Volumetric Survey of JIM CHAPMAN LAKE

August 2005/ July 2007 Survey

Prepared by:

The Texas Water Development Board

February 2008

Texas Water Development Board

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Executive Summary

In March of 2005 the Texas Water Development Board entered into agreement with the U.S. Army Corps of Engineers, Fort Worth District, for the purpose of performing a volumetric survey of Jim Chapman Lake while the water level was near the conservation pool elevation (440.0 feet above mean sea level). Data collected during this survey was used in creating updated area-capacity tables.

Bathymetric data collection began in August of 2005 while the water surface elevation of the lake was approximately 5.5 feet below conservation pool elevation. Navigational impediments associated with this low water surface elevation prevented TWDB from surveying the lake in its entirety. Extended drought conditions throughout Texas in 2006 held water levels down, preventing TWDB from returning to Jim Chapman Lake. Spring and early summer flooding throughout Texas in 2007 brought an end to the drought, returning Jim Chapman Lake's water levels to near conservation pool elevation. Bathymetric data collection on Jim Chapman Lake was completed in July of 2007.

Cooper Dam and Jim Chapman Lake (also known as Cooper Lake) was authorized by the Flood Control Act in 1955. Embankment construction began in 1986, and deliberate impoundment began on September 28, 1991. The US Army Corps of Engineers built Jim Chapman Lake to control flooding on the Sulphur River, and to serve as water supply storage for the North Texas Municipal Water District, the Sulphur River Municipal Water District, and the city of Irving.

The results of the TWDB 2005/ 2007 Survey indicate Jim Chapman Lake has a total capacity of 298,930 acre-feet and encompasses 17,958 acres at conservation pool elevation. Sediment storage, below elevation 415.5 feet, is 38,598 acre-feet. Therefore, conservation storage capacity at conservation pool elevation is 260,332 acre-feet. Original total reservoir capacity per the US Army Corps of Engineers was 310,312 acre-feet at conservation pool elevation. The original sediment storage was 37,192 acre-feet; therefore, conservation storage capacity was 273,120 acre-feet at conservation pool elevation. These data suggest the reservoir has experienced an 11,382

acre-feet (3.7%) decrease in total reservoir capacity and a 12,788 acre-feet (4.7%) decrease in conservation storage capacity since impoundment. The original surface area of Jim Chapman Lake, per the US Army Corps of Engineers, was 19,305 acres. This suggests Jim Chapman Lake has experienced a 1,347 acre (7.0%) decrease in surface area since impoundment. Due to the differences in the methodologies used to calculate the reservoir's capacity between original impoundment and 2007, comparison of these values is not recommended and is presented here for informational purposes only. The TWDB considers the 2007 survey to be a significant improvement over previous methods and recommends that the same methodology be used to resurvey Jim Chapman Lake in 5 to 10 years.

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Jim Chapman Lake General Information

Cooper Dam and Jim Chapman Lake are located on the South Sulphur River approximately four miles southeast of Cooper, Texas, in Delta and Hopkins Counties. (Figure 1) Cooper Dam was authorized by the Flood Control Act approved August 3, 1955 (Public Law 218, 84th Congress, 1st Session).[1] Embankment construction began in 1986[2] with deliberate impoundment beginning on September 28, 1991[3]. Additional pertinent data about Cooper Dam can be found in Table 1. Though still widely known as Cooper Lake, the lake was officially renamed Jim Chapman Lake by order of President Clinton in 1998, in honor of local congressman Jim Chapman from nearby Sulphur Springs, TX.[2]

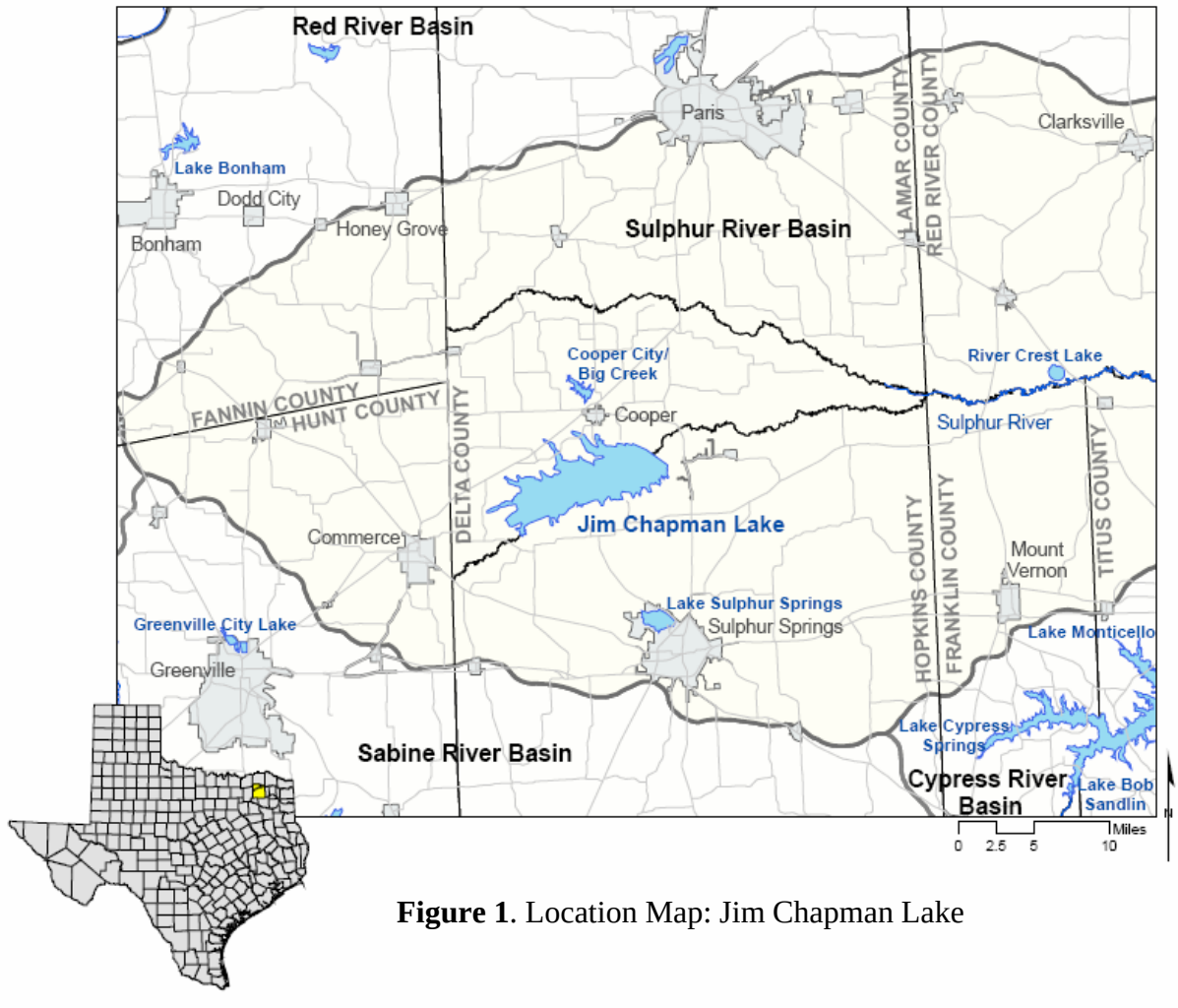


Figure 1. Location Map: Jim Chapman Lake

Table 1: Pertinent Data for Cooper Dam and Jim Chapman Lake[3]

Owner: U.S. Army Corps of Engineers, Fort Worth District
Engineer (Design): U.S. Army Corps of Engineers
Location: On the South Sulphur River at river mile 23.2 in Delta and Hopkins Counties, about 4 miles southeast of Cooper, TX
Drainage Area: 479 square miles
Dam:

Type	Rolled earth fill
Length	28,072 feet
Maximum Height	79.5 feet
Top Width	30 feet

Emergency Spillway:

Type	Uncontrolled Ogee Weir
Crest Elevation	446.2 feet NGVD
Length	700 feet

Outlet Works:

Type	1 gate-controlled conduit
Dimension	10.5 feet diameter
Invert elevation	394.0.0 feet NGVD
Control	4.45' x 10.5' service gates

Reservoir Data (Based on TWDB 2005/ 2007 Volumetric Survey)

Feature	**Elevation (ft above msl)**	**Incremental Capacity (Acre-feet)**	**Accumulative Capacity (Acre-feet)**	**Area (Acres)**
Top of Dam	464.5	N/A	N/A	N/A
Maximum design water surface	459.5	N/A	N/A	N/A
Top of flood-control pool	446.2	N/A	N/A	N/A
Top of Conservation Pool	440.0	260,332*	298,930	17,958
Sediment Storage	415.5	38,598	38,598	5,002
Streambed	386.0	0	0	0

*This value represents conservation storage capacity, the amount of water available between elevations 440.0 and 415.5 feet or total storage capacity minus sediment storage capacity.

Jim Chapman Lake was built by the U.S. Army Corps of Engineers to control flooding on the Sulphur River, and to serve as water supply storage for the North Texas Municipal Water District, the Sulphur River Municipal Water District, and the city of Irving.[2,4] The water rights for Jim Chapman Lake are divided between these three entities as described in Table 2 and summarized below:

Table 2. Summary of allocated water rights for Jim Chapman Lake

Entity	Percent of Water Supply Space	Usable Storage* (acre-feet)
Sulphur River Municipal Water District	26.282	71,750
North Texas Municipal Water District	36.859	100,625
City of Irving, Texas	36.859	100,625
Total	100.00	273,000

*Indicates water storage between elevations 440.0 to 415.5 feet only. Full authorization regarding storage restrictions, including sediment storage below elevation 415.5 feet and diversions, can be found in the complete certificates on file with the Texas Commission on Environmental Quality: 03-4797, 03-4797A, 03-4797B, 03-4798, 03-4799, 03-4799A, 03-4799B, and 03-4799C.

•**Certificate of Adjudication No. 03-4797** Priority Date: November 19, 1965

Authorizes the Sulphur River Municipal Water District to impound in Cooper Reservoir between elevations 415.5 and 440.0 feet above mean sea level a maximum of 71,750 acre-feet of water and below elevation 415.5 feet above mean sea level a maximum of 9,720 acre-feet, making a total of 81,470 acre-feet of water. The Sulphur River Municipal Water District is authorized to divert and use from Cooper Reservoir a maximum of 26,960 acre-feet of water per annum for municipal purposes and 11,560 acre-feet of water per annum for industrial purposes within their service area.

•**Amendment to Certificate of Adjudication No. 03-4797A** Granted: November 18, 1992

In addition to authorizing the Sulphur River Municipal Water District to use 26,960 acre-feet of water per annum for municipal purposes within the District's service area, the District is authorized to transfer and use a maximum of 11,274 acre-feet of municipal use water that is committed to the City of Commerce within the Trinity River Basin. In addition to authorizing the District to use 11,560 acre-feet of water per annum for industrial purposes within the District's service area, the District is authorized to transfer and use a maximum of 4,832 acre-feet of industrial use water that is committed to the City of Commerce for municipal or industrial use within the Trinity River Basin.

•**Amendment to Certificate of Adjudication No. 03-4797B** Issued: October 27, 1997

Authorizes the North Texas Municipal Water District to use 6,000 acre-feet of storage (of the 8,000 acre-feet used by the City of Cooper as a member city of the Sulphur River Municipal Water District) in Cooper Reservoir (Jim Chapman Lake) out of the total storage of 81,470 acre-feet authorized for use by the Sulphur River Municipal Water District. Authorizes the North Texas Municipal Water District to divert and use not to exceed 3,214 acre-feet per annum of the remaining 15,686 acre-foot annual diversion of water authorized for municipal use by the Sulphur River Municipal Water District (26,960 acre-feet of water per annum less the 11,274 acre-feet of water per annum previously committed for use to the City of Commerce) within the North Texas Municipal Water District service area in the Trinity River Basin.

•**Certificate of Adjudication No. 03-4798** Priority Date: November 19, 1965

Authorizes the North Texas Municipal Water District to impound in Cooper Reservoir between elevations 415.5 and 440.0 feet above mean sea level a maximum of 100,625 acre-feet of water and below elevation 415.5 feet above mean sea level a maximum of 13,640 acre-feet, making a total of 114,265 acre-feet of water. The North Texas Municipal Water District is authorized to divert and use from Cooper Reservoir a maximum of 54,000 acre-feet of water per annum for municipal purposes within their service area.

•**Certificate of Adjudication No. 03-4799** Priority Date: November 19, 1965

Authorizes the City of Irving to impound in Cooper Reservoir between elevations 415.5 and 440.0 feet above mean sea level a maximum of 100,625 acre-feet of water and below elevation 415.5 feet above mean sea level a maximum of 13,640 acre-feet, making a total of 114,265 acre-feet of water. The City of Irving is authorized to divert and use from Cooper Reservoir a maximum of 44,820 acre-feet of water per annum for municipal purposes and 9,180 acre-feet of water per annum for industrial purposes within their service area.

•**Certificate of Adjudication No. 03-4799A** Granted: April 12, 2000

Defines the point on the perimeter of Jim Chapman Lake from which the City of Irving's diversion facility may make authorized diversions and sets the authorized diversion rate to 220 million gallons per day at a maximum rate of 340.36 cubic feet per second. Re-authorizes the City of Irving to divert and use 44,820 acre-feet of water per annum for municipal purposes and re-purposes the 9,180 acre-feet of water per annum to be used for municipal and industrial purposes within the service area of the City of Irving.

•**Certificate of Adjudication No. 03-4799B** Granted: June 6, 2001

Authorizes the City of Irving to use the bed and banks of Doe Branch, tributary of the Elm Fork Trinity River, and the Elm Fork Trinity River to convey the City of Irving's Lake Chapman water to the City of Dallas' Elm Fork Water Treatment Plant for subsequent diversion. Restricts the rate at which water will be discharged from Lake Chapman into Doe Branch to a maximum rate of 200 cubic feet per second, not to exceed 54,000 acre-feet per annum, less carriage losses, as originally authorized through Certificate of Adjudication No. 03-4799.

•**Certificate of Adjudication No. 03-4799C** Granted: January 6, 2006

Removes the requirement that water diverted but not consumed be returned to the Trinity River Basin at the owner's disposal plant and the disposal plants of the industrial users, and allows instead, the City of Irving to re-use a maximum of 31,600 acre-feet of water per annum, less carriage losses, of its Sulphur River Basin water in the Trinity River Basin. Prior to the reuse of water, the City of Irving must amend this Certificate of Adjudication to identify specific points of discharge and diversion, satisfy the requirements of the Texas Water Code for use of bed and banks for the delivery of the reuse water, and provide a method for measuring and accounting for all Jim Chapman Lake water reused within the Trinity River Basin. The complete certificates are on file in the Records Division of the Texas Commission on Environmental Quality.

Volumetric Survey of Jim Chapman Lake

Introduction

The TWDB Hydrographic Survey Program was authorized by the state legislature in 1991. The Texas Water Code authorizes the TWDB, at the request of a political subdivision, to perform a survey to determine reservoir storage capacity, sedimentation levels, rates of sedimentation, projected water supply availability, or potential mitigative measures, and to conduct other bathymetric studies.

In March of 2005 the Texas Water Development Board entered into agreement with the U.S. Army Corps of Engineers, Fort Worth District, for the purpose of performing a volumetric survey of Jim Chapman Lake while the water level was near the conservation pool elevation (440.0 feet above mean sea level). Data collected during this survey was used in creating updated area-capacity tables. Additionally, three of the original sediment range lines, cleared of trees and vegetation, were located and surveyed (Appendix D).

Datum

The vertical datum used during this survey is that used by the United States Geological Survey (USGS) for the reservoir elevation gauge USGS 07342495 Jim L. Chapman Lk nr Cooper, TX.[5] The datum for this gauge is reported as National Geodetic Vertical Datum 1929 (NGVD29) or mean sea level, thus elevations reported here are in feet above mean sea level. Volume and area calculations in this report are referenced to water levels provided by the USGS gauge. The horizontal datum used for this report is NAD83 State Plane Texas North Central Zone.

Bathymetric Survey

Bathymetric data collection for Jim Chapman Lake began in August of 2005. Between August 5 and August 10, 2005, data was collected across approximately 70% of the lake's surface area. During this time the water surface elevation of the lake measured between 434.79 feet and 434.54 feet above mean sea level, almost 5.5 feet below conservation pool elevation. Navigational impediments associated with this low water

surface elevation prevented TWDB from surveying the remaining 30% of the lake. Extended drought conditions throughout Texas in 2006 held water levels down, preventing TWDB from returning to Jim Chapman Lake. Spring and early summer flooding throughout Texas in 2007 brought an end to the drought, returning Jim Chapman Lake's water levels to near conservation pool elevation. TWDB returned to Jim Chapman Lake on July 18th, 19th and July 23rd through the 26th, 2007 to complete the volumetric survey. Water surface elevations during this time measured between 441.46 feet on July 19th and 440.5 feet on July 26th.

The survey team used two boats equipped with a depth sounder integrated with Differential Global Positioning System (DGPS) equipment to navigate along pre-planned range lines spaced approximately 500 feet apart in a perpendicular fashion to the original stream channel. During the 2005/ 2007 survey, the team navigated approximately 342 miles of range lines and collected over 216,000 data points. Figure 2 shows the location of the data points collected during the TWDB 2005/ 2007 survey.

The depth sounder was calibrated each day using the velocity profiler (to measure the speed of sound in the water column) and a modified bar check (using a weighted tape or stadia rod used to verify the depth readings). The average speed of sound through the water column varied between 4,940 and 4,952 feet per second during the August 2005 survey. During the July 2007 timeframe the average speed of sound varied between 4,840 and 4,945 feet per second.

Data Processing

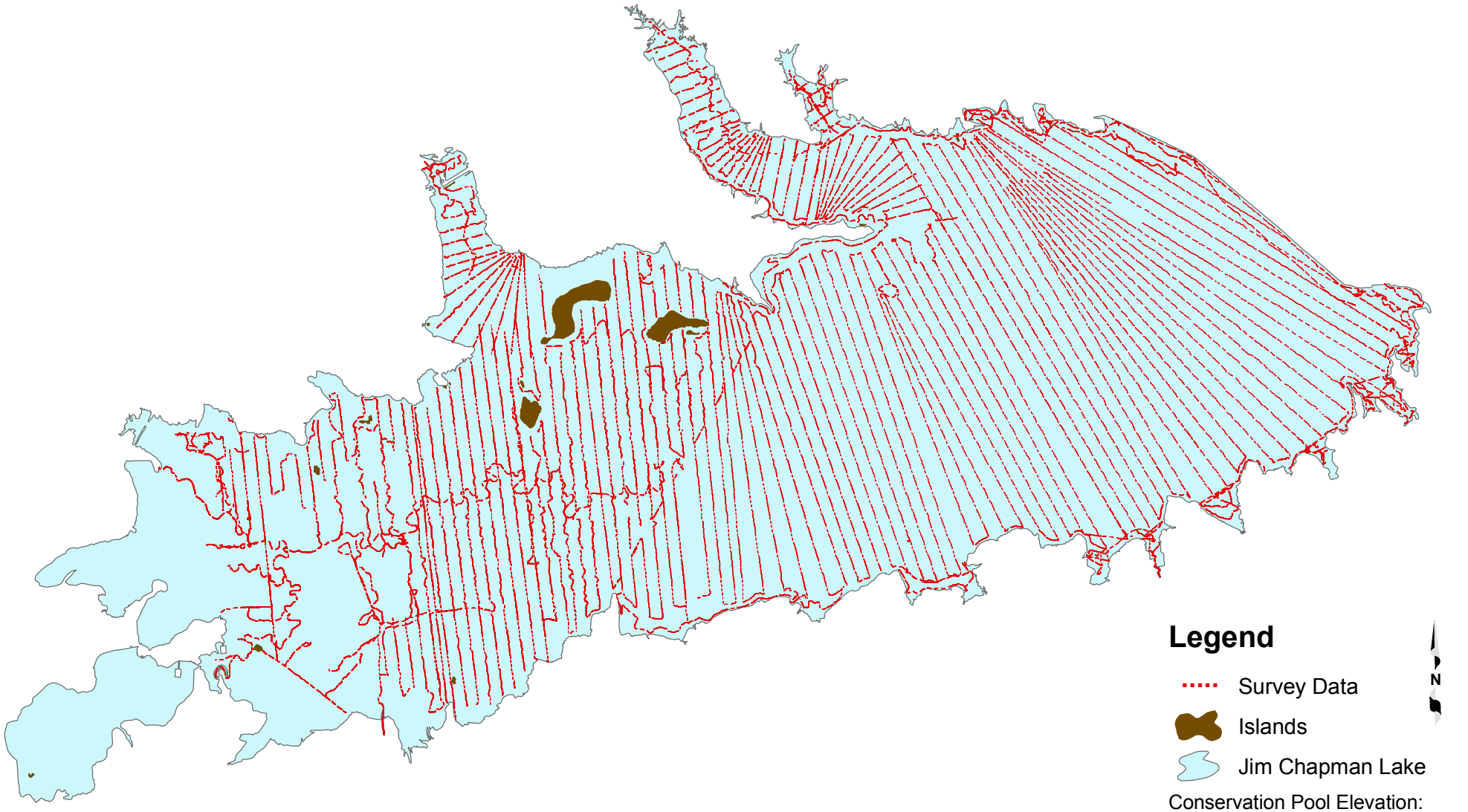
Model Boundary

Due to the difficulty of collecting data in the upper one-third of the reservoir, several boundaries representing the reservoir at various water surface elevations were digitized. When modeling the reservoir bathymetry these additional boundaries represented defined contours leading to a better representation of the reservoir's true bathymetry. Boundaries were digitized from satellite ASTER images and aerial photographs, or digital orthophoto quarter-quadrangle images (DOQQs)[6], using Environmental Systems Research Institute's (ESRI) ArcGIS 9.1 software. The quarter-quadrangles that cover Jim Chapman Lake are Tira NW, Tira SW, Cooper South NW, Cooper South NE, Cooper South SW, Cooper South SE, Klondike NE, and Klondike SE.

Figure 2

Jim Chapman Lake

Data Points Collected During TWDB Survey



The boundary representing conservation pool elevation was digitized from the land/water interface visible in the 1995-1996 aerial photographs. Although regions included in the Tira NW, Tira SW, Cooper South SW, and Cooper South SE DOQQs were photographed on February 2, 1995, while the reservoir water surface elevation measured 441.26 feet and the remaining images were photographed on January 27, 1996, while the reservoirs water surface elevation measured 439.41 feet, this boundary was given an elevation of 440 feet. The 1995-1996 aerial photographs have a resolution of 1-meter.

Additional boundaries were digitized from the 2004 1-meter resolution aerial photographs (photographed on September 30, 2004), 2005 2-meter resolution aerial photographs (photographed on August 21, 2005), 2006 1-meter aerial photographs (photographed on August 18, 2006), and 15-meter ASTER satellite imagery (taken on April 7, 2006). The water surface elevations at the time of these photographs measured 430.93 feet, 434.04 feet, 426.35 feet, and 432.8 feet, respectively (Figure 3). Each boundary was checked for accuracy against the data collected by TWDB. In areas where there was disagreement, those sections of the boundary were not included in the lake's model.

Triangulated Irregular Network (TIN) Model

Upon completion of data collection, the raw data files are edited in HYPACK MAX to remove any data anomalies. The water surface elevations for each respective day are applied and the depths are converted to corresponding elevations and exported as a MASS points file. The MASS points and boundary files are used in creating a Triangulated Irregular Network (TIN) model with the 3D Analyst Extension of ArcGIS. The 3D Analyst algorithms use Delaunay's criteria for triangulation to place a triangle between three non-uniformly spaced points, including the boundary vertices.[7] The Jim Chapman Lake TIN Model was enhanced through the use of a Self-Similar Interpolation routine developed by TWDB. The Self-Similar Interpolation routine is discussed further in the following section.

Using Arc/Info software, volumes and areas were calculated from the TIN model for the entire reservoir at one-tenth of a foot intervals, from elevation 393.0 feet to elevation 440.0 feet. The Elevation-Capacity Table and Elevation-Area Table, updated for 2007, are presented in Appendix A and B, respectively. The Area-Capacity Curves are presented in Appendix C.

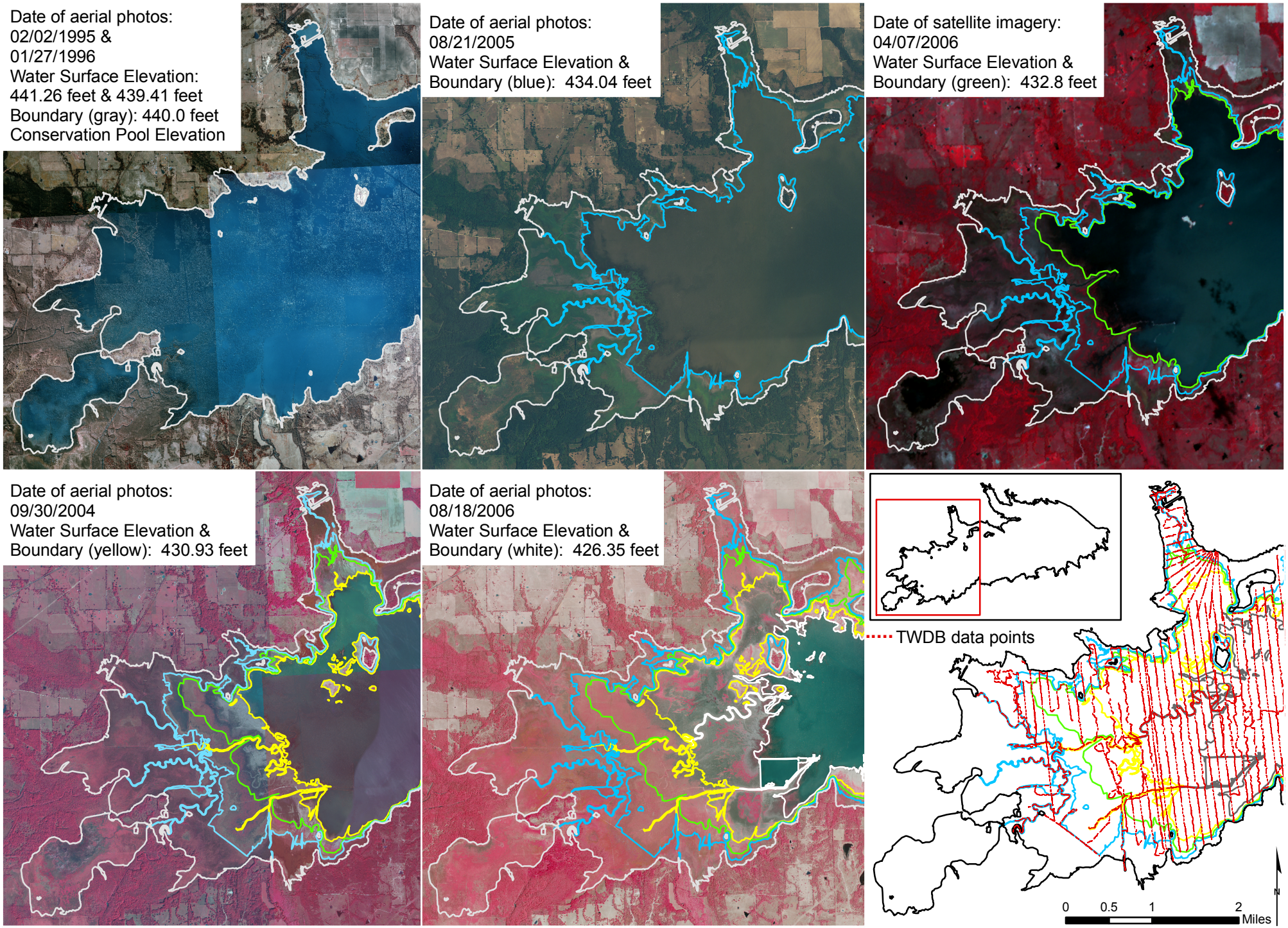


Figure 3. Illustrates the various boundaries digitized from the aerial photography and satellite data in the upper reaches of Jim Chapman Lake, in relation to the data TWDB was able to collect throughout 2005 and 2007.

The TIN model was interpolated and averaged using a cell size of 5 feet and converted to a raster. The raster was used to produce Figure 4, an Elevation Relief Map representing the topography of the reservoir bottom, Figure 5, a map showing shaded depth ranges for Jim Chapman Lake, and Figure 6, a 5-foot contour map (attached).

Self-Similar Interpolation

A limitation of the Delaunay method for triangulation in the TIN model results in artificially-curved contour lines extending into the reservoir where the reservoir walls are steep and the reservoir is relatively narrow. These curved contours are likely a poor representation of the true reservoir bathymetry in these areas. To ameliorate these problems, a Self-Similar Interpolation routine (developed by TWDB) was used to interpolate the bathymetry in between many 500 foot-spaced survey lines. The Self-Similar Interpolation technique effectively increases the density of points input into the TIN model, and directs the TIN interpolation to better represent the reservoir topography.[13] In the case of Jim Chapman Lake, the application of Self-Similar was used (primarily) to improve the representation of the submerged river channel. Although the true meandering of the channel is not accurately captured (Figure 7), the interpolated bathymetry is an improved representation of the bathymetry relative to that obtained without using the Self-Similar technique. The final TIN model, all area and capacity calculations, and Figures 4-6 were created by incorporating the interpolated points with the TWDB measured sounding points. Therefore, the products resulting from this volumetric survey of Jim Chapman Lake should not be used for any purposes other than to estimate the current reservoir area and capacity. In areas where obvious geomorphic features indicate a high-probability of cross-section shape changes (e.g. incoming tributaries, significant widening/narrowing of channel, etc.), the assumptions used in applying the Self-Similar Interpolation technique are not likely to be valid; therefore, Self-Similar Interpolation was not used in areas of Jim Chapman Lake where a high probability of change between cross-sections exists.[8]

Figure 4

Jim Chapman Lake

Elevation Relief Map

2,800,000 2,820,000 2,840,000

7,180,000

7,160,000

N

0 0.5 1 2 Miles

Prepared by: TEXAS WATER DEVELOPMENT BOARD 2005/ 2007 Survey

Legend

Elevation

(feet above mean sea level)

Conservation Pool

Elevation: 440.0 feet

- 438.1 - 440
- 436.1 - 438
- 434.1 - 436
- 432.1 - 434
- 430.1 - 432
- 428.1 - 430
- 426.1 - 428
- 424.1 - 426
- 422.1 - 424
- 420.1 - 422
- 418.1 - 420
- 416.1 - 418
- 414.1 - 416
- 412.1 - 414
- 410.1 - 412
- 408.1 - 410
- 406.1 - 408
- 404.1 - 406
- 402.1 - 404
- 400.1 - 402
- 398.1 - 400
- 396.1 - 398
- 394.1 - 396
- 393.4 - 394

Projection: NAD83

State Plane Texas North Central

Figure 5

Jim Chapman Lake

Depth Ranges Map

2,800,000 2,820,000 2,840,000

7,180,000

7,160,000

Legend

Conservation Pool
Elevation: 440.0 feet

Islands

Depth Ranges

- 0 - 2'
- 2 - 4'
- 4 - 6'
- 6 - 8'
- 8 - 10'
- 10 - 12'
- 12 - 14'
- 14 - 16'
- 16 - 18'
- 18 - 20'
- 20 - 22'
- 22 - 24'
- 24 - 26'
- 26 - 28'
- 28 - 30'
- 30 - 32'
- 32 - 34'
- 34 - 36'
- 36 - 38'
- 38 - 40'
- 40 - 42'
- 42 - 44'
- 44 - 46'
- > 46'

Projection: NAD 83
State Plane Texas
North Central

N

0 0.5 1 2 Miles

Prepared by: TEXAS WATER DEVELOPMENT BOARD 2005/ 2007 Survey

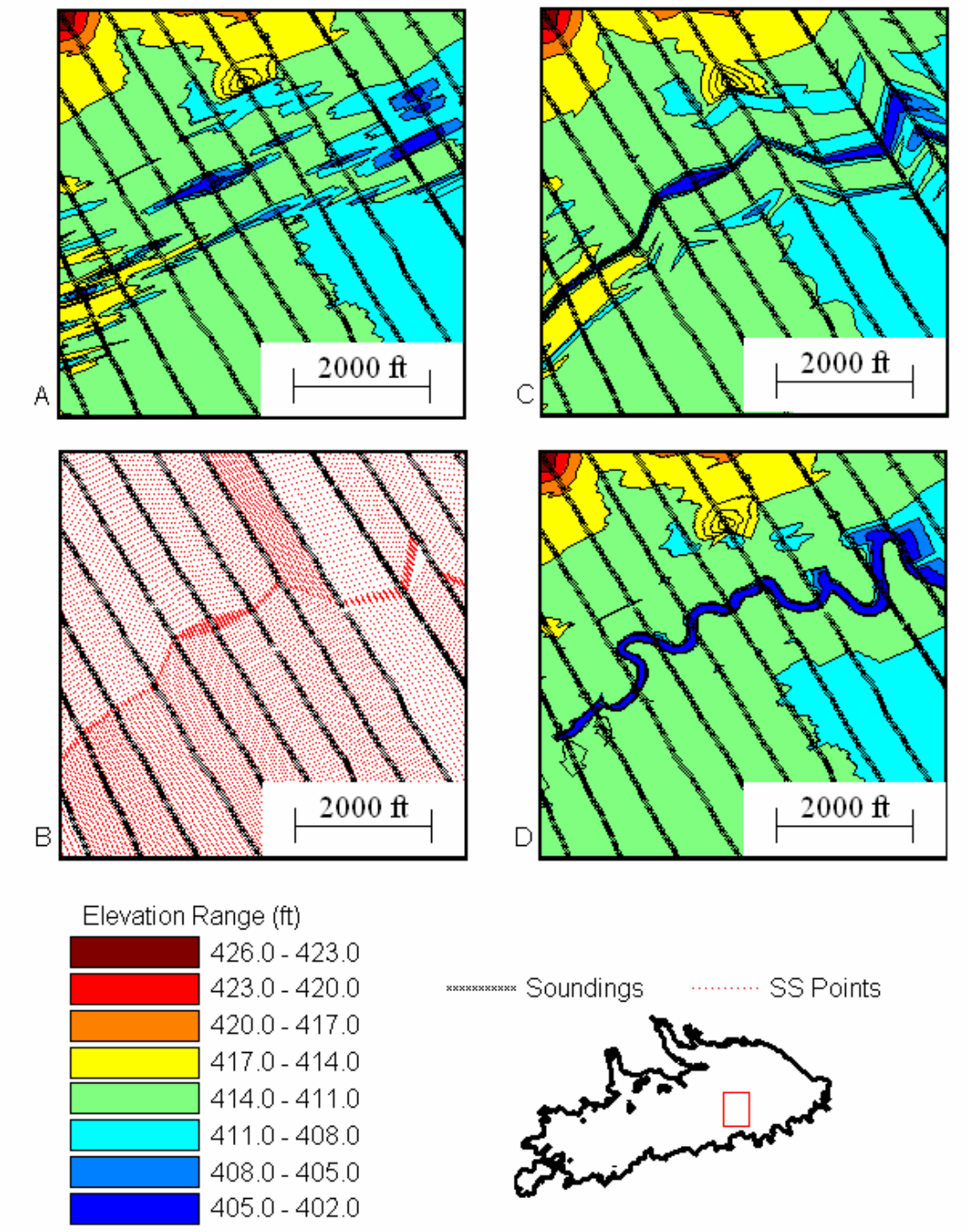


Figure 7. Channel reconstruction throughout Lake Jim Chapman using Self-Similar Interpolation. In 7A, the TIN Model represents the river channel as a deep hole each time TWDB survey data cross the channel. Figure 7B illustrates the density of points added through Self-Similar Interpolation. In 7C, the TIN Model is built incorporating the interpolated points, and the channel is represented as straight segments between survey lines. While the Self-Similar Interpolation routine can not capture the true meandering of the channel, as shown in Figure 7D, the reconstructed channel is a better representation of the channel than shown in Figure 7A. The true meandering channel shown in 7D was created by inputting available digital hypsography [9,10] into the TIN Model. The hypsography was not used in the final model because its associated elevations are no longer valid.

Sediment Range Lines

Before impoundment of Jim Chapman Lake, several sediment range lines were established. Trees and other impediments were cleared to create these range lines, creating clear areas for boat travel and data collection. Information on the location of these range lines was taken from an A.I.D Associates, Inc. Lake Map of Cooper Lake, 3rd Edition.[11] TWDB was able to locate the cleared areas visible in the 1995-1996 aerial photographs, and collected data along three range lines in these areas. Cross-sections profiling the bathymetry along these three range lines are presented in Appendix D. A map showing the location of these sediment range lines and a table listing the endpoint coordinates for these lines is also presented.

Survey Results

The results of the TWDB 2005/ 2007 Survey indicate Jim Chapman Lake has a total capacity of 298,930 acre-feet and encompasses 17,958 acres at conservation pool elevation. Sediment storage, below elevation 415.5 feet, is 38,598 acre-feet. Therefore, conservation storage capacity at conservation pool elevation is 260,332 acre-feet. Original total reservoir capacity per the US Army Corps of Engineers was 310,312 acre-feet at conservation pool elevation. The original sediment storage was 37,192 acre-feet; therefore, conservation storage capacity was 273,120 acre-feet at conservation pool elevation. These data suggest the reservoir has experienced an 11,382 acre-feet (3.7%) decrease in total reservoir capacity and a 12,788 acre-feet (4.7%) decrease in conservation storage capacity since impoundment. The original surface area of Jim Chapman Lake, per the US Army Corps of Engineers, was 19,305 acres. This suggests Jim Chapman Lake has experienced a 1,347 acre (7.0%) decrease in surface area since impoundment. Due to the differences in the methodologies used to calculate the reservoir's capacity between original impoundment and 2007, comparison of these values is not recommended and is presented here for informational purposes only.[12] The TWDB considers the 2007 survey to be a significant improvement over previous methods and recommends that the same methodology be used to resurvey Jim Chapman Lake in 5 to 10 years.

TWDB Contact Information

More information about the Hydrographic Survey Program can be found at: http://www.twdb.state.tx.us/assistance/lakesurveys/volumetricindex.asp.
Any questions regarding the TWDB Hydrographic Survey Program may be addressed to Barney Austin, Director of Surface Water Resources, at 512-463-8856, or by email at: Barney.Austin@twdb.state.tx.us.

References

1. Texas Water Development Board, Report 126, Engineering Data on Dams and Reservoirs in Texas, Part I, October 1974.
2. U.S. Army Corps of Engineers, Lake History, Jim Chapman Lake / Cooper Dam, viewed 15 November 2007, http://www.swfwc.usace.army.mil/cooper/Information/History.asp, updated 6 March 2007.
3. Texas Water Development Board, Comprehensive Surface Water Information, Texas Major Reservoirs, Jim Chapman, TWDB Reservoir Information Sheet, Engineering Plate, viewed 16 November 2007, http://wiid.twdb.state.tx.us/ims/ResInfo/viewer.htm?DISCL=1&.
4. U.S. Army Corps of Engineers, Noname Lake Home Page, Jim Chapman Lake / Cooper Dam, viewed 15 November 2007, http://www.swf-wc.usace.army.mil/cooper/, updated 24 July 2007.
5. United States Geological Survey, http://tx.usgs.gov/ 07 June 2006.
6. U.S Department of Agriculture, Farm Service Agency, Aerial Photography Field Office, National Agriculture Imagery Program, http://www.apfo.usda.gov/NAIP.html, 2/10/06.
7. ESRI, Environmental Systems Research Institute. 1995. ARC/INFO Surface Modeling and Display, TIN Users Guide.
8. Furnans, Jordan. Texas Water Development Board. 2006. "HydroEdit User's Manual."
9. StratMap, Hypsography 1:24,000 DLG for COOPER SOUTH, TX 7.5 Minute Quad. Austin, TX: Texas Natural Resources Information System, 2000.
10. StratMap, Texas Natural Resources Information System, http://www.tnris.org/StratMap.aspx?layer=122, 8/10/07.
11. A.I.D Associates, Inc., Cooper Lake [map]. 3rd edition, Scale not given. Dallas, Texas: A.I.D Associates, Inc., 2003.
12. United States Department of Agriculture, Natural Resource Conservation Service, National Engineering Handbook, Section 3, Sedimentation, Chapter 7, Field Investigations and Surveys, December 1983.

Appendix A

Jim Chapman Lake

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD
CAPACITY IN ACRE-FEET
ELEVATION INCREMENT IS ONE TENTH FOOT

2005/ 2007 SURVEY
Conservation Pool Elevation 440.0'
Sediment Storage 415.5'

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
393	0	0	0	0	0	0	0	0	0	0
394	0	0	0	0	0	0	0	0	0	0
395	0	0	0	0	0	0	0	0	0	0
396	0	0	0	0	0	0	0	0	1	1
397	1	1	1	1	1	1	1	1	1	1
398	1	1	1	1	2	2	2	2	2	2
399	2	2	3	3	3	3	3	4	4	5
400	5	6	16	35	59	87	120	156	196	239
401	286	335	386	441	499	559	622	688	756	827
402	901	976	1,055	1,135	1,219	1,305	1,394	1,485	1,578	1,673
403	1,771	1,871	1,974	2,079	2,186	2,296	2,409	2,523	2,641	2,760
404	2,882	3,007	3,133	3,263	3,395	3,529	3,667	3,806	3,949	4,094
405	4,241	4,392	4,546	4,703	4,864	5,028	5,195	5,365	5,539	5,716
406	5,896	6,079	6,265	6,454	6,647	6,844	7,044	7,248	7,455	7,664
407	7,877	8,093	8,313	8,536	8,762	8,992	9,225	9,461	9,701	9,943
408	10,189	10,437	10,689	10,945	11,203	11,464	11,729	11,996	12,267	12,541
409	12,818	13,100	13,385	13,673	13,967	14,264	14,565	14,870	15,178	15,491
410	15,808	16,129	16,455	16,785	17,119	17,457	17,798	18,143	18,492	18,844
411	19,199	19,558	19,921	20,287	20,656	21,029	21,406	21,786	22,170	22,557
412	22,947	23,341	23,738	24,139	24,543	24,950	25,361	25,774	26,190	26,610
413	27,032	27,458	27,887	28,319	28,753	29,191	29,632	30,076	30,523	30,973
414	31,426	31,883	32,342	32,805	33,270	33,738	34,210	34,685	35,163	35,645
415	36,130	36,618	37,109	37,602	38,099	38,598	39,099	39,604	40,111	40,622
416	41,136	41,653	42,173	42,696	43,222	43,752	44,284	44,820	45,359	45,900
417	46,445	46,992	47,542	48,095	48,651	49,210	49,772	50,337	50,905	51,476
418	52,051	52,628	53,209	53,793	54,380	54,970	55,562	56,158	56,756	57,358
419	57,962	58,569	59,180	59,792	60,408	61,027	61,648	62,273	62,900	63,531
420	64,164	64,801	65,441	66,083	66,729	67,378	68,030	68,685	69,343	70,004
421	70,668	71,335	72,005	72,678	73,354	74,033	74,716	75,401	76,090	76,782
422	77,478	78,177	78,880	79,586	80,295	81,009	81,727	82,449	83,176	83,907
423	84,643	85,383	86,127	86,876	87,631	88,390	89,154	89,923	90,696	91,475
424	92,257	93,045	93,837	94,635	95,437	96,245	97,058	97,876	98,700	99,530
425	100,366	101,208	102,056	102,910	103,771	104,639	105,513	106,392	107,278	108,169
426	109,066	109,968	110,876	111,790	112,715	113,652	114,597	115,547	116,503	117,465
427	118,434	119,408	120,388	121,374	122,366	123,366	124,373	125,387	126,410	127,440
428	128,478	129,523	130,575	131,633	132,698	133,769	134,847	135,931	137,022	138,120
429	139,225	140,338	141,457	142,581	143,712	144,849	145,990	147,137	148,288	149,444
430	150,604	151,769	152,938	154,112	155,291	156,475	157,665	158,860	160,061	161,269
431	162,495	163,731	164,973	166,221	167,474	168,734	169,998	171,269	172,545	173,827
432	175,115	176,408	177,708	179,013	180,324	181,642	182,966	184,298	185,636	186,986
433	188,342	189,705	191,074	192,449	193,831	195,219	196,614	198,016	199,424	200,839
434	202,262	203,721	205,206	206,698	208,196	209,699	211,208	212,721	214,238	215,760
435	217,285	218,815	220,348	221,885	223,426	224,971	226,519	228,072	229,628	231,189
436	232,754	234,323	235,895	237,472	239,053	240,637	242,226	243,818	245,414	247,013
437	248,617	250,224	251,834	253,449	255,067	256,690	258,317	259,948	261,583	263,222
438	264,866	266,514	268,166	269,822	271,484	273,151	274,823	276,500	278,182	279,870
439	281,565	283,266	284,974	286,688	288,410	290,140	291,879	293,626	295,383	297,150
440	298,930									

Appendix B

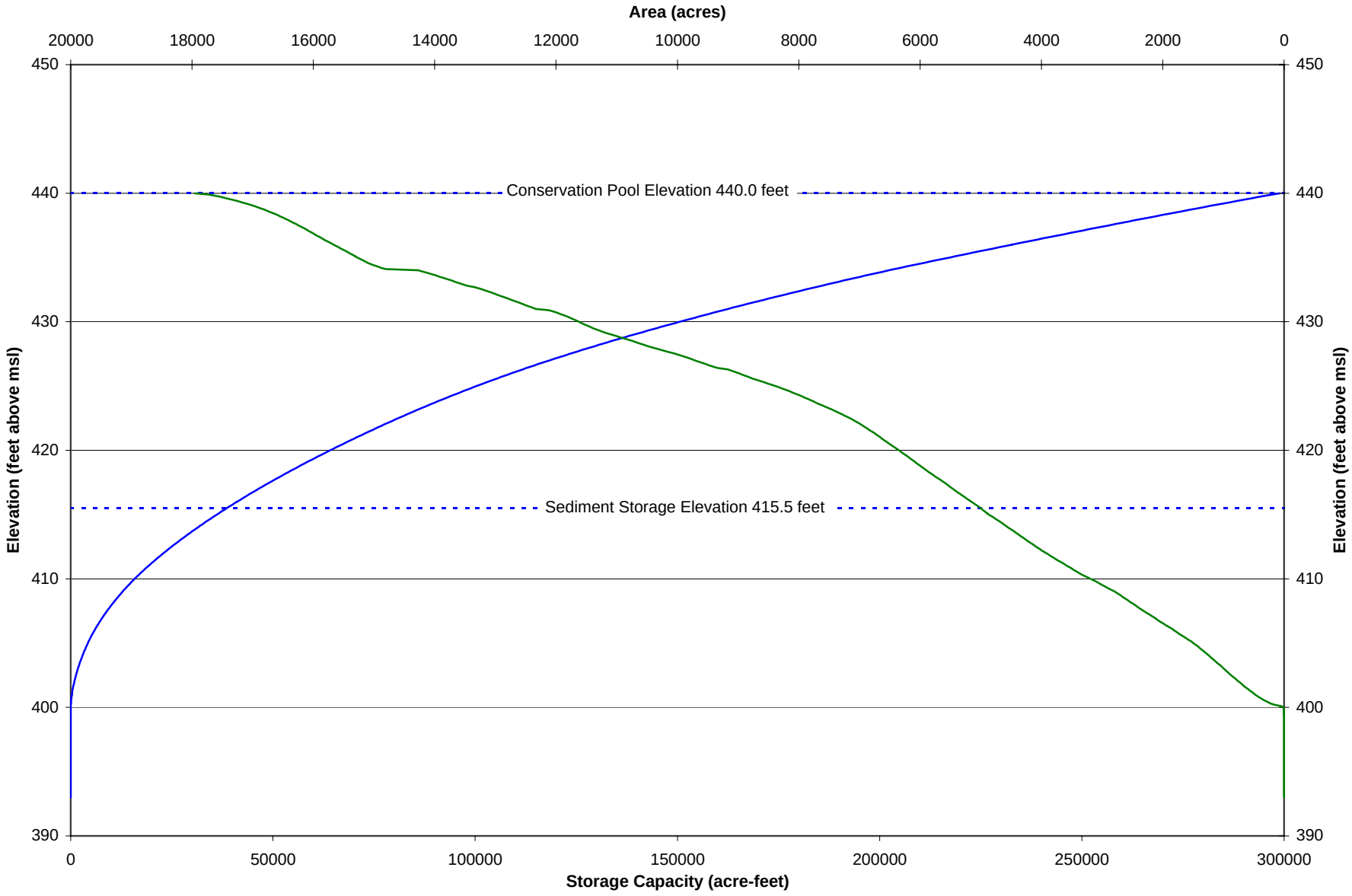
Jim Chapman Lake

RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD
AREA IN ACRES
ELEVATION INCREMENT IS ONE TENTH FOOT

2005/ 2007 SURVEY
Conservation Pool Elevation 440.0'
Sediment Storage 415.5'

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
393	0	0	0	0	0	0	0	0	0	0
394	0	0	0	0	0	0	0	0	0	0
395	0	0	0	0	0	0	0	0	0	0
396	0	0	0	0	0	0	0	0	0	0
397	0	0	0	1	1	1	1	1	1	1
398	1	1	1	1	1	1	1	1	1	1
399	1	2	2	2	2	2	3	4	5	6
400	8	51	153	218	264	306	345	382	416	448
401	477	504	532	560	591	619	646	671	696	721
402	746	771	796	821	847	874	898	921	945	967
403	990	1,013	1,038	1,062	1,087	1,112	1,136	1,160	1,184	1,208
404	1,232	1,255	1,280	1,307	1,335	1,360	1,384	1,409	1,436	1,464
405	1,492	1,523	1,556	1,590	1,622	1,653	1,688	1,721	1,753	1,784
406	1,814	1,845	1,878	1,914	1,950	1,984	2,019	2,051	2,082	2,114
407	2,145	2,177	2,211	2,247	2,282	2,314	2,347	2,379	2,410	2,440
408	2,471	2,503	2,536	2,568	2,598	2,629	2,661	2,692	2,723	2,756
409	2,792	2,830	2,869	2,911	2,952	2,992	3,029	3,067	3,105	3,146
410	3,190	3,237	3,279	3,320	3,360	3,398	3,433	3,468	3,503	3,538
411	3,573	3,607	3,642	3,677	3,712	3,749	3,786	3,820	3,853	3,886
412	3,921	3,955	3,990	4,023	4,056	4,088	4,118	4,148	4,179	4,211
413	4,242	4,272	4,302	4,332	4,363	4,393	4,423	4,453	4,484	4,518
414	4,549	4,581	4,610	4,639	4,669	4,700	4,733	4,766	4,799	4,833
415	4,865	4,895	4,923	4,950	4,976	5,002	5,030	5,060	5,092	5,124
416	5,154	5,185	5,216	5,246	5,277	5,309	5,342	5,373	5,402	5,430
417	5,459	5,488	5,517	5,545	5,573	5,603	5,634	5,665	5,698	5,729
418	5,760	5,791	5,822	5,854	5,885	5,913	5,941	5,969	6,000	6,029
419	6,058	6,087	6,115	6,143	6,172	6,201	6,231	6,260	6,290	6,320
420	6,349	6,381	6,413	6,444	6,474	6,505	6,535	6,566	6,596	6,626
421	6,655	6,683	6,713	6,744	6,775	6,808	6,841	6,873	6,905	6,940
422	6,973	7,008	7,043	7,079	7,118	7,158	7,200	7,244	7,288	7,332
423	7,377	7,423	7,470	7,517	7,564	7,618	7,667	7,713	7,758	7,804
424	7,851	7,900	7,950	8,000	8,050	8,103	8,157	8,212	8,269	8,329
425	8,387	8,449	8,514	8,577	8,643	8,706	8,767	8,826	8,883	8,938
426	8,996	9,053	9,109	9,168	9,339	9,404	9,472	9,532	9,593	9,654
427	9,714	9,773	9,831	9,890	9,956	10,029	10,108	10,188	10,265	10,341
428	10,412	10,486	10,553	10,616	10,678	10,742	10,809	10,877	10,947	11,017
429	11,087	11,156	11,220	11,280	11,337	11,390	11,440	11,488	11,534	11,580
430	11,626	11,670	11,715	11,762	11,814	11,868	11,926	11,984	12,046	12,116
431	12,331	12,393	12,450	12,507	12,563	12,620	12,675	12,733	12,791	12,848
432	12,908	12,967	13,025	13,083	13,142	13,210	13,278	13,346	13,457	13,534
433	13,597	13,658	13,720	13,784	13,850	13,915	13,981	14,049	14,119	14,191
434	14,275	14,810	14,884	14,950	15,008	15,061	15,109	15,152	15,194	15,235
435	15,274	15,313	15,352	15,390	15,429	15,467	15,506	15,546	15,586	15,627
436	15,668	15,707	15,748	15,788	15,827	15,865	15,902	15,940	15,977	16,014
437	16,051	16,088	16,126	16,167	16,207	16,247	16,288	16,329	16,372	16,414
438	16,457	16,500	16,545	16,592	16,641	16,691	16,743	16,798	16,855	16,914
439	16,976	17,042	17,111	17,183	17,260	17,342	17,429	17,520	17,619	17,730
440	17,958									



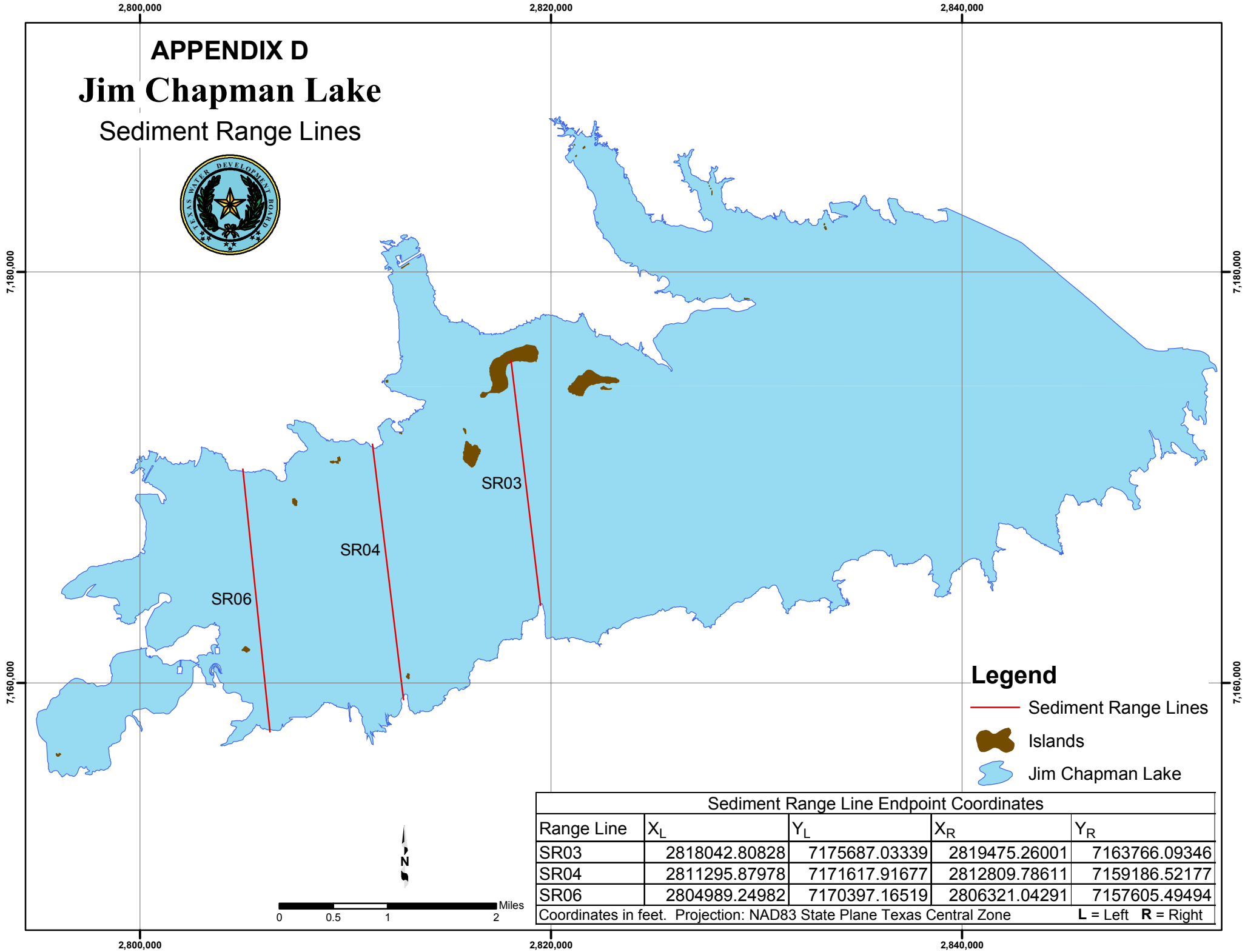
Jim Chapman Lake
2005/ 2007 Survey
Prepared by: TWDB

Appendix C: Area and Capacity Curves

APPENDIX D

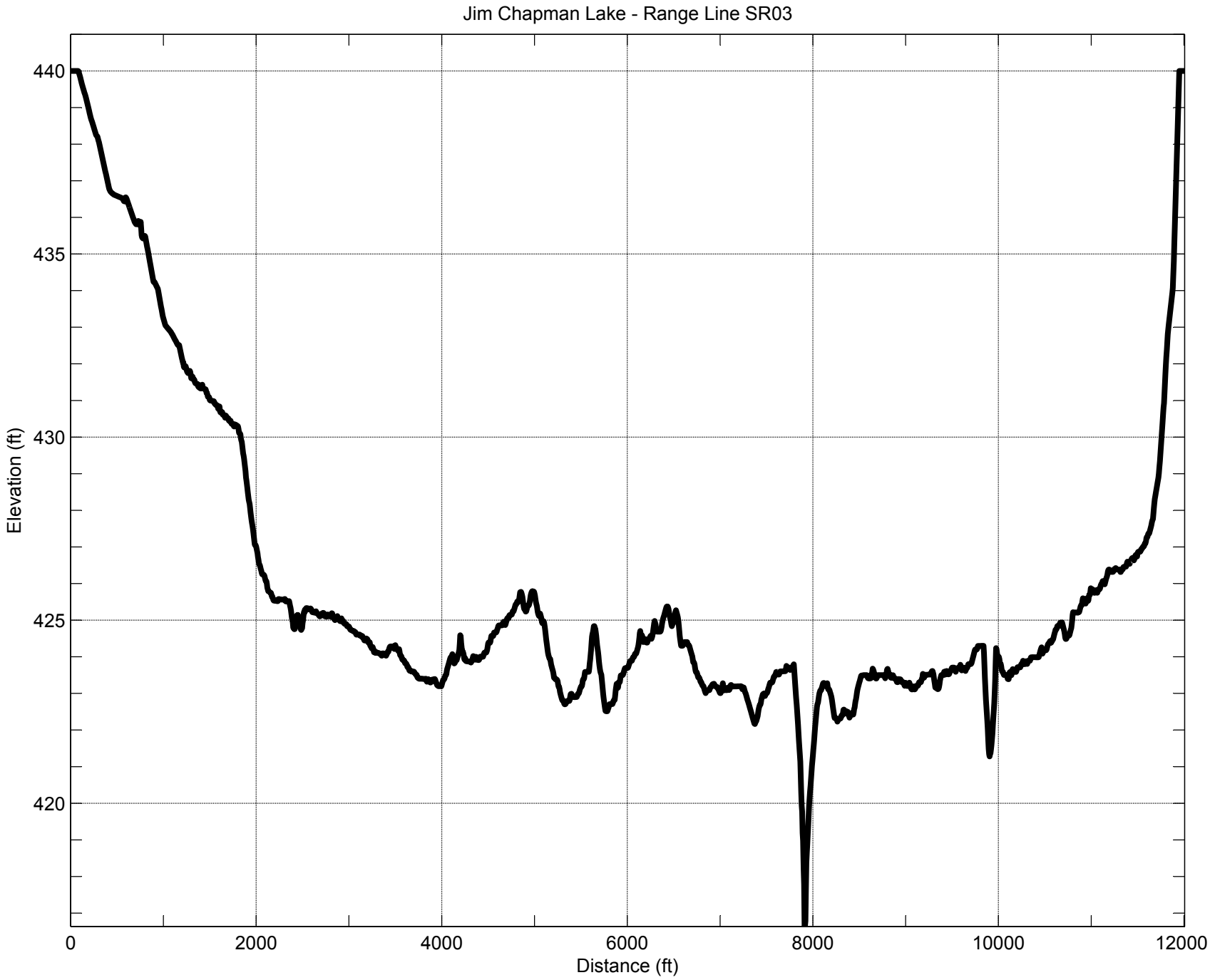
Jim Chapman Lake

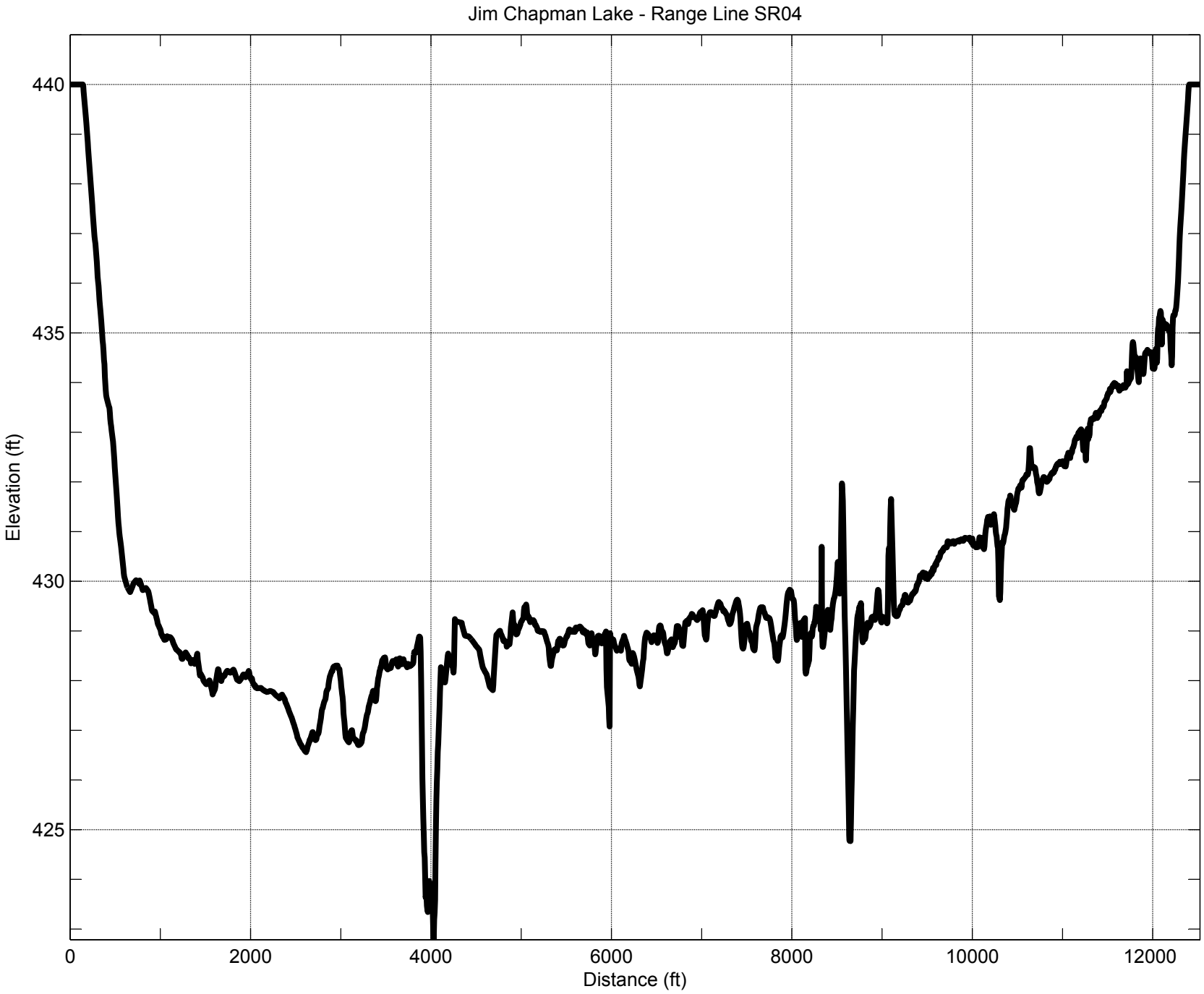
Sediment Range Lines



Sediment Range Line Endpoint Coordinates				
Range Line	X_L	Y_L	X_R	Y_R
SR03	2818042.80828	7175687.03339	2819475.26001	7163766.09346
SR04	2811295.87978	7171617.91677	2812809.78611	7159186.52177
SR06	2804989.24982	7170397.16519	2806321.04291	7157605.49494

Coordinates in feet. Projection: NAD83 State Plane Texas Central Zone **L** = Left **R** = Right


Jim Chapman Lake - Range Line SR03
Elevation (ft)
440
435
430
425
420
0
2000
4000
6000
8000
10000
12000
Distance (ft)


Jim Chapman Lake - Range Line SR04
440
435
430
425
Elevation (ft)
0
2000
4000
6000
8000
10000
12000
Distance (ft)

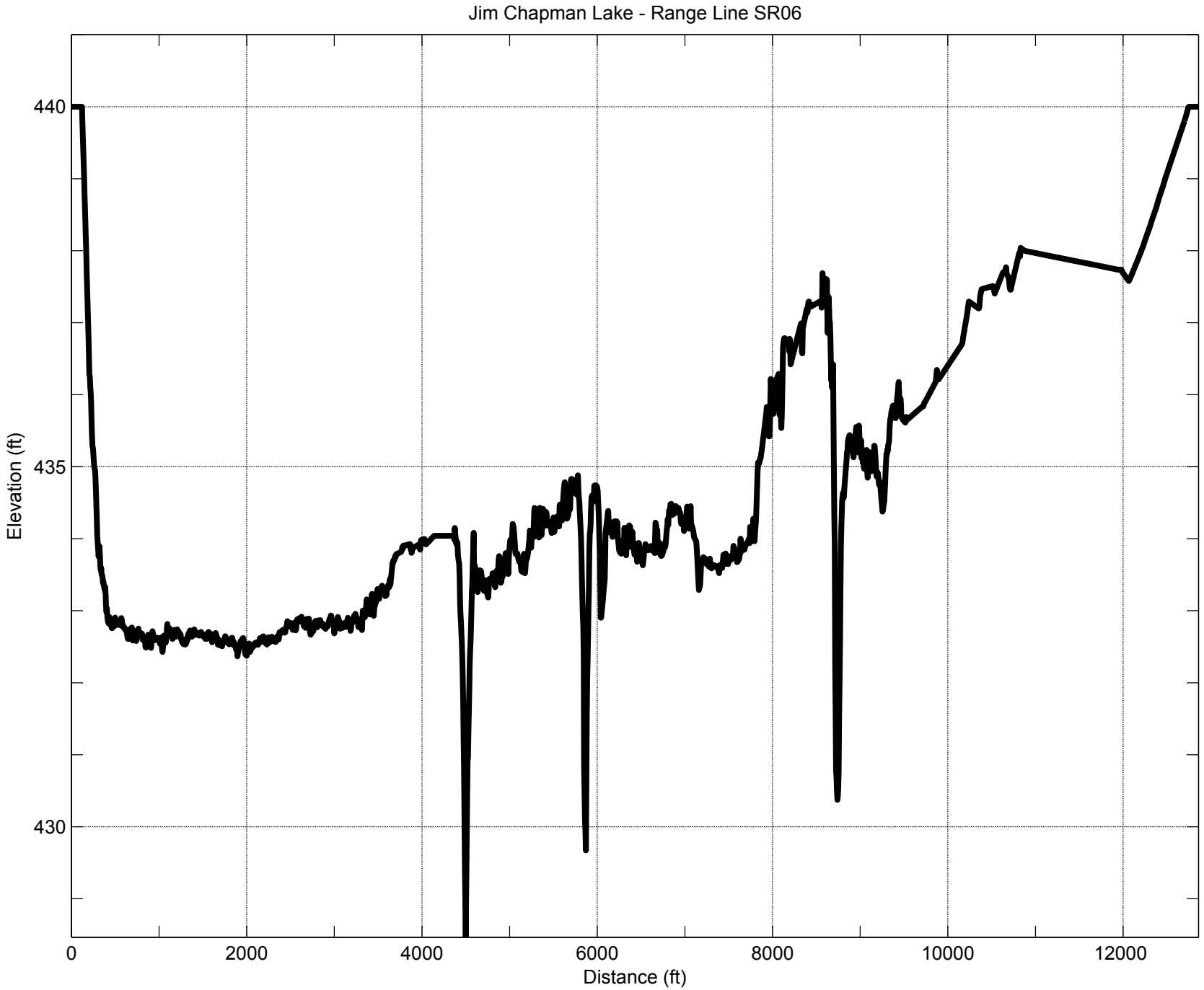

Jim Chapman Lake - Range Line SR06
440
435
430
Elevation (ft)
0
2000
4000
6000
8000
10000
12000
Distance (ft)

Figure 6

Jim Chapman Lake

5' - Contour Map

CONTOURS

(Elevations in feet above mean sea level)

- 395
- 400
- 405
- 410
- 415
- 420
- 425
- 430
- 435
- Islands
- Jim Chapman Lake

Conservation Pool Elevation
440.0 feet above mean sea level

Projection: NAD83
State Plane Texas
North Central Zone

This map is the product of a survey conducted by the Texas Water Development Board's Hydrographic Survey Program to determine the capacity of Jim Chapman Lake. The Texas Water Development Board makes no representations nor assumes any liability.

2,820,000

2,840,000

7,160,000

N

0 0.25 0.5 1 Miles

Prepared by: TEXAS WATER DEVELOPMENT BOARD 2005/ 2007 Survey