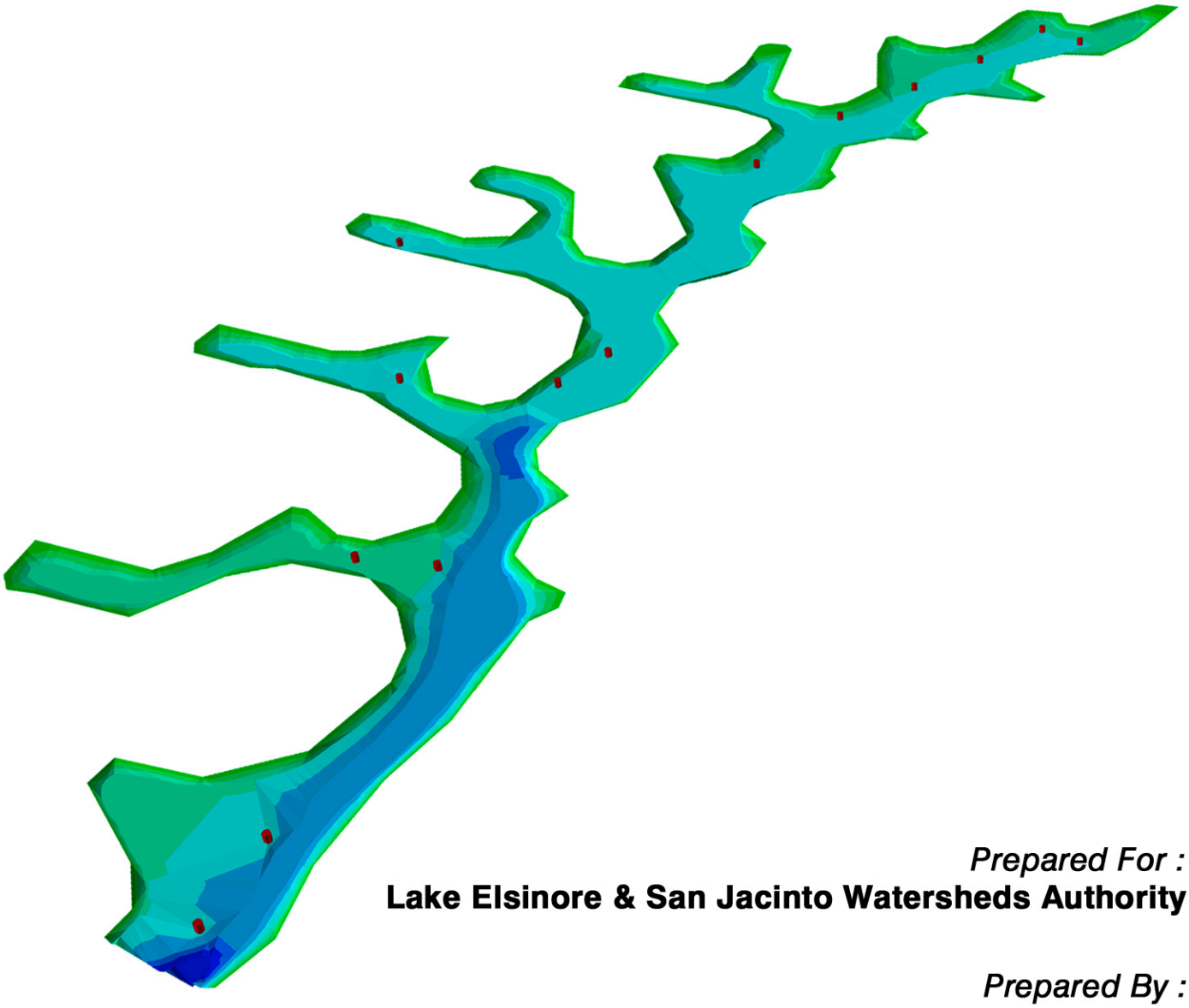
Canyon Lake East Bay Sedimentation Characterization



Prepared For :

Lake Elsinore & San Jacinto Watersheds Authority

Prepared By :

HDR

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August 2002

CANYON LAKE EAST BAY
SEDIMENTATION CHARACTERIZATION STUDY

Prepared for:

Lake Elsinore and San Jacinto Watersheds Authority
11615 Sterling Avenue
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August 2002

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1.0 INTRODUCTION

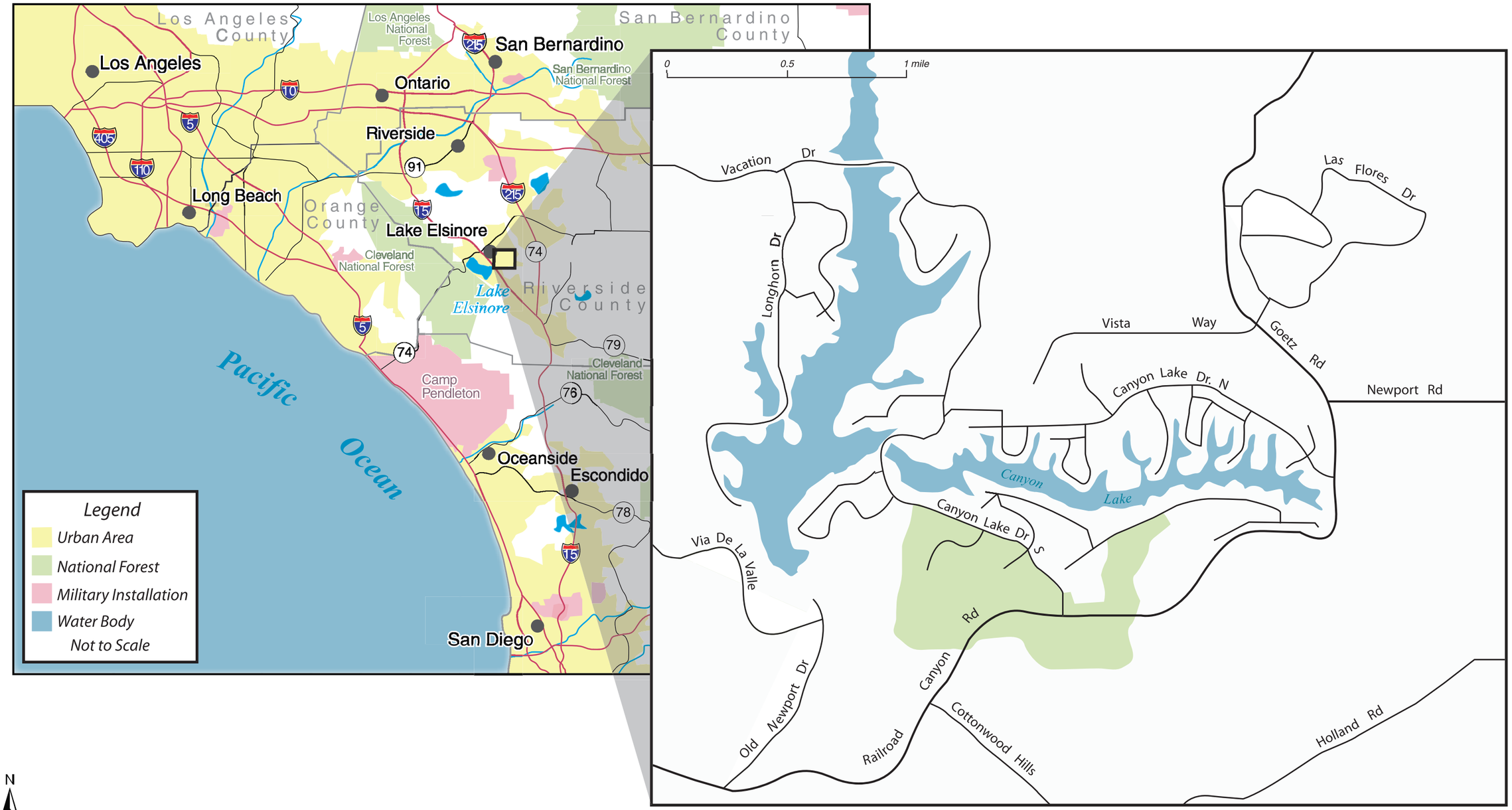
1.1 PROJECT LOCATION

Canyon Lake (Railroad Canyon Reservoir) lies approximately 75 miles southeast of Los Angeles and approximately 30 miles south of the City of Riverside, California. Canyon Lake is a manmade reservoir situated between granitic mountains in southwest Riverside County and is located within the City of Canyon Lake between I-215 and I-15 within the 735 square mile San Jacinto River watershed (see Figure 1 and Appendix D). Canyon Lake was created in 1927 with the construction of Railroad Canyon Dam due to the demand for water in the region. Currently Canyon Lake encompasses a total of 472 acres with 14.9 miles of shoreline (water elevation – 1376').

The valley surrounding Canyon Lake is bordered on the south and west by the Santa Ana Mountains and the Cleveland National Forest and on the north and east by foothills of the San Jacinto Mountains. Canyon Lake is located at the confluence of the San Jacinto River and Salt Creek. The water storage capacity of the lake is approximately 11,000 acre-feet at an elevation of 1,380 feet. Elsinore Valley Municipal Water District (EVMWD) is responsible for monitoring the water levels, the use and quality of the water resources of Canyon Lake. Contract agreements between the water district and the property owners' association allow for a minimum water elevation of 1,372 feet, the spill elevation is 1,381.76 feet.

1.1 SEDIMENT CHARACTERIZATION PROGRAM DESCRIPTION

The Canyon Lake East Bay sediment characterization has been prepared to determine the amount of sediment contained within the East Bay portion of Canyon Lake and to determine if the sediment contains any chemical constituents, which may constrain potential disposal options. The results (sediment volume and chemical characteristics) of this study will be utilized to quantify the details of the proposed sediment removal project for use in the Environmental Impact Report (EIR) currently



Source : NavTech, 2002

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FIGURE 1

Regional Location and Vicinity Map

Canyon Lake East Bay Sediment Characterization

Lake Elsinore and San Jacinto Watersheds Authority

being prepared for the Canyon Lake In-Lake Treatment Program and future sediment removal and disposal cost estimates.

This sediment volume and chemical constituent data will be evaluated along with other East Bay sediment and water quality studies prepared to date to determine the final approach to sediment removal and water quality enhancement.

East Bay sediment loading is primarily derived from inflows of stormwater in Salt Creek and to a lesser degree from localized erosions from areas tributary to the East Bay.

2.0 CURRENT LAKE CHARACTERISTICS

This section provides a detailed description of the hydrogeologic characteristics of Canyon Lake.

2.1 EXISTING CONDITIONS – EAST BAY

Canyon Lake is situated upstream of, and on the main inflow into Lake Elsinore. Since dam construction in 1927, Canyon Lake has acted as an interceptor for sediments, containing phosphorus and other nutrients, heavy metals and other constituents that would otherwise flow into Lake Elsinore from the greater San Jacinto River watershed. The average annual sediment loading to the lake is estimated at 17,000 cubic yards (CY), with minimum average annual phosphorus loading of 17 tons per year (Horne, 2002).

Although Canyon Lake can currently be classified as morphometrically mesotrophic, it is showing signs of eutrophication due to the high sediment loading and internal mixing. The high levels of nutrient loading, including phosphorus, have contributed to increased algae growth in the lake. This algae sinks to the bottom of the lake where it decays and consumes the available dissolved oxygen in the deep water. The water depths in the deeper portions of the lake, allows permanent summer thermal stratification, essentially trapping the algae in the deep water where it consumes the dissolved oxygen. This results in water quality issues including higher treatment costs for the deep water, which is used for drinking water. Other drinking water quality issues are associated with the presence of soluble iron and manganese, high pH and turbidity, taste and odor and possible blue-green algal toxicity. In addition, the high sediment accumulation in the shallow East Bay has interfered with boating, and contributes to hydrogen sulfide odors and submerged weed growth (Horne, 2002).

2.2 IN-LAKE EAST BAY CHARACTERISTICS

Since 1927, it is estimated that Canyon Lake has intercepted a large amount of sediment from the greater San Jacinto River watershed. Although the exact amount of sediment trapped in Canyon Lake is not known, at the current time, average annual sediment loading to the lake is estimated at

17,000 CY (2 to 3 inches per year of deposition per year), which is over 60 times the rate for a normal lake (Horne, 2002). This sedimentation has contributed to a loss of overall reservoir storage capacity, an increase in the total nutrient levels (including phosphorus) in the lakebed sediments, a decrease in overall water quality of the lake, and a reduction in the recreational use of the lake due to the raising of the lake bed.

The East Bay has been the site of substantial sediment deposition. Sediment accumulation in the East Bay dates back to 1969, therefore, there are only 33 years of sediment accumulation. Actual water volume has varied by as much as 6' throughout the last 18 months, because of this, low water depth measurements range from 1' to 5'6", which is still substantially lower than measurements in the 9' range ten years ago. Estimates indicate that more than 500,000 CY of sediment have been deposited into the East Bay (Horne, 2002).

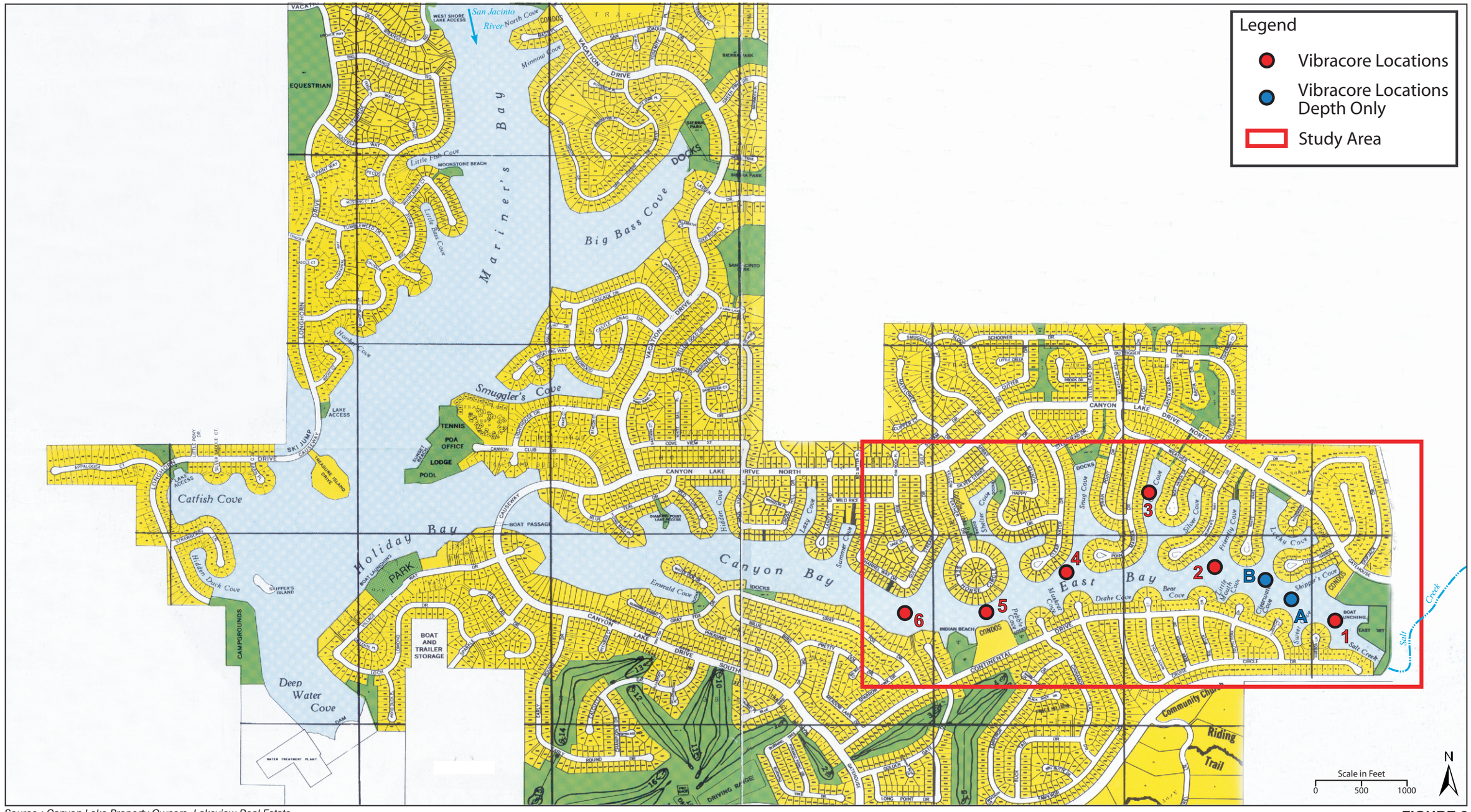
3.0 SEDIMENT SAMPLING METHODS AND FINDINGS

3.1 SEDIMENT SAMPLING METHODS/LOCATIONS

HDR conducted a preliminary assessment of the East Bay of Canyon Lake on May 29, 2002. The purpose of this subsurface assessment was to identify the basic sediment composition within the lake as well as the type and quantity of the sediment. This data will be used for potential future sediment removal operatives.

Core samples were collected at six areas (Figure 2) through the entire width of accumulated sediment. The coring locations (Core #1 through Core #6) were selected prior to drilling activities, but were slightly adjusted due to measured water depths. Core #1 was located the furthest east and core #6 was located the furthest west within the East Bay. The areas for coring were located in areas representing significant sediment accumulation as identified by the Lake Elsinore & San Jacinto Watersheds Authority (LESJWA) and the City of Canyon Lake. Two additional cores were taken at the east end of the study area (Cores A & B), the materials from these cores were measured for depths (3'3" and 3'8") and then discarded. The total study area of the in-lake sedimentation analysis covers approximately 65 acres of open water and shoreline in the East Bay of Canyon Lake (Figure 3).

On May 29, 2002, core samples were obtained at each location utilizing the vibacore methodology. During this innovative procedure, dedicated 2-inch diameter aluminum core barrels were vibrated into the lake bottom until refusal at each site (Figure 4). Core barrel penetration is greatest within water-saturated sediments such as sand and silt. Consolidated sediments, such as clay or rock, restrict the core barrel from penetrating and may be used as a plug for retaining sediment within the core barrel. As anticipated, the natural base of the fluvial system at Canyon Lake consists of clay and was used as a plug. The excess core barrel above the water line was cut off using a hacksaw and retained for later disposal. The top of each core barrel was filled with water, capped, and winched out of the bottom of the lake by a floating platform, tripod, and hand winch. Recovery at each site was noted, and each core was measured, labeled, and capped in the field after collection.



Source : Canyon Lake Property Owners, Lakeview Real Estate

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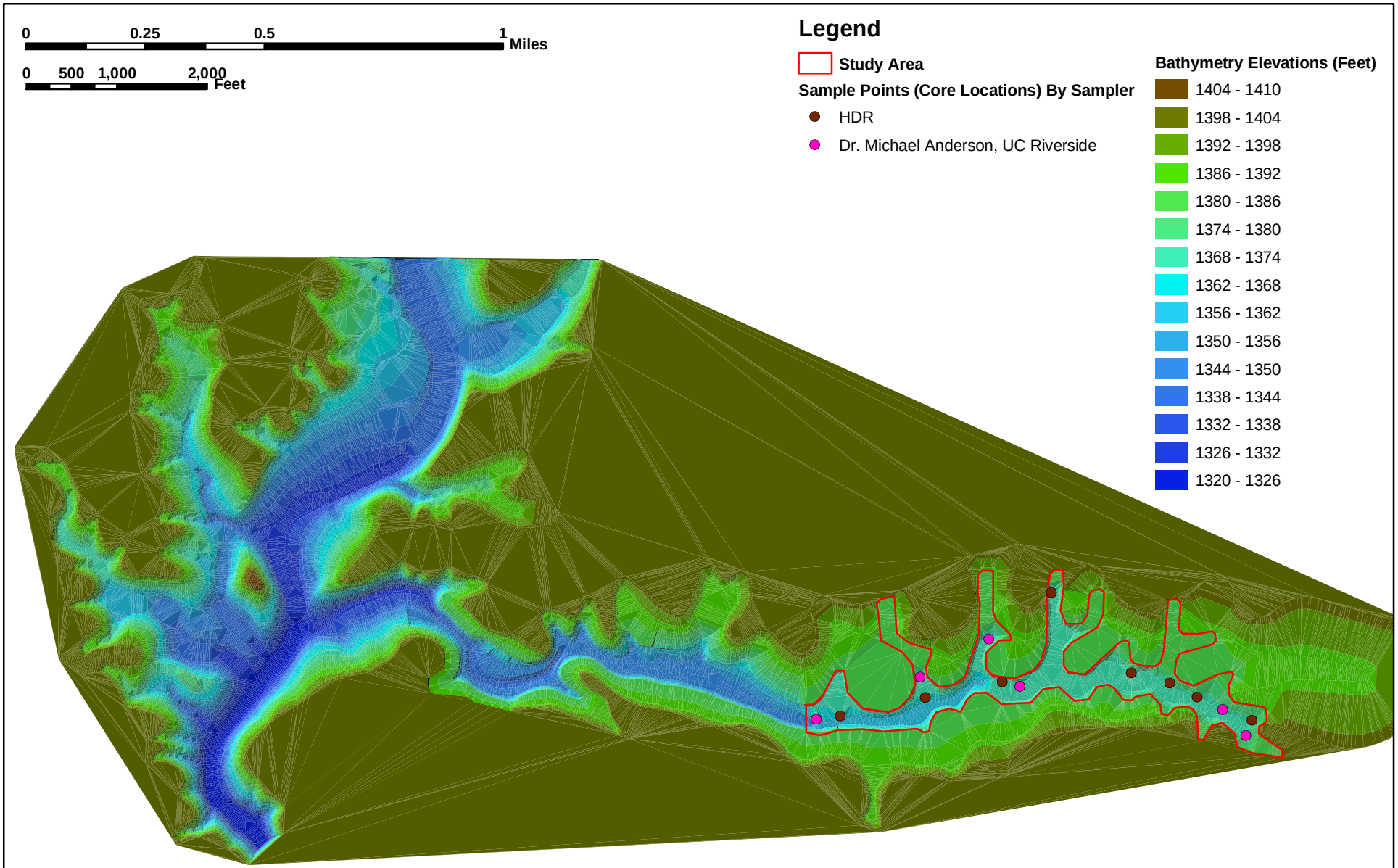
FIGURE 2

In-Lake Sediment Core Sampling Locations

Canyon Lake East Bay Sediment Characterization

Lake Elsinore and San Jacinto Watersheds Authority



Sources: Dr. Michael Anderson, UC Riverside, 2002;
USGS Elsinore 1:100,000 Quadrangle, 1901;
USGS 1:24,000 Wildomar Quadrangle;
W.P. Rowe, Railroad Canyon Survey, 1920

FIGURE 3
Canyon Lake Bathymetry & Study Area
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority

Source : Field Survey; May 29, 2002

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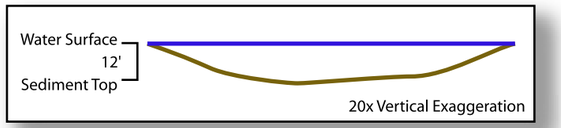
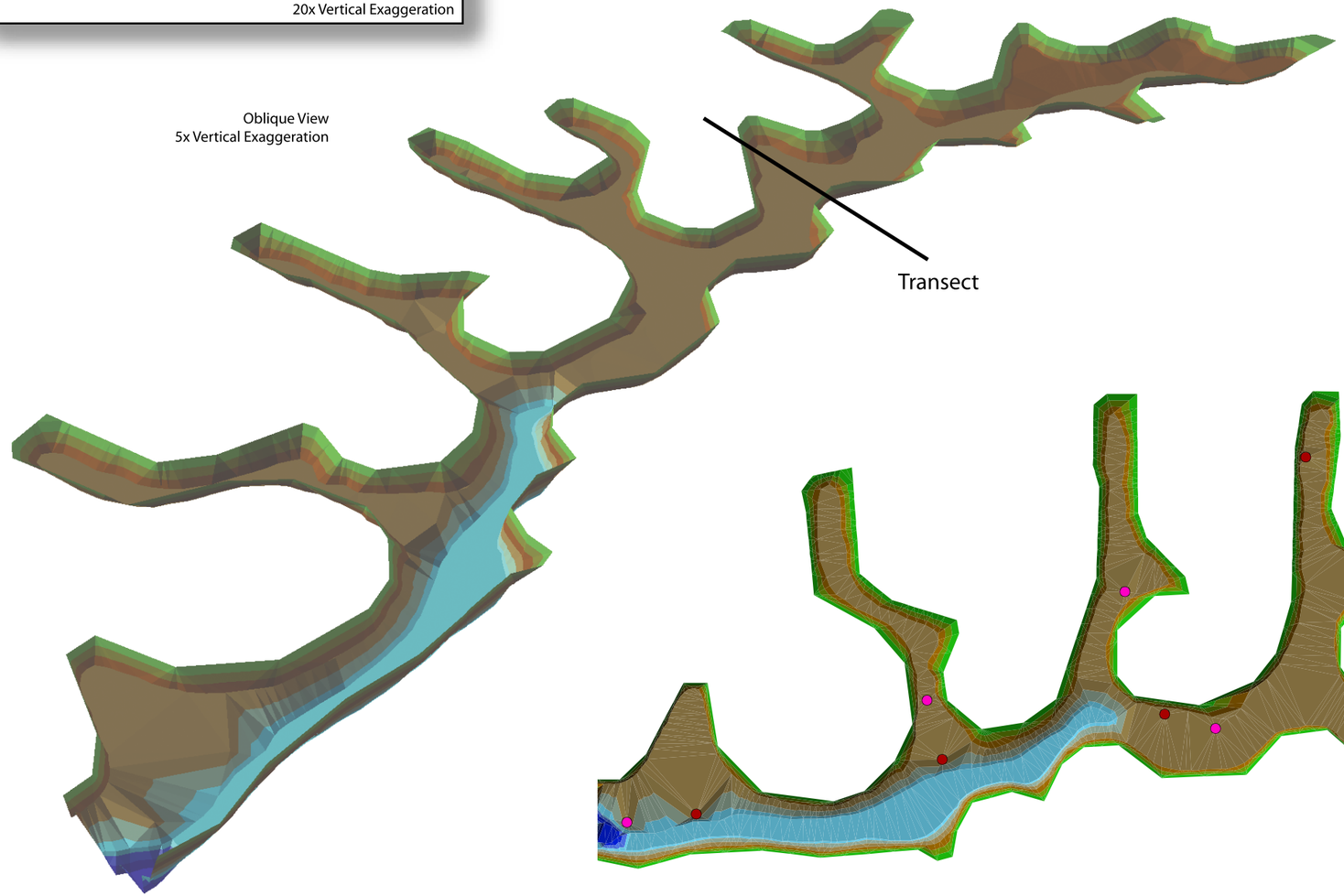
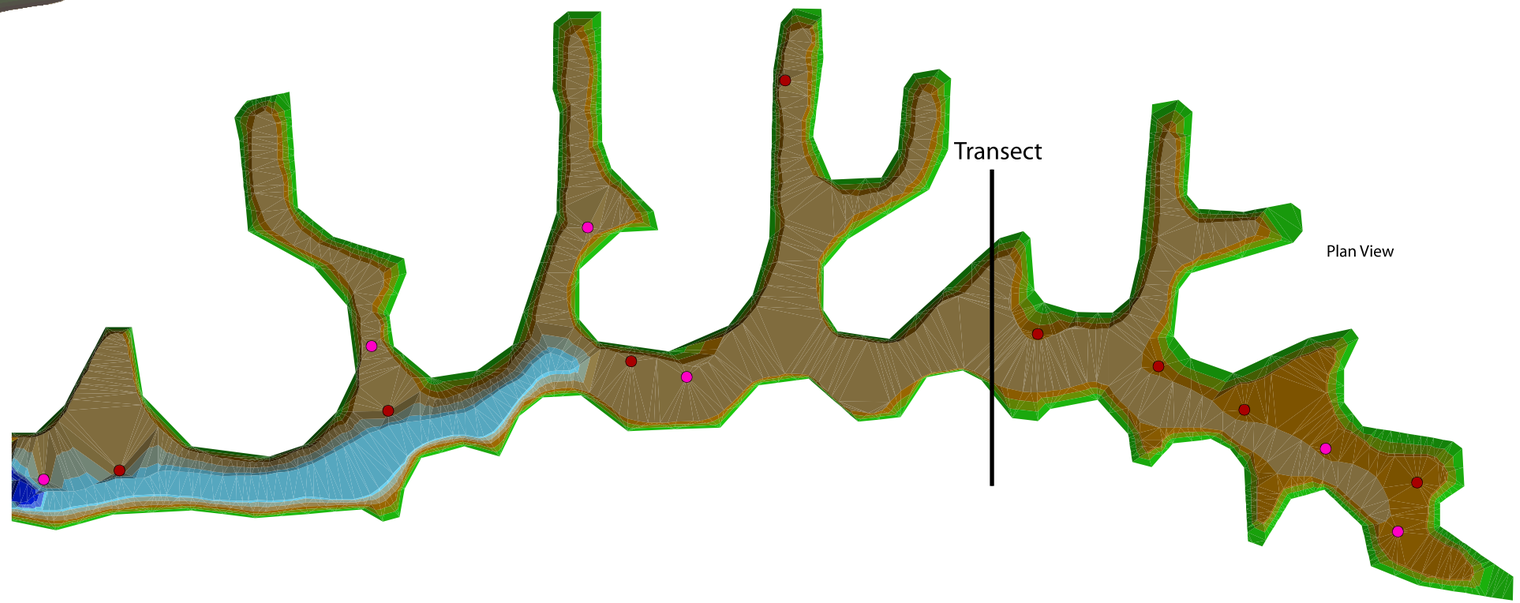
FIGURE 4
Vibracoring Photos
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority



Oblique View
5x Vertical Exaggeration





Legend

Sample Points (Core Locations) By Sampler

- HDR
- Dr. Michael Anderson, UC Riverside

Sediment Elevation

- 1378 - 1382
- 1374 - 1378
- 1370 - 1374
- 1366 - 1370
- 1362 - 1366
- 1358 - 1362
- 1354 - 1358
- 1350 - 1354

**Sediment Topography Is Depicted At Spill Elevation of 1382 Feet, Not Water Elevation of 1376.73 Feet At Time of Survey*
-Water Elevation Is Depicted At the Midpoint of Darker Green Shade

N

0 0.25 Miles

0 500 Feet

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Sources: Dr. Michael Anderson, UC Riverside, 2002;
USGS Elsinore 1:100,000 Quadrangle, 1901;
USGS 1:24,000 Wildomar Quadrangle;
W.P. Rowe, Railroad Canyon Survey, 1920

FIGURE 5
Canyon East Bay Lake Sediment Topography
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority

3.1.1 EAST BAY SEDIMENT COMPOSITION

On June 1, 2002 collected cores were opened, geologically logged and submitted for laboratory analysis. The core depths varied from 2'4" to 5'7" (Table 3-1). All cores were logged according to soil classification system-ASTM D2487. The geologist determined sample intervals within each core and collected individual samples (Appendix A and B).

Table 1
Core Sample Depths

Core Sample	Water Depth (depth to top of sediment) (inches/feet)	Core Depth (inches/feet)	Sediment Thickness (inches/feet)
1	67" / 5' 7"	54" / 4' 6"	43" / 3' 7"
2	72" / 6'	67" / 5' 7"	43" / 3' 7"
3	118" / 9' 10"	55" / 4' 7"	42" / 3' 6"
4	84" / 7'	49" / 4' 1"	30" / 2' 6"
5	83" / 6' 11"	28" / 2' 4"	20" / 1' 8"
6	97" / 8' 1"	37" / 3' 1"	21" / 1' 9"
A	72" / 6'	39" / 3' 3"	39" / 3' 3"
B	72" / 6'	44" / 3' 8"	44" / 3' 8"

3.1.2 EAST BAY SEDIMENT CHEMICAL COMPOSITION

Sediment accumulated at the six coring sites consists of approximately 1'8" to 3'8' of organic-rich dark gray mud above grayish-brown sandy clay. The mud is soft and unconsolidated. The sandy clay is very compacted, restricting further penetration of the core barrel, and acting as a plug. Composite samples were obtained from each core and analyzed by American Environmental Testing Laboratory for California Administrative Manual (CAM) 17 Metals and total phosphorus. Based upon the analytical results, additional analysis may be required of archived samples. None of the 17 CAM metals that were tested for exceeded the State of California limits and sediment disposal options are not constrained.

Generally, there is minimal detectable soluble phosphorus in the sediment cores, which could contribute to algae growth in the lake. The low levels indicate that soluble phosphorus in the sediments may have gone into solution into the lake water. Earlier studies (Anderson, 2002 and Horne, 2002) indicate very similar results despite using a lower detection limit for soluble phosphorus. The collective results suggest further testing may be required should raw material be dredged from the lake. A nitrogen, phosphorus, and potassium (NPK) test on the dredged material may indicate more accurate soluble and insoluble phosphorus loads. This test may be required under federal or California regulations in order for the dredged material to be used for land applications such as a soil or fertilizer amendments or prior to transportation and disposal. Tables 2 and 3 list results of analysis and detailed results are included in Appendix C.

Table 2
Phosphorus Results

	American Environmental Testing Laboratory Results	Dr. Anderson of UC - Riverside Results*	
Core Sample	Phosphorus (total) (mg/kg)	Porewater SRP (mg/l)	Phosphorus (total) (mg/kg)
1	ND	0.194	720.2
2	ND	0.274	353.7
3	ND	0.034	627.3
4	ND	0.058	493.3
5	ND	0.019	426.2
6	ND	0.035	492.9
AVERAGE	N/A	0.102	518.9

** ND – Not Detectable*
** Dr. Michael A. Anderson, Department of Environmental Sciences, University of California, Riverside*

Table 3
Analytical Results (mg/Kg)

Analytes (CA Limit)	Core 1	Core 2	Core 3	Core 4	Core 5	Core 6
Antimony (500)	ND	ND	ND	ND	ND	ND
Arsenic (500)	ND	ND	ND	ND	ND	ND
Barium (10,000)	92.5	85.0	141.0	186.0	123.0	112.0
Beryllium (75)	ND	ND	ND	ND	ND	ND
Cadmium (100)	ND	ND	ND	ND	ND	ND
Chromium (500)	7.7	6.2	16.1	11.6	8.4	24.8
Cobalt (8,000)	4.1J	3.5J	9.1	7.0	4.6J	9.4
Copper (2,500)	12.1	0.4	23.4	12.7	12.7	20.3
Lead (1,000)	ND	ND	12.2	5.8	4.8J	6.0
Mercury [by EPA 7471] (20)	ND	ND	ND	ND	ND	ND
Molybdenum (3,500)	ND	ND	ND	ND	ND	ND
Nickel (2,000)	3.1J	2.8J	7.4	5.8	6.3	7.9
Selenium (100)	ND	ND	ND	ND	ND	ND
Silver (500)	ND	ND	ND	ND	ND	ND
Thallium (700)	ND	ND	ND	ND	ND	ND
Vanadium (2,400)	24.2	20.0	51.5	30.3	40.3	63.0
Zinc (5,000)	25.3	20.5	57.5	32.1	28.1	41.0

**ND – Not Detectable*

3.2 EAST BAY SEDIMENT SURFACE TOPOGRAPHY

The model of the sediment top surface was created from the coring depths collected from the field survey conducted on May 29, 2002. Sampled water depths in Canyon Lake's East Bay range from 5'7" to 9'10" , and average 8' (water elevation 1,376'). The volume of water at this elevation over the 65 acre study area is 620,000 cubic yards or 385 acre-feet of water. Additional depths from a similar study by Dr. Michael Anderson at the University of California Riverside were included in the development of the model to increase precision and accuracy. These additional points did not factor into the sediment depth calculations directly, rather they contributed to the creation of the sediment bathymetry model. The data collected from the core samples was used to interpolate a Triangular Irregular Network (TIN). The TIN surface is illustrated graphically as well as a component in the calculations of sediment volume.

The lake sediment topography within the East Bay of Canyon Lake is a gradual incline slope with greater depths in the eastern third and within the northerly coves (Figure 5). Sediment depths in those areas averaged 3'6" versus 2' in the western portions of the East Bay, this is most likely due to decreased velocities of water flow and lesser slopes of the lakebed bathymetry. The average

sediment depth derived from the sediment topography model across the 65 acres of the East Bay is 2'2"*. Sediment composition consisted of an organic rich, dark gray, mud above a grayish brown sandy clay.*

3.3 EAST BAY BATHYMETRY

Several reference materials were acquired in order to identify an accurate Canyon Lake lakebed configuration; 1901 USGS 1:100,000 Elsinore Quadrangle and the original pre-1920 survey topography (Figure 6) that was acquired from Western Municipal Water District. In order to develop bathymetric data for Canyon Lake survey contours from the pre-1920 dam plans and the 1901 Quad were digitized and georeferenced to the existing 1,400 foot contour from the 1979 USGS 7.5 minute 1:24,000 Wildomar Quadrangle. After evaluating elevation data developed from sediment cores, it was apparent that during development of the City of Canyon Lake or the construction of the reservoir the topographic configuration changed considerably. This change was due to dredging, grading, and other natural events.

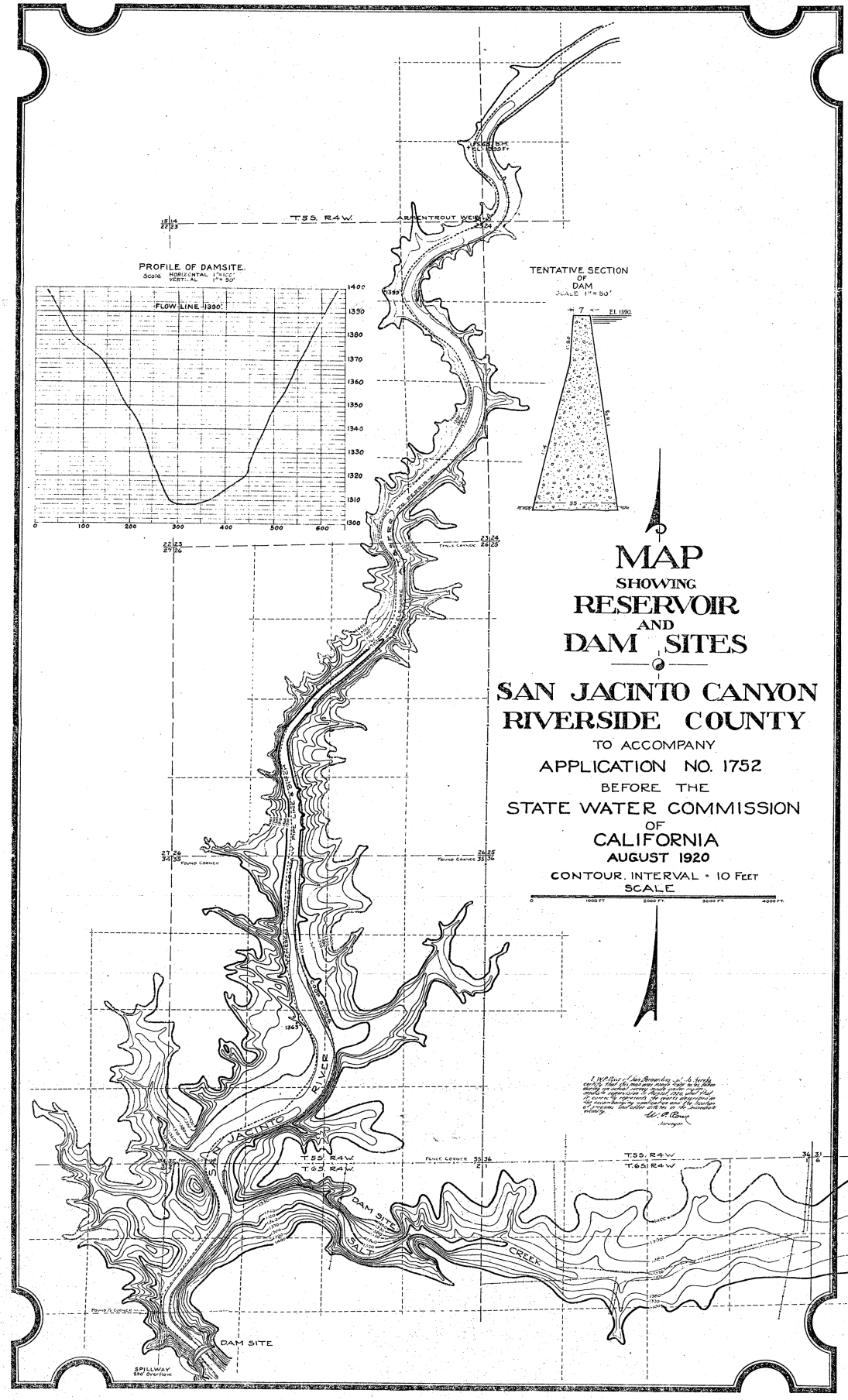
The lake bottom topography of Canyon Lake is described as a gradual incline sloped basin with intermingled steeper shelves (Figure 7). The lakebed bathymetry was created by subtracting a thickness of sediment estimated from the six core samples collected during the core sediment sampling on May 29, 2002. Over 1,400 data points were extracted from the sediment topography TIN and given a new elevation based on a nearest-neighbor interpolation from the cores. The resulting new lattice was used to create a TIN for the approximate location and depth of the lake bottom.

3.4 EAST BAY SEDIMENT VOLUME CALCULATION

The East Bay contains moderate amounts of sediments from erosion and stormwater runoff. The approximate total volume of sediments within the East Bay analysis area is 225,000cy (60,703 m^3) or 140 acre feet. The sediment volume is a result of taking the difference from the two TIN volumes (surface to sediment top and surface to lake bottom) calculated from the waters surface (Figure 8). All modeling elevations were normalized to the spill elevation of 1,382 feet rather than

** This average core sample sediment depth is 2'11". When depths are applied to the sediment topography and lakebed bathymetry models and computed using a nearest neighbor analysis the average for the entire 65 acre study area decreases to 2'2".*

the water elevation during sampling of 1,376 feet, however, sediment calculations were done using the water elevation as the volume limiting plane. This was done in order to accommodate the use of existing elevation data available through the USGS and existing GIS databases, while maintaining the integrity of the field survey data.



Source : Western Municipal Water District

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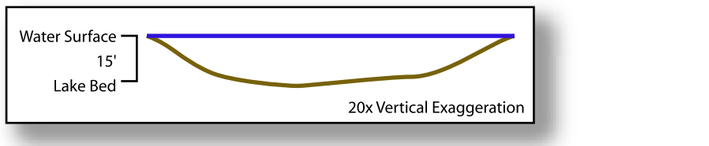
FIGURE 6
1920 Railroad Canyon Topographical Survey
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority



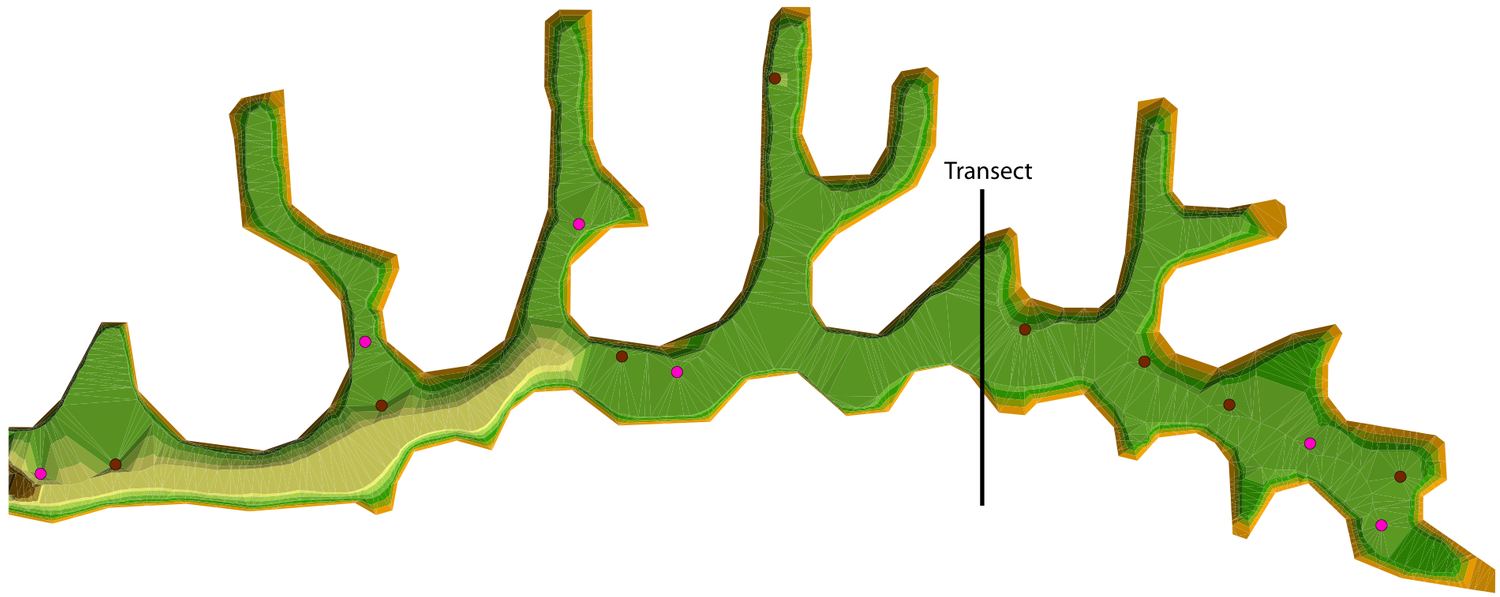
Legend

Sample Points (Core Locations) By Sampler

- HDR
- Dr. Michael Anderson, UC Riverside

Lake Bed Elevation

- 1378 - 1382
- 1374 - 1378
- 1369 - 1374
- 1365 - 1369
- 1361 - 1365
- 1357 - 1361
- 1352 - 1357
- 1348 - 1352



** Lake Bathymetry Is Depicted At Spill Elevation of 1382 Not Water Elevation of 1376.73*
** *Elevations Are Listed In U.S. Feet*

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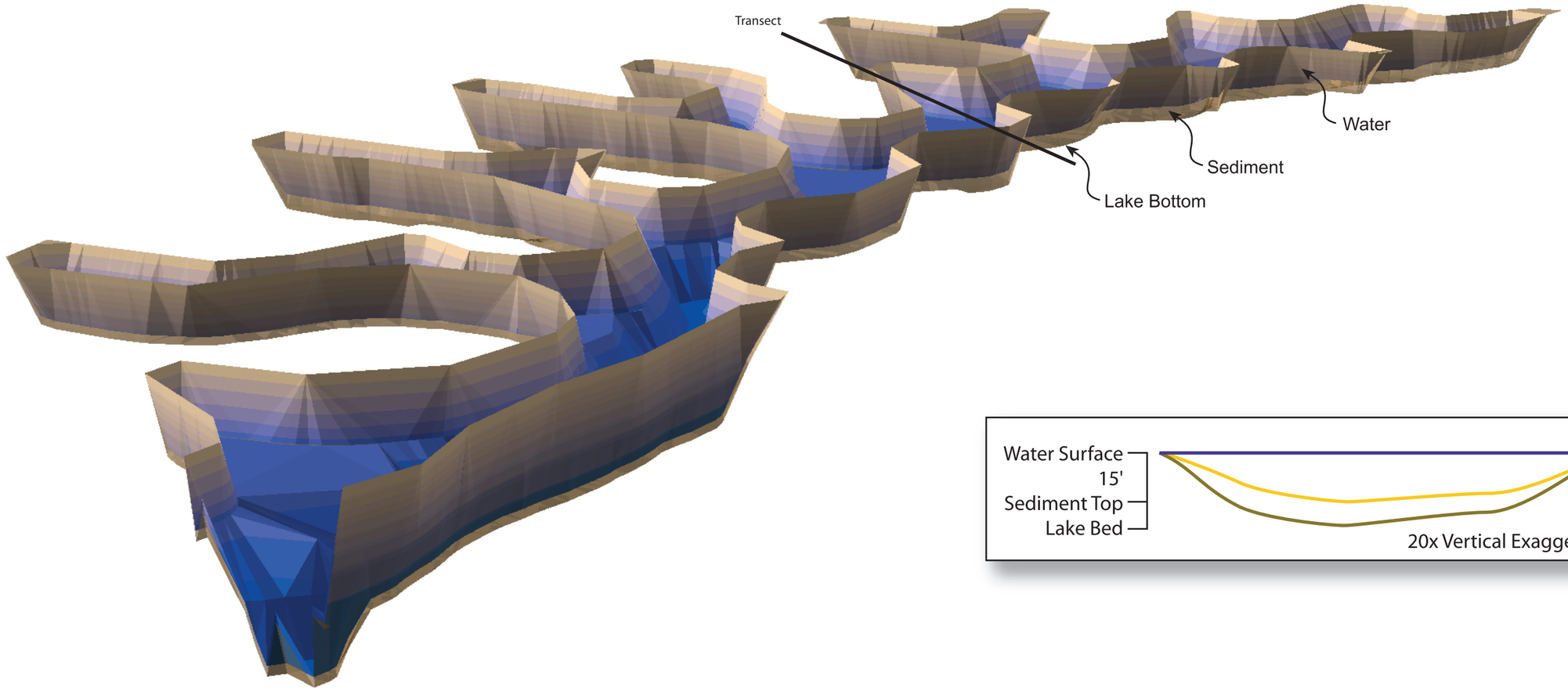
N

0 0.25 Miles

0 500 Feet

Sources: Dr. Michael Anderson, UC Riverside, 2002;
USGS Elsinore 1:100,000 Quadrangle, 1901;
USGS 1:24,000 Wildomar Quadrangle;
W.P. Rowe, Railroad Canyon Survey, 1920

FIGURE 7
Canyon Lake East Bay Bathymetry
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority



** Lake Bathymetry Is Depicted At Spill Elevation of 1382 Not Water Elevation of 1376.73*
** *Elevations Are Listed In U.S. Feet*

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FIGURE 8
Canyon Lake Sediment Profiles
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority

4.0 RECOMMENDATIONS

In order to ensure a comprehensive analysis of the East Bay sediments, and their relationship to the water quality characteristics of Canyon Lake, it is recommended that the following items be addressed:

- Conduct additional coring in the East Bay, closer to the causeway to determine a more accurate and complete estimate of sediments in the entire East Bay.
- Conduct a water depth survey using established sampling points based upon a 100-foot grid pattern to obtain an accurate sediment layer profile and water depths for the East Bay.

5.0 REFERENCES

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APPENDIX A

CORE LOG

CORE ID: CORE 1	CORE DATE: 29 MAY 02	TIME: 0935 HOURS	LOG DATE: 01 JUNE 02
RECOVERY: 4' 6"	WATER DEPTH: 5' 7"		
SAMPLE INTERVAL	**SOIL PROFILE**	**ASTM SYMBOL**	**DESCRIPTION**
0-43"		OH	Dark gray mud, very soft, wet, organic rich, no sand content
43" - 54"		CL	Light brown (tan) sandy clay, moist, tight, trace coarse sand

CORE ID: CORE 2	CORE DATE: 29 MAY 02	TIME: 1037 HOURS	LOG DATE: 01 JUNE 02
RECOVERY: 5' 7"	WATER DEPTH: 6'		
SAMPLE INTERVAL	**SOIL PROFILE**	**ASTM SYMBOL**	**DESCRIPTION**
0-43"		OH	Dark gray mud, very soft, wet, organic rich, no sand content
43" - 56"		CL	Brown sandy clay, tight, moist, gravel at 49"
56" - 67"		SP	Dark gray sand, poorly graded, moist, trace coarse sand/clay

CORE ID: CORE 3	CORE DATE: 29 MAY 02	TIME: 1137 HOURS	LOG DATE: 01 JUNE 02
RECOVERY: 4' 7"	WATER DEPTH: 9' 10"		
SAMPLE INTERVAL	**SOIL PROFILE**	**ASTM SYMBOL**	**DESCRIPTION**
0 - 42"		OH	Dark gray mud, very soft, wet, organic rich, no sand content
42" - 47"		CL	Light green sandy clay, moist
47" - 55"		CL	Light brown sandy clay, moist, tight, trace coarse sand

CORE ID: CORE 4	CORE DATE: 29 MAY 02	TIME: 1217 HOURS	LOG DATE: 01 JUNE 02
RECOVERY: 4' 1"	WATER DEPTH: 7'		
SAMPLE INTERVAL	**SOIL PROFILE**	**ASTM SYMBOL**	**DESCRIPTION**
0 - 30"		OH	Dark gray mud, very soft, wet, organic rich, no sand content 0 - 27", 27 - 30" trace sand
30" - 35"		CL	Dark gray clay, moist, tight, trace fine sand, gravel at 34"
35" - 49"		CL	Reddish-brown sandy clay, moist, soft

CORE ID: CORE 5	CORE DATE: 29 MAY 02	TIME: 1305 HOURS	LOG DATE: 01 JUNE 02
RECOVERY: 2' 4"	WATER DEPTH: 6' 11"		
SAMPLE INTERVAL	**SOIL PROFILE**	**ASTM SYMBOL**	**DESCRIPTION**
0 - 20"		OH	Dark gray mud, very soft, wet, organic rich, 7.5-10.5" brown clayey sand, wet, gravel at 8", grayish green clayey sand, wet, trace gravel
20" - 25"		SC	Grayish green clayey sand, wet, trace gravel
25" - 28"		CL	Gray clay, moist, tight, trace fine sand

CORE ID: CORE 6	CORE DATE: 29 MAY 02	TIME: 1345 HOURS	LOG DATE: 01 JUNE 02
RECOVERY: 3' 1"	WATER DEPTH: 8' 1"		
SAMPLE INTERVAL	**SOIL PROFILE**	**ASTM SYMBOL**	**DESCRIPTION**
0 - 21"		OH	Dark gray mud, very soft, wet, organic rich, clay interval 14-17"
21" - 24"		CL	Dark gray sandy clay, moist, soft, organic rich
24" - 37"		CL	Reddish-brown sandy clay, moist, soft

FOOTNOTES FOR CORE LOG RESULTS

Table 4 contains a listing of the soil profiles obtained from Canyon Lake core sampling. The American Society for Testing Materials (ASTM) was consulted for profile descriptions.

ASTM SMMBOL

SC Clayey sands, sand-clay mixtures.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays
OH Organic clays of medium to high plasticity

APPENDIX B

CORE PHOTOGRAPHS

Core 1

Core 2

Core 3

Core 4

Core 5

Core 6

Source : NavTech, 2002

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APPENDIX B
Core Photos
Canyon Lake East Bay Sediment Characterization
Lake Elsinore and San Jacinto Watersheds Authority

APPENDIX C

LAB RESULTS

American Environmental Testing Laboratory Inc

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Ordered By

HDR Engineering, Inc.
9444 Farnham Street Suite 300
San Diego, CA 92123

Telephone: (858)712-8335
Attention: Jeff Thornbury

Number of Pages 7
Date Received 06/04/2002
Date Reported 06/06/2002

Job Number	Order Date	Client
22101	06/04/2002	HDR

Project ID: CANYON LAKE
Project Name: Canyon Lake Coring Project

Enclosed please find results of analyses of 6 soil samples which were analyzed as specified on the attached chain of custody If there are any questions, please do not hesitate to call

Checked By _____ Approved By _____

Cyrus Razmara, Ph D
Laboratory Director

American Environmental Testing Laboratory Inc
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CHAIN OF CUSTODY RECORD

COMPANY: HDR Engineering — PHONE: (858) 712-8353
PROJECT MANAGER: Andrea Heckman — FAX: (858) 712-8333
PROJECT NAME: Canyon Lake Coring Project — PROJECT #:
SITE NAME AND ADDRESS:

AETL JOB No 22101 — Page 1 of 1

	SAMPLE ID	LAB ID	DATE	TIME	MATRIX	CONTAINER NUMBER/SIZE	PRES	17 CAM Metals	Total phosphorus	TEST INSTRUCTIONS & COMMENTS
1	Core #1	AE116217	6/1/02	1400	S	4	—	X	X	* Please retain
2	Core #2	AE116218	6/1/02	1420	S	4	—	X	X	extra samples for
3	Core #3	AE116219	6/1/02	1430	S	4	—	X	X	future analysis
4	Core #4	AE116220	6/1/02	1440	S	4	—	X	X	
5	Core #5	AE116221	6/1/02	1450	S	4	—	X	X	
6	Core #6	AE116222	6/1/02	1500	S	4	—	X	X	
7										
8										
9										
10										
11										
12										
13										
14										
15										

SAMPLE RECEIPT - TO BE FILLED BY LABORATORY

TOTAL NUMBER OF CONTAINERS	24	PROPERLY COOLED (Y) N / NA	
CUSTODY SEALS Y / N / (NA)		SAMPLES INTACT (Y) N / NA	
RECEIVED IN GOOD COND (Y) N		SAMPLES ACCEPTED (Y) N	

TURN AROUND TIME

☒ NORMAL ☐ RUSH ☐ SAME DAY ☐ 24 HRS ☐ 48 HRS ☐ 72 HRS.

RELINQUISHED BY SAMPLER 1	RELINQUISHED BY 2	RELINQUISHED BY 3
Signature:	Signature:	Signature:
Printed Name: Glen Christensen	Printed Name:	Printed Name:
Date: 6/3/02 Time: 3:30 pm	Date: Time:	Date: Time:
RECEIVED BY 1	**RECEIVED BY 2**	**RECEIVED BY LABORATORY 3**
Signature:	Signature:	Signature: Golden State
Printed Name:	Printed Name:	Printed Name: J Hunt
Date: Time:	Date: Time:	Date: 6-4-02 Time: 8:10

DISTRIBUTION WHITE - Laboratory, CANARY Laboratory, PINK - Project/Account Manager, YELLOW - Sampler/Originator

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ANALYTICAL RESULTS

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Page 2
Project ID CANYON LAKE
Project Name Canyon Lake Coring Project

AETL Job Number	Submitted	Client
22101	06/04/2002	HDR

Method (6010/7000CAM), CAM Title 22 Metals (SW-846)

QC Batch No 06042002-1 QC Prepared 06/04/2002 QC Analyzed 06/04/2002

Our Lab I.D.				AE116217	AE116218	AE116219	AE116220
Client Sample I D			Method Blank	Core #1	Core #2	Core #3	Core #4
Date Sampled			06/01/2002	06/01/2002	06/01/2002	06/01/2002	06/01/2002
Date Prepared			06/04/2002	06/04/2002	06/04/2002	06/04/2002	06/04/2002
Preparation Method			3050B	3050B	3050B	3050B	3050B
Date Analyzed			06/04/2002	06/04/2002	06/04/2002	06/04/2002	06/04/2002
Matrix			Soil	Soil	Soil	Soil	Soil
Units			mg/Kg	mg/Kg	mg/Kg	mg/Kg	mg/Kg
Dilution Factor			1	1	1	1	1
Analytes	MDL	PQL	Results	Results	Results	Results	Results
Antimony	5 0	10 0	ND	ND	ND	ND	ND
Arsenic	5 0	10 0	ND	ND	ND	ND	ND
Barium	2 5	5 0	ND	92 5	85 0	141	186
Beryllium	1 3	2 5	ND	ND	ND	ND	ND
Cadmium	1 3	2 5	ND	ND	ND	ND	ND
Chromium	2 5	5 0	ND	7 7	6 2	16.1	11 6
Cobalt	2 5	5 0	ND	4 1J	3 5J	9 1	7 0
Copper	2 5	5 0	ND	12 1	8 4	23 4	12 7
Lead	2 5	5 0	ND	ND	ND	12 2	5 8
Mercury (By EPA 7471)	0 1	0 2	ND	ND	ND	ND	ND
Molybdenum	2 5	5 0	ND	ND	ND	ND	ND
Nickel	2 5	5 0	ND	3 1J	2 8J	7 4	5 8
Selenium	5 0	10 0	ND	ND	ND	ND	ND
Silver	2 5	5 0	ND	ND	ND	ND	ND
Thallium	5 0	10 0	ND	ND	ND	ND	ND
Vanadium	2 5	5 0	ND	24 2	20 0	51 5	30 3
Zinc	2 5	5 0	ND	25 3	20 5	57 5	32 1

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Page 3
Project ID CANYON LAKE
Project Name Canyon Lake Coring Project

AETL Job Number	Submitted	Client
22101	06/04/2002	HDR

Method (6010/7000CAM), CAM Title 22 Metals (SW-846)

QC Batch No 06042002-1 QC Prepared 06/04/2002 QC Analyzed 06/04/2002

Our Lab I.D			AE116221	AE116222			
Client Sample I D			Core #5	Core #6			
Date Sampled			06/01/2002	06/01/2002			
Date Prepared			06/04/2002	06/04/2002			
Preparation Method			3050B	3050B			
Date Analyzed			06/04/2002	06/04/2002			
Matrix			Soil	Soil			
Units			mg/Kg	mg/Kg			
Dilution Factor			1	1			
Analytes	**MDL**	**PQL**	**Results**	**Results**			
Antimony	5 0	10 0	ND	ND			
Arsenic	5 0	10 0	ND	ND			
Barium	2 5	5 0	123	112			
Beryllium	1 3	2 5	ND	ND			
Cadmium	1 3	2.5	ND	ND			
Chromium	2 5	5.0	8 4	24.8			
Cobalt	2 5	5 0	4 6J	9 4			
Copper	2 5	5 0	12 7	20 3			
Lead	2 5	5 0	4 8J	6 0			
Mercury (By EPA 7471)	0 1	0 2	ND	ND			
Molybdenum	2 5	5 0	ND	ND			
Nickel	2 5	5 0	6 3	7 9			
Selenium	5 0	10 0	ND	ND			
Silver	2 5	5 0	ND	ND			
Thallium	5 0	10 0	ND	ND			
Vanadium	2 5	5 0	40 3	63 0			
Zinc	2 5	5 0	28 1	41 0			

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Page 4
Project ID CANYON LAKE
Project Name: Canyon Lake Coring Project

AETL Job Number	Submitted	Client
22101	06/04/2002	HDR

Analytes			Phosphorus (total)			
Methods of Analyses			(365.2)			
Date Prepared			06/05/2002			
Date Analyzed			06/05/2002			
Matrix			Soil			
QC Batch Number			06052002 / 06052002			
Units			mg/Kg			
Method Detection Limit			10			
Practical Quantitation Limit			10			
Dilution Factor			1			
Lab ID	Sample ID	Sampled	Results			
AE116217	Core #1	06/01/2002	ND			
AE116218	Core #2	06/01/2002	ND			
AE116219	Core #3	06/01/2002	ND			
AE116220	Core #4	06/01/2002	ND			
AE116221	Core #5	06/01/2002	ND			
AE116222	Core #6	06/01/2002	ND			
N/A	Method Blank	06/01/2002	ND			

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Page 5
Project ID CANYON LAKE
Project Name Canyon Lake Coring Project

AETL Job Number	Submitted	Client
22101	06/04/2002	HDR

Method (365 2), Phosphorus (total), Colorimetric

QUALITY CONTROL REPORT

QC Batch No 06052002 QC Prepared 06/05/2002 QC Analyzed 06/05/2002

Analytes	MS Concen	MS Recov	MS % REC	MS DUP Concen	MS DUP Recov	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit	
Phosphorus (total)	0 20	0 19	97	0 20	0 19	94	3 1	80-120	<20	

QC Batch No 06052002 QC Prepared 06/05/2002 QC Analyzed 06/05/2002

Analytes	SM Result	SM DUP Result	RPD %	SM RPD % Limit	LCS Concen	LCS Recov	LCS % REC	LCS/LCSD % Limit		
Phosphorus (total)	ND	ND	<1	<20	0 20	0 20	100	80-120		

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Page 6
Project ID CANYON LAKE
Project Name Canyon Lake Coring Project

AETL Job Number	Submitted	Client
22101	06/04/2002	HDR

Method (6010/7000CAM), CAM Title 22 Metals (SW-846)

QUALITY CONTROL REPORT

QC Batch No 06042002-1 QC Prepared 06/04/2002 QC Analyzed 06/04/2002

Analytes	MS Concen	MS Recov	MS % REC	MS DUP Concen	MS DUP Recov	MS DUP % REC	RPD %	MS/MSD % Limit	MS RPD % Limit	
Antimony	1 00	1 01	101	1 00	1 04	104	2 9	80-120	<15	
Arsenic	1 00	0 99	99	1 00	0 98	98	1 0	80-120	<15	
Barium	1 00	0 91	91	1 00	0 97	97	6 4	80-120	<15	
Beryllium	1 00	0 94	94	1 00	0 97	97	3.1	80-120	<15	
Cadmium	1 00	0 93	93	1 00	0 95	95	2 1	80-120	<15	
Chromium	1 00	0 93	93	1 00	0 96	96	3 2	80-120	<15	
Cobalt	1 00	0 94	94	1 00	0 96	96	2 1	80-120	<15	
Copper	1 00	0 95	95	1 00	0 97	97	2 1	80-120	<15	
Lead	1 00	0 90	90	1 00	0 93	93	3 3	80-120	<15	
Mercury (By EPA 7471)	0 01	0 01	100	0 01	0 01	102	2 0	80-120	<15	
Molybdenum	1 00	0 95	95	1 00	0 98	98	3 1	80-120	<15	
Nickel	1 00	0 93	93	1 00	0 95	95	2 1	80-120	<15	
Selenium	1 00	0 97	97	1 00	0 99	99	2 0	80-120	<15	
Silver	1 00	0.96	95	1 00	0 96	96	1 0	80-120	<15	
Thallium	1 00	0 99	99	1 00	0 97	97	2 0	80-120	<15	
Vanadium	1 00	0 94	94	1 00	0 97	97	3 1	80-120	<15	
Zinc	1 00	0 94	94	1 00	0 96	96	2 1	80-120	<15	

QC Batch No 06042002-1 QC Prepared 06/04/2002 QC Analyzed 06/04/2002

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS/LCSD % Limit						
Antimony	1 00	0 91	91	80-120						
Arsenic	1 00	0 99	99	80-120						
Barium	1 00	0 94	94	80-120						
Beryllium	1 00	0 93	93	80-120						
Cadmium	1 00	0 98	98	80-120						
Chromium	1 00	0 95	95	80-120						
Cobalt	1 00	0 98	98	80-120						
Copper	1 00	0 97	97	80-120						
Lead	1 00	0 95	95	80-120						

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ANALYTICAL RESULTS

Page 7
Project ID CANYON LAKE
Project Name Canyon Lake Coring Project

AETL Job Number	Submitted	Client
22101	06/04/2002	HDR

Method (6010/7000CAM), CAM Title 22 Metals (SW-846)

QC Batch No 06042002-1 QC Prepared 06/04/2002 QC Analyzed 06/04/2002

Analytes	LCS Concen	LCS Recov	LCS % REC	LCS/LCSD % Limit						
Mercury (By EPA 7471)	0 01	0 01	99	80-120						
Molybdenum	1 00	0 94	94	80-120						
Nickel	1 00	0 97	97	80-120						
Selenium	1 00	0 98	98	80-120						
Silver	1 00	0.95	95	80-120						
Thallium	1 00	0 99	99	80-120						
Vanadium	1 00	0 96	96	80-120						
Zinc	1 00	0 97	97	80-120						

APPENDIX D

SITE PHOTOGRAPHY