Volumetric Survey of Big Creek Lake

February 2022

Texas Water Development Board

June 2023

Texas Water Development Board

Prepared for:

City of Cooper, Texas

This report was prepared by staff of the Surface Water Division:

Mindy Conyers, Manager
Nathan Leber
Holly Holmquist
Khan Iqbal
Josh Duty

Published and distributed by the

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

Executive summary

The Texas Water Development Board (TWDB) entered into an agreement with the City of Cooper, Texas, to perform a volumetric survey of Big Creek Lake (Delta County, Texas). Surveying was performed using a multi-frequency (208 kHz, 50 kHz, and 12 kHz), sub-bottom profiling depth sounder; although only data collected at the 208 kHz frequency was analyzed for this report.

Big Creek Dam, impounding Big Creek Reservoir, known as Big Creek Lake, is located on Big Creek, a tributary of the South Sulphur River, in Delta County, one mile north of Cooper, Texas. The conservation pool elevation of Big Creek Lake is 458.0 feet above mean sea level. The TWDB collected bathymetric data for Big Creek Lake on February 12, 2022, while daily average water surface elevations measured 456.06 feet above mean sea level.

The 2022 TWDB volumetric survey indicates Big Creek Lake has a total reservoir capacity of 2,919 acre-feet and encompasses 475 acres at conservation pool elevation (458.0 feet above mean sea level). Previous capacity estimates include the permitted amount of 4,890 acre-feet and an estimate of 4,625 acre-feet in 2011 by Purkeypile Consulting. Because of differences in past and present survey methodologies, direct comparison of volumetric surveys to others to estimate loss of area and capacity can be unreliable. Information from past surveys is presented here for informational purposes only.

The TWDB recommends that a similar methodology be used to resurvey Big Creek Lake in 10 years or after a major high flow event. To further improve estimates of capacity loss, the TWDB recommends a volumetric and sedimentation survey. Sedimentation surveys include additional analysis of the multi-frequency data for post-impoundment sediment by correlation with sediment core samples and a map identifying the spatial distribution of sediment throughout the reservoir.

Table of Contents

List of Tables

List of Figures

Appendices

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

Introduction

The Hydrographic Survey Program of the Texas Water Development Board (TWDB) was authorized by the 72nd Texas State Legislature in 1991. Texas Water Code Section 15.804 authorizes the TWDB to perform surveys to determine reservoir storage capacity, sedimentation levels, rates of sedimentation, and projected water supply availability.

The TWDB entered into an agreement with the City of Cooper, Texas, to perform a volumetric survey of Big Creek Lake (Texas Water Development Board, 2023). This report provides an overview of the survey methods, analysis techniques, and associated results. Also included are the following contract deliverables: (1) an elevation-area-capacity table of the reservoir acceptable to the Texas Commission on Environmental Quality (Appendices A and B), (2) a bottom contour map (Figure 6), and (3) a shaded relief plot of the reservoir bottom (Figure 4).

Big Creek Lake general information

Big Creek Dam, impounding Big Creek Reservoir, known as Big Creek Lake, is located on Big Creek, a tributary of the South Sulphur River, in Delta County, one mile north of Cooper, Texas (Figure 1). Big Creek Lake is owned and operated by the City of Cooper, Texas. Construction on Big Creek Dam and impoundment of Big Creek Lake was completed in 1987 (Texas Parks and Wildlife, 2022). The reservoir was built primarily for municipal water supply for the City of Cooper, Texas (City of Cooper, 2022). Additional pertinent data about Big Creek Dam and Big Creek Lake can be found in Table 1.

Water rights for Big Creek Lake have been appropriated to the City of Cooper, Texas, through Permit No. 4060 (Texas Commission on Environmental Quality, 2022a). The complete certificate is on file at the Texas Commission on Environmental Quality (TCEQ).

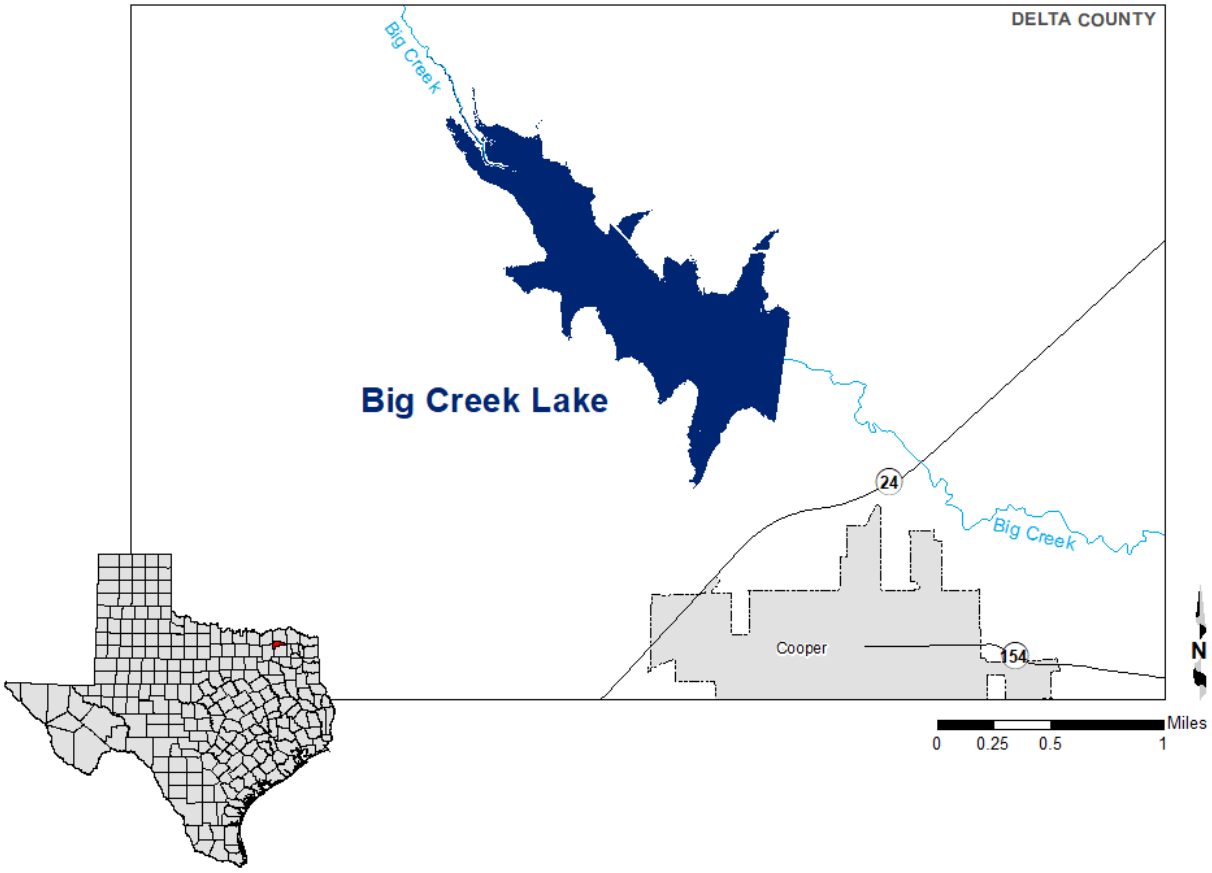


Figure 1. Location map.

Table 1. Pertinent Data for Big Creek Dam and Big Creek Lake

Owner(s)	
City of Cooper, Texas	
Location	
On Big Creek one mile north of Cooper, Texas	
Drainage area	
Total drainage area	11.92 square miles
Dam	
Type	Earthfill embankment
Length	
Main embankment	3,550 feet
Spillway section	800 feet
Height	38.0 feet
Top width	20.0 feet
Top of dam elevation	468.84 feet above mean sea level
Spillway	
Emergency	
Type	Earthen
Location	Excavated into right abutment
Elevation	461.5 feet above mean sea level
Principal	
Type	Reinforced concrete circular morning glory drop inlet structure
Dimension	12-foot diameter morning glory inlet, 7-foot diameter conduit and stilling basin
Crest elevation	458.0 feet above mean sea level

Reservoir Data (Based on 2022 TWDB survey)

Feature	Elevation (feet above mean sea level)	Capacity (acre-feet)	Area (acres)
Top of dam	468.84	10,924	1,042
Emergency spillway crest elevation	461.5	4,861	631
Top of conservation pool	458.0	2,919	475

Sources: Texas Commission on Environmental Quality, 2022b.

Volumetric survey of Big Creek Lake

Datum

The vertical datum used during this survey is the National Geodetic Vertical Datum 1929 (NGVD29). Elevations herein are reported in feet relative to the NGVD29 datum. Volume and area calculations in this report are referenced to the average water surface elevation measured by TWDB on February 22, 2022, using Trimble Global Navigation Satellite System (GNSS) equipment enabled with Virtual Reference Station (VRS) capabilities to collect data in real-time kinematic (RTK) accuracy. The global positioning system (GPS) data were collected in vertical datum North American Vertical Datum 1988 (NAVD88). Elevations were converted to NGVD29 by subtracting 0.053 feet. The vertical datum transformation offset for the conversion from NAVD88 to NGVD29 was determined by applying the National Oceanic and Atmospheric Administration National Geodetic Survey's Coordinate Conversion and Transformation Tool (NCAT) (National Geodetic Survey, 2022) to a single reference point in the vicinity of the survey, at the drop inlet spillway *Latitude 33°23'32.4996"N, Longitude 95°41'39.8004"W NAD83.* The horizontal datum used for this report is North American Datum 1983 (NAD83), and the horizontal coordinate system is State Plane Texas North Central Zone (feet).

TWDB bathymetric data collection

The TWDB collected bathymetric data for Big Creek Lake on February 12, 2022, while daily average water surface elevations measured 456.06 feet above mean sea level. For data collection, the TWDB used a Specialty Devices, Inc. (SDI), single-beam, multi-frequency (208 kHz, 50 kHz, and 12 kHz) sub-bottom profiling depth sounder integrated with differential global positioning system (DGPS) equipment; although only data collected at the 208 kHz frequency was analyzed for this report. Data were collected along pre-planned survey lines oriented perpendicular to the assumed location of the original river channels and spaced approximately 250 feet apart. The depth sounder was calibrated daily using a velocity profiler to measure the speed of sound in the water column and a weighted tape or stadia rod for depth reading verification. Each speed of sound profile, or velocity cast, is saved for further data processing. Figure 2 shows the data collection locations for the 2022 TWDB survey.

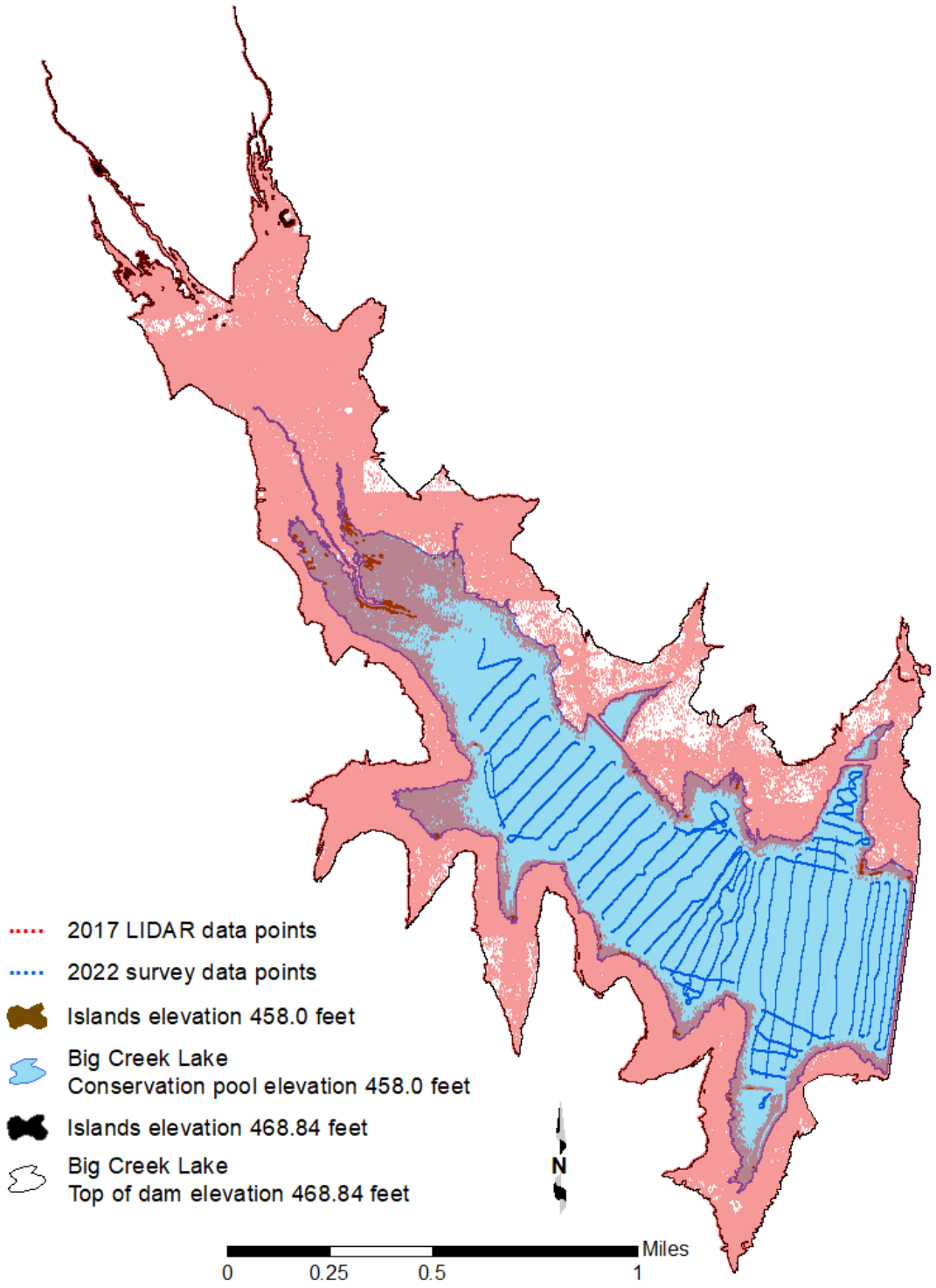


Figure 2. **2022 TWDB sounding data (*blue dots*) and 2017 LIDAR data points (*red dots*).**

Data processing

Model boundary

The model boundaries of the reservoir were developed from Light Detection and Ranging (LIDAR) data available from the Texas Natural Resource Information System. LIDAR data collected between December 29, 2016, and April 14, 2017 (Texas Water Development Board, 2017). The LIDAR data (.las) files were imported into an LAS Dataset and the dataset was converted to a raster using a cell size of 1.0 meters by 1.0 meters. The horizontal datum of the LIDAR data is Universal Transverse Mercator (UTM) North American Datum 1983 (NAD83; meters) Zone 14, and the vertical datum is North American Vertical Datum 1988 (NAVD88; meters). Bathymetric and topographic contours at elevations 139.61455 meters equivalent to 458.053 feet NAVD88 or 458.00 feet NGVD29, normal pool elevation, and 142.918582 meters equivalent to 468.893 feet NAVD88 or 468.84 feet NGVD29, crest of dam elevation, were extracted. The topographic contour was edited to close the contour across the top of the dam. Horizontal coordinate transformations to NAD83 State Plane Texas North Central Zone (feet) coordinates were done using the ArcGIS Project tool.

LIDAR data points

To utilize the LIDAR data in the reservoir bathymetric and topographic models, the LIDAR data (.las) files were converted to a multipoint feature class in an Environmental Systems Research Institute's ArcGIS file geodatabase filtered to include only data classified as ground points. A topographical model of the data was generated. The ArcGIS tool Terrain to Points was used to extract points from the Terrain, or topographical model of the reservoir. The Terrain was created using the z-tolerance Pyramid Type. Points were extracted from the terrain at the z-tolerance level of 0.1 meters. New attribute fields were added to convert the elevations from meters to feet NAVD88 and then to feet above mean sea level for compatibility with the bathymetric survey data. The point file was then projected to NAD83 State Plane Texas North Central Zone (feet) using the ArcGIS Project tool.

Triangulated Irregular Network model

Following completion of data collection, the raw data files collected by the TWDB were edited to remove data anomalies. The current bottom surface of the reservoir is automatically determined by the data acquisition software. Hydropick software, developed by TWDB staff, was used to display, interpret, and edit the multi-frequency data by manually removing data anomalies in the current bottom surface. The speed of sound profiles, also known as velocity casts, were used to further refine the measured depths. For each location velocity casts are collected, the harmonic mean sound speed of all the casts are calculated. From this, depths collected using one average speed of sound are corrected with an overall optimum speed of sound for each specific depth (Specialty Devices, Inc., 2018).

All data were exported into a single file. The water surface elevation at the time of each sounding was used to convert each sounding depth to a corresponding reservoir-bottom elevation. This survey point dataset was then preconditioned by inserting a uniform grid of artificial survey points between the actual survey lines. Bathymetric elevations at these artificial points were determined using an anisotropic spatial interpolation algorithm described in the next section. This technique creates a high resolution, uniform grid of interpolated bathymetric elevation points throughout a majority of the reservoir (McEwen *et al.* 2011a). The resulting point file was used in conjunction with sounding, LIDAR, and boundary data to create the volumetric and topographic Triangulated Irregular Network (TIN) models utilizing the 3D Analyst Extension of ArcGIS. The 3D Analyst algorithm uses Delaunay's criteria for triangulation to create a grid composed of triangles from non-uniformly spaced points, including the boundary vertices (Environmental Systems Research Institute, 1995).

Spatial interpolation of reservoir bathymetry

Isotropic spatial interpolation techniques such as the Delaunay triangulation used by the 3D Analyst extension of ArcGIS are, in many instances, unable to suitably interpolate bathymetry between survey lines common to reservoir surveys. Reservoirs and stream channels are anisotropic morphological features where bathymetry at any particular location is more similar to upstream and downstream locations than to transverse locations. Interpolation schemes that do not consider this anisotropy lead to the creation of several types of artifacts in the final representation of the reservoir bottom surface and hence to

errors in volume. These artifacts may include artificially curved contour lines extending into the reservoir where the reservoir walls are steep or the reservoir is relatively narrow, intermittent representation of submerged stream channel connectivity, and oscillations of contour lines in between survey lines. These artifacts reduce the accuracy of the resulting volumetric TIN model in areas between actual survey data.

To improve the accuracy of bathymetric representation between survey lines, the TWDB developed various anisotropic spatial interpolation techniques. Generally, the directionality of interpolation at different locations of a reservoir can be determined from external data sources. A basic assumption is that the reservoir profile in the vicinity of a particular location has upstream and downstream similarity. In addition, the sinuosity and directionality of submerged stream channels can be determined by directly examining the survey data, or more robustly by examining scanned USGS 7.5-minute quadrangle maps (DRGs), hypsography files (the vector format of USGS 7.5-minute quadrangle map contours), and historical aerial photographs, when available. Using the survey data, polygons are created to partition the reservoir into segments with centerlines defining the directionality of interpolation within each segment. Using the interpolation definition files and survey data, the current reservoir-bottom elevation is calculated for each point in the high-resolution uniform grid of artificial survey points. The reservoir boundary, artificial survey points grid, and survey data points are used to create the volumetric TIN model representing reservoir bathymetry. Specific details of this interpolation technique can be found in the HydroTools manual (McEwen and others, 2011a) and in McEwen and others (2011b).

In areas inaccessible to survey data collection, such as small coves and shallow upstream areas of the reservoir, linear interpolation is used for volumetric estimations (McEwen and others, 2011a). Linear interpolation results in improved elevation-capacity and elevation-area calculations.

Figure 3 illustrates typical results from application of the anisotropic interpolation as applied to Big Creek Lake. In Figure 3A, deeper channels and steep slopes indicated by surveyed cross-sections are not continuously represented in areas between survey cross-sections. This is an artifact of the TIN generation routine rather than an accurate representation of the physical bathymetric surface. Inclusion of interpolation points in creation of the volumetric TIN model, represented in Figure 3B, directs Delaunay triangulation to better represent the reservoir bathymetry between survey cross-sections.

The bathymetry shown in Figure 3C was used in computing reservoir elevation-capacity (Appendix A) and elevation-area (Appendix B) tables.

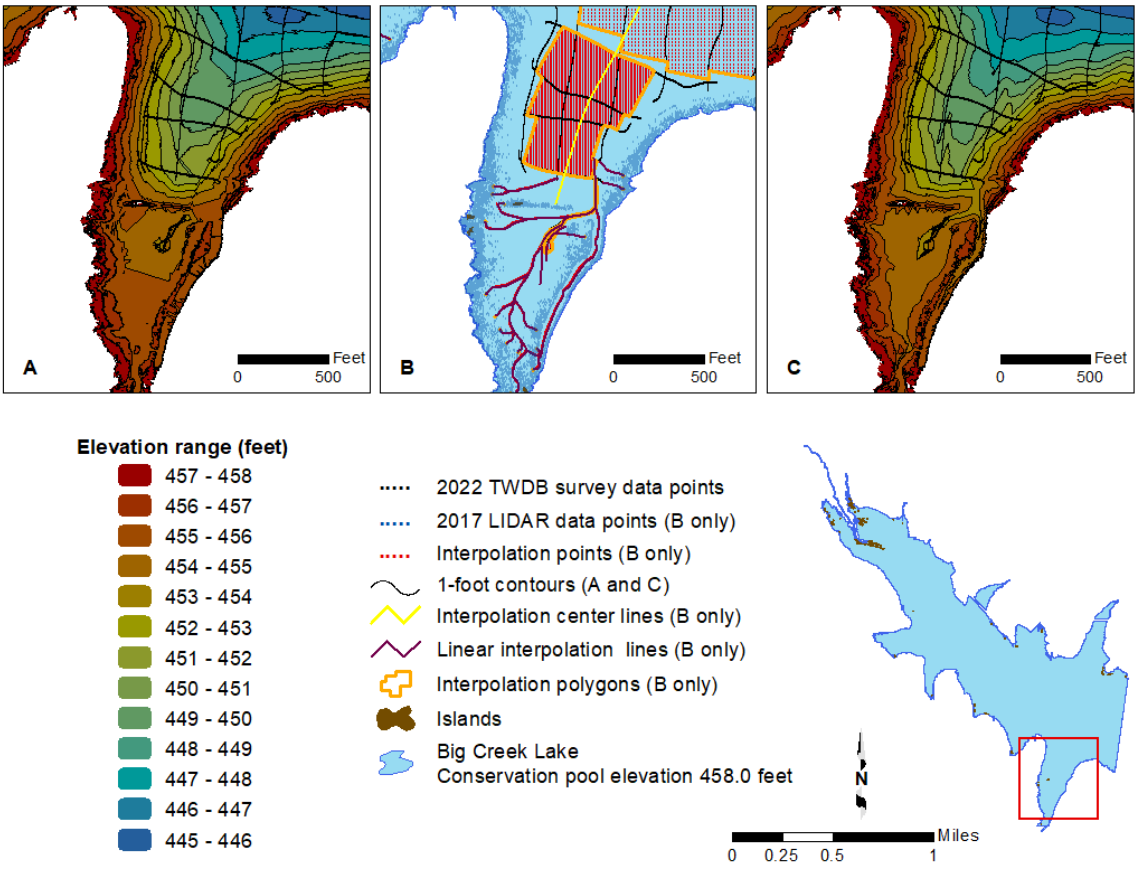


Figure 3. **Anisotropic spatial interpolation as applied to Big Creek Lake sounding data; A) bathymetric contours without interpolated points, B) sounding points (*black*) and interpolated points (*red*), C) bathymetric contours with interpolated points.**

Area, volume, and contour calculation

Volumes and areas were computed for the entire reservoir at 0.01-foot intervals, from 442.64 to 458.00 feet for the bathymetric TIN model, and from 442.64 to 468.84 feet for the bathymetric and topographic TIN model, though only values at 0.1-foot increments are presented here in the report. The bathymetric elevation-capacity table and bathymetric elevation-area table, based on the 2022 survey and analysis, are presented in Appendices A and B, respectively. The bathymetric capacity curve is presented in Appendix C, and the bathymetric area curve is presented in Appendix D. The topographic elevation-capacity table and topographic elevation-area table developed from the 2022 survey and analysis are

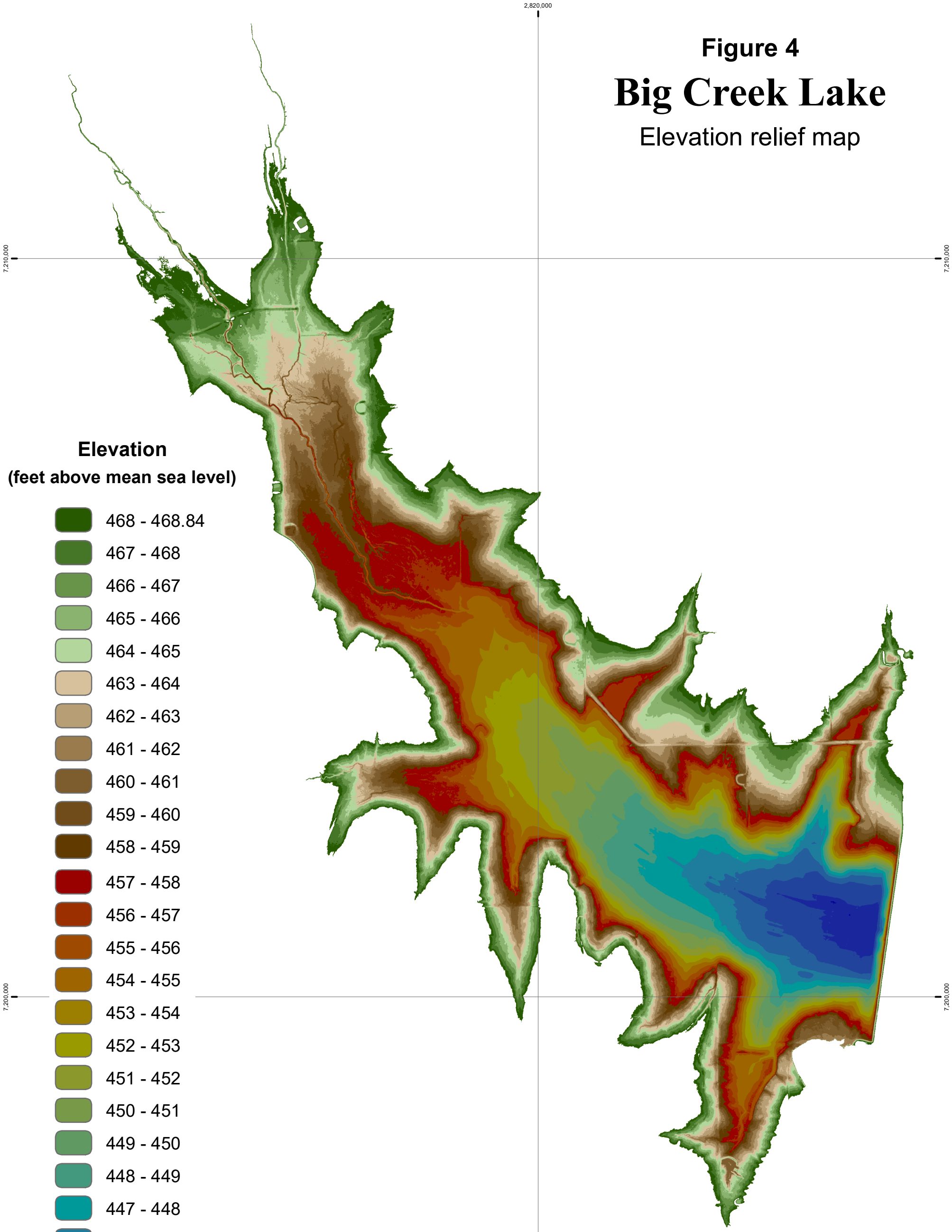
presented in Appendices E and F, respectively. The topographic capacity curve is presented in Appendix G, and the topographic area curve is presented in Appendix H.

The bathymetric and topographic TIN models were converted to a raster representation using a cell size of 1 foot by 1 foot. The raster data then were used to produce three figures: (1) an elevation relief map representing the topography of the reservoir bottom (Figure 4); (2) a depth range map showing depth ranges for Big Creek Lake (Figure 5); and (3) a 2-foot contour map (Figure 6).

Figure 4

Big Creek Lake

Elevation relief map



Elevation
(feet above mean sea level)

- 468 - 468.84
- 467 - 468
- 466 - 467
- 465 - 466
- 464 - 465
- 463 - 464
- 462 - 463
- 461 - 462
- 460 - 461
- 459 - 460
- 458 - 459
- 457 - 458
- 456 - 457
- 455 - 456
- 454 - 455
- 453 - 454
- 452 - 453
- 451 - 452
- 450 - 451
- 449 - 450
- 448 - 449
- 447 - 448
- 446 - 447
- 445 - 446
- 444 - 445
- 443 - 444
- 442.7 - 443

Conservation pool elevation:
458.0 feet above mean sea level
Projection: NAD83 State Plane
Texas North Central Zone (feet)

N

0 0.125 0.25 0.5
Miles

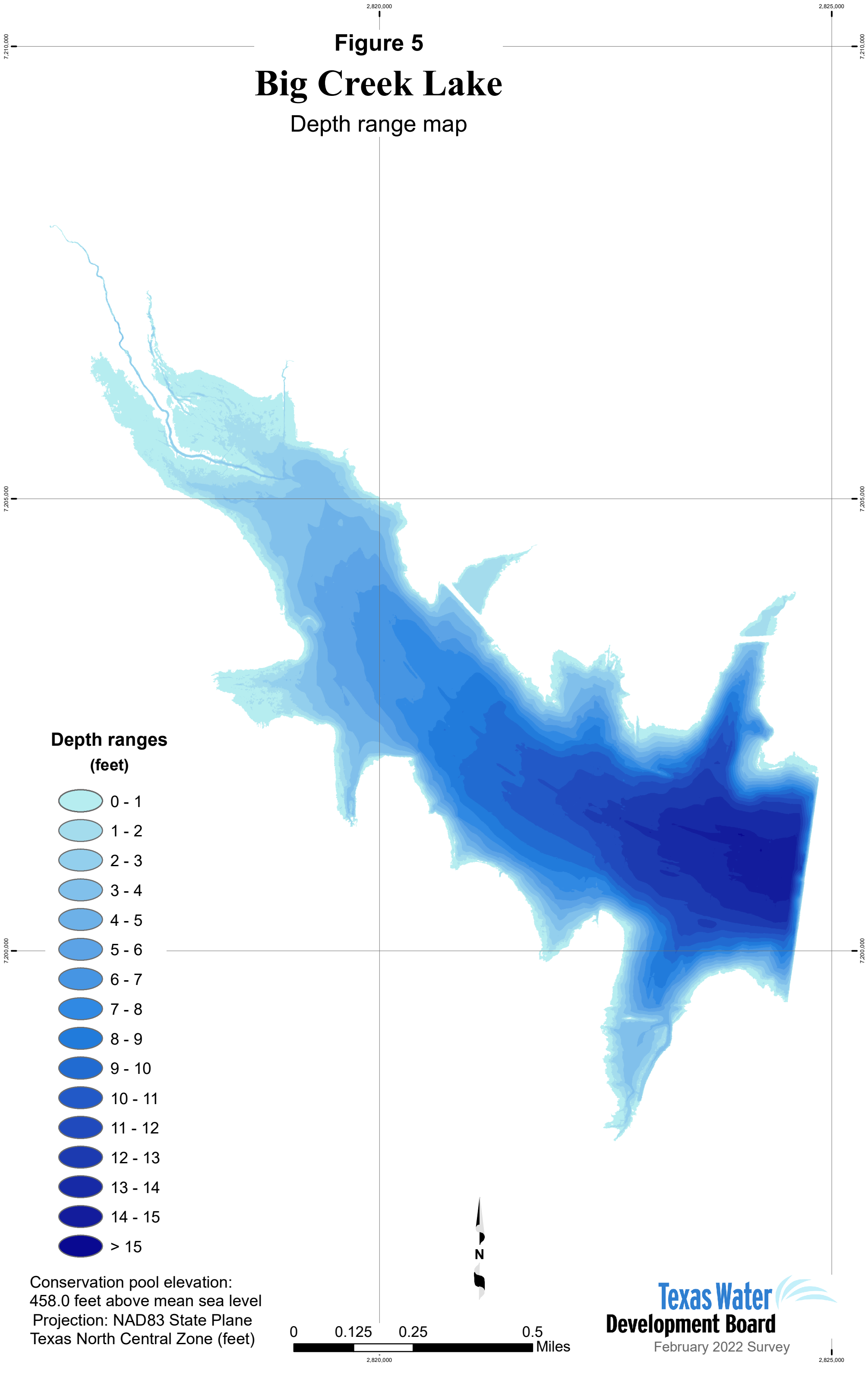
Texas Water Development Board

February 2022 Survey

Figure 5

Big Creek Lake

Depth range map



Conservation pool elevation:
458.0 feet above mean sea level
Projection: NAD83 State Plane
Texas North Central Zone (feet)

Texas Water Development Board

February 2022 Survey

Survey results

Volumetric survey

The 2022 TWDB volumetric survey indicates that Big Creek Lake has a total reservoir capacity of 2,919 acre-feet and encompasses 475 acres at conservation pool elevation (458.0 feet above mean sea level). Current area and capacity estimates are compared to previous area and capacity estimates at different elevations in Table 2. Because of differences in past and present survey methodologies, direct comparison of volumetric surveys to others to estimate loss of area and capacity can be unreliable.

Table 2. Surface area, total capacity, and conservation pool elevation.

Survey	Surface Area (acres)	Total Capacity (acre-feet)	Elevation[a]	Source
Unknown	1,129.5	13,296	468.84	Texas Commission on Environmental Quality, 2022
TWDB 2022	1,042	10,924	468.84	
Authorized storage[b]	512.8	4,890	458.0	Texas Commission on Environmental Quality, 2022
Purkeypile Consulting 2011[b]	512.8	4,625	458.0	Texas Commission on Environmental Quality, 2022
TWDB 2022	475	2,919	458.0	

a. Feet above mean sea level NGVD29. Notes: Normal pool/ conservation pool elevation is 458.0 feet, and the effective dam crest elevation is 468.84 feet.
b. Source: Texas Commission on Environmental Quality, 2022b.

Comparison of capacity estimates of Big Creek Lake derived using differing methodologies are provided in Table 3 for sedimentation rate calculation. Long-term trends indicate Big Creek Lake loses capacity at an average of 49 acre-feet per year since impoundment due to sedimentation below conservation pool elevation (Figure 7).

Table 3. Average annual capacity loss comparisons.

Survey comparisons	TCEQ authorized storage versus TWDB 2022	Purkeypile Consulting 2011 versus TWDB 2022
Total capacity (acre-feet) at top of conservation pool elevation 458.0 feet	4,890[a]	4,625[a]
	2,919	2,919
Volume difference (acre-feet)	1,971	1,706
Percent change	40.3	36.9
Number of years	35[b]	11
Capacity loss rate (acre-feet/year)	56	155
Capacity loss rate (acre-feet/square mile of drainage area of 11.92 square miles /year)	5	13

a. Source: Texas Commission on Environmental Quality, 2022b.
b. Big Creek Dam was completed, and deliberate impoundment began in1987 (Texas Parks and Wildlife, 2022).

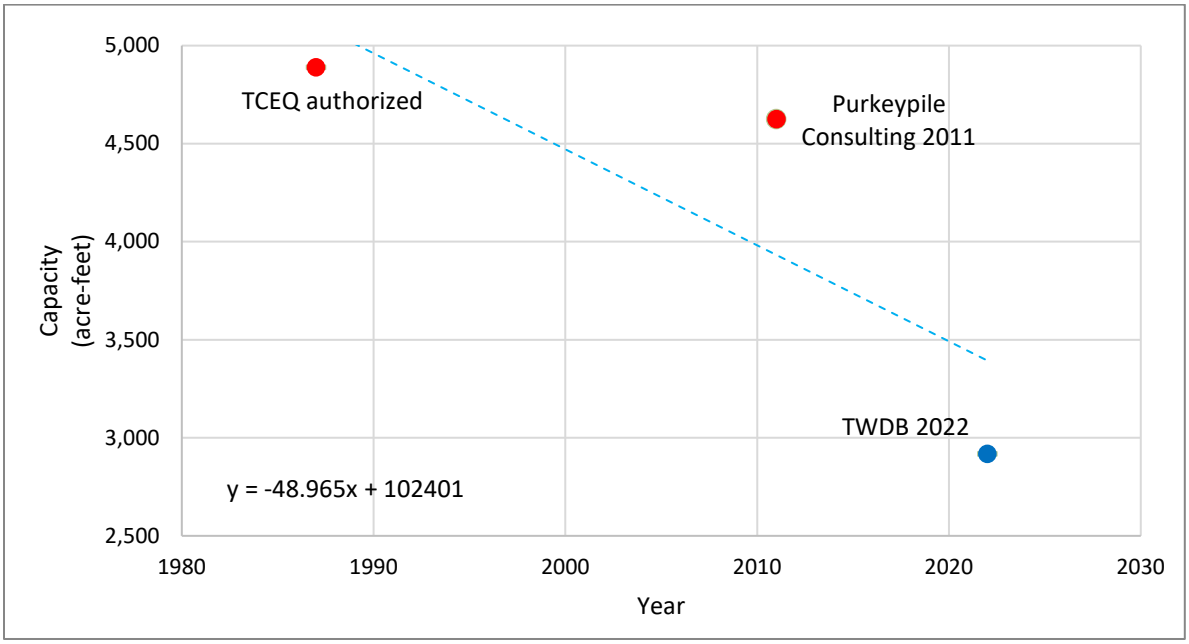


Figure 7. **Plot of current and previous capacity estimates (acre-feet). The TWDB capacity estimate plotted as a blue dot and other surveys as red dots. The blue trend line illustrates the total average loss of capacity through 2022.**

Recommendations

The TWDB recommends that a similar methodology be used to resurvey Big Creek Lake in 10 years or after a major high flow event. To further improve estimates of capacity loss, TWDB recommends a volumetric and sedimentation survey. Sedimentation surveys include additional analysis of the multi-frequency data for post-impoundment sediment by correlation with sediment core samples and a map identifying the spatial distribution of sediment throughout the reservoir.

TWDB contact information

For more information about the TWDB Hydrographic Survey Program, visit www.twdb.texas.gov/surfacewater/surveys. Any questions regarding the TWDB Hydrographic Survey Program or this report may be addressed to: Hydrosurvey@twdb.texas.gov.

References

City of Cooper, 2022, Water Quality Report | City of Cooper Texas, accessed October 31, 2022, at https://www.cityofcoopertx.municipalimpact.com/water-quality-report.

Environmental Systems Research Institute, 1995, ARC/INFO Surface Modeling and Display, TIN Users Guide: ESRI, California.

McEwen, T., Brock, N., Kemp, J., Pothina, D. and Weyant, H., 2011a, HydroTools User's Manual: Texas Water Development Board.

McEwen, T., Pothina, D. and Negusse, S., 2011b, Improving efficiency and repeatability of lake volume estimates using Python: Proceedings of the 10th Python for Scientific Computing Conference.

National Geodetic Survey, 2022, NGS Coordinate Conversion and Transformation Tool (NCAT), accessed September 22, 2022, at https://geodesy.noaa.gov/NCAT/.

Texas Commission on Environmental Quality, 2022a, Texas Water Rights Viewer, accessed October 12, 2022, at https://www.tceq.texas.gov/permitting/water_rights.

Texas Commission on Environmental Quality, 2022b, Pertinent Dam Data: Dam (Inventory No. TX06314).

Texas Parks and Wildlife, 2022, Fishing Big Creek Reservoir, accessed October 31, 2022, at https://tpwd.texas.gov/fishboat/fish/recreational/lakes/big_creek/.

Texas Water Development Board, 2017, TNRIS DataHub, Strategic Mapping Program (StratMap), East Texas Lidar, accessed October 31, 2022, at https://data.tnris.org/collection?c=f09f36b9-12b1-4c88-bccb-017afa9bc3d8#9.72/33.2672/-95.6943.

Texas Water Development Board, 2022, Contract No. 2348012713 with the City of Cooper, Texas.

Appendix A

Big Creek Lake

RESERVOIR BATHYMETRIC CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — Febraury 2022 Survey

CAPACITY IN ACRE-FEET — Conservation pool elevation 458.0 feet NGVD29

ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION (Feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
442	0	0	0	0	0	0	0	0	0	0
443	0	0	0	0	0	0	0	1	1	2
444	3	4	6	8	10	12	14	17	20	23
445	27	31	35	39	43	48	53	58	63	69
446	75	81	87	94	100	107	114	122	129	137
447	145	153	162	170	179	188	197	207	217	227
448	237	248	259	270	281	293	305	318	330	343
449	356	370	384	398	412	427	442	457	473	489
450	505	521	537	554	571	588	606	624	642	661
451	680	699	719	739	759	780	801	822	844	866
452	888	911	934	957	981	1,004	1,029	1,053	1,078	1,103
453	1,129	1,155	1,181	1,208	1,235	1,262	1,290	1,318	1,347	1,375
454	1,404	1,434	1,464	1,494	1,525	1,556	1,588	1,620	1,652	1,686
455	1,719	1,754	1,789	1,824	1,859	1,896	1,932	1,969	2,006	2,043
456	2,080	2,118	2,156	2,195	2,233	2,272	2,312	2,352	2,392	2,433
457	2,474	2,516	2,558	2,601	2,644	2,688	2,733	2,779	2,825	2,872
458	2,919									

Appendix B

Big Creek Lake

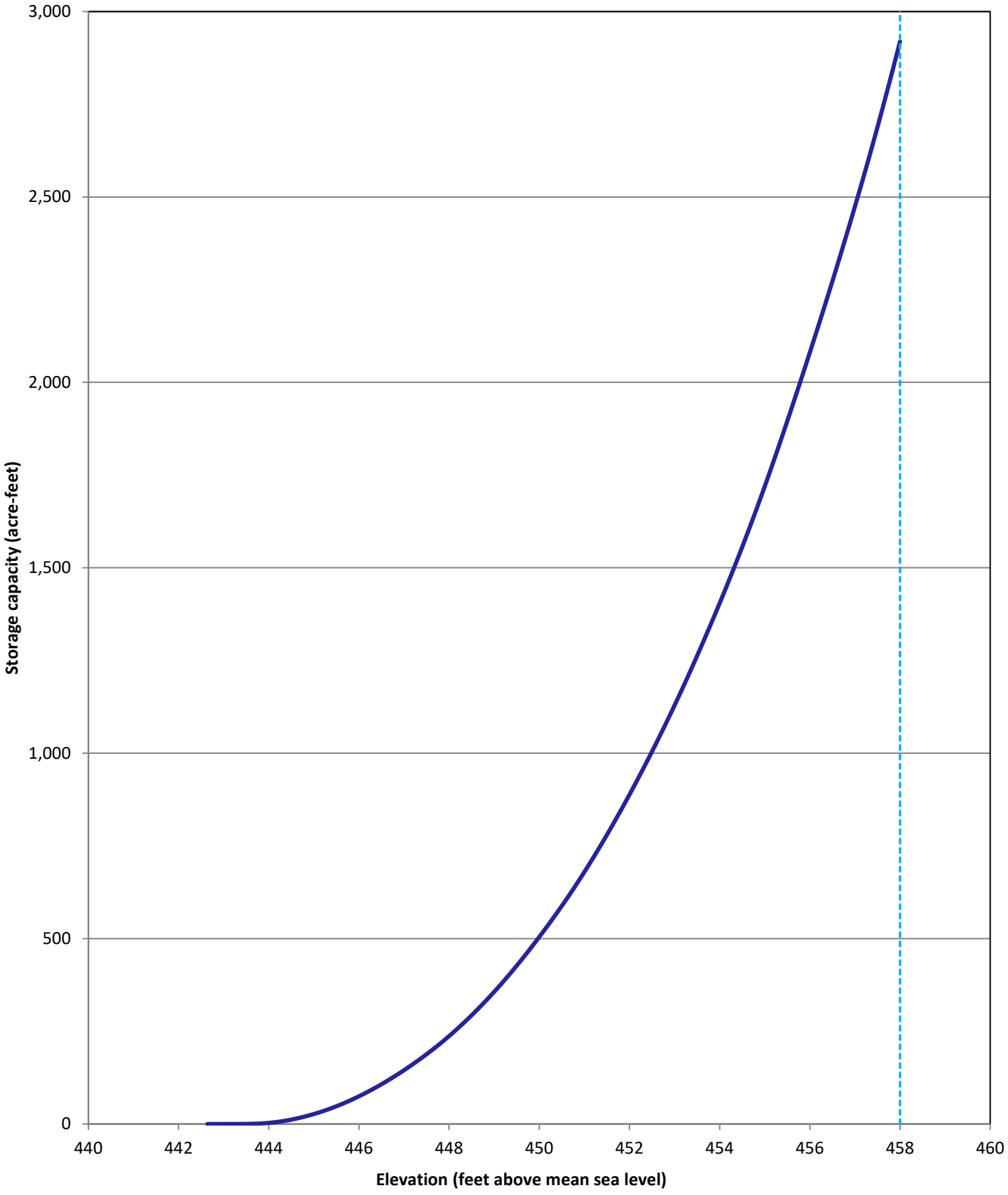
RESERVOIR BATHYMETRIC AREA TABLE

TEXAS WATER DEVELOPMENT BOARD — Febraury 2022 Survey

AREA IN ACRES — Conservation pool elevation 458.0 feet NGVD29

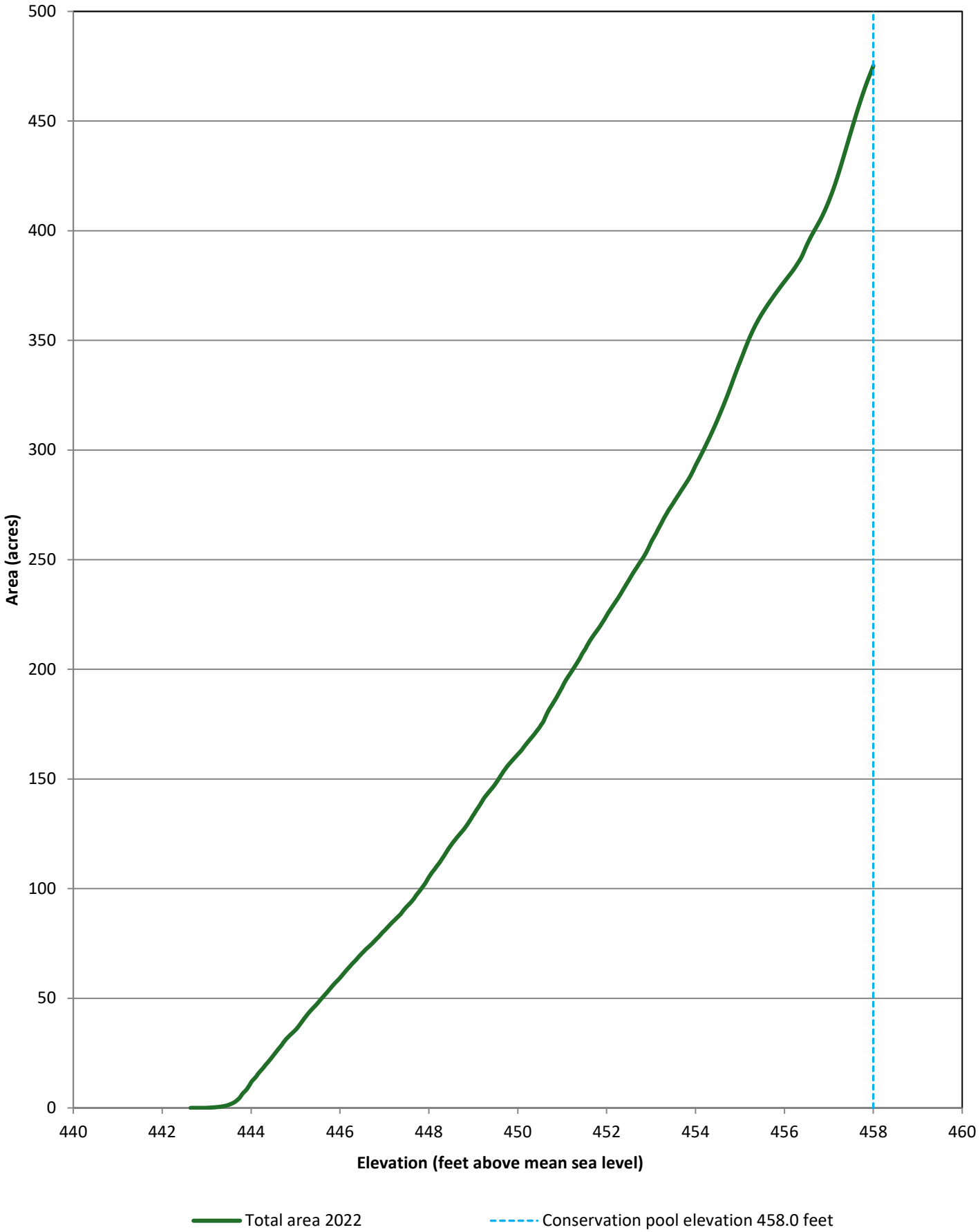
ELEVATION INCREMENT IS ONE TENTH FOOT

ELEVATION (Feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
442	0	0	0	0	0	0	0	0	0	0
443	0	0	0	1	1	1	2	4	6	8
444	12	14	17	19	21	24	27	29	32	34
445	36	38	41	43	46	48	50	52	55	57
446	59	62	64	66	68	71	73	75	77	79
447	81	83	85	87	89	92	94	97	99	102
448	105	108	111	114	117	120	123	125	127	130
449	134	137	140	143	145	148	151	154	157	159
450	161	163	166	169	171	174	177	181	185	188
451	192	196	199	202	205	209	212	215	218	221
452	225	228	231	234	237	241	244	247	250	254
453	258	262	265	269	273	276	279	282	285	289
454	293	297	301	305	309	314	319	324	329	335
455	340	345	350	355	359	362	366	368	371	374
456	377	379	382	385	389	393	397	401	405	409
457	414	419	425	432	438	445	452	458	464	470
458	475									



Big Creek Lake
February 2022 Survey
Prepared by: TWDB

Appendix C: Bathymetric capacity curve



Big Creek Lake
February 2022 Survey
Prepared by: TWDB

Appendix D: Bathymetric area curve

Appendix E

Big Creek Lake

RESERVOIR BATHYMETRIC AND TOPOGRAPHIC CAPACITY TABLE

TEXAS WATER DEVELOPMENT BOARD — February 2022 Survey

CAPACITY IN ACRE-FEET — Conservation pool elevation 458.0 feet NGVD29

ELEVATION INCREMENT IS ONE TENTH FOOT — Top of dam elevation 468.84 feet NGVD29

ELEVATION (Feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
442	0	0	0	0	0	0	0	0	0	0
443	0	0	0	0	0	0	0	1	1	2
444	3	4	6	8	10	12	14	17	20	23
445	27	31	35	39	43	48	53	58	63	69
446	75	81	87	94	100	107	114	122	129	137
447	145	153	162	170	179	188	197	207	217	227
448	237	248	259	270	281	293	305	318	330	343
449	356	370	384	398	412	427	442	457	473	489
450	505	521	537	554	571	588	606	624	642	661
451	680	699	719	739	759	780	801	822	844	866
452	888	911	934	957	981	1,004	1,029	1,053	1,078	1,103
453	1,129	1,155	1,181	1,208	1,235	1,262	1,290	1,318	1,347	1,375
454	1,404	1,434	1,464	1,494	1,525	1,556	1,588	1,620	1,652	1,686
455	1,719	1,754	1,789	1,824	1,860	1,896	1,932	1,969	2,006	2,043
456	2,081	2,118	2,156	2,195	2,233	2,273	2,312	2,352	2,392	2,433
457	2,474	2,516	2,558	2,601	2,645	2,689	2,734	2,779	2,826	2,873
458	2,920	2,968	3,017	3,066	3,115	3,165	3,216	3,266	3,318	3,369
459	3,421	3,474	3,527	3,580	3,633	3,688	3,742	3,797	3,852	3,908
460	3,965	4,021	4,078	4,136	4,194	4,253	4,311	4,371	4,431	4,491
461	4,551	4,613	4,674	4,736	4,798	4,861	4,925	4,988	5,053	5,117
462	5,183	5,248	5,314	5,381	5,448	5,515	5,583	5,652	5,721	5,791
463	5,861	5,931	6,002	6,074	6,146	6,219	6,292	6,366	6,441	6,516
464	6,591	6,667	6,744	6,821	6,898	6,977	7,055	7,135	7,215	7,295
465	7,376	7,458	7,540	7,623	7,707	7,791	7,875	7,960	8,046	8,132
466	8,219	8,306	8,394	8,482	8,571	8,660	8,751	8,841	8,932	9,024
467	9,116	9,209	9,303	9,397	9,491	9,587	9,683	9,779	9,876	9,974
468	10,072	10,171	10,271	10,371	10,472	10,574	10,676	10,779	10,882	

Appendix F

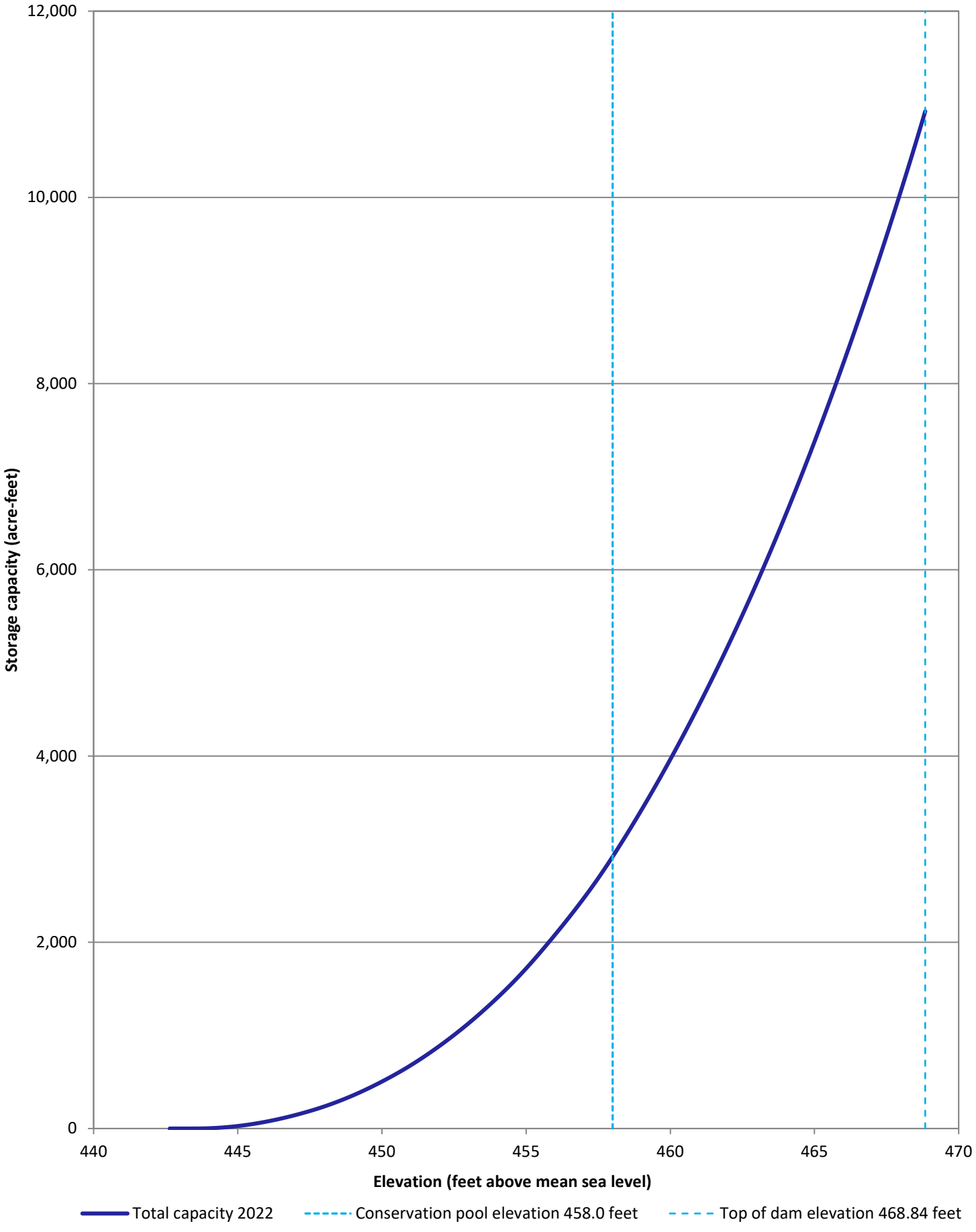
Big Creek Lake

RESERVOIR BATHYMETRIC AND TOPOGRAPHIC AREA TABLE

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

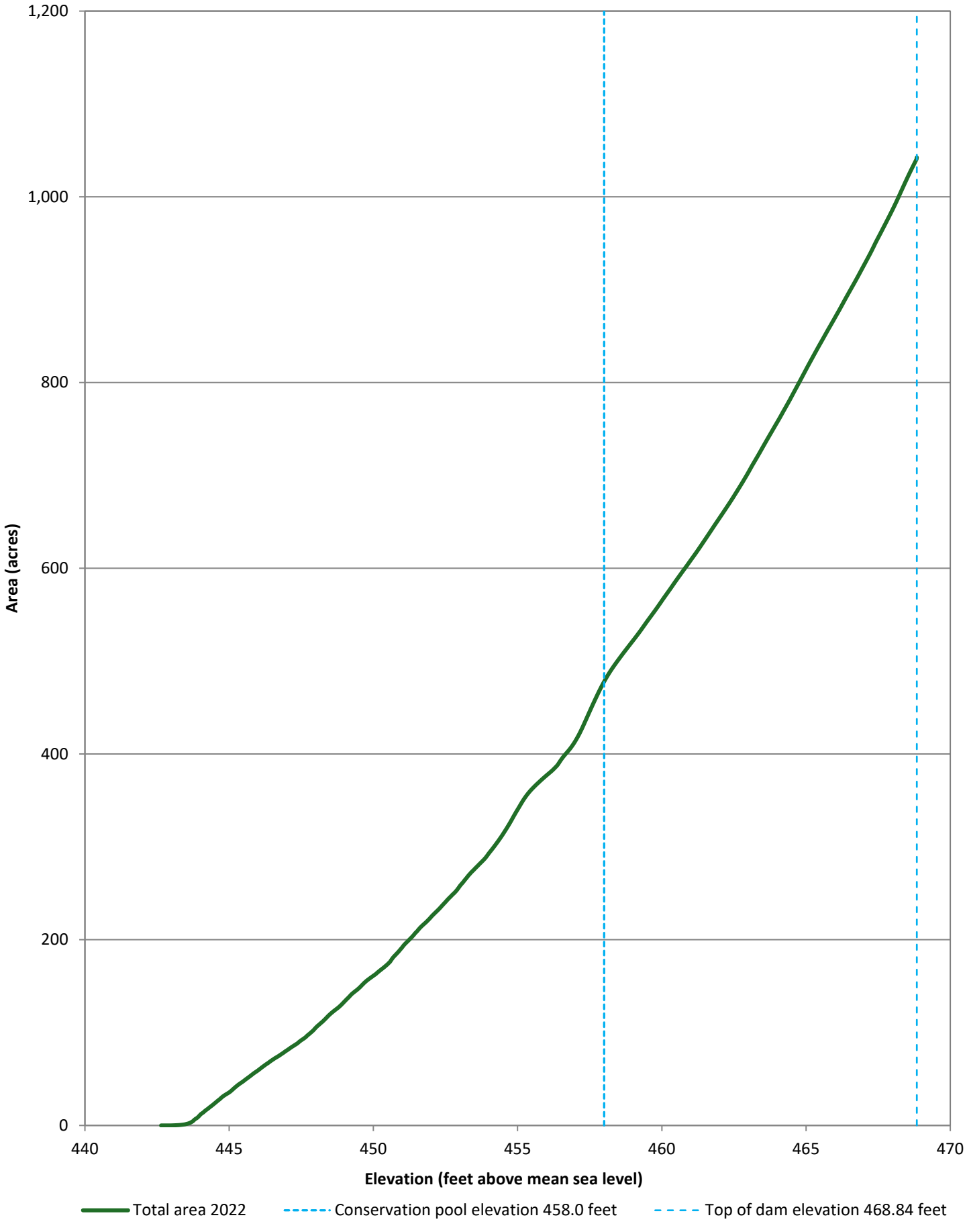
February 2022 Survey
Conservation pool elevation 458.0 feet NGVD29
Top of dam elevation 468.84 feet NGVD29

ELEVATION (Feet NGVD29)	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
442	0	0	0	0	0	0	0	0	0	0
443	0	0	0	1	1	1	2	4	6	8
444	12	14	17	19	21	24	27	29	32	34
445	36	38	41	43	46	48	50	52	55	57
446	59	62	64	66	68	71	73	75	77	79
447	81	83	85	87	89	92	94	97	99	102
448	105	108	111	114	117	120	123	125	127	130
449	134	137	140	143	145	148	151	154	157	159
450	161	163	166	169	171	174	177	181	185	188
451	192	196	199	202	205	209	212	215	218	221
452	225	228	231	234	237	241	244	247	250	254
453	258	262	265	269	273	276	279	282	285	289
454	293	297	301	305	309	314	319	324	329	335
455	340	345	350	355	359	362	366	369	371	374
456	377	380	382	385	389	394	398	401	405	409
457	414	419	425	432	439	446	453	459	466	472
458	478	483	488	493	497	502	506	510	514	518
459	522	526	530	535	539	543	548	552	556	560
460	565	569	574	578	583	587	591	596	600	604
461	609	613	617	622	626	631	636	640	645	650
462	654	659	663	668	673	678	683	688	693	698
463	703	709	714	720	725	730	736	741	747	752
464	757	763	768	774	779	785	791	797	802	808
465	814	820	826	831	837	842	848	853	859	864
466	870	875	881	887	892	898	903	909	914	920
467	926	932	938	944	950	956	962	968	974	980
468	986	993	999	1,006	1,013	1,020	1,026	1,033	1,039	



Big Creek Lake
February 2022 Survey
Prepared by: TWDB

Appendix G: Bathymetric and topographic capacity curve



Big Creek Lake
February 2022 Survey
Prepared by: TWDB

Appendix H: Bathymetric and topographic area curve

Figure 6

Big Creek Lake

2' - contour map

CONTOURS
(feet above mean sea level)

- 468
- 466
- 464
- 462
- 460
- 458
- 456
- 454
- 452
- 450
- 448
- 446
- 444

- Big Creek Lake Conservation pool elevation 458.0 feet
- Islands Elevation 458.0 feet
- Top of dam elevation 468.84 feet
- Islands Elevation 468.84 feet

Projection: NAD83 State Plane Texas North Central Zone (feet)

Delta 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 Big Creek Lake. The Texas Water Development Board makes no representations nor assumes any liability.

2,815,000 2,820,000 2,825,000

7,210,000 7,205,000 7,200,000

Texas Water Development Board

February 2022 Survey

N

0 0.25 0.5 Miles