Volumetric Survey of LAKE COLEMAN

July- August 2006 Survey

Prepared by:

The Texas Water Development Board

April 2007

Texas Water Development Board

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Prepared for:

City of Coleman

With Support Provided by:

U.S. Army Corps of Engineers, Fort Worth District

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Executive Summary

In February of 2006 the Texas Water Development Board (TWDB) entered into agreement with the US Army Corps of Engineers, Fort Worth District, for the purpose of performing a volumetric survey of Lake Coleman while the reservoir was near the top of the conservation pool elevation. This information was converted into updated area-capacity tables. In addition, sediment range lines were established by TWDB to examine the reservoir in cross-section and to facilitate future tracking of any sedimentation in Lake Coleman.

The results of the TWDB 2006 Survey indicate Lake Coleman has a total reservoir capacity of 38,094 acre-feet and encompasses 1,811 acres at conservation pool elevation, 1,717.5 ft above msl. Dead pool storage is 18 acre-feet, at dead pool elevation, 1,662.5 ft above msl. Therefore, conservation storage capacity at conservation pool elevation is 38,076 acre-feet.

Impoundment of Lake Coleman began in April of 1966. Original reservoir capacity, as per Certificate of Adjudication No. 14-1702, was 40,000 acre-feet. This indicates the reservoir has experienced a 4.8% decrease in total reservoir capacity, or 1,906 acre-feet loss, since it was first impounded. Information provided by the City of Coleman indicates the original surface area of the lake encompassed 2,000 acres. The TWDB 2006 survey indicates a 9.5%, or 189 acre, loss in surface area at the conservation pool elevation, since Lake Coleman was first impounded.

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Lake Coleman General Information

Lake Coleman is located in the Colorado River Basin on Jim Ned Creek in Coleman County, 14 miles north of the city of Coleman, TX (Figure 1). Construction on Coleman Dam and Lake Coleman began in August of 1965. Deliberate impoundment began in April of 1966 and the dam was completed on May 10, 1966.[1] Lake Coleman serves as a source of water supply for the City of Coleman as well as recreation.

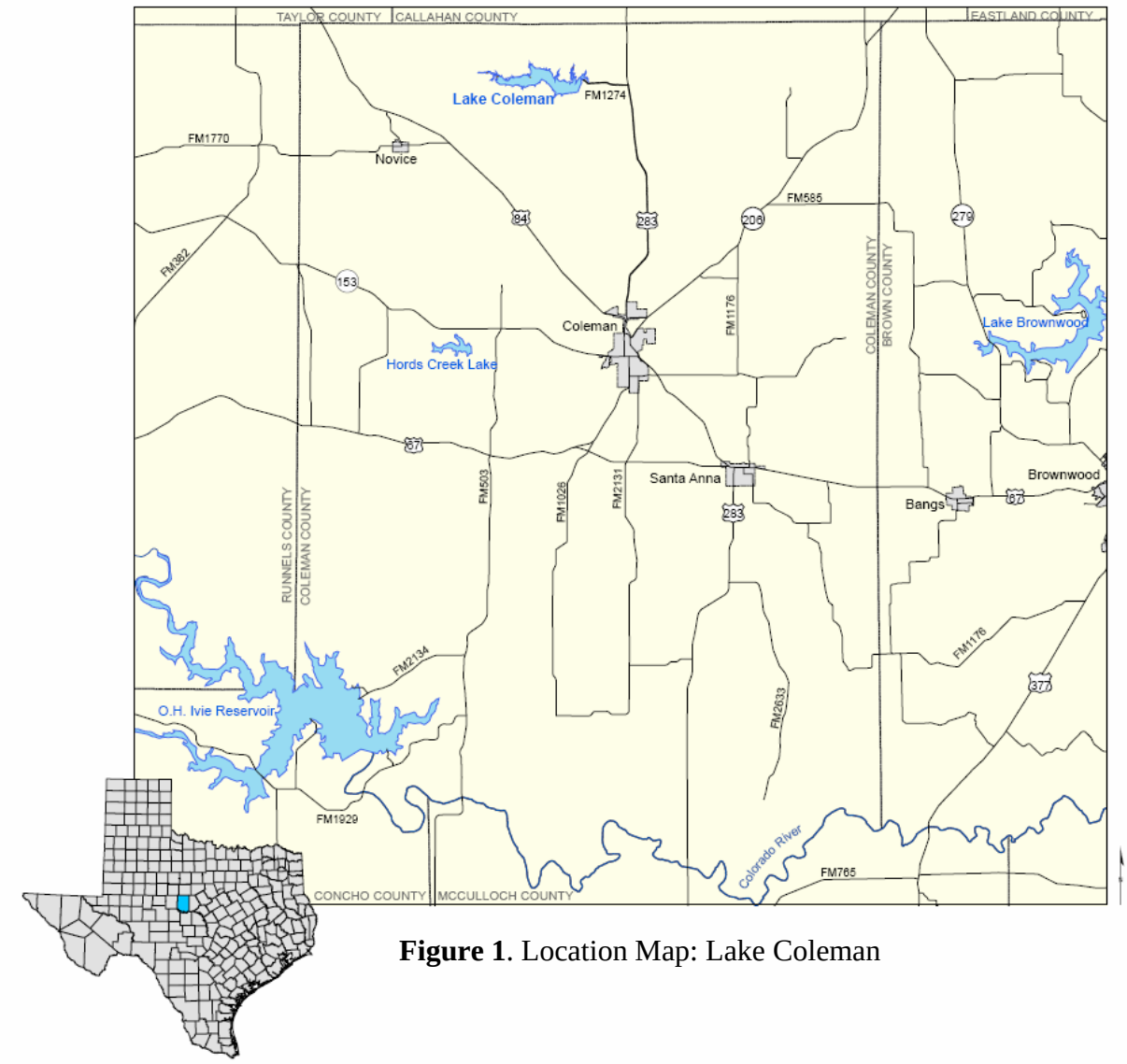


Figure 1. Location Map: Lake Coleman

Certificate of Adjudication No. 14-1702 authorizes the City of Coleman to maintain an existing dam and reservoir (Lake Coleman) on Jim Ned Creek and impound therein not to exceed 40,000 acre-feet of water. The owner is authorized to divert and use not to exceed 4,500 acre-feet of water per annum from Lake Coleman for municipal purposes and an additional 4,500 acre-feet of water per annum for industrial purposes.

The owner is also authorized to use the impounded waters for recreation purposes. The effective date of the owner's right is August 25, 1958. The owner is also required to maintain a suitable outlet to allow the free passage of water that the owner is not entitled to divert or impound. The complete certificate is on file in the Records Division of the Texas Commission on Environmental Quality.

The following table is a list of pertinent data about Coleman Dam and Lake Coleman.[1]

Table 1: Pertinent Data for Coleman Dam and Lake Coleman

Owner: City of Coleman
Engineer (Design): Forrest and Cotton, Inc.
Location: On Jim Ned Creek in Coleman County, 14 miles north of Coleman, and 45 miles southeast of Abilene
Drainage Area: 292 square miles

Dam:	
Type	Earthfill
Length	3,200 ft
Maximum Height	90 ft
Top Width	20 ft
Spillway (Service):	
Type	Drop inlet, 28-ft diameter at crest with 7-ft diameter outlet pipe
Crest Control	none
Crest elevation	1,717.5 ft above msl
Spillway (Emergency):	
Type	Country
Control	None
Crest Elevation	1,726.0 ft above msl
Crest length	1,500 ft
Outlet Works:	
Type	1 conduit, 24-inch diameter
Lowest inlet invert elevation	1,662.5.0 ft above msl
Control	3 slide gates, each 2 x 2 ft
Reservoir Data:	
Feature	**Elevation** (feet above msl)
Top of dam	1,740.0
Emergency Spillway	1,726.0
Service Spillway	1,717.5
Invert Elevation	1,662.5
Streambed	1,650.0

Volumetric Survey of Lake Coleman

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 February of 2006 the Texas Water Development Board entered into agreement with the US Army Corps of Engineers, Fort Worth District, for the purpose of performing a volumetric survey of Lake Coleman while the reservoir was near the top of the conservation pool elevation. This information was converted into updated area-capacity-tables. In addition, 12 sediment range lines were established by TWDB to examine the reservoir in cross-section and to facilitate future tracking of any sediment in Lake Coleman.

Datum

The vertical datum used during this survey is that used by the United States Geological Survey (USGS) for the reservoir elevation gauge USGS 08140770 Lk Coleman nr Novice, TX.[2] The datum for this gauge is reported as National Geodetic Vertical Datum 1929 (NGVD29) or mean sea level (msl), thus elevations reported here are in feet (ft) above msl. 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 Central Zone.

Bathymetric Survey

Bathymetric data collection for Lake Coleman occurred on July 19th and 20th and August 11th of 2006, while the water surface elevation was below the conservation pool elevation of 1,717.5 ft. The water surface elevation measured 1,713.80 ft, 1,713.77 ft, and 1,713.10 ft respectively, during the TWDB survey. 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 2006 survey, the team navigated approximately 67.5 miles of range lines and collected over 41,800 data points. Figure 2 shows the data points collected during the TWDB 2006 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 was performed to verify the depth reading. The average speed of sound through the water column varied between 4,846 and 5,100 feet per second during the 2006 survey.

Data Processing

Model Boundary

The reservoir boundary was digitized from aerial photographs using Environmental Systems Research Institute's (ESRI) ArcGIS 9.1 software. The aerial photographs, or digital orthophoto quarter-quadrangle images (DOQQs), used for Lake Coleman were Crooked Creek SW, McEwen Draw SW, and McEwen Draw SE. These images were photographed on November 26, 2004. At the time of the photographs the water surface elevation measured 1,718.5 ft above msl, one foot above the conservation pool elevation. The reservoir boundary was digitized at the land water interface visible in the aerial photos and labeled with the corresponding elevation of 1,718.5 ft.

The United States Department of Agriculture, Farm Service Agency's, Aerial Photography Field Office (APFO), National Agriculture Imagery Program (NAIP) acquires the photographic imagery during the agricultural growing seasons in the continental U.S.[4] The imagery resides in the public domain and can be downloaded from the Texas Natural Resources Information System (TNRIS) website at http://www.tnris.state.tx.us/. For more information visit the APFO website at http://www.apfo.usda.gov/NAIP.html or contact TNRIS.

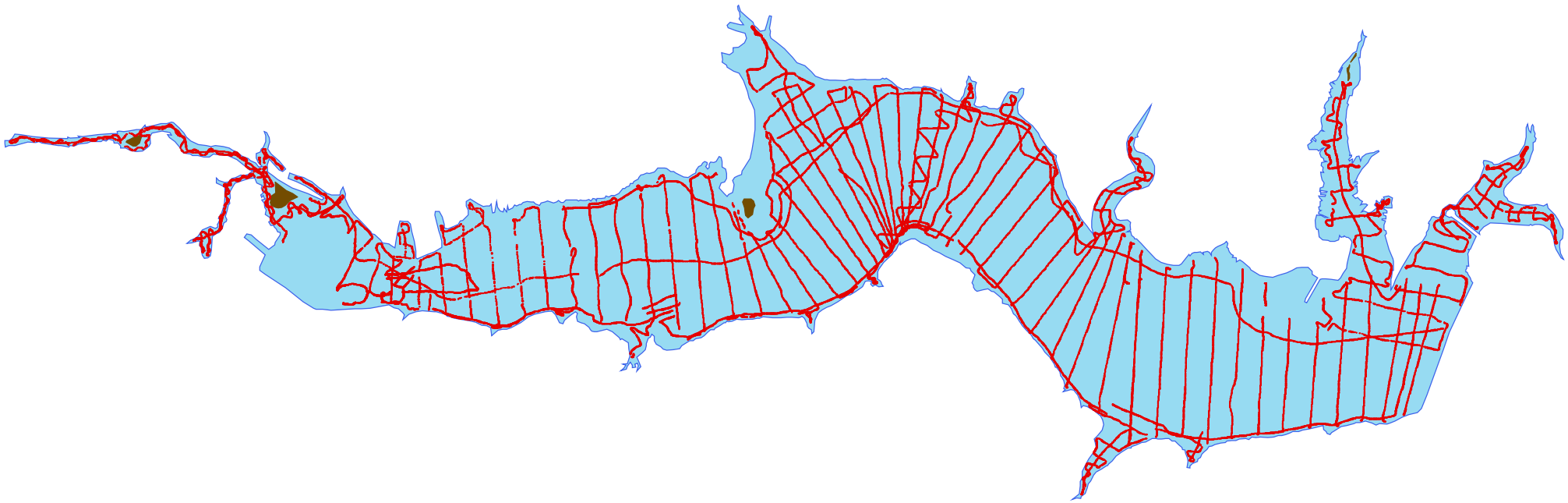
Triangular Irregular Network (TIN) Model

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

Figure 2

Lake Coleman

Data Points Collected During 2006 TWDB Survey



N

0 0.25 0.5 1 Miles

Legend

- Data points
- Islands
- Lake Coleman boundary elev. 1,718.5

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 to create a Triangulated Irregular Network (TIN) model, a function of the 3D Analyst Extension of ArcGIS. The model uses Delaunay's criteria for triangulation to place a triangle between three non-uniformly spaced points, including the boundary.[5] The Lake Coleman TIN Model was enhanced through the use of a Self-Similar Interpolation routine developed by the TWDB. See the following section on Self-Similar Interpolation and the Shallow Area Problem for more information.

Using Arc/Info software, volumes and areas are calculated from the TIN Model for the entire reservoir at one-tenth of a foot intervals, from elevation 1,657.3 ft to elevation 1,717.5 ft. The Elevation-Capacity Table and Elevation-Area Table, updated for 2006, are presented in Appendix A and B, respectively. The Area-Capacity Curves are presented in Appendix C. Although the reservoir boundary was digitized above the conservation pool elevation, data was collected while the water surface elevation was between 3.7 and 4.4 feet below conservation pool elevation. Therefore, the Area-Capacity-Tables are only calculated to conservation pool elevation, 1,717.5 ft.

The TIN Model was interpolated and averaged using a cell size of 10 ft and converted to a raster. The raster was used to produce Figure 3, an Elevation Relief Map representing the topography of the reservoir bottom, Figure 4, a map showing shaded depth ranges for Lake Coleman, and Figure 5, a 5-ft contour map (attached).

Self-Similar Interpolation and the Shallow Area Problem

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 this problem, a Self-Similar Interpolation routine was used to interpolate the bathymetry in between many 500 ft-spaced survey lines to increase the density of points input into the TIN Model. Self-Similar interpolation of Lake Coleman was concentrated along the river channel and along the shore where steeper slopes were encountered. The increased point density alters the mean triangle shape from long and skinny to more equilateral, thus providing better representations of reservoir topography.[6] By restricting the self-similar

Figure 3

Lake Coleman

Elevation Relief

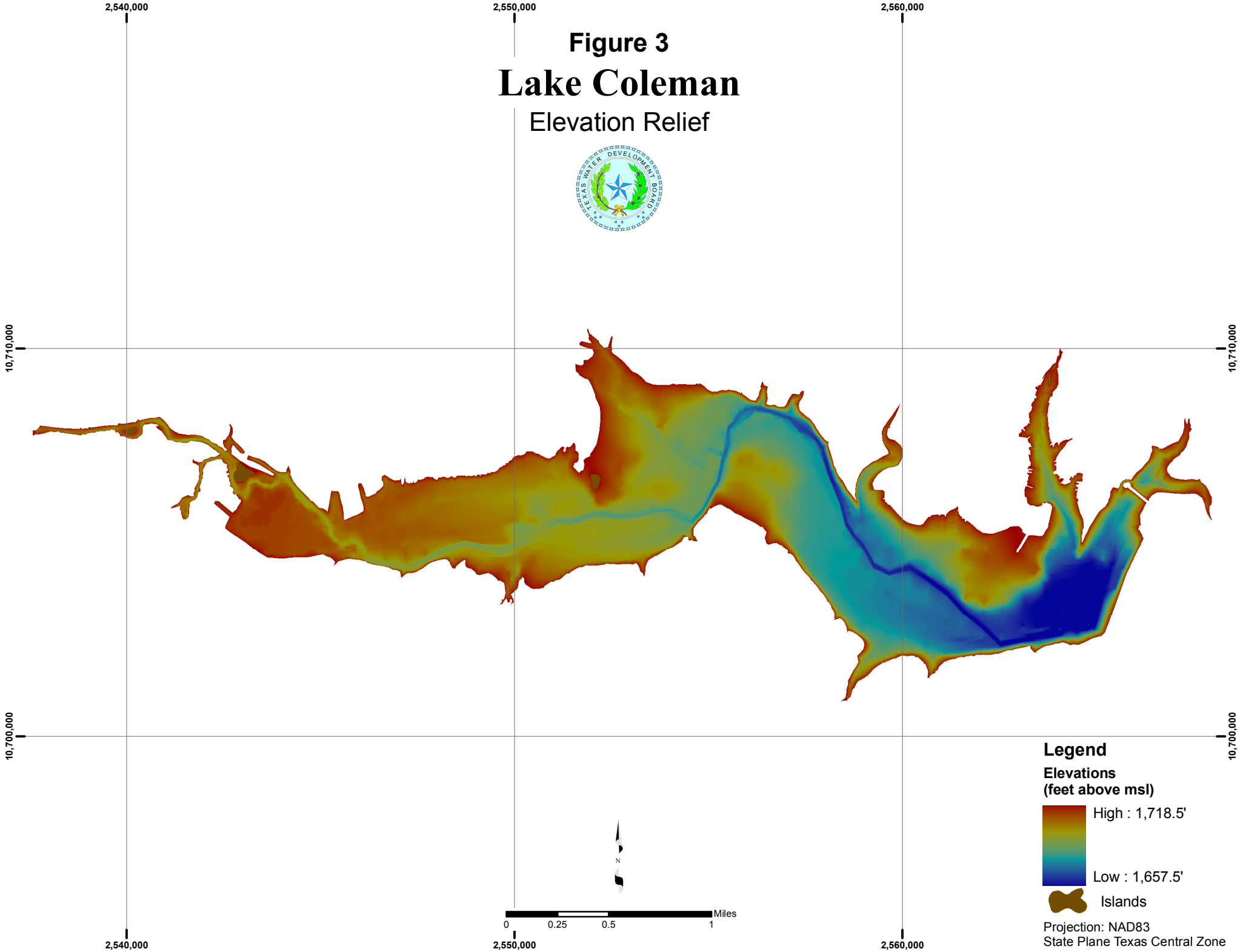
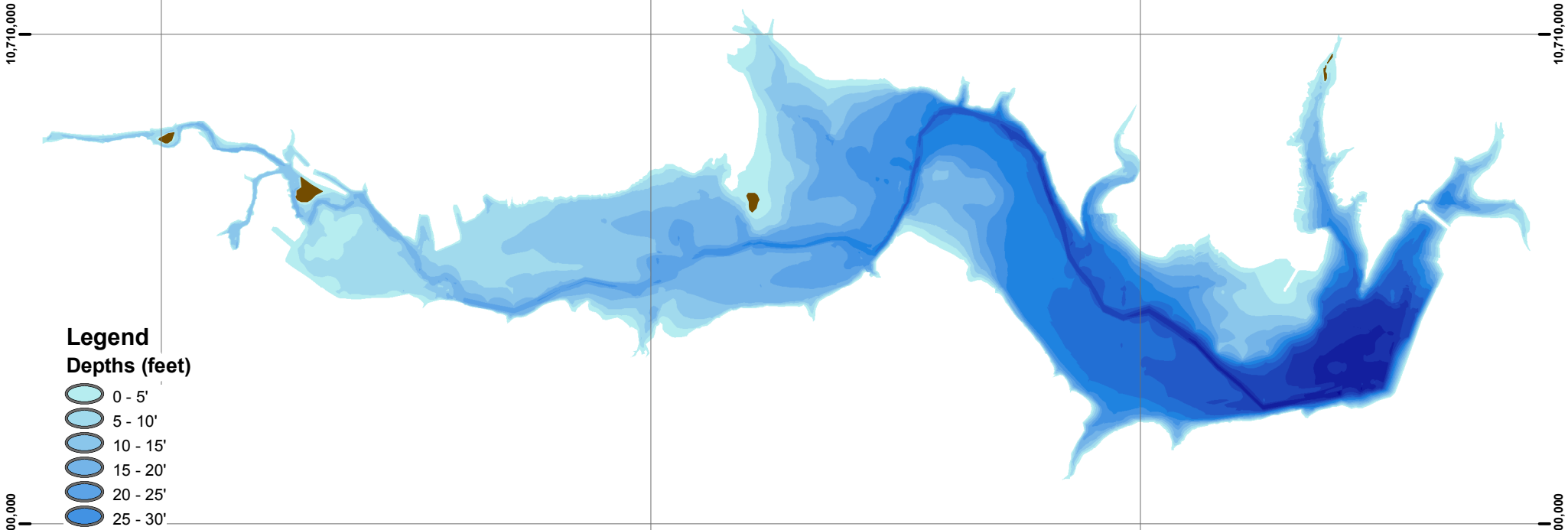


Figure 4

Lake Coleman

Depth Ranges



interpolation routine to the steep sloped edges and the river channel in the main body of the reservoir, the TIN Model was able to capture the meandering characteristics of the inundated river channel. 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.), this self-similar assumption is not likely to be valid; therefore, self-similar interpolation was not used in those areas of Lake Coleman.[6] Figure 6 illustrates how the Self-Similar Interpolation Routine affects the TIN generation process and the resulting contour lines.

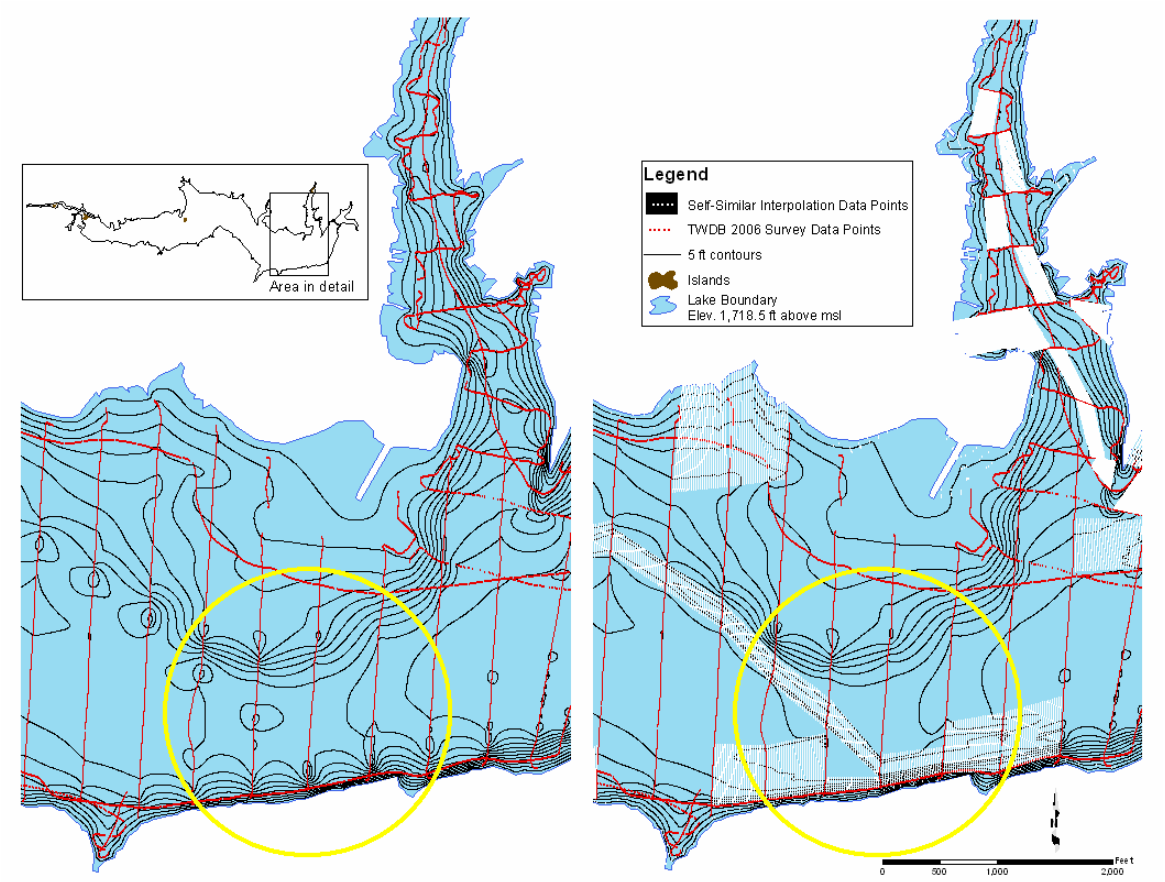


Figure 6. The image on the left illustrates the artificially curved contour lines (yellow circle), a function of the TIN generation process, extending into the reservoir every 500 feet and corresponding with the TWDB survey data. The TIN Model represents the inundated river channel as deep holes every 500 ft where the boat passed over the channel. By restricting the Self-Similar Interpolation to the river channel, poorly represented areas along the shore, and in areas of the coves where a low probability of change in topography from one transect to the next is expected, the contours, in the image on the right, are more representative of the expected reservoir topography.

Another limitation of the Delaunay method of TIN generation involves the calculation of areas and volumes in sections of the reservoir that were too shallow for bathymetric data collection by boat. This "shallow area problem," as identified by

TWDB, is corrected using the HydroEdit interpolation routines developed by TWDB. The Delaunay triangulation method, within ArcGIS, creates large flat triangles throughout these un-surveyed areas for which each corner of the triangle lies on the reservoir boundary. These triangles do not suggest any change in slope along the boundary and are assigned zero depths, causing an artificial spike in the elevation-area graphs at the last elevation interval for which reservoir areas/volumes are calculated. To correct this, the HydroEdit software program linearly interpolates elevations along connecting lines between the digitized reservoir boundary points and their closest sounding points. These interpolated data points are used in conjunction with the surveyed sounding points and the Self-Similar Interpolated points to generate the TIN model. The additional data points result in a model with a more realistic representation of the reservoir bathymetry[6] and better defined steeply sloped shorelines and shallow areas. Figure 7 illustrates the "Shallow Area Problem."

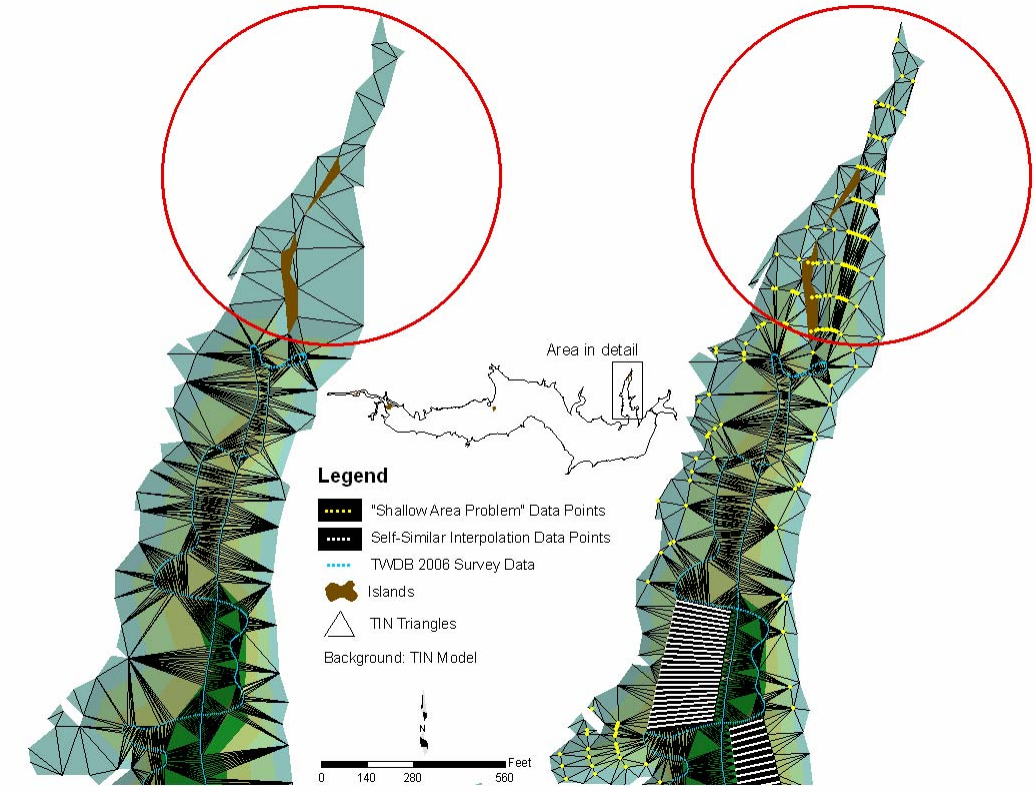


Figure 7. The image on the left illustrates how triangles form during the TIN generation process without the Self-Similar and "Shallow Area Problem" data points. The red circle highlights those triangles where all three vertices are on the boundary, creating flat triangles. The image on the right illustrates how the TIN triangles are formed after the Self-Similar and "Shallow Area Problem" data points are added. Notice the flat triangles no longer exist.

Additionally, several data points were added in the upper reaches of the reservoir where water depths became too shallow for the boat to navigate. The survey crew observed birds standing throughout this area and estimated the average depth of water near the vegetated areas to be approximately one foot. Photographs of the area, taken by the survey crew, indicate several of the vegetated areas were dry during the survey, suggesting the elevations of these areas are approximately one foot above the water surface. These observations were made while the water surface elevation of the reservoir was 1,713.77 ft; therefore these points were given elevations 1,712.77 ft and 1,714.77 ft (Figure 8). Figure 9 shows the final point density, including the survey data and added points, after the Self-Similar Interpolation and "Shallow Area Problem" routines were employed. The Self-Similar Interpolation and "Shallow Area Problem" routines were applied to approximately 25% of the reservoir area (at elevation 1,718.5 ft).

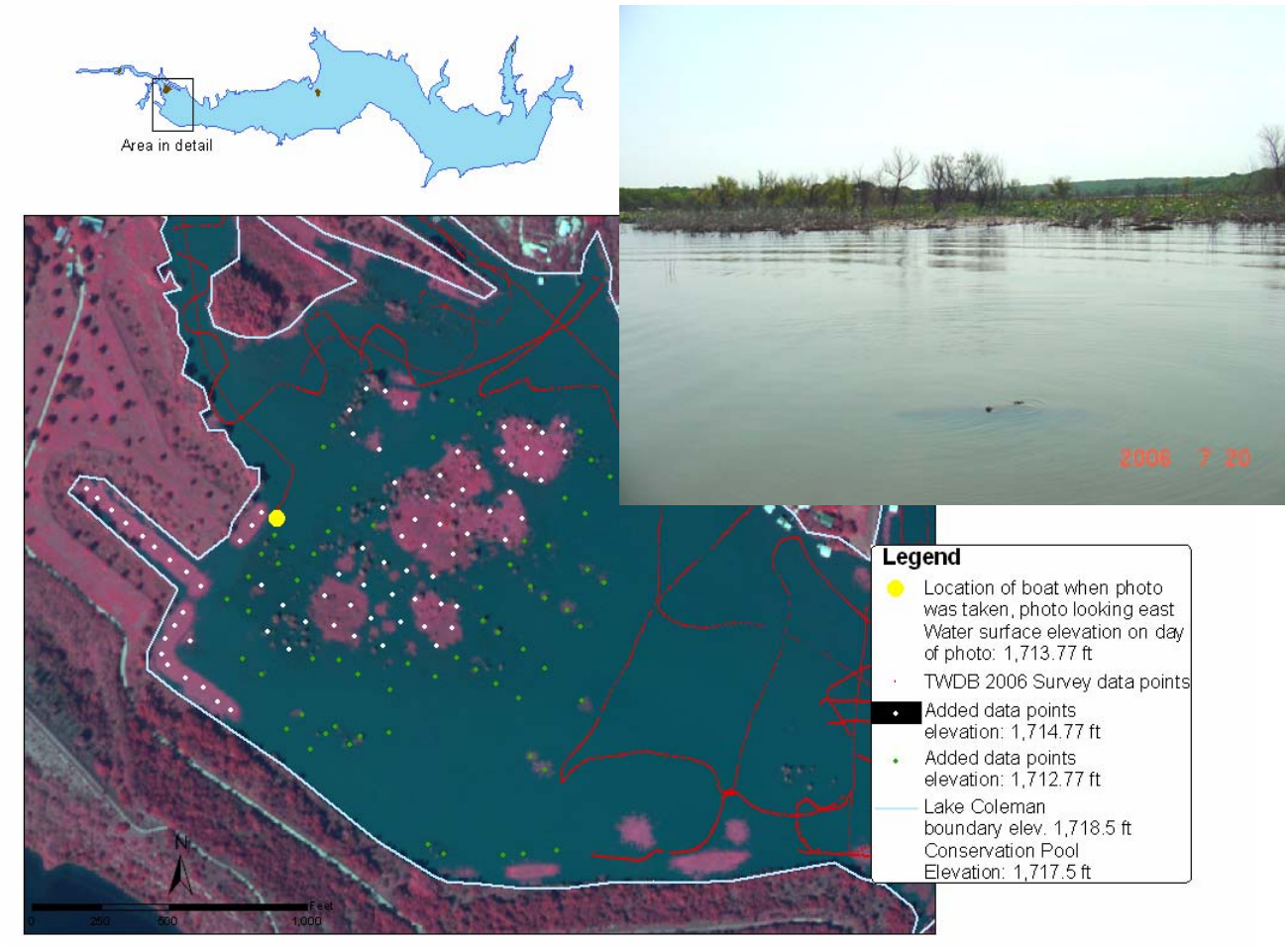
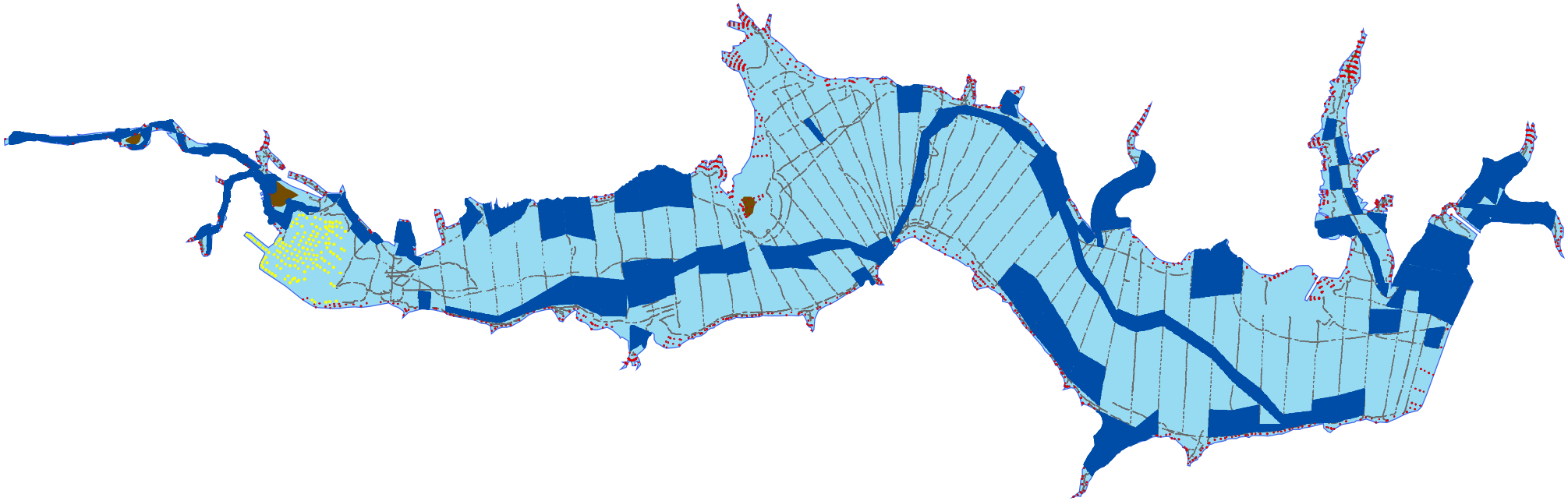


Figure 8. Illustrates the methodology used to determine depths/ elevations for an area of the reservoir that was too shallow to navigate by boat. A combination of photographs, such as the one shown here, and field observations were used to estimate the elevations of these additional data points.

Figure 9

Lake Coleman

Data Interpolated Using Self-Similar and "Shallow Area Problem" Routines



Legend

- Data Points Collected during TWDB 2006 Survey
- Manually added data points based on field observations
- Self-Similar Interpolation Routine Results
- Shallow Area Problem Routine Results
- Islands
- Lake Coleman boundary elev. 1,718.5 ft

N

0 0.25 0.5 1 Miles

Sediment Range Lines

The TWDB established 12 sediment range lines to examine the reservoir in cross-section and to facilitate future tracking of any sedimentation in Lake Coleman. Prior studies of Lake Coleman were unavailable for comparison. Each cross-section is presented in Appendix D, along with a map showing the locations of the sediment range lines and a table listing the endpoint coordinates of each range line.

Survey Results

The results of the TWDB 2006 Survey indicate Lake Coleman has a volume of 38,094 acre-feet and encompasses 1,811 acres at conservation pool elevation, 1,717.5 ft. Dead Pool Storage is 18 acre-feet, at dead pool elevation, 1,662.5 ft. Therefore, conservation storage capacity at conservation pool elevation is 38,076 acre-feet. Original reservoir capacity, as per Certificate of Adjudication No. 14-1702, was 40,000 acre-feet. This indicates the reservoir has experienced a 4.8% decrease in total reservoir capacity, or 1,906 acre-feet loss, since it was designed. Information provided by the City of Coleman[1] indicates the original surface area of the lake encompassed 2,000 acres. The TWDB 2006 survey indicates a 9.5%, or 189 acre, loss in surface area at the conservation pool elevation. Due to the differences in the methodologies used to calculate the reservoir's capacity between original impoundment and 2006, comparison of these values is not recommended and is presented here for informational purposes only.[3] The TWDB considers the 2006 survey to be a significant improvement over previous methods and recommends that the same methodology be used to resurvey Lake Coleman 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. United States Geological Survey, http://tx.usgs.gov/ 07 June 2006.
3. United States Department of Agriculture, Natural Resource Conservation Service, National Engineering Handbook, Section 3, Sedimentation, Chapter 7, Field Investigations and Surveys, December 1983.
4. 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.
5. ESRI, Environmental Systems Research Institute. 1995. ARC/INFO Surface Modeling and Display, TIN Users Guide.
6. Furnans, Jordan. Texas Water Development Board. 2006. "HydroEdit User's Manual."

Appendix A

Lake Coleman

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — JULY- AUGUST 2006 SURVEY

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 1,717.5.0'

ELEVATION INCREMENT IS ONE TENTH FOOT — Dead Pool Elevation 1,662.5 '

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1,657				0	0	0	0	0	0	0
1,658	0	0	0	0	0	0	0	0	0	0
1,659	0	0	0	0	0	1	1	1	1	1
1,660	1	1	1	1	2	2	2	3	3	3
1,661	4	4	5	5	6	7	8	8	9	10
1,662	11	13	14	15	17	18	20	22	24	26
1,663	29	31	34	37	40	43	46	49	53	57
1,664	61	65	69	73	78	83	87	92	97	103
1,665	108	113	119	125	130	136	142	148	155	161
1,666	167	174	181	187	194	201	208	215	222	230
1,667	237	245	252	260	268	276	284	292	300	308
1,668	316	325	333	341	350	358	367	376	385	393
1,669	402	411	421	430	439	449	458	468	477	487
1,670	497	507	517	527	537	548	558	568	579	590
1,671	601	612	623	634	646	657	669	680	692	704
1,672	716	728	740	753	765	777	790	802	815	828
1,673	841	854	867	880	894	907	920	934	948	961
1,674	975	989	1,004	1,018	1,032	1,047	1,061	1,076	1,091	1,106
1,675	1,121	1,136	1,152	1,167	1,183	1,198	1,214	1,230	1,246	1,263
1,676	1,279	1,296	1,312	1,329	1,346	1,364	1,381	1,399	1,417	1,435
1,677	1,453	1,471	1,490	1,509	1,528	1,548	1,568	1,588	1,608	1,628
1,678	1,649	1,670	1,692	1,713	1,735	1,757	1,780	1,802	1,825	1,848
1,679	1,872	1,896	1,920	1,944	1,969	1,994	2,019	2,045	2,071	2,097
1,680	2,124	2,151	2,178	2,205	2,233	2,261	2,289	2,318	2,347	2,376
1,681	2,405	2,435	2,465	2,495	2,525	2,556	2,587	2,618	2,649	2,681
1,682	2,713	2,745	2,778	2,811	2,844	2,877	2,911	2,945	2,980	3,014
1,683	3,049	3,085	3,120	3,157	3,193	3,230	3,267	3,305	3,343	3,381
1,684	3,420	3,459	3,499	3,539	3,579	3,620	3,661	3,703	3,745	3,787
1,685	3,830	3,873	3,917	3,961	4,005	4,049	4,094	4,139	4,185	4,231
1,686	4,277	4,323	4,370	4,417	4,464	4,511	4,559	4,607	4,655	4,704
1,687	4,753	4,802	4,851	4,901	4,951	5,001	5,052	5,103	5,154	5,205
1,688	5,257	5,309	5,361	5,414	5,466	5,519	5,572	5,626	5,679	5,733
1,689	5,787	5,841	5,896	5,950	6,005	6,060	6,116	6,171	6,227	6,283
1,690	6,339	6,396	6,453	6,510	6,567	6,624	6,682	6,740	6,798	6,857
1,691	6,915	6,974	7,034	7,093	7,153	7,213	7,273	7,334	7,395	7,457
1,692	7,519	7,581	7,644	7,707	7,771	7,834	7,898	7,963	8,028	8,093
1,693	8,158	8,224	8,289	8,356	8,422	8,489	8,556	8,624	8,692	8,760
1,694	8,828	8,897	8,966	9,036	9,105	9,175	9,246	9,316	9,387	9,459
1,695	9,530	9,602	9,674	9,747	9,819	9,893	9,966	10,040	10,114	10,189
1,696	10,264	10,339	10,415	10,491	10,567	10,644	10,721	10,798	10,876	10,955
1,697	11,033	11,112	11,191	11,271	11,351	11,432	11,512	11,594	11,675	11,757
1,698	11,840	11,922	12,006	12,089	12,173	12,258	12,343	12,429	12,515	12,601
1,699	12,688	12,776	12,864	12,953	13,042	13,132	13,223	13,314	13,406	13,498
1,700	13,591	13,684	13,778	13,872	13,967	14,063	14,159	14,256	14,353	14,451
1,701	14,549	14,648	14,747	14,847	14,947	15,048	15,150	15,252	15,355	15,458
1,702	15,561	15,665	15,770	15,875	15,980	16,086	16,193	16,300	16,407	16,515
1,703	16,624	16,733	16,842	16,952	17,063	17,174	17,285	17,397	17,510	17,623
1,704	17,737	17,851	17,965	18,081	18,196	18,313	18,429	18,547	18,665	18,783
1,705	18,902	19,022	19,142	19,263	19,384	19,506	19,628	19,751	19,875	19,999
1,706	20,124	20,249	20,375	20,502	20,628	20,756	20,884	21,013	21,143	21,273
1,707	21,403	21,534	21,666	21,798	21,931	22,065	22,199	22,334	22,470	22,606
1,708	22,742	22,880	23,017	23,156	23,294	23,434	23,574	23,714	23,855	23,997
1,709	24,139	24,281	24,424	24,568	24,713	24,857	25,003	25,149	25,295	25,442
1,710	25,590	25,739	25,888	26,037	26,187	26,338	26,490	26,642	26,795	26,948
1,711	27,101	27,255	27,410	27,565	27,720	27,876	28,033	28,190	28,347	28,505
1,712	28,664	28,823	28,983	29,143	29,304	29,465	29,627	29,789	29,952	30,117
1,713	30,282	30,447	30,613	30,779	30,946	31,113	31,280	31,448	31,616	31,784
1,714	31,953	32,122	32,292	32,462	32,632	32,803	32,974	33,145	33,317	33,490
1,715	33,664	33,837	34,011	34,185	34,360	34,534	34,709	34,885	35,061	35,236
1,716	35,413	35,589	35,766	35,944	36,121	36,299	36,477	36,655	36,834	37,013
1,717	37,192	37,372	37,552	37,732	37,913	38,094				

Appendix B

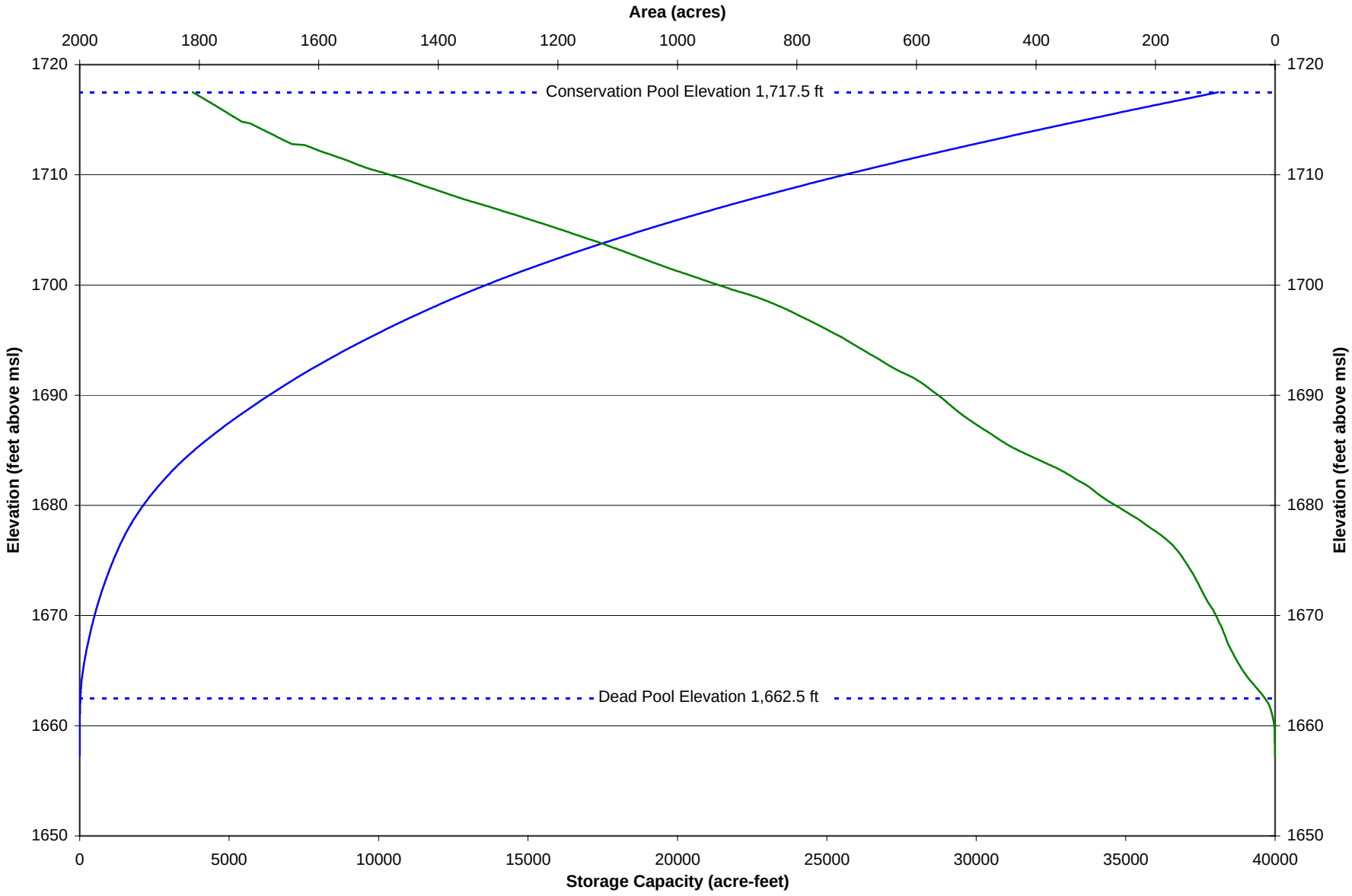
Lake Coleman

RESERVOIR AREA TABLE

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

JULY- AUGUST 2006 SURVEY
Conservation Pool Elevation 1,717.5.0'
Dead Pool Elevation 1,662.5 '

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
1,657				0	0	0	0	0	0	0
1,658	0	0	0	0	0	0	0	0	0	0
1,659	0	0	0	1	1	1	1	1	1	1
1,660	1	1	2	2	2	3	3	4	4	4
1,661	5	5	6	6	7	7	8	9	9	10
1,662	11	12	14	15	16	17	18	20	21	23
1,663	24	26	27	29	31	32	34	35	37	38
1,664	40	42	43	44	46	47	49	50	51	52
1,665	54	55	56	57	58	60	61	62	63	64
1,666	65	66	67	68	69	70	71	72	73	74
1,667	75	76	77	77	78	79	80	81	81	82
1,668	83	83	84	85	85	86	87	88	88	89
1,669	90	91	92	93	94	95	95	96	97	98
1,670	99	100	101	102	103	104	105	106	107	108
1,671	110	111	112	113	114	115	116	117	118	119
1,672	120	121	122	123	124	125	126	127	128	129
1,673	130	130	131	132	133	134	135	137	138	139
1,674	140	141	142	143	144	146	147	148	149	150
1,675	152	153	154	155	156	158	159	160	162	164
1,676	165	167	168	170	172	174	176	178	180	182
1,677	184	186	189	191	193	196	199	201	204	207
1,678	210	212	215	217	220	222	225	228	231	234
1,679	237	240	243	246	249	252	255	258	261	264
1,680	267	270	273	276	279	282	285	288	290	293
1,681	295	298	300	302	305	307	309	312	315	318
1,682	321	324	328	331	334	337	340	342	345	349
1,683	352	356	359	362	366	370	374	378	382	386
1,684	390	394	398	402	406	410	414	418	422	426
1,685	430	434	438	441	444	447	450	453	456	459
1,686	462	465	468	470	473	476	478	481	484	487
1,687	490	493	496	499	502	504	507	510	513	515
1,688	518	520	523	525	528	530	533	535	537	539
1,689	541	543	546	548	550	552	554	557	559	561
1,690	564	566	569	571	574	576	579	581	583	586
1,691	588	591	594	597	600	603	606	610	613	618
1,692	622	626	629	633	636	639	643	646	649	652
1,693	655	658	661	664	667	670	673	677	680	683
1,694	686	689	692	696	699	702	705	708	711	714
1,695	717	720	723	726	730	734	737	741	744	748
1,696	751	755	758	762	766	769	773	776	780	784
1,697	788	791	795	799	802	806	810	814	818	822
1,698	826	830	835	839	843	848	853	858	862	867
1,699	873	879	885	891	897	903	909	914	919	925
1,700	931	936	942	948	953	958	964	969	974	980
1,701	985	991	997	1,002	1,008	1,013	1,018	1,023	1,028	1,033
1,702	1,038	1,043	1,048	1,053	1,058	1,063	1,068	1,073	1,078	1,083
1,703	1,088	1,092	1,098	1,103	1,108	1,113	1,118	1,123	1,128	1,133
1,704	1,138	1,144	1,150	1,155	1,160	1,166	1,171	1,177	1,182	1,188
1,705	1,193	1,199	1,205	1,210	1,216	1,221	1,227	1,233	1,239	1,244
1,706	1,250	1,256	1,261	1,267	1,273	1,279	1,285	1,291	1,297	1,303
1,707	1,309	1,315	1,321	1,327	1,333	1,340	1,346	1,352	1,358	1,363
1,708	1,369	1,374	1,380	1,385	1,391	1,396	1,402	1,407	1,413	1,418
1,709	1,424	1,429	1,435	1,440	1,445	1,451	1,457	1,463	1,469	1,475
1,710	1,481	1,487	1,493	1,499	1,505	1,512	1,518	1,523	1,528	1,533
1,711	1,538	1,543	1,547	1,552	1,557	1,563	1,568	1,573	1,578	1,583
1,712	1,589	1,595	1,600	1,604	1,609	1,614	1,619	1,623	1,645	1,649
1,713	1,653	1,657	1,660	1,664	1,668	1,672	1,675	1,679	1,683	1,686
1,714	1,690	1,694	1,698	1,701	1,705	1,709	1,712	1,716	1,728	1,731
1,715	1,734	1,737	1,740	1,743	1,746	1,749	1,752	1,755	1,758	1,761
1,716	1,764	1,767	1,771	1,774	1,777	1,780	1,783	1,786	1,789	1,792
1,717	1,795	1,798	1,801	1,804	1,808	1,811				



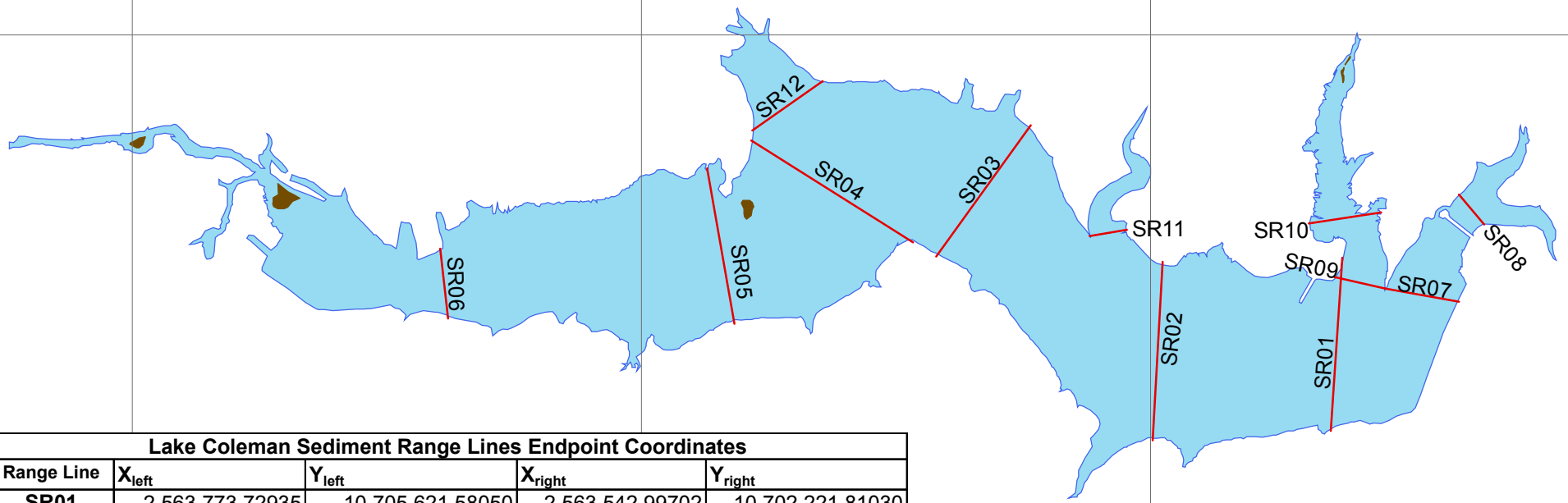
Lake Coleman
July-August 2006 Survey
Prepared by: TWDB

Appendix C: Area and Capacity Curves

Appendix D

Lake Coleman

Sediment Range Lines



Lake Coleman Sediment Range Lines Endpoint Coordinates				
Range Line	X_{left}	Y_{left}	X_{right}	Y_{right}
SR01	2,563,773.72935	10,705,621.58050	2,563,542.99702	10,702,221.81030
SR02	2,560,244.73673	10,705,541.09630	2,560,042.37313	10,702,028.64240
SR03	2,557,648.18754	10,708,227.74990	2,555,799.96489	10,705,642.27810
SR04	2,552,165.22889	10,707,927.04930	2,555,344.64680	10,705,924.14170
SR05	2,551,290.14761	10,707,376.82320	2,551,832.19295	10,704,319.68740
SR06	2,546,052.47463	10,705,798.57630	2,546,209.37589	10,704,428.09650
SR07	2,566,061.75625	10,704,754.82240	2,564,619.24625	10,705,012.73110
SR08	2,566,563.71336	10,706,270.27940	2,566,068.26360	10,706,865.00470
SR09	2,564,615.22082	10,705,011.86510	2,563,620.48197	10,705,245.22340
SR10	2,564,541.18041	10,706,506.98090	2,563,114.38853	10,706,290.70250
SR11	2,559,540.63600	10,706,167.25550	2,558,811.40289	10,706,043.75630
SR12	2,553,564.43468	10,709,094.39820	2,552,183.37421	10,708,118.58320

Established by: TWDB 2006 Coordinates in feet, NAD83 State Plane Texas Central Zone

2,540,000 2,550,000 2,560,000

10,710,000 10,700,000

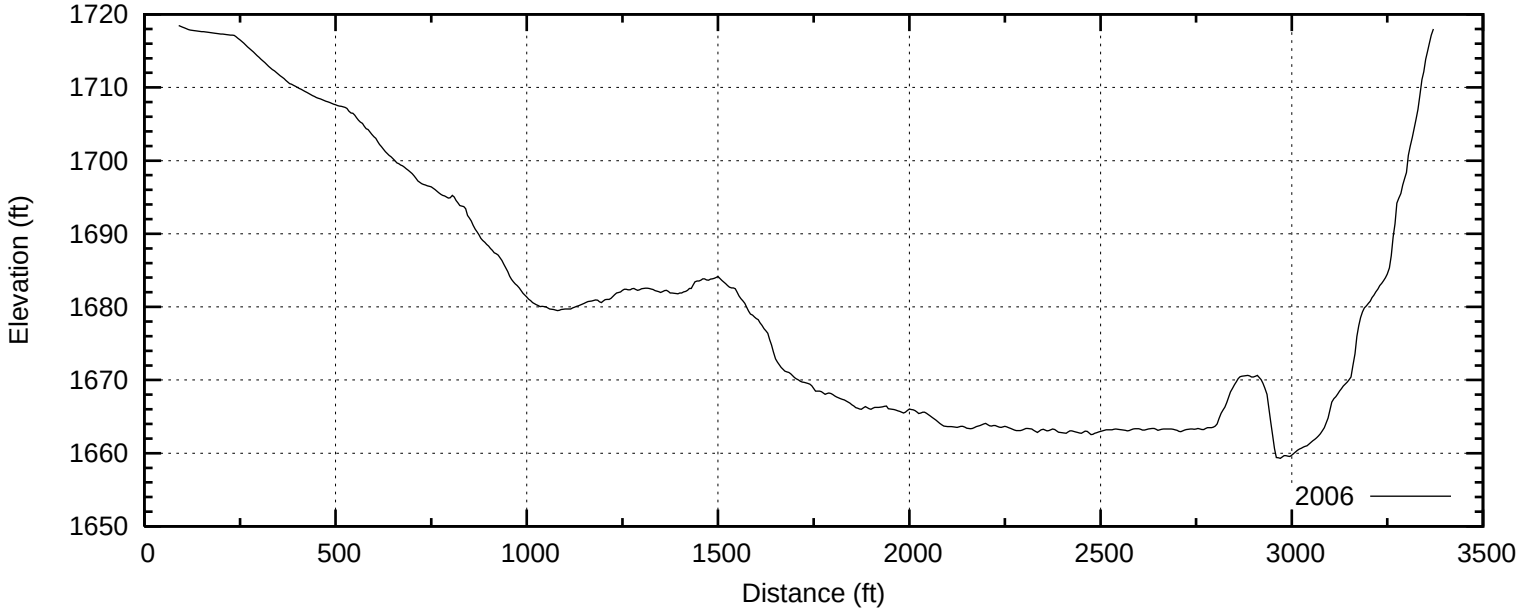
0 0.25 0.5 1 Miles

Legend

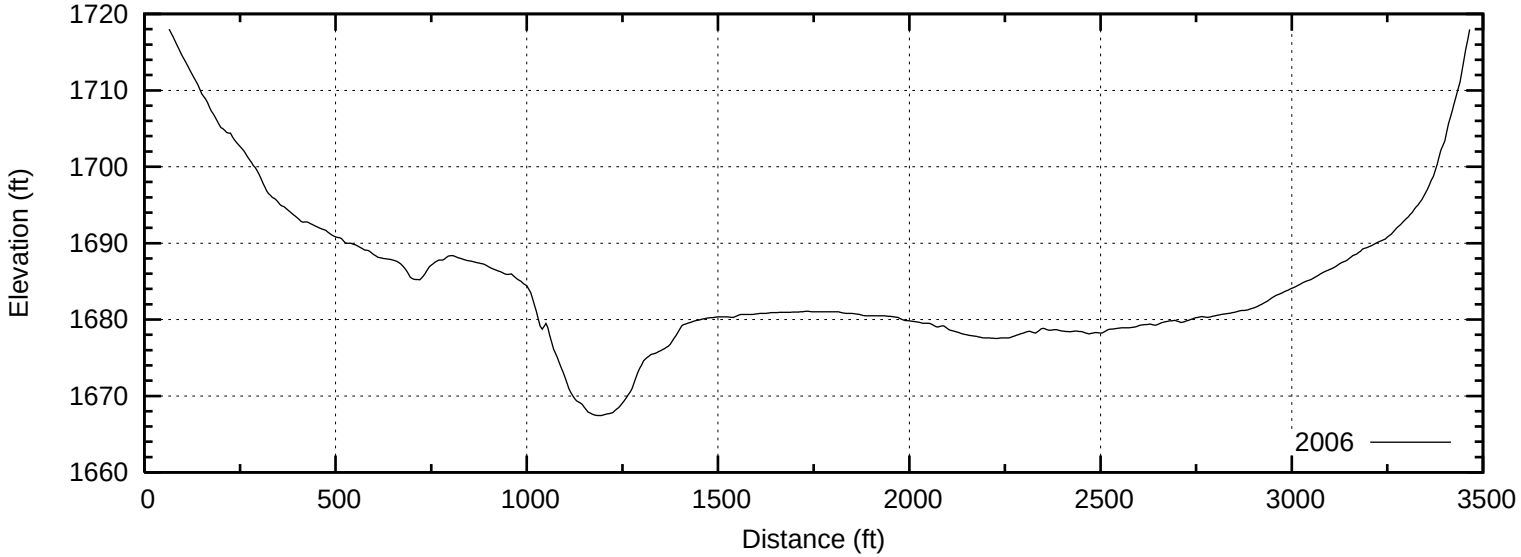
- Sediment Range Lines
- Islands
- Lake Coleman Boundary Elev. 1,718.5'

Lake Coleman

Range Line SR01

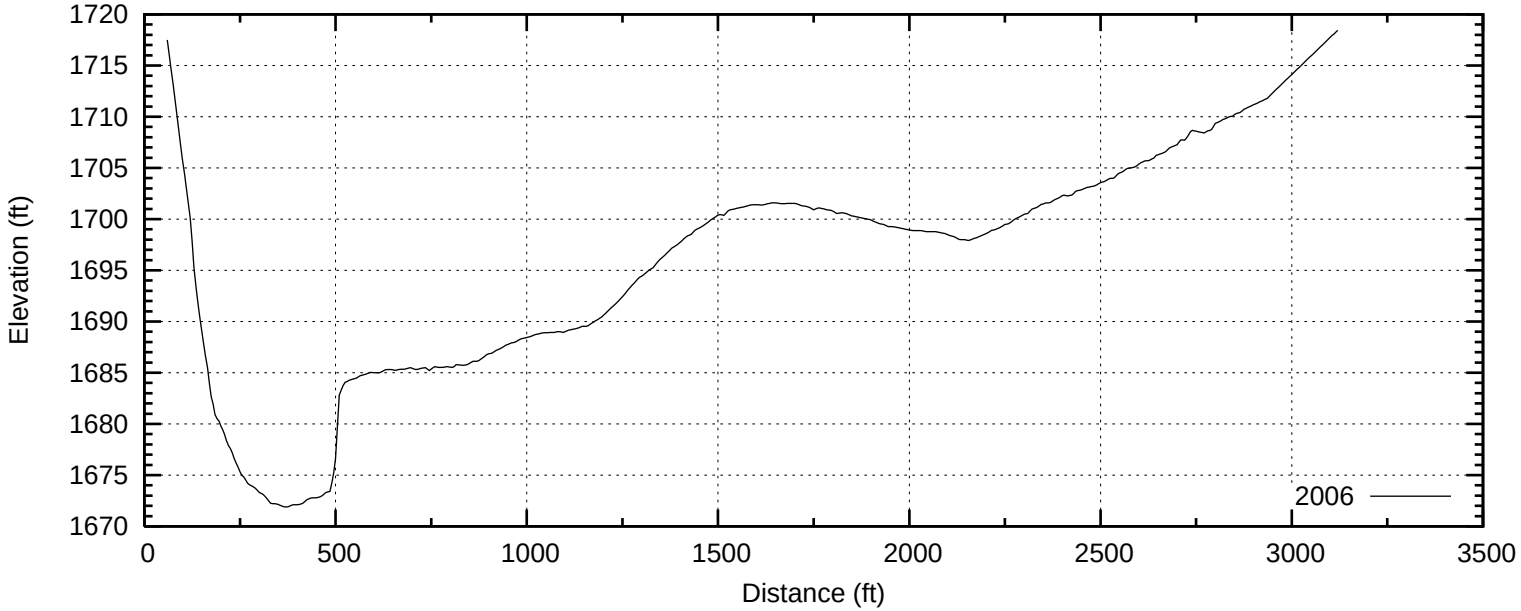


Range Line SR02

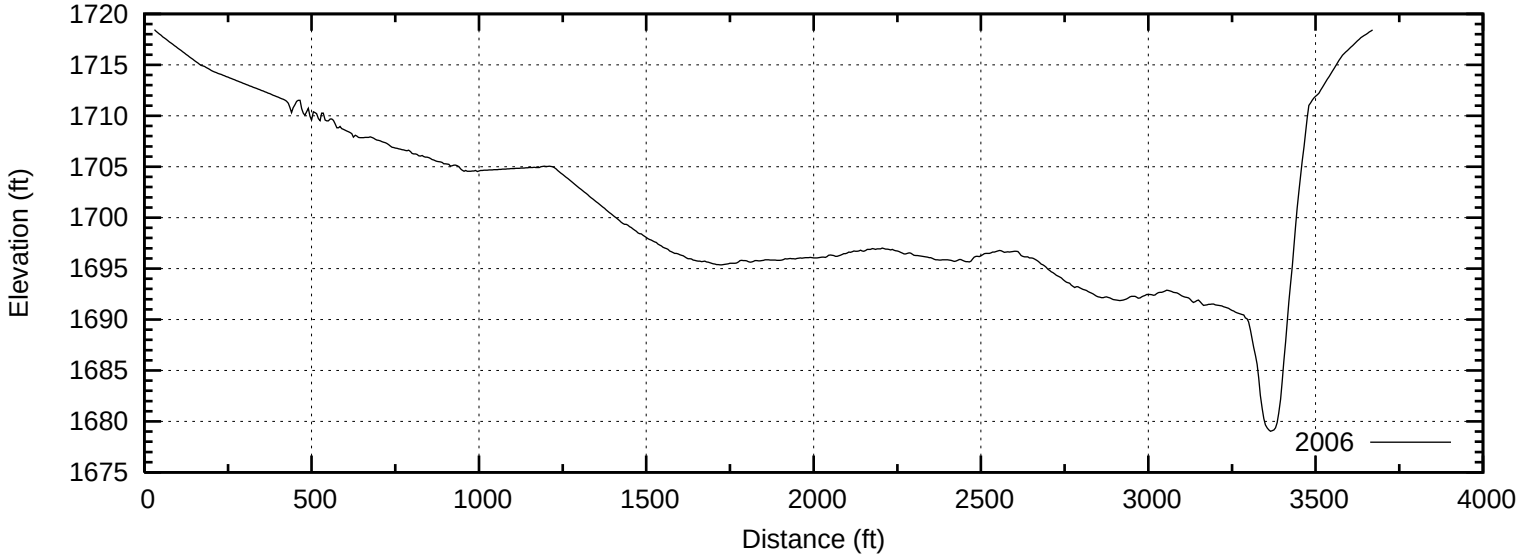


Lake Coleman

Range Line SR03

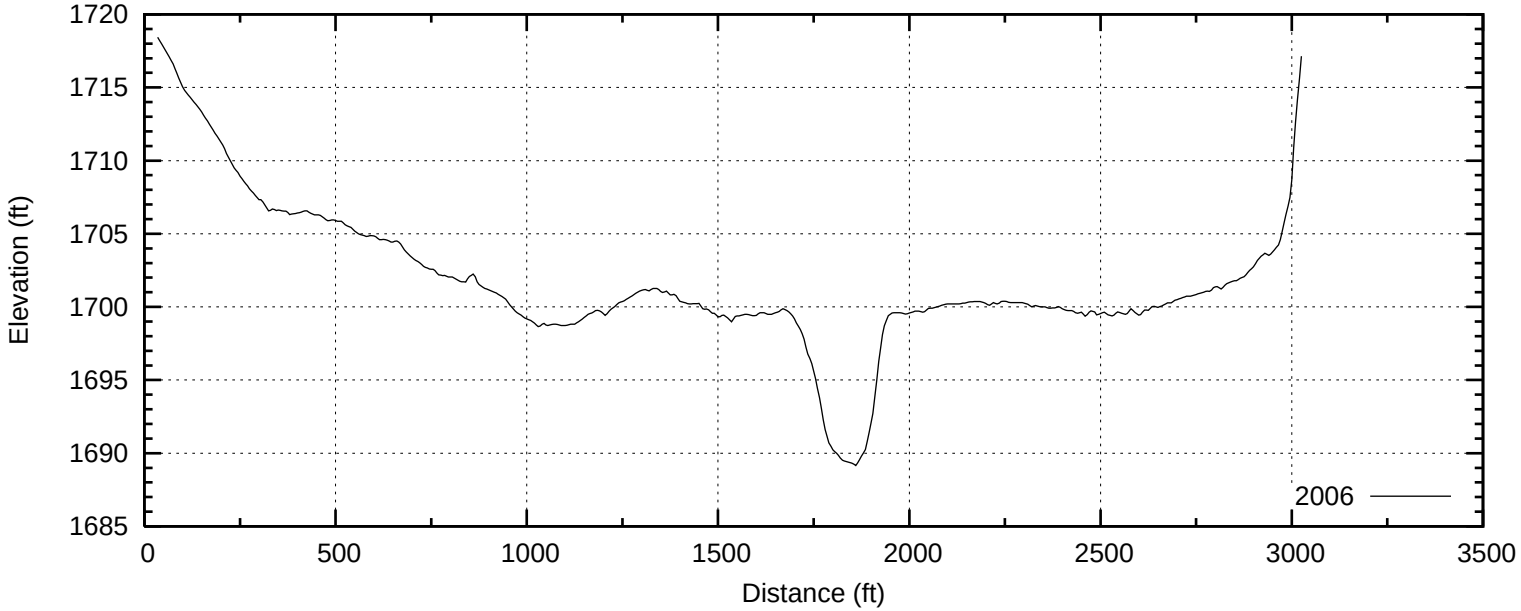


Range Line SR04

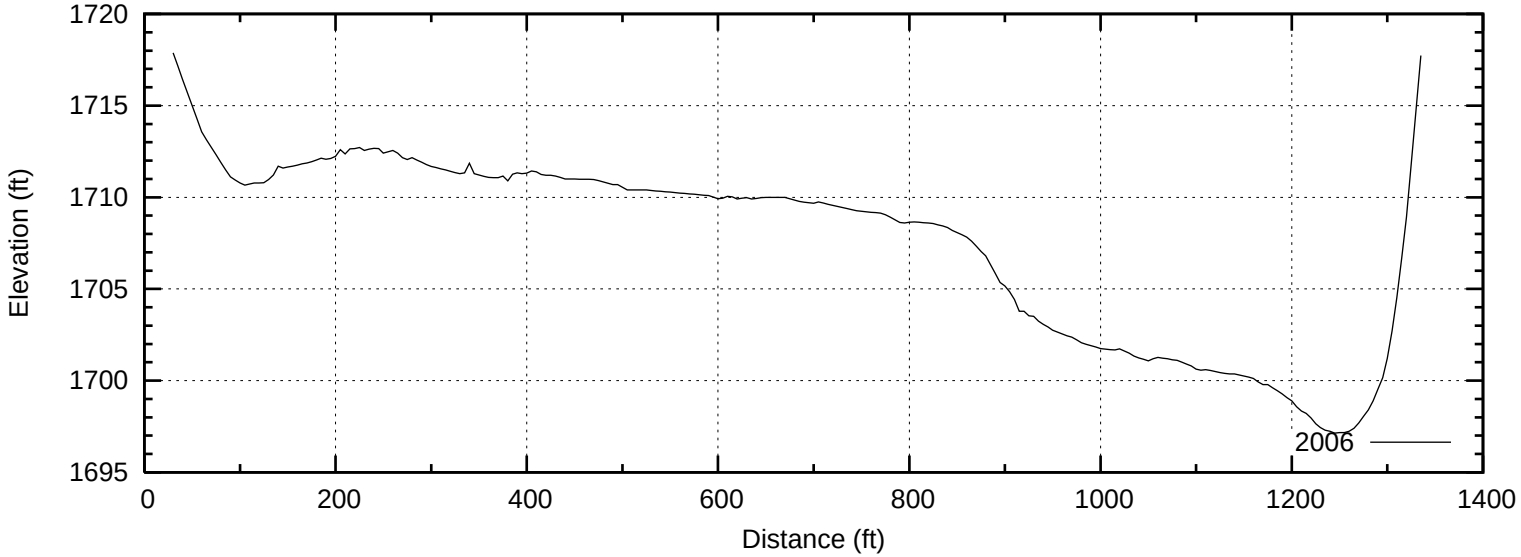


Lake Coleman

Range Line SR05

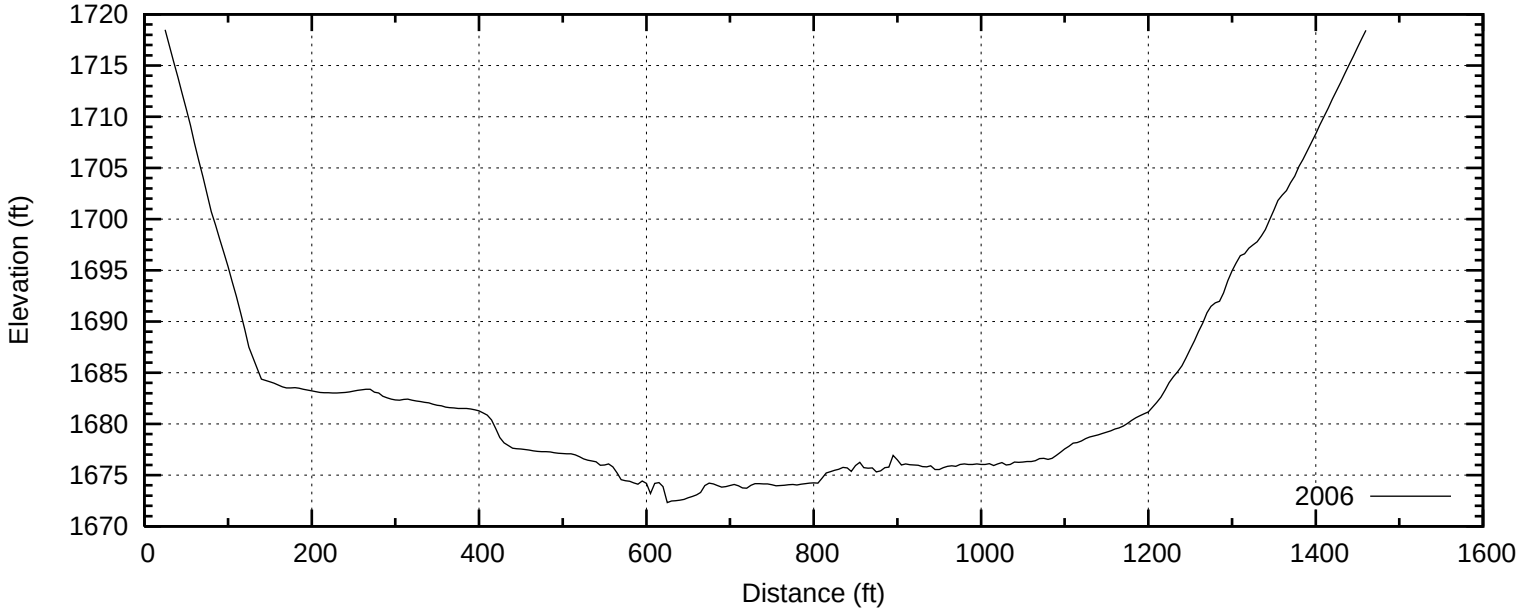


Range Line SR06

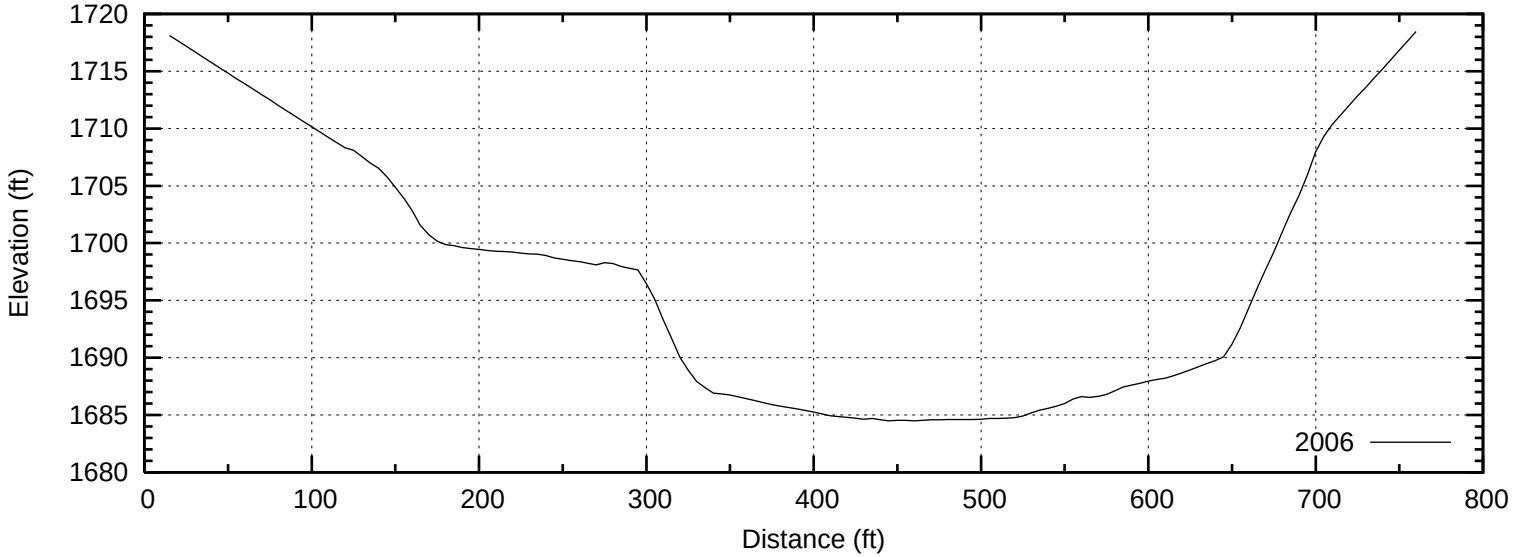


Lake Coleman

Range Line SR07

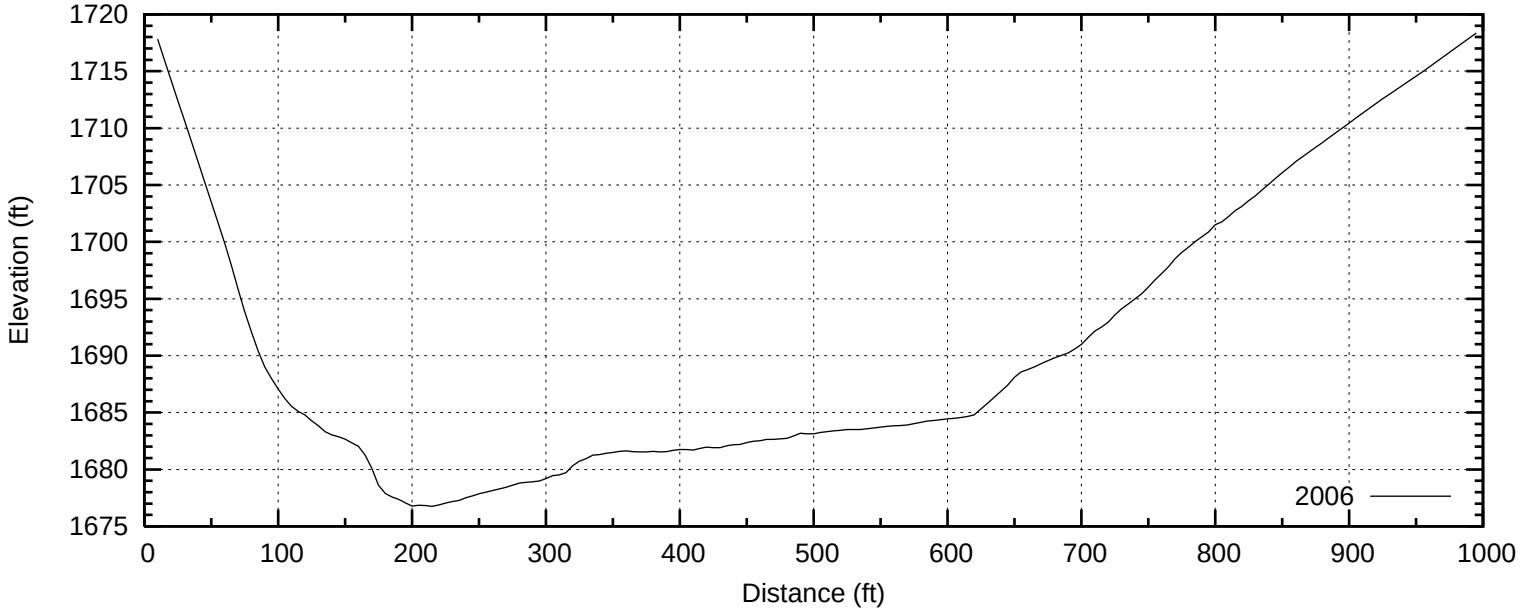


Range Line SR08

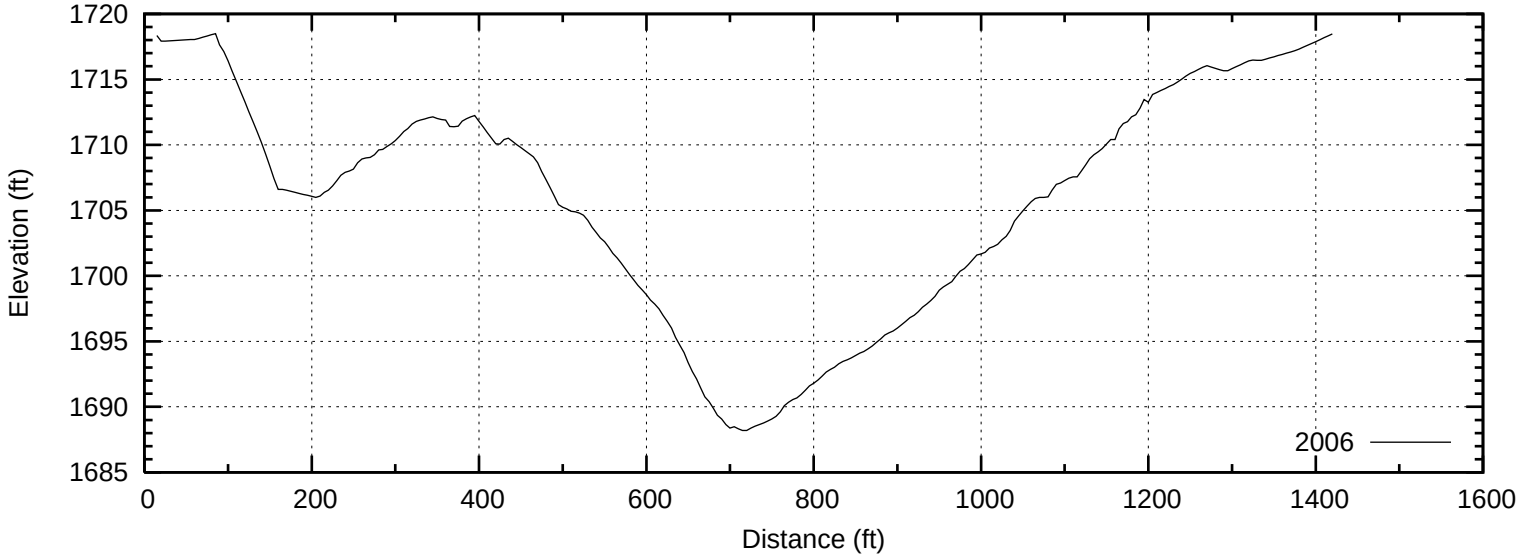


Lake Coleman

Range Line SR09

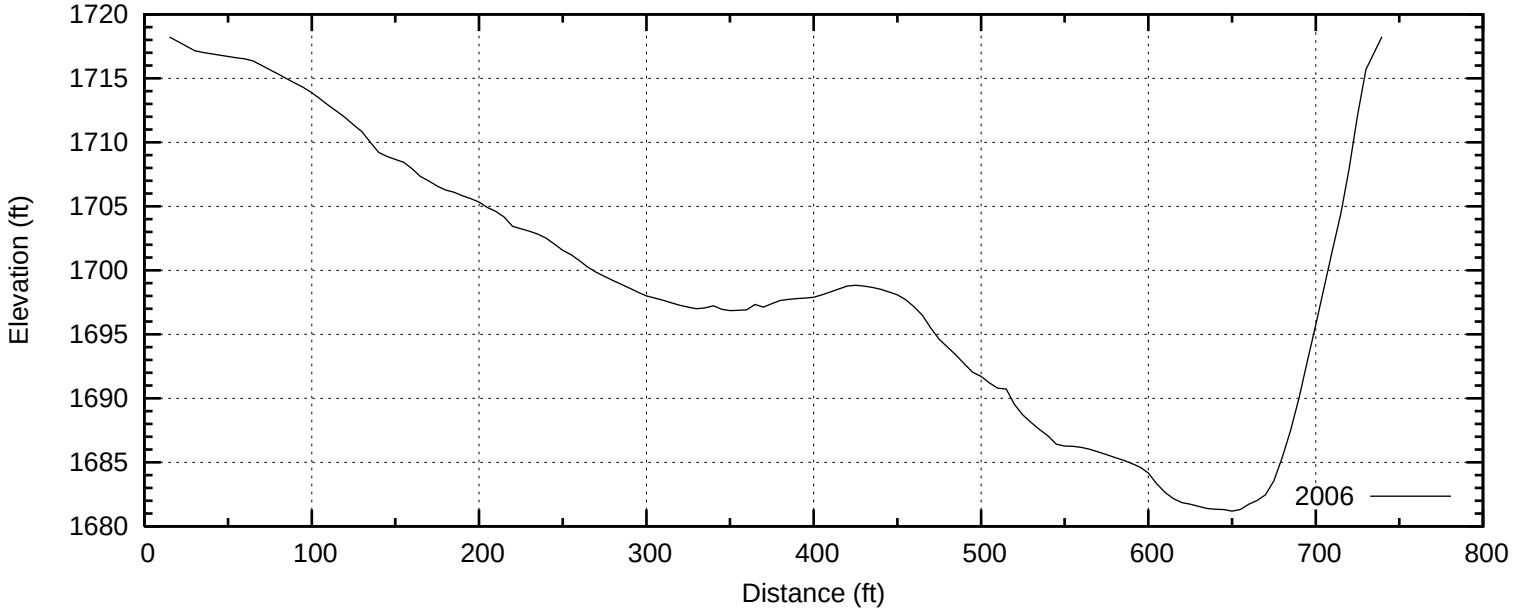


Range Line SR10



Lake Coleman

Range Line SR11



Range Line SR12

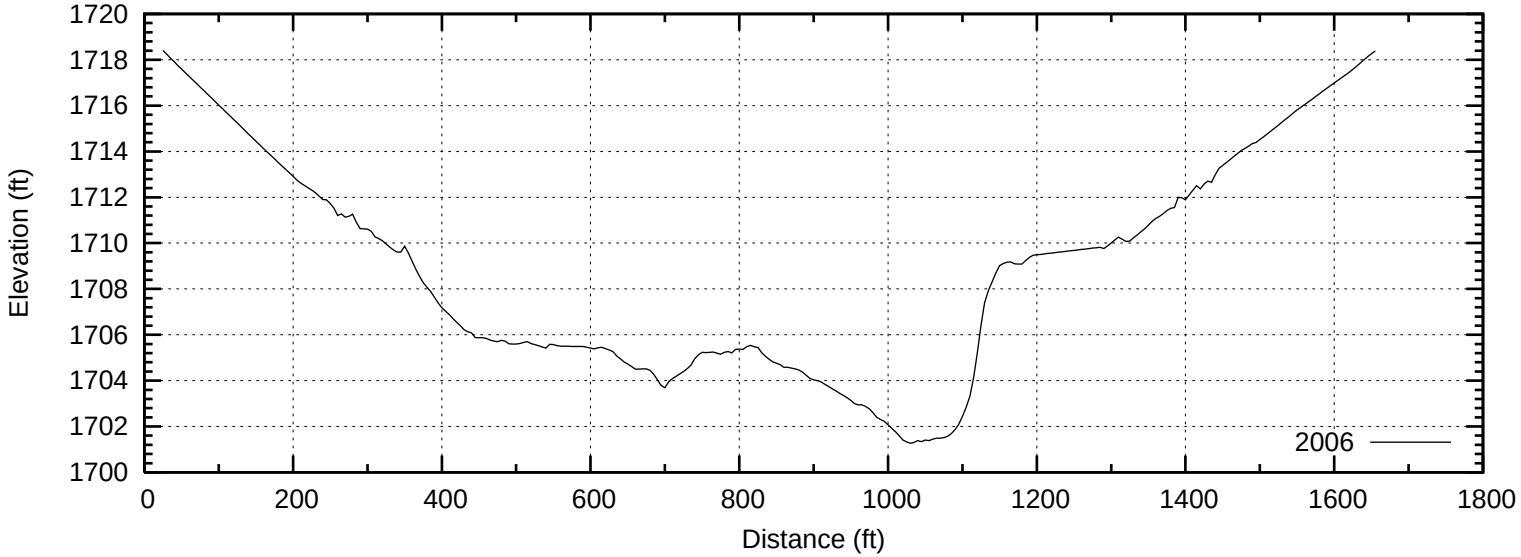
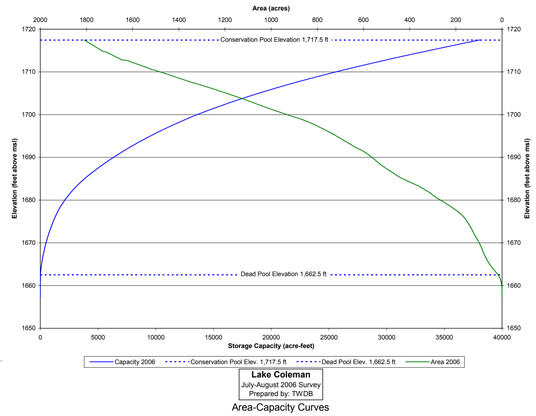


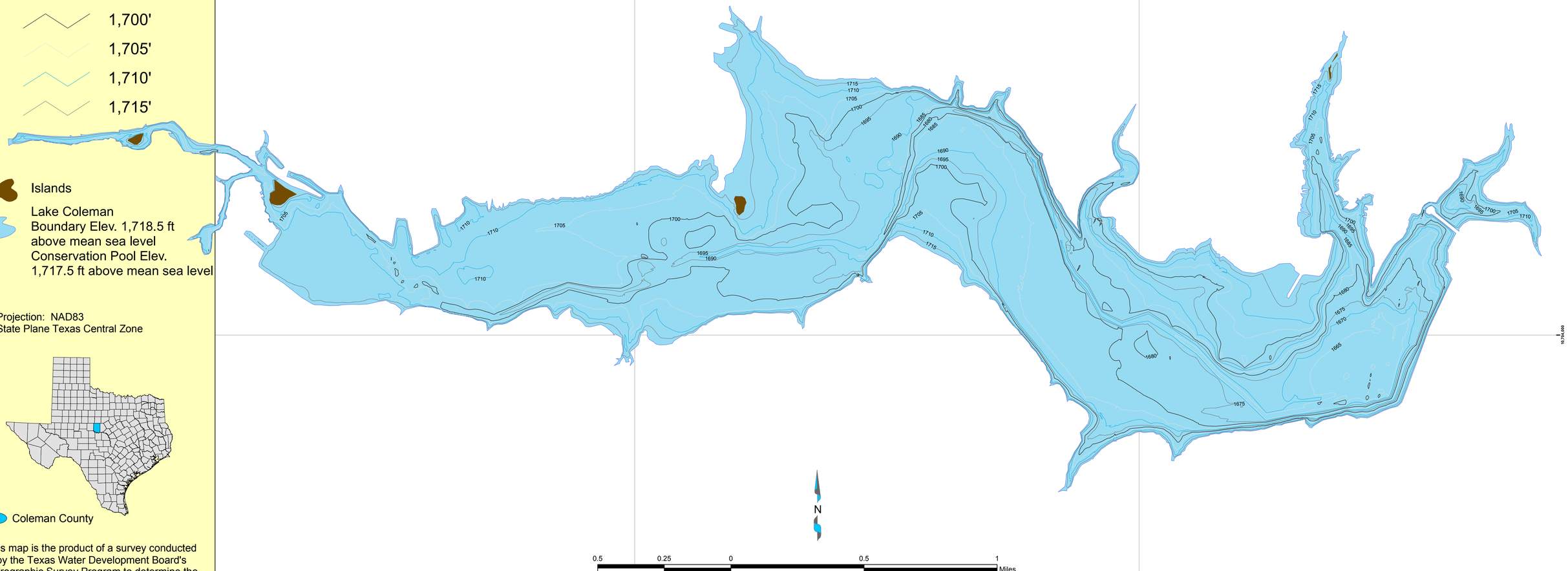
Figure 5

LAKE COLEMAN

5' - Contour Map



Area-Capacity Curves



CONTOURS

- 1,660'
- 1,665'
- 1,670'
- 1,675'
- 1,680'
- 1,685'
- 1,690'
- 1,695'
- 1,700'
- 1,705'
- 1,710'
- 1,715'

Islands

Lake Coleman
Boundary Elev. 1,718.5 ft above mean sea level
Conservation Pool Elev. 1,717.5 ft above mean sea level

Projection: NAD83
State Plane Texas Central Zone

Coleman County

This map is the product of a survey conducted by the Texas Water Development Board's Hydrographic Survey Program to determine the capacity of Lake Coleman. The Texas Water Development Board makes no representation or assumes any liability.

Prepared by : TEXAS WATER DEVELOPMENT BOARD JULY-AUGUST 2006 SURVEY