BUFFALO BILL RESERVOIR

1986 Sedimentation Survey

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16. ABSTRACT

Buffalo Bill Reservoir was surveyed in 1986 to acquire the field data necessary for developing a reservoir topographic map and computing revised reservoir capacity. The data were also used to determine the volume of sediment that has accumulated in the reservoir since the dam was closed in 1910. Sonic depth recording and automated positioning equipment were used to acquire continuous depth and sounding positions throughout the reservoir. Reservoir capacity was determined using contour surface areas computed by the SURFACE II Graphics System and by contour digitizing.

The reservoir in 1986 had a capacity of 398,687 acre-feet and a surface area of 6746 acres at elevation 5360. Since 1910, 58,153 acre-feet of sediment has accumulated below elevation 5360. which represents a 12.7 percent loss in storage capacity.

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BUFFALO BILL RESERVOIR

1986 SEDIMENTATION SURVEY

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April, 1991

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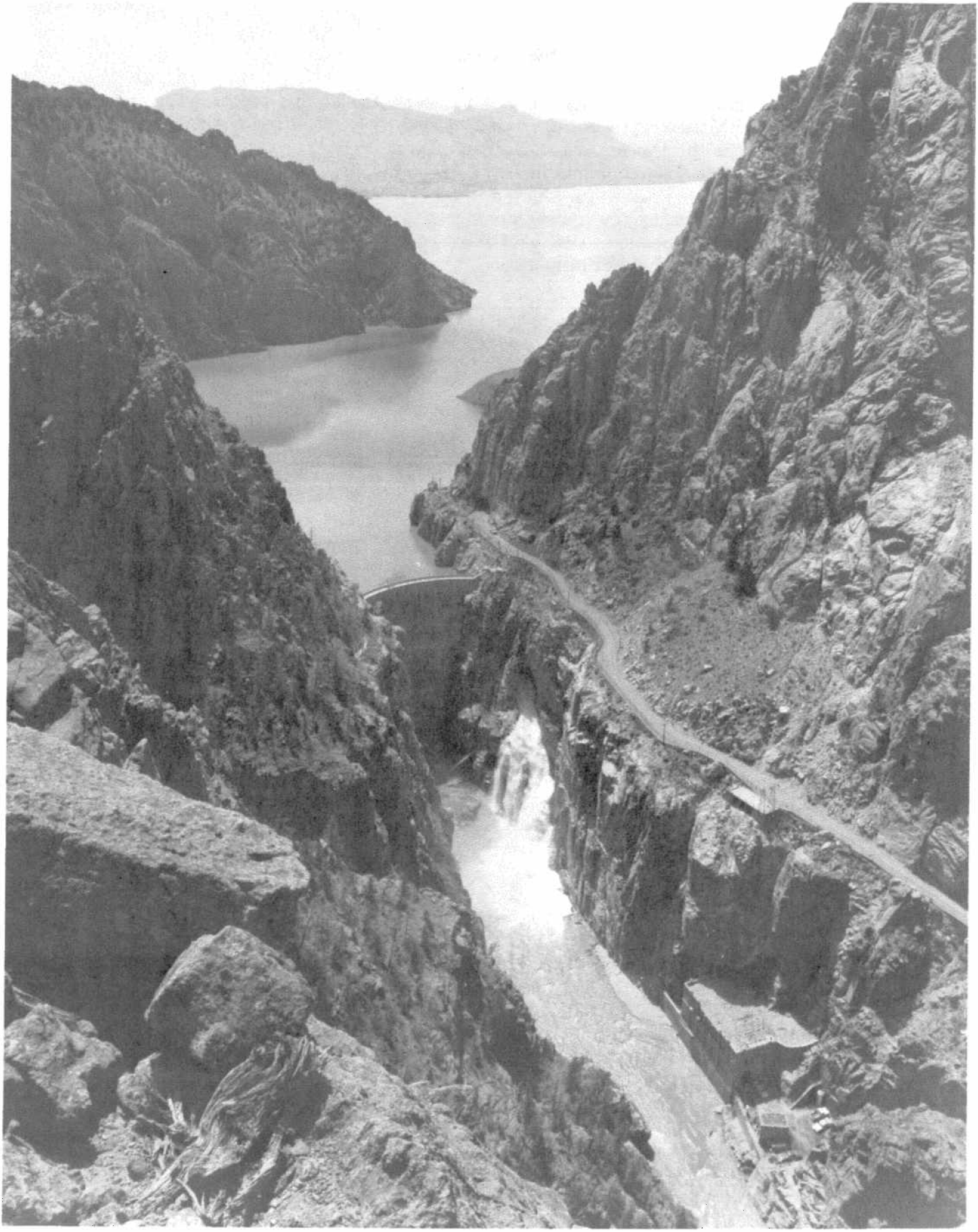

Frontispiece – Buffalo Bill Reservoir

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INTRODUCTION

Buffalo Bill Dam and Reservoir are the major storage features of the Shoshone Project near Cody in northwestern Wyoming. The dam is located on the Shoshone River approximately one mile below the confluence of the North Fork and South Fork in Section 12, R 102 W, T 52 N, in Park County, Wyoming (figure 1). By road, the dam is about 7 miles southwest from Cody, Wyoming, on U.S. Highway 16 leading into Yellowstone National Park. Prior to 1945 the dam was known as Shoshone Dam.

Construction of Shoshone Project was authorized by the Secretary of Interior on February 10, 1904. Construction of Buffalo Bill Dam began in May of that year and was completed by June 1908. Closure of the diversion outlets was made on May 10, 1910, which marked the beginning of reservoir filling.

Buffalo Bill Dam (figure 2), in June, 1986 at the time of the resurvey was a rubble concrete, arch structure with a structural height of 328 feet, base width of 108 feet, and a crest length of 200 feet. The dam impounded a reservoir of 398,700 acre-feet at elevation 5360.0 (all elevations in this report are in feet Shoshone Project Datum). The spillway, located upstream on the left abutment, consisted of an uncontrolled concrete weir 300 feet in length discharging into a concrete side channel connected to the river by a 20- by 20-foot unlined tunnel. The newest outlet works completed in 1959, consisted of a 20- by 17-foot horseshoe tunnel through the left abutment to an interior trashrack and bulkhead gate housing, and then into a 7.5-foot concrete-lined tunnel terminating at a gatehouse immediately downstream from the dam at the left abutment.

The Shoshone Powerplant, located about 300 feet downstream from Buffalo Bill Dam, began operations in 1922 with the last of three generators placed in operation in 1931 and ceased operation in 1980. The plant had a maximum head of 220 feet and an installed capacity of 6012 kilowatts.

Buffalo Bill Reservoir when filled to the top of the original conservation pool elevation 5360 extended upstream 7.1 miles on the North Fork, Shoshone River, and 5.4 miles upstream on the South Fork, Shoshone River. The reservoir inundated an area in the Shoshone Valley of about 6,700 acres upstream of the Shoshone Canyon National Monument and Buffalo Bill Dam. The reservoir had an initial capacity in 1910 of 456,840 of which 48,200 acre-feet was dead or inactive capacity.

The Buffalo Bill Dam Modification, which is near completion as of April 1, 1991, has been constructed in order to increase the design capacity of the spillway and to allow the dam to overtop efficiently without damage due to the revised inflow design flood. In the modification the dam has been raised to elevation 5395.0 feet. The top of conservation elevation has been revised from elevation 5360.0 to 5393.5. At the top of the revised conservation pool elevation the reservoir has a surface area of 8,315 acres and a capacity of 644,540 acre-feet. The modification of the emergency spillway structure includes a revised intake structure and the installation of two 20.5- by 28.0-foot top seal spillway radial gates to provide control of flood releases.

Hydropower changes in the modification include the construction of the new Buffalo Bill Powerplant, having three operating 6 megawatt units, on the right riverbank about 4,500 feet downstream of the dam. The modification also includes the removal of one 5 megawatt unit from the old Shoshone Powerplant and the installation of a new 3 megawatt unit.

Modifications within the reservoir include the construction of relatively low dikes in the delta areas of the North and South Forks, Shoshone River, to provide dust abatement when the sediment "mud" flats would normally be exposed to wind, and construction of a dike across Diamond Creek to control flows from Diamond Creek and reduce inundated land areas caused by floodflows into Buffalo Bill Reservoir. The revised surface area and capacity for the top of conservation elevation 5393.5 given above include the surface area and capacity behind the dust abatement dikes and exclude the area and capacity behind Diamond Creek Dike.

SUMMARY AND CONCLUSION

This report presents the results of the 1986 sediment survey of Buffalo Bill Reservoir. The report includes a discussion of watershed characteristics, the methods used to measure and analyze 76.1 years of sediment accumulation, and the development of new reservoir topography. The major purposes for the survey were to develop new reservoir topography and area-capacity relationships to satisfy the State of Wyoming requirements for water rights applications, and to determine the storage depletion caused by sedimentation deposition since closure.

Standard land surveying methods were used to establish ground control points for use in the bathymetric survey. The survey used some depth sounding equipment and an automated range-range positioning system to acquire data for the underwater contour development. The survey system continuously recorded bottom depth and horizontal coordinate position as the survey vessel traveled over the control lines and offset parallel lines covering the entire inundated reservoir area. Water surface elevations recorded at the reservoir gauge were used to convert depth to true bottom elevation. These data, together with contours developed from the 1980-1981 aerial photogrammetric survey, were used to develop new reservoir topography.

The reservoir as determined from the 1986 resurvey, has a storage capacity of 398,687 acre-feet and a surface area of 6,746 acres at elevation 5360 (the top of the existing spillway crest). The revised area and capacity tables were produced by a computer program that uses measured contour surface areas and a curve-fitting technique to compute the area and capacity at prescribed elevation increments.

A summary of reservoir watershed characteristics and sediment data for the 1986 resurvey are given in table 1. Since closure in 1910, the reservoir has accumulated a volume of 58,153 acre-feet of sediment below elevation 5360. This

represents an average annual loss of 764 acre-feet and a total loss in capacity of 12.7 percent. During the period since closure, sediment has deposited at an annual rate of 0.51 acre-feet per square mile of contributing drainage.

DESCRIPTION OF WATERSHED

Drainage Area

The drainage area for Buffalo Bill Reservoir above the dam is 1470 square miles. The total basin is considered to be sediment contributing, excluding only the area of the reservoir. The northern portion of the basin is drained by the North Fork of the Shoshone River which joins the South Fork to form the Shoshone River within the reservoir area near the dam.

The drainage basin (figure 3) is bounded on the west by the Absaroka Range of the Rocky Mountains which lies east of the Continental Divide along the border of Yellowstone National Park. The divide of the Yellowstone River basin forms part of its northern boundary. The Absaroka Mountains also create the divide between the South Fork of the Shoshone and the Wind River basin.

Topography within the basin is very mountainous with steep gradient over most of the area. Elevations in the basin range from about 5,360 feet at the dam to 12,000 feet near the basin divide in the south.

Geology

The geology of the basin illustrated in figure 4 was taken from the State Geologic Map of Wyoming published by the U.S. Geological Survey in 1925. The higher elevations of the drainage basin are underlain by igneous, basalt rock comprising about 90 percent of the entire watershed. Sedimentary rock surfaces only in the narrow valley portions along the two main forks of the Shoshone River upstream of the reservoir.

Precipitation

The precipitation within the region is described on the Wyoming Average Annual Precipitation Map published by the U.S. Department of Agriculture [1]. The mean annual precipitation varies widely over the basin, ranging from about 12 inches at the dam to over 60 inches along the western and southern boundaries of the drainage. About 50 percent of the normal annual precipitation falls during the months of April through June [2].

Runoff

Most of the runoff from the basin enters the reservoir by the North and South Fork of the Shoshone. These two forks converge in the reservoir about one mile upstream of the dam axis. The nearest gauge for the North Fork, Shoshone River is located about 1.7 miles upstream of the reservoir high water line near the town of Wapiti. This gauge controls a drainage area of 775 square miles. The average discharge for 12 years of record, water years 1922-1926 and 1980-1986, was 629,600 acre-feet per year (table 2). The nearest gauge on the South Fork, Shoshone River is located about 1.0 miles upstream of the reservoir high water line at the County road Bridge crossing. The gauge controls a drainage area of 585 square miles. The average discharge for 17 years (water years 1923-1926, 1974-1986) was 289,310 acre-feet per year (table 2). Several small tributaries, one gauged and several ungauged also contribute flow to the reservoir. Due to the unmeasured tributary, inflow and other losses which occur, the project estimates the inflow by the equation: *Inflow = Outflow - Change in storage.* The inflow values listed in table 1 from 1959 were estimated by this equation. The average annual inflow from 1959 to 1986 by this formula is 944,550 acre-feet.

Erosion

Large flow events on both the North and South Fork contribute relatively large quantities of coarse sediment and debris. Following large storm events, the delta becomes littered with debris deposits, some of which move into the reservoir and are carried on to the dam. The debris problem is due to high velocity flow higher in the basin which attacks the streambanks and undermines the root system causing the trees adjacent to the stream to fall and eventually enter the stream. The wide bay area of reservoir near the upstream end of the South Fork arm becomes a large debris trap where wind and waves tend to drive the large floating debris (figure 5).

RESERVOIR OPERATIONS

The reservoir operates primarily to provide irrigation to approximately 107,000 acres of farm and range land within the Shoshone Valley downstream of the dam. The active storage allocated to conservation between elevation 5259.6 and 5360.6 as of the 1959 sedimentation survey was 375,800 acre-feet. The surcharge storage above elevation 5360 to elevation 5380, allowing for some 7 feet overtopping of the dam parapet walls, is about 149,400 acre feet. Total dead and inactive storage below elevation 5259.6 is approximately 48,200 acre-feet.

Since the primary use of the water is for irrigation, the releases made for power are coordinated with the Shoshone Irrigation District. For 50 years prior to 1980, the Shoshone Powerplant, having installed capacity of 6.0 megawatts, was operated to pass irrigation water downstream according to irrigation demand. The Heart

Mountain Powerplant, constructed in 1948, with installed capacity of 5 megawatts, is also operated to pass a portion of the irrigation flow demand. The Shoshone Powerplant became obsolete and was deactivated in 1980.

Except for excess spring runoff releases, only irrigation releases are made during the irrigation season as the irrigation release is usually in excess of powerplant capacity. Following the irrigation season, the inflows and storage above 200,000 acre-feet are released as uniformly as possible during the fall and winter through January. Beginning on February 1, releases are based on forecasts of spring runoff to assure a full reservoir to elevation 5360 by July 1.

The fluctuations of Buffalo Bill Reservoir since 1913 have ranged between the maximum stage of record elevation 5367.3 occurring on June 15, 1918, and the minimum stage, outside of the initial filling period, of elevation 5225.3 occurring on January 23-25, 1941. According to the stage duration curve (figure 6) the reservoir is operated in the conservation pool 84 percent of the time and in the surcharge pool 15 percent of the time. The mean reservoir stage during the period of record, the stage exceeded 50 percent of the time, is approximately elevation 5343.

SURVEYS AND EQUIPMENT

Past Surveys

Information describing details of the very early surveys has not been located. The original survey of the reservoir was apparently made in 1905 by the Reclamation Service, approximately five years before the dam was closed. Supplemental shoreline mapping was made by the same agency soon after the lake was filled. A topographical map of the reservoir was made having a contour interval of 10 feet and a scale of 1:12000. This map was the basis of the original area capacity table reproduced in table 1.

In 1941, a resurvey was made for Reclamation by the Civilian Conservation Corps. A composite map was drawn having contours determined by both 1905 and 1941 surveys. A report of the results of this survey was prepared in the Denver Reclamation Office dated May, 1949.

Another resurvey was made in 1958 and 1959 for Reclamation by the U.S. Geological Survey. A new reservoir topography with 10-foot contour intervals and a scale of 1:12000 was developed. The topography was used to revise the storage capacity and determine sedimentation conditions in the reservoir although no comprehensive report of the survey was made.

In preparation for the enlargement of Buffalo Bill Reservoir, new topography was begun by the U.S. Geological Survey in 1970 in cooperation with Reclamation. While the topography was never completed, preliminary maps were used in feasibility studies for modification.

New topography as developed in 1981 from contracted aerial photography. The reservoir shoreline was mapped at a scale of 1:4800 and a contour interval of 5 feet from the reservoir surface elevation 5353.5 (Shoshone Project Datum) to the maximum proposed reservoir boundary. Orthophoto maps were prepared covering the entire shoreline. Adequate ground control was established so that detailed structural topography could be prepared at a 2-foot contour interval where needed for dam and reservoir modification.

1986 Resurvey

Field work for the 1986 resurvey began in the spring of 1985 and ended in October, 1986. The advance field work consisted of establishing permanent range lines to serve as control for this and future resurveys and other control points as were needed. To develop range end monuments to serve as control for this resurvey, a traverse was surveyed around the perimeter of the reservoir establishing ten range lines on the North Fork, Shoshone River; four range lines on the South Fork, Shoshone River; and two range lines on Diamond Creek. The traverse was tied to known triangulation points in the area near the dam. State plane coordinates for all range line monuments were established and vertical control for the monuments were obtained from a benchmark near the dam.

On June 18, 1986, a bathymetric survey of the reservoir was begun. As this was a year of large spring runoff, the reservoir was full to elevation 5365 and spilling over the free overflow spillway. Because of hazardous conditions near the dam and spillway, the survey of that area was delayed until October 10, 1986. A contour survey method was employed using the Reclamation-owned automated survey system [3]. The automated system (figure 7) is composed of electronic depth sounding equipment interfaced with line-of-sight microwave positioning equipment to determine the ground profile along established range lines or offsets. In order to produce adequate data for developing contours of Buffalo Bill Reservoir, a grid spacing at 500- and 1000-foot intervals in the main body of the reservoir and 250-foot intervals in the canyon area near the dam was selected. After calibrating the sounding equipment and positioning equipment, the survey system (figure 8) was ordered to collect positioning and depth data along prescribed range lines and offsets as the survey vessel proceeded along the lines at about 5 feet per second. The master receiver/transmitter (figure 9) on the vessel transmitted microwave signals to fixed shore receiver/transmitters (figure 10) and converted the elapsed time for reply to range distances which were then used to compute the coordinate position of the survey vessel. Controls necessary for operating system included horizontal grid coordinates of all range ends and shore station points, reservoir elevations and the elevation of end shore station antennas. As the system collected data near a predètermined course and along chosen offset lines (figure 11), the system gave direction through a track indicator to the boat pilot for maintaining course. The range and offset data were collected and stored on magnetic

tape for later processing on the mainframe computer. A graph plotter was used to track the vessel and to provide a postplot of the range profiles. Auxiliary field equipment included portable radios for vessel to shore communications and another boat (figure 12) to move equipment and personnel around the reservoir.

NEW RESERVOIR TOPOGRAPHY

The reservoir contours developed in 1980 and 1981 from the aerial photogrammetric survey were used together with bathymetric data to produce a new topographic map of Buffalo Bill Reservoir. The new map index and topography are shown on figures 13 and 14. This topography was produced in conformity to requirements by the State of Wyoming for Reclamation water rights application. The map has a scale of 1:4800 and a contour interval of 5 feet.

The data used in developing the map included digital coordinate and depth data acquired by the automated system plus contour data taken off the contractor's orthophoto maps. Due to the rugged nature of the canyon near the dam and the terrain along Diamond Creek, additional contour data had to be used to fill in gaps in the bathymetric data. A composite posting of all of the data used in developing the underwater map is available in the Denver Office.

Following a careful editing of all depth and position data, the Surface II Graphics System [4] was used to develop a contour map of the underwater portion of the reservoir. The graphics system is used in four phases: the first phase plots the horizontal position of the data; the second phase connects the data into a uniform grid, using a search technique specified by the user; the third phase plots a contour map from the uniform grid; and the fourth phase computes the area of all closed contours and produces an elevation-area table.

The final reservoir map shown on figure 14 was prepared by the Denver Office Computer Drafting Unit of the Drafting Section. The contours appearing on the map from elevation 5355 to 5410 were digitized and reproduced by the Drafting Unit from the contractor's orthophoto map sheets. The contours below elevation 5355 were digitized and reproduced by the Drafting Unit from the underwater map produced by the graphics system.

REVISED SURFACE AREA AND STORAGE CAPACITY

The elevation versus contour area table used to compute reservoir capacity was developed by the following methods. The contour areas for the lower portion of the reservoir between elevations 5180 and 5335 were computed directly by the Surface II

graphics system for those contours which closed. The contours between elevations 5340 and 5355 which did not completely close on the computer-produced underwater map were closed by examining existing topography and making a judgement closure. These four contours plus three contours between elevations 5360 and 5370 were digitized to produce the surface areas. A final 1986 elevation versus area table was developed for the whole range of elevations at 5 foot intervals between elevation 5180 and 5370. The resulting data presented in item 46 of table 1 was used as input for computing the 1986 storage capacity for the reservoir.

The elevation versus storage relationship was determined by means of Reclamation's program ACAP85 [5]. The resulting surface area and storage capacity versus elevation relationships are shown graphically in figure 15. The computer program was written to include computation of 0.01- to 1.0-foot area increments by linear interpolation between measured contour areas. The respective capacity and capacity equations are then obtained by integration of the area equations. The initial capacity equation is tested over successive intervals to ensure that the equation fits within an allowable error term. The equation is used over the whole range that fits within the allowable error term. For the next interval, beginning where the initial allowable error term was exceeded, a new capacity equation is tested to fit until the error term is exceeded. Thus, the capacity curve is defined by a series of curves, each fitting a certain region of data within a specific elevation interval as constrained by the limiting error term. The final area equations are obtained by differentiation of the capacity equation, which are of second-order polynomial form:

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

where:

y = capacity
x = elevation
a_1 = intercept, and
a_2 and a_3 = coefficients

Results of the 1986 area and capacity computations are listed in columns (4) and (5) of table 2. Listed in columns (2) and (3) of this table are the original area and capacity values. A special set of area-capacity tables has been published separately for the 0.01-, 0.1-, and 1-foot elevation increments. At spillway crest elevation 5360, the 1986 capacity is 398,687 acre-feet and the surface area is 6746 acres.

SEDIMENT RANGE PROFILES

The locations of sediment range lines established for future monitoring and to serve as control lines for the 1986 resurvey are shown on figure 16. The range lines which were surveyed with range end monuments established were ranges 1 through 9 on the North Fork, ranges 20 through 23 on the South Fork, and ranges 30 and 31 on Diamond Creek. Additional ranges 10 through 18 on the North Fork and ranges 24

through 29 on the South Fork were drawn on the 1980 orthophoto sheets from which contour intersection data were taken for developing cross sections. Cross section data for the surveyed lines were developed by reading the automated positioning data printout and selectively choosing data points that best represented the section profiles. The profile data above reservoir level at the time of the hydrographic survey were taken off the 1986 reservoir topography up to the elevation of the end monuments. In many instances a gap existed between the uppermost contour for elevation 5410 and the monument location, a gap which was not surveyed. Plots of these range lines are shown on figures 17 through 46.

Profile information for previously surveyed range lines was not available. Therefore, no comparative cross section plots were prepared, and the measured change in contour areas is assumed to represent the storage loss due to sedimentation.

SEDIMENT ANALYSIS

Sediment Accumulation

The 1986 resurvey results indicate a deposit of 58,153 acre-feet of sediment below elevation 5360 since closure in May 1910. The average annual rate of sediment deposition in the 76.1-year period between closure and June 1986 was 764 acre-feet per year, or 0.51 acre-foot per square mile of contributory drainage area. The storage loss in terms of percent of original storage capacity was 12.7 percent. These deposition quantities represent only change in storage and do not precisely represent sediment inflows. The total amount of sediment inflow, which has not been measured during the operating period, could be expected to differ somewhat in quantity from deposited volume due to trap efficiency of the reservoir and compaction of deposited sediments.

Sedimentation Summary

The Buffalo Bill Reservoir sediment accumulation and water storage data based on the 1986 resurvey are summarized in table 1. These data reflect the changes that have occurred in the reservoir since closure and during the interval since the last survey in 1958. These data and other information on the watershed and reservoir allocations are given for the purpose of continuing reservoir investigations and research.

Longitudinal Distribution

The distribution of sediment through the length of the reservoir is illustrated in part by plots of the thalweg profile representing the 1905 original profile and the 1986 resurveyed profile, as shown in figures 47 and 48. Thalweg elevation representing 1905 conditions are taken from the original reservoir topography. Since these elevations represent the even 10-foot contour crossings on the channel, it is assumed that they only approximate the thalweg and that the actual channel thalweg is

slightly lower. Thalweg elevations representing 1986 conditions are taken from the 1986 revised topography, except for the upstream portion of the North and South Fork where the elevations were read off the 1980 orthophoto map sheets which had been developed from aerial photogrammetry.

Figure 47 shows the longitudinal profile of the reservoir along the North Fork, Shoshone River. The 1905 profile extends upstream only as far as the 5,360-foot contour crossing, the upper most contour on the original maps. The 1986 profile extends upstream to the 5,415-foot contour crossing, a point considered to be above any future reservoir induced changes. Distance to each contour is measured from the dam along the meandering low flow channel extending up through the reservoir. The 1986 profile shows the delta forming upstream between Range 6 and Range 9, although a distinct pivot point is not clearly evident.

Figure 48 shows the longitudinal profile of the reservoir along the South Fork, Shoshone River. The 1905 profile displays an approximate slope of 0.0067 from the confluence of the North and South Fork to the 5,360-foot contour crossing upstream. The delta area of the 1986 profile from about Station 115+00 to Station 265+00 displays a typical profile [6] having an approximate slope of 0.0037, about 55 percent of the original streambed slope. The pivot point on the South Fork delta is quite evident near thalweg Station 115+00. Distances to each contour are measured from the confluence of the North and South Fork, Shoshone River, about 5,000 feet upstream of the dam.

Depth Distribution

Of special interest for future reservoir planning, a theoretical distribution of sediment in the reservoir was computed (table 3) using the Empirical Area Reduction Method [6]. A sediment inflow volume of 58,153 acre-feet was assumed in the distribution. This volume was equal to the total volume measured by the 1986 survey. The depth-capacity relationship plotted on figure 49 indicates the reservoir to be type II [6]. Sediment distribution results are tabulated on columns 8, 9, and 10 of table 4 for a type II reservoir. These computations indicate that the sediment would reach an elevation of 5199.2 feet as determined from the 1986 resurvey. The sediment distribution curves on figure 50 show how the actual distribution compares with the theoretical distribution of a type II reservoir. The curves show percentage of depth plotted against percentage of depth deposited. The greatest differences in the actual and type II curve lie between the 50 and 60 percent depth.

Table 1.--Reservoir Sediment Data Summary

Buffalo Bill
NAME OF RESERVOIR

43-1c
DATA SHEET NO.

DAM	1. OWNER Bureau of Reclamation		2. STREAM Shoshone		3. STATE Wyoming	
	4. SEC 7 T 52N R102W		5. NEAREST PO Cody		6. COUNTY Park	
	7. LAT 44°30'05" LONG 109°11'00"		8. TOP OF DAM 5370		9. SPILLWAY CREST 5360	
RESERVOIR	10. STORAGE ALLOCATION	11. ELEVATION TOP OF POOL	12. ORIGINAL SURFACE AREA, Ac	13. ORIGINAL CAPACITY, AF	14. GROSS STORAGE ACRE FEET	15. DATE STORAGE BEGAN
	a. FLOOD CONTROL					
	b. MULTIPLE USE					May, 1910[1]
	c. POWER					
	d. WATER SUPPLY					16. DATE NORMAL OPERATION BEGAN
	e. IRRIGATION	5360	6682	455,838	455,838	
	f. CONSERVATION					
	g. INACTIVE	5259.6	1772	61,900	61,900	June, 1913
	17. LENGTH OF RESERVOIR 7.9 MILES			AVG. WIDTH OF RESERVOIR 1.32 MILES		
BASIN	18. TOTAL DRAINAGE AREA 1504 SQ. MI.			22. MEAN ANNUAL PRECIPITATION 11.48-43.90 IN.		
	19. NET SEDIMENT CONTRIBUTING AREA 1495			23. MEAN ANNUAL RUNOFF 11.02[3] IN.		
	20. LENGTH 57[2] MI	AV. WIDTH 34 MI		24. MEAN ANNUAL RUNOFF 863,900[3] AC.-FT.		
	21. MAX. ELEV. 12,000+/-	MIN. ELEV. 5360 ELEV.		25. ANNUAL TEMP. MEAN RANGE		

SURVEY DATA

26. DATE OF SURVEY	27. PER. YRS.	28. ACCL. YRS.	29. TYPE OF SURVEY	30. NO. OF RANGES OR INTERVAL	31. SURFACE AREA, AC.	32. CAPACITY ACRE-FEET	33. C/I RATIO AF/AF
1910		0	R	10 ft	6682	456,840[4]	
1941	31.7	31.7	R	10 ft	6711	439,851	
1958	17.0	48.7	R	10 ft	6691	421,333	
1986	27.4	76.1	D	5 ft	6746	398,687	

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
1941	N/A	929,200[5]	1,336,600[5]	24,158,000[5]	929,200	24,158,600
1958	N/A	923,800	1,359,700	15,704,300	927,000	39,862,900
1986	N/A	933,300	1,258,800	25,568,900	929,500	65,435,100

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.
1941	16,989	536	0.36	16,989	536	0.36
1958	18,518	1089	0.73	35,507	729	0.49
1986	22,646	826	0.55	58,153	764	0.51

26. DATE OF SURVEY	39. AV. DRY WT. (#/FT^3)	40. SED. DEP. TONS/MI.^{2}-YR.		41. STORAGE LOSS, PCT.		SED. INFLOW, PPM	
		a. PERIOD	b. TOTAL TO DATE	a. AV. ANNUAL	b. TOTAL TO DATE	a. PER.	b. TOT.
1941	Unknown	Unknown	Unknown	0.12	3.72	Unk	Unk
1958	Unknown	Unknown	Unknown	0.16	7.77	Unk	Unk
1986	Unknown	Unknown	Unknown	0.17[4]	12.73[4]	Unk	Unk

26. DATE OF SURVEY	43. DEPTH DESIGNATION RANGE IN FEET BELOW AND ABOVE CREST ELEVATION											
	220-200	200-180	180-160	160-140	140-120	120-100	100-80	80-60	60-40	40-30	30-0	
	PERCENT OF TOTAL SEDIMENT LOCATED WITHIN DEPTH DESIGNATION											
1986	0.5	2.4	6.2	7.2	8.5	10.6	14.2	20.0	21.8	7.6	1.0	

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														
1986	N/A														

Table 1.--Reservoir Sediment Data Summary, continued

45. RANGE IN RESERVOIR OPERATION

WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF	WATER YEAR	MAX. ELEV.	MIN. ELEV.	INFLOW, AF
1910	5290	5140		1949	5360	5306	797,700
1911	5307	5140		1950	5360	5303	979,500
1912	5356	5140		1951	5360	5322	1,276,400
1913	5360	5140		1952	5358	5312	931,300
1914	5360	5359		1953	5359	5299	778,200
1915	5360	5351		1954	5360	5313	856,600
1916	5360	5354	1,120,100	1955	5343	5303	612,000
1917	5360	5341	1,042,900	1956	5360	5306	1,137,000
1918	5360	5336	1,334,500	1957	5360	5299	978,400
1919	5360	5335	525,300	1958	5360	5278	720,700
1920	5360	5322	1,050,600	1959	5360	5240	844,500[6]
1921	5360	5310	964,200	1960	5347	5310	621,000
1922	5360	5351	851,300	1961	5361	5301	672,100
1923	5360	5338	906,800	1962	5364	5310	1,044,100
1924	5360	5351	901,200	1963	5364	5313	971,000
1925	5360	5350	1,296,500	1964	5364	5302	927,700
1926	5360	5349	782,900	1965	5364	5305	1,258,800
1927	5360	5342	1,179,200	1966	5361	5336	713,400
1928	5360	5349	1,336,600	1967	5365	5293	1,115,900
1929	5360	5349	795,800	1968	5359	5278	861,800
1930	5360	5349	865,900	1969	5362	5320	807,000
1931	5360	5341	618,400	1970	5365	5302	993,100
1932	5360	5331	957,700	1971	5363	5305	1,240,600
1933	5360	5330	855,500	1972	5362	5299	1,052,700
1934	5360	5331	590,600	1973	5353	5313	743,000
1935	5360	5343	958,600	1974	5365	5310	1,216,200
1936	5360	5341	978,000	1975	5363	5319	992,400
1937	5360	5340	770,400	1976	5363	5308	1,171,100
1938	5360	5335	1,043,100	1977	5343	5315	441,200
1939	5360	5327	831,200	1978	5363	5313	1,093,400
1940	5343	5268	694,300	1979	5355	5313	724,100
1941	5355	5230	906,600	1980	5363	5321	828,900
1942	5360	5346	905,700	1981	5367	5330	843,400
1943	5360	5335	1,359,700	1982	5364	5312	1,160,200
1944	5360	5337	767,800	1983	5363	5331	916,300
1945	5360	5322	868,000	1984	5364	5335	931,900
1946	5360	5345	819,100	1985	5354	5328	597,800
1947	5360	5333	1,004,500	1986	5365	5327	1,097,000
1948	5360	5338	911,700				

46. ELEVATION - AREA - CAPACITY DATA FOR 1986

ELEV.	AREA	CAP.	ELEV.	AREA	CAP.	ELEV.	AREA	CAP.
5180	0	0	5250	1159	29,409	5320	3802	186,292
5190	13	39	5260	1428	42,317	5330	4492	227,682
5200	105	539	5270	1697	57,964	5340	5358	276,997
5210	263	2464	5280	1972	76,262	5350	6096	334,182
5220	427	5894	5290	2306	97,587	5360	6746	398,687
5230	651	11,209	5300	2655	122,374	5370	7409	469,289
5240	913	19,079	5310	3164	151,487			

47. REMARKS AND REFERENCES

[1] Originally for irrigation only - powerplant began operation in April, 1922 and ceased operation in 1980.
[2] Dam below junction of North and South Fork Shoshone River, length for longest fork.
[3] Average for 1916 - 1986 inclusive.
[4] 1910 area and capacity values recomputed by current methods for comparison with 1986 area and capacity values to compute sediment deposition.
[5] For 1916 - 1941.
[6] Inflow from 1959 computed by formula: Inflow = Outflow - ΔStorage.

48. AGENCY MAKING SURVEY

49. AGENCY SUPPLYING DATA Bureau of Reclamation | DATE Bureau of Reclamation

Table 2.--Measured Annual Streamflow Entering Reservoir
(acre-feet)

Water Year	North Fork - Shoshone River Near Wapiti, WY	South Fork - Shoshone River Above Buffalo Bill	Diamond Creek Near Mouth
1922	512,80		Ungauged
1923	579,959	331,023	
1924	519,153	283,355	
1925	889,069	395,109	
1926	559,973	250,463	
	Gauge Discontinued	Gauge Discontinued	
1974		381,723	
1975		329,417	
1976		355,539	
1977		131,946	
1978		335,471	
1979		180,090	
1980	594,982	241,668	
1981	614,806	240,162	
1982	843,526	393,050	5255
1983	677,706	288,276	4009
1984	653,934	295,494	5222
1985	479,492	146,498	3816
1986	788,527	338,997	4612

Table 3.--Buffalo Bill Sediment Distribution,
Reservoir Sediment Deposition Study,
Empirical Area Reduction Method
Sediment Inflow 5815.3AF Reservoir Type 2

	ORIGINAL		RELATIVE		SEDIMENT		REVISED	
ELEV (FT)	AREA (AC)	CAPACITY (AF)	DEPTH	AREA	AREA (AC)	VOLUME (AF)	AREA (AC)	CAPACITY (FT)
5360.0	6682.0	456840.	1.000	.000	.0	58153.	6682.0	398687.
5350.0	6018.0	393340.	.955	.682	202.5	57141.	5815.5	336199.
5340.0	5377.0	336365.	.909	.881	261.6	54820.	5115.4	281545.
5330.0	4845.0	285255.	.864	1.011	300.0	52012.	4545.0	233243.
5320.0	4317.0	239445.	.818	1.103	327.3	48875.	3989.7	190570.
5310.0	3820.0	198760.	.773	1.170	347.2	45503.	3472.8	153257.
5300.0	3363.0	162845.	.727	1.218	361.4	41959.	3001.6	120886.
5290.0	2869.0	131685.	.682	1.250	371.1	38296.	2497.9	93389.
5280.0	2444.0	105120.	.636	1.270	376.9	34556.	2067.1	70564.
5270.0	2109.0	82355.	.591	1.277	379.2	30776.	1729.8	51579.
5260.0	1785.0	62885.	.545	1.274	378.3	26989.	1406.7	35896.
5259.6	1772.0	60418.	.544	1.274	378.2	26837.	1393.8	33581.
5250.0	1458.0	46670.	.500	1.261	374.3	23226.	1083.7	23444.
5240.0	1181.0	33475.	.455	1.238	367.4	19517.	813.6	13958.
5230.0	886.0	23140.	.409	1.204	357.5	15893.	528.5	7247.
5220.0	666.0	15380.	.364	1.161	344.6	12382.	321.4	2998.
5210.0	463.0	9735.	.318	1.107	328.7	9016.	134.3	719.
5200.0	322.0	5810.	.273	1.041	313.2	5807.	8.8	3.
5199.2	311.5	5563.	.269	1.035	311.5	5563.	.0	0.
5190.0	187.0	3265.	.227	.962	187.0	3265.	.0	0.
5180.0	127.0	1695.	.182	.867	127.0	1695.	.0	0.
5170.0	67.0	725.	.136	.752	67.0	725.	.0	0.
5160.0	22.0	280.	.091	.610	22.0	280.	.0	0.
5150.0	17.0	85.	.045	.419	17.0	85.	.0	0.
5140.0	.0	0.	.000	.000	.0	0.	.0	0.

Table 4.--Summary of 1986 Survey Results and Sediment Distribution Computations

Elevation (ft)	Original Area (Acres)	Original Capacity (acre-ft)	1986 Area (acres)	1986 Capacity (acre-ft)	Measured Sediment Volume (acre-ft)	Percent of Measured Sediment	Computed 1986 Capacity (acre-ft)	Computed Sediment Volume (acre-ft)	Percent of Computed Sediment
5370			7409	469,289					
5360	6682	456,840	6746	398,687	58,153	100.0	398,687	58,153	100.0
5350	6018	393,340	6096	334,182	59,158	101.7	336,199	57,141	98.3
5340	5377	336,365	5358	276,997	59,368	102.1	281,545	54,820	94.3
5330	4845	285,255	4492	227,682	57,573	99.0	233,243	52,012	89.4
5320	4317	239,445	3802	186,292	53,153	91.4	190,570	48,875	84.0
5310	3820	198,760	3164	151,487	47,273	81.3	153,257	45,503	78.2
5300	3363	162,845	2655	122,374	40,471	69.6	120,886	41,959	72.1
5290	2869	131,685	2306	97,587	34,098	58.6	93,389	38,296	65.9
5280	2444	105,120	1972	76,262	28,858	49.6	70,564	34,556	59.4
5270	2109	82,355	1697	57,964	24,391	41.9	51,579	30,776	52.9
5260	1785	62,885	1428	42,317	20,568	35.4	35,896	26,989	46.4
5259.6	1772	60,418	1417	41,748	18,670	32.1	33,581	26,837	46.1
5250	1458	46,670	1159	29,409	17,261	29.7	23,444	23,226	39.9
5240	1181	33,475	913	19,079	14,396	24.8	13,958	19,517	33.6
5230	886	23,140	651	11,209	11,931	20.5	7247	15,893	27.3
5220	666	15,380	427	5894	9486	16.3	2998	12,382	21.3
5210	463	9735	263	2464	7271	12.5	719	9016	15.5
5200	322	5810	105	539	5271	9.1	3	5807	10.0
5199.2	311	5557	95	460	5097	8.8	0	5097	8.8
5190	187	3265	13	39	3226	5.5	0	3226	5.6
5183.2	146	2132	0	0	2132	3.7	0	2132	3.7
5180	127	1695	0	0	1695	2.9	0	1695	2.9
5170	67	725	0	0	725	1.2	0	725	1.2
5160	22	280	0	0	280	0.5	0	280	0.5
5150	17	85	0	0	85	0.1	0	85	0.1
5140	0	0	0	0	0	0.0	0	0	0.0

BIBLIOGRAPHY

[1] Wyoming Average Annual Precipitation, U.S. Dept. of Agriculture, SCS-Base MP-P-21418-13ABCD-XG-, June, 1983.

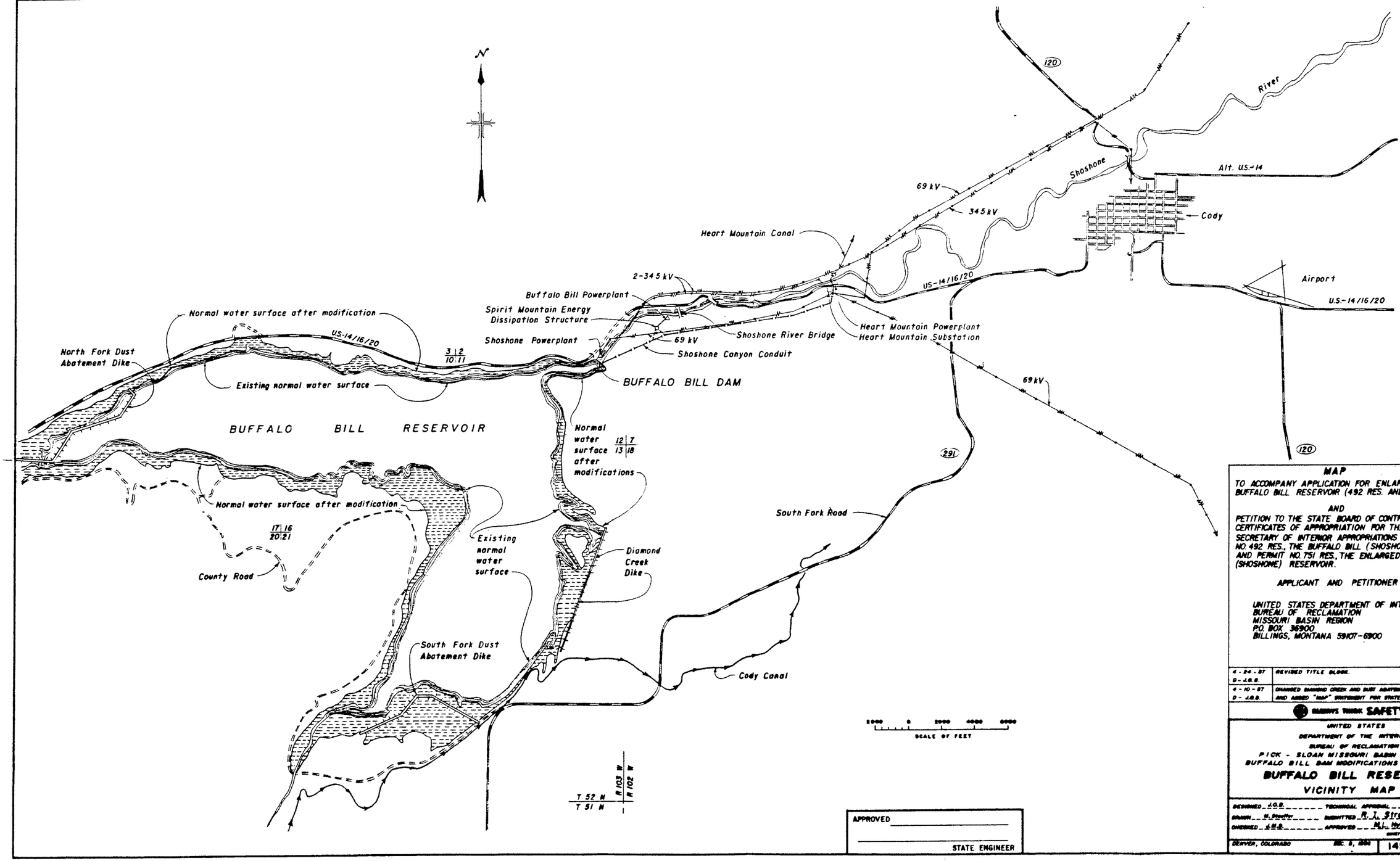
[2] Climatological Data, Annual Summary, Wyoming, Vol. 90, No. 13, 1981 - U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, Environmental Data and Information Service, National Climatic Center, Ashville, N.C.

[3] Blanton, J.O., "Procedures for Monitoring Reservoir Sedimentation: Technical Guideline", Bureau of Reclamation, Denver Office, Denver, Colorado, October 1982.

[4] Surface II Graphics System, Kansas Geological Survey, 240 pages, Lawrence, Kansas, 1978.

[5] ACAP85 User's Manual, Bureau of Reclamation, Denver Office, Denver, CO., 1985.

[6] Design of Small Dams, 2nd ed., Bureau of Reclamation, App. A., U.S. Government Printing Office, Washington, D.C., 1987.



MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D-J.B.B.	REVISED TITLE BLOCK.
4-10-87 D-J.B.B.	CHANGED DIAMOND CREEK AND DUST ABATEMENT DIKE LOCATIONS AND ADDED "MAP" STATEMENT FOR STATE OF WYOMING.

GIVE US THIS DAY SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
P.I.C.K. - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

VICINITY MAP

DESIGNED J.G.B. — TECHNICAL APPROVAL R.J. Strand
DRAWN W. Beasley — SUBMITTED R. J. Strand
CHECKED J.G.B. — APPROVED M.J. Hyatt
CHIEF, HYDROLOGY BRANCH

DENVER, COLORADO — DEC. 8, 1986 — 1458-D-689

Figure 1

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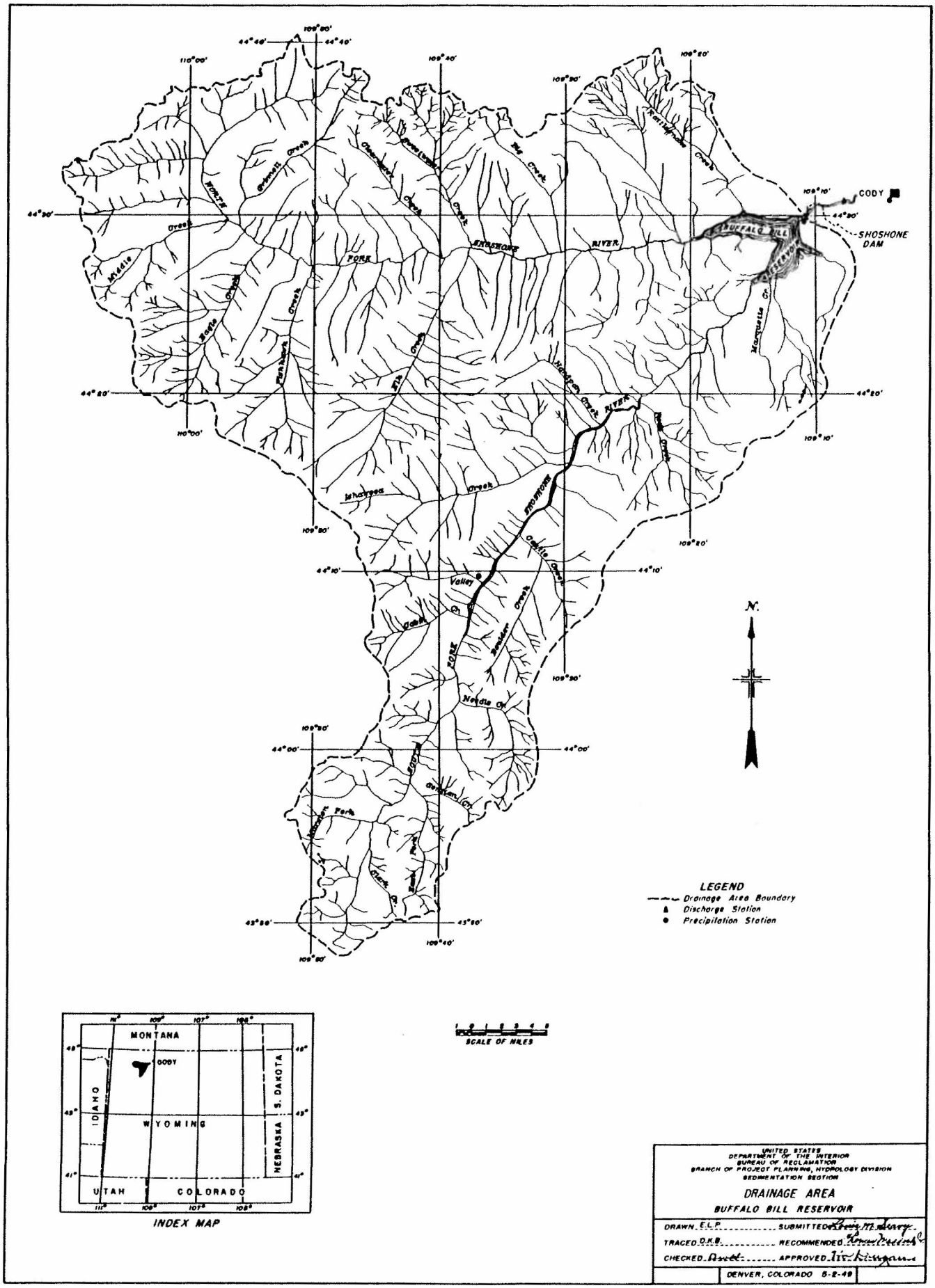


Figure 3 – Drainage Area

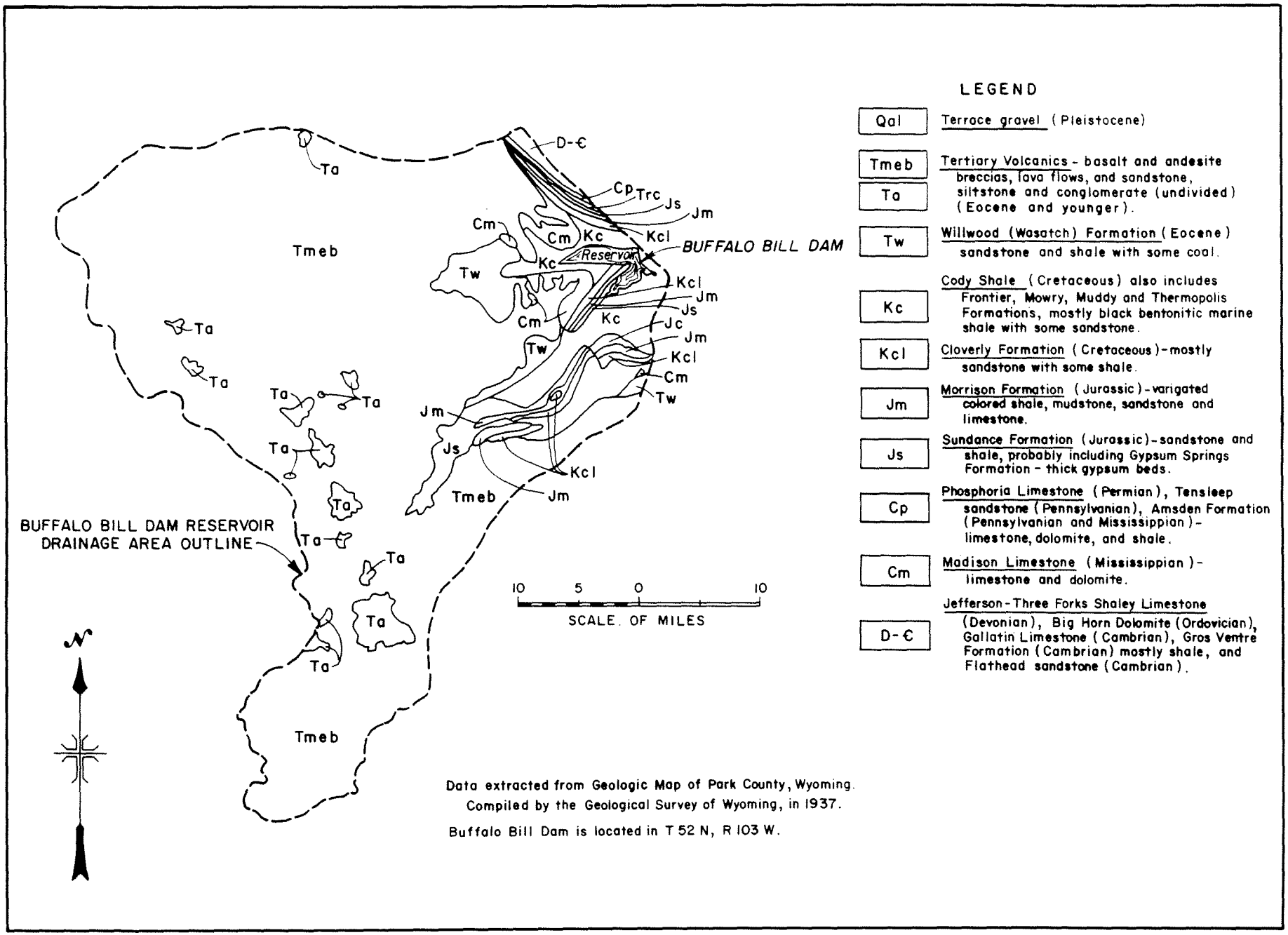


Figure 4 – Geologic Map

Figure 5.—Debris deposits on South Fork arm

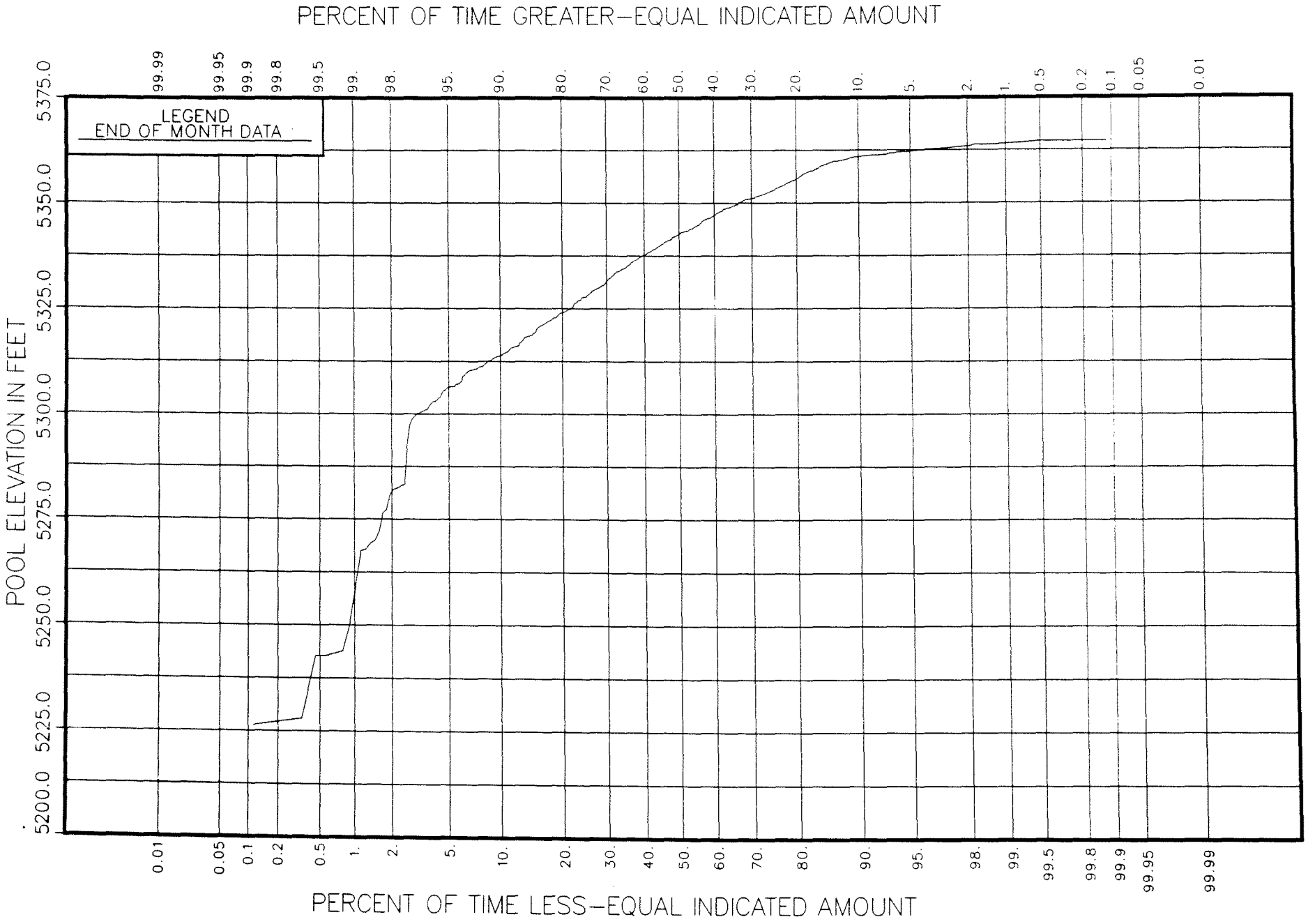


Figure 6 – Reservoir stage-duration

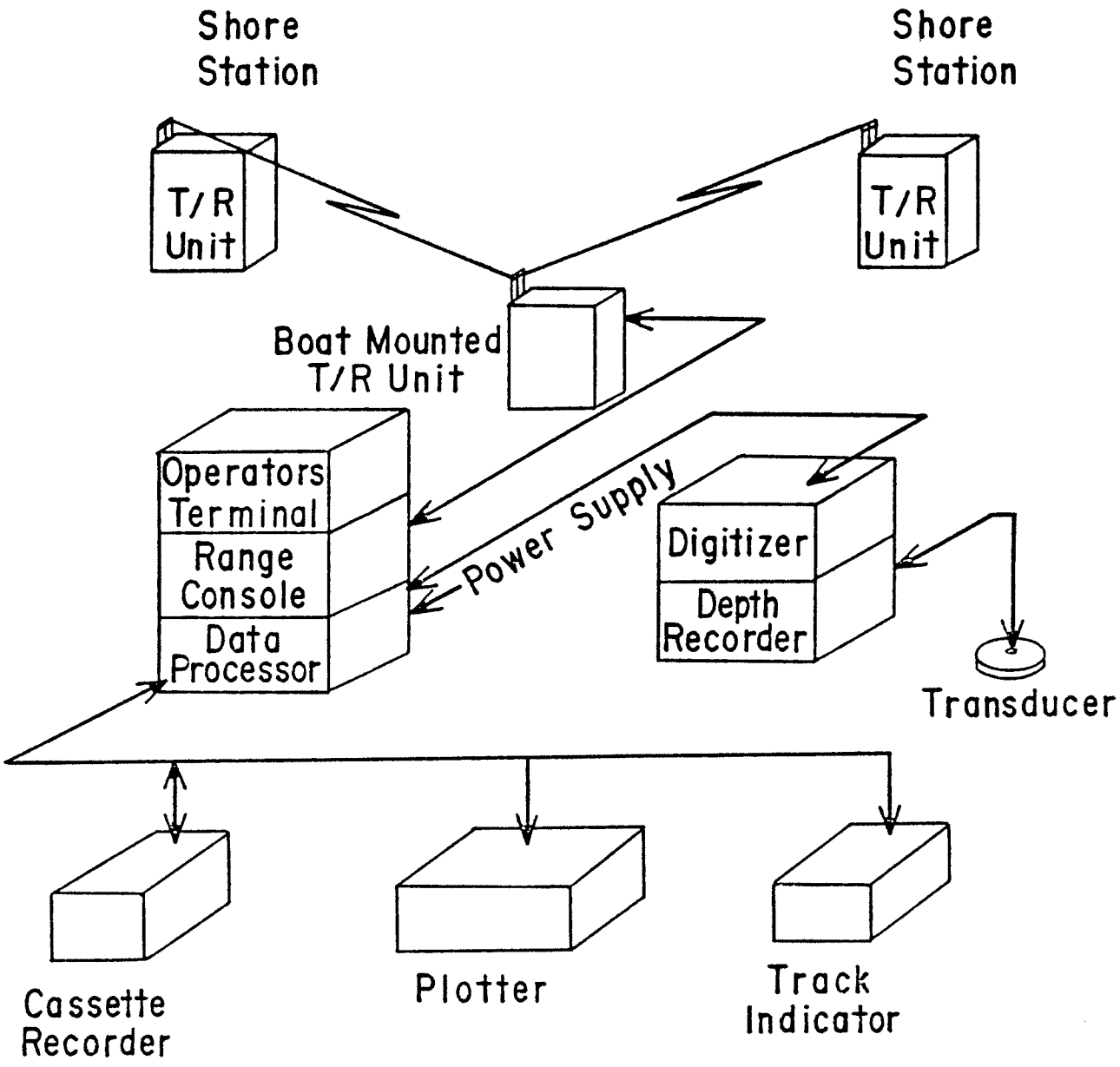


Figure 7 – Components of automated survey system

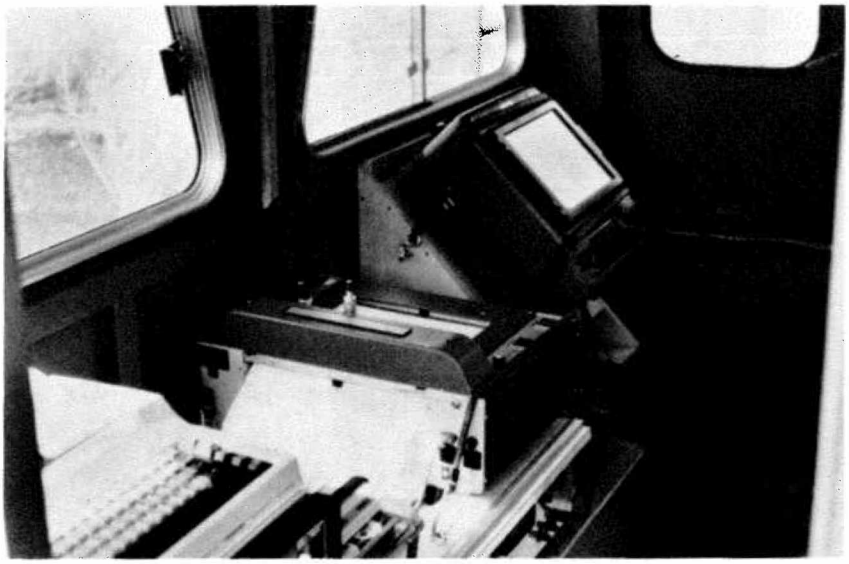


Figure 8.—System components housed on survey boat

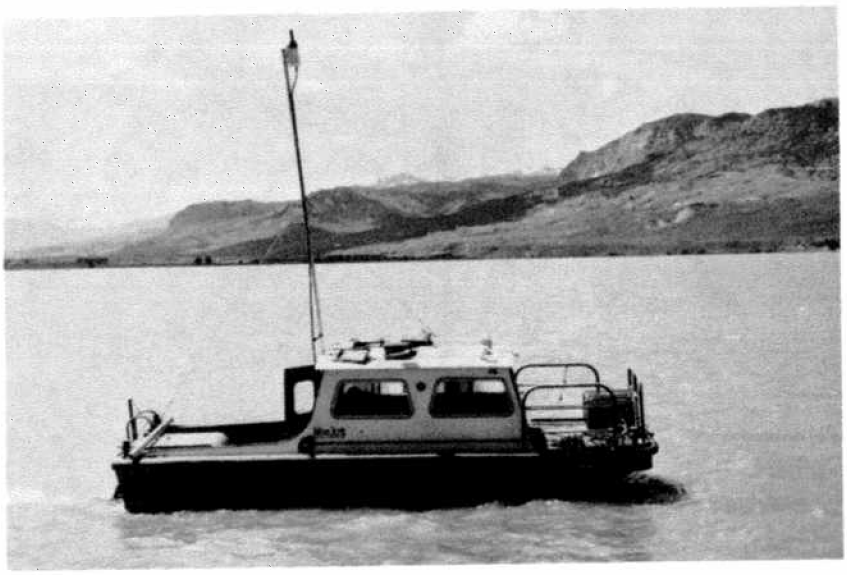


Figure 9.—Master receiver/transmitter on survey boat

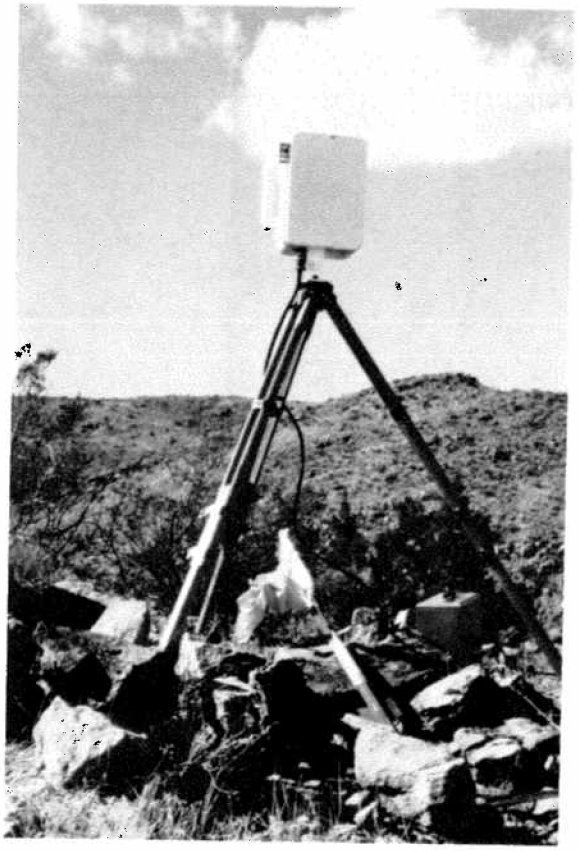


Figure 10.—Shore-based receiver/transmitter

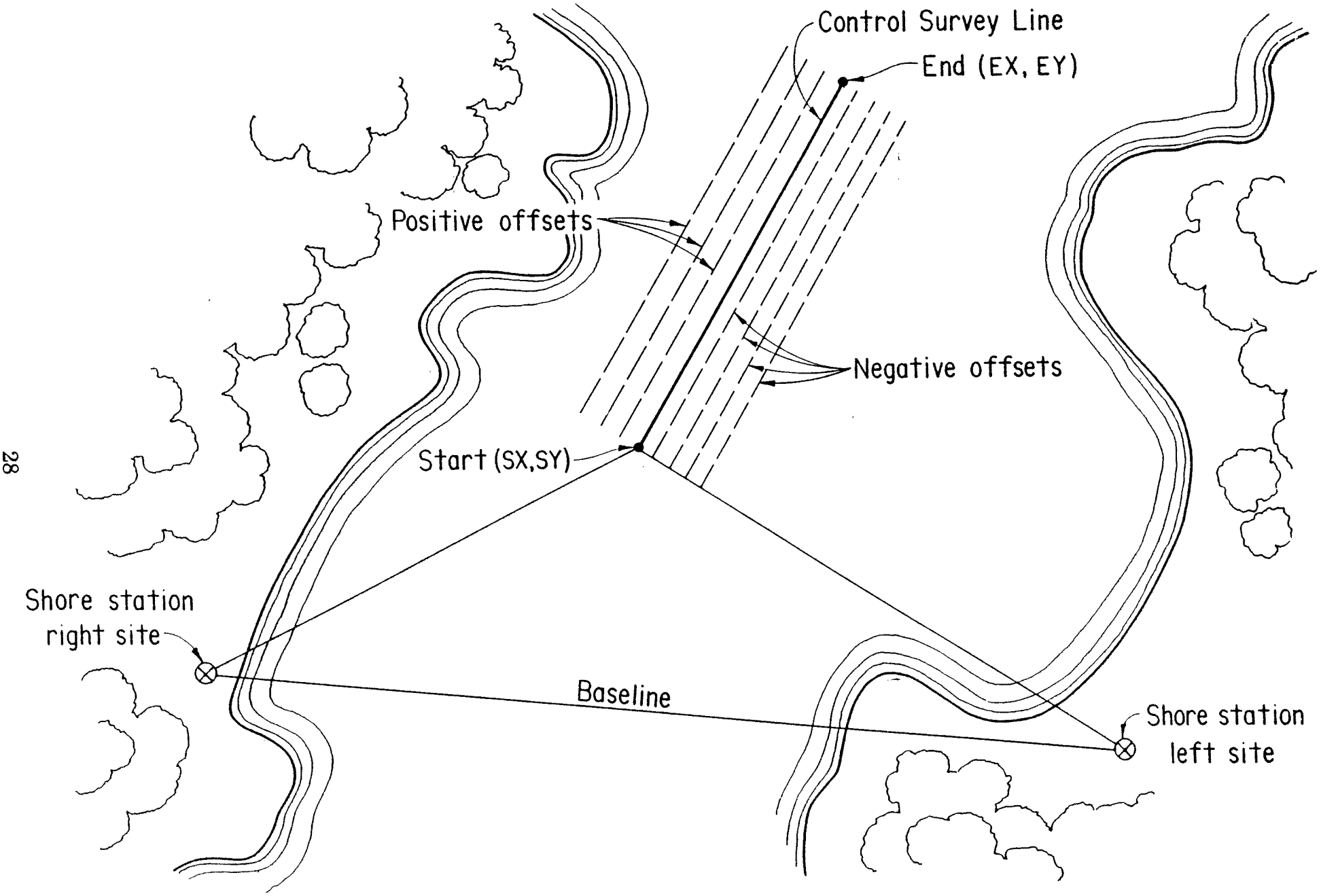
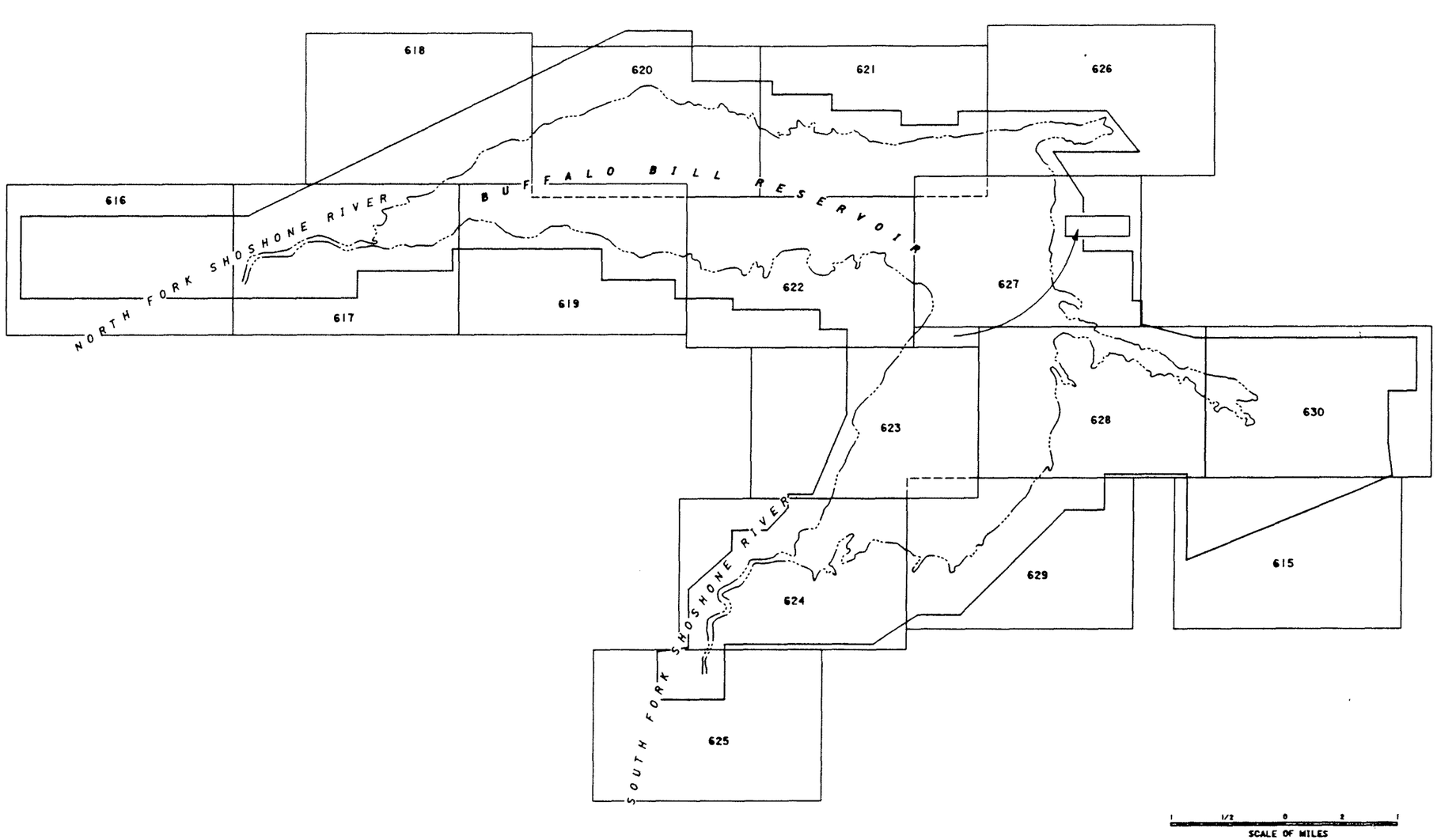


Figure 11 – Typical layout for offset line survey

Figure 12.—Auxiliary work boat



N

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751. RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.A.B.	REVISED TITLE BLOCK
4-10-87 D - J.A.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS. LTR. DATED 3-24-87.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
INDEX MAP

RECOMMENDED J.A.B.	TECHNICAL APPROVAL R.I. Strand	
DRAWN E.J. Garcia	SUBMITTED R.J. Strand	
CHECKED J.A.B.	APPROVED M.L. Hyatt	CHIEF, ENGINEERING BRANCH
DENVER, COLORADO COMPUTER DRAFTING	DEC. 6, 1986	1458-D-688

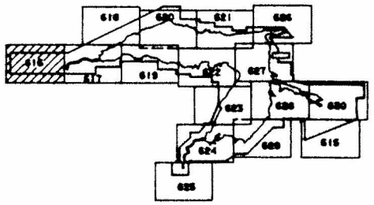
M MR 6 87

Figure 13

E. 336,000 | E. 338,000 | E. 340,000 | E. 342,000 | E. 344,000 | E. 346,000

N. 1,364,000

N. 1,362,000



N

NOTES

Normal high water line - Elevation 5393.5 ft.
Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360.
To convert to U.S.C. and G.S. datum, add 8.69 ft.
--- 5360 Top of existing Conservation Pool.
--- 5393.5 Top of proposed Conservation Pool.

NORTH FORK SHOSHONE RIVER

N. 1,358,000

5400

400 0 400 800 1200
SCALE OF FEET

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

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PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-97 R - I.A.S.	NEW 1988 TITLE BLOCK
4-10-97 R - I.A.S.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS, LTR. DATED 3-21-97.

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BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
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DRAWN R.I. Strand — SUBMITTED R.I. Strand
CHECKED I.A.S. — APPROVED M.L. Hyatt
CHIEF, ENGINEERING BRANCH

DENVER, COLORADO
COMPUTER DRAFTING
DEC. 8, 1988
SHEET 1 OF 16

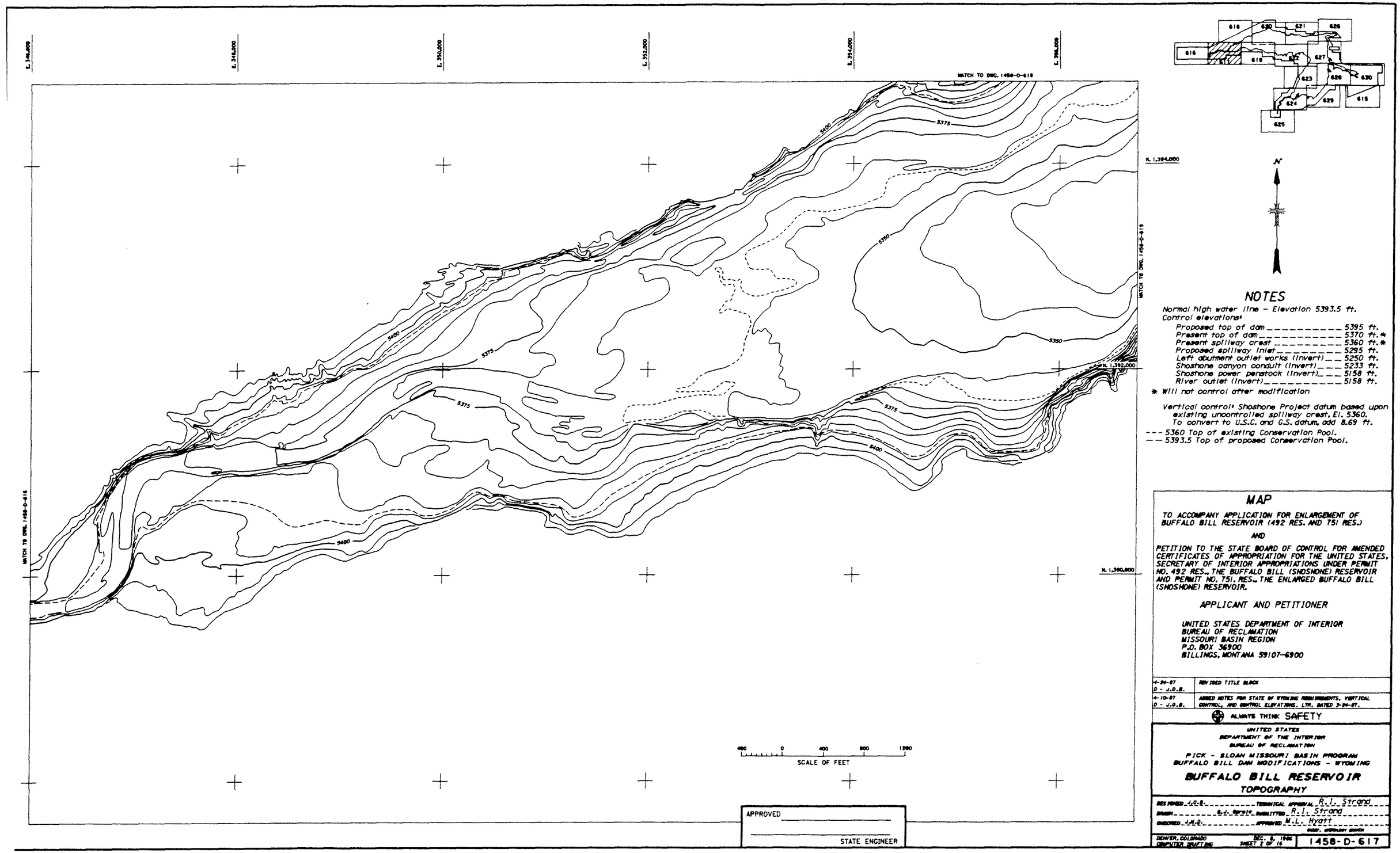
1458-D-616

MOTION TO APPL. 1458-D-617

M MAY 6 '97

K

Figure 14 (Sheet 1 of 16)



N

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Vertical control¹ Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

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ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
TOPOGRAPHY

DES REVISED J.O.B.	TECHNICAL APPROVAL	R.I. Strand
DRAWN	SUBMITTED	R.I. Strand
CHECKED J.M.D.	APPROVED	M.L. Hyatt
		CHIEF, HYDROLOGY BRANCH

DENVER, COLORADO COMPUTER DRAFTING | DEC. 6, 1986 SHEET 2 OF 16 | 1458-D-617

APPROVED _____
STATE ENGINEER

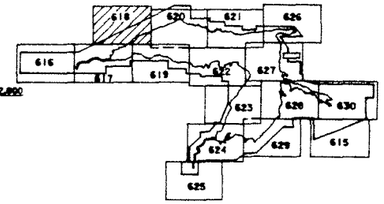
Figure 14 (Sheet 2 of 16)

E. 350,000 E. 352,000 E. 354,000 E. 356,000 E. 358,000 E. 360,000

N. 1,402,880

N. 1,400,880

N. 1,398,880



N

NOTES

Normal high water line - Elevation 5393.5 ft.
Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

MATCH TO DWG. 1456-D-520

MATCH TO DWG. 1456-D-517

5400
5375
5380

400 0 400 800 1200
SCALE OF FEET

APPROVED _____

_____
STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.O.B.	REVISED TITLE BLOCK
4-10-87 D - J.O.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DES. DRAWN J.O.B. TECHNICAL APPROVAL R.I. Strand
DRAWN D.D. Brulard SUBMITTED R.I. Strand
CHECKED J.A.D. APPROVED M.L. Hyatt
CHIEF, HYDROLOGY BRANCH

DENVER, COLORADO COMPUTER DRAFTING DEC. 8, 1986 SHEET 3 OF 16 1456-D-618

Figure 14 (Sheet 3 of 16)

E. 356,000 E. 360,000 E. 362,000 E. 364,000 E. 366,000

MATCH TO DWG. 1458-D-620

MATCH TO DWG. 1458-D-617

MATCH TO DWG. 1458-D-622

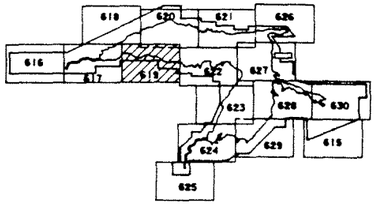
N. 1,394,000

N. 1,392,000

N. 1,390,000

N. 1,388,000

5360 5375 5400 5350 5325 5300



N

NOTES

Normal high water line - Elevation 5393.5 ft.
Control elevations¹

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

400 0 400 800 1200
SCALE OF FEET

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751. RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.O.B.	REVISED TITLE BLOCK
4-10-87 D - J.O.B.	ADDED NOTES PER STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

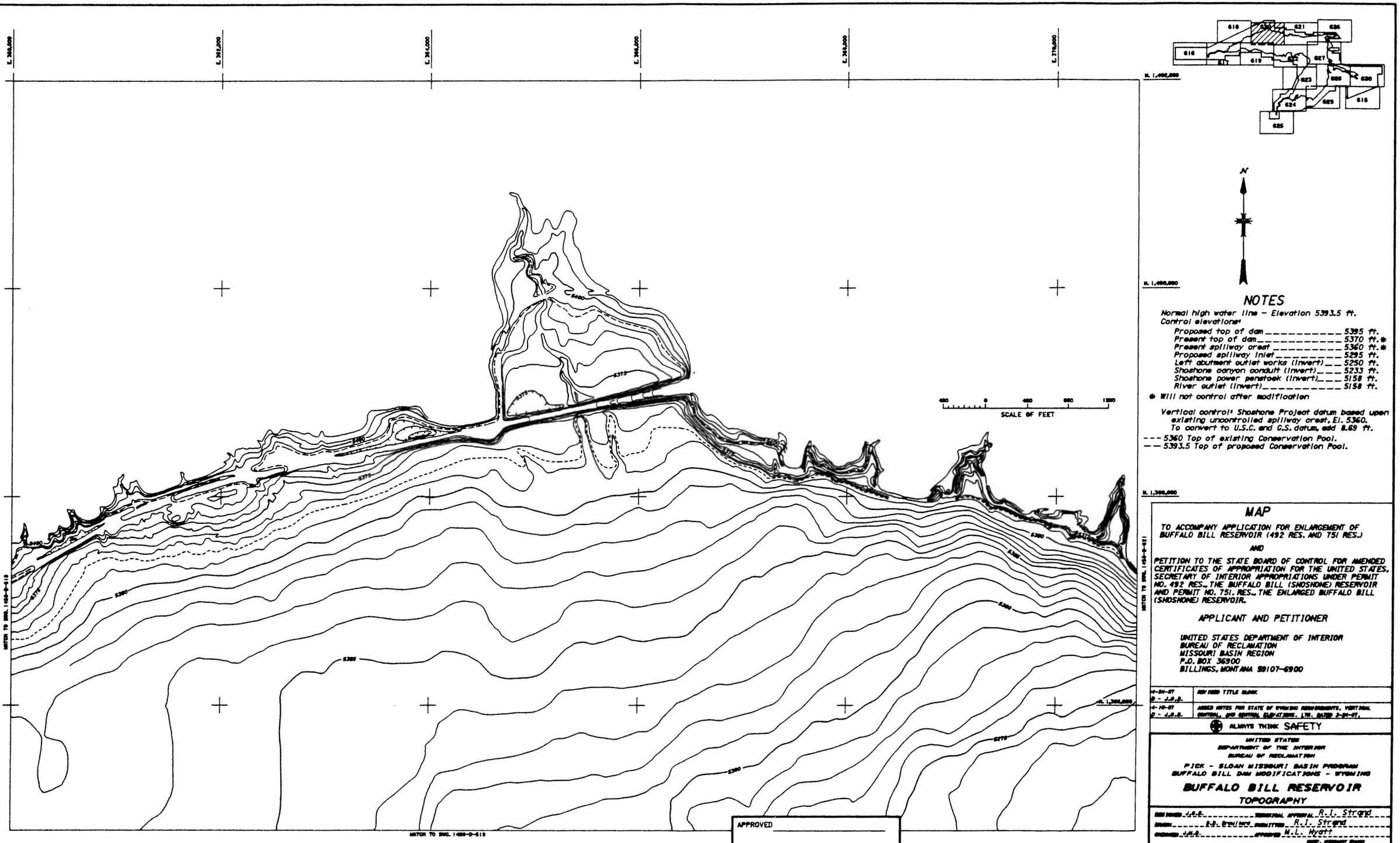
PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
TOPOGRAPHY

DESIGNED J.O.B. TECHNICAL APPROVAL R.I. Strand
DRAWN D.J. Sprain SUBMITTED R.L. Strand
CHECKED J.M.D. APPROVED M.L. Hyatt
CHIEF, HYDROLOGY BRANCH

DENVER, COLORADO COMPUTER DRAFTING | DEC. 8, 1986 SHEET 4 OF 16 | 1458-D-619

Figure 14 (Sheet 4 of 16)



NOTES

Normal high water line – Elevation 5393.5 ft.
Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360.
To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-97 D - J.D.S.	REVISED TITLE BLOCK
4-10-97 D - J.D.S.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-21-97.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

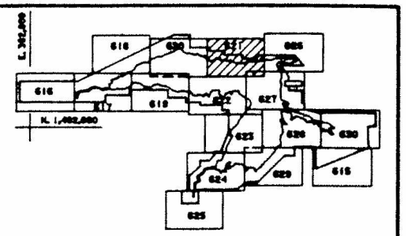
TOPOGRAPHY

DESIGNED J.D.S.	REGIONAL APPROVAL R.L. Strand
DRAWN D.D. Graney	SUBMITTED R.L. Strand
CHECKED J.A.S.	APPROVED M.L. Hyatt
DENVER, COLORADO DIRECTORY, DRAFTING	DEC. 8, 1982 SHEET 5 OF 16

1458-D-620

Figure 14 (Sheet 5 of 16)

E. 372,000 E. 374,000 E. 376,000 E. 378,000 E. 380,000



N. 1,402,000

N

N. 1,398,000

From Section Corner $\frac{4|3}{9|10}$, T. 52 N, R. 103 W. ; S. 89° 08' 35" E. ; 14,256.2'

N. 1,394,000

400 0 400 800 1200
SCALE OF FEET

MATCH TO DWG. 1458-D-622

MATCH TO DWG. 1458-D-627

MATCH TO DWG. 1458-D-620

MATCH TO DWG. 1458-D-626

NOTES

Normal high water line – Elevation 5393.5 ft.
Control elevations:

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
—— 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 B - J.O.S.	NEW STYLE TITLE BLOCK
4-10-87 B - J.O.S.	ADDED NOTES FOR STATE OF WYOMING RESERVOIRS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. CHANGED TXT. LTR. DATED 3-31-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

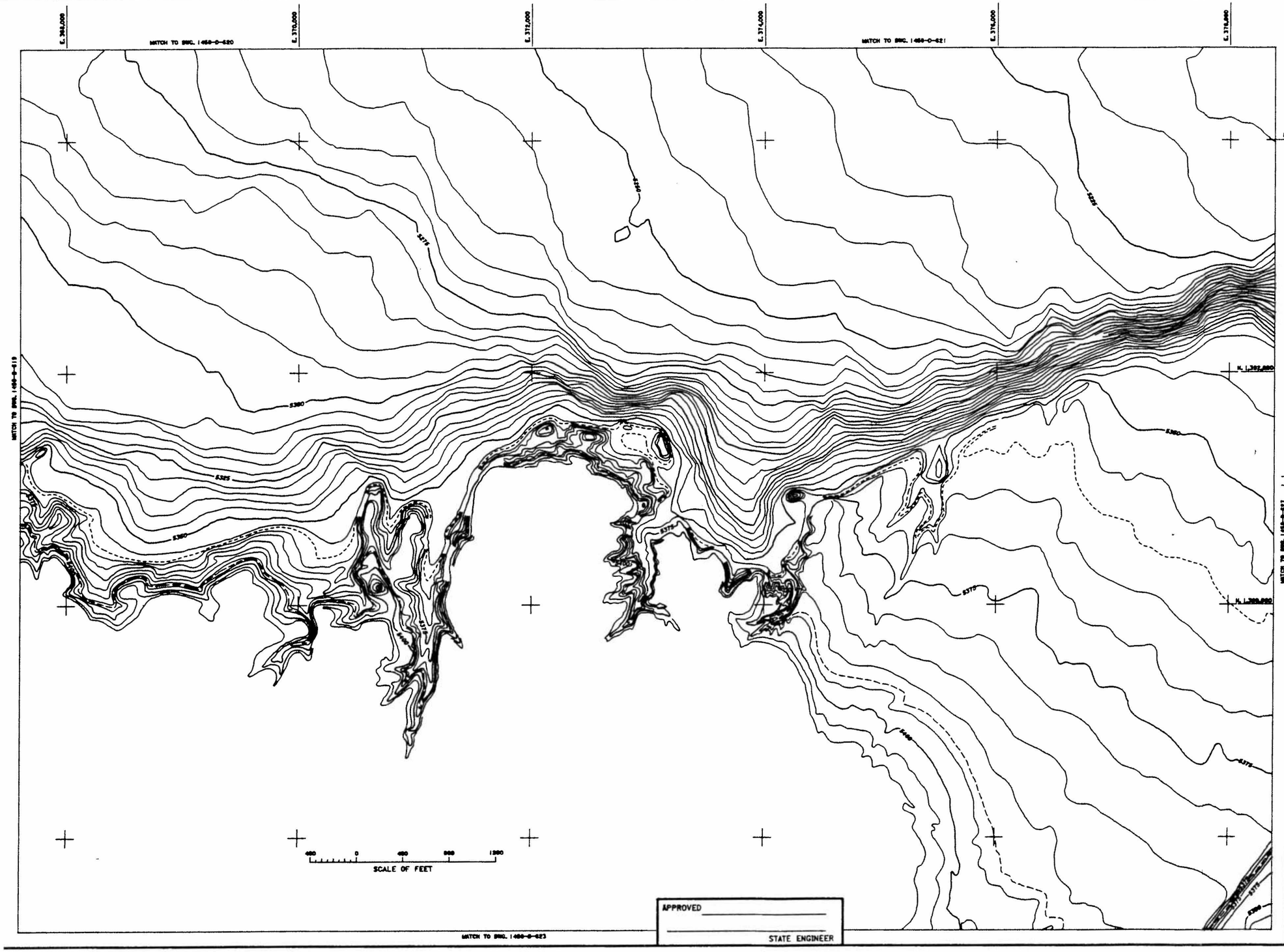
TOPOGRAPHY

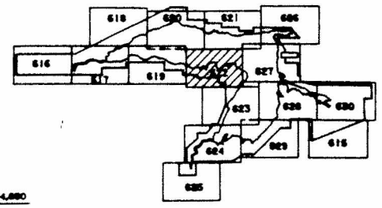
DES. ISSUED J.O.S.	TECHNICAL APPROVAL R.I. Strand	
DRAWN E.J. Garcia	SUBMITTED R.I. Strand	
CHECKED J.A.E.	APPROVED M.L. Hyatt	CHIEF, ENGINEERING DIVISION
DENVER, COLORADO COMPUTER DRAFTING	DEC. 6, 1982 SHEET 6 OF 16	1458-D-621

APPROVED

STATE ENGINEER

Figure 14(Sheet 6 of 16)





NOTES

Normal high water line – Elevation 5393.5 ft.

Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5290 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.

— — 5393.5 Top of proposed Conservation Pool.

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - U.S.B.	REVISED TITLE BLOCK
4-10-87 D - U.S.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
TOPOGRAPHY

DES. RVWED. J.D.S. — TECHNICAL APPROVAL R.J. Strand
DRAWN R.J. Strand — SUBMITTED R.J. Strand
CHECKED J.D.S. — APPROVED M.L. Hyatt
REGIONAL DIRECTOR

BOWSER, COLORADO — DIRECTOR, DRAFTING — DEC. 3, 1986 — SHEET 7 OF 16

1458-D-622

M NOV 6 '87

Figure 14 (Sheet 7 of 16)

E. 374,000 E. 378,000 E. 378,000 E. 380,000 E. 382,000

MATCH TO DWG. 1456-D-622

N. 1,386,000 N. 1,384,000 N. 1,382,000 N. 1,380,000

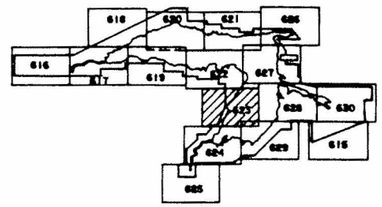
MATCH TO DWG. 1456-D-624 MATCH TO DWG. 1456-D-623

5400 5375 5370 5360 5300 5250 5233 5200

SCALE OF FEET 400 0 400 800 1200

APPROVED

STATE ENGINEER



N

NOTES

Normal high water line – Elevation 5393.5 ft.
Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360.
To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-84-87 D-J.G.S.	NEW NEED TITLE BLOCK
4-10-87 D-J.G.S.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS, LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DES. MANAGER J.G.S. TECHNICAL APPROVAL R.L. Strand
DRAWN D.J. Garvin SUBMITTED R.L. Strand
CHECKED J.G.S. APPROVED M.L. Hyatt
CHIEF, ENGINEERING BRANCH

DENVER, COLORADO COMPUTER PRINTING DEC. 6, 1965 SHEET 8 OF 16

1456-D-623

M MW 6 '87

K

Figure 14 (Sheet 8 of 16)

E. 368,000 E. 370,000 E. 372,000 E. 374,000 E. 376,000 E. 378,000

MATCH TO DWG. 1458-D-623

N. 1,380,800

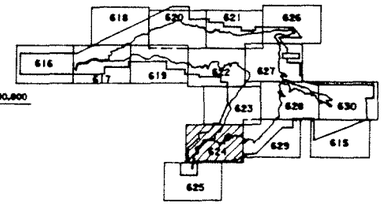
N. 1,378,000

N. 1,376,000

N. 1,374,000

5400 5375 5350

MATCH TO DWG. 1458-D-625



N

NOTES

Normal high water line - Elevation 5393.5 ft.
Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
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Shoshone canyon conduit (Invert)	5233 ft.
Shoshone power penstock (Invert)	5158 ft.
River outlet (Invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360.
To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751. RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.O.B.	REVISED TITLE BLOCK
4-10-87 D - J.O.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DES. REVISED J.O.B.	TECHNICAL APPROVAL R.J. Strand
DRAWN E.J. Bergin	SUBMITTED R.J. Strand
CHECKED J.A.D.	APPROVED M.L. Hyatt
DENVER, COLORADO COMPUTER DRAFTING	DEC. 8, 1986 SHEET 9 OF 16

1458-D-624

400 0 400 800 1200
SCALE OF FEET

APPROVED _____

_____
STATE ENGINEER

Figure 14 (Sheet 9 of 16)

E. 364,000 E. 366,000 E. 368,000 E. 370,000 E. 372,000 E. 374,000

N. 1,372,000 N. 1,370,000 N. 1,368,000

MATCH TO DWG. 1458-D-624

5393.5

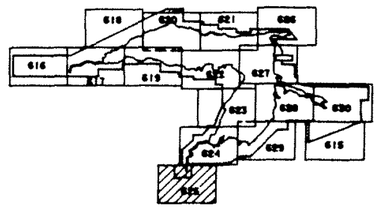
5400

SOUTH FORK SHOSHONE RIVER

400 0 400 800 1200
SCALE OF FEET

APPROVED

STATE ENGINEER



N

NOTES

Normal high water line - Elevation 5393.5 ft.
Control elevations¹

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control¹ Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-97 B - J.D.S.	REVISED TITLE BLOCK
4-10-97 B - J.D.S.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-97.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DESIGNED J.D.S. TECHNICAL APPROVAL R.I. Strand
DRAWN K.J. Gerrie SUBMITTED R.I. Strand
CHECKED J.D.S. APPROVED M.L. Hyatt
SUPERV. ENGINEERING DESIGN

SURVEY, ENLARGED DEC. 6, 1988
CONSTRUCT. DRAFTING SHEET 10 OF 16

1458-D-625

M MR 4 '97

Figure 14 (Sheet 10 of 16)

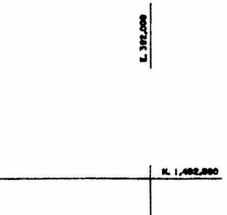
E. 342,000 E. 344,000 E. 346,000 E. 348,000 E. 350,000 E. 352,000

N. 1,402,000

N. 1,400,000

N. 1,398,000

N. 1,396,000



N

To Section Corner
T. 52 N.,R. 103 W.

4 | 3
9 | 10

SHOSHONE RIVER

5400 5375 5350 5325 5300 5275 5250

SCALE OF FEET
400 0 400 800 1200

MATCH TO DWG. 1458-D-627

MATCH TO DWG. 1458-D-627

NOTES

Normal high water line – Elevation 5393.5 ft.
Control elevations*

Proposed top of dam	5395 ft.
Present top of dam	5370 ft.*
Present spillway crest	5360 ft.*
Proposed spillway inlet	5295 ft.
Left abutment outlet works (invert)	5250 ft.
Shoshone canyon conduit (invert)	5233 ft.
Shoshone power penstock (invert)	5158 ft.
River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

CERTIFICATE OF ENGINEER

State of Wyoming

I, David G. Wilde, of Mills, Wyoming, hereby certify that these maps were prepared by Bureau of Reclamation personnel in our Cody, Billings, and Denver offices, and accurately show the locations, elevation contours, and capacities for the proposed enlargement of the existing Buffalo Bill Dam and Reservoir. The maps were prepared primarily from aerial photos and field surveys done in 1980 and 1986.

Engineer, Bureau of Reclamation
Wyoming Registration No. 563

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D-J.G.S.	REVISED TITLE BLOCK
4-10-87 D-J.G.S.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTOUR ELEVATIONS. CHANGED TIE AND CORRECTED CONTOURS. LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
TOPOGRAPHY

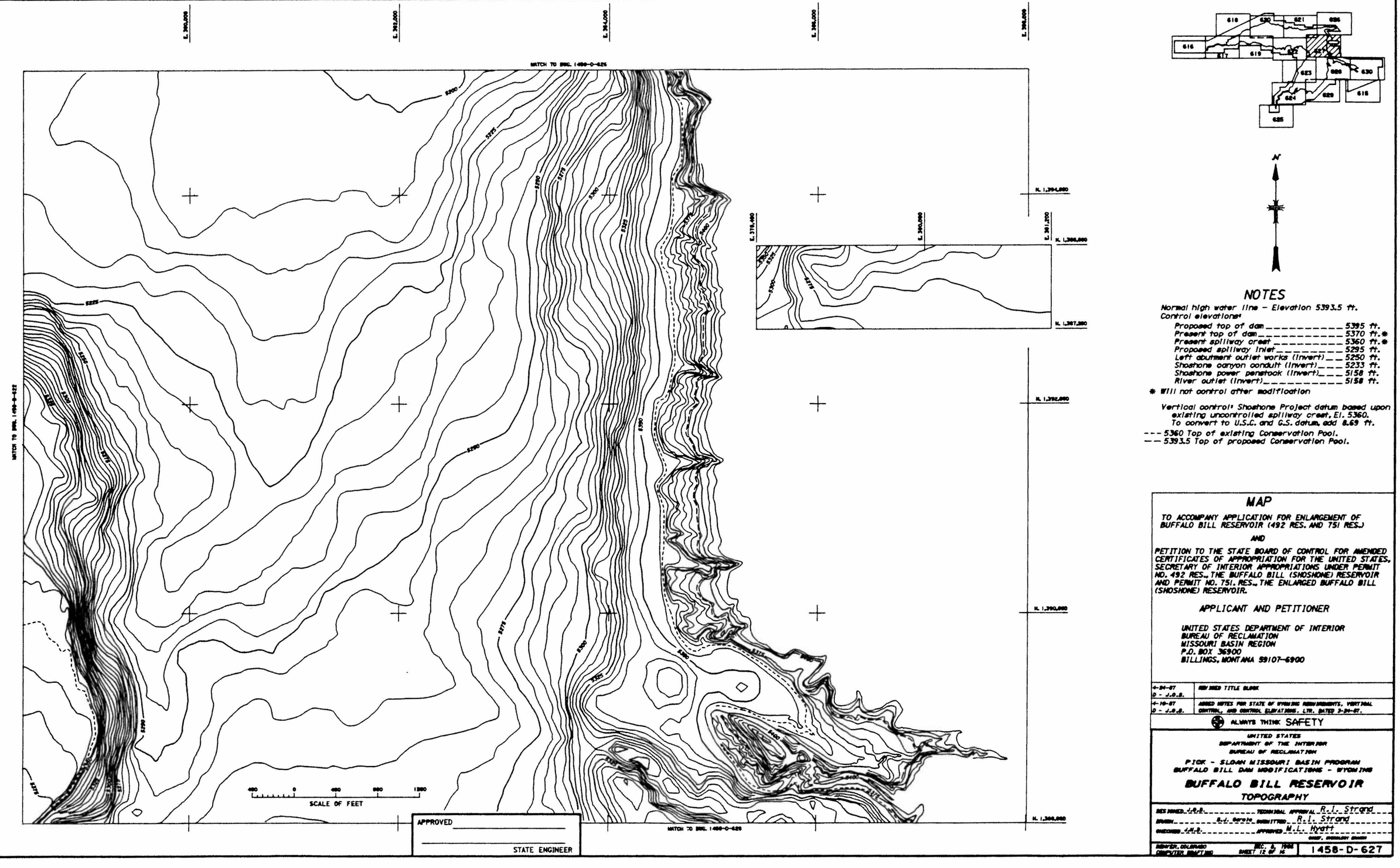
DES. BASED J.G.S. TECHNICAL APPROVAL R.I. Strand
DRAWN E.J. Gerdis SUBMITTED R.I. Strand
CHECKED J.G.S. APPROVED M.L. Hyatt
CHIEF, ENGINEERING BRANCH
DENVER, COLORADO COMPUTER DRAFTING DEC. 5 1988 SHEET 11 OF 16

1458-D-626

M MAY 6 '87

K

Figure 14 (Sheet 11 of 16)



NOTES

Normal high water line – Elevation 5393.5 ft.
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Proposed top of dam	5395 ft.
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River outlet (invert)	5158 ft.

* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.O.S.	REVISED TITLE BLOCK
4-10-87 D - J.O.S.	ADDED NOTES FOR STATE OF WYOMING BASIN BOUNDARYS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

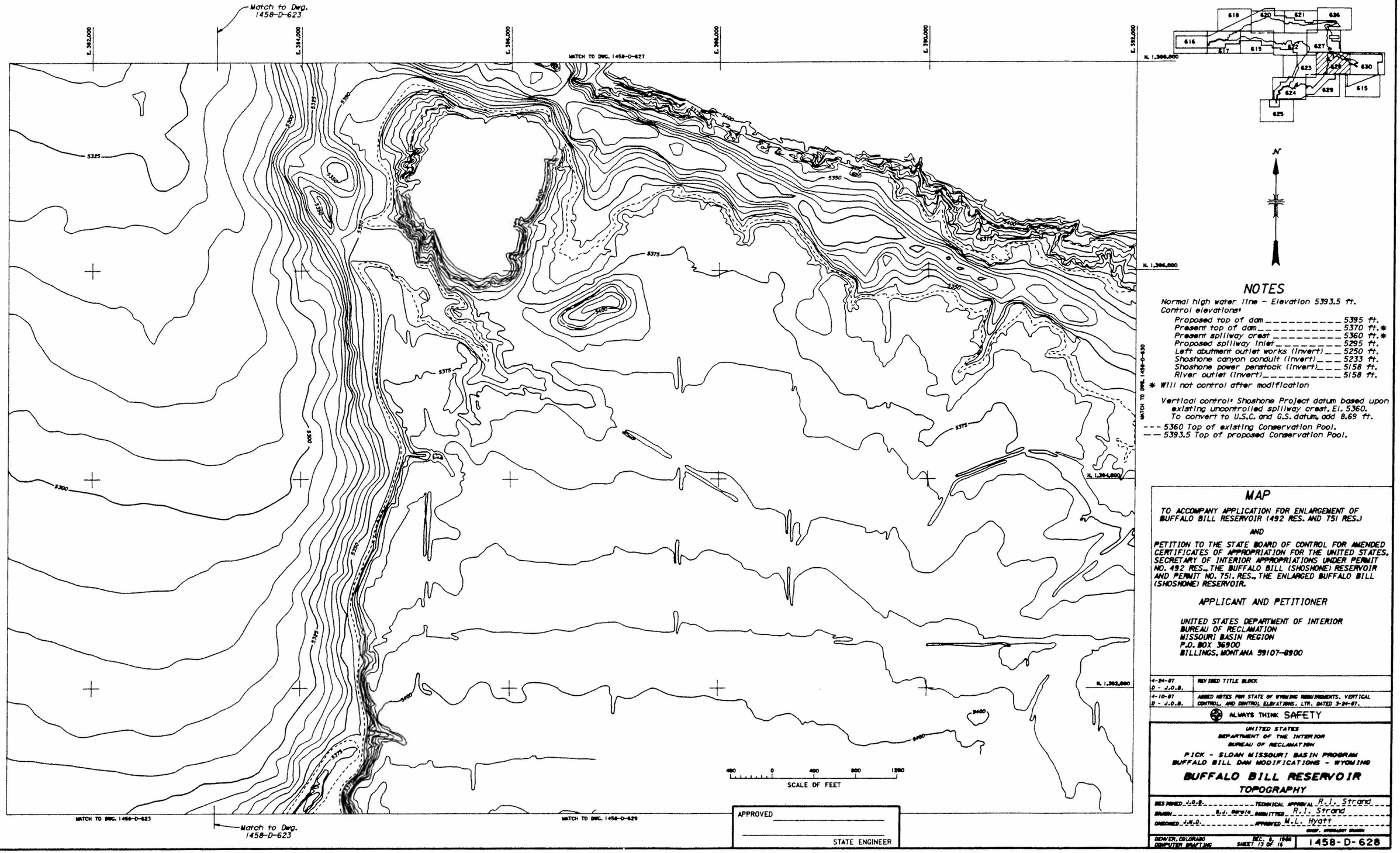
BUFFALO BILL RESERVOIR
TOPOGRAPHY

DES. MANAGER J.O.S.		TECHNICAL APPROVAL R.I. Strand	
DRAWN R.J. Garvin	SUBMITTED R.I. Strand		
CHECKED J.A.S.	APPROVED M.L. Hyatt		
		CHIEF, HYDROLOGY BRANCH	
DENVER, COLORADO COMPUTER-DRAFTED	DEC. 6, 1986	SHEET 12 OF 16	1458-D-627

NOV 6 '87

K

Figure 14 (Sheet 12 of 16)



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— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751. RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.O.B.	REVISED TITLE BLOCK
4-10-87 D - J.O.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

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UNITED STATES
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BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR
TOPOGRAPHY

DES. MINED J.O.B.	TECHNICAL APPROVAL R.J. Strand	
DRAWN B.J. Bargle	SUBMITTED R.J. Strand	
CHECKED J.M.D.	APPROVED M.L. Hyatt	CHIEF, HYDRAULIC BRANCH
DENVER, COLORADO COMPUTER DRAFTING	DEC. 8, 1986 SHEET 13 OF 16	1458-D-628

Figure 14 (Sheet 13 of 16)

E. 378,000 E. 380,000 E. 382,000 E. 384,000 E. 386,000 E. 388,000

MATCH TO DWG. 1458-D-628

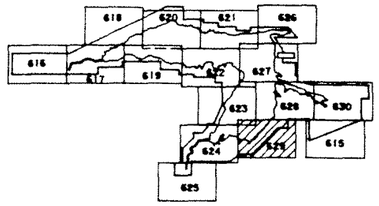
MATCH TO DWG. 1458-D-624

N. 1,380,000

N. 1,378,000

N. 1,376,800

5325 5350 5375 5400



N

NOTES

Normal high water line - Elevation 5393.5 ft.
Control elevations:

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* Will not control after modification

Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

400 0 400 800 1200
SCALE OF FEET

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D - J.O.B.	REVISED TITLE BLOCK
4-10-87 D - J.O.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DESIGNED J.O.B.		TECHNICAL APPROVAL	R.I. Strand
DRAWN	B.J. Gerwig	SUBMITTED	R.I. Strand
CHECKED J.M.P.		APPROVED	M.L. Hyatt
			SUPT., HYDRAULIC BRANCH
DENVER, COLORADO COMPUTER DRAFTING		DEC. 5, 1986 SHEET 14 OF 16	1458-D-629

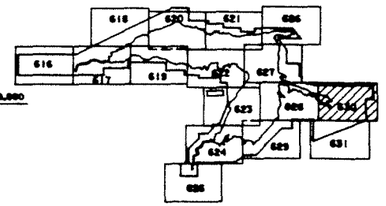
Figure 14 (Sheet 14 of 16)

E. 392,000 E. 394,000 E. 396,000 E. 398,000 E. 400,000 E. 402,000

N. 1,366,000 N. 1,364,000 N. 1,362,000

5400 5375 5350

MATCH TO DWG. 1458-D-615



N

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Normal high water line – Elevation 5393.5 ft.
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¹ Vertical control: Shoshone Project datum based upon existing uncontrolled spillway crest, El. 5360. To convert to U.S.C. and G.S. datum, add 8.69 ft.

--- 5360 Top of existing Conservation Pool.
— — 5393.5 Top of proposed Conservation Pool.

SCALE OF FEET

APPROVED

STATE ENGINEER

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751 RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-97 B - J.B.B.	REVISED TITLE BLOCK
4-10-97 B - J.B.B.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL CONTROL, AND CENTRAL MERIDIANS. CHANGED BOUNDARIES. LTR. DATED 3-24-97.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN-MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DES. FINISHED J.B.B. TECHNICAL APPROVAL R.I. Strand
DRAWN B.J. Gerdis SUBMITTED R.I. Strand
CHECKED J.B.B. APPROVED M.L. Hyatt
CHIEF, ENGINEERING DIVISION

DENVER, COLORADO DIRECTOR, DRAFTING DEC. 5, 1996 SHEET 15 OF 16 | 1458-D-630

MATCH TO DWG. 1458-D-615

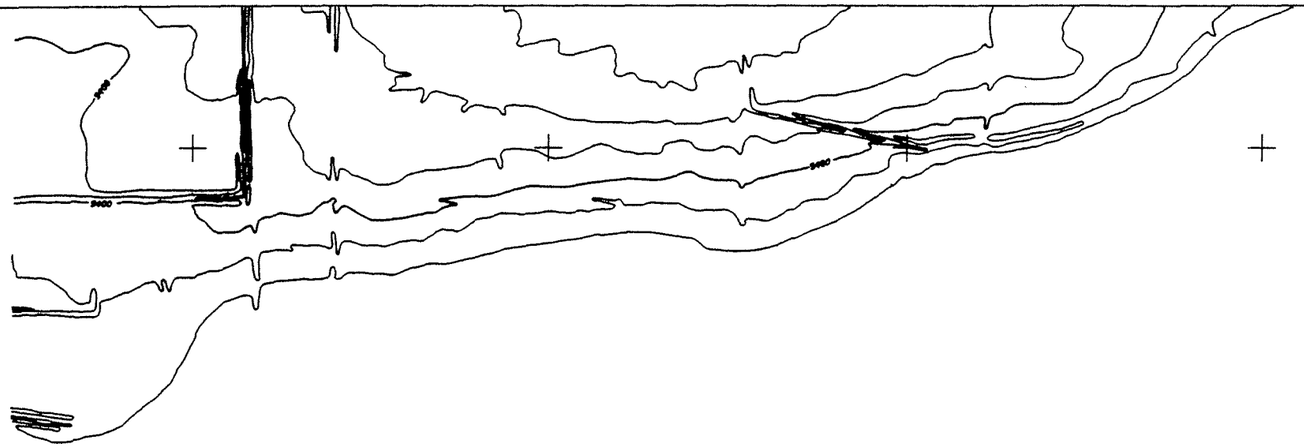
Figure 14 (Sheet 15 of 16)

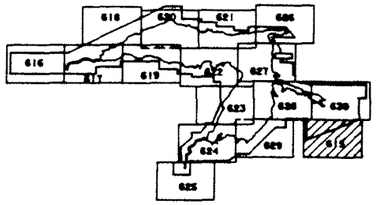
E. 392,000 E. 394,000 E. 396,000 E. 398,000 E. 400,000

MATCH TO DRG. 1456-D-630

N. 1,378,000

N. 1,376,000





N

NOTES

Normal high water line - Elevation 5393.5 ft.
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Proposed top of dam	5395 ft.
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— — 5393.5 Top of proposed Conservation Pool.

MAP

TO ACCOMPANY APPLICATION FOR ENLARGEMENT OF BUFFALO BILL RESERVOIR (492 RES. AND 751 RES.)

AND

PETITION TO THE STATE BOARD OF CONTROL FOR AMENDED CERTIFICATES OF APPROPRIATION FOR THE UNITED STATES, SECRETARY OF INTERIOR APPROPRIATIONS UNDER PERMIT NO. 492 RES., THE BUFFALO BILL (SHOSHONE) RESERVOIR AND PERMIT NO. 751, RES., THE ENLARGED BUFFALO BILL (SHOSHONE) RESERVOIR.

APPLICANT AND PETITIONER

UNITED STATES DEPARTMENT OF INTERIOR
BUREAU OF RECLAMATION
MISSOURI BASIN REGION
P.O. BOX 36900
BILLINGS, MONTANA 59107-6900

4-24-87 D-J.G.S.	REVISED TITLE BLOCK
4-10-87 D-J.G.S.	ADDED NOTES FOR STATE OF WYOMING REQUIREMENTS, VERTICAL DATUM, AND CONTROL ELEVATIONS. LTR. DATED 3-24-87.

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

PICK - SLOAN MISSOURI BASIN PROGRAM
BUFFALO BILL DAM MODIFICATIONS - WYOMING

BUFFALO BILL RESERVOIR

TOPOGRAPHY

DES. DRAWN J.G.S. TECHNICAL APPROVAL R.I. Strand
TRACED R.J. Smith SUBMITTED R.I. Strand
CHECKED J.G.S. APPROVED M.L. Hyatt
CHIEF, ENGINEERING BRANCH

DENVER, COLORADO DEC. 3, 1948
COMPUTER DRAFTED SHEET 16 OF 16

1458-D-615

400 0 400 800 1200
SCALE OF FEET

APPROVED _____

STATE ENGINEER

Figure 14 (Sheet 16 of 16)

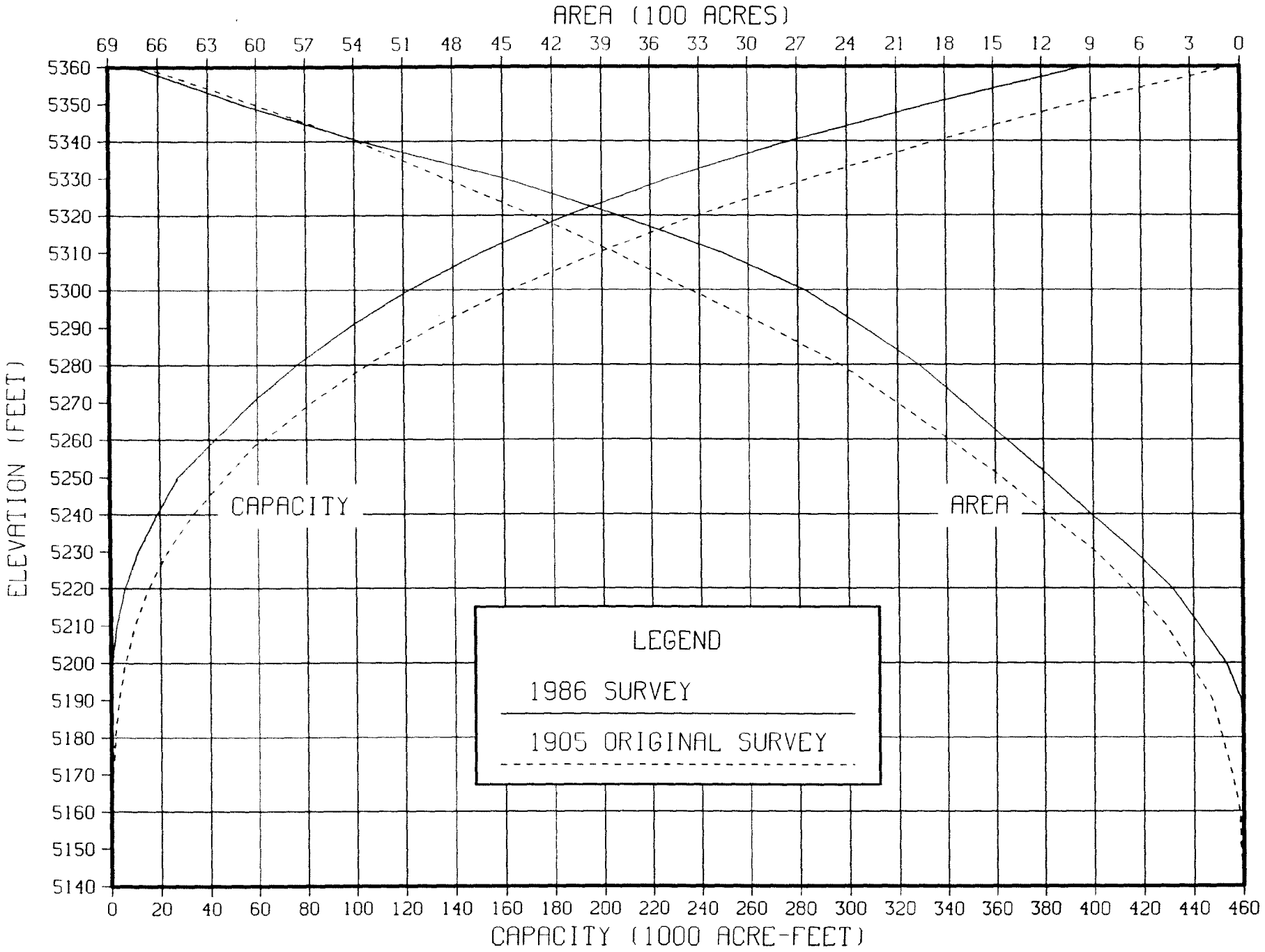

Figure 15 – Area and capacity curves

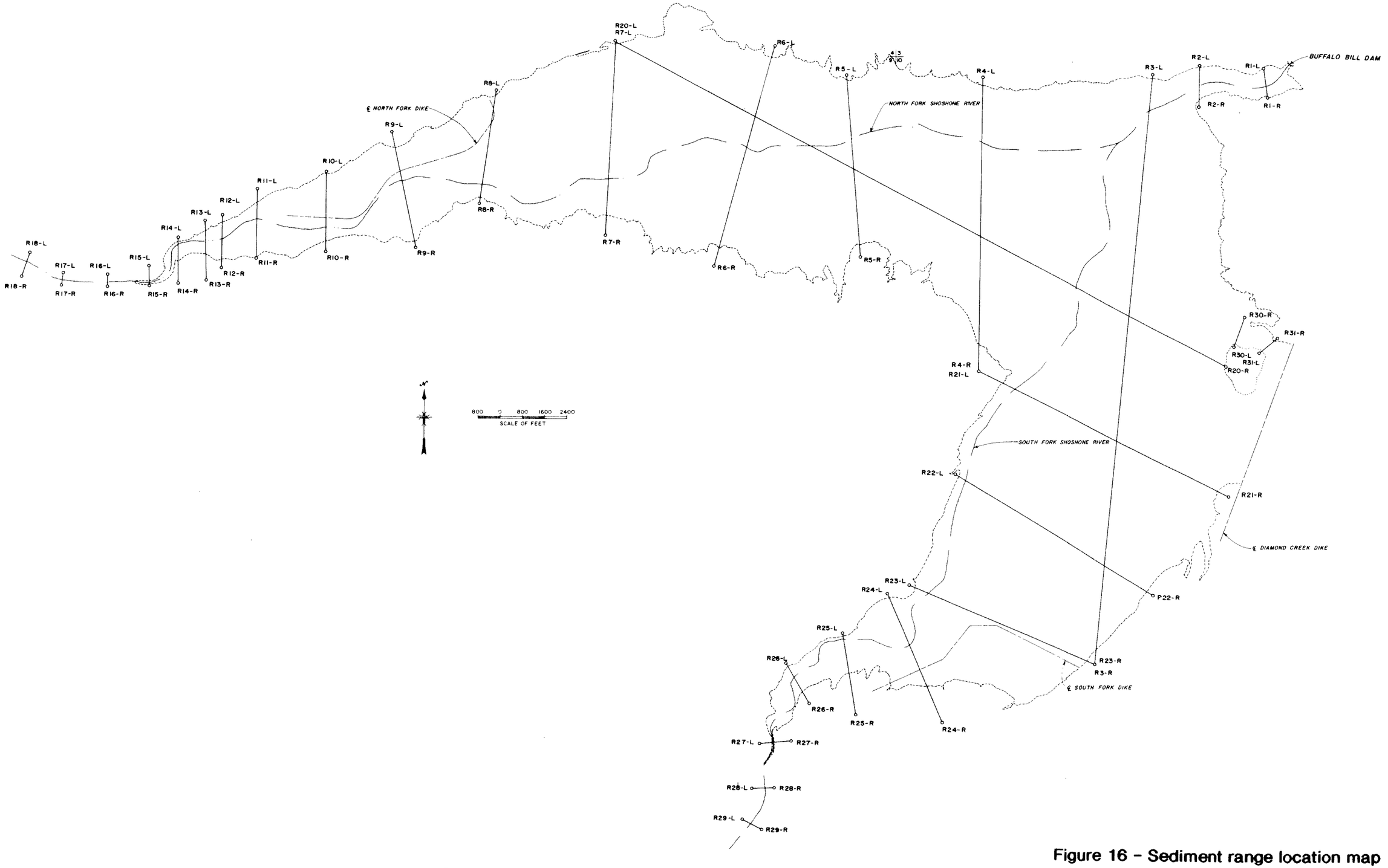

Figure 16 – Sediment range location map

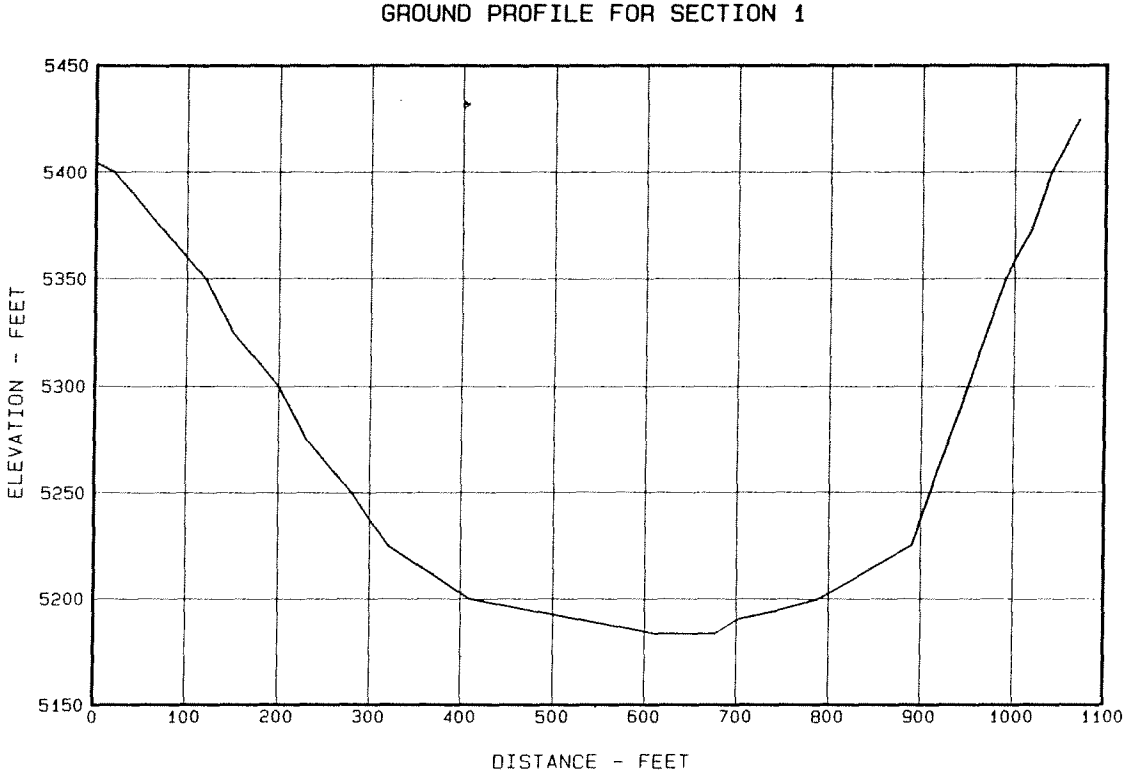

Figure 17 - 1986 Sediment Range 1-North Fork

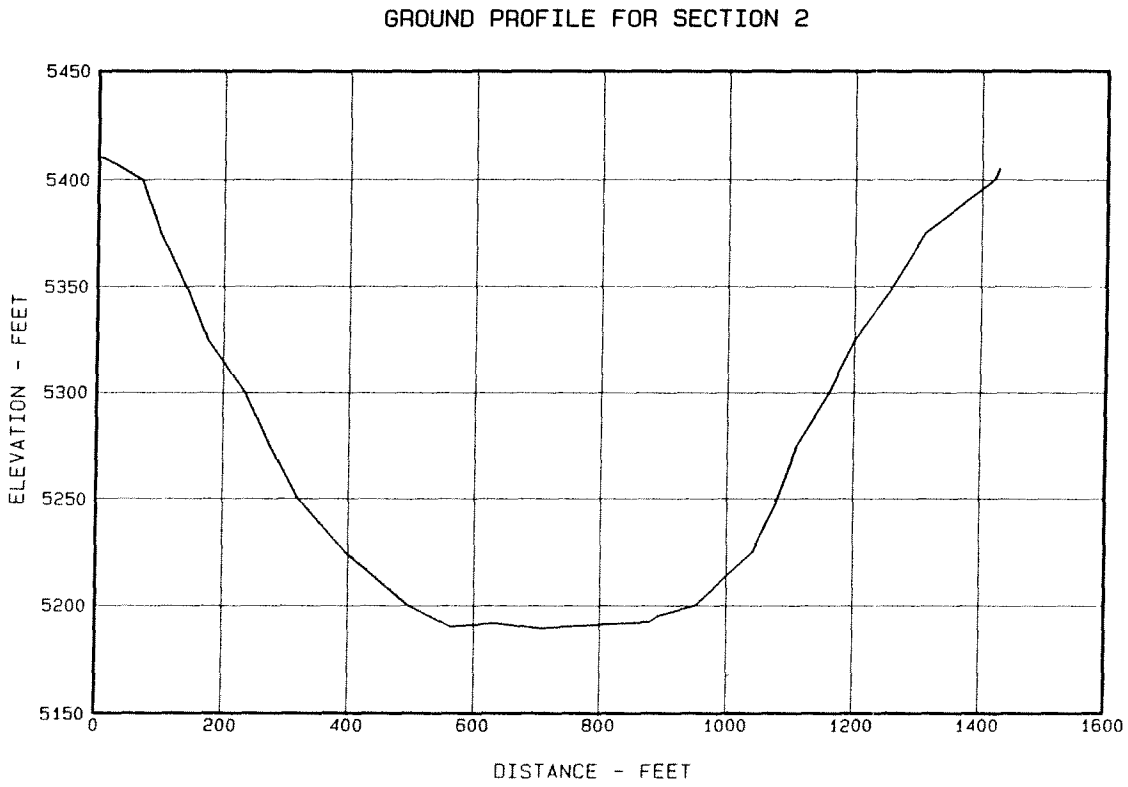

Figure 18 - 1986 Sediment Range 2-North Fork

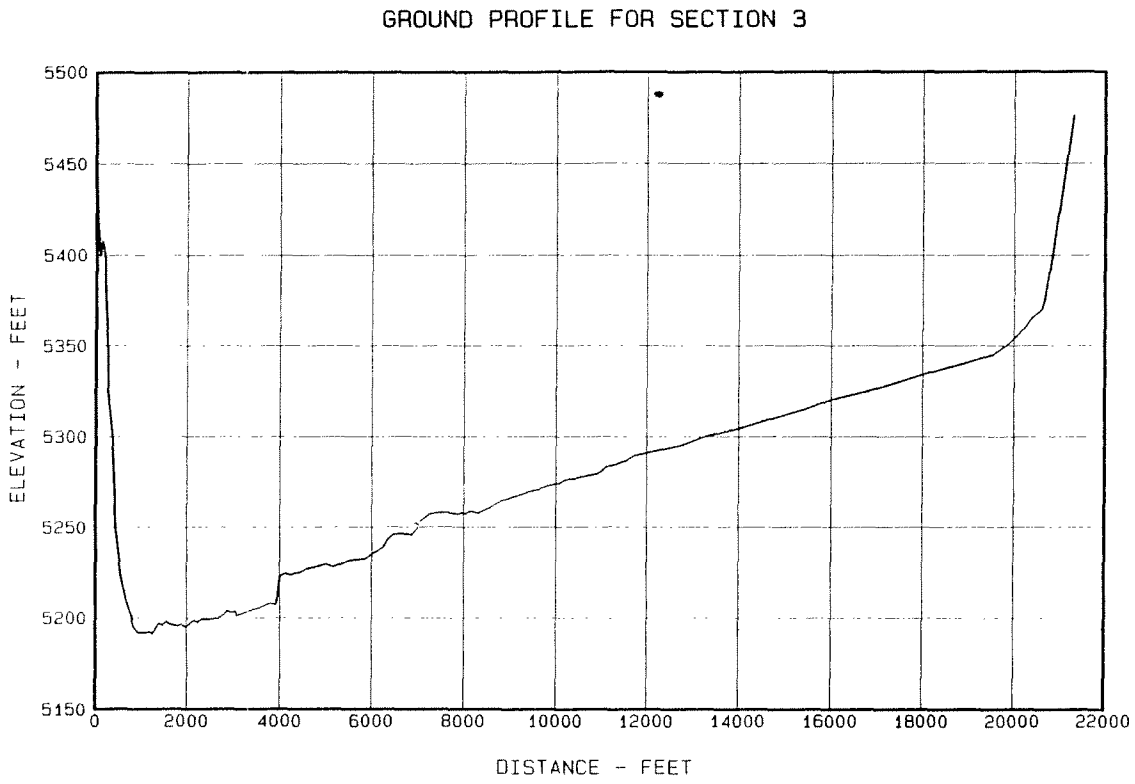

Figure 19 - 1986 Sediment Range 3-North Fork

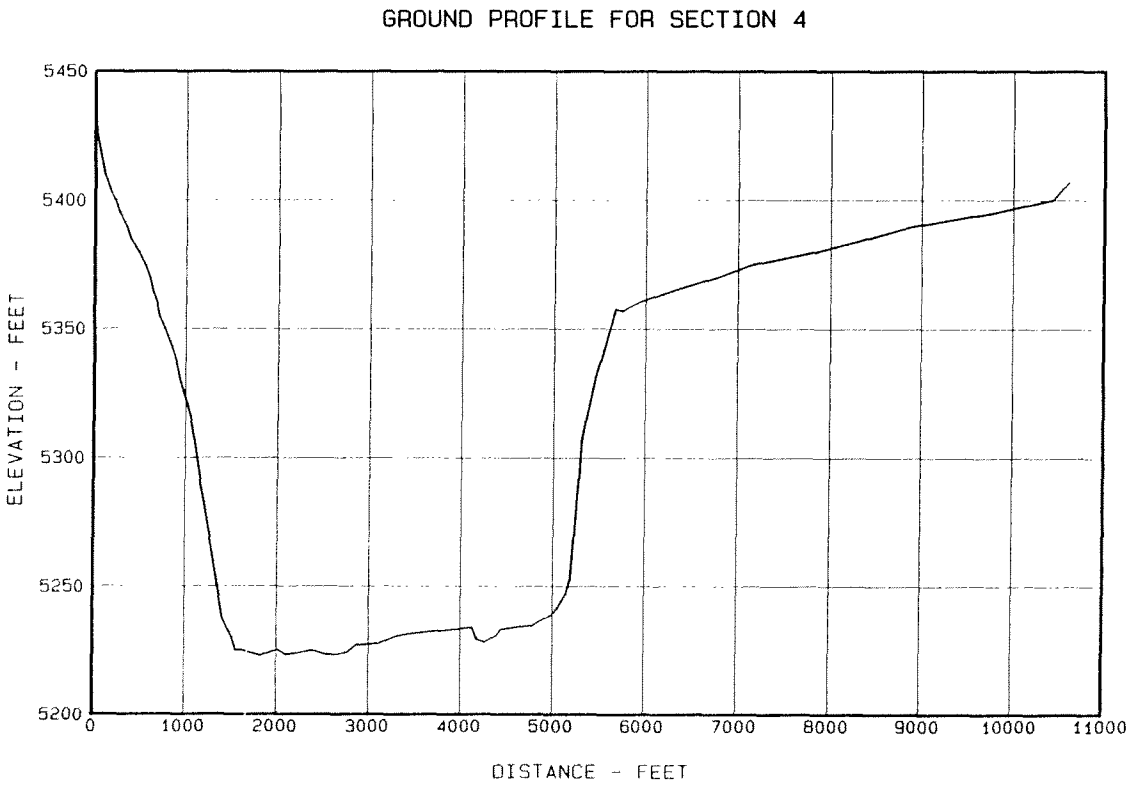

Figure 20 - 1986 Sediment Range 4-North Fork

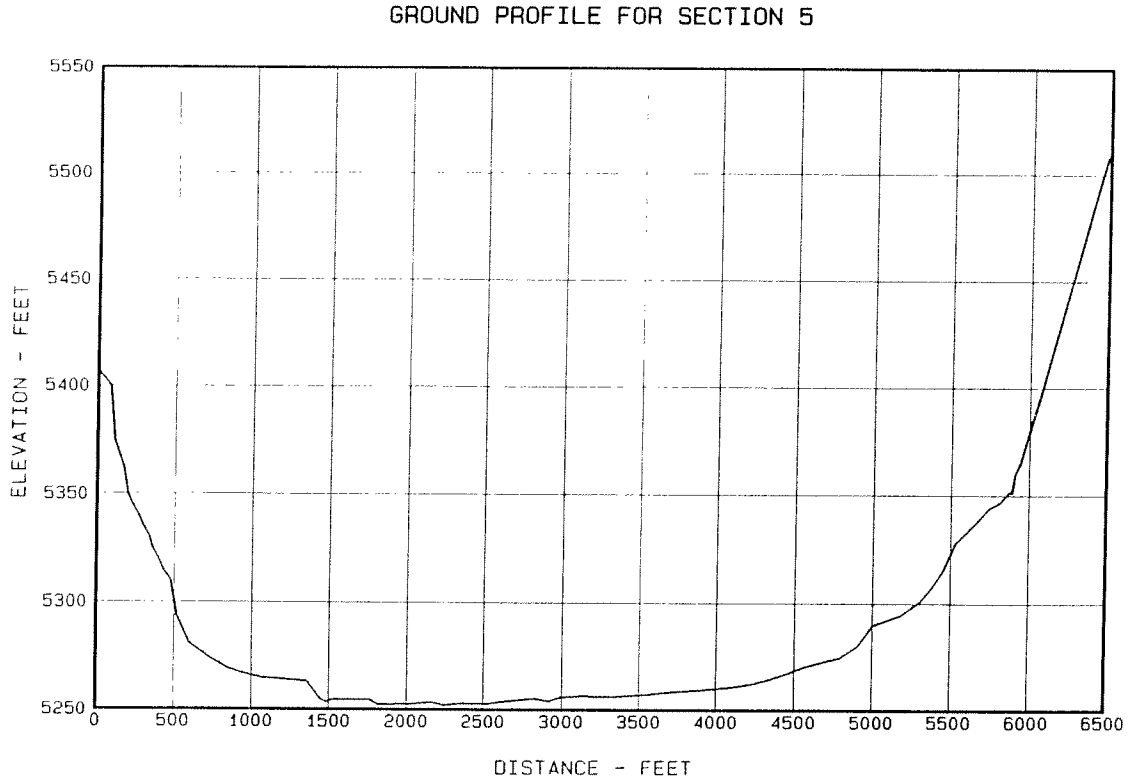

Figure 21 - 1986 Sediment Range 5-North Fork

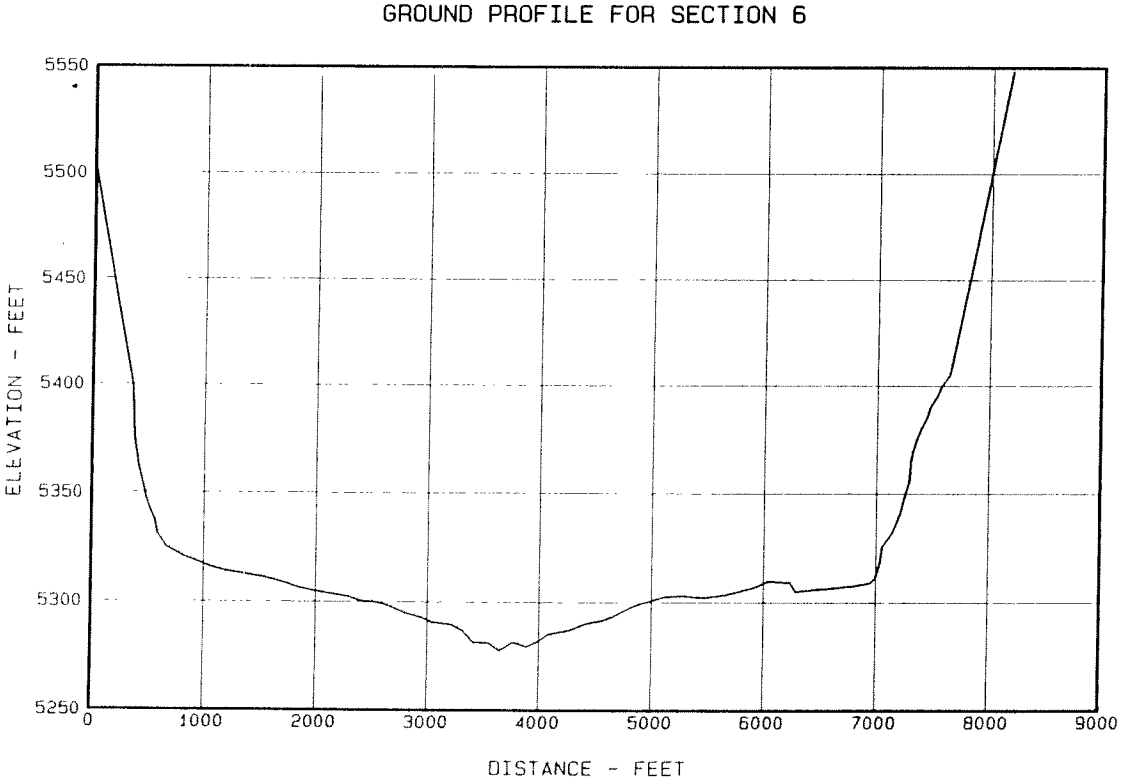

Figure 22 - 1986 Sediment Range 6-North Fork

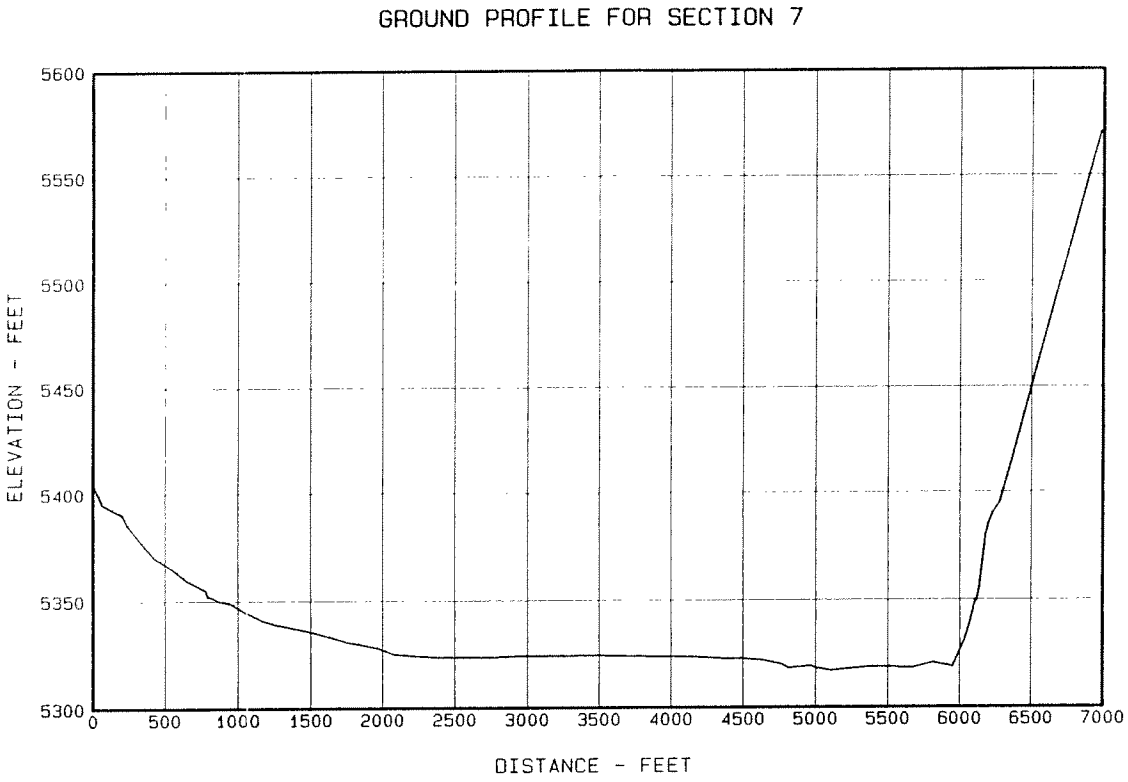

Figure 23 - 1986 Sediment Range 7-North Fork

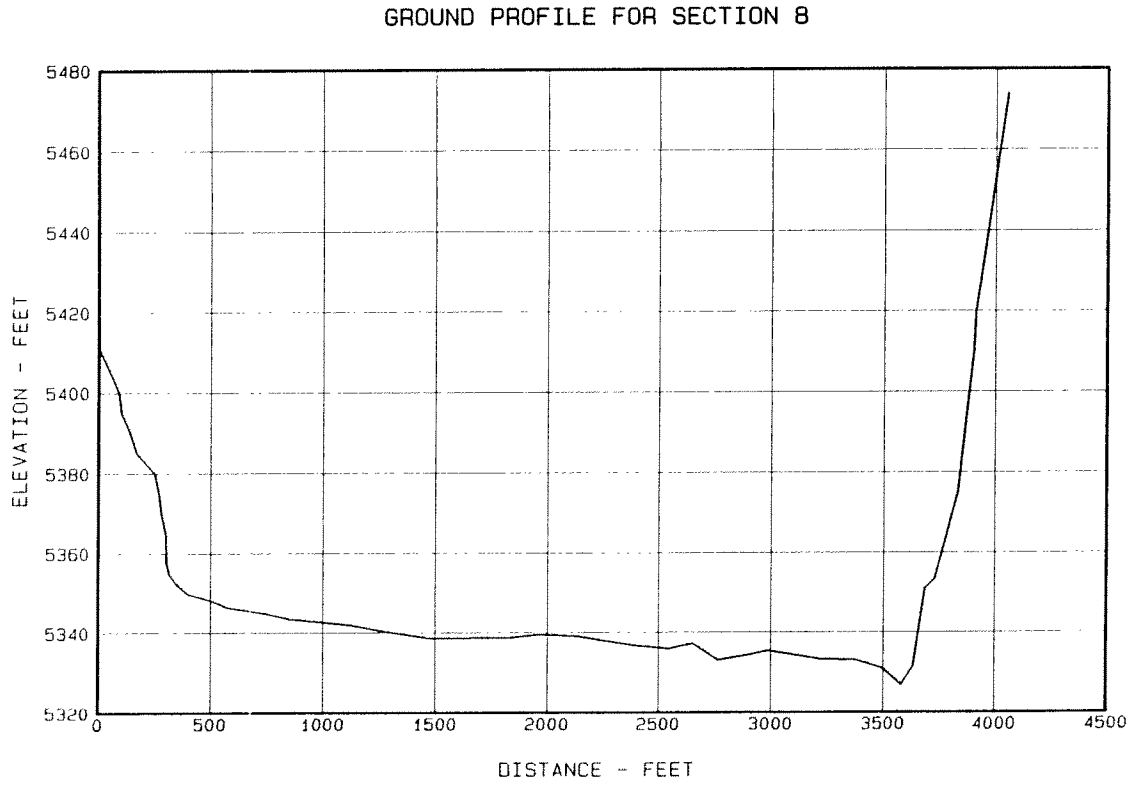

Figure 24 - 1986 Sediment Range 8-North Fork

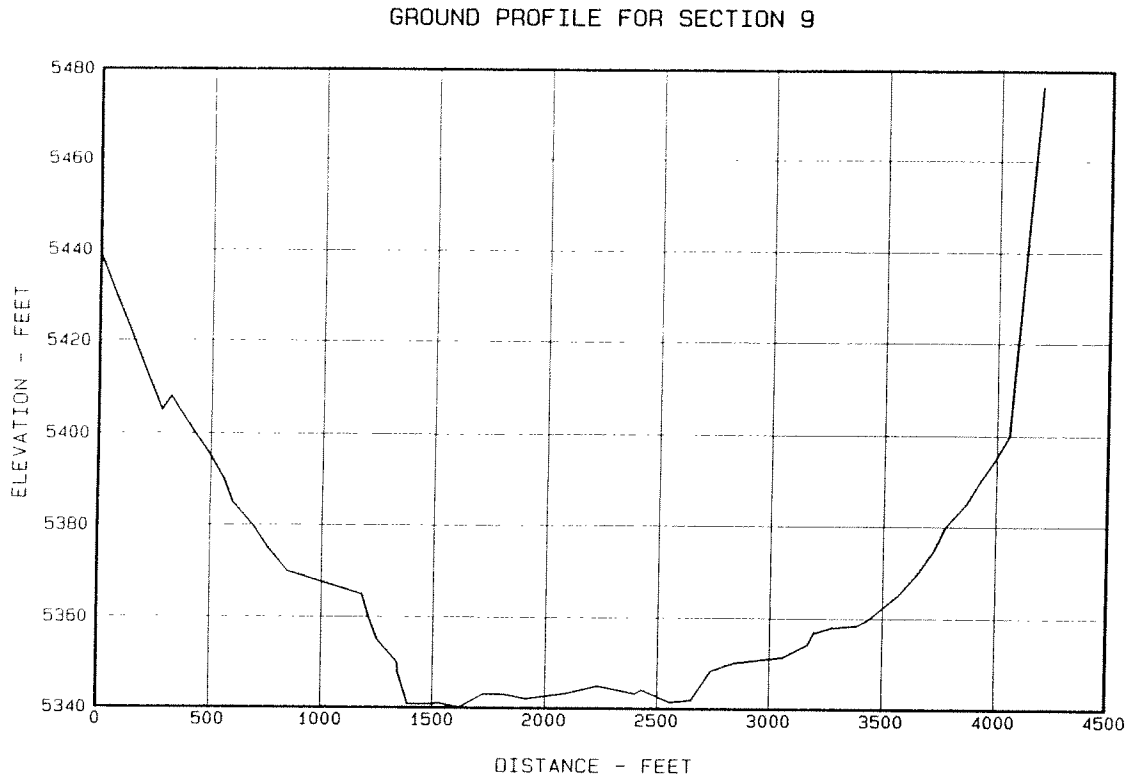

Figure 25 - 1986 Sediment Range 9-North Fork

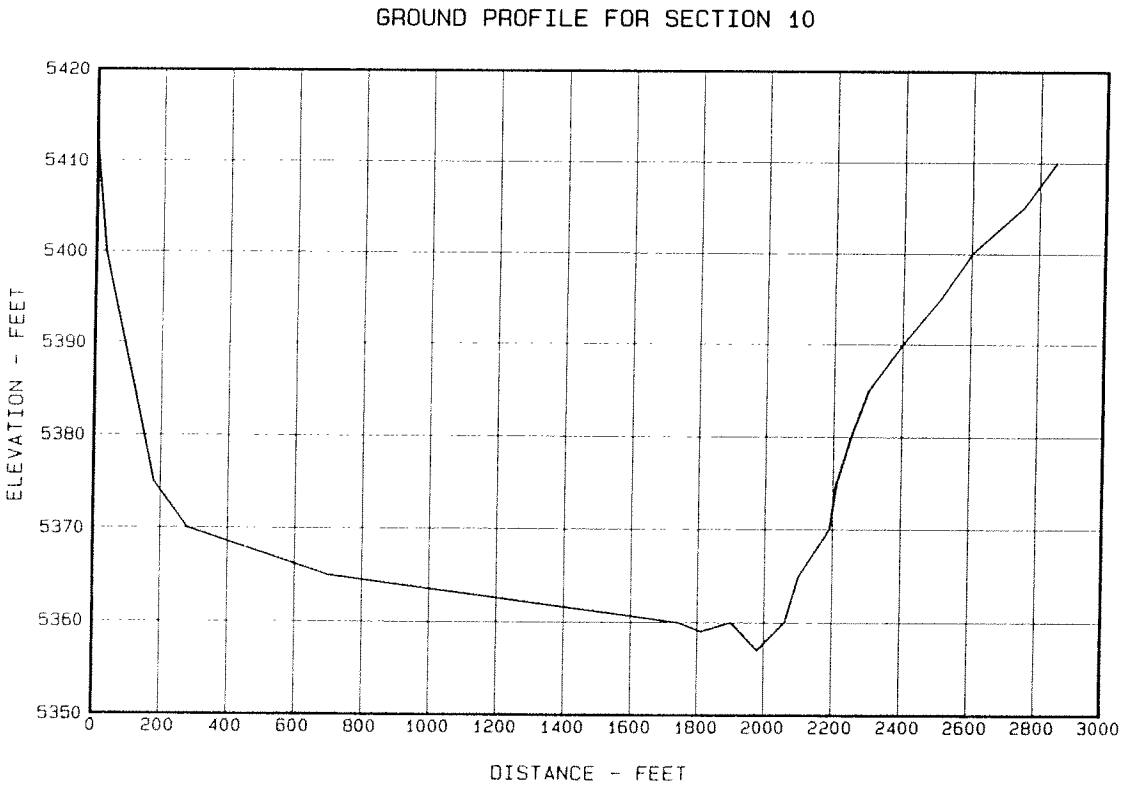

Figure 26 - 1986 Sediment Range 10-North Fork

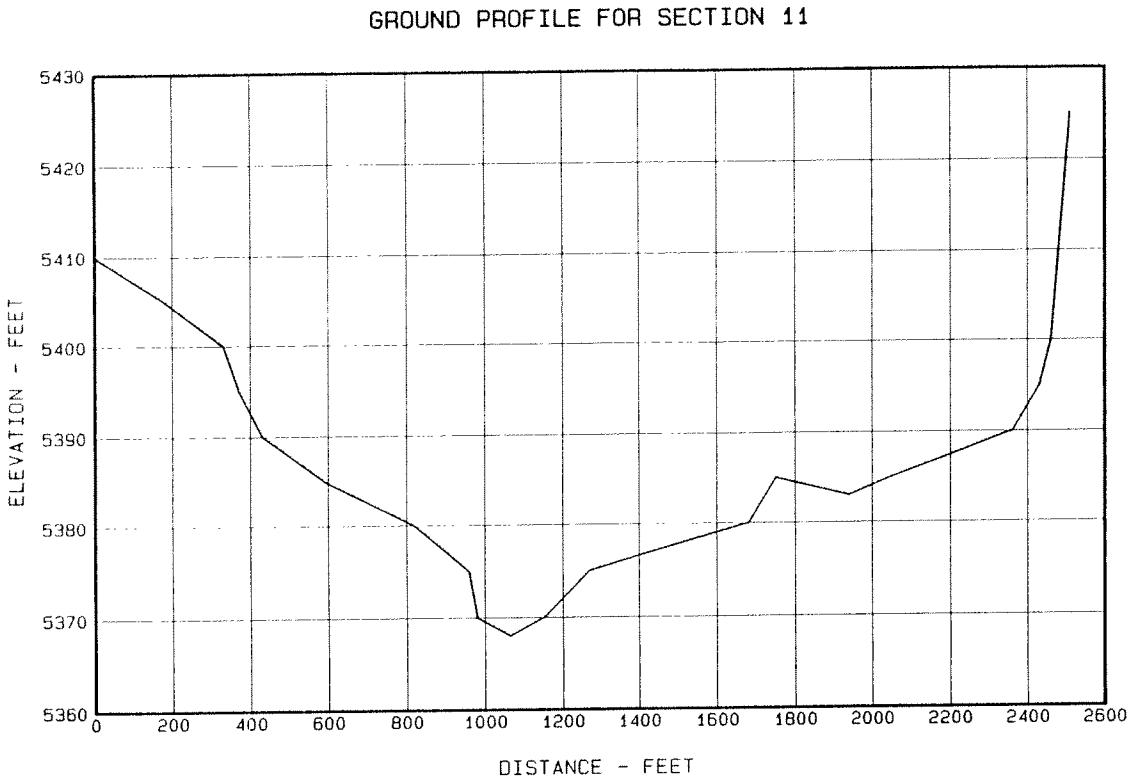

Figure - 27 1986 Sediment Range 11-North Fork

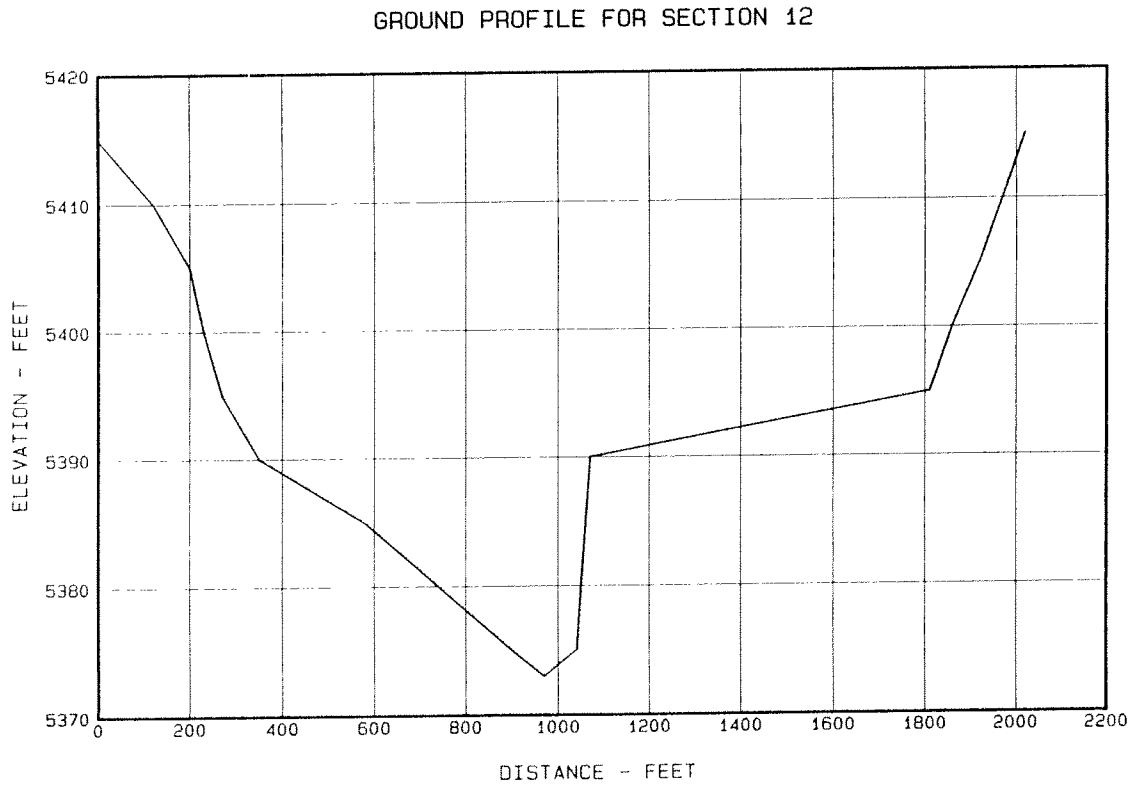

Figure 28 - 1986 Sediment Range 12-North Fork

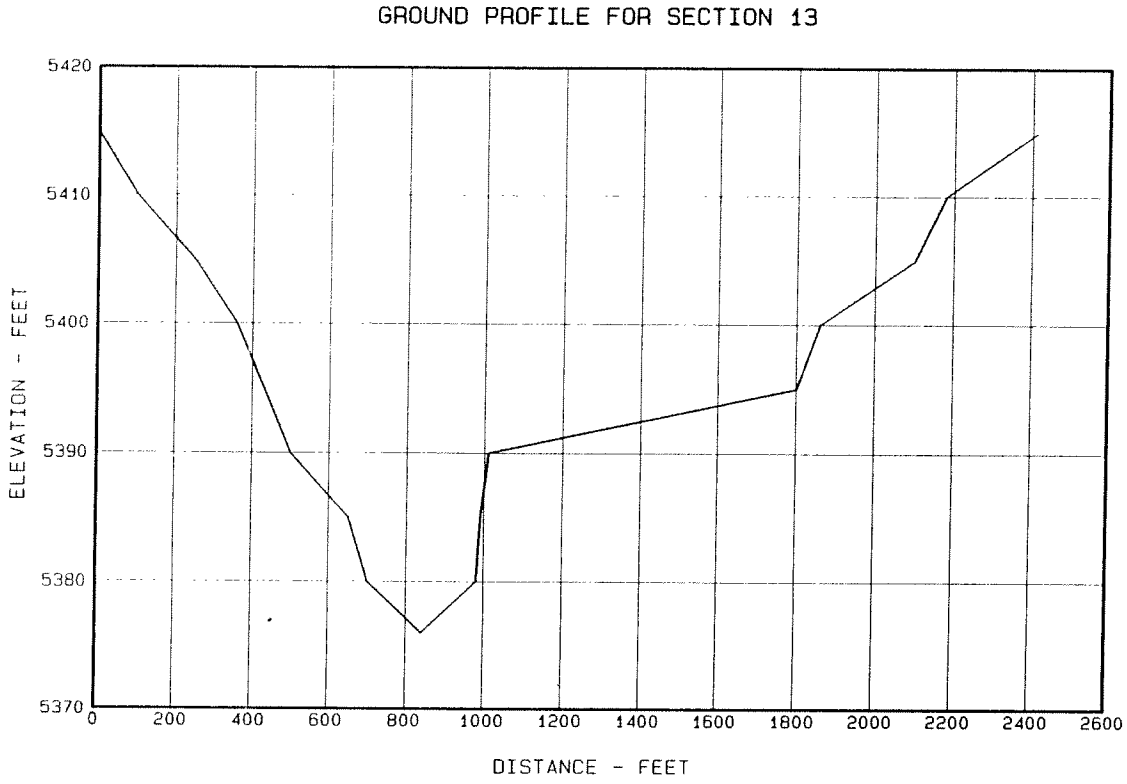

Figure 29 - 1986 Sediment Range 13-North Fork

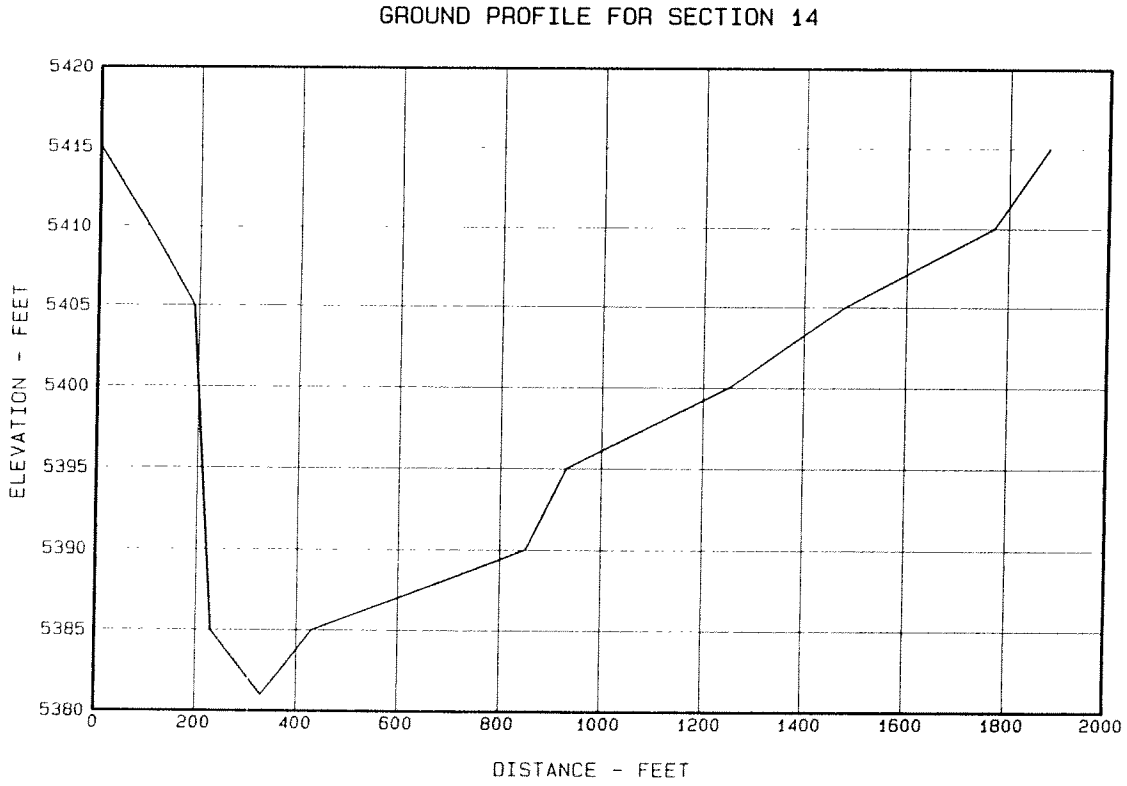

Figure 30 - 1986 Sediment Range 14-North Fork

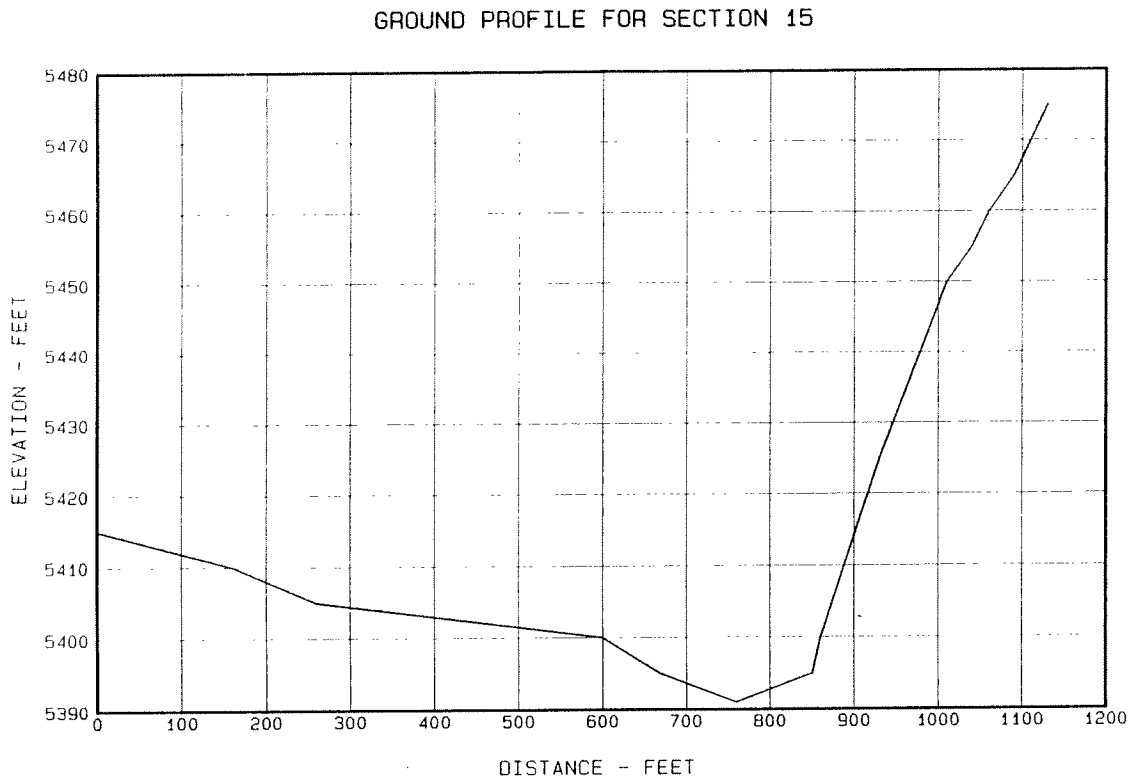

Figure 31 - 1986 Sediment Range 15-North Fork

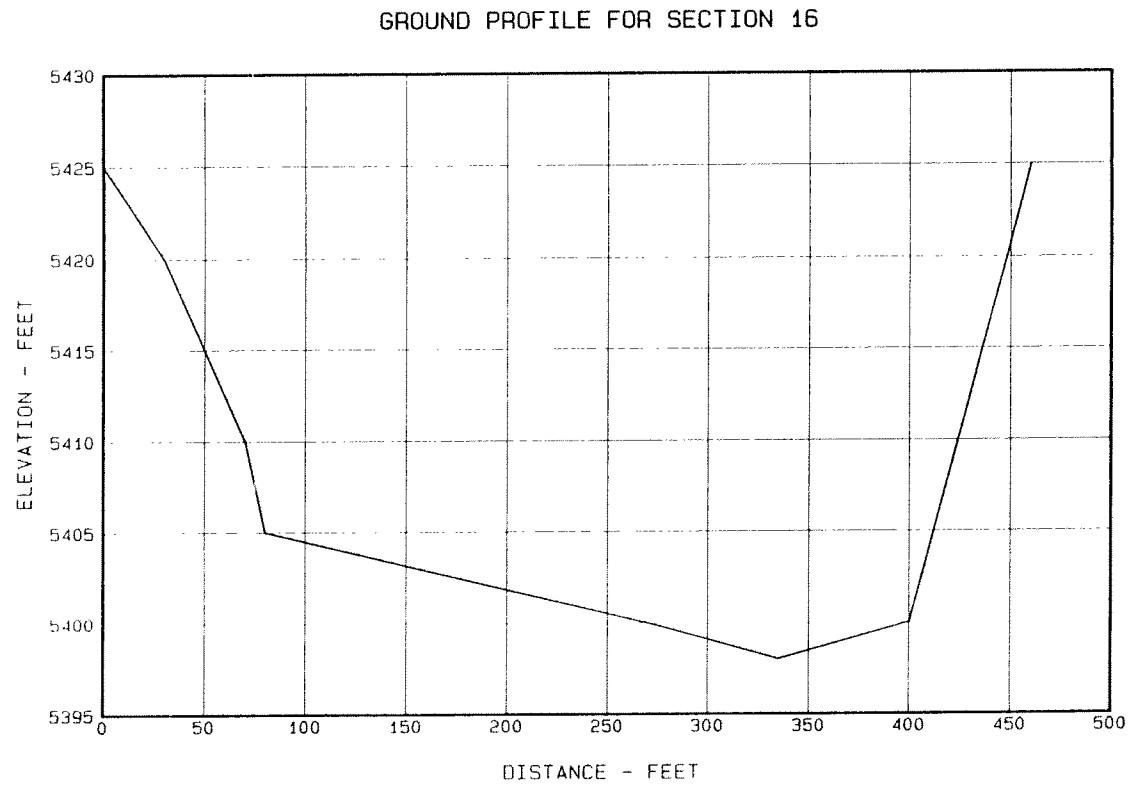

Figure 32 - 1986 Sediment Range 16-North Fork

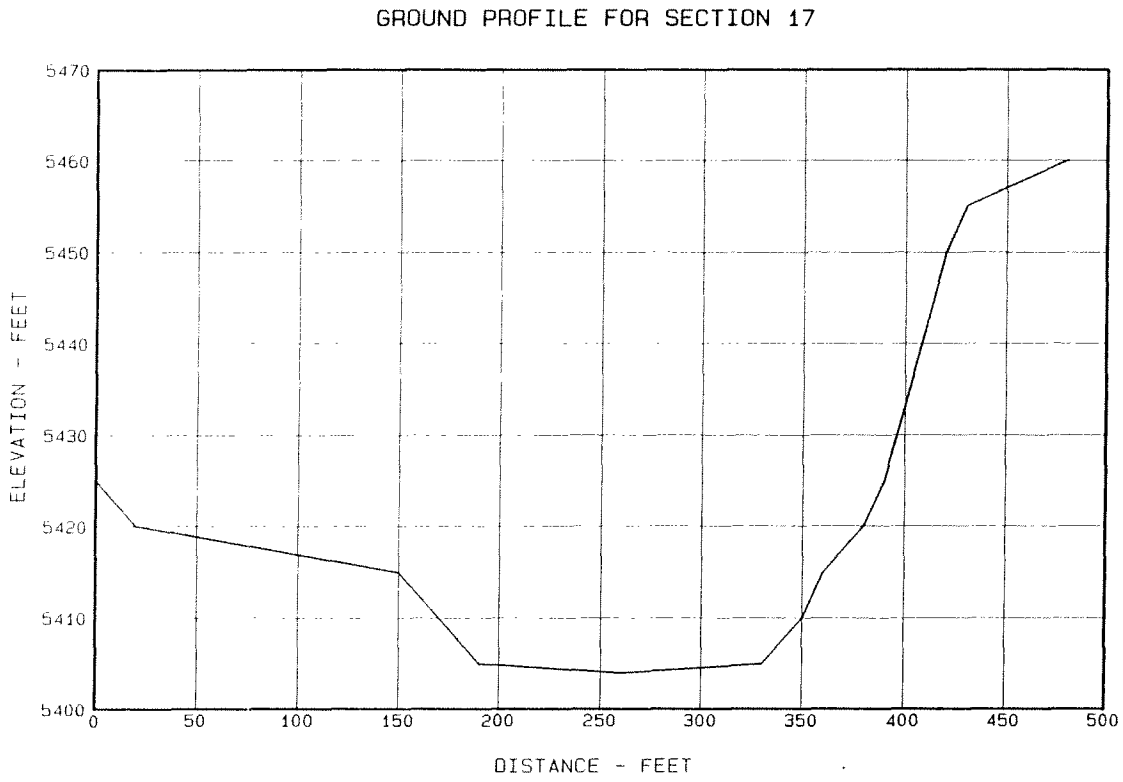

Figure 33 - 1986 Sediment Range 17-North Fork

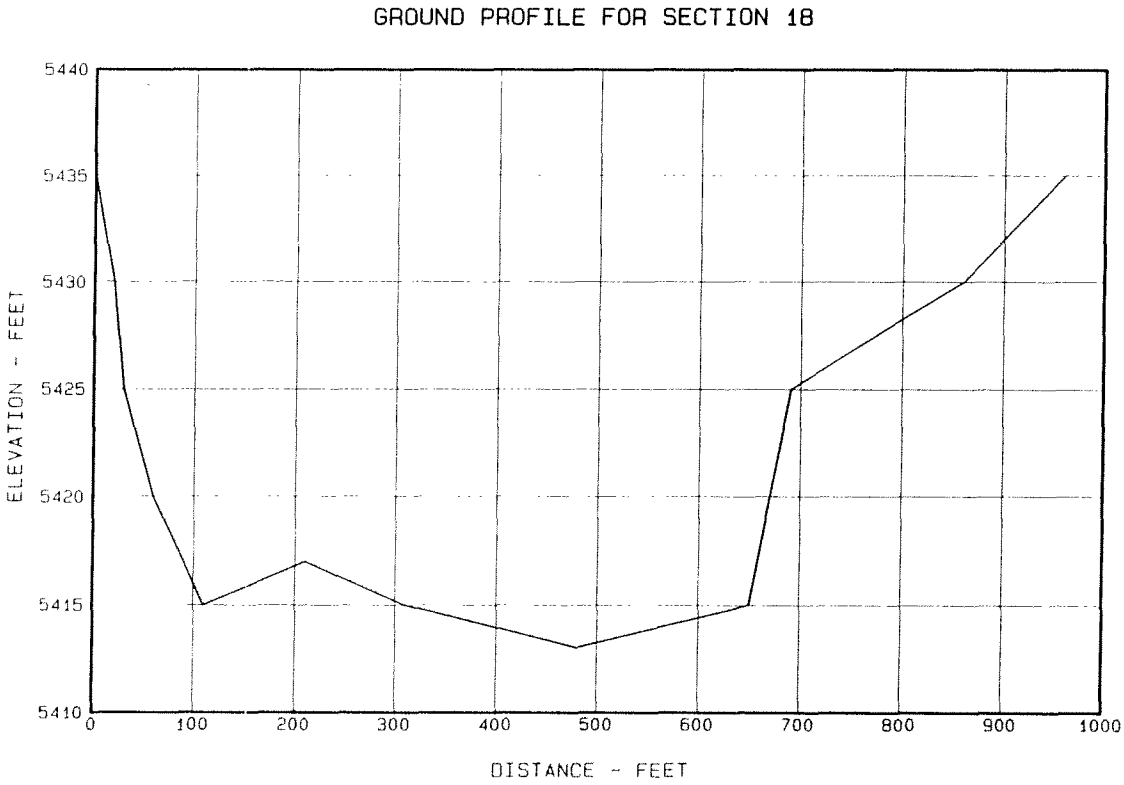

Figure 34 - 1986 Sediment Range 18-North Fork

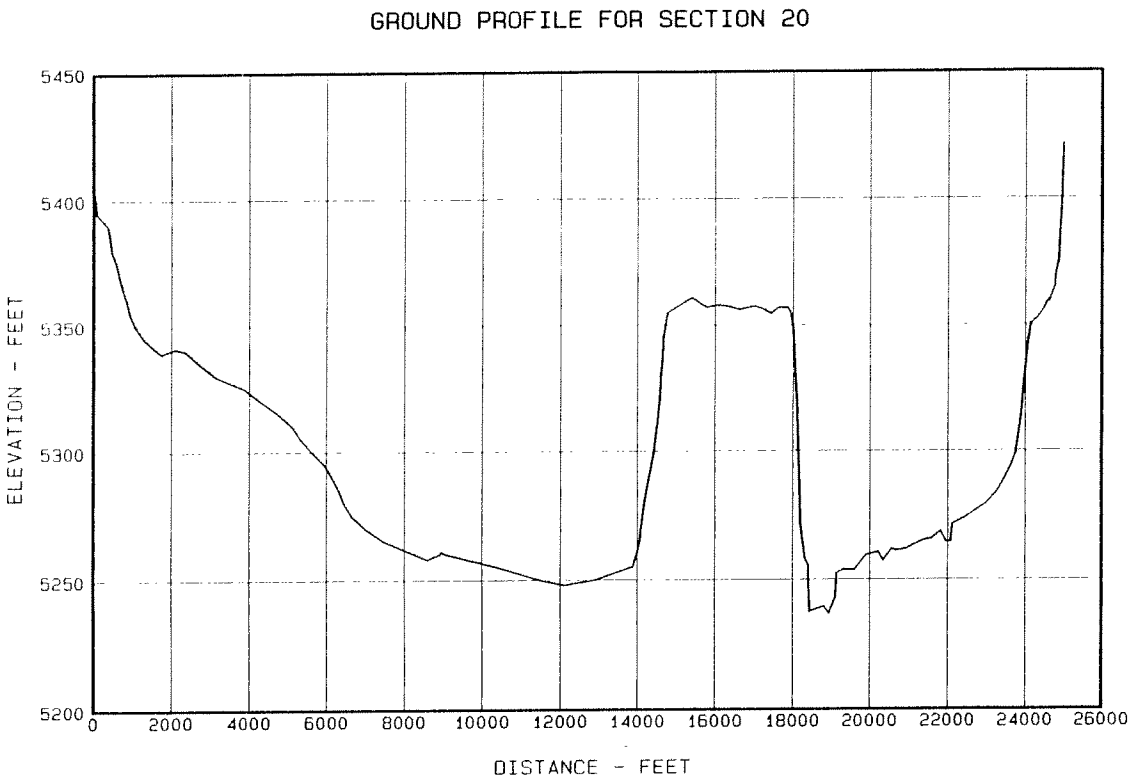

Figure 35 - 1986 Sediment Range 20-South Fork

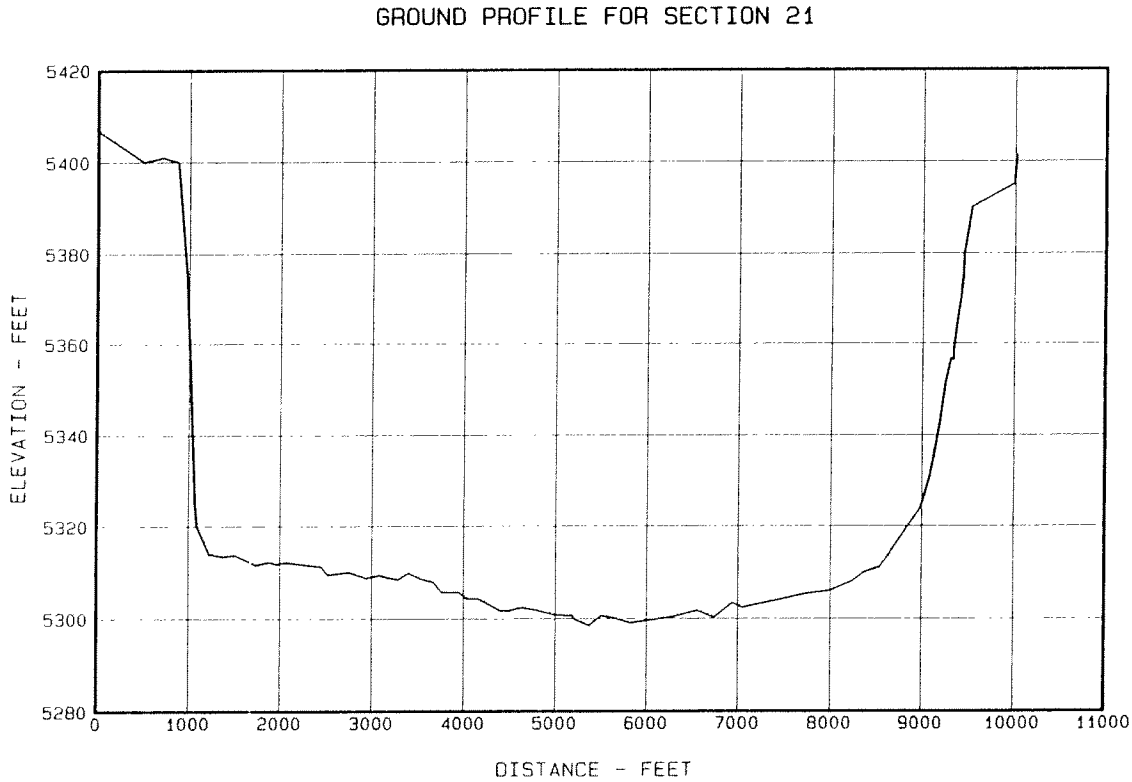

Figure 36 - 1986 Sediment Range 21-South Fork

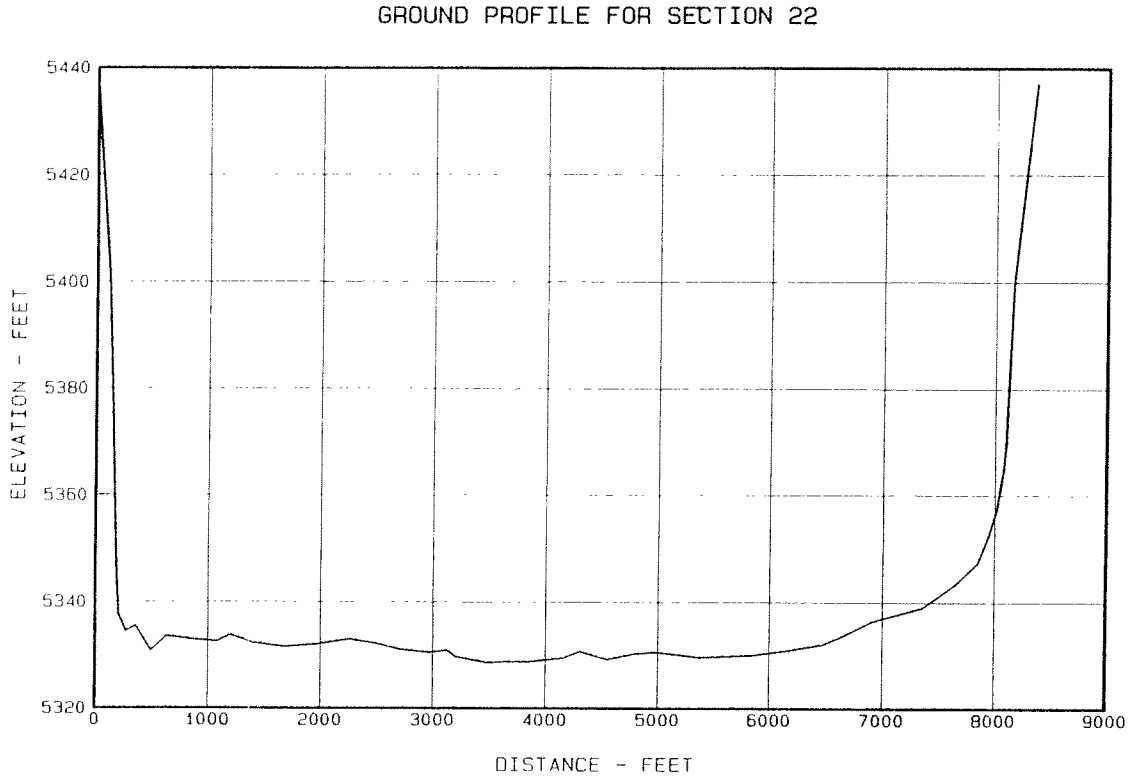

Figure 37 - 1986 Sediment Range 22-South Fork

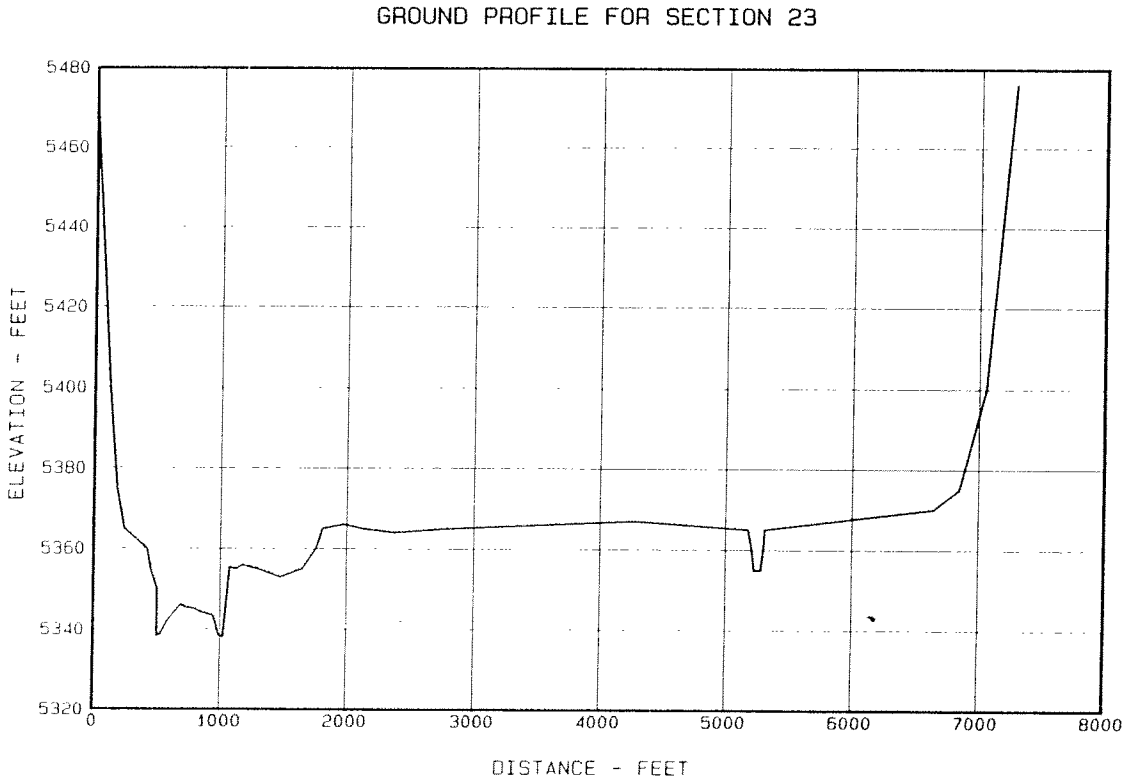

Figure 38 - 1986 Sediment Range 23-South Fork

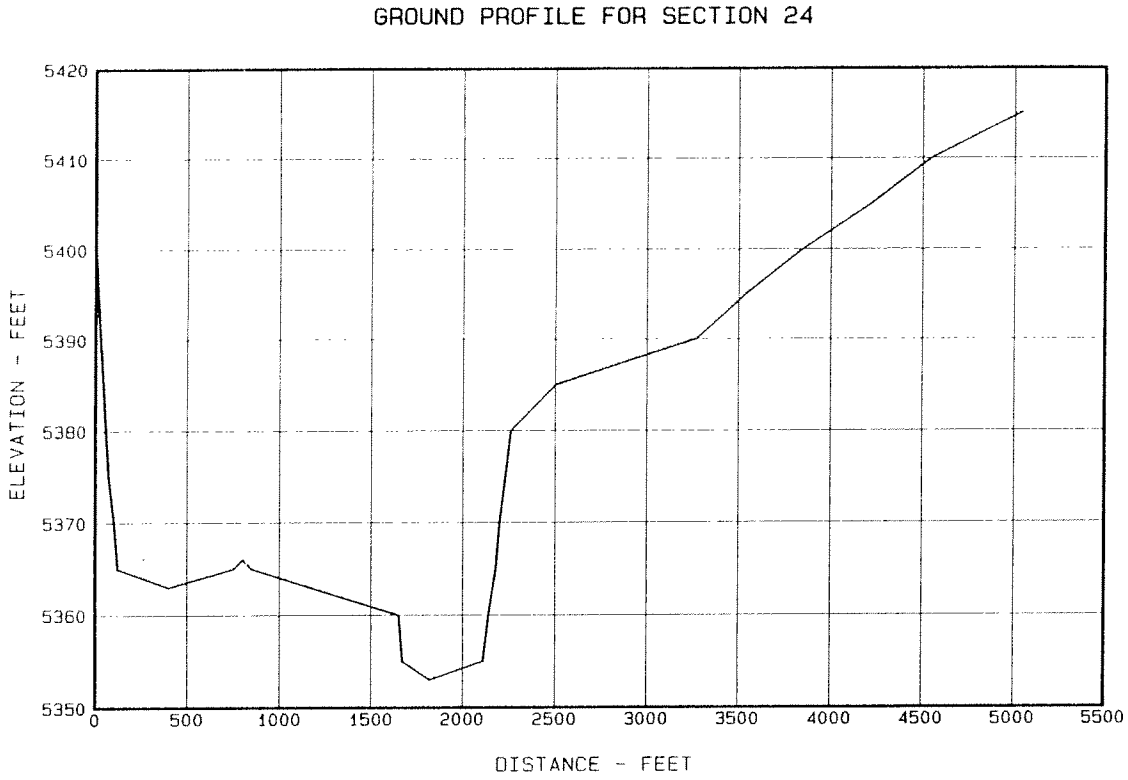

Figure 39 - 1986 Sediment Range 24-South Fork

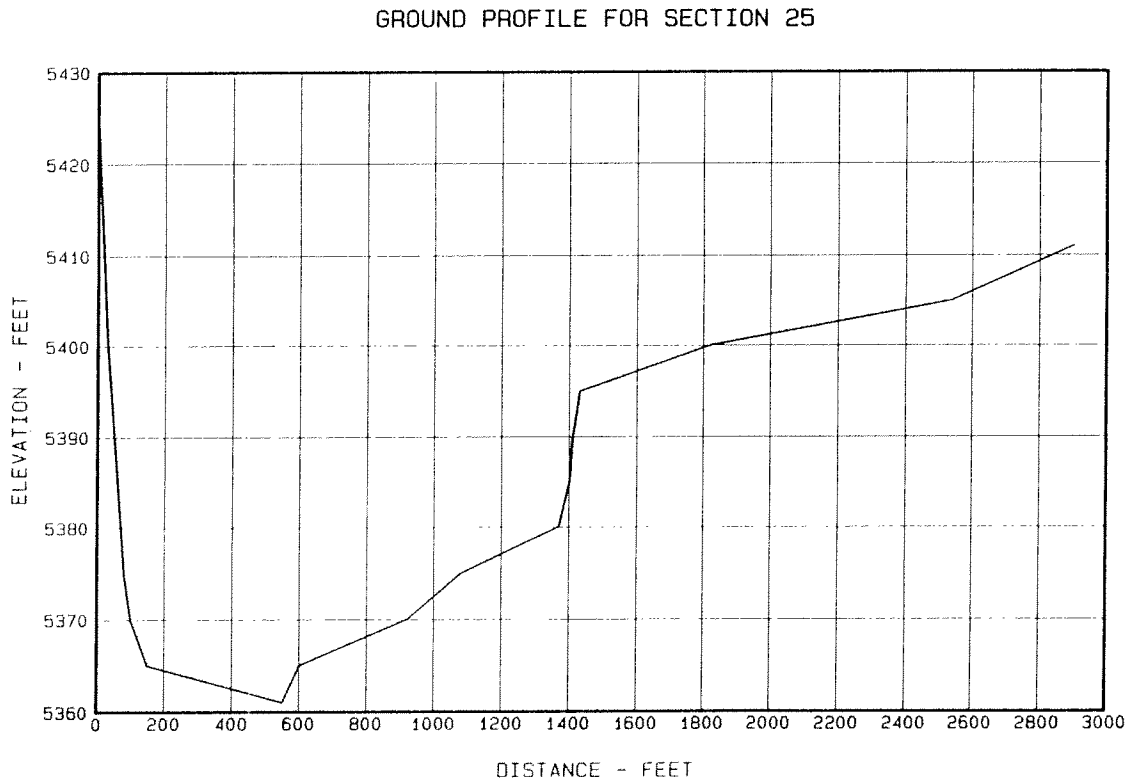

Figure 40 - 1986 Sediment Range 25-South Fork

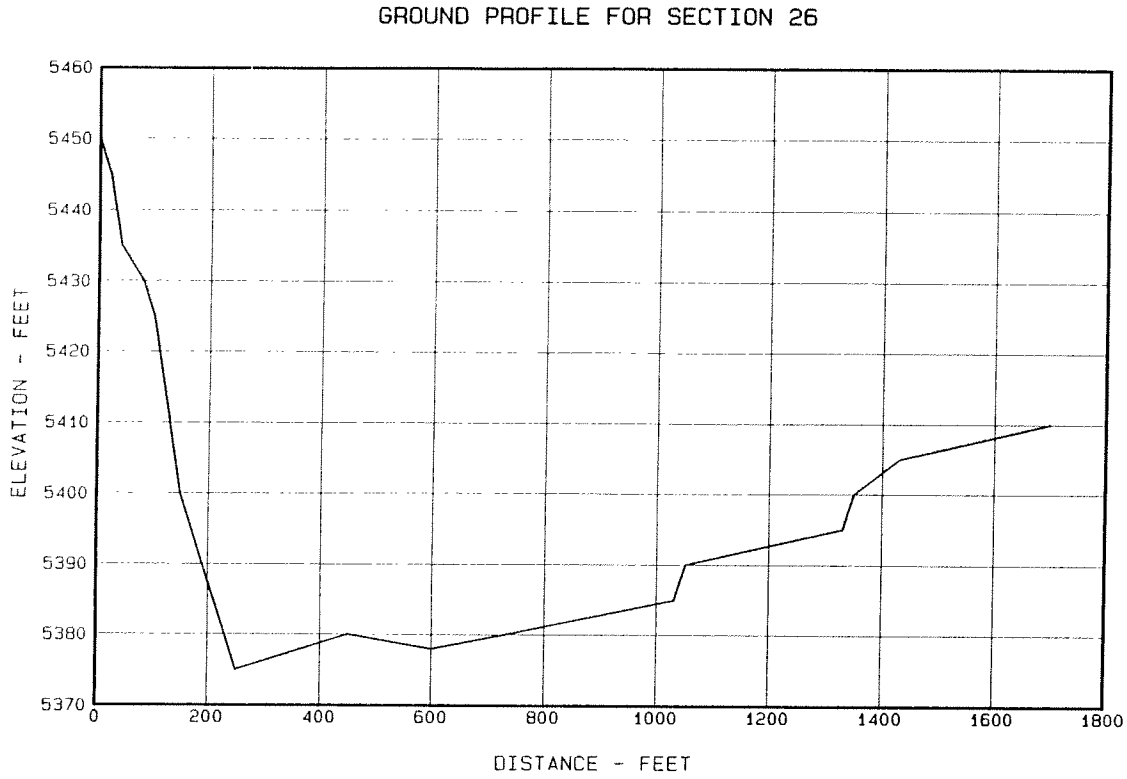

Figure 41 -1986 Sediment Range 26-South Fork

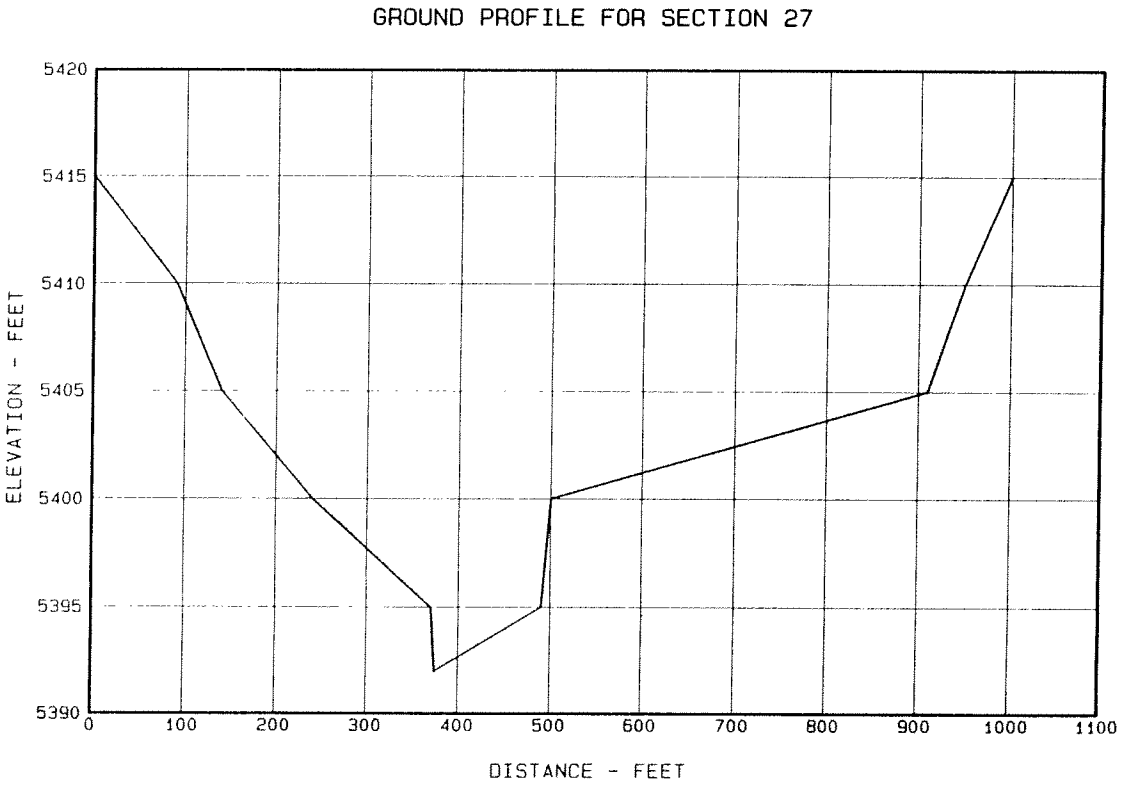

Figure 42 - 1986 Sediment Range 27-South Fork

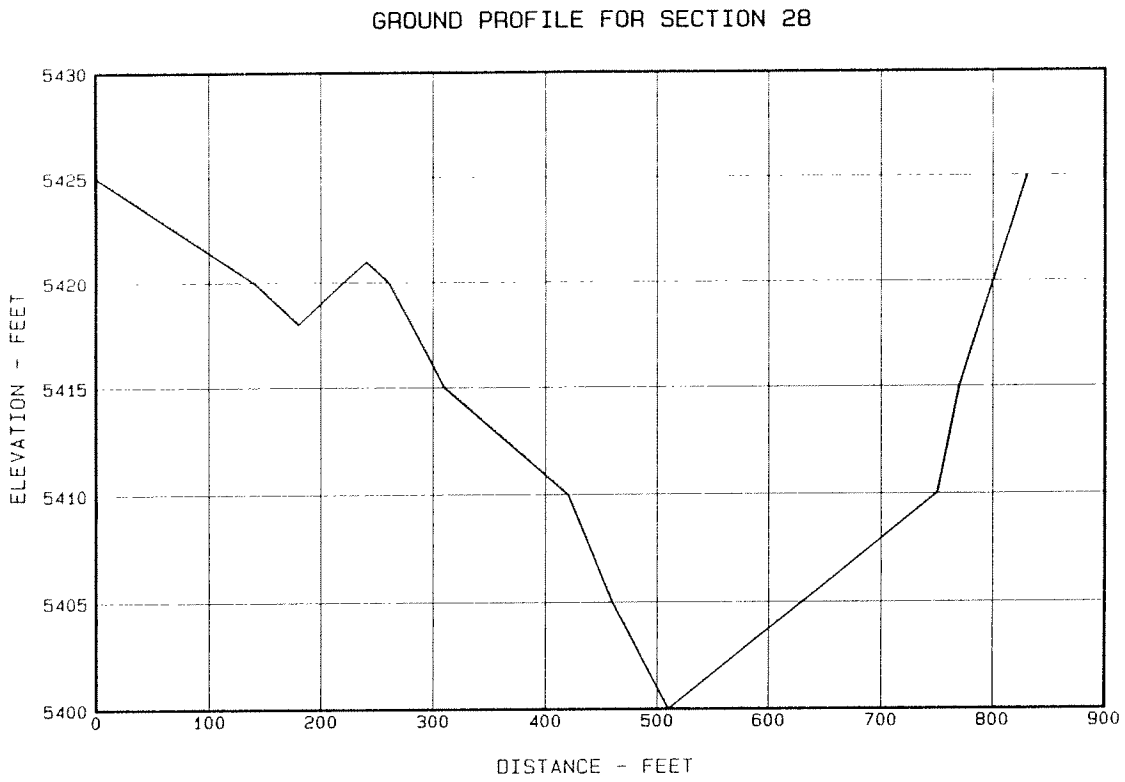

Figure 43 - 1986 Sediment Range 28-South Fork

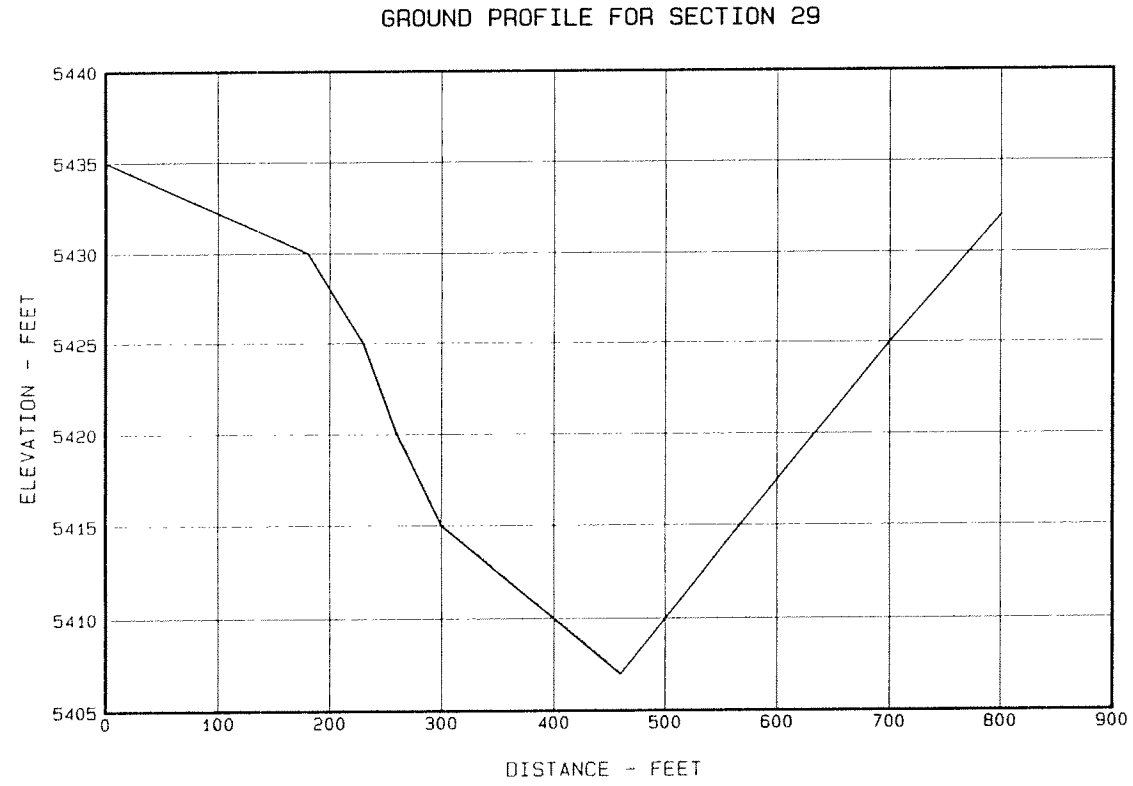

Figure 44 - 1986 Sediment Range 29-South Fork

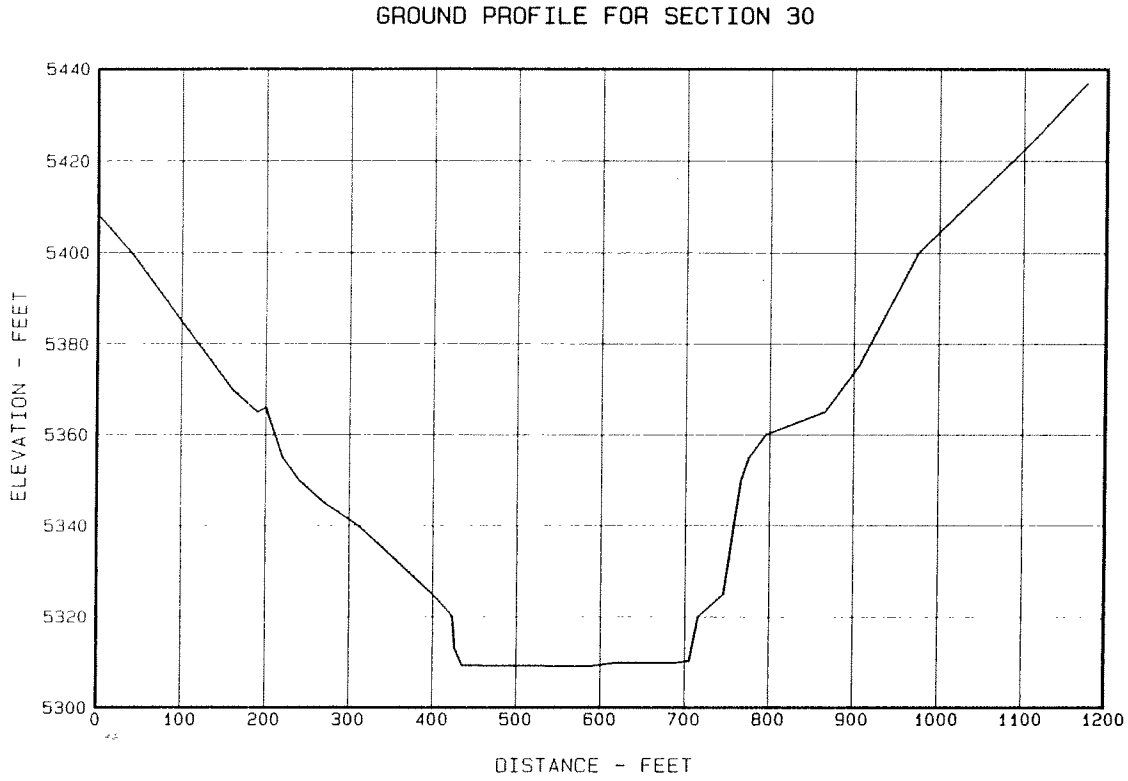

Figure 45 - 1986 Sediment Range 30-Diamond Creek

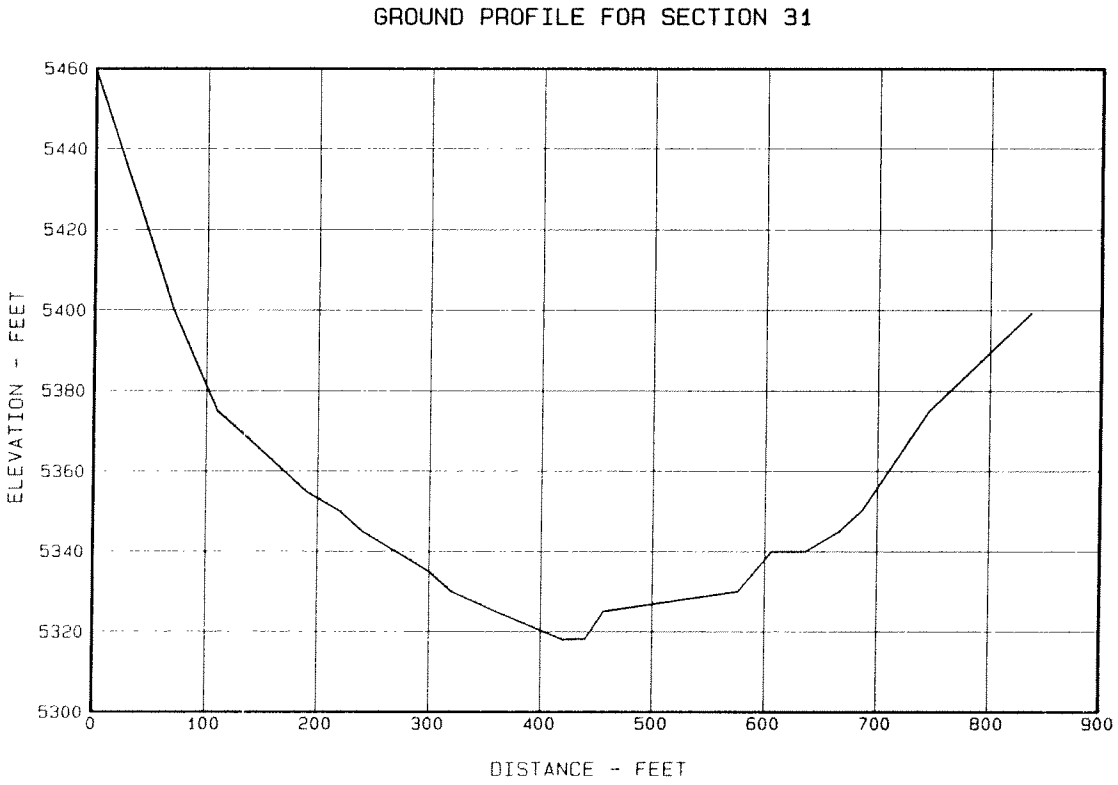

Figure 46 - 1986 Sediment Range 31-Diamond Creek

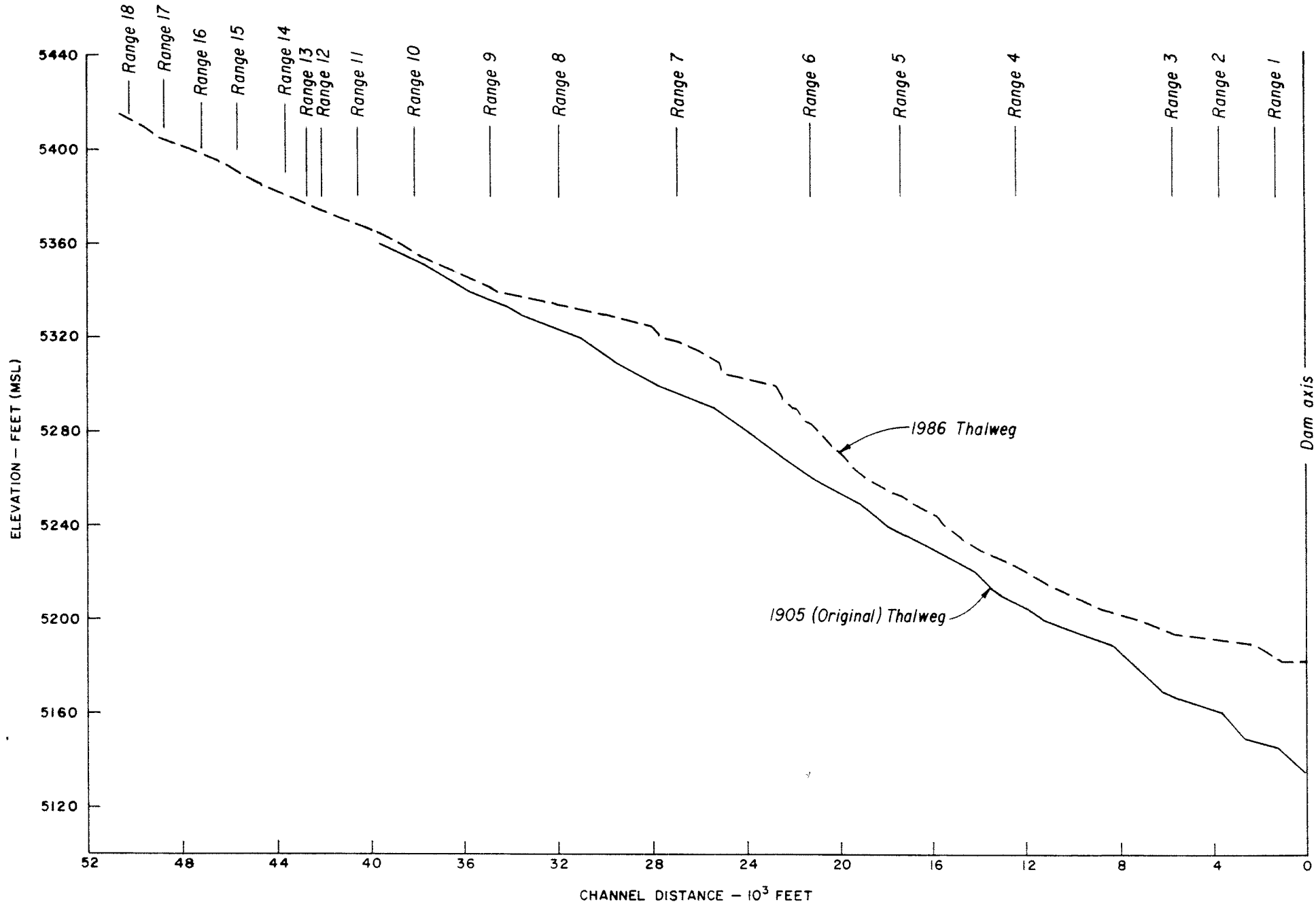

Figure 47 - Longitudinal profiles-North Fork,Shoshone River

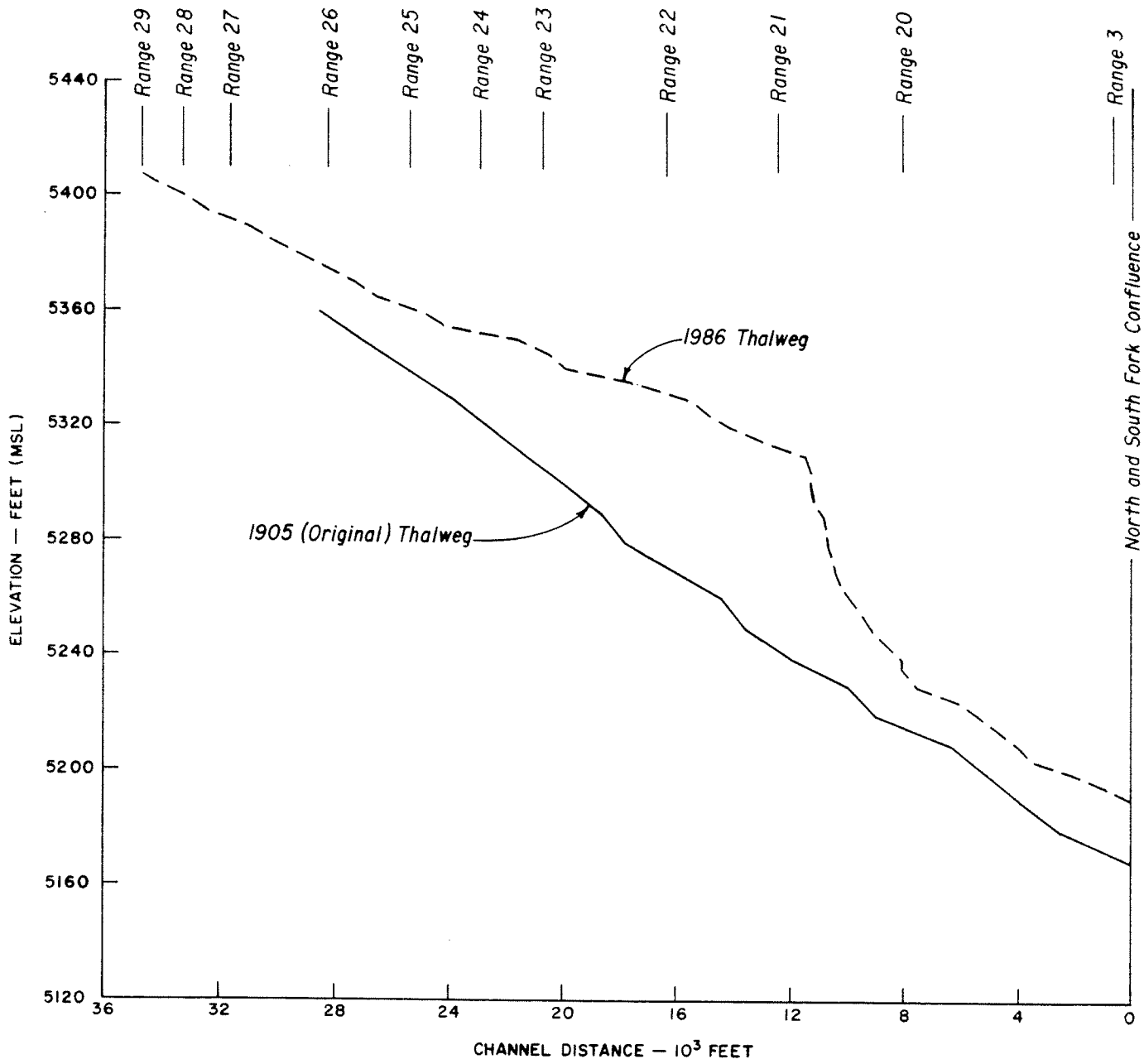

Figure 48 - Longitudinal profiles-South Fork,Shoshone River

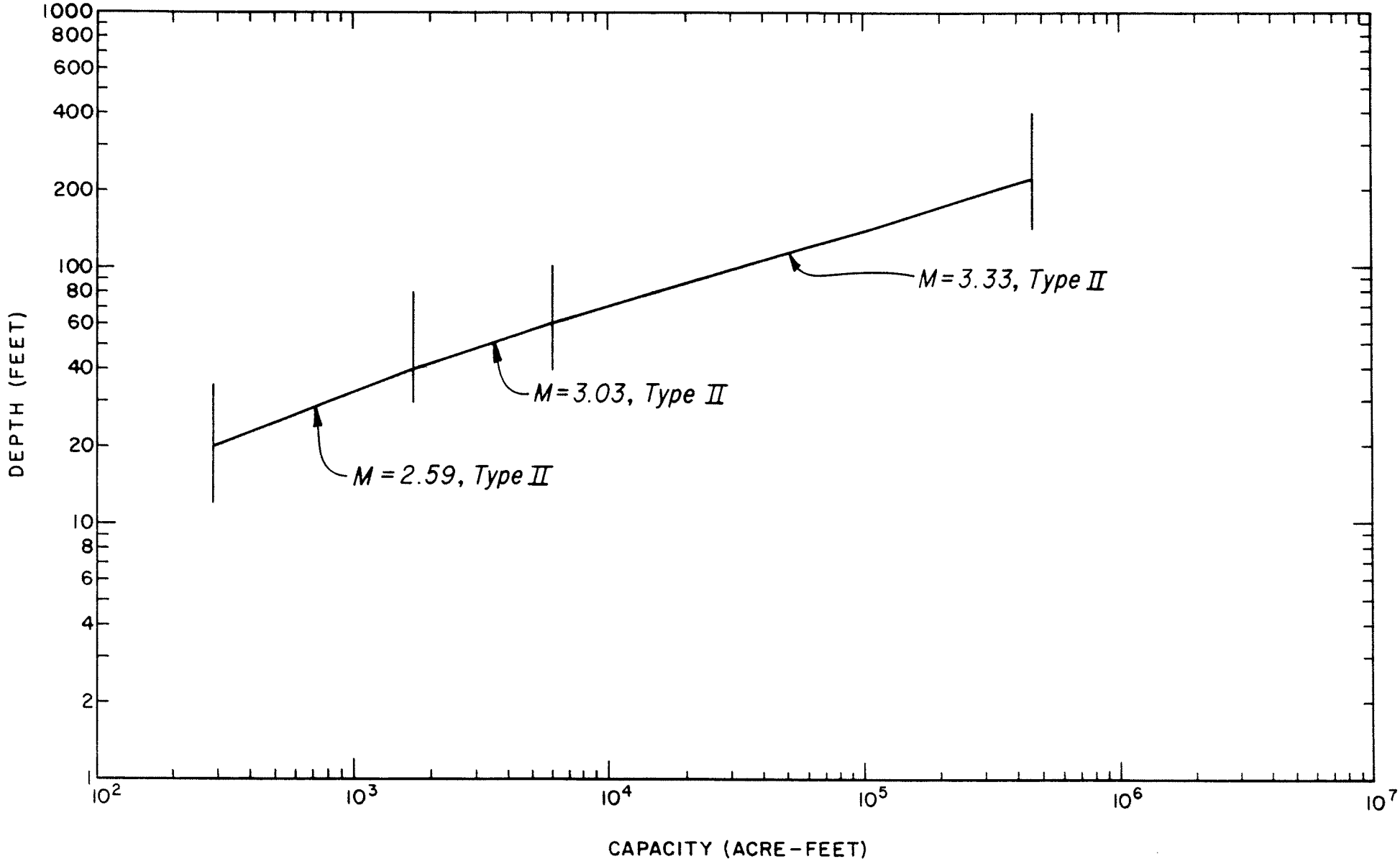

Figure 49 – Depth-capacity relationship for typing reservoir

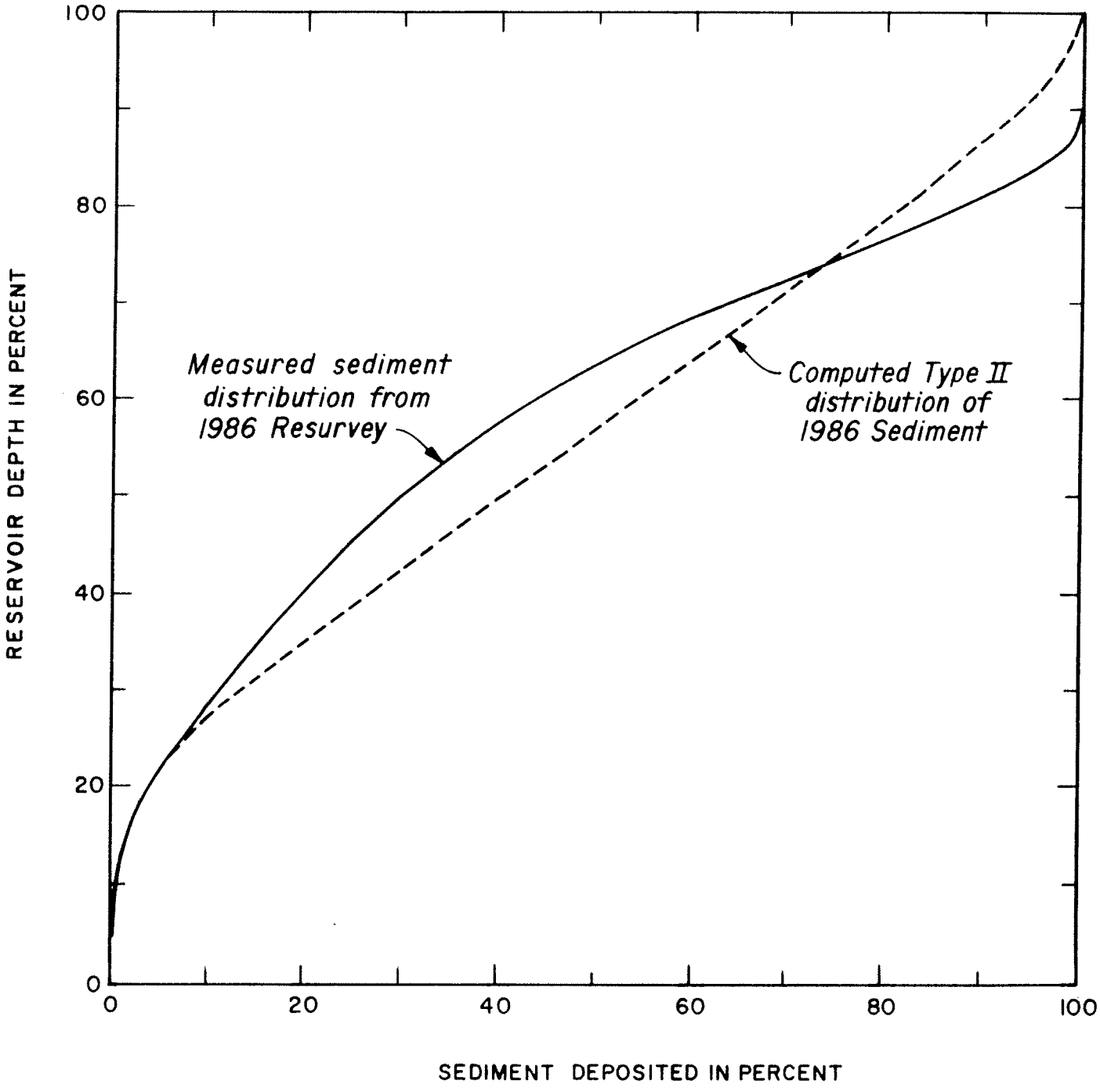

Figure 50 – Percent depth versus percent sediment deposit

*U.S. GOVERNMENT PRINTING OFFICE 1991-0-573-185/40002

Mission of the Bureau of Reclamation

The Bureau of Reclamation of the U.S. Department of the Interior is responsible for the development and conservation of the Nation's water resources in the Western United States.

The Bureau's original purpose "to provide for the reclamation of arid and semiarid lands in the West" today covers a wide range of interrelated functions. These include providing municipal and industrial water supplies; hydroelectric power generation; irrigation water for agriculture; water quality improvement; flood control; river navigation; river regulation and control; fish and wildlife enhancement; outdoor recreation; and research on water-related design, construction, materials, atmospheric management, and wind and solar power.

Bureau programs most frequently are the result of close cooperation with the U.S. Congress, other Federal agencies, States, local governments, academic institutions, water-user organizations, and other concerned groups.

A free pamphlet is available from the Bureau entitled "Publications for Sale." It describes some of the technical publications currently available, their cost, and how to order them. The pamphlet can be obtained upon request from the Bureau of Reclamation, Attn D-922, P O Box 25007, Denver Federal Center, Denver CO 80225-0007.