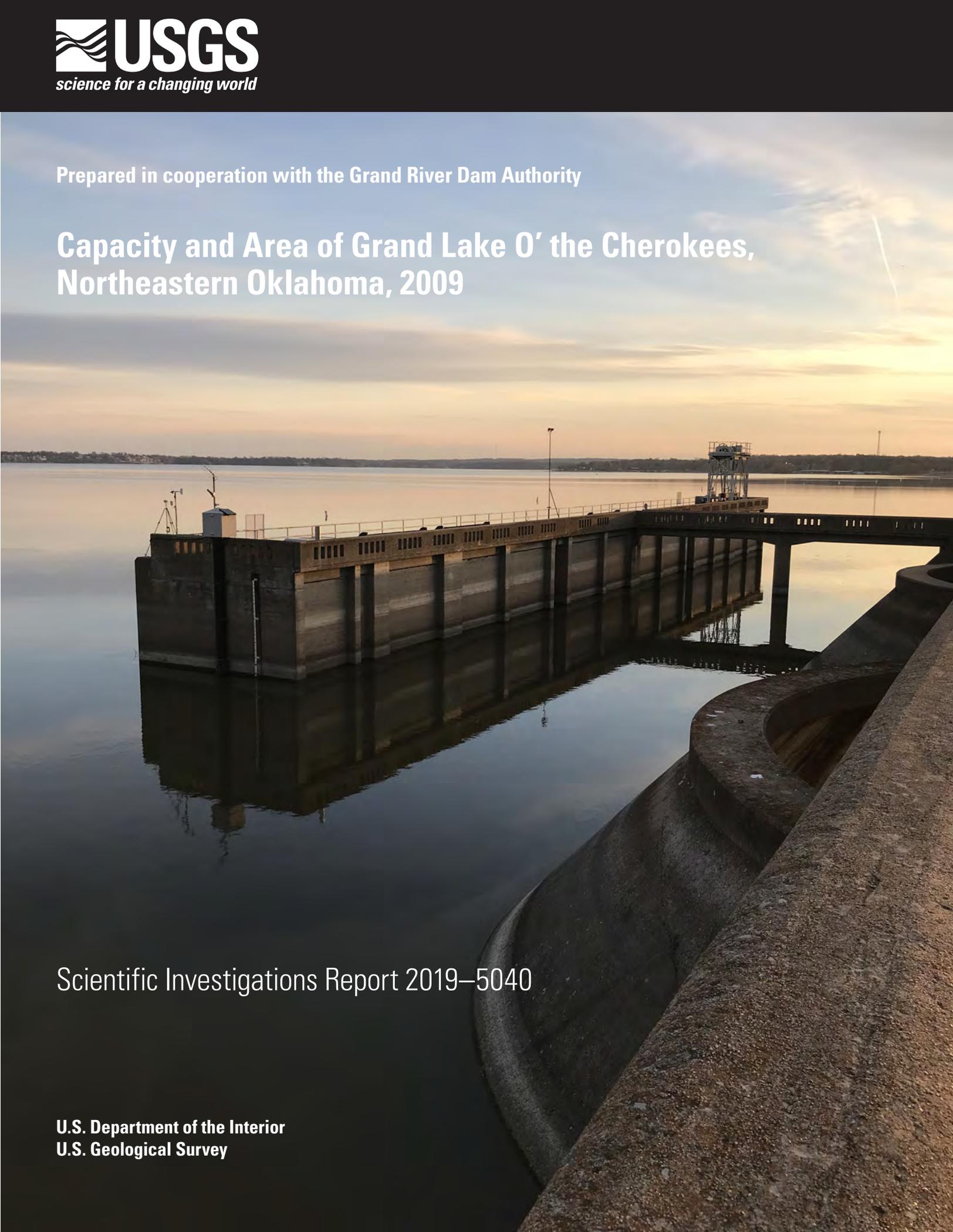


Prepared in cooperation with the Grand River Dam Authority

Capacity and Area of Grand Lake O' the Cherokees, Northeastern Oklahoma, 2009

Scientific Investigations Report 2019–5040



Cover. Intake structure located on Pensacola Dam of Grand Lake O' the Cherokees at Langley, Oklahoma; photograph by Kevin Smith, U.S. Geological Survey.

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By Shelby L. Hunter and Laura G. Labriola

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U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
DAVID BERNHARDT, Secretary

U.S. Geological Survey
James F. Reilly II, Director

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Conversion Factors

U.S. customary units to International System of Units

Multiply	By	To obtain
Length		
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
Area		
acre	4,047	square meter (m ²)
acre	0.4047	hectare (ha)
acre	0.4047	square hectometer (hm ²)
acre	0.004047	square kilometer (km ²)
Volume		
acre-foot (acre-ft)	1,233	cubic meter (m ³)
acre-foot (acre-ft)	0.001233	cubic hectometer (hm ³)

Datum

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88) unless specified otherwise.

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Elevation, as used in this report, refers to distance above the vertical datum.

The lake project operates in what is known as Pensacola Datum. This datum is converted by subtracting 1.40 feet from NAVD 88. Pensacola Datum has been used in the study area since the inception of the lake in March 1940.

Abbreviations

DEM	digital elevation model
FERC	Federal Energy Regulatory Commission
GIS	geographic information system
GRDA	Grand River Dam Authority
NED	National Elevation Dataset (USGS)
NOAA	National Oceanic and Atmospheric Administration
OWRB	Oklahoma Water Resources Board
TIN	triangulated irregular network
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey

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By Shelby L. Hunter and Laura G. Labriola

Abstract

In February 2017, the Grand River Dam Authority filed to relicense the Pensacola Hydroelectric Project with the Federal Energy Regulatory Commission. The predominant feature of the Pensacola Hydroelectric Project is Pensacola Dam, which impounds Grand Lake O' the Cherokees (locally called Grand Lake) in northeastern Oklahoma. Identification of information gaps and assessment of project effects on stakeholders are central aspects of the Federal Energy Regulatory Commission relicensing process. Due to the natural changes to the reservoir over time, new capacity and area tables are needed periodically. The most recent complete capacity and area table was produced in 1940. Capacity and area tables identify the relations between the elevation of the water surface and the volume of water that can be impounded at each water surface elevation. This report (1) presents an updated capacity and area table for Grand Lake O' the Cherokees for 2009, (2) describes the methods used to calculate the updated capacity and area values presented in the table, and (3) compares the updated capacity table to historical capacity tables produced from a survey in 1940 and from a hydrographic survey of the lake by the Oklahoma Water Resources Board in 2009.

The new capacity values computed for Grand Lake O' the Cherokees indicate that capacity at conservation pool elevation has decreased about 157,000 acre-feet or 10 percent since 1940 and capacity at top of dam elevation has decreased about 200,000 acre-feet or 8 percent since 1940. This difference in the capacities could be attributed to the advancements of technologies; the techniques used for surveying lakes have changed from the 1940 survey to the 2009 survey. Another possible reason for loss in capacity could be as time progresses, lakes like Grand Lake O' the Cherokees slowly impound sediment carried by the rivers that feed into the lakes, thus diminishing the amount of water that the lake holds. The most recent survey used measured water depths and Global Position System collected electronically, but the methods used to collect data in 1940 are unknown. Due to the advancement of technology, the 2009 survey is likely more precise than the 1940 survey.

Introduction

In February 2017, the Grand River Dam Authority (GRDA) filed to relicense the Pensacola Hydroelectric Project with the Federal Energy Regulatory Commission (FERC). The predominant feature of the Pensacola Hydroelectric Project (FERC license number 1494; GRDA, 2017) is Pensacola Dam, which impounds Grand Lake O' the Cherokees (locally called Grand Lake) in northeastern Oklahoma. Identification of information gaps and assessment of project effects on stakeholders are central aspects of the FERC relicensing process (FERC, 2012). One of the information gaps is that a complete capacity and area table has not been produced since 1940. Capacity and area tables identify the relations between the elevation of the water surface and the volume of water that can be impounded at each water surface elevation.

In the 78-year history of Grand Lake O' the Cherokees, only three capacity and area tables have been developed. The first capacity and area table was developed in 1940, when the Pensacola Dam was built by the U.S. Army Corps of Engineers (USACE), spanning water surface elevations from 612.33 to 758.33 feet (ft) above the North American Vertical Datum of 1988 (NAVD 88). An updated capacity and area table was published in 1949, spanning water surface elevations from 714.33 to 754.43 ft above NAVD 88. The most recent capacity and area table was calculated by the Oklahoma Water Resources Board (OWRB) in 2009, spanning water surface elevations from 613.46 to 746.46 ft above NAVD 88. The table published in 1940 is the only one that covers a range of elevations that is large enough for the GRDA to make educated decisions about the management of the lake.

As time progresses, lakes like Grand Lake O' the Cherokees slowly impound sediment carried by the rivers that feed into the lakes, thus diminishing the amount of water that the lake holds. Due to this natural phenomenon, an updated capacity and area table is needed to identify the volume of water that the lake can hold at any given elevation. It is important for the stakeholders to use an updated version of the capacity and area table to assist in making educated decisions in matters pertaining to electricity generation and flood-plain management. The stakeholders in this area

include GRDA and citizens that occupy property bordering Grand Lake O' the Cherokees and its tributaries. By using data from U.S. Geological Survey (USGS) streamgages to identify the amount of water flowing into the lake and by using the updated capacity and area table, GRDA will be better informed about how much water to release to minimize damage to stakeholders' properties that border the affected areas (USGS, 2018). Because the capacity and area table developed by the OWRB in 2009 does not span the range of elevations above conservation pool elevation and because new data were made available in 2017 from bathymetric surveys of the contributing Neosho, Spring, and Elk Rivers, the USGS, in cooperation with the GRDA, updated the capacity and area table for Grand Lake O' the Cherokees for 2009. The data from the (USGS) streamgage 07190000, Grand Lake O' the Cherokees at Langley, OK (USGS, 2018), along with the updated capacity and area values presented in this report, can be used by the GRDA when making decisions about the management of this lake.

Purpose and Scope

This report (1) presents an updated capacity and area table for Grand Lake O' the Cherokees for 2009, (2) describes the methods used to calculate the updated capacity and area values presented in the table, and (3) compares the updated capacity table to historical capacity tables. The historical capacity tables compared are the capacity table from a survey in March 1940 and the capacity table produced from a hydrographic survey of the lake by the OWRB (2009). The causes for the changes in capacity from 1940 and 2009 were not investigated in this study.

Description of the Study Area

Grand Lake O' the Cherokees is supplied primarily by three major rivers in northeastern Oklahoma: the Neosho, Spring, and Elk Rivers (fig. 1). The lake spans parts of Craig, Delaware, Mayes, and Ottawa Counties in northeastern Oklahoma, making it the third largest lake in terms of both surface area and capacity in Oklahoma (OWRB, 2015). The hydroelectric energy produced by Grand Lake O' the Cherokees serves citizens in 75 of the 77 counties in Oklahoma (GRDA, 2015). The Pensacola Dam spans 1 mile between the communities of Langley and Disney, Oklahoma (fig. 1). The elevations of the top of the conservation pool and the top of the dam are 742.00 ft and 757.00 ft above the Pensacola Datum, respectively, and 743.40 ft and 758.40 ft above NAVD 88, respectively (USACE, 2018b) (fig. 1). The lake project operates in Pensacola Datum. This datum has been used since the construction of the dam in March 1940 and can be converted to National Geodetic Vertical Datum of 1929 (NGVD 29) by adding 1.07 ft (USACE, 2018a) and to

NAVD 88 by adding approximately 1.40 ft as it varies slightly across the study area (National Oceanic and Atmospheric Administration [NOAA], 2018) (fig. 2).

Methods for Computing Capacity and Area

The capacity and area of Grand Lake O' the Cherokees were computed from a triangular irregular network (TIN) surface created in ArcGIS 10.5.1, a geographic information system (GIS; Esri, Inc., 2018a). The TIN surface was created from three datasets: (1) a 2009 OWRB bathymetric survey of Grand Lake (OWRB, 2009, 2016), (2) a 2017 USGS bathymetric survey of the Neosho, Spring, and Elk Rivers (Hunter and others, 2017; Smith and others, 2017), and (3) a 2010 lidar-derived digital elevation model (DEM) (USGS, 2016). The OWRB bathymetric survey covered most of the lake area at conservation pool elevation (fig. 3). The DEM data were used in areas with land-surface elevations above the conservation pool elevation of 743.40 ft above NAVD 88 (figs. 1 and 3). Because the OWRB (2009) bathymetric-survey data were the predominant source of data used (in terms of quantity and areal coverage) (fig. 3), the results and products of this report and the accompanying data release (Labriola and Hunter, 2019) were considered to reflect bathymetric conditions in 2009.

Data Processing

The OWRB bathymetric-survey contour data (OWRB, 2009, 2016) were used to create a contour boundary of 745.33 ft above NAVD 88 because it is the maximum elevation the data in the report reaches. The OWRB bathymetric-survey point elevations were converted from NGVD 29 to NAVD 88 by adding 0.33 ft (NOAA, 2018) (fig. 2). While using the OWRB datasets to create a TIN, the results match up closely to the results from OWRB 2009 for NGVD 29, rather than for Pensacola Datum; for this report, OWRB data were assumed to be in NGVD 29. The USGS bathymetric-survey point elevations were prioritized in instances of overlap with OWRB data (2009, 2016) because they were more recently measured. The portion of the National Elevation Dataset (NED; USGS, 2016) used in this study was created with light detection and ranging (lidar) technology, producing DEMs with a 2-ft by 2-ft cell size and 1-ft contours. The contours and DEMs were used to supplement data for areas not covered by either the OWRB or USGS bathymetric surveys. First, contour data generated from the NED (USGS, 2016) were used to make a maximum elevation boundary representing 759 ft above NAVD 88 (spillways and dam were filled in with lower elevation contours). The DEMs were clipped and merged to the area within the 759-ft boundary and not covered with OWRB or USGS point data. The merged DEM was resampled to a coarser 10-ft by 10-ft cell size, which was considered adequate for the purposes of this study, because high resolution

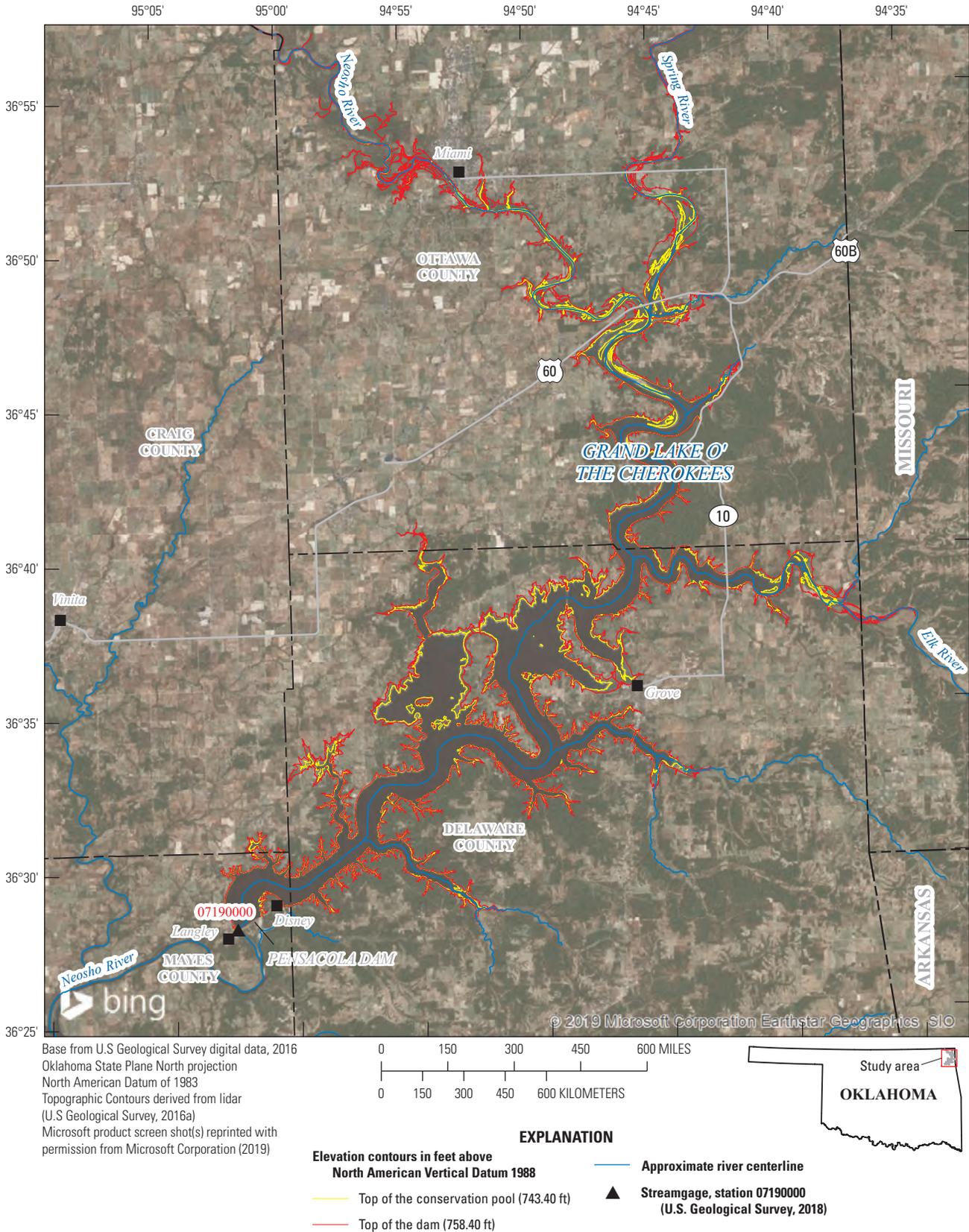
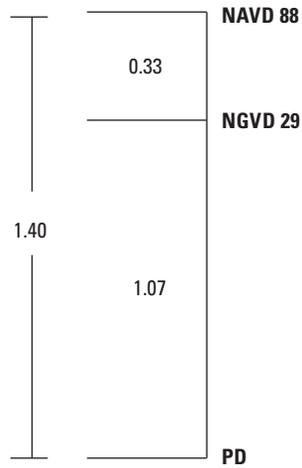


Figure 1. Elevation contours for the Grand Lake O' the Cherokees study area in northeastern Oklahoma.

4 Capacity and Area of Grand Lake O' the Cherokees, Northeastern Oklahoma, 2009



	Elevations, in feet		
	NAVD 88	NGVD 29	PD
Conservation Pool	743.40	743.07	742.00
Top of the Dam	758.40	758.07	757.00

Figure 2. Datum transformations and conversions for the North American Vertical Datum of 1988 (NAVD 88), National Geodetic Vertical Datum of 1929 (NGVD 29), and Pensacola Datum (PD) used in the computation of capacity and area for Grand Lake O' the Cherokees, northeastern Oklahoma.

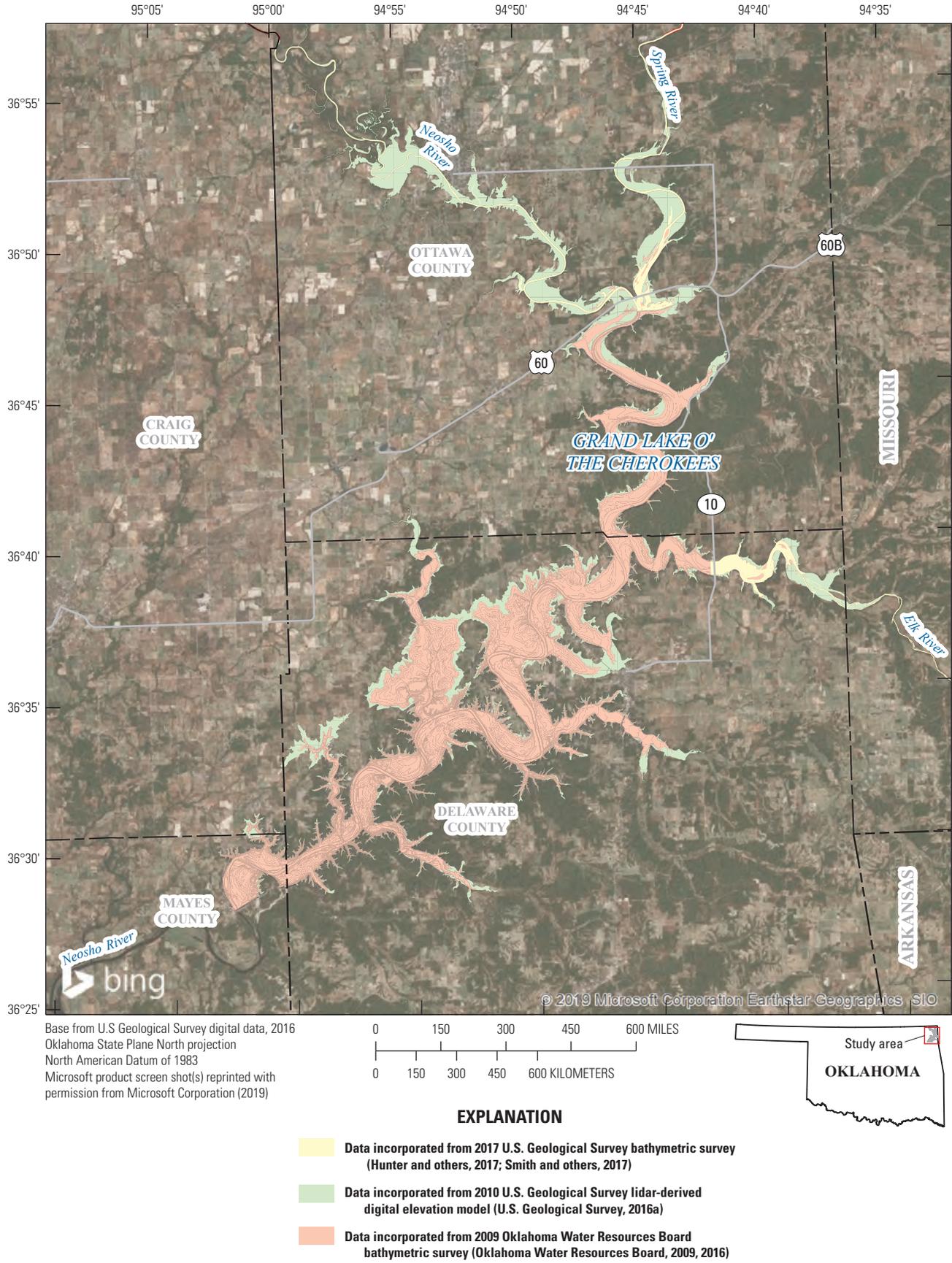


Figure 3. Extents of bathymetric and lidar-derived data used in triangulated irregular network analysis for Grand Lake O' the Cherokees, northeastern Oklahoma.

limits computational processing. The resampled DEM was converted to point data by using the “Raster to Point” tool (Esri, Inc., 2018a).

The following datasets, which were modified by using the techniques previously described, were used as inputs to the “Create TIN” tool (Esri, Inc., 2018b): point elevation and contour boundary (OWRB, 2009, 2016), point elevation (Smith and others, 2017), and point elevation and contour boundary (USGS, 2016). The TIN was used in the “Surface Volume” tool (Esri, Inc., 2018c) to calculate capacity and area encompassing elevations from 612 ft to 759 ft above NAVD 88 in 0.01-ft intervals. The TIN surface, input data, and digital capacity and area tables were published by Labriola and Hunter (2019) and projected in the Oklahoma State Plane North coordinate system (EPSG Geodetic Parameter Registry, 2018).

Capacity and Area Results

The data calculated as part of this study are reported in table 1, and the previous calculated capacities are graphed in figure 4, along with the capacities calculated as part of this study, for comparison. These newly calculated capacities are comparable to those derived from the previous capacity and area tables (OWRB, 2009).

The capacity and area table from 1940 gives the interpolated capacity of water at conservation pool elevation

743.40 ft above NAVD 88 as 1,584,615 acre-ft (Raye L. Thornton, USACE, written commun., 2018). Almost 70 years later, the new capacity table gives the capacity of water at conservation pool elevation 743.40 ft above NAVD 88 as 1,424,435 acre-ft (table 1; fig. 4). The updated calculation of the capacity at the top of the dam is less than that in the capacity and area table from 1940; the interpolated 1940 capacity is 2,387,410 acre-ft at an elevation of 758.40 ft above NAVD 88, while the 2009 capacity is 2,183,182 acre-ft at an elevation of 758.40 ft above NAVD 88 (fig. 4). The capacity of Grand Lake O’ the Cherokees at conservation pool elevation has decreased about 157,000 acre-feet or 10 percent since 1940, and capacity at top of dam elevation has decreased about 200,000 acre-feet or 8 percent since 1940. This difference in the capacities could be attributed to the advancements of technologies; the techniques used for surveying lakes have changed from the 1940 survey to the 2009 survey (OWRB, 2009). Another possible reason for loss in capacity could be that as time progresses, lakes like Grand Lake O’ the Cherokees slowly impound sediment carried by the rivers that feed into the lakes, thus diminishing the amount of water that the lake holds. The most recent survey used depths and Global Positioning System points collected electronically, but the methods used for collecting data in 1940 are unknown (OWRB, 2009). Due to the advancement of technology, the 2009 survey is likely more precise than the 1940 survey (OWRB, 2009).

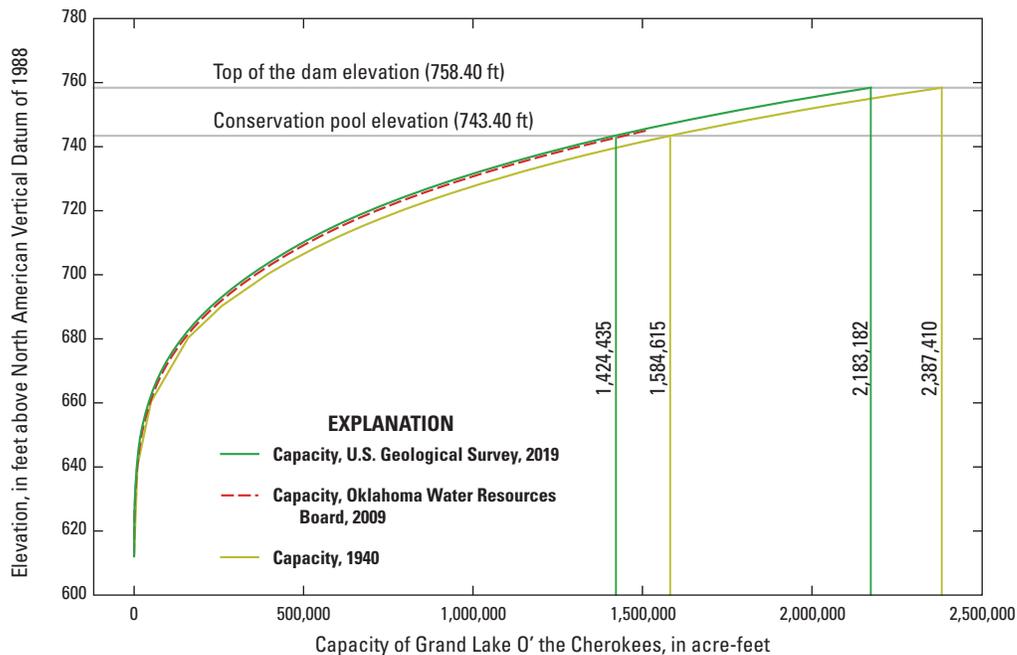


Figure 4. Capacity of Grand Lake O’ the Cherokees as calculated with elevation data from 1940, from the Oklahoma Water Resources Board (OWRB, 2009), and from the U.S. Geological Survey (USGS, calculations from current study), 2009.

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
612	Capacity	--	--	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.05
	Area	--	--	0.00	0.00	0.00	0.02	0.05	0.10	0.18	0.29
613	Capacity	0.08	0.14	0.23	0.36	0.54	0.80	1.12	1.51	1.97	2.47
	Area	0.45	0.70	1.09	1.55	2.17	2.89	3.58	4.29	4.79	5.24
614	Capacity	3.02	3.64	4.30	5.01	5.80	6.65	7.58	8.56	9.59	10.68
	Area	5.82	6.37	6.87	7.51	8.20	8.89	9.54	10.10	10.62	11.14
615	Capacity	11.82	13.02	14.26	15.56	16.91	18.31	19.77	21.29	22.87	24.50
	Area	11.66	12.20	12.72	13.22	13.75	14.30	14.89	15.49	16.08	16.70
616	Capacity	26.21	28.02	29.93	31.93	34.04	36.27	38.58	40.99	43.49	46.09
	Area	17.56	18.54	19.54	20.51	21.79	22.70	23.60	24.52	25.49	26.52
617	Capacity	48.79	51.61	54.53	57.56	60.70	63.96	67.32	70.78	74.35	78.05
	Area	27.60	28.70	29.77	30.84	32.01	33.08	34.11	35.15	36.28	37.56
618	Capacity	81.86	85.78	89.82	93.97	98.22	102.59	107.08	111.69	116.47	121.42
	Area	38.69	39.80	40.90	42.03	43.15	44.25	45.40	47.00	48.59	50.45
619	Capacity	126.56	131.88	137.36	142.99	148.78	154.71	160.78	166.98	173.31	179.78
	Area	52.31	53.98	55.59	57.15	58.61	59.98	61.32	62.67	64.03	65.42
620	Capacity	186.40	193.16	200.06	207.10	214.29	221.61	229.08	236.70	244.47	252.39
	Area	66.87	68.32	69.73	71.13	72.52	73.95	75.43	76.93	78.50	80.00
621	Capacity	260.47	268.69	277.06	285.58	294.24	303.05	312.02	321.13	330.39	339.80
	Area	81.49	82.96	84.43	85.91	87.39	88.88	90.38	91.87	93.35	94.84
622	Capacity	349.36	359.07	368.93	378.95	389.12	399.44	409.93	420.59	431.42	442.44
	Area	96.36	97.87	99.39	100.91	102.46	104.05	105.72	107.45	109.25	111.00
623	Capacity	453.62	464.98	476.53	488.25	500.18	512.31	524.64	537.18	549.93	562.88
	Area	112.74	114.50	116.34	118.25	120.26	122.30	124.35	126.48	128.52	130.58
624	Capacity	576.05	589.47	603.18	617.26	631.80	646.82	662.37	678.45	695.05	712.14
	Area	132.85	135.51	138.83	142.94	147.83	152.84	158.06	163.53	168.54	173.25
625	Capacity	729.71	747.80	766.43	785.61	805.33	825.54	846.24	867.45	889.14	911.34
	Area	178.28	183.54	189.10	194.50	199.68	204.51	209.52	214.61	219.37	224.51
626	Capacity	934.03	957.18	980.74	1,004.72	1,029.13	1,053.96	1,079.22	1,104.86	1,130.88	1,157.29
	Area	229.23	233.62	237.74	241.88	246.12	250.55	254.53	258.32	262.14	266.19

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
627	Capacity	1,184.12	1,211.38	1,239.04	1,267.09	1,295.52	1,324.31	1,353.50	1,383.11	1,413.16	1,443.64
	Area	270.37	274.64	278.56	282.39	286.12	289.85	293.91	298.31	302.71	306.75
628	Capacity	1,474.51	1,505.77	1,537.44	1,569.51	1,601.96	1,634.75	1,667.89	1,701.36	1,735.15	1,769.27
	Area	310.66	314.64	318.72	322.62	326.24	329.68	333.04	336.30	339.57	342.89
629	Capacity	1,803.73	1,838.54	1,873.70	1,909.20	1,945.04	1,981.24	2,017.80	2,054.74	2,092.06	2,129.77
	Area	346.34	349.86	353.27	356.67	360.21	363.82	367.42	371.35	375.12	379.09
630	Capacity	2,167.89	2,206.43	2,245.37	2,284.76	2,324.63	2,364.98	2,405.83	2,447.17	2,488.95	2,531.18
	Area	383.32	387.37	391.57	396.32	401.06	406.04	410.95	415.64	420.11	424.50
631	Capacity	2,573.85	2,616.94	2,660.43	2,704.28	2,748.49	2,793.05	2,837.96	2,883.21	2,928.79	2,974.69
	Area	428.85	432.91	436.68	440.31	443.90	447.40	450.80	454.13	457.39	460.59
632	Capacity	3,020.90	3,067.43	3,114.26	3,161.39	3,208.81	3,256.54	3,304.57	3,352.89	3,401.51	3,450.43
	Area	463.72	466.78	469.79	472.78	475.76	478.77	481.74	484.71	487.71	490.71
633	Capacity	3,499.65	3,549.18	3,599.00	3,649.13	3,699.55	3,750.27	3,801.31	3,852.65	3,904.30	3,956.27
	Area	493.73	496.76	499.74	502.71	505.72	508.81	511.89	514.97	518.11	521.21
634	Capacity	4,008.54	4,061.12	4,114.02	4,167.22	4,220.73	4,274.55	4,328.66	4,383.07	4,437.77	4,492.76
	Area	524.27	527.35	530.47	533.58	536.66	539.67	542.63	545.55	548.46	551.37
635	Capacity	4,548.05	4,603.62	4,659.48	4,715.64	4,772.11	4,828.90	4,885.99	4,943.38	5,001.08	5,059.11
	Area	554.26	557.17	560.08	563.16	566.35	569.37	572.36	575.41	578.65	582.16
636	Capacity	5,117.52	5,176.30	5,235.48	5,295.07	5,355.09	5,415.54	5,476.41	5,537.70	5,599.43	5,661.63
	Area	585.92	589.74	593.86	598.08	602.30	606.62	610.82	615.04	619.59	624.36
637	Capacity	5,724.30	5,787.43	5,851.03	5,915.12	5,979.73	6,044.87	6,110.52	6,176.71	6,243.51	6,310.95
	Area	629.06	633.62	638.39	643.50	648.77	653.91	659.14	664.90	671.18	677.57
638	Capacity	6,379.03	6,447.73	6,517.00	6,586.84	6,657.21	6,728.13	6,799.62	6,871.65	6,944.23	7,017.35
	Area	683.98	689.90	695.59	701.05	706.46	711.99	717.64	723.10	728.47	733.89
639	Capacity	7,091.01	7,165.21	7,239.94	7,315.20	7,390.97	7,467.23	7,543.97	7,621.19	7,698.87	7,777.03
	Area	739.30	744.55	750.03	755.21	760.18	765.03	769.77	774.51	779.23	783.99
640	Capacity	7,855.67	7,934.78	8,014.37	8,094.45	8,175.00	8,256.03	8,337.54	8,419.54	8,502.02	8,585.00
	Area	788.71	793.51	798.40	803.14	807.90	812.71	817.54	822.38	827.28	832.24
641	Capacity	8,668.47	8,752.43	8,836.89	8,921.85	9,007.33	9,093.34	9,179.86	9,266.88	9,354.40	9,442.41
	Area	837.15	842.09	847.08	852.15	857.53	862.70	867.73	872.68	877.65	882.59

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
642	Capacity	9,530.91	9,619.91	9,709.39	9,799.37	9,889.85	9,980.84	10,072.36	10,164.44	10,257.17	10,350.56
	Area	887.48	892.37	897.29	902.27	907.31	912.53	917.95	923.97	930.57	937.05
643	Capacity	10,444.57	10,539.18	10,634.38	10,730.15	10,826.51	10,923.44	11,020.95	11,119.06	11,217.78	11,317.12
	Area	943.16	949.05	954.87	960.64	966.41	972.23	978.10	984.13	990.29	996.49
644	Capacity	11,417.09	11,517.69	11,618.93	11,720.82	11,823.38	11,926.66	12,030.70	12,135.59	12,241.44	12,348.31
	Area	1,002.81	1,009.18	1,015.63	1,022.24	1,029.14	1,036.49	1,044.43	1,053.59	1,063.48	1,074.06
645	Capacity	12,456.28	12,565.37	12,675.41	12,786.39	12,898.30	13,011.13	13,124.89	13,239.57	13,355.20	13,471.79
	Area	1,085.64	1,095.66	1,105.08	1,114.54	1,123.73	1,132.96	1,142.13	1,151.52	1,161.01	1,170.93
646	Capacity	13,589.39	13,708.01	13,827.68	13,948.40	14,070.20	14,193.10	14,317.13	14,442.30	14,568.62	14,696.09
	Area	1,181.08	1,191.42	1,201.94	1,212.55	1,223.38	1,234.65	1,245.99	1,257.44	1,268.95	1,280.44
647	Capacity	14,824.71	14,954.49	15,085.46	15,217.63	15,351.00	15,485.58	15,621.38	15,758.45	15,896.79	16,036.49
	Area	1,291.94	1,303.66	1,315.76	1,327.72	1,339.75	1,351.88	1,364.37	1,377.00	1,390.03	1,403.99
648	Capacity	16,177.58	16,320.05	16,463.90	16,609.16	16,755.92	16,904.18	17,054.01	17,205.35	17,358.16	17,512.42
	Area	1,417.75	1,431.68	1,445.35	1,460.04	1,475.08	1,490.33	1,505.98	1,520.82	1,535.33	1,549.99
649	Capacity	17,668.18	17,825.45	17,984.14	18,144.21	18,305.66	18,468.43	18,632.50	18,797.87	18,964.54	19,132.55
	Area	1,565.29	1,579.85	1,593.86	1,607.66	1,621.15	1,634.23	1,647.18	1,660.17	1,673.37	1,687.06
650	Capacity	19,301.96	19,472.83	19,645.25	19,819.29	19,994.83	20,171.86	20,350.31	20,530.11	20,711.25	20,893.71
	Area	1,701.18	1,716.30	1,732.56	1,747.94	1,762.88	1,777.51	1,791.34	1,804.73	1,817.99	1,831.16
651	Capacity	21,077.49	21,262.60	21,449.08	21,637.01	21,826.45	22,017.40	22,209.87	22,403.87	22,599.40	22,796.45
	Area	1,844.48	1,857.89	1,871.89	1,886.69	1,901.89	1,917.15	1,932.35	1,947.66	1,962.92	1,978.22
652	Capacity	22,995.05	23,195.22	23,396.88	23,599.94	23,804.32	24,010.01	24,217.02	24,425.28	24,634.77	24,845.47
	Area	1,993.85	2,009.32	2,023.82	2,037.31	2,050.14	2,063.63	2,076.40	2,088.82	2,100.95	2,112.98
653	Capacity	25,057.36	25,270.46	25,484.73	25,700.18	25,916.80	26,134.59	26,353.52	26,573.61	26,794.86	27,017.28
	Area	2,124.97	2,136.83	2,148.58	2,160.43	2,172.05	2,183.59	2,195.13	2,206.66	2,218.27	2,230.13
654	Capacity	27,240.87	27,465.62	27,691.54	27,918.64	28,146.90	28,376.31	28,606.86	28,838.57	29,071.41	29,305.39
	Area	2,241.73	2,253.30	2,265.11	2,276.81	2,288.38	2,299.78	2,311.27	2,322.79	2,334.12	2,345.33
655	Capacity	29,540.48	29,776.70	30,014.04	30,252.53	30,492.16	30,732.93	30,974.84	31,217.91	31,462.11	31,707.39
	Area	2,356.54	2,367.80	2,379.14	2,390.60	2,402.03	2,413.37	2,424.91	2,436.45	2,447.43	2,458.28
656	Capacity	31,953.76	32,201.20	32,449.74	32,699.37	32,950.08	33,201.90	33,454.86	33,709.03	33,964.47	34,221.29
	Area	2,468.99	2,479.85	2,490.94	2,501.68	2,512.55	2,523.87	2,535.53	2,547.91	2,561.16	2,575.21

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
657	Capacity	34,479.52	34,739.16	35,000.18	35,262.57	35,526.30	35,791.39	36,057.82	36,325.54	36,594.51	36,864.75
	Area	2,589.42	2,603.35	2,617.06	2,630.56	2,644.06	2,657.68	2,670.83	2,683.49	2,696.07	2,708.69
658	Capacity	37,136.25	37,409.01	37,683.04	37,958.36	38,234.98	38,512.91	38,792.22	39,072.89	39,354.89	39,638.21
	Area	2,721.31	2,733.92	2,746.68	2,759.70	2,772.65	2,786.15	2,799.98	2,813.39	2,826.56	2,839.97
659	Capacity	39,922.87	40,208.86	40,496.18	40,784.85	41,074.89	41,366.29	41,659.05	41,953.16	42,248.60	42,545.35
	Area	2,853.25	2,866.52	2,879.87	2,893.53	2,907.18	2,920.86	2,934.44	2,947.76	2,960.91	2,974.08
660	Capacity	42,843.43	43,142.92	43,443.86	43,746.22	44,050.02	44,355.28	44,661.99	44,970.13	45,279.71	45,590.69
	Area	2,987.76	3,002.09	3,016.53	3,030.76	3,045.26	3,059.85	3,074.20	3,088.66	3,102.86	3,116.70
661	Capacity	45,903.04	46,216.76	46,531.83	46,848.27	47,166.07	47,485.24	47,805.84	48,127.87	48,451.33	48,776.22
	Area	3,130.35	3,143.88	3,157.56	3,171.24	3,184.83	3,198.77	3,213.13	3,227.47	3,241.69	3,256.15
662	Capacity	49,102.55	49,430.33	49,759.56	50,090.27	50,422.47	50,756.18	51,091.40	51,428.21	51,766.61	52,106.58
	Area	3,270.48	3,285.05	3,299.68	3,314.56	3,329.53	3,344.59	3,360.02	3,376.12	3,391.86	3,407.62
663	Capacity	52,448.15	52,791.31	53,136.04	53,482.39	53,830.42	54,180.15	54,531.60	54,884.77	55,239.67	55,596.34
	Area	3,423.69	3,439.50	3,455.20	3,471.82	3,488.80	3,505.86	3,523.09	3,540.38	3,557.80	3,575.60
664	Capacity	55,954.83	56,315.21	56,677.46	57,041.56	57,407.51	57,775.35	58,145.04	58,516.56	58,889.91	59,265.09
	Area	3,594.28	3,613.29	3,631.80	3,650.18	3,668.96	3,687.67	3,706.10	3,724.29	3,742.63	3,761.00
665	Capacity	59,642.11	60,020.98	60,401.73	60,784.40	61,169.01	61,555.61	61,944.20	62,334.83	62,727.53	63,122.32
	Area	3,779.41	3,798.05	3,817.07	3,836.28	3,856.11	3,875.88	3,896.06	3,916.56	3,937.47	3,958.42
666	Capacity	63,519.18	63,918.04	64,318.90	64,721.75	65,126.57	65,533.38	65,942.17	66,353.02	66,765.89	67,180.80
	Area	3,978.61	3,998.56	4,018.56	4,038.42	4,058.08	4,077.95	4,098.08	4,118.65	4,138.92	4,159.26
667	Capacity	67,597.76	68,016.78	68,437.89	68,861.08	69,286.41	69,713.86	70,143.41	70,575.06	71,008.85	71,444.75
	Area	4,179.88	4,200.64	4,221.48	4,242.48	4,263.96	4,284.94	4,306.02	4,327.16	4,348.51	4,369.47
668	Capacity	71,882.74	72,322.83	72,764.98	73,209.19	73,655.48	74,103.88	74,554.42	75,007.14	75,462.11	75,919.40
	Area	4,390.44	4,411.17	4,431.81	4,452.47	4,473.42	4,494.69	4,516.18	4,538.36	4,561.23	4,584.69
669	Capacity	76,379.11	76,841.30	77,305.91	77,772.83	78,242.01	78,713.43	79,187.06	79,662.91	80,140.97	80,621.19
	Area	4,609.58	4,634.15	4,657.80	4,680.58	4,703.07	4,725.27	4,747.42	4,769.56	4,791.51	4,812.78
670	Capacity	81,103.52	81,587.98	82,074.59	82,563.33	83,054.16	83,547.07	84,042.08	84,539.19	85,038.43	85,539.76
	Area	4,833.92	4,855.36	4,876.78	4,897.89	4,918.77	4,939.54	4,960.53	4,981.75	5,002.93	5,023.77
671	Capacity	86,043.17	86,548.64	87,056.20	87,565.85	88,077.60	88,591.45	89,107.42	89,625.52	90,145.80	90,668.28
	Area	5,044.36	5,065.14	5,086.07	5,106.93	5,127.92	5,149.16	5,170.32	5,191.83	5,213.79	5,235.74

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
672	Capacity	91,192.95	91,719.82	92,248.92	92,780.26	93,313.89	93,849.83	94,388.04	94,928.54	95,471.38	96,016.63
	Area	5,257.75	5,279.75	5,302.15	5,324.83	5,347.85	5,370.70	5,393.59	5,416.59	5,440.32	5,464.55
673	Capacity	96,564.29	97,114.37	97,666.91	98,221.95	98,779.43	99,339.28	99,901.46	100,465.97	101,032.83	101,602.06
	Area	5,488.64	5,513.00	5,537.97	5,562.70	5,586.74	5,610.24	5,633.39	5,656.88	5,680.35	5,704.27
674	Capacity	102,173.69	102,747.71	103,324.08	103,902.77	104,483.80	105,067.16	105,652.83	106,240.82	106,831.18	107,423.87
	Area	5,728.35	5,751.95	5,775.38	5,798.60	5,821.91	5,845.15	5,868.18	5,891.83	5,915.23	5,938.65
675	Capacity	108,018.91	108,616.30	109,216.06	109,818.19	110,422.72	111,029.71	111,639.23	112,251.31	112,865.92	113,483.11
	Area	5,962.11	5,985.77	6,009.46	6,033.22	6,057.44	6,082.42	6,108.07	6,133.39	6,158.86	6,184.92
676	Capacity	114,102.89	114,725.26	115,350.24	115,977.76	116,607.84	117,240.49	117,875.73	118,513.55	119,153.88	119,796.66
	Area	6,210.62	6,236.94	6,262.53	6,287.89	6,313.75	6,339.30	6,365.46	6,390.85	6,415.59	6,439.91
677	Capacity	120,441.87	121,089.53	121,739.68	122,392.33	123,047.50	123,705.20	124,365.44	125,028.17	125,693.34	126,360.94
	Area	6,464.38	6,489.03	6,513.91	6,539.18	6,564.33	6,589.66	6,615.07	6,639.54	6,663.82	6,688.34
678	Capacity	127,031.05	127,703.70	128,378.93	129,056.74	129,737.08	130,419.87	131,105.07	131,792.63	132,482.59	133,174.99
	Area	6,713.80	6,739.42	6,765.19	6,790.97	6,815.77	6,840.02	6,863.81	6,887.60	6,911.64	6,936.33
679	Capacity	133,869.87	134,567.24	135,267.08	135,969.37	136,674.06	137,381.16	138,090.66	138,802.50	139,516.63	140,233.02
	Area	6,961.29	6,986.12	7,010.68	7,034.93	7,058.90	7,083.14	7,106.88	7,129.83	7,152.67	7,175.15
680	Capacity	140,951.67	141,672.62	142,395.92	143,121.67	143,849.86	144,580.52	145,313.70	146,049.36	146,787.52	147,528.21
	Area	7,197.86	7,221.17	7,245.24	7,269.68	7,294.26	7,319.15	7,344.24	7,369.03	7,394.42	7,419.16
681	Capacity	148,271.32	149,016.82	149,764.75	150,515.14	151,268.04	152,023.47	152,781.47	153,542.08	154,305.34	155,071.26
	Area	7,442.98	7,466.96	7,491.62	7,516.37	7,541.62	7,567.13	7,592.93	7,619.29	7,645.85	7,672.77
682	Capacity	155,839.90	156,611.26	157,385.34	158,162.16	158,941.77	159,724.19	160,509.46	161,297.55	162,088.46	162,882.23
	Area	7,699.91	7,727.25	7,754.32	7,782.17	7,810.04	7,838.43	7,866.82	7,895.03	7,923.23	7,952.49
683	Capacity	163,678.99	164,478.77	165,281.58	166,087.39	166,896.16	167,707.87	168,522.56	169,340.15	170,160.60	170,983.94
	Area	7,982.69	8,012.89	8,043.27	8,072.94	8,102.30	8,132.26	8,161.36	8,190.24	8,218.92	8,247.90
684	Capacity	171,810.18	172,639.33	173,471.41	174,306.46	175,144.51	175,985.67	176,830.07	177,677.77	178,528.72	179,382.84
	Area	8,276.90	8,306.14	8,335.59	8,365.38	8,395.83	8,427.53	8,460.71	8,493.26	8,525.45	8,556.96
685	Capacity	180,240.12	181,100.50	181,963.99	182,830.62	183,700.39	184,573.33	185,449.52	186,329.01	187,211.82	188,098.04
	Area	8,588.39	8,619.24	8,650.70	8,681.92	8,713.38	8,745.55	8,778.35	8,811.39	8,844.82	8,879.52
686	Capacity	188,987.70	189,880.78	190,777.29	191,677.24	192,580.66	193,487.63	194,398.11	195,312.16	196,229.78	197,151.02
	Area	8,913.75	8,947.95	8,982.24	9,016.69	9,051.96	9,087.31	9,122.59	9,158.32	9,194.20	9,230.83

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
687	Capacity	198,075.97	199,004.59	199,936.85	200,872.73	201,812.27	202,755.40	203,702.06	204,652.16	205,605.68	206,562.57
	Area	9,267.97	9,304.37	9,340.70	9,377.13	9,413.54	9,449.09	9,483.89	9,518.08	9,552.20	9,585.79
688	Capacity	207,522.89	208,486.72	209,453.96	210,424.46	211,398.15	212,375.02	213,355.04	214,338.22	215,324.54	216,314.01
	Area	9,620.73	9,655.55	9,688.92	9,720.99	9,752.91	9,784.42	9,815.98	9,847.48	9,879.00	9,910.22
689	Capacity	217,306.60	218,302.34	219,301.21	220,303.17	221,308.17	222,316.29	223,327.55	224,341.99	225,359.63	226,380.51
	Area	9,941.70	9,973.11	10,004.18	10,034.86	10,065.38	10,096.94	10,128.46	10,160.35	10,192.54	10,225.05
690	Capacity	227,404.64	228,432.04	229,462.68	230,496.49	231,533.56	232,573.84	233,617.28	234,663.85	235,713.49	236,766.08
	Area	10,257.68	10,290.28	10,322.18	10,354.31	10,386.84	10,418.62	10,450.11	10,481.20	10,511.53	10,540.07
691	Capacity	237,821.47	238,879.57	239,940.40	241,003.99	242,070.45	243,139.87	244,212.29	245,287.82	246,366.45	247,448.13
	Area	10,567.45	10,594.64	10,622.01	10,650.01	10,679.47	10,708.95	10,739.72	10,770.91	10,801.52	10,832.06
692	Capacity	248,532.84	249,620.52	250,711.18	251,804.88	252,901.63	254,001.48	255,104.40	256,210.42	257,319.57	258,431.96
	Area	10,861.98	10,891.68	10,921.65	10,952.30	10,982.83	11,013.85	11,044.61	11,075.82	11,107.48	11,140.40
693	Capacity	259,547.64	260,666.63	261,788.85	262,914.23	264,042.76	265,174.41	266,309.21	267,447.29	268,588.88	269,733.92
	Area	11,173.30	11,206.15	11,238.02	11,269.61	11,300.91	11,332.17	11,364.10	11,398.10	11,433.25	11,467.86
694	Capacity	270,882.52	272,034.70	273,190.47	274,349.82	275,512.83	276,679.48	277,849.69	279,023.35	280,200.38	281,380.78
	Area	11,503.95	11,539.79	11,575.42	11,611.68	11,648.50	11,684.49	11,719.59	11,753.46	11,787.15	11,820.91
695	Capacity	282,564.56	283,751.73	284,942.35	286,136.36	287,333.68	288,534.34	289,738.33	290,945.63	292,156.23	293,370.13
	Area	11,854.64	11,888.91	11,923.41	11,956.67	11,989.74	12,023.33	12,056.50	12,089.49	12,122.44	12,155.22
696	Capacity	294,587.25	295,807.58	297,031.14	298,257.97	299,488.07	300,721.41	301,957.98	303,197.82	304,441.03	305,687.68
	Area	12,187.28	12,219.39	12,251.92	12,284.67	12,317.23	12,349.50	12,381.97	12,415.09	12,449.26	12,483.99
697	Capacity	306,937.85	308,191.57	309,448.78	310,709.37	311,973.40	313,240.88	314,511.82	315,786.22	317,064.05	318,345.31
	Area	12,519.36	12,555.02	12,588.93	12,623.19	12,657.43	12,692.17	12,726.68	12,761.16	12,795.50	12,829.81
698	Capacity	319,630.02	320,918.21	322,209.98	323,505.37	324,804.35	326,106.85	327,412.85	328,722.32	330,035.24	331,351.66
	Area	12,864.31	12,899.71	12,935.76	12,972.02	13,007.43	13,042.56	13,077.41	13,111.90	13,146.54	13,182.03
699	Capacity	332,671.61	333,995.13	335,322.29	336,653.17	337,987.81	339,326.20	340,668.31	342,014.15	343,363.71	344,717.00
	Area	13,217.09	13,253.32	13,290.11	13,327.59	13,365.18	13,402.41	13,439.79	13,477.07	13,514.24	13,551.42
700	Capacity	346,073.98	347,434.57	348,798.75	350,166.47	351,537.70	352,912.43	354,290.60	355,672.18	357,057.15	358,445.51
	Area	13,587.93	13,623.90	13,659.57	13,694.78	13,729.92	13,764.56	13,798.74	13,832.75	13,866.70	13,900.51
701	Capacity	359,837.25	361,232.35	362,630.80	364,032.57	365,437.65	366,845.99	368,257.55	369,672.36	371,090.39	372,511.64
	Area	13,934.24	13,967.79	14,001.17	14,034.22	14,067.13	14,099.59	14,131.88	14,164.17	14,196.43	14,228.40

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
702	Capacity	373,936.06	375,363.61	376,794.29	378,228.14	379,665.25	381,105.64	382,549.27	383,996.13	385,446.19	386,899.46
	Area	14,259.91	14,291.13	14,322.43	14,354.71	14,387.64	14,420.06	14,452.48	14,484.56	14,516.63	14,548.77
703	Capacity	388,355.95	389,815.67	391,278.55	392,744.57	394,213.70	395,686.01	397,161.49	398,640.15	400,122.04	401,607.14
	Area	14,581.12	14,613.16	14,644.55	14,675.68	14,707.22	14,738.96	14,770.62	14,802.74	14,834.87	14,867.21
704	Capacity	403,095.48	404,587.11	406,082.11	407,580.60	409,082.53	410,587.95	412,096.87	413,609.29	415,125.26	416,644.75
	Area	14,899.74	14,932.93	14,967.36	15,002.21	15,036.59	15,071.79	15,106.49	15,142.03	15,177.47	15,211.90
705	Capacity	418,167.60	419,693.75	421,223.14	422,755.74	424,291.59	425,830.79	427,373.41	428,919.50	430,469.16	432,022.41
	Area	15,245.11	15,277.73	15,309.89	15,342.13	15,375.07	15,409.04	15,443.40	15,478.67	15,514.60	15,550.26
706	Capacity	433,579.23	435,139.65	436,703.69	438,271.40	439,842.76	441,417.73	442,996.35	444,578.64	446,164.60	447,754.25
	Area	15,586.35	15,622.24	15,658.61	15,695.50	15,731.63	15,767.92	15,804.56	15,841.19	15,877.97	15,914.90
707	Capacity	449,347.59	450,944.69	452,545.53	454,150.10	455,758.46	457,370.64	458,986.70	460,606.67	462,230.52	463,858.25
	Area	15,952.19	15,989.83	16,026.78	16,064.66	16,102.65	16,141.07	16,180.17	16,219.08	16,257.91	16,296.93
708	Capacity	465,489.89	467,125.42	468,764.83	470,408.21	472,055.61	473,707.02	475,362.40	477,021.72	478,685.03	480,352.38
	Area	16,335.82	16,374.69	16,413.81	16,453.70	16,494.19	16,534.03	16,573.48	16,613.01	16,653.10	16,693.96
709	Capacity	482,023.84	483,699.49	485,379.35	487,063.42	488,751.72	490,444.28	492,141.22	493,842.69	495,548.69	497,259.29
	Area	16,735.56	16,777.54	16,819.61	16,861.87	16,904.15	16,947.14	16,991.87	17,037.34	17,082.69	17,129.50
710	Capacity	498,974.64	500,694.97	502,420.27	504,150.45	505,885.31	507,624.80	509,368.88	511,117.59	512,870.95	514,628.94
	Area	17,178.06	17,228.32	17,277.74	17,325.48	17,371.90	17,417.77	17,463.82	17,510.41	17,556.78	17,603.07
711	Capacity	516,391.61	518,159.11	519,931.53	521,709.07	523,491.91	525,280.11	527,073.63	528,872.57	530,676.97	532,486.65
	Area	17,650.72	17,699.42	17,749.52	17,801.72	17,855.18	17,908.59	17,962.11	18,016.75	18,070.68	18,122.43
712	Capacity	534,301.32	536,120.76	537,944.92	539,773.86	541,607.53	543,445.82	545,288.71	547,136.19	548,988.29	550,845.02
	Area	18,170.70	18,217.95	18,265.45	18,313.33	18,359.84	18,405.97	18,451.78	18,497.87	18,544.11	18,590.64
713	Capacity	552,706.46	554,572.83	556,444.28	558,320.94	560,202.89	562,090.09	563,982.58	565,880.45	567,783.60	569,692.04
	Area	18,638.42	18,688.94	18,740.22	18,793.24	18,845.80	18,898.25	18,951.96	19,005.24	19,057.87	19,110.77
714	Capacity	571,605.73	573,524.68	575,448.95	577,378.58	579,313.64	581,254.42	583,201.01	585,153.36	587,111.31	589,074.96
	Area	19,163.16	19,215.99	19,269.44	19,323.17	19,378.73	19,436.83	19,495.16	19,551.54	19,607.59	19,665.93
715	Capacity	591,044.52	593,020.05	595,001.61	596,989.05	598,982.15	600,980.78	602,984.90	604,994.50	607,009.54	609,030.01
	Area	19,725.35	19,785.45	19,845.52	19,903.05	19,958.82	20,013.75	20,068.64	20,123.28	20,177.53	20,232.05
716	Capacity	611,055.97	613,087.49	615,124.68	617,167.59	619,216.27	621,270.72	623,330.93	625,396.98	627,468.85	629,546.54
	Area	20,287.28	20,343.41	20,400.40	20,457.88	20,515.81	20,573.03	20,631.42	20,689.62	20,747.84	20,806.01

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
717	Capacity	631,630.06	633,719.39	635,814.52	637,915.52	640,022.46	642,135.35	644,254.16	646,378.91	648,509.58	650,646.18
	Area	20,864.30	20,922.24	20,980.52	21,039.57	21,099.35	21,158.43	21,217.84	21,277.01	21,336.28	21,395.64
718	Capacity	652,788.70	654,937.17	657,091.73	659,252.55	661,419.83	663,593.91	665,774.71	667,962.20	670,156.36	672,357.23
	Area	21,454.72	21,514.90	21,576.62	21,639.90	21,706.81	21,774.53	21,841.36	21,908.20	21,974.94	22,042.24
719	Capacity	674,564.80	676,779.05	678,999.95	681,227.35	683,461.20	685,701.47	687,948.09	690,201.05	692,460.36	694,726.01
	Area	22,108.94	22,176.10	22,241.70	22,306.30	22,370.64	22,434.58	22,497.82	22,561.28	22,624.80	22,688.27
720	Capacity	696,998.02	699,276.35	701,560.98	703,851.98	706,149.42	708,453.24	710,763.46	713,080.09	715,403.19	717,732.81
	Area	22,751.75	22,814.77	22,877.92	22,942.28	23,006.46	23,070.04	23,134.23	23,198.53	23,263.60	23,328.83
721	Capacity	720,068.96	722,411.63	724,760.83	727,116.51	729,478.76	731,847.70	734,223.43	736,605.88	738,995.00	741,390.78
	Area	23,394.13	23,459.43	23,524.41	23,589.46	23,655.87	23,723.29	23,791.00	23,857.85	23,924.65	23,990.95
722	Capacity	743,793.15	746,201.91	748,617.07	751,038.64	753,466.62	755,900.94	758,341.57	760,788.46	763,241.60	765,700.99
	Area	24,055.89	24,119.48	24,183.62	24,247.82	24,311.59	24,374.79	24,437.68	24,500.26	24,562.66	24,624.89
723	Capacity	768,166.56	770,638.35	773,116.39	775,600.69	778,091.28	780,588.10	783,091.11	785,600.27	788,115.64	790,637.32
	Area	24,686.65	24,749.16	24,811.69	24,874.44	24,937.18	24,999.20	25,060.84	25,122.51	25,185.02	25,248.38
724	Capacity	793,165.30	795,699.61	798,240.26	800,787.27	803,340.63	805,900.33	808,466.42	811,038.99	813,618.06	816,203.82
	Area	25,311.43	25,374.71	25,438.36	25,501.84	25,565.27	25,628.68	25,693.38	25,758.06	25,823.75	25,891.68
725	Capacity	818,796.38	821,395.70	824,001.69	826,614.32	829,233.59	831,859.47	834,491.91	837,130.96	839,776.65	842,429.11
	Area	25,959.51	26,026.64	26,093.15	26,159.58	26,225.80	26,291.62	26,357.46	26,423.48	26,490.67	26,558.47
726	Capacity	845,088.37	847,754.55	850,427.60	853,107.57	855,794.52	858,488.49	861,189.55	863,897.69	866,612.83	869,334.99
	Area	26,627.20	26,696.07	26,765.06	26,834.51	26,904.72	26,974.83	27,046.21	27,116.41	27,186.58	27,256.77
727	Capacity	872,064.22	874,800.61	877,544.28	880,295.39	883,054.09	885,820.50	888,594.76	891,376.84	894,166.90	896,965.01
	Area	27,327.99	27,400.01	27,473.65	27,548.80	27,625.39	27,703.21	27,781.65	27,860.15	27,941.59	28,019.74
728	Capacity	899,770.75	902,584.03	905,405.17	908,234.13	911,070.64	913,914.78	916,766.90	919,626.75	922,494.23	925,369.00
	Area	28,094.95	28,171.37	28,251.15	28,327.53	28,402.79	28,480.91	28,560.54	28,636.68	28,711.81	28,783.52
729	Capacity	928,250.89	931,139.88	934,035.91	936,938.83	939,848.58	942,765.17	945,688.54	948,618.67	951,555.51	954,498.92
	Area	28,854.36	28,925.21	28,995.05	29,063.46	29,131.72	29,199.98	29,267.42	29,335.10	29,401.42	29,466.71
730	Capacity	957,448.86	960,405.33	963,368.35	966,337.95	969,314.18	972,297.08	975,286.72	978,283.11	981,286.24	984,296.17
	Area	29,531.96	29,597.43	29,663.08	29,728.96	29,795.66	29,862.49	29,930.24	29,997.57	30,065.23	30,133.50
731	Capacity	987,312.97	990,336.63	993,367.18	996,404.65	999,449.13	1,002,500.66	1,005,559.26	1,008,625.12	1,011,698.37	1,014,779.17
	Area	30,202.36	30,271.10	30,339.92	30,409.58	30,480.12	30,550.40	30,622.12	30,695.18	30,770.16	30,845.31

Table 1. Capacity and area of Grand Lake O' the Cherokees, northeastern Oklahoma, 2009.—Continued

[All elevation values in feet above North American Vertical Datum of 1988 (NAVD 88). Capacity in acre-feet by tenth-foot elevation increments. Area in acres by tenth-foot elevation increments. --, not applicable]

Water-surface elevation		0.00	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
732	Capacity	1,017,867.38	1,020,962.90	1,024,065.70	1,027,175.88	1,030,293.55	1,033,418.81	1,036,551.71	1,039,692.31	1,042,840.67	1,045,996.79
	Area	30,918.82	30,991.51	31,064.70	31,139.03	31,214.48	31,290.77	31,367.43	31,444.67	31,522.39	31,600.49
733	Capacity	1,049,160.79	1,052,332.75	1,055,512.80	1,058,701.07	1,061,897.66	1,065,102.61	1,068,315.89	1,071,537.55	1,074,767.51	1,078,005.61
	Area	31,679.73	31,759.69	31,841.48	31,924.10	32,007.90	32,090.91	32,174.76	32,258.38	32,340.53	32,421.42
734	Capacity	1,081,251.78	1,084,505.98	1,087,768.33	1,091,038.94	1,094,317.82	1,097,604.96	1,100,900.39	1,104,204.23	1,107,516.48	1,110,837.09
	Area	32,501.88	32,582.52	32,664.63	32,747.50	32,830.19	32,912.73	32,996.20	33,080.59	33,164.19	33,248.34
735	Capacity	1,114,166.23	1,117,504.05	1,120,850.35	1,124,205.12	1,127,568.16	1,130,939.58	1,134,319.60	1,137,708.14	1,141,104.87	1,144,509.82
	Area	33,334.95	33,420.90	33,505.55	33,589.15	33,671.80	33,757.22	33,843.28	33,926.58	34,008.26	34,091.09
736	Capacity	1,147,923.18	1,151,345.05	1,154,775.35	1,158,213.89	1,161,660.37	1,165,114.65	1,168,576.82	1,172,046.88	1,175,524.63	1,179,009.85
	Area	34,176.40	34,260.89	34,344.82	34,425.40	34,503.80	34,581.94	34,661.28	34,739.55	34,814.97	34,889.18
737	Capacity	1,182,502.44	1,186,002.37	1,189,509.70	1,193,024.54	1,196,546.88	1,200,076.72	1,203,614.14	1,207,159.37	1,210,712.38	1,214,273.17
	Area	34,962.60	35,036.06	35,110.65	35,186.04	35,260.88	35,335.93	35,413.12	35,491.05	35,569.15	35,646.39
738	Capacity	1,217,841.69	1,221,418.12	1,225,002.70	1,228,595.81	1,232,197.90	1,235,809.22	1,239,429.84	1,243,059.73	1,246,698.75	1,250,346.79
	Area	35,724.28	35,804.61	35,887.75	35,975.35	36,067.04	36,159.42	36,252.96	36,344.54	36,435.65	36,524.77
739	Capacity	1,254,003.66	1,257,669.25	1,261,343.51	1,265,026.42	1,268,717.97	1,272,418.24	1,276,127.47	1,279,845.79	1,283,573.40	1,287,310.04
	Area	36,612.31	36,699.35	36,785.81	36,872.27	36,958.81	37,047.01	37,137.68	37,229.50	37,321.39	37,411.28
740	Capacity	1,291,055.68	1,294,810.52	1,298,574.95	1,302,349.26	1,306,133.29	1,309,927.09	1,313,730.79	1,317,544.77	1,321,369.28	1,325,204.33
	Area	37,501.77	37,595.45	37,693.40	37,792.11	37,888.71	37,987.28	38,087.58	38,192.63	38,297.62	38,403.31
741	Capacity	1,329,050.10	1,332,906.92	1,336,774.93	1,340,654.08	1,344,544.10	1,348,444.78	1,352,355.61	1,356,276.50	1,360,207.50	1,364,148.14
	Area	38,512.26	38,624.21	38,736.02	38,846.37	38,953.86	39,058.28	39,158.52	39,259.18	39,359.97	39,451.47
742	Capacity	1,368,099.43	1,372,060.30	1,376,030.29	1,380,009.01	1,383,996.13	1,387,991.59	1,391,995.19	1,396,006.96	1,400,026.98	1,404,071.68
	Area	39,558.01	39,654.16	39,744.48	39,829.45	39,913.26	39,995.25	40,076.83	40,158.82	40,242.58	40,498.63
743	Capacity	1,408,126.35	1,412,190.29	1,416,262.91	1,420,344.22	1,424,435.37	1,428,535.80	1,432,645.68	1,436,765.08	1,440,894.11	1,445,032.90
	Area	40,593.05	40,683.34	40,769.23	40,857.27	40,957.63	41,051.38	41,146.25	41,242.07	41,338.82	41,437.13
744	Capacity	1,449,181.62	1,453,340.50	1,457,509.71	1,461,689.50	1,465,880.27	1,470,082.18	1,474,295.41	1,478,520.30	1,482,757.33	1,487,007.16
	Area	41,537.71	41,640.20	41,744.41	41,853.51	41,962.51	42,075.26	42,189.85	42,308.90	42,432.41	42,562.84
745	Capacity	1,491,270.54	1,495,549.49	1,499,843.06	1,504,151.54	1,508,519.04	1,512,926.72	1,517,344.64	1,521,773.10	1,526,212.02	1,530,662.16
	Area	42,719.13	42,860.48	43,009.32	43,161.77	44,026.55	44,127.36	44,233.06	44,336.56	44,442.39	44,556.28
746	Capacity	1,535,123.30	1,539,595.71	1,544,079.65	1,548,574.94	1,553,081.66	1,557,599.43	1,562,128.85	1,566,670.31	1,571,222.62	1,575,785.74
	Area	44,666.82	44,782.96	44,895.82	45,009.38	45,122.66	45,232.39	45,360.41	45,468.81	45,577.49	45,684.80

Summary

In February 2017, the Grand River Dam Authority filed to relicense the Pensacola Hydroelectric Project with the Federal Energy Regulatory Commission. The predominant feature of the Pensacola Hydroelectric Project is Pensacola Dam, which impounds Grand Lake O' the Cherokees (locally called Grand Lake) in northeastern Oklahoma. Identification of information gaps and assessment of project effects on stakeholders are central aspects of the Federal Energy Regulatory Commission relicensing process. One of the information gaps is that a complete capacity and area table has not been produced since 1940. Capacity and area tables identify the relations between the elevation of the water surface and the volume of water that can be impounded at each water surface elevation. This report (1) presents the updated capacity and area table for Grand Lake O' the Cherokees for 2009, (2) describes the methods used to calculate the updated capacity and area values presented in the table, and (3) compares the updated capacity table (2009) to historical capacity tables produced from a survey in 1940 and from a hydrographic survey of the lake by the Oklahoma Water Resources Board in 2009.

The new capacity values computed for Grand Lake O' the Cherokees indicate that between 1940 and 2009, capacity at conservation pool has decreased about 157,000 acre-feet or 10 percent since 1940 and capacity at top of dam elevation has decreased about 200,000 acre-feet or 8 percent since 1940. This difference in the capacities could be attributed to the advancements of technologies; the techniques used for surveying lakes have changed from the 1940 survey to the 2009 survey. Another possible reason for loss in capacity could be as time progresses, lakes like Grand Lake O' the Cherokees slowly impound sediment carried by the rivers that feed into the lakes, thus diminishing the amount of water that the lake holds. The most recent survey used depths and Global Positioning System points collected electronically, but the methods used for collecting data in 1940 are unknown. Due to the advancement of technology, the 2009 survey is likely more precise than the 1940 survey.

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