RECLAMATION

Managing Water in the West

Merritt Reservoir
2003 Survey

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

September 2004

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188
1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE September 2004	3. REPORT TYPE AND DATES COVERED Final	
4. TITLE AND SUBTITLE Merritt Reservoir 2003 Survey			5. FUNDING NUMBERS PR
6. AUTHOR(S) Ronald L. Ferrari			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Bureau of Reclamation, Technical Service Center, Denver CO 80225-0007			8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Bureau of Reclamation, Denver Federal Center, PO Box 25007, Denver CO 80225-0007			10. SPONSORING/MONITORING AGENCY REPORT NUMBER DIBR
11. SUPPLEMENTARY NOTES Hard copy available at Bureau of Reclamation Technical Service Center, Denver, Colorado			
12a. DISTRIBUTION/AVAILABILITY STATEMENT			12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Bureau of Reclamation (Reclamation) surveyed Merritt Reservoir in June of 2003 to develop a topographic map and compute a present storage-elevation relationship (area-capacity tables). The underwater survey was conducted near lake elevation 2,945.6 feet (project datum). The underwater survey used sonic depth recording equipment interfaced with a global positioning system (GPS) that gave continuous sounding positions throughout the underwater portions of the reservoir covered by the survey vessel. The above-water topography was determined by digitizing the developed reservoir contour lines from the U.S. Geological Survey quadrangle (USGS quad) map of the reservoir area. The new topographic map of Merritt Reservoir was developed from the combined digitized USGS quad contours and June 2003 underwater measured topography. This study assumed no change from elevation 2,945 (feet) and above due to lack of 2003 above water data.

As of June 2003, at maximum water surface elevation 2,949.8, the surface area was 3,222 acres with a total capacity of 78,375 acre-feet. Since dam closure on February 19, 1964, about 7,886 acre-feet of change have been estimated below elevation 2,946.0, resulting in a 10.6 percent loss in reservoir volume. This study assumed the calculated change is due to accuracy difference between the two surveys, the lack of updated above water topography, shoreline erosion, and sediment inflow.

14. SUBJECT TERMS	15. NUMBER OF PAGES
reservoir area and capacity/ sedimentation/ reservoir surveys/ sonar/ sediment distribution/ contour area/ reservoir area/ sedimentation survey/ global positioning system/ lake	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UL	UL	UL	UL

Merritt Reservoir

2003 Survey

by

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September 2004

ACKNOWLEDGMENTS

The Bureau of Reclamation's (Reclamation) Sedimentation and River Hydraulics Group of the Technical Service Center (TSC) prepared and published this report. Ronald Ferrari and Shraon Nuanes of the TSC conducted the hydrographic survey. Ron Ferrari of the TSC completed the data processing needed to generate the new topographic map and area-capacity tables. Kent Collins of the TSC performed the technical peer review of this documentation.

UNITED STATES DEPARTMENT OF THE INTERIOR

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The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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INTRODUCTION

Merritt Dam and Reservoir are located in north central Nebraska in Cherry County. The dam, formed on the Snake River, is located about 8 miles southwest of Burge and 23 miles southwest of Valentine, Nebraska (fig. 1). The reservoir is located at the confluence of Boardman Creek and Snake River. The dam, reservoir, and facilities are part of the Ainsworth Unit of the Missouri River Basin Project.

Merritt Dam was constructed from August 1961 thru May 1964 with initial storage beginning on February 19 of 1964. The dam is a zoned earthfill structure whose dimensions are:

Hydraulic height[1]	115	feet	Structural height	126	feet
Top width	30	feet	Crest length	3,222	feet
Crest elevation	2,956.0	feet[2]			

The spillway is an ungated morning-glory structure that consists of a concrete intake structure, concrete conduit, concrete stilling basin, and outlet channel. The spillway crest elevation is 2,946.0 and provides a discharge of 2,080 cubic feet per second (cfs) at maximum reservoir elevation 2,949.8. A river outlet works consists of a concrete intake structure, concrete conduit, gate chamber, access shaft and house, 54-inch diameter steel pipe, control house and stilling basin with a discharge capacity of 730 cfs. The canal outlet works consist of a 78-inch diameter steel pipe and concrete control house. The discharge capacity is 580 cfs and discharges into the Ainsworth Canal.

The drainage area above Merritt Dam is around 660 square miles and all is considered sediment contributing. The basin has very little elevation relief, from approximately 3,800 feet at the headwaters to the normal water surface elevation of 2,946 feet. The drainage area is comprised primarily of sand dunes covered with grasses with some reports stating that due to the large sand dunes, less than ten percent of the drainage area contributes to the actual runoff. The reservoir is around 15.8 miles in length and around 0.3 miles in width.

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[1]The definition of such terms as "hydraulic height," "structural height," etc. may be found in manuals such as Reclamation's *Design of Small Dams* and *Guide for Preparation of Standing Operating Procedures for Dams and Reservoirs*, or ASCE's *Nomenclature for Hydraulics*.

[2]Elevation levels are shown in feet. All elevations shown in this report are based on the original project datum established by U.S. Bureau of Reclamation that was reportedly tied to the National Geodetic Vertical Datum of 1929 (NGVD29). The 2003 survey confirm that Reclamation's datum was tied to NGVD29 and around 1.0 feet less than the North American Vertical Datum of 1988 (NAVD88).

SUMMARY AND CONCLUSIONS

This Reclamation report presents the 2003 results of the survey of Merritt Reservoir. The primary objectives of the survey were to gather data needed to:

- develop reservoir topography
- compute area-capacity relationships
- estimate storage depletion due to sediment deposition

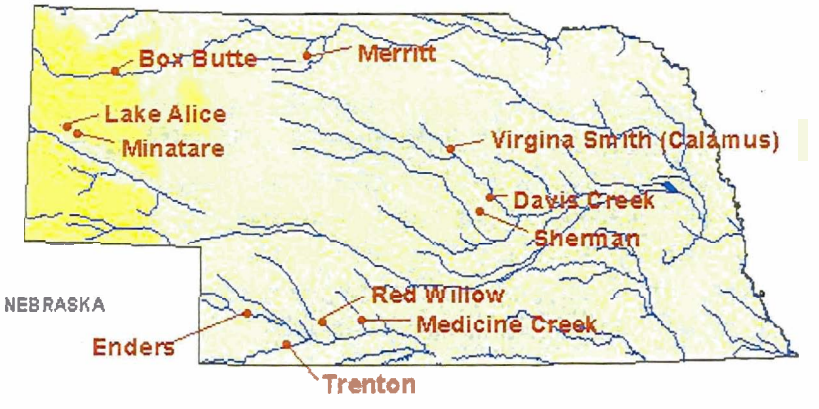

Figure 1 - Merritt Reservoir location map.

A Real-time Kinematic (RTK) GPS control survey established a temporary horizontal and vertical control point near the reservoir for the hydrographic survey. The RTK GPS control base was set on the National Geoldetic Survey (NGS) datum point "Y 431" located several miles from the lake. The horizontal control was established in Nebraska state plane coordinates, north zone, in the North American Datum of 1983 (NAD83) and the vertical control was tied to the North American Vertical Datum of 1988 (NAVD88) and the Reclamation project datum. All elevations in this report are referenced to the Reclamation project or construction datum that, for this study, was tied to the NGVD29 and around 1.0 feet less than the NAVD88.

The underwater survey was conducted in June of 2003 near reservoir water surface elevation 2,945.6. The bathymetric survey was run using sonic depth recording equipment interfaced with a differential global positioning system (DGPS) capable of determining sounding locations within the reservoir. The system continuously recorded depth and horizontal coordinates of the survey boat as it was navigated along grid lines covering Merritt Reservoir. The positioning system provided information to allow the boat operator to maintain a course along these grid lines. Water surface elevations recorded by the reservoir gauge (tied to the Reclamation vertical datum) during the time of collection were used to convert the sonic depth measurements to true

reservoir bottom elevations. The above-water topography was determined by digitizing previously developed contour lines from the U.S. Geological Survey quadrangle (USGS quad) maps of the reservoir area.

The 2003 Merritt Reservoir topographic map is a combination of the USGS quad contours and the underwater survey data. A computer graphics program using the collected reservoir data generated the 2003 reservoir surface areas at predetermined contour intervals. The 2003 area and capacity tables were produced by a computer program that uses measured contour surface areas and a curve-fitting technique to compute area and capacity at prescribed elevation increments (Bureau of Reclamation, 1985).

Tables 1 and 2 contain summaries of the Merritt Reservoir and watershed characteristics for the 2003 survey. The 2003 survey determined that the reservoir has a total storage capacity of 66,726 acre-feet and a surface area of 2,909 acres at active conservation elevation 2,946.0. Since closure in February of 1964, the reservoir has an estimated volume change of 7,886 acre-feet below reservoir elevation 2,945.0. This volume represents a 10.6 percent loss in total original capacity at this elevation.

RESERVOIR OPERATIONS

Merritt Reservoir is part of the Ainsworth Unit of the Pick-Sloan Missouri Basin Program that supplies water for irrigating 34,540 acres of land in the Ainsworth Irrigation District. The June 2003 capacity table shows 78,375 acre-feet of total storage below the maximum water surface elevation 2,949.8. The 2003 survey measured a minimum lake bottom elevation of 2,848.2. The following values are from the June 2003 capacity table:

- 11,649 acre-feet of surcharge between elevation 2,946.0 and 2,949.8.
- 62,064 acre-feet of conservation use between elevation 2,896.0 and 2,946.0.
- 3,888 acre-foot of inactive storage between elevation 2,875.0 and 2,896.0.
- 774 acre-foot of dead storage below 2,875.0.

Merritt Reservoir readily available inflow and end-of-month stage records in table 1, operation period 1968 through 2003, show the calculated inflow and annual fluctuation for these years of operation. The computed average inflow into the reservoir for these years of record was 183,100 acre-feet per year. The maximum reservoir elevation was 2,946.8 recorded in May of 1982 with a minimum elevation of 2,916.4 recorded in September of 1968.

HYDROGRAPHIC SURVEY EQUIPMENT AND METHOD

The hydrographic survey equipment was mounted in the cabin of a 24-foot trihull aluminum vessel equipped with twin in-board motors (figure 2). The hydrographic system included a GPS receiver with a built-in radio, a depth sounder, a helmsman display for navigation, a computer, and hydrographic system software for collecting the underwater data. An on-board generator

supplied power to all the equipment. The shore equipment included a second GPS receiver with an external radio. The GPS receiver and antenna were mounted on a survey tripod over a known datum point and a 12-volt battery provided the power for the shore unit.

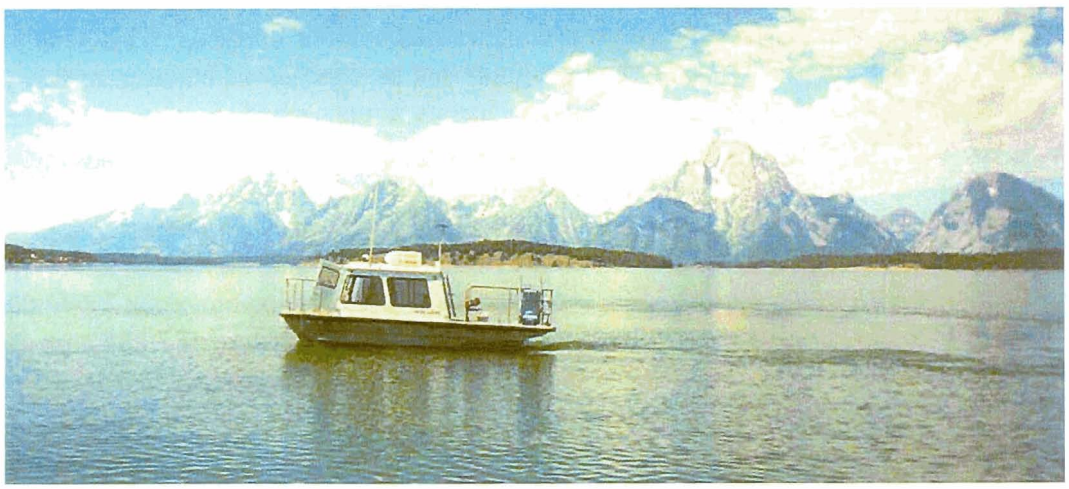

Figure 2 - Survey vessel with mounted hydrographic equipment on Jackson Lake in Wyoming

The Sedimentation and River Hydraulics Group uses RTK GPS with the major benefit being precise heights measured in real time to monitor water surface elevation changes. The basic outputs from an RTK receiver are precise 3D coordinates in latitude, longitude, and height with accuracies on the order of 2 centimeters horizontally and 3 centimeters vertically. The output is on the GPS datum of WGS-84, which the hydrographic collection software converted into Nebraska's NAD83 state plane north zone coordinate system. The RTK GPS system employs two receivers that track the same satellites simultaneously just like with differential GPS.

Merritt Reservoir's hydrographic survey was conducted on June 4 through 7 of 2003 near water surface elevation 2,945.6 (Reclamation project datum). The bathymetric survey was run using sonic depth recording equipment, interfaced with an RTK GPS, capable of determining sounding locations within the reservoir. The survey system software continuously recorded reservoir depths and horizontal coordinates as the survey boat moved across closely spaced grid lines covering the reservoir area. Most of the transects (grid lines) were run somewhat perpendicular to the downstream alignment of the reservoir at around 300-foot spacing. Data was also collected along the shore as the boat traversed between transects. The survey vessel's guidance system gave directions to the boat operator to assist in maintaining the course along these predetermined lines. During each run, the depth and position data were recorded on the notebook computer hard drive for subsequent processing. The underwater data set includes about 935,000 data points.

The 2003 underwater data were collected by a depth sounder that was calibrated by lowering a weighted cable below the boat with beads marking known depths. The depth sounder was

calibrated by adjusting the speed of sound, which can vary with density, salinity, temperature, turbidity, and other conditions. The collected data were digitally transmitted to the computer collection system via a RS-232 port. The depth sounder also produces an analog hard-copy chart of the measured depths. These graphed analog charts were printed for all survey lines as the data were collected and recorded by the computer. The charts were analyzed during post-processing, and when the analog charted depths indicated a difference from the recorded computer bottom depths, the computer data files were modified. The water surface elevations at the dam, recorded by a Reclamation gauge, were used to convert the sonic depth measurements to true lake-bottom elevations.

Merritt Reservoir Datum

Prior to the underwater survey, a RTK GPS survey was conducted from the NGS control point "Y 431" to tie horizontal and vertical control to a temporary point and the reservoir water surface. All vertical information for this study is referenced to the Reclamation reservoir water surface gauge measurements that were found to be tied to NGVD29. The RTK GPS water surface measurement found the NGS vertical of NAVD88 to be around 1.0 feet higher then the Reclamation gauge readings. The reported vertical shifts were from this one time RTK GPS survey.

RESERVOIR AREA AND CAPACITY

Topography Development

The topography of Merritt Reservoir was developed from the 2003 collected underwater and the digitized contours from the USGS quad maps. The digitized USGS contour lines were the Merritt Reservoir water surface labeled elevation 2,946 and the elevation 2940 contour. These USGS quad maps were developed from aerial photography dated 1980. This study found the enclosed digitized surface area of the labeled 2946 contour, with the islands surfaces removed, to correspond to the original surface area at elevation 2,943.8. The enclosed digitized surface area of the labeled 2940 contour corresponds to the original surface area at elevation 2935. ARC/INFO V7.0.2 geographic information system software was used to digitize the USGS quad contours. The digitized contours were transformed to Nebraska's NAD 1983 state plane coordinates, north zone, using the ARC/INFO PROJECT command.

The digitized 2946 contour line was used to perform a clip of Merritt Reservoir triangular irregular network (TIN) such that interpolation was not allowed to occur outside the enclosed polygon. This contour was selected since it was the closest available data to represent the reservoir water surface at the time the survey was conducted, which was near reservoir elevation 2,945.6. This clip was performed using the hardclip option of the ARC/INFO CREATETIN command. Using ARCEDIT, the underwater collected data and digitized contours from the quad maps were plotted. The plot showed that the underwater data did not lie completely within this clip, which required modifications to include the entire underwater data set. Modified areas included the shoreline around the islands and some of the shoreline of the reservoir. It is assumed these changes were due to erosion along these shorelines. Using select and move

commands within ARCEDIT, the vertices of the clip were shifted to fit all the collected underwater data. The clip was assigned an elevation of 2,943.8 to reflect the original area of the developed polygons.

Contours for the reservoir below elevation 2,943.8 were computed from the underwater data set using the triangular irregular network (TIN) surface-modeling package within ARC/INFO. A TIN is a set of adjacent non-overlapping triangles computed from irregularly spaced points with x,y coordinates and z values. TIN was designed to deal with continuous data such as elevations. The TIN software uses a method known as Delaunay's criteria for triangulation where triangles are formed among all data points within the polygon clip. The method requires that a circle drawn through the three nodes of a triangle will contain no other point, meaning that sample points are connected to their nearest neighbors to form triangles using all collected data. This method preserves all collected survey points. Elevation contours are then interpolated along the triangle elements. The TIN method is discussed in greater detail in the ARC/INFO V7.0.2 *Users Documentation,* (ESRI, 1992).

The linear interpolation option of the ARC/INFO TINCONTOUR command was used to interpolate contours from the Merritt Reservoir TIN. In addition, the contours were generalized by filtering out vertices along the contours. This generalization process improved the presentability of the resulting contours by removing very small variations in the contour lines. This generalization had no bearing on the computation of surface areas and volumes for Merritt Reservoir since the areas were calculated from the developed TIN. The areas of the enclosed contour polygons at one-foot increments were developed from the survey data for elevations 2,849.0 through elevation 2,940.0. The 2003 study assumed no change in area, since the original survey, for elevation 2,945.0 and above. The contour topography at 2-foot intervals is presented on figure 3 through 5.

Development of 2003 Contour Areas

The 2003 contour surface areas for Merritt Reservoir were computed at 1-foot increments from elevation 2,849.0 to 2,940.0. The 2003 underwater survey measured a minimum reservoir bottom elevation of 2,848.2. These calculations were performed using the ARC/INFO VOLUME command. This command computes areas at user-specified elevations directly from the TIN and takes into consideration all regions of equal elevation. As indicated above, the 2003 underwater survey data was collected near reservoir elevation 2,946.5. For the purpose of this study, the measured 2003 survey areas at 2-foot increments from elevation 2,850.0 through 2,940.0 were used to compute the new area and capacity tables. This study assumed no change in original area from elevation 2,945.0 and above. The area and capacity program computed the areas between elevation 2,940.0 and 2,945.0 by assuming a straight-line interpolation.

2003 Storage Capacity

The storage-elevation relationships based on the measured surface areas were developed using the area-capacity computer program ACAP85 (Bureau of Reclamation, 1985). The 2003

surveyed surface areas at 2-foot contour intervals from reservoir elevation 2,850.0 to elevation 2,940.0 were used as the control parameters for computing the 2003 Merritt Reservoir capacity. Since this study did not collect above water data, the original surface areas for elevation 2,945.0 and 2,950.0 were used to complete the area and capacity table. The program can compute an area and capacity at elevation increments 0.01- to 1.0-foot by linear interpolation between the given contour surface areas. The program begins by testing the initial capacity equation over successive intervals to ensure that the equation fits within an allowable error limit. The error limit was set at 0.000001 for Merritt Reservoir. The capacity equation is then used over the full range of intervals fitting within this allowable error limit. For the first interval at which the initial allowable error limit is exceeded, a new capacity equation (integrated from basic area curve over that interval) is utilized until it exceeds the error limit. Thus, the capacity curve is defined by a series of curves, each fitting a certain region of data. Differentiating the capacity equations, which are of second order polynomial form, derives final area equations:

$$y = a_1 + a_2x + a_3x^2$$

where:

y = capacity
x = elevation above a reference base
a_1 = intercept
a_2 and a_3 = coefficients

Results of the Merritt Reservoir area and capacity computations are listed in table 1 and columns 4 and 5 of table 2. On table 2, columns 2 and 3 list the original surface areas and recomputed original capacities. A separate set of 2003 area and capacity tables has been published for the 0.01, 0.1 and 1-foot elevation increments (Bureau of Reclamation 2003). A description of the computations and coefficients output from the ACAP85 program is included with these tables. Both the original and 2003 area-capacity curves are plotted on figure 6. As of June 2003, at elevation 2,946.0, the surface area was 2,909 acres with a total capacity of 66,726 acre-feet.

RESERVOIR SEDIMENT ANALYSES

Figure 6 is a plot of Merritt Reservoir original surface area and capacity versus the 2003 measured surface area and capacity that illustrates the differences between the two surveys. Since Merritt Dam closure in February of 1964, the measured total volume change at reservoir elevation 2,945.0 was estimated to be 7,886 acre-feet. The estimated average annual rate of capacity lost for this period (39.3 years) was 200.7 acre-feet per year. The storage loss in terms of percent of original storage capacity was 10.6 percent at spillway crest elevation 2,946.0. It must be noted that the 2003 area and capacity tables were generated assuming no change in original area and capacity from elevation 2,945.0 and above which in all probability is not the case.

The original estimated 100 years of sediment accumulation for Merritt Reservoir was 12,000 acre-feet below elevation 2946.0. The 2003 study estimated an annual inflow of sediment of 200.7 acre-feet per year for a total sediment accumulation of 20,000 acre-feet in the first 100

years of operation. From table 1 and 2, the 2003 study shows that of the total computed sediment 27.3 percent, or 2,156 acre-feet, has accumulated below dead storage elevation 2,896.0 with the rest accumulating in the active storage areas between elevation 2896.0 and 2946.0. In the active zone, 35.6 percent or 2,804 acre-feet between elevation 2,896.0 and 2930.0 and 37.1 percent or 2,926 acre-feet between elevation 2930.0 and 2946.0. From table 1, range in reservoir operation, it appears that for most years of operation the minimum reservoir elevation is near or above elevation 2,930 causing the majority of the sediment inflow to settle and accumulate in the upper portion of the reservoir on the Snake River arm.

For this study the computed storage loss or sediment accumulation since Merritt Dam closure was determined by comparing the newly computed reservoir capacity with the original reported capacities. On a Reclamation area - capacity curve for Merritt Reservoir, drawing 719-705-3, it states that the original topography was developed on 5-foot contour intervals from aerial photography and the original topography data was corrected for the dam location. This is noted since the 2003 sediment accumulation results assume reliable original data. An above water survey should be conducted if better information is needed for elevation 2,940.0 and above. A resurvey of Merritt Reservoir should be considered in the future if major sediment inflow events are observed.

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RESERVOIR SEDIMENT
DATA SUMMARY

Merritt Reservoir

NAME OF RESERVOIR

1
DATA SHEET NO.

DAM

1. OWNER Bureau of Reclamation	2. STREAM Snake River	3. STATE Nebraska
4. SEC. 29 TWP. 31 N RANGE 30 W	5. NEAREST P.O. Burge	6. COUNTY Cherry
7. LAT 42° 38' 06" LONG 100° 52' 18"	8. TOP OF DAM ELEVATION 2,956.0[1]	9. SPILLWAY CREST EL 2,946.0[2]

RESERVOIR

10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. 2002 SURFACE AREA, AC	13. 2002 CAPACITY, AF	14. GROSS STORAGE ACRE-FEET	15. DATE STORAGE BEGAN
a. SURCHARGE	2,949.8[3]	3,222	11,650	86,140	
b. FLOOD CONTROL					
c. POWER					2/19/64
d. JOINT USE					
e. CONSERVATION	2,946.0	2,906	67,690	74,490	16. DATE NORMAL OPERATION BEGAN
f. INACTIVE	2,896.0	415	5,190	6,800	
g. DEAD	2,875.0	119	1,610	1,610	2/19/64

17. LENGTH OF RESERVOIR 15.8[4] MILES — AVG. WIDTH OF RESERVOIR 0.3 MILES

BASIN

18. TOTAL DRAINAGE AREA 660[5] SQUARE MILES	22. MEAN ANNUAL PRECIPITATION 21[6] INCHES
19. NET SEDIMENT CONTRIBUTING AREA 660[5] SQUARE MILES	23. MEAN ANNUAL RUNOFF 5.2[7] INCHES
20. LENGTH MILES — AV. WIDTH	24. MEAN ANNUAL RUNOFF 183,100[8] ACRE-FEET
21. MAX. ELEVATION — MIN. ELEVATION	25. ANNUAL TEMP. MEAN 49°F RANGE -33°F to 112°F[6]

SURVEY DATA

26. DATE OF SURVEY	27. PER.	28. ACCL	29. TYPE OF SURVEY	30. NO. OF RANGES OR	31. SURFACE AREA, AC.	32. CAPACITY ACRE-FEET	33. C/I RATIO
2/64			Contour (D)	5-ft	2,909[9]	74,612[9]	.41
6/03	39.3		Contour (D)	2-ft	2,909[9]	66,726[9]	.36

26. DATE OF SURVEY	34. PERIOD ANNUAL PRECIP.	35. PERIOD WATER INFLOW, ACRE FEET			WATER INFLOW TO DATE, AF	
		a. MEAN ANN.	b. MAX. ANN.	c. TOTAL	a. MEAN ANN.	b. TOTAL
6/03	21	183,100[10]	201,600	6,591,000	183,100	6,591,000

26. DATE OF SURVEY	37. PERIOD CAPACITY LOSS, ACRE-FEET			38. TOTAL SEDIMENT DEPOSITS TO DATE, AF		
	a. TOTAL	b. AV. ANN.	c. /MI.²-YR.	a. TOTAL	b. AV. ANNUAL	c. /MI.²-YR.
6/03	7,886[11]	200.7	0.3	7,886	200.7	0.3

26. DATE OF SURVEY	39. AV. DRY WT. (#/FT³)	40. SED. DEP. TONS/MI.²-YR.		41. STORAGE LOSS, PCT.		42.	
		a. PERIOD	b. TOTAL TO	a. AV.	b. TOTAL TO	a.	b.
6/03				.27[11]	10.6[11]		

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE BY RESERVOIR ELEVATION										
	2845-2870	2870-2890	2890-2896	2896-2910	2910-2920	2920-2930	2930-2940	2940-2946 crest			
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION										
6/03	8.1	14.1	5.1	11.6	8.2	15.9	27.5	9.5			

26. DATE OF SURVEY	44. REACH DESIGNATION PERCENT OF TOTAL ORIGINAL LENGTH OF RESERVOIR														
	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-105	105-110	110-115	115-120	120-125
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN REACH DESIGNATION														

Table 1. - Reservoir sediment data summary (page 1 of 2).

45. RANGE IN RESERVOIR OPERATION[10]

YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF	YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF
1968	2,946.1	2,916.4	160,200	1969	2,945.9	2,925.0	163,200
1970	2,945.9	2,930.8	173,000	1971	2,946.2	2,932.1	174,500
1972	2,946.2	2,941.2	176,800	1973	2,946.3	2,931.6	174,700
1974	2,946.0	2,930.3	171,100	1975	2,946.2	2,926.4	171,400
1976	2,946.8	2,927.4	162,700	1977	2,946.2	2,937.3	169,200
1978	2,946.2	2,936.9	167,700	1979	2,946.0	2,937.1	164,500
1980	2,946.2	2,928.5	184,100	1981	2,946.7	2,937.7	174,800
1982	2,946.8	2,934.8	187,000	1983	2,946.5	2,939.0	195,300
1984	2,945.8	2,936.4	200,800	1985	2,946.7	2,935.9	192,200
1986	2,944.8	2,932.6	200,000	1987	2,944.0	2,929.9	197,000
1988	2,945.8	2,933.6	195,800	1989	2,946.1	2,930.1	186,900
1990	2,946.2	2,936.2	184,100	1991	2,946.2	2,932.1	182,500
1992	2,946.2	2,932.1	191,900	1993	2,946.0	2,939.5	188,900
1994	2,946.0	2,943.2	176,900	1995	2,946.7	2,931.7	191,300
1996	2,946.4	2,929.8	195,700	1997	2,946.5	2,937.2	201,600
1998	2,946.5	2,934.1	195,200	1999	2,945.9	2,927.6	196,600
2000	2,946.6	2,924.8	185,600	2001	2,946.2	2,928.0	196,800
2002	2,946.2	2,923.6	180,600	2003	2,946.1	2,938.3	180,500

46. ELEVATION - AREA - CAPACITY DATA FOR **2003 CAPACITY**[12]

ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY	ELEVATION	AREA	CAPACITY
2,848.2	0	0	2,850	0	0	2,852	1	1
2,854	1	3	2,856	6	10	2,858	11	27
2,860	20	59	2,862	27	106	2,864	34	168
2,866	41	242	2,868	48	331	2,870	57	436
2,872	65	558	2,874	74	698	2,876	83	856
2,878	93	1,032	2,880	106	1,231	2,882	129	1,466
2,884	153	1,748	2,886	180	2,081	2,888	212	2,474
2,890	240	2,926	2,892	270	3,435	2,894	307	4,012
2,896	343	4,662	2,898	381	5,386	2,900	426	6,194
2,902	472	7,092	2,904	519	8,083	2,906	577	9,178
2,908	635	10,390	2,910	695	11,720	2,912	771	13,186
2,914	846	14,803	2,916	923	16,572	2,918	988	18,484
2,920	1,053	20,525	2,922	1,126	22,704	2,924	1,204	25,033
2,926	1,295	27,533	2,928	1,397	30,225	2,930	1,503	33,125
2,932	1,626	36,254	2,934	1,765	39,646	2,936	1,896	43,307
2,938	2,025	47,228	2,940	2,155	51,407	2,945	2,826	63,859
2,946	2,909	66,726	2,949.8	3,222	78,375			

47. REMARKS AND REFERENCES

1 All elevations in feet and based on original project datum that were tied to NGVD29.
2 Uncontrolled morning-glory overflow spillway.
3 Original values computed from 5-foot contours developed from aerial photography.
4 Total of main stream, Snake River, and two smaller arms that make up the reservoir at elevation 2946.
5 From USGS water year records, 1981. Report states runoff affected by large presence of sand dunes with only forty four square miles contributing to water runoff.
6 Bureau of Reclamation Project Data Book, 1981. Values for Ainsworth Unit.
7 Calculated using mean annual runoff value of 183,100 AF, item 24, 1968 through 2003. (See remark #6).
8 Annual computed inflows by water year from readily available records from 1968 through 2003.
9 Surface area & capacity at elevation 2,946.0, top of active conservation, by indicated year. The original capacity was recomputed and the 2003 values computed by BOR program ACAP.
10 Maximum and minimum elevations and annual computed inflows by water year from 1968 through 2003 (BOR available records).
11 All sediment computations are computed by comparing the 2003 results with the original results at spillway crest elevation 2,946.0. This assumed the original data is of a reliable accuracy. The 2003 survey assumed no change since the original survey from elevation 2,945 and above. Computed storage loss is due accuracy differences between original and 2003 surveys and due to accumulation of sediment.
12 Capacities computed by Reclamation's ACAP computer program.

48. AGENCY MAKING SURVEY Bureau of Reclamation
49. AGENCY SUPPLYING DATA Bureau of Reclamation | DATE September 2004

Table 1. - Reservoir sediment data summary (page 2 of 2).

1	2	3	4	5	6	7	8
Elevations (feet)	Original Survey (acres)	Original Capacity (acre-feet)	2003 Survey (acres)	2003 Survey (acre-feet)	2003 Sediment Volume (acre-feet)	2003 Percent of Sediment	Percent of Reservoir Depth
2,949.8	3222	86261	3222	78375			100.0
2,946.0	2909	74612	2909	66726	7886	100.0	96.4
2,945.0	2826	71745	2826	63859	7886	100.0	95.4
2,940.0	2454	58545	2155	51407	7138	90.5	90.6
2,938.0	2284	53807	2025	47228	6579	83.4	88.7
2,935.0	2030	47335	1831	41444	5891	74.7	85.9
2,930.0	1670	38085	1503	33125	4960	62.9	81.1
2,925.0	1370	30485	1250	26260	4225	53.6	76.3
2,920.0	1132	24230	1053	20525	3705	47.0	71.6
2,915.0	944	19040	884	15669	3371	42.7	66.8
2,910.0	756	14790	695	11720	3070	38.9	62.0
2,905.0	603	11393	548	8616	2777	35.2	57.3
2,900.0	497	8643	426	6194	2449	31.1	52.5
2,896.0	415	6818	343	4662	2156	27.3	48.7
2,895.0	395	6413	325	4328	2085	26.4	47.7
2,890.0	301	4673	240	2926	1747	22.2	42.9
2,885.0	232	3340	167	1908	1432	18.2	38.2
2,880.0	170	2335	106	1231	1104	14.0	33.4
2,875.0	119	1613	79	774	839	10.6	28.6
2,870.0	95	1078	57	436	642	8.1	23.9
2,865.0	73	658	37	203	455	5.8	19.1
2,860.0	52	345	20	59	286	3.6	14.3
2,855.0	29	143	4	5	138	1.7	9.5
2,850.0	14	35	0	0	35	0.4	4.8
2,848.2	9	14	0	0	14	0.2	3.1
2,845.0	0	0	0	0	0	0.0	0.0

1	Elevation of reservoir water surface.
2	Original reservoir surface area.
3	Original reservoir capacity recomputed using ACAP.
4	Reservoir surface area from 2003 survey.
5	Reservoir capacity computed using ACAP.
6	Measured sediment volume = column (3) - column (5).
7	Measured sediment expressed in percentage of total sediment 7,886.
8	Depth of reservoir expressed in percentage of total depth of 104.8 feet.

Table 2. - Summary of 2003 survey results

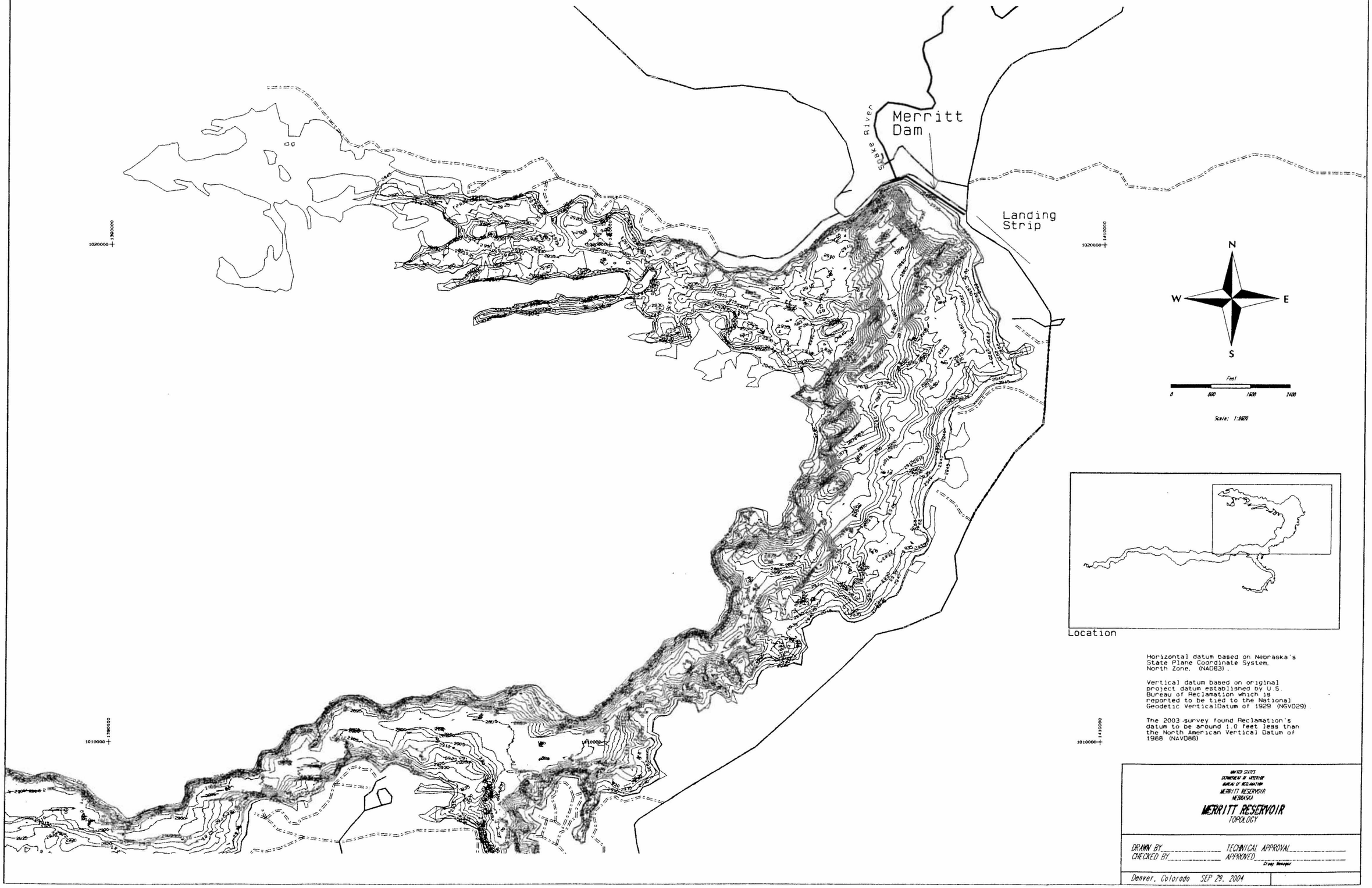

Figure 3 – Merritt Reservoir topographic map

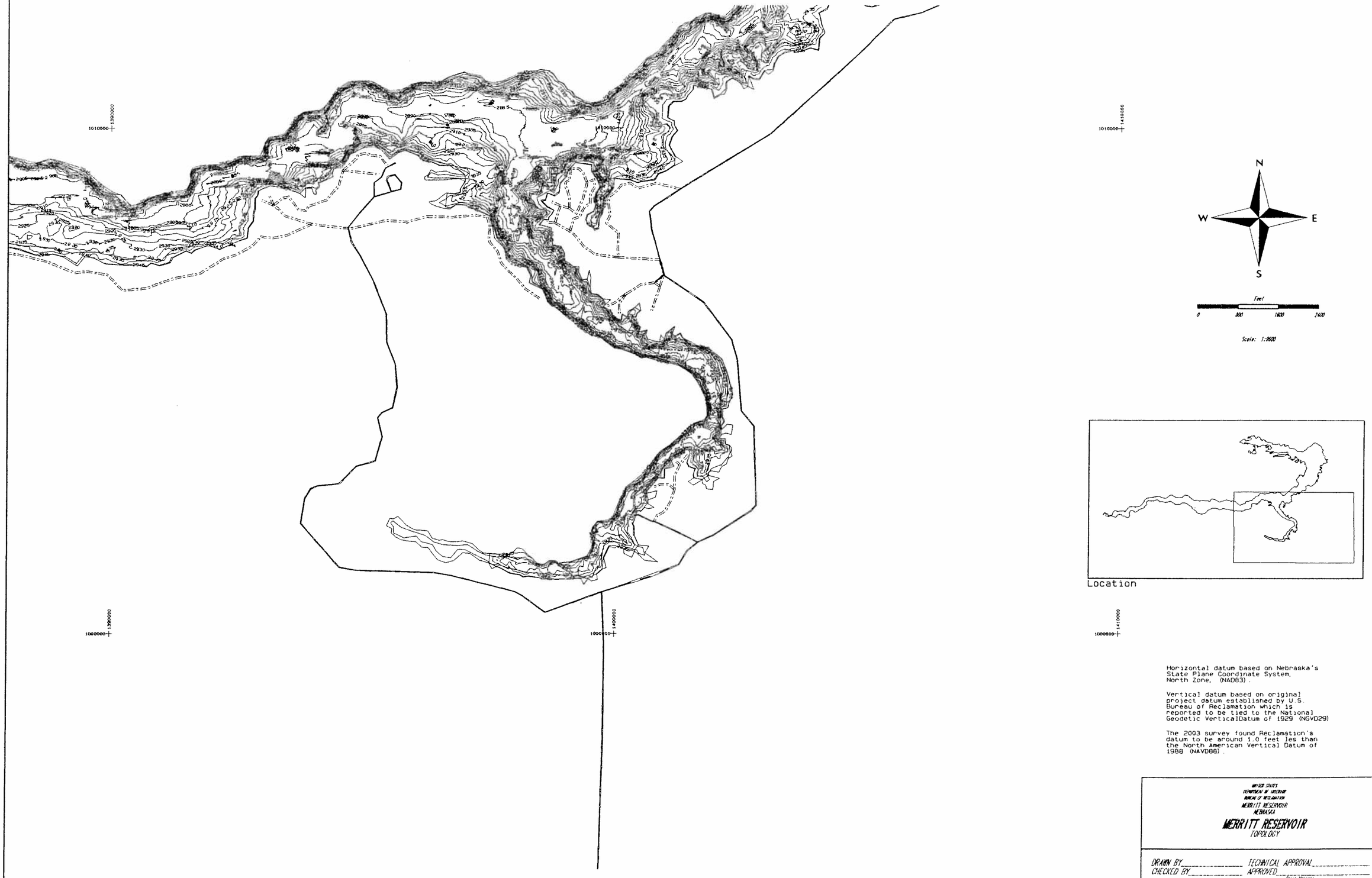

Figure 4. – Merritt Reservoir topographic map.

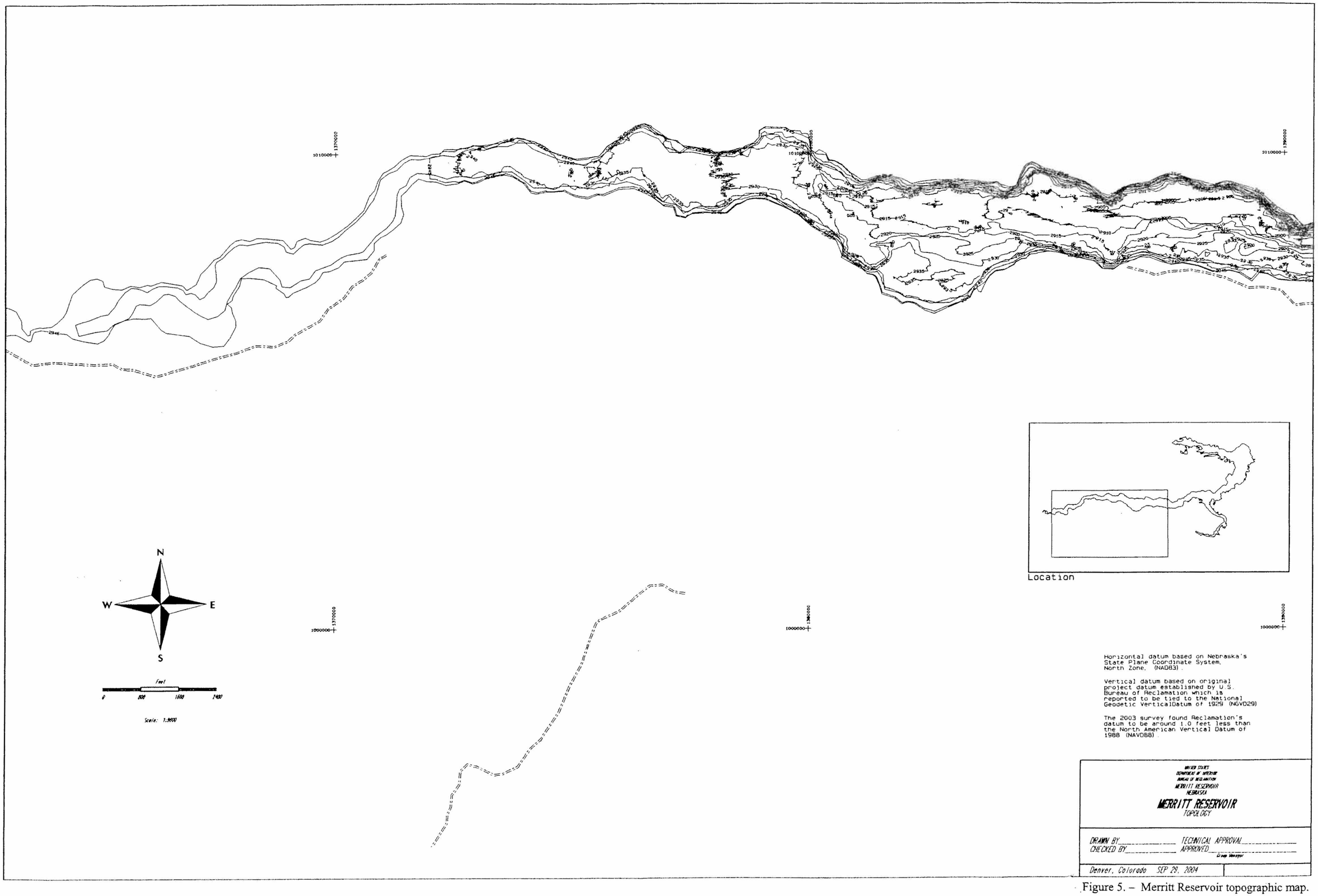

Figure 5. – Merritt Reservoir topographic map.

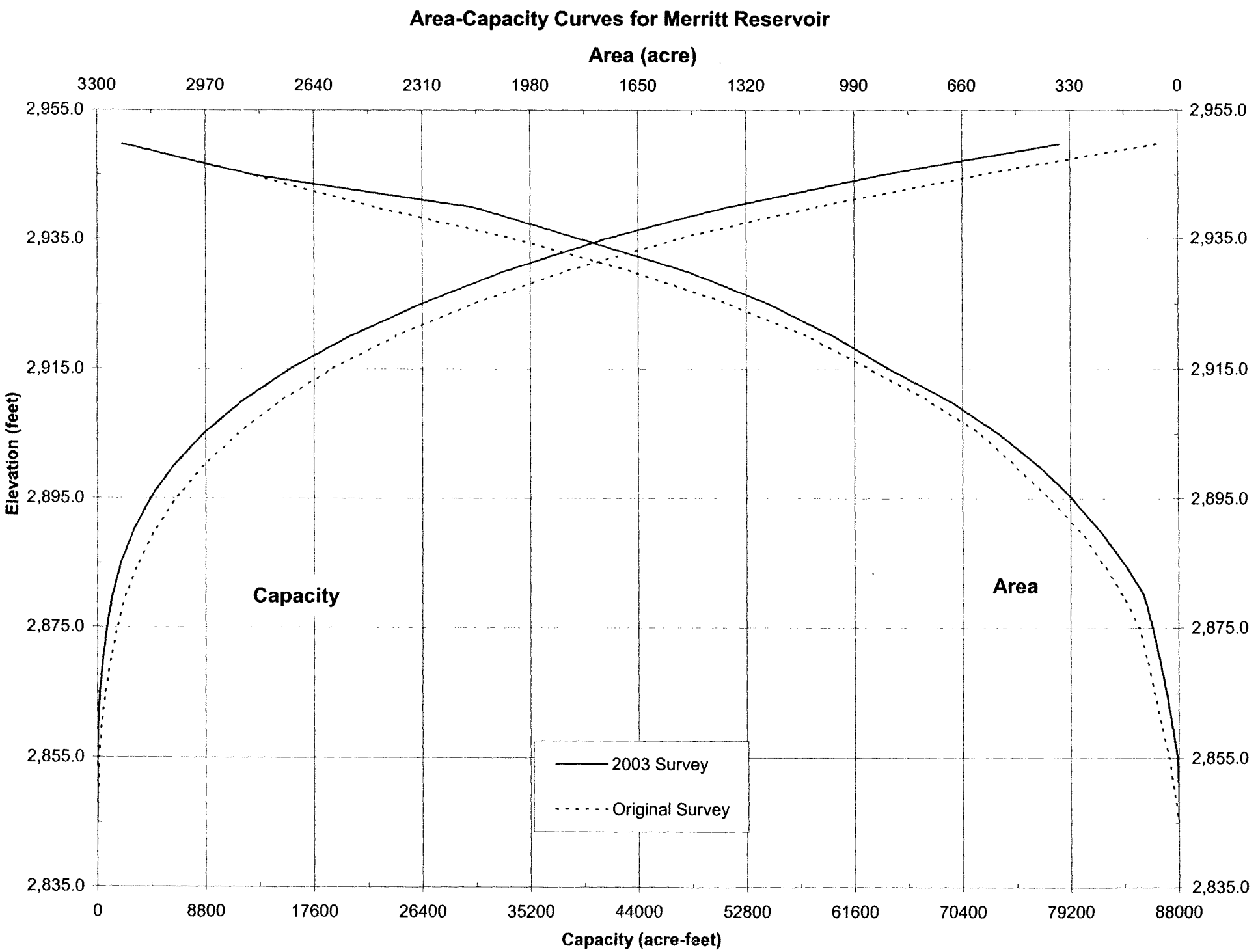

Figure 6. - 2003 area and capacity curves.