2005 LAKE LAS VEGAS WATER QUALITY MONITORING REPORT

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(NDEP)
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I. INTRODUCTION

A. Project History

J. Carlton Adair, then President of the Port Holiday Authority conceived the idea of Lake Las Vegas in 1964. The 2243-acre development project was known as Port Holiday, and the lake was called "Lake Adair." Project land was acquired from the federal government under a land exchange act (PL88-639) authorized by Congress on October 8, 1964. Approximately 170 acres of privately owned land in the Lake Mead National Recreation Area (LMNRA) was exchanged for 2,243 acres in Las Vegas Wash (LVW). That property was located along the western border of the LMNRA in the LVW (Figure 1).

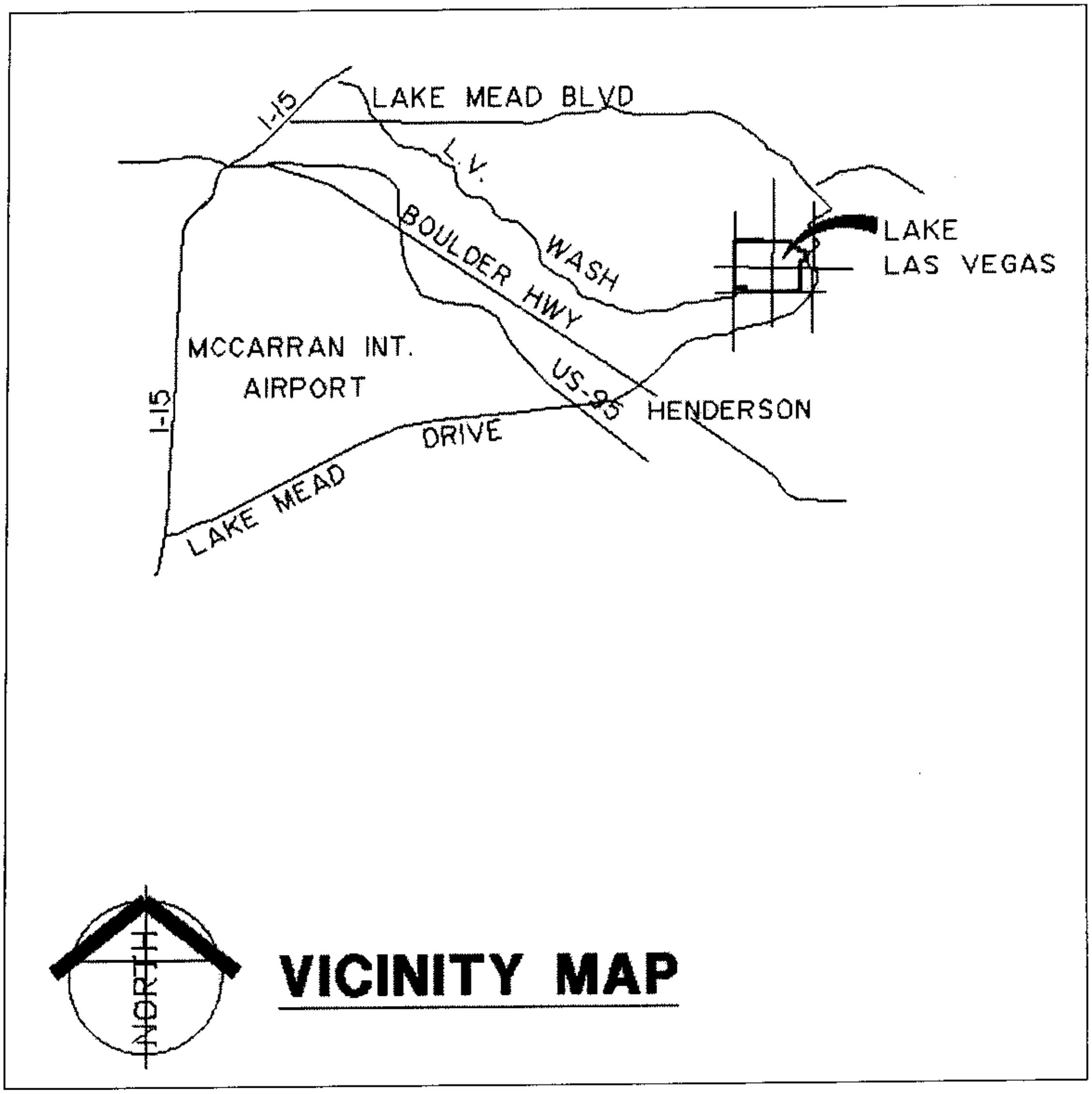
Carlton Adair halted the project in 1971, though a considerable amount of engineering and feasibility work had been done. The project remained idle until 1982 when it was reinitiated as the Lake at Las Vegas Project by Barry Silverton and the Pacific Malibu Development Corporation of Los Angeles, CA. Pacific Malibu and its prime consultant J. M. Montgomery (JMM) Consulting Engineers conducted extensive engineering and environmental studies during 1984-1987. Transcontinental Corporation of Santa Barbara, California, acquired controlling interest in the project in 1988. Transcontinental Corporation and its consultants completed the engineering and environmental studies and obtained the necessary local, state, and federal permits required to start construction of the project. Construction began on April 1, 1989. The project is now called "Lake Las Vegas Resort."

B. Project Description

The focal point of the project is a 320-acre recreational lake that is developed behind a 4800-ft., S-shaped earthen dam, 1500 ft. upstream of North Shore Road. The 190-ft. high dam was constructed with 3.0 million cubic yards of locally available materials. Lake elevation is maintained between 1401.85 ft. and 1404.85 ft. (NAVD 88). At an elevation of 1404.85 ft., the Lake has a storage capacity of approximately 10,000 acre feet, comprises 320 surface acres, a two mile length, a one mile width, and 12.3 miles of shoreline. Lake fill water is drawn from Lake Mead, and conveyed by the Basic Management Incorporated Pipeline (BMI). Approximately 7,000 – 9,000 acre-feet are required annually for project irrigation, seepage, evaporative losses from the lake.

Las Vegas Wash flows are by-passed under the lake through two 84-inch diameter reinforced concrete pipelines. The bypass system is 9,450 ft. in length and designed to pass Las Vegas Wash (LVW) flows up to approximately 1,200 cubic feet per second (cfs). Flows currently average about 311 cubic feet per second in LVW in 2005.

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



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II. METHODS

The revised Clark County 208 Water Management Plan was approved by the Clark County Board of County Commissioners on April 5, 1988 and certified by the State of Nevada on August 8, 1988. This plan required a water quality-monitoring program be developed for Lake Las Vegas Resort. The monitoring was required to insure that construction activities and operations of the reservoir did not violate the Las Vegas Wash water quality standards. The water quality-monitoring program was initiated in June 1991, and Lake Las Vegas has submitted annual reports to Nevada Division of Environmental Protection for review.

A. Lake Las Vegas Monitoring Sites

Since 1991, water quality monitoring was conducted on Lake Las Vegas monthly in January, February, November, and December, biweekly during March and October, and weekly during April through September.

Water quality monitoring was conducted at sites shown in Figure 2, at fixed points along the historical center channel in the deepest part of the Lake.

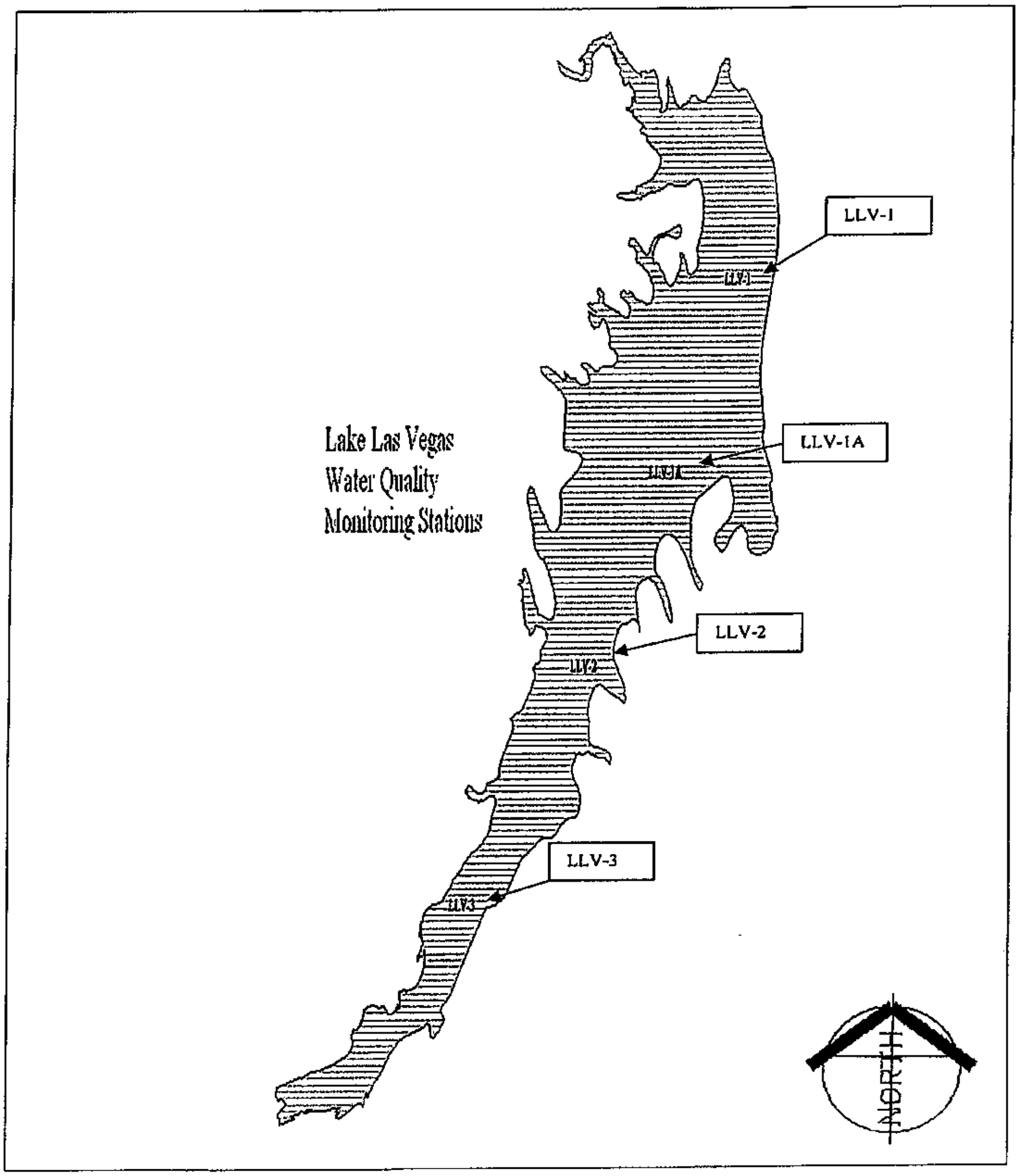

Figure 2. **Location of water quality monitoring stations at Lake Las Vegas.**

B. Field Measurements

Temperature, dissolved oxygen, pH, and specific conductance were measured throughout the vertical column at all sites with a Hydrolab Surveyor Model 4 a Water Quality Analyzer or a YSI Water Quality Analyzer (Table 1). Transparency was measured at each lake site with a Secchi disc. Duplicate measurements were made on approximately 10% of the measurements.

Table 1. **2005 Lake Las Vegas physical, chemical and biological analyses.**

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)	Surface	"	"
Turbidity (NTU)	0 - 2.5 m Integrated	"	EPA 180.1
Chemical			
Total Nitrogen (μg/l)	0 - 2.5 m Integrated	"	APHA (1995)
Ammonia-N (μg/l)	"	"	EPA 350.2
Total Kjeldehl Nitrogen	"	"	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	"	"	EPA 375.4
BOD 5	"	"	EPA 405.1
Biological			
Chlorophyll-a (μg/l)	"	"	Janik
Phytoplankton Counts (ng/m3)	"	"	"
Zooplankton Counts (No./l)	0 - 15 m Net Tow	"	"
Fecal Coliform (MPN/100ml)	"	"	"

C. Chemical and Biological Analysis

Depth integrated water samples were collected from 0 - 2.5 m at main-lake sampling sites (Figure 2). Additional depth samples were also collected quarterly at 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 millipore filters.

Analyses were run on field duplicates at a frequency of approximately 10% of the samples. A State of Nevada certified laboratory ran 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 2005 for analysis of toxic substances.

Monthly Zooplankton samples were collected at LLV-1 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-1. 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) than 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 sedimented range from 2.0 – 10.0 mL depending of algal density.

Biovolumes:
Cell volumes are calculated based on the measurements of at least 20 individuals of each species and the geometrical formulae which most closely approximates 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 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.

D. Statistical Analysis

Statistical analysis was performed using Jandels Sigma Stat Analytical software. All data sets were tested for normality and heterogeneity. Data sets were analyzed using appropriate non-parametric statistical tests for non-normal distributed data. Statistical significance was defined at an alpha of < 0.05 unless otherwise noted.

E. Water Quality Guidelines

The water quality guidelines presented in table 2 are patterned after standards established for Lake Mead (NAC 445.1351). These guidelines were established and adapted as part of the Clark County 208 Amendment to protect and 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
5) Propagation of aquatic life, including a warm water fishery

Table 2. **Water quality guidelines for Lake Las Vegas**

1. The lake waters should be free of:
   a. Visible floating, suspended, or settleable 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 mg/l in the epilimnion during stratification, and 5mg/l through out the water column the rest of the year.
4. The average chlorophyll-a concentration in the epilimnion (0-2.5 m) 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 MPN/100 ml and not over 10% of such samples should exceed 400 MPN/100;
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 2000 mg/l throughout the water column;
8. Turbidity must not exceed that characteristic of natural conditions by more than 10 NTU.

III. WATER QUALITY RESULTS

A. Lake Water Surface Elevation

Water for Lake Las Vegas is pumped from the hypolimnion of Lake Mead through the Basic Management Incorporated (BMI) pipelines. Lake Las Vegas; Lake Mead inflows totaled eight hundred seventy-two (872) acre-feet during 2005 (Figure 3). Two thousand one hundred fifty-two (2,152) acre-feet of lake water were lost to seepage/evaporation.

In 2005, approximately thirteen thousand four hundred seventy (13,470) acre-feet of storm water discharged into the lake. Additionally, Lake Las Vegas released approximately ten thousand nine hundred ninety (10,990) acre-feet through the dam's appurtenance, back to the Las Vegas Wash.

There was a 0.8 foot drop in lake elevation in 2005. Elevations are now referenced to the NAVD88.

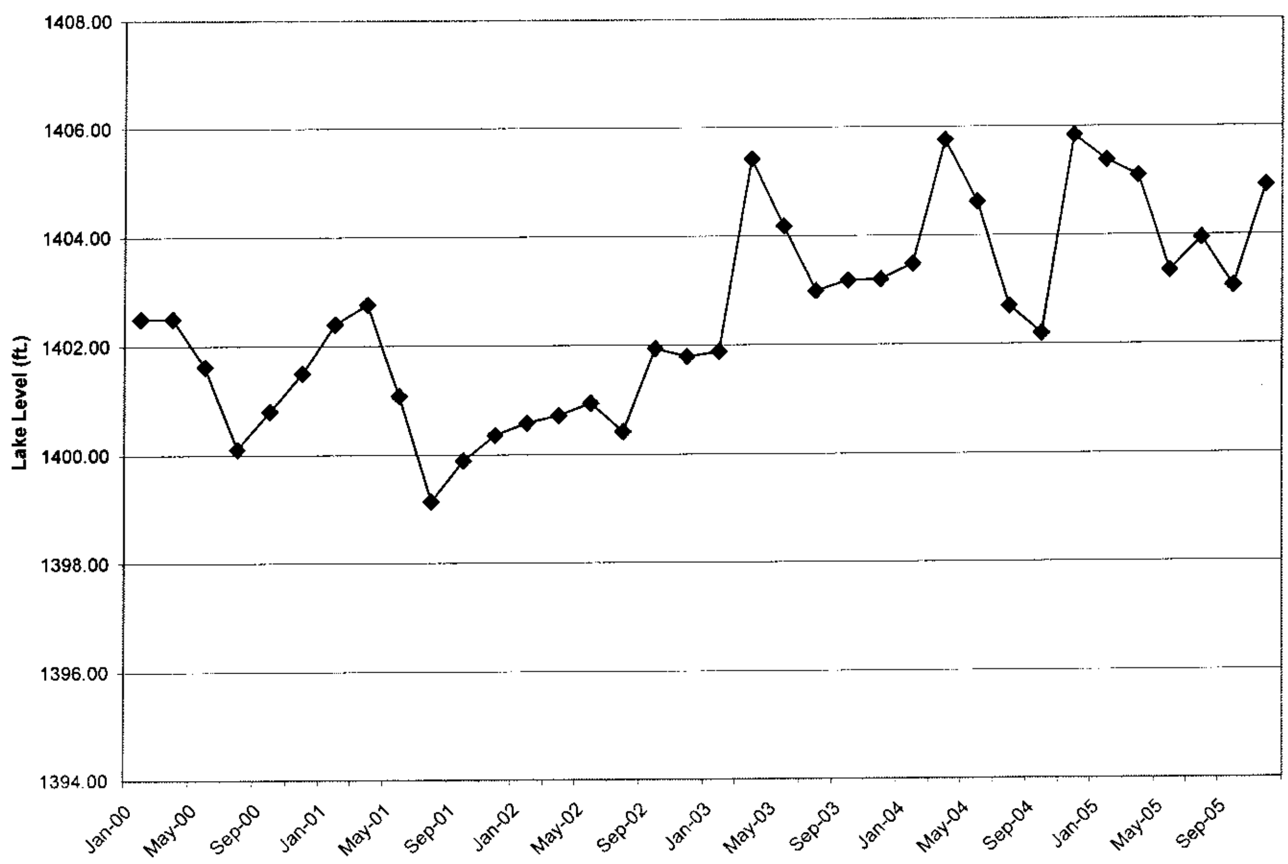

Figure 3. **2000-2005 Lake Las Vegas Surface elevations.**

Table 3. 2005 Storm water inflow and outflow of Lake Las Vegas

Date	Inflow (A/F)	Outflow Net (A/F)	Recovery (A/F)
1/3/05-1/6/05	1566	1852	-286
1/7/2005	124	0	124
1/11/2005	253	0	253
1/26/2005	95	0	95
1/29/2005	159	0	159
2/11/2005	1037	1005	32
2/18/05-2/23/05	5070	4656	414
3/23/2005	50	18	32
7/24/2005	709	0	709
7/28/2005	31	0	31
10/18/2005	4377	3461	916
Total	**13,471**	**10,992**	**2,479**

B. Physical Analysis

Temperature

Surface temperatures in Lake Las Vegas ranged from 9.6°C to 30.9°C during 2005, with the lowest temperatures found in January and the highest in July (Figure 4). The Lake was uniformly mixed top to bottom during December, but reflected various stages of thermal stratification during the remaining quarters through early spring. By March, the Lake began to stratify with the thermocline developing between eight to fourteen meters (Table 4). The Lake remained stratified during the summer and early fall months.

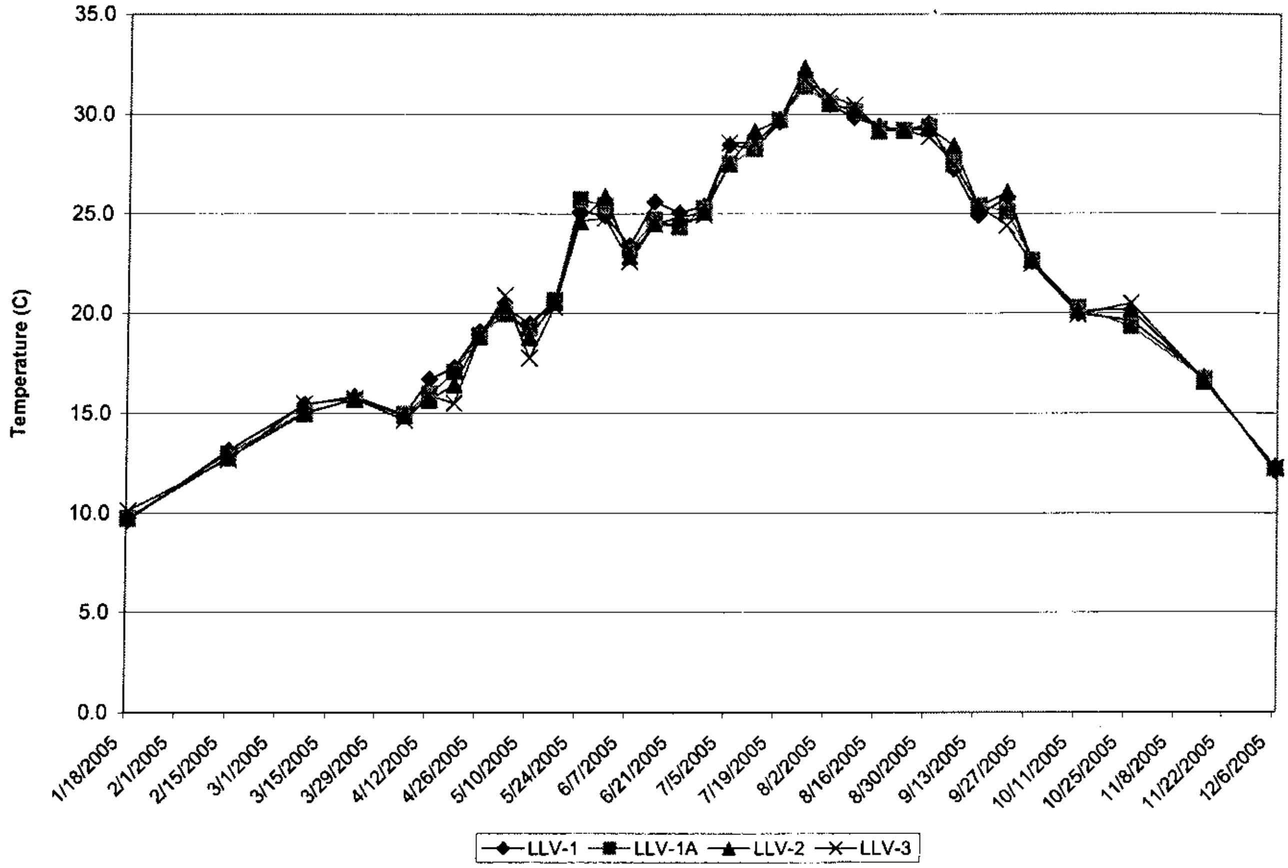

Figure 4. **Lake Las Vegas surface temperature (°C) measurements at Lake monitoring stations in 2005.**

Table 4. **Lake Las Vegas temperature (°C) profiles at Lake monitoring station LLV-1A during March, June, September, and December 2005.**

Depth (m)	3/22/2005	6/21/2005	9/21/2005	12/6/2005
0	15.7	24.3	25.1	12.2
2	15.5	24.1	23.7	12.2
4	15.1	24.0	25.5	12.2
6	14.8	23.34	23.4	12.1
8	14.2	22.7	23.3	12.1
10	11.5	21.9	23.2	12.1
12	11.2	17.1	22.3	12.1
14	11.0	14.4	17.4	12.1
16	10.9	13.1	14.9	12.1
18	10.8	12.7	13.7	12.1
20	10.7	12.4	13.2	12.1
22	10.6	12.3	13.2	12.1

Dissolved Oxygen

Dissolved oxygen concentrations at the lake surface didn't have considerable variations between the sites throughout the year (Figure 5). Concentration ranged from approximately 6.7 to 10.3 ppm. Concentrations at depth exhibited the common dissolved oxygen trends found within monomictic lakes that stratify (Table 5).

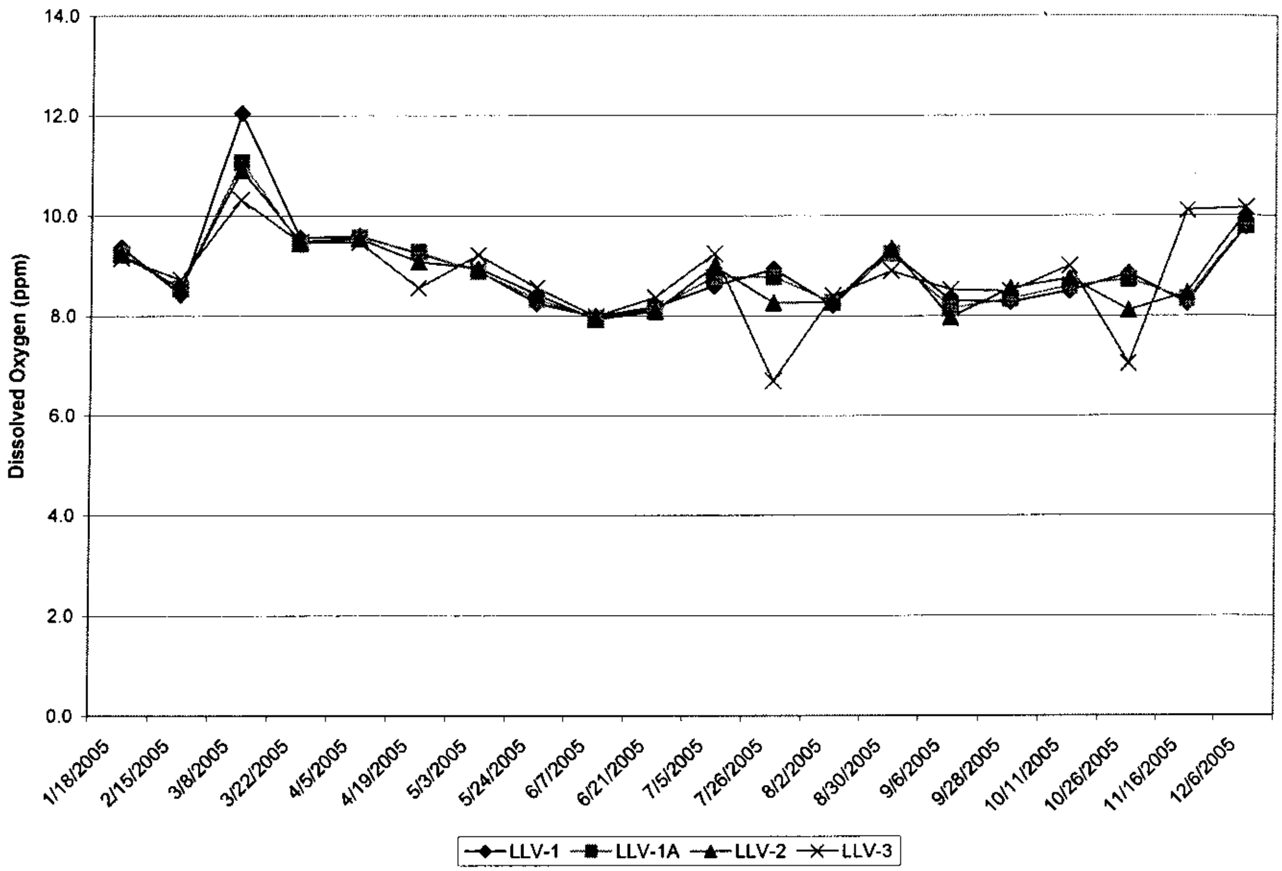

Figure 5. **Lake Las Vegas dissolved oxygen (ppm) in surface waters at Lake monitoring stations during 2005.**

The Lake remained relatively well mixed during the late fall through late spring. During the period of stratification, dissolved oxygen concentrations, below the thermocline, were less than 5.0 ppm (Table 5).

Table 5. **Lake Las Vegas dissolved oxygen (ppm) profiles at station LLV-1A during March, June, September, and December 2005.**

Depth (m)	3/22/2005	6/21/2005	9/21/2005	12/6/2005
0	9.4	8.2	8.7	9.8
2	9.4	8.2	8.9	9.7
4	9.2	8.1	7.8	9.8
6	8.8	7.9	7.4	9.7
8	7.4	7.4	7.3	9.7
10	5.6	6.4	6.4	9.6
12	5.3	1.4	2.7	9.6
14	5.1	.3	.3	9.6
16	4.7	.2	.3	9.7
18	4.1	.3	.5	9.6
20	3.8	.3	.6	9.6
22	3.7	.4	1.3	9.6

pH

There was little seasonal variation in pH of surface waters in Lake Las Vegas during 2005 (Figure 6). Surface water pH values varied slightly between the four Lake sites ranging between 7.5 and 8.5 in 2005 (Figure 6). Minor variability's 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 vales decreased as bicarbonate concentrations declined with the onset of anaerobic conditions (Table 6).

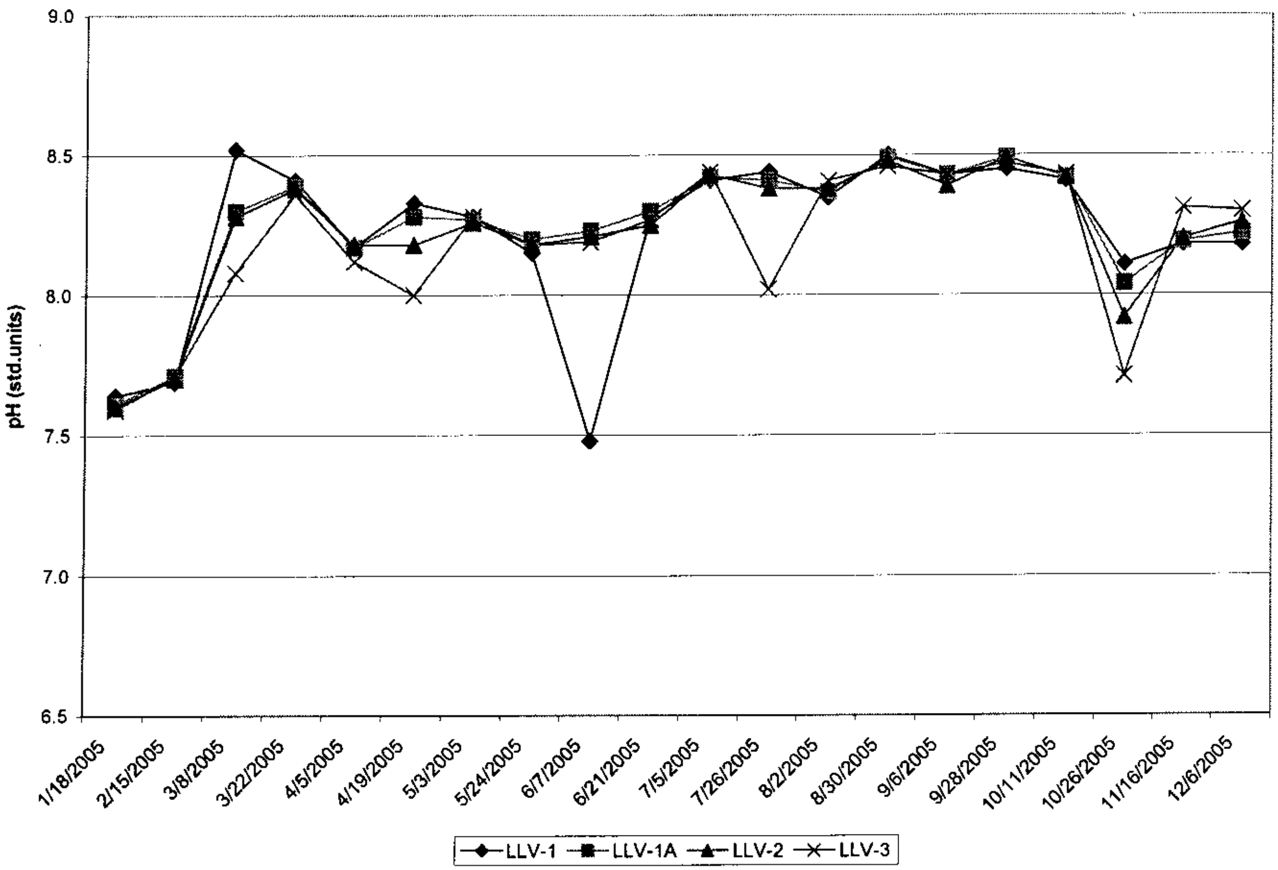

Figure 6. **Lake Las Vegas pH (standard units) in surface water at Lake monitoring stations during 2005.**

Table 6. **Lake Las Vegas pH (standard units) profiles at station LLV-1A during March, June, September and December 2005.**

Depth (m)	3/22/2005	6/21/2005	9/21/2005	12/6/2005
0	8.4	8.3	8.5	8.2
2	8.4	8.3	8.5	8.2
4	8.3	8.2	8.4	8.2
6	8.2	8.2	8.3	8.2
8	7.8	8.1	8.2	8.2
10	7.5	7.9	8.1	8.2
12	7.5	7.5	7.8	8.2
14	7.5	7.4	7.6	8.2
16	7.5	7.4	7.6	8.2
18	7.5	7.4	7.6	8.2
20	7.5	7.5	7.6	8.2
22	7.5	7.5	7.7	8.2

Conductance

Lake water conductivity ranged between roughly 1231 µmho/cm 2091 µmho/cm at the surface during 2005 (Figure 7). Conductivity did not vary significantly between the four lake sites. Conductivity did not vary greatly with depth. As a result of the December 2004 storm event, Lake Las Vegas conductance and total dissolved solids concentration decreased.

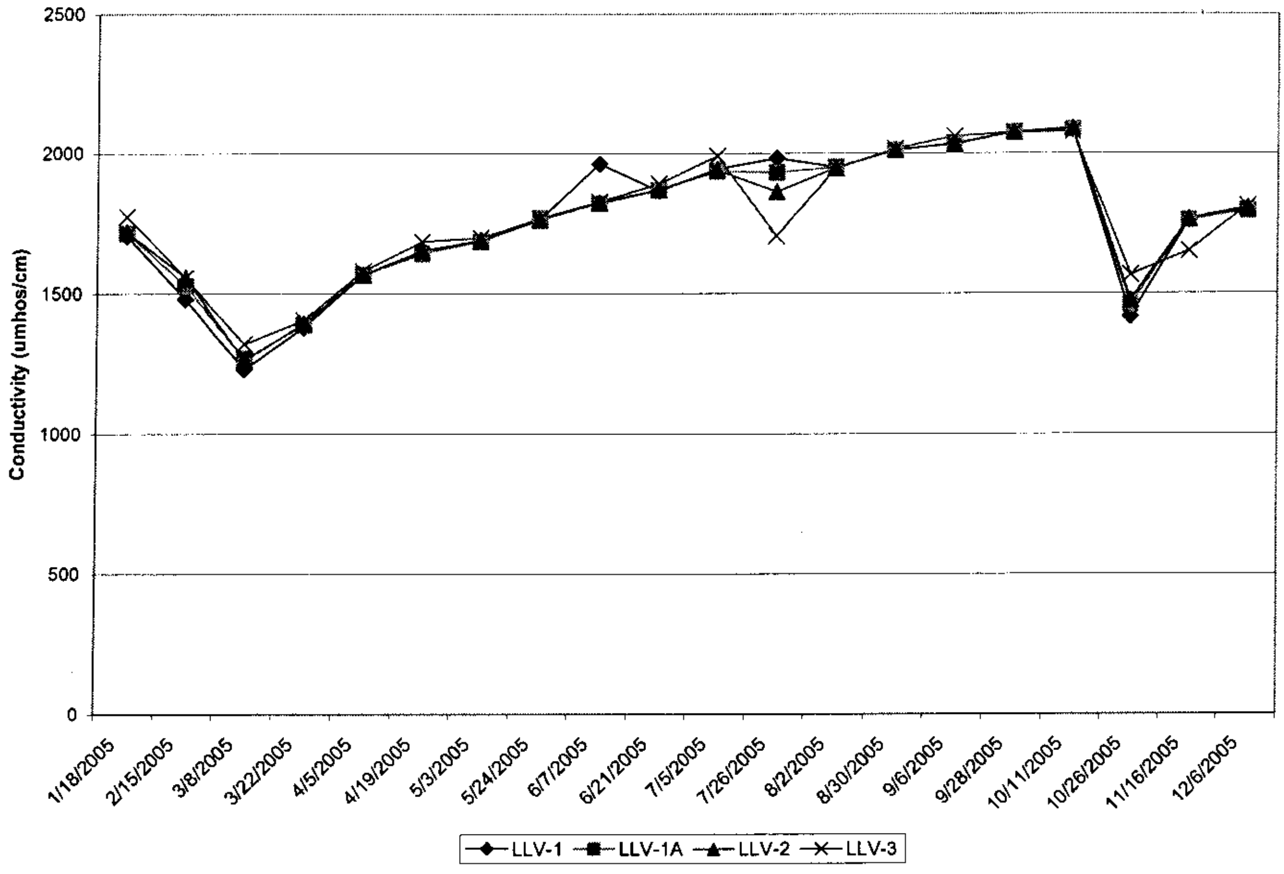

Figure 7. **Lake Las Vegas conductance (µmhos/cm) in surface waters at Lake monitoring stations during 2005.**

Table 7. **Lake Las Vegas conductance (µmhos/cm) profiles at station LLV-1A during March, June, September, and December 2005.**

Depth (m)	3/22/2005	6/21/2005	9/21/2005	12/6/2005
0	1389	1867	2067	1794
2	1397	1868	2060	1796
4	1403	1864	2061	1796
6	1457	1866	2062	1796
8	1581	1875	2064	1797
10	1910	1886	2066	1797
12	1935	1824	2050	1797
14	1952	1871	1937	1797
16	1974	1921	1956	1797
18	1994	1959	1997	1797
20	2023	1971	2014	1797
22	2036	1972	2044	1797

Transparency (Secchi)

There was considerable seasonal and spatial variability in Lake transparency values during 2005 with values ranging between 1.0 and 9.5 meters of lake depth. With the great quantity of storm water discharge into the lake in 2005, transparency was high during the spring and fall and lower during the summer months. (Figure 8).

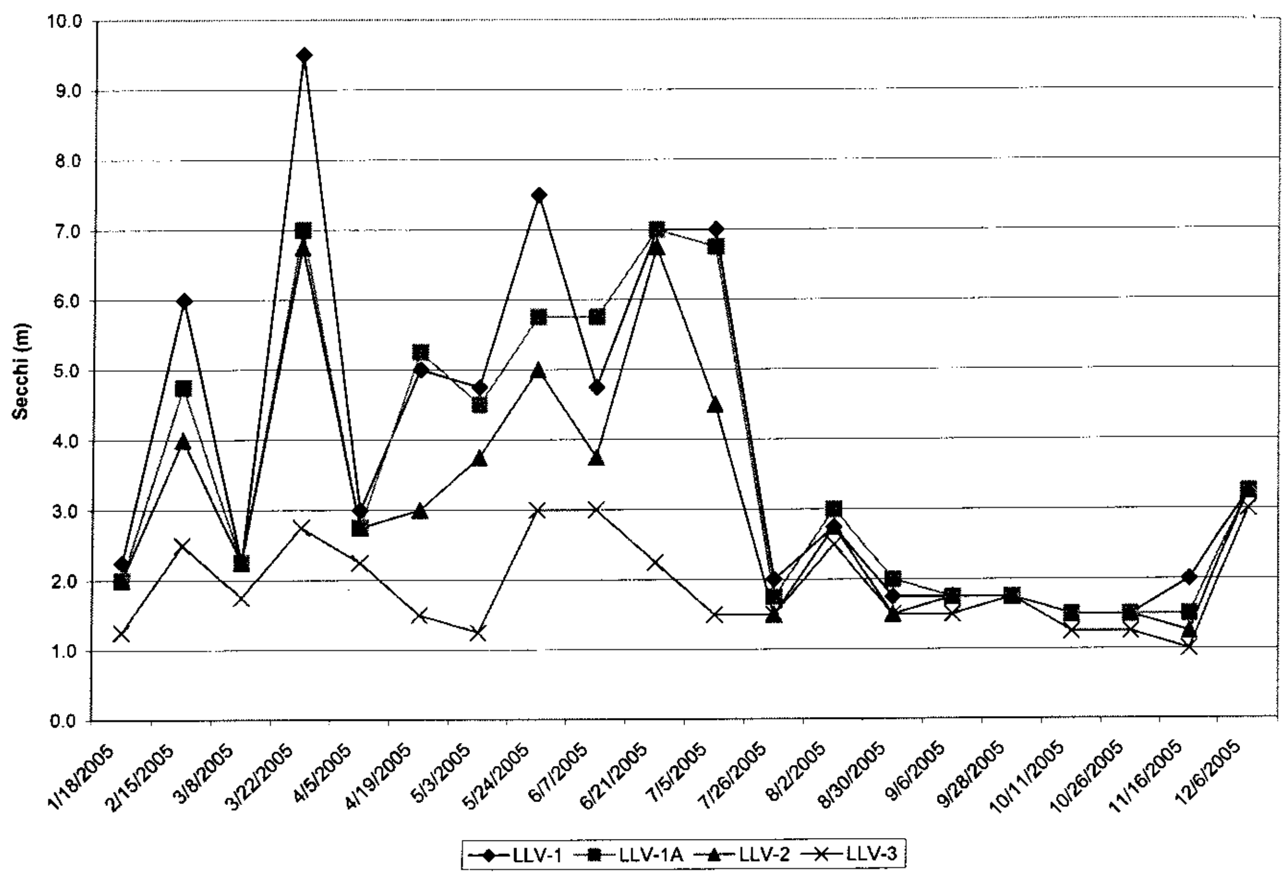

Figure 8. **Lake Las Vegas transparency (m) measurements in surface water at Lake monitoring stations during 2005.**

Turbidity

Monthly Turbidity values did not vary between the four sites with concentrations varying between 1.0 and 2.0 ppm at the surface (0-2.5m). There was no significant difference in turbidity concentrations between depths at site LLV-1A in 2005 ($p>0.05$) (Table 8).

Table 8. **2005 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 (m)	BOD5 (ppm)	TDS (ppm)	TSS (ppm)	TURB (ppm)	Chl-a (ppb)	Ortho Phos (ppb)	Total Phos (ppb)	Nitrite + Nitrate (ppb)	Ammonia (ppb)	TKN (ppb)	Total Nitrogen (ppb)	Ca (ppm)	Cl (ppm)	HCO3 (ppm)	SO4 (ppm)	Na (ppm)	K (ppm)	Mg (ppm)
3/22/05	0	2	846	1	1	1	12	22	2475	90	900	3375	138	135	76	463	112	18	36
3/22/05	5	2	976	1	1	1	23	25	2486	90	860	3346	145	135	76	502	116	19	38
3/22/05	10	2	1212	1	1	1	52	56	2401	60	790	3191	241	180	68	740	167	19	62
3/22/05	20	2	1438	1	1	1	70	74	2319	50	760	3079	243	190	76	736	178	19	62
6/21/05	0	2	1346	1	1	1	5	11	2095	50	800	2895	170	300	80	697	150	29	44
6/21/05	5	2	1344	1	1	1	5	11	2055	50	730	2785	160	250	75	701	140	28	43
6/21/05	10	2	1342	2	1	1	6	18	2094	50	730	2824	160	180	95	697	150	27	42
6/21/05	20	2	1448	3	1	1	179	189	1815	50	840	2655	180	210	90	766	150	29	45
9/20/05	0	2	1478	4	1	18	10	19	1749	50	1060	2809	169	220	80	761	170	19	48
9/20/05	5	2	1474	2	1	8	8	13	2550	50	1020	3570	171	220	85	774	170	19	49
9/20/05	10	2	1468	2	1	21	8	19	1513	170	1070	2583	173	200	80	764	165	19	47
9/20/05	20	2	1402	2	1	1	51	51	1034	360	87	1121	178	210	105	750	154	18	46
12/6/05	0	2	1298	3	1	5	5	30	1942	100	790	2732	141	200	85	671	132	16	40
12/6/05	5	2	1276	2	1	6	5	32	1951	60	650	2601	149	190	85	668	134	16	42
12/6/05	10	2	1244	2	1	6	5	19	2120	50	650	2770	147	200	80	664	135	16	42
12/6/05	20	2	1284	3	1	7	6	22	1921	50	610	2531	143	190	85	673	133	16	41

C. Chemical Analysis

Total Suspended Solids

Monthly total suspended solids concentrations varied between 1.0 and 7.8 ppm with no significant differences between the sites. ($p>0.05$). The highest concentrations occurred post October storm. (Figure 9). There were no significant differences in total suspended solids concentrations between depths at site LLV-1A in 2005 ($p>0.05$) (Table 8).

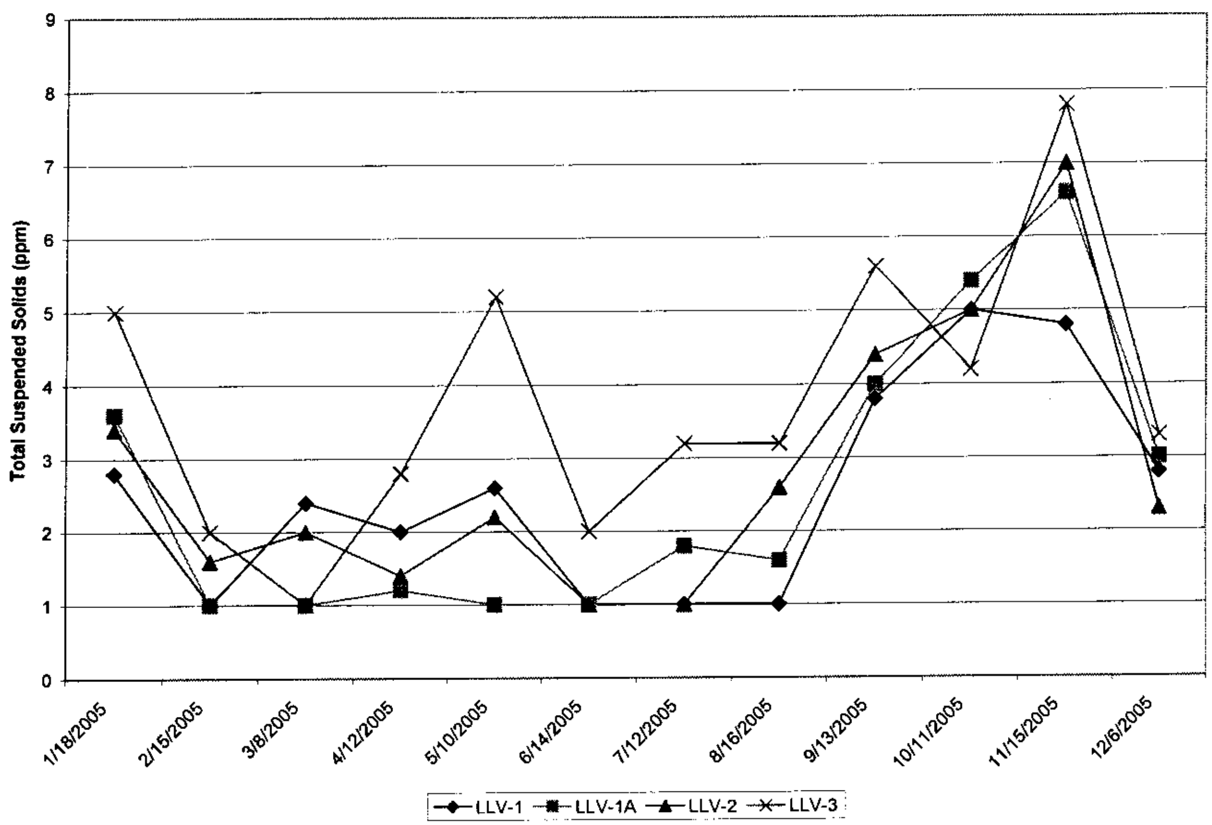

Figure 9. **Lake Las Vegas total suspended solids (ppm) concentrations in surface waters at Lake monitoring stations during 2005.**

Total Dissolved Solids

There was no significant difference in monthly total dissolved solids (TDS) concentrations between the four Lake sites ($p>0.05$) (Figure 10). Monthly concentrations ranged between 785 and 1736 ppm at the surface (0-2.5m). There was no significant difference in total dissolved solids concentrations between depths at site LLV-1A in 2005 ($p>0.05$) (Table 8).

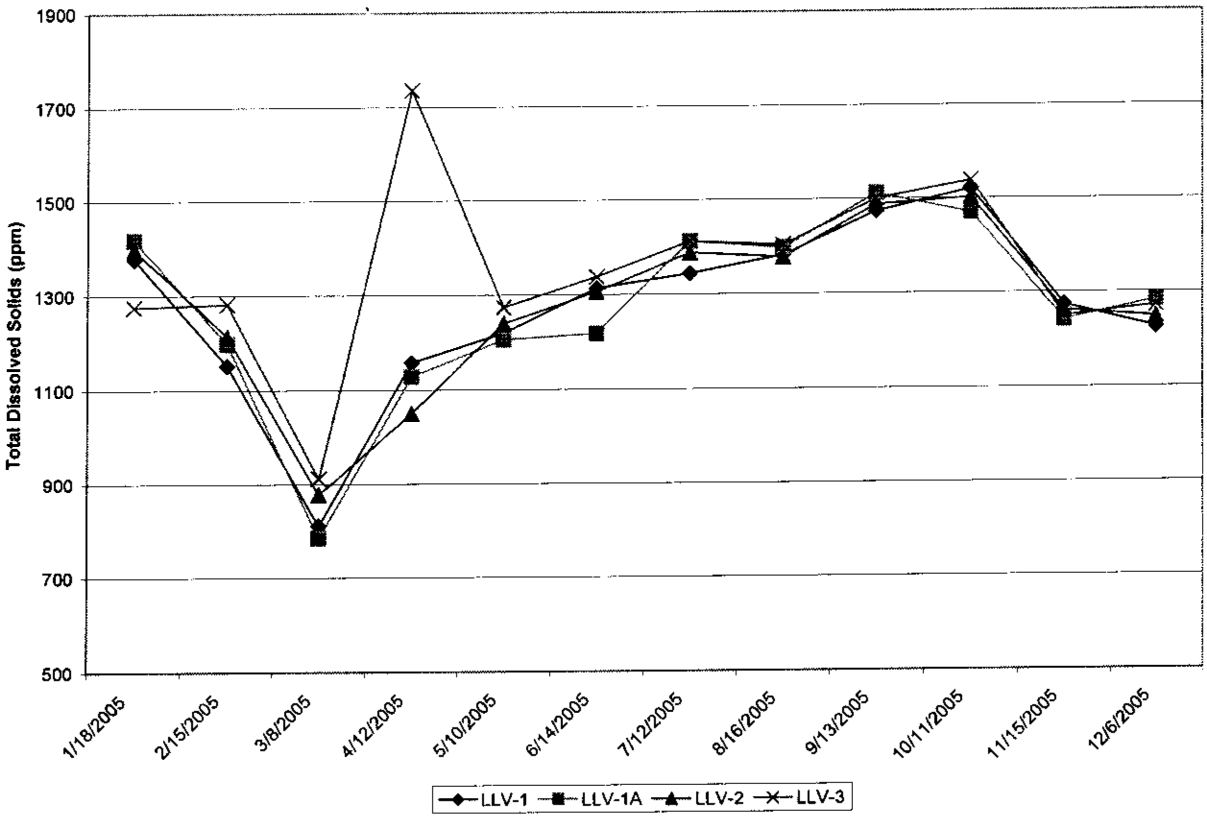

Figure 10. **Lake Las Vegas total dissolved solids (ppm) concentrations at Lake monitoring stations during 2005.**

Major Ion Concentrations

Quarterly depth samples did not vary significantly at site LLV-1A for the ions of calcium, sodium, chloride, potassium, sulfate and magnesium ($p>0.05$) (Table 8). Calcium, Choride, Bicarbonate, Sodium, Potassium, and Magnesium concentrations did not vary with depth or time.

Total Phosphorus

Monthly concentrations ranged between 10 and 76 ppb at the surface (0-2.5m). (Figure 11) This is compared to 6 and 53 ppb last year. In 2005 there was no significant difference between the sites ($p>0.005$) (Figure 11). Monthly total phosphorus concentrations varied slightly between depths at site LLV-1A, but were not significantly different ($p>0.05$) (Table 8).

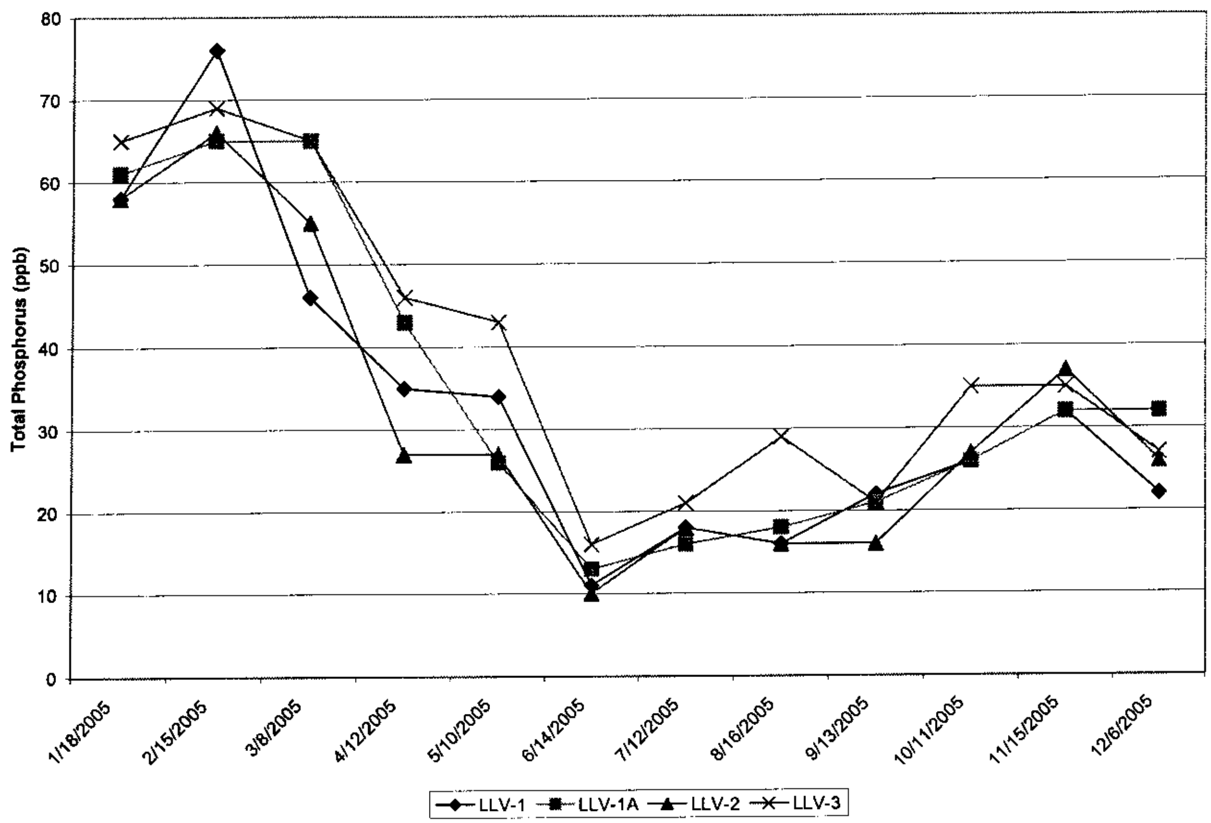

Figure 11. **Lake Las Vegas total phosphorus (ppb) concentrations in surface waters at Lake monitoring stations during 2005.**

Ortho-Phosphorus

Monthly Ortho-phosphorus concentrations did not vary significantly between sites and ranged between 5 and 56 ppb as compared with 5 and 23 ppb in 2004 ($p>0.05$) (Figure 12). Monthly ortho-phosphorus concentrations did not show a significant difference between depths. ($p>0.05$) (Table 8).

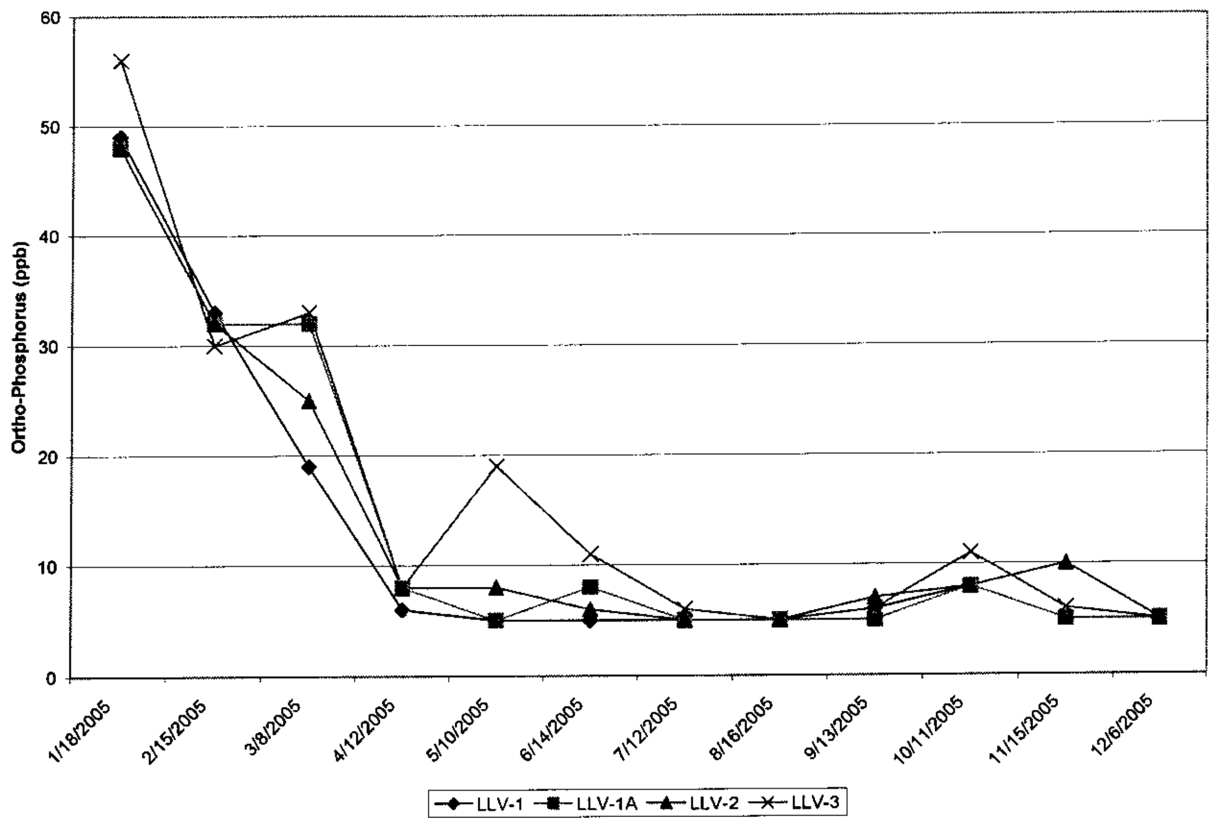

Figure 12. **Lake Las Vegas ortho-phosphorus (ppb) concentrations in surface waters at Lake monitoring stations during 2005.**

(Nitrite + Nitrate) – Nitrogen

Monthly nitrite plus nitrate surface water concentrations ranged between 1619 and 2860 ppb at the four Lake sites in 2005 with no significant difference as compared with 459 and 237 ppb in 2004 ($p>0.05$) (Figure 13). Monthly nitrite plus nitrate concentrations were not significantly different by site or depth ($p>0.05$) (Table 8).

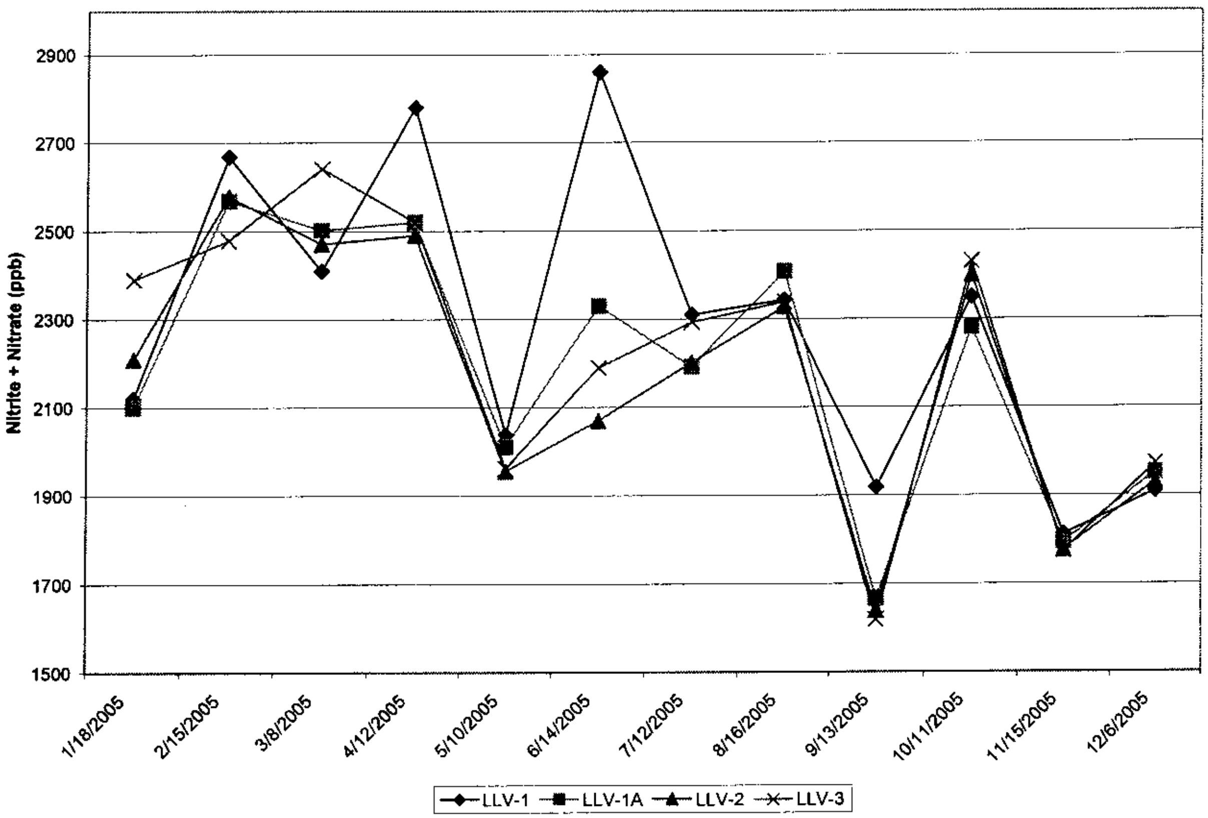

Figure 13. **Lake Las Vegas nitrite + nitrate (ppb) concentrations in surface waters at Lake monitoring stations during 2005.**

Ammonia - Nitrogen

Monthly ammonia surface water concentrations ranged between 50 to 360 ppb during 2005, with no significant difference between the four Lake sites as compared to 50 to 310 ppb in 2004 ($p>0.05$) (Figure 14). Variability in concentrations between depths was not found significant for ammonia during 2005 at site LLV-1A ($p>0.05$) (Table 8). Ammonia concentrations peaked during February due to storm water contributions.

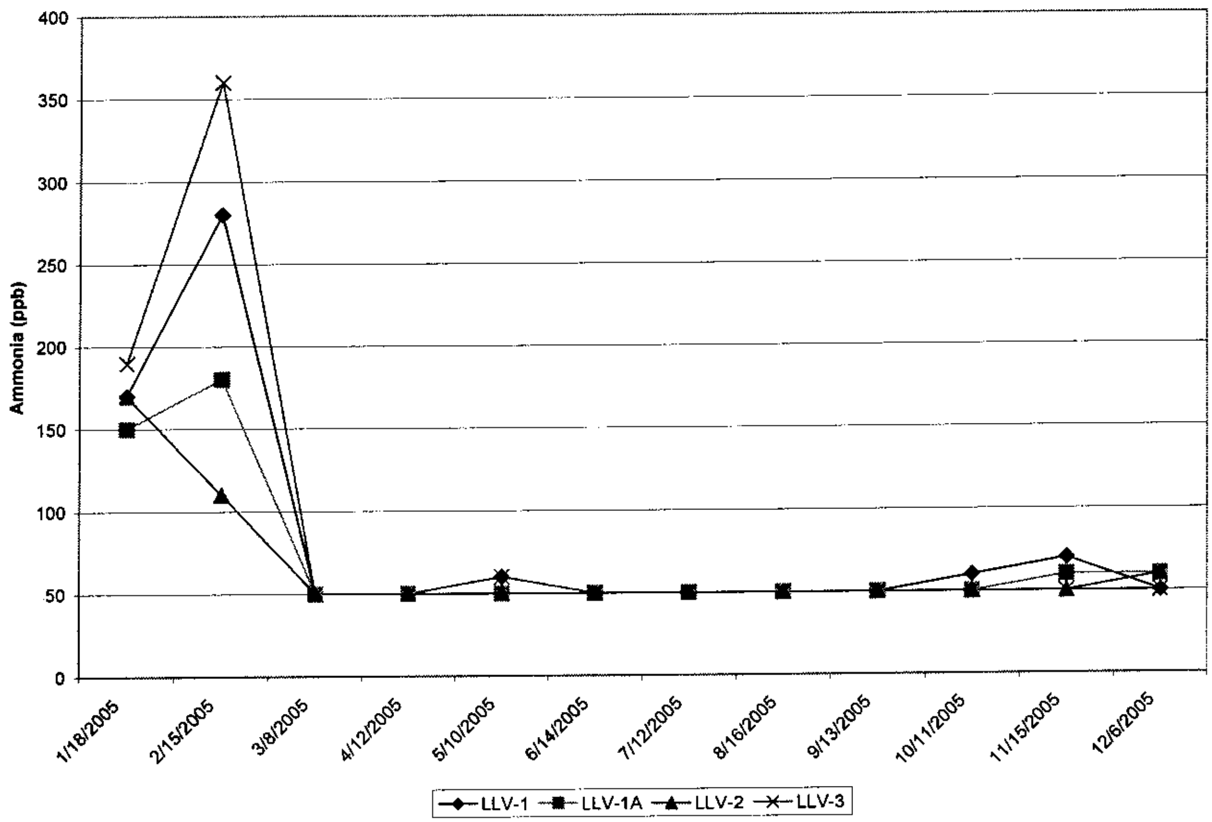

Figure 14. **Lake Las Vegas ammonia-N concentrations (ppb) in surface waters at Lake monitoring stations during 2005.**

Total Nitrogen

Monthly total nitrogen concentrations ranged between 2479 and 3702 ppb and were not significantly different between sites (p>0.05) but slightly elevated when compared to 1249 and 3170 ppb in 2004 (Figure 15). No significant difference was found between depths at site LLV-1A during 2005 (p>0.05) (Table 8).

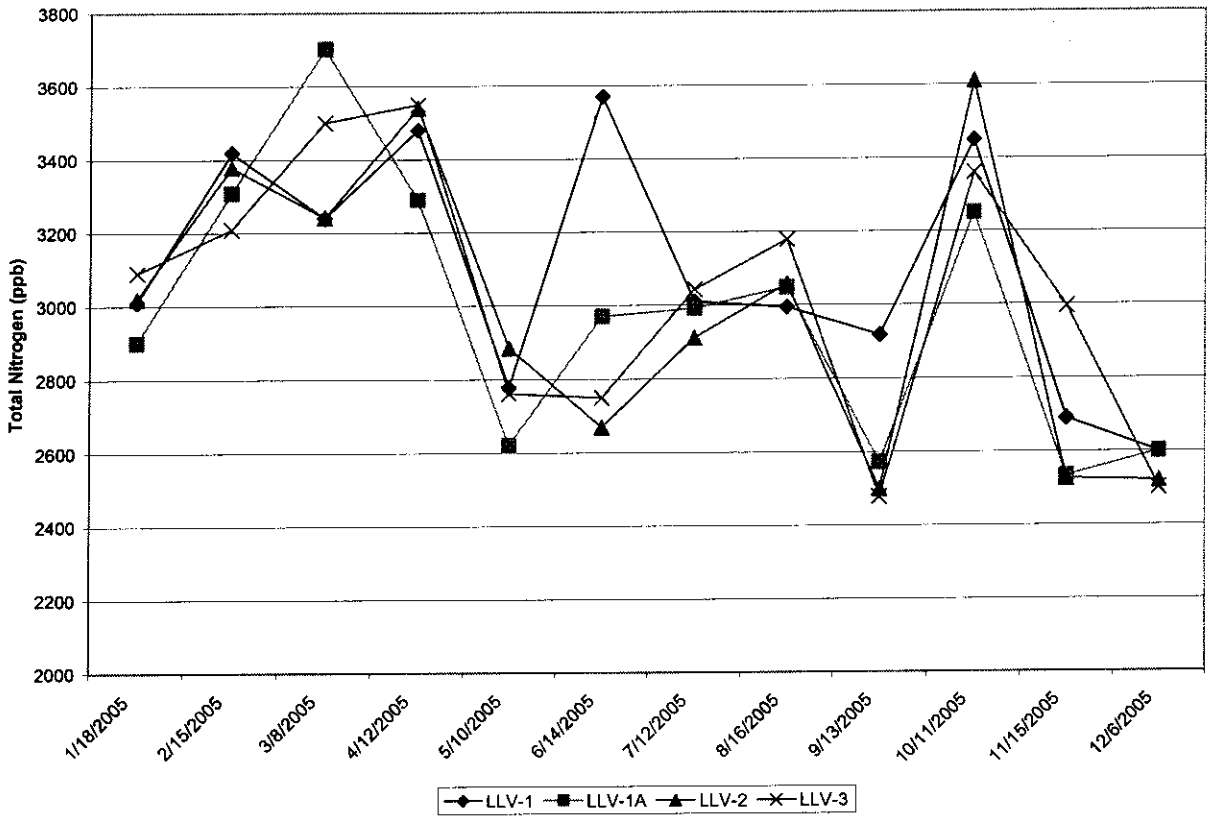

Figure 15. **Lake Las Vegas Total Nitrogen (ppb) concentrations in surface waters at Lake monitoring stations during 2005.**

D. Biological Analysis

Zooplankton Species Composition and Abundance

Numerous species of zooplankton have been identified in the 0 – 15 m vertical plankton tows at station LLV-1 in 2005 (Table 9). Copepods dominated the population with a frequency of (67%), followed by Cladocerans (26%) and Rotifers (7%) during 2005.

Diaptomus sp. exhibited the greatest average annual average density in 2005 of 136,422 No./cu.m (Table 9). Of the Cladoceran family, *Daphnia pulex* dominated with average densities totaling 111,859 no./cu.m comprising 19% or the total biomass. This genus is well known for their ability to control Phytoplankton populations in pelagic zones.

Table 9. **Lake Las Vegas zooplankton species identified in the 0 – 15 m vertical plankton tows at station LLV-1 during 2005.**

Division	Genus/Species	No./m^3	FREQ	RFREQ
1. Cladocerans	*Alona sp.*	7,470	5	1.3
	Bosmina longirostris	10,418	7	1.8
	Daphnia pulex	111,859	74	18.9
	Moina sp.	21,964	14	3.7
	Total Cladoceran	151,711	100	25.7
2. Copepods	*Copepodid*	67,401	17	11.4
	Cyclops vernalis	1,697	0	0.3
	Diacyclops bicuspidatus	5,144	1	0.9
	Diaptomus sp.	136,422	34	23.1
	Mesocyclops edax	20,209	5	3.4
	Nauplii	165,445	42	28.0
	Total Copepods	396,318	100	67.1
3. Rotifers	*Brachionus caudatus*	668	2	0.1
	Hexarthra sp.	277	1	0.0
	Keratella cochlearis	11,615	27	2.0
	Notholca squamula	1,370	3	0.2
	Polyarthra remata	2,790	6	0.5
	Synchaeta sp.	26,260	61	4.4
	Total Rotifers	42,980	100	7
	Total Zooplankton	591,009		

Chlorophyll-a

Chlorophyll-a concentrations ranged from 1 to 20 ppb in surface water during 2005 compared to 1 to 26 ppb in 2004. Concentrations were not significantly different between sites ($p>0.05$) (Table 8).

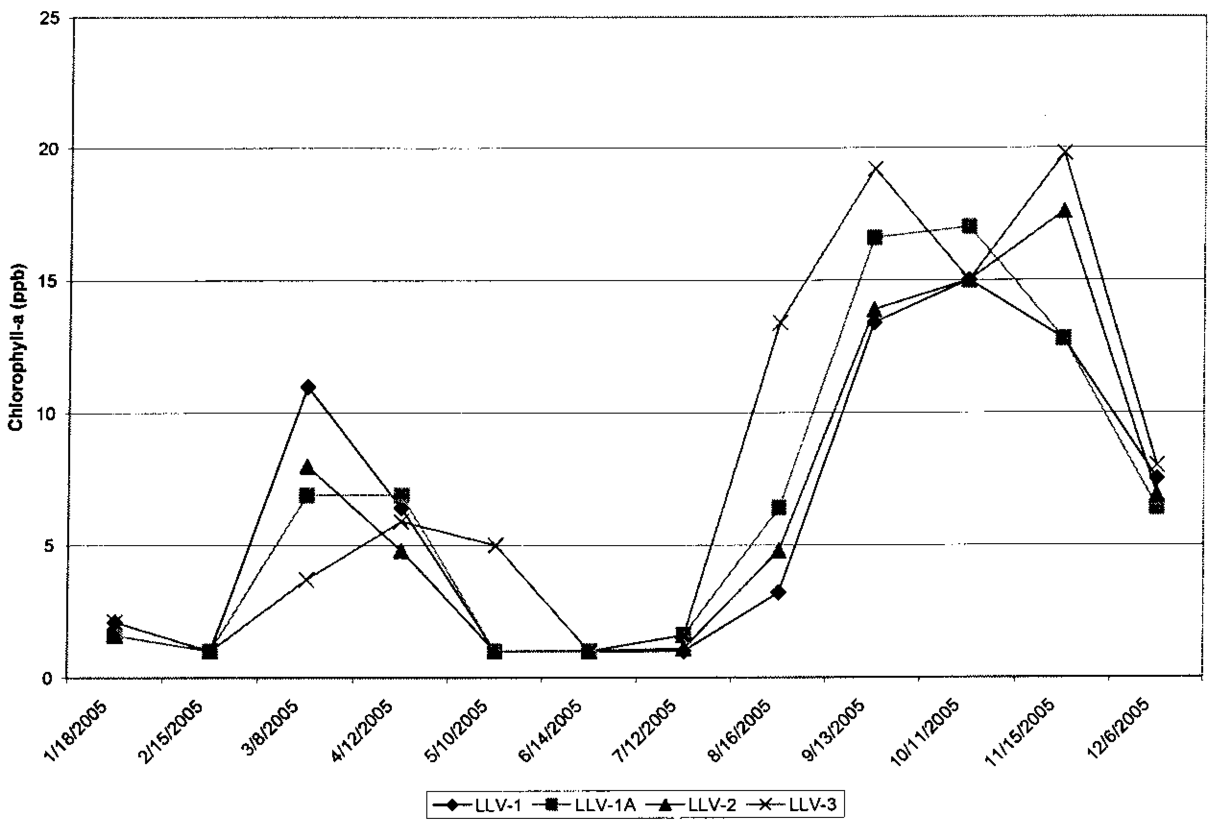

Figure 16. **Lake Las Vegas chlorophyll "a" (ppb) concentrations in surface waters at Lake monitoring stations during 2005.**

Phytoplankton

Six (6) taxonomic divisions of phytoplankton were found at LLV-1 during 2005 (Table 10). By abundance the most frequently observed division was Bacillariophyceae in 2005 (41%) (Figure17). The remaining five (5) divisions relative frequencies were as follows: Cryptophyta (4%), Cyanophyta (48%), Chlorophyta (3%), Haptophyta (3.4%) Pyrrhophyta (0.1), were distributed in relation to Chlorophyta during the year. (Table 10).

Table 10. **Lake Las Vegas phytoplankton species (no/m^3) identified in the 0 – 15 m vertical plankton tows at station LLV-1 during 2005.**

DIVISION	Genus/Species	BIOMAS (mg/m^3)	Freq	Rfreq
1. BACILLARIOPHYCEAE	*Amphiprora alata*	2.7	0.0	0.0
	Anomoeoneis vitrea	1319.4	11.0	4.5
	Cyclotella 6-10 um	244.7	2.0	0.8
	Cyclotella < 6um	401.1	3.3	1.4
	Cyclotella glomerata	276.2	2.3	0.9
	Cyclotella meneghiniana	9424.3	78.5	32.4
	Nitzschia spp.	194.5	1.6	0.7
	Skeletonema sp.	61.5	0.5	0.2
	Stephanodiscus sp.	47.1	0.4	0.2
	Synedra sp.	31.8	0.3	0.1
	TOTAL BACILLARIOPHYCEAE	12003.3	100.0	41.3
2. CHLOROPHYTA	*Actinastrum hantzschii*	0.5	0.1	0.0
	Ankyra judayi	1.1	0.1	0.0
	Chlamydomonas globosa	501.4	63.7	1.7
	Chlamydomonas sp.	186.1	23.6	0.6
	Coelastrum microporum	2.2	0.3	0.0
	Dictyosphaerium ehrenbergianum	1.2	0.2	0.0
	Dictyosphaerium pulchellum	3.9	0.5	0.0
	Monoraphidium contortum	3.8	0.5	0.0
	Monoraphidium minutum	0.1	0.0	0.0
	Oocystis borgei	12.2	1.5	0.0
	Oocystis sp.	1	0.1	0.0
	Pyramichlamys dissecta	35.9	4.6	0.1
	Quadrigula closterioides	2.2	0.3	0.0
	Scenedesmus communis	1.3	0.2	0.0
	Scenedesmus ecornis	3.9	0.5	0.0
	Scenedesmus ellipticus	0.1	0.0	0.0
	Schizochlamys compacta	11.2	1.4	0.0
	Sphaerocystis schroeteri	16.3	2.1	0.1
	Tetraedron minimum	3.3	0.4	0.0
	TOTAL CHLOROPHYTA	787.7	100.0	2.7
3. CRYPTOPHYTA	*Cryptomonas erosa*	153	12.9	0.5
	Cryptomonas marssonii	14.1	1.2	0.0
	Cryptomonas spp.	276.9	23.4	1.0
	Katablepharis ovalis	8.3	0.7	0.0
	Rhodomonas minuta	730.4	61.8	2.5
	TOTAL CRYPTOPHYTA	1182.7	100.0	4.1

Table 10 continued. **Lake Las Vegas phytoplankton species (no/m^3) identified in the 0 – 15 m vertical plankton tows at station LLV-1 during 2005.**

DIVISION	Genus/Species	BIOMAS (mg/m3)	Freq	Rfreq
4. CYANOBACTERIA	*Anabaena aphanizemenoides*	12539.7	89.1	43.1
	Anabaena sp.	9.4	0.1	0.0
	Aphanizomenon sp.	85.2	0.6	0.3
	Aphanocapsa delicatissima	77.9	0.6	0.3
	Aphanothece clathrata	919.6	6.5	3.2
	Geitlerinema sp.	4.4	0.0	0.0
	Merismopedia hyalina	3.1	0.0	0.0
	Merismopedia tenuissima	2.8	0.0	0.0
	Planktolyngbya c.f. microspira	0.8	0.0	0.0
	Planktolyngbya contorta	0.8	0.0	0.0
	Planktothrix perornata	14.1	0.1	0.0
	Planktothrix rubescens	198.5	1.4	0.7
	Pseudanabaena c.f. biceps	62.9	0.4	0.2
	Pseudanabaena galeata	32.8	0.2	0.1
	Pseudanabaena limnetica	52	0.4	0.2
	Pseudanabaena raphidioides	0.2	0.0	0.0
	Raphidiopsis mediterranea	8.9	0.1	0.0
	Raphidiopsis sp.	8.9	0.1	0.0
	Single coccoid (<2 um)	31.9	0.2	0.1
	Spirulina subsalsa	1.9	0.0	0.0
	Synechococcus nidulans	15.7	0.1	0.1
	TOTAL CYANOBACTERIA	14071.5	100.0	48.4
5. HAPTOPHYTA	*Chrysochromulina parva*	975.6	100.0	3.4
	TOTAL HAPTOPHYTA	975.6	100.0	3.4
6. PYRRHOPHYTA	*Glenodinium sp.*	1.1	7.0	0.0
	Gymnodinium sp.	14.6	93.0	0.1
	TOTAL PYRRHOPHYTA	15.7	100.0	0.1
	TOTAL PHYTOPLANKTON	29077.3		

In 2005 Bio-chemical oxygen demands (BOD_5) concentrations ranged between 2 and 4 ppm. Concentrations fluctuate the greatest during the year, coinciding with algal cycles observed. These increases often occur with lake turn over in the fall and storm events.

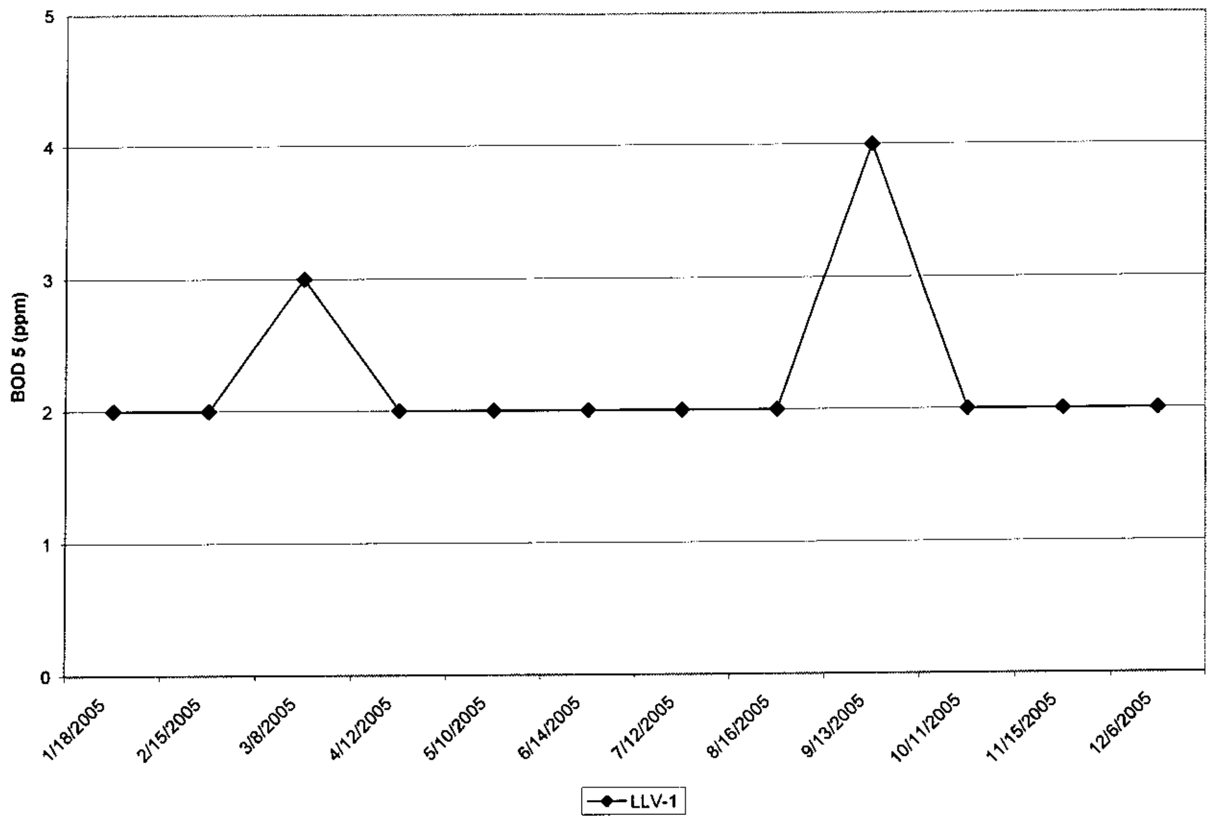

Figure 17. **Lake Las Vegas Biochemical Oxygen Demand (ppm) concentrations in surface waters at Lake Monitoring Station (LLV-1) during 2005.**

Bacteria

Fecal coliform monitoring was completed on a monthly basis at Lake site LLV-1 in 2005. In 2005, bacteria sampling frequency was completed weekly during the months of April through October due to increased recreational use. Fecal coliform counts in surface waters were below body contact limits in 2005.

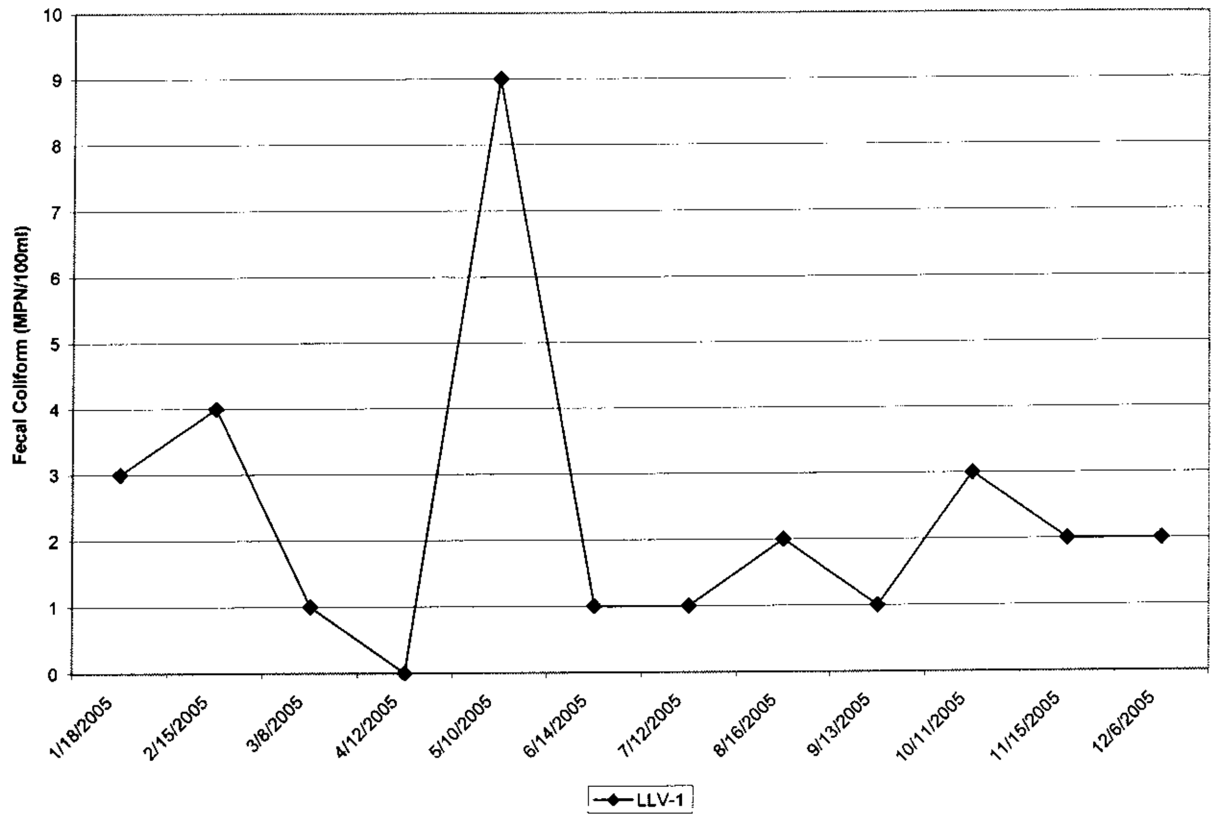

Figure 18. **Lake Las Vegas fecal coliform counts (MPN/100ml) in surface waters at Lake monitoring station (LLV-1) during 2005.**

Toxic Substances

Water samples for toxic analysis were collected from the surface (0m) and bottom (1m from bottom) of station LLV-1 during December 2005, 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 below levels of detection. (Appendix C).

IV. SUMMARY

The water quality in Lake Las Vegas was within the proposed water quality guidelines for recreational uses. Average chlorophyll-a concentrations were at or below the proposed guideline of five- (5) µg/l during April – July, but exceeded the guidelines during the months of August and September. The chlorophyll-a guideline is applied at that time of year to protect water quality during the peak recreation period. Fecal coliform bacteria were below the action level of 200 MPN/100ml. Concentrations of toxic metals, pesticides, herbicides and other toxic organic compounds were below detection limits. Water quality in Lake Las Vegas continues to be very good. The Total dissolved solids and associated ions were exhibiting the greatest damage due to the December 2004 storm event. At the current concentrations, irrigation water is being removed from the lake without the need to blend with Lake Mead Water.

V. REFERENCES

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VI. APPENDIX

Annual Toxicity Analysis

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: December 21, 2005

REPORT NUMBER: 05-4023

CLIENT: Lake Las Vegas Resort
1605 Lake Las Vegas Parkway
Henderson, Nevada 89011

CLIENT PROJECT:

CLIENT PO #:

Sampled By: Client
Date Sampled: 12/06/05
Time Sampled: Refer to COC

Submitted by: Client
Date Received: 12/06/05
Time Received: 1546

Report Attention: Steven Weber

Sample ID	Parameter	Result	Unit	Detection Limit	Method	Date Analyzed	Analyst
LLV 1A 0m	Nitrite	0.05	mg/L	0.01	EPA 354.1	12/07/05	RA
	Turbidity	ND	NTU	1.0	EPA 180.1	12/06/05	JN
LLV 1A 20m	Nitrite	0.05	mg/L	0.01	EPA 354.1	12/07/05	RA
	Turbidity	ND	NTU	1.0	EPA 180.1	12/06/05	JN

ND: non-detect
EPA Flag: none
NOTE: 608, 625, and 8151 subcontracted to Anatek Labs, Moscow, ID (See attached laboratory report).

REVIEWED BY: [signature]
Ronald W. Winter
Laboratory Director

Sample ID: LLV 1A 0m
Method: 8260B GCMS

Analyzed by: AF
Date Analyzed: 12/21/05

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: 05-4023
December 21, 2005

Sample ID: LLV 1A 20m
Method: 8260B GCMS

Analyzed by: AF
Date Analyzed: 12/21/05

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