Annual Water Quality Report

LAKE ISABELLA

Water Year 2002

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Lake Isabella

I. Purpose

This report is part of an environmental monitoring program that began at Lake Isabella in April 1974. The monitoring program was implemented to determine the level of water quality in the lake for both recreation and environmental health and to satisfy the Department of Army Engineering Regulation 1110-2-8154, “Water Quality and Environmental Management for Corps Civil Works Projects”.

II. Brief Description of Lake Isabella

Lake Isabella is located in south-central California, 33 miles northeast of Bakersfield. The lake is nestled in the Sierra Nevada foothills and is surrounded by grasslands and blue oaks. The lake is composed of two branches, one with a length of 8 miles and the other with a length of 9 miles. At maximum capacity, the lake has 11,400 surface acres and holds 570,000 acre-feet of water. The lake was created by the construction of Isabella Dam on the Kern River. The dam is 185 feet high above the streambed at the highest point. Since being built by the US Army Corps of Engineers for flood control and irrigation, the lake has become a popular destination for recreation. Summers are warm and the winters mild, allowing for year-round activities.

Water quality monitoring by the United States Army Corps of Engineers (USACE) began at Lake Isabella in April 1974. Generally there are two sample events a year, spring (April) and late summer (August). Since the start of the monitoring program, a water quality report is produced yearly to list results and address any concerns of the previous water year.

Generally Lake Isabella has a depth of less than 100 feet during the sampling events and is considered a mesotrophic lake when characterized by its clarity. A mesotrophic lake is one that has qualities between an oligotrophic (clear and nutrient limited, example Lake Tahoe) and a eutrophic lake (low clarity and high in nutrients, example Clear Lake). Unlike many of the eutrophic lakes that are monitored by the USACE, Lake Isabella can maintain aerobic conditions (available dissolved oxygen, DO) at the bottom depths during warm late summer months. Similar to many eutrophic lakes, Lake Isabella is warm (>20ºC) in the late summer. Due to the high late summer temperatures, only warmwater fish species could reliably survive in the lake year round. Warmwater fish species include bass, carp, perch, bluegill, crappie, and catfish. Although clearer than eutrophic (nutrient rich) lakes, mesotrophic lakes also can have low water clarity due to algal blooms. Being relatively shallow, the clarity of the lake is subject to being diminished by sediments suspended by wind action. Water clarity is often measured in terms of Secchi Disc depth or SD (Appendix A). Historically, the water clarity in Lake Isabella is good with only ~14.3 % of the samples not meeting the recreational goal of 4 feet or greater (Figure 1). In 2001 the Spring SD measure was 4.08 feet and the late summer sample SD value was better at 5.92 feet.

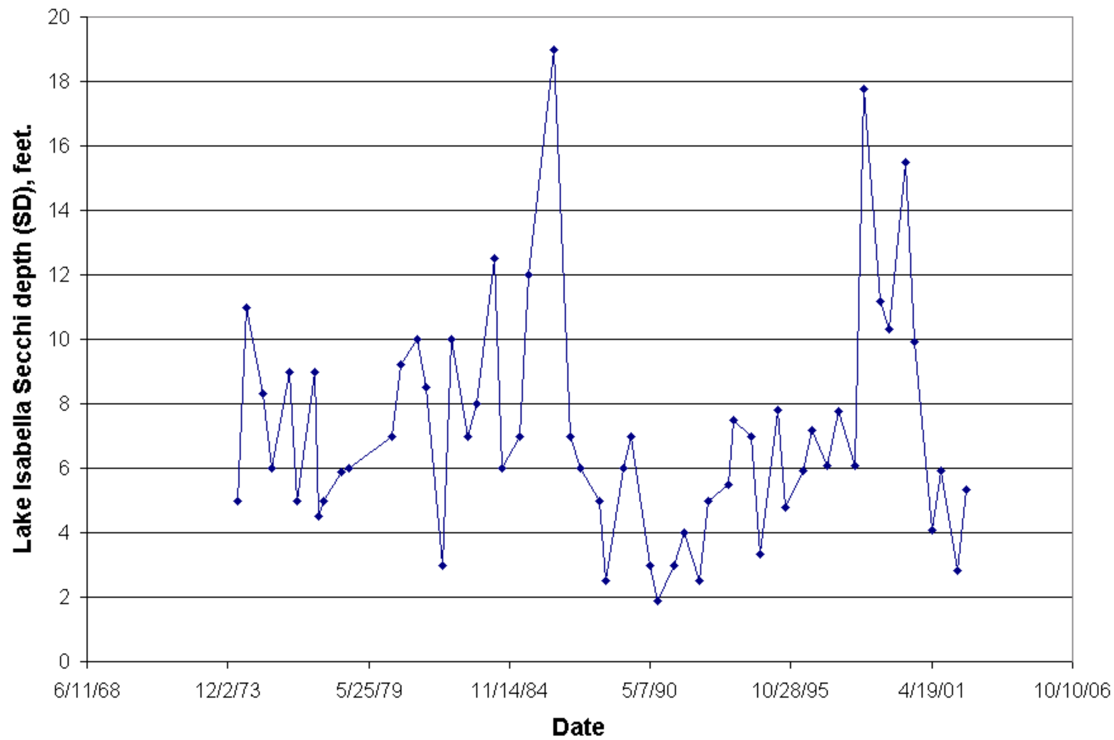


Figure 1. Historical Secchi Depth Values at Lake Isabella (2002 values included).

The 2001 Water Quality Report listed several contaminants of concern at Lake Isabella. The contaminants of concern included MTBE and some dissolved metals (selenium, manganese, and mercury). These contaminants are examined in this 2002 water quality report.

III. Sample Summaries for this year.

Introduction

The following general summaries are split into their respective sample types. Each type of sample summary includes a discussion of both the spring (April) and late summer

(August) samples to better examine trends within the current year. The types of parameters monitored this year include: Secchi Disc depths, water column profiles (temperature, DO and pH), phytoplankton characterization, metals concentrations, MTBE concentrations, Inorganic characterization (alkalinity, phosphorous, nitrogen, etc..), and fish mercury concentrations. For a more detailed explanation of the importance for each type of sample, please see Appendix A.

SECCHI DEPTH

The Secchi Disc depths found during the spring and late summer sampling were lower than the historical average (historical mean SD = 7.1 feet). More often the clarity is better in the late summer than in the late spring, but not always. In spring 2002 the water clarity was low and the SD was 2.83 feet, which was worse than the previous year (2001 Spring SD = 4.08 feet) and less than the recreational goal of 4 feet. The late summer SD of 5.33 feet was above the recreational goal of 4 feet and but was less than the previous year (Summer 2001 SD = 5.92) (Appendix B).

TEMPERATURE VALUES

The temperature profiles for Lake Isabella are indicative of a seasonally well-mixed shallow lake. The lake is semi stratified in the spring, but is mixed by the warm temperatures of late summer. The difference in the depth of the lake between the spring and late summer sampling events was relatively small (spring depth = 91.9 feet, late summer depth= 78.7 feet), but the average temperatures were very different (spring average temp. = 13.1 ºC, late summer average temp.= 22.1 ºC). Lake Isabella's temperature increases in late summer due to not having a deep-water area to buffer it from the warm summer air temperatures. Due to the warmth of the water, coldwater fish species would find it difficult to breed and survive year round. For detailed results obtained during the sampling events, please see Appendix B.

DISSOLVED OXYGEN

The dissolved oxygen (DO) concentration differs greatly from spring to late summer. In the spring DO concentrations are 10.10 mg/L near the surface and low 5.61 mg/L at the bottom of the lake. DO concentrations near the surface are near saturation, which is 10.29 mg/L at 14 ºC. DO concentrations in the late summer are much lower and nearly constant from near the surface (DO = 3.76 mg/l) to near the bottom of the lake where it decreases (DO =3.41 mg/l). The lower DO values at the bottom of the lake are associated the decomposition of waste materials. Fish species that require greater than 5 mg/l DO and cooler water temperatures (< 20ºC) would be unlikely to thrive year round in Lake Isabella. For detailed results obtained during the sampling events, please see Appendix B.

PH LEVELS

In the spring sample event, pH values in the lake were slightly basic (pH = ~7.7) throughout the water column. The pH values in the late summer profile varied widely. The pH was slightly basic towards the middle waters (max pH = 7.47) and nearly neutral at the top and bottom (pH near surface = 7.03, pH bottom = 7.15). The lower pH values at the top and bottom of the lake increase the likelihood that higher soluble metal concentrations will be in those areas. For detailed results obtained during the sampling events, please see Appendix B.

PHYTOPLANKTON

In the spring sample event the algal biomass within the lake was low (Biomass = 1380.33 μg/L) compared to spring 2001 (2001 Spring biomass = 3521.53 μg/L). In spring 2001 and 2002 diatoms were the most dominant species. In late summer the same trend occurred and the phytoplankton population was much higher in summer 2001 (2001 Summer Biomass = 808.49 ug/L) than summer 2002 (Biomass = 438.69 ug/L). Diatoms were the most dominant species during the 2002 late summer sampling events, but blue-green algae dominated in summer 2001. Interestingly, no blue-green were found in the late summer 2002 water sample. Although the water clarity during the late summer sampling event was lower in 2002 compared to 2001, the algal species seen in 2002 can be better utilized by in the aquatic food chain. While most phytoplankton species must obtain nitrogen (a required nutrient for growth) from aqueous forms in the lake, blue-green algae have the ability to use the atmospheric nitrogen gas (by nitrogen fixation). In lakes that are limited in nitrogen availability, nitrogen fixing is a distinct advantage. Blue-green algae is often thought of as a nuisance due to the inability of it to be used in the aquatic food chain and for its impact on water clarity. For detailed results obtained during the 2002 sampling events, please see Appendix C.

METALS

Only one of the dissolved heavy metal samples exceeded any criteria during either the 2002 spring and summer sampling events.

In one spring lake influent sample the concentration of manganese (Spring Mn influent = 65 ppb) was higher than the secondary MCL (Mn MCL = 50 ppb). The secondary manganese MCL is not based on toxic effects, but rather to minimize the objectionable qualities manganese for human usage (laundry stains and taste). Contaminants will continue to be monitored in the coming year for any changes. For detailed results obtained during the sampling events, please see Appendix D.

MTBE

Concentrations for MTBE around the lake were found to be below the detection limit (< 2 ppb) during both spring and late summer sampling events. For detailed results obtained during the sampling events, please see Appendix F.

INORGANIC ANALYSIS

The spring and summer sample results were within expected ranges and levels. The only result to note was the low alkalinity value (Alkalinity inlet = 20 mg/L $CaCO_3$) associated with waters flowing into the lake during spring 2002. The spring 2002 inlet sample alkalinity was the lowest of all of the lakes monitored by the USACE [another granitic watershed?]. For detailed results obtained during the 2002 sampling events, please see Appendix E.

FISH TISSUE ANALYSIS

Fish tissue analysis for total mercury was performed on a composite sample composed of tissue from three black bass collected in June 2002. The composite sample had a resulting total mercury concentration of 0.21 ppm. This is below the California Office of Environmental Health Hazard Assessment action level to continue fish monitoring (0.3 ppm) and well below the U.S. F.D.A. criteria for a fish advisory (1 ppm). For detailed results obtained during the sampling events, please see Appendix G.

IV. Conclusions

Lake Isabella is a relatively shallow mesotrophic lake that can support warmwater fish species. Coldwater fish that require temperatures below 20°C and dissolved oxygen concentrations greater than 5 mg/L would have difficulties surviving the summer conditions at Lake Isabella. Water clarity in Lake Isabella during the 2002 sampling events was lower than average and below the recreational goal of 4 feet during the spring.

In the 2002 Lake Isabella sampling events only dissolved manganese exceeded a secondary water quality limit based on aesthetics. Manganese concentrations were above the secondary MCL for drinking water in one lake influent sample during the spring. Since the MCL for manganese isn't based on toxic effects, but rather on objectionable qualities, it isn't considered a contaminant of concern. Although the 2001 water quality report listed several contaminants of concern they were not apparent this year. Nonetheless levels in Lake Isabella will continue to be monitored in the event that this year's values are anomalous.

Fish tissue mercury concentrations in fish composite samples were below the California OEHHA's screening level for a second consecutive year (<.3 ppm) nonetheless mercury in fish tissue will be monitored for another year to see if there are variations that take concentrations above this level.

V. References

North American Lake Management Society (1990). *Lake and Reservoir Restoration Guidance Manual*, EPA 440/4-90-006, U.S. Environmental Protection Agency, Washington, DC.

Novotny, V., and H. Olem (1994). *Water Quality: Prevention, Identification, and Management of Diffuse Pollution*, Van Nostrand Reinhold, New York, New York.

Tchobanoglous, G., F. L. Burton, and H. D. Stensel (2003) *Wastewater engineering: treatment and reuse / Metcalf & Eddy, Inc*., McGraw-Hill, Boston, MA.

Welch, E.B. (1992) *Ecological Effects of Wastewater: Applied limnology and pollutant effects,* Chapman and Hall, Cambridge University Press, Great Britain.

Wetzel, R.G. (1975). *Limnology*, W.B. Saunders Company, Philadelphia, PA.

VI. Appendices

Appendix A: Glossary of Sample Types

Glossary of Sample Types

This glossary of sample types is intended to provide a general background and indicate the importance of each sample in determining water quality. These are meant to be brief and basic. If a further explanation is desired please refer to the list of references provided in this report.

Secchi Depth

One of the oldest and easiest methods to determine lake clarity is the Secchi depth (SD). The Secchi depth is determined by dropping a Secchi disc into a water body and determining the depth that it is last visible from the surface of the water. Secchi discs are generally white and 20 cm in diameter. Secchi depth values are most impacted by the light intensity at the time of sampling and the scattering of light by solid particulates within the water column. Algal growth (phytoplankton) and sediment re-suspension are often major constituents of solid particulates within the water column. Secchi depth values can be used to estimate the Trophic state or the nutrient levels within the lake. The more nutrients are available, the larger likelihood of algal blooms that limit water clarity. Due to recreational concerns for safety, the goal for Secchi depth values is four feet or greater.

Temperature Profiles and Data Points

The temperature profile of a lake provides information how a lake is operating and the potential for aquatic biota to live within the lake. The temperature profile is a direct indicator if a lake is stratified. Stratification in lakes is created generally by temperature affecting the density of water molecules. Stratification is usually indicated by a region of similar temperature nearer the surface of the water (epilimnion), then a region of temperature transition (metalimnion), to another layer of nearly constant temperature at the bottom of the lake (hypolimnion). Each layer in a stratified lake is important, but the existence of a hypolimnion can drastically impact how well a lake can handle warmer temperatures such as those found in northern California during the summer. The hypolimnion acts as a buffer against large temperature shifts. The nature of dam operation is that water is discharged near the bottom, releasing the hypolimnion, and eliminating stratification. This operation limits the ability of reservoirs to regulate their temperature during the summer months. Stratification isn't always desirable. When a lake isn't stratified and is instead well mixed, the required nutrients near the bottom of the lake become available to phytoplankton for growth. Temperatures within lakes also indicate which species of fish will survive within a lake. Coldwater species of fish require temperatures below 20 degrees C in order to spawn and survive. If a lake is often above 20 degrees C, then only warmwater fish species will survive.

Dissolved Oxygen (DO) Concentration Profiles

DO is required by organisms for respiration and for chemical reactions within lake waters. The recommended level for DO for most aquatic species survival is 5mg/L. In lakes, biota waste (detritus) falls to the bottom of the lake to be utilized by bacteria. The bacteria need oxygen and will deplete levels near the bottom of a lake, especially during warm temperature, high respiration conditions. For nutrient rich (eutrophic) lakes more organisms will grow, create wastes, and cause oxygen depleted regions at the lowest areas. Under these conditions only aquatic species that can survive low DO conditions in warm water near the surface will survive.

PH Profiles

The pH profiles of the lakes indicate the potential for certain chemical reactions to occur. In high pH (greater than pH = 7 or basic) aquatic systems, metal pollutants tend to form into insoluble compounds that fall onto the lake floor. In low pH (less than pH = 7 or acidic) systems or areas metal ions become soluble and available for uptake into aquatic organisms. Other compounds like ammonia that are introduced into a low pH aquatic environment will transform into soluble nitrate and be utilized by organisms.

Phytoplankton Analysis

Phytoplankton analysis indicates the health, nutrients, and biodiversity within a lake. Lakes that have few nutrients available (Oligotrophic) will generally have a much lower quantity of phytoplankton (high Secchi depth) but the number of phytoplankton species seen will be large. In a lake that is nutrient rich (eutrophic) there are generally large phytoplankton blooms (low Secchi depth), but they are made up of a couple of phytoplankton species. Certain species of phytoplankton are preferred food sources for zooplankton (small invertebrates). Generally species like diatoms and green algae can be consumed by the filter-feeding zooplankton, but species like bluegreen algae are low in nutrients and are difficult to consume. Some species like the dinoflagellates can grow horn like points to discourage potential predators. In nutrient rich waters where there is plenty of phosphorous, nitrogen can be limited for biological growth. While most species can't grow due to the lack of nitrogen, bluegreen algae (cyanobacteria) have the ability to utilize nitrogen from the atmosphere when required. This gives bluegreen algae the ability to dominate in many eutrophic lakes.

Soluble Metals Analysis

The soluble metals analysis indicates the exposure of humans and aquatic organisms to toxic metals. These metals often build up as they are consumed through the food chain. Water samples provide an indicator for additional problems. Soluble forms of metal ions are more prevalent in low pH (pH <7, or acidic) environments.

MTBE Analysis

MTBE (methyl tertiary-butyl ether) is a chemical additive to gasoline to improve combustion. Due to its high solubility, MTBE travels and blends into aquatic systems rapidly. While not found to be extremely hazardous at low levels, the offensive smell and taste is detectible by humans at extremely low concentrations. The effect of MTBE on humans and aquatic systems is still under investigation.

Inorganic Analysis

Alkalinity

Alkalinity is measured in terms of mg/L of calcium carbonate. It indicates a lakes ability to buffer incoming acidic pollution and situational changes.

Ammonia

Ammonia is a gas that is toxic to fish and is more visible at a higher pH. Ammonia is created through anthropogenic inputs, bacteria cell respiration, and the decomposition of dead cells. Due to being a gas, given time ammonia will volatilize from the water. At a lower pH, much of the ammonia is converted to ammonium (a nutrient for root bound plant life) and utilizes DO in the nitrification process.

Chloride

The chloride ion is an indicator of any salinity increases within a lake. Most fresh water aquatic species are sensitive to salinity changes.

Nitrate

Nitrate is the nitrogen product created through the nitrification of ammonium. Nitrate is a soluble form of the nutrient nitrogen and is utilized by phytoplankton.

Total Phosphorous

The total phosphorous provides a measure of both utilized and soluble phosphorous within water samples. Phosphorous is a required nutrient for plant growth and development.

Ortho Phosphorous

Ortho phosphorous is the soluble form of phosphorous that is utilized by free-floating aquatic plants (phytoplankton).

Kjeldahl N

Kjeldahl nitrogen or total Kjeldahl nitrogen (TKN) is a measure of the total concentration of nitrogen in a sample. This includes ammonia, ammonium, nitrite, nitrate, nitrogen gas, and nitrogen contained within organisms.

COD

Chemical Oxygen Demand (COD) is a measure of the total oxygen required to complete the chemical and biological demands of a sample.

Fish Tissue Analysis

Fish tissue is analyzed to examine potential exposure of humans to toxicants as well as the health of the aquatic food chain. In aquatic systems toxic contaminants can build up (or bioaccumulate) within animals at the top of the food chain. Contaminants (especially organic pollutants) are retained within the fat tissue of an organism, therefore in fish samples the lipid content is often measured.

Lake Code Designation

Laboratory Reports are provided in the previous sections.

Sample ID is "XX-YY-ZZ" where

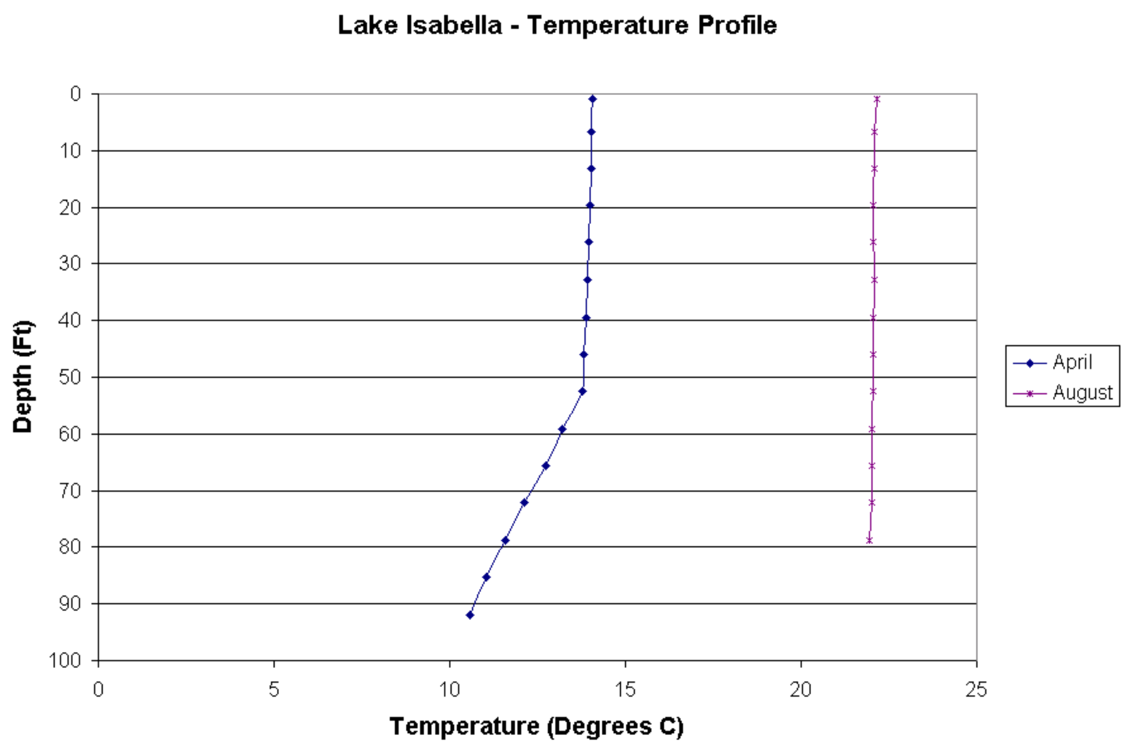
XX designation:
BB for Black Butte
EA for Eastman
EN for Englebright
HE for Hensley
IS for Isabella
KA for Kaweah
ME for Mendocino
MC for Martis Creek
NH for New Hogan
PF for Pine Flat
SO for Sonoma
SU for Success

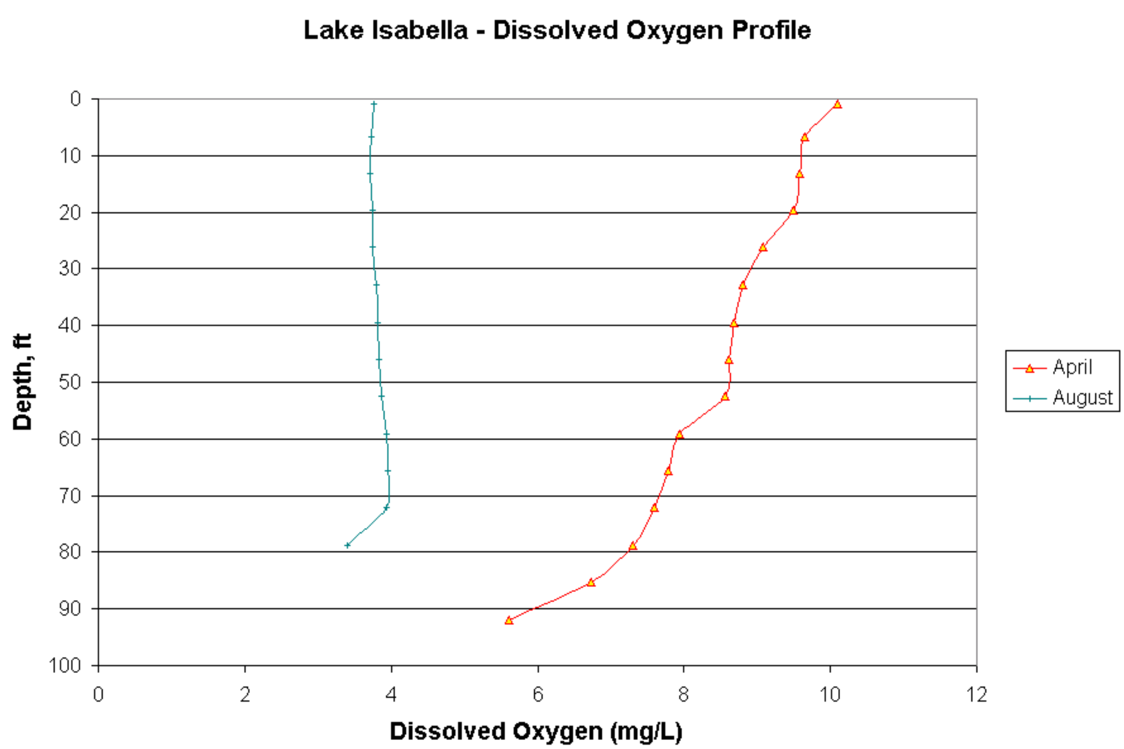
YY designation
SP for Spring
SU for Summar

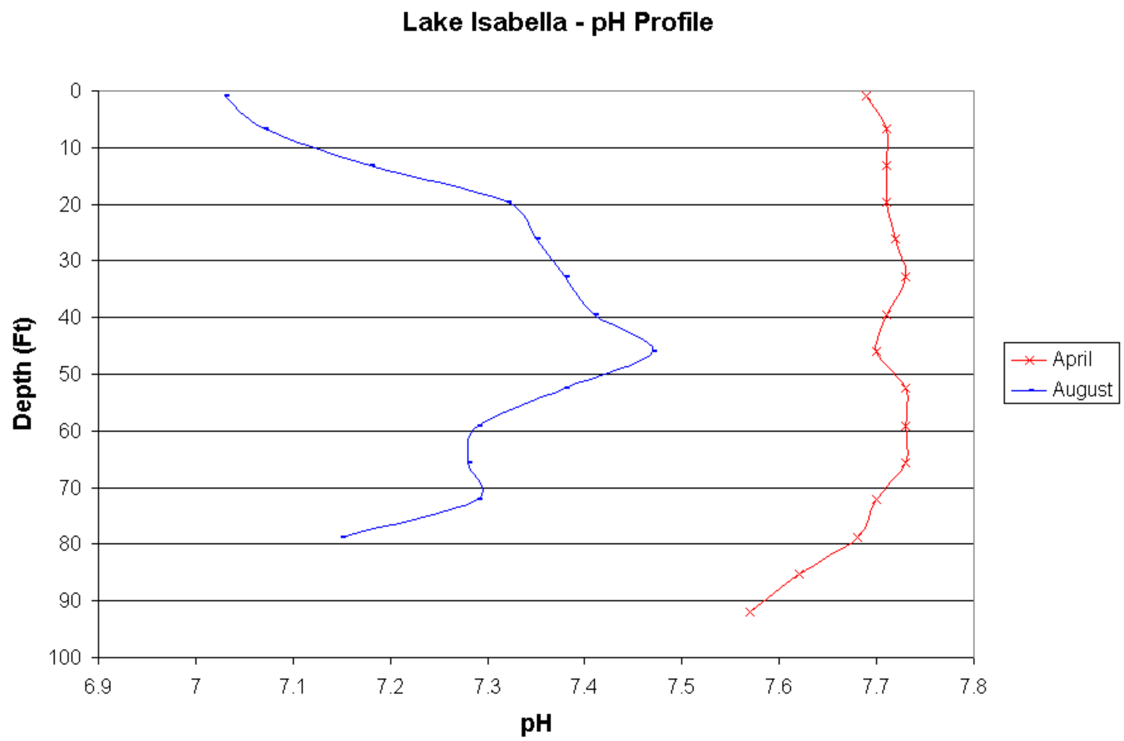
ZZ designation
S for surface of Lake
B for bottom of Lake
I-1 for inflow1
I-2 for inflow 2
O for outflow

Example: BB-SU-S is for a water sample taken from Black Butte in the Summer on the Lake's Surface.

Appendix B: Profile Data and Charts (Secchi Disc, Temperature, DO, and pH)


Lake Isabella - Temperature Profile
Depth (Ft)
Temperature (Degrees C)
April
August
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25

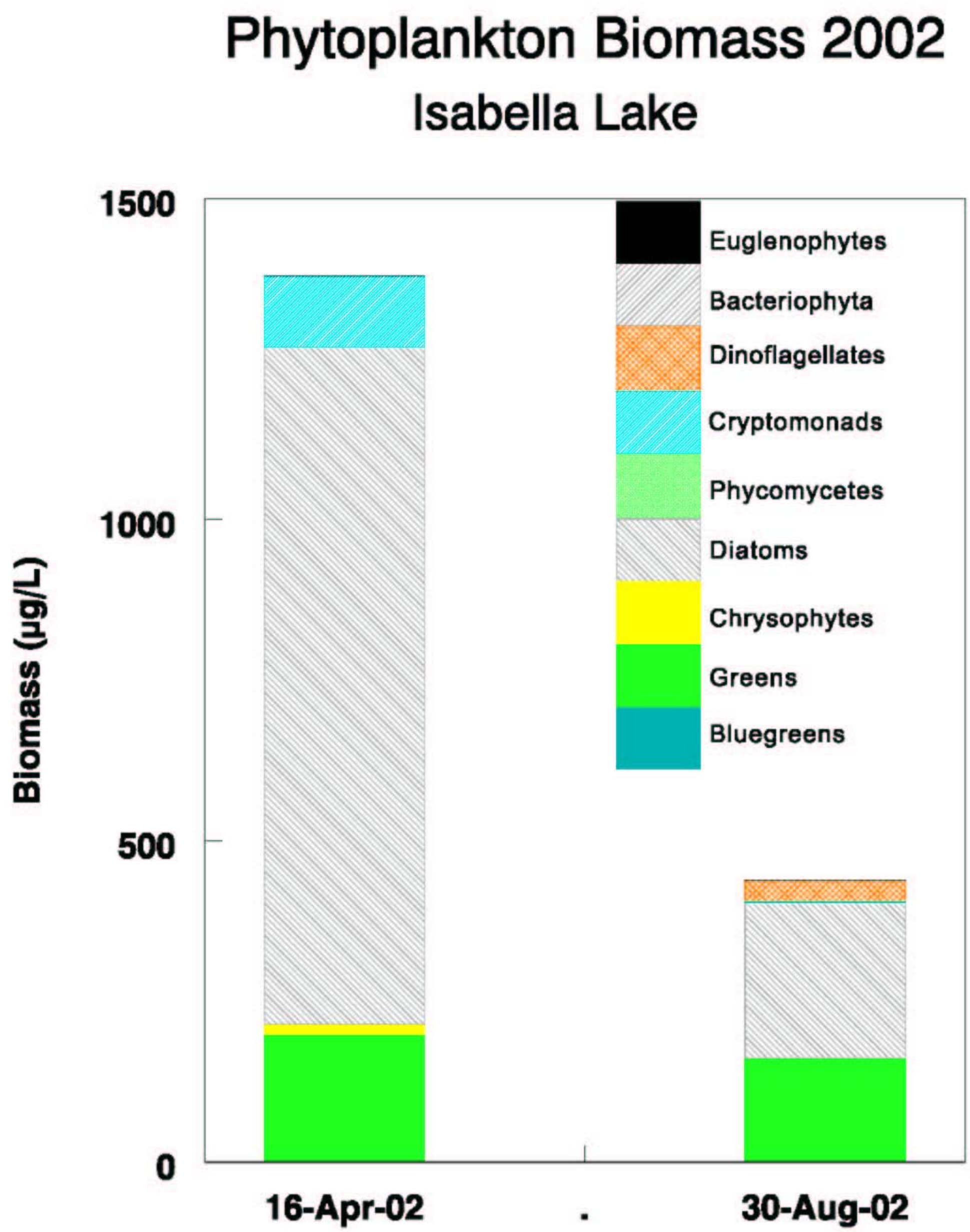

Lake Isabella - Dissolved Oxygen Profile
Depth, ft
Dissolved Oxygen (mg/L)
April
August
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12


Lake Isabella - pH Profile
Depth (Ft)
0
10
20
30
40
50
60
70
80
90
100
6.9
7
7.1
7.2
7.3
7.4
7.5
7.6
7.7
7.8
pH
April
August

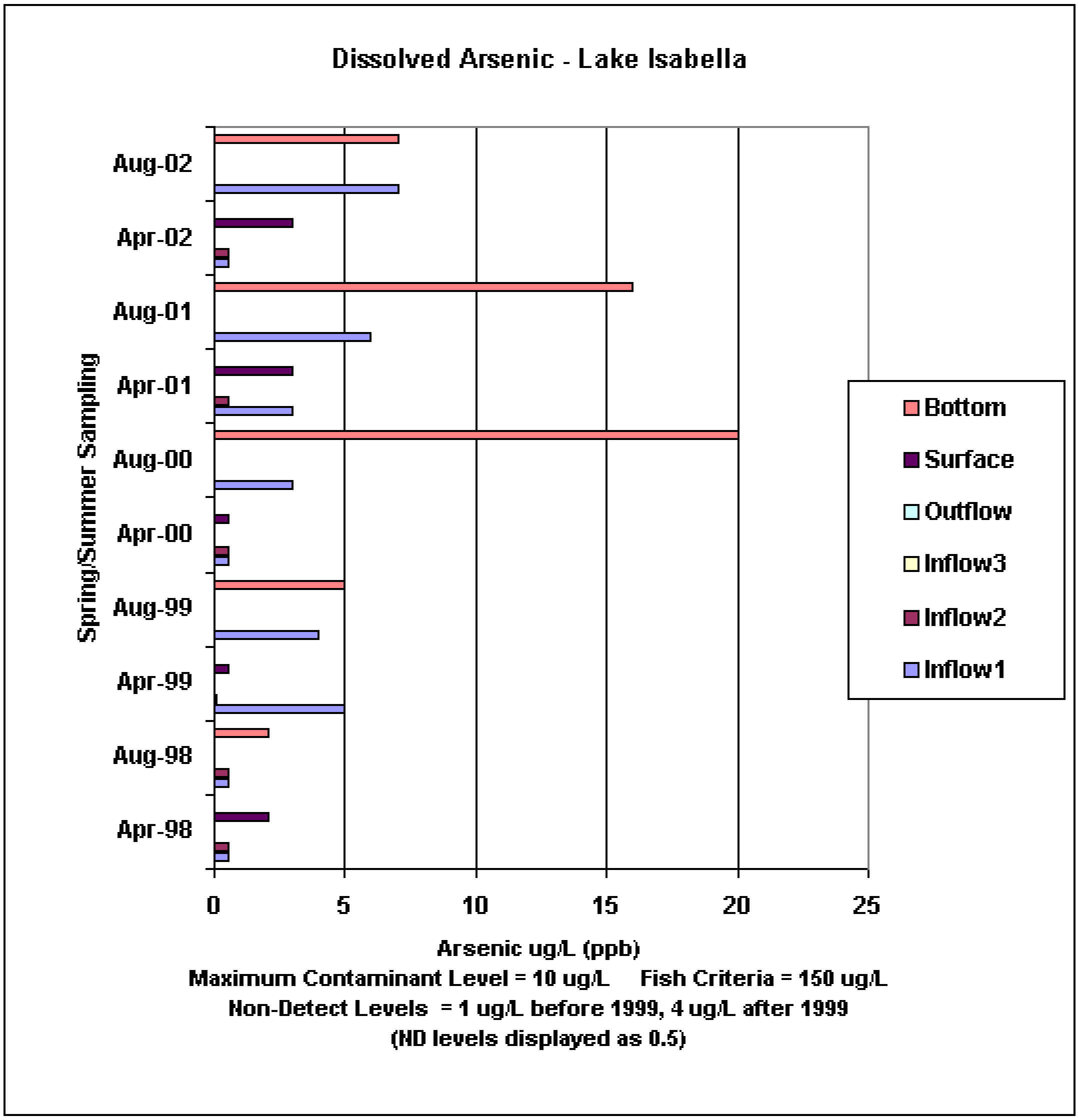
LAKE ISABELLA					
Sample Location: Behind dam				**Date:** 4/16/02	
Observers: Tim McLaughlin				**Time:** 9:00 am	
Lake Elevation: 2552.88					
Weather Conditions:					
Wind Speed: 5		**Precipitation:**0		**Temp (F):** 58	
SECCHI Depth: 2 feet and 10 inches					
Depth-M	**Depth-F**	**Temp-C**	**Cond**	**DOmg/L**	**pH**
27	91.9	10.57	129	5.61	7.57
26	85.3	11.05	125	6.74	7.62
24	78.7	11.58	122	7.31	7.68
22	72.2	12.11	120	7.59	7.70
20	65.6	12.72	119	7.78	7.73
18	59.1	13.21	117	7.94	7.73
16	52.5	13.76	113	8.57	7.73
14	45.9	13.83	114	8.62	7.70
12	39.4	13.88	113	8.68	7.71
10	32.8	13.91	113	8.81	7.73
8	26.2	13.94	113	9.08	7.72
6	19.7	14.00	112	9.50	7.71
4	13.1	14.03	111	9.59	7.71
2	6.6	14.04	111	9.65	7.71
0.03	1	14.05	111	10.10	7.69
SOUTH FORK KERN (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs**
53.8	8.4		-	-	50
NORTH FORK KERN (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs**
54.6	8.64		-	-	1599
VISUAL OBSERVATIONS: Water very cloudy due to high inflows.					

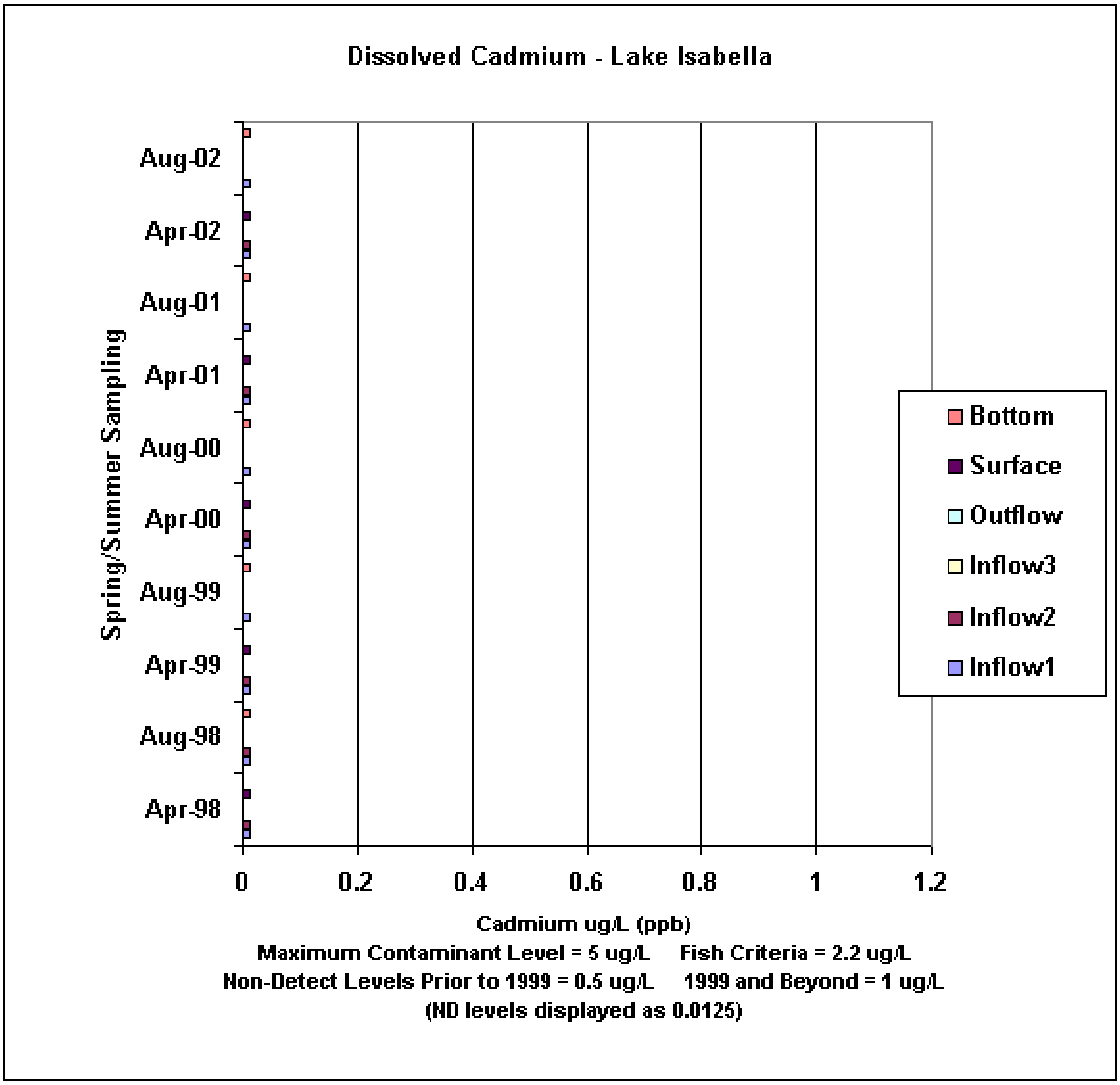
LAKE ISABELLA					
Sample Location: Behind dam				**Date:** 8/20/02	
Observers: Tim McLaughlin				**Time:** 9:30 am	
Lake Elevation: 2549					
Weather Conditions:					
Wind Speed: 20		**Precipitation:** 0		**Temp (F):** 75	
SECCHI Depth: 5 feet and 4 inches					
Depth-M	**Depth-F**	**Temp-C**	**Cond**	**DOmg/L**	**pH**
24.3	78.7	21.96	115	3.41	7.15
22	72.2	22.01	114	3.93	7.29
20	65.6	22.01	114	3.96	7.28
18	59.1	22.03	114	393	7.29
16	52.5	22.04	113	3.87	7.38
14	45.9	22.06	113	3.83	7.47
12	39.4	22.05	113	3.81	7.41
10	32.8	22.07	113	3.79	7.38
8	26.2	22.06	114	3.75	7.35
6	19.7	22.06	114	3.74	7.32
4	13.1	22.08	114	3.72	7.18
2	6.6	22.10	114	3.73	7.07
0.03	1	22.17	114	3.76	7.03
SOUTH FORK KERN (Inflow) - DRY					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs**
-	-		-	-	-
NORTH FORK KERN (Inflow)					
Temp (F)	**pH**		**DOmg/L**	**EC**	**Flow rate (cfs**
77.1	8.19		-	-	138
VISUAL OBSERVATIONS: Very windy.					

Appendix C: Phytoplankton Data and Charts

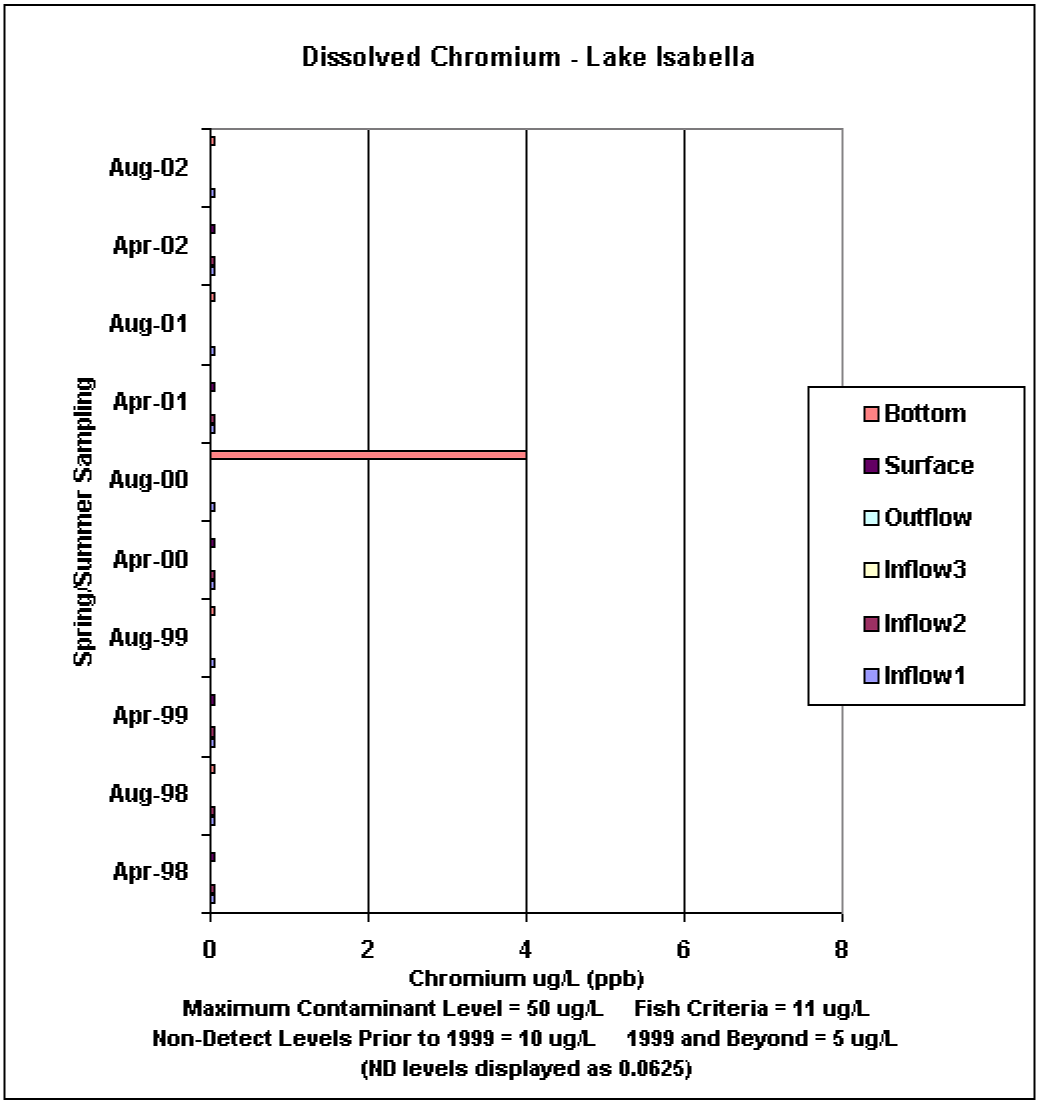

Phytoplankton Biomass 2002
Isabella Lake
Biomass (µg/L)
1500
1000
500
0
Euglenophytes
Bacteriophyta
Dinoflagellates
Cryptomonads
Phycomycetes
Diatoms
Chrysophytes
Greens
Bluegreens
16-Apr-02
.
30-Aug-02

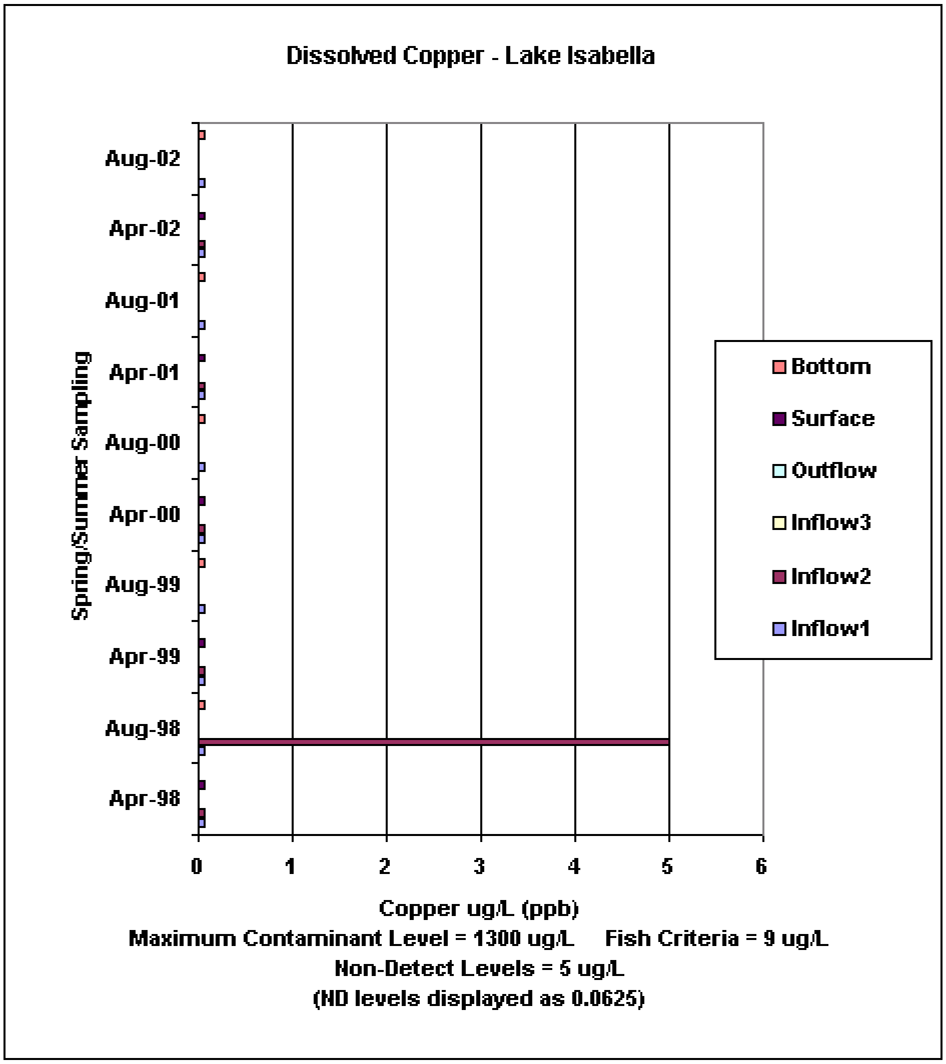
Appendix D: Metals Data and Charts

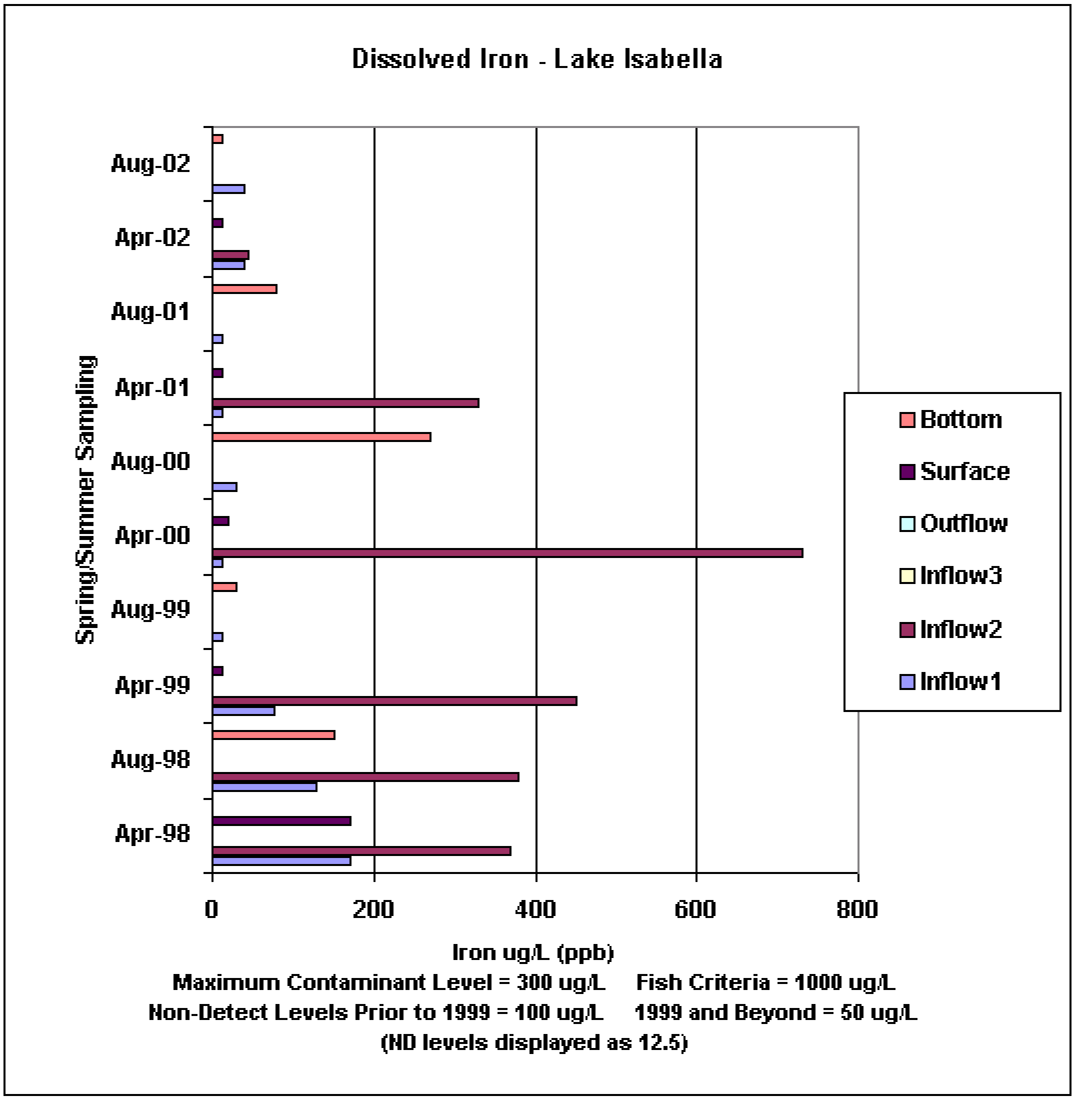

Dissolved Arsenic - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
5
10
15
20
25
Arsenic ug/L (ppb)
Maximum Contaminant Level = 10 ug/L Fish Criteria = 150 ug/L
Non-Detect Levels = 1 ug/L before 1999, 4 ug/L after 1999
(ND levels displayed as 0.5)
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1



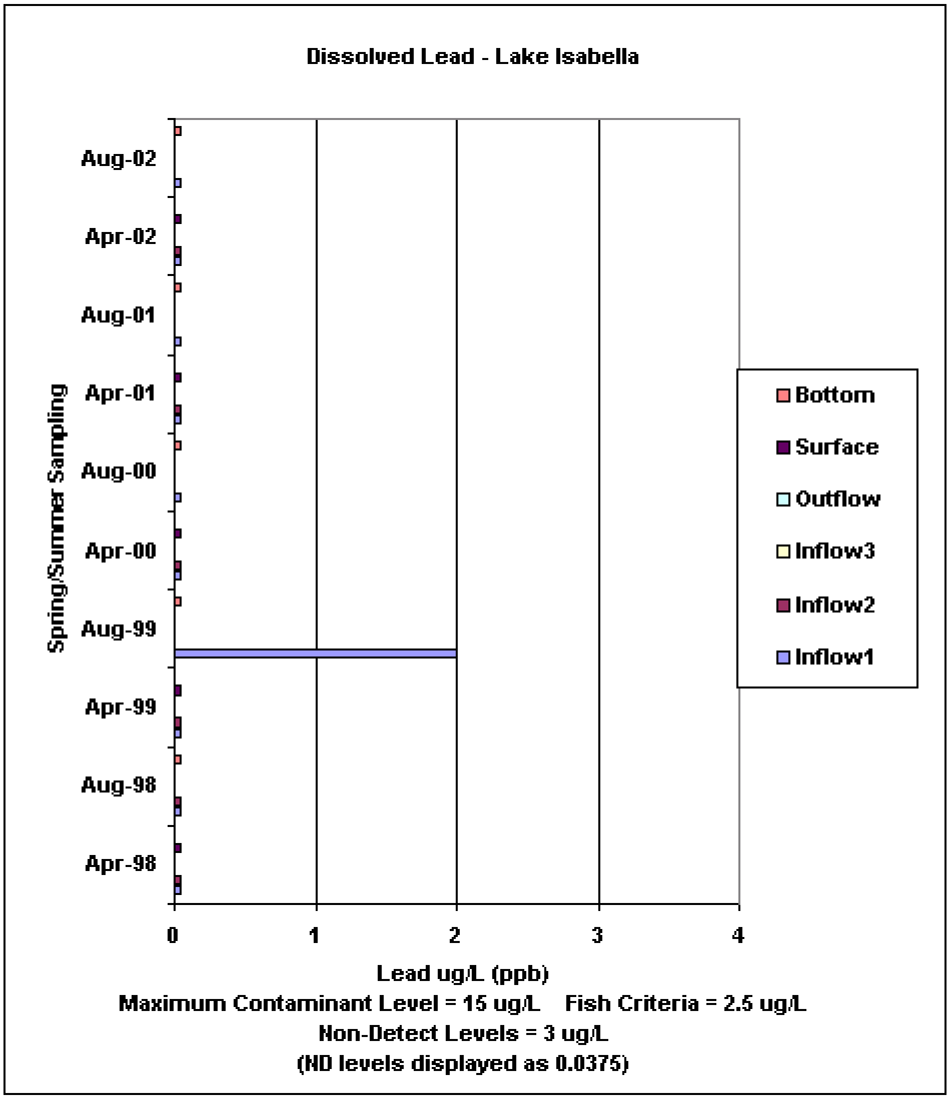
Dissolved Cadmium - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
0.2
0.4
0.6
0.8
1
1.2
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Cadmium ug/L (ppb)
Maximum Contaminant Level = 5 ug/L Fish Criteria = 2.2 ug/L
Non-Detect Levels Prior to 1999 = 0.5 ug/L 1999 and Beyond = 1 ug/L
(ND levels displayed as 0.0125)

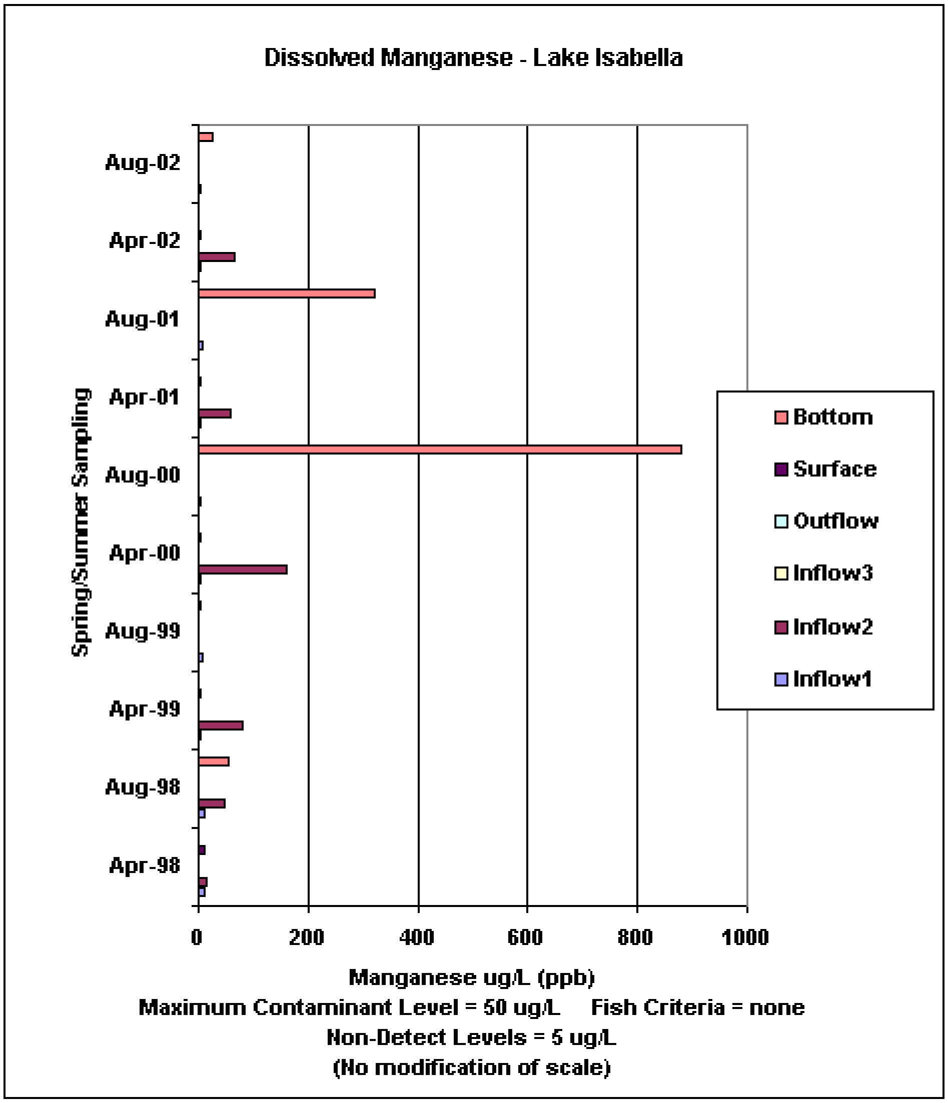

Dissolved Chromium - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
2
4
6
8
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Chromium ug/L (ppb)
Maximum Contaminant Level = 50 ug/L Fish Criteria = 11 ug/L
Non-Detect Levels Prior to 1999 = 10 ug/L 1999 and Beyond = 5 ug/L
(ND levels displayed as 0.0625)

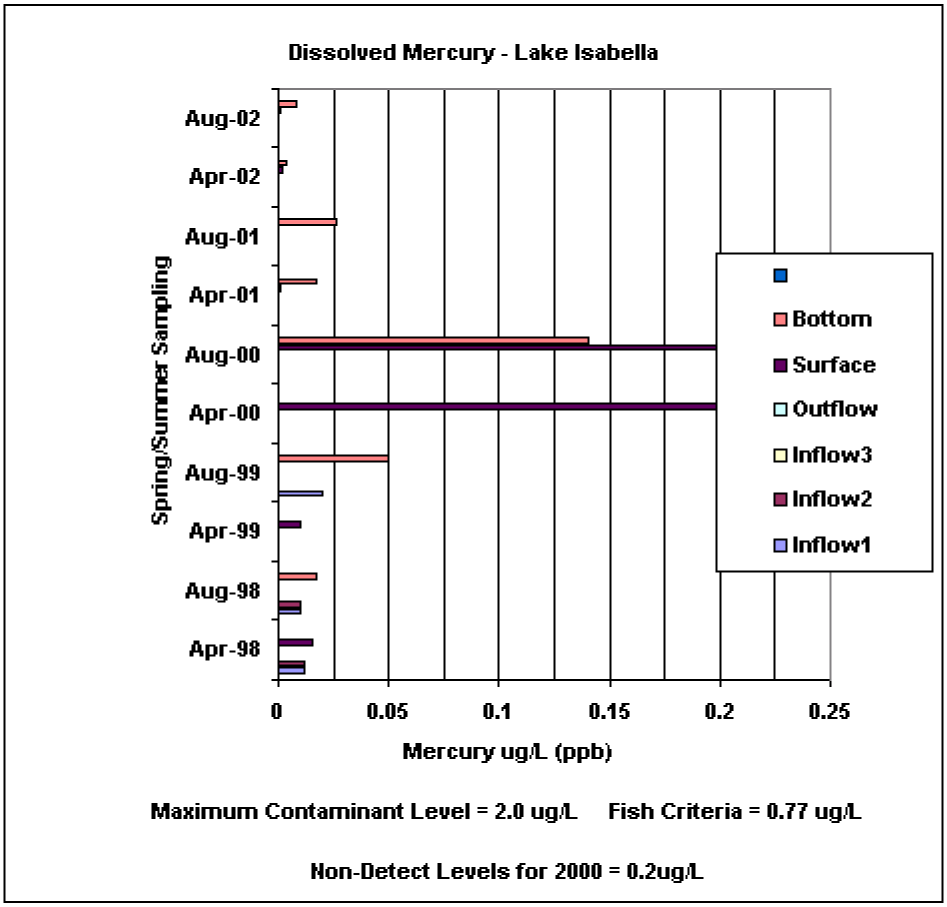

Dissolved Copper - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
1
2
3
4
5
6
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Copper ug/L (ppb)
Maximum Contaminant Level = 1300 ug/L Fish Criteria = 9 ug/L
Non-Detect Levels = 5 ug/L
(ND levels displayed as 0.0625)

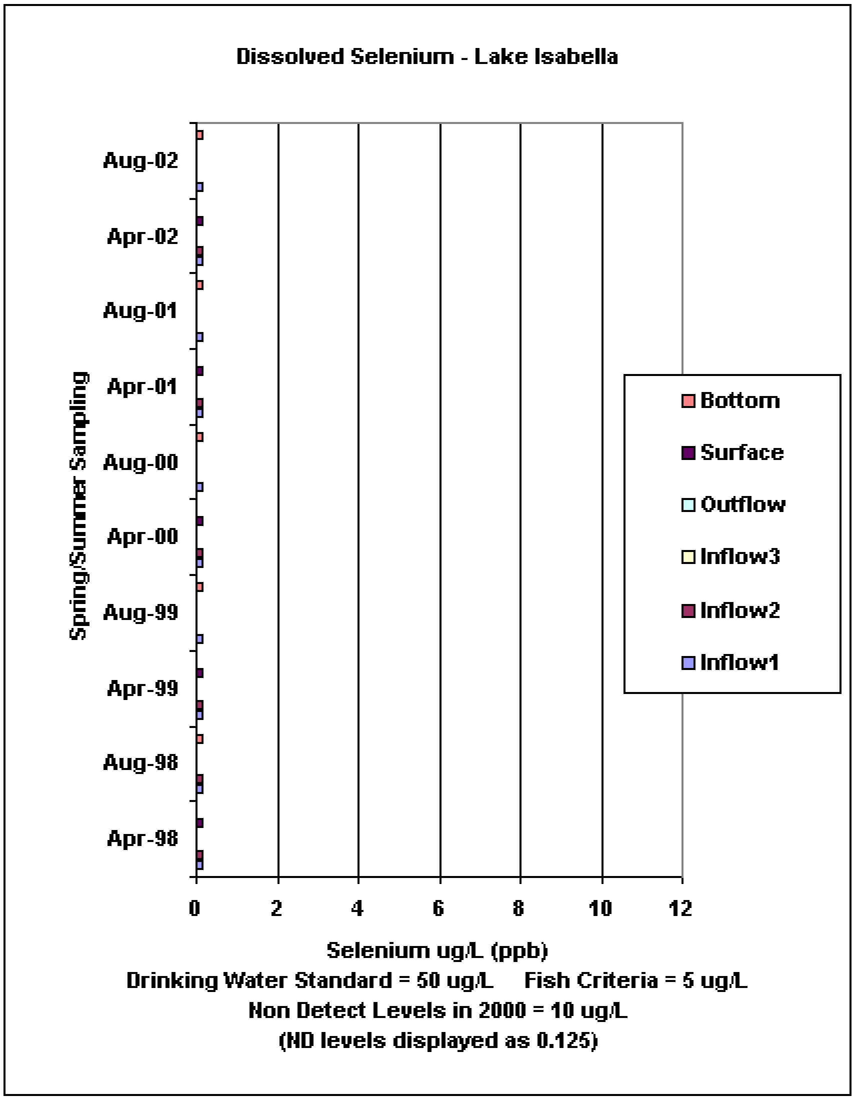


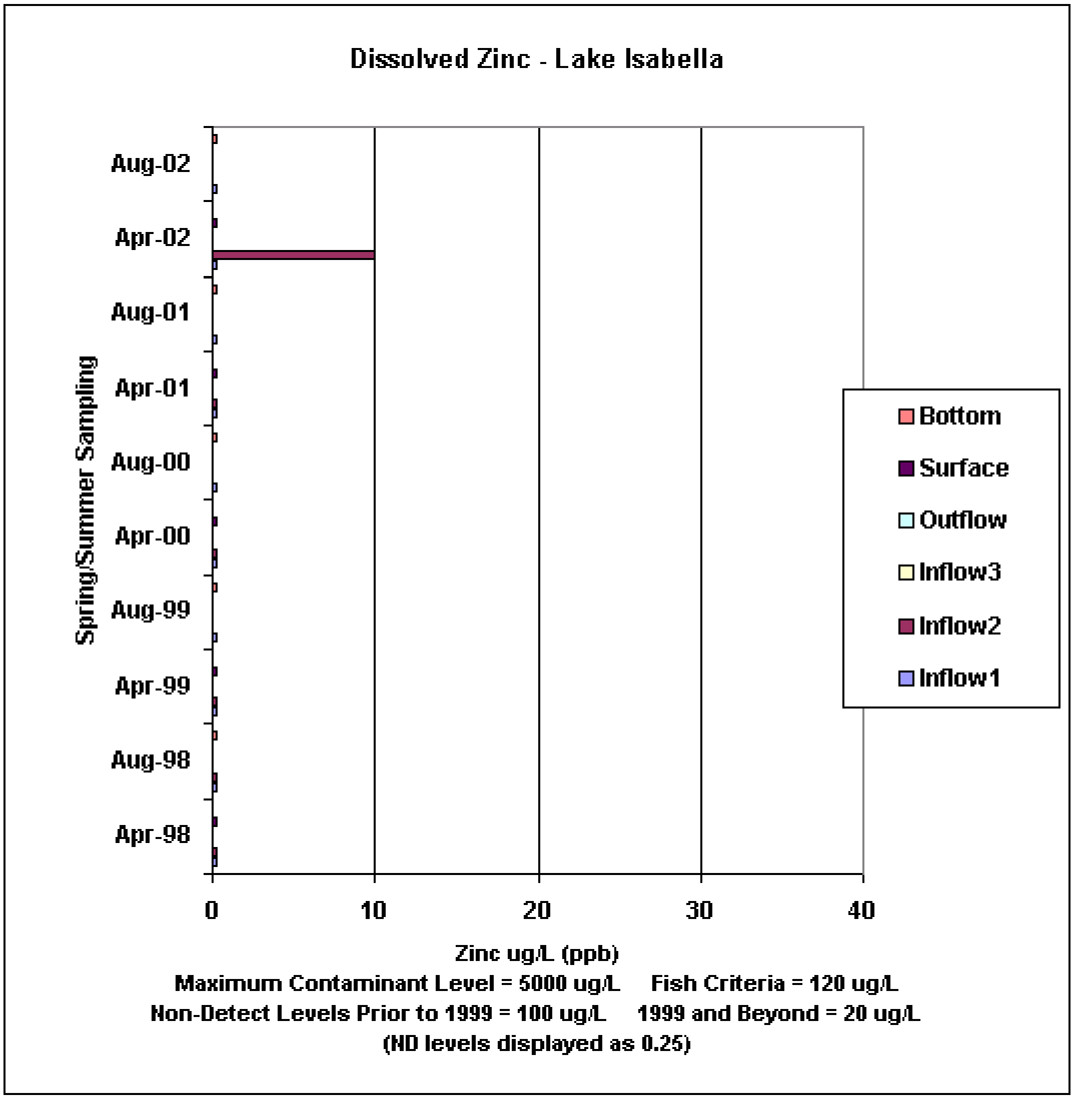
Dissolved Iron - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
200
400
600
800
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Iron ug/L (ppb)
Maximum Contaminant Level = 300 ug/L Fish Criteria = 1000 ug/L
Non-Detect Levels Prior to 1999 = 100 ug/L 1999 and Beyond = 50 ug/L
(ND levels displayed as 12.5)


Dissolved Lead - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
1
2
3
4
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Lead ug/L (ppb)
Maximum Contaminant Level = 15 ug/L Fish Criteria = 2.5 ug/L
Non-Detect Levels = 3 ug/L
(ND levels displayed as 0.0375)


Dissolved Manganese - Lake Isabella
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Spring/Summer Sampling
0
200
400
600
800
1000
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Manganese ug/L (ppb)
Maximum Contaminant Level = 50 ug/L Fish Criteria = none
Non-Detect Levels = 5 ug/L
(No modification of scale)


Dissolved Mercury - Lake Isabella
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
Spring/Summer Sampling
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
0
0.05
0.1
0.15
0.2
0.25
Mercury ug/L (ppb)
Maximum Contaminant Level = 2.0 ug/L   Fish Criteria = 0.77 ug/L
Non-Detect Levels for 2000 = 0.2ug/L


Dissolved Selenium - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
2
4
6
8
10
12
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Selenium ug/L (ppb)
Drinking Water Standard = 50 ug/L   Fish Criteria = 5 ug/L
Non Detect Levels in 2000 = 10 ug/L
(ND levels displayed as 0.125)


Dissolved Zinc - Lake Isabella
Spring/Summer Sampling
Aug-02
Apr-02
Aug-01
Apr-01
Aug-00
Apr-00
Aug-99
Apr-99
Aug-98
Apr-98
0
10
20
30
40
Bottom
Surface
Outflow
Inflow3
Inflow2
Inflow1
Zinc ug/L (ppb)
Maximum Contaminant Level = 5000 ug/L Fish Criteria = 120 ug/L
Non-Detect Levels Prior to 1999 = 100 ug/L 1999 and Beyond = 20 ug/L
(ND levels displayed as 0.25)

Appendix E: Inorganic Sample Data

Inorganic Results (mg/L) For surface lake waters (spring)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity		60	40	50	60	30	40	70	80	20		100
Ammonia		<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Chloride		21	2	21	4	4	3	<1	6	5		4
Nitrate		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	<0.1		<0.1
Total P		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		<0.1
Sulfate		5.3	2.6	4.2	8.9	2	1	8.2	9	2.1		4.7
Kjeldahl N		0.6	0.1	0.4	0.2	<0.1	0.3	0.2	0.2	0.2		<0.1
COD					<50							
Tot Solids		120	70	100	110	60	78	100	120	21		150

Inorganic Results (mg/L) For inlet waters to the lakes (spring) (I-1 only)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	100	70	40	50	20	30	40	80	90	10	100	50
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1		0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chloride	13	25	3	21	<1	<1	4	<1	6	4	3	2
Nitrate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1
Total P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	
Sulfate	18	2.1	2.3	3	2.8	1.9	0.8	8.8	11	1.6	11	3.5
Kjeldahl N	<0.1	0.2	<0.1	0.3	<0.1	<0.1	0.2	0.2	0.1	0.1	0.1	<0.1
COD	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tot Solids	170	130	59	110	60	60	90	110	150	30	130	90

Inorganic Results (mg/L) For surface lake waters (summer)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	140	70	40	50	50	40	70	90	80	10	80	110
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	0.1	<0.1
Chloride	16	26	4	19	6	5	5	5	9	3	5	8
Nitrate	<0.1	1.5	<0.1	1.3	0.7	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1
Total P	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ortho P	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfate	16	4.1	3.6	3.5	5.9	2	0.7	7.4	14	1.6	6.4	4.4
Kjeldahl N	<0.1	2.7	<0.1	0.4	0.4	0.3	<0.1	0.2	<0.1	<0.1	0.2	0.6
COD	<50	60	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Tot Solids	200	190	50	120	98	80	80	120	120	52	100	170

Inorganic Results (mg/L) For inlet waters to the lakes (summer) (I-1 only)												
	BB	EA	EN	HE	IS	KA	MC	ME	NH	PF	SO	SU
Alkalinity	150	90	40		60	40	80	100	130	20	110	180
Ammonia												
Chloride	16	490	5		10	8	3	5	14	4	5	22
Nitrate												
Total P												
Ortho P												
Sulfate	16	4.5	3		9.8	3.2	<0.5	6	14	2.7	5.4	8.7
Kjeldahl N												
COD												
Tot Solids	200	1300	50		140	100	100	150	200	50	140	280

Appendix F: MTBE Table

2002 MTBE Results
Units are ug/L (ppb)

The following table provides an overview of the lab results for the 2002 MTBE monitoring program.

Lake	Spring S	Spring S-1	Spring S-M	Spring S-C	Summer S	Summer S-1	Summer S-M	Summer S-C	Remarks
Black Butte	2		2		<2		<2		
Eastman	5				<2				
Englebright	3		3		10		10	10	
Hensley	3		3		3		3		
Isabella	<2	<2	<2	<2	<2	<2	<2	<2	
Kaweah	2		2	<2	8		6	6	
Martis Cr.	<2				<2				
Mendocino	<2				<2				
New Hogan	<2				3				
Pine Flat	<2		<2		2		2		
Sonoma		3	<2		<2		2		
Success	4		4	4	11	12	11	11	

Notes:

1. Non-Detect is indicated by "<2" since the Reporting Limit is 2 ppb or 0.002 ppm.

2. No enforceable acceptance criteria has been established for MTBE. See EPA Fact sheet.

3. Maps are provided to illustrate the sampling locations for samples: S / S-1, S-M, and S-C. Sample S and sample S1 are located near the dam; sample S-M is located within 50 ft of the Marina; and sample S-C is located near the center of the lake.

4. For 2002, the number of MTBE water sampling at each lake is based on last year's lab results.

5. 2 samples were taken from Eastman, Martis Creek, Mendocino, and New Hogan because MTBE was historically non-detectable. The 2002 results of non-detectable levels were similar except Lake Eastman and New Hogan now reported low, detectable levels of MTBE.

6. 4 samples were taken from Black Butte, Hensley, Pine Flat and Sonoma because of historically low detectable levels of MTBE.

7. 6 to 8 samples were taken from Englebright, Isabella, Kaweah and Success because of historically higher MTBE being found. The 2002 results were similar except Isabella now reported non-detectible levels.

8. In 2001, very high MTBE levels were reported at Lake Isabella during the Spring (18 ug/L near the marina) . During Spring 2000, Lake Isabella reported 21 ug/L. The 2002 results indicate that the previous MTBE problem near the marina was not visible during the Spring 2002 sampling event, and may have been rectified.

G. Fish tissue analysis table

2002 Fish Tissue Results

The following table provides an overview of the lab results for the 2002 fish tissue program. N/A indicates data is not available due to lack of fish collection. Sample Preparation, filleting and Extraction were in accordance with EPA 823-R-95-007, Sep 95, Volume 1, Section 7.2 (Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisory) which requires the following: Only the edible portion of the fillet shall be analyzed (i.e no skin, tail, fin, head). Tissue digestion shall be accomplished by adding concentrated nitric acid and heating the tube in an aluminum block to reflux the acid. The digestate shall be cooled, diluted to a final volume of 25 ml and analyzed by CVAA. The laboratory conductng the preparation and analysis was Toxscan, Inc in Watsonville, CA and the laboratory mercury analysis was in accordance with CVAA per EPA 7471. The Percent Lipids were per EPA 1664. The FDA criteria for a fish advisory is 1 ppm. The California OEHHA's action level to continue fish tissue monitoring is 0.3 ppm.

Lake	Type of Fish	Type of Analysis (number of fish)	Date collected	Percent Lipids	Mercury Total ppm	FDA Criteria
Black Butte	Sm M Bass	Composite (3)	6/12/02	0.24	0.26	1 ppm
Eastman	Note 4	--------------------	-----------	----------	-----------	< Mon 00
Englebright	Note 5	N/A	N/A	N/A	N/A	
Hensley	Black Bass	Composite (3)	4/23/02	<0.10	0.72	1 ppm
Isabella	Black Bass	Composite (3)	6/4/02	0.20	0.21	1 ppm
Kaweah	Sm M Bass	Composite (3)	7/14/02	0.11	0.53	1 ppm
Martis Cr	Note 4	--------------------	-----------	----------	-----------	< Mon 00
Mendocino	Note 6	N/A	N/A	N/A	N/A	
New Hogan	Lg M Bass	Single (1)	6/3/02	<0.10	0.34	1 ppm
Pine Flat	Note 4	--------------------	-----------	----------	-----------	< Mon 01
Sonoma	Note 6	N/A	N/A	N/A	N/A	
Success	Black Bass	Composite (3)	4/15/02	<0.10	0.18	1 ppm

Notes:

9. Non-Detect is indicated by "<0.02". The lab Detection Limit for mercury is 0.02 ppm.
10. Total Mercury was reported in mg/g or ppm.
11. Total Mercury was conducted instead of Methyl Mercury since EPA 832 allows Total Mercury analysis for an initial screening program. When specific problem areas are identified, methyl mercury analysis are normally performed later as part of the actual health risk assessment.
12. The fish tissue program was terminated at Eastman and Martis Creek in 2001 and in Pine Flat in 2002 due to low total mercury results. In 2000, the total mercury was only 0.089 ppm for Eastman (Catfish) and the total mercury was <0.02 ppm for Martis Creek (Brown Trout). For Pine Flat total mercury was 0.21 ppm in 2000 (composite of three Sacramento Sucker fish) and 0.23 in 2001 (composite of three spotted bass).
13. Due to seasonal conditions, a fish could not be successfully collected at Lake Englebright. Another attempt will be accomplished for the 2003 report.
14. Fish were not collected at Mendocino or Sonoma due to communication difficulties.

The above 2002 total mercury results indicate only Hensley is higher than average. However, in 2001, the total mercury results were only 0.30 ppm for Hensley (small mouth bass). The 2003 fish tissue program should provide additional data. EPA fact sheet on fish advisories (EPA-823-F-99-016) indicates that the mean average mercury results from numerous lakes in the Northeast United States were found to be 0.46-0.51 ppm for largemouth bass and 0.34-0.53 for smallmouth bass.