

# Bathymetric and Sediment Survey of Wabaunsee Lake, Wabaunsee County, Kansas



Kansas Biological Survey  
*Applied Science and Technology for  
Reservoir Assessment (ASTRA) Program*  
Report 2008-07 (April 2009)

*Revised Area-Elevation-Capacity Tables and Figures, January 2010*



**KANSAS**  

---

**WATER**  

---

**OFFICE**

**This work was funded by the Kansas Water Office through the State Water Plan Fund in support of the Reservoir Sustainability Initiative.**

## SUMMARY

On June 3, 2008, the Kansas Biological Survey (KBS) performed a bathymetric survey of Wabaunsee Lake in Wabaunsee County, Kansas. The survey was carried out using acoustic echosounding apparatus linked to a global positioning system. The bathymetric survey was georeferenced to both horizontal and vertical reference datums.

Sediment samples were collected from four sites within the reservoir: One sample was taken near the dam; a second at mid-lake; and the remaining two in the upper ends of each of the two major arms. Initial sampling was performed on the same day as the bathymetric survey, following completion of the survey. Due to the loss of one sediment sample during shipping, the lake was resampled for sediment on April 8, 2009. Sediment samples were analyzed for particle size distributions.

### Summary Data:

<b>Bathymetric Survey:</b>		
Date of survey:		June 3, 2008
<b>Reservoir Statistics:</b>		
Water elevation on date of survey:		1287.3 ft.
Area on date of survey:		201 acres
Volume on date of survey:		3590 acre-feet
Maximum depth:		39.6
Year constructed:		1932-1936; completed 1937
<b>Elevation Benchmark (if applicable)</b>		
UTM location of elevation benchmark:		744015.8, 4305514.9
UTM Zone:		14N
UTM datum:		NAD83
Elevation of benchmark, from GPS:		1289.2 ft.
Vertical datum, all data:		NAVD88
<b>Sediment Survey:</b>		
Date of sediment survey:		June 3, 2008 April 8, 2009

# TABLE OF CONTENTS

<b>SUMMARY</b> .....	i
<b>TABLE OF CONTENTS</b> .....	ii
<b>LIST OF FIGURES</b> .....	iii
<b>LIST OF TABLES</b> .....	iv
<b><u>LAKE HISTORY AND PERTINENT INFORMATION</u></b> .....	1
<b><u>BATHYMETRIC SURVEYING PROCEDURE</u></b>	
Pre-survey preparation:.....	3
Survey procedures: .....	3
Establishment of lake level on survey date: .....	4
Location of lake elevation benchmark .....	5
NGS OPUS solution report .....	6
Post-processing .....	8
<b><u>BATHYMETRIC SURVEY RESULTS</u></b>	
Area-Volume-Elevation Tables.....	11
<b><u>SEDIMENT SAMPLING</u></b> .....	14
Procedures.....	14
Results .....	14

## **LIST OF FIGURES**

Figure 1.	Wabaunsee Lake, looking northwest .....	1
Figure 2.	Location of Wabaunsee Lake in Wabaunsee County, Kansas. ....	2
Figure 3.	a. View east toward boat ramp .....	5
	b. Close-up view of lake elevation benchmark site .....	5
Figure 4.	Bathymetric survey transects.....	7
Figure 5.	Reservoir depth map .....	10
Figure 6.	Cumulative area-elevation curve. ....	13
Figure 7.	Cumulative volume-elevation curve.....	13
Figure 8.	Location of sediment sampling sites in Wabaunsee Lake . ....	15
Figure 9.	Sediment particle size analysis .....	16
Figure 10.	Particle size distribution of sediment samples in Wabaunsee Lake.....	17

**LIST OF TABLES**

Table 1. Cumulative area in acres by tenth foot elevation increments..... 11

Table 2. Cumulative volume in acre-feet by tenth foot elevation increments ..... 12

Table 3 Sediment sampling site data..... 14

## LAKE HISTORY AND PERTINENT INFORMATION

(This section is summarized from the Lake Wabaunsee website and the Kansas Department of Wildlife and Parks website.)

[www.lakewabaunsee.com](http://www.lakewabaunsee.com)

[www.kdwp.state.ks.us](http://www.kdwp.state.ks.us)

A very detailed history of Lake Wabaunsee, too long to reprint here, can be found at:

<http://www.lakewabaunsee.com/Communities/History.html>



**Figure 1. Wabaunsee Lake, looking northwest. Photo by J. Aber, used with permission.**

**Location:** Located in Wabaunsee County, Kansas, approximately 30 miles southwest of Topeka and 5 miles west of Eskridge, Kansas. The reservoir forms in the east branch of Mill Creek in the Kansas/Lower Republican River Basin.

**Purpose:** Drinking water supply, contact recreation, and wildlife objectives.

**History of Construction:** Initial work on the lake was performed from 1932-1936 by the Kansas Emergency Relief Corporation and then transferred to the Federal Works Progress Administration (FWP). The project was approximately 15% complete when FWP took over and by the end of 1936, all earthwork was finished. The entire project was completed in 1937.

**Type of Structure:** The structure consists of an earthen dam 65-feet high, 30-foot wide and 1,400 feet in length and impounds approximately 3,864 acre-feet of water. The spring-fed lake feeds off of 13 flowing cold-water springs.

# Wabaunsee County, Kansas

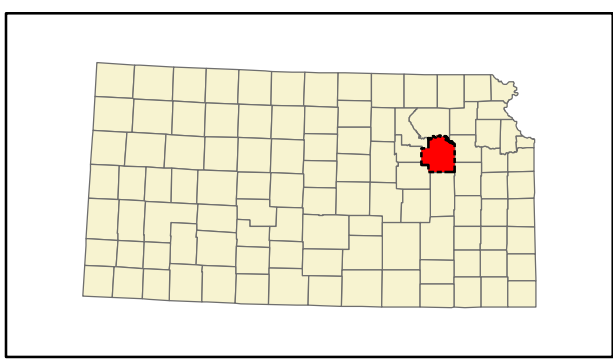
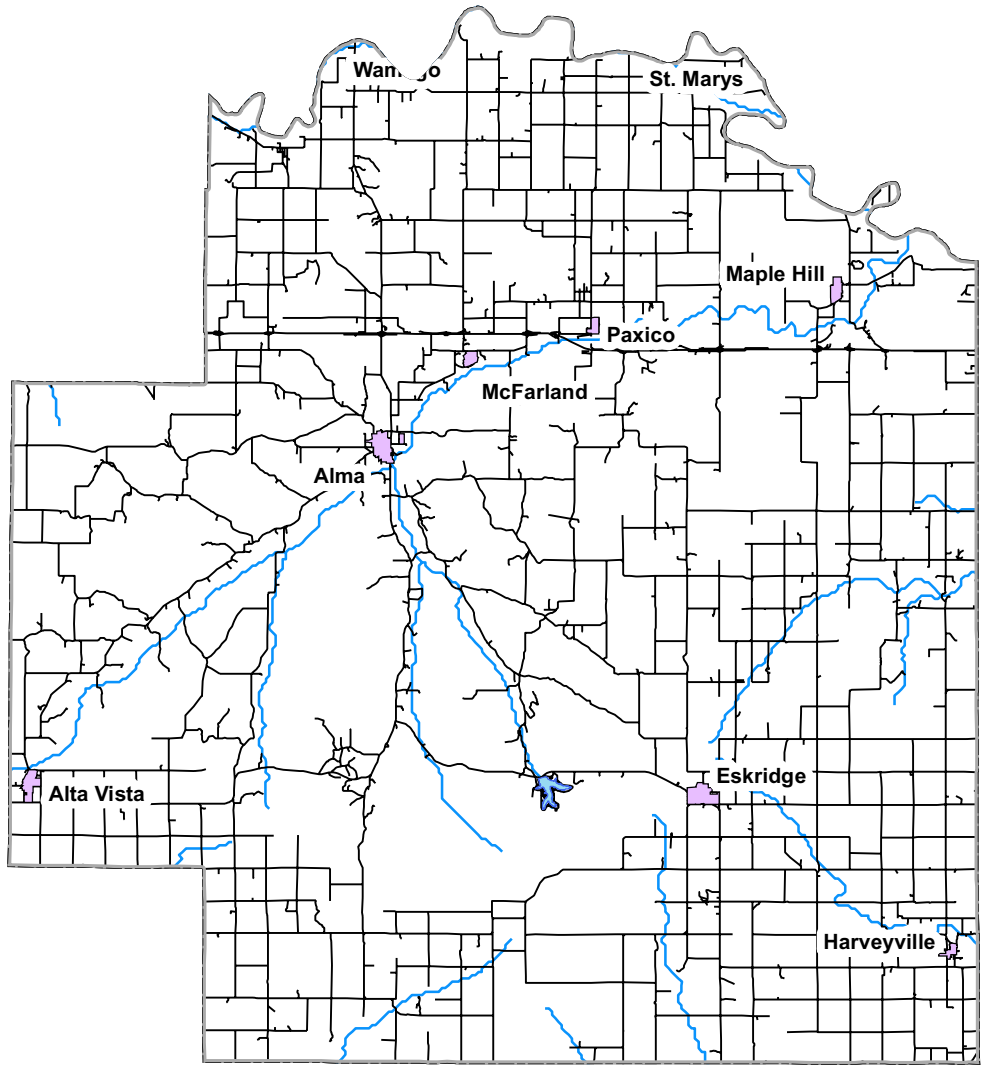


Figure 2. Location of Wabaunsee Lake in Wabaunsee County.

## **Reservoir Bathymetric (Depth) Surveying Procedures**

KBS operates a Biosonics DT-X acoustic echosounding system ([www.biosonicsinc.com](http://www.biosonicsinc.com)) with a 200 kHz split-beam transducer and a 38-kHz single-beam transducer. In addition to providing basic information on reservoir depth profiles, the Biosonics system also permits the assessment of bottom sediment composition. Latitude-longitude information is provided by a JRC global positioning system (GPS) that interfaces with the Biosonics system. ESRI's ArcGIS is used for on-lake navigation and positioning, with GPS data feeds provided by the Biosonics unit through a serial cable. Power is provided to the echosounding unit, command/navigation computer, and auxiliary monitor by means of a inverter and battery backup device that in turn draw power from the 12-volt boat battery.

### **Pre-survey preparation:**

Geospatial reference data: Prior to conducting the survey, geospatial data of the target lake is acquired, including georeferenced National Agricultural Imagery Project (NAIP) photography. The lake boundary is digitized as a polygon shapefile from the FSA NAIP georeferenced aerial photography obtained online from the Data Access and Service Center (DASC) at the Kansas Geological Survey. Prior to the lake survey, a series of transect lines are created as a shapefile in ArcGIS for guiding the boat during the survey. Transect lines are spaced more closely (25-50 meters separation) on smaller state/local lakes, while a spacing of 100-150 meters is used for federal reservoirs.

### **Survey procedures:**

Calibration (Temperature and ball check): After boat launch and initialization of the Biosonics system and command computer, system parameters are set in the Biosonics Visual Acquisition software. The temperature of the lake at 1-2 meters is taken with a research-grade metric electronic thermometer. This temperature, in degrees Celsius, is input to the Biosonics Visual Acquisition software to calculate the speed of sound in water at the given temperature at the given depth. Start range, end range, ping duration, and ping interval are also set at this time. A ball check is performed using a tungsten-carbide sphere supplied by Biosonics for this purpose. The ball is lowered to a known distance (1.0 meter) below the transducer faces. The position of the ball in the water column (distance from the transducer face to the ball) is clearly visible on the echogram. The echogram distance is compared to the known distance to assure that parameters are properly set and the system is operating correctly.

On-lake survey procedures: Using the GPS Extension of ArcGIS, the GPS data feed from the GPS receiver via the Biosonics echosounder, and the pre-planned transect pattern, the location of the boat on the lake in real-time is shown on the command/navigation computer screen. To assist the boat operator in navigation, an auxiliary LCD monitor is connected to the computer and placed within the easy view of the boat operator. Transducer face depth on all dates is 0.5 meters below the water surface. The transect pattern is maintained except when modified by obstructions in the lake (e.g., partially submerged trees) or shallow water and mudflats. Data are automatically logged in new files every half-hour (approximately 9000-ping files) by the Biosonics system.

## **Establishment Of Lake Level On Survey Dates:**

### **State and Local Reservoirs:**

Most state and local lakes in Kansas do not have water surface elevation gauges. Therefore, a local benchmark at the edge of a lake is established, typically a concrete pad or wall adjacent to the water. The location of the benchmark is photographed and a description noted. On the day of the survey, the vertical distance between the water surface and the surface of the benchmark is measured. In cases where the benchmark must be established a distance away from the lake, a survey-grade laser level is used to establish the vertical distance between benchmark and water surface.

A TopCon HiPerLite+ survey-grade static global positioning system is used to establish the height of the benchmark. The unit is set at a fixed distance above the benchmark, and the vertical distance between the benchmark and the Antenna Reference Point recorded. The unit is allowed to record data points for a minimum of two hours at a rate of one point every 10 seconds.

Following GPS data acquisition, the data are downloaded at the office from the GPS unit, converted from TopCon proprietary format to RINEX format, and uploaded to the National Geodetic Survey (NGS) On-line Positioning User Service (OPUS). Raw data are processed by OPUS with respect to three NGS CORS (Continuously Operating Reference Stations) locations and results returned to the user.

The elevation of the benchmark is provided in meters as the orthometric height (NAVD88, computed using GEOID03). The vertical difference between the lake surface on the survey day is subtracted from the OPUS-computer orthometric height to produce the lake elevation value, in meters. This lake elevation value is entered as an attribute of the lake perimeter polygon shapefile in postprocessing.

Lake water surface elevation on June 3, 2008 was 1287.31 feet above sea level.

**Location of Lake Elevation Benchmark:**

**Wabaunsee Lake:** The northeast corner of the concrete dock adjacent to the main boat ramp on the north side of the lake.

UTM (NAD83, Zone 14): Easting (X) [meters] 744015.8, Northing (Y) [meters] 4305514.9



**Figure 3a. View east toward boat ramp.**



**Figure 3b. Close-up view. Lake level was measured from the water surface to the top of the concrete pad at the eastern edge (left in picture) of the concrete.**

Date: Wed, 4 Jun 2008 12:16:09 -0400  
 From: opus <opus@ngs.noaa.gov>  
 To: mjakub@ku.edu  
 Subject: OPUS solution : waba155p.080 000369466  
 Reply-To: ngs.opus@noaa.gov

FILE: waba155p.080 000369466

2005 NOTE: The IGS precise and IGS rapid orbits were not available  
 2005 at processing time. The IGS ultra-rapid orbit was/will be used to  
 2005 process the data.  
 2005

NGS OPUS SOLUTION REPORT  
 =====

All computed coordinate accuracies are listed as peak-to-peak values.  
 For additional information: [www.ngs.noaa.gov/OPUS/Using\\_OPUS.html#accuracy](http://www.ngs.noaa.gov/OPUS/Using_OPUS.html#accuracy)

USER: mjakub@ku.edu DATE: June 04, 2008  
 RINEX FILE: waba155p.08o TIME: 16:16:02 UTC

SOFTWARE: page5 0612.06 master11.pl START: 2008/06/03 15:28:00  
 EPHEMERIS: igu14822.eph [ultra-rapid] STOP: 2008/06/03 21:25:00  
 NAV FILE: brdc1550.08n OBS USED: 11647 / 12095 : 96%  
 ANT NAME: TPSHIPER\_PLUS NONE # FIXED AMB: 60 / 65 : 92%  
 ARP HEIGHT: 1.455 OVERALL RMS: 0.017 (m)

REF FRAME: NAD\_83 (CORS96) (EPOCH:2002.0000) ITRF00 (EPOCH:2008.4229)

X:	-536015.634 (m)	0.001 (m)	-536016.347 (m)	0.001 (m)
Y:	-4944081.398 (m)	0.031 (m)	-4944080.036 (m)	0.031 (m)
Z:	3980854.966 (m)	0.026 (m)	3980854.846 (m)	0.026 (m)

LAT:	38 51 52.69213	0.003 (m)	38 51 52.71509	0.003 (m)
E LON:	263 48 44.67626	0.004 (m)	263 48 44.64077	0.004 (m)
W LON:	96 11 15.32374	0.004 (m)	96 11 15.35923	0.004 (m)
EL HGT:	362.508 (m)	0.040 (m)	361.439 (m)	0.040 (m)
ORTHO HGT:	392.953 (m)	0.045 (m)	[NAVD88 (Computed using GEOID03)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 14)	SPC (1501 KS N)
Northing (Y) [meters]	4305514.936	60554.350
Easting (X) [meters]	744015.898	557287.538
Convergence [degrees]	1.76560857	1.14673834
Point Scale	1.00033328	0.99997942
Combined Factor	1.00027638	0.99992254

US NATIONAL GRID DESIGNATOR: 14SQJ4401605515 (NAD 83)

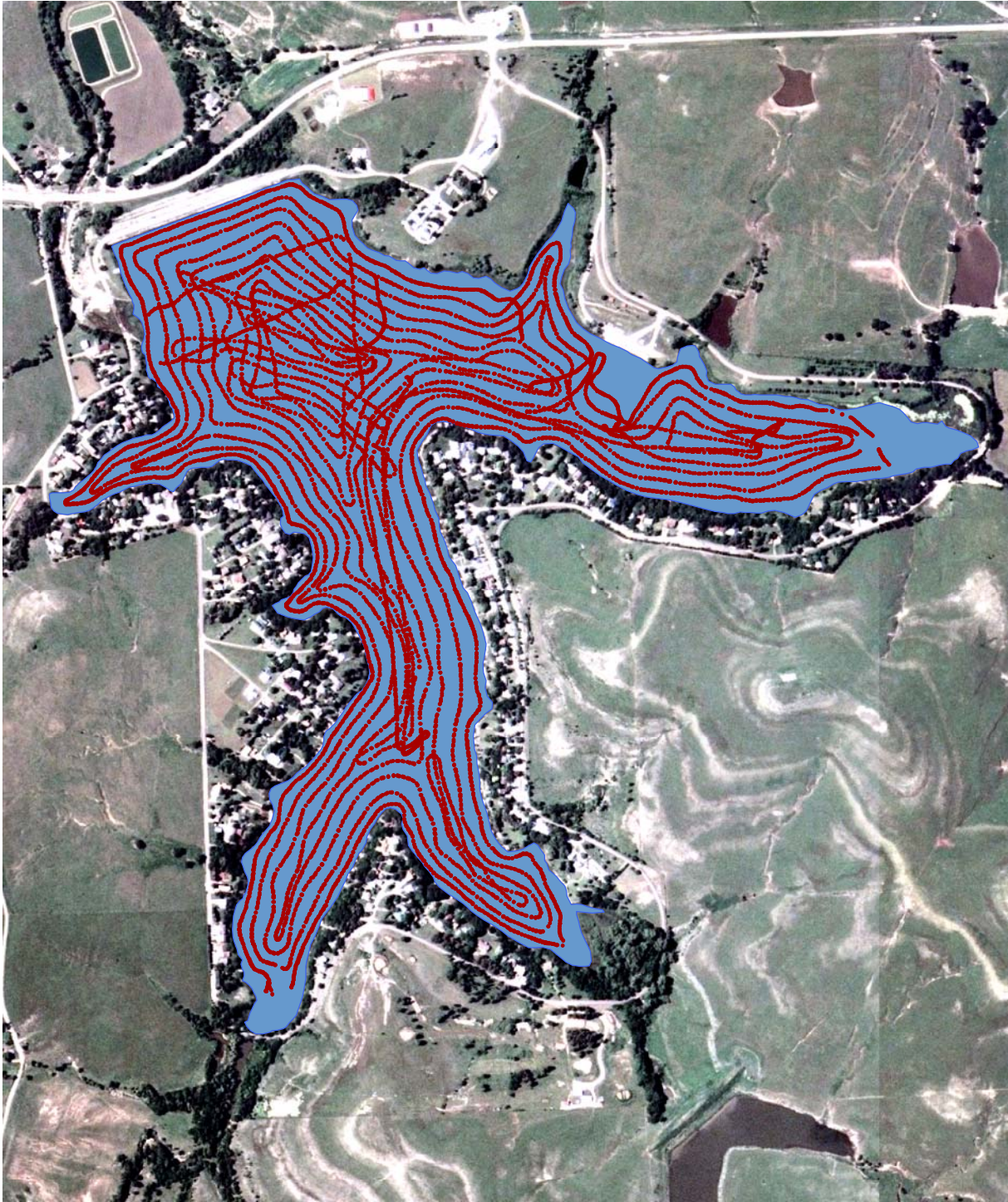
BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
AF9527	HBRK HILLSBORO CORS ARP	N381816.715	W0971736.655	114675.5
AJ1832	NDS1 NEODESHA (2) CORS ARP	N371805.504	W0953605.332	180962.7
AH9088	LTHM LATHROP CORS ARP	N393433.425	W0941012.528	191278.6

NEAREST NGS PUBLISHED CONTROL POINT

JF1330	TURN	N385210.993	W0961348.392	3728.5
--------	------	-------------	--------------	--------

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.



0 0.25 0.5 Miles



Figure 4. Bathymetric Survey Transects for Wabaunsee Lake

## **Post-processing** (*Visual Bottom Typer*)

The Biosonics DT-X system produces data files in a proprietary DT4 file format containing acoustic and GPS data. To extract the bottom position from the acoustic data, each DT4 file is processed through the Biosonics Visual Bottom Typer (VBT) software. The processing algorithm is described as follows:

*“The BioSonics, Inc. bottom tracker is an “end\_up” algorithm, in that it begins searching for the bottom echo portion of a ping from the last sample toward the first sample. The bottom tracker tracks the bottom echo by isolating the region(s) where the data exceeds a peak threshold for N consecutive samples, then drops below a surface threshold for M samples. Once a bottom echo has been identified, a bottom sampling window is used to find the next echo. The bottom echo is first isolated by user\_defined threshold values that indicate (1) the lowest energy to include in the bottom echo (bottom detection threshold) and (2) the lowest energy to start looking for a bottom peak (peak threshold). The bottom detection threshold allows the user to filter out noise caused by a low data acquisition threshold. The peak threshold prevents the algorithm from identifying the small energy echoes (due to fish, sediment or plant life) as a bottom echo.”* (Biosonics Visual Bottom Typer User’s Manual, Version 1.10, p. 70).

Data is output as a comma-delimited (\*.csv) text file. A set number of qualifying pings are averaged to produce a single report (for example, the output for ping 31 {when pings per report is 20} is the average of all values for pings 12-31). Standard analysis procedure for all 2008 and later data is to use the average of 7 pings to produce one output value.

All raw \*.csv files are merged into one master \*.csv file using the shareware program File Append and Split Tool (FAST) by Boxer Software (Ver. 1.0, 2006).

## **Post-processing** (*Excel*)

The master \*.csv file created by the FAST utility is imported into Microsoft Excel. Excess header lines are deleted (each input CSV file has its own header), and the header file is edited to change the column headers “#Ping” to “Ping” and “E1” to “E11”, characters that are not ingestable by ArcGIS. Entries with depth values of zero (0) are deleted, as are any entries with depth values less than the start range of the data acquisition parameter (typically 0.49 meters or less) (indicating areas where the water was too shallow to record a depth reading).

In Excel, depth adjustments are made. A new field – Adj\_Depth – is created. The value for AdjDepth is calculated as  $AdjDepth = Depth + (Transducer\ Face\ Depth)$ , where the Transducer Face Depth represents the depth of the transducer face below water level in meters (Typically, this value is 0.5 meters). Four values are computed in Excel: DepthM, DepthFt, ElevM and ElevFt, where:

$$\text{DepthM} = \text{Adj\_Depth}$$
$$\text{DepthFt} = \text{Adj\_Depth} * 3.28084$$

These water depths are RELATIVE water depths that can vary from day-to-day based on the elevation of the water surface. In order to normalize all depth measurements to an absolute reference, water depths must be subtracted from an established value for the elevation of the water surface at the time of the bathymetric survey. Determination of water surface elevation has been described in an earlier section on establishment of lake levels.

To set depths relative to lake elevation, another field is added to the attribute table of the point shapefile, ElevM. The value for this attribute is then computed as  $\text{Depth\_ElevM} = (\text{Elevation of the Water Surface in meters above sea level}) - \text{Adj\_Depth}$ . Elevation of the water surface in feet above sea level is also computed by converting ElevM to elevation in feet ( $\text{ElevM} * 3.28084$ ).

Particularly for multi-day surveys, ADJ\_DEPTH, Depth\_M, and Depth\_Ft should **NOT** be used for further analysis or interpolation. If water depth is desired, it should be produced by subtracting Elev\_M or Elev\_Ft from the reference elevation used for interpolation purposes (for federal reservoirs, the elevation of the water surface on the day that the aerial photography from which the lake perimeter polygon was digitized).

### **Post-processing** (ArcGIS):

Ingest to ArcGIS is accomplished by using the Tools – Add XY Data option. The projection information is specified at this time (WGS84). Point files are displayed as Event files, and are then exported as a shapefile (filename convention: ALLPOINTS\_WGS84.shp). The pointfile is then reprojected to the UTM coordinate system of the appropriate zone (14 or 15) (filename convention ALLPOINTS\_UTM.shp).

Raster interpolation of the point data is performed using the same input data and the Topo to Raster option within the 3D Extension of ArcGIS. The elevation of the reservoir on the date of aerial photography used to create the perimeter/shoreline shapefile was used as the water surface elevation in all interpolations from point data to raster data.

Contour line files are derived from the raster interpolation files using the ArcGIS command under 3D Analyst – Raster Surface – Contour.

Area-elevation-volume tables are derived using an ArcGIS extension custom written for and available from the ASTRA Program. Summarized, the extension calculates the area and volume of the reservoir at 1/10-foot elevation increments from the raster data for a series of water surfaces beginning at the lowest elevation recorded and progressing upward in 1/10-foot elevation increments to the reference water surface. Cumulative volume is also computed in acre-feet.

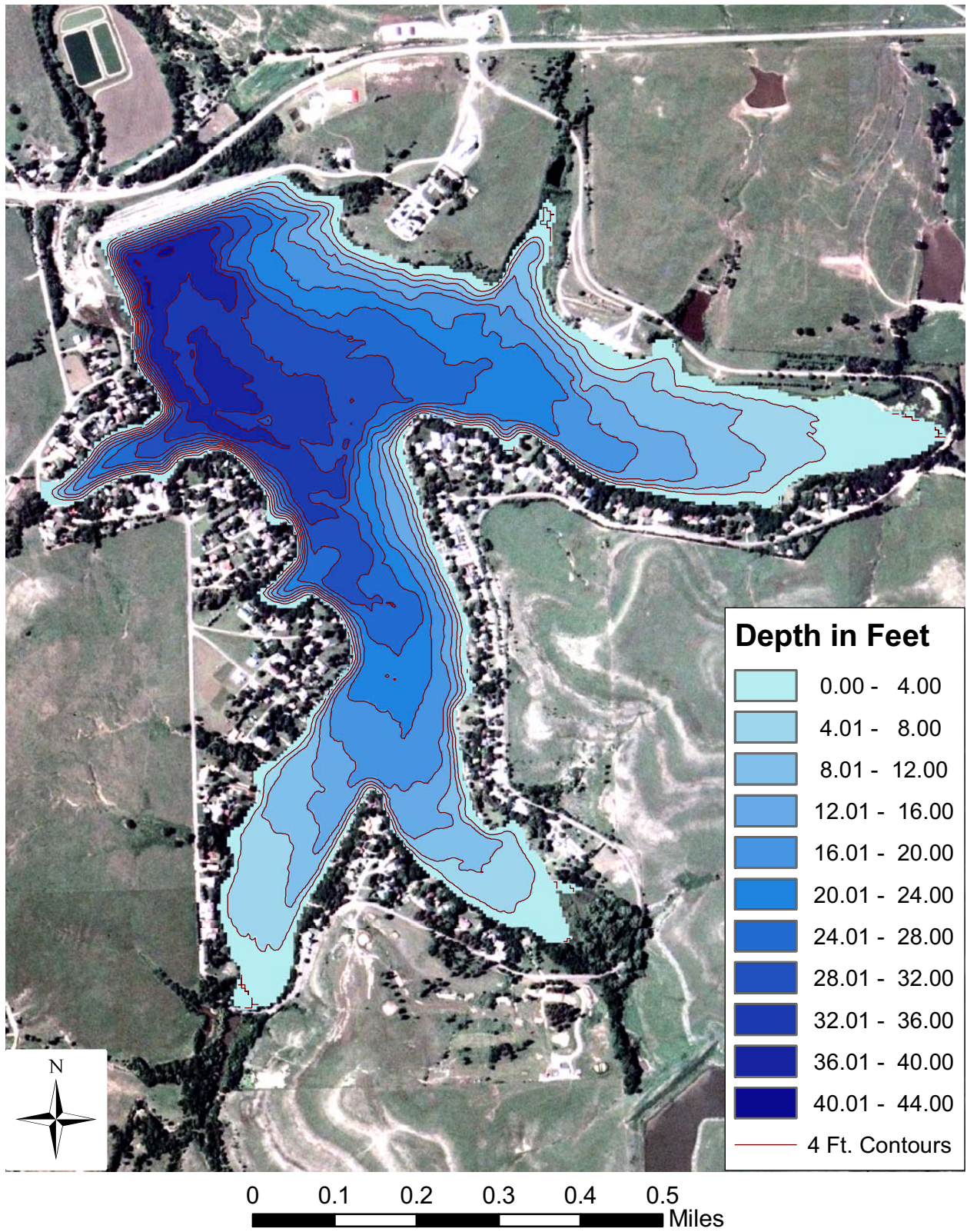


Figure 5. Water depth based on June 2008 bathymetric survey. Depths are based on a pool elevation of 1287.31 feet.

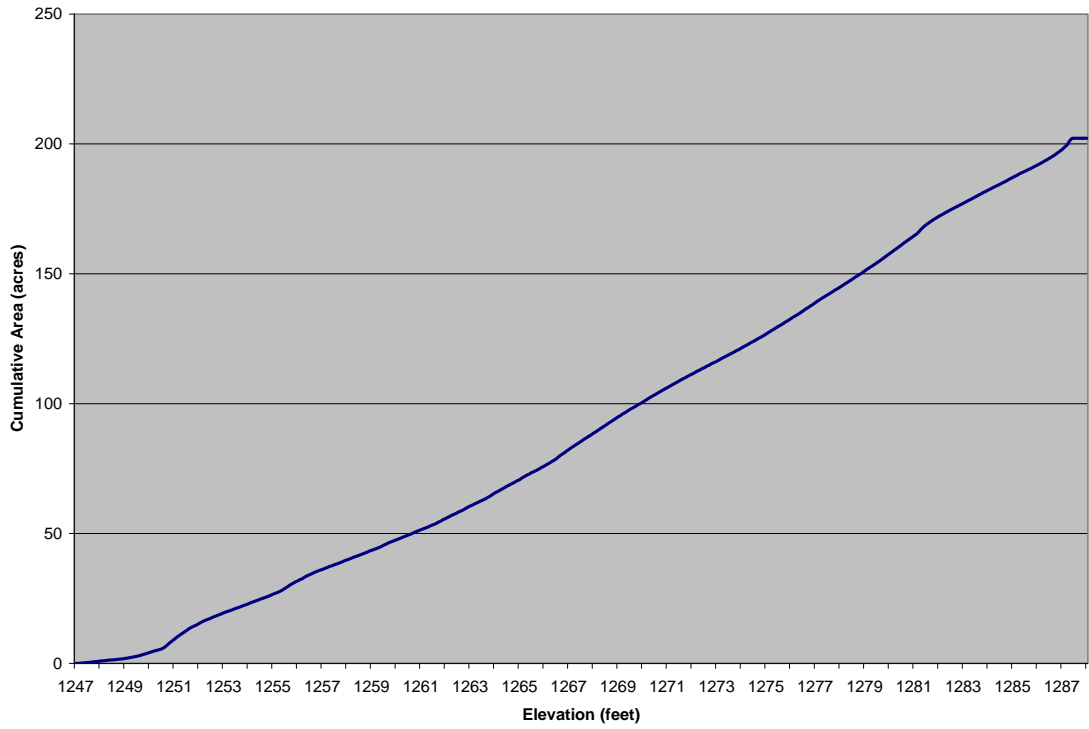
**Table 1**

**Cumulative area in acres by tenth foot elevation increments**

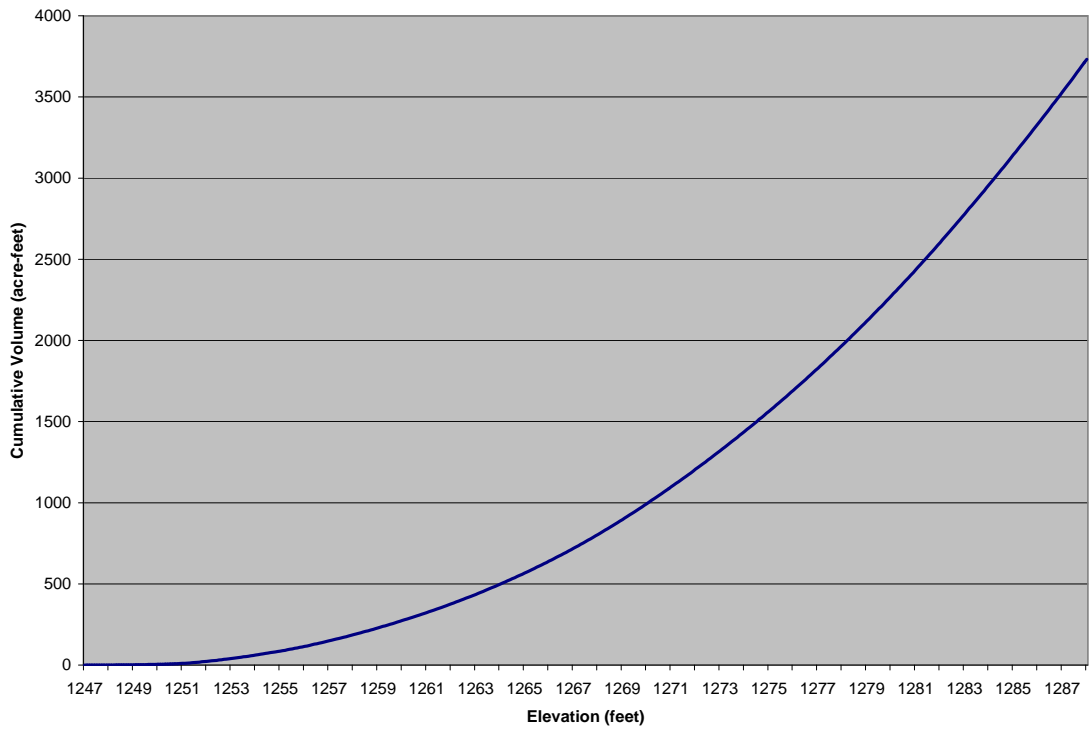
<b><u>Elevation (ft NGVD)</u></b>	<b><u>0.00</u></b>	<b><u>0.10</u></b>	<b><u>0.20</u></b>	<b><u>0.30</u></b>	<b><u>0.40</u></b>	<b><u>0.50</u></b>	<b><u>0.60</u></b>	<b><u>0.70</u></b>	<b><u>0.80</u></b>	<b><u>0.90</u></b>
<b>1247</b>	0	0	0	0	0	0	0	1	1	1
<b>1248</b>	1	1	1	1	1	1	1	2	2	2
<b>1249</b>	2	2	2	2	3	3	3	3	4	4
<b>1250</b>	4	4	5	5	5	6	6	7	8	9
<b>1251</b>	9	10	11	11	12	13	13	14	14	15
<b>1252</b>	15	16	16	17	17	17	18	18	19	19
<b>1253</b>	19	20	20	20	21	21	22	22	22	23
<b>1254</b>	23	23	24	24	24	25	25	25	26	26
<b>1255</b>	27	27	27	28	28	29	30	30	31	31
<b>1256</b>	32	32	33	33	34	34	35	35	35	36
<b>1257</b>	36	37	37	37	38	38	38	39	39	39
<b>1258</b>	40	40	41	41	41	42	42	42	43	43
<b>1259</b>	44	44	44	45	45	46	46	46	47	47
<b>1260</b>	48	48	48	49	49	49	50	50	51	51
<b>1261</b>	51	52	52	53	53	53	54	54	55	55
<b>1262</b>	56	56	57	57	58	58	59	59	60	60
<b>1263</b>	61	61	61	62	62	63	63	64	64	65
<b>1264</b>	66	66	67	67	68	68	69	69	70	70
<b>1265</b>	71	71	72	72	73	73	74	74	75	75
<b>1266</b>	76	77	77	78	78	79	80	80	81	82
<b>1267</b>	82	83	84	84	85	86	86	87	87	88
<b>1268</b>	89	89	90	90	91	92	92	93	94	94
<b>1269</b>	95	96	96	97	97	98	98	99	100	100
<b>1270</b>	101	101	102	102	103	104	104	105	105	106
<b>1271</b>	106	107	107	108	108	109	109	110	110	111
<b>1272</b>	111	112	112	113	113	114	114	115	115	116
<b>1273</b>	116	117	117	118	118	119	119	120	120	121
<b>1274</b>	121	122	122	123	124	124	125	125	126	126
<b>1275</b>	127	127	128	129	129	130	130	131	132	132
<b>1276</b>	133	133	134	135	135	136	136	137	138	138
<b>1277</b>	139	140	140	141	141	142	143	143	144	144
<b>1278</b>	145	146	146	147	147	148	149	149	150	150
<b>1279</b>	151	152	152	153	154	154	155	156	156	157
<b>1280</b>	158	158	159	160	160	161	162	163	163	164
<b>1281</b>	165	165	166	167	168	169	170	170	171	172
<b>1282</b>	172	173	173	174	174	175	175	176	176	177
<b>1283</b>	177	178	178	179	179	180	180	181	181	182
<b>1284</b>	182	183	183	184	184	185	185	186	186	187
<b>1285</b>	187	188	188	189	189	189	190	190	191	191
<b>1286</b>	192	192	193	193	194	195	195	196	196	197
<b>1287</b>	198	199	200	201						

**Table 2****Cumulative volume in acre-feet by tenth foot elevation increments**

<b><u>Elevation (ft NGVD)</u></b>	<b><u>0.00</u></b>	<b><u>0.10</u></b>	<b><u>0.20</u></b>	<b><u>0.30</u></b>	<b><u>0.40</u></b>	<b><u>0.50</u></b>	<b><u>0.60</u></b>	<b><u>0.70</u></b>	<b><u>0.80</u></b>	<b><u>0.90</u></b>
<b>1247</b>	0	0	0	0	0	0	0	0	0	0
<b>1248</b>	0	0	1	1	1	1	1	1	1	1
<b>1249</b>	2	2	2	2	3	3	3	3	4	4
<b>1250</b>	5	5	5	6	6	7	7	8	9	10
<b>1251</b>	11	11	13	14	15	16	17	19	20	22
<b>1252</b>	23	25	26	28	30	31	33	35	37	39
<b>1253</b>	41	43	44	47	49	51	53	55	57	59
<b>1254</b>	62	64	66	69	71	74	76	79	81	84
<b>1255</b>	86	89	92	94	97	100	103	106	109	112
<b>1256</b>	115	118	122	125	128	132	135	139	142	146
<b>1257</b>	149	153	157	160	164	168	172	176	180	183
<b>1258</b>	187	191	196	200	204	208	212	216	221	225
<b>1259</b>	229	233	238	242	247	251	256	261	265	270
<b>1260</b>	275	279	284	289	294	299	304	309	314	319
<b>1261</b>	324	329	334	340	345	350	356	361	366	372
<b>1262</b>	378	383	389	394	400	406	412	418	424	430
<b>1263</b>	436	442	448	454	460	467	473	479	486	492
<b>1264</b>	499	505	512	519	525	532	539	546	553	560
<b>1265</b>	567	574	581	588	596	603	610	618	625	633
<b>1266</b>	640	648	656	663	671	679	687	695	703	711
<b>1267</b>	719	728	736	744	753	761	770	778	787	796
<b>1268</b>	805	814	823	832	841	850	859	868	878	887
<b>1269</b>	896	906	916	925	935	945	954	964	974	984
<b>1270</b>	994	1004	1015	1025	1035	1045	1056	1066	1077	1087
<b>1271</b>	1098	1109	1119	1130	1141	1152	1162	1173	1184	1196
<b>1272</b>	1207	1218	1229	1240	1252	1263	1274	1286	1297	1309
<b>1273</b>	1321	1332	1344	1356	1368	1379	1391	1403	1415	1427
<b>1274</b>	1439	1452	1464	1476	1488	1501	1513	1526	1538	1551
<b>1275</b>	1563	1576	1589	1602	1615	1628	1641	1654	1667	1680
<b>1276</b>	1693	1707	1720	1733	1747	1760	1774	1788	1801	1815
<b>1277</b>	1829	1843	1857	1871	1885	1899	1913	1928	1942	1957
<b>1278</b>	1971	1985	2000	2015	2029	2044	2059	2074	2089	2104
<b>1279</b>	2119	2134	2149	2165	2180	2195	2211	2226	2242	2258
<b>1280</b>	2274	2289	2305	2321	2337	2353	2369	2386	2402	2418
<b>1281</b>	2435	2451	2468	2485	2501	2518	2535	2552	2569	2586
<b>1282</b>	2604	2621	2638	2655	2673	2690	2708	2725	2743	2761
<b>1283</b>	2778	2796	2814	2832	2850	2868	2886	2904	2922	2940
<b>1284</b>	2958	2977	2995	3013	3032	3050	3069	3087	3106	3125
<b>1285</b>	3144	3162	3181	3200	3219	3238	3257	3276	3295	3314
<b>1286</b>	3334	3353	3372	3392	3411	3431	3450	3470	3490	3509
<b>1287</b>	3529	3549	3569	3590						



**Figure 6. Cumulative area-elevation curve**



**Figure 7. Cumulative volume-elevation curve**

## **SEDIMENT SAMPLING PROCEDURES**

Sediment samples were collected from three sites within the reservoir using a Wildco drop-corer (Wildlife Supply Company, Buffalo, NY). One sample is taken near the dam; a second at mid-lake; and a third in the upper end/transitional area. Sampling is typically performed on the same day as the bathymetric survey, following completion of the survey. As the drop-corer samples only the upper sediment, the entire sample in each case is collected and sealed in a sampling container. Samples are then shipped to MidWest Laboratories (Omaha, NE), for texture, bulk density, and other analyses.

**Sediment re-sampling:** The original sample from site WB-1 was damaged in shipping for analysis. On April 8, 2009, the site was re-sampled. A GPS linked to ArcGIS and the map of original coring sites was used to locate the boat within  $\pm 5$  meters of the original site. One additional new site (WB-4), near the dam, was taken as well. At each location, a Ponar dredge was used to take a sediment sample from the top 3-5 inches of sediment. The sample was manually mixed to ensure uniformity and a sample amount of 32 volumetric ounces (~940 cubic centimeters) was taken. This sampled was then sealed and shipped to MidWest Laboratories for texture analysis.

## **SEDIMENT SAMPLING RESULTS:**

Sampling sites were distributed across the length of the reservoir (Figure 8). Silt percentages decreased from 52% and 62% at the inflow end (WB-2 and WB-3) to 20% near the dam (WB-4). Conversely, the sand and clay fractions increased from the inflow end to the dam (Table 3; Figure 9; Figure 10).

**Table 3**  
**Wabauensee Lake Sediment Sampling Site Data**

<b>CODE</b>	<b>UTMX</b>	<b>UTMY</b>	<b>Sand %</b>	<b>Silt %</b>	<b>Clay %</b>
WB-1	743620.8	4305433.1	34	26	40
WB-2	743642.2	4304735.5	14	52	34
WB-3	744317.8	4305339.4	16	62	22
WB-4	743237.2	4305634.8	36	20	44

Coordinates are Universal Transverse Mercator (UTM), NAD83, Zone 14 North

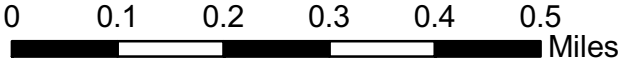
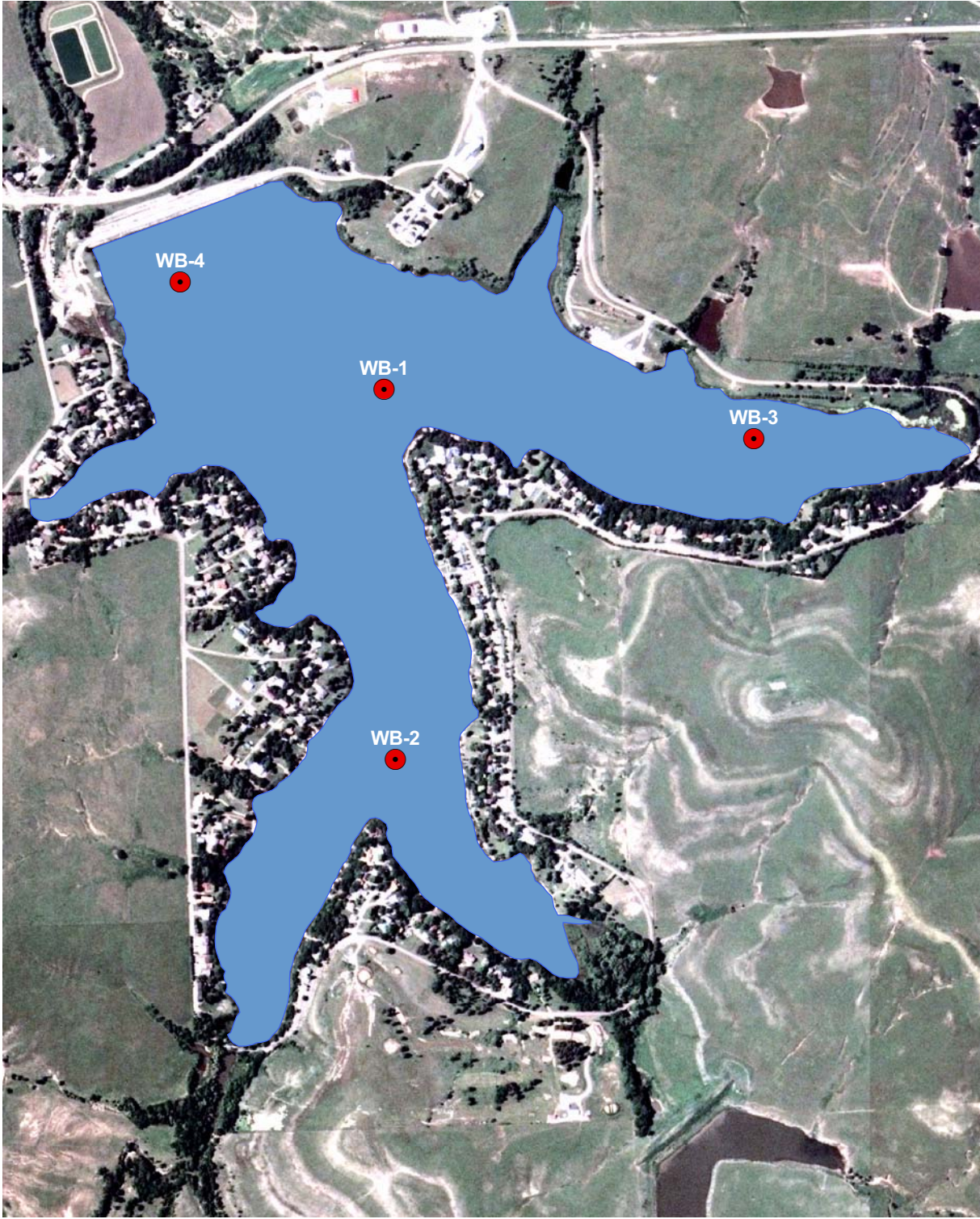


Figure 8. Location of sediment samples in Wabaunsee Lake

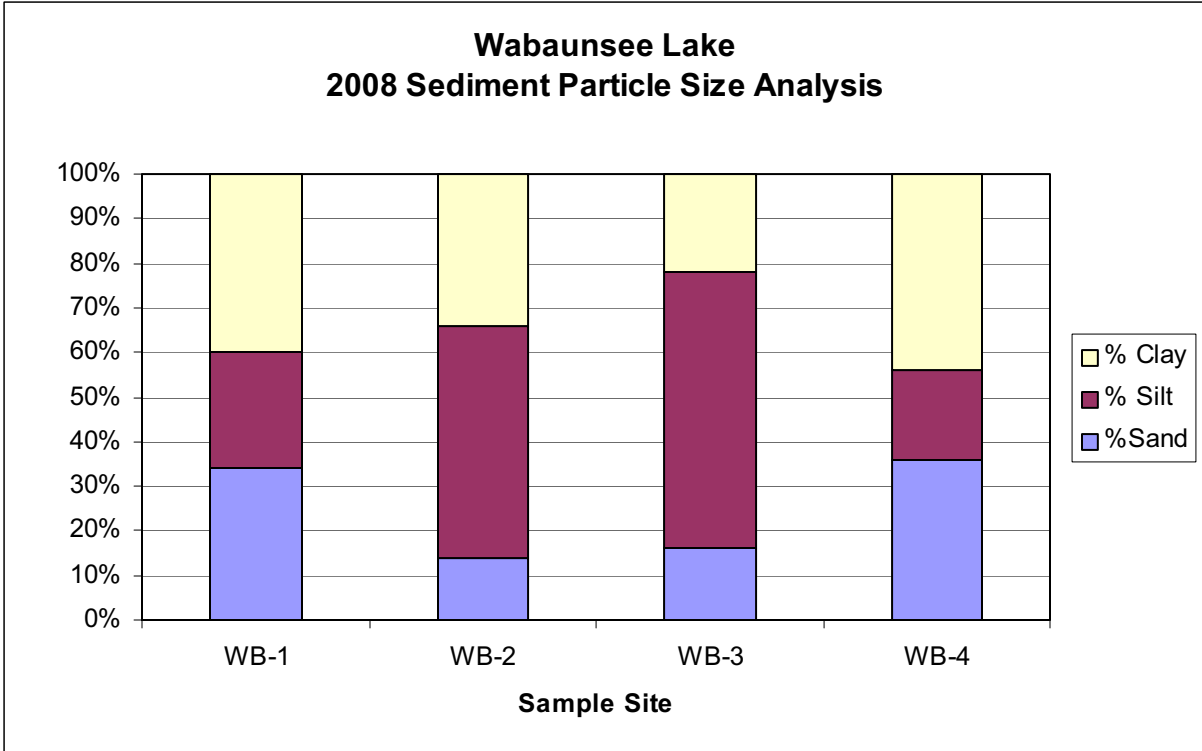


Figure 9. Sediment particle size analysis.

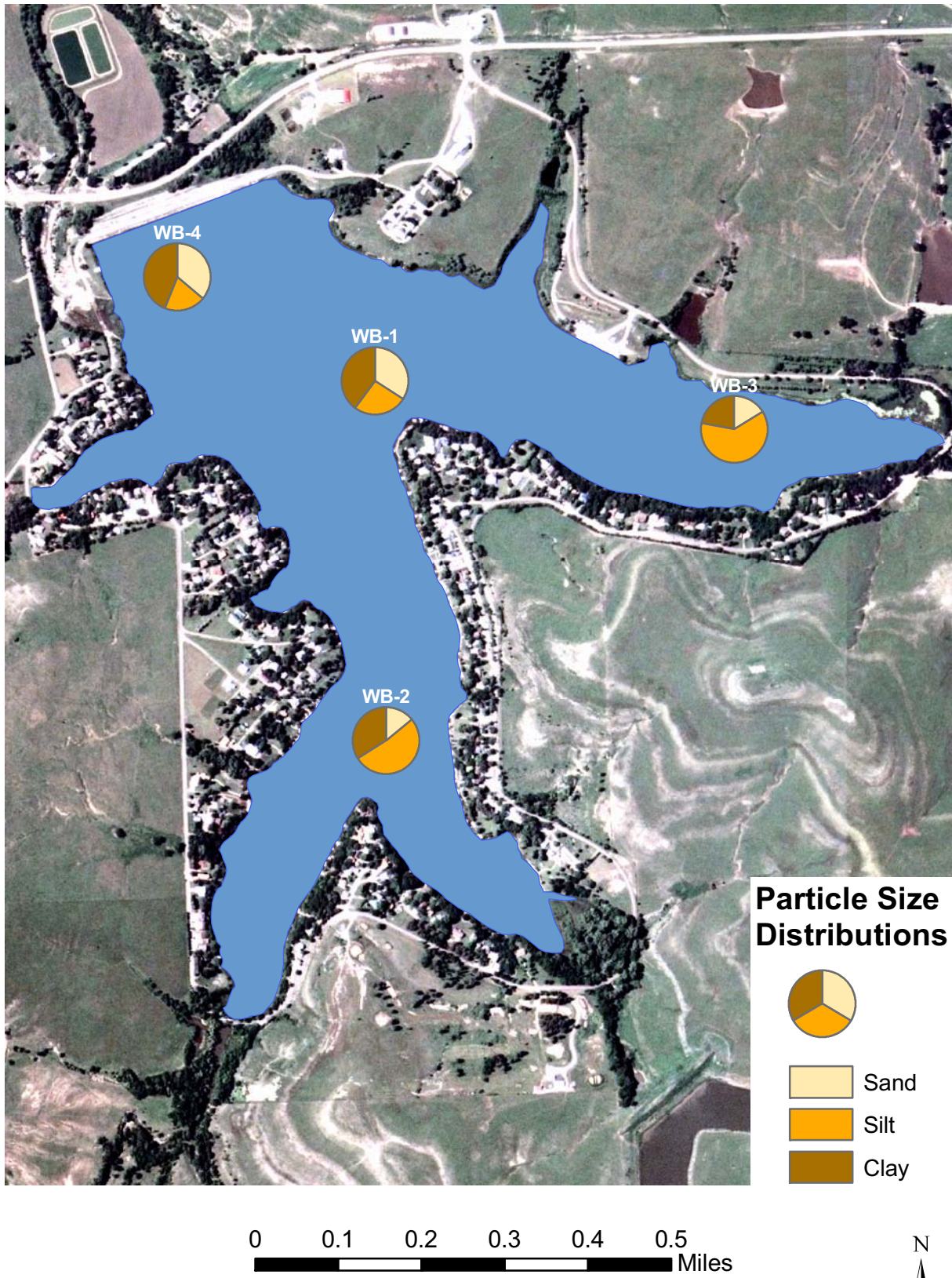


Figure 10. Particle size distribution of sediment samples in Wabaunsee Lake