UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SEDIMENTATION RESURVEY OF GUERNSEY RESERVOIR, 1957

NORTH PLATTE PROJECT, WYOMING AND NEBRASKA

Sedimentation Section Report

HYDROLOGY BRANCH

DIVISION OF PROJECT INVESTIGATIONS
COMMISSIONER'S OFFICE
DENVER, COLORADO

AUGUST 1958

UNITED STATES DEPARTMENT OF THE INTERIOR
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Sedimentation Section
Hydrology Branch
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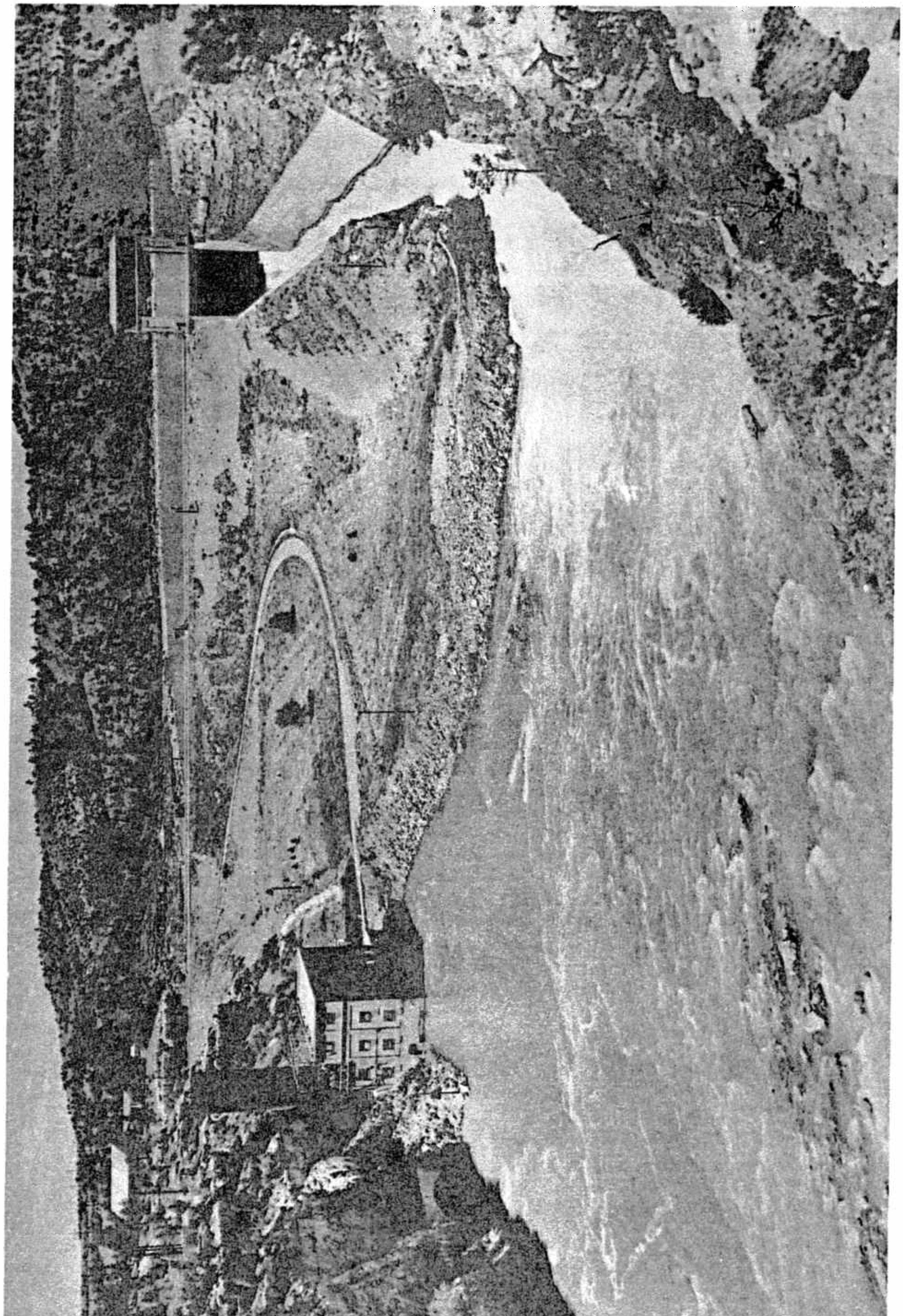

1957 SEDIMENTATION RESURVEY OF GUERNSEY RESERVOIR

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1957 SEDIMENTATION RESURVEY OF GUERNSEY RESERVOIR

Introduction

Guernsey Dam, which impounds the water of Guernsey Reservoir, was completed in 1927. Guernsey Dam is located on the North Platte River near Guernsey, Wyoming. The reservoir originally had a capacity of 73,810 acre-feet, and due to the sedimentation process, the capacity had diminished to 49,150 acre-feet by 1947.

Guernsey Reservoir is utilized as a storage reservoir for the irrigation water supplied to the extensive downstream irrigation interests and for power production.

The results of a sedimentation resurvey of Guernsey Reservoir, performed in July of 1957, are presented in this report.

The objectives of the 1957 resurvey were to establish new area-capacity curves, and to determine the effect of the sedimentation process on the reservoir for the 10-year period from 1947 to 1957. It was necessary to perform the resurvey in 1957 so that the sediment accumulation could be determined prior to the October 1957 closing of the newly constructed Glendo Dam. Glendo Dam is 16 miles upstream from the high-water line of Guernsey Reservoir, and it will greatly reduce the sediment inflow to Guernsey. This will extend the useful life of Guernsey Reservoir for many additional years.

This 1957 resurvey was performed jointly by the Bureau Project Office in Casper, Wyoming, and the Sedimentation Section of the Commissioner's Office in Denver, Colorado.

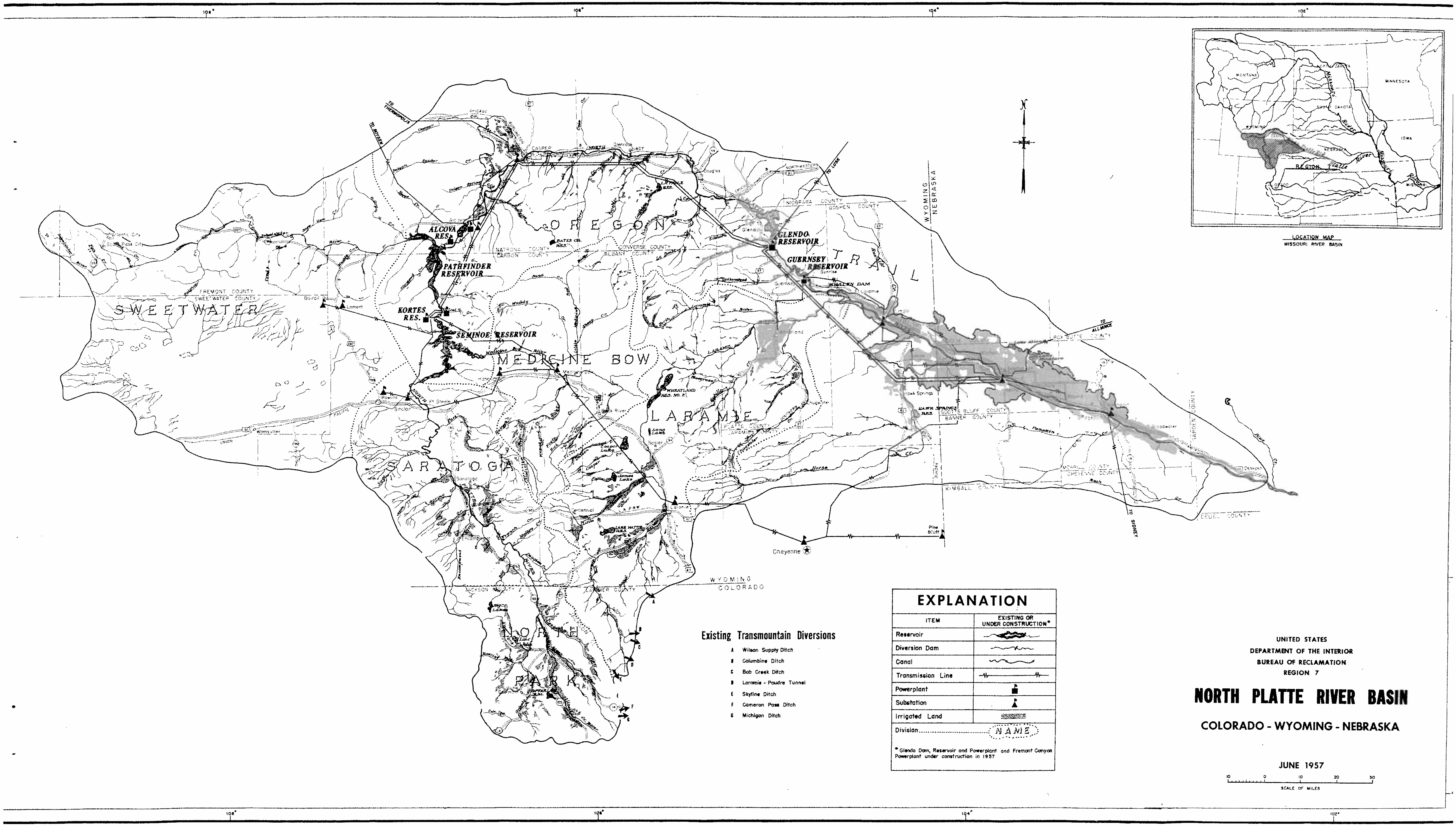
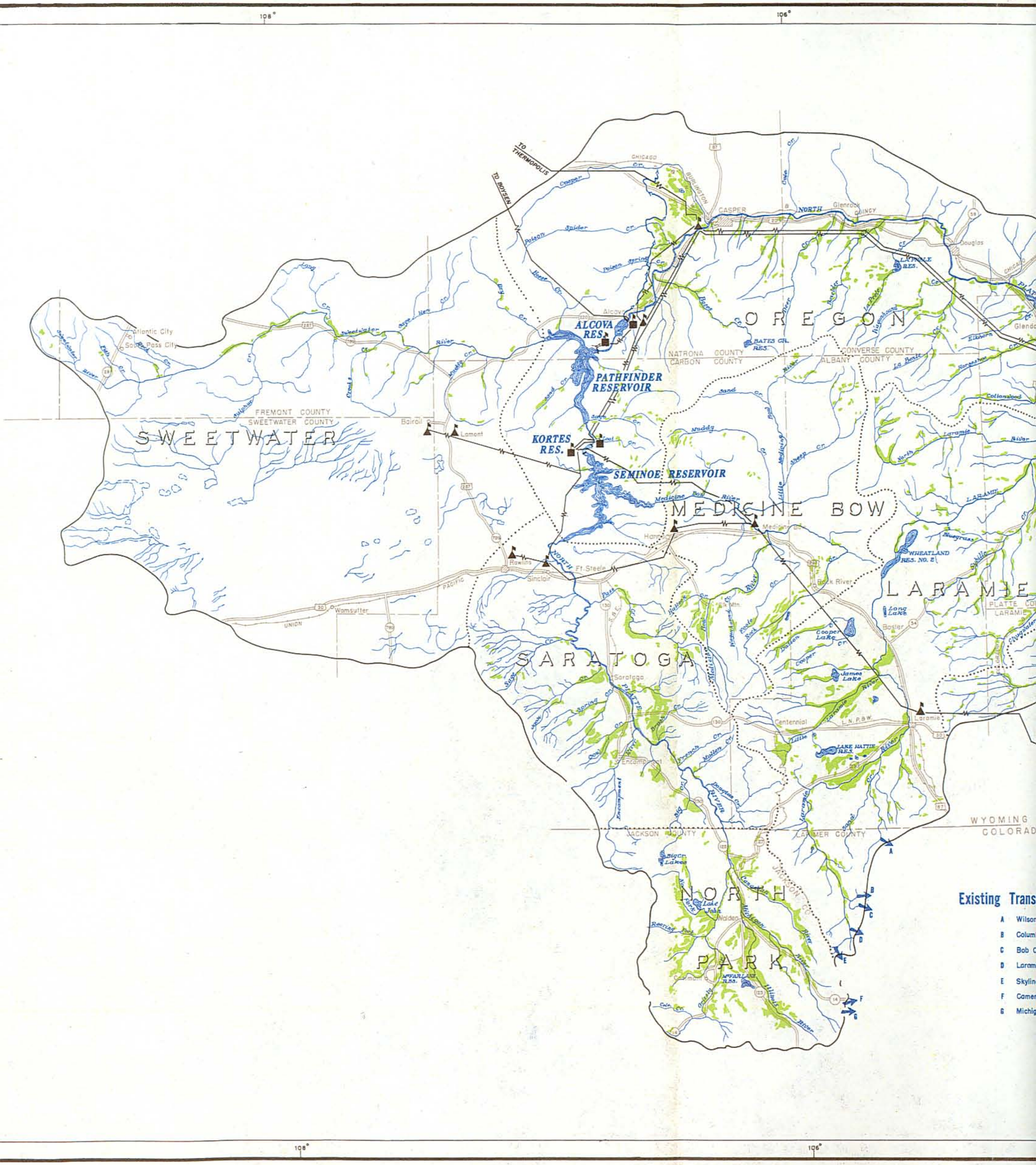
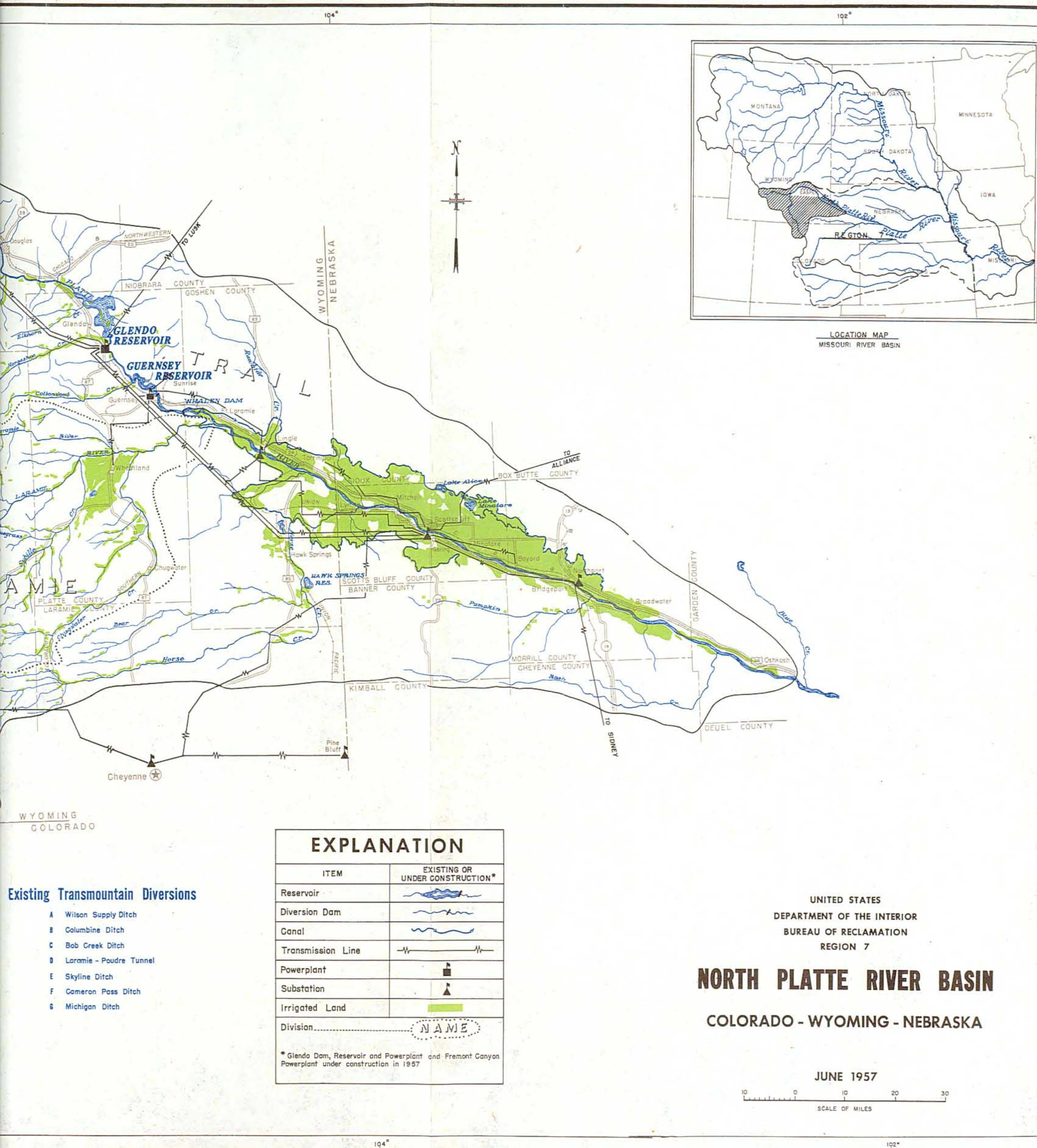

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
REGION 7
NORTH PLATTE RIVER BASIN
COLORADO - WYOMING - NEBRASKA
JUNE 1957
SCALE OF MILES
LOCATION MAP
MISSOURI RIVER BASIN
EXPLANATION
ITEM
EXISTING OR UNDER CONSTRUCTION*
Reservoir
Diversion Dam
Canal
Transmission Line
Powerplant
Substation
Irrigated Land
Division
NAME
* Glendo Dam, Reservoir and Powerplant and Fremont Canyon Powerplant under construction in 1957
Existing Transmountain Diversions
A Wilson Supply Ditch
B Columbine Ditch
C Bob Creek Ditch
D Laramie - Poudre Tunnel
E Skyline Ditch
F Cameron Pass Ditch
G Michigan Ditch
SWEETWATER
OREGON
MEDICINE BOW
LARAMIE
SARATOGA
NORTH PARK
ALCOVA RES.
PATHFINDER RESERVOIR
KORTES RES.
SEMINOE RESERVOIR
GLENDO RESERVOIR
GUERNSEY RESERVOIR
WHALEN DAM
WHEATLAND RES. NO. 2
WYOMING
NEBRASKA
WYOMING
COLORADO
Casper
Cheyenne
Pine Bluff
TO SIDNEY
TO ALLIANCE
TO LUSK

Figure 1.



108°
106°
SWEETWATER
OREGON
MEDICINE BOW
LARAMIE
SARATOGA
NORTH PARK
ALCOVA RES.
PATHFINDER RESERVOIR
KORTES RES.
SEMINOE RESERVOIR
BATES CR. RES.
LA PRELE RES.
WHEATLAND RES. NO. 2
LAKE HATTIE RES.
McFARLANE RES.
Long Lake
Cooper Lake
James Lake
Lake John
Big Cr. Lakes
TO THERMOPOLIS
TO BOYSEN
CASPER
Glenrock
Douglas
Alcova
Atlantic City
South Pass City
Bairoil
Lamont
Rawlins
Sinclair
Ft. Steele
Hanna
Medicine Bow
Rock River
Bosler
Laramie
Centennial
Saratoga
Encampment
Wamsutter
Walden
Coalmont
Elk Mtn.
NATRONA COUNTY
CARBON COUNTY
CONVERSE COUNTY
ALBANY COUNTY
FREMONT COUNTY
SWEETWATER COUNTY
PLATTE COUNTY
JACKSON COUNTY
LARIMER COUNTY
JACKSON CO.
WYOMING
COLORADO
CHICAGO
BURLINGTON
QUINCY
UNION
PACIFIC
L. N. P. & W.
NORTH PLATTE RIVER
Medicine Bow River
Laramie River
Sweetwater River
Existing Trans
A Wilson
B Colum
C Bob C
D Laram
E Skylin
F Camer
G Michig



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MISSOURI RIVER BASIN
MONTANA
NORTH DAKOTA
MINNESOTA
SOUTH DAKOTA
WYOMING
IOWA
NEBRASKA
COLORADO
MISSOURI
Missouri River
North Platte River
Platte River
REGION
GLENDO RESERVOIR
GUERNSEY RESERVOIR
WHALEN DAM
HAWK SPRINGS RES.
Lake Alice
Lake Minatare
TRAIL
WYOMING
NEBRASKA
COLORADO
NIOBRARA COUNTY
GOSHEN COUNTY
PLATTE COUNTY
LARAMIE COUNTY
SIOUX COUNTY
BOX BUTTE COUNTY
SCOTTS BLUFF COUNTY
BANNER COUNTY
MORRILL COUNTY
CHEYENNE COUNTY
KIMBALL COUNTY
GARDEN COUNTY
DEUEL COUNTY
Douglas
Glendo
Guernsey
Sunrise
Ft Laramie
Lingle
Torrington
Wheatland
Chugwater
Hawk Springs
Mitchell
Scottsbluff
Gering
Minatare
Bayard
Northport
Bridgeport
Broadwater
Oshkosh
Pine Bluff
Cheyenne
TO LUSK
TO ALLIANCE
TO SIDNEY
NORTHWESTERN
CHICAGO
PACIFIC
UNION
Horse Cr.
Bear Cr.
Pumpkin Cr.
Blue Cr.
Rawhide Cr.
Laramie River
104°
102°

Figure

Purpose and Scope of Report

The purpose of this investigation was: (1) to obtain the necessary data for preparing new area-capacity curves for Guernsey Reservoir, (2) to determine the sediment yield for the drainage area above Guernsey Reservoir for the 10-year period from 1947 to 1957, (3) to obtain information on the sediment disposition, gradation, and trap efficiency for this reservoir, and (4) to determine the total deposition of sediment in Guernsey Reservoir prior to the closing of Glendo Dam.

The analysis of these data should provide information needed for the efficient operation of Guernsey Reservoir, aid in estimating the useful life of the reservoir, assist in the design of other structures relative to increasing the usefulness of the projects, and provide a basis for the determination of the sediment trap efficiency of Glendo Reservoir, which is immediately upstream from Guernsey Reservoir.

Ownership

Guernsey Dam and Reservoir are owned by the United States Government and operated by the Bureau of Reclamation, Department of the Interior.

Location

Guernsey Dam is 2 miles northwest of Guernsey, Wyoming, and impounds the water of the North Platte River.

Guernsey Reservoir is located in Sections 5-10, 15-18, 20-22, 27 and 28, T. 27 N., R. 66 W.; Sections 35 and 36, T. 28 N., R. 67 W.; and Sections 1, 2, 10, 11, and 12, T. 27 N., R. 67 W., Platte County, Wyoming.

The drainage area of Guernsey Reservoir below Alcova Dam includes parts of Natrona, Carbon, Converse, Albany, Niobrara, and Goshen Counties, Wyoming, in addition to Platte County in which the reservoir is entirely located.

Purpose Served

Guernsey Dam was built by the Bureau of Reclamation as a feature of the North Platte Project, and was completed in 1927. It is used for storage of irrigation water, to reregulate Alcova releases and inflow below Alcova, and for power production. An effort is made to have the reservoir full at the start of the irrigation season. Releases from Guernsey Reservoir during the irrigation season are those required to meet the irrigation demands of the North Platte Project and other irrigators exercising a demand on the flow of the river.

Power Development

The existing Guernsey Powerplant utilizes an operating head ranging from 55 feet to 95 feet. Over the 29-year period 1928-1956, generation has averaged 20,100,000 kw-hrs annually. The presently installed plant capacity is 4,800 kw.

Irrigation

The area downstream on the North Platte River exercises demands on water stored at Guernsey. Releases from Guernsey Reservoir average about 1,130,000 acre-feet per year. The principal agricultural products grown on the land irrigated by the North Platte Project are sugar beets, potatoes, beans, corn, and alfalfa. The length of the growing season is about 5 months.

Description of the Dam

Guernsey Dam is located in a rocky canyon of the river. The dam consists of an impervious embankment of sluiced clay, sand, and gravel protected with a thick layer of rock riprap. The crest is about 135 feet above the foundation, 95 feet above the river bed, and 10 feet above the normal high-water line fixed by the crest of its spillway gates. The crest is 560 feet long and 25 feet wide. A roadway on the crest crosses the dam to the north spillway and extends to recreation areas along the north shore of the reservoir. At normal high-water stage, the north spillway can discharge 52,200 cubic feet per second and the south spillway 26,200 cubic feet per second.

The powerplant intake sill is at an elevation of 4,360 feet. This intake has a slide roller gate, 20 by 26 feet, which is electrically operated. The intake is connected with the south spillway tunnel and the penstock tunnel, which is 12 feet in diameter by 662 feet long.

The existing powerplant consists of two 3,400-horsepower vertical Francis-type turbines and two 2,300-volt, 3-phase, 60-cycle synchronous alternators. The rated capacity of each unit is 3,000 kva. Water is supplied to the turbines from the power intake structure located near the dam's right abutment. A 20-foot-diameter shaft enters a blocked-off section of the original river-diversion tunnel, which is utilized as a desilting chamber. The power water then flows through a 12-foot-diameter pressurized tunnel, a 144-inch-diameter steel penstock with surge tank, and two 102-inch-diameter pipe branches to the turbine valves in the powerhouse. The 49- by 72-foot concrete and steel building is equipped with an overhead crane and other auxiliary equipment.

Description of the Reservoir

The present area of the reservoir at the crest elevation of 4,420 feet is 2,382 acres. This is 4 acres less than in 1947 and 23 acres less than the original 1927 area of 2,405 acres. Its present capacity is 44,800 acre-feet which is 4,350 acre-feet less than in 1947, and 29,010 acre-feet less than original 1927 capacity of 73,810 acre-feet.

The length of the reservoir from the dam to the head of the reservoir is 14.6 miles.

The width of the reservoir at the dam and for a distance of about 5 miles above the dam is narrow, ranging from less than 500 feet to approximately one-fourth mile in width. Both sides of the valley along this portion of the reservoir are steep and generally canyon-like. Above this reach the reservoir broadens out over a 4-mile stretch, ranging from about 1/2 mile to almost 1 mile in width.

At Range 10B, which is 9 miles upstream from the dam, the reservoir narrows again and winds through a canyon for 3 miles, ranging from 1/4 mile to 300 feet in width. Upstream from this point the slopes of the valley sides are less steep, but the reservoir remains narrow to its headwaters. The head of the reservoir is opposite Wendover, Wyoming, and about 1/4 mile above the mouth of Cottonwood Creek.

Description of the Drainage Area

For the general description of the drainage area to Guernsey Reservoir, the reader is referred to pages 3, 4, 5, and 6 of the report entitled, "Sedimentation Survey of Guernsey Reservoir," published by the Bureau of Reclamation in November, 1948.

The North Platte River drains an area of 16,200 square miles above Guernsey Dam, of which 10,800 square miles of this area is above Alcova Dam. The sediment-contributing area to Guernsey then, for the period of this report from 1947 to 1957 is 5,400 square miles.

The climate at Guernsey Dam is typical of the semiarid high plains in which the dam is located. The winters are long and cold. Extreme temperatures have ranged from -27° F. to 104° F. The mean minimum and maximum are 11.9° and 40.3° for January and 56.7° and 89.7° for July. The average annual precipitation is 14.79 inches, ranging from an average of 0.36 inch in February to 2.88 and 2.89 inches in May and June. Snowfall amounts to about 40 inches during the winter months. The maximum precipitation for 24 hours within the drainage basin was 4 inches at Elk Mountain on April 25, 1924, and also at Fort Laramie on June 28, 1947.

The average annual outflow of water from Guernsey Reservoir for the 30-year period from 1928 to 1957 was 1,134,800 acre-feet per year. The average outflow for the 10-year period from the 1948 water year through the 1957 water year was 1,023,600 acre-feet. The 4 years from 1954 through 1957 were unusually dry, with an average outflow of 805,200 acre-feet of water per year.

HISTORY OF 1957 RESURVEY

Preliminary Work

The resurvey of Guernsey Reservoir was begun on May 7, 1957, when a survey party from the project office at Casper, Wyoming, began locating and flagging range ends. Some range ends were missing and had to be reestablished; others which had been lost due to sloughing of the reservoir banks were reestablished back from the original locations.

Upon completing the flagging of the range ends, the survey crew proceeded to rerun the aggradation and degradation ranges at Wendover and in the channel downstream from the dam.

Depth Recorder Survey

The main portion of the Guernsey resurvey started on July 9, 1957, with the traversing of the ranges by boat using the supersonic Edo Depth Recorder. This work continued for about 2-1/2 weeks and progressed from the dam to the upstream end of the reservoir. In the delta area where the water was too shallow for the boat to navigate, the ranges were surveyed on foot with a leveling instrument and rod.

A brief description of the techniques involved in surveying with the survey recorder is given so that future parties who may be inexperienced in reservoir surveys can more quickly get organized and perform their work.

The party consisted of five men who were assigned to the following positions:

1. Depth recorder operator (Boat)
2. Flagman (Boat)
3. Boat operator (Boat)

4. Transitman (Shore)

5. Plane table man (Shore)

The transitman was located at the end of the range to be run, and the plane table man and his recorder were located at another known point at an approximate right angle to the range line from which the entire range was visible. These men used a jeep to get to these points where convenient, and where not, they were transported by boat. While the instrument setups were being made, the depth recorder operator and flagman proceeded to the range end opposite the transitman and began a hand level survey from the range end to the water edge. One or two shots were taken in the water in the area too close to shore for the boat to safely maneuver to define the slope. The water's edge and range end were located by the plane table man utilizing radio communication. The next step was to drive the boat along the range towards the transitman at a speed of 2 or 3 knots with the depth recorder in operation. The boat was kept on line by continuous direction from the transitman using a flag. On long ranges the radio was used by the transitman. Before the beginning of the boat run, a standby signal was given by the flagman. Once the boat was in position, the flagman called "Mark," and signaled with his red flag to the plane table man. At that instant the depth recorder operator marked his chart and noted the time to seconds which was given him by the flagman. A 15-second interval was used between marks and each fifth mark was signaled by a white flag. Upon completion of the run the last mark was made and the time recorded. The time interval was then checked against the number of mark periods and the number of marks then checked by radio with the plane table man to insure against any mistakes. The next step was to survey the line between the range end and water edge near the transitman and to get 1 or 2 shots in the water close to shore. The check bar setting, frequency of power supply, draft of transducer, direction of run, and other pertinent data were recorded in a field book. This same general procedure was performed throughout the entire day except for check bar settings which were made three times each day. The check bar setting consisted of lowering a steel plate into the water to the average depth of the ranges surveyed and adjusting the frequency of the power supplied so that the depth recorder exactly registered the depth of the plate. A check was then made at the greatest depth of water and at 5 feet to determine the maximum variance of the recorder chart with the actual depth of the plate. On this resurvey, the largest variance was about 0.3 feet.

The water surface elevation as read at the dam 2 or 3 times each day was used for vertical control except in the upstream area of the reservoir where a level circuit was run in from a U. S. Geological Survey benchmark. In the upstream area of the reservoir where the water was too shallow for operation of the depth recorder, the procedure was as follows: A small boat was used and measurements were made by lead sounding line. At each measurement the flag was waved for the plane table man and the depth recorded in a field book. Two men were in the boat, plus one at the transit and one at the plane table. This permitted the two remaining men to run the level circuit along the shoreline to tie in the water surface elevations which were no longer truly indicated by the dam site recorder. In some places where there was no water, the two men in the boat were required to proceed on foot with level instrument for vertical control.

Sediment Density and Size Distribution Survey

Upon completing the survey recorder work, the next phase was to collect sediment samples and to measure the in-place density of the sediment. On July 23 and 24, 1957, work was commenced with the Sub-Aqueous Sampler and the Radioisotope Sediment Densitometer (RSD). This was the first reservoir work where the RSD was primarily relied upon to determine the in-place density of the reservoir sediment deposition The Sub-Aqueous Sampler was used to collect samples from which size analysis tests could be made in order that sediment distribution by size throughout the reservoir would be known.

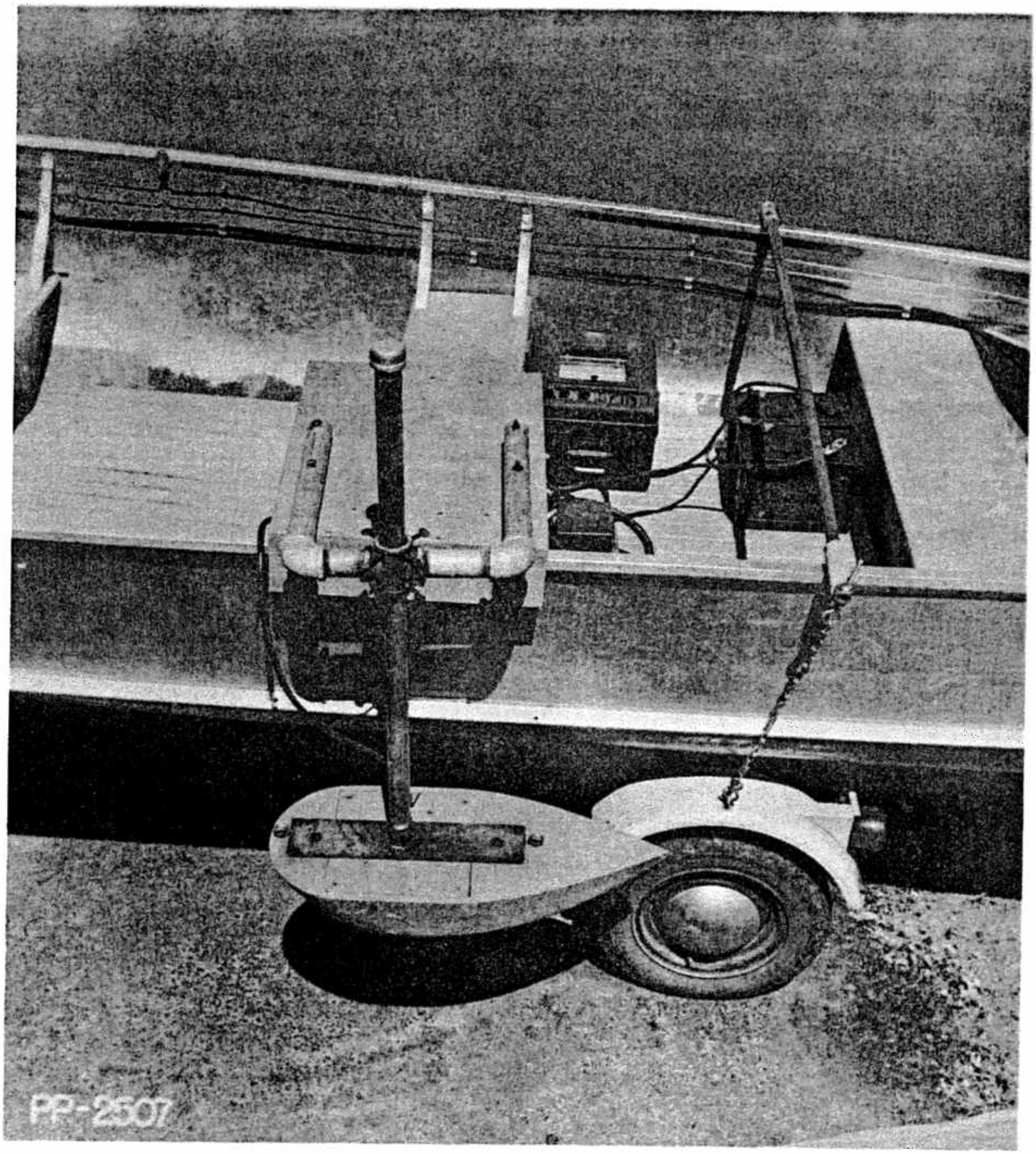
The Sub-Aqueous Sampler is shown in Figure 6 with the A-frame attached to the boat ready for use. The sampler was lowered from the boat by cable and allowed to penetrate the sediment deposits to a predetermined depth. The maximum penetration was governed by the compaction of the sediments, the deepest penetration in Guernsey Reservoir being 6 feet. Eight samples at varying degrees of penetration were taken with the Sub-Aqueous Sampler from near the dam to the delta area of the reservoir. Besides these 8 samples, 2 more were taken in the sand and gravel area of the extreme upper end of the reservoir by pushing a plastic tube into the bed by hand.

The Radioisotope Sediment Densitometer is shown in Figure 7 and Figure 8. The RSD with the probe in the retracted position was transported to the measurement site. It was then lowered over the side of the boat until only a couple of inches of the working shield was above water. The probe was then lowered to the extended position and the cap removed. The dosimeter was charged, read, and placed in the probe. At the moment the dosimeter was in position, time was started. The probe was then capped and the RSD lowered to the desired depth. When the probe entered the sediment the time was recorded as "time into sediment." After the required test time had elapsed the RSD was raised. When it left the sediment the time was recorded as "time out of sediment." When the original position was reached the probe was uncapped and the dosimeter withdrawn and the final reading taken. The time the dosimeter left the probe was recorded as "stop" time. The computations were then immediately made on the form as shown in Figure 9. If the computed dry density was unusual in any respect, another measurement was made to check the results.

The cobalt 60 source used in the RSD can present a definite radiation hazard if the probe is unshielded. It is important to work quickly when the probe is out of the water, or when the dosimeter is being placed in or removed from the RSD. The cobalt 60 source should be installed and removed only by properly trained personnel, and all men in the crew should wear personal dosimeters which should be read daily to check upon the radiation received by the crew.

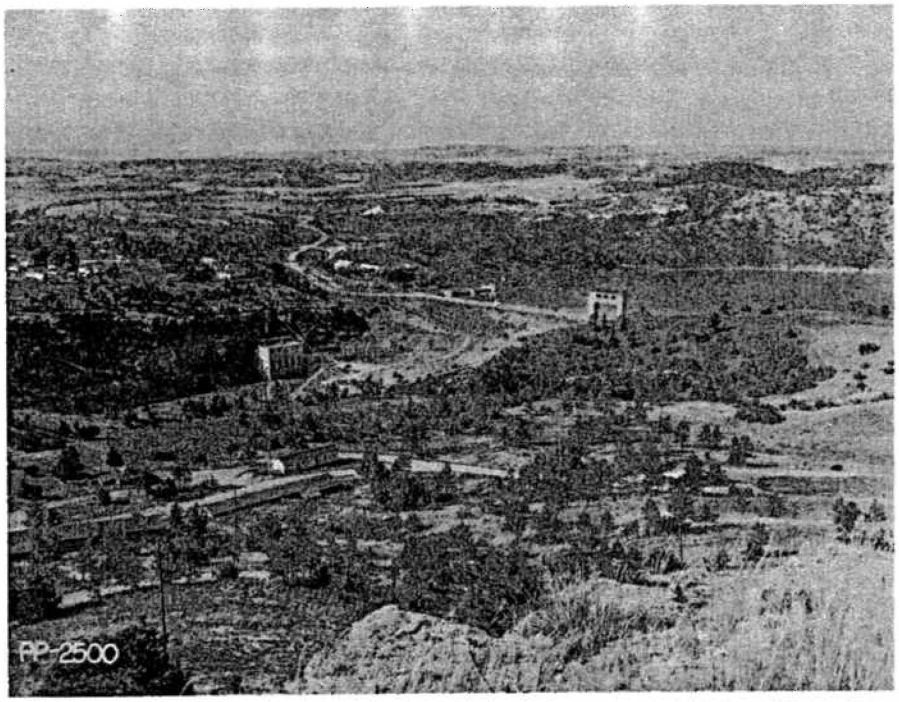
DENSITY AND SIZE DISTRIBUTION OF SEDIMENT

Twenty-three samples were taken in Guernsey Reservoir for the purpose of determining the density of the sediment deposition and the distribution of the sediment sizes throughout the reservoir. Thirteen of the samples were with the Radioisotope Densitometer, which were for the determination of the density of the sediments. Ten other samples were used for size analysis data and also for density of the sediments, which were determined in the Bureau laboratory. Eight of these samples were taken

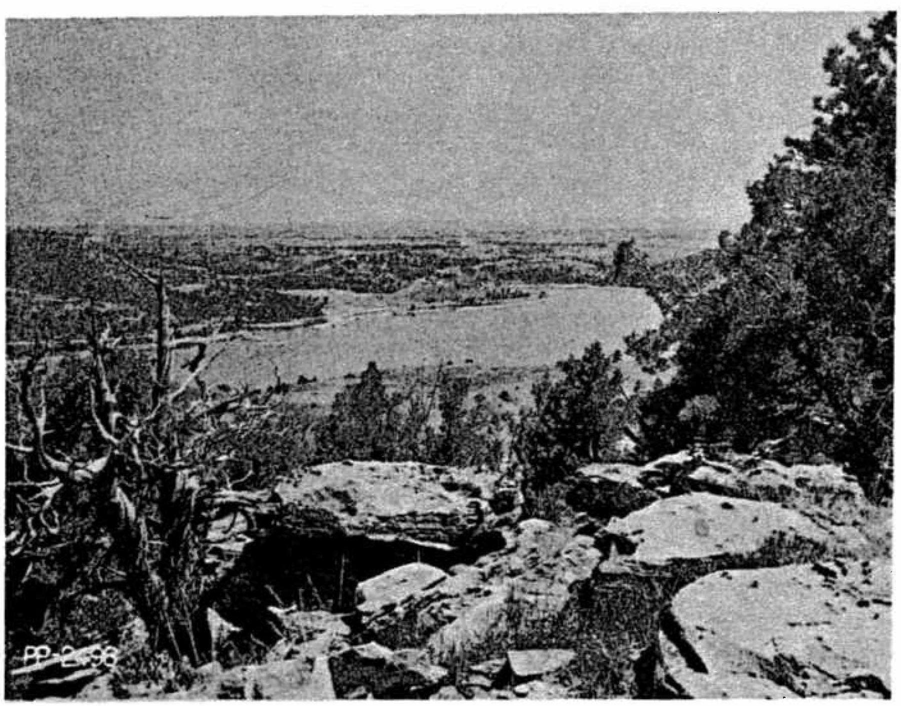


Depth recorder equipment in normal position for operation to survey profile of reservoir cross-section.

Figure 2.

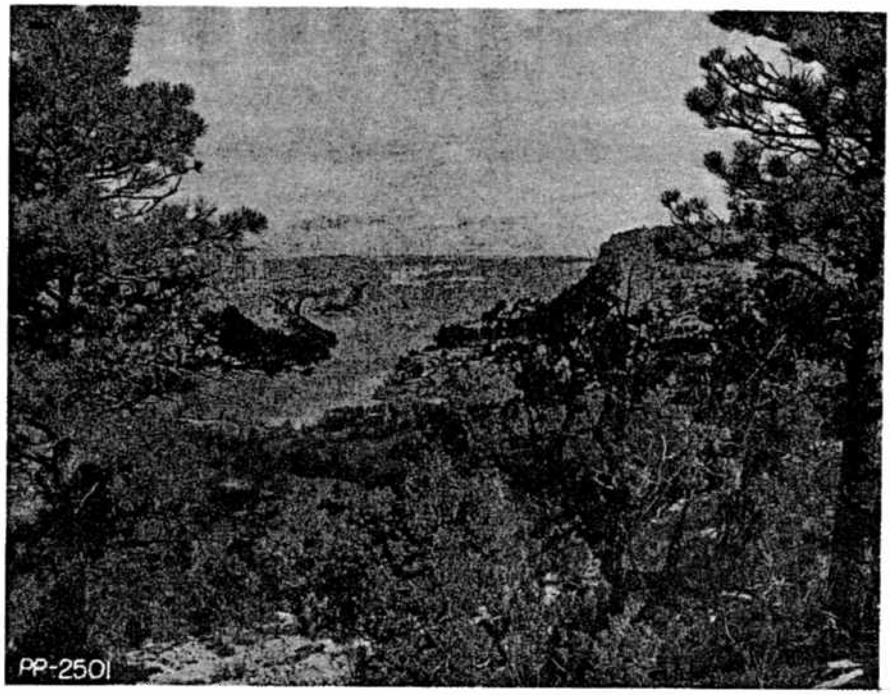


Guernsey Dam and Powerhouse.

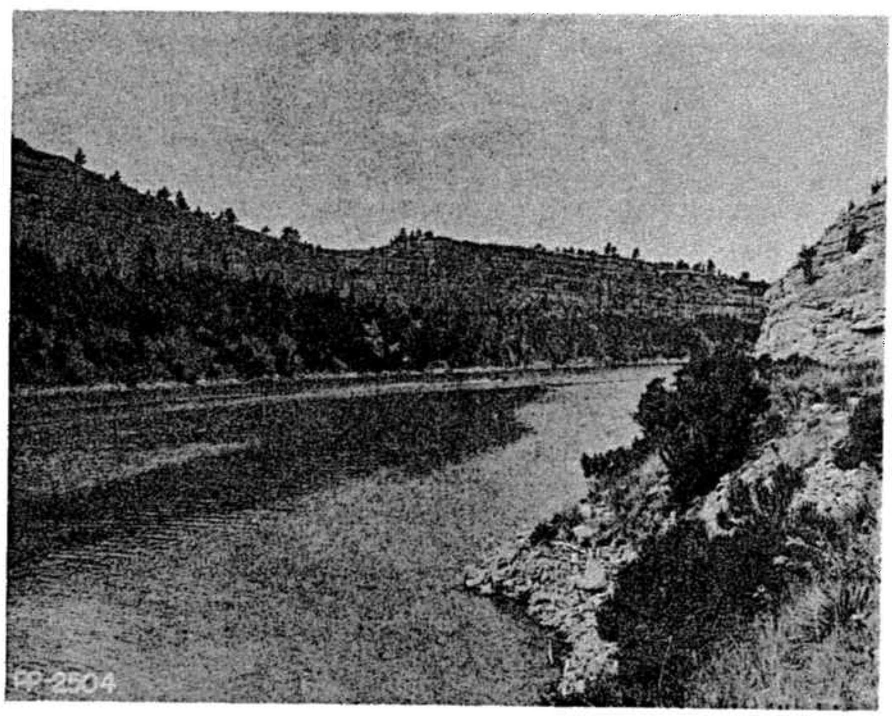


Guernsey Reservoir in vicinity of dam.

Figure 3.

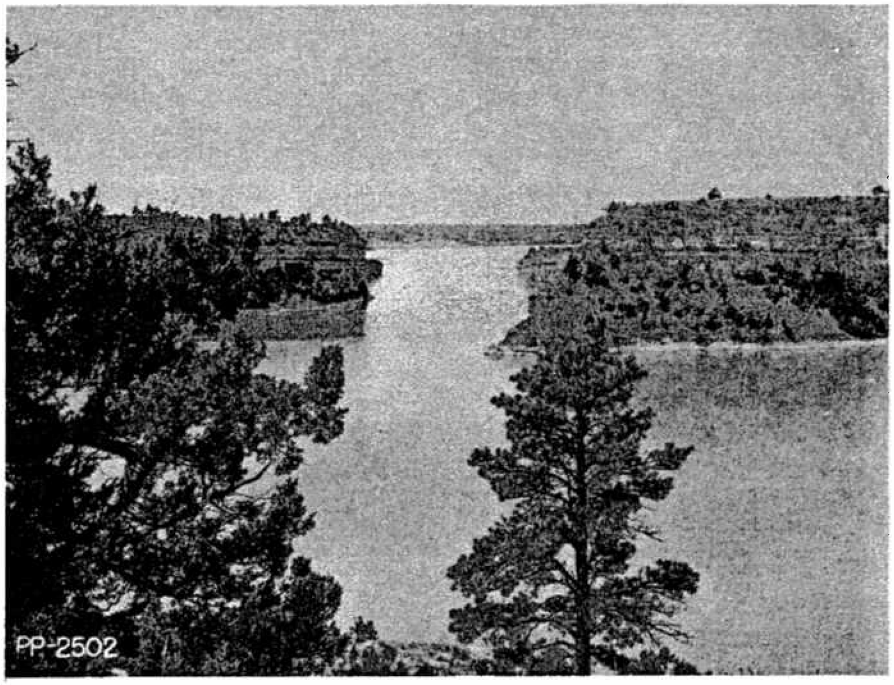


Guernsey Reservoir from left bank looking upstream. Range 20 is located in center of photograph.



Guernsey Reservoir in vicinity of Range 18.

Figure 4.



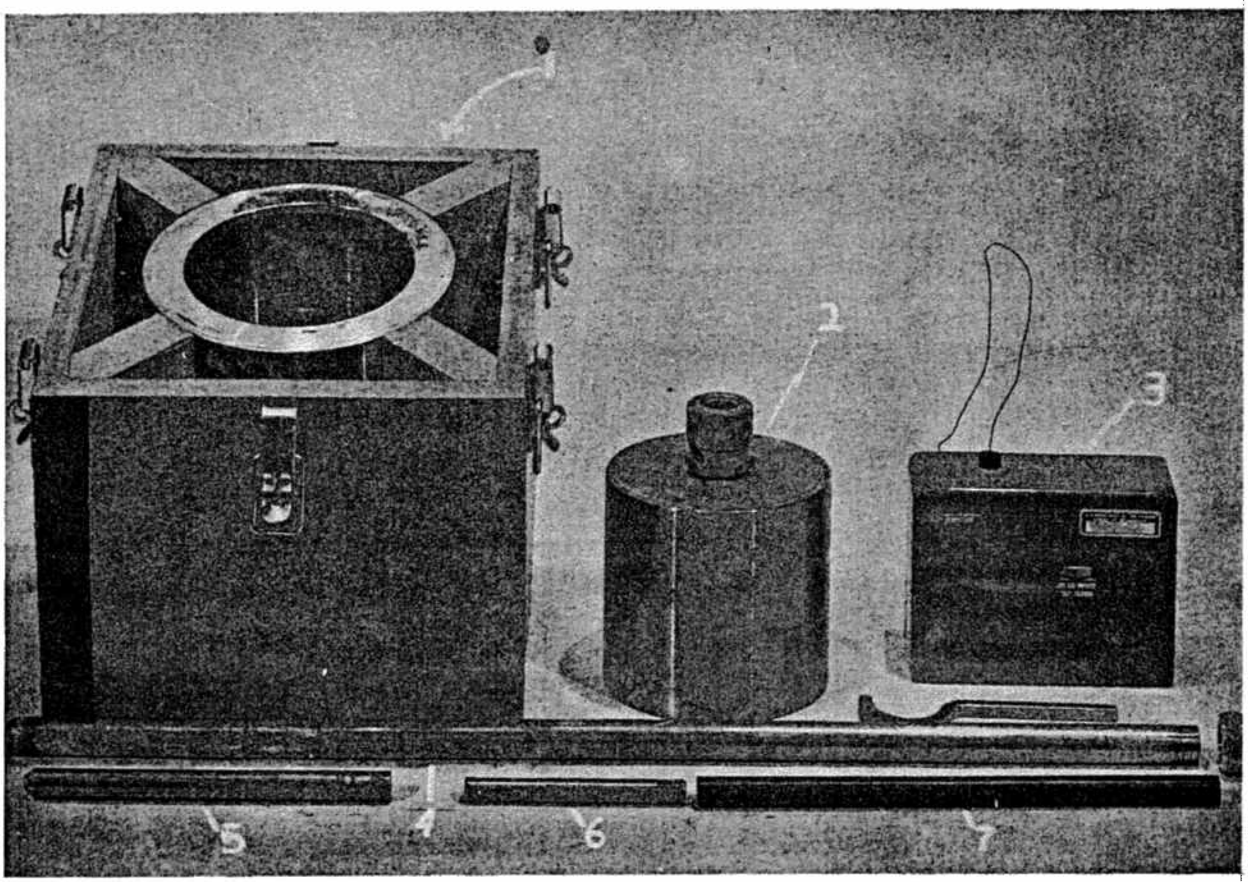
Guernsey Reservoir with Long Canyon to right and gap leading to the lake portion of the reservoir in the background.

Lake portion of Guernsey Reservoir showing low relief and flat beaches.

Figure 5.

Sub-Aqueous Sampler and A-Frame in position ready for lowering into the reservoir sediments. Plastic tube is located inside 2-inch pipe stem and held in place by cutter-head. Disk-like lead weight supplies the penetration force and valve in pipe-tee at top of pipe stem prevents sample from falling out of plastic tube when apparatus is raised.

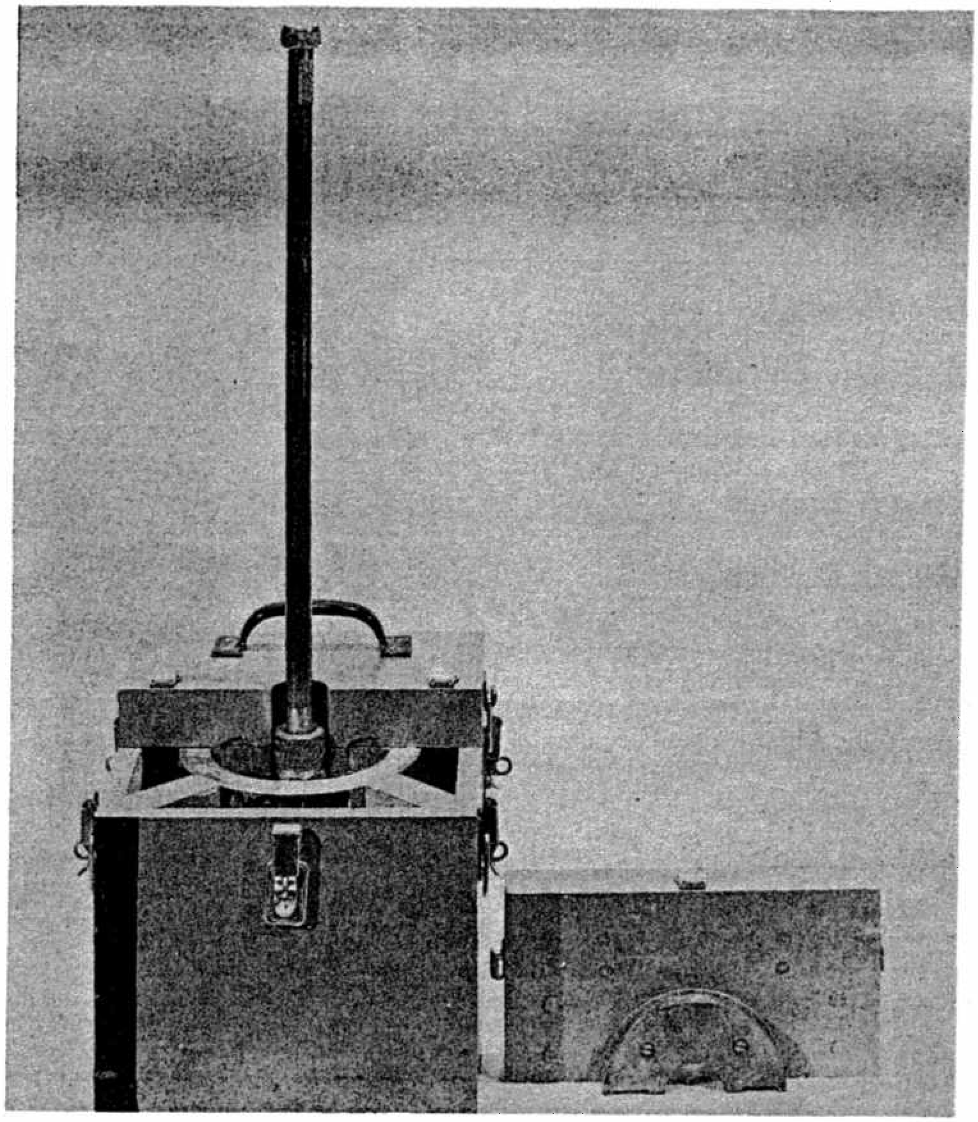
Figure 6



Radioisotope Sediment Densitometer Photo shows the major components of the RSD:

1. Storage shield
2. Working shield
3. Dosimeter Charger
4. Probe shell
5. Lead column to separate source and detector
6. Dosimeter
7. Dosimeter holder

Figure 7



Radioisotope Sediment Densitometer with the probe in the retracted position and in the storage shield.

Figure 8

Sheet ___ of ___

Sample Data Sheet

SEDIMENT DENSITY MEASUREMENT WITH RADIOISOTOPES SEDIMENT DENSITOMETER

Date ______________________ Personnel ______________________

Project ______________________ ______________________

Location ______________________ ______________________

______________________ ______________________

Surface elevation ______________

Depth to top of sediment __________

Depth of measurement __________

Dosimeter number ______________

Dosimeter readings:

Final ______________

Initial ______________

(1) Difference ______________

(7) Water rate ______________

(8) Water correction =(6)x(7)= ____

(9) Sediment reading =(1)-(8)= ____

(10) Sediment rate =(9)/(5)= _____

Time:

(2) Into sediment ______________

(3) Out of sediment ______________

(4) Stop time ______________

(5) Time in sediment =(3)-(2)= ____

(6) Transit time =(4)-(5)= ______

(11) Intensity ratio, R=(10)/(7)= ____

Wet density ______________

Specific gravity ______________

Dry density ______________

Remarks: ____

Figure 9

with the sub-aqueous sampler and two by pushing a plastic tube into the bed by hand.

Tables 1 and 2 summarize the results of the 23 samples. Note that on R-22A and R-19B, the results for the 2-foot penetration for both the RSD and SA samples compare very well. The results for the 6-foot penetration do not compare though, the reason being that the RSD probe measured the point density at 6-foot penetration, while the SA took a core with the maximum depth of 6 feet, which gave an integrated sample from the surface of the sediment to 6-foot depth. It is interesting that the results from the 6-foot penetration with the RSD probe varied so much from the smaller penetrations because in past reservoir work the smaller penetration core samples were used exclusively to give the density of the sediments. The RSD shows that the density of the sediments at the greater depths is, in general, probably larger than has been realized in the past. In the future, with further development of the RSD, it may be possible to penetrate deeper into the sediments and learn more about the long time compaction of the reservoir deposits.

The sediment size analysis curve of the 2-foot penetration samples is given in Figure 10. The sample from R-22A is made up of the finest particles as would be expected, since the sediment had to travel through the entire reservoir before being deposited. By the same token, the samples from R-9 and R-6 are the coarsest, because they are located in the upper end of the reservoir. R-13, R-19B, R-10B, and R-15, however, are fairly close to each other in particle size make-up, and do not fall on the graph in the order of their progression downstream in the reservoir. This is very similar to the results found in the 1947 resurvey, where the range near the dam and those in the upper end of the reservoir fell in their logical order on the size analysis curve while the in-between ranges did not follow this sequence.

The correlation of density with the location of the sample in the reservoir, and with depth of penetration, is given in **Figure 11.** Note that as the penetration increases the density increases in each case for a specified range. There is a fairly uniform slope to each of these curves. The correlation of density with the location of the sample in the reservoir gives a relation similar to what may be expected; the sediment near the dam being lightest, and the sands in the upper end of the reservoir being the heaviest.

The average density of the sediment deposited in Guernsey Reservoir for the period from 1947 to 1957 was found to be 60.7 pounds per cubic foot. The method of computation used was to divide the reservoir into 6 segments and determine the acre-feet of deposition in each segment. Then the densities as determined by field measurements in each of these segments was applied to the volume of deposition. The total tonnage of deposition in the reservoir thus determined. This total tonnage was divided by the total volume of sediment deposited from 1947 to 1957 to arrive at the average density of 60.7 pounds per cubic foot.

Table 1

SIZE ANALYSES OF SEDIMENT SAMPLES FROM GUERNSEY RESERVOIR
North Platte River, Wyoming

Range	Sample	Penetration (ft)	Dry density lb/cu ft	Mechanical analysis: Percent equal to or less than 0.001 mm	0.002 mm	0.005 mm	0.009 mm	0.019 mm	0.037 mm	0.074 mm	0.149 mm	0.297 mm	0.589 mm	1.19 mm	2.38 mm	4.76 mm	9.52 mm
22A	1	2.0	40.8	33	54	82	93	97	100	--	--	--	--	--	--	--	--
22A	1A	6.0	48.6	34	52	76	87	97	100	--	--	--	--	--	--	--	--
19B	2	2.0	59.6	22	32	45	57	74	89	99.5	100	--	--	--	--	--	--
19B	2A	5.0	71.6	16	22	32	39	55	75	95	99.5	100	--	--	--	--	--
15	3	1.7	70.0	24	32	45	54	71	91	99	99.8	100	--	--	--	--	--
15	3A	2.0	74.4	16	22	32	41	56	81	98	99.5	100	--	--	--	--	--
13	4	1.8	53.9	26	33	50	61	78	94	99	99.5	100	--	--	--	--	--
10B	5	1.0	82.3	24	30	43	54	70	87	99	99.5	99.8	100	--	--	--	--
9	7	0.8	145.5	--	--	--	--	--	2	4	14	62	90	95	97	99	100
6	6	0.5	142.7	--	--	--	--	--	1	2	2	3	31	67	89	99	100

Table 2
DENSITY OF SEDIMENT SAMPLES FROM GUERNSEY RESERVOIR
North Platte River, Wyoming

Range	Field sample No.	El of sample M.S.L.	Penetration ft	Sub-aqueous sampler: Wet density lb/cu ft	Sub-aqueous sampler: Dry density lb/cu ft	Radioisotope sediment densitometer: Wet density lb/cu ft	Radioisotope sediment densitometer: Dry density lb/cu ft	Specific gravity**
R-22A	1		2.0	91.0	40.8			2.69
R-22A	1A		6.0	100.8	48.6			2.68
R-22A	1B	4159.5	2.0			84	35	
R-22A	1C	4159.5	6.0			123	98	
R-20	12	4170.6	3.0			94	49	
R-19B	2		2.0	106.5	59.6			2.65
R-19B	2A		5.0	115.5	71.6			2.65
R-19B	2B	4180.8	2.0			104	66	
R-18	11	4181.1	2.0			83	33	
R-18	11A	4181.1	3.0			88	40	
R-16	10	4185.6	2.0			91	44	
R-15	3		1.7	112.4	70.0			2.64
R-15	3A		2.0	115.8	74.4			2.64
R-14	9	4192.9	2.0			77	22	
R-14	9A	4192.9	3.0			88	39	
R-13	4		1.8 est	92.7	53.9			2.61
R-13	4B	4206.6	2.0			92	47	
R-13	4C	4206.6	5.0			113	81	
R-12	8	4204.5	2.0			98	58	
R-10B	5		1.0	122.7	82.3			2.64
R-10B	5B	4211.0	2.0			104	67	
*R-9	7		0.8	167.4	145.5			2.65
*R-6	6		0.5	157.3	142.7			2.63

*These samples taken by pushing plastic tube into sediment.
**For RSD computations, the specific gravity was assumed at 2.65.

Sediment Disposition in Guernsey Reservoir

Longitudinal Distribution

The variation of the thickness of the sediment deposition in Guernsey Reservoir is presented graphically by **Figure 12, page 49.** The 1957 profile of the thalweg is shown along with the 1937 and 1947 profiles, and also the 1927 original thalweg profile. The 1937 profile does not extend all the way to the headwater of the reservoir because the resurvey was not completed.

The thickest deposition of sediment is located at Range 18 where it amounts to 37 feet. The 1947 resurvey showed that the thickest deposition was at Range 14 where it was 33 feet. Thus, it is shown that during the 10-year period from 1947 to 1957 the tendency was for the sediment to be deposited closer to the dam than during the previous period, the section with the deepest sediment deposit having moved closer to the dam by 2.4 miles.

The 1947 longitudinal profile shows a sharp break in grade of the deposition at the entrance to the canyon. This was explained in the 1948 report with the statement, "It is believed that the greatest depth of sediment was deposited in the vicinity of Range 14 for the following reasons: 1, below this range the width of the lake narrows, restricting the flow of the stream; 2, the drawdown of the lake has produced little or no current below this range, based on the operation levels of the lake during irrigation seasons." The 1957 profile shows that this break in grade no longer exists and that the slope of the sediment deposition is more uniform throughout the entire length of reservoir. This change in sediment disposition from 1947 to 1957 can be explained in part by the fact that Guernsey

Reservoir was operated for a six-year period at a lower than normal elevation. This six-year period started in 1951 and lasted through 1956. The average month-end reservoir elevation during this six years was 4,407.49 feet. The twelve years preceding this period, 1939 through 1950, had an average month-end reservoir elevation of 4,411.26 feet. The yearly averages of the month-end elevations are:

Year	Elevation	Year	Elevation
1939	4410.15	1948	4413.65
1940	4409.81	1949	4411.15
1941	4407.68	1950	4413.22
1942	4412.13	1951	4406.10
1943	4410.87	1952	4405.10
1944	4409.14	1953	4408.54
1945	4412.06	1954	4408.47
1946	4412.49	1955	4408.22
1947	4412.81	1956	4408.52

This lower operating level of the reservoir for a sustained period of six years undoubtedly contributed to the fact that the sediment deposition during 1947 to 1957 occurred closer to the dam than in the previous years of operation. The other reason for this change in deposition pattern is that the sediment in the upstream half of the reservoir has probably reached a minimum slope based on sediment size and reservoir operation. The 1947 slope was the same as the 1957 slope, 2.5 feet per mile. In 1937 the slope was 3.3 feet per mile, while the original slope of the river channel was 5.7 feet per mile. It can be expected that the future sediment accumulation will continue to build up the portion of the reservoir near the dam till the slope of the thalweg is 2.5 feet per mile throughout nearly the entire length of the reservoir. The power intake sill will, of course, always provide a control and therefore the sediment will slope uniformily to perhaps Range 20 where it will then break its grade and slope towards the power intake sill. The ratio between the present sediment slope and the original river channel slope is $\frac{2.5 \text{ feet/mile}}{5.7 \text{ feet/mile}} = 0.44$.

Lateral Distribution

The lateral distribution of the sediment in Guernsey Reservoir is shown by **Figure 13, page 51.**

Range 21 is typical of the deposition in the canyon-like portion of the reservoir near the dam. The sediment is equally distributed over the bottom forming a very flat surface. Range 15 is typical of the lake portion of the reservoir where a channel is always found which is a result of the drawdown of the reservoir. Except for the channel, the sediment is laid down fairly uniformly in layers which form a flat bottom. Ranges 5 and 8 are typical of the head of the reservoir. Ranges 5 and 8 cross sections are similar to what one would expect to find in an aggrading river channel. Actually, most of the year this portion of the reservoir does not experience the effects of the reservoir storage and it usually functions as a river channel would.

The lateral distribution of the sediment, at the sections where there are creeks tributary to the reservoir, changes from the typical cross section shown. At these points the sediment brought in by the reservoir tributaries drops out and deltas are formed at their mouths. This is probably the greatest factor causing the 4420-foot contour area of the reservoir to diminish as the years pass.

Sediment Disposition Curves

The 1947 and 1957 sediment disposition curves are shown in **Figure 14, page 53.** The curves illustrate clearly that during the 1947-1957 period the sediment was deposited in a greater percent in the lower elevations of the reservoir which are found towards the dam.

In the period that Guernsey Dam was planned and designed, there was no procedure for forecasting the shape of the sediment disposition curve. The original data pertaining to the depth and capacity of the reservoir were used in this present investigation to determine, if a forecast had been made, if it would match the actual sediment disposition curve. The relation between capacity and depth indicated that a Van't Hul Type III curve should be used up to a 40-foot depth, and from 40 feet to the surface a Type II should be used. This particular reservoir is an excellent example, however, as to why engineering judgment must be used on forecasting disposition of sediments rather than only applying empirical methods. The Sediment Disposition Curves in Figure 14 show that the sediment was deposited closer to a Van't Hul Type I curve than to a Type II or III. The reason for this is that the portion of the lake between Ranges 15 and 10 acted as a huge stilling basin and the amount of deposition that occurred here was abnormally large when based upon the depth-capacity relationship. Had a sediment disposition forecast been made for this reservoir, it would have been necessary to consider the effect of the lake storage on the disposition plus the narrow neck near Range 15, and several other factors peculiar to this reservoir. The factors are itemized in the "Interim Report, Distribution of Sediment in Reservoirs" published in June 1954 by the Bureau of Reclamation.

<u>Area-Capacity Curves</u>

The 1927, 1947, and 1957 area and capacity curves are presented in Figure 15, page 55. An area and capacity table is given in Table 3, page 32.

The capacity curves illustrate clearly the large loss of storage in Guernsey Reservoir between 1927 and 1947 when compared with the period from 1947 to 1957. The loss in capacity for the first 20 years was nearly 25,000 acre-feet, while in the last 10 years it was only 4,350 acre-feet.

The loss of area at the 4420 contour indicates only a very small loss of 19 acres in the first 20 years, and 4 acres in the last 10 years of Guernsey Reservoir operation for a thirty year loss of area of 23 acres. The area curves, however, show loss of area at all of the contours. The area loss at contour 4395 amounts to nearly 900 acres for the 30-year period. The area curves also show that the reservoir has completely been filled in with sediment from elevation 4,329 feet to 4,359 feet. The capacity in this 30-foot vertical interval amounted to 2,900 acre-feet.

At the present time the sediment deposit is up to the sill of the power intake. This means that water passing through the turbines has, and will continue to have, a large concentration of silt and clay which of course causes abnormal wear on the blades of the turbine wheels.

<u>Sediment Distribution by Segments</u>

The reservoir was divided into six segments to facilitate the computation of the total tonnage of sediment deposited in the reservoir during the period from 1947 to 1957.

Information on the deposition within these segments is given in **Table 4, page 33.**

A comparison of the sediment deposited during the 1927 to 1947 period and the 1947 to 1957 period is given in **Table 5, page 34.**

Table 3

AREA-CAPACITY TABLE
Guernsey Reservoir

Contour line el	Capacity 1927 acre-ft	Capacity 1947 acre-ft	Capacity 1957 acre-ft	Area 1927 acres	Area 1947 acres	Area 1957 acres
4, 420	73, 810	49, 150	44, 800	2, 405	2, 386	2, 382
4, 415	62, 250	37, 770	33, 540	2, 208	2, 159	2, 122
4, 410	51, 730	27, 680	23, 680	1, 994	1, 874	1, 822
4, 405	42, 240	19, 570	15, 775	1, 797	1, 376	1, 340
4, 400	33, 690	13, 790	10, 315	1, 618	948	844
4, 395	26, 110	10, 050	6, 905	1, 409	561	520
4, 390	19, 850	7, 588	4, 800	1, 098	425	322
4, 385	14, 920	5, 650	3, 360	873	350	254
4, 380	11, 060	4, 052	2, 215	671	289	204
4, 375	8, 069	2, 726	1, 320	528	242	154
4, 370	5, 765	1, 647	660	395	190	110
4, 365	4, 066	802	200	286	148	74
4, 360	2, 834	189	2	207	99	5
4, 355	1, 910	0. 6	0	162	1. 6	0
4, 350	1, 192	0	0	125	0	0
4, 345	639	0	0	96	0	0
4, 340	278	0	0	50	0	0
4, 335	92	0	0	25	0	0
4, 330	19	0	0	6	0	0
4, 329	4	0	0	1	0	0

Table 4

Sediment Distribution by Segments - 1947-1957

Segment	Capacity 1947 acre-feet	Capacity 1957 acre-feet	Sediment deposited 1947-1957 acre-feet	Density of sediment lbs/cu ft	Sediment deposited 1947-1957 tons
Head of reservoir to Range 10B	3,047	2,797	250	144.1	784,625
Range 10B to Range 12	3,556	3,629	* -73	69.1	* -110,166
Range 12 to Range 15A	22,073	20,605	1,468	52.1	1,665,795
Range 15A to Range 19B	5,225	4,016	1,209	57.3	1,508,326
Range 19B to Range 21	8,801	7,645	1,156	61.1	1,538,356
Range 21 to Dam	6,448	6,108	340	48.6	360,634
	49,150	44,800	4,350		5,747,570

*This represents scour of sediment which was deposited elsewhere in the reservoir.

Average density of sediment, arrived at by dividing total tonnage by total acre-feet of sediment deposited in the 10-year period, is 60.7 lb per cu ft.

Table 5

1927 to 1957 Sediment Distribution by Segments

Segment	Capacity 1927 acre-feet	Capacity 1947 acre-feet	Capacity 1957 acre-feet	Deposition 1927-1947 acre-feet	Deposition 1947-1957 acre-feet	Deposition 1927-1957 acre-feet
Head of reservoir to Range 10B	6,525	3,047	2,797	3,478	250	3,728
Range 10B to Range 12	7,111	3,556	3,629	3,555	* -73	3,482
Range 12 to Range 15A	35,442	22,073	20,605	13,369	1,468	14,837
Range 15A to Range 19B	7,256	5,225	4,016	2,031	1,209	3,240
Range 19B to Range 21	10,405	8,801	7,645	1,604	1,156	2,760
Range 21 to Dam	7,071	6,448	6,108	623	340	963
	73,810	49,150	44,800	24,660	4,350	29,010

*This represents scour of sediment which was deposited elsewhere in the reservoir.

STATISTICAL SUMMARY
Guernsey Reservoir

Age	30 years
Watershed	
Total area, 1927 to 1938	5,500 sq mi (1)
Total area, 1938 to 1957	5,400 sq mi (2)
Reservoir	
Area at crest stage, 1927	2,405 acres
Area at crest stage, 1947	2,386 acres
Area at crest stage, 1957	2,382 acres
Storage capacity, 1927	73,810 acre-feet
Storage capacity, 1947	49,150 acre-feet
Storage capacity, 1957	44,800 acre-feet
Storage per sq mi of drainage area, 1927	13.42 acre-ft/sq mi
Storage per sq mi of drainage area, 1947	9.10 acre-ft/sq mi
Storage per sq mi of drainage area, 1957	8.30 acre-ft/sq mi
Sedimentation	
Sediment accumulated, 1927-1947	24,660 acre-ft
Sediment accumulated, 1947-1957	4,350 acre-ft
Sediment accumulated, 1927-1947	28,580,000 tons
Sediment accumulated, 1947-1957	5,748,000 tons
Sediment* yield, 1927-1947	0.23 acre-ft/sq mi/yr
Sediment* yield, 1947-1957	0.08 acre-ft/sq mi/yr
Depletion of Storage	
Yearly loss of original capacity, 1927-1947	1.67% per year
Yearly loss of original capacity, 1947-1957	0.59% per year
Yearly loss of original capacity, 1927-1957	1.31%
Loss of original capacity, 1927-1947	33.41%
Loss of original capacity, 1947-1957	5.90%
Total loss of original capacity, 1927-1957	39.31%

*Does not include the sediment passing Guernsey Dam. Please see section on **Trap Efficiency.**

(1) Area between Pathfinder Dam and Guernsey Dam.
(2) Area between Alcova Dam and Guernsey Dam.

Trap Efficiency

The Geological Survey took suspended sediment measurements below Guernsey Dam during the period from April 1947 through the 1952 water year. The gaging station that was used is located about 3/4 mile below the dam, and because of its proximity to the dam, it can be assumed that the suspended sediment measured at this station is that which passed through the reservoir.

From July 20, 1947, to September 30, 1952, the USGS measured 208,500 tons of suspended sediment discharged from Guernsey Reservoir. From October 1, 1952, to July 20, 1957, the suspended sediment discharge was estimated using the relationship between water and sediment established in the 1947 to 1952 measurements. It was thus determined that 288,000 tons of suspended sediment was discharged from Guernsey Reservoir during the 10-year period between the 1947 and 1957 resurveys.

It has previously been stated in this report that the same 10-year deposition in Guernsey Reservoir was 5,747,570 tons.

Therefore:

$$\text{Trap Efficiency} = \frac{5,747,570}{5,747,570 + 288,000} = 95.2\%$$

This is the average trap efficiency for the reservoir from 1947 to 1957.

This trap efficiency was checked using USGS suspended sediment measurements at Cassa, Wyoming, which is upstream from Guernsey Reservoir a short distance. Over a 5.2-year period of records (1947-1952), it was shown that 4,616,500 tons of sediment entered Guernsey Reservoir and 208,500 tons were discharged past the dam. From this data, the trap efficiency was shown to be 95.5 percent. This close agreement substantiates the 10-year trap efficiency of 95.2 percent which was calculated on the basis of sediment actually deposited, and that measured downstream from the reservoir.

The volume of the sediment which was passed through Guernsey Reservoir amounted to 275 acre-feet. This figure is based upon the density of the sediments as deposited near the dam at Range 22A.

Channel Condition Below Guernsey Dam

The channel downstream from Guernsey Dam has in general aggraded between 1953 and 1957. This is shown in the cross-sections in **Figure 16, page 57.** At one section, the Geological Survey Gaging Station, the cross-section is plotted for 1947 as well as 1953 and 1957. This section shows aggradation since 1947 as well as from 1953. The location of the sections* shown in the figure are as follows:

Section 11--1,425 feet below end of spillway chute

Section 12--1,765 feet below end of spillway chute

Section 17--4,150 feet below end of spillway chute

USGS Station--5,368 feet below end of spillway chute

Section 11 is on a river bend and since 1953 there has been a redistribution of the bed material so that the deepest portion of the channel has moved from the center to the outside bend. This section has neither degraded or aggraded but has remained relatively stable.

*It was impossible to locate 2 of the sections used in the 1947 resurvey. These sections were Range 0.5 and 0.9 as described on page 16 of Reference 3.

Section 12 is on the same river bend as Section 11. This section shows an average of about 0.7 foot of aggradation since 1953. Both Sections 11 and 12 are upstream from Sunrise Creek which is the only tributary in this reach of the river. Therefore, the aggradation at Section 12 probably originated from a gravel groin constructed in the tailrace near the powerhouse.

Section 17 aggraded approximately 2 feet between 1953 and 1957. Since this section is downstream from Sunrise Creek, the aggradation material is undoubtedly gravels contributed by Sunrise Creek. The lower discharges of the recent years has not been sufficient to transport the bed load as it has in the first 20-year period.

The USGS Gaging Station aggraded approximately 1 foot between 1947 and 1953. Some aggradation also occurred between 1953 and 1957. This aggradation, as at Section 17, originated from sediment contributed by Sunrise Creek.

The period from 1953 to 1957, and from 1947 to 1957 for the gaging station, resulted in general aggradation of the channel below Guernsey Dam. However, the long-time result, from 1927 to 1957, is that of degradation. The 1957 condition, even with the recent aggradation, shows a net degrading of 1 to 2 feet at Sections 11 and 12, and about 3 feet at Section 17 and the gaging station.

Future Sediment Deposition in Guernsey Reservoir

The construction of Glendo Dam will decrease the deposition rate in Guernsey Reservoir a substantial amount. The sediment contributing area of the drainage basin will be reduced from 5,400 square miles to about 700 square miles, which is about 13 percent of the pre-Glendo area.

The 1927 to 1957 average deposition rate in Guernsey Reservoir has been about 970 acre-feet per year, or a yearly loss of 1.31 percent of the original storage capacity of 73,810 acre-feet.

To make an estimate of the future sedimentation rate, a soil erosion map was examined of the past and present area of the Guernsey drainage basin. Erosion severity areas were planimetered and the following was determined as shown in the table.

Soil Erosion Areas

Soil condition	Drainage area: Before Glendo 5,400 square miles	Drainage area: After Glendo 700 square miles
Minor erosion	12 percent	24 percent
Moderate sheet erosion	78 percent	55 percent
Severe sheet erosion	8 percent	21 percent
Severe erosion with geologic erosion predominant	2 percent	0 percent
	100 percent	100 percent

The condition of the soils in the two areas with respect to the severity of erosion can be expected to give about equal sediment contributions per square mile. The fact that one basin is smaller means that the sediment yield which actually reaches Guernsey Reservoir will be higher for the 700-square mile basin than for the 5,400-square mile basin. It has been shown that as the drainage basin increases in size, the sediment yield decreases, when other factors are equal.

The sediment yield for the 5,400 square miles over the period from 1927 to 1957 was 212 tons/square mile/year. Using the relationship as developed by Glymph in Reference 6, the sediment yield for the 700-square mile basin is 290 tons/square mile/year. Based on the average density of 60.7 pounds/cubic feet of the deposited sediment, the average yearly reservoir deposition will be 150 acre-feet/year.

Summary

Guernsey Reservoir has been subject to an unusually high sedimentation rate during its 30-year life up to 1957. This is due primarily to the fact that the capacity is small when compared to the large size of the drainage basin.

In the period from 1927 to 1957, Guernsey Reservoir lost 39.3 percent of its original capacity to sediment deposition. The 10-year period form 1947 to 1957, however, was a period of reduced storage loss. From 1927 to 1947 the loss was 1.67 percent per year while the 1947 to 1957 loss was only 0.59 percent per year. This difference in loss rate was due primarily to reduced reservoir inflow during the latter 10 years. This dry period was the cause of two contributing factors to a relatively small capacity loss during the last 10-year period. One factor was that less sediment was carried by the North Platte River above Guernsey Reservoir and thus there was less sediment available for deposition. The other factor was the low operating level of the reservoir from 1951 through 1956 which caused the deposited sediments to be exposed to the sun and air more than normal. This exposure caused the sediments to compact so that they occupied less reservoir space than an equivalent deposition during the 1927 to 1947 period.

The pattern of disposition of the sediments within the reservoir has changed so that during the last 10 years the deposition has occurred much closer to the dam than in the previous years. This is due to the lower operation level of the reservoir, and the fact that a stable slope of the sediments has been established in the topset bed of the reservoir. The slope of the sediments here has reached 2.5 feet per mile.

The density of the last 10 years of sediment deposition averages out to be 60.7 lb/cu ft. The density as found in the 1947 resurvey was 53.2 lb/cu ft. This increase is due, as mentioned above, to the sediments having been exposed to air and sun during the period of low reservoir operation.

The trap efficiency of Guernsey Reservoir for the period from 1947 to 1957 was 95.2 percent. The 1927-1947 trap efficiency reported in Reference 3 was calculated to be 92.2 percent for Guernsey Reservoir. This lower trap efficiency is explained by the fact that it was based on only 6 months of sediment measurements below Guernsey Dam, and these particular 6 months had unusually high sediment discharges from Guernsey Dam.

The channel below Guernsey Dam has aggraded in recent years, though the 1927 to 1957 result has been a net degradation of from 1 to 3 feet.

The storage loss to Guernsey Reservoir has been very large in past years. The construction of Glendo Dam, however, has reduced the sediment contributing area to Guernsey Reservoir from 5,400 square miles to 700 square miles. This reduction of sediment contributing area will, therefore, reduce the future sediment inflow to Guernsey Reservoir from the historic 970 acre-feet/year to about 150 acre-feet/year. The construction of Glendo Dam has, therefore, extended the useful life of Guernsey Reservoir by many years.

ACKNOWLEDGMENT

The preparation of this report and the data analysis herein were performed by Kenneth R. Wright, Hydraulic Engineer, Sedimentation Section, Hydrology Branch, Division of Project Investigations. Mr. Wright also served as technical supervisor in the acquisition of the field data.

The report was reviewed by Whitney M. Borland, Head, Sedimentation Section. Acknowledgment is also made to Messrs. J. R. Riter and H. P. Dugan, Chief and Assistant Chief, respectively, of the Division of Project Investigations and Herbert S. Riesbol, Chief, Hydrology Branch, for their review of this report.

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Mr. Q. L. Florey of the Chemical Engineering Branch, Engineering Laboratories Division, supervised the Radioisotope Sediment Densitometer sampling and assisted Messrs. C. R. Miller and K. R. Wright in taking samples of reservoir deposits with the Sub-Aqueous Sampler.

The Project Office at Casper performed the tedious job of interpreting the depth recorder charts, drawing new reservoir topography

maps, and computing new area-capacity tables. The Casper Project Office is commended for their rapid, neat, and accurate work on this portion of the resurvey.

The resurvey was performed at the request of Region 7 of the Bureau of Reclamation, R. J. Walter, Jr., Regional Director.

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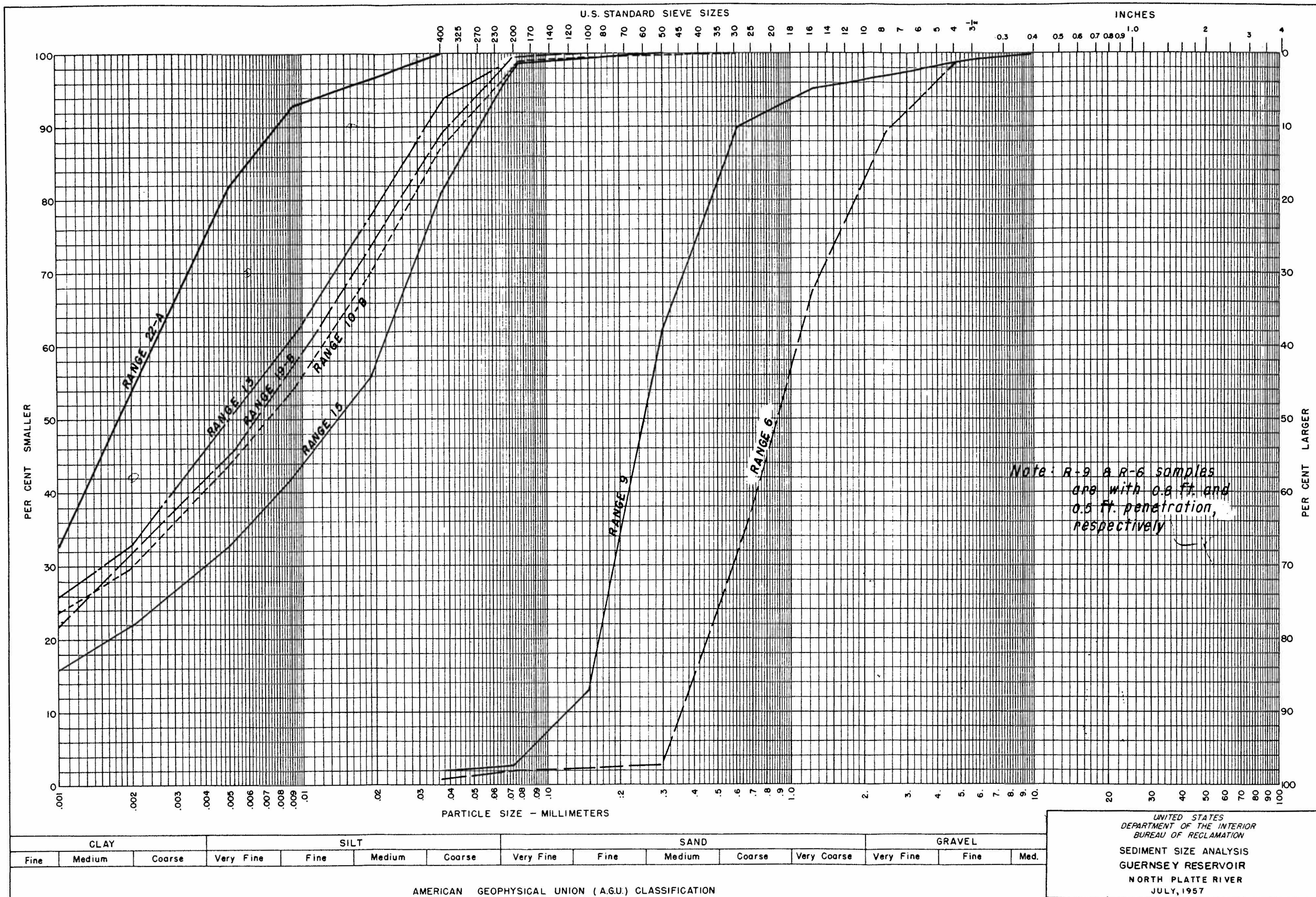


SIZE ANALYSIS OF SEDIMENT SAMPLES TAKEN WITH 2 FOOT PENETRATION

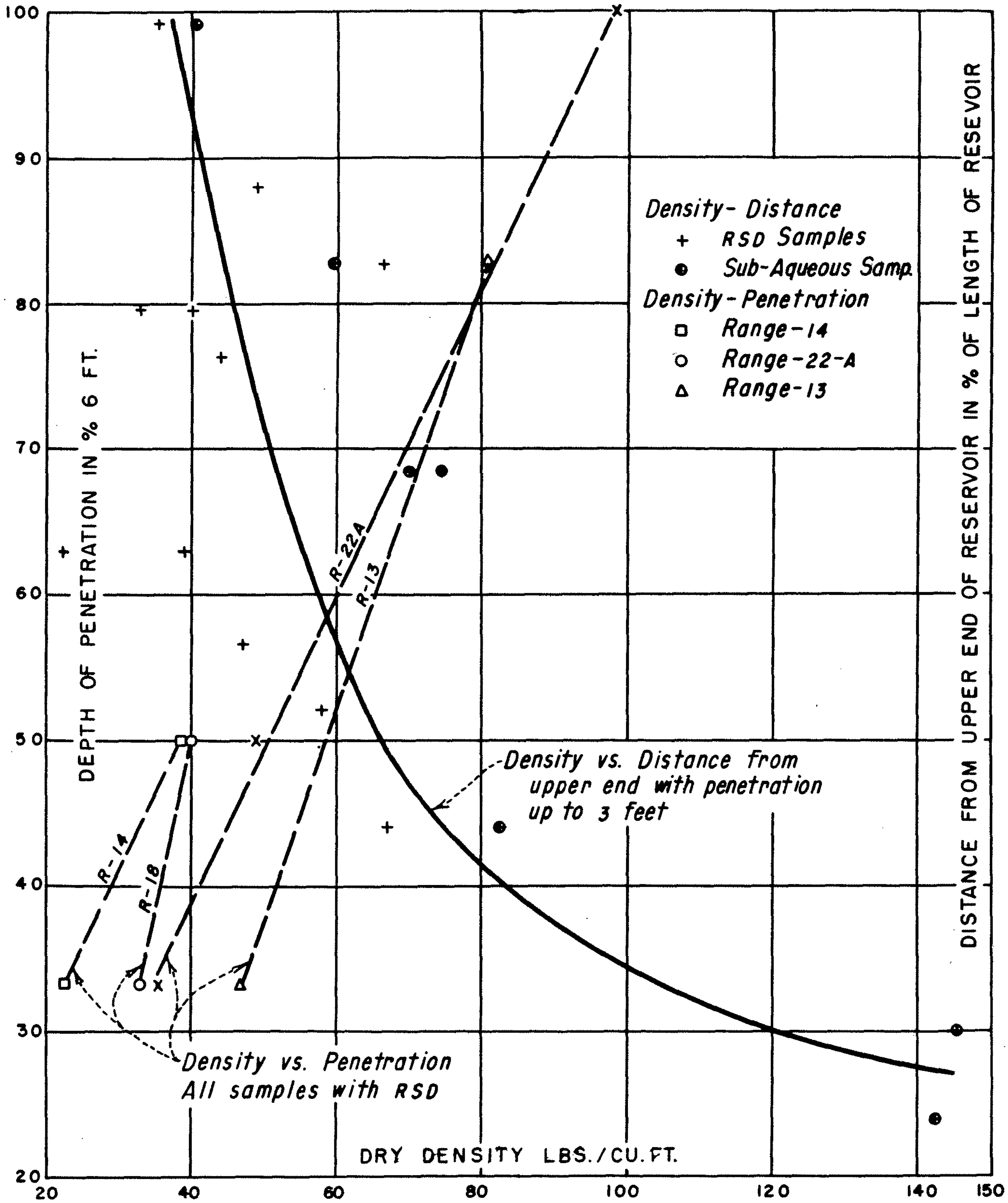
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

SEDIMENT SIZE ANALYSIS
GUERNSEY RESERVOIR
NORTH PLATTE RIVER
JULY, 1957

DRAWN J.M.H. SUBMITTED
TRACED RECOMMENDED
CHECKED APPROVED

DENVER, COLORADO APR. 3, 1947

Figure 10.



NORTH PLATTE RIVER
GUERNSEY RESERVOIR
CORRELATION OF DEPTH WITH
LOCATION AND PENETRATION OF SEDIMENT SAMPLES

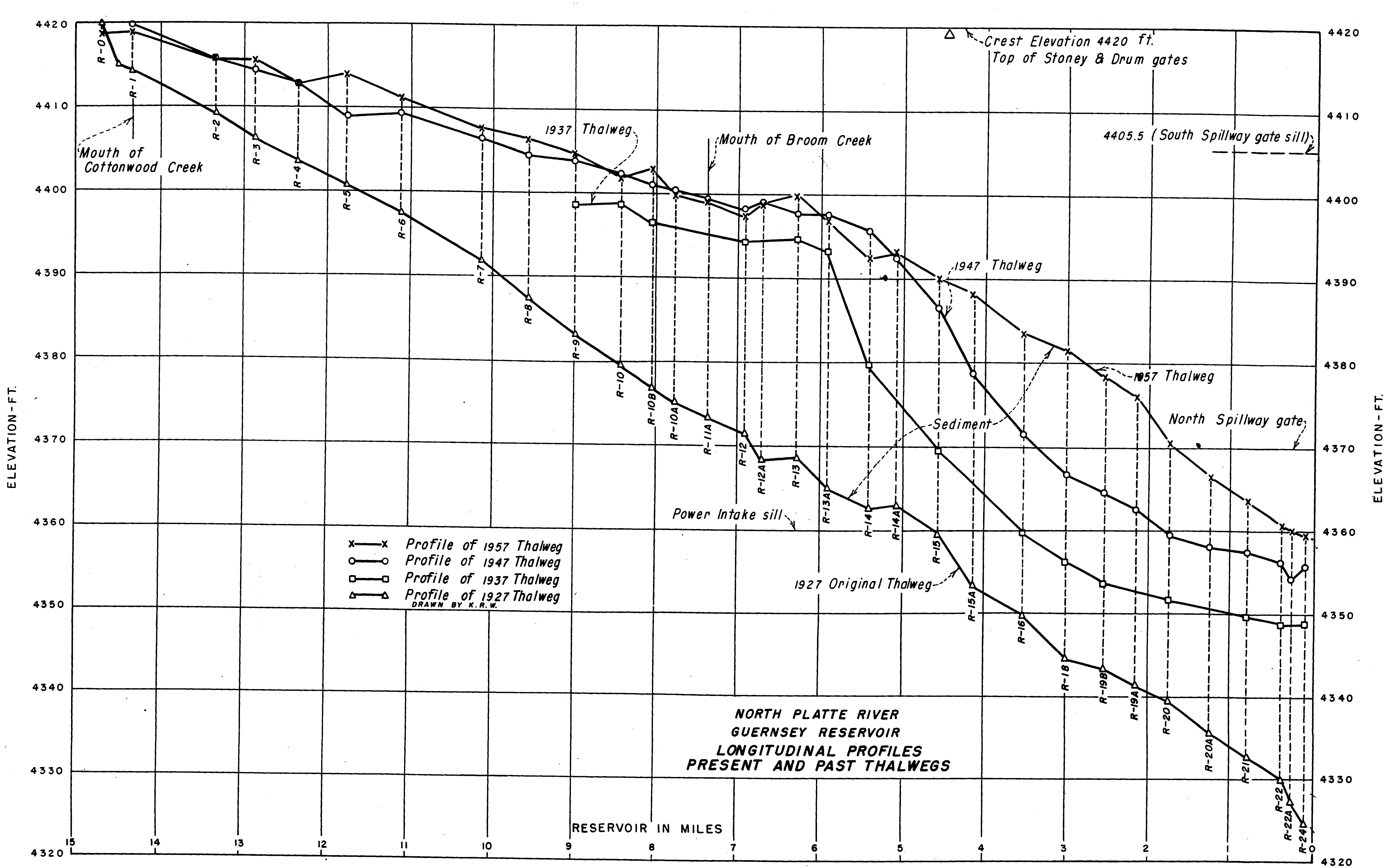
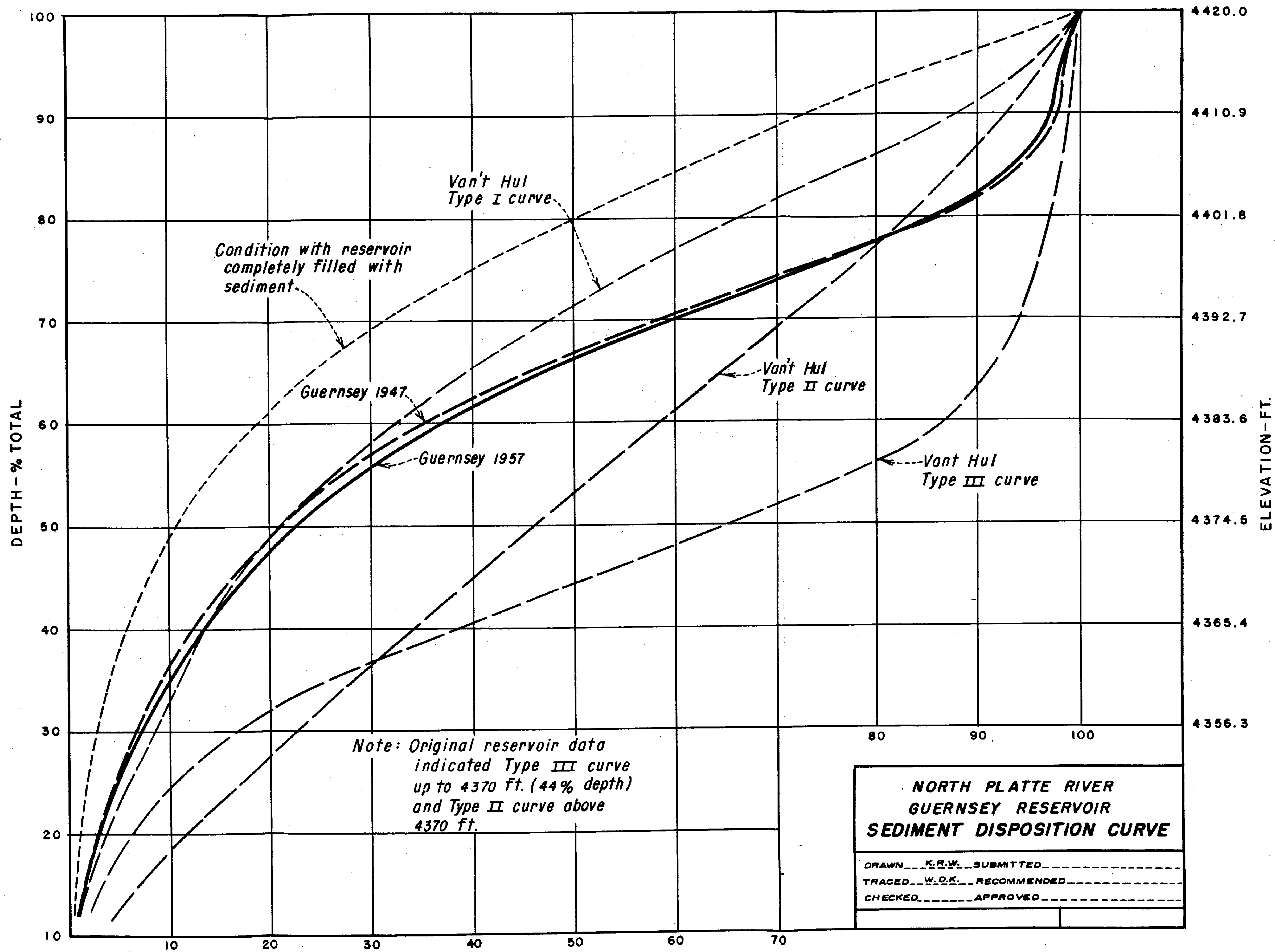
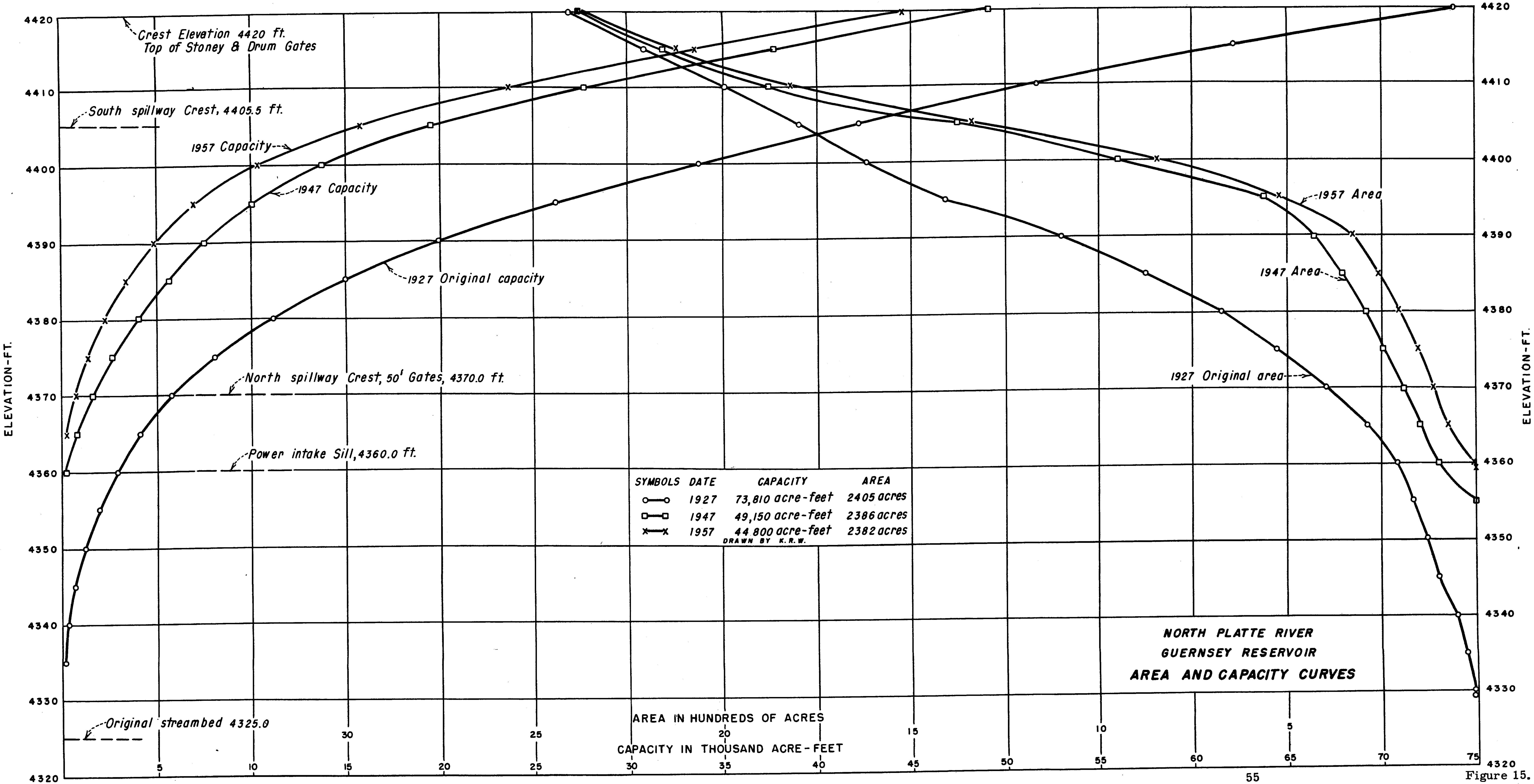

NORTH PLATTE RIVER
GUERNSEY RESERVOIR
LONGITUDINAL PROFILES
PRESENT AND PAST THALWEGS
ELEVATION-FT.
RESERVOIR IN MILES
Crest Elevation 4420 ft.
Top of Stoney & Drum gates
4405.5 (South Spillway gate sill)
Mouth of Cottonwood Creek
Mouth of Broom Creek
1937 Thalweg
1947 Thalweg
1957 Thalweg
1927 Original Thalweg
Sediment
Power Intake sill
North Spillway gate
Profile of 1957 Thalweg
Profile of 1947 Thalweg
Profile of 1937 Thalweg
Profile of 1927 Thalweg
DRAWN BY K.R.W.

Figure 12.



NORTH PLATTE RIVER
GUERNSEY RESERVOIR
SEDIMENT DISPOSITION CURVE
DRAWN K.R.W. SUBMITTED
TRACED W.D.K. RECOMMENDED
CHECKED APPROVED
Van't Hul Type I curve
Condition with reservoir completely filled with sediment
Guernsey 1947
Guernsey 1957
Van't Hul Type II curve
Vant Hul Type III curve
Note: Original reservoir data indicated Type III curve up to 4370 ft. (44% depth) and Type II curve above 4370 ft.
DEPTH - % TOTAL
ELEVATION - FT.
SEDIMENT DEPOSITED - % TOTAL
10
20
30
40
50
60
70
80
90
100
4420.0
4410.9
4401.8
4392.7
4383.6
4374.5
4365.4
4356.3

Figure 14.



Crest Elevation 4420 ft. Top of Stoney & Drum Gates
South spillway Crest, 4405.5 ft.
1957 Capacity
1947 Capacity
1927 Original capacity
North spillway Crest, 50' Gates, 4370.0 ft.
Power intake Sill, 4360.0 ft.
Original streambed 4325.0
1957 Area
1947 Area
1927 Original area
SYMBOLS DATE CAPACITY AREA
1927 73,810 acre-feet 2405 acres
1947 49,150 acre-feet 2386 acres
1957 44 800 acre-feet 2382 acres
DRAWN BY K.R.W.
NORTH PLATTE RIVER
GUERNSEY RESERVOIR
AREA AND CAPACITY CURVES
ELEVATION-FT.
AREA IN HUNDREDS OF ACRES
CAPACITY IN THOUSAND ACRE-FEET

Figure 15.

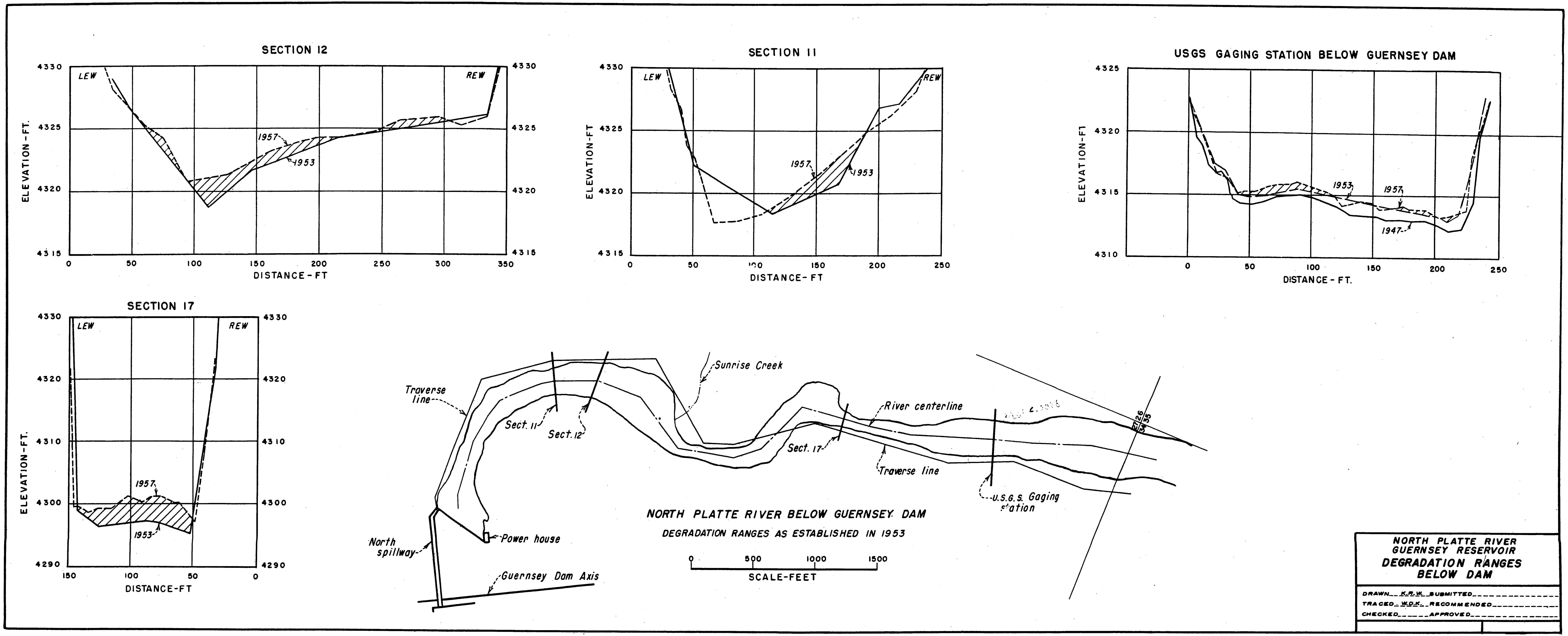

SECTION 12
LEW
REW
1957
1953
ELEVATION-FT.
DISTANCE-FT
SECTION 11
LEW
REW
1957
1953
ELEVATION-FT
DISTANCE-FT
USGS GAGING STATION BELOW GUERNSEY DAM
1953
1957
1947
ELEVATION-FT
DISTANCE-FT.
SECTION 17
LEW
REW
1957
1953
ELEVATION-FT.
DISTANCE-FT
Traverse line
Sunrise Creek
River centerline
Sect. 11
Sect. 12
Sect. 17
Traverse line
U.S.G.S. Gaging station
North spillway
Power house
Guernsey Dam Axis
NORTH PLATTE RIVER BELOW GUERNSEY DAM
DEGRADATION RANGES AS ESTABLISHED IN 1953
0 500 1000 1500
SCALE-FEET
NORTH PLATTE RIVER
GUERNSEY RESERVOIR
DEGRADATION RANGES
BELOW DAM
DRAWN K.R.W. SUBMITTED
TRACED W.D.K. RECOMMENDED
CHECKED APPROVED

Figure 16.

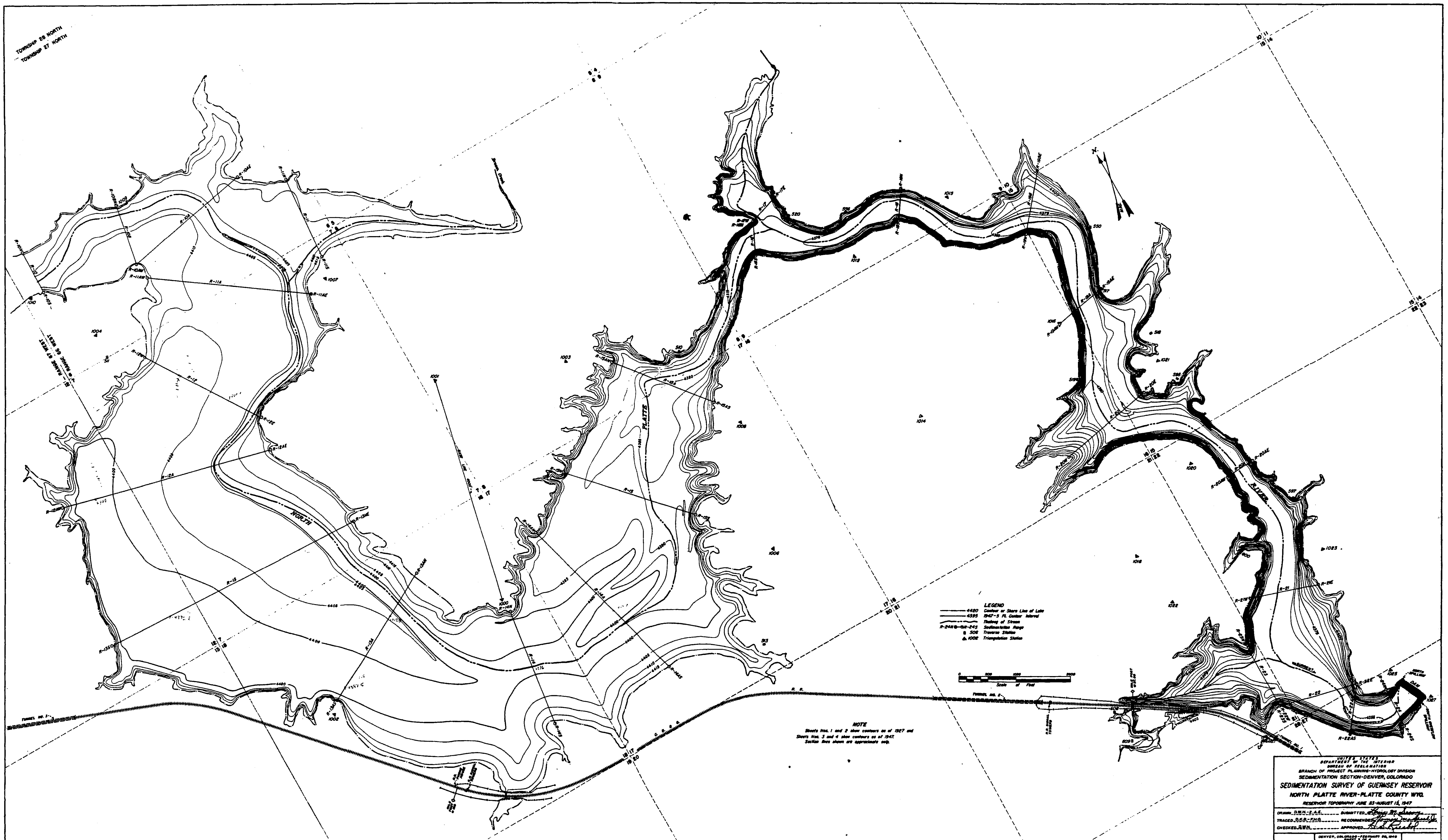
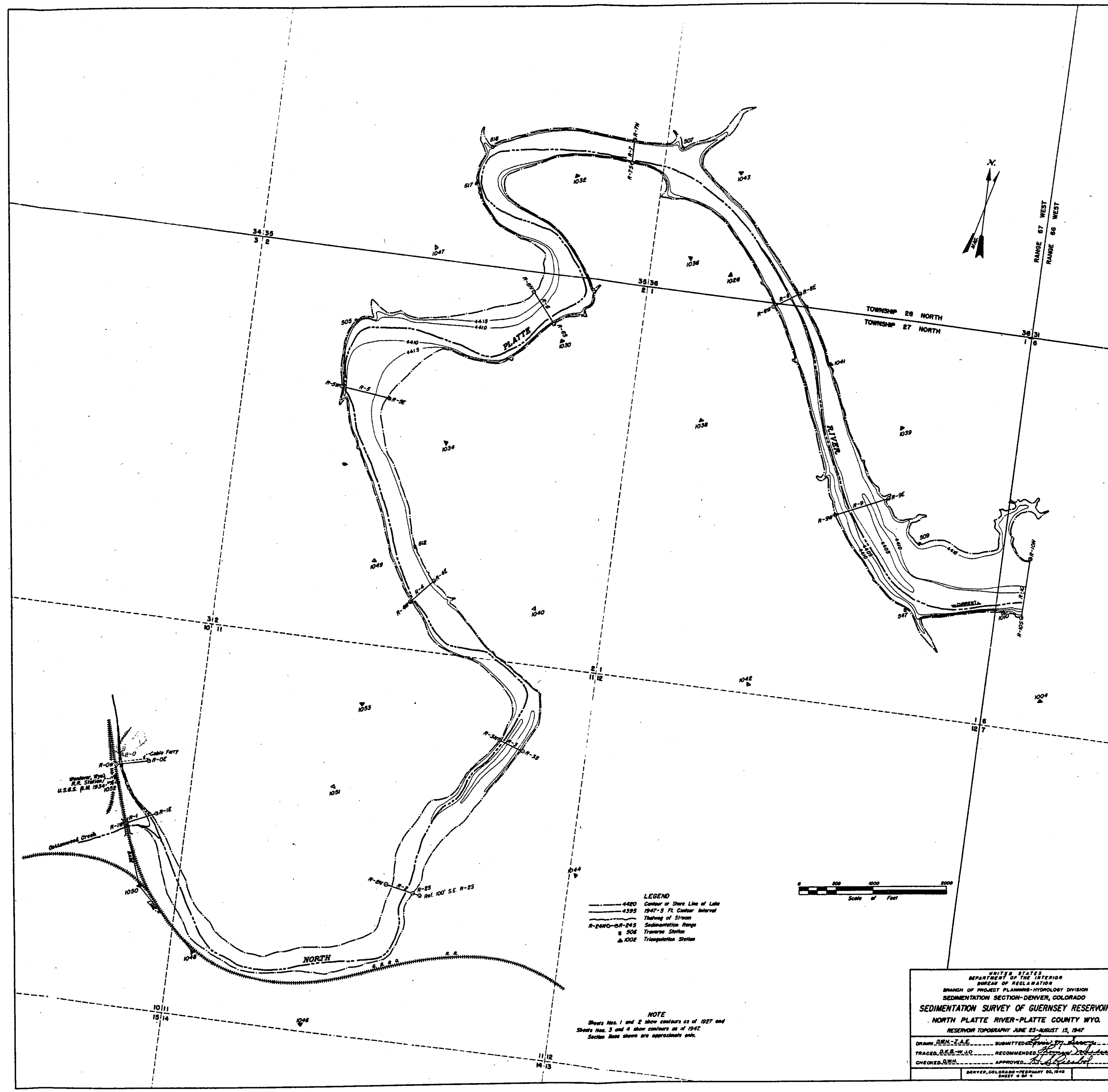


 Figure 17. Sheet 3 of 4.



61 Figure 17. Sheet 4 of 4.

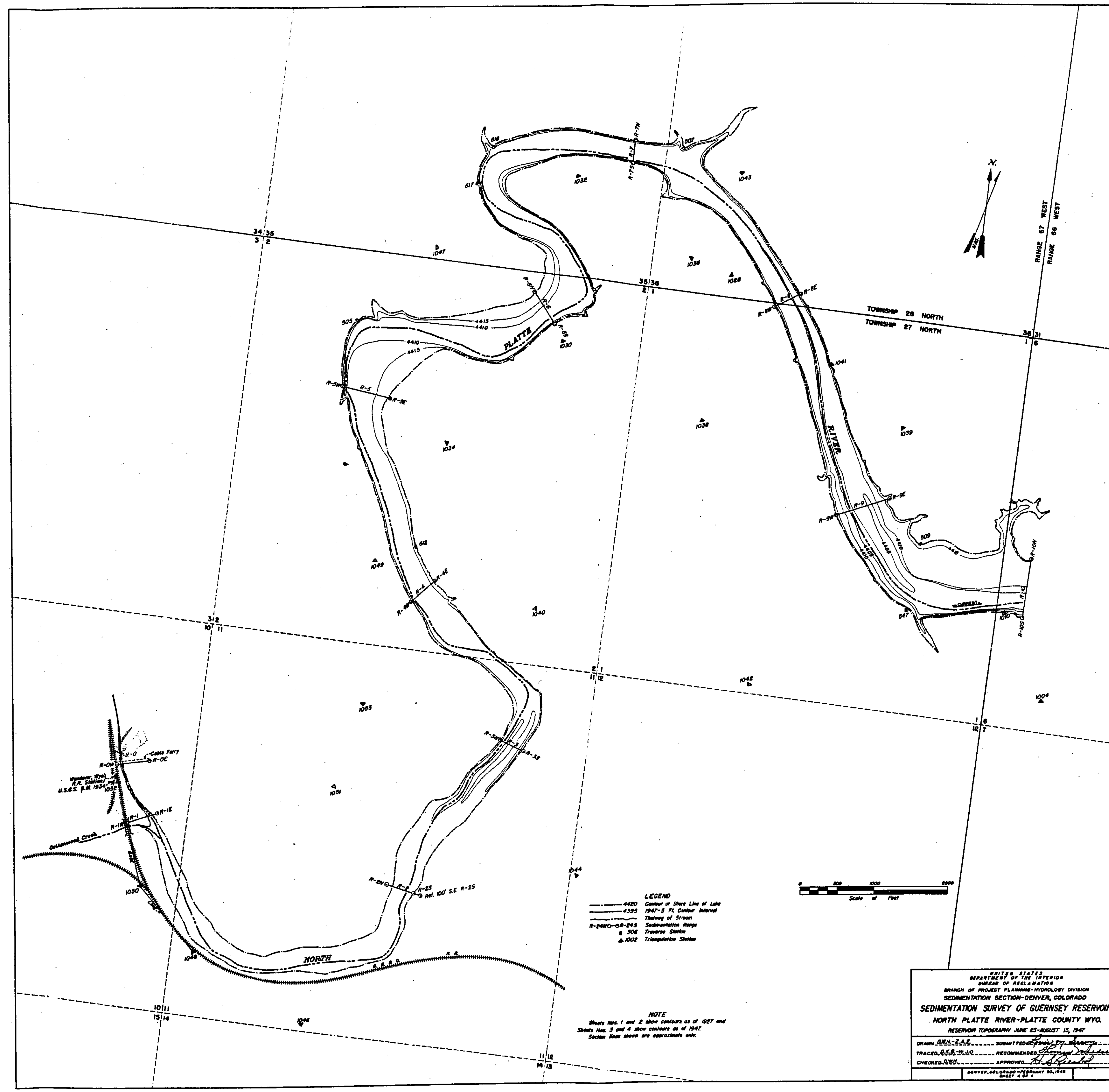
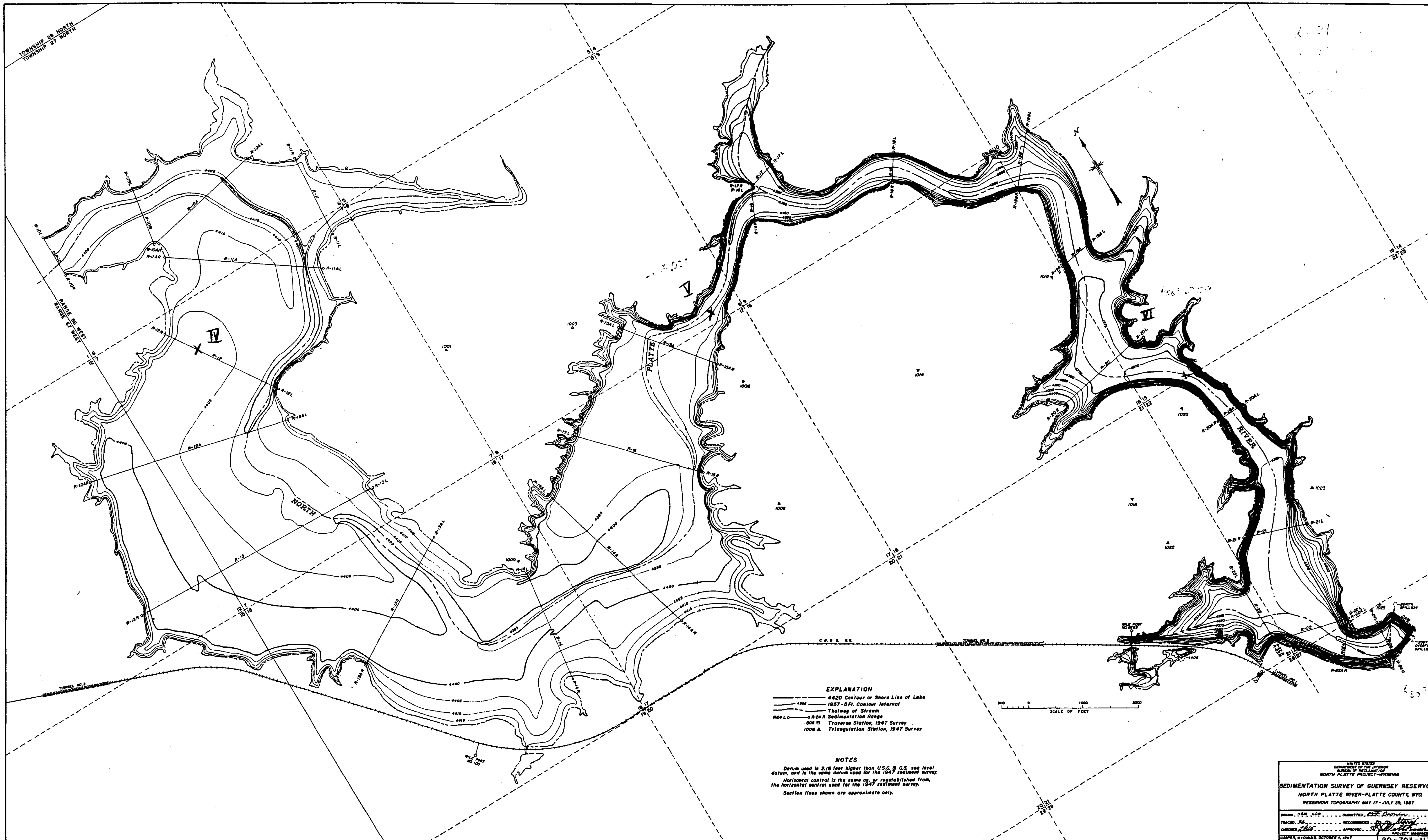


 Figure 17. Sheet 4 of 4.



63 Figure 18. Sheet 1 of 2.

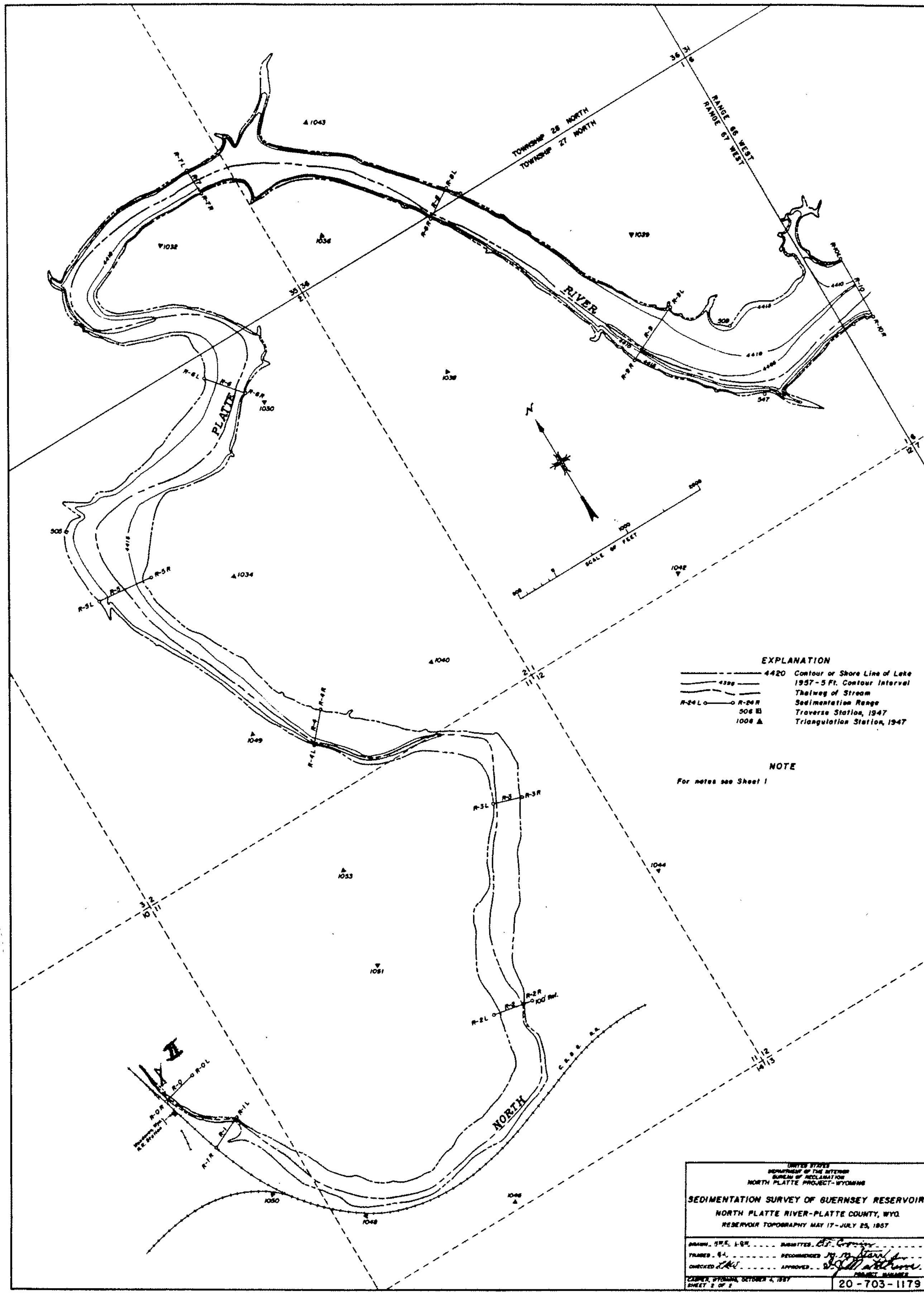


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Figure 18. Sheet 2 of 2.