.0	1.96	Sample collected, bag in good condition
11/30/09	11:27	19.3	10/6/09	11:21	55.0	1.30	Sample collected, bag in good condition
3/25/10	10:02	16.0	11/30/09	11:27	114.9	0.52	Sample collected, bag in good condition
5/4/10	11:29	11.0	3/25/10	10:02	40.1	1.02	Sample collected, bag in good condition
7/7/10	11:00	-----	5/4/10	11:29	64.0	-----	No sample collected, fitting broken, system repaired
8/6/10	8:50	-----	7/7/10	11:00	29.9	-----	No sample collected, bag damaged
					Mean:	**1.29**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 28

Date Installed: 6/12/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	9:05	-----	-----	-----	-----	-----	Bags Installed
7/10/09	10:19	-----	6/12/09	9:05	28.1	-----	No sample collected, meter disturbed, reinstalled
8/5/09	7:30	-----	7/10/09	10:19	25.9	-----	No sample collected, meter missing, replaced
8/31/09	12:36	-----	8/5/09	7:30	26.2	-----	No sample collected, meter disturbed, reinstalled
10/6/09	11:29	-----	8/31/09	12:36	36.0	-----	No sample collected, meter disturbed, reinstalled
11/30/09	11:37	-----	10/6/09	11:29	55.0	-----	No sample collected, bag damaged, bag replaced
3/25/10	10:10	150	11/30/09	11:37	114.9	4.83	Sample collected, bag in good condition
5/4/10	11:36	26.3	3/25/10	10:10	40.1	2.43	Sample collected, bag in good condition
7/7/10	11:06	-----	5/4/10	11:36	64.0	-----	No sample collected, meter missing, replaced
8/6/10	9:05	-----	7/7/10	11:06	29.9	-----	No sample collected, meter missing
					Mean:	**4.21**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 29

Date Installed: 6/12/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	9:45	-----	-----	-----	-----	-----	Bags Installed
7/10/09	10:24	-----	6/12/09	9:45	28.0	-----	No sample collected, meter missing, replaced
8/5/09	7:19	-----	7/10/09	10:24	25.9	-----	No sample collected, meter missing, replaced
8/31/09	12:44	-----	8/5/09	7:19	26.2	-----	No sample collected, meter disturbed, reinstalled
10/6/09	11:35	-----	8/31/09	12:44	36.0	-----	No sample collected, meter disturbed, reinstalled
11/30/09	11:55	9.5	10/6/09	11:35	55.0	0.64	Sample collected, bag in good condition
3/25/10	10:16	150	11/30/09	11:55	114.9	4.83	Sample collected, bag in good condition
5/4/10	11:46	-----	3/25/10	10:16	40.1	-----	No sample collected, bag damaged, bag replaced
7/7/10	11:10	16.5	5/4/10	11:46	64.0	0.96	Sample collected, bag in good condition
8/6/10	9:14	-----	7/7/10	11:10	29.9	-----	No sample collected, bag damaged
					Mean:	**2.79**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 30

Date Installed: 6/12/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/12/09	9:56	-----	-----	-----	-----	-----	Bags Installed
7/7/09	13:35	-----	6/12/09	9:56	25.2	-----	No sample collected, meter missing, replaced
8/4/09	7:55	-----	7/7/09	13:35	27.8	-----	No sample collected, meter missing, replaced
8/31/09	12:51	-----	8/4/09	7:55	27.2	-----	No sample collected, meter missing, replaced
10/6/09	11:57	-----	8/31/09	12:51	36.0	-----	No sample collected, meter disturbed, reinstalled
11/30/09	12:02	14.0	10/6/09	11:57	55.0	0.94	Sample collected, bag in good condition
3/25/10	10:27	16.3	11/30/09	12:02	114.9	0.52	Sample collected, bag in good condition
5/4/10	11:52	18.5	3/25/10	10:27	40.1	1.71	Sample collected, bag in good condition
7/7/10	11:20	21.5	5/4/10	11:52	64.0	1.24	Sample collected, bag in good condition
8/6/10	10:51	11.0	7/7/10	11:20	30.0	1.36	Sample collected, bag in good condition
					Mean:	**0.99**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 31

Date Installed: 6/16/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	7:40	-----	-----	-----	-----	-----	Bags Installed
7/7/09	13:48	16.0	6/16/09	7:40	21.3	2.79	Sample collected, bag in good condition
8/4/09	8:08	-----	7/7/09	13:48	27.8	-----	No sample collected, meter missing, replaced
8/31/09	12:54	-----	8/4/09	8:08	27.2	-----	No sample collected, meter missing, replaced
10/6/09	11:49	-----	8/31/09	12:54	36.0	-----	No sample collected, meter missing, replaced
11/30/09	12:07	-----	10/6/09	11:49	55.0	-----	No sample collected, meter missing, replaced
3/25/10	8:47	-----	11/30/09	12:07	114.9	-----	No sample collected, meter missing, replaced
5/4/10	11:55	-----	3/25/10	8:47	40.1	-----	No sample collected, meter missing, replaced
7/7/10	11:25	-----	5/4/10	11:55	64.0	-----	No sample collected, meter missing, replaced
8/6/10	10:32	-----	7/7/10	11:25	30.0	-----	No sample collected, meter missing
					Mean:	**2.79**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 32

Date Installed: 6/16/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	7:52	-----	-----	-----	-----	-----	Bags Installed
7/7/09	13:27	-----	6/16/09	7:52	21.2	-----	No sample collected, meter disturbed, reinstalled
8/4/09	12:35	25.5	7/7/09	13:27	28.0	3.38	Sample collected, bag in good condition
8/31/09	13:03	12.0	8/4/09	12:35	27.0	1.64	Sample collected, bag in good condition
10/6/09	12:10	11.0	8/31/09	13:03	36.0	1.13	Sample collected, bag in good condition
11/30/09	12:11	8.5	10/6/09	12:10	55.0	0.57	Sample collected, bag in good condition
3/25/10	10:36	6.5	11/30/09	12:11	114.9	0.21	Sample collected, bag in good condition
5/4/10	11:59	11.0	3/25/10	10:36	40.1	1.02	Sample collected, bag in good condition
7/7/10	11:29	13.3	5/4/10	11:59	64.0	0.77	Sample collected, bag in good condition
8/6/10	9:28	-----	7/7/10	11:29	29.9	-----	No sample collected, bag damaged
					Mean:	**0.89**	

Seepage Meter Field Measurements

Location: Lake Jessup

Site: 33

Date Installed: 6/16/09

Chamber Diameter: 0.58 m

Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	8:12	-----	-----	-----	-----	-----	Bags Installed
7/7/09	13:16	-----	6/16/09	8:12	21.2	-----	No sample collected, meter disturbed, reinstalled
8/4/09	12:42	7.5	7/7/09	13:16	28.0	0.99	Sample collected, bag replaced
8/31/09	13:10	-----	8/4/09	12:42	27.0	-----	No sample collected, meter disturbed, reinstalled
10/6/09	12:16	23.5	8/31/09	13:10	36.0	2.42	Sample collected, bag in good condition
11/30/09	12:18	8.0	10/6/09	12:16	55.0	0.54	Sample collected, bag in good condition
3/25/10	10:44	23.5	11/30/09	12:18	114.9	0.76	Sample collected, bag replaced
5/4/10	12:04	20.0	3/25/10	10:44	40.1	1.85	Sample collected, bag replaced
7/7/10	11:34	3.5	5/4/10	12:04	64.0	0.20	Sample collected, bag in good condition
8/6/10	9:34	-----	7/7/10	11:34	29.9	-----	No sample collected, meter missing
					Mean:	**0.94**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 34

Date Installed: 6/16/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	8:21	-----	-----	-----	-----	-----	Bags Installed
7/7/09	13:10	-----	6/16/09	8:21	21.2	-----	No sample collected, meter disturbed, reinstalled
8/4/09	12:51	20.5	7/7/09	13:10	28.0	2.71	Sample collected, bag in good condition
8/31/09	13:19	-----	8/4/09	12:51	27.0	-----	No sample collected, meter missing, replaced
10/6/09	12:25	-----	8/31/09	13:19	36.0	-----	No sample collected, meter disturbed, reinstalled
11/30/09	12:24	106	10/6/09	12:25	55.0	7.14	Sample collected, bag in good condition
3/25/10	10:52	-----	11/30/09	12:24	114.9	-----	No sample collected, bag damaged, bag replaced
5/4/10	12:27	-----	3/25/10	10:52	40.1	-----	No sample collected, bag damaged, bag replaced
7/7/10	11:40	-----	5/4/10	12:27	64.0	-----	No sample collected, bag damaged, bag replaced
8/6/10	9:40	-----	7/7/10	11:40	29.9	-----	No sample collected, meter disturbed
					Mean:	**5.65**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 35

Date Installed: 6/16/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	8:41	-----	-----	-----	-----	-----	Bags Installed
7/7/09	13:02	8.8	6/16/09	8:41	21.2	1.53	Sample collected, bag in good condition
8/4/09	12:58	8.3	7/7/09	13:02	28.0	1.09	Sample collected, bag in good condition
8/31/09	13:26	3.8	8/4/09	12:58	27.0	0.51	Sample collected, bag in good condition
10/6/09	12:35	6.3	8/31/09	13:26	36.0	0.64	Sample collected, bag in good condition
11/30/09	12:31	5.3	10/6/09	12:35	55.0	0.35	Sample collected, bag in good condition
3/25/10	11:00	-----	11/30/09	12:31	114.9	-----	No sample collected, meter missing, replaced
5/4/10	-----	-----	3/25/10	11:00	-----	-----	Site Eliminated
7/7/10	-----	-----	5/4/10	-----	-----	-----	Site Eliminated
8/6/10	-----	-----	7/7/10	-----	-----	-----	Site Eliminated
					Mean:	**0.71**	

Seepage Meter Field Measurements

Location: Lake Jessup | Site: 36

Date Installed: 6/16/09 | Chamber Diameter: 0.58 m | Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	9:17	-----	-----	-----	-----	-----	Bags Installed
7/7/09	12:56	-----	6/16/09	9:17	21.2	-----	No sample collected, meter disturbed, reinstalled
8/4/09	8:20	-----	7/7/09	12:56	27.8	-----	No sample collected, meter missing, replaced
8/31/09	13:31	-----	8/4/09	8:20	27.2	-----	No sample collected, meter missing, replaced
10/6/09	-----	-----	8/31/09	13:31	-----	-----	Site Eliminated
11/30/09	-----	-----	10/6/09	-----	-----	-----	Site Eliminated
3/25/10	-----	-----	11/30/09	-----	-----	-----	Site Eliminated
5/4/10	-----	-----	3/25/10	-----	-----	-----	Site Eliminated
7/7/10	-----	-----	5/4/10	-----	-----	-----	Site Eliminated
8/6/10	-----	-----	7/7/10	-----	-----	-----	Site Eliminated
					Mean:	-----	

Seepage Meter Field Measurements

Location: Lake Jessup — Site: 37

Date Installed: 6/16/09 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	9:29	-----	-----	-----	-----	-----	Bags Installed
7/10/09	10:38	-----	6/16/09	9:29	24.0	-----	No sample collected, bag damaged, bag replaced
8/4/09	13:05	6.5	7/10/09	10:38	25.1	0.96	Sample collected, bag in good condition
8/31/09	13:34	-----	8/4/09	13:05	27.0	-----	No sample collected, meter disturbed, reinstalled
10/6/09	12:41	9.8	8/31/09	13:34	36.0	1.00	Sample collected, bag in good condition
11/30/09	12:39	5.0	10/6/09	12:41	55.0	0.34	Sample collected, bag in good condition
3/25/10	11:05	14.0	11/30/09	12:39	114.9	0.45	Sample collected, bag in good condition
5/4/10	12:11	5.3	3/25/10	11:05	40.0	0.49	Sample collected, bag in good condition
7/7/10	11:46	21.5	5/4/10	12:11	64.0	1.24	Sample collected, bag in good condition
8/6/10	9:48	8.5	7/7/10	11:46	29.9	1.05	Sample collected, bag in good condition
					Mean:	**0.67**	

Seepage Meter Field Measurements

Location: Lake Jessup — Site: 38

Date Installed: 6/16/09 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	9:39	-----	-----	-----	-----	-----	Bags Installed
7/10/09	10:47	12.0	6/16/09	9:39	24.0	1.85	Sample collected, bag in good condition
8/4/09	13:11	42.3	7/10/09	10:47	25.1	6.23	Sample collected, bag in good condition
8/31/09	13:46	33.3	8/4/09	13:11	27.0	4.56	Sample collected, bag in good condition
10/6/09	12:47	7.3	8/31/09	13:46	36.0	0.75	Sample collected, bag in good condition
11/30/09	12:45	-----	10/6/09	12:47	55.0	-----	No sample collected, bag damaged, bag replaced
3/25/10	11:11	29.0	11/30/09	12:45	114.9	0.93	Sample collected, bag in good condition
5/4/10	12:19	10.3	3/25/10	11:11	40.0	0.95	Sample collected, bag in good condition
7/7/10	11:53	-----	5/4/10	12:19	64.0	-----	No sample collected, bag damaged, bag replaced
8/6/10	10:03	8.5	7/7/10	11:53	29.9	1.05	Sample collected, bag in good condition
					Mean:	**1.78**	

Seepage Meter Field Measurements

Location: Lake Jessup — Site: 39

Date Installed: 6/16/09 — Chamber Diameter: 0.58 m — Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	9:48	-----	-----	-----	-----	-----	Bags Installed
7/7/09	12:43	-----	6/16/09	9:48	21.1	-----	No sample collected, meter disturbed, reinstalled
8/4/09	8:39	-----	7/7/09	12:43	27.8	-----	No sample collected, fitting broken, system repaired
8/31/09	8:37	-----	8/4/09	8:39	27.0	-----	No sample collected, meter missing, replaced
10/6/09	8:31	12.8	8/31/09	8:37	36.0	1.31	Sample collected, bag in good condition
11/30/09	8:27	16.5	10/6/09	8:31	55.0	1.11	Sample collected, bag in good condition
3/15/10	9:06	80.0	11/30/09	8:27	105.0	2.82	Sample collected, bag replaced
5/4/10	9:10	14.0	3/15/10	9:06	50.0	1.04	Sample collected, bag in good condition
7/7/10	8:35	-----	5/4/10	9:10	64.0	-----	No sample collected, bag damaged, bag replaced
8/6/10	10:11	5.8	7/7/10	8:35	30.1	0.71	Sample collected, bag in good condition
					Mean:	**1.73**	

Seepage Meter Field Measurements

Location: Lake Jessup	Site: 40

Date Installed: 6/16/09	Chamber Diameter: 0.58 m	Sediment Area Covered: 0.27 m2

Date	Time Collected	Volume Collected (liters)	Previous Collection Event		Seepage Time (days)	Seepage (liters/m2-day)	Comments / Observations
			Date	Time			
6/16/09	10:11	-----	-----	-----	-----	-----	Bags Installed
7/7/09	12:36	-----	6/16/09	10:11	21.1	-----	No sample collected, meter disturbed, reinstalled
8/4/09	13:25	26.0	7/7/09	12:36	28.0	3.43	Sample collected, bag replaced
8/31/09	8:46	7.5	8/4/09	13:25	26.8	1.04	Sample collected, bag in good condition
10/6/09	8:37	4.5	8/31/09	8:46	36.0	0.46	Sample collected, bag in good condition
11/30/09	8:36	16.0	10/6/09	8:37	55.0	1.08	Sample collected, bag replaced
3/15/10	9:13	-----	11/30/09	8:36	105.0	-----	No sample collected, meter missing, replaced
5/4/10	9:15	-----	3/15/10	9:13	50.0	-----	No sample collected, meter missing, replaced
7/7/10	8:40	-----	5/4/10	9:15	64.0	-----	No sample collected, meter missing, replaced
8/5/10	9:15	-----	7/7/10	8:40	29.0	-----	No sample collected, meter missing
					Mean:	**1.37**	

APPENDIX B

CHEMICAL CHARACTERISTICS OF GROUNDWATER SEEPAGE SAMPLES COLLECTED IN LAKE JESUP FROM JUNE 2009 – AUGUST 2010

Chemical Characteristics of Groundwater Seepage Samples Collected in Lake Jesup from August 2009 - August 2010

Site	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH_3 (µg/l)	NO_X (µg/l)	Organic N (µg/l)	Total N (µg/l)	SRP (µg/l)	Organic P (µg/l)	Total P (µg/l)
Site 1	8/4/09	6.66	761	66.0	1,530	162	1,549	3,241	149	100	249
Site 1	3/15/10	7.38	1,127	104	809	824	1,930	3,563	293	233	526
Site 1	5/4/10	6.80	789	121	2,297	533	1,452	4,282	516	63	579
Site 1	7/7/10	6.85	892	69.0	632	296	1,327	2,255	273	56	329
Site 1	8/5/10	6.87	1,143	56.6	340	297	445	1,082	133	50	183
Log-Normal Mean:		**6.91**	**928**	**79.8**	**906**	**362**	**1,207**	**2,608**	**241**	**84**	**340**
Site 2	8/4/09	7.37	755	67.0	903	342	1,128	2,373	72	29	101
Site 2	10/6/09	7.49	644	97.6	736	1,071	894	2,701	150	19	169
Site 2	11/30/09	7.28	856	93.8	1,123	893	1,416	3,432	200	15	215
Site 2	3/15/10	7.98	1,598	292	8,004	642	1,420	10,066	1,013	211	1,224
Site 2	5/4/10	7.27	1,584	165	916	4,364	1,693	6,973	953	89	1,042
Site 2	7/7/10	7.34	860	81.4	964	176	1,114	2,254	141	50	191
Site 2	8/5/10	7.22	1,182	57.4	638	229	1,188	2,055	105	28	133
Log-Normal Mean:		**7.42**	**1010**	**105**	**1,189**	**624**	**1,241**	**3,553**	**227**	**42**	**275**
Site 3	8/31/09	7.65	658	92.8	1,000	509	1,470	2,979	191	15	206
Site 3	10/6/09	7.56	572	76.4	244	83	871	1,198	178	58	236
Site 3	3/15/10	7.39	946	87.0	983	355	1,354	2,692	191	22	213
Site 3	5/4/10	6.78	726	82.2	219	281	1,424	1,924	24	34	58
Site 3	7/7/10	7.03	757	72.6	261	149	1,394	1,804	27	34	61
Site 3	8/5/10	7.24	1,088	74.0	1,135	82	1,304	2,521	44	21	65
Log-Normal Mean:		**7.27**	**773**	**80.5**	**500**	**193**	**1,284**	**2,093**	**75**	**28**	**116**
Site 4	8/4/09	7.43	773	76.4	1,015	213	989	2,217	54	30	84
Site 4	10/6/09	7.33	584	74.4	399	393	1,601	2,393	118	34	152
Site 4	11/30/09	7.29	826	90.8	1,640	832	1,683	4,155	264	27	291
Site 4	3/15/10	7.19	1,054	101	1,971	940	1,402	4,313	376	307	683
Site 4	5/4/10	6.85	772	75	527	607	1,352	2,486	229	22	251
Log-Normal Mean:		**7.22**	**788**	**82.8**	**928**	**525**	**1,383**	**2,983**	**171**	**45**	**230**
Site 5	8/4/09	7.71	701	79.6	819	601	853	2,273	69	52	121
Site 5	7/7/10	7.14	747	74.2	40	291	1,576	1,907	13	11	24
Site 5	8/5/10	7.78	1,101	168	126	10,020	2,145	12,291	822	19	841
Log-Normal Mean:		**7.54**	**832**	**100**	**160**	**1,206**	**1,423**	**3,763**	**90**	**22**	**135**
Site 6	8/4/09	7.32	694	74.8	828	301	968	2,097	42	33	75
Site 6	8/31/09	7.67	593	77.2	189	316	1,549	2,054	56	123	179
Site 6	10/6/09	7.49	615	79.2	431	823	1,679	2,933	195	255	450
Site 6	11/30/09	7.20	817	88.6	510	1,476	1,158	3,144	268	17	285
Site 6	3/15/10	7.54	990	97.8	336	1,875	795	3,006	439	47	486
Site 6	5/4/10	7.01	755	84.8	90	966	1,123	2,179	154	20	174
Site 6	7/7/10	7.05	747	85.8	800	94	1,193	2,087	85	45	130
Log-Normal Mean:		**7.32**	**735**	**83.7**	**363**	**571**	**1,176**	**2,459**	**132**	**50**	**211**
Site 7	10/6/09	7.48	588	83.8	678	770	2,171	3,619	86	17	103
Site 7	3/15/10	7.52	1,282	163	4,954	1,110	2,078	8,142	406	284	690
Site 7	5/4/10	7.20	731	77.4	158	216	941	1,315	41	26	67
Log-Normal Mean:		**7.40**	**820**	**102**	**810**	**569**	**1,619**	**3,384**	**113**	**50**	**168**
Site 8	8/4/09	7.61	964	86.8	1,507	335	1,108	2,950	214	158	372
Site 8	10/6/09	7.30	2,894	185	14,124	424	7,125	21,673	1,808	32	1,840
Site 8	3/25/10	7.08	1,988	93.0	14,158	234	4,328	18,720	1,872	278	2,150
Site 8	5/4/10	7.31	2,583	271	12,697	61	2,957	15,715	2,241	426	2,667
Site 8	7/7/10	6.99	1,944	260	9,270	41	5,129	14,440	3,239	356	3,595
Log-Normal Mean:		**7.25**	**1945**	**160**	**8,128**	**153**	**3,491**	**12,212**	**1,394**	**184**	**1,698**

Chemical Characteristics of Groundwater Seepage Samples Collected in Lake Jesup from August 2009 - August 2010

Site	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH_3 (µg/l)	NO_X (µg/l)	Organic N (µg/l)	Total N (µg/l)	SRP (µg/l)	Organic P (µg/l)	Total P (µg/l)
Site 9	8/4/09	7.29	746	72.8	1,000	374	1,020	2,394	109	33	142
Site 9	8/31/09	7.61	674	89.4	393	2,545	2,261	5,199	190	42	232
Site 9	3/15/10	7.55	933	106	132	843	1,278	2,253	293	12	305
Site 9	5/4/10	7.08	757	99.2	358	819	1,168	2,345	239	19	258
Log-Normal Mean:		**7.38**	**772**	**91.0**	**369**	**900**	**1,362**	**2,848**	**195**	**24**	**226**
Site 10	8/4/09	7.59	777	123	2,286	1,496	949	4,731	445	224	669
Site 10	10/6/09	7.47	743	115	698	3,369	2,387	6,454	333	42	375
Site 10	11/30/09	7.20	767	77.8	324	28	898	1,250	274	14	288
Site 10	3/15/10	7.14	949	117	1,157	11	1,306	2,474	169	25	194
Site 10	5/4/10	6.72	696	79.6	113	21	932	1,066	55	60	115
Log-Normal Mean:		**7.22**	**782**	**100**	**583**	**127**	**1,199**	**2,515**	**207**	**46**	**276**
Site 11	3/15/10	7.83	1,297	180	5,532	523	1,398	7,453	245	245	490
Log-Normal Mean:		**7.83**	**1297**	**180**	**5,532**	**523**	**1,398**	**7,453**	**245**	**245**	**490**
Site 12	8/31/09	7.57	1,260	133	702	10,565	866	12,133	2,263	536	2,799
Site 12	11/30/09	7.01	1,035	110	552	169	1,807	2,528	449	247	696
Site 12	3/15/10	7.81	3,731	311	3,571	10	2,899	6,480	572	2,062	2,634
Site 12	5/4/10	7.45	1,772	157	419	1,751	1,076	3,246	1,961	288	2,249
Log-Normal Mean:		**7.45**	**1714**	**163.5**	**873**	**420**	**1,486**	**5,040**	**1,033**	**530**	**1,843**
Site 13	8/4/09	7.19	863	73.8	885	110	1,941	2,936	81	51	132
Site 13	8/31/09	7.36	670	83.4	1,760	90	1,195	3,045	220	35	255
Site 13	11/30/09	7.39	994	118	3,333	1,102	1,488	5,923	486	3	489
Site 13	3/25/10	7.37	1,904	302	11,127	797	3,962	15,886	2,939	14	2,953
Site 13	5/4/10	7.02	1,101	110	1,989	1,521	1,500	5,010	608	50	658
Site 13	7/7/10	7.39	1,536	102	2,089	20	2,307	4,416	291	61	352
Log-Normal Mean:		**7.29**	**1108**	**116**	**2,493**	**253**	**1,902**	**5,148**	**406**	**25**	**473**
Site 14	8/31/09	7.50	915	122	2,242	611	1,607	4,460	442	23	465
Site 14	3/25/10	7.17	745	81.2	1,246	431	1,227	2,904	127	150	277
Site 14	5/4/10	7.50	943	135	1,135	324	2,040	3,499	564	99	663
Log-Normal Mean:		**7.39**	**863**	**110**	**1,469**	**440**	**1,590**	**3,565**	**316**	**70**	**440**
Site 15	8/4/09	7.56	857	139.0	3,057	169	1,234	4,460	252	102	354
Site 15	3/25/10	7.42	1,452	129	1,376	145	1,508	3,029	353	107	460
Site 15	7/7/10	7.36	820	107	3,186	451	1,190	4,827	260	90	350
Log-Normal Mean:		**7.45**	**1007**	**124**	**2,375**	**223**	**1,303**	**4,025**	**285**	**99**	**385**
Site 16	5/4/10	7.51	1,205	195	4,543	976	2,832	8,351	1,295	177	1,472
Log-Normal Mean:		**7.51**	**1205**	**195**	**4,543**	**976**	**2,832**	**8,351**	**1,295**	**177**	**1,472**
Site 17	8/31/09	7.53	542	80.8	919	697	1,341	2,957	77	24	101
Site 17	3/25/10	7.56	1,059	137	228	6,109	1,312	7,649	304	20	324
Site 17	8/5/10	7.56	657	77.0	258	394	1,835	2,487	104	34	138
Log-Normal Mean:		**7.55**	**722**	**95**	**378**	**1,188**	**1,478**	**3,832**	**135**	**25**	**165**
Site 18	8/4/09	7.59	706	93.8	83	1,176	910	2,169	272	146	418
Site 18	5/4/10	7.20	760	127	3,275	1,050	1,876	6,201	285	55	340
Site 18	7/7/10	7.46	687	117	2,999	10	804	3,813	244	22	266
Site 18	8/5/10	7.60	623	81.0	959	9	909	1,877	105	33	138
Log-Normal Mean:		**7.46**	**692**	**103.1**	**940**	**103**	**1,057**	**3,132**	**211**	**49**	**269**

Chemical Characteristics of Groundwater Seepage Samples Collected in Lake Jesup from August 2009 - August 2010

Site	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH_3 (µg/l)	NO_X (µg/l)	Organic N (µg/l)	Total N (µg/l)	SRP (µg/l)	Organic P (µg/l)	Total P (µg/l)
Site 19	8/4/09	7.68	677	85.4	381	3,556	734	4,671	215	109	324
Site 19	8/31/09	7.44	546	82.0	1,294	637	1,205	3,136	230	40	270
Log-Normal Mean:		**7.56**	**608**	**83.7**	**702**	**1,505**	**940**	**3,827**	**222**	**66**	**296**
Site 21	8/31/09	7.45	580	92.0	508	182	1,068	1,758	33	24	57
Site 21	11/30/09	7.39	750	108	1,638	581	1,430	3,649	178	11	189
Site 21	5/4/10	7.31	738	110	1,464	211	1,437	3,112	121	16	137
Site 21	8/5/10	7.42	936	117	2,750	78	3,876	6,704	35	49	84
Log-Normal Mean:		**7.39**	**740**	**106.3**	**1,353**	**204**	**1,708**	**3,401**	**71**	**21**	**106**
Site 22	8/4/09	7.73	1,007	174	2,979	2,871	903	6,753	665	17	682
Site 22	11/30/09	7.55	718	98.8	824	38	996	1,858	80	14	94
Site 22	3/15/10	7.49	1,038	114	623	2,915	10,814	14,352	705	16	721
Log-Normal Mean:		**7.59**	**909**	**125**	**1,152**	**683**	**2,135**	**5,647**	**335**	**16**	**359**
Site 23	8/4/09	7.43	584	65.8	644	983	829	2,456	11	8	19
Site 23	10/6/09	7.41	583	89.2	1,264	233	869	2,366	40	2	42
Site 23	11/30/09	7.20	694	77.2	123	387	1,801	2,311	20	3	23
Site 23	3/15/10	7.50	784	80.0	103	332	829	1,264	22	41	63
Log-Normal Mean:		**7.38**	**656**	**77.6**	**319**	**414**	**1,018**	**2,030**	**21**	**7**	**33**
Site 24	10/6/09	7.39	526	70.2	433	380	727	1,540	52	16	68
Site 24	11/30/09	7.44	722	90.2	158	1,406	1,340	2,904	52	20	72
Site 24	3/15/10	7.39	717	94.2	75	1,098	892	2,065	40	14	54
Site 24	5/4/10	7.84	986	152	31	3,839	829	4,699	79	31	110
Log-Normal Mean:		**7.51**	**720**	**97.6**	**112**	**1,225**	**921**	**2,567**	**54**	**19**	**73**
Site 25	8/4/09	7.45	734	109	1,647	101	1,004	2,752	85	72	157
Site 25	8/31/09	7.89	1,094	214	3,476	1,286	1,416	6,178	1,467	434	1,901
Site 25	10/6/09	7.99	1,442	285	6,070	4,874	10,087	21,031	2,343	187	2,530
Log-Normal Mean:		**7.77**	**1050**	**188**	**3,263**	**859**	**2,430**	**7,098**	**664**	**180**	**911**
Site 27	8/4/09	7.84	816	109	922	1,311	720	2,953	398	25	423
Site 27	8/31/09	7.39	513	82.0	1,003	128	1,251	2,382	45	75	120
Site 27	10/6/09	7.37	532	74.2	336	155	1,319	1,810	15	19	34
Site 27	11/30/09	7.30	782	91.0	222	1,692	1,082	2,996	40	25	65
Site 27	3/25/10	7.20	687	79.6	425	270	776	1,471	62	88	150
Site 27	5/4/10	7.20	770	111	358	2,025	847	3,230	305	22	327
Log-Normal Mean:		**7.38**	**672**	**90.1**	**468**	**537**	**972**	**2,379**	**77**	**35**	**133**
Site 28	3/25/10	8.00	988	215	4,079	4,151	1,336	9,566	1,229	32	1,261
Site 28	5/4/10	7.73	1,013	247	8,498	96	2,108	10,702	1,209	12	1,221
Log-Normal Mean:		**7.86**	**1000**	**230**	**5,888**	**631**	**1,678**	**10,118**	**1,219**	**20**	**1,241**
Site 29	11/30/09	7.33	709	91.2	1,388	2,105	1,752	5,245	322	33	355
Site 29	3/25/10	7.79	954	296	17,556	2,991	765	21,312	1,851	16	1,867
Site 29	7/7/10	7.19	415	64.6	682	41	522	1,245	26	6	32
Log-Normal Mean:		**7.43**	**655**	**120**	**2,552**	**637**	**888**	**5,182**	**249**	**15**	**277**
Site 30	11/30/09	7.33	629	93.0	1,082	1,708	1,507	4,297	274	81	355
Site 30	3/25/10	6.91	552	100	1,439	1,073	2,176	4,688	390	69	459
Site 30	5/4/10	7.55	896	274	14,433	100	755	15,288	1,837	92	1,929
Site 30	7/7/10	7.06	356	67.2	1,180	82	632	1,894	223	44	267
Site 30	8/6/10	7.38	500	87.4	1,988	42	609	2,639	303	28	331
Log-Normal Mean:		**7.24**	**561**	**108**	**2,210**	**229**	**990**	**4,340**	**421**	**58**	**488**

Chemical Characteristics of Groundwater Seepage Samples Collected in Lake Jesup from August 2009 - August 2010

Site	Date Collected	pH (s.u.)	Conductivity (µmho/cm)	Alkalinity (mg/l)	NH_3 (µg/l)	NO_X (µg/l)	Organic N (µg/l)	Total N (µg/l)	SRP (µg/l)	Organic P (µg/l)	Total P (µg/l)
Site 32	8/4/09	7.22	517	74.8	1,545	148	1,366	3,059	143	29	172
Site 32	8/31/09	7.53	597	110	2,220	6,543	301	9,064	1,796	19	1,815
Site 32	10/6/09	7.50	475	109	1,015	2,695	309	4,019	391	22	413
Site 32	11/30/09	7.45	1,145	252	36,979	49	400	37,428	5,445	16	5,461
Site 32	3/25/10	7.50	891	242	10,279	8,714	457	19,450	3,353	28	3,381
Site 32	5/4/10	7.38	578	96.8	1,211	1,535	11,790	14,536	688	14	702
Site 32	7/7/10	6.91	287	54.0	388	81	693	1,162	91	22	113
Log-Normal Mean:		**7.35**	**590**	**116**	**2,507**	**754**	**789**	**7,528**	**734**	**21**	**788**
Site 33	8/4/09	7.61	621	117	4,951	173	740	5,864	624	82	706
Site 33	10/6/09	7.61	491	100	1,782	587	975	3,344	89	248	337
Site 33	11/30/09	7.15	699	107	1,877	612	3,349	5,838	358	51	409
Site 33	3/25/10	7.48	815	152	3,242	7,211	1,230	11,683	1,663	255	1,918
Site 33	5/4/10	7.45	583	79.6	606	109	1,314	2,029	25	264	289
Site 33	7/7/10	7.39	681	176	7,914	22	2,369	10,305	378	60	438
Log-Normal Mean:		**7.45**	**640**	**118**	**2,522**	**320**	**1,449**	**5,509**	**260**	**127**	**536**
Site 34	8/4/09	7.73	586	118	5,695	41	486	6,222	413	97	510
Site 34	11/30/09	7.23	660	105	4,640	1,093	2,167	7,900	436	395	831
Log-Normal Mean:		**7.48**	**622**	**111**	**5,141**	**212**	**1,026**	**7,011**	**424**	**196**	**651**
Site 35	8/4/09	7.59	745	159	5,122	3,039	240	8,401	825	453	1,278
Site 35	8/31/09	7.71	518	136	3,671	92	2,056	5,819	1,109	45	1,154
Site 35	10/6/09	7.76	480	138	1,926	12	1,192	3,130	1,405	31	1,436
Site 35	11/30/09	7.47	864	258	1,802	846	1,666	4,314	2,522	32	2,554
Log-Normal Mean:		**7.63**	**632**	**167**	**2,842**	**231**	**995**	**5,069**	**1,342**	**67**	**1,525**
Site 37	8/4/09	7.58	963	175	1,978	47,554	863	50,395	6,195	481	6,676
Site 37	10/6/09	7.59	461	108	954	263	732	1,949	46	106	152
Site 37	11/30/09	7.26	670	97.4	1,094	495	1,644	3,233	158	308	466
Site 37	3/25/10	7.24	416	64.2	513	343	1,018	1,874	72	68	140
Site 37	5/4/10	7.70	1,168	253	4,994	36,787	989	42,770	5,439	236	5,675
Site 37	7/7/10	7.30	540	76.4	678	50	765	1,493	42	12	54
Site 37	8/6/10	7.22	653	93.8	1,321	250	1,578	3,149	213	34	247
Log-Normal Mean:		**7.41**	**654**	**112**	**1,249**	**997**	**1,034**	**5,314**	**286**	**100**	**469**
Site 38	8/4/09	7.68	1,445	146	11,012	134	730	11,876	829	403	1,232
Site 38	8/31/09	7.52	1,797	185	17,008	463	796	18,267	1,916	61	1,977
Site 38	10/6/09	7.49	994	182	5,560	755	1,368	7,683	774	27	801
Site 38	3/25/10	7.42	1,201	104	1,671	147	1,254	3,072	467	109	576
Site 38	5/4/10	7.25	717	106	3,713	52	2,556	6,321	22	140	162
Site 38	8/6/10	7.11	911	110	3,241	21	792	4,054	185	50	235
Log-Normal Mean:		**7.41**	**1125**	**135**	**5,250**	**140**	**1,124**	**7,128**	**364**	**89**	**591**
Site 39	10/6/09	7.73	515	142	882	1,594	807	3,283	182	8	190
Site 39	11/30/09	7.45	690	93.2	258	1,039	1,262	2,559	87	6	93
Site 39	3/15/10	7.20	534	55.2	39	158	1,274	1,471	11	4	15
Site 39	5/4/10	7.57	622	87.8	316	81	1,082	1,479	47	31	78
Site 39	8/6/10	7.81	658	83.2	507	8	1,172	1,687	10	44	54
Log-Normal Mean:		**7.50**	**623**	**78.3**	**200**	**102**	**1,195**	**1,751**	**26**	**13**	**49**
Site 40	8/4/09	7.56	615	98.2	2,205	169	823	3,197	234	27	261
Site 40	8/31/09	8.05	1,177	188	6,697	588	2,239	9,524	993	34	1,027
Site 40	10/6/09	8.00	575	190	284	857	604	1,745	260	15	275
Site 40	11/30/09	7.48	880	106	139	2,099	886	3,124	243	11	254
Log-Normal Mean:		**7.77**	**778**	**139**	**874**	**650**	**997**	**3,589**	**348**	**20**	**370**

APPENDIX C

QUALITY ASSURANCE DATA

SAMPLE DUPLICATE RECOVERY
FOR LAKE JESUP SEEPAGE COLLECTED FROM
AUGUST 2009 to AUGUST 2010

PARAMETERS	UNITS	SAMPLE ID	SAMPLE DESCRIPTION	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	REPEAT 1	REPEAT 2	MEAN	s	% RELATIVE STD. DEVIATION (RSD)	RELATIVE % DEVIATION (RPD)	ACCEPTANCE RANGE (% RSD)
pH	s.u.	09-4088	SP13	11/30/09	11/30/09	12/03/09	7.39	7.41	7.4	0.0	**0.19**	0.27	0-2
pH	s.u.	09-3547	SP10	10/06/09	10/06/09	10/06/09	7.47	7.45	7.5	0.0	**0.19**	0.27	0-2
pH	s.u.	09-3557	SP37	10/06/09	10/06/09	10/06/09	7.59	7.58	7.6	0.0	**0.09**	0.13	0-2
pH	s.u.	09-4098	SP30	11/30/09	11/30/09	12/03/09	7.33	7.35	7.3	0.0	**0.19**	0.27	0-2
pH	s.u.	09-4106	SP40	11/30/09	11/30/09	12/04/09	7.48	7.47	7.5	0.0	**0.09**	0.13	0-2
pH	s.u.	09-2426	SP13	08/04/09	08/04/09	08/05/09	7.19	7.19	7.2	0.0	**0.00**	0.00	0-2
pH	s.u.	09-2436	SP 27	08/04/09	08/04/09	08/05/09	7.80	7.81	7.8	0.0	**0.09**	0.13	0-2
pH	s.u.	09-2443	SP40	08/05/09	08/05/09	08/05/09	7.56	7.60	7.6	0.0	**0.37**	0.53	0-2
pH	s.u.	09-2845	FCEB	08/31/09	08/31/09	09/02/09	5.71	5.73	5.7	0.0	**0.25**	0.35	0-2
pH	s.u.	09-2854	40	08/31/09	08/31/09	09/02/09	8.05	8.01	8.0	0.0	**0.35**	0.50	0-2
pH	s.u.	10-1041	SP 30	05/04/10	05/04/10	05/05/10	7.55	7.57	7.6	0.0	**0.19**	0.26	0-2
pH	s.u.	10-0604	Site #12	03/15/10	03/15/10	03/28/10	7.81	7.82	7.8	0.0	**0.09**	0.13	0-2
pH	s.u.	10-0608	Site #39	03/15/10	03/15/10	03/28/10	7.20	7.20	7.2	0.0	**0.00**	0.00	0-2
pH	s.u.	10-1968	SP21	08/05/10	08/05/10	08/06/10	7.42	7.39	7.4	0.0	**0.29**	0.41	0-2
pH	s.u.	10-0712	Site #29	03/25/10	03/25/10	04/06/10	7.79	7.79	7.8	0.0	**0.00**	0.00	0-2
pH	s.u.	10-1047	SP 39	05/04/10	05/04/10	05/05/10	7.57	7.59	7.6	0.0	**0.19**	0.26	0-2
pH	s.u.	10-1666	SP18	07/07/10	07/07/10	07/08/10	7.46	7.45	7.5	0.0	**0.09**	0.13	0-2
pH	s.u.	10-1029	SP 12	05/04/10	05/04/10	05/05/10	7.45	7.47	7.5	0.0	**0.19**	0.27	0-2
pH	s.u.	10-1673	SP37 Field Dup	07/07/10	07/08/10	07/08/10	7.28	7.27	7.3	0.0	**0.10**	0.14	0-2
Alkalinity	mg/l	09-3547	SP10	10/06/09	10/06/09	10/06/09	115	115	115.0	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	09-3557	SP37	10/06/09	10/06/09	10/06/09	108	108	108.0	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	09-4088	SP13	11/30/09	11/30/09	12/03/09	118	118	118.0	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	09-4098	SP30	11/30/09	11/30/09	12/03/09	93.0	93.2	93.1	0.1	**0.15**	0.21	0-4
Alkalinity	mg/l	09-4106	SP40	11/30/09	11/30/09	12/04/09	106	107	106.5	0.7	**0.66**	0.94	0-4
Alkalinity	mg/l	09-2426	SP13	08/04/09	08/04/09	08/05/09	73.8	74.6	74.2	0.6	**0.76**	1.08	0-4
Alkalinity	mg/l	09-2436	SP 27	08/04/09	08/04/09	08/05/09	108	108	108.0	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	09-2443	SP40	08/04/09	08/04/09	08/05/09	98.2	99.2	99	0.7	**0.72**	1.01	0-4
Alkalinity	mg/l	09-2845	FCEB	08/31/09	08/31/09	09/02/09	0.6	0.6	0.6	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	09-2854	SP 40	08/31/09	08/31/09	09/02/09	188	187	187.5	0.7	**0.38**	0.53	0-4
Alkalinity	mg/l	10-1666	SP18	07/07/10	07/07/10	07/08/10	117	116	116.5	0.7	**0.61**	0.86	0-4
Alkalinity	mg/l	10-0608	#39	03/15/10	03/15/10	03/28/10	55.2	54.8	55.0	0.3	**0.51**	0.73	0-4
Alkalinity	mg/l	10-1673	SP37 Field Dup	07/07/10	07/07/10	07/08/10	76.2	75.8	76.0	0.3	**0.37**	0.53	0-4
Alkalinity	mg/l	10-1029	SP 12	05/04/10	05/04/10	05/05/10	157.0	157.0	157.0	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	10-0604	#12	03/15/10	03/15/10	03/28/10	311.0	311.0	311	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	10-1041	SP 30	05/04/10	05/04/10	05/05/10	274	273	274	0.7	**0.26**	0.37	0-4
Alkalinity	mg/l	10-0712	#29	03/25/10	03/25/10	04/06/10	296	296	296	0.0	**0.00**	0.00	0-4
Alkalinity	mg/l	10-1047	SP 39	05/04/10	05/04/10	05/05/10	87.8	88.2	88.0	0.3	**0.32**	0.45	0-4
Alkalinity	mg/l	10-1968	SP21	08/05/10	08/05/10	08/06/10	117.0	117.0	117.0	0.0	**0.00**	0.00	0-4
Conductivity	$\mu\Omega$	09-2426	SP13	08/04/09	08/04/09	08/13/09	863	863	863.0	0.0	**0.00**	0.00	0-5
Conductivity	$\mu\Omega$	09-2436	SP27 F.D.	08/04/09	08/04/09	08/13/09	817	817	817	0.0	**0.00**	0.00	0-5
Conductivity	$\mu\Omega$	09-2837	SP3	08/31/09	08/31/09	09/25/09	658	656	657.0	1.4	**0.22**	0.30	0-5
Conductivity	$\mu\Omega$	09-2843	SP14	08/31/09	08/31/09	09/25/09	915	912	913.5	2.1	**0.23**	0.33	0-5
Conductivity	$\mu\Omega$	09-2847	SP21	08/31/09	08/31/09	09/25/09	580	582	581.0	1.4	**0.24**	0.34	0-5
Conductivity	$\mu\Omega$	09-3549	SP24	10/06/09	10/06/09	10/29/09	526	526	526.0	0.0	**0.00**	0.00	0-5
Conductivity	$\mu\Omega$	09-3557	SP37	10/06/09	10/06/09	10/29/09	461	467	464	4.2	**0.91**	1.29	0-5
Conductivity	$\mu\Omega$	09-3558	SP38	10/06/09	10/06/09	10/29/09	994	993	994	0.7	**0.07**	0.10	0-5
Conductivity	$\mu\Omega$	09-4084	SP4	11/30/09	11/30/09	12/07/09	826	826	826.0	0.0	**0.00**	0.00	0-5
Conductivity	$\mu\Omega$	09-4094	FCEB	11/30/09	11/30/09	12/07/09	2	2	2	0.0	**0.00**	0.00	0-5
Conductivity	$\mu\Omega$	09-4106	SP40	11/30/09	11/30/09	12/07/09	880	880	880.0	0.0	**0.00**	0.00	0-5
Conductivity	$\mu\Omega$	09-2433	SP23	08/04/09	08/04/09	08/13/09	584	580	582	2.8	**0.49**	0.69	0-5
Conductivity	$\mu\Omega$	09-2854	SP40	08/31/09	08/31/09	09/25/09	1177	1172	1175	3.5	**0.30**	0.43	0-5
Conductivity	$\mu\Omega$	10-1660	SP5	07/07/10	07/07/10	07/15/10	747	745	746	1.4	**0.19**	0.27	0-5
Conductivity	$\mu\Omega$	10-1669	SP30 Field Dup	07/07/10	07/07/10	07/15/10	354	356	355	1.4	**0.40**	0.56	0-5
Conductivity	$\mu\Omega$	10-1965	SP5 F.D.	08/05/10	08/05/10	08/13/10	1094	1091	1093	2.1	**0.19**	0.27	0-5

SAMPLE DUPLICATE RECOVERY
FOR LAKE JESUP SEEPAGE COLLECTED FROM
AUGUST 2009 to AUGUST 2010

SRP	µg/l	09-2424	SP #9	08/04/09	08/04/09	08/06/09	9	9	9	0.0	**0.00**	0.00	0-5
SRP	µg/l	09-2434	SP #25	08/04/09	08/04/09	08/06/09	85	85	85	0.0	**0.00**	0.00	0-5
SRP	µg/l	09-2846	SP #19	08/31/09	08/31/09	09/03/09	227	228	228	0.7	**0.31**	0.44	0-5
SRP	µg/l	09-3547	SP #10	10/06/09	10/06/09	10/07/09	933	931	932	1.4	**0.15**	0.21	0-5
SRP	µg/l	09-3557	SP #37	10/06/09	10/06/09	10/07/09	46	47	47	0.7	**1.52**	2.15	0-5
SRP	µg/l	09-4088f	SP #13	11/30/09	11/30/09	12/02/09	486	485	486	0.7	**0.15**	0.21	0-5
SRP	µg/l	09-4098f	SP #30	11/30/09	11/30/09	12/02/09	276	277	277	0.7	**0.26**	0.36	0-5
SRP	µg/l	09-4099f	SP #32	11/30/09	11/30/09	12/02/09	274	276	275	1.4	**0.51**	0.73	0-5
SRP	µg/l	10-0599F	Site # 6	03/15/10	03/15/10	03/17/10	439	441	440	1.4	**0.32**	0.45	0-5
SRP	µg/l	10-0607F	Site # 24	03/15/10	03/15/10	03/17/10	40	40	40.0	0.0	**0.00**	0.00	0-5
SRP	µg/l	10-0710F	Site # 28	03/25/10	03/25/10	03/26/10	1229	1234	1232	3.5	**0.29**	0.41	0-5
SRP	µg/l	10-0710F	Site # 28	03/25/10	03/25/10	03/26/10	1572	1594	1583.0	15.6	**0.98**	1.39	0-5
SRP	µg/l	10-1028F	SP 10	05/04/10	05/04/10	05/05/10	55	55	55.0	0.0	**0.00**	0.00	0-5
SRP	µg/l	10-1038F	SP 27	05/04/10	05/04/10	05/05/10	305	307	306	1.4	**0.46**	0.65	0-5
SRP	µg/l	10-1664F	SP13	07/07/10	07/07/10	07/08/10	291	293	292.0	1.4	**0.48**	0.68	0-5
SRP	µg/l	10-1673F	SP37 Field Dup	07/07/10	07/07/10	07/08/10	43	43	43	0.0	**0.00**	0.00	0-5
SRP	µg/l	10-1970f	SP 37	08/06/10	08/06/10	08/06/10	1	0	0.5	0.0	**1.43**	2.02	0-5
NOx	µg/l	09-2424	SP #9	08/04/09	08/04/09	08/06/09	374	376	375	1.4	**0.38**	0.53	0-4
NOx	µg/l	09-2434	SP #25	08/04/09	08/04/09	08/06/09	101	102	101.5	0.7	**0.70**	0.99	0-4
NOx	µg/l	09-2846	SP #19	08/31/09	08/31/09	09/03/09	617	609	613.0	5.7	**0.92**	1.31	0-4
NOx	µg/l	09-3547	SP #10	10/06/09	10/06/09	10/07/09	3369	3466	3417.5	68.6	**2.01**	2.84	0-4
NOx	µg/l	09-4088f	SP #13	11/30/09	11/30/09	12/02/09	1102	1101	1101.5	0.7	**0.06**	0.09	0-4
NOx	µg/l	09-4098f	SP #30	11/30/09	11/30/09	12/02/09	1704	1711	1707.5	4.9	**0.29**	0.41	0-4
NOx	µg/l	09-4099f	SP #32	11/30/09	11/30/09	12/02/09	1708	1701	1704.5	4.9	**0.29**	0.41	0-4
NOx	µg/l	10-0599F	Site # 6	03/15/10	03/15/10	03/17/10	1875	1893	1884.0	12.7	**0.68**	0.96	0-4
NOx	µg/l	10-0607F	Site # 24	03/15/10	03/15/10	03/17/10	1098	1095	1096.5	2.1	**0.19**	0.27	0-4
NOx	µg/l	10-0710F	Site # 28	03/25/10	03/25/10	03/26/10	4151	4143	4147.0	5.7	**0.14**	0.19	0-4
NOx	µg/l	10-0710F	Site # 28	03/25/10	03/25/10	03/26/10	4811	4811	4811.0	0.0	**0.00**	0.00	0-4
NOx	µg/l	10-1028F	SP 10	05/04/10	05/04/10	05/05/10	0	0	0	0.0	**0.00**	0.00	0-4
NOx	µg/l	10-1038F	SP 27	05/04/10	05/04/10	05/05/10	2025	2048	2036.5	16.3	**0.80**	1.13	0-4
NOx	µg/l	10-1664F	SP13	07/07/10	07/07/10	07/08/10	20	20	20.0	0.0	**0.00**	0.00	0-4
NOx	µg/l	10-1673F	SP37 Field Dup	07/07/10	07/07/10	07/08/10	50	50	50.0	0.0	**0.00**	0.00	0-4
NOx	µg/l	10-1970f	SP 37	08/06/10	08/06/10	08/06/10	250	254	252.0	2.8	**1.12**	1.59	0-4
Total N	µg/l	09-2844	SP #17	08/31/09	08/31/09	09/26/09	2957	2940	2948.5	12.0	**0.41**	0.58	0-10
Total N	µg/l	09-2854	SP #40	08/31/09	08/31/09	09/26/09	9524	9327	9426	139.3	**1.48**	2.09	0-10
Total N	µg/l	09-2427	SP #15	08/04/09	08/04/09	10/27/09	4460	4611	4535.5	106.8	**2.35**	3.33	0-10
Total N	µg/l	09-2437	SP #32	08/04/09	08/04/09	10/27/09	3059	3026	3042.5	23.3	**0.77**	1.08	0-10
Total N	µg/l	09-3556f	SP #35	10/06/09	10/06/09	12/07/09	3130	3178	3154.0	33.9	**1.08**	1.52	0-10
Total N	µg/l	09-3546f	SP #8	10/06/09	10/06/09	12/07/09	11491	11420	11455.5	50.2	**0.44**	0.62	0-10
Total N	µg/l	09-4091FP	SP #22	11/30/09	11/30/09	12/22/09	451	451	451.0	0.0	**0.00**	0.00	0-10
Total N	µg/l	09-4101FP	SP #34	11/30/09	11/30/09	12/22/09	151	161	156.0	7.1	**4.53**	6.41	0-10
Total N	µg/l	10-0600P	Site # 7	03/15/10	03/15/10	04/02/10	7033	6993	7013.0	28.3	**0.40**	0.57	0-10
Total N	µg/l	10-0710P	Site # 28	03/25/10	03/25/10	04/15/10	9566	9560	9563.0	4.2	**0.04**	0.06	0-10
Total N	µg/l	10-1028P	SP 10	05/04/10	05/04/10	05/12/10	1066	1075	1070.5	6.4	**0.59**	0.84	0-10
Total N	µg/l	10-1038P	SP 27	05/04/10	05/04/10	05/12/10	3230	3164	3197	46.7	**1.46**	2.06	0-10
Total N	µg/l	10-1663P	FCEB	07/07/10	07/07/10	07/13/10	11	10	11	0.4	**3.97**	5.61	0-10
Total N	µg/l	10-1673P	SP37 Field Dup	07/07/10	07/07/10	07/20/10	1390	1328	1359.0	43.8	**3.23**	4.56	0-10
Total N	µg/l	10-1663P	FCEB	07/07/10	07/07/10	07/27/10	0	0	0	0.0	**0.00**	0.00	0-10
Total N	µg/l	10-1970P	SP 37	08/06/10	08/06/10	08/16/10	3149	2862	3005.5	202.9	**6.75**	9.55	0-10
Total N	µg/l	10-1972P	SP 39	08/06/10	08/06/10	08/16/10	1687	1699	1693.0	8.5	**0.50**	0.71	0-10
Total N	µg/l	09-4271p	row's Creek - 10.0mg	12/11/09	12/11/09	02/02/10	396	392	394.0	2.8	**0.72**	1.02	0-10
Total N	µg/l	09-4241p	ldier's Creek - 10.0m	12/11/09	12/11/09	02/02/10	372	382	377.0	7.1	**1.88**	2.65	0-10
Total P	µg/l	09-2844	SP #17	08/31/09	08/31/09	09/26/09	102	101	101.5	0.7	**0.70**	0.99	0-5
Total P	µg/l	09-2854	SP #40	08/31/09	08/31/09	09/26/09	906	875	890.5	21.9	**2.46**	3.48	0-5
Total P	µg/l	09-2427	SP #15	08/04/09	08/04/09	10/27/09	150	160	155.0	7.1	**4.56**	6.45	0-5
Total P	µg/l	09-2437	SP #32	08/04/09	08/04/09	10/27/09	84	90	87.0	4.2	**4.88**	6.90	0-5
Total P	µg/l	09-3556f	SP #35	10/06/09	10/06/09	12/07/09	403	406	404.5	2.1	**0.52**	0.74	0-5
Total P	µg/l	09-3546f	SP #8	10/06/09	10/06/09	12/07/09	1693	1722	1707.5	20.5	**1.20**	1.70	0-5
Total P	µg/l	09-4101FP	SP #34	11/30/09	11/30/09	12/22/09	831	828	829.5	2.1	**0.26**	0.36	0-5
Total P	µg/l	10-1028P	SP 10	05/04/10	05/04/10	05/12/10	115	113	114.0	1.4	**1.24**	1.75	0-5
Total P	µg/l	10-1038P	SP 27	05/04/10	05/04/10	05/12/10	327	326	326.5	0.7	**0.22**	0.31	0-5
Total P	µg/l	10-1663P	FCEB	07/07/10	07/07/10	07/13/10	0	0	0.1	0.0	**0.00**	0.00	0-5
Total P	µg/l	10-1673P	SP37 Field Dup	07/07/10	07/07/10	07/20/10	28	28	28	0.0	**0.00**	0.00	0-5
Total P	µg/l	10-1663P	FCEB	07/07/10	07/07/10	07/27/10	0	0	0	0.0	**0.00**	0.00	0-5
Total P	µg/l	10-1970P	SP 37	08/06/10	08/06/10	08/16/10	179	177	178.0	1.4	**0.79**	1.12	0-5
Total P	µg/l	10-1972P	SP 39	08/06/10	08/06/10	08/16/10	54	58	56.2	2.5	**4.53**	6.41	0-5
Total P	µg/l	09-4271p	row's Creek - 10.0mg	12/11/09	12/11/09	02/02/10	61	62	61.5	0.7	**1.15**	1.63	0-5
Total P	µg/l	09-4241p	ldier's Creek - 10.0m	12/11/09	12/11/09	02/02/10	14	14	14.0	0.0	**0.00**	0.00	0-5
Total P	µg/l	09-4251p	Gee Creek - 5.0mg/l	12/11/09	12/11/09	02/02/10	101	100	100.5	0.7	**0.70**	1.00	0-5
Total P	µg/l	09-4261p	anford Canal - 15.0mg	12/11/09	12/11/09	02/02/10	12	12	12.0	0.0	**0.00**	0.00	0-5

SAMPLE DUPLICATE RECOVERY

FOR LAKE JESUP SEEPAGE COLLECTED FROM AUGUST 2009 to AUGUST 2010

Ammonia	µg/l	09-2419	SP #2	08/04/09	08/04/09	08/18/09	903	908	905.5	3.5	**0.39**	0.55	0-10
Ammonia	µg/l	09-2429	SP #18	08/04/09	08/04/09	08/18/09	83	84	83.5	0.7	**0.85**	1.20	0-10
Ammonia	µg/l	09-2439	SP #34	08/04/09	08/04/09	08/18/09	5695	5662	5679	23.3	**0.41**	0.58	0-10
Ammonia	µg/l	09-2846	SP #19	08/31/09	08/31/09	09/18/09	1294	1309	1301.5	10.6	**0.81**	1.15	0-10
Ammonia	µg/l	09-2854	SP #40	08/31/09	08/31/09	09/18/09	6697	6244	6470.5	320.3	**4.95**	7.00	0-10
Ammonia	µg/l	09-3548	SP #23	10/06/09	10/06/09	10/29/09	1264	1265	1264.5	0.7	**0.06**	0.08	0-10
Ammonia	µg/l	09-3558	SP #38	10/06/09	10/06/09	10/29/09	5560	5555	5557.5	3.5	**0.06**	0.09	0-10
Ammonia	µg/l	09-4088p	SP #13	11/30/09	11/30/09	12/18/09	3333	3372	3352.5	27.6	**0.82**	1.16	0-10
Ammonia	µg/l	09-4098p	SP #30	11/30/09	11/30/09	12/18/09	1082	1154	1118.0	50.9	**4.55**	6.44	0-10
Ammonia	µg/l	10-0603P	Site # 11	03/15/10	03/15/10	03/25/10	5487	5532	5509.5	31.8	**0.58**	0.82	0-10
Ammonia	µg/l	10-0710P	Site # 28	03/25/10	03/25/10	03/25/10	4079	4134	4106.5	38.9	**0.95**	1.34	0-10
Ammonia	µg/l	10-1028P	SP 10	05/04/10	05/04/10	05/12/10	113	106	109.5	4.9	**4.52**	6.39	0-10
Ammonia	µg/l	10-1038P	SP 27	05/04/10	05/04/10	05/12/10	358	367	362.5	6.4	**1.76**	2.48	0-10
Ammonia	µg/l	10-1665P	SP15	07/07/10	07/07/10	07/15/10	3186	3180	3183.0	4.2	**0.13**	0.19	0-10
Ammonia	µg/l	10-1967P	SP 18	08/05/10	08/05/10	08/19/10	959	969	964.0	7.1	**0.73**	1.04	0-10
Color	PCU	09-2845	FCEB	08/31/09	08/31/09	09/03/09	0	0	0.1	0.0	**0.00**	0.00	0-5
Color	PCU	09-3547	SP10	10/06/09	10/06/09	10/06/09	59	61	60	1.4	**2.36**	3.33	0-5
Color	PCU	09-3557	SP37	10/0609	10/0609	10/06/09	53	53	53.0	0.0	**0.00**	0.00	0-5
Color	PCU	09-3560	SP40	10/06/09	10/06/09	10/06/09	47	49	48.0	1.4	**2.95**	4.17	0-5
Color	PCU	09-4088	SP13	11/30/09	11/30/09	11/30/09	58	58	58.0	0.0	**0.00**	0.00	0-5
Color	PCU	09-4098	SP30	11/30/09	11/30/09	11/30/09	43	43	43.0	0.0	**0.00**	0.00	0-5
Color	PCU	09-4106	SP40	11/30/09	11/30/09	11/30/09	52	52	52.0	0.0	**0.00**	0.00	0-5
Color	PCU	10-0607F	Site #24	03/15/10	03/15/10	03/16/10	41	40	41	0.7	**1.75**	2.47	0-5
Color	PCU	10-0608F	Site #39	03/15/10	03/15/10	03/16/10	95	95	95.0	0.0	**0.00**	0.00	0-5
Color	PCU	10-0711F	SP 28F.D	03/25/10	03/25/10	03/26/10	56	56	56.0	0.0	**0.00**	0.00	0-5
Color	PCU	10-1028F	SP10	05/04/10	05/04/10	05/06/10	53	53	53.0	0.0	**0.00**	0.00	0-5
Color	PCU	10-1038F	SP27	05/04/10	05/04/10	05/06/10	52	52	52	0.0	**0.00**	0.00	0-5
Color	PCU	10-1665F	SP 15	07/07/10	07/07/10	07/08/10	43	44	43.5	0.7	**1.63**	2.30	0-5
Color	PCU	10-1673F	SP 37 F.D.	07/07/10	07/07/10	07/08/10	102	102	102.0	0.0	**0.00**	0.00	0-5
Color	PCU	10-1970F	SP 37	08/06/10	08/06/10	08/06/10	40	41	41	0.7	**1.75**	2.47	0-5
Color	PCU	10-1972F	SP 39	08/06/10	08/06/10	08/06/10	47	47	47.0	0.0	**0.00**	0.00	0-5
Color	PCU	10-1972F	SP 39	08/06/10	08/06/10	08/06/10	48	48	48.0	0.0	**0.00**	0.00	0-5

MATRIX SPIKE RECOVERY STUDY
LAKE JESUP SEEPAGE SAMPLES COLLECTED FROM:
August 2009 - August 2010

PARAMETERS	UNITS	SAMPLE ID	SAMPLE DESCRIPTION	DATE COLLECTED	DATE RECEIVED	DATE ANALYZED	INITIAL CONC.	INITIAL VOLUME (ml)	SPIKE CONC.	SPIKE VOLUME ADDED (ml)	Dilution Factor	THEOR. CONC.	ACTUAL CONC.	PERCENT RECOVERY	ACCEPTANCE RANGE
Alkalinity	mg/l	09-2437	SP27 Field Dup	08/04/09	08/04/09	08/05/09	108	50	1000	0.5	1	118	119	101%	95.6 - 105
Alkalinity	mg/l	09-2854	SP40	08/31/09	08/31/09	09/02/09	187	50	1000	0.5	1	197	198.0	101%	95.6 - 105
Alkalinity	mg/l	09-3547	SP10	10/06/09	10/06/09	10/06/09	115	50	1000	0.4	1	123	123.0	100%	95.6 - 105
Alkalinity	mg/l	09-4088	SP13	11/30/09	11/30/09	10/30/09	3	10	10000	0.75	1	753	743	99%	95.6 - 105
Alkalinity	mg/l	10-0608	Site #39	03/15/10	03/15/10	03/28/10	54.8	50	1000	0.3	1	60.8	60.8	100%	95.6 - 105
Alkalinity	mg/l	10-1041	SP 30	05/04/10	05/04/10	05/05/10	274	50	1000	0.2	1	278	278	100%	95.6 - 105
Alkalinity	mg/l	10-1673	SP37 Field Dup	07/07/10	07/07/10	07/08/10	76.2	50	1000	0.4	1	84.8	84.2	99%	95.6 - 105
Alkalinity	mg/l	10-0603	SP11	03/15/10	03/15/10	03/28/10	180	50	1000	0.3	1	186	186	100%	95.6 - 105
Alkalinity	mg/l	10-0711	SP28 F.D.	03/25/10	03/25/10	04/06/10	215	50	1000	0.3	1	218	221	101%	95.6 - 105
Alkalinity	mg/l	10-0718	SP38	03/25/10	03/25/10	04/06/10	104	50	1000	0.2	1	108	108	100%	95.6 - 105
SRP	µg/l	09-2434f	SP #25	08/04/09	08/04/09	08/06/09	85	10	10000	0.5	1	574	585	102%	90-110
SRP	µg/l	09-3547f	SP #10	10/06/09	10/06/09	10/07/09	909	10	10000	0.1	1	931	1009	108%	90-110
SRP	µg/l	09-4088f	SP #13	11/30/09	11/30/09	12/02/09	486	10	10000	0.2	1	633	686	108%	90-110
SRP	µg/l	10-0599F	Site # 6	03/15/10	03/15/10	03/17/10	439	10	20000	0.2	1	639	602	94%	90-110
SRP	µg/l	10-1038F	SP 27	05/04/10	05/04/10	05/05/10	305	10	20000	0.2	1	705	697	99%	90-110
SRP	µg/l	10-1673F	SP37 Field Dup	07/07/10	07/07/10	07/08/10	43	10	20000	0.06	1	163	163	100%	90-110
SRP	µg/l	10-1970F	SP 37	08/06/10	08/06/10	08/06/10	213	10	20000	0.1	1	413	423	102%	90-110
NOx	µg/l	09-2434f	Site #4	10/22/09-10/30/09	06/05/19	08/06/09	101	10	100000	0.15	1	1601	1620	101%	92-111
NOx	µg/l	10-0599F	Site # 6	03/15/10	03/15/10	03/17/10	1875	10	11300	0.3	1	2214	2040	92%	92-111
NOx	µg/l	10-1038F	SP 27	05/04/10	05/04/10	05/05/10	2025	10	11300	0.1	1	2138	2203	103%	92-111
NOx	µg/l	10-1673F	SP37 Field Dup	07/07/10	07/07/10	07/08/10	50	10	11300	0.05	1	106.5	110	103%	92-111
NOx	µg/l	10-1970F	SP 37	08/06/10	08/06/10	08/06/10	250	10	22600	0.1	1	476	483	101%	92-111
Total N	µg/l	09-2437	SP #32	08/04/09	08/04/09	10/27/09	3059	5	100000	0.05	1	4059.0	5096	126%	90-110
Total N	µg/l	09-3556F	SP #35	10/06/09	10/06/09	12/07/09	3130	5	100000	0.05	1	4130.0	5369	130%	90-110
Total N	µg/l	09-4101FP	SP #34	11/30/09	11/30/09	12/22/09	7900	5	226000	0.05	1	10160.0	10236	101%	90-110
Total N	µg/l	10-1038P	SP 27	05/04/10	05/04/10	05/12/10	3230	5	226000	0.05	1	5490	5417	99%	90-110
Total N	µg/l	10-1673P	SP37 Field Dup	07/07/10	07/07/10	07/20/10	1390	5	226000	0.1	1	5910	6001	102%	90-110
Total N	µg/l	10-1663P	FCEB	07/07/10	07/07/10	07/27/10	42	5	226000	0.1	1	4562	4802	105%	90-110
Total N	µg/l	10-1972P	SP 39	08/06/10	08/03/10	08/16/06	1687	5	11300	0.02	1	1732	1699	98%	90-110
Total P	µg/l	09-2844	SP #17	08/31/09	08/31/09	09/26/09	102	5	50000	0.05	1	602	94.0	16%	94-106
Total P	µg/l	09-2437	SP #32	08/04/09	08/04/09	10/27/09	84	5	50000	0.05	1	584	544.0	93%	94-106
Total P	µg/l	09-3556F	SP #35	10/06/09	10/06/09	12/07/09	403	5	50000	0.05	1	903	947.0	105%	94-106
Total P	µg/l	09-4101FP	SP #34	11/30/09	11/30/09	12/22/09	831	5	50000	0.05	1	1331	1275.0	96%	94-106
Total P	µg/l	0-1038P RED	SP 27	05/04/10	05/04/10	06/24/10	327	5	50000	0.1	1	1327	1307.0	98%	94-106
Total P	µg/l	10-1673P	SP37 Field Dup	07/07/10	07/07/10	07/20/10	28	5	50000	0.05	1	528	560.0	106%	94-106
Total P	µg/l	10-1663P	FCEB	07/07/10	07/07/10	07/27/10	0.1	5	50000	0.05	1	500.1	512.0	102%	94-106
Total P	µg/l	10-1972P	SP 39	08/06/10	08/03/10	08/16/10	54	5	2000	0.04	1	70	68.0	97%	94-106
Ammonia	µg/l	09-2429p	SP #18	08/04/09	08/04/09	08/18/09	83	10	100000	0.15	1	1583	1682.0	106%	80-120
Ammonia	µg/l	09-2846p	SP #19	08/31/09	08/31/09	09/18/09	1294	10	100000	0.1	1	2544	2298.0	90%	80-120
Ammonia	µg/l	09-3558p	SP #38	10/06/09	10/06/09	10/29/09	5430	10	100000	0.1	1	6430	6215.0	97%	80-120
Ammonia	µg/l	09-4088P	SP #13	11/30/09	11/30/09	12/18/09	3333	10	100000	0.1	1	4333	4402.0	102%	80-120
Ammonia	µg/l	10-1038P	SP 27	05/04/10	05/04/10	05/12/10	358	10	100000	1.0	1	1280.0	1358	106%	80-120
Color	PCU	09-3547	SP10	10/06/09	10/06/09	10/09/09	73	25	500	0.75	5	148.0	149	101%	80-120
Color	PCU	09-3560	SP40	10/06/09	10/06/09	10/16/09	49	25	500	0.75	5	124.0	119	96%	80-120
Color	PCU	09-4088	SP 13	11/30/09	11/30/09	12/04/09	58	25	500	1	5	158.0	158	100%	80-120
Color	PCU	09-4160	SP 40	11/30/09	11/30/09	12/08/09	52	25	500	1	5	152.0	152	100%	80-120

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FOR LAKE JESUP SEEPAGE COLLECTED FROM
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PARAMETERS	UNITS	SAMPLE DESCRIPTION	DATE PREPPED	DATE ANALYZED	ACTUAL CONC.	THEOR. CONC.	% RECOVERY	ACCEPTANCE RANGE
Alkalinity	mg/l	CCV	10/06/09	10/06/09	8.2	8.4	98%	87.4-110%
Alkalinity	mg/l	CCV	10/06/09	10/06/09	8.4	8.8	95%	87.4-110%
Alkalinity	mg/l	CCV	12/03/09	12/03/09	8.2	8.6	95%	87.4-110%
Alkalinity	mg/l	CCV	12/03/09	12/03/09	7.8	8.1	96%	87.4-110%
Alkalinity	mg/l	CCV	12/04/09	12/04/09	8.6	8.6	100%	87.4-110%
Alkalinity	mg/l	CCV	08/05/09	08/05/09	10.8	11.0	98%	87.4-110%
Alkalinity	mg/l	CCV	08/05/09	08/05/09	10.8	10.0	108%	87.4-110%
Alkalinity	mg/l	CCV	08/05/09	08/05/09	11.0	10.6	104%	87.4-110%
Alkalinity	mg/l	CCV	09/02/09	09/02/09	10.0	10.8	93%	87.4-110%
Alkalinity	mg/l	CCV	09/02/09	09/02/09	10.0	10.6	94%	87.4-110%
Alkalinity	mg/l	CCV	07/08/10	07/08/10	8.8	8.6	102%	87.4-110%
Alkalinity	mg/l	CCV	03/28/10	03/28/10	6.6	6.8	97%	87.4-110%
Alkalinity	mg/l	CCV	07/08/10	07/08/10	8.8	8.6	102%	87.4-110%
Alkalinity	mg/l	CCV	05/05/10	05/05/10	4.4	4.6	96%	87.4-110%
Alkalinity	mg/l	CCV	03/28/10	03/28/10	6.6	6.8	97%	87.4-110%
Alkalinity	mg/l	CCV	05/05/10	05/05/10	4.4	4.6	96%	87.4-110%
Alkalinity	mg/l	CCV	04/06/10	04/06/10	4.2	4.2	100%	87.4-110%
Alkalinity	mg/l	CCV	05/05/10	05/05/10	4.4	4.6	96%	87.4-110%
Alkalinity	mg/l	CCV	08/06/10	08/06/10	8.8	8.6	102%	87.4-110%
SRP	μg/l	CCV	08/06/09	08/06/09	110	100	110%	90-110%
SRP	μg/l	CCV	08/06/09	08/06/09	113	100	113%	90-110%
SRP	μg/l	CCV	09/03/09	09/03/09	116	125	93%	90-110%
SRP	μg/l	CCV	10/07/09	10/07/09	118	125	94%	90-110%
SRP	μg/l	CCV	10/07/09	10/07/09	90	100	90%	90-110%
SRP	μg/l	CCV	12/02/09	12/02/09	102	100	102%	90-110%
SRP	μg/l	CCV	12/02/09	12/02/09	108	100	108%	90-110%
SRP	μg/l	CCV	12/02/09	12/02/09	95	100	95%	90-110%
SRP	μg/l	CCV	03/17/10	03/17/10	107	100	107%	90-110%
SRP	μg/l	CCV	03/17/10	03/17/10	95	100	95%	90-110%
SRP	μg/l	CCV	03/26/10	03/26/10	99	100	99%	90-110%
SRP	μg/l	CCV	03/26/10	03/26/10	102	100	102%	90-110%
SRP	μg/l	CCV	05/05/10	05/05/10	94	100	94%	90-110%
SRP	μg/l	CCV	05/05/10	05/05/10	100	100	100%	90-110%
SRP	μg/l	CCV	07/08/10	07/08/10	99	100	99%	90-110%
SRP	μg/l	CCV	07/08/10	07/08/10	102	100	102%	90-110%
SRP	μg/l	CCV	08/06/10	08/06/10	98	100	98%	90-110%
NOx	μg/l	CCV	08/06/09	08/06/09	945	1000	95%	90-110%
NOx	μg/l	CCV	08/06/09	08/06/09	950	1000	95%	90-110%
NOx	μg/l	CCV	09/03/09	09/03/09	917	1000	92%	90-110%

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FOR LAKE JESUP SEEPAGE COLLECTED FROM AUGUST 2009 to AUGUST 2010

NOx	µg/l	CCV	10/07/09	10/07/09	950	1000	95%	90-110%
NOx	µg/l	CCV	10/07/09	10/07/09	1929	2000	96%	90-110%
NOx	µg/l	CCV	12/02/09	12/02/09	1910	2000	96%	90-110%
NOx	µg/l	CCV	12/02/09	12/02/09	1910	2000	96%	90-110%
NOx	µg/l	CCV	12/02/09	12/02/09	1928	2000	96%	90-110%
NOx	µg/l	CCV	03/17/10	03/17/10	1970	2000	99%	90-110%
NOx	µg/l	CCV	03/17/10	03/17/10	2044	2000	102%	90-110%
NOx	µg/l	CCV	03/26/10	03/26/10	1986	2000	99%	90-110%
NOx	µg/l	CCV	03/26/10	03/26/10	1986	2000	99%	90-110%
NOx	µg/l	CCV	05/05/10	05/05/10	1958	2000	98%	90-110%
NOx	µg/l	CCV	05/05/10	05/05/10	1946	2000	97%	90-110%
NOx	µg/l	CCV	07/08/10	07/08/10	1911	2000	96%	90-110%
NOx	µg/l	CCV	07/08/10	07/08/10	1925	2000	96%	90-110%
NOx	µg/l	CCV	08/06/10	08/06/10	1866	2000	93%	90-110%
Total N	µg/l	CCV	09/26/09	09/26/09	370	400	93%	90-110%
Total N	µg/l	CCV	09/26/09	09/26/09	1200	1000	120%	90-110%
Total N	µg/l	CCV	10/27/09	10/27/09	2038	2000	102%	90-110%
Total N	µg/l	CCV	10/27/09	10/27/09	2013	2000	101%	90-110%
Total N	µg/l	CCV	12/07/09	12/07/09	1925	2000	96%	90-110%
Total N	µg/l	CCV	12/07/09	12/07/09	1986	2000	99%	90-110%
Total N	µg/l	CCV	12/22/09	12/22/09	1967	2000	98%	90-110%
Total N	µg/l	CCV	12/22/09	12/22/09	1919	2000	96%	90-110%
Total N	µg/l	CCV	04/02/10	04/02/10	2034	2000	102%	90-110%
Total N	µg/l	CCV	04/15/10	04/15/10	1918	2000	96%	90-110%
Total N	µg/l	CCV	05/12/10	05/12/10	1963	2000	98%	90-110%
Total N	µg/l	CCV	05/12/10	05/12/10	1983	2000	99%	90-110%
Total N	µg/l	CCV	07/13/10	07/13/10	2148	2000	107%	90-110%
Total N	µg/l	CCV	07/20/10	07/20/10	2091	2000	105%	90-110%
Total N	µg/l	CCV	07/27/10	07/27/10	2034	2000	102%	90-110%
Total N	µg/l	CCV	08/16/10	08/16/10	1792	1750	102%	90-110%
Total N	µg/l	CCV	08/16/10	08/16/10	1682	1750	96%	90-110%
Total N	µg/l	CCV	02/02/10	02/02/10	1410	1500	94%	90-110%
Total N	µg/l	CCV	02/02/10	02/02/10	1431	1500	95%	90-110%
Total P	µg/l	CCV	09/26/09	09/26/09	1621	1500	108%	90-110%
Total P	µg/l	CCV	09/26/09	09/26/09	1570	1500	105%	90-110%
Total P	µg/l	CCV	10/27/09	10/27/09	1550	1500	103%	90-110%
Total P	µg/l	CCV	10/27/09	10/27/09	1596	1500	106%	90-110%
Total P	µg/l	CCV	12/07/09	12/07/09	1540	1500	103%	90-110%
Total P	µg/l	CCV	12/07/09	12/07/09	1616	1500	108%	90-110%
Total P	µg/l	CCV	12/22/09	12/22/09	1577	1500	105%	90-110%
Total P	µg/l	CCV	12/22/09	12/22/09	2195	2000	110%	90-110%
Total P	µg/l	CCV	05/12/10	05/12/10	189	200	95%	90-110%

Continuing Calbration Verification Recovery

FOR LAKE JESUP SEEPAGE COLLECTED FROM AUGUST 2009 to AUGUST 2010

Total P	µg/l	CCV	05/12/10	05/12/10	194	200	97%	90-110%
Total P	µg/l	CCV	07/13/10	07/13/10	192	200	96%	90-110%
Total P	µg/l	CCV	07/20/10	07/20/10	211	200	106%	90-110%
Total P	µg/l	CCV	07/27/10	07/27/10	203	200	102%	90-110%
Total P	µg/l	CCV	08/16/10	08/16/10	209	200	105%	90-110%
Total P	µg/l	CCV	08/16/10	08/16/10	202	200	101%	90-110%
Total P	µg/l	CCV	02/02/10	02/02/10	191	200	96%	90-110%
Total P	µg/l	CCV	02/02/10	02/02/10	206	200	103%	90-110%
Total P	µg/l	CCV	02/02/10	02/02/10	191	200	96%	90-110%
Total P	µg/l	CCV	02/02/10	02/02/10	193	200	97%	90-110%
Ammonia	µg/l	CCV	08/18/09	08/18/09	944	1000	94%	90-110%
Ammonia	µg/l	CCV	08/18/09	08/18/09	973	1000	97%	90-110%
Ammonia	µg/l	CCV	08/18/09	08/18/09	991	1000	99%	90-110%
Ammonia	µg/l	CCV	09/18/09	09/18/09	1025	1000	103%	90-110%
Ammonia	µg/l	CCV	09/18/09	09/18/09	958	1000	96%	90-110%
Ammonia	µg/l	CCV	10/29/09	10/29/09	964	1000	96%	90-110%
Ammonia	µg/l	CCV	10/29/09	10/29/09	981	1000	98%	90-110%
Ammonia	µg/l	CCV	12/18/09	12/18/09	980	1000	98%	90-110%
Ammonia	µg/l	CCV	12/18/09	12/18/09	968	1000	97%	90-110%
Ammonia	µg/l	CCV	03/25/10	03/25/10	1048	1000	105%	90-110%
Ammonia	µg/l	CCV	03/25/10	03/25/10	1042	1000	104%	90-110%
Ammonia	µg/l	CCV	05/12/10	05/12/10	1035	1000	104%	90-110%
Ammonia	µg/l	CCV	05/12/10	05/12/10	1056	1000	106%	90-110%
Ammonia	µg/l	CCV	07/15/10	07/15/10	1025	1000	103%	90-110%
Ammonia	µg/l	CCV	08/19/10	08/19/10	1029	1000	103%	90-110%
Color	PCU	CCV	09/03/09	09/03/09	20	20	100%	85-115%
Color	PCU	CCV	10/06/09	10/06/09	20	20	100%	85-115%
Color	PCU	CCV	10/06/09	10/06/09	20	20	100%	85-115%
Color	PCU	CCV	10/06/09	10/06/09	20	20	100%	85-115%
Color	PCU	CCV	11/30/09	11/30/09	15	15	100%	85-115%
Color	PCU	CCV	11/30/09	11/30/09	15	15	100%	85-115%
Color	PCU	CCV	11/30/09	11/30/09	15	15	100%	85-115%
Color	PCU	CCV	03/16/10	03/16/10	15	15	100%	85-115%
Color	PCU	CCV	03/16/10	03/16/10	40	40	100%	85-115%
Color	PCU	CCV	03/26/10	03/26/10	40	40	100%	85-115%
Color	PCU	CCV	05/06/10	05/06/10	40	40	100%	85-115%
Color	PCU	CCV	05/06/10	05/06/10	40	40	100%	85-115%
Color	PCU	CCV	07/08/10	07/08/10	40	40	100%	85-115%
Color	PCU	CCV	07/08/10	07/08/10	40	40	100%	85-115%
Color	PCU	CCV	08/06/10	08/06/10	40	40	100%	85-115%
Color	PCU	CCV	08/06/10	08/06/10	40	40	100%	85-115%
Color	PCU	CCV	08/06/10	08/06/10	40	40	100%	85-115%

Laboratory Control Standard Recovery

FOR LAKE JESUP SEEPAGE COLLECTED FROM AUGUST 2009 to AUGUST 2010

PARAMETERS	UNITS	SAMPLE DESCRIPTION	DATE PREPPED	DATE ANALYZED	ACTUAL CONC.	THEOR. CONC.	% RECOVERY	ACCEPTANCE RANGE (%)
Alkalinity	mg/l	LCS	08/05/09	08/05/09	10.4	10.6	98%	95.6 - 105
Alkalinity	mg/l	LCS	09/02/09	09/02/09	10.4	10.4	100%	95.6 - 105
Alkalinity	mg/l	LCS	10/06/09	10/06/09	8.8	8.8	100%	95.6 - 105
Alkalinity	mg/l	LCS	10/30/09	10/30/09	8.8	8.8	100%	95.6 - 105
Alkalinity	mg/l	LCS	03/28/10	03/28/10	10.8	10.6	102%	95.6 - 105
Alkalinity	mg/l	LCS	05/05/10	05/05/10	10.6	10.8	98%	95.6 - 105
Alkalinity	mg/l	LCS	07/08/10	07/08/10	6.4	6.2	103%	95.6 - 105
Alkalinity	mg/l	LCS	03/28/10	03/28/10	6.4	6.2	103%	95.6 - 105
Alkalinity	mg/l	LCS	04/06/10	04/06/10	6.2	6.0	103%	95.6 - 105
Alkalinity	mg/l	LCS	04/06/10	04/06/10	6.2	6.0	103%	95.6 - 105
SRP	µg/l	LCS	08/06/09	08/06/09	227	250	91%	90-110
SRP	µg/l	LCS	10/07/09	10/07/09	471	450	105%	90-110
SRP	µg/l	LCS	12/02/09	12/02/09	472	450	105%	90-110
SRP	µg/l	LCS	03/17/10	03/17/10	490	500	98%	90-110
SRP	µg/l	LCS	05/05/10	05/05/10	211	200	106%	90-110
SRP	µg/l	LCS	07/08/10	07/08/10	754	800	94%	90-110
SRP	µg/l	LCS	08/06/10	08/06/10	207	200	104%	90-110
NOx	µg/l	LCS	08/06/09	08/06/09	999	1000	100%	90-110
NOx	µg/l	LCS	03/17/10	03/17/10	204	200	102%	90-110
NOx	µg/l	LCS	05/05/10	05/05/10	739	800	92%	90-110
NOx	µg/l	LCS	07/08/10	07/08/10	462	500	92%	90-110
NOx	µg/l	LCS	08/06/10	08/06/10	479	500	96%	90-110
Total N	µg/l	LCS	10/27/09	10/27/09	4186	4000	105%	90-110
Total N	µg/l	LCS	12/07/09	12/07/09	1918	2000	96%	90-110
Total N	µg/l	LCS	12/22/09	12/22/09	3156	3000	105%	90-110
Total N	µg/l	LCS	05/12/10	05/12/10	3970	3616	110%	90-110
Total N	µg/l	LCS	07/20/10	07/20/10	4656	4520	103%	90-110
Total N	µg/l	LCS	07/27/10	07/27/10	5154	5424	95%	90-110
Total N	µg/l	LCS	08/16/06	08/16/06	5158	5424	95%	90-110
Total P	µg/l	LCS	09/26/09	09/26/09	697	652	107%	90-110
Total P	µg/l	LCS	10/27/09	10/27/09	1167	1141	102%	90-110
Total P	µg/l	LCS	12/07/09	12/07/09	1267	1304	97%	90-110
Total P	µg/l	LCS	12/22/09	12/22/09	1053	1000	105%	90-110
Total P	µg/l	LCS	06/24/10	06/24/10	535	500	107%	90-110
Total P	µg/l	LCS	07/20/10	07/20/10	524	500	105%	90-110
Total P	µg/l	LCS	07/27/10	07/27/10	496	500	99%	90-110
Total P	µg/l	LCS	08/16/10	08/16/10	603	600	101%	90-110

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Ammonia	μg/l	LCS	08/18/09	08/18/09	1323	1500	88%	80-120
Ammonia	μg/l	LCS	09/18/09	09/18/09	1351	1500	90%	80-120
Ammonia	μg/l	LCS	10/29/09	10/29/09	586	575	102%	80-120
Ammonia	μg/l	LCS	12/18/09	12/18/09	698	617	113%	80-120
Ammonia	μg/l	LCS	05/12/10	05/12/10	560	575	97%	80-120
Color	PCU	LCS	10/09/09	10/09/09	15	15	100%	85-115
Color	PCU	LCS	10/16/09	10/16/09	15	15	100%	85-115
Color	PCU	LCS	12/04/09	12/04/09	19	20	95%	85-115
Color	PCU	LCS	12/08/09	12/08/09	19	20	95%	85-115

METHOD BLANK RECOVERY

FOR LAKE JESUP SEEPAGE SAMPLES COLLECTED FROM OCTOBER 2009 to MARCH 2010

PARAMETERS	UNITS	SAMPLE DESCRIPTION	DATE PREPPED	DATE ANALYZED	ACTUAL CONC.	ACCEPTANCE RANGE
Alkalinity	mg/l	Method Blank	10/06/09	10/06/09	0.6	<1
Alkalinity	mg/l	Method Blank	10/06/09	10/06/09	0.4	<1
Alkalinity	mg/l	Method Blank	12/03/09	12/03/09	0.4	<1
Alkalinity	mg/l	Method Blank	12/03/09	12/03/09	0.6	<1
Alkalinity	mg/l	Method Blank	12/04/09	12/04/09	0.6	<1
Alkalinity	mg/l	Method Blank	08/05/09	08/05/09	0.6	<1
Alkalinity	mg/l	Method Blank	08/05/09	08/05/09	0.6	<1
Alkalinity	mg/l	Method Blank	08/05/09	08/05/09	0.6	<1
Alkalinity	mg/l	Method Blank	09/02/09	09/02/09	0.6	<1
Alkalinity	mg/l	Method Blank	09/02/09	09/02/09	0.4	<1
Alkalinity	mg/l	Method Blank	07/08/10	07/08/10	0.8	<1
Alkalinity	mg/l	Method Blank	03/28/10	03/28/10	0.8	<1
Alkalinity	mg/l	Method Blank	07/08/10	07/08/10	0.6	<1
Alkalinity	mg/l	Method Blank	05/05/10	05/05/10	0.6	<1
Alkalinity	mg/l	Method Blank	03/28/10	03/28/10	0.8	<1
Alkalinity	mg/l	Method Blank	05/05/10	05/05/10	0.4	<1
Alkalinity	mg/l	Method Blank	04/06/10	04/06/10	0.4	<1
Alkalinity	mg/l	Method Blank	05/05/10	05/05/10	0.4	<1
Alkalinity	mg/l	Method Blank	08/06/10	08/06/10	0.4	<1
SRP	µg/l	Method Blank	08/06/09	08/06/09	0	0
SRP	µg/l	Method Blank	08/06/09	08/06/09	0	0
SRP	µg/l	Method Blank	09/03/09	09/03/09	0	0
SRP	µg/l	Method Blank	10/07/09	10/07/09	0	0
SRP	µg/l	Method Blank	10/07/09	10/07/09	0	0
SRP	µg/l	Method Blank	12/02/09	12/02/09	0	0
SRP	µg/l	Method Blank	12/02/09	12/02/09	0	0
SRP	µg/l	Method Blank	12/02/09	12/02/09	0	0
SRP	µg/l	Method Blank	03/17/10	03/17/10	0	0
SRP	µg/l	Method Blank	03/17/10	03/17/10	0	0
SRP	µg/l	Method Blank	03/26/10	03/26/10	0	0
SRP	µg/l	Method Blank	03/26/10	03/26/10	0	0
SRP	µg/l	Method Blank	05/05/10	05/05/10	0	0
SRP	µg/l	Method Blank	05/05/10	05/05/10	0	0
SRP	µg/l	Method Blank	07/08/10	07/08/10	0	0
SRP	µg/l	Method Blank	07/08/10	07/08/10	0	0
SRP	µg/l	Method Blank	08/06/10	08/06/10	0	0

METHOD BLANK RECOVERY

FOR LAKE JESUP SEEPAGE SAMPLES COLLECTED FROM OCTOBER 2009 to MARCH 2010

NOx	μg/l	Method Blank	08/06/09	08/06/09	0	0
NOx	μg/l	Method Blank	08/06/09	08/06/09	0	0
NOx	μg/l	Method Blank	09/03/09	09/03/09	0	0
NOx	μg/l	Method Blank	10/07/09	10/07/09	0	0
NOx	μg/l	Method Blank	10/07/09	10/07/09	0	0
NOx	μg/l	Method Blank	12/02/09	12/02/09	0	0
NOx	μg/l	Method Blank	12/02/09	12/02/09	0	0
NOx	μg/l	Method Blank	12/02/09	12/02/09	0	0
NOx	μg/l	Method Blank	03/17/10	03/17/10	0	0
NOx	μg/l	Method Blank	03/17/10	03/17/10	0	0
NOx	μg/l	Method Blank	03/26/10	03/26/10	0	0
NOx	μg/l	Method Blank	03/26/10	03/26/10	0	0
NOx	μg/l	Method Blank	05/05/10	05/05/10	0	0
NOx	μg/l	Method Blank	05/05/10	05/05/10	0	0
NOx	μg/l	Method Blank	07/08/10	07/08/10	0	0
NOx	μg/l	Method Blank	07/08/10	07/08/10	0	0
NOx	μg/l	Method Blank	08/06/10	08/06/10	0	0
Total N	μg/l	Method Blank	09/26/09	09/26/09	0	0
Total N	μg/l	Method Blank	09/26/09	09/26/09	0	0
Total N	μg/l	Method Blank	10/27/09	10/27/09	0	0
Total N	μg/l	Method Blank	10/27/09	10/27/09	0	0
Total N	μg/l	Method Blank	12/07/09	12/07/09	0	0
Total N	μg/l	Method Blank	12/07/09	12/07/09	0	0
Total N	μg/l	Method Blank	12/22/09	12/22/09	0	0
Total N	μg/l	Method Blank	12/22/09	12/22/09	0	0
Total N	μg/l	Method Blank	04/02/10	04/02/10	0	0
Total N	μg/l	Method Blank	04/15/10	04/15/10	0	0
Total N	μg/l	Method Blank	05/12/10	05/12/10	0	0
Total N	μg/l	Method Blank	05/12/10	05/12/10	0	0
Total N	μg/l	Method Blank	07/13/10	07/13/10	0	0
Total N	μg/l	Method Blank	07/20/10	07/20/10	0	0
Total N	μg/l	Method Blank	07/27/10	07/27/10	0	0
Total N	μg/l	Method Blank	08/16/10	08/16/10	0	0
Total N	μg/l	Method Blank	08/16/10	08/16/10	0	0
Total N	μg/l	Method Blank	02/02/10	02/02/10	0	0
Total N	μg/l	Method Blank	02/02/10	02/02/10	0	0
Total P	μg/l	Method Blank	09/26/09	09/26/09	0	0
Total P	μg/l	Method Blank	09/26/09	09/26/09	0	0
Total P	μg/l	Method Blank	10/27/09	10/27/09	0	0
Total P	μg/l	Method Blank	10/27/09	10/27/09	0	0

METHOD BLANK RECOVERY

FOR LAKE JESUP SEEPAGE SAMPLES COLLECTED FROM OCTOBER 2009 to MARCH 2010

Total P	µg/l	Method Blank	12/07/09	12/07/09	0	0
Total P	µg/l	Method Blank	12/07/09	12/07/09	0	0
Total P	µg/l	Method Blank	12/22/09	12/22/09	0	0
Total P	µg/l	Method Blank	12/22/09	12/22/09	0	0
Total P	µg/l	Method Blank	05/12/10	05/12/10	0	0
Total P	µg/l	Method Blank	05/12/10	05/12/10	0	0
Total P	µg/l	Method Blank	07/13/10	07/13/10	0	0
Total P	µg/l	Method Blank	07/20/10	07/20/10	0	0
Total P	µg/l	Method Blank	07/27/10	07/27/10	0	0
Total P	µg/l	Method Blank	08/16/10	08/16/10	0	0
Total P	µg/l	Method Blank	08/16/10	08/16/10	0	0
Total P	µg/l	Method Blank	02/02/10	02/02/10	0	0
Total P	µg/l	Method Blank	02/02/10	02/02/10	0	0
Total P	µg/l	Method Blank	02/02/10	02/02/10	0	0
Total P	µg/l	Method Blank	02/02/10	02/02/10	0	0
Ammonia	µg/l	Method Blank	08/18/09	08/18/09	0	0
Ammonia	µg/l	Method Blank	08/18/09	08/18/09	0	0
Ammonia	µg/l	Method Blank	08/18/09	08/18/09	0	0
Ammonia	µg/l	Method Blank	09/18/09	09/18/09	0	0
Ammonia	µg/l	Method Blank	09/18/09	09/18/09	0	0
Ammonia	µg/l	Method Blank	10/29/09	10/29/09	0	0
Ammonia	µg/l	Method Blank	10/29/09	10/29/09	0	0
Ammonia	µg/l	Method Blank	12/18/09	12/18/09	0	0
Ammonia	µg/l	Method Blank	12/18/09	12/18/09	0	0
Ammonia	µg/l	Method Blank	03/25/10	03/25/10	0	0
Ammonia	µg/l	Method Blank	03/25/10	03/25/10	0	0
Ammonia	µg/l	Method Blank	05/12/10	05/12/10	0	0
Ammonia	µg/l	Method Blank	05/12/10	05/12/10	0	0
Ammonia	µg/l	Method Blank	07/15/10	07/15/10	0	0
Ammonia	µg/l	Method Blank	08/19/10	08/19/10	0	0
Color	PCU	Method Blank	09/03/09	09/03/09	<1	<1
Color	PCU	Method Blank	10/06/09	10/06/09	<1	<1
Color	PCU	Method Blank	10/06/09	10/06/09	<1	<1
Color	PCU	Method Blank	10/06/09	10/06/09	<1	<1
Color	PCU	Method Blank	11/30/09	11/30/09	<1	<1
Color	PCU	Method Blank	11/30/09	11/30/09	<1	<1
Color	PCU	Method Blank	11/30/09	11/30/09	<1	<1
Color	PCU	Method Blank	03/16/10	03/16/10	<1	<1
Color	PCU	Method Blank	03/16/10	03/16/10	<1	<1
Color	PCU	Method Blank	03/26/10	03/26/10	<1	<1

METHOD BLANK RECOVERY
FOR LAKE JESUP SEEPAGE SAMPLES COLLECTED FROM OCTOBER 2009 to MARCH 2010

Color	PCU	Method Blank	05/06/10	05/06/10	<1	<1
Color	PCU	Method Blank	05/06/10	05/06/10	<1	<1
Color	PCU	Method Blank	07/08/10	07/08/10	<1	<1
Color	PCU	Method Blank	07/08/10	07/08/10	<1	<1
Color	PCU	Method Blank	08/06/10	08/06/10	<1	<1
Color	PCU	Method Blank	08/06/10	08/06/10	<1	<1
Color	PCU	Method Blank	08/06/10	08/06/10	<1	<1