Volumetric Survey of AQUILLA LAKE

March 2008 Survey

Prepared by:

The Texas Water Development Board

April 2009

Texas Water Development Board

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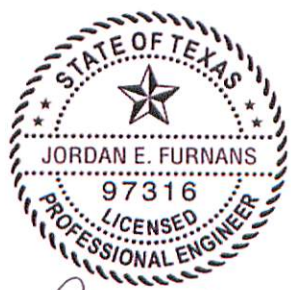

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Executive Summary

In March of 2008, the Texas Water Development Board (TWDB) entered into agreement with the U.S. Army Corps of Engineers (USACE), for the purpose of performing a volumetric survey of Aquilla Lake. This survey was performed while the water surface elevation of the reservoir was held at approximately five feet above conservation pool elevation to better estimate the volume of water that can be stored in the flood pool as part of a reallocation study being carried out by USACE and the Brazos River Authority. The conservation pool elevation for the lake is 537.5 feet above mean sea level (NGVD 29). Bathymetric data collection occurred March 27th through April 2nd of 2008 while the daily average water surface elevation of the lake ranged between 542.2 feet and 542.5 feet above mean sea level (NGVD 29).

This survey was performed using a single-frequency (200 kHz) depth sounder and differential GPS navigation equipment. Data was collected along pre-planned survey lines spaced at approximately 250 foot intervals perpendicular to the submerged river channel.

The results of the TWDB 2008 Volumetric Survey indicate Aquilla Lake has a total reservoir capacity of 44,566 acre-feet and encompasses 3,066 acres at conservation pool elevation (537.5 feet above mean sea level, NGVD 29). An additional 15,446 acre-feet of water can be stored between conservation pool elevation and 542.1 feet above mean sea level, for a total reservoir capacity of 60,012 acre-feet at elevation 542.1 feet. At elevation 542.1 feet, Aquilla Lake encompasses 3,650 acres.

TWDB previously surveyed Aquilla Lake in October of 1995 and April of 2002. Comparisons of capacities at conservation pool elevation derived from current and previous surveys suggest Aquilla Lake looses between 84 acre-feet per year and 218 acre-feet per year. Detailed spatial comparisons of survey results from 1995, 2002, and 2008 were not performed, yet could provide further insight into the locations of active depositional environments in Aquilla Lake. To improve estimates of sediment accumulation rates, TWDB recommends resurveying Aquilla Lake in approximately 10 years or after a major flood event, and that the next lake survey be a sedimentation survey. In sedimentation surveys, TWDB employs a multi-frequency depth sounder to measure both the water depth and the sediment thickness throughout the lake. Results from sedimentation surveys include current reservoir capacities, computed sediment volumes, and maps identifying the spatial distribution of sediment throughout the lake.

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Note: *References to brand names throughout this report do not imply endorsement by the Texas Water Development Board*

Aquilla Lake General Information

Aquilla Dam and Aquilla Lake are located on Aquilla and Hackberry Creeks, (tributaries of the Brazos River) approximately seven miles southeast of Hillsboro, in Hill County, Texas[1], (Figure 1). Aquilla Lake is owned by the U.S. Government and maintained and operated by the U.S. Army Corps of Engineers, Fort Worth District. Construction on Aquilla Lake began on June 14, 1978, with deliberate impoundment beginning on April 29, 1983. The dam was completed on May 16, 1983.[2] The reservoir serves primarily as flood control and water supply storage. Additional pertinent data about Aquilla Dam can be found in Table 1.

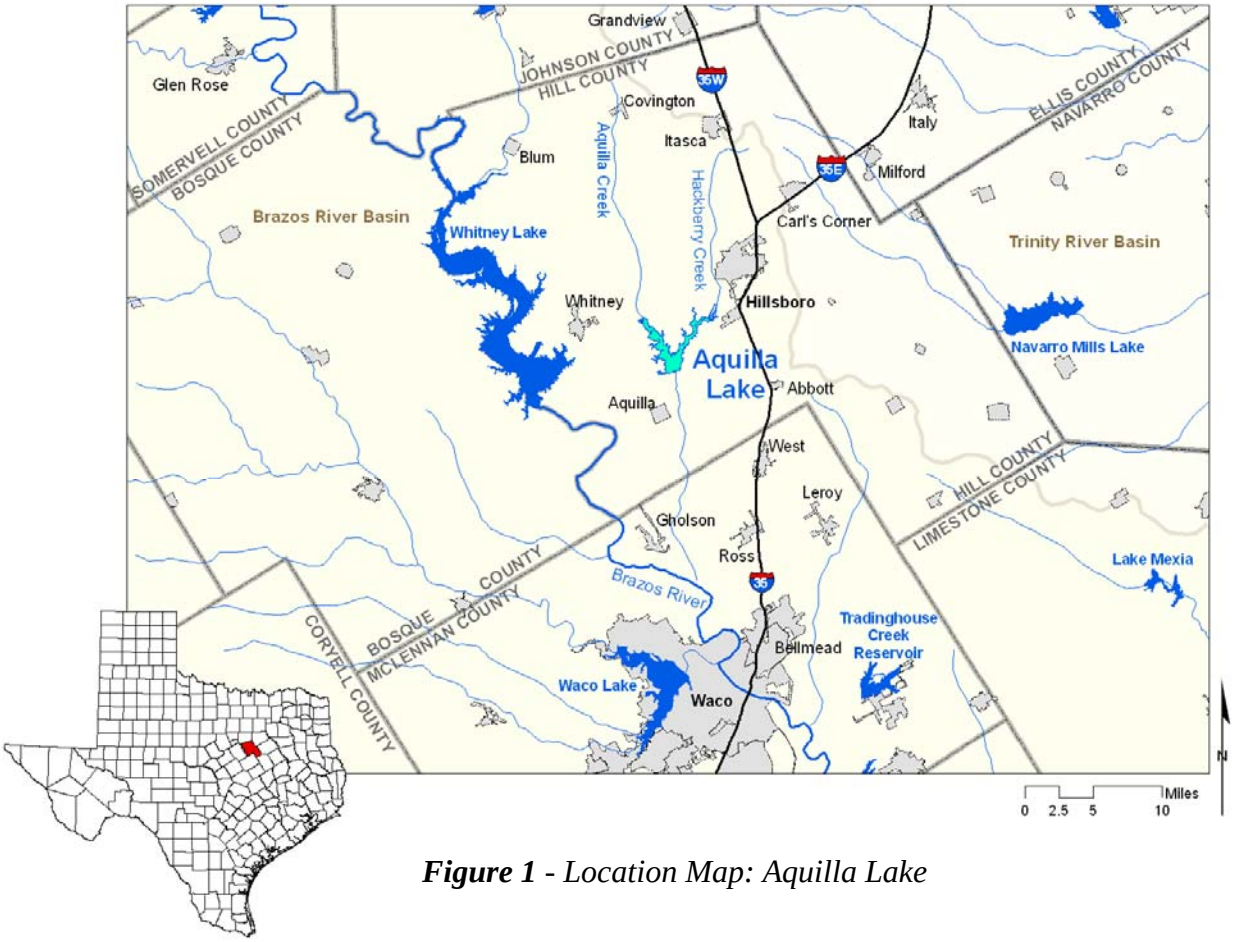

Figure 1 *- Location Map: Aquilla Lake*

Table 1. Pertinent Data for Aquilla Dam and Aquilla Lake[1,2]

Owner

The U.S. Government, Operated by the U.S. Army Corps of Engineers, Fort Worth District.

Engineer (Design)

U.S Army Corps of Engineers, Fort Worth District

Location of Dam

At river mile 23.3 on Aquilla Creek, in the Brazos River Basin, approximately 7 miles southeast of Hillsboro and 1 mile east of Aquilla in Hill County, Texas.

Drainage Area

252 square miles

Dam

Type	Rolled earthfill
Length	11,890 feet
Maximum Height	104.55 feet
Top Width	38 feet

Spillway

Type	Limited service
Length	1,200 feet net at crest
Crest elevation	564.5 feet above mean sea level
Control	None

Outlet Works

Type	1 gate controlled conduit
Dimension	10 foot diameter
Invert elevation	503.0 feet above mean sea level
Control	2 Service and 2 Emergency 4.5’ by 10’ manually operated gates

Low Flow Outlets (discharges to flood control conduit)

Type	1-1.0 foot diameter pipe emptying into flood control conduit
Invert elevation	505.0 feet above mean sea level
Control	1.0 foot sluice gate

Reservoir Data (Based on TWDB 2008 Volumetric Survey)

Feature	**Elevation (feet above mean sea level)**	**Capacity (Acre-feet)**	**Area (Acres)**
Top of Dam	582.5	N/A	N/A
Maximum design water surface	577.5	N/A	N/A
Spillway Crest	564.5	N/A	N/A
Top of flood control pool	556.0	N/A	N/A
2008 Reallocation Study	542.1	60,012	3,650
Top of conservation pool	537.5	44,566*	3,066
Sediment pool**	503.0	106	73
Usable storage		44,460***	
Streambed	478.0	0	0

*Total Reservoir Capacity

**The sediment pool or dead pool storage is that capacity of water below the invert of the lowest outlet

***Conservation Storage Capacity (Total Reservoir Capacity minus Sediment Pool Storage)

Water Rights

The water rights for Aquilla Lake are appropriated to the Brazos River Authority through Certificate of Adjudication No. 12-5158. Certificate of Adjudication No. 12-5158 authorizes the Brazos River Authority to store 52,400 acre-feet of water in Aquilla Lake up to conservation pool elevation 537.5 feet above mean sea level. The Brazos River Authority is authorized a priority right to divert and use a maximum of 13,896 acre-feet of water per year for municipal, industrial, and mining purposes. Aquilla Lake may also be used for non-consumptive recreation purposes. This certificate has a priority date of October 25, 1976.

The Brazos River Authority optimizes water supply from its reservoirs and run-of-the-river supplies through a coordinated system operation of its water rights.[3] For the purposes of system operation, the Authority is authorized by Certificate of Adjudication No. 12-5158 to exceed the priority right and divert a yearly maximum of 17,000 acre-feet of water for municipal purposes, 18,200 acre-feet of water for industrial purposes, and 200 acre-feet of water for mining purposes. Any diversions in excess of the 13,896 acre-feet in any calendar year are charged against the sum of the amounts designated as priority rights in the other reservoirs included in the System Operation Order. This system operation is incorporated into the Brazos River Authority's water rights for all lakes in the system: Lake Possum Kingdom, Lake Granbury, Lake Whitney, Lake Aquilla, Lake Proctor, Lake Belton, Lake Stillhouse Hollow, Lake Georgetown, Lake Granger, Lake Limestone, and Lake Somerville.[3]

Certificate of Adjudication No. 12-5167, issued December 14, 1987, authorizes the Brazos River Authority to divert and use a maximum of 30,000 acre-feet of water per year from the reservoirs authorized under Certificates of Adjudication 12-5155 (Possum Kingdom Reservoir), 12-5156 (Lake Granbury), 12-5157 (Lake Whitney), 12-5158 (Lake Aquilla), 12-5159 (Lake Proctor), 12-5160 (Lake Belton), 12-5161 (Stillhouse Hollow Reservoir), 12-5162 (Lake Georgetown), 12-5163 (Lake Granger), 12-5164 (Somerville Lake), and 12-5165 (Lake Limestone) for municipal purposes in the San Jacinto-Brazos Coastal Basin. The Brazos River Authority is also authorized to divert and use and maximum of 170,000 acre-feet per year from the previously listed reservoirs for industrial purposes in the San Jacinto-Brazos Coastal Basin. This certificate may not be construed as authorizing an appropriative right in excess of those rights, above, held by the Brazos

River Authority. The complete certificates are on file in the Records Division of the Texas Commission on Environmental Quality.

Volumetric Survey of Aquilla Lake

The Hydrographic Survey Program of the Texas Water Development Board (TWDB) was authorized by the state legislature in 1991. The Texas Water Code authorizes TWDB to perform surveys to determine reservoir storage capacity, sedimentation levels, rates of sedimentation, and projected water supply availability.

In March of 2008, the Texas Water Development Board (TWDB) entered into agreement[4] with the U.S. Army Corps of Engineers, for the purpose of performing a volumetric survey of Aquilla Lake. This survey was performed while the reservoir was held approximately five feet above conservation pool elevation to better estimate the volume of water that can be stored in the flood pool as part of a reallocation study being carried out by the U.S. Army Corps of Engineers and the Brazos River Authority. This report describes the methods used in conducting the volumetric survey, including data collection methods and data processing techniques. This report serves as the final contract deliverable from TWDB to the U.S. Army Corps of Engineers, and contains as deliverables: (1) an elevation-area-capacity table of the lake acceptable to the Texas Commission on Environmental Quality [Appendix A,B], (2) a bottom contour map [Figure 5], and (3) a shaded relief plot of the lake bottom [Figure 3].

Datum

The vertical datum used during this survey is that used by the United States Geological Survey (USGS) for the reservoir elevation gage USGS 08093350 Aquilla Lk abv Aquilla, TX.[5] The datum for this gage is reported as National Geodetic Vertical Datum 1929 (NGVD 29) 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 gage. The horizontal datum used for this report is North American Datum of 1983 (NAD83) State Plane Texas North Central Zone (feet).

TWDB Bathymetric Data Collection

Bathymetric data collection occurred March 27th through April 2nd 2008 while the daily average water surface elevation of the lake ranged between 542.2 feet and 542.5 feet above mean sea level (NGVD 29). For data collection, TWDB used a Knudsen Engineering Ltd. single-frequency (200 kHz) depth sounder integrated with Differential Global Positioning System (DGPS) equipment. A Specialty Devices, Inc. multi-frequency sub-bottom profiling depth sounder integrated with DGPS was also used. Although the Specialty Devices, Inc. depth sounder collects data with 200 kHz, 50 kHz, and 24 kHz frequency signals, only data from the 200 kHz frequency signal was used in developing this report. Data collection occurred while navigating along pre-planned range lines oriented perpendicular to the location of the original river channels and spaced approximately 250 feet apart. Data was also collected along some of the survey lines used during the 2002 Aquilla Lake survey conducted by TWDB. A weighted tape and stadia rod were used to physically verify the depth readings recorded by the Knudsen and Specialty Devices, Inc. echosounders. During the 2008 survey, team members collected approximately 99,460 data points over cross-sections totaling nearly 160 miles in length. Figure 2 shows where data points were collected during the TWDB 2008 survey.

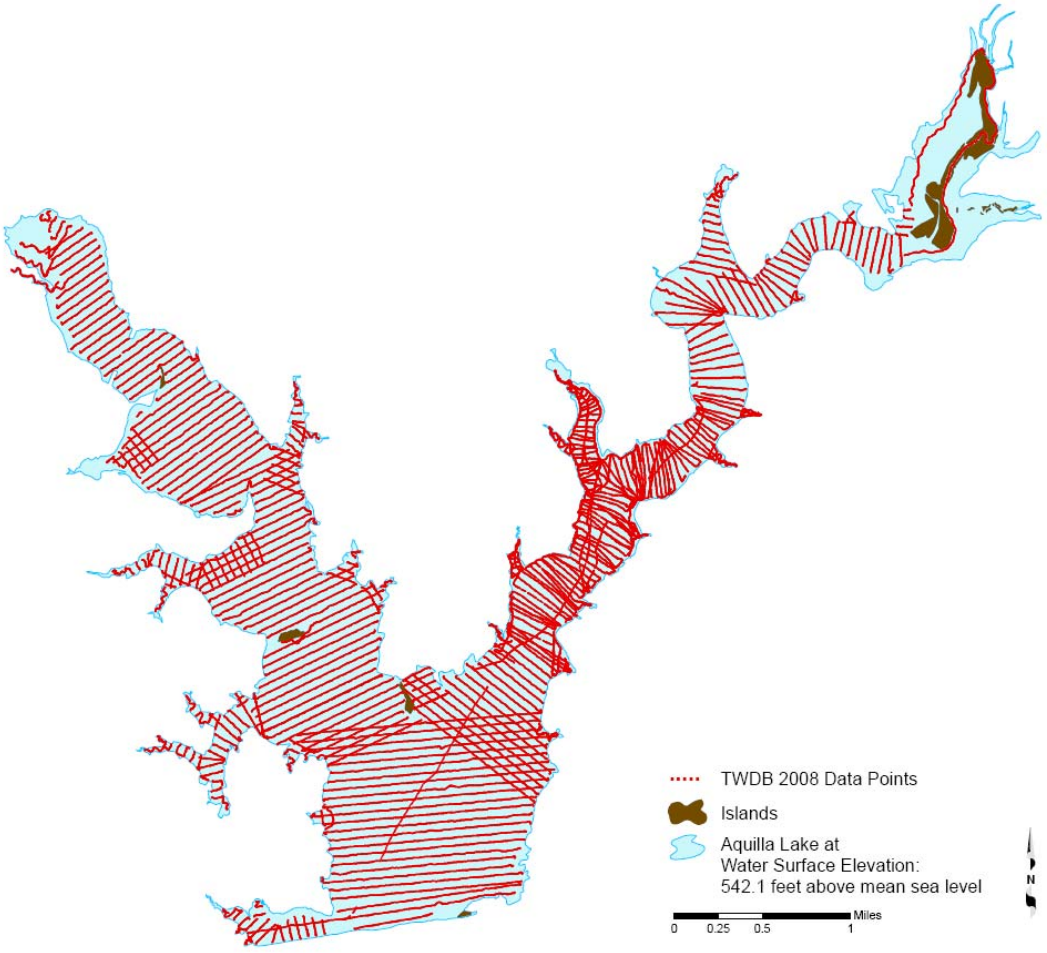

Figure 2 *– TWDB 2008 survey data points for Aquilla Lake*

Data Processing

Model Boundaries

The U.S. Army Corps of Engineers, Fort Worth District, supplied TWDB with aerial photographs of Aquilla Lake taken on March 21, 2008 while the lake's water surface elevation was 542.1 feet above mean sea level. The reservoir boundary was digitized from these aerial photographs using Environmental Systems Research Institute's (ESRI) ArcGIS 9.1 software. Additional reservoir footprint information was available from digital ortho quarter quadrangle (DOQQ) aerial photos[6] from the Texas Natural Resources Information System (TNRIS)[7]. The quarter quadrangles that cover Aquilla Lake are Peoria NW, Peoria NE, Peoria SW, and Peoria SE. From DOQQs dated August 19, 2006, a 531.34 foot contour was digitized to supplement the TWDB survey data in

locations where the survey data alone was insufficient to properly represent the reservoir bathymetry. A 538.3 foot contour was also used to supplement TWDB survey data, and was digitized from DOQQs taken on August 4, 2004, August 31, 2004, and December 9, 2004 while the water surface elevation measured 538.31 feet, 537.9 feet, and 538.42 feet, respectively. The 2006 DOQQs are of 2-meter resolution while the 2004 DOQQs used in digitizing the 538.3 foot contour are of 1-meter resolution; therefore, the physical boundary of Aquilla Lake at 538.3 feet may be within ± 1 meter of the location derived from the manual delineation. Both contours were verified for accuracy against the sounding data collected during the 2008 survey.

Triangular Irregular Network (TIN) Model

Upon completion of the data collection effort, the raw data files collected by TWDB were edited using customized MATLAB processing scripts and the HydroEdit software package. Specifically, HydroEdit applies a median filter to the raw survey data and removes individual data anomalies or points with incorrect GPS coordinates. HydroEdit also uses the water surface elevations at the times of each sounding to convert sounding depths to corresponding bathymetric elevations. The MATLAB processing scripts are then used to visually inspect each of the filtered cross-sections to indentify and rectify any series of data anomalies that were not edited using the HydroEdit filters. For processing outside of MATLAB and HydroEdit, the sounding coordinates (X,Y,Z) are exported as a MASS points file. Using the "Self-Similar Interpolation" technique (described below), TWDB interpolated bathymetric elevation data located in-between surveyed cross sections. To better represent reservoir bathymetry in shallow regions, TWDB used the "Line Extrapolation" technique.[8]

To create a surface representation of the Aquilla Lake bathymetry, the 3D Analyst Extension of ArcGIS (ESRI, Inc.) is used. This extension allows for the creation of a triangulated irregular network (TIN) model of the bathymetry, where each MASS point and boundary node becomes the vertex of a triangular portion of the reservoir bottom surface.[9] From the TIN model, reservoir capacities and areas are calculated at one-tenth of a foot (0.1 foot) intervals, from elevation 497.2 feet to elevation 542.1 feet.

The Elevation-Capacity and Elevation-Area Tables, updated for 2008, are presented in Appendices A and B, respectively. Tables are provided with elevations

referenced to the NGVD 29 datum. The Area-Capacity Curves are presented in Appendix C.

The Aquilla Lake TIN model was interpolated and averaged using a cell size of 1 foot by 1 foot and converted to a raster. The raster was used to produce an Elevation Relief Map representing the topography of the reservoir bottom (Figure 3), a map showing shaded depth ranges for Aquilla Lake (Figure 4), and a 5-foot contour map (Figure 5 - attached). The reservoir extent depicted in these figures is that corresponding to elevation 542.1 feet.

Self-Similar Interpolation

A limitation of the Delaunay method for triangulation when creating TIN models 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. Also, if the surveyed cross sections are not perpendicular to the centerline of submerged river channel (the location of which is often unknown until after the survey), then the TIN model is not likely to well-represent the true channel bathymetry.

To ameliorate these problems, a Self-Similar Interpolation routine (developed by TWDB) was used to interpolate the bathymetry in between many 250 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.[8] In the case of Aquilla Lake, the application of Self-Similar Interpolation helped represent the lake morphology near the banks and improved the representation of the submerged river channel (Figure 6). 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 Aquilla Lake where a high probability of change between cross-sections exists.[8] Figure 6 illustrates typical results of the application of the Self-Similar Interpolation routine in Aquilla Lake, and the bathymetry shown in Figure 6C was used in computing reservoir capacity and area tables (Appendix A, B).

Figure 3

Aquilla Lake

Elevation Relief Map

2,360,000 2,370,000 2,380,000 2,390,000

6,670,000 6,660,000 6,650,000

Elevations
(in feet above mean sea level)

- 540.1 - 542.1
- 538.1 - 540
- 536.1 - 538
- 534.1 - 536
- 532.1 - 534
- 530.1 - 532
- 528.1 - 530
- 526.1 - 528
- 524.1 - 526
- 522.1 - 524
- 520.1 - 522
- 518.1 - 520
- 516.1 - 518
- 514.1 - 516
- 512.1 - 514
- 510.1 - 512
- 508.1 - 510
- 506.1 - 508
- 504.1 - 506
- 502.1 - 504
- 500.1 - 502
- 498.1 - 500
- 497.2 - 498
- Islands at 542.1 feet
- 537.5 foot contour

N

0 0.25 0.5 1 Miles

Conservation Pool Elevation:
537.5 feet above mean sea level
Elevation depicted in map: 542.1
feet above mean sea level
Projection: NAD83
State Plane
Texas North Central Zone

Figure 4

Aquilla Lake

Depth Ranges Map

2,360,000 2,370,000 2,380,000 2,390,000

6,670,000 6,660,000 6,650,000

Depth Ranges

4.6 -0' above Conservation Pool

Depth below Conservation Pool

- 0 - 5'
- 5 - 10'
- 10 - 15'
- 15 - 20'
- 20 - 25'
- 25 - 30'
- 30 - 35'
- 35 - 40'
- > 40'

Islands at 542.1 feet

537.5 foot contour

Conservation Pool Elevation: 537.5 feet above mean sea level

Elevation depicted in map: 542.1 feet above mean sea level

Projection: NAD83

State Plane

Texas North Central Zone

N

0 0.25 0.5 1 Miles

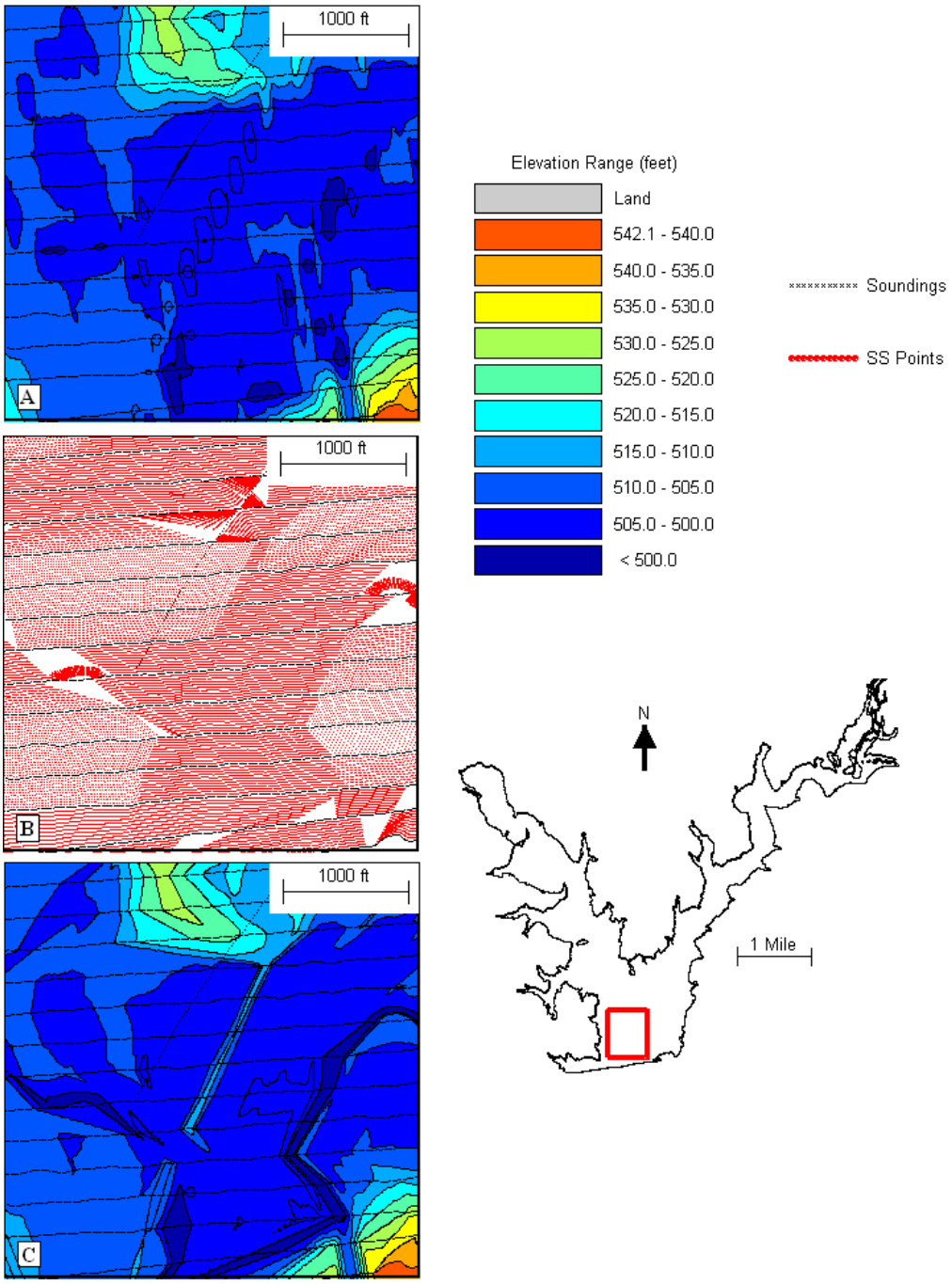

Figure 6 *- Application of the Self-Similar Interpolation technique to Aquilla Lake sounding data – A) bathymetric contours without interpolated points, B) Sounding points (black) and interpolated points (red) with reservoir boundary shown at elevation 542.1 feet (black), C) bathymetric contours with the interpolated points. Note: In 6A the deeper channels indicated by the surveyed cross sections are not continuously represented in the areas in-between the cross sections. This is an artifact of the TIN generation routine, rather than an accurate representation of the physical bathymetric surface. Inclusion of the interpolated points (6C) corrects this and smoothes the bathymetric contours.*

Volumetric Survey Results

The results of the TWDB 2008 Volumetric Survey indicate Aquilla Lake has a total reservoir capacity of 44,566 acre-feet and encompasses 3,066 acres at conservation pool elevation (537.5 feet above mean sea level, NGVD 29). An additional 15,446 acre-feet of water can be stored between conservation pool elevation and 542.1 feet above mean sea level, for a total reservoir capacity of 60,012 acre-feet at elevation 542.1 feet. At elevation 542.1 feet, Aquilla Lake encompasses 3,650 acres.

The original capacity of Aquilla Lake at conservation pool elevation was calculated by the U.S. Army Corps of Engineers in 1964 to be 52,400 acre-feet.[1] TWDB previously surveyed Aquilla Lake in October of 1995 and April of 2002. Due to differences in the methods used in calculating the original area and capacity of Aquilla Lake with methods currently in use, comparison of these original values with those derived from TWDB surveys is not recommended. TWDB also does not recommend directly comparing results from one TWDB survey to the next; unless the data from each survey were collected and are processed using similar techniques.

To properly compare results from TWDB surveys of Aquilla Lake, TWDB applied the 2008 data processing techniques to the survey data collected in 1995 and 2002. Specifically, TWDB re-edited the survey data using HydroEdit and applied the Self-Similar Interpolation and line extrapolation techniques[8] to both the 1995 and 2002 survey datasets. Revised Aquilla Lake capacities at conservation pool elevation are presented in Table 2. TWDB did not revise the lake areas as the original 1995 and 2002 lake boundaries were used in re-assessing each survey dataset.

Table 2 - Revised 1995 and 2002 Survey Results for Aquilla Lake

	Area @ CPE	Volume @ CPE (acre-feet)		Volume Difference (ΔV)	
Year	(acres)	Original	Revised	Acre-Feet	% of Original
1995	3,266	45,962	46,896	934	2.0%
2002	3,020	45,319	45,151	-168	-0.4%
2008	3,066	<>	44,566	<>	<>

As presented in Table 2, revision of the 1995 survey data using current TWDB data processing methods resulted in an increase in reservoir capacity of approximately 2.0%. Such an increase is typical for lakes of similar size and shape as Aquilla Lake, and is due to the improved representation of the lake bathymetry between adjacent cross sections that is obtained when interpolation is used (see Figure 6 and the section entitled "Self-Similar Interpolation"). In contrast, revision of the 2002 survey data resulted in a relatively small loss in volume. Re-editing of the 2002 survey data using HydroEdit yielded a survey dataset more comparable to those measured in 1995 and 2008. The decrease in volume resulting from the re-editing was then nearly offset by the associated increase in volume resulting from application of the Self-Similar interpolation and line extrapolation techniques.

Comparisons of the capacities (at conservation pool elevation) from 1995, 2002, and 2008 (Table 3) suggest Aquilla Lake looses between 84 acre-feet per year and 218 acre-feet per year. TWDB notes that the lake areas at CPE are different for each of the three compared surveys (Table 2), and that some of the reported volume differences are directly attributable to the area differences.

Table 3 - Volume Comparisons for Aquilla Lake

	Volume Comparisons @ CPE (acre-feet)		
Survey	Comparison #1	Comparison #2	Comparison #3
1995	46,896	<>	46,896
2002	45,151	45,151	<>
2008	<>	44,566	44,566
ΔV	1,745 (3.7%)	585 (1.3%)	2,330 (5.0%)
# of Years	8	7	15
Sedimentation Rate	218 Acre-ft/Year	84 acre-ft/year	155 acre-ft/year

Recommendations

To improve estimates of sediment accumulation rates, TWDB recommends resurveying Aquilla Lake in approximately 10 years or after a major flood event. To further improve estimates of sediment accumulation, TWDB recommends conducting a sedimentation survey. For sedimentation surveys, TWDB employs a multi-frequency depth sounder to measure both the water depth the sediment thickness throughout the lake. TWDB also collects sediment core samples as direct spot-measurements of accumulated sediment; these measurements are used in assessing the multi-frequency sounding data and deriving lake-wide sediment thickness datasets. Results from sedimentation surveys include current reservoir capacities, computed sediment volumes, and maps identifying the spatial distribution of sediment throughout the lake.

Additional information detailing sediment accumulation within Aquilla Lake may be derived through detailed spatial comparisons of survey results from 1995, 2002, and 2008. Such comparisons could provide insight into the locations of active depositional environments and/or locations of scour within Aquilla Lake. Analysis of the differing lake boundaries from the 1995, 2002 and 2008 surveys would also provide insight on sediment movement within the vicinity of Aquilla Lake.

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:

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Appendix A

Aquilla Lake

RESERVOIR CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — MARCH 2008 SURVEY

CAPACITY IN ACRE-FEET — Conservation Pool Elevation 537.5 Feet NGVD 29

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
497	0	0	0	0	0	0	0	0	0	0
498	0	0	0	0	1	1	1	1	1	2
499	2	3	3	3	4	5	5	6	7	8
500	8	9	10	11	12	13	14	16	17	19
501	20	22	24	27	30	33	36	39	43	47
502	51	55	60	65	70	75	80	86	93	99
503	106	114	122	130	138	147	157	166	176	187
504	198	210	222	234	247	261	275	289	304	319
505	334	350	367	384	401	419	437	456	475	495
506	515	536	557	579	601	624	647	671	695	719
507	744	770	796	822	849	876	904	933	962	991
508	1,021	1,052	1,083	1,115	1,147	1,180	1,213	1,247	1,281	1,316
509	1,351	1,387	1,424	1,460	1,498	1,536	1,574	1,613	1,653	1,693
510	1,734	1,776	1,818	1,861	1,904	1,948	1,993	2,039	2,085	2,132
511	2,180	2,228	2,277	2,326	2,376	2,427	2,478	2,531	2,583	2,637
512	2,691	2,745	2,801	2,857	2,914	2,971	3,029	3,088	3,147	3,208
513	3,269	3,332	3,395	3,459	3,524	3,591	3,658	3,726	3,795	3,865
514	3,936	4,008	4,080	4,153	4,227	4,301	4,376	4,452	4,528	4,605
515	4,682	4,760	4,839	4,919	4,999	5,080	5,162	5,244	5,326	5,410
516	5,494	5,579	5,664	5,750	5,836	5,923	6,011	6,100	6,189	6,279
517	6,370	6,461	6,554	6,647	6,741	6,835	6,930	7,026	7,123	7,221
518	7,319	7,419	7,520	7,622	7,725	7,828	7,933	8,038	8,145	8,252
519	8,360	8,469	8,579	8,690	8,801	8,913	9,027	9,141	9,255	9,371
520	9,487	9,604	9,722	9,840	9,959	10,079	10,200	10,321	10,443	10,566
521	10,689	10,813	10,937	11,063	11,189	11,316	11,444	11,572	11,701	11,831
522	11,961	12,092	12,224	12,356	12,490	12,623	12,758	12,893	13,029	13,166
523	13,304	13,442	13,581	13,721	13,861	14,002	14,144	14,286	14,429	14,573
524	14,717	14,863	15,009	15,157	15,305	15,455	15,605	15,756	15,909	16,063
525	16,218	16,373	16,531	16,689	16,848	17,008	17,169	17,331	17,495	17,659
526	17,825	17,991	18,159	18,327	18,497	18,667	18,839	19,011	19,184	19,358
527	19,533	19,709	19,886	20,064	20,243	20,423	20,605	20,788	20,971	21,156
528	21,342	21,529	21,718	21,907	22,098	22,290	22,484	22,679	22,874	23,071
529	23,269	23,467	23,667	23,868	24,070	24,273	24,477	24,683	24,889	25,097
530	25,305	25,514	25,725	25,936	26,148	26,362	26,576	26,791	27,008	27,225
531	27,444	27,663	27,884	28,106	28,330	28,555	28,781	29,008	29,237	29,467
532	29,698	29,930	30,164	30,399	30,635	30,873	31,112	31,353	31,595	31,839
533	32,085	32,331	32,580	32,829	33,080	33,333	33,586	33,842	34,098	34,356
534	34,615	34,875	35,136	35,399	35,663	35,928	36,195	36,463	36,733	37,004
535	37,277	37,551	37,826	38,103	38,382	38,662	38,944	39,228	39,513	39,800
536	40,089	40,378	40,670	40,962	41,256	41,551	41,848	42,145	42,444	42,744
537	43,045	43,347	43,651	43,955	44,260	44,566	44,873	45,181	45,490	45,799
538	46,109	46,420	46,732	47,044	47,367	47,690	48,014	48,339	48,666	48,993
539	49,321	49,651	49,981	50,312	50,645	50,978	51,312	51,647	51,984	52,321
540	52,659	52,999	53,339	53,680	54,023	54,366	54,711	55,056	55,403	55,751
541	56,100	56,449	56,800	57,152	57,506	57,860	58,216	58,572	58,930	59,290
542	59,650	60,012								

Appendix B

Aquilla Lake

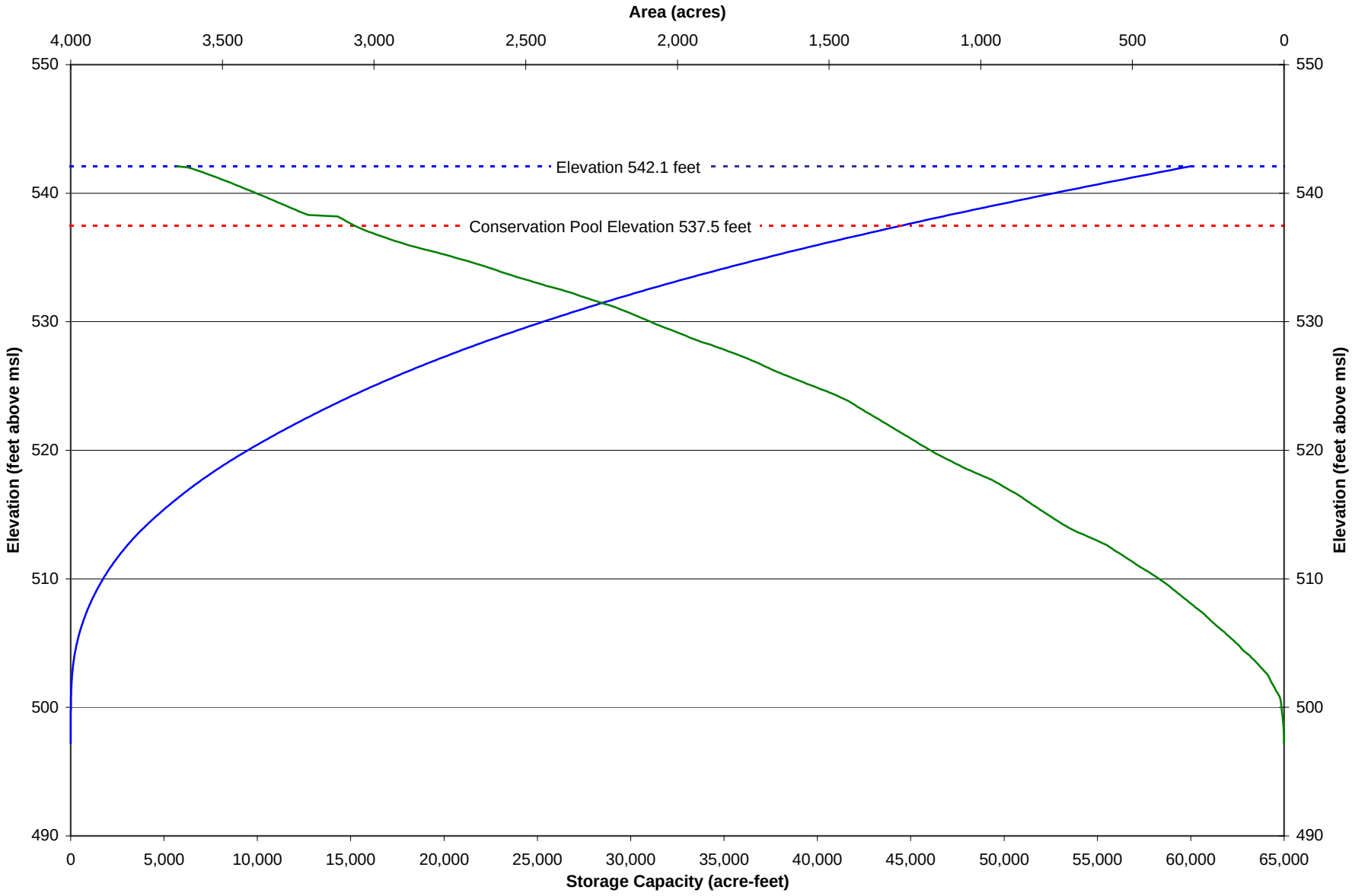
RESERVOIR AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — MARCH 2008 SURVEY

AREA IN ACRES — Conservation Pool Elevation 537.5 Feet NGVD 29

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION in Feet	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
497	0	0	0	0	0	0	0	0	0	0
498	0	1	1	1	2	2	2	3	3	3
499	4	4	5	5	6	6	7	7	8	8
500	9	9	9	10	10	11	12	13	15	16
501	18	21	24	26	29	31	33	35	38	41
502	43	45	47	49	51	53	57	60	64	69
503	73	77	80	84	87	91	95	100	104	108
504	113	117	122	128	134	138	141	145	148	152
505	157	162	166	171	176	181	186	190	195	199
506	205	210	215	220	225	230	235	239	243	248
507	252	257	261	266	271	276	282	288	293	298
508	303	308	314	319	325	330	335	340	346	351
509	356	362	367	372	377	382	388	394	400	406
510	412	418	424	431	438	444	451	459	466	473
511	480	486	492	498	504	511	518	524	530	537
512	544	551	558	564	570	576	583	592	601	610
513	619	628	638	648	657	667	678	687	696	704
514	712	719	726	733	740	747	753	759	766	772
515	779	786	792	799	805	812	818	825	831	837
516	844	850	856	862	868	875	882	889	897	904
517	912	919	927	934	941	948	956	963	973	982
518	993	1,003	1,013	1,022	1,032	1,042	1,051	1,060	1,068	1,077
519	1,086	1,094	1,102	1,110	1,119	1,128	1,136	1,144	1,151	1,159
520	1,166	1,174	1,181	1,188	1,195	1,202	1,209	1,215	1,222	1,229
521	1,236	1,243	1,251	1,258	1,265	1,272	1,279	1,287	1,294	1,300
522	1,308	1,315	1,322	1,328	1,335	1,343	1,350	1,357	1,364	1,372
523	1,379	1,386	1,393	1,400	1,407	1,413	1,420	1,427	1,434	1,442
524	1,451	1,460	1,469	1,479	1,488	1,498	1,509	1,521	1,532	1,543
525	1,553	1,565	1,575	1,586	1,596	1,607	1,618	1,628	1,639	1,650
526	1,661	1,671	1,681	1,690	1,700	1,709	1,718	1,727	1,736	1,745
527	1,755	1,765	1,775	1,786	1,796	1,808	1,820	1,832	1,843	1,854
528	1,866	1,877	1,889	1,902	1,917	1,929	1,941	1,951	1,962	1,972
529	1,982	1,992	2,003	2,014	2,025	2,037	2,049	2,059	2,070	2,079
530	2,089	2,098	2,108	2,119	2,129	2,138	2,148	2,159	2,170	2,180
531	2,191	2,202	2,213	2,225	2,243	2,255	2,267	2,280	2,293	2,306
532	2,319	2,331	2,342	2,356	2,370	2,385	2,401	2,416	2,432	2,446
533	2,460	2,474	2,489	2,503	2,517	2,531	2,545	2,558	2,570	2,583
534	2,595	2,608	2,621	2,634	2,647	2,660	2,674	2,688	2,704	2,719
535	2,733	2,748	2,763	2,778	2,795	2,812	2,828	2,845	2,861	2,878
536	2,892	2,905	2,919	2,932	2,945	2,958	2,970	2,981	2,994	3,005
537	3,017	3,028	3,039	3,048	3,057	3,066	3,074	3,082	3,090	3,097
538	3,105	3,112	3,120	3,217	3,228	3,238	3,248	3,258	3,268	3,278
539	3,288	3,298	3,308	3,318	3,328	3,338	3,348	3,358	3,368	3,378
540	3,388	3,398	3,409	3,419	3,429	3,440	3,450	3,461	3,472	3,483
541	3,493	3,504	3,515	3,527	3,538	3,550	3,561	3,573	3,586	3,599
542	3,613	3,650								



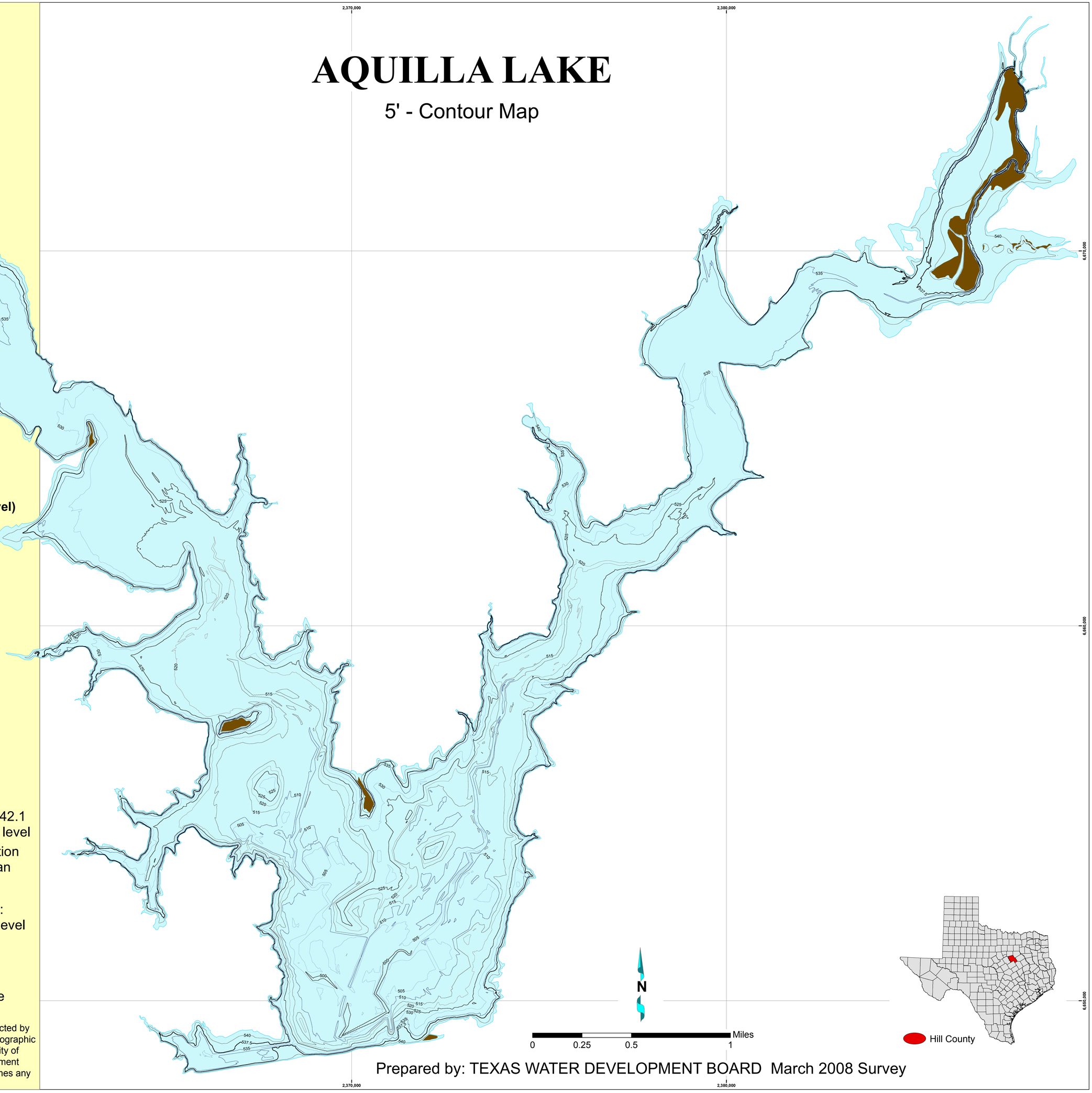
Aquilla Lake
March 2008 Survey
Prepared by: TWDB

Appendix C: Area and Capacity Curves

Figure 5

AQUILLA LAKE

5' - Contour Map



CONTOURS

(in feet above mean sea level)

- 540
- 537.5
- 535
- 530
- 525
- 520
- 515
- 510
- 505
- 500

Islands at elevation 542.1 feet above mean sea level

Aquilla Lake at elevation 542.1 feet above mean sea level

Conservation Pool Elevation: 537.5 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 Aquilla Lake. The Texas Water Development Board makes no representations nor assumes any liability.

Prepared by: TEXAS WATER DEVELOPMENT BOARD March 2008 Survey