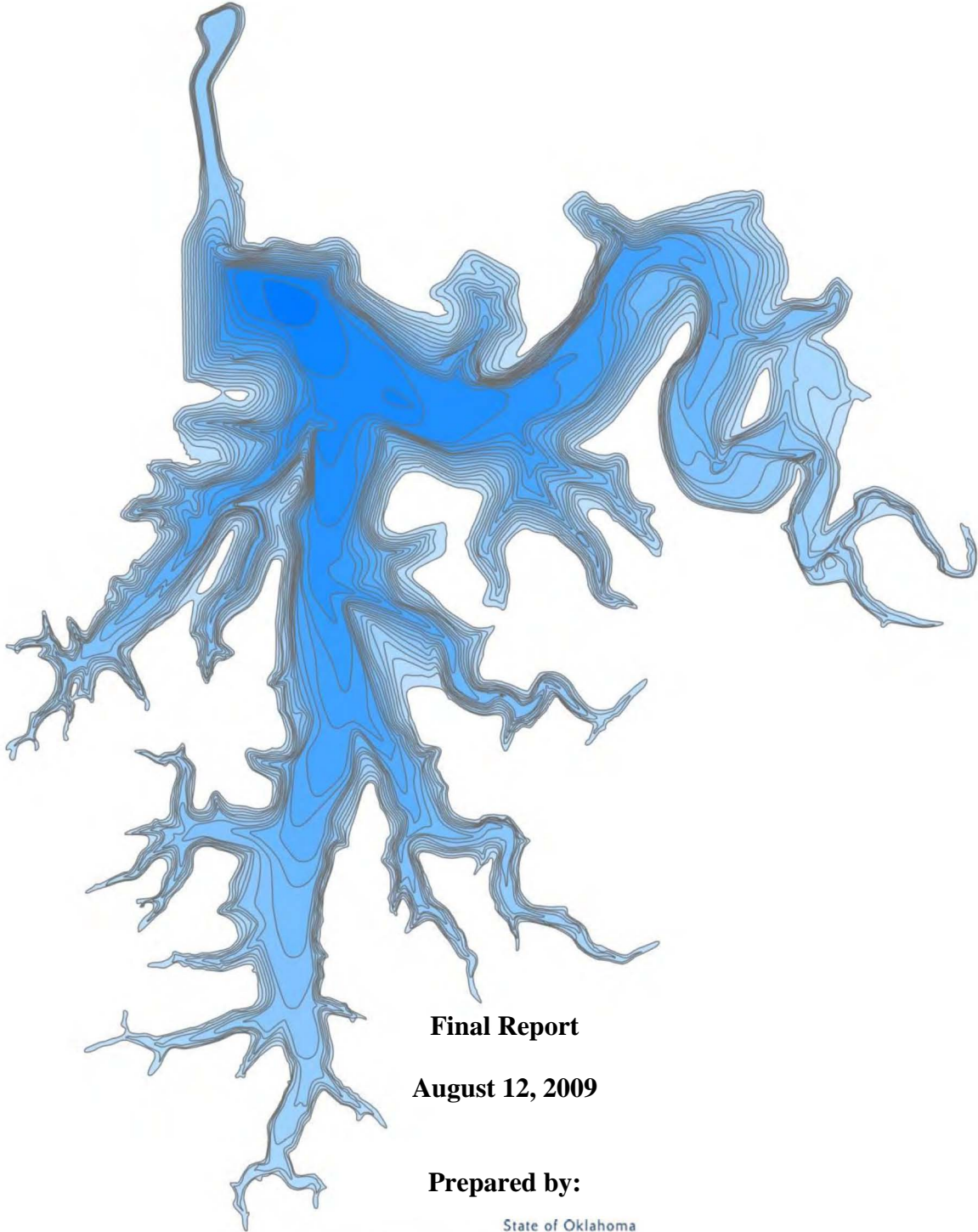


HYDROGRAPHIC SURVEY of W.R. HOLWAY RESERVOIR



Final Report

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Prepared by:

State of Oklahoma
OWRB
WATER RESOURCES BOARD
the water agency

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W.R. HOLWAY RESERVOIR HYDROGRAPHIC SURVEY REPORT

INTRODUCTION

The Oklahoma Water Resources Board (OWRB) conducted a hydrographic survey of W.R. Holway Reservoir in early February of 2009. The purpose of this survey was to produce a new elevation-area-capacity table for W.R. Holway Reservoir that would aid in a dependable yield determination conducted by the United States Army Corps of Engineers (USACE).

LAKE BACKGROUND

W.R. Holway Reservoir is located in Mayes County (**Figure 1**). Originally named Chimney Rock Reservoir, it was finished in 1968 as part of the Salina Pumped-Storage Project. It is operated as a pumped-storage type hydro-electric power development.

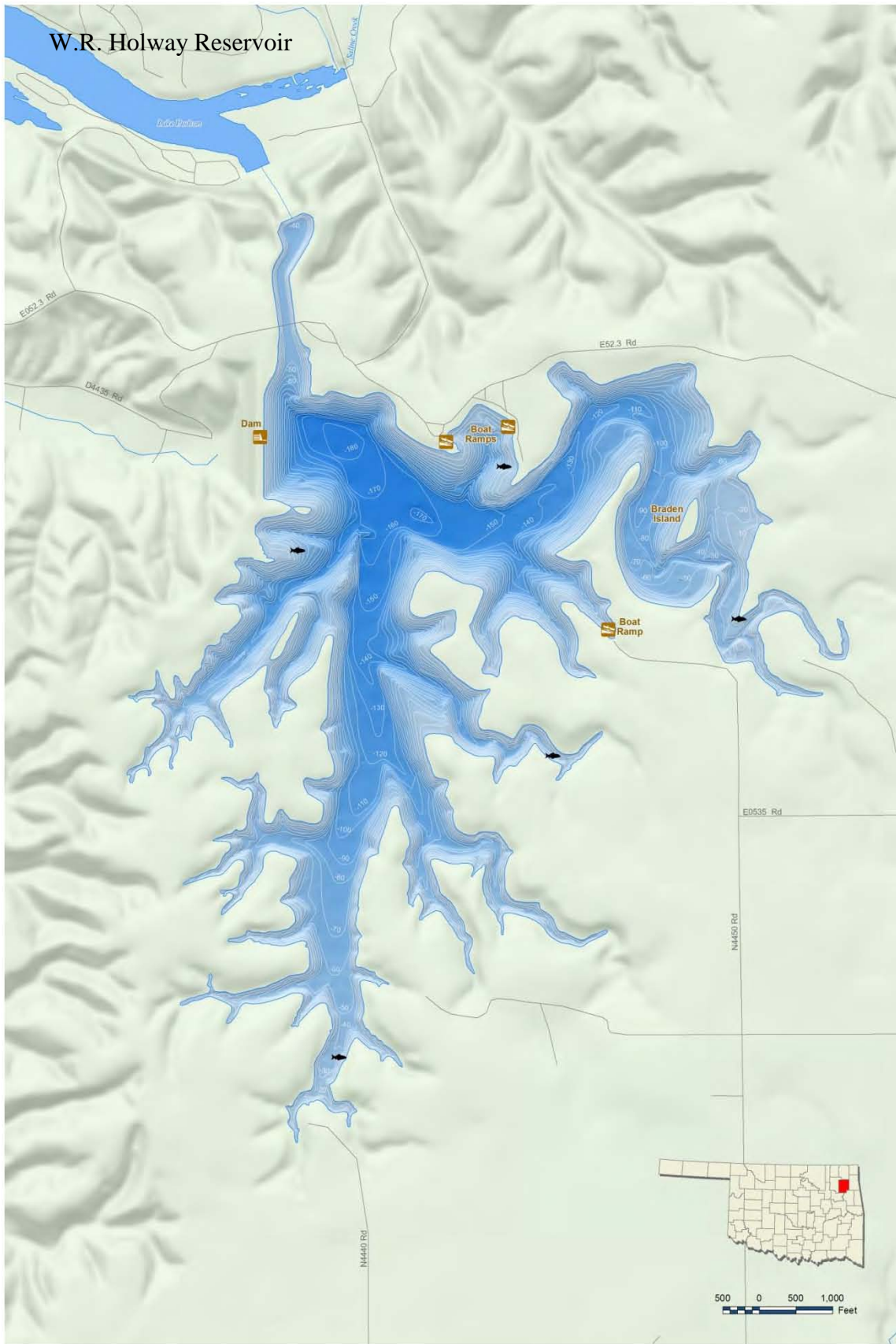


Figure 1: Location map for W.R. Holway Reservoir.

HYDROGRAPHIC SURVEYING PROCEDURES

The process of surveying a reservoir uses a combination of Geographic Positioning System (GPS) and acoustic depth sounding technologies that are incorporated into a hydrographic survey vessel. As the survey vessel travels across the lake's surface, the echosounder gathers multiple depth readings every second. The depth readings are stored on the survey vessel's on-board computer along with the positional data generated from the vessel's GPS receiver. The collected data files are downloaded daily from the computer and brought to the office for editing after the survey is completed. During editing, data "noise" is removed or corrected, and average depths are converted to elevation readings based on the daily-recorded lake level elevation on the day the survey was performed. Accurate estimates of area-capacity can then be determined for the lake by building a 3-D model of the reservoir from the corrected data. The process of completing a hydrographic survey includes four steps: pre-survey planning, field survey, data processing, and GIS application.

Pre-survey Planning

Boundary File

The boundary file for Grand was on-screen digitized from the 2006 color digital orthoimagery quarter quadrangle (DOQQ) mosaic of Mayes County, Oklahoma. The screen scale was set to 1:1,500. The digitized line is to represent the shoreline as closely as possible. Due to the photography being a summer photo, it was difficult to determine the actual shoreline when there are trees and other vegetation hanging over the lake. The 1995 DOQQs of the lakes were used as back ground reference. The reservoir boundaries were digitized in North American Datum (NAD) 1983 State Plane Coordinates (Oklahoma North-3501).

Set-up

HYPACK software from Hypack, Inc. was used to assign geodetic parameters, import background files, and create virtual track lines (transects). The geodetic parameters assigned were State Plane NAD 83 Zone OK-3501 Oklahoma North with distance units and depth as US Survey Feet. The survey transects were spaced according to the accuracy required for the project. The survey transects within the digitized reservoir boundary were at 300 ft increments and ran perpendicular to the original stream channels and tributaries. Approximately 60 virtual transects were created for the W.R. Holway Reservoir.

Field Survey

Lake Elevation Acquisition

The lake elevation for W.R. Holway Reservoir was obtained from Grand River Dam Authority (GRDA) personnel. Hourly lake elevations were obtained for the days that survey was performed.

Method

The procedures followed by the OWRB during the hydrographic survey adhere to U.S. Army Corps of Engineers (USACE) standards (USACE, 2002). The quality control and quality

assurance procedures for equipment calibration and operation, field survey, data processing, and accuracy standards are presented in the following sections.

Technology

The Hydro-survey vessel is an 18-ft aluminum Silverstreak hull with cabin, powered by a single 115-Horsepower Mercury outboard motor. Equipment used to conduct the survey included: a ruggedized notebook computer; Syqwest Bathy 1500 Echo Sounder, with a depth resolution of 0.1 ft; Trimble Navigation, Inc. Pro XR GPS receiver with differential global positioning system (DGPS) correction; and an Odom Hydrographics, Inc, DIGIBAR-Pro Profiling Sound Velocimeter. The software used was HYPACK.

Survey

A two-man survey crew was used during the project. Data collection for W.R. Holway Reservoir occurred in February of 2009. Data collection began at the dam and moved upstream. The survey crew followed the parallel transects created during the pre-survey planning while collecting depth soundings and positional data. Data was also collected along a path parallel to the shoreline at a distance that was determined by the depth of the water and the draft of the boat – generally, two to three feet deep. Areas with depths less than this were avoided.

Quality Control/Quality Assurance

While on board the Hydro-survey vessel, the Syqwest Bathy 1500 Echo Sounder was calibrated using A DIGIBAR-Pro Profiling Sound Velocimeter, by Odom Hydrographics. The sound velocimeter measures the speed of sound at incremental depths throughout the water column. The factors that influence the speed of sound—depth, temperature, and salinity—are all taken into account. Deploying the unit involved lowering the probe, which measures the speed of sound, into the water to the calibration depth mark to allow for acclimation and calibration of the depth sensor. The unit was then gradually lowered at a controlled speed to a depth just above the lake bottom, and then was raised to the surface. The unit collected sound velocity measurements in feet/seconds (ft/sec) at 1 ft increments on both the deployment and retrieval phases. The data was then reviewed for any erroneous readings, which were then edited out of the sample. The sound velocity corrections were then applied to the raw depth readings.

A quality assurance cross-line check was performed on intersecting transect lines and channel track lines to assess the estimated accuracy of the survey measurements. The overall accuracy of an observed bottom elevation or depth reading is dependent on random and systematic errors that are present in the measurement process. Depth measurements contain both random errors and systematic bias. Biases are often referred to as systematic errors and are often due to observational errors. Examples of bias include a bar check calibration error, tidal errors, or incorrect squat corrections. Bias, however, does not affect the repeatability, or precision, of results. The precision of depth readings is affected by random errors. These are errors present in the measurement system that cannot be easily reduced by further calibration. Examples of random error include uneven bottom topography, bottom vegetation, positioning error, extreme listing of survey vessel, and speed of sound variation in the water column. An assessment of the accuracy of an individual depth or bottom elevation must fully consider all the error components contained in the observations that were used to determine that

measurement. Therefore, the ultimate accuracy must be estimated (thus the use of the term “estimated accuracy”) using statistical estimating measures (USACE, 2002).

The depth accuracy estimate is determined by comparing depth readings taken at the intersection of two lines and computing the difference. This is done on multiple intersections. The mean difference of all intersection points is used to calculate the mean difference (MD). The mean difference represents the bias present in the survey. The standard deviation (SD), representing the random error in the survey, is also calculated. The mean difference and the standard deviation are then used to calculate the Root Mean Square (RMS) error. The RMS error estimate is used to compare relative accuracies of estimates that differ substantially in bias and precision (USACE, 2002). According to the USACE standards, the RMS at the 95% confidence level should not exceed a tolerance of ± 2.0 ft for this type of survey. This simply means that on average, 19 of every 20 observed depths will fall within the specified accuracy tolerance.

HYPACK Cross Statistics program was used to assess vertical accuracy and confidence measures of acoustically recorded depths. The program computes the sounding difference between intersecting lines of single beam data. The program provides a report that shows the standard deviation and mean difference. Cross check data from Grand Lake was used to calculate the quality control data. These two lakes were surveyed within a month of each other using the same equipment and setup, so no additional bias or error is expected. A total of 111 cross-sections points at W.R. Holway Reservoir were used to compute error estimates. A mean difference of 0.5 ft and a standard deviation of 0.43 ft were computed from intersections. The following formulas were used to determine the depth accuracy at the 95% confidence level.

$$RMS = \sqrt{\sigma^2_{Random\ error} + \sigma^2_{Bias}}$$

where:

Random error = Standard deviation

Bias = Mean difference

RMS = root mean square error (68% confidence level)

and:

$$RMS (95\%) \text{ depth accuracy} = 1.96 \times RMS (68\%)$$

An RMS of ± 1.3 ft with a 95% confidence level is less than the USACE’s minimum performance standard of ± 2.0 ft for this type of survey. A mean difference, or bias, of 0.5 ft is equal to the USACE’s standard maximum allowable bias of ± 0.5 ft for this type of survey.

The GPS system is an advanced high performance geographic data-acquisition tool that uses DGPS to provide sub-meter positional accuracy on a second-by-second basis. Potential errors are reduced with differential GPS because additional data from a reference GPS receiver at a known position are used to correct positions obtained during the survey. Before the survey,

Trimble's Pathfinder Controller software was used to configure the GPS receiver. To maximize the accuracy of the horizontal positioning, the horizontal mask setting was set to 15 degrees and the Position Dilution of Precision (PDOP) limit was set to 6. The position interval was set to 1 second and the Signal to Noise Ratio (SNR) mask was set to 4. The United States Coast Guard reference station used in the survey is located near Sallisaw, Oklahoma. The reference beacon system transmitted corrected signals in real time, so no post-processing corrections of position data were needed.

A latency test was performed to determine the fixed delay time between the GPS and single beam echo sounder. The timing delay was determined by running reciprocal survey lines over a channel bank. The raw data files were downloaded into HYPACK, LATENCY TEST program. The program varies the time delay to determine the "best fit" setting. A position latency of 0.1 seconds was produced and adjustments were applied to the raw data in the EDIT program.

Data Processing

The collected data was transferred from the field computer onto an OWRB desktop computer. After downloading the data, each raw data file was reviewed using the EDIT program within HYPACK. The EDIT program allowed the user to assign transducer offsets, latency corrections, tide corrections, display the raw data profile, and review/edit all raw depth information. Raw data files are checked for gross inaccuracies that occur during data collection.

Offset correction values of 3.2 ft. starboard, 6.6 ft. forward, and -1.1 ft. vertical were applied to all raw data along with a latency correction factor of 0.1 seconds. The speed of sound corrections were applied during editing of raw data.

A correction file was produced using the HYPACK TIDES program to account for the variance in lake elevation at the time of data collection. Within the EDIT program, the corrected depths were subtracted from the elevation reading to convert the depth in feet to an elevation.

After editing the data for errors and correcting the spatial attributes (offsets and tide corrections), a data reduction scheme was needed. To accomplish this, the corrected data was resampled spatially at a 10 ft interval using the Sounding Selection program in HYPACK. The resultant data was saved and exported out as a xyz.txt file. The HYPACK raw and corrected data files for W.R. Holway Reservoir are located on the DVD entitled *Holway HYPACK/GIS Metadata*.

GIS Application

Geographic Information System (GIS) software was used to process the edited XYZ data collected from the survey. The GIS software used was ArcGIS Desktop and ArcMap, version 9.2, from Environmental System Research Institute (ESRI). All of the GIS datasets created are in Oklahoma State Plane North Coordinate System referenced to the North American Datum 1983. Horizontal and vertical units are in feet. The edited data points in XYZ text file format were converted into ArcMap point coverage format. The point coverage contains the

X and Y horizontal coordinates and the elevation and depth values associated with each collected point.

Volumetric and area calculations were derived using a Triangulated Irregular Network (TIN) surface model. The TIN model was created in ArcMap, using the collected survey data points and the lake boundary inputs. The TIN consists of connected data points that form a network of triangles representing the bottom surface of the lake. The lake volume was calculated by slicing the TIN horizontally into planes 0.1 ft thick. The cumulative volume and area of each slice are shown in **APPENDIX A: Area-Capacity Data**.

Contours, depth ranges, and the shaded relief map were derived from a constructed digital elevation model grid. This grid was created using the ArcMap Topo to Raster Tool and had a spatial resolution of five feet. A low pass 3x3 filter was run to lightly smooth the grid to improve contour generation. The contours were created at a 10-ft interval using the ArcMap Contour Tool. The contour lines were edited to allow for polygon topology and to improve accuracy and general smoothness of the lines. The contours were then converted to a polygon coverage and attributed to show 10-ft depth ranges across the lake. The bathymetric maps of the lakes are shown with 10-ft contour intervals in **APPENDIX B: W.R. Holway Reservoir Maps**.

All geographic datasets derived from the survey contain Federal Geographic Data Committee (FGDC) compliant metadata documentation. The metadata describes the procedures and commands used to create the datasets. The GIS metadata file for both lakes is located at on the DVD entitled *Holway HYPACK/GIS Metadata*.

RESULTS

Results from the 2009 OWRB survey indicate that W.R. Holway Reservoir encompasses 762 acres and contains a cumulative capacity of 50,372 ac-ft at the normal pool elevation (865 ft National Geodetic Vertical Datum (NGVD)). The average depth for W.R. Holway Reservoir was 66.1 ft.

SUMMARY and COMPARISON

Table 1 is comparison of area and volume changes of W.R. Holway Reservoir at the normal pool elevation. Based on the design specifications, W.R. Holway Reservoir had an area of 712 acres and cumulative volume of 48,000 acre-feet of water at normal pool elevation (865 ft NGVD). The surface area of the lake has had an increase of 50 acres or approximately 7%. The 2009 survey shows that W.R. Holway Reservoir has an apparent increase in capacity of 4.9% or approximately 2,372 acre-feet. Caution should be used when directly comparing between the design specifications and the 2009 survey conducted by the OWRB because different methods were used to collect the data and extrapolate capacity and area figures. This could account for the apparent gain in area and capacity, which is unlikely to be seen in Oklahoma reservoirs. It is the recommendation of the OWRB that another survey using the same method used in the 2009 survey be conducted in 10-15 years. By using the 2009 survey

figures as a baseline, a future survey would allow an accurate sedimentation rate to be obtained.

Table 1: Area and Volume Comparisons of W.R. Holway Reservoir at normal pool (865 ft NGVD).

Feature	Survey Year	
	1968 Design Specifications	2009
Area (acres)	712	762
Cumulative Volume (acre-feet)	48,000	50,372
Mean depth (ft)	67.4	66.1
Maximum Depth (ft)	--	182

REFERENCES

U.S. Army Corps of Engineers (USACE). 2002. Engineering and Design - Hydrographic Surveying, Publication EM 1110-2-1003, 3rd version.

Oklahoma Water Resources Board (OWRB). 1970. Oklahoma Water Atlas.

APPENDIX A: Area-Capacity Data

Table A. 1: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments.

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)											
		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
682	Area						0.000	0.001	0.004	0.008	0.013
	Capacity						0.000	0.000	0.000	0.001	0.002
683	Area	0.020	0.027	0.039	0.062	0.093	0.130	0.172	0.219	0.304	0.487
	Capacity	0.004	0.006	0.009	0.014	0.022	0.033	0.048	0.067	0.092	0.132
684	Area	0.731	1.039	1.406	1.794	2.190	2.578	2.964	3.349	3.791	4.281
	Capacity	0.192	0.280	0.402	0.562	0.761	0.999	1.276	1.592	1.948	2.352
685	Area	4.528	4.596	4.665	4.733	4.802	4.871	4.941	5.010	5.080	5.150
	Capacity	2.800	3.256	3.719	4.189	4.666	5.150	5.640	6.138	6.643	7.154
686	Area	5.220	5.290	5.361	5.434	5.511	5.590	5.670	5.753	5.841	5.931
	Capacity	7.673	8.198	8.731	9.271	9.818	10.37	10.94	11.51	12.09	12.68
687	Area	6.023	6.115	6.209	6.303	6.399	6.495	6.592	6.690	6.789	6.888
	Capacity	13.27	13.88	14.50	15.12	15.76	16.40	17.06	17.72	18.39	19.08
688	Area	6.989	7.090	7.192	7.295	7.398	7.502	7.606	7.711	7.815	7.920
	Capacity	19.77	20.48	21.19	21.92	22.65	23.40	24.15	24.92	25.69	26.48
689	Area	8.026	8.132	8.239	8.347	8.455	8.566	8.678	8.790	8.904	9.017
	Capacity	27.28	28.09	28.90	29.73	30.57	31.43	32.29	33.16	34.05	34.94
690	Area	9.132	9.246	9.362	9.478	9.594	9.711	9.828	9.945	10.06	10.18
	Capacity	35.85	36.77	37.70	38.64	39.59	40.56	41.54	42.53	43.53	44.54
691	Area	10.29	10.41	10.52	10.64	10.75	10.86	10.98	11.09	11.20	11.31
	Capacity	45.56	46.60	47.64	48.70	49.77	50.85	51.94	53.05	54.16	55.29
692	Area	11.43	11.54	11.65	11.76	11.88	11.99	12.11	12.22	12.34	12.45
	Capacity	56.43	57.57	58.73	59.90	61.09	62.28	63.48	64.70	65.93	67.17
693	Area	12.57	12.69	12.81	12.93	13.05	13.17	13.29	13.43	13.57	13.72
	Capacity	68.42	69.68	70.96	72.25	73.54	74.86	76.18	77.51	78.86	80.23
694	Area	13.89	14.07	14.27	14.49	14.76	15.09	15.48	15.90	16.37	16.89
	Capacity	81.61	83.01	84.42	85.86	87.32	88.82	90.35	91.91	93.53	95.19
695	Area	17.42	17.54	17.66	17.78	17.91	18.04	18.17	18.30	18.43	18.57
	Capacity	96.92	98.67	100.4	102.2	104.0	105.8	107.6	109.4	111.3	113.1
696	Area	18.71	18.85	18.99	19.14	19.29	19.44	19.60	19.77	19.93	20.10
	Capacity	115.0	116.8	118.7	120.6	122.6	124.5	126.5	128.4	130.4	132.4
697	Area	20.26	20.43	20.60	20.78	20.97	21.16	21.36	21.57	21.79	22.01
	Capacity	134.4	136.5	138.5	140.6	142.7	144.8	146.9	149.1	151.2	153.4
698	Area	22.24	22.47	22.71	22.96	23.19	23.42	23.64	23.85	24.06	24.26
	Capacity	155.6	157.9	160.1	162.4	164.7	167.0	169.4	171.8	174.2	176.6
699	Area	24.47	24.66	24.86	25.06	25.25	25.44	25.63	25.81	26.00	26.19
	Capacity	179.0	181.5	184.0	186.5	189.0	191.5	194.1	196.6	199.2	201.8
700	Area	26.38	26.57	26.76	26.95	27.14	27.33	27.53	27.73	27.93	28.12
	Capacity	204.5	207.1	209.8	212.5	215.2	217.9	220.6	223.4	226.2	229.0
701	Area	28.32	28.52	28.72	28.92	29.11	29.31	29.50	29.70	29.90	30.09
	Capacity	231.8	234.6	237.5	240.4	243.3	246.2	249.2	252.1	255.1	258.1
702	Area	30.28	30.48	30.69	30.90	31.11	31.32	31.54	31.76	31.98	32.20
	Capacity	261.1	264.2	267.2	270.3	273.4	276.5	279.7	282.8	286.0	289.2

Table A. 2: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		703	Area	32.42	32.65	32.88	33.11	33.35	33.59	33.84	34.08
	Capacity	292.5	295.7	299.0	302.3	305.6	309.0	312.3	315.7	319.1	322.6
704	Area	34.84	35.10	35.36	35.62	35.88	36.14	36.41	36.67	36.94	37.22
	Capacity	326.1	329.6	333.1	336.6	340.2	343.8	347.4	351.1	354.8	358.5
705	Area	34.84	35.10	35.36	35.62	35.88	36.14	36.41	36.67	36.94	37.22
	Capacity	326.1	329.6	333.1	336.6	340.2	343.8	347.4	351.1	354.8	358.5
706	Area	40.05	40.26	40.46	40.67	40.88	41.09	41.31	41.52	41.73	41.94
	Capacity	401.3	405.3	409.3	413.4	417.5	421.6	425.7	429.8	434.0	438.2
707	Area	42.15	42.36	42.56	42.76	42.96	43.15	43.33	43.52	43.71	43.91
	Capacity	442.4	446.6	450.9	455.1	459.4	463.7	468.1	472.4	476.8	481.1
708	Area	44.10	44.29	44.48	44.67	44.87	45.06	45.26	45.45	45.64	45.83
	Capacity	485.5	490.0	494.4	498.9	503.3	507.8	512.3	516.9	521.4	526.0
709	Area	46.02	46.21	46.40	46.59	46.79	46.99	47.19	47.39	47.59	47.80
	Capacity	530.6	535.2	539.8	544.5	549.2	553.9	558.6	563.3	568.0	572.8
710	Area	48.00	48.21	48.42	48.64	48.85	49.07	49.29	49.51	49.73	49.95
	Capacity	577.6	582.4	587.3	592.1	597.0	601.9	606.8	611.7	616.7	621.7
711	Area	50.18	50.41	50.63	50.86	51.09	51.33	51.56	51.79	52.03	52.27
	Capacity	626.7	631.7	636.8	641.9	646.9	652.1	657.2	662.4	667.6	672.8
712	Area	52.51	52.76	53.01	53.27	53.54	53.82	54.10	54.41	54.75	55.03
	Capacity	678.0	683.3	688.6	693.9	699.2	704.6	710.0	715.4	720.9	726.4
713	Area	55.32	55.61	55.91	56.22	56.54	56.87	57.21	57.55	57.89	58.23
	Capacity	731.9	737.4	743.0	748.6	754.3	759.9	765.6	771.4	777.2	783.0
714	Area	58.57	58.92	59.28	59.63	59.99	60.34	60.69	61.05	61.41	61.77
	Capacity	788.8	794.7	800.6	806.5	812.5	818.5	824.6	830.7	836.8	843.0
715	Area	62.45	62.60	62.74	62.89	63.03	63.17	63.31	63.46	63.60	63.74
	Capacity	849.2	855.4	861.7	868.0	874.3	880.6	886.9	893.3	899.6	906.0
716	Area	63.89	64.03	64.18	64.34	64.50	64.65	64.81	64.97	65.13	65.29
	Capacity	912.4	918.8	925.2	931.6	938.0	944.5	951.0	957.5	964.0	970.5
717	Area	65.45	65.60	65.76	65.92	66.08	66.24	66.39	66.55	66.71	66.87
	Capacity	977.0	983.6	990.2	996.7	1,003	1,010	1,017	1,023	1,030	1,037
718	Area	67.03	67.18	67.34	67.50	67.66	67.82	67.98	68.14	68.31	68.47
	Capacity	1,043	1,050	1,057	1,063	1,070	1,077	1,084	1,091	1,097	1,104
719	Area	68.63	68.80	68.96	69.13	69.30	69.47	69.64	69.82	69.99	70.18
	Capacity	1,111	1,118	1,125	1,132	1,139	1,146	1,153	1,160	1,167	1,174
720	Area	70.36	70.54	70.72	70.91	71.10	71.29	71.49	71.69	71.88	72.08
	Capacity	1,181	1,188	1,195	1,202	1,209	1,216	1,223	1,230	1,237	1,245
721	Area	72.27	72.46	72.66	72.85	73.04	73.23	73.44	73.68	73.96	74.19
	Capacity	1,252	1,259	1,266	1,274	1,281	1,288	1,296	1,303	1,310	1,318
722	Area	74.43	74.66	74.90	75.13	75.37	75.61	75.86	76.10	76.34	76.58
	Capacity	1,325	1,333	1,340	1,348	1,355	1,363	1,370	1,378	1,386	1,393
723	Area	76.83	77.07	77.31	77.55	77.79	78.04	78.28	78.54	78.81	79.09
	Capacity	1,401	1,409	1,416	1,424	1,432	1,440	1,447	1,455	1,463	1,471

Table A. 3: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		724	Area	79.39	79.69	80.02	80.36	80.72	81.10	81.51	81.96
	Capacity	1,479	1,487	1,495	1,503	1,511	1,519	1,527	1,535	1,544	1,552
725	Area	85.40	85.75	86.09	86.39	86.65	86.89	87.10	87.31	87.52	87.72
	Capacity	1,560	1,569	1,577	1,586	1,595	1,603	1,612	1,621	1,630	1,638
726	Area	87.93	88.13	88.34	88.54	88.74	88.95	89.15	89.35	89.56	89.75
	Capacity	1,647	1,656	1,665	1,674	1,682	1,691	1,700	1,709	1,718	1,727
727	Area	89.95	90.14	90.33	90.52	90.71	90.89	91.08	91.26	91.45	91.63
	Capacity	1,736	1,745	1,754	1,763	1,772	1,781	1,790	1,800	1,809	1,818
728	Area	91.82	92.01	92.19	92.39	92.58	92.79	92.99	93.20	93.40	93.62
	Capacity	1,827	1,836	1,845	1,855	1,864	1,873	1,882	1,892	1,901	1,910
729	Area	93.83	94.05	94.27	94.49	94.72	94.94	95.17	95.40	95.63	95.86
	Capacity	1,920	1,929	1,939	1,948	1,958	1,967	1,977	1,986	1,996	2,005
730	Area	96.09	96.31	96.54	96.78	97.01	97.26	97.50	97.75	98.00	98.25
	Capacity	2,015	2,024	2,034	2,044	2,053	2,063	2,073	2,083	2,092	2,102
731	Area	98.51	98.77	99.03	99.28	99.54	99.79	100.04	100.28	100.52	100.76
	Capacity	2,112	2,122	2,132	2,142	2,152	2,162	2,172	2,182	2,192	2,202
732	Area	101.00	101.24	101.48	101.72	101.96	102.20	102.44	102.68	102.92	103.17
	Capacity	2,212	2,222	2,232	2,242	2,252	2,263	2,273	2,283	2,293	2,304
733	Area	103.42	103.67	103.92	104.18	104.45	104.71	104.98	105.24	105.52	105.79
	Capacity	2,314	2,324	2,335	2,345	2,356	2,366	2,377	2,387	2,398	2,408
734	Area	106.07	106.35	106.64	106.93	107.22	107.52	107.83	108.13	108.45	108.78
	Capacity	2,419	2,429	2,440	2,451	2,461	2,472	2,483	2,494	2,505	2,515
735	Area	110.48	110.68	110.89	111.10	111.30	111.50	111.71	111.90	112.10	112.30
	Capacity	2,526	2,538	2,549	2,560	2,571	2,582	2,593	2,604	2,616	2,627
736	Area	112.49	112.68	112.87	113.06	113.25	113.43	113.62	113.81	113.99	114.18
	Capacity	2,638	2,649	2,661	2,672	2,683	2,694	2,706	2,717	2,729	2,740
737	Area	114.37	114.55	114.74	114.93	115.12	115.31	115.50	115.69	115.89	116.08
	Capacity	2,751	2,763	2,774	2,786	2,797	2,809	2,820	2,832	2,844	2,855
738	Area	116.28	116.48	116.67	116.87	117.06	117.26	117.45	117.65	117.84	118.04
	Capacity	2,867	2,878	2,890	2,902	2,913	2,925	2,937	2,949	2,960	2,972
739	Area	118.24	118.43	118.63	118.82	119.02	119.22	119.42	119.62	119.81	120.01
	Capacity	2,984	2,996	3,008	3,020	3,032	3,043	3,055	3,067	3,079	3,091
740	Area	120.22	120.42	120.62	120.83	121.03	121.24	121.45	121.67	121.88	122.10
	Capacity	3,103	3,115	3,127	3,139	3,152	3,164	3,176	3,188	3,200	3,212
741	Area	122.32	122.54	122.77	122.99	123.22	123.45	123.69	123.93	124.17	124.42
	Capacity	3,225	3,237	3,249	3,261	3,274	3,286	3,298	3,311	3,323	3,336
742	Area	124.67	124.92	125.19	125.47	125.79	126.09	126.38	126.67	126.97	127.27
	Capacity	3,348	3,361	3,373	3,386	3,398	3,411	3,423	3,436	3,449	3,461
743	Area	127.56	127.86	128.15	128.44	128.74	129.04	129.33	129.63	129.93	130.23
	Capacity	3,474	3,487	3,500	3,513	3,525	3,538	3,551	3,564	3,577	3,590
744	Area	130.54	130.84	131.15	131.45	131.77	132.09	132.41	132.74	133.08	133.43
	Capacity	3,603	3,616	3,629	3,643	3,656	3,669	3,682	3,695	3,709	3,722

Table A. 4: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		745	Area	135.5	135.7	135.9	136.1	136.3	136.5	136.7	136.9
	Capacity	3,735	3,749	3,763	3,776	3,790	3,804	3,817	3,831	3,845	3,858
746	Area	137.6	137.8	138.0	138.2	138.4	138.6	138.8	139.0	139.3	139.5
	Capacity	3,872	3,886	3,900	3,913	3,927	3,941	3,955	3,969	3,983	3,997
747	Area	139.7	139.9	140.1	140.4	140.6	140.8	141.0	141.2	141.5	141.7
	Capacity	4,011	4,025	4,039	4,053	4,067	4,081	4,095	4,109	4,123	4,137
748	Area	141.9	142.1	142.4	142.6	142.8	143.1	143.3	143.5	143.8	144.0
	Capacity	4,151	4,166	4,180	4,194	4,208	4,223	4,237	4,251	4,266	4,280
749	Area	144.2	144.5	144.7	144.9	145.2	145.4	145.7	145.9	146.2	146.4
	Capacity	4,295	4,309	4,323	4,338	4,352	4,367	4,382	4,396	4,411	4,425
750	Area	146.7	146.9	147.2	147.4	147.7	148.0	148.2	148.5	148.8	149.0
	Capacity	4,440	4,455	4,469	4,484	4,499	4,514	4,529	4,543	4,558	4,573
751	Area	149.3	149.6	149.9	150.2	150.4	150.7	151.0	151.3	151.7	152.0
	Capacity	4,588	4,603	4,618	4,633	4,648	4,663	4,678	4,693	4,708	4,724
752	Area	152.3	152.6	152.9	153.3	153.6	153.9	154.3	154.6	155.0	155.3
	Capacity	4,739	4,754	4,769	4,785	4,800	4,815	4,831	4,846	4,862	4,877
753	Area	155.7	156.0	156.4	156.8	157.1	157.5	157.9	158.3	158.6	159.0
	Capacity	4,893	4,908	4,924	4,940	4,955	4,971	4,987	5,003	5,019	5,034
754	Area	159.4	159.8	160.3	160.7	161.1	161.5	161.9	162.4	162.9	163.4
	Capacity	5,050	5,066	5,082	5,098	5,114	5,131	5,147	5,163	5,179	5,196
755	Area	165.5	165.9	166.1	166.4	166.6	166.9	167.1	167.4	167.6	167.8
	Capacity	5,212	5,229	5,245	5,262	5,279	5,295	5,312	5,329	5,345	5,362
756	Area	168.1	168.3	168.6	168.8	169.0	169.3	169.5	169.7	170.0	170.2
	Capacity	5,379	5,396	5,413	5,429	5,446	5,463	5,480	5,497	5,514	5,531
757	Area	170.4	170.7	170.9	171.1	171.4	171.6	171.8	172.1	172.3	172.5
	Capacity	5,548	5,565	5,582	5,599	5,617	5,634	5,651	5,668	5,685	5,703
758	Area	172.8	173.0	173.2	173.5	173.7	173.9	174.2	174.4	174.6	174.9
	Capacity	5,720	5,737	5,754	5,772	5,789	5,807	5,824	5,841	5,859	5,876
759	Area	175.1	175.3	175.6	175.8	176.0	176.3	176.5	176.8	177.0	177.3
	Capacity	5,894	5,911	5,929	5,946	5,964	5,982	5,999	6,017	6,035	6,052
760	Area	177.5	177.7	178.0	178.2	178.5	178.7	179.0	179.2	179.5	179.7
	Capacity	6,070	6,088	6,106	6,124	6,141	6,159	6,177	6,195	6,213	6,231
761	Area	179.9	180.2	180.4	180.7	180.9	181.2	181.4	181.7	181.9	182.2
	Capacity	6,249	6,267	6,285	6,303	6,321	6,339	6,357	6,375	6,394	6,412
762	Area	182.4	182.7	182.9	183.2	183.5	183.7	184.0	184.3	184.5	184.8
	Capacity	6,430	6,448	6,467	6,485	6,503	6,522	6,540	6,558	6,577	6,595
763	Area	185.1	185.4	185.7	185.9	186.2	186.5	186.8	187.2	187.5	187.8
	Capacity	6,614	6,632	6,651	6,670	6,688	6,707	6,725	6,744	6,763	6,782
764	Area	188.1	188.5	188.8	189.2	189.6	189.9	190.3	190.7	191.1	191.6
	Capacity	6,800	6,819	6,838	6,857	6,876	6,895	6,914	6,933	6,952	6,971
765	Area	193.2	193.5	193.7	194.0	194.3	194.5	194.8	195.1	195.4	195.6
	Capacity	6,991	7,010	7,029	7,049	7,068	7,088	7,107	7,126	7,146	7,166

Table A. 5: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		766	Area	195.9	196.2	196.4	196.7	197.0	197.2	197.5	197.8
	Capacity	7,185	7,205	7,224	7,244	7,264	7,283	7,303	7,323	7,343	7,363
767	Area	198.6	198.9	199.2	199.5	199.7	200.0	200.3	200.6	200.9	201.2
	Capacity	7,382	7,402	7,422	7,442	7,462	7,482	7,502	7,522	7,542	7,562
768	Area	201.5	201.7	202.0	202.3	202.6	202.9	203.2	203.5	203.8	204.1
	Capacity	7,582	7,603	7,623	7,643	7,663	7,684	7,704	7,724	7,745	7,765
769	Area	204.4	204.6	204.9	205.2	205.5	205.8	206.1	206.4	206.7	207.0
	Capacity	7,785	7,806	7,826	7,847	7,867	7,888	7,909	7,929	7,950	7,971
770	Area	207.3	207.6	208.0	208.3	208.6	208.9	209.2	209.5	209.8	210.1
	Capacity	7,991	8,012	8,033	8,054	8,074	8,095	8,116	8,137	8,158	8,179
771	Area	210.4	210.7	211.1	211.4	211.7	212.0	212.3	212.7	213.0	213.3
	Capacity	8,200	8,221	8,242	8,263	8,285	8,306	8,327	8,348	8,370	8,391
772	Area	213.7	214.0	214.3	214.7	215.0	215.3	215.7	216.0	216.4	216.7
	Capacity	8,412	8,434	8,455	8,476	8,498	8,520	8,541	8,563	8,584	8,606
773	Area	217.1	217.4	217.8	218.1	218.5	218.9	219.2	219.6	220.0	220.4
	Capacity	8,628	8,649	8,671	8,693	8,715	8,737	8,759	8,780	8,802	8,824
774	Area	220.8	221.2	221.6	222.0	222.4	222.8	223.2	223.6	224.1	224.5
	Capacity	8,847	8,869	8,891	8,913	8,935	8,957	8,980	9,002	9,024	9,047
775	Area	227.6	227.9	228.3	228.6	229.0	229.3	229.6	230.0	230.3	230.6
	Capacity	9,070	9,092	9,115	9,138	9,161	9,184	9,207	9,230	9,253	9,276
776	Area	230.9	231.2	231.5	231.8	232.2	232.5	232.8	233.1	233.4	233.7
	Capacity	9,299	9,322	9,345	9,368	9,392	9,415	9,438	9,461	9,485	9,508
777	Area	234.1	234.4	234.7	235.1	235.4	235.7	236.0	236.4	236.7	237.0
	Capacity	9,531	9,555	9,578	9,602	9,625	9,649	9,673	9,696	9,720	9,743
778	Area	237.3	237.6	238.0	238.3	238.6	239.0	239.3	239.7	240.0	240.4
	Capacity	9,767	9,791	9,815	9,839	9,862	9,886	9,910	9,934	9,958	9,982
779	Area	240.7	241.1	241.5	241.9	242.2	242.6	242.9	243.3	243.6	244.0
	Capacity	10,006	10,030	10,054	10,079	10,103	10,127	10,151	10,176	10,200	10,224
780	Area	244.3	244.6	245.0	245.3	245.7	246.0	246.4	246.7	247.1	247.4
	Capacity	10,249	10,273	10,298	10,322	10,347	10,371	10,396	10,421	10,445	10,470
781	Area	247.7	248.1	248.4	248.8	249.1	249.5	249.8	250.2	250.5	250.8
	Capacity	10,495	10,520	10,544	10,569	10,594	10,619	10,644	10,669	10,694	10,719
782	Area	251.2	251.5	251.9	252.2	252.5	252.9	253.2	253.6	253.9	254.3
	Capacity	10,744	10,769	10,795	10,820	10,845	10,870	10,896	10,921	10,946	10,972
783	Area	254.6	255.0	255.4	255.7	256.1	256.5	256.8	257.2	257.6	257.9
	Capacity	10,997	11,023	11,048	11,074	11,099	11,125	11,151	11,176	11,202	11,228
784	Area	258.3	258.7	259.1	259.5	259.9	260.3	260.7	261.1	261.5	261.9
	Capacity	11,254	11,280	11,306	11,331	11,357	11,383	11,409	11,436	11,462	11,488
785	Area	264.7	265.1	265.5	266.0	266.4	266.8	267.1	267.5	267.9	268.2
	Capacity	11,514	11,541	11,567	11,594	11,621	11,647	11,674	11,701	11,727	11,754
786	Area	268.6	269.0	269.3	269.7	270.1	270.4	270.8	271.1	271.5	271.9
	Capacity	11,781	11,808	11,835	11,862	11,889	11,916	11,943	11,970	11,997	12,024

Table A. 6: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		787	Area	272.2	272.6	273.0	273.3	273.7	274.1	274.4	274.8
	Capacity	12,052	12,079	12,106	12,133	12,161	12,188	12,216	12,243	12,271	12,298
788	Area	275.9	276.2	276.6	277.0	277.3	277.7	278.1	278.5	278.8	279.2
	Capacity	12,326	12,353	12,381	12,409	12,436	12,464	12,492	12,520	12,548	12,575
789	Area	279.6	279.9	280.3	280.7	281.1	281.4	281.8	282.2	282.6	283.0
	Capacity	12,603	12,631	12,659	12,687	12,716	12,744	12,772	12,800	12,828	12,857
790	Area	283.3	283.7	284.1	284.5	284.9	285.3	285.7	286.1	286.5	286.8
	Capacity	12,885	12,913	12,942	12,970	12,999	13,027	13,056	13,084	13,113	13,141
791	Area	287.2	287.7	288.1	288.5	288.9	289.3	289.7	290.1	290.6	291.0
	Capacity	13,170	13,199	13,228	13,257	13,285	13,314	13,343	13,372	13,401	13,430
792	Area	287.2	287.7	288.1	288.5	288.9	289.3	289.7	290.1	290.6	291.0
	Capacity	13,170	13,199	13,228	13,257	13,285	13,314	13,343	13,372	13,401	13,430
793	Area	296.1	296.5	297.0	297.5	298.0	298.5	299.0	299.5	300.1	300.6
	Capacity	13,753	13,783	13,813	13,842	13,872	13,902	13,932	13,962	13,992	14,022
794	Area	301.1	301.7	302.2	302.7	303.3	303.8	304.4	304.9	305.5	306.1
	Capacity	14,052	14,082	14,112	14,142	14,173	14,203	14,234	14,264	14,295	14,325
795	Area	308.5	309.0	309.5	310.0	310.4	310.9	311.4	311.9	312.3	312.8
	Capacity	14,356	14,387	14,418	14,449	14,480	14,511	14,542	14,573	14,604	14,636
796	Area	313.2	313.7	314.2	314.6	315.1	315.5	316.0	316.4	316.8	317.3
	Capacity	14,667	14,698	14,730	14,761	14,793	14,824	14,856	14,887	14,919	14,951
797	Area	317.7	318.2	318.6	319.1	319.5	320.0	320.4	320.9	321.3	321.8
	Capacity	14,982	15,014	15,046	15,078	15,110	15,142	15,174	15,206	15,238	15,270
798	Area	322.2	322.7	323.1	323.6	324.0	324.5	325.0	325.4	325.9	326.3
	Capacity	15,302	15,335	15,367	15,399	15,432	15,464	15,497	15,529	15,562	15,594
799	Area	326.8	327.3	327.7	328.2	328.6	329.1	329.6	330.0	330.5	331.0
	Capacity	15,627	15,660	15,692	15,725	15,758	15,791	15,824	15,857	15,890	15,923
800	Area	331.5	331.9	332.4	332.9	333.4	333.8	334.3	334.8	335.3	335.8
	Capacity	15,956	15,989	16,023	16,056	16,089	16,122	16,156	16,189	16,223	16,256
801	Area	336.3	336.8	337.2	337.7	338.2	338.7	339.2	339.7	340.2	340.7
	Capacity	16,290	16,324	16,357	16,391	16,425	16,459	16,493	16,527	16,561	16,595
802	Area	341.2	341.7	342.2	342.7	343.2	343.8	344.3	344.8	345.3	345.8
	Capacity	16,629	16,663	16,697	16,731	16,766	16,800	16,834	16,869	16,903	16,938
803	Area	346.4	346.9	347.4	348.0	348.5	349.1	349.6	350.2	350.8	351.3
	Capacity	16,973	17,007	17,042	17,077	17,112	17,147	17,181	17,216	17,251	17,287
804	Area	351.9	352.5	353.1	353.7	354.3	355.0	355.6	356.3	357.0	357.7
	Capacity	17,322	17,357	17,392	17,428	17,463	17,499	17,534	17,570	17,605	17,641
805	Area	360.7	361.1	361.6	362.1	362.6	363.0	363.5	364.0	364.5	364.9
	Capacity	17,677	17,713	17,749	17,786	17,822	17,858	17,894	17,931	17,967	18,004
806	Area	365.4	365.9	366.4	366.8	367.3	367.8	368.3	368.8	369.2	369.7
	Capacity	18,040	18,077	18,113	18,150	18,187	18,223	18,260	18,297	18,334	18,371
807	Area	370.2	370.7	371.2	371.6	372.1	372.6	373.1	373.6	374.1	374.5
	Capacity	18,408	18,445	18,482	18,519	18,556	18,594	18,631	18,668	18,706	18,743

Table A. 7: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		808	Area	375.0	375.5	376.0	376.5	377.0	377.4	377.9	378.4
	Capacity	18,781	18,818	18,856	18,893	18,931	18,969	19,007	19,044	19,082	19,120
809	Area	379.9	380.4	380.8	381.3	381.8	382.3	382.8	383.3	383.8	384.3
	Capacity	19,158	19,196	19,234	19,272	19,311	19,349	19,387	19,425	19,464	19,502
810	Area	384.8	385.2	385.7	386.2	386.7	387.2	387.8	388.3	388.8	389.3
	Capacity	19,541	19,579	19,618	19,656	19,695	19,734	19,772	19,811	19,850	19,889
811	Area	389.8	390.3	390.8	391.4	391.9	392.4	392.9	393.5	394.0	394.6
	Capacity	19,928	19,967	20,006	20,045	20,084	20,123	20,163	20,202	20,241	20,281
812	Area	395.2	395.7	396.3	396.9	397.4	398.0	398.6	399.1	399.7	400.3
	Capacity	20,320	20,360	20,399	20,439	20,479	20,519	20,558	20,598	20,638	20,678
813	Area	400.9	401.5	402.0	402.6	403.2	403.8	404.4	405.0	405.6	406.2
	Capacity	20,718	20,759	20,799	20,839	20,879	20,920	20,960	21,000	21,041	21,082
814	Area	406.8	407.4	408.0	408.6	409.2	409.8	410.5	411.1	411.8	412.4
	Capacity	21,122	21,163	21,204	21,245	21,285	21,326	21,367	21,409	21,450	21,491
815	Area	415.5	416.1	416.6	417.1	417.6	418.1	418.6	419.1	419.6	420.1
	Capacity	21,532	21,574	21,616	21,657	21,699	21,741	21,783	21,825	21,867	21,909
816	Area	420.6	421.1	421.6	422.1	422.6	423.1	423.6	424.1	424.6	425.1
	Capacity	21,951	21,993	22,035	22,077	22,119	22,162	22,204	22,246	22,289	22,331
817	Area	425.7	426.2	426.7	427.2	427.7	428.2	428.7	429.2	429.7	430.2
	Capacity	22,374	22,416	22,459	22,502	22,544	22,587	22,630	22,673	22,716	22,759
818	Area	430.7	431.2	431.7	432.2	432.7	433.2	433.8	434.3	434.8	435.3
	Capacity	22,802	22,845	22,888	22,931	22,975	23,018	23,061	23,105	23,148	23,192
819	Area	435.8	436.3	436.8	437.4	437.9	438.4	438.9	439.4	439.9	440.5
	Capacity	23,235	23,279	23,323	23,366	23,410	23,454	23,498	23,542	23,586	23,630
820	Area	441.0	441.5	442.0	442.6	443.1	443.6	444.2	444.7	445.2	445.7
	Capacity	23,674	23,718	23,762	23,806	23,851	23,895	23,939	23,984	24,028	24,073
821	Area	446.3	446.8	447.4	447.9	448.4	449.0	449.5	450.1	450.6	451.1
	Capacity	24,117	24,162	24,207	24,252	24,296	24,341	24,386	24,431	24,476	24,521
822	Area	451.7	452.2	452.8	453.3	453.9	454.4	455.0	455.5	456.1	456.7
	Capacity	24,567	24,612	24,657	24,702	24,748	24,793	24,839	24,884	24,930	24,975
823	Area	457.2	457.8	458.3	458.9	459.5	460.0	460.6	461.2	461.8	462.3
	Capacity	25,021	25,067	25,113	25,158	25,204	25,250	25,296	25,342	25,389	25,435
824	Area	462.9	463.5	464.1	464.7	465.3	465.9	466.6	467.2	467.9	468.6
	Capacity	25,481	25,527	25,574	25,620	25,667	25,713	25,760	25,807	25,853	25,900
825	Area	479.7	480.3	480.9	481.4	481.9	482.5	483.0	483.5	484.1	484.6
	Capacity	25,948	25,996	26,044	26,092	26,140	26,189	26,237	26,285	26,334	26,382
826	Area	485.1	485.6	486.2	486.7	487.2	487.8	488.3	488.8	489.4	489.9
	Capacity	26,431	26,479	26,528	26,576	26,625	26,674	26,723	26,772	26,820	26,869
827	Area	490.5	491.0	491.5	492.1	492.6	493.2	493.7	494.3	494.8	495.4
	Capacity	26,918	26,968	27,017	27,066	27,115	27,164	27,214	27,263	27,313	27,362
828	Area	495.9	496.5	497.0	497.6	498.1	498.7	499.2	499.8	500.3	500.8
	Capacity	27,412	27,461	27,511	27,561	27,611	27,660	27,710	27,760	27,810	27,860

Table A. 8: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

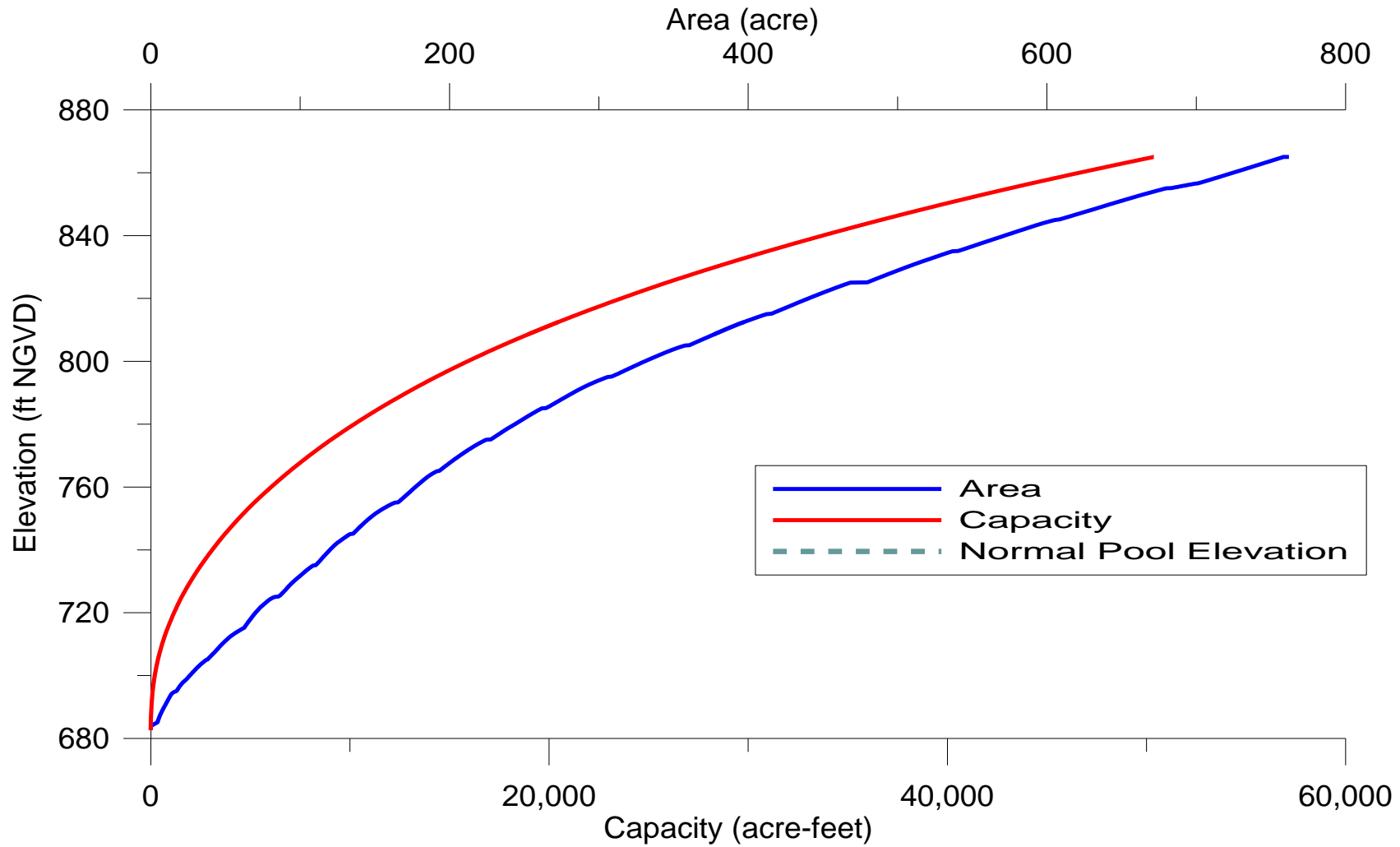
W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		829	Area	501.4	501.9	502.5	503.1	503.6	504.2	504.7	505.3
	Capacity	27,910	27,961	28,011	28,061	28,111	28,162	28,212	28,263	28,313	28,364
830	Area	507.0	507.6	508.1	508.7	509.3	509.9	510.4	511.0	511.6	512.2
	Capacity	28,415	28,465	28,516	28,567	28,618	28,669	28,720	28,771	28,822	28,873
831	Area	512.8	513.4	514.0	514.6	515.2	515.8	516.4	517.0	517.6	518.2
	Capacity	28,925	28,976	29,027	29,079	29,130	29,182	29,233	29,285	29,337	29,389
832	Area	518.8	519.4	520.0	520.7	521.3	521.9	522.5	523.1	523.7	524.3
	Capacity	29,440	29,492	29,544	29,596	29,649	29,701	29,753	29,805	29,858	29,910
833	Area	524.9	525.5	526.1	526.8	527.4	528.0	528.6	529.2	529.9	530.5
	Capacity	29,962	30,015	30,068	30,120	30,173	30,226	30,279	30,331	30,384	30,437
834	Area	531.1	531.7	532.4	533.0	533.6	534.3	534.9	535.6	536.3	537.0
	Capacity	30,491	30,544	30,597	30,650	30,703	30,757	30,810	30,864	30,917	30,971
835	Area	540.7	541.4	542.0	542.7	543.3	544.0	544.6	545.3	545.9	546.5
	Capacity	31,025	31,079	31,133	31,188	31,242	31,296	31,351	31,405	31,460	31,515
836	Area	547.2	547.8	548.4	549.1	549.7	550.3	551.0	551.6	552.2	552.9
	Capacity	31,569	31,624	31,679	31,734	31,789	31,844	31,899	31,954	32,009	32,064
837	Area	553.5	554.1	554.8	555.4	556.0	556.6	557.3	557.9	558.5	559.2
	Capacity	32,120	32,175	32,230	32,286	32,342	32,397	32,453	32,509	32,565	32,620
838	Area	559.8	560.4	561.1	561.7	562.3	563.0	563.6	564.2	564.9	565.5
	Capacity	32,676	32,732	32,788	32,845	32,901	32,957	33,013	33,070	33,126	33,183
839	Area	566.2	566.8	567.4	568.1	568.7	569.4	570.0	570.6	571.3	571.9
	Capacity	33,239	33,296	33,353	33,410	33,466	33,523	33,580	33,637	33,694	33,752
840	Area	572.6	573.2	573.8	574.5	575.1	575.8	576.4	577.0	577.7	578.3
	Capacity	33,809	33,866	33,923	33,981	34,038	34,096	34,154	34,211	34,269	34,327
841	Area	578.9	579.6	580.2	580.9	581.5	582.1	582.8	583.4	584.1	584.7
	Capacity	34,385	34,443	34,501	34,559	34,617	34,675	34,733	34,792	34,850	34,908
842	Area	585.4	586.0	586.6	587.3	587.9	588.6	589.2	589.9	590.5	591.2
	Capacity	34,967	35,025	35,084	35,143	35,202	35,260	35,319	35,378	35,437	35,496
843	Area	591.9	592.5	593.2	593.9	594.5	595.2	595.9	596.6	597.3	598.0
	Capacity	35,556	35,615	35,674	35,733	35,793	35,852	35,912	35,972	36,031	36,091
844	Area	598.8	599.6	600.3	601.1	601.9	602.7	603.5	604.3	605.1	606.0
	Capacity	36,151	36,211	36,271	36,331	36,391	36,451	36,512	36,572	36,632	36,693
845	Area	608.3	609.0	609.8	610.5	611.2	611.9	612.7	613.4	614.1	614.8
	Capacity	36,754	36,815	36,876	36,937	36,998	37,059	37,120	37,181	37,243	37,304
846	Area	615.5	616.2	616.9	617.6	618.3	619.0	619.7	620.4	621.1	621.8
	Capacity	37,366	37,427	37,489	37,551	37,613	37,675	37,736	37,798	37,861	37,923
847	Area	622.5	623.2	623.9	624.6	625.4	626.1	626.8	627.5	628.2	628.9
	Capacity	37,985	38,047	38,110	38,172	38,235	38,297	38,360	38,423	38,485	38,548
848	Area	629.6	630.3	631.0	631.7	632.4	633.1	633.7	634.4	635.1	635.8
	Capacity	38,611	38,674	38,737	38,800	38,864	38,927	38,990	39,054	39,117	39,181
849	Area	636.5	637.2	637.9	638.6	639.3	640.0	640.6	641.3	642.0	642.7
	Capacity	39,244	39,308	39,372	39,436	39,499	39,563	39,627	39,692	39,756	39,820

Table A. 9: W.R. Holway Reservoir Capacity/Area by 0.1-ft Increments (cont).

W.R. HOLWAY RESERVOIR AREA-CAPACITY TABLE OKLAHOMA WATER RESOURCES BOARD 2009 Survey Capacity in acre-feet by tenth foot elevation increments Area in acres by tenth foot elevation increments											
Elevation (ft NGVD)		0.09	0.19	0.29	0.39	0.49	0.59	0.69	0.79	0.89	0.99
		850	Area	643.5	644.2	644.9	645.6	646.3	647.0	647.7	648.4
	Capacity	39,884	39,949	40,013	40,078	40,142	40,207	40,272	40,336	40,401	40,466
851	Area	650.5	651.2	651.9	652.6	653.3	654.0	654.7	655.5	656.2	656.9
	Capacity	40,531	40,596	40,662	40,727	40,792	40,858	40,923	40,988	41,054	41,120
852	Area	657.6	658.4	659.1	659.8	660.5	661.3	662.0	662.7	663.5	664.2
	Capacity	41,185	41,251	41,317	41,383	41,449	41,515	41,581	41,648	41,714	41,780
853	Area	665.0	665.7	666.5	667.2	668.0	668.8	669.5	670.3	671.1	671.8
	Capacity	41,847	41,913	41,980	42,047	42,113	42,180	42,247	42,314	42,381	42,448
854	Area	672.6	673.4	674.2	674.9	675.7	676.5	677.3	678.1	678.9	679.7
	Capacity	42,516	42,583	42,650	42,718	42,785	42,853	42,921	42,988	43,056	43,124
855	Area	683.4	684.5	685.7	686.8	687.9	689.0	690.2	691.3	692.4	693.6
	Capacity	43,193	43,261	43,329	43,398	43,467	43,536	43,605	43,674	43,743	43,812
856	Area	694.7	695.8	697.0	698.1	699.3	701.1	701.9	702.7	703.4	704.1
	Capacity	43,882	43,951	44,021	44,091	44,161	44,231	44,301	44,371	44,441	44,512
857	Area	704.8	705.5	706.2	706.9	707.6	708.3	709.0	709.7	710.4	711.1
	Capacity	44,582	44,653	44,723	44,794	44,865	44,936	45,006	45,077	45,148	45,219
858	Area	711.8	712.5	713.2	713.9	714.6	715.3	716.0	716.6	717.3	718.0
	Capacity	45,291	45,362	45,433	45,504	45,576	45,647	45,719	45,791	45,862	45,934
859	Area	718.7	719.4	720.1	720.8	721.4	722.1	722.8	723.5	724.2	724.8
	Capacity	46,006	46,078	46,150	46,222	46,294	46,366	46,438	46,511	46,583	46,656
860	Area	725.5	726.2	726.9	727.6	728.2	728.9	729.6	730.3	731.0	731.6
	Capacity	46,728	46,801	46,873	46,946	47,019	47,092	47,165	47,238	47,311	47,384
861	Area	732.3	733.0	733.7	734.3	735.0	735.7	736.4	737.0	737.7	738.4
	Capacity	47,457	47,530	47,604	47,677	47,751	47,824	47,898	47,972	48,045	48,119
862	Area	739.1	739.7	740.4	741.1	741.8	742.4	743.1	743.8	744.4	745.1
	Capacity	48,193	48,267	48,341	48,415	48,489	48,563	48,638	48,712	48,786	48,861
863	Area	745.8	746.5	747.1	747.8	748.5	749.1	749.8	750.5	751.1	751.8
	Capacity	48,936	49,010	49,085	49,160	49,234	49,309	49,384	49,459	49,534	49,610
864	Area	752.5	753.1	753.8	754.5	755.1	755.8	756.5	757.1	757.8	758.5
	Capacity	49,685	49,760	49,835	49,911	49,986	50,062	50,138	50,213	50,289	50,365
865	Area	762.1									
	Capacity	50,372									

Figure A. 1. Area-Capacity Curve for W.R. Holway Reservoir

W.R. Holway Reservoir Area-Capacity by Elevation 2009 Survey



APPENDIX B: W.R. Holway Reservoir Maps

Figure B. 1: W.R. Holway Reservoir Bathymetric Map with 10-foot Contour Intervals.



W.R. Holway Reservoir

10-Foot Depth Contours

CAUTION - The intention of this map is to give a generalized overview of the lake depths. There may be shallow underwater hazards such as rocks, shoals, and vegetation that do not appear on this map. **THIS MAP SHOULD NOT BE USED FOR NAVIGATION PURPOSES.**

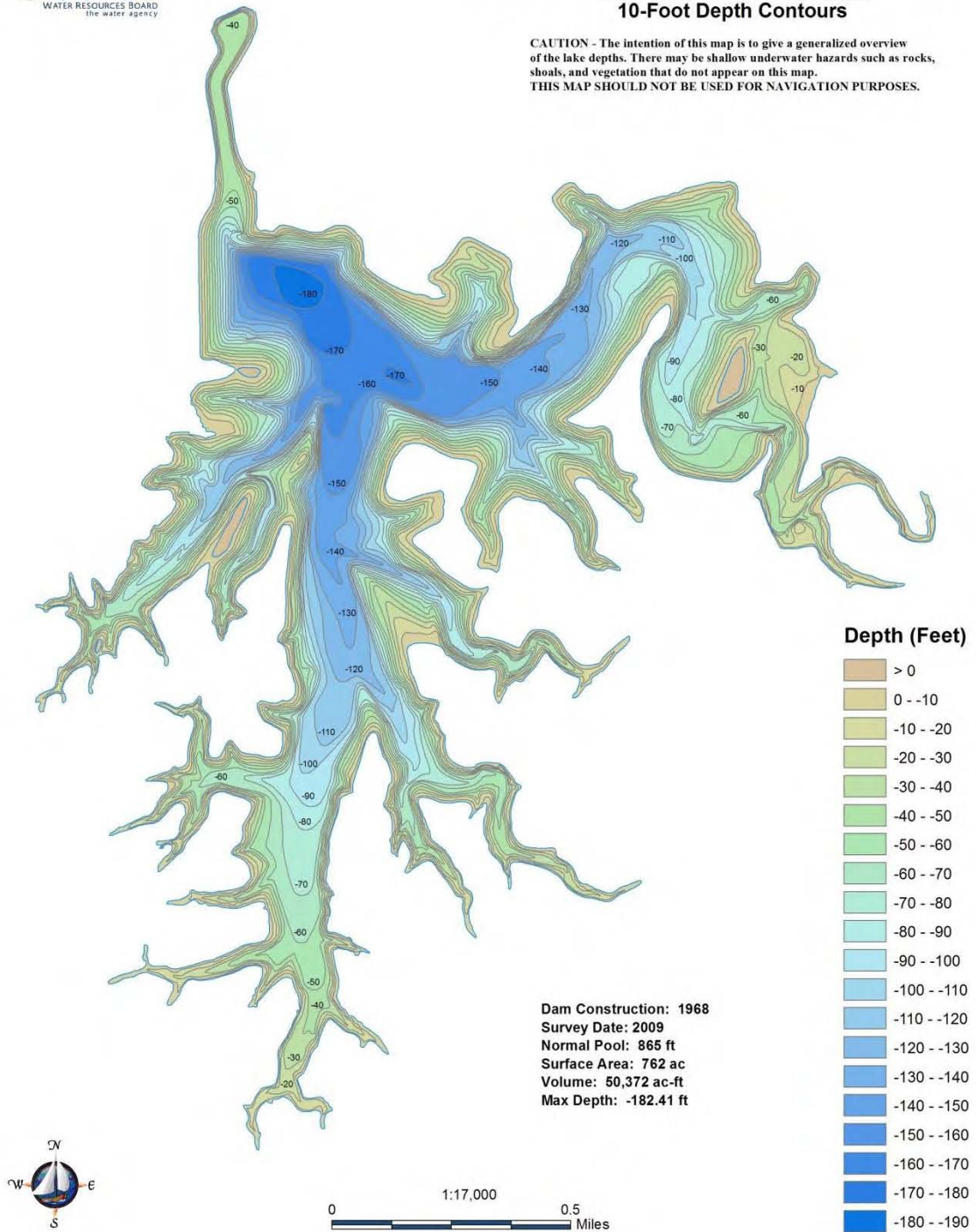
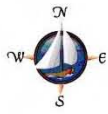


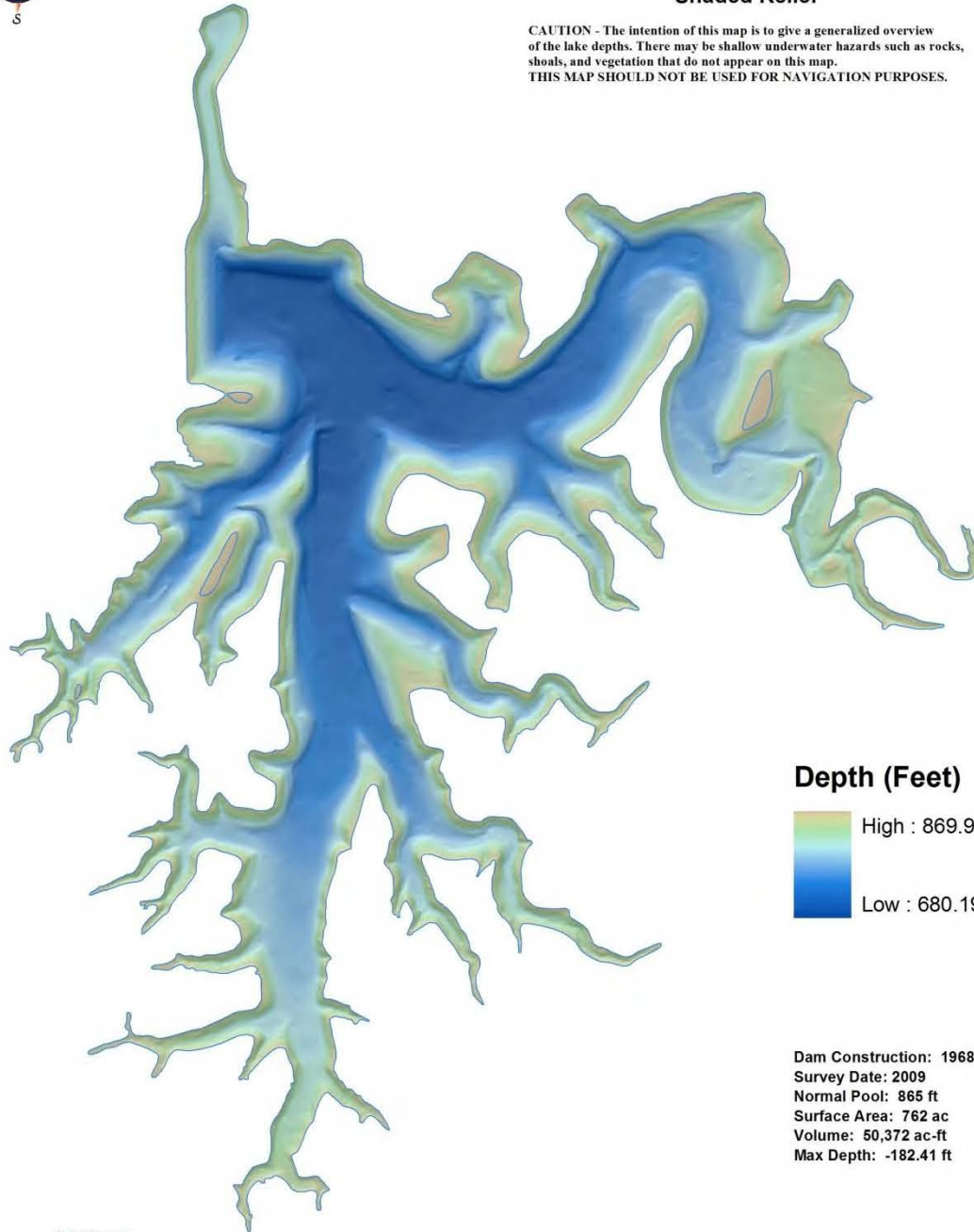
Figure B. 2: W.R. Holway Reservoir Shaded Relief Bathymetric Map.



W.R. Holway Reservoir

Shaded Relief

CAUTION - The intention of this map is to give a generalized overview of the lake depths. There may be shallow underwater hazards such as rocks, shoals, and vegetation that do not appear on this map. THIS MAP SHOULD NOT BE USED FOR NAVIGATION PURPOSES.



Depth (Feet)



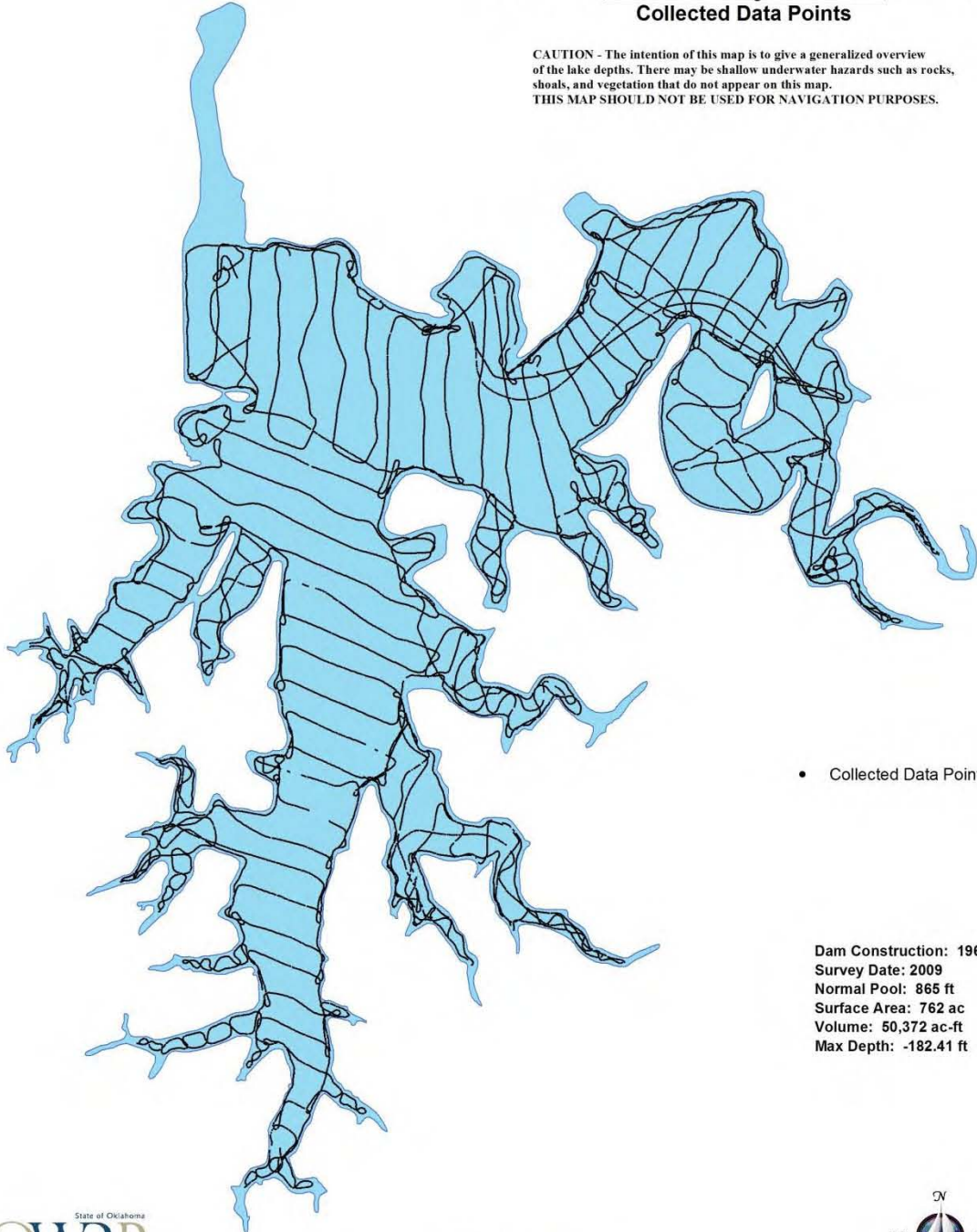
Dam Construction: 1968
Survey Date: 2009
Normal Pool: 865 ft
Surface Area: 762 ac
Volume: 50,372 ac-ft
Max Depth: -182.41 ft



Figure B. 3: W.R. Holway Reservoir Collected Data Points.

W.R. Holway Reservoir Collected Data Points

CAUTION - The intention of this map is to give a generalized overview of the lake depths. There may be shallow underwater hazards such as rocks, shoals, and vegetation that do not appear on this map.
THIS MAP SHOULD NOT BE USED FOR NAVIGATION PURPOSES.



• Collected Data Points

Dam Construction: 1968
Survey Date: 2009
Normal Pool: 865 ft
Surface Area: 762 ac
Volume: 50,372 ac-ft
Max Depth: -182.41 ft

