2010 Lake Las Vegas Water Quality Monitoring Report

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ndep
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I. INTRODUCTION

J. Carlton Adair conceived the idea of Lake Las Vegas in 1964. The project consisted of a 2,243-acre development project and a lake called Lake Adair. In 1988 Transcontinental Corporation of Santa Barbara, California, acquired controlling interest in the project and began construction on April 1, 1989. The 320 acre Lake is owned and operated by Lake Las Vegas Master Association. The Lake is part of a 3,592 acre residential and commercial development called Lake Las Vegas Resort (LLVR). LLVR is located less than 25 miles from both McCarran Airport and the Las Vegas Strip (**Figure 1**).

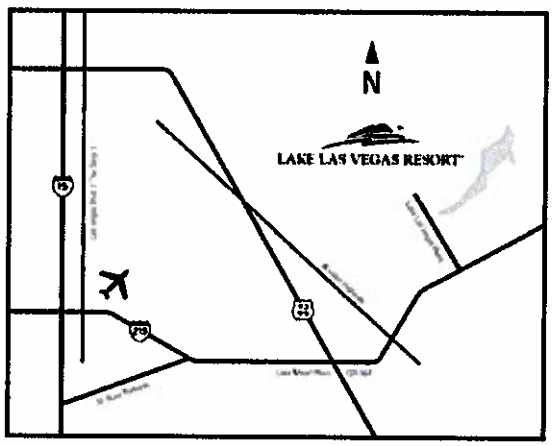

Figure 1. Location of Lake Las Vegas Resort, Clark County, Nevada.

At an elevation of 1,405.9 feet (ft) North American Vertical Datum (NAVD88), the Lake has a storage capacity of approximately 10,000 acre-feet (AF), comprising approximately of a two-mile length, a one-mile width, and 12.3 miles of shoreline. **Table 1** shows further details of the geometric characteristics of Lake Las Vegas (the Lake). Lake fill water is drawn from Lake Mead, and conveyed by the Basic Water Company (BWC) Pipeline. To meet the demands of irrigation, seepage, and evaporation approximately 7,000 AF of fill water must be added to the Lake each year.

Table 1. Approximate Geometric characteristics* of Lake Las Vegas, Clark County, Nevada.

Characteristic	Measurement
Drainage Area	1,800 square miles
Surface Area	320 acres
Maximum Length	2.1 miles
Maximum Width	1.0 miles
Maximum Depth	150 feet
Average Depth	33 feet
Volume	10,700 acre-feet
Length of Shoreline	12.6 miles

*Based on www.lakelasvegas.com/LLVResortFastFacts.pdf

Approved by the Clark County Board of County Commissioners on April 5, 1988 and certified by the State of Nevada on August 8, 1988, the approved Clark County 208 Water Quality Management Plan required a water quality-monitoring program to be developed for Lake Las Vegas. The water quality monitoring program was implemented to ensure that the Lake water's quality is maintained based on the water quality guidelines established for Lake Mead per the Nevada Administrative Code (NAC) as part of County 208 Amendment dated June 4, 1990, in order to enhance the following beneficial uses at Lake Las Vegas:

1) Irrigation
2) Recreation not involving contact with the water (boating, sailing, canoeing),
3) Recreation involving contact with the water (swimming, bathing, diving),
4) Propagation of wildlife and propagation of aquatic life, including a warm water fishery

The following are the guidelines as described in the County 208 Amendment, that the Lake water should adhere to.

1. The Lake waters should be free of:
    a. Visible floating, suspended, or settlable solids,
    b. Sludge banks, lime infestations, heavy growths of attached plants (Periphyton) and animals, or of floating algae mats,
    c. Discoloration or excessive turbidity,
    d. Visible oil or slicks,
    e. Surfactant concentrations that produce foam when water is agitated or aerated,
    f. Toxicants in toxic amounts;
2. The pH as measured in standard units should range between 7.0 and 9.0 in 90% of the measurements.
3. Dissolved oxygen concentrations should be 5 milligrams per liter (mg/L) in the epilimnion during stratification, and 5 mg/L throughout the water column the rest of the year.
4. The average chlorophyll-a concentration in the epilimnion (0-2.5 meters) should not exceed 0.005 mg/L during April through September. The average must include at least two samples per month. The single value must not exceed .010 mg/L in 10% of the samples.
5. In all Lake areas, the log mean of not less than five fecal coliform samples taken over a 30 day period during the recreational season (April-September) should not exceed 200 the most probable number (MPN)/100 milliliter (mL) and not over 10% of such samples should exceed 400 MPN/100 mL;
6. Average temperature in the epilimnion should not exceed 2°C above ambient temperature (e.g. temperature in epilimnion in Lake Mead)
7. Total dissolved solids concentrations should not exceed an annual average of 2,000 mg/L throughout the water column;
8. Turbidity must not exceed that characteristic of natural conditions by more than 10 Nephelometric Turbidity Units (NTU).

Since June 1991, Lake Las Vegas has submitted annual reports to the Nevada Division of Environmental Protection for review. Through 2007, water quality monitoring was performed monthly in January, February, November, and December, biweekly in March and October, and weekly during the months from April through September at four sites within the Lake.

In 2008, the water sampling protocol was changed to monthly sampling and approved by the Nevada Division of Environmental Protection. The water quality sampling locations were reduced to two sites LLV-1A and LLV-3 (**Figure 2**) and the new program required Lake water sampling to be done at varying depths instead of the conventional sampling from water surface at all the sites. These modifications to the previous water monitoring protocol were made in order to better understand the overall limnological response of the reservoir besides understanding the surface water quality.

In 2010, the water sampling protocol was temporarily modified to biweekly sampling at Site LLV-1A to better monitor the water quality and changes in plankton populations due to a phytoplankton (*Prymnesium parvum*) bloom. Sampling frequencies for field, biological, and chemical samples changed between weekly, bi-weekly, and monthly (**Table 2**). Site LLV-3 was only sampled from January to March, and therefore the 2010 report addresses water quality at LLV-1A only.

Figure 2. Water Quality monitoring sites at Lake Las Vegas.

Table 2. 2010 Lake Las Vegas sampling frequencies at site LLV-1A.

Month	Physical	Plankton	Chemical
January	Bi-Weekly	Bi-Weekly	Monthly
February	Monthly	Monthly	Monthly
March	Weekly	Weekly	Monthly
April	Weekly	Weekly	Bi-Weekly
May	Weekly	Weekly	Bi-Weekly
June	Weekly	Weekly	Bi-Weekly
July	Weekly	Bi-Weekly	Bi-Weekly
August	Weekly	Bi-Weekly	Bi-Weekly
September	Bi-Weekly	Bi-Weekly	Bi-Weekly
October	Bi-Weekly	Bi-Weekly	Bi-Weekly
November	Bi-Weekly	Bi-Weekly	Bi-Weekly
December	Monthly	Monthly	Monthly

II. METHODS

A. Lake Las Vegas Monitoring Sites

In accordance with the water quality monitoring protocol, vertical sampling was performed at 0 meters (m), 5m, 10m, and 20m depths at site LLV-1A (**Figure 2**).

B. Field Measurements

Temperature, dissolved oxygen, pH, and specific conductance were measured throughout the vertical column at LLV-1A with a Hydrolab Surveyor Model 4, a Water Quality Analyzer, or an YSI Water Quality Analyzer (**Table 3**). Transparency was measured at each Lake site with a Secchi disc. Duplicate measurements were made on approximately 10 percent of the measurements.

Table 3. 2010 Lake Las Vegas physical, chemical and biological analyses methods.

Sampling Program			
Measurements	Depth(s)	Frequency	Method(s)
Physical			
Temperature (°C)	1.0 m Intervals Surface to Bottom	Variable	Electronic Multimeter
Dissolved Oxygen (mg/L)	"	"	"
pH (Std. Units)	"	"	"
Conductivity (µmhos/cm)	"	"	"
Secchi Depth (m)	Variable	"	EPA 1991
Turbidity (NTU)	0 - 2.5 m Integrated	"	EPA 180.1

Sampling Program (continued)			
Measurements	Depth(s)	Frequency	Method(s)
Chemical			
Total Nitrogen (μg/L)	0 - 2.5 m Integrated	"	SM 4500.N
Ammonia-N (μg/L)	"	"	EPA 350.2
Total Kjeldehl Nitrogen (TKN) (μg/L)	"	"	EPA 351.3
Total Phosphorus (μg/L)	"	"	EPA 365.2
Ortho-Phosphorus (μg/L)	"	"	EPA 365.2
Total Suspended Solids (mg/L)	"	"	EPA 160.1
Total Dissolved Solids (mg/L)	"	"	EPA 160.2
Major Anions/Cations (mg/L)	"	"	EPA 200.7
Sulfate (mg/L)	"	"	EPA 375.4
BOD 5 (mg/L)	"	"	EPA 405.1
Biological			
Chlorophyll a (μg/L)	"	"	SM 10200H
Phytoplankton Counts (mg/m^3)	"	"	Janik 1994
Zooplankton Counts (#/m^3)	0 - 15 m Net Tow	"	Janik 1994
Fecal Coliform (MPN/100ml)	"	"	SM 9223B

C. Chemical and Biological Measurements and Analysis

Depth integrated water samples were collected from 0-2.5 m at main-lake sampling site LLV-1A utilizing an integrated pvc sampler known by the trade name of "Sludge Judge." Additional depth samples were also collected quarterly at 0 m, 5 m, 10 m, and 20 m at site LLV-1A with a Van Dorn sampler. Samples requiring filtration were filtered through 0.45 μm (micrometer) millipore filters utilizing a hand operated pneumatic filler pump.

Analyses were run on field duplicates at a frequency of approximately 10 percent of the samples. A State of Nevada certified laboratory analyzed the chemical and biological analyses with EPA-approved methods. Samples were collected from the surface and near the bottom at site LLV-1A in December 2010 for analysis of toxic substances.

Zooplankton samples were collected at LLV-1A in a vertical tow from 0-15 m with an 80 μm Wisconsin plankton net. Phytoplankton (algae) was collected quarterly from the surface (0-2.5 m) from site LLV-1A. Phytoplankton samples were identified and enumerated to the level of species when possible.

Phytoplankton

Utermohl Method

The inverted-microscope method or Utermohl method (Utermohl 1958, Kellar et al. 1980, Janik 1984) is used for enumeration and identification of phytoplankton samples.

Counting Procedure:

The procedure incorporates a stratified design using at least three (x 78, 280, 560) magnifications (Janik 1984). The rational for this approach is that phytoplankton in most lakes have greatest axial linear dimension (GALD) that spans three orders of magnitude from 1-2 µm to 1000 µm or more for filamentous taxa.

Sample Sedimentation:

Wild™ and Hydro-Bios™ combined plate chambers consisting of a top cylinder (Sedimentation cylinder) of 10 mL capacity and a bottom-plate chamber (base plate) are used. The bottom diameter of the base chamber is 25.5 mm. Volumes sediment range from 2.0 – 10.0 mL depending on algal density.

Biovolumes:

Cell volumes are calculated based on the measurements of at least 20 individuals of each species and the geometrical formula which most closely approximate the cell shape (Lund et al. 1958). Cell sizes are measured at x 560 with a calibrated ocular micrometer. For most organisms the measurements are taken from outside cell wall to outside cell wall.

Zooplankton

Samples are analyzed with a Wild M40 inverted phase contrast microscope (Wetzel 1975 and Likens 1979). Samples will be counted at: x 78. Higher magnification of x 280 and 560 are available to facilitate identifications.

Sample Preparation and Counting Procedure

The zooplankton sample is mixed by gently inverting the sample bottle for 30 seconds. A wide-bore automatic pipette is used to withdraw 2.9 mL of sample and fill a Hydro-Bios combination plate chamber. A cover slip is then placed on top of the chamber and allowed to settle for 15 minutes before counting. A second chamber is then prepared for a total of 5.8 mL for each sample. The entire 510 mm^2 plate chamber is counted in continuous strips.

IV. WATER QUALITY RESULTS

A. Lake Water Surface Elevation

Water for Lake Las Vegas is pumped from Lake Mead through BWC pipelines. In 2010, Lake Las Vegas surface elevations fluctuated by approximately three and a half (3.5) ft. during the year with approximately two thousand four hundred forty-three (2,443) AF of Lake Mead water being added during 2010 (**Figure 3**). Approximately two thousand forty (2,040) AF of Lake water were lost to seepage/evaporation. Both golf courses opted to not overseed, so irrigation water use was minimal during the late fall. Lake levels represented in **Figure 3** are measured on the first of each month.

In 2010, approximately two thousand three hundred twenty-six (2,326) AF of stormwater discharged into the Lake. Additionally, Lake Las Vegas released stormwater five thousand one hundred sixty-three (5,163) AF through the dam's appurtenance, back to the Las Vegas Wash. Due to major storms in December, water elevation between December 2010 and January 2011 significantantly increased.

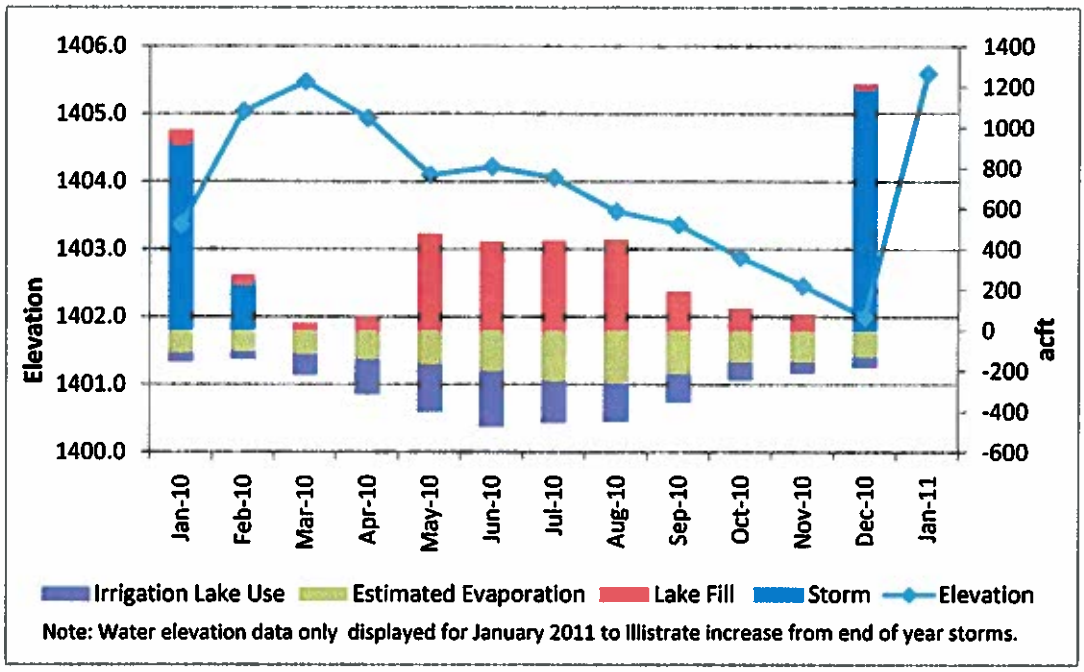

Figure 3. 2010 Lake Las Vegas surface elevations and Lake water budget.

B. Physical Analysis
Temperature

Deep reservoirs and lakes in temperate climates are subject to seasonal stratification due to solar thermal loading and wind induced mixing. During summer periods, as the day length increases with increased solar altitude, thermal loading of lakes and reservoirs significantly increases the thermal energy in the surface waters (Hutchinson 1959). Early in the season, wind often mixes these waters throughout the reservoir, both as the day length becomes progressively longer and solar thermal loading increases, wind generated mixing cannot thoroughly mix the solar warmed surface waters throughout the entire water body. The result is thermal stratification with warm, less dense waters on the surface, and cool denser waters at the bottom. Stratification typically results in three distinct vertical zones in the water column: the hypolimnion, the epilimnion, and the metalimnion (Wetzel 1975).

The hypolimnion is the deep water zone, filled with cold, dense water. It is often relatively quiescent because it is separated from contact with the atmosphere. Oxygen consumption due to decomposition of organic matter can lead to depressed levels of dissolved oxygen called hypolimnietic anoxia (Wetzel 1975). The epilimnion is the well-mixed surface layer that is in contact with the atmosphere and is thereby influenced by solar and wind energy. Primary production is a large component of the epilimnion because it generally corresponds with the photic zone and light availability. Between the hypolimnion and the epilimnion lies a transition layer called the metalimnion. The metalimnion is also called the thermocline because it is typified by a temperature gradient. The thermocline is an important physical factor for all biota, since it impedes vertical mixing and exchange between the epilimnion and the hypolimnion, acting to restrict nutrient and gas circulation due to the kinetic energy needed to pass from less dense, warm water through the gradient to denser, colder water (Hutchinson 1959).

Stratification in temperature zones is mostly seasonal. The stratification process is often reversed in the fall when cooler atmospheric temperatures reduce the surface temperatures of the reservoir. Differences in hypolimnion and epilimnion water temperatures and associated densities diminish allowing wind produced currents to mix the whole reservoir, a process known as turnover (Wetzel 1975).

Turnover has several important impacts on reservoir and lake systems. Top to bottom mixing in the fall redistributes the biotic and chemical components. This includes the reoxygenation of anoxic and depressed hypolimnetic waters, nutrient redistribution, and thermal homogeny.

Surface temperatures in Lake Las Vegas did not have considerable variations between the two sites throughout the year. Surface temperatures were measured at site LLV-1A with an observed average temperature of 19.5°C (range: 8.2 to 30.1°C) during 2010 (**Figure 4**). Temperature profiles reflected typical of lakes that stratify in the summer and destratify during the winter. During 2010 site LLV-1A remained in a state of stratification longer due to an unseasonably warm spring and fall. The reservoir started to see the beginnings of thermal stratification in February and remained fully stratified until late November at site LLV-1A (**Figure 5**). The thermocline was clearly observed at a depth between 10 and 12 meters.

Dissolved Oxygen

The distribution of oxygen in reservoirs is closely related to photosynthesis, respiration, thermal stratification, and organic matter. Oxygen is important in that its presence or absence influences not only the ability of organisms to occupy a particular zone of the reservoir, but also its bearing on the type of chemical reactions that can occur with regard to nutrient cycling. Plants and animals consume oxygen during respiration, but when the appropriate amount of light and nutrients are available, plants can produce diffusion from the atmosphere (reaeration). Oxygen in water is typically measured as dissolved oxygen (DO) and the loss of dissolved oxygen due to biological activity in the breakdown of organic matter is called the biological oxygen demand (BOD); loss due to chemical activity is the chemical oxygen demand. A dynamic equilibrium exists between oxygen gas in the atmosphere and the DO levels in aquatic systems that is a function of atmospheric pressure, temperature, and oxygen levels in water. This theoretical equilibrium is termed saturation dissolved oxygen. Temperature and saturation oxygen concentration have an inverse relationship: cold water has higher saturation dissolved oxygen than warm water. Oxygen saturation levels are often useful to consider because over saturation may be an indicator of high levels of photosynthesis while under saturation can indicate an increase in organic matter and/or pollutants or phytoplankton respiration.

Both seasonal and daily variations in oxygen can affect the components of a reservoir system. Seasonally, oxygen may remain at or close to equilibrium levels throughout the depth of the reservoir under isothermal (unstratified) conditions. Once thermal stratification occurs, the oxygen levels decrease, especially in the photic zones where significant respiration takes place. Anoxia can occur in the hypolimnion. At the same time that the hypolimnion is under saturated, the epilimnion may be supersaturated due to intense photosynthesis. The reservoir will not reach equilibrium across the oxygen gradient due to the thermocline barrier. On a daily basis, oxygen in the photic zone may fall below saturation levels in the early morning, increase as the light and therefore photosynthesis increases until super saturation is reached in the afternoon, only to be depleted again once night time respiration begins.

Dissolved oxygen concentrations at the Lake surface did not have considerable variations between the sites throughout the year. Surface dissolved oxygen concentrations were measured at site LLV-1A with an observed average concentration of 9.7 mg/L (range: 6.8 to 14.3 mg/L) during 2010 (**Figure 4**).

Concentrations at depth exhibited the common dissolved oxygen trends found within monomictic lakes that stratify (**Figure 6**). At site LLV-1A during the months of thermal stratification, February through November, dissolved oxygen concentrations at the epilimnion were above 5.0 mg/L. Below the thermocline, concentrations were less than 5.0 mg/L at site LLV-1A. As mentioned in reference to temperature, dissolved oxygen exhibited greater influence due to the warmer spring and fall. Evident by the less homogines profiles in February, March and November (**Figure 6**).

Biological Oxygen Demand (BOD_5)

BOD_5 is an indirect measure of the concentration of biologically degradable material present in organic wastes. It usually reflects the amount of oxygen consumed in five days by biological processes breaking down organic waste (NALMS 2009).

Surface BOD_5 concentrations were measured at site LLV-1A with an observed average concentration of 4 mg/L (range: 2 to 8 mg/L) (**Figure 7**). BOD_5 concentrations were higher than normal until fall. During January and February high concentrations can be attributed to storm inflows. The *P. parvum* bloom and higher season temperatures also contributed to the increase in BOD_5 concentrations. As the *P. parvum* bloom subsided and temperatures began to decrease in the fall, BOD_5 concentrations returned to 2 mg/L.

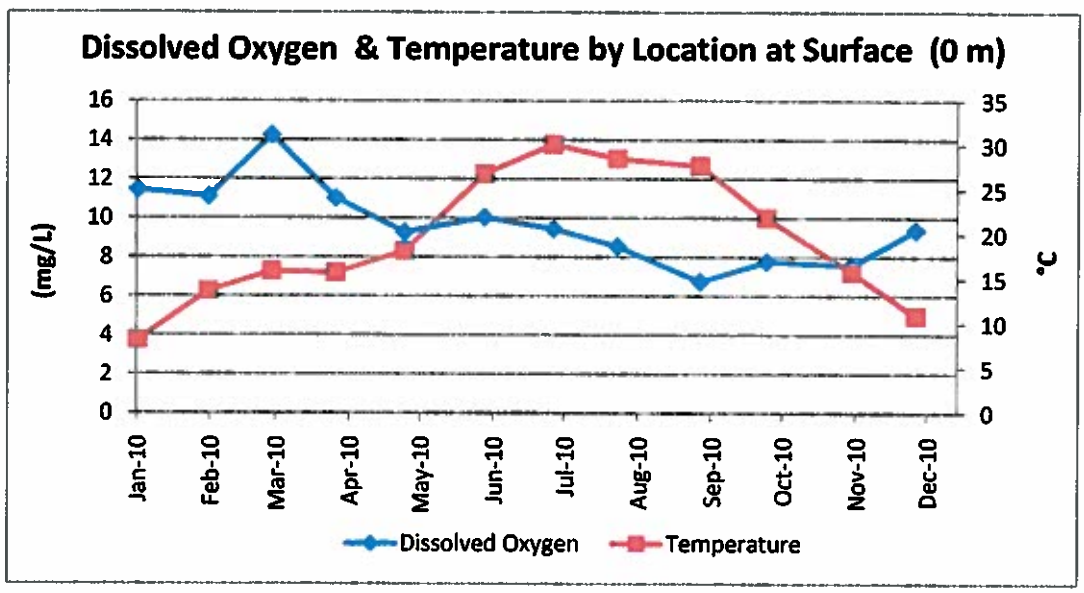

Figure 4. Lake Las Vegas surface water temperature (°C) and dissolved oxygen (mg/L) measurements at Lake monitoring sites in 2010.

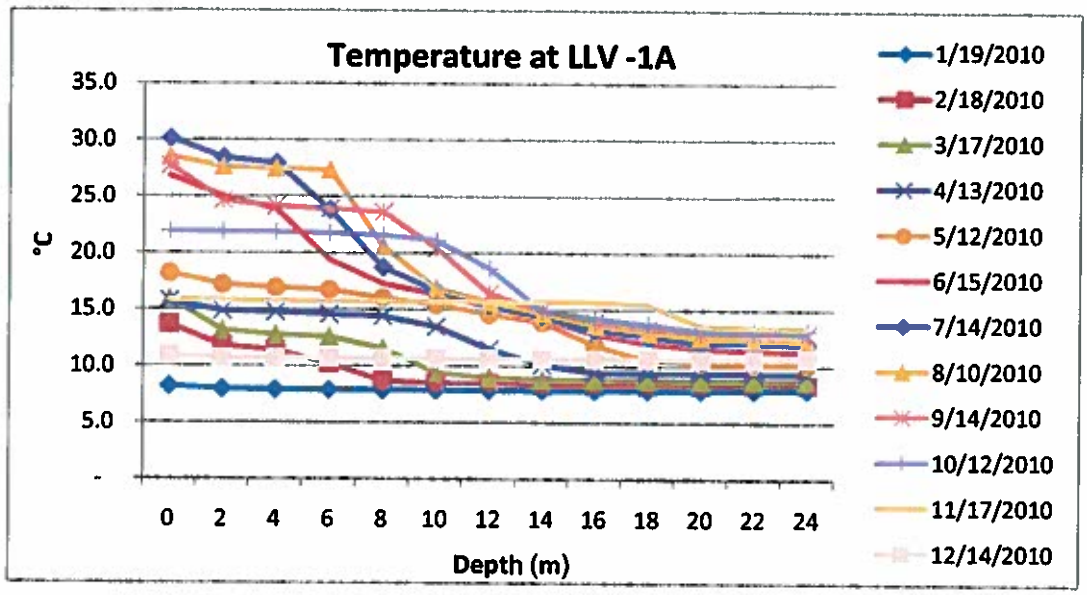

Figure 5. Lake Las Vegas monthly temperature (°C) profile at site LLV-1A during 2010.

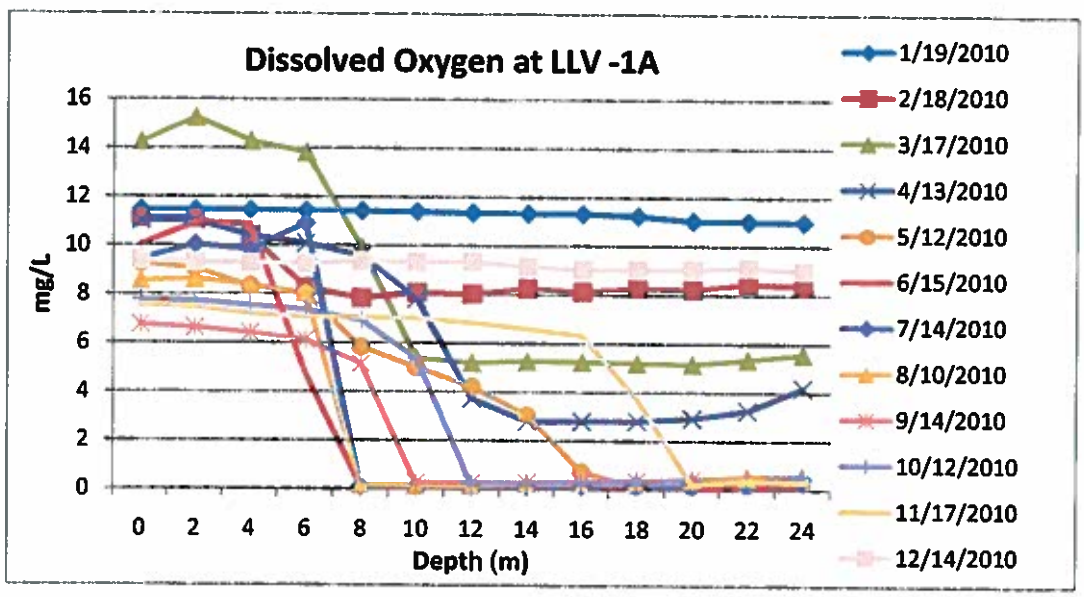

Figure 6. Lake Las Vegas monthly dissolved oxygen profile at site LLV-1A during 2010.

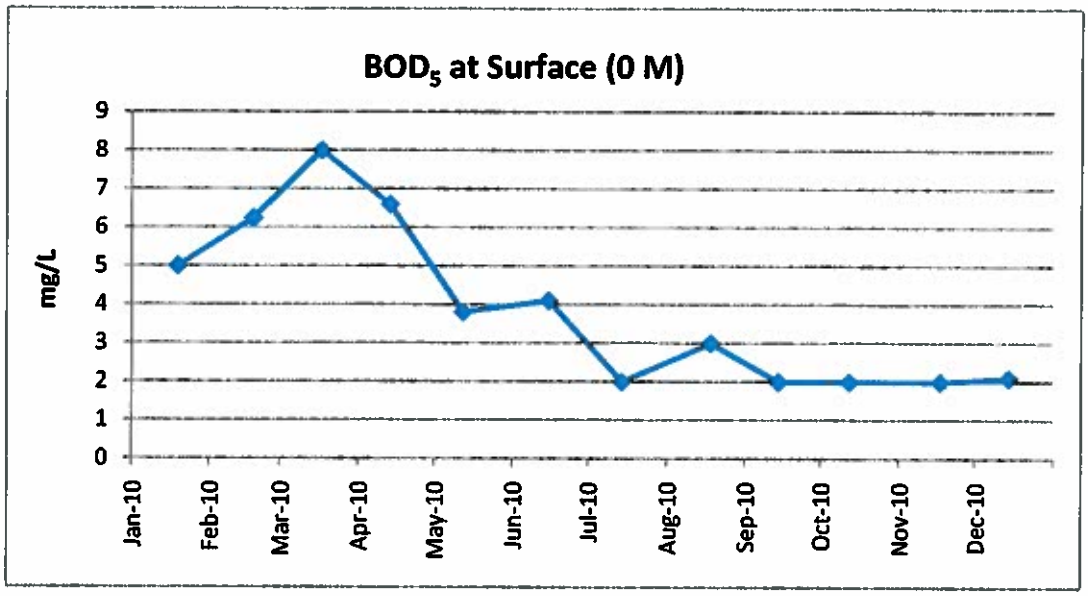

Figure 7. Lake Las Vegas Biochemical Oxygen Demand (mg/L) concentrations in surface waters at Lake monitoring site LLV-1A during 2010.

pH

The pH of a water body describes how acidic or alkaline the water is based on an exponential scale of 1 to 14. A pH reading of less than 7 indicates acidity, greater than 7 indicates alkaline conditions and a pH of 7 is considered neutral. Most lakes and reservoirs have a pH that ranges between 6 and 9. Changes in pH of a lake or reservoir may influence other nutrients and minerals including iron, ammonia, phosphate, and carbon dioxide. pH may vary with depth in a reservoir, especially during summer months when phytoplankton abundance and production may lead to higher pH values in areas of photosynthesis and lower in areas where respiration or decay of organic matter is occurring such as the hypolimnion. pH may be affected by photosynthesis and respiration since pH is closely related to the amount of and form of carbon the water column.

Surface water pH values were measured at site LLV-1A with an observed average concentration of 8.5 Std Units (range: 8.0 to 8.9 std units) (**Figure** 8). Throughout the water column all pH results were between 7.0 and 9.0. Variability can be attributed to spatial distribution of phytoplankton activity. Depth profiles of pH indicated the pH followed a similar trend of dissolved oxygen. During periods of stratification pH values decreased as bicarbonate concentrations declined with the onset of anaerobic conditions (**Figure 9**).

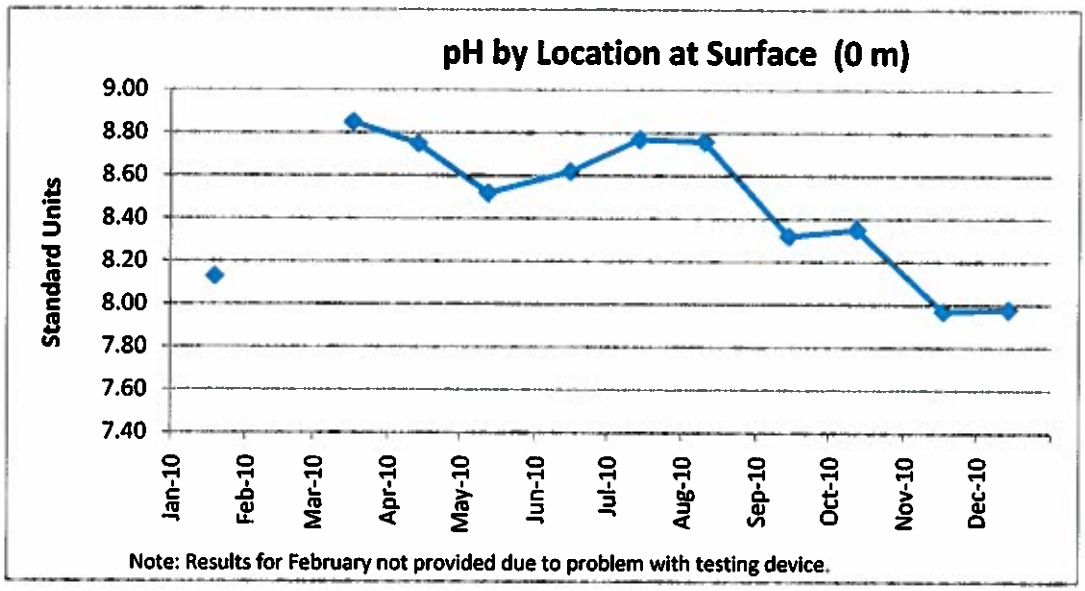

Figure 8. Lake Las Vegas surface water pH (standard units) measurements at Lake monitoring site LLV-1A during 2010.

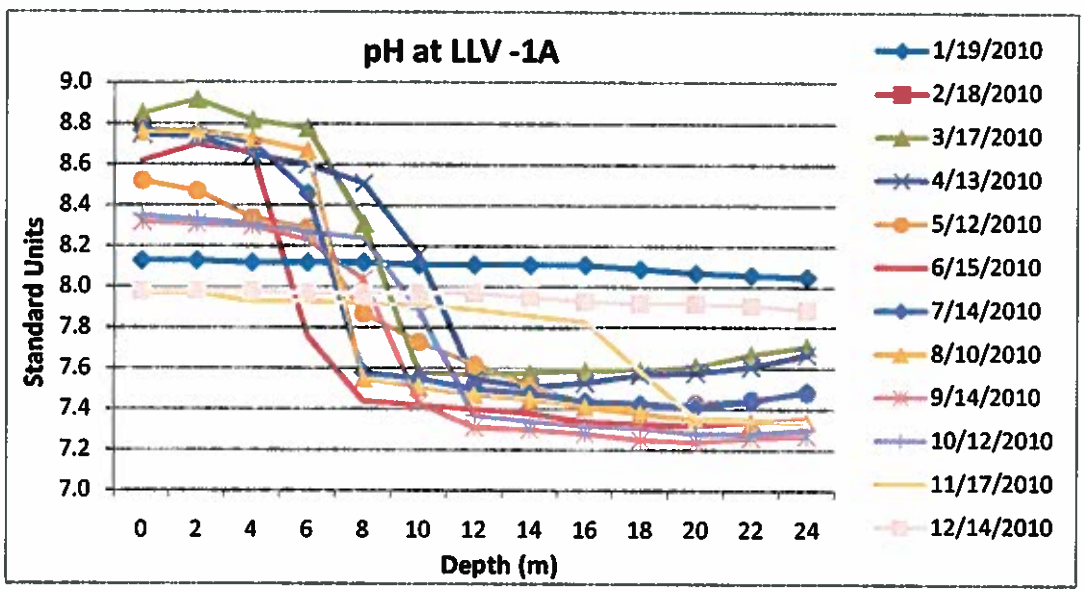

Figure 9. Lake Las Vegas monthly pH (standard units) profile at site LLV-1A during 2010.

Major Ion Concentrations

The spatial and temporal distribution of the major cations are separable into conservative ions, whose concentrations within a lake undergo relatively minor changes from biotic utilization or biotical mediated changes in the environment and dynamic ions whose concentrations can be influenced strongly by metabolism. Of the major cations, magnesium, sodium, and potassium ions are relatively conservative both in their chemical reactivity under typical freshwater conditions and their small biotic requirements (Wetzel 1975).

Quarterly depth samples did not vary significantly at site LLV-1A for the ions of calcium, sodium, chloride, potassium, sulfate and magnesium and bicarbonate (**Table 4**).

A slight increase in bicarbonate can be contributed to the *P. parvum* bloom. Increases in sodium is related to the increase in total dissolved solids due to evaporation.

Table 4. 2010 Lake Las Vegas chemical concentrations at site LLV-1A during the months of March, June, September and December at 0, 5, 10 and 20m depths.

Date	Depth	Ca (mg/L)	Cl (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Na (mg/L)	K (mg/L)	Mg (mg/L)
3/17/10	0	166	343	55	705	244	20	62
3/17/10	5	165	382	65	758	243	20	62
3/17/10	10	211	525	100	997	323	24	79
3/17/10	20	216	459	100	889	327	25	81
6/15/10	0	182	325	50	712	311	17	70
6/15/10	5	194	351	63	755	319	18	73
6/15/10	10	187	316	83	708	316	18	73
6/15/10	20	216	343	98	827	366	21	82
9/14/10	0	171	329	65	758	319	21	67
9/14/10	5	171	313	63	790	324	22	67
9/14/10	10	177	308	108	816	310	21	66
9/14/10	20	193	351	143	857	332	23	70
12/14/10	0	175	322	94	702	337	26	64
12/14/10	5	173	344	94	753	319	25	63
12/14/10	10	174	301	91	731	328	25	63
12/14/10	20	178	328	91	755	328	25	64

Specific Conductance

Electrical conductivity is a measure of a body of water's ability to conduct electricity, and therefore a measure of the water's ionic activity and content. Higher concentrations of ionic (dissolved) constituents in a lake or reservoir lead to higher conductivity. Conductivity of the same water changes substantially as its temperature changes. Electrical Conductivity that is normalized at a temperature of 25 °C is called specific conductance, allowing direct comparison of various water samples or water bodies.

Surface conductivity was measured at site LLV-1A with an observed average of 2,610 micromhos per centimeter (µmhos/cm) (range: 1,932 to 2,910 µmhos/cm) during 2010. Specific conductivity did not vary significantly with depth (**Figure 11**).

Total Dissolved Solids (TDS)

Total Dissolved Solids (TDS) is a measure of the amount of material dissolved in water (mostly inorganic salts). Typically these may be aggregates of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrates, and cations such as of calcium, magnesium, manganese, sodium, potassium, and other cations which form salts. The inorganic salts are measured by filtering a water sample to remove any suspended particulate material, evaporating the water, and weighing the solids that remain. An important use of the measure involves the examination of the quality of drinking water. Water that has a high content of inorganic material frequently has taste problems and/or water hardness problems. As an example, water that contains an excessive amount of dissolved salt (sodium chloride) is not suitable for drinking. High TDS solutions have the capability of changing the chemical nature of water. High TDS concentrations exert varying degrees of osmotic pressures and often become lethal to the biological inhabitants of an aquatic environment (NALMS 2009).

Monthly surface TDS concentrations were high at the beginning of 2010 due to the lack storm event realted dilution during 2009. Concentrations were relatively stable throughout the spring and summer periods then increased during the fall and winter months (**Figure 10**). Although not represented in **Figure 10**, because December 2010 sampling occurred mid month prior to storms, the storms at the end of 2010 contribute to a significant decrease in TDS at the beginning 2011 (Jan 2011 surface concentration TDS t,370 mg/L). Monthly surface concentrations were measured at site LLV-1A with an observed average concentration of 1,817 mg/L (range: 1,434 to 2,090 mg/L) during 2010. The difference between the average concentration at the surface water and the maximum depth of 20 m is 212 mg/L at site LLV-1A (**Figure 12**). TDS concentrations remain below the annual average of 2,000 mg/L guideline for irrigation purposes.

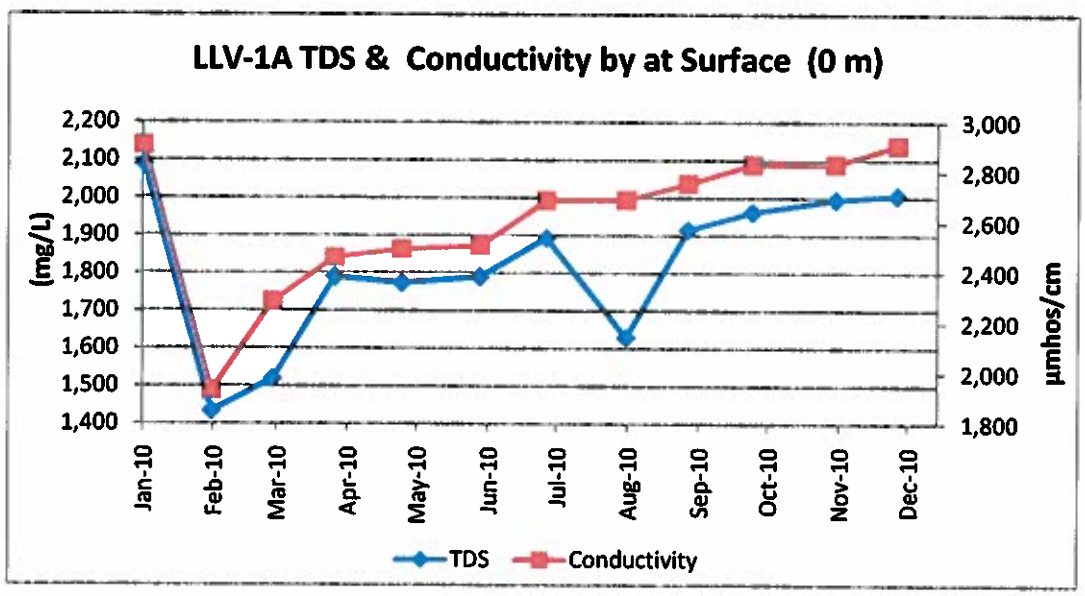

Figure 10. Lake Las Vegas surface conductance (µmhos/cm) and TDS (mg/L) measurements at Lake monitoring site LLV-1A during 2010.

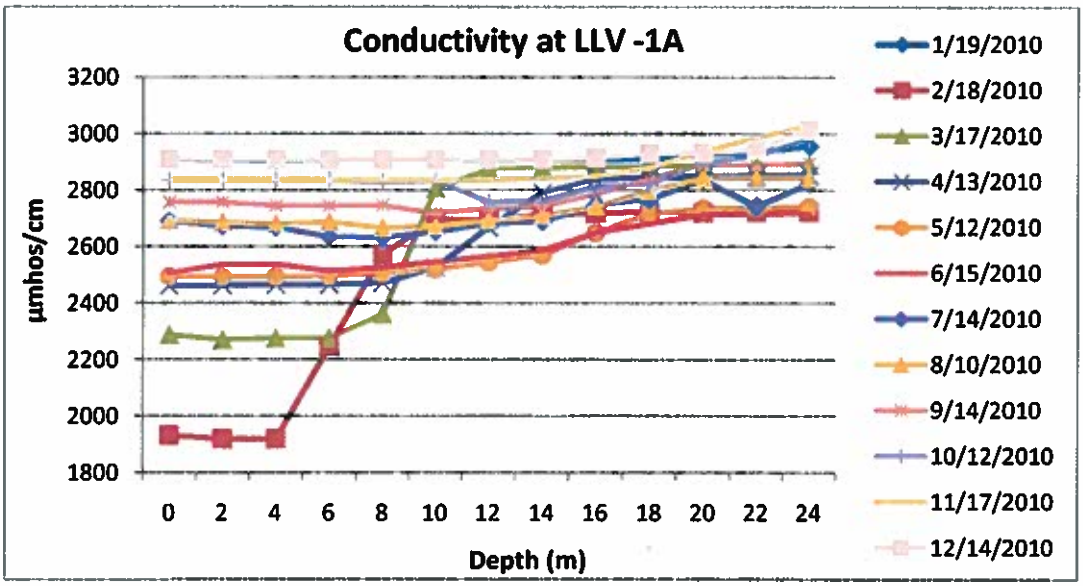

Figure 11. Lake Las Vegas monthly conductance (µmhos/cm) profile at site LLV-1A during 2010.

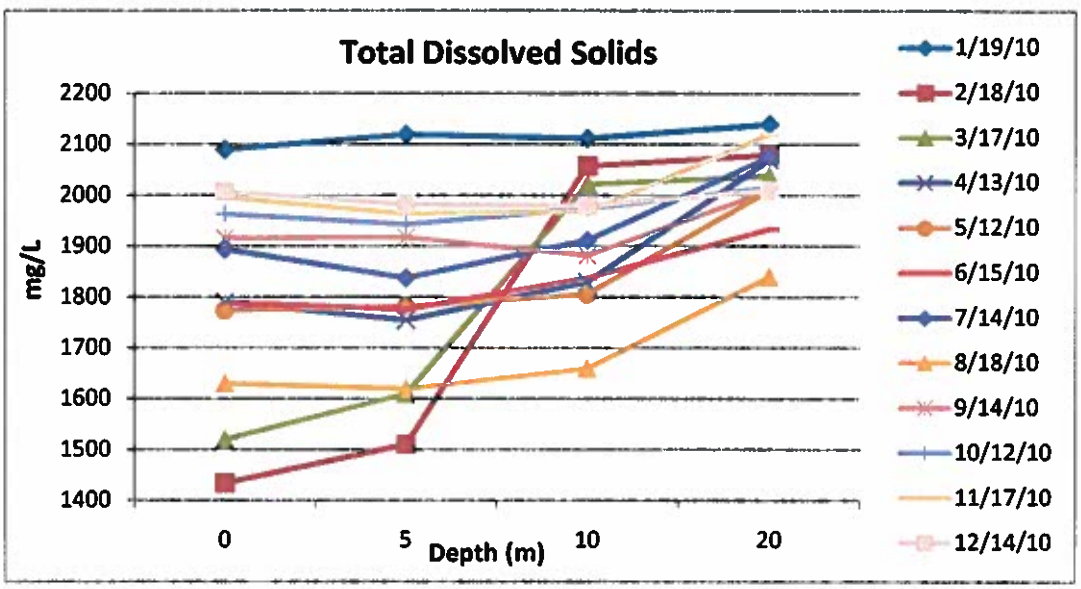

Figure 12. Lake Las Vegas monthly dissolved solids (mg/L) profiles at site LLV-1A during 2010.

Turbidity, Transparency (Secchi) and Total Suspended Solids (TSS)

Turbidity is a measure of the clarity of lake water. Total Suspended Solids (TSS), are dissolved inorganic material by evaporation found in a water system. (Wetzel 1975). The more suspended particles (TSS) in the water the less clear or transparent the lake water becomes. These reflective properties of lake water are usually measured by lowering a secchi disk into the water until it can no longer be seen. The average of at least two measurements is taken. A lower result indicates that the lake is more characteristically eutrophic, whereas a higher result indicates the lake is more characteristically oligotrophic. Measurement trends vary throughout the summer due to algae populations. Turbidity is related to total suspended solids influence by both internal and external sources such as: dust particles, phytoplankton, and organic matter. Turbidity is affected by wind action, precipitation and land use practices.

Lake turbidity during 2010 was poor, or more characteristically eutrophic. Monthly surface values were measured at site LLV-1A with an observed average concentration of 7 NTU (range: 3 to 15 NTU). Secchi disk monthly surface values, were measured at sites LLV-1A with an observed average concentration of 1.5 m (range: 0.8 to 2.6 m) during 2010 (**Figure 13**). Turbidity was highest in January and September. The *P. parvum* bloom discussed in the phytoplankton section is the main cause of the poor transparency at the Lake. Since turbidity, as estimated by secchi measurements is highly dependent on the concentration of suspended solids measured, similar inverse trends are often observed.

Monthly surface TSS concentrations were measured at site LLV-1A with an observed average concentration of 20 mg/L (range: 1 to 80 mg/L) during 2010 (**Figure 13**). The difference between the average concentration at the surface water and the maximum depth of 20 m is five (5) mg/L at site LLV-1A (**Figure 14**). The concentration increase with depth was also observed in the *chlorophyll a* data and reflects the presence of a phytoplankton bloom, which is discussed later.

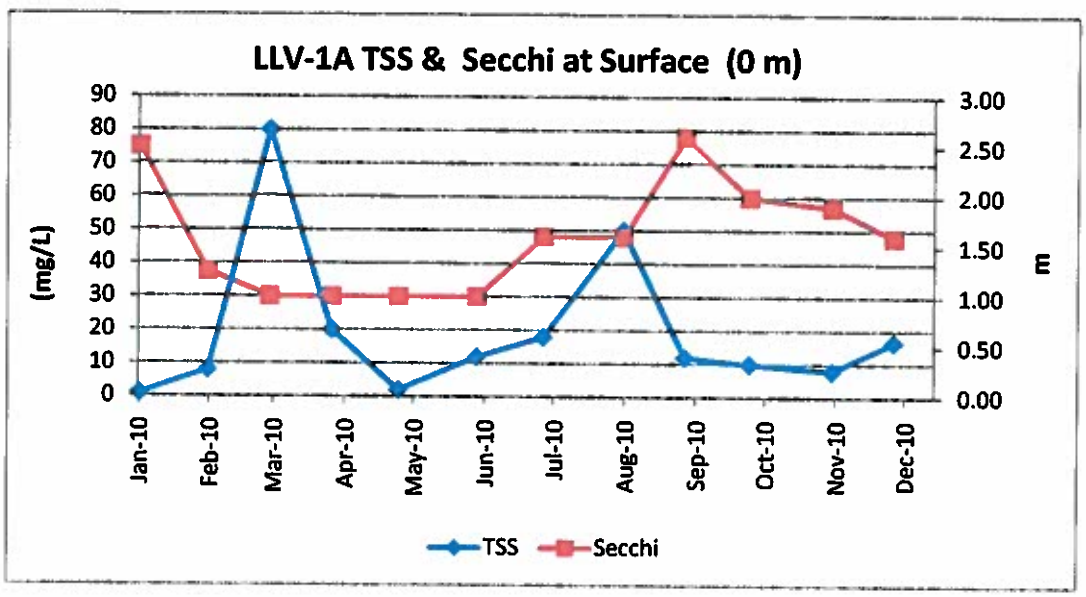

Figure 13. Lake Las Vegas surface total suspended solids (mg/L) and Secchi (m) measurements at Lake monitoring sites during 2010.

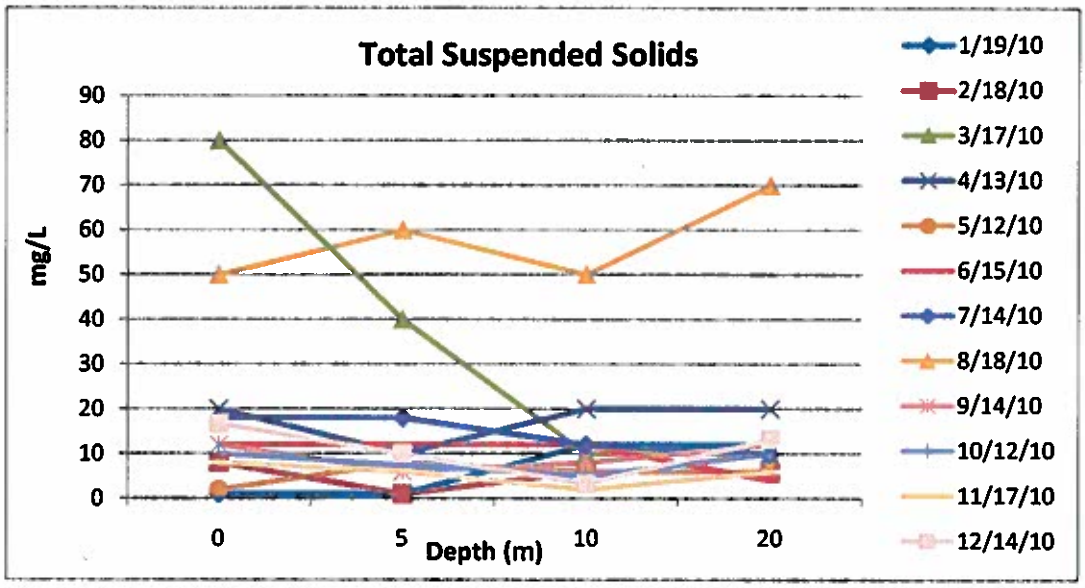

Figure 14. Lake Las Vegas monthly total suspended solids (mg/L) profiles at site LLV-1A during 2010.

C. Chemical Analysis

Phosphorus

Phosphorus is a common growth limiting nutrient in phytoplankton even though the quantity needed by plants is much smaller than other nutrients, such as carbon or nitrogen. Phosphorus's critical role as a growth limiting nutrient is partially due to the fact that the only biological available form of phosphorus is soluble phosphate (PO_4). (Wetzel 1975) Most phosphorus is unavailable to biota because it tends to strongly adsorb to particles in the water, with the exception of anoxic conditions. Phosphate may accumulate over the winter when primary production is at a minimum, but by late spring the levels of available phosphate may be reduced to less that 2.0 µg/L through algal uptake. This lack of available phosphate results in a system where phosphate is continuously recycled back to phytoplankton after excretion from fish, zooplankton, or bacterial activity. Internal loading from the sediments and lake mixing are important methods of returning phosphates that have left the photic zone and return them to the epilimnion for use. (Hutchinson 1957)

Surface total phosphorus concentrations were measured at site LLV-1A with an observed average concentration of 21 µg/L (range: 5 to 39 µg/L) (**Figure 15**). Storms in January and February attributed to peak total phosphorous concentration of 39 µg/L in February. Monthly total phosphorus concentrations varied with depth and were consistent with the typical stratified lake (**Figure 16**).

Surface otho-phosphorus concentrations were measured at site LLV-1A with an observed average concentration of 8 µg/L (range: 5 to 15 µg/L) (**Figure 15**). The low concentrations at the end of June and through July correspond with the decrease in algae biomass. Sedimentation of decaying phytoplankton and the accumulation of organic phosphorous within the stratified

hypolimnion may account for the observed reduction in ortho-phosphorous. Monthly ortho-phosphorus concentrations corresponded with the concentrations of phosphorous seen at depth. (**Figure 17**).

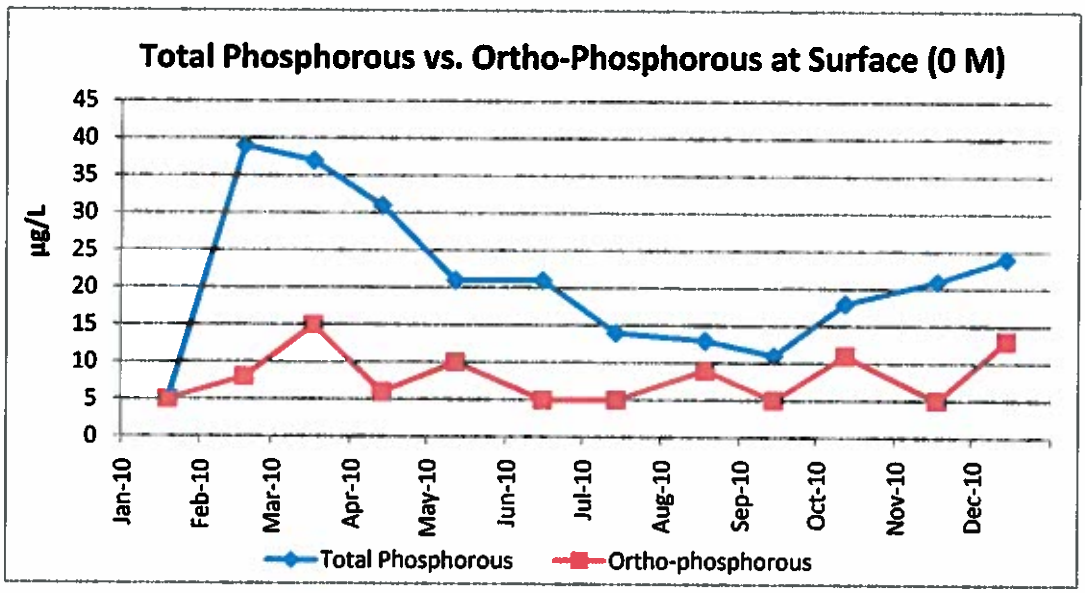

Figure 15. Lake Las Vegas surface total phosphorus (µg/L) and Ortho-phosphorous (µg/L) profiles at Lake monitoring sites during 2010.

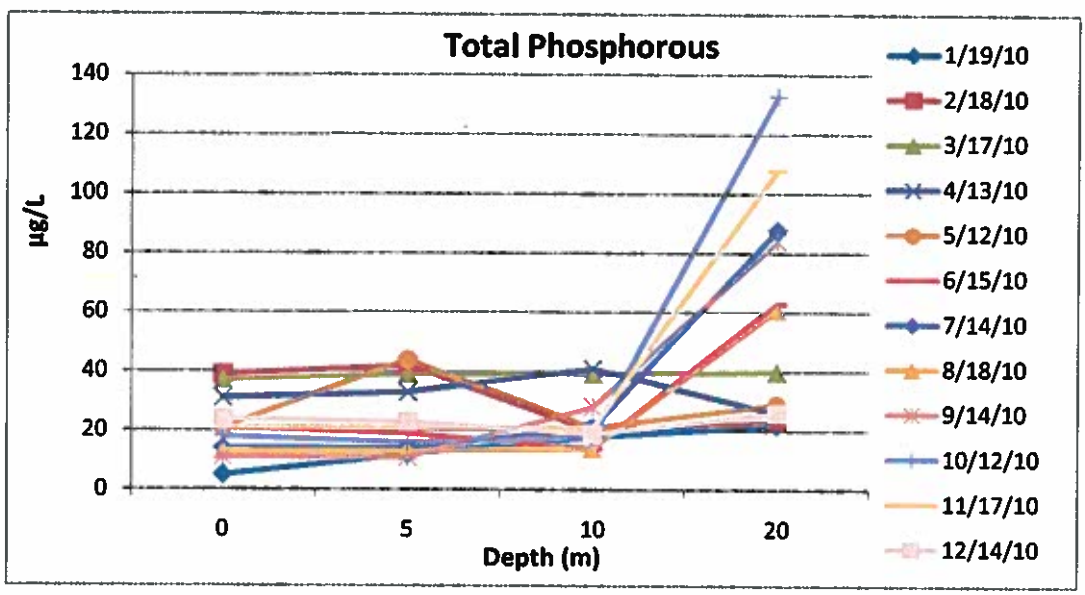

Figure 16. Lake Las Vegas monthly total phosphorus (µg/L) profiles at site LLV-1A during 2010.

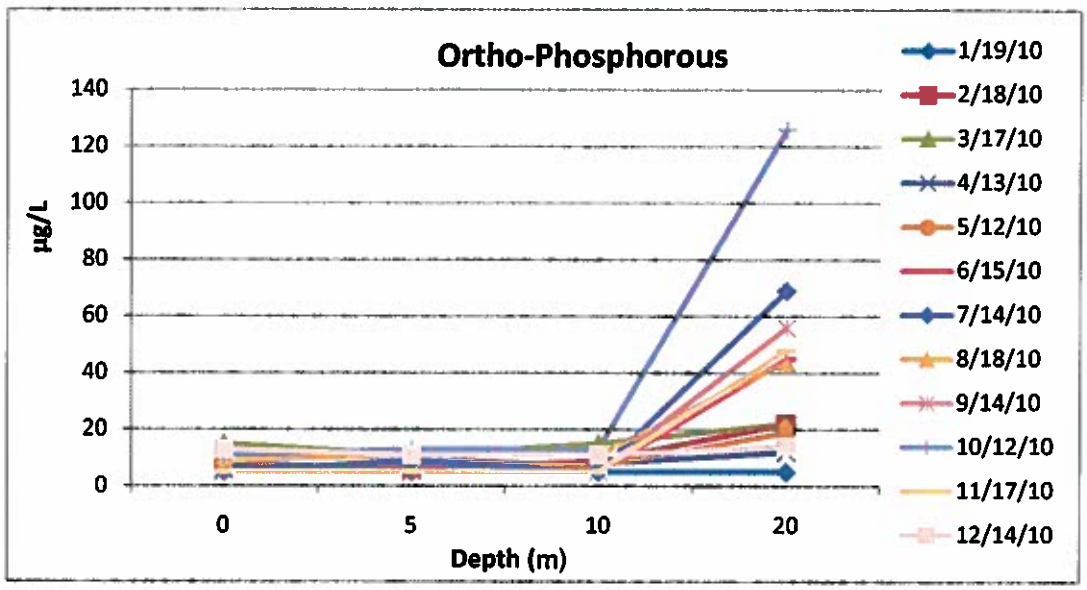

Figure 17. Lake Las Vegas monthly ortho-phosphorus µg/L profiles site LLV-1A during 2010.

Nitrogen

Nitrogen enters lakes and reservoirs as nitrate in rainfall and atmospheric deposition in the watershed, moving freely through soils and streams. In addition, decomposing bacteria breaks down organic matter and convert the nitrate to ammonia.

Nitrogen in aquatic systems may exist in several forms: dissolved nitrogen gas (N_2), organic nitrogen incorporated into organic matter, ionized (NH_4^+) and undissociated ammonia (NH_4OH+NH_3), nitrite ion (NO_2^-) and nitrate ion (NO_3^-). The prevalence of ionized versus undissociated ammonia is primarily pH dependent, such that the fraction as unionized species (NH_4OH+NH_3) increases significantly above pH = 8. Unionized ammonia is toxic to aquatic life. (Wetzel 1975) Under aerobic conditions, bacteria mediate the oxidation of ammonia to nitrate, with an intermediate step of nitrite, in a process known as nitrification. In the nitrification reaction, 1.0 g of ammonia consumes 4.57 g of oxygen (Charpa 1997). In the absence of oxygen, bacteria mediate the reduction of nitrate to nitrogen gas.

Monthly Surface nitrate plus nitrite concentrations were measured at site LLV-1A with an observed average concentration of 532 µg/L (range: 5 to 1,290 µg/L) (**Figure 18**). Sampling results for August and September represented in **Figure 18** were reported at the non detect level of five (5) µg/L. High concentrations in February can be attributed to storms in January and February. Concentrations varied by depth with the difference between the average concentration at the surface water and the maximum depth of 20 m being 307 µg/L at site LLV-1A. Concentrations were heavily influenced by thermal stratification and the presence of anaerobic conditions (**Figure 19**).

Ammonia - Nitrogen

Monthly ammonia surface water concentrations were relatively stable from March to October. Surface ammonia concentrations were measured at site LLV-1A with an observed average concentration of 92 µg/L (range: 50 to 280 µg/L) (**Figure 18**). Variability in concentrations between depths were significant for ammonia during 2010 (**Figure 20**) attributed to the low DO concentrations in the hypolimnion when the Lake was stratified. The difference between the average concentration at the surface water and the maximum depth of 20 m is 411 (µg/L) at site LLV-1A. These concentrations at depth are expected during stratification where denitrification occurs.

Organic Nitrogen

Organic nitrogen concentrations are calculated by subtracting the ammonia concentration from the TKN concentration. Organic nitrogen is comprised of detritus and plankton suspended within the water column, and remaining insoluble until decomposition breaks down the organic matter and bacteria process and release the nitrogen back into the system.

Monthly organic nitrogen concentrations were measured at site LLV-1A with an observed average surface concentration of 536 µg/L (range 140 to 940 µg/L) (**Figure 18**). An observed increase in organic nitrogen was measured from February to September at site LLV-1A (**Figure 21**). This increase corresponds to an increase in phytoplankton activity during the same period, causing organic nitrogen concentrations to follow the same trend.

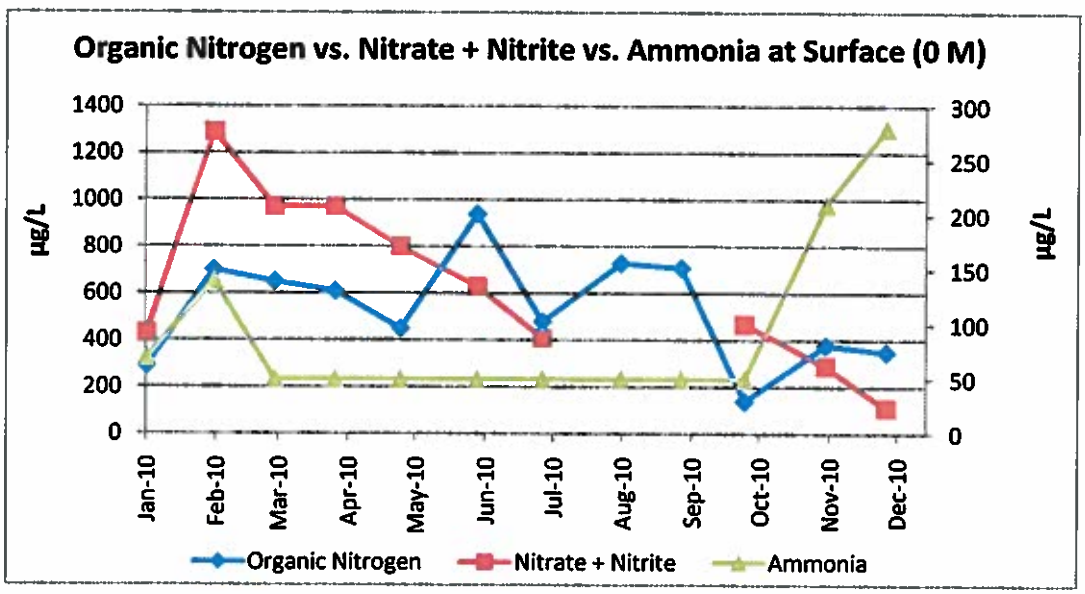

Figure 18. Lake Las Vegas surface nitrite + nitrate (µg/L), ammonia (µg/L), and Organic Nitrogen (µg/L) measures at Lake monitoring site LLV-1A during 2010.

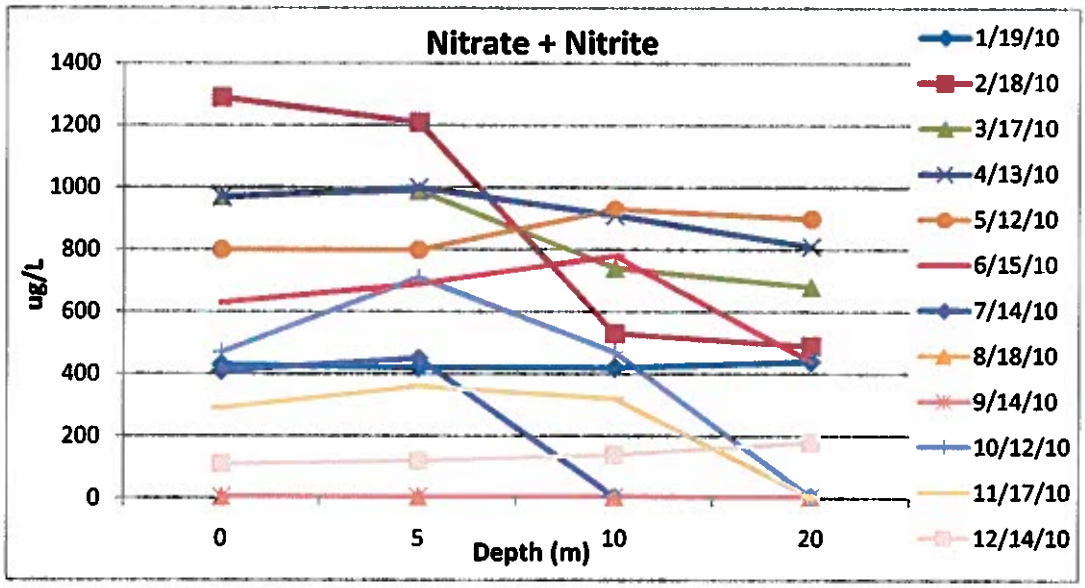

Figure 19. Lake Las Vegas monthly nitrate + nitrite (µg/L) profiles at site LLV-1A during 2010.

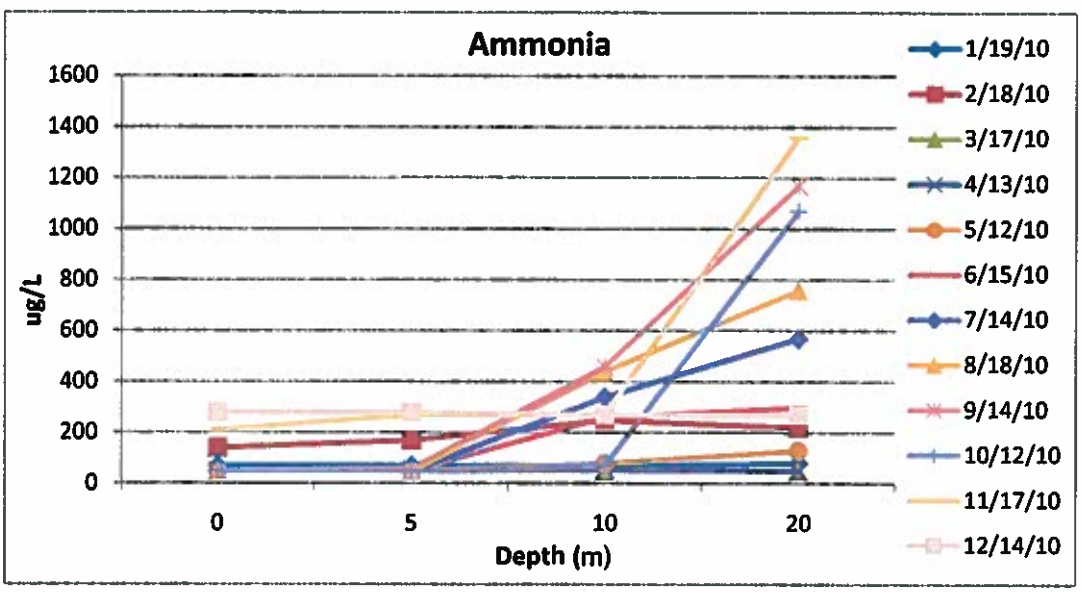

Figure 20. Lake Las Vegas monthly ammonia (µg/L) profiles at site LLV-1A during 2010.

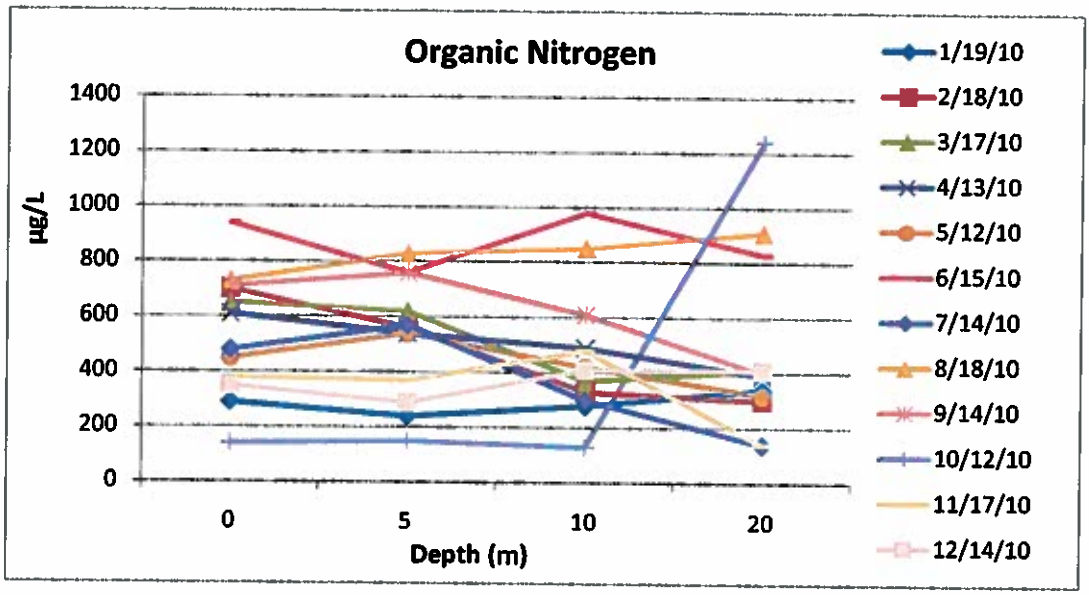

Figure 21. Lake Las Vegas monthly Organic Nitrogen (µg/L) profiles at site LLV-1A during 2010.

D. Biological Analysis

Phytoplankton Species Composition and Abundance

Phytoplankton, also commonly known as algae, are microscopic plants that grow in sunlit water that contains phosphates, nitrates, and other nutrients. Algae, like all aquatic plants, add oxygen to the water and are important in the fish food chain. Phytoplankton is either suspended in water (plankton) or attached to rocks and other substrates (periphyton). Their abundance, as measured by the amount of *chlorophyll a* (green pigment) in an open water sample, is commonly used to classify the trophic status of a lake. Phytoplankton are an essential part of the lake ecosystem and provide the food base for most lake organisms, including fish. Phytoplankton populations vary widely from day to day, as life cycles are short (NALMS 2009).

In December 2009 *Prymnesium parvum (P. parvum)* was collected and identified in the waters of the Lake at Lake Las Vegas. *P. parvum* is a microbial, toxigenic, unicellular, invasive species that can affect an entire ecosystem. *P. parvum* not only negatively affect its prey and competitors, but can also negatively affect nontargeted species. Conditions that are believed to contribute to the toxic bloom include high salinity, low temperatures and high nutrients (Remmel 2011). Storms in January and February increased total phosphorous levels, allowing *P. parvum* to inhibit the growth of several other competing species. *P. parvum* competes by releasing toxins that can kill gill-breathing organisms, invertebrates, planktonic algae and bacteria. To meet energy needs, *P. parvum* can also consume phytoplankton, zooplankton and bacteria. By March, *P. parvum* came to dominate the Lake.

Starting in March phytoplankton and zooplankton were tested more frequently for a period of time (**Table 3**). Starting in April, the decision was also made to no longer test for phytoplankton and zooplankton at site LLV-3 in order to better monitor phytoplankton levels, especially *P.* parvum at one site. Since phytoplankton and zooplankton were only tested for

three months at site LLV-3, the data represented for phytoplankton and zooplankton is only representative of site LLV-1A.

Eight (8) taxonomic divisions of phytoplankton were found at site LLV-1A during 2010 (**Figure 22**). The results for phytoplankton and zooplankton are reported by relative frequency. Relative frequency is the frequency (biomass volume) of each division or species divided by the total biomass volume of all divisions or species. By biomass, the most relatively frequent observed division in 2010 was Haptophyta (LLV-1A, 93.2%). The remaining seven (7) divisions relative frequencies were as follows: Cyanobacteria (LLV-1A 3.49%), Chlorophyta (LLV-A 1.07%), Bacillariophyceae (LLV-1A, 0.77%), Chrysophyta (LLV-1A, 1.28%) Cryptophyta (LLV-1A, 0.19%), Microflagellates (LLV-1A, 0.02%), and Pyrrhophyta (LLV-1A 0.02%) were distributed in relation to Haptophyta during the year.

Species of phytoplankton in 2010 was dominated by *P. parvum* of the taxonomic division, Haptophyta (Golden Algae). At site LLV-1A *P. parvum* had a 93.02% relative frequency. Of the other species no other species was observed to have a larger portion than 2% of the observed annual biomass.

Phytoplankton populations were the most abundant during the spring months and declined after May (**Figure 23**). This was also observed in the *chlorophyll a* concentrations (**Figure 28**).

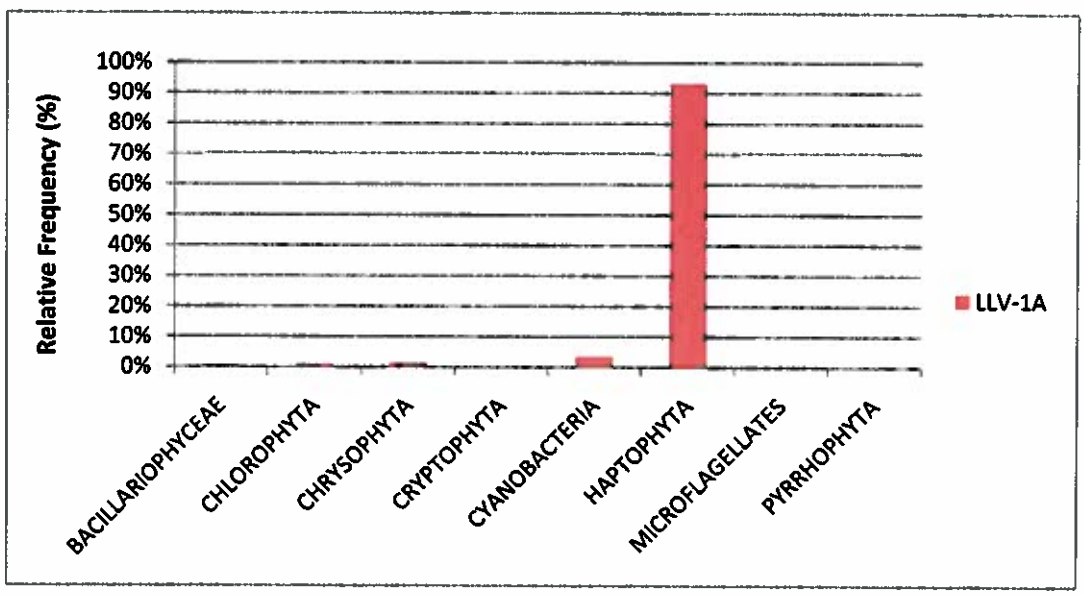

Figure 22. Lake Las Vegas Phytoplankton relative frequency by taxonomic division at site LLV-1A during 2010.

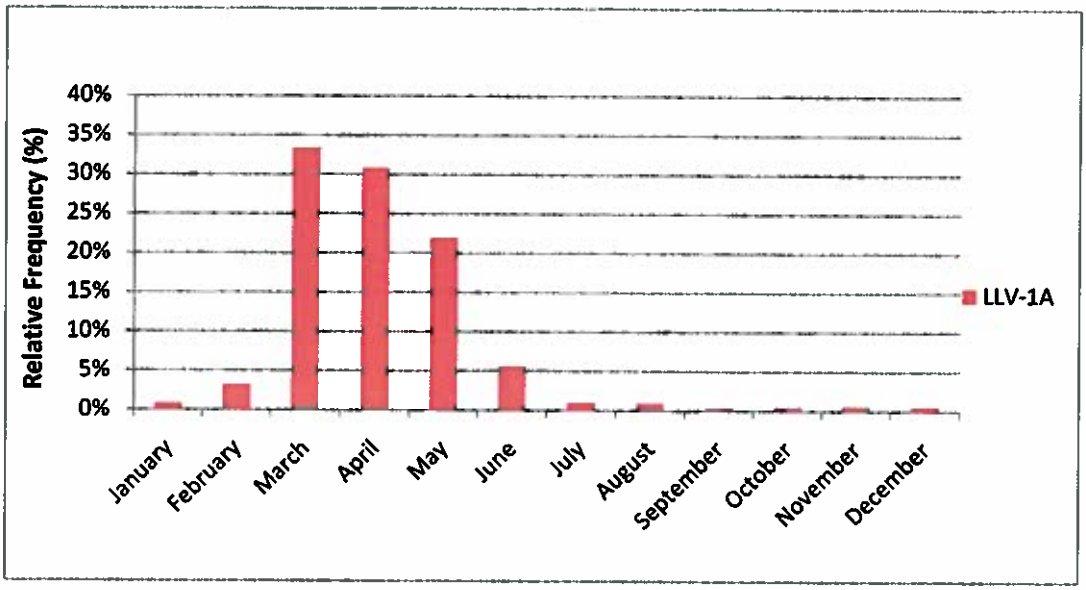

Figure 23. Lake Las Vegas Phytoplankton by month at site LLV-1A during 2010.

Zooplankton Species Composition and Abundance

Copepods dominated the zooplankton population with a relative frequency of 84.3%, of the biomass at site LLV-1A, followed by Rotifers (15.6% LLV-1A) and Cladocerans (0.1% LLV-1A) during 2010 (**Figure 24**). Several species of zooplankton have been identified in the 0 – 15 m vertical plankton tows at site LLV-1A in 2010 (**Figure 25**). A total of ten (10) species were observed in 2010, but approximately 80 percent of the biomass was attributed to three species, reflecting an overall lower diversity of zooplankton (**Figure 25**). Of the three species *Nauplii (Copepods)* exhibited the greatest average annual average density in 2010 (**Figure 25**).

Zooplankton frequencies correlate with the *P. parvum* dominance consistent during most of the year and greatest during the month of March and April (**Figure 26**). In general, populations were greater during the spring months, corresponding to periods of food (phytoplankton) availability. It has been noted that there is a negative relationship between *P. parvum* and cladoceran (Remmel 2011). This negative relationship is evident by the almost nonexistent presence of cladoceran in the Lake during 2010 (**Figure 24**).

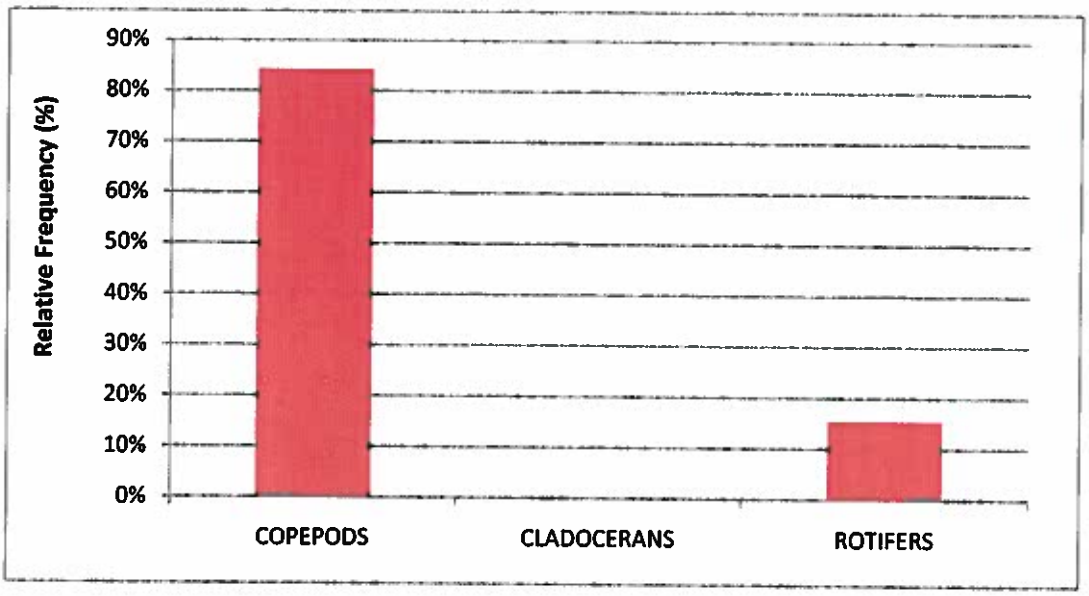

Figure 24. Lake Las Vegas Zooplankton relative frequency by kingdom at site LLV-1A during 2010.

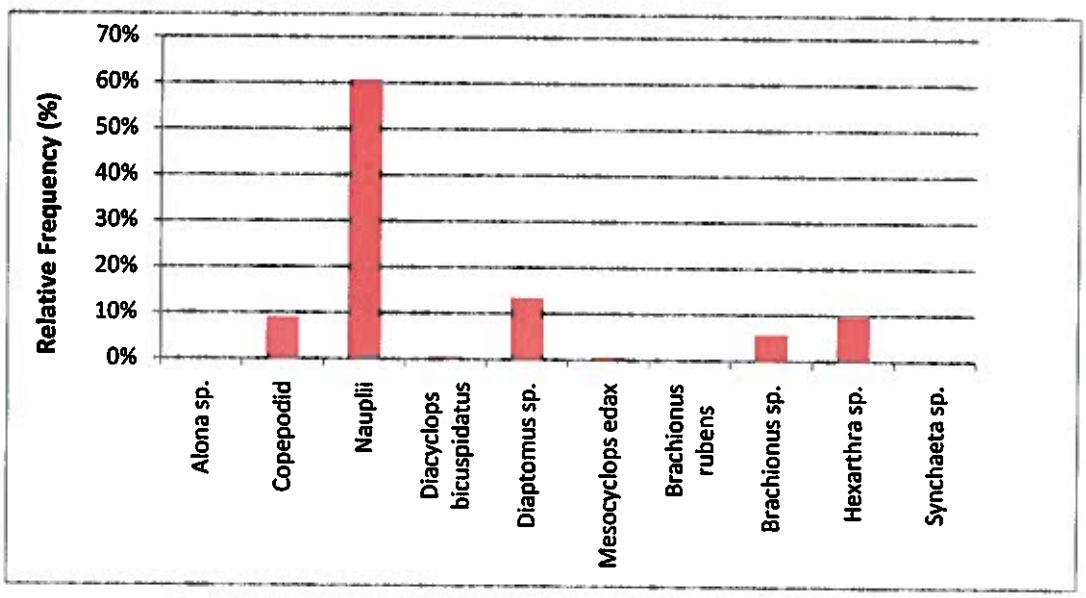

Figure 25. Lake Las Vegas Zooplankton relative frequency by species at site LLV-1A during 2010.

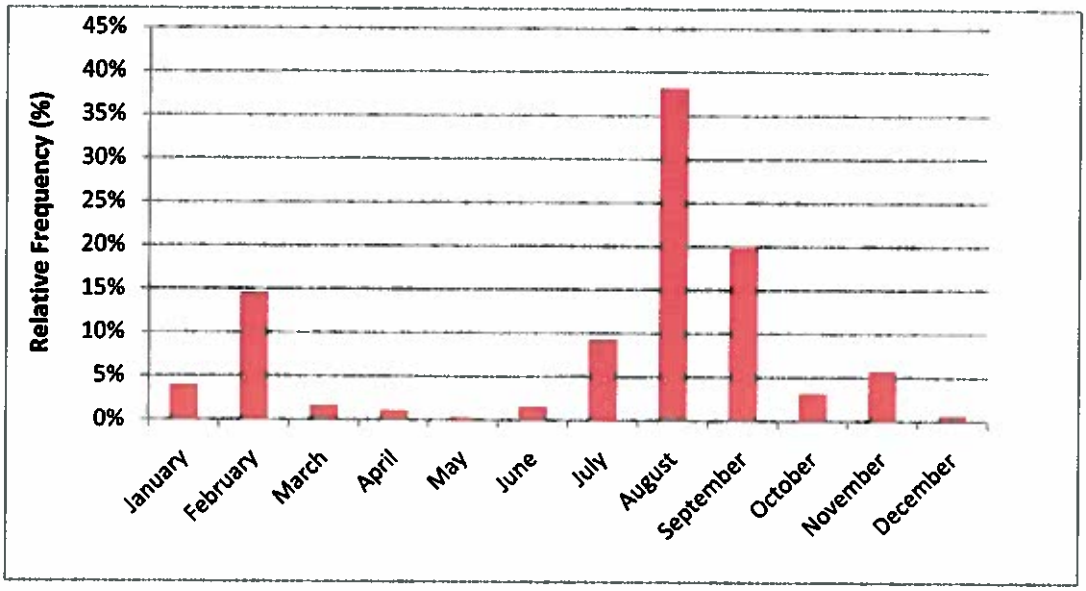

Figure 26. Lake Las Vegas Zooplankton frequency by month at site LLV-1A during 2010.

Chlorophyll a

Chlorophyll are the green pigments found in plants tissues. There are several known types of chlorophyll; *chlorophyll a* and *chlorophyll b* are the two most common forms. Chlorophyll is a major light gathering pigment of all photosynthetic organisms and is essential for the process of photosynthesis. The amount of *chlorophyll a* present in lake water depends on the abundance and species of algae. Different algae species have different levels of *Chlorophll a* within their cells. *Chlorophyll a* is used as a common indicator of water quality (NALMS 2009).

Surface *chlorophyll a* concentrations were measured at site LLV-1A with an observed average concentration of 15 mg/m^3 (range: 2 to 38 mg/m^3) (**Figure 27**). Concentrations at the surface were above 5 mg/m^3 for most of the year due to the *P. parvum* bloom. Concentrations with depth varied throughout the year but were also above 5 mg/m^3 because of the *P. parvum* bloom (**Figure 28**). While the highest concentrations of *P. parvum* were observed from February to May, their presence in the Lake after May contributed to the high concentrations of *chlorophyll a* observed in the Lake throughout the year.

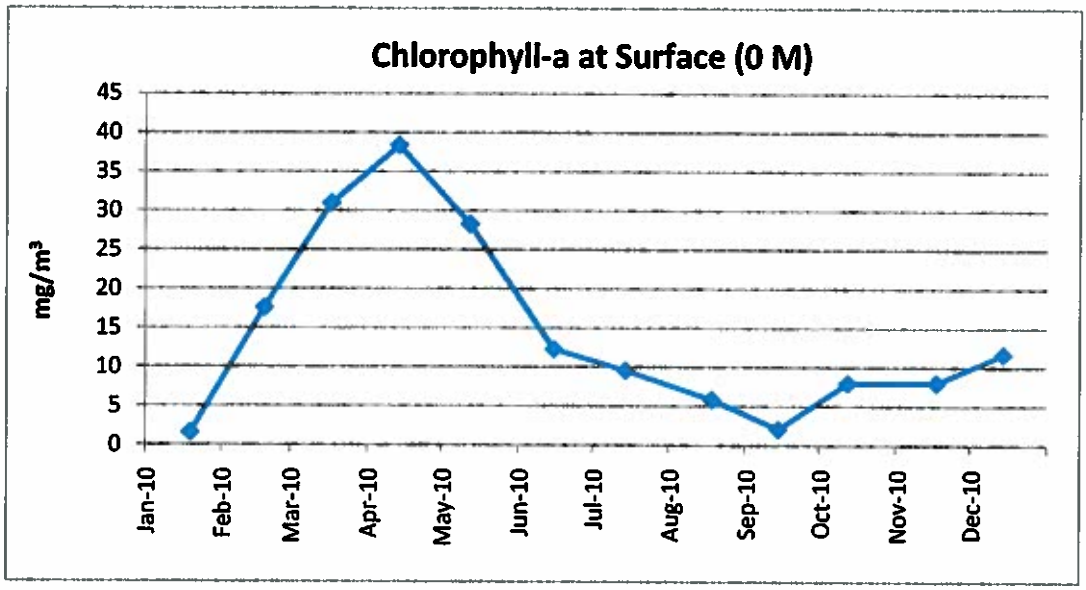

Figure 27. Lake Las Vegas *chlorophyll a* (mg/L) concentrations in surface waters at Lake monitoring sites during 2010.

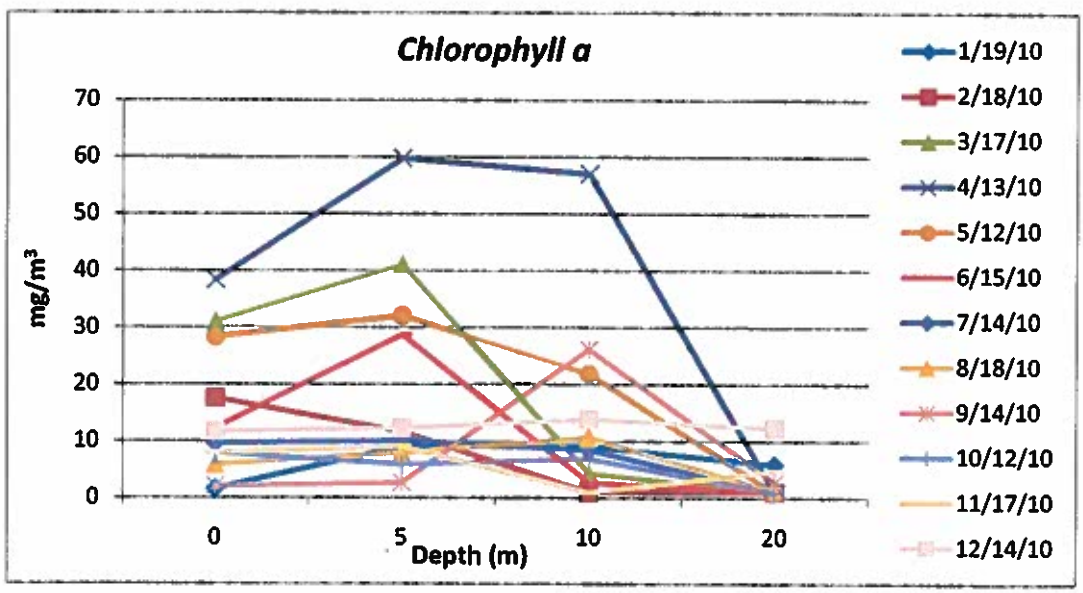

Figure 28. Lake Las Vegas monthly *chlorophyll a* (mg/L) profile at site LLV-1A during 2010.

Bacteria

Fecal coliform monitoring was completed on a monthly basis at site LLV-1A in 2010. Fecal coliform counts in surface waters were below body contact limits of 200 MPN / 100mL in 2010 (**Figure 29**). Fecal coliform were at or below the detection limit, averaging 1 MPN/100mL and ranging from 1 to 2 MPN/100mL at site LLV-1A.

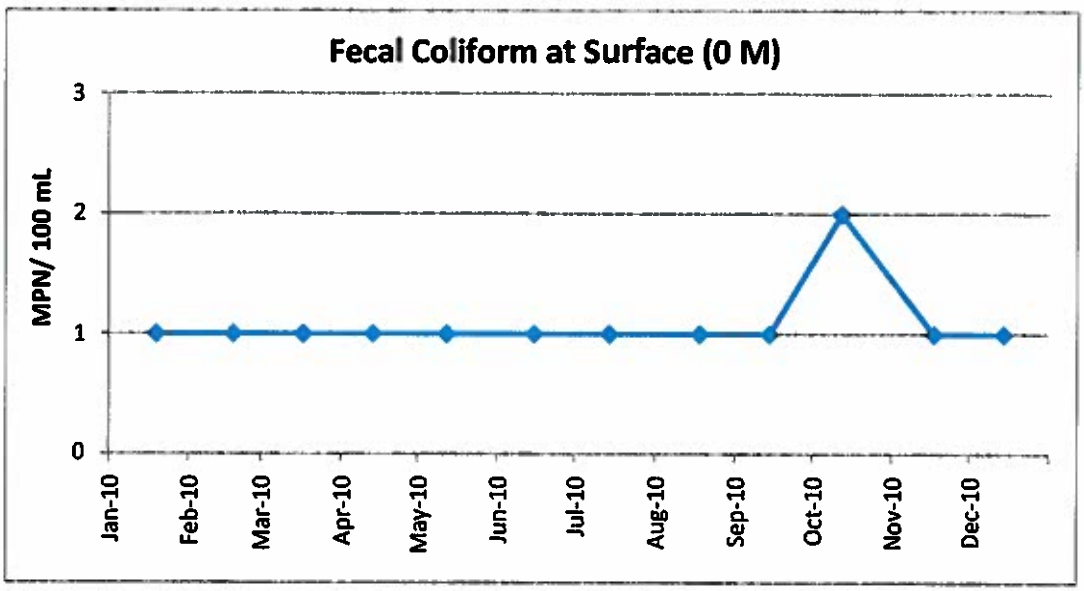

Figure 29. Lake Las Vegas fecal coliform counts (MPN/100ml) in surface waters at Lake monitoring sites during 2010.

Fish

Fish mortality was first observed approximately 30 days after the first occurrence of *P. parvum* in December 2009. Since record keeping on dead fish began in February 2010, maintenance workers collected dead fish almost daily with an average of 54 fish collected daily, and a range of zero (0) to 697 removed over a 105-day period from February 27th to July 2nd.

These statistics are skewed so that during the peak biomass of *P. parvum*, a greater number of dead fish were observed with significantly fewer observed after the peak of the bloom. (Weber et al. 2010)

The common carp (*Cyprimas carpio)* was by far the dominant species affected by the presence of *P. parvum* attributing to over 82 percent of the collected dead fish. In addition, largemouth bass (*Micropterus samiodes)*, channel catfish (*Ictarlurus punctaus),* and bluegills (*Lepomis macrochirus)* also were affected; at 13 percent, 4 percent, and 0.8 percent of the total respectively. In this case the influence of the common carp's feeding habit with the shallow littoral reaches of the reservoir possibly impacted species more readily than other pelagic feeding game fish such as the largemouth bass since the life cycle of *P. parvum* includes a non-flagellated cyst form that may be present at high concentrations on lake sediments. In most previously reported fish kills from *P. parvum* toxicity, game fish were the most common group. In

contrast, rough fish, common carp, were the primary fish impacted with the highest mortality in Lake Las Vegas. (Weber et al. 2010)

Toxic Substances

Water samples for toxic analysis were collected from the surface (0m) and bottom (1m from bottom) of site LLV-1A on December 14, 2010, when the Lake was completely mixed. These samples were analyzed for toxic metals, trihalomethanes, pesticides, herbicides, PCBs, and various other organic and inorganic chemicals. Trace metal concentrations were well below the recommended MCLs. Concentrations of pesticides, herbicides and other toxic organic compounds also were also below levels of detection (**Appendix A**).

IV. SUMMARY

Most of the water quality guidelines were met this year by the Lake. pH results were between 7.0 and 9.0 in all measurements. Dissolved oxygen concentrations were five (5) mg/L in the epilimnion during stratification and five (5) mg/L throughout the water column the rest of the year. Fecal coliform bacteria were below the action level of 200 MPN/100ml. Temperatures in the epilimnion did not exceed 2°C above ambient temperature. Total dissolved solids annual average concentration throughout the water column was 1,895 mg/L, below the exceedance level of 2,000 mg/L. The total dissolved solids and associated ions were exhibiting the highest concentrations in late fall due to summer evaporations. Concentrations of toxic metals, pesticides, herbicides and other toxic organic compounds were below detection limits.

However the water quality in Lake Las Vegas during 2010 was influenced by the *P. parvum* bloom. Average *chlorophyll a* concentrations were above the proposed guideline of five (5) µg/L during April through September. The *chlorophyll a* guideline is applied at that time of year to protect water quality during the peak recreation period. Turbidity exceeded that characteristic of natural conditions by more than 10 NTU.

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VI. APPENDIX A

Annual Toxicity Analysis

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: December 28, 2010

REPORT NUMBER: 10-4802

CLIENT: Lake Las Vegas Master Association
1605 Lake Las Vegas Parkway
Henderson, Nevada 89011

CLIENT PROJECT:

CLIENT PO #:

Sampled By: Client
Date Sampled: 12/14/10
Time Sampled: Refer to COC

Submitted by: J. Pauli
Date Received: 12/14/10
Time Received: 1220

Report Attention: P. Rosia

Sample ID	Parameter	Result	Unit	Detection Limit	Method	Date Analyzed	Analyst
LLV-1A 0m	Nitrite	ND	mg/L	0.1	EPA300.0	12/15/10	NH
	Turbidity	5	NTU	1.0	EPA2130B	12/23/10	DC
LLV-1A 20m	Nitrite	ND	mg/L	0.1	EPA300.0	12/15/10	NH
	Turbidity	6	NTU	1.0	EPA2130B	12/23/10	DC

ND: non-detect
EPA Flag: none
NOTE: 608, 8270, and 8151 subcontracted to Anatek Labs, Moscow, ID (See attached laboratory report)

REVIEWED BY:

John Sloan
Laboratory Director

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www.ssalabs.com

Silver State Analytical Laboratories
Report Number: 10-4802
December 28, 2010

Sample ID: LLV-1A 0m
Method: EPA8260B

Analyzed by: JS
Date Analyzed: 12/26/10

Compound	Result µg/L	Reporting Limit µg/L	Compound	Result µg/L	Reporting Limit µg/L
Bromomethane	ND	5	Carbon disulfide	ND	15
Bromobenzene	ND	5	Carbon tetrachloride	ND	5
Bromochloromethane	ND	5	Chlorobenzene	ND	5
Bromodichloromethane	ND	5	Chloroethane	ND	5
Bromoform	ND	5	Chloroform	ND	5
2-Butanone (MEK)	ND	25	Chloromethane	ND	5
2-Chloroethyl vinyl ether	ND	5	cis-1,2-Dichloroethene	ND	5
2-Chlorotoluene	ND	5	cis-1,3-Dichloropropene	ND	5
2-Hexanone	ND	20	Dibromochloromethane	ND	5
4-Chlorotoluene	ND	5	Dibromomethane	ND	5
4-Methyl-2-Pentanone	ND	20	Dichlorodifluoromethane	ND	5
Acrylonitrile	ND	20	Dimethyl Disulfide	ND	5
Benzene	ND	4	Ethylbenzene	ND	5
1,1,1,2-Tetrachloroethane	ND	5	Hexachlorobutadiene	ND	5
1,1,1-Trichloroethane	ND	5	Isopropylbenzene (Cumene)	ND	5
1,1,2,2- Tetrachloroethane	ND	5	m and p-Xylene	ND	5
1,1,2-Trichloroethane	ND	5	Methylene chloride	ND	5
1,1-Dichloroethane	ND	5	Methyl-tert-butylether	ND	5
1,1-Dichloroethene	ND	5	Naphthalene	ND	5
1,1-Dichloropropene	ND	5	n-Butylbenzene	ND	5
1,2,3-Trichlorobenzene	ND	5	n-Propylbenzene	ND	5
1,2,3-Trichloropropane	ND	5	o-Xylene	ND	5
1,2,4-Trichlorobenzene	ND	5	p-Isopropyltoluene	ND	5
1,2,4-Trimethylbenzene	ND	5	sec-Butylbenzene	ND	5
1,2-Dibromo-3-chloropropane	ND	5	Styrene	ND	5
1,2-Dibromoethane	ND	5	tert-Butylbenzene	ND	5
1,2-Dichlorobenzene	ND	5	Tetrachloroethene	ND	4
1,2-Dichloroethane	ND	5	Toluene	ND	5
1,2-Dichloropropane	ND	5	trans-1,2-Dichloroethene	ND	5
1,3,5-Trimethylbenzene	ND	5	trans-1,3-Dichloropropene	ND	5
1,3-Dichlorobenzene	ND	5	Trichloroethene	ND	5
1,3-Dichloropropane	ND	5	Trichlorofluoromethane	ND	5
1,4-Dichlorobenzene	ND	5	Vinyl chloride	ND	5
2,2-Dichloropropane	ND	5			

ND: non-detect
EPA Flag: none

Silver State Analytical Laboratories
Report Number: 10-4802
December 28, 2010

Sample ID: LLV-1A 20m
Method: EPA8260B

Analyzed by: JS
Date Analyzed: 12/26/10

Compound	Result µg/L	Reporting Limit µg/L	Compound	Result µg/L	Reporting Limit µg/L
Bromomethane	ND	5	Carbon disulfide	ND	15
Bromobenzene	ND	5	Carbon tetrachloride	ND	5
Bromochloromethane	ND	5	Chlorobenzene	ND	5
Bromodichloromethane	ND	5	Chloroethane	ND	5
Bromoform	ND	5	Chloroform	ND	5
2-Butanone (MEK)	ND	25	Chloromethane	ND	5
2-Chloroethyl vinyl ether	ND	5	cis-1,2-Dichloroethene	ND	5
2-Chlorotoluene	ND	5	cis-1,3-Dichloropropene	ND	5
2-Hexanone	ND	20	Dibromochloromethane	ND	5
4-Chlorotoluene	ND	5	Dibromomethane	ND	5
4-Methyl-2-Pentanone	ND	20	Dichlorodifluoromethane	ND	5
Acrylonitrile	ND	20	Dimethyl Disulfide	ND	5
Benzene	ND	4	Ethylbenzene	ND	5
1,1,1,2-Tetrachloroethane	ND	5	Hexachlorobutadiene	ND	5
1,1,1-Trichloroethane	ND	5	Isopropylbenzene (Cumene)	ND	5
1,1,2,2- Tetrachloroethane	ND	5	m and p-Xylene	ND	5
1,1,2-Trichloroethane	ND	5	Methylene chloride	ND	5
1,1-Dichloroethane	ND	5	Methyl-tert-butylether	ND	5
1,1-Dichloroethene	ND	5	Naphthalene	ND	5
1,1-Dichloropropene	ND	5	n-Butylbenzene	ND	5
1,2,3-Trichlorobenzene	ND	5	n-Propylbenzene	ND	5
1,2,3-Trichloropropane	ND	5	o-Xylene	ND	5
1,2,4-Trichlorobenzene	ND	5	p-Isopropyltoluene	ND	5
1,2,4-Trimethylbenzene	ND	5	sec-Butylbenzene	ND	5
1,2-Dibromo-3-chloropropane	ND	5	Styrene	ND	5
1,2-Dibromoethane	ND	5	tert-Butylbenzene	ND	5
1,2-Dichlorobenzene	ND	5	Tetrachloroethene	ND	4
1,2-Dichloroethane	ND	5	Toluene	ND	5
1,2-Dichloropropane	ND	5	trans-1,2-Dichloroethene	ND	5
1,3,5-Trimethylbenzene	ND	5	trans-1,3-Dichloropropene	ND	5
1,3-Dichlorobenzene	ND	5	Trichloroethene	ND	5
1,3-Dichloropropane	ND	5	Trichlorofluoromethane	ND	5
1,4-Dichlorobenzene	ND	5	Vinyl chloride	ND	5
2,2-Dichloropropane	ND	5			

ND: non-detect
EPA Flag: none

SilverState Analytical Laboratories

CHAIN-OF-CUSTODY RECORD

3638 E. Sunset Road, Suite 100, Las Vegas, Nevada 89120
Phone: (702) 873-4478 Fax: (702) 873-7967

Page _____ of _____

Project/Job #

Payment Method/PO #

SEND INVOICE TO
Name
Company: Lake Las Vegas
Mailing Address: 1605 Lake Las Vegas Parkway
City, State, Zip: Henderson, NV 89011

REPORT RESULTS TO
Name
Company: Lake Las Vegas
Mailing Address: 1605 Lake Las Vegas Parkway
City, State, Zip: Henderson, NV 89011
Phone
Fax

Sampled By: Lake Las Vegas
Report Attention
On-Site pH/Temperature

Turnaround Time (Specify Below with an X)
Standard 10 Business Days ☐
Rush: 24h | 48h | 72h | Other
NOTE: A surcharge is applied for rush samples

Other Pertinent Info: ANNUAL TOXIC ORGANICS SCREEN

ANALYSES REQUESTED

Circle Applicable Program: SDWA CWA RCRA Other
Reporting requirements: RL MDL POL
Report Level: I II III IV
NOTE: Surcharges apply to Level III and IV

Date Sampled	Time Sampled	Sample Location/ Sample ID	Silver State Lab ID	Comp/ Grab	Matrix*	Preservative	Number/Type of Containers**	608 (PEST/PCB)	8260 (VOC)	8270 (SVOC)	8151 (Herbicides)	Nitrite, Turbidity	Circle Applicable Program
14 DEC 10	0950	LLV-1A 0 m	4802-1	G	AQ	varies		X	X	X	X	X	
↓	1005	LLV-1A 20 m	-2	G	AQ	varies		X	X	X	X	X	*Metals

Tampering with sample name, date, time, and location may constitute fraud

Relinquished by Signature/Print: J.m PAULI
Time/Date: 1220 14 DEC 10

Received by Signature/Print: S. West S. West
Time/Date: 12:20 12-14-10

Method of Delivery
Receiving Laboratory

Authorized by _____ Date _____
Authorization is required to process samples. This obligates your organization for fee pertaining to services rendered. If collections or legal services are required to recover said fees, your organization will be responsible for all fees and cost in addition to service fees.

Special Instructions

Note: Samples are discarded 30 days after results are reported. Samples deemed hazardous are returned to the client upon completion of analysis.

* Key: AQ – Aqueous S – Soil W – Waste OT – Other

** Key: P – Plastic G – Glass V – VOA Vial OT – Other

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504 E Sprague Ste D • Spokane WA 99202 • (509) 838-3999 • Fax (509) 838-4433 • email spokane@anateklabs.com

Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-001	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A OM / 4802-1	**Sampling Time**	9:50 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
2,4,5-T	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
2,4,5-TP (Silvex)	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
2,4-D	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
2,4-DB	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Chloramben	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dacthal	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dalapon	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dicamba	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dichloroprop	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dinoseb	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Pentachlorophenol	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Picloram	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	

Surrogate Data

Sample Number 101217043-001

Surrogate Standard	Method	Percent Recovery	Control Limits
3,5-Dichlorobenzoic Acid	EPA 8151A	88.5	35-145

Certifications held by Anatek Labs ID EPA ID00013, AZ 0701, CO ID00013, FL(NELAP) E87893, ID ID00013, IN C-ID-01, KY 90142, MT CERT0028, NM ID00013, OR ID200001-002, WA C595
Certifications held by Anatek Labs WA EPA WA00169, CA Cert2832, ID WA00169, WA C585, MT Cert0095

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number 101217043-002
Client Sample ID LLV-1A 20M / 4808-2
Matrix Water
Comments

Sampling Date 12/14/2010
Sampling Time 10:05 AM
Sample Location

Date/Time Received 12/16/2010 11:30 AM
Extraction Date 12/20/2010

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
2,4,5-T	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
2,4,5-TP (Silvex)	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
2,4-D	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
2,4-DB	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Chloramben	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dacthal	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dalapon	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dicamba	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dichloroprop	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Dinoseb	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Pentachlorophenol	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	
Picloram	ND	ug/L	0.1	12/20/2010	SAT	EPA 8151A	

Surrogate Data

Sample Number 101217043-002

Surrogate Standard	Method	Percent Recovery	Control Limits
3,5-Dichlorobenzoic Acid	EPA 8151A	93.5	35-145

Authorized Signature

John Coddington, Lab Manager

MCL EPA's Maximum Contaminant Level
ND Not Detected
PQL Practical Quantitation Limit

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The results reported relate only to the samples indicated.
Soil/solid results are reported on a dry-weight basis unless otherwise noted.

Certifications held by Anatek Labs ID EPA ID00013, AZ 0701, CO ID00013, FL(NELAP) E87893, ID ID00013, IN C-ID-01, KY 90142, MT CERT0028, NM ID00013, OR ID200001-002, WA C595
Certifications held by Anatek Labs WA EPA WA00169, CA Cert2632, ID WA00169, WA C585, MT Cert0095

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-001	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A OM / 4802-1	**Sampling Time**	9:50 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
4,4-DDD	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
4,4-DDE	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
4,4-DDT	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Aldrin	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
alpha-BHC	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Aroclor 1016 (PCB-1016)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1221 (PCB-1221)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1232 (PCB-1232)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1242 (PCB-1242)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1248 (PCB-1248)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1254 (PCB-1254)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1260 (PCB-1260)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
beta-BHC	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Chlordane	ND	ug/L	0.1	12/20/2010	SAT	EPA 608	
delta-BHC	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Dieldrin	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endosulfan I	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endosulfan II	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endosulfan sulfate	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endrin	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endrin aldehyde	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endrin ketone	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number 101217043-001
Client Sample ID LLV-1A OM / 4802-1
Matrix Water
Comments

Sampling Date 12/14/2010
Sampling Time 9:50 AM
Sample Location

Date/Time Received 12/16/2010 11:30 AM
Extraction Date 12/20/2010

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
gamma-BHC (Lindane)	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Heptachlor	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Heptachlor epoxide	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Methoxychlor	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Toxaphene	ND	ug/L	0.1	12/20/2010	SAT	EPA 608	

Surrogate Data

Sample Number 101217043-001

Surrogate Standard	Method	Percent Recovery	Control Limits
DCB	EPA 608	83.4	30-130

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-002	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A 20M / 4808-2	**Sampling Time**	10:05 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
4,4-DDD	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
4,4-DDE	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
4,4-DDT	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Aldrin	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
alpha-BHC	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Aroclor 1016 (PCB-1016)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1221 (PCB-1221)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1232 (PCB-1232)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1242 (PCB-1242)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1248 (PCB-1248)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1254 (PCB-1254)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
Aroclor 1260 (PCB-1260)	ND	ug/L	0.2	12/20/2010	SAT	EPA 608	
beta-BHC	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Chlordane	ND	ug/L	0.1	12/20/2010	SAT	EPA 608	
delta-BHC	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Dieldrin	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endosulfan I	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endosulfan II	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endosulfan sulfate	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endrin	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endrin aldehyde	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Endrin ketone	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
gamma-BHC (Lindane)	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-002	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A 20M / 4808-2	**Sampling Time**	10:05 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Heptachlor	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Heptachlor epoxide	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Methoxychlor	ND	ug/L	0.01	12/20/2010	SAT	EPA 608	
Toxaphene	ND	ug/L	0.1	12/20/2010	SAT	EPA 608	

Surrogate Data

Sample Number 101217043-002

Surrogate Standard	Method	Percent Recovery	Control Limits
DCB	EPA 608	83.2	30-130

Authorized Signature

John Coddington, Lab Manager

MCL EPA's Maximum Contaminant Level
ND Not Detected
PQL Practical Quantitation Limit

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Soil/solid results are reported on a dry-weight basis unless otherwise noted.

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number 101217043-001
Client Sample ID LLV-1A OM / 4802-1
Matrix Water
Comments

Sampling Date 12/14/2010
Sampling Time 9:50 AM
Sample Location

Date/Time Received 12/16/2010 11:30 AM
Extraction Date 12/20/2010

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
1,2,4-Trichlorobenzene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
1,2-Dichlorobenzene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
1,2-Diphenyl hydrazine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
1,3-Dichlorobenzene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
1,4-Dichlorobenzene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
1-Methylnaphthalene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,3,4,6-Tetrachlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,3,5,6-Tetrachlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,4,5-Trichlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,4,6-Trichlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,4-Dichlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,4-Dimethylphenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,4-Dinitrophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,4-Dinitrotoluene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2,6-Dinitrotoluene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2-Chloronaphthalene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2-Chlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2-Methylnaphthalene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2-Methylphenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2-Nitroaniline	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
2-Nitrophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
3,3'-Dichlorobenzidine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-001	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A OM / 4802-1	**Sampling Time**	9:50 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
3+4-Methylphenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
3-Nitroaniline	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4,6-Dinitro-2-methylphenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4-Bromophenyl-phenylether	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4-Chloro-3-methylphenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4-Chloroaniline	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4-Chlorophenyl-phenylether	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4-Nitroaniline	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
4-Nitrophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Acenaphthene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Acenaphthylene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Aniline	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Anthracene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzidine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzo(ghi)perylene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzo[a]anthracene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzo[a]pyrene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzo[b]fluoranthene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzo[k]fluoranthene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Benzyl alcohol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
bis(2-Chloroethoxy)methane	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
bis(2-Chloroethyl)ether	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
bis(2-chloroisopropyl)ether	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	

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Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-001	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A OM / 4802-1	**Sampling Time**	9:50 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
bis(2-Ethylhexyl)phthalate	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Butylbenzylphthalate	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Carbazole	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Chrysene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Dibenz[a,h]anthracene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Dibenzofuran	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Diethylphthalate	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Dimethylphthalate	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Di-n-butylphthalate	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Di-n-octylphthalate	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Fluoranthene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Fluorene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Hexachlorobenzene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Hexachlorobutadiene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Hexachlorocyclopentadiene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Hexachloroethane	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Indeno[1,2,3-cd]pyrene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Isophorone	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Naphthalene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Nitrobenzene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Nitrosodimethylamine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
n-Nitroso-di-n-propylamine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
n-Nitrosodiphenylamine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-001	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A OM / 4802-1	**Sampling Time**	9:50 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Pentachlorophenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Phenanthrene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Phenol	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Pyrene	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	
Pyridine	ND	ug/L	0.5	1/5/2011	EMP	EPA 8270C	

Surrogate Data

Sample Number 101217043-001

Surrogate Standard	Method	Percent Recovery	Control Limits
2,4,6-Tribromophenol	EPA 8270C	81.1	53-122
2-Fluorobiphenyl	EPA 8270C	84.1	12-116
2-Fluorophenol	EPA 8270C	79.4	10-139
Nitrobenzene-d5	EPA 8270C	80.1	68-118
Phenol-d5	EPA 8270C	85.5	28-154
Terphenyl-d14	EPA 8270C	85.8	52-144

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Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
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Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-002	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A 20M / 4808-2	**Sampling Time**	10:05 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
1,2,4-Trichlorobenzene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
1,2-Dichlorobenzene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
1,2-Diphenyl hydrazine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
1,3-Dichlorobenzene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
1,4-Dichlorobenzene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
1-Methylnaphthalene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,3,4,6-Tetrachlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,3,5,6-Tetrachlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,4,5-Trichlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,4,6-Trichlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,4-Dichlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,4-Dimethylphenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,4-Dinitrophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,4-Dinitrotoluene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2,6-Dinitrotoluene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2-Chloronaphthalene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2-Chlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2-Methylnaphthalene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2-Methylphenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2-Nitroaniline	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
2-Nitrophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
3,3'-Dichlorobenzidine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
3+4-Methylphenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	

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Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-002	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A 20M / 4808-2	**Sampling Time**	10:05 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
3-Nitroaniline	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4,6-Dinitro-2-methylphenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4-Bromophenyl-phenylether	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4-Chloro-3-methylphenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4-Chloroaniline	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4-Chlorophenyl-phenylether	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4-Nitroaniline	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
4-Nitrophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Acenaphthene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Acenaphthylene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Aniline	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Anthracene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzidine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzo(ghi)perylene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzo[a]anthracene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzo[a]pyrene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzo[b]fluoranthene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzo[k]fluoranthene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Benzyl alcohol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
bis(2-Chloroethoxy)methane	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
bis(2-Chloroethyl)ether	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
bis(2-chloroisopropyl)ether	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
bis(2-Ethylhexyl)phthalate	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	

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Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number 101217043-002
Client Sample ID LLV-1A 20M / 4808-2
Matrix Water
Comments

Sampling Date 12/14/2010
Sampling Time 10:05 AM
Sample Location

Date/Time Received 12/16/2010 11:30 AM
Extraction Date 12/20/2010

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Butylbenzylphthalate	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Carbazole	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Chrysene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Dibenz[a,h]anthracene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Dibenzofuran	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Diethylphthalate	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Dimethylphthalate	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Di-n-butylphthalate	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Di-n-octylphthalate	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Fluoranthene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Fluorene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Hexachlorobenzene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Hexachlorobutadiene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Hexachlorocyclopentadiene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Hexachloroethane	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Indeno[1,2,3-cd]pyrene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Isophorone	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Naphthalene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Nitrobenzene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Nitrosodimethylamine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
n-Nitroso-di-n-propylamine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
n-Nitrosodiphenylamine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Pentachlorophenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	

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Client: SILVER STATE ANALYTICAL LABS
Address: 3638 E. SUNSET ROAD
LAS VEGAS, NV 89120
Attn: JOHN SLOAN

Batch #: 101217043
Project Name: LAB ID 4802

Analytical Results Report

Sample Number	101217043-002	**Sampling Date**	12/14/2010	**Date/Time Received**	12/16/2010 11:30 AM
Client Sample ID	LLV-1A 20M / 4808-2	**Sampling Time**	10:05 AM	**Extraction Date**	12/20/2010
Matrix	Water	**Sample Location**			
Comments					

Parameter	Result	Units	PQL	Analysis Date	Analyst	Method	Qualifier
Phenanthrene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Phenol	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Pyrene	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	
Pyridine	ND	ug/L	0.5	1/3/2011	EMP	EPA 8270C	

Surrogate Data

Sample Number 101217043-002

Surrogate Standard	Method	Percent Recovery	Control Limits
2,4,6-Tribromophenol	EPA 8270C	87.0	53-122
2-Fluorobiphenyl	EPA 8270C	85.1	12-116
2-Fluorophenol	EPA 8270C	80.6	10-139
Nitrobenzene-d5	EPA 8270C	82.1	68-118
Phenol-d5	EPA 8270C	78.0	28-154
Terphenyl-d14	EPA 8270C	92.4	52-144

Authorized Signature

John Coddington, Lab Manager

MCL EPA's Maximum Contaminant Level
ND Not Detected
PQL Practical Quantitation Limit

This report shall not be reproduced except in full, without the written approval of the laboratory.
The results reported relate only to the samples indicated.
Soil/solid results are reported on a dry-weight basis unless otherwise noted.

Certifications held by Anatek Labs ID: EPA ID00013, AZ 0701, CO ID00013, FL(NELAP) E87893, ID ID00013, IN C-ID-01, KY 90142, MT CERT0028, NM ID00013, OR ID200001-002, WA C595
Certifications held by Anatek Labs WA: EPA WA00169, CA Cert2632, ID WA00169, WA C585, MT Cert0095

SilverState Analytical Laboratories

CHAIN-OF-CUSTODY RECORD

Phone: (702) 873-4478 Fax: (702) 873-7967

01217 043 SSAL Last Due 12/29/2010
st SAMP 12/14/201 1st RCVD 12/16/2010
AB ID 4802

Project/Job #:	Payment Method/PO #
SEND INVOICE TO: Name	
Company	
Mailing Address	
City, State, Zip	

REPORT RESULTS TO:
Name: John Sloan Title
Company: Silver State Analytical Laboratories
Mailing Address: 3638 E. Sunset Suite 100
City, State, Zip: Las Vegas, NV 89120
Phone: Fax:

Sampled By:
Report Attention: J. Sloan
On-Site pH/Temperature

Turnaround (Specify Below with an X)
Standard 7-10 Business Days ☐
Rush: 24h | 48h | 72h | Other
NOTE: A surcharge is applied for rush samples

Other Pertinent Info.

Reporting requirements: Use RL / MDL / PQL
Report Level ⊕: I II III IV
Circle Applicable Program: SDWA CWA RCRA Other
⊕ Level III and IV will be surcharged.

ANALYSES REQUESTED

Date Sampled	Time Sampled	Sample Location/ Sample ID	Silver State Lab ID	Comp/ Grab	Matrix*	Preservative	Number/Type of Containers**	608 (Pest/PCB)	8270 (SVOC)	8151 (Herb)									
12/14/10	0950	LLV-1A 0m	4802-1	G	AQ	Cool		X	X	X			1						
12/14/10	1005	LLV-1A 20m	4808-2	G	AQ	Cool		X	X	X			2						

MUOBS

Relinquished by Signature/Print: John Sloan
Time/Date: 1600 12/15/10
Received by Signature/Print:

Authorized by: Date:
Authorization is required to process samples. This obligates your organization for the purchasing to services rendered. If collections or legal services are required to recover unpaid fees, your organization will be responsible for all fees and cost in addition to service fees.

Special Instructions:
NOTE: Samples are discarded 30 days after reporting. Hazardous samples are returned to sender.

* Key AQ – Aqueous S – Soil W – Waste OT – Other

Distribution: White – Lab Yellow – Client Pink – Other

ANATEK LABS RECEIVING LIST

- ☑ RECEIVED INTACT
- ☑ LABELS & CHAINS AGREE
- ☐ NO HEADSPACE
- ☐ PRESERVATIVE —

TEMP: 5.2 °C

NUMBER OF CONTAINERS: 6 SHIPPED VIA: Fed x

DATE & TIME: 12/16/10 11:30 INSPECTED BY: BT