REDACTED

USACE WATER CONTROL MANUAL
FOR
MALHEUR RIVER RESERVOIRS

These Projects are considered authority of Section 7 for the U.S. Army Corps of Engineers. The Malheur River Reservoirs are operated and owned by the U.S. Bureau of Reclamation.

U.S. Bureau of Reclamation Area Office Manager
Contact Number: 208.383.2248

U.S. Army Corps of Engineers
Chief of Hydrology: John Heitstuman, P.E., D.WRE
Contact Number: 509.527.7293
Water Management Program Manager: Jonathan Roberts, P.E., PMP
Contact Number: 509.527.7518

U.S. ARMY CORPS OF ENGINEERS, WALLA WALLA DISTRICT APRIL 1968

PRELIMINARY INFORMATION REPORT

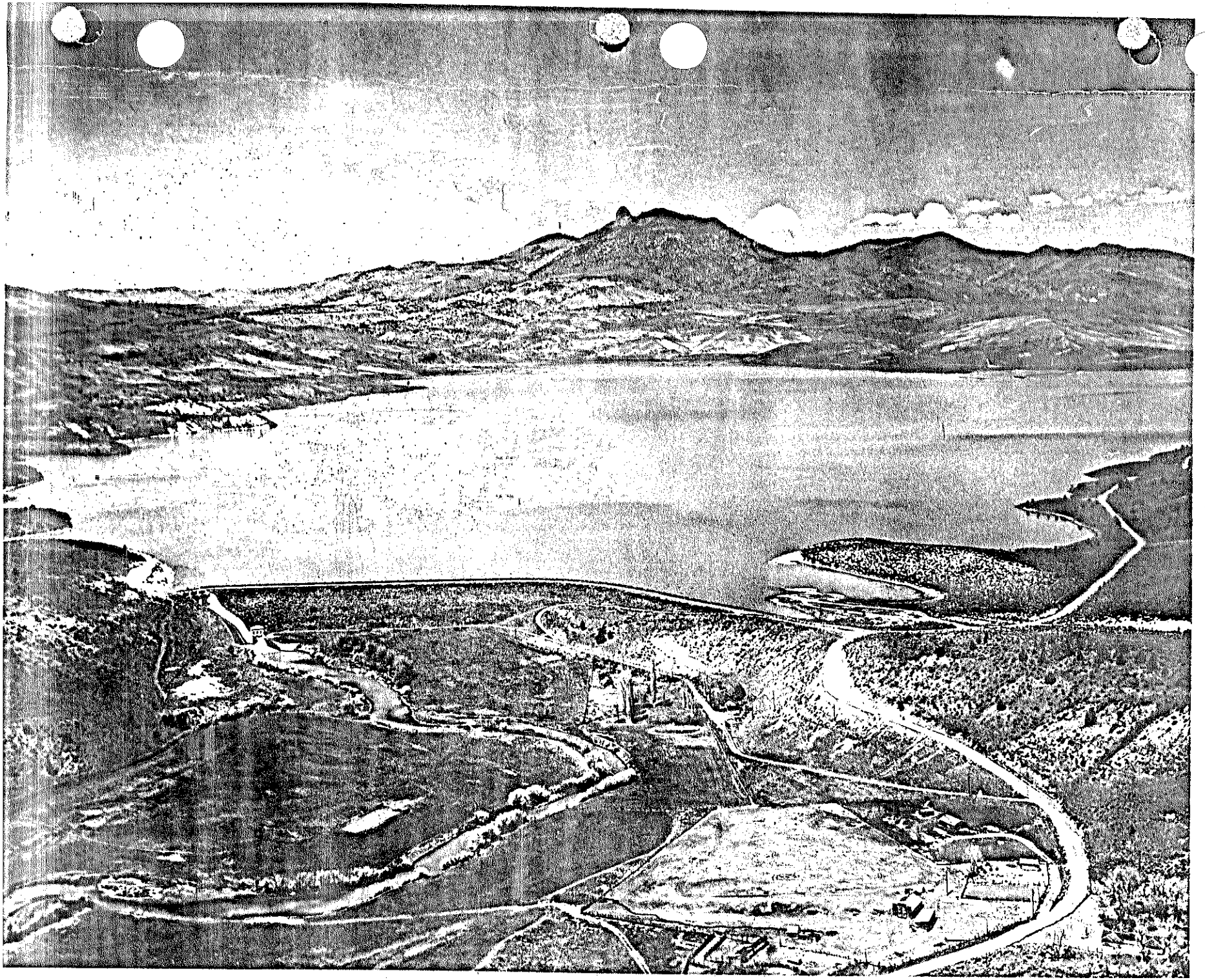
PERTAINING TO

RESERVOIR REGULATIONS

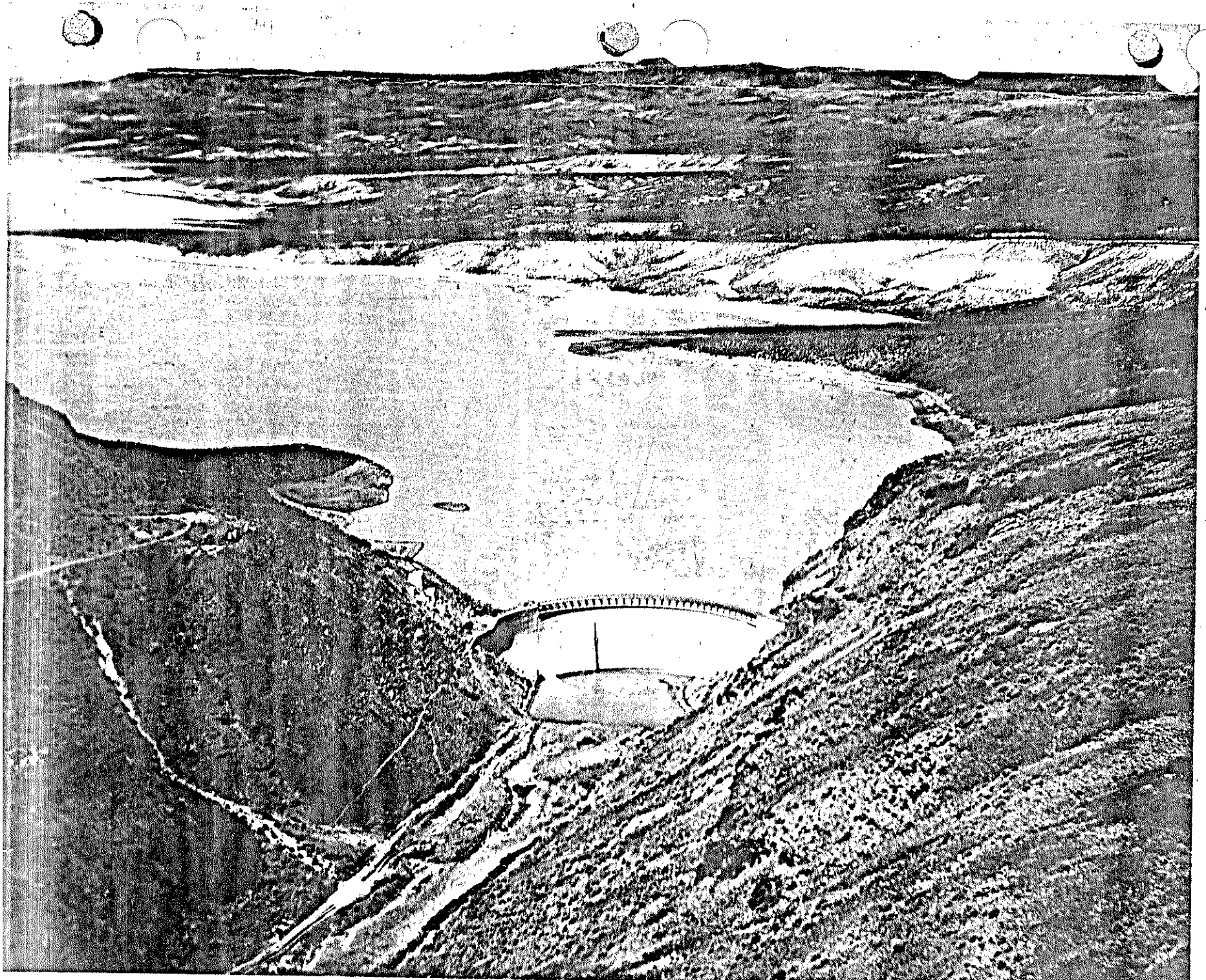
MALHEUR RIVER RESERVOIRS

MALHEUR RIVER, OREGON

U. S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON
CORPS OF ENGINEERS
APRIL 1968



AGENCY VALLEY DAM AND RESERVOIR



WARM SPRINGS DAM AND RESERVOIR

DECEMBER 1988

WATER CONTROL MANUAL REVISIONS FOR MALHEUR RIVER RESERVOIRS

The following revisions are provided for the updating of this Water Control Manual. This Manual will be reviewed annually and updated if necessary. Major revisions pertaining to format and content in accordance with references ETL 110 2 251 and ER 1110-2-240 will be accomplished as time and manpower become available.

DECEMBER 1988 revisions include:

a. [redacted] (Pages ii & iii, Pink sheet)
b. [redacted] (Pages 7-5 & 7-6)

JUNE 1988 revisions include:

a. [redacted] (Page ii, Pink sheet)
b. [redacted] (Pages 7-5,7-6, & 7-7)

NOVEMBER AND DECEMBER 1987 revisions include:

a. Notice to Users (Pink Sheet, page i)
b. [redacted] (Pink Sheet, page ii)
c. Table of Contents (Yellow Sheets, pages a thru e)
d. Pertinent Data for Dams and Reservoirs (Blue Sheets, pages A to D)
e. Section 5 - [redacted] (pages 5 1 to 5 7)
f. Section 7 - Water Control Management
   (1) TEXT (pages 7-1 to 7-3)
   (2) [redacted] (page 7-4)
   (3) [redacted] (pages 7-5 & 7-6)

MARCH 1987 revisions include:

a. [redacted] (pink sheet Pages i-ii).
b. Water Control Management:
   (1) [redacted] (Pages 9-2 TO 9-3).

1985 revisions include:

a. [redacted] (Pink Sheet Pages i-ii).
b. [redacted]:
   (1) Bully Creek Dam (Page iii)
   (2) Agency Vallley (Page iv)
   (3) Warm Springs (Page v)
c. Hydrologic Forecasts (Appendix B):
   (1) Bureau of Reclamation (6 Sheets, Page B-1).
d. Water Control Management:
   (1) [redacted] (Pages 9-2 TO 9-3).

1985 WATER CONTROL MANUAL STATUS SHEET
VALE PROJECT – MALHEUR RIVER RESERVOIRS, OREGON

CHAPTER NUMBER	ITEM*	PRIORITY	STATUS	PLANNED ACTION
I	INTRODUCTION	3	4	
II	DESCRIPTION	3	4	
III	HISTORY	3	4	ALL MANUAL ITEMS WILL BE REVIEWED PERIODICALLY.
IV	WATERSHED CHARACTERISTICS	3	4	
V	DATA COLLECTION	2	4	
VI	HYDROLOGIC FORECASTS	2	1	
VII	WATER CONTROL PLAN	1	3	
VIII	EFFECT OF WATER CONTROL PLAN	2	6	
IX	WATER CONTROL MGT.	2	4	
SUPPORTING INFORMATION:				
	PHOTO	3	4	
	PERTINENT DATA	2	4	

* Includes charts & tables associated with each chapter

STATUS CODES

APPROVED MANUALS:

1. TECHNICAL ASPECTS ADEQUATE AND APPROVED; FINISHED FORM (up-to-date).
2. TECHNICAL ASPECTS ADEQUATE AND APPROVED; DRAFT FORM (preliminary).
3. APPROVED, BUT SOME ASPECTS INCOMPLETE OR NEED REVISION.

MANUALS NOT APPROVED:

4. DRAFT FORM; NOT ALL ASPECTS APPROVED.
5. PORTIONS INCOMPLETE AND/OR OUTDATED.

6. INCOMPLETE CHAPTER (report published prior to ETL 1110-2-251, " Engineering and Design – Preparation of Water Control Manuals," dated 14 March 1980).

NA – Not applicable

WATER CONTROL MANUAL REVISIONS FOR THE MALHEUR RIVER RESERVOIRS

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   (1) TEXT (pages 7-1 to 7-3)
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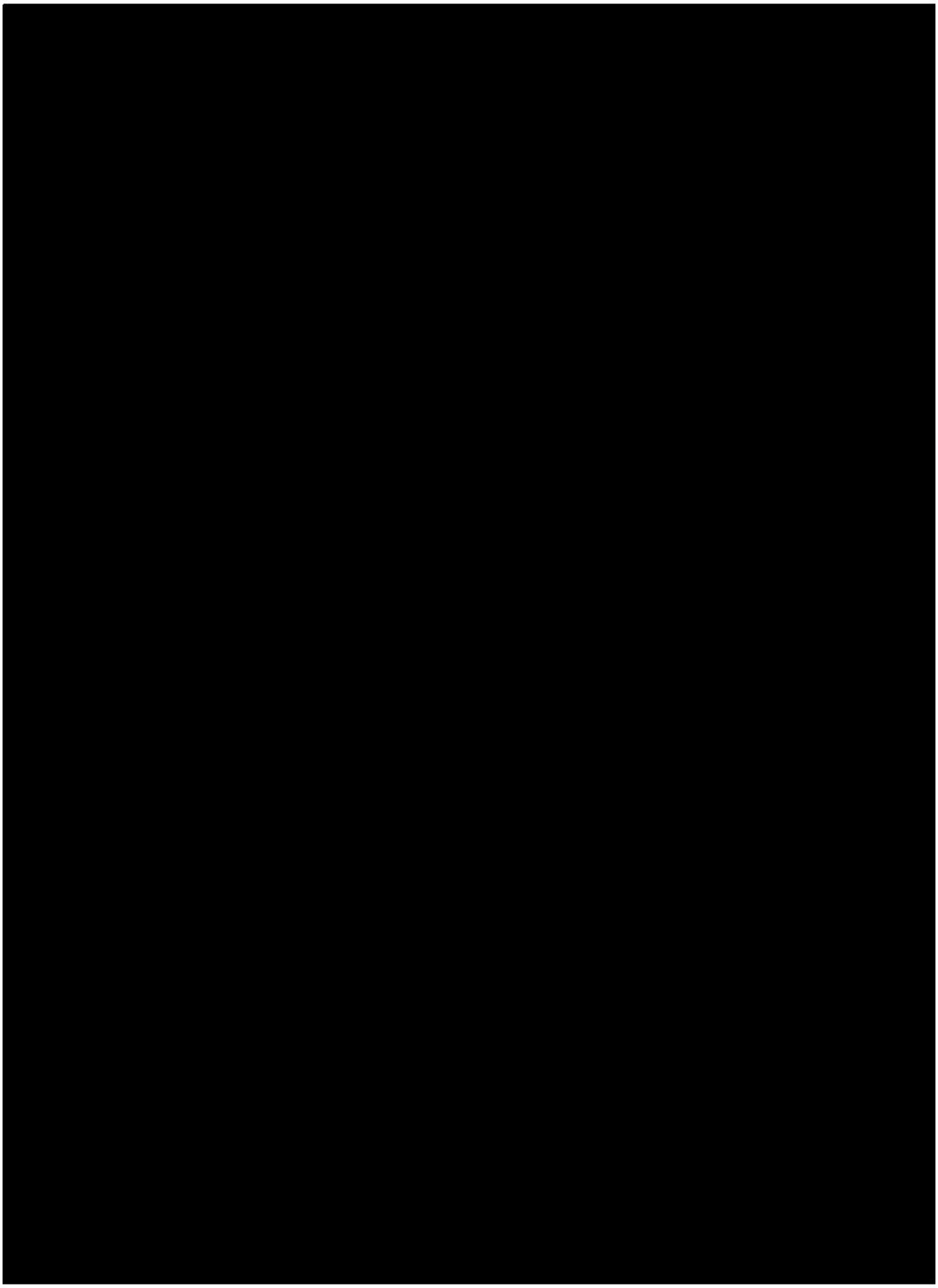
   (2) [redacted] (Pages 9-2 TO 9-3).

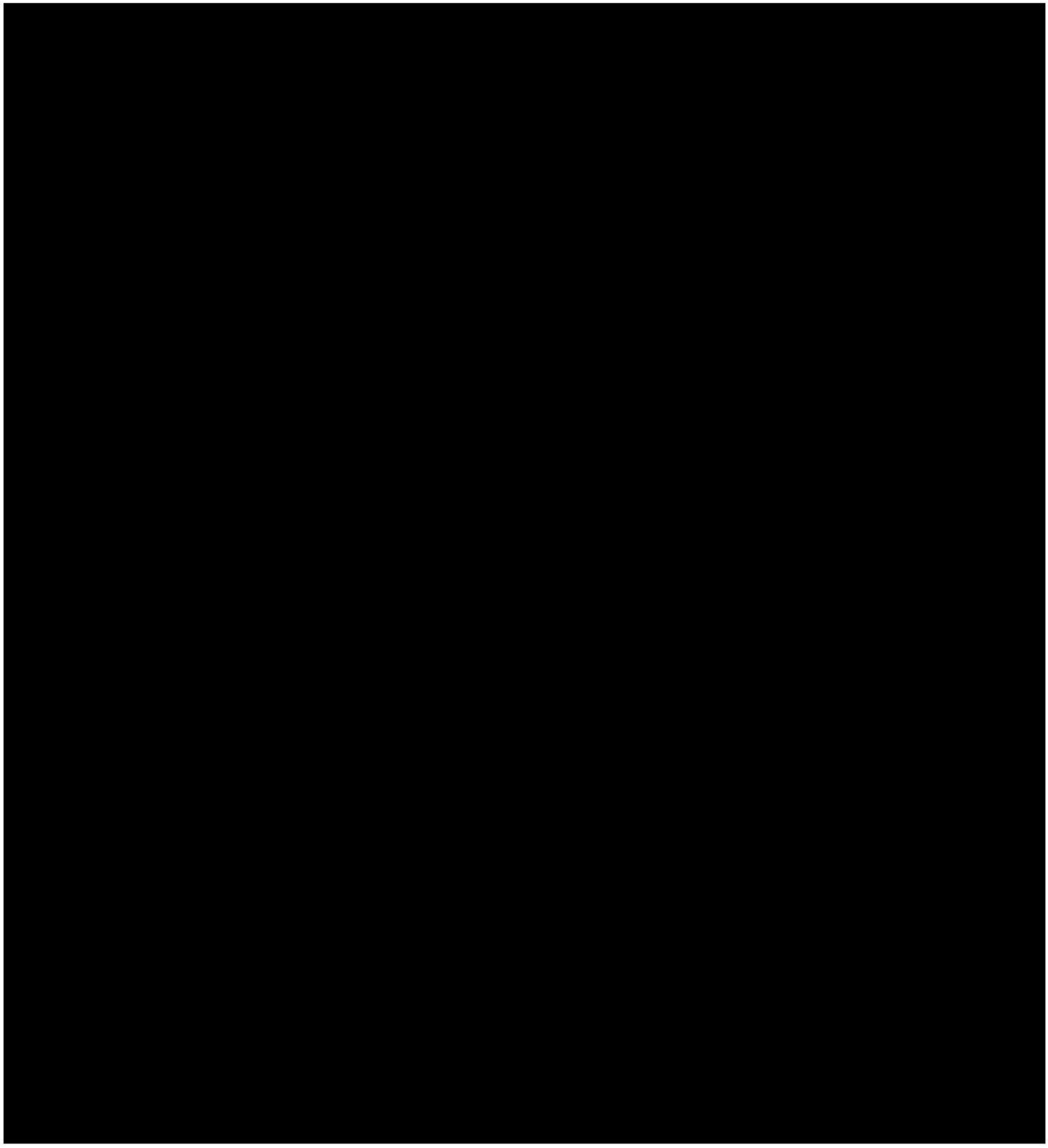
NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in loose-leaf form, and only those sections, or parts thereof, requiring changes will be revised and printed. Therefore, this copy should be preserved in good condition so that inserts can be made to keep the manual current.

As a continuing program it will be necessary to revise portions of this manual annually in order to keep it up to date. Revisions to this manual will be made by the Walla Walla District's Planning Division - Hydrology Branch. Whenever revisions are necessitated, new pages containing the revised material will be printed with the date of revision and issued to each person having a copy of the manual so that substitution may be made.



INDEX



APPENDIX B - FORECAST PROCEDURES

B - 1 Warm Springs Inflow

B - 2 Agency Valley Inflow

B - 3 Bully Creek Inflow

PLATES (CONTINUED)

PERTINENT DATA

BULLY CREEK RESERVOIR

LOCATION

Approximately 9 miles Northwest of Vale, Malheur County, Oregon.

RESERVOIR

Total Capacity at Max. pool (Elev. 2523)	38,000 ac. ft.
Total Capacity at full pool (Elev. 2516)	31,378 ac. ft.
Joint use storage space	29,978 ac. ft.
Dead Storage (Elev. 2456.58)	1,400 ac. ft.
Surface Area at full pool	950 acres
Size	Approx. 3.5 miles by .5 mile.

DAM

Located on Bully Creek about 12.5 miles upstream from confluence with Malheur River.

Type	rolled earth fill
Volume	1,017,000 c.y.
Maximum height	104 feet
Crest elevation	2529 feet
Crest length	3080 feet
Spillway Crest Elevation	2516 feet
Sluice Gate Crest Elevation	2494 feet
Sluiceway Capacity (Elev. 2516)	4,900 c.f.s.
Spillway Capacity (Elev. 2523)	10,200 c.f.s.
Bully Creek Outlet Capacity (Elev. 2516)	270 c.f.s.

HYDROLOGY

Drainage area above dam 547 sq. miles

Reservoir Inflow:

	From Bully Creek (acre-feet)	Diversion from Malheur River (acre-feet)
Average Annual	18,000	6,600
Minimum Annual	200	0
Maximum Annual	66,000	25,000

PERTINENT DATA

AGENCY VALLEY RESERVOIR

LOCATION

Near Beulah, Malheur County, Oregon.

RESERVOIR

Total Capacity at full pool (Elev. 3340)	60,000 ac. ft.
Joint use storage space	60,000 ac. ft.
Surface Area at full pool	1,900 acres

DAM

Located on North Fork Malheur River about 15 miles upstream from confluence with main stem.

Type	Zoned earth fill
Volume	646,000 cu. yds.
Maximum height	110 feet
Crest elevation	3348 feet
Crest length	1850 feet
Spillway Crest Elevation	3323 feet
Spillway Capacity (Elev. 3340)	10,000 c.f.s.
Outlet Capacity (Elev. 3340)	600 c.f.s.

HYDROLOGY

Drainage area above dam	420 sq. mi.
Average Annual Inflow (1938-52)	102,000 ac. ft.
Minimum Annual Inflow (1952)	160,000 ac. ft.
Maximum Annual Inflow (1934)	29,000 ac. ft.

PRELIMINARY INFORMATION REPORT
PERTAINING TO RESERVOIR REGULATIONS
MALHEUR RIVER RESERVOIRS
MALHEUR RIVER, OREGON

SECTION 1 - INTRODUCTION

1.01 PURPOSE AND SCOPE

Paragraph 7d of Engineering Circular No. 1110-2-22 requires that a "Preliminary Information Report" pertaining to development of regulations required by Section 7 of the December 1944 Flood Control Act, be submitted when proposed regulations under Section 7 are presented to the Chief of Engineers for processing. The purpose of this report is to supply background information for understanding the basis for the proposed Section 7 regulations. It contains a general description of the drainage basin and development, including details of regulation facilities. The proposed Flood Control Regulations and Flood Control Regulation Schedule are presented. Flood control benefits allocated to the project prior to authorization are compared to those benefits expected by use of the proposed regulations. Copies of correspondence concerning development of the proposed Section 7 regulations are included in Appendix A.

1.02 MALHEUR RIVER SYSTEM

The system of dams and reservoirs involved in the regulation of floods on the Malheur River are Warm Springs, Agency Valley, Harper Diversion Dam, and Bully Creek. Warm Springs Dam was constructed by the Warm Springs Irrigation District and is operated by that organization. It controls the runoff from about 1,000 square miles of Malheur River headwaters. Agency Valley, Bully Creek and Harper Diversion Dams were constructed by the

Bureau of Reclamation. They are operated and maintained by the Vale-Oregon Irrigation District. Agency Valley Dam controls 420 square miles of North Fork tributary area, and Bully Creek Dam controls 547 square miles of the Bully Creek tributary. There is no significant amount of storage in the reservoir created by Harper Diversion Dam. It serves to divert irrigation water supply from the main river. About one-half of the drainage area upstream of Vale, Oregon is uncontrolled.

SECTION II - BASIN DESCRIPTION

2.01 TOPOGRAPHY AND STREAMS

The Malheur River, one of the major tributaries of Snake River and a part of the Columbia River drainage system, is located in east central Oregon. In total area the basin contains approximately 4,800 square miles. The river rises in the Strawberry Mountains at approximate elevation 9600 feet above mean sea level and flows generally eastward about 160 miles to its confluence with Snake River. The main tributaries are North Fork which drains about 530 square miles, South Fork which drains about 630 square miles and Willow and Bully Creeks with drainage areas of about 640 square miles each. Drainage basin areas are shown on Plate 1. Area-elevation curves are shown on Plate 4.

The watershed area above the valley is generally steep to rolling hills and mountains sparsely vegetated with grasses, sage, and scrub timber. A few areas near the headwaters of the basin offer some pine and fir timber of commercial value. The development in the area is centered around the irrigated valleys along the lower reaches of the streams. These areas largely constitute the flood damage sections of the Malheur River Basin. Two population centers are within these areas and are Vale, Malheur County Seat, and Ontario which is located at the confluence of Malheur and Snake Rivers.

2.02 ECONOMY AND POPULATION

Agriculture is a fundamental basis for the economy of Malheur County. Crops produced vary from extensive crops such as grain, hay and pasture

grown on benchlands to intensive truck cropping on the productive bottom lands. The predominant type of farming combines the raising of hay, grain, pasture, and other forage crops with dairying. Row crops such as potatoes, onions, and sugar beets are raised on better class lands. Livestock are grazed on adjacent private and public dry grazing lands. The area is served by two branch railroads known as the Burns and Brogan branches of the Union Pacific System with their terminus at Ontairo, Oregon. U. S. Highways 20 and 26, which traverse the area in an east-west and north-south direction, respectively, converge at Vale, providing easy accessibility to the main valleys of the basin. A good system of county roads provides an adequate farm-to-market network throughout the area.

The town, Vale, Oregon, with 1,520 persons, is the principle population center in the Malheur River Basin.

SECTION III - HYDROLOGIC FEATURES

3.01 CLIMATE

The climate of Malheur River Basin is semiarid, characterized by relatively severe seasonal temperature extremes, low humidity, and light precipitation. In general, the climate is subject to the moderating influence of the prevailing westerly flow of maritime air from the Pacific Ocean, but occasional influxes of polar air masses cause brief periods of extremely cold temperatures. Extreme recorded temperatures within the basin are 112 degrees Fahrenheit at Beulah and minus 53 degrees Fahrenheit at Drewsey. Mean daily temperatures at Vale average 26.4 degrees in January, and 72.7 degrees in July. The basin normal annual precipitation is 15.0 inches which varies from 8.0 inches at Ontario to about 40.0 inches in the higher elevations on the western boundary. The longest precipitation record in the basin is at Vale where the normal annual precipitation is 8.99 inches for 63 years of record. The seasonal distribution of precipitation is similar to that generally observed in the Pacific Northwest with the greatest amounts normally occurring in the winter months in the form of snow. A large portion of the winter snowfall accumulates until the advent of melting temperatures in March and April. Records of snow courses within the basin generally show the maximum accumulation of snow on March 1. The Blue Mountain Springs snow course, located at an elevation of 5,900 feet on the western boundary, has the maximum recorded average 1 March snow accumulation within the basin, its average snow depth for 26 years of record being 46 inches

with snow-water equivalent of 14.8 inches. Location of climatic stations and snow courses are shown on Plate 1. Climatological data are summarized on Table 1; evaporation data on Table 14.

3.02 STREAMFLOW CHARACTERISTICS

Malheur River and its tributaries ordinarily have very low flows during the summer, fall, and winter months with high flows occurring during the spring with melting of the accumulated snow pack. Brief periods of high runoff occasionally occur during the winter as a result of rain or melting of snow from unseasonable warm temperatures. Floods most generally occur in February or March as a result of rapid snowmelt. The snowmelt is generally caused by warm winds, usually accompanied by rain. Records indicate that frozen ground under the snow at low elevations is one of the major causes of serious floods. Melting of the snow at high elevations, which usually occurs in April and May, has not been a cause of any of the major floods of record.

3.03 PAST FLOODS

The largest known flood in the Malheur River Basin was that of 25 February 1957. The actual flood peak at Vale is estimated at about 19,300 cfs. Without the benefit of regulation by Warm Springs and Agency Valley Reservoirs, it is estimated the natural flow at Vale would have been about 28,000 cfs. Discharge and runoff data are shown on Tables 2 through 5.

Some of the largest floods of record at Vale are shown in the following tabulation:

Date	Observed Flow cfs	Natural Flow cfs
25 Feb 1957	19,300	28,000
2 Mar 1910	22,800	22,800
23 Dec 1964	5,200	22,600
30 Jan 1965	10,800	21,800
2 Feb 1963	13,500	18,000
26 Mar 1962	------	17,600
5 Feb 1925	------	17,100
25 Feb 1904	17,000	17,000

The largest known flood on Bully Creek occurred on 22 December 1964 with a peak reservoir inflow of 11,200 cfs. Other notable floods which have occurred on Bully Creek are Feb. 1957, 8980 cfs; March 1910, 6240 cfs; Feb. 1904, 5730 cfs; and Feb. 1963, 5000 cfs. Almost complete control of the 1963 flood was accomplished by Bully Creek Reservoir which was under construction at that time. The reservoir completely controlled the December 1964 flood.

All of the large floods of record in Malheur River Basin occurred as the result of warm rains falling on frozen ground. The frozen ground was usually covered with snow and snowmelt contributed to all the large floods.

3.04. FLOOD FREQUENCIES

Preliminary studies of annual flood peak frequencies were made in 1965 for Malheur River. The period at all stations for these studies was from 1904 through 1965. The computed curves were examined and adjusted for consistency with basin characteristics and drainage areas. The natural curves were obtained by adjusting recorded flows for the regulation affects of storage reservoirs when they existed. Plate 3 shows peak discharge frequency curves for various locations. The following table summarizes the average recurrence interval of natural peak discharges.

Average Recurrence Interval in Years	Malheur at Vale Natural Peak cfs	Bully Creek near Vale Natural Peak cfs.
5	9,400	2,250
10	14,000	3,900
20	19,200	6,200
50	27,900	10,500
100	35,700	15,000

Preliminary studies of maximum annual flood volume frequencies were made in 1966 for North Fork Malheur River above Agency Valley near Beulah, Malheur River near Drewsey, and Bully Creek near Vale. The respective record periods were 1937 through 1965, 1927 through 1965, and 1938 through 1962 plus 104 percent of Bully Creek at Warm Springs for 1964 and 1965. The resulting frequency curves of maximum annual 1-day, 3-day, 10-day, and 30-day volumes are shown on Plates 17, 18 and 19.

3.05 CHANNEL CAPACITIES AND FLOOD DAMAGES

The damage areas in Malheur River Basin for which the reservoir system can provide flood control protection is conveniently divided into four segments as follows:

	Channel Capacity - c.f.s.
Bully Creek below dam	3,000
Malheur River above Vale	4,000
Malheur River through Vale	16,000
Malheur River below Vale	8,000

Malheur River and Bully Creek floods affect a major portion of the town of Vale and environs, inundating homes, schools, business and commercial houses, municipal properties and traffic routes. Flood damages in the agricultural areas along Malheur River above and below Vale are made up in large part by loss of, or damage to crops. Other significant damages to farm lands are weed infestation and surface erosion, with resultant expenses for cleanup and leveling operations. Public and private utilities, such as roads and bridges and irrigation works are also subject to damage.

Major channel improvement works were constructed on lower Bully Creek and Malheur River through Vale by the Corps of Engineers in 1960 and 1961. Plate 2 shows a discharge-damage curve.

SECTION IV - PROJECT DESCRIPTIONS

4.01 BULLY CREEK DAM

Various schemes for development of an irrigation project on Bully Creek have been proposed since 1911. The Bureau of Reclamation initiated investigations of this site in 1938. Progress in the development plans was interrupted by the emergency of World War II. The project became a part of the Columbia River Basin Report of February 1947. A subsequent supplemental report on Bully Creek Extension, Vale Project, Oregon, dated May 1949, provided additional information to that incorporated in the Columbia River Basin Report. A feasibility report dated September 1957 established economic justification and construction of the dam was completed in 1963.

The dam is an earthfill structure with a height of 104 feet above the riverbed and a length of 3080 feet. Water is released from storage through a 48-inch steel pipe controlled by two square, high-pressure gates. Each gate is housed separately; one, which is two-feet, three inches square, discharges water into the old Bully Creek channel, and the other, which is three feet, three inches square discharges into irrigation lateral No. 197-13L. The upstream end of the 48-inch steel pipe is controlled by a three-foot six-inch square, hydraulically-operated, high-pressure gate. A 56-inch, concrete-encased, steel pipe conveys water from the reservoir to this gate.

A concrete-lined spillway channel is located in the right abutment. It is controlled by ten 4-foot square sluice gates with crests at elevation

2494 feet m.s.l. A 70-foot free overflow spillway crest is located above the sluice gates with crest at elevation 2516 feet m.s.l. The total capacity of the sluice gates with full pool elevation of 2516 feet m.s.l. is 4,900 cfs. The total capacity of the sluice gates and the free-overflow section at maximum pool elevation of 2523 feet m.s.l. is 10,200 cfs. A general plan and sections of Bully Creek Dam are shown on Plate 8. Reservoir storage capacities are shown on Table 8. Spillway and outlet discharge capacities are shown on Plates 9, 11, and 12. Plate 10 is a map of the reservoir area.

4.02 AGENCY VALLEY DAM

Construction of the Vale Irrigation Project was authorized by the President on October 21, 1926. On March 28, 1932, a contract was executed by the Bureau of Reclamation and the Vale-Oregon Irrigation District, providing for construction of Agency Valley Dam on the North Fork of the Malheur River, to provide additional storage needed to insure an adequate supply of water. Construction of the dam was completed in 1935.

Water is released from storage through a concrete-lined tunnel in the right abutment, controlled by two, 36-inch needle valves at the downstream end. The spillway is a concrete-lined open channel in the right abutment, controlled by three 18- by 17-foot radial gates. The spillway has a capacity of 10,000 c.f.s. at normal pool elevation of 3340 feet m.s.l. A general plan and sections are shown on Plate 5. Reservoir storage capacities are shown on Table 7. Outlet discharge capacities are shown on Plates 5 and 22.

4.03 WARM SPRINGS DAM

Early demands for a stabilized supply of irrigation water resulted in the organization of the Warm Springs Irrigation District to build Warm Springs Dam in 1919 with private capital raised by the sale of bonds voted by landowners within the district. A contract between the U. S. Government and the Vale-Oregon Irrigation District was signed October 22, 1926, that provided for the purchase of one-half interest in the Warm Springs Reservoir by the Bureau of Reclamation. The contract also provided for construction of Harpers Diversion Dam, main canal, branch canals, structures in connection therewith, and the construction of necessary drainage works for the Warm Springs Irrigation District.

The dam is a concrete thin arch, located on the Middle Fork of Malheur River, rising 106 feet above the streambed. Water is released from storage through two openings at the base of the dam, each controlled by a 3-foot 3-inch by 6-foot gate. The spillway is a 324-foot, free-overflow section with 5 feet of flashboards installed on the crest at elevation 3401 feet m.s.l. The spillway has a capacity of 12,000 cfs at normal full pool elevation of 3406 feet m.s.l.

Recently completed studies under the Bureau of Reclamation's Safety of Dams Program indicate that the existing spillway at Warm Springs Dam must be modified to provide increased discharge capacity so as to conform to present day engineering design standards. During the interim period, pending completion of the required spillway modification, storage in the reservoir must be limited according to the Flood Control Regulation

Schedule to prevent possible encroachment on the dam freeboard during extreme floods and so assure the safety of the dam. A general plan and sections of the dam are shown on Plate 6. Reservoir storage capacity is shown on Table 6.

4.04 HARPERS DIVERSION DAM

The Harpers Diversion Dam was constructed in 1929 by the Bureau of Reclamation under contract with the Vale-Oregon Irrigation District. It is located on the main stem of Malheur River about 20 miles upstream from the town of Vale. Its principal function is the diversion of water from the main river into the Vale Main Canal for irrigation use or storage in Bully Creek Reservoir or both. The dam is a concrete gate structure with embankment wing rising 21 feet above the streambed. The diversion headworks are controlled by a 10-foot 6-inch by 13-foot canal radial headgate. Diversion is made into a 2,150-foot, horseshoe-shaped tunnel which empties into the Vale Main Canal. The diversion capacity is 662 c.f.s. The spillway consists of seven, 20-foot by 10-foot hinged steel gates. A general plan and sections are shown on Plate 7.

CODE OF FEDERAL REGULATIONS 2 DEC 1970

TITLE 33 - NAVIGATION AND NAVIGABLE WATERS

Chapter II--Corps of Engineers
Department of the Army

PART 208 - FLOOD CONTROL REGULATIONS

BULLY CREEK, AGENCY VALLEY, AND WARM SPRINGS DAMS AND RESERVOIRS
MALHEUR RIVER BASIN, MALHEUR AND HARNEY COUNTIES, OREGON

Pursuant to the provisions of Section 7 of the Act of Congress approved December 22, 1944 (58 Stat. 890; 33 U.S.C. 709) the following Section 208.93 is hereby prescribed to govern the use and operation of Bully Creek, Agency Valley, and Warm Springs Dams and Reservoirs in the Malheur River Basin, Oregon, for flood control purposes.

208.93 BULLY CREEK, AGENCY VALLEY, AND WARM SPRINGS DAMS AND RESERVOIRS, MALHEUR RIVER BASIN, OREGON. The Bureau of Reclamation, acting through the Vale, Oregon Irrigation District, shall operate Bully Creek, Agency Valley, and Warm Springs Dams and Reservoirs in the interest of flood control, as follows:

(a) Storage space up to 30,000 acre-feet between elevations 2456.6 feet and 2516.0 feet in Bully Creek Reservoir, up to 60,000 acre-feet between elevations 3263.2 feet and 3340.0 feet in Agency Valley Reservoir, and up to 95,500 acre-feet between elevations 3381.5 feet and 3406.0 feet in Warm Springs Reservoir will be kept available for flood purposes on a seasonal basis in accordance with the Flood Control Regulation Schedule currently in force.

force for purposes of this Section. Copies of the Flood Control Regulation Schedule currently in force shall be kept on file in, and may be obtained from, the office of the District Engineer, Corps of Engineers, and the Regional Director, Bureau of Reclamation, in charge of the locality.

(e) Nothing in the regulations in this Section shall be construed to require dangerously rapid changes in magnitude of water releases, or that releases be made at rates or in a manner that would be inconsistent with requirements for protecting the dams and the reservoirs from major damage or inconsistent with safe routing of the inflow design flood.

(f) The Bureau of Reclamation shall procure current basic hydrological data, make determinations of required flood control space reservations from the Flood Control Regulation Schedule currently in force, and make calculations of permissible releases from the reservoirs as are required to accomplish the flood control objectives prescribed in this Section.

(g) The Bureau of Reclamation shall keep the District Engineer, Corps of Engineers, currently advised of hydrological data and operating criteria which affect the schedule of operation. Details of the hydrologic reporting network and operating criteria are described in "Report on Reservoir Regulations for Flood Control, Malheur River Reservoirs."

Stanley R. Resor

Date 2 Dec 70

Stanley R. Resor
Secretary of the Army

Part 2. - Forecast Schedule. This schedule applies during the snowmelt season from February 1 through June 30 each year. Reservoir releases will be made to provide the flood control space as rapidly as possible without causing appreciable downstream damages. The inflow forecast to be used is for total inflow to Bully Creek Reservoir from the current date through June 30. Flood control space shall be reserved according to the following table except as necessary to limit outflows to 3,000 cubic feet per second or flows at the gaging station, Malheur River below Nevada Dam near Vale, Oregon, to 8,000 cubic feet per second insofar as possible.

Forecast Inflow Bully Creek Reservoir through June 30 (1,000 acre-feet)	Flood Control Space Reservation (1,000 acre-feet)
15	0
25	5
35	10
45	15
55	20
65	25
75	30

B. AGENCY VALLEY AND WARM SPRINGS RESERVOIRS

The flood control space reservations for Agency Valley and Warm Springs Reservoirs are the maximums of the requirements as determined under applicable Parts 1 and 2 which follow. In the event that the damtender at Warm Springs or Agency Valley Reservoirs loses communication to receive instructions, or in the absence of other instructions, the reservoir releases from Agency Valley and Warm Springs Reservoirs will be made according to the Rule Curve Schedules currently in force.

Part 1. - Rule Curve Schedule, Agency Valley Reservoir. A minimum flood control space reservation of 10,000 acre-feet shall be maintained during the November 1 through January 31 period each year. Storage in this space may be accumulated after February 1 on the basis of a straight-line interpolation between 10,000 acre-feet of space available on February 1 and full reservoir on March 31. Temporary storage may be made in the space reservation as necessary to minimize downstream flood damages in accordance with current river flow forecasts. In the event that the damtender loses communication to receive instructions or in the absence of other instructions and remaining reservoir space is less than indicated by minimum flood control space reservation, releases will be made as follows: (1) 1,000 cubic feet per second, if inflow is greater than 1,000 cubic feet per second; (2) maintain current rate if inflow is less than 1,000 cubic feet per second. In order to

full capacity discharge of the outlets has been reached. The maximum discharge reached in this manner should be continued until the storage in excess of that permitted by this rule curve schedule has been evacuated.

Part 2. - Forecast Schedule. This schedule applies during the snowmelt season from February 1 through June 30 each year. Releases for the necessary evacuation of flood control space will be made to provide the flood control space as rapidly as possible without causing downstream damages. The reservoir inflow forecast to be used is for the total combined inflow to Agency Valley and Warm Springs Reservoirs from the current date through June 30. The indicated space reservation for each reservoir shall be kept available according to the following table, except as necessary, to limit downstream flows at the gaging station, Malheur River below Nevada Dam near Vale, Oregon, to 8,000 cubic feet per second insofar as possible.

Forecast of Combined Inflow, Agency Valley and Warm Springs Reservoirs through June 30	Flood Control Space Reservation	
	Agency Valley	Warm Springs *
(1,000 acre-feet)	(1,000 acre-feet)	(1,000 acre-feet)
120	0	0
160	5.3	10.7
200	10.7	21.3
225	14.0	28.0
300	18.6	37.4
400	24.6	49.4
500	30.6	61.4
600	36.6	73.4
700	42.6	85.4

C. INFLOW FORECASTS

Forecasts of inflow to Bully Creek, Agency Valley, and Warm Springs Reservoirs shall be made according to procedures contained in the Report on Reservoir Regulations for Flood Control, Malheur River Reservoirs.

Prepared pursuant to Flood Control Regulations for Bully Creek, Agency Valley, and Warm Springs Reservoirs (33 CFR 208).

APPROVED
Acting Commissioner
Bureau of Reclamation

APPROVED
Actg Chief of Engineers

DATE 9 November 1970

*Space reservation in Warm Springs Reservoir is considered as space below elevation 3406.

5.03 SYSTEM REGULATION

A high degree of climatological homogeneity exists throughout the basin so that a single plan of reservoir operation could be generally applicable to all areas. Usually, provision of maximum control of peak flows at each reservoir results in maximum reduction of flood flows at Vale; however, in some situations this may not be true. In order to provide flexibility to accomplish maximum control in all situations, each reservoir is regulated independently.

A basic premise of all flood-control considerations in Malheur River Basin has been the conservation of irrigation water supply. The plan of operation was originally designed to provide flood-control regulation to whatever extent was consistent with that basic premise. Only the overriding consideration for safety of the Warm Springs Dam has resulted in deviation from that basic premise. This deviation is explained in detail in Section VI of this report.

The effectiveness of total river regulation provided by regulating the reservoirs independently according to the Flood Control Regulation Schedule has been studied. The regulation schedule for each reservoir was applied to the runoff years 1928 to 1961 by months except daily studies were made of all flood situations. Plates 20 and 21 show probability of reservoir storage exceeding given values on the first of each month, November through April, at Bully Creek and Agency Valley reservoirs when operated according to the plan.

It will be noted from these plates that there is a high probability of more space in the reservoirs being available during the flood potential season, from November to April, than is required by the flood control regulation schedule. This occurs as a result of the annual heavy draft of reservoir storage to supply irrigation requirements. Occasionally, during March and April and sometimes as early as February, the runoff forecasts will indicate that some reservoir space can safely be evacuated and held available for flood control without jeopardizing the opportunity to refill the reservoirs to supply irrigation needs.

Generally, the flood control objective will be to control the discharge of Malheur River through the town of Vale to about 8,000 cfs. It will not always be possible to do this, however. During large floods, the maximum discharge resulting from the uncontrolled area sometimes exceeds 8,000 cfs. The frequency curves on Plate 3 indicate that this can be expected to occur once in about 16 years on the average.

5.04 REGULATION OF DECEMBER 1964 AND JANUARY 1965 FLOODS

The floods of December 1964 and January 1965 provided opportunity to test the preliminary plan of regulation. This occurrence was quite unusual by having two large floods occur in the same season and only one month apart. Plates 14 and 15 show the actual regulation of these floods.

The three reservoirs completely contained the inflow at each location providing complete reservoir control of the Dec. 1964 flood. This was possible because of the heavy draft of irrigation water during the summer of 1964. The actual flow estimated at Vale did not exceed about 5,200 cfs, all of which was contributed

from uncontrolled areas. It is estimated that the peak flow at Vale would have reached 22,600 cfs without the benefit of reservoir storage. None of the reservoirs became filled during the flood period. Plate 14 shows regulation of the December 1964 flood.

A similar flood again occurred during late January 1965, except that a larger portion of the flood flows originated in the uncontrolled area. The actual peak flow at Vale is estimated to have been about 10,200 cfs. The estimated natural peak flow was about 21,800 cfs. There was no water released from Agency Valley or Warm Springs Reservoirs and neither of these reservoirs completely filled during the flood. Bully Creek Reservoir contained about 20,000 acre-feet of storage at the beginning of the flood and releases were gradually increased to a maximum of about 2,000 cfs to prevent premature filling. Plate 15 shows regulation of the January 1965 flood.

5.05 REGULATION OF EXTREME FLOODS

Standard project floods for Malheur River at Vale and tributary inflows to each reservoir have not been derived. In lieu thereof, an approximate 200-year inflow hydrograph for each regulated tributary was combined with the January 1965 flood hydrograph for the uncontrolled area which was increased to the magnitude of the 200-year frequency peak flow for the uncontrolled area. Time of occurrence was assumed as typical of the basin whereas Bully Creek and Agency Valley peak inflows would occur at the same time; Warm Springs four hours later; and the uncontrolled peak would occur at Vale 12 hours later. Tributary hydrographs were routed to Vale by displacing the Bully Creek flows four hours in time; Agency Valley 16 hours;

and Warm Springs 20 hours. The resulting flood hydrographs were regulated twice under different assumed storages in the reservoirs at the beginning of the flood. Regulation number one assumed that the reservoirs contained storage amounts having a 25 percent probability of being exceeded on 1 February at the beginning of the flood. Regulation number two assumed that the reservoirs contained storage amounts having a 50 percent probability of being exceeded on 1 February at the beginning of the flood. Plate 16 shows the results of these regulations. The assumed natural peak discharge of 44,300 cfs at Vale was reduced to 24,900 cfs by each regulation. The peak discharge from the uncontrolled area was 20,000 cfs. In each case, it was assumed that communication with the damtenders was not available and reservoir operations followed the Rule Curve Schedules.

Because the typical flood hydrographs for Malheur River tributaries contain the peak discharge within the first 48 hours, it is considered that some degree of regulation of the peak flow will very likely be made even during the extremely rare floods. Regulation of the spillway design flood at each dam is shown on Plates 25, 26, and 27.

SECTION VI - DISCUSSION OF FLOOD CONTROL REGULATIONS

6.01 ASSUMPTIONS OF ORIGINAL PLAN

Flood control benefits for Bully Creek Dam and Reservoir were allocated by letter dated 16 January 1957 from the District Engineer, Walla Walla District, Corps of Engineers to the Area Engineer, Snake River Development Office, Bureau of Reclamation under file designation NPWGW. A copy of that letter is contained in Appendix A as Item A-2. Those benefits were based upon the following assumptions:

a. Bully Creek Dam would be constructed substantially as shown on Plate 13 labeled Drawing No. 126-D-380 and included in the Bully Creek feasibility report dated September 1957.

b. Channel capacity of Bully Creek from the dam to mouth assumed to be at least 3,000 cfs. Channel capacity of Malheur River below Vale assumed to be 8,000 cfs.

c. Establishment of adequate hydrologic network for realistic reservoir control and forecasting.

d. Rule Curve space reservations for control of winter floods were as follows:

Bully Creek - 10,000 acre-feet minimum space reservation from 1 October to 1 March.

Agency Valley - 20,000 acre-feet from 1 October to 1 February.

Warm Springs - 40,000 acre-feet from 1 October to 1 February.

e. Flood control space reservations based on runoff forecasts as follows:

Bully Creek - On 1 February, 50 percent of forecasted inflow to 30 September. On 1 March, 50 percent of forecasted inflow to 30 September, with minimum of 10,000 acre-feet when other reservoirs have forecasted surplus; and 5,000 acre-feet minimum when other reservoirs do not have expected surplus. On 1 April, 50 percent of forecasted inflow to 30 September, with minimum of 10,000 acre-feet when other reservoirs have forecasted surplus; and 50 percent of forecasted inflow in excess of 10,000 acre-feet when other reservoirs do not have expected surplus. On 1 May, none.

Agency Valley and Warm Springs - On 1 February and 1 March, 50 percent of forecasted inflow from date to 30 September.

6.02 DEVIATIONS FROM PLANNING ASSUMPTIONS AND THEIR EFFECTS

Section V of this report proposes Flood Control Regulations and Schedule for operation of the Malheur River Reservoirs. Paragraph 6.01 above presents the operating assumptions which served as a basis for allocation of flood-control benefits. Several deviations from the planned operation of paragraph 6.01 are apparent in the proposed Regulations of Section V. Those deviations and their effects are discussed in the following paragraph in the same order as the basic assumptions are presented in paragraph 6.01.

a. Bully Creek Dam Design. Bully Creek Dam has been constructed essentially as shown on Plates 8 and 9. This project is significantly different from that proposed on Plate 13 which was assumed as a basis for benefit evaluation. Those changes most significant for controlling floods are: (1) spillway capacity, (2) reservoir capacity, and (3) outlet capacity.

The revised spillway design is based upon the use of 3,000 cfs channel capacity in Bully Creek to protect 10,000 acre-feet of inviolate flood-control space from 1 November to 1 March. Control of the spillway design

flood shown on Plate 26 also uses 6,600 acre-feet of surcharge storage in combination with a sluice capacity of 5,200 cfs and a spillway capacity of 5,000 cfs. The rigid design requirement to release 3,000 cfs for protection of 10,000 acre-feet of flood control space may result in somewhat higher flood discharges at Vale for the more frequent floods than would occur if greater spillway capacity had been constructed as originally designed. The results of analysis shown on Plate 20 indicate a very small chance that Bully Creek Reservoir storage will exceed 20,000 acre-feet prior to 1 March, and therefore, the requirement to pass 3,000 cfs is expected to occur only about once in 20 years on the average.

The reservoir capacity remains the same as originally designed except that provision for 6,600 acre-feet of surcharge storage has been added. This will not have any effect upon the originally planned flood-control operation.

The combined outlet capacity has been increased somewhat from the original design. It is pointed out, however, that only a small portion of the combined capacity can be released into Bully Creek; and that the full capacity of the canal probably cannot be relied upon for reservoir evacuation.

b. Channel Capacities. The assumption of 8,000 cfs channel capacity for Malheur River below Vale remains valid. Although an assumed capacity of 3,000 cfs for Bully Creek from the dam to the mouth may be valid for short periods of time, it is doubtful that the channel could withstand sustained flows of 3,000 cfs without severe bank erosion and possible avulsion. In January 1965, about 2,000 cfs was released from the reservoir for an extended

period of time. This flow resulted in severe bank erosion with property loss. Postflood recovery operations by the Corps of Engineers accomplished channel restoration at this location; however, additional channel problems can be expected with extended periods of discharges in excess of 2,000 cfs.

c. Hydrologic Network. Since the addition of the river gaging station, Malheur River below Nevada Dam near Vale, Oregon, in 1967, the hydrologic network for the basin is considered adequate to implement the Flood Control Regulations. The extent of the network is shown on Plate 1. Discharge rating tables for 5 stations are shown on Tables 9 through 13.

d. Rule Curve Space Reservations. These space reservations for control of winter floods are the same as originally planned for Bully Creek; have been increased for Warm Springs; and reduced at Agency Valley.

The increase of winter flood control space from 40,000 acre-feet to 54,500 acre-feet at Warm Springs has resulted from the Bureau of Reclamation's "Safety of Dams" program which indicated a need for reservoir storage in addition to the existing spillway capacity in order to protect the structure in the event of a spillway design flood. The regulation of the spillway design flood is shown on Plate 27. The requirement to use up to the full capacity of the outlets to protect the rule curve space reservation for the possible occurrence of a spillway design flood results in a release of almost 2,000 cfs greater than would otherwise be required for small or intermediate floods. Plans for modification of the spillway are being developed by the Bureau of Reclamation.

The decrease in rule curve space reservation from 20,000 acre-feet to 10,000 acre-feet at Agency Valley Reservoir from 1 November to 1 February is

proposed on the basis of Bureau of Reclamation studies indicating a possible loss of irrigation water supply in some years if the 20,000 acre-feet of space were maintained. Reference to Plate 21 indicates a greater than 50 percent chance that more than 10,000 acre-feet will be available through 1 April each year. Plates 23 and 24 show the liklihood of having sufficient space available to store the entire maximum annual 10-day and 3-day volumes when operated according to the proposed regulations.

e. Forecast Space Reservations. The amounts of flood control space to be provided on the basis of seasonal runoff forecasts have been reduced at all three reservoirs. Instead of providing space equal to a percentage of the forecasted seasonal volume as originally planned, it is now proposed to provide space according to curves enveloping the historical requirements for flood control. This technique gives greater assurance of conserving the irrigation water supply; and still retains an enveloping safety factor for flood control. The enveloping curves are shown on Plates 28 and 29. Procedures for forecasting seasonal runoff are shown in Appendix B.

6.03 CONCLUSIONS AND RECOMMENDATION

A comparison of the degree of flood regulation expected by use of the proposed Part 208 Regulations and the degree expected from original assumptions for flood control benefit allocation is shown on Plate 3A. A lesser degree of flood reduction is expected under the proposed Regulations for those floods having recurrence intervals from about 5 to 150 years. A significantly greater degree of flood reduction is now expected for those floods having recurrence intervals from 150 years to over 1,000 years.

These changes in flood reductions are largely due to restrictions placed upon project operations to insure safety of the dams during the possible occurrence of spillway design floods. Those restrictions are discussed in paragraphs 6.02a for Bully Creek and 6.02d for Warm Springs. When greater spillway capacity is constructed at Warm Springs, as presently planned by the Bureau of Reclamation, greater use can be made of the reservoir space for controlling the more frequent floods.

Flood control benefits amounting to $56,000, assignable directly to Bully Creek Reservoir and to coordinated operation of the three reservoirs, was used by the Bureau of Reclamation for economic justification of Bully Creek Dam. It was estimated in 1957 that Warm Springs and Agency Valley Reservoirs were earning an additional $204,000 annual flood control benefit. This amount was attributed to incidental flood control operation.

A preliminary check has been made of the effect of the operation plan changes on flood control benefits. This check was based on a comparison of remaining flood ~~control~~ damages resulting from the two curves of regulated flood frequencies shown on Plate 3A. The comparison indicated there would be little difference in overall benefits earned by the two plans of operation.

In consideration of the basic function of the reservoirs to provide irrigation water supply, and structural limitations of the dams and reservoirs, all the reasonable flood control capability of the projects has been incorporated into the proposed Regulations. It is concluded that those Regulations proposed in paragraphs 5.01 and 5.02 are practical and feasible for existing conditions. Their adoption is recommended.

SECTION VII - WATER CONTROL MANAGEMENT

7-01. General. Flood Control and irrigation interests affected by the regulation of the of the Vale Project's three Malheur River reservoirs (Beulah, Warm Springs, and Bully Creek,) requires close cooperation and coordination between (1) the Corps of Engineers and the Bureau of Reclamation (USBR), (2) the USBR and Water District 9 irrigation districts (Warm Springs Irrigation District and Vale Irrigation District), and (3) the irrigation districts and the State of Oregon Water Resources Department. The administration of regulating programs will at all times reflect due consideration of the integrated interests involved. Organizational charts for the key entities involved with the operation of the Malheur River reservoir system are shown on page 7-4 and corresponding personnel names and telephone numbers are listed on pages 7-5 and 7-6. The organization and responsibility of these agencies, as they relate to the operation of the Beulah, Warm Springs, and Bully Creek reservoirs are summarized in the following paragraphs.

7-02. Bureau of Reclamation. The Regional Office, Region 1, Bureau of Reclamation in Boise, Idaho, is directly responsible for the operation of the Vale Project's three Malheur River reservoirs (Beulah, Warm Springs, and Bully Creek) to accomplish the flood control and refill regulation objectives. These objectives will at all times be in accordance with criteria set forth in this Manual, Section V - Flood Control Regulations Proposed (Paragraph 5-01 - Part 208 - Flood Control Regulations; Paragraph 5-02 - Flood Control Regulation Schedule). The Water Resources and Operations Branch Chief is responsible for the coordination of flood control and refill regulation for all Bureau reservoirs in Region 1. The Central Snake Projects Office is responsible for implementing the flood control and refill regulation plans for the three Malheur River reservoirs on a day-to-day basis during the flood season. The Central Snake Projects Superintendent and his staff is also responsible for the operation and maintenance of the Vale Project's three dams and reservoirs. The organization of the Bureau, as it pertains to flood control regulation and project operation and maintenance, is shown on page 7-4 and corresponding personnel names and telephone numbers are listed on page 7-5.

Responsibilities of the Bureau of Reclamation for flood control include:

1. Maintenance of adequate hydrologic reporting network.

2. Collection and dissemination of hydrologic and reservoir data.

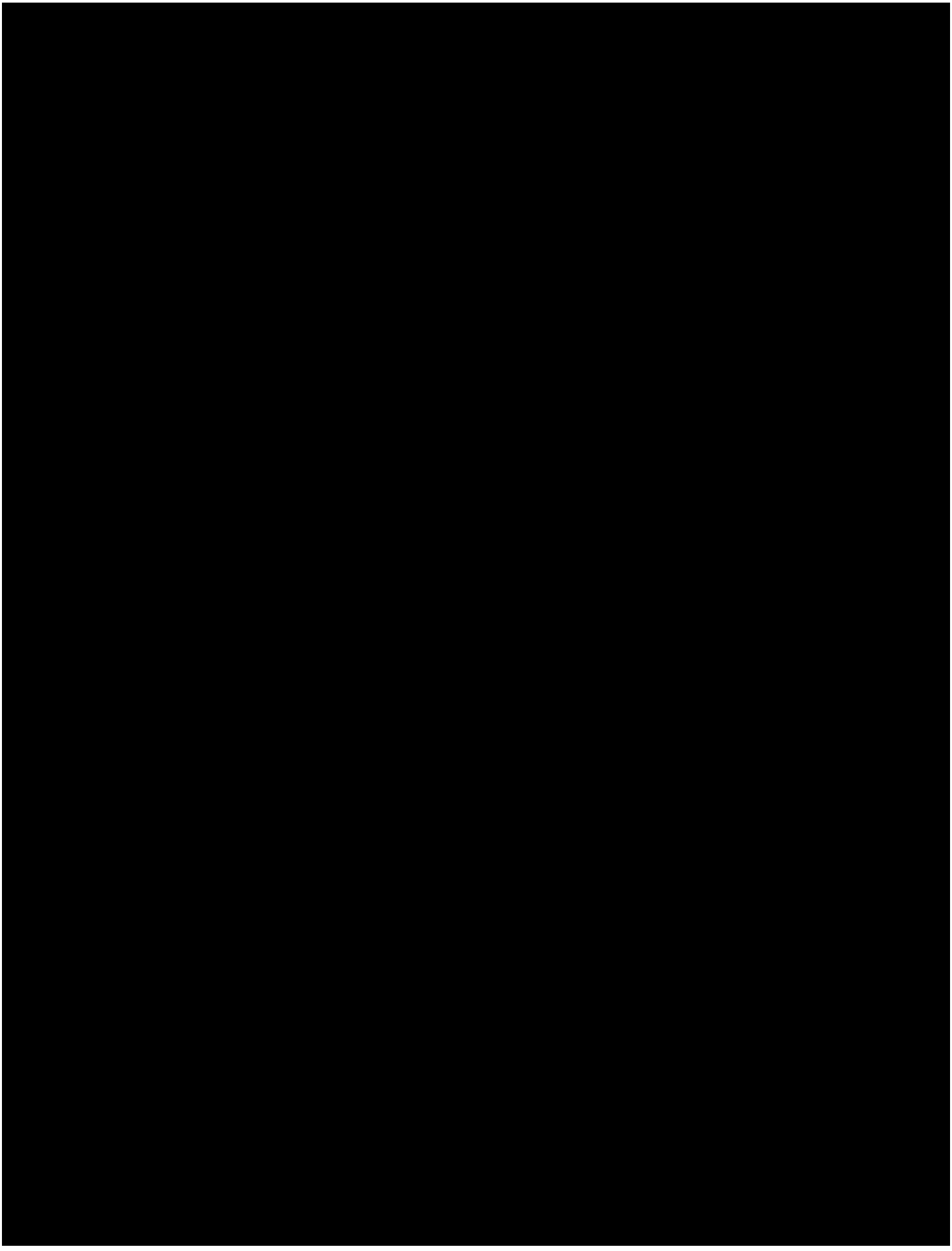
3. Preparation of periodic forecasts of runoff for the period and establish details of the flood control evacuation and refill schedules.

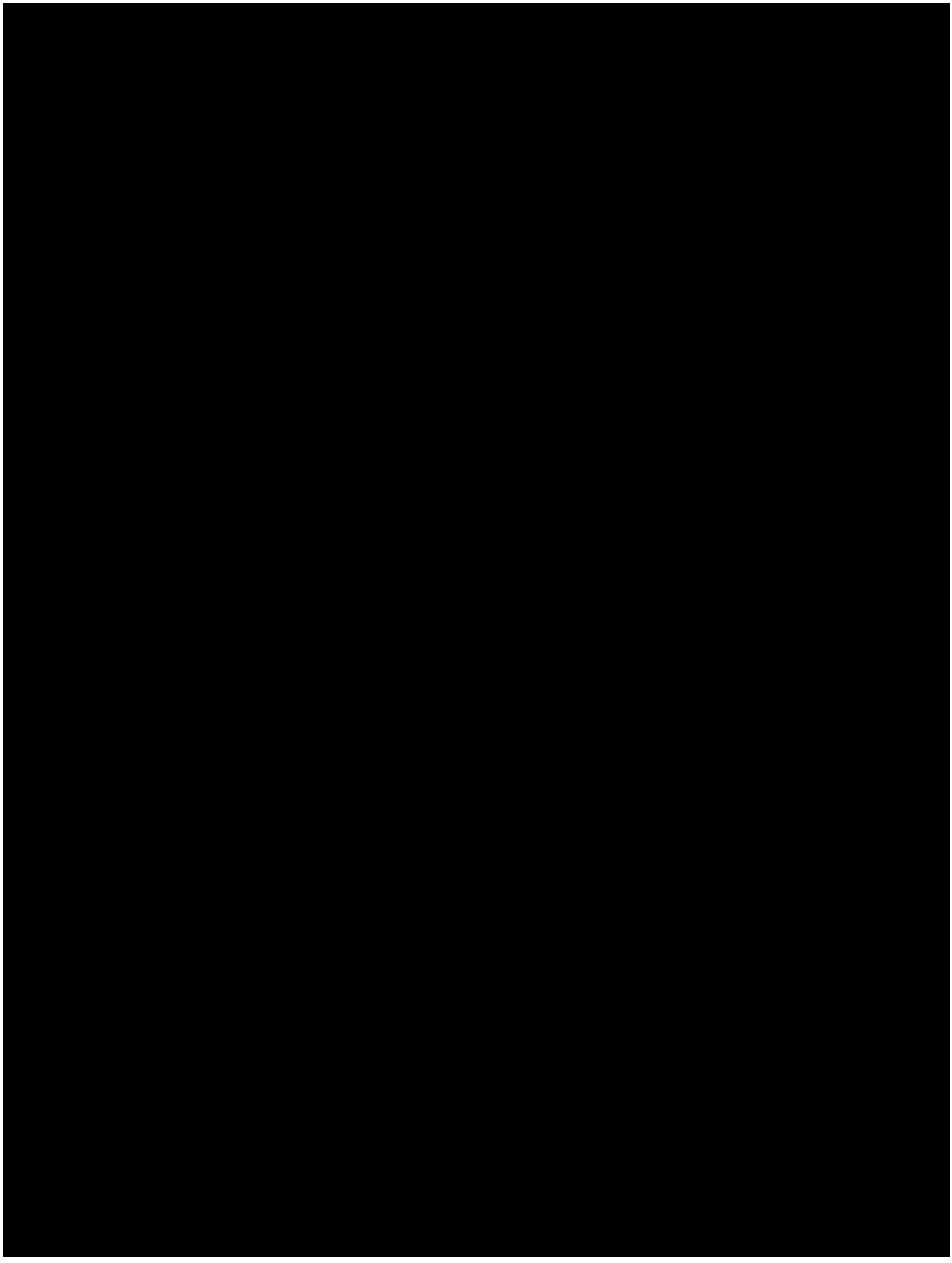
4. Passing on runoff volume forecasts and provide flood control regulation instructions via the Central Snake Projects Office to the Warm Springs and Vale Irrigation Districts for making releases from the Beulah, Warm Springs, and Bully Creek reservoirs in order to conform with flood control criteria in this Manual or as these criteria may be modified by agreement between the Corps of Engineers and Bureau of Reclamation.

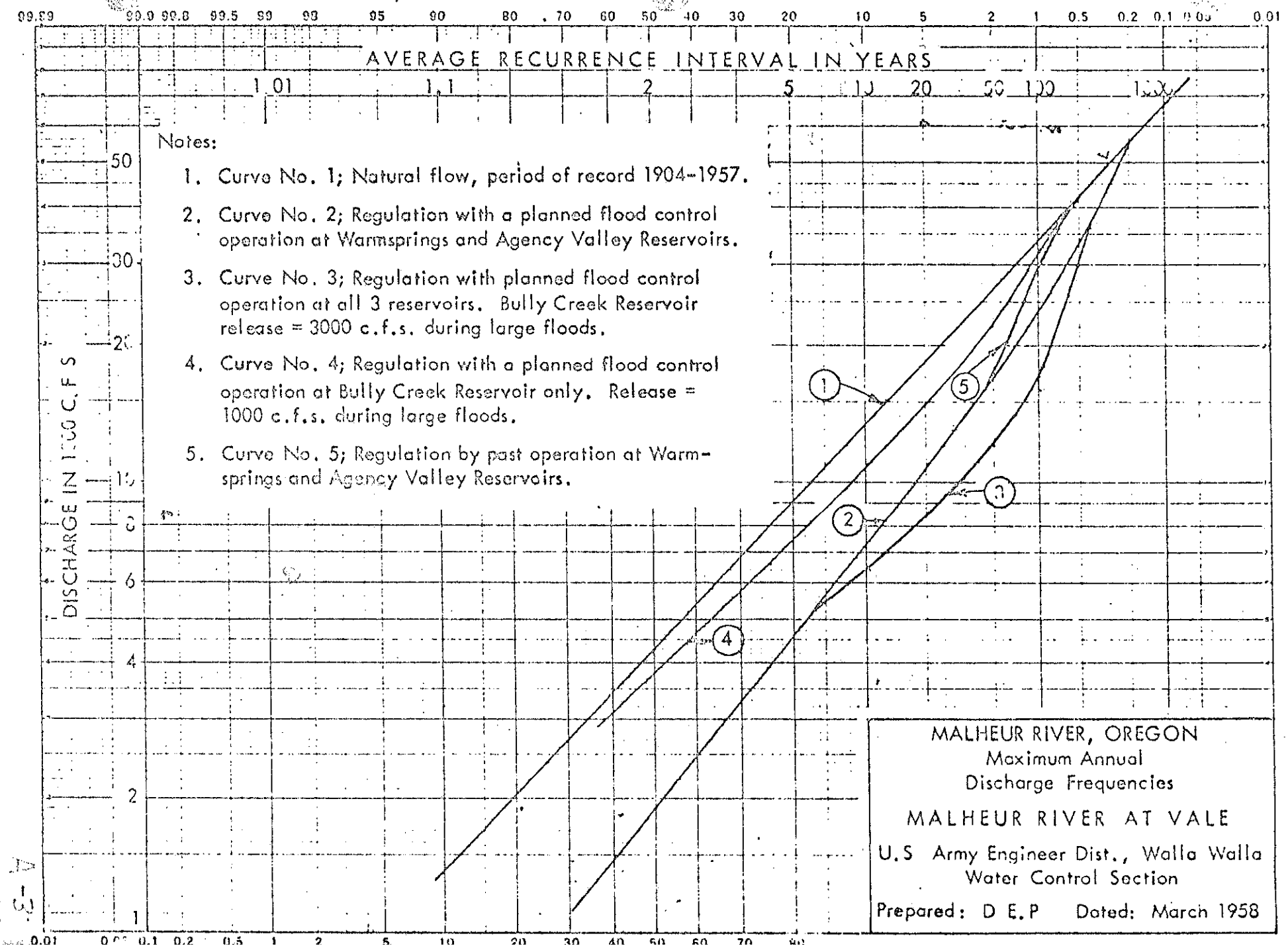
b. Watermasters Section. Responsibilities of the Watermasters Section include: (1) supervising watermasters, (2) deciding water distribution questions, and (3) ensuring state law compliance in distributions. The District 9 Watermaster is responsible for the accounting and distributing of water within the district. Watermaster District 9 is composed of the Warm Springs Irrigation District and the Vale Irrigation District. Watermaster District 9 boundaries generally follow Malheur County boundaries and also includes areas of Baker, Grant, and Harney Counties.

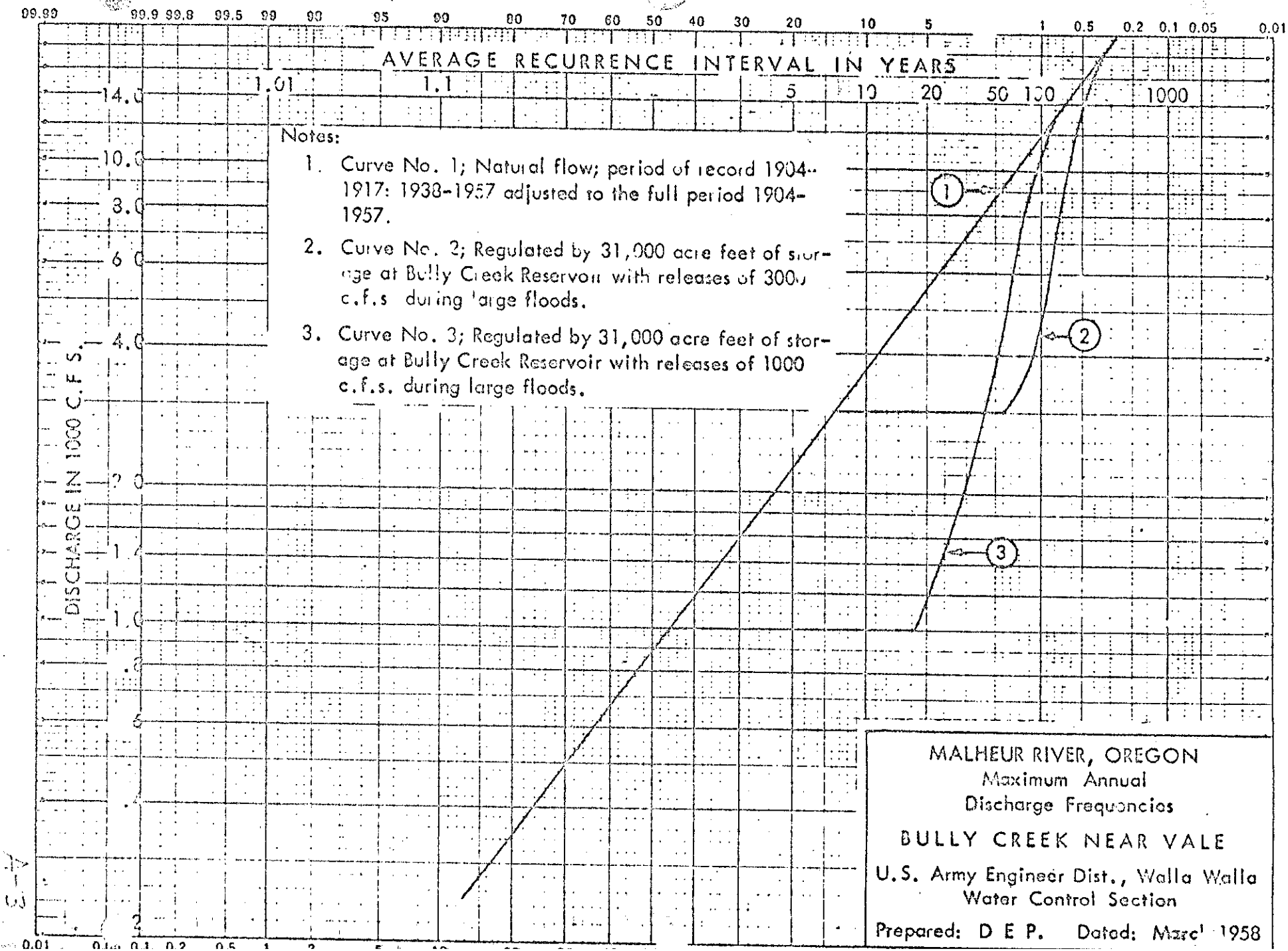
7-06. Other Agencies. While not involved with project regulation, the National Weather Service, Soil Conservation Service, and the Geological Survey collect support data (precipitation and temperature, snow survey measurements, and streamflows) under contract with the regulating agencies. This data is essential for the regulation and these data collection programs must be supported and continued.

7-07. Public Information. The regulating agencies have an obligation to provide pertinent regulation information to the Oregon Department of Water Resources so that they can routinely monitor the regulation and evaluate the effectiveness of regulation. When significant regulation and release changes are necessary, the regulating agencies have an obligation to provide public information news releases.






99.99 99.9 99.8 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
AVERAGE RECURRENCE INTERVAL IN YEARS
1.01 1.1 2 5 10 20 50 100 200
DISCHARGE IN 1000 C.F.S
50
30
20
15
10
6
4
2
1
0.01 0.05 0.1 0.2 0.5 1 2 5 10 20 30 40 50 60 70 80
Notes:
1. Curve No. 1; Natural flow, period of record 1904-1957.
2. Curve No. 2; Regulation with a planned flood control operation at Warmsprings and Agency Valley Reservoirs.
3. Curve No. 3; Regulation with planned flood control operation at all 3 reservoirs. Bully Creek Reservoir release = 3000 c.f.s. during large floods.
4. Curve No. 4; Regulation with a planned flood control operation at Bully Creek Reservoir only. Release = 1000 c.f.s. during large floods.
5. Curve No. 5; Regulation by past operation at Warmsprings and Agency Valley Reservoirs.
1
2
3
4
5
MALHEUR RIVER, OREGON
Maximum Annual
Discharge Frequencies
MALHEUR RIVER AT VALE
U.S Army Engineer Dist., Walla Walla
Water Control Section
Prepared: D E.P Dated: March 1958



Notes:

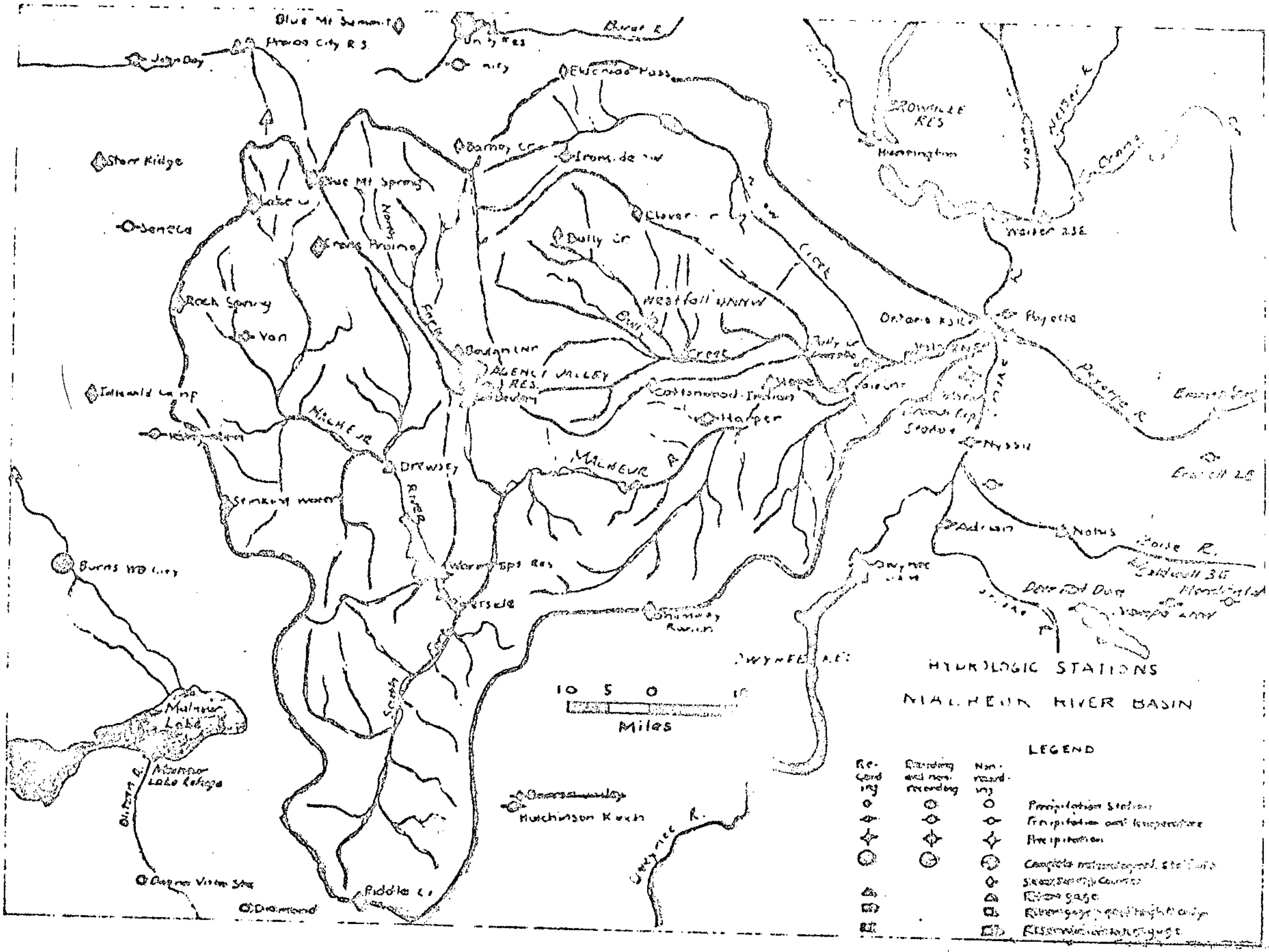
1. Curve No. 1; Natural flow; period of record 1904-1917; 1938-1957 adjusted to the full period 1904-1957.
2. Curve No. 2; Regulated by 31,000 acre feet of storage at Bully Creek Reservoir with releases of 3000 c.f.s during large floods.
3. Curve No. 3; Regulated by 31,000 acre feet of storage at Bully Creek Reservoir with releases of 1000 c.f.s. during large floods.

MALHEUR RIVER, OREGON
Maximum Annual
Discharge Frequencies

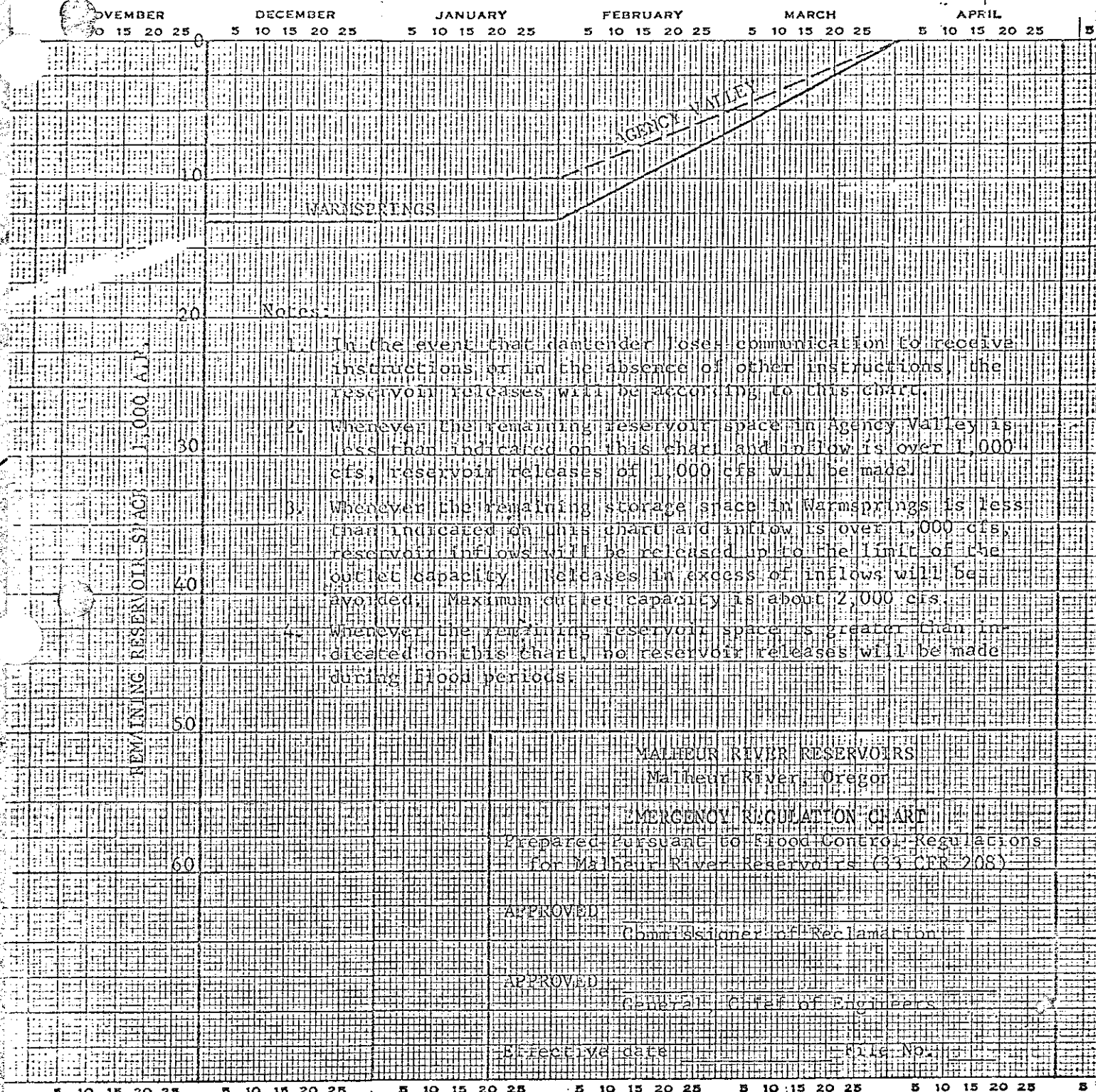
BULLY CREEK NEAR VALE

U.S. Army Engineer Dist., Walla Walla
Water Control Section

Prepared: D E P. Dated: March 1958


HYDROLOGIC STATIONS
MALHEUR RIVER BASIN
LEGEND
Recording
Standard and non-recording
Non-recording
Precipitation Station
Precipitation and temperature
Precipitation
River gage
Blue Mt Summit
Prairie City R S
John Day
Starr Ridge
Seneca
Blue Mt Spring
Lake Cr
Rock Spring
Von
Idlewild Camp
Burns WB City
Malheur Lake
Malheur Lake Refuge
Diamond
Riddle Cr
Hutchinson Ranch
Stinking Water
Drewsey
Malheur R
Warm Spr Res
Beulah
Agency Valley Res
Barney Cr
Ironside
Eldorado Pass
Unity Res
Burnt R
Dooley Cr
Clover Cr
Westfall
Bully Cr
Cottonwood
Harper
Chimney Rock
Ontario KSLC
Fayette
Payette R
Weiser R
Brownlee Res
Huntington
Weiser 3 SE
Nyssa
Adrian
Notus
Boise R
Caldwell 3 E
Owyhee Dam
Owyhee Res
Owyhee R
Deer Flat Dam
Emmett 2 E
North Fork
River
Miles
10 5 0 10

A-6



Notes:

1. In the event that damtender loses communication to receive instructions or in the absence of other instructions, the reservoir releases will be according to this chart.
2. Whenever the remaining reservoir space in Agency Valley is less than indicated on this chart and inflow is over 1,000 cfs, reservoir releases of 1,000 cfs will be made.
3. Whenever the remaining storage space in Warmsprings is less than indicated on this chart and inflow is over 1,000 cfs, reservoir inflows will be released up to the limit of the outlet capacity. Releases in excess of inflows will be avoided. Maximum outlet capacity is about 2,000 cfs.
4. Whenever the remaining reservoir space is greater than indicated on this chart, no reservoir releases will be made during flood periods.

MALHEUR RIVER RESERVOIRS
Malheur River, Oregon
EMERGENCY REGULATION CHART
Prepared Pursuant to Flood Control Regulations for Malheur River Reservoirs (33 CFR 208)

APPROVED:
Commissioner of Reclamation

APPROVED:
General, Chief of Engineers

Effective date ____ File No. ____

A-18

APPENDIX B

RUNOFF VOLUME

FORECAST PROCEDURES

MALHEUR RIVER RESERVOIRS UNREGULATED FLOW VOLUME FORECAST PROCEDURE

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PACIFIC NORTHWEST REGION

THE BUREAU OF RECLAMATION FORECAST PROCEDURE CONSISTS OF A MULTIPLE REGRESSION EQUATION OF THE FOLLOWING FORM:

$$Y = K + C1(X1) + C2(X2) + C3(X3) + C4(X4)$$

WHERE,

Y = FORECASTED RUNOFF VOLUME FOR THE PERIOD 1 DECEMBER THROUGH 30 JUNE IN 1000'S OF ACRE FEET (KAF).

X1 = INDEX OF OBSERVED RUNOFF VOLUME FOR THE PERIOD 1 OCTOBER THROUGH 30 NOVEMBER IN KAF.

X2 = INDEX OF OBSERVED/EXPECTED TOTAL MONTHLY PRECIPITATION IN INCHES FOR THE 1 OCTOBER THROUGH FEBUARY TIME PERIOD.

X3 = INDEX OF OBSERVED/EXPECTED 1 MARCH SNOW WATER CONTENT IN INCHES.

X4 = INDEX OF OBSERVED/EXPECTED TOTAL MONTHLY PRECIPITATION FOR THE PERIOD 1 MARCH THROUGH 30 JUNE IN INCHES.

C1, C2, C3, C4, K = COEFFICIENTS OF REGRESSION.

THE REGRESSION EQUATION IS FOR THE 1 OCTOBER THROUGH 31 JULY FORECAST PERIOD ONLY. TO FORECAST OTHER TIME PERIODS, SUBTRACT OBSERVED RUNOFF, 1 OCTOBER THROUGH DATE, FROM THE EQUATION RESULT. THE VARIABLES X1 THROUGH X4 ARE COMPUTED USING PROCEDURES ON PAGE B-1 SHEETS 2 AND 3.

1 = OCT.-NOV. ANTECEDENT RUNOFF BULLY CREEK RESERVOIR INFLOW (KAF):

OCT	NOV
_____	_____

X1 = TOTAL OCT.-NOV. R.O. =_____ (KAF)
(ENTER X1 ON PAGE B-1, SHEET 5)

X2 = OCT.-FEB. PRECIPITATION (INCHES) (1):

STATION	WGHT	OCT	NOV	DEC	JAN	FEB
BEULAH (BEU)	3.00					
BURNS WSO (BNOO)	2.00					
VALE (VAEO)	1.00					
WARM SPRINGS (WAR)	1.00					
(A)=TOTALS		_____	_____	_____	_____	_____
(B)=WEIGHT (WGHT)		1.00	1.00	1.00	1.00	1.00
(A*B)=WGHT TOTALS		_____	_____	_____	_____	_____

X2 = TOTAL WGHT OCT.-FEB. PRECIPITATION =_____ INCHES
(ENTER X2 ON PAGE B-1, SHEET 5)

(1) REFER TO TABLE 2, PAGE B-1, SHEET 4

X3 = MAR. 1 SNOW (INCHES):

STATION	WGHT (A)	OBSERVED WATER CONTENT (INCHES) (B)	NORMAL SNOW WATER ACCUM. (2) DATE-1 MAR (C)	EXPECTED 1 MARCH TOTAL WATER CONTENT (D)=(B)*(C)	WGHT 1 MARCH WATER CONTENT (INCHES) (D)*(A)
BLUE MTN SPR. (BLPO)	3.00				
IDLEWILD CAMP (IDCO)	1.00				
IZEE SUMMIT (IZSO)	1.00				
LAKE CREEK (LKCO)	2.00				
ROCK SPRING (RCSO)	1.00				
STARR RIDGE (STRO)	1.00				

X3 = TOTAL WGHT 1 MAR. WATER CONTENT =_____ INCHES
(ENTER X3 ON PAGE B-1, SHEET 5)

(2) REFER TO TABLE 1, PAGE B-1, SHEET 4

X4 = MAR.-JUNE PRECIPITATION (INCHES) (3)

STATION	WGHT	MAR	APR	MAY	JUNE
BEULAH (BEU)	3.00				
BURNS WSO (BNOO)	2.00				
VALE (VAEO)	1.00				
WARM SPRINGS (WAR)	1.00				
(A)=TOTALS		____	____	____	____
(B)=WGHT		1.00	1.00	1.00	0.50
(A)*(B)=WGHT TOTALS		____	____	____	____

X4 = TOTAL WGHT MAR.-JUNE PRECIPITATION =_____ INCHE
(ENTER X4 ON PAGE B-1, SHEET 4)

(3) REFER TO TABLE 2, PAGE B-1, SHEET 4

	BEULAH OBSERVED RUNOFF 1 DEC.-DATE		WARM SPRINGS OBSERVED RUNOFF 1 DEC.-DATE		BULLY CREEK OBSERVED RUNOFF 1 DEC.-DATE	
MONTH	RUNOFF	SUM R.O. (4)	RUNOFF	SUM R.O.	RUNOFF	SUM R.O.
DEC						
JAN						
APR						
MAY						

(4) ENTER SUM R.O. 1 OCT-DATE FROM PAGE B-1, SHEET 5

TABLE 1

STATION	NORMAL SNOW WATER ACCUMULATION (DATE-1 MARCH) (INCHES)	
	1 JAN	1 FEB
BLUE MTN SPRINGS (BLPO)	8.24	3.30
IDLE WILD CAMP (IDCO)	3.10	0.90
IZEE SUMMIT (IZSO)	3.60	1.40
LAKE CREEK (LKCO)	5.57	2.71
ROCK SPRING (RCSO)	3.55	1.40
STARR RIDGE (STRO)	2.90	0.80

TABLE 2

STATION	EXPECTED MONTHLY PRECIPITATION (INCHES)					
	JAN	FEB	MAR	APR	MAY	JUNE
BEULAH (BEU)	1.46	1.03	1.01	0.70	1.09	1.09
BURNS WSO (BNOO)	1.60	1.15	1.15	1.12	0.70	0.98
VALE (VAEO)	1.18	0.79	0.73	0.64	1.06	0.88
WARM SPRINGS (WAR)	1.25	0.46	0.64	0.65	0.60	1.60

1985 MALHEUR RIVER RESERVOIRS UNREGULATED FLOW VOLUME FORECAST PROCEDURE

FORECAST PERIOD _____ FORECAST DATE _____

1. FOR BEULAH:

1 DECEMBER THROUGH 30 JUNE VOLUME FORECAST

$$Y1 = (-68.09) + (20.4757)X1 + (1.4669)X2 + (0.6854)X3 + (1.0821)X4$$

$$Y1 = (-68.09) + (20.4757)\underline{\quad\quad} + (1.4661)\underline{\quad\quad} + (0.6854)\underline{\quad\quad}$$

$$+ (1.0821)\underline{\quad\quad}$$

Y1 = _____ KAF (BEULAH INFLOW)

NOTE: X1, X2, X3, AND X4 VALUES FOR INSERTION INTO THE ABOVE EQUATION ARE COMPUTED ON SHEETS 2 AND 3.

FORECAST DATE THROUGH 30 JUNE VOLUME FORECAST

Y (DATE-31 JULY) = Y1 (1 OCT. - 31 JULY) - OBSERVED RUNOFF IN KAF (1 DEC. - DATE)

Y (DATE-31 JULY) = _____ - _____

Y (DATE-31 JULY) = _____ KAF (BEULAH INFLOW)

2. FOR WARM SPRINGS:

1 DECEMBER THROUGH 30 JUNE VOLUME FORECAST

$$Y1 = (-168.03) + (40.5660)X1 + (2.8529)X2 + (1.3312)X3 + (2.3842)X4$$

$$Y1 = (-168.03) + (40.5660)\underline{\quad\quad} + (2.8529)\underline{\quad\quad} + (1.3312)\underline{\quad\quad}$$

$$+ (2.3842)\underline{\quad\quad}$$

Y1 = _____ KAF (WARM SPRINGS INFLOW)

NOTE: X1, X2, X3, AND X4 VALUES FOR INSERTION INTO THE ABOVE EQUATION ARE COMPUTED ON SHEETS 2 AND 3.

FORECAST DATE THROUGH 31 JULY VOLUME FORECAST

Y (DATE-31 JULY) = Y1 (1 OCT. - 31 JULY) - OBSERVED RUNOFF IN KAF
(1 DEC. - DATE)

Y (DATE-31 JULY) = _____ - _____
= _____ KAF (WARM SPRINGS INFLOW)

3. FOR BULLY CREEK:

1 DECEMBER THROUGH 30 JUNE VOLUME FORECAST

$$Y1 = (-63.66) + (23.0267)X1 + (0.9830)X2 + (0.2159)X3 + (0.6917)X4$$

$$Y1 = (-63.66) + (23.0267)\underline{\quad\quad} + (0.9830)\underline{\quad\quad} + (0.2159)\underline{\quad\quad}$$

$$+ (0.6917)\underline{\quad\quad}$$

Y1 = _____ KAF (BULLY CREEK INFLOW)

NOTE: X1, X2, X3, AND X4 VALUES FOR INSERTION INTO THE ABOVE EQUATION ARE COMPUTED ON SHEETS 2 AND 3.

FORECAST DATE THROUGH 31 JULY VOLUME FORECAST

Y (DATE-31 JULY) = Y1 (1 OCT. - 31 JULY) - OBSERVED RUNOFF IN KAF
(1 DEC. - DATE)

Y (DATE-31 JULY) = _____ - _____

Y (DATE-31 JULY) = _____ KAF (BULLY CREEK INFLOW)

TABLE 1

CLIMATOLOGICAL DATA

MALHEUR BASIN

Map No.	Station	Elev.	Temperature in degrees F.				Annual precipitation				Snowfall	
			Length of record	Annual mean	Mean max.	Mean min.	Length of record	Average	Max. yearly amount	Min. yearly amount	Length of record	Avera depth
		Feet	Years	°F.	°F.	°F.	Years	Inches	Inches	Inches	Years	Inch
1	Warmsprings Reservoir	3336	29	49.2	64.0	34.4	30	8.33	13.11	3.33	26	16.7
2	Beulah	3277	32	47.0	62.7	31.3	33	11.22	14.27	6.40	--	--
3	Harper	2510	--	--	--	--	31	8.20	13.72	4.22	--	--
4	Vale 1 W	2240	64	49.5	64.5	34.6	63	8.99	15.19	4.92	60	18.5
5	Ironside	3915	--	--	--	--	5	11.23	15.53	8.15	--	--
6	Malheur Br. Exp. Sta.	2230	18	50.8	63.8	37.8	18	9.63	13.90	5.16	17	17.9
7	Ontario KSRV	2145	13	51.1	65.1	37.1	14	9.28	12.57	4.86	--	--

From U. S. Weather Bureau Climatological Data through 1960.

Table 1

TABLE 2
DISCHARGE AND RUN-OFF DATA
Malheur River and Tributaries

Stream	Location	Drainage area	Period of record 1/	Annual run-off			Extreme discharge	
				Mean	Max.	Min.	Max.	Min.
		Sq. mi.	Years	Acre-feet			C.f.s.	C.f.s.
Malheur River	Near Drewsey	910	1926-1960-C	126,700	274,400	24,850	10,700	0
Malheur River	Below Warm Springs Res.	1,100	1906-1960-B	123,800	258,700	33,900	7,200	0
Malheur River	Near Riverside	1,910	1909-1914-B	250,000	356,000	189,000	11,700	2.0
Malheur River	Near Namorf	2,560	1913-1929-B	277,375	478,400	132,400	12,600	4.0
Malheur River	Near Hope	3,030	1919-1949-B	152,940	376,500	52,500	8,100	4.0
Malheur River	At Little Valley nr. Hope	3,010	1949-1960-C	158,500	344,600	46,600	12,300	12.0
Malheur River	At Vale	3,880	1890-1914-B	438,100	895,000	265,000	22,800	4.0
Malheur River	Below Nevada Dam	3,880	1926-1936-B	108,030	249,000	21,090	3,660	0.0
S. Fork, Malheur R.	Near Riverside	800	1910-1914-B	73,100	49,000	24,100	1,990	6.0
N. Fork, Malheur R.	Above Reservoir	355	1936-1960-C	92,600	145,400	53,690	1,600	12.0
N. Fork, Malheur R.	At Beulah	440	1926-1960-C	98,460	175,900	12,810	7,000	0.0
N. Fork, Malheur R.	At Foley's Ranch	436	1909-1914-B	108,800	148,000	69,600	5,910	5.0
N. Fork, Malheur R.	At Juntura		1919-1934-B	94,500	103,000	86,000	945	0
Bully Creek	At West Fall		1911-1914-B	5,315	6,920	3,710	182	1.0
Bully Creek	At Warm Springs	585	1903-1914-B	53,500	2/149,000	18,300	6,240	0.1
Bully Creek	Near Vale	570	1936-1960-C	30,410	59,850	5,080	8,900	0.0
Willow Creek	Near Malheur	259	1905-1929-B	10,000	20,700	2,190	1,400	0.0
Willow Creek	Near Brogan	380	1904-1914-B	17,300	35,000	3,560		0.1

1/ C - Record continuous for the period listed. B - Record intermittent for the period listed.
2/ Average annual run-off contains 1904 water year run-off of 149,000 acre-feet, which is 500 percent of the annual run-off for the period 1936-1960 for Bully Creek near Vale.

Table 2

Malheur R. near Drewsey, Oregon
Monthly Runoff - 1,000 A.F.

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1926-27	2.0	3.7	6.2	5.8	22.6	29.2	40.3	30.3	20.4	2.3	0.8	1.6	165.0
1927-28	3.0	5.4	5.9	6.5	5.6	48.5	35.9	26.9	2.9	0.9	0.2	0.2	142.0
1928-29	2.0	2.6	2.0	2.1	2.3	14.1	15.3	10.7	4.8	0.5	0.1	0.1	56.6
-30	1.4	2.6	4.2	3.2	10.6	10.4	6.7	2.1	0.8	0.2	0.1	0.3	42.6
-31	1.7	1.9	1.6	2.9	4.2	10.0	11.9	3.3	1.2	0.4	0.1	0.1	39.2
-32	1.4	2.0	2.7	2.9	3.4	38.5	43.5	24.3	5.4	0.6	0.3	0.2	125.0
-33	0.3	0.3	0.6	1.2	1.1	12.9	27.0	18.6	11.0	1.0	0.1	0.2	74.4
-34	0.9	2.8	3.7	4.8	4.2	4.2	2.6	1.1	0.5	0.1	0	0	24.9
-35	0.4	2.8	3.9	3.7	3.5	9.6	27.9	8.7	1.6	0.3	0	0	62.5
-36	0.9	2.1	2.0	3.7	9.9	21.5	44.1	12.2	2.3	0.3	0.1	0.1	99.2
-37	0.9	2.2	2.9	2.0	2.9	10.1	22.8	11.8	3.4	0.4	0.1	0.1	59.4
-38	1.5	3.5	14.9	9.0	12.2	45.1	70.0	31.3	9.1	1.4	0.4	0.4	198.8
-39	1.0	3.0	3.5	3.3	3.8	26.6	24.1	6.2	1.2	0.4	0	0	73.1
-40	0.7	2.0	2.9	4.0	29.2	46.8	42.2	9.8	1.8	0.2	0.1	1.2	140.9
-41	3.5	5.5	8.6	6.6	15.6	80.8	49.0	23.9	9.0	1.8	0.9	1.7	206.8
-42	2.5	4.7	6.4	5.1	6.6	25.3	68.4	18.8	9.8	2.0	0.5	0.7	150.8
-43	1.2	4.9	10.9	21.9	19.3	50.9	91.9	32.2	14.1	3.9	1.1	1.1	253.5
-44	2.2	4.3	3.4	3.2	6.7	14.0	15.5	5.5	4.1	1.1	0.5	0.6	60.9
-45	1.5	3.1	3.8	11.0	26.0	21.0	30.7	33.0	13.7	1.5	0.5	0.9	146.8
-46	1.9	3.4	7.9	6.7	9.2	43.9	51.3	23.0	6.3	1.3	0.5	1.2	156.4
-47	2.9	4.0	7.1	3.8	22.0	15.7	18.8	9.4	4.3	0.8	0.4	0.4	89.6
-48	1.9	3.3	3.9	7.4	8.4	8.2	25.9	29.2	15.4	1.8	0.8	0.7	107.0
-49	2.6	3.8	4.3	2.9	15.4	26.2	40.6	23.0	4.1	0.6	0.2	0.2	123.7
-50	1.7	3.1	3.7	4.0	8.3	20.5	35.7	16.0	9.2	1.6	0.6	0.3	104.5
-51	2.2	4.0	7.8	5.9	28.9	25.3	51.1	16.7	3.9	0.3	0.1	0.2	146.3
-52	3.1	3.9	6.7	3.9	9.3	52.9	136.3	41.8	9.7	2.5	0.7	1.2	272.0
-53	1.5	2.7	4.0	27.3	17.9	17.9	41.8	32.6	25.9	3.9	1.3	0.7	177.6
-54	2.0	4.2	5.6	7.3	12.1	15.9	24.7	11.2	6.5	1.1	0.4	0.5	91.7
-55	2.1	3.7	3.3	3.1	3.4	5.5	12.4	16.9	5.1	1.6	0.4	0.3	57.8
-56	2.0	3.6	15.2	17.3	12.8	52.9	61.4	32.5	8.4	1.3	0.8	0.6	208.8
-57	3.5	4.9	5.5	3.4	47.0	40.9	46.3	32.1	8.2	0.8	0.3	0.4	193.1
-58	3.4	3.7	3.8	5.9	38.4	36.7	91.9	69.9	14.5	2.8	1.1	1.1	273.1
-59	2.8	4.0	4.9	6.2	5.8	8.3	18.9	6.5	2.5	0.6	0.1	1.0	61.7
-60	3.4	3.6	3.3	3.4	5.1	43.4	46.3	12.5	6.0	0.4	0.2	0.4	128.0
-61	1.7	4.1	3.6	4.4	11.1	11.3	18.9	6.5	5.4	0.5	0.2	0.2	67.8
Sum	67.7	119.4	180.7	215.8	444.8	945.0	1,392.1	690.5	252.5	41.2	14.0	18.9	4,381.5
Mean	1.9	3.4	5.2	6.2	12.7	27.0	39.8	19.7	7.2	1.2	0.4	0.5	125.2

Table 3

N. Fork Malheur R. above Agency Valley Res., near Beulah, Oreg.
Monthly Runoff - 1,000 A.F.

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1936-37	2.0	2.2	2.3	2.0	2.9	4.7	12.2	13.8	5.5	2.4	1.8	1.8	53.6
1937-38	2.2	2.9	7.0	3.7	4.8	17.4	36.5	28.3	11.1	3.7	2.7	3.0	123.3
1938-39	3.3	2.6	3.0	2.9	2.8	12.9	11.9	7.6	3.3	2.1	1.5	1.8	55.6
-40	2.1	2.2	2.5	2.8	6.1	19.0	24.4	10.3	3.9	2.2	1.9	2.6	79.9
-41	3.2	3.7	4.3	3.0	4.9	27.7	31.7	23.2	9.0	4.0	3.2	3.2	121.1
-42	3.5	3.7	5.3	4.8	4.3	9.0	34.7	17.2	11.2	4.5	2.9	2.7	103.7
-43	3.0	3.6	4.8	7.2	7.5	18.8	43.5	24.1	13.0	5.7	3.6	2.9	137.6
-44	3.5	3.6	2.9	3.0	3.8	6.4	9.7	8.0	5.7	3.2	2.4	2.3	54.5
-45	2.6	3.0	3.0	3.6	5.9	8.4	14.5	22.4	9.7	3.9	2.7	2.6	82.3
-46	2.9	3.3	4.5	2.9	2.8	15.4	30.8	21.9	8.2	3.9	2.7	3.2	102.4
-47	3.4	3.5	4.4	3.6	7.3	8.2	11.6	11.1	5.4	3.0	2.5	2.5	66.5
-48	2.8	3.2	3.1	3.5	4.6	4.5	12.3	23.3	16.6	5.2	3.2	2.6	84.8
-49	3.4	3.5	3.5	3.1	5.1	12.2	24.4	20.1	5.8	2.9	2.5	2.6	89.0
-50	3.0	3.5	3.3	2.9	4.1	9.5	20.5	18.8	10.5	4.4	3.0	2.5	85.9
-51	3.7	3.2	3.9	3.4	6.8	8.6	25.9	14.1	5.6	3.0	2.4	2.4	83.0
-52	3.5	3.3	3.5	3.6	4.7	16.9	53.9	29.4	11.4	4.4	2.9	2.7	140.3
-53	2.9	2.6	3.3	10.1	7.7	10.7	22.9	22.0	23.1	6.4	3.6	3.2	118.4
-54	3.9	3.9	3.6	4.6	6.0	7.9	16.9	14.0	7.0	3.6	2.9	3.1	77.2
-55	3.1	3.0	2.8	2.9	3.0	3.7	6.6	12.8	7.6	3.5	2.4	2.6	53.9
-56	2.8	3.4	6.5	5.5	5.6	20.4	29.9	21.8	8.7	4.0	2.8	3.0	114.3
-57	3.6	3.6	3.8	3.1	14.8	13.8	19.5	21.7	9.2	2.9	2.6	2.3	100.9
-58	3.7	3.2	3.5	3.7	13.4	14.6	39.2	40.3	12.4	5.3	3.3	2.8	145.4
-59	3.5	3.4	3.8	4.0	3.7	5.9	13.3	9.8	5.7	3.0	2.5	2.8	61.3
-60	3.4	3.1	2.6	3.0	3.0	13.2	24.3	13.2	8.0	3.2	2.6	2.4	81.9
-61	2.7	3.2	2.9	3.0	5.5	7.0	10.6	8.2	5.7	2.3	1.9	2.1	55.1
Sum	77.7	80.4	94.1	95.9	141.1	296.8	581.7	457.4	223.3	92.7	66.5	65.7	2,271.9
Mean	3.1	3.2	3.8	3.8	5.6	11.9	23.3	18.3	8.9	3.7	2.7	2.6	90.9

Table 4

Bully Creek near Vale, Oregon
Monthly Runoff - 1,000 A.F.

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Total
1937-38	.3	.3	3.2	1.2	4.7	17.5	6.9	.8	.5	.4	.3	.2	36.3
1938-39	.4	.3	.3	.2	.1	1.2	.8	.3	.2	.3	.2	.1	4.4
1939-40	.3	.2	.1	.2	9.3	16.9	12.7	.5	.4	.4	.4	1.0	42.4
-41	3.3	2.7	2.1	2.4	14.7	31.9	9.0	1.8	1.9	.9	1.2	.8	72.9
-42	.8	.9	1.8	1.5	3.7	12.4	11.8	2.9	2.0	1.1	1.0	1.1	41.0
-43	.9	1.1	3.4	10.2	11.0	16.3	12.1	2.3	3.5	1.5	1.1	1.1	64.4
-44	.9	.9	.8	.8	1.5	2.5	.7	1.3	1.3	.8	.8	.8	12.9
-45	.7	.7	.7	1.9	8.9	5.0	3.2	2.6	3.0	1.4	1.1	.8	30.1
-46	.8	.6	2.1	1.7	2.5	15.3	6.5	1.3	1.3	1.3	1.2	1.4	35.8
-47	.9	.8	.8	.6	4.1	.6	.3	1.1	1.4	.9	.6	.8	13.0
-48	.8	.7	.5	.6	.6	.3	.2	.3	.8	.7	.6	.7	6.9
-49	.6	.5	.3	.3	1.4	3.6	1.5	1.6	1.0	.8	1.0	1.2	13.7
-50	.6	.6	.5	.5	1.7	5.8	2.2	.9	1.2	.9	1.0	.8	16.8
-51	.8	.5	.7	.7	10.4	3.4	2.3	1.1	1.1	.9	.9	1.0	23.8
-52	1.0	.5	.5	.6	1.8	18.5	25.3	2.3	2.3	1.8	2.3	1.9	59.0
-53	1.1	.9	.9	9.5	5.7	4.4	4.1	4.5	12.3	1.4	1.2	1.3	47.2
-54	1.2	.7	.9	2.5	3.0	.7	1.0	.9	1.2	1.0	.9	.8	14.7
-55	.8	.5	.4	.5	.4	.3	.3	.5	.4	.4	.4	.2	5.1
-56	.1	.2	2.7	3.4	4.1	14.5	1.6	1.1	1.2	1.1	1.2	1.5	32.3
-57	1.8	1.8	1.2	1.0	20.8	18.3	5.2	4.0	2.0	1.2	1.5	1.2	59.8
-58	1.4	.7	.8	1.0	20.0	10.0	16.9	2.4	2.2	1.6	1.5	1.4	59.9
-59	1.2	.9	.8	1.0	1.0	.7	.5	.7	1.0	.9	.9	1.5	11.0
-60	.8	.6	.6	.6	.7	12.1	3.8	.8	1.1	1.3	1.0	.9	24.4
-61	.7	.6	.4	.5	2.0	1.3	.5	.5	.4	.4	.3	.1	7.8
Sum	22.2	18.2	26.5	43.4	134.1	213.5	129.4	36.5	43.7	23.4	22.6	22.6	735.6
Mean	.9	.8	1.1	1.8	5.6	8.9	5.4	1.5	1.8	1.0	.9	.9	30.6

Table 5

Warmsprings Reservoir

Active Storage Capacity Table

(1400 A.F. dead storage below elev. 3327)

Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.
3330.0	0	4	3335.0	800	34	3340.0	3100	60	3345.0	7050	100
.1	4	4	.1	834	34	.1	3160	60	.1	7150	100
.2	8	4	.2	868	34	.2	3220	60	.2	7250	100
.3	12	4	.3	902	34	.3	3280	60	.3	7350	100
.4	16	4	.4	936	34	.4	3340	60	.4	7450	100
.5	20	4	.5	970	30	.5	3400	70	.5	7550	100
.6	24	4	.6	1000	30	.6	3470	70	.6	7650	100
.7	28	4	.7	1030	30	.7	3540	70	.7	7750	100
.8	32	4	.8	1060	40	.8	3610	70	.8	7850	100
.9	36	4	.9	1100	40	.9	3680	70	.9	7950	100
3331.0	40	10	3336.0	1140	40	3341.0	3750	70	3346.0	8050	100
.1	50	10	.1	1180	40	.1	3820	70	.1	8150	100
.2	60	10	.2	1220	40	.2	3890	70	.2	8250	100
.3	70	10	.3	1260	40	.3	3960	70	.3	8350	110
.4	80	10	.4	1300	40	.4	4030	70	.4	8460	110
.5	90	10	.5	1340	40	.5	4100	70	.5	8570	110
.6	100	10	.6	1380	40	.6	4170	70	.6	8680	110
.7	110	10	.7	1420	40	.7	4240	70	.7	8790	110
.8	120	10	.8	1460	40	.8	4310	80	.8	8900	110
.9	130	10	.9	1500	40	.9	4390	80	.9	9010	110
3332.0	140	16	3337.0	1540	40	3342.0	4470	70	3347.0	9120	110
.1	156	16	.1	1580	40	.1	4540	80	.1	9230	110
.2	172	16	.2	1620	40	.2	4620	80	.2	9340	110
.3	188	16	.3	1660	40	.3	4700	80	.3	9450	110
.4	204	16	.4	1700	50	.4	4780	80	.4	9560	110
.5	220	16	.5	1750	50	.5	4860	80	.5	9670	110
.6	236	16	.6	1800	50	.6	4940	80	.6	9780	120
.7	252	16	.7	1850	50	.7	5020	80	.7	9900	120
.8	268	16	.8	1900	50	.8	5100	80	.8	10020	120
.9	284	16	.9	1950	50	.9	5180	80	.9	10140	120
3333.0	300	22	3338.0	2000	50	3343.0	5260	80	3348.0	10260	120
.1	322	22	.1	2050	50	.1	5340	80	.1	10380	120
.2	344	22	.2	2100	50	.2	5420	80	.2	10500	120
.3	366	22	.3	2150	50	.3	5500	80	.3	10620	120
.4	388	22	.4	2200	50	.4	5580	90	.4	10740	120
.5	410	22	.5	2250	50	.5	5670	90	.5	10860	120
.6	432	22	.6	2300	50	.6	5760	90	.6	10980	120
.7	454	22	.7	2350	50	.7	5850	90	.7	11100	120
.8	476	22	.8	2400	60	.8	5940	90	.8	11220	120
.9	498	22	.9	2460	60	.9	6030	90	.9	11340	130
3334.0	520	28	3339.0	2520	60	3344.0	6120	90	3349.0	11470	120
.1	548	28	.1	2580	60	.1	6210	90	.1	11590	120
.2	576	28	.2	2640	60	.2	6300	90	.2	11710	130
.3	604	28	.3	2700	60	.3	6390	90	.3	11840	130
.4	632	28	.4	2760	60	.4	6480	90	.4	11970	130
.5	660	28	.5	2820	60	.5	6570	90	.5	12100	130
.6	688	28	.6	2880	60	.6	6660	90	.6	12230	130
.7	716	28	.7	2940	60	.7	6750	100	.7	12360	130
.8	744	28	.8	3000	50	.8	6850	100	.8	12490	130
.9	772	28	.9	3050	50	.9	6950	100	.9	12620	130

Warmsprings Reservoir

Active Storage Capacity Table

Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.
3347.0	12750		3352.0	20000		3357.0	29000		3362.0	39700	
.1	12880	130	.1	20160	160	.1	29200	200	.1	39930	230
.2	13010	130	.2	20320	160	.2	29400	200	.2	40160	230
.3	13140	130	.3	20480	160	.3	29600	200	.3	40390	230
.4	13270	130	.4	20640	160	.4	29800	200	.4	40620	230
.5	13400	130	.5	20800	160	.5	30000	200	.5	40850	230
.6	13540	140	.6	20960	160	.6	30200	200	.6	41080	230
.7	13680	140	.7	21120	160	.7	30400	200	.7	41310	230
.8	13820	140	.8	21280	160	.8	30600	200	.8	41540	230
3348.9	13960	140	3353.9	21440	160	3358.9	30800	200	3363.9	41770	230
3349.0	14100	140	3354.0	21600	170	3359.0	31000	210	3364.0	42000	240
.1	14240	140	.1	21770	170	.1	31210	210	.1	42240	240
.2	14380	140	.2	21940	170	.2	31420	210	.2	42480	240
.3	14520	140	.3	22110	170	.3	31630	210	.3	42720	240
.4	14660	140	.4	22280	170	.4	31840	210	.4	42960	240
.5	14800	140	.5	22450	170	.5	32050	210	.5	43200	240
.6	14940	140	.6	22620	170	.6	32260	210	.6	43440	240
.7	15080	140	.7	22790	170	.7	32470	210	.7	43680	240
.8	15220	140	.8	22960	170	.8	32680	210	.8	43920	240
3349.9	15360	140	3354.9	23130	170	3359.9	32890	210	3364.9	44160	240
3350.0	15500	140	3355.0	23300	180	3360.0	33100	210	3365.0	44400	250
.1	15640	140	.1	23480	180	.1	33310	210	.1	44650	250
.2	15780	140	.2	23660	180	.2	33520	210	.2	44900	250
.3	15920	140	.3	23840	180	.3	33730	210	.3	45150	250
.4	16060	140	.4	24020	180	.4	33940	210	.4	45400	250
.5	16200	150	.5	24200	180	.5	34150	210	.5	45650	250
.6	16350	150	.6	24380	180	.6	34360	210	.6	45900	250
.7	16500	150	.7	24560	180	.7	34570	210	.7	46150	250
.8	16650	150	.8	24740	180	.8	34780	210	.8	46400	250
3350.9	16800	150	3355.9	24920	180	3360.9	34990	210	3365.9	46650	250
3351.0	16950	150	3356.0	25100	190	3361.0	35200	220	3366.0	46900	250
.1	17100	150	.1	25290	190	.1	35420	220	.1	47150	250
.2	17250	150	.2	25480	190	.2	35640	220	.2	47400	250
.3	17400	150	.3	25670	190	.3	35860	220	.3	47650	250
.4	17550	150	.4	25860	190	.4	36080	220	.4	47900	250
.5	17700	150	.5	26050	190	.5	36300	220	.5	48150	250
.6	17850	150	.6	26240	190	.6	36520	220	.6	48400	250
.7	18000	150	.7	26430	190	.7	36740	220	.7	48650	250
.8	18150	150	.8	26620	190	.8	36960	220	.8	48900	250
3351.9	18300	150	3356.9	26810	190	3361.9	37180	220	3366.9	49150	250
3352.0	18450	150	3357.0	27000	200	3362.0	37400	230	3367.0	49400	260
.1	18600	150	.1	27200	200	.1	37630	230	.1	49660	260
.2	18750	150	.2	27400	200	.2	37860	230	.2	49920	260
.3	18900	150	.3	27600	200	.3	38090	230	.3	50180	260
.4	19050	150	.4	27800	200	.4	38320	230	.4	50440	260
.5	19200	160	.5	28000	200	.5	38550	230	.5	50700	260
.6	19360	160	.6	28200	200	.6	38780	230	.6	50960	260
.7	19520	160	.7	28400	200	.7	39010	230	.7	51220	260
.8	19680	160	.8	28600	200	.8	39240	230	.8	51480	260
.9	19840	160	.9	28800	200	.9	39470	230	.9	51740	260

Table 6

Active Storage Capacity Table

Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.
40.0	52000	270	45.0	65900	290	50.0	81000	310	55.0	97000	330
3367.1	52270	270	3372.1	66190	290	3377.1	81310	310	3382.1	97330	330
.2	52540	270	.2	66480	290	.2	81620	310	.2	97660	330
.3	52810	270	.3	66770	290	.3	81930	310	.3	97990	330
.4	53080	270	.4	67060	290	.4	82240	310	.4	98320	330
.5	53350	270	.5	67350	290	.5	82550	310	.5	98650	330
.6	53620	270	.6	67640	290	.6	82860	310	.6	98980	330
.7	53890	270	.7	67930	290	.7	83170	310	.7	99310	330
.8	54160	270	.8	68220	290	.8	83480	310	.8	99640	330
3368.9	54430	270	3373.9	68510	290	3378.9	83790	310	3383.9	99970	330
41.0	54700	270	46.0	68800	300	51.0	84100	320	56.0	100300	330
.1	54970	270	.1	69100	300	.1	84420	320	.1	100630	330
.2	55240	270	.2	69400	300	.2	84740	320	.2	100960	330
.3	55510	270	.3	69700	300	.3	85060	320	.3	101290	330
.4	55780	270	.4	70000	300	.4	85380	320	.4	101620	330
.5	56050	270	.5	70300	300	.5	85700	320	.5	101950	330
.6	56320	270	.6	70600	300	.6	86020	320	.6	102280	330
.7	56590	270	.7	70900	300	.7	86340	320	.7	102610	330
.8	56860	270	.8	71200	300	.8	86660	320	.8	102940	330
3369.9	57130	270	3374.9	71500	300	3379.9	86980	320	3384.9	103270	330
42.0	57400	280	47.0	71800	300	52.0	87300	320	57.0	103600	340
.1	57680	280	.1	72100	300	.1	87620	320	.1	103940	340
.2	57960	280	.2	72400	300	.2	87940	320	.2	104280	340
.3	58240	280	.3	72700	300	.3	88260	320	.3	104620	340
.4	58520	280	.4	73000	300	.4	88580	320	.4	104960	340
.5	58800	280	.5	73300	300	.5	88900	320	.5	105300	340
.6	59080	280	.6	73600	300	.6	89220	320	.6	105640	340
.7	59360	280	.7	73900	300	.7	89540	320	.7	105980	340
.8	59640	280	.8	74200	300	.8	89860	320	.8	106320	340
3370.9	59920	280	3375.9	74500	300	3380.9	90180	320	3385.9	106660	340
43.0	60200	280	48.0	74800	310	53.0	90500	320	58.0	107000	340
.1	60480	280	.1	75110	310	.1	90820	320	.1	107340	340
.2	60760	280	.2	75420	310	.2	91140	320	.2	107680	340
.3	61040	280	.3	75730	310	.3	91460	320	.3	108020	340
.4	61320	280	.4	76040	310	.4	91780	320	.4	108360	340
.5	61600	280	.5	76350	310	.5	92100	320	.5	108700	340
.6	61880	280	.6	76660	310	.6	92420	320	.6	109040	340
.7	62160	280	.7	76970	310	.7	92740	320	.7	109380	340
.8	62440	280	.8	77280	310	.8	93060	320	.8	109720	340
3371.9	62720	280	3376.9	77590	310	3381.9	93380	320	3386.9	110060	340
44.0	63000	290	49.0	77900	310	54.0	93700	330	59.0	110400	340
.1	63290	290	.1	78210	310	.1	94030	330	.1	110740	340
.2	63580	290	.2	78520	310	.2	94360	330	.2	111080	340
.3	63870	290	.3	78830	310	.3	94690	330	.3	111420	340
.4	64160	290	.4	79140	310	.4	95020	330	.4	111760	340
.5	64450	290	.5	79450	310	.5	95350	330	.5	112100	340
.6	64740	290	.6	79760	310	.6	95680	330	.6	112440	340
.7	65030	290	.7	80070	310	.7	96010	330	.7	112780	340
.8	65320	290	.8	80380	310	.8	96340	330	.8	113120	340
.9	65610	290	.9	80690	310	.9	96670	330	.9	113460	340

Table 6

Active Storage Capacity Table

Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.	Elev.	Capacity	Diff.
60.0	113800		65.0	131800		70.0	151600		75.0	173100	
3387.1	114150	350	3392.1	132180	380	3397.1	152020	420	3402.1	173540	440
.2	114500	350	.2	132560	380	.2	152440	420	.2	173980	440
.3	114850	350	.3	132940	380	.3	152860	420	.3	174420	440
.4	115200	350	.4	133320	380	.4	153280	420	.4	174860	440
.5	115550	350	.5	133700	380	.5	153700	420	.5	175300	440
.6	115900	350	.6	134080	380	.6	154120	420	.6	175740	440
.7	116250	350	.7	134460	380	.7	154540	420	.7	176180	440
.8	116600	350	.8	134840	380	.8	154960	420	.8	176620	440
3388.9	116950	350	.9	135220	380	3398.9	155380	420	3403.9	177060	440
61.0	117300	350	66.0	135600	390	71.0	155800	430	76.0	177500	450
.1	117650	350	3393.1	135990	390	.1	156230	430	.1	177950	450
.2	118000	350	.2	136380	390	.2	156660	430	.2	178400	450
.3	118350	350	.3	136770	390	.3	157090	430	.3	178850	450
.4	118700	350	.4	137160	390	.4	157520	430	.4	179300	450
.5	119050	350	.5	137550	390	.5	157950	430	.5	179750	450
.6	119400	350	.6	137940	390	.6	158380	430	.6	180200	450
.7	119750	350	.7	138330	390	.7	158810	430	.7	180650	450
.8	120100	350	.8	138720	390	.8	159240	430	.8	181100	450
3389.9	120450	350	.9	139110	390	.9	159670	430	3404.9	181550	450
62.0	120800	360	67.0	139500	400	3399 72.0	160100	430	77.0	182000	450
.1	121160	360	3394.1	139900	400	.1	160530	430	.1	182450	450
.2	121520	360	.2	140300	400	.2	160960	430	.2	182900	450
.3	121880	360	.3	140700	400	.3	161390	430	.3	183350	450
.4	122240	360	.4	141100	400	.4	161820	430	.4	183800	450
.5	122600	360	.5	141500	400	.5	162250	430	.5	184250	450
.6	122960	360	.6	141900	400	.6	162680	430	.6	184700	450
.7	123320	360	.7	142300	400	.7	163110	430	.7	185150	450
.8	123680	360	.8	142700	400	.8	163540	430	.8	185600	450
3390.9	124040	360	.9	143100	400	3400 .9	163970	430	3505.9	186050	450
63.0	124400	370	68.0	143500	400	73.0	164400	430	78.0	186500	450
.1	124770	370	3395.1	143900	400	.1	164830	430	.1	186950	450
.2	125140	370	.2	144300	400	.2	165260	430	.2	187400	450
.3	125510	370	.3	144700	400	.3	165690	430	.3	187850	450
.4	125880	370	.4	145100	400	.4	166120	430	.4	188300	450
.5	126250	370	.5	145500	400	.5	166550	430	.5	188750	450
.6	126620	370	.6	145900	400	.6	166980	430	.6	189200	450
.7	126990	370	.7	146300	400	.7	167410	430	.7	189650	450
.8	127360	370	.8	146700	400	.8	167840	430	.8	190100	450
3391.9	127730	370	3396.9	147100	400	3401.9	168270	430	3506.9	190550	450
64.0	128100	370	69.0	147500	410	74.0	168700	440	79.0	191000	460
.1	128470	370	.1	147910	410	.1	169140	440	.1	191460	460
.2	128840	370	.2	148320	410	.2	169580	440	.2	191920	460
.3	129210	370	.3	148730	410	.3	170020	440	.3	192380	460
.4	129580	370	.4	149140	410	.4	170460	440	.4	192840	460
.5	129950	370	.5	149550	410	.5	170900	440	.5	193300	460
.6	130320	370	.6	149960	410	.6	171340	440	.6	193760	460
.7	130690	370	.7	150370	410	.7	171780	440	.7	194220	460
.8	131060	370	.8	150780	410	.8	172220	440	.8	194680	460
.9	131430	370	.9	151190	410	.9	172660	440	.9	195140	460

DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
VALE PROJECT ~ OREGON

CAPACITY TABLE FOR AGENCY VALLEY RESERVOIR

BEULAH ~ OREGON
FILE NO. - 1354.

Elev. w.s.	Storage Ac.-Ft.	Diff.	Elev. w.s.	Storage Ac.-Ft.	Diff.	Elev. w.s.	Storage Ac.-Ft.	Diff.	Elev. w.s.	Storage Ac.-Ft.	Diff.
3263	0	1	3283	1,495	250	3303	10,995	740	3323	32,225	1385
64	1	2	84	1,745	275	04	11,735	785	24	33,610	1415
3265	3	4	3285	2,020	285	3305	12,520	815	3325	35,025	1450
66	7	8	86	2,305	310	06	13,335	830	26	36,475	1480
67	15	12	87	2,615	350	07	14,165	880	27	37,955	1500
68	27	18	88	2,965	380	08	15,045	920	28	39,455	1520
69	45	25	89	3,345	405	09	15,965	985	29	40,975	1555
3270	70	35	3290	3,750	430	3310	16,950	1000	3330	42,530	1590
71	105	40	91	4,180	455	11	17,950	1025	31	44,120	1625
72	145	50	92	4,635	470	12	18,975	1050	32	45,745	1660
73	195	55	93	5,105	480	13	20,025	1085	33	47,405	1680
74	250	60	94	5,585	505	14	21,110	1110	34	49,085	1735
3275	310	75	3295	6,090	515	3315	22,220	1165	3335	50,820	1760
76	385	110	96	6,605	540	16	23,385	1185	36	52,580	1790
77	495	120	97	7.145	590	17	24,570	1205	37	54,370	1820
78	615	140	98	7,735	610	18	25,775	1225	38	56,190	1850
79	755	170	99	8,345	630	19	27,000	1250	39	58,040	1885
3280	925	180	3300	8,975	650	3320	28,250	1295	3340	59,925	
81	1,105	190	01	9,625	670	21	29,545	1325			
82	1,295	200	02	10,295	700	22	30,870	1355			

NOTE:
Elevation of outlet tunnel is 3263.21.
Mercury gage is graduated between
Elevations 3272.00 and 3340.00.

COMPUTED: W.N.K.
TRACED: J.G.P.
CHECKED: J.L.Q.

January 10, 1936

Table 7

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,456.5										1
2,456.6	2	4	5	6	7	9	10	11	13	14
2,456.7	15	16	18	19	20	22	23	24	25	27
2,456.8	28	29	31	32	33	34	36	37	38	40
2,456.9	41	42	43	45	46	47	49	50	51	52
2,457.0	54	55	56	58	59	60	62	63	64	66
2,457.1	67	68	70	71	72	74	75	76	78	79
2,457.2	80	82	83	84	86	87	88	90	91	92
2,457.3	94	95	96	98	99	100	102	103	104	106
2,457.4	107	108	110	111	112	114	115	116	118	119
2,457.5	120	122	123	124	126	127	128	130	131	132
2,457.6	133	135	136	137	139	140	141	143	144	145
2,457.7	147	148	149	151	152	153	155	156	157	159
2,457.8	160	161	163	164	165	167	168	169	171	172
2,457.9	173	175	176	177	179	180	181	183	184	185
2,458.0	187	188	189	191	192	194	195	196	198	199
2,458.1	200	202	203	205	206	207	209	210	211	213
2,458.2	214	216	217	218	220	221	222	224	225	226
2,458.3	228	229	231	232	233	235	236	237	239	240
2,458.4	242	243	244	246	247	248	250	251	253	254
2,458.5	255	257	258	259	261	262	264	265	266	268
2,458.6	269	270	272	273	275	276	277	279	280	281
2,458.7	283	284	285	287	288	290	291	292	294	295
2,458.8	296	298	299	301	302	303	305	306	307	309
2,458.9	310	312	313	314	316	317	318	320	321	323
2,459.0	324	325	327	328	330	331	332	334	335	337
2,459.1	338	340	341	342	344	345	347	348	349	351
2,459.2	352	354	355	356	358	359	361	362	364	365
2,459.3	366	368	369	371	372	373	375	376	378	379
2,459.4	381	382	383	385	386	388	389	390	392	393
2,459.5	395	396	398	399	400	402	403	405	406	407
2,459.6	409	410	412	413	415	416	417	419	420	422
2,459.7	423	424	426	427	429	430	432	433	434	436
2,459.8	437	439	440	441	443	444	446	447	448	450
2,459.9	451	453	454	456	457	458	460	461	463	464

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Table

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,460.0	465	467	468	470	471	473	474	476	477	479
2,460.1	480	482	483	485	486	488	489	491	492	494
2,460.2	495	497	498	500	501	503	504	506	507	509
2,460.3	510	512	513	514	516	517	519	520	522	523
2,460.4	525	526	528	529	531	532	534	535	537	538
2,460.5	540	541	543	544	546	547	549	550	552	553
2,460.6	555	556	558	559	561	562	564	565	566	568
2,460.7	569	571	572	574	575	577	578	580	581	583
2,460.8	584	586	587	589	590	592	593	595	596	598
2,460.9	599	601	602	604	605	607	608	610	611	613
2,461.0	614	616	617	619	620	622	624	625	627	628
2,461.1	630	631	633	635	636	638	639	641	643	644
2,461.2	646	647	649	650	652	654	655	657	658	660
2,461.3	662	663	665	666	668	669	671	673	674	676
2,461.4	677	679	681	682	684	685	687	688	690	692
2,461.5	693	695	696	698	700	701	703	704	706	707
2,461.6	709	711	712	714	715	717	719	720	722	723
2,461.7	725	726	728	730	731	733	734	736	738	739
2,461.8	741	742	744	745	747	749	750	752	753	755
2,461.9	757	758	760	761	763	764	766	768	769	771
2,462.0	772	774	776	777	779	781	782	784	786	788
2,462.1	789	791	793	794	796	798	799	801	803	804
2,462.2	806	808	809	811	813	815	816	818	820	821
2,462.3	823	825	826	828	830	831	833	835	836	838
2,462.4	840	841	843	845	847	848	850	852	853	855
2,462.5	857	858	860	862	863	865	867	868	870	872
2,462.6	873	875	877	879	880	882	884	885	887	889
2,462.7	890	892	894	895	897	899	900	902	904	906
2,462.8	907	909	911	912	914	916	917	919	921	922
2,462.9	924	926	927	929	931	932	934	936	938	939
2,463.0	941	943	945	946	948	950	952	953	955	957
2,463.1	959	961	962	964	966	968	970	971	973	975
2,463.2	977	979	980	982	984	986	988	989	991	993
2,463.3	995	996	998	1,000	1,002	1,004	1,005	1,007	1,009	1,011
2,463.4	1,013	1,014	1,016	1,018	1,020	1,022	1,023	1,025	1,027	1,029

December 17, 1964

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Table 8

BULLY CREEK RES, Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,463.5	1,031	1,032	1,034	1,036	1,038	1,039	1,041	1,043	1,045	1,047
2,463.6	1,048	1,050	1,052	1,054	1,056	1,057	1,059	1,061	1,063	1,065
2,463.7	1,066	1,068	1,070	1,072	1,074	1,075	1,077	1,079	1,081	1,082
2,463.8	1,084	1,086	1,088	1,090	1,091	1,093	1,095	1,097	1,099	1,100
2,463.9	1,102	1,104	1,106	1,108	1,109	1,111	1,113	1,115	1,117	1,118
2,464.0	1,120	1,122	1,124	1,126	1,128	1,130	1,132	1,133	1,135	1,137
2,464.1	1,139	1,141	1,143	1,145	1,147	1,149	1,151	1,152	1,154	1,156
2,464.2	1,158	1,160	1,162	1,164	1,166	1,168	1,170	1,171	1,173	1,175
2,464.3	1,177	1,179	1,181	1,183	1,185	1,187	1,189	1,190	1,192	1,194
2,464.4	1,196	1,198	1,200	1,202	1,204	1,206	1,208	1,210	1,211	1,213
2,464.5	1,215	1,217	1,219	1,221	1,223	1,225	1,227	1,229	1,230	1,232
2,464.6	1,234	1,236	1,238	1,240	1,242	1,244	1,246	1,248	1,249	1,251
2,464.7	1,253	1,255	1,257	1,259	1,261	1,263	1,265	1,267	1,268	1,270
2,464.8	1,272	1,274	1,276	1,278	1,280	1,282	1,284	1,286	1,287	1,289
2,464.9	1,291	1,293	1,295	1,297	1,299	1,301	1,303	1,305	1,307	1,308
2,465.0	1,310	1,312	1,314	1,316	1,318	1,320	1,322	1,324	1,326	1,328
2,465.1	1,330	1,332	1,334	1,336	1,338	1,340	1,342	1,344	1,346	1,348
2,465.2	1,350	1,352	1,354	1,356	1,358	1,360	1,362	1,364	1,366	1,368
2,465.3	1,370	1,372	1,374	1,376	1,378	1,380	1,382	1,384	1,386	1,388
2,465.4	1,390	1,392	1,394	1,396	1,398	1,400	1,402	1,404	1,406	1,408
2,465.5	1,410	1,412	1,414	1,416	1,418	1,420	1,422	1,424	1,426	1,428
2,465.6	1,430	1,432	1,434	1,436	1,438	1,440	1,442	1,444	1,446	1,448
2,465.7	1,450	1,452	1,454	1,456	1,458	1,460	1,462	1,464	1,466	1,468
2,465.8	1,470	1,472	1,474	1,476	1,478	1,480	1,482	1,484	1,486	1,488
2,465.9	1,490	1,492	1,494	1,496	1,498	1,500	1,502	1,504	1,506	1,508
2,466.0	1,510	1,513	1,515	1,517	1,519	1,521	1,523	1,525	1,527	1,529
2,466.1	1,531	1,533	1,536	1,538	1,540	1,542	1,544	1,546	1,548	1,550
2,466.2	1,552	1,554	1,556	1,559	1,561	1,563	1,565	1,567	1,569	1,571
2,466.3	1,573	1,575	1,577	1,579	1,582	1,584	1,586	1,588	1,590	1,592
2,466.4	1,594	1,596	1,598	1,600	1,602	1,604	1,607	1,609	1,611	1,613
2,466.5	1,615	1,617	1,619	1,621	1,623	1,625	1,627	1,630	1,632	1,634
2,466.6	1,636	1,638	1,640	1,642	1,644	1,646	1,648	1,650	1,653	1,655
2,466.7	1,657	1,659	1,661	1,663	1,665	1,667	1,669	1,671	1,673	1,676
2,466.8	1,678	1,680	1,682	1,684	1,686	1,688	1,690	1,692	1,694	1,696
2,466.9	1,699	1,701	1,703	1,705	1,707	1,709	1,711	1,713	1,715	1,717

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December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,467.0	1,719	1,722	1,724	1,726	1,728	1,730	1,732	1,735	1,737	1,739
2,467.1	1,741	1,743	1,746	1,748	1,750	1,752	1,754	1,756	1,759	1,761
2,467.2	1,763	1,765	1,767	1,770	1,772	1,774	1,776	1,778	1,780	1,783
2,467.3	1,785	1,787	1,789	1,791	1,793	1,796	1,798	1,800	1,802	1,804
2,467.4	1,807	1,809	1,811	1,813	1,815	1,817	1,820	1,822	1,824	1,826
2,467.5	1,828	1,831	1,833	1,835	1,837	1,839	1,841	1,844	1,846	1,848
2,467.6	1,850	1,852	1,854	1,857	1,859	1,861	1,863	1,865	1,868	1,870
2,467.7	1,872	1,874	1,876	1,878	1,881	1,883	1,885	1,887	1,889	1,892
2,467.8	1,894	1,896	1,898	1,900	1,902	1,905	1,907	1,909	1,911	1,913
2,467.9	1,915	1,918	1,920	1,922	1,924	1,926	1,929	1,931	1,933	1,935
2,468.0	1,937	1,940	1,942	1,944	1,946	1,949	1,951	1,953	1,955	1,958
2,468.1	1,960	1,962	1,965	1,967	1,969	1,971	1,974	1,976	1,978	1,980
2,468.2	1,983	1,985	1,987	1,989	1,992	1,994	1,996	1,999	2,001	2,003
2,468.3	2,005	2,008	2,010	2,012	2,014	2,017	2,019	2,021	2,024	2,026
2,468.4	2,028	2,030	2,033	2,035	2,037	2,039	2,042	2,044	2,046	2,049
2,468.5	2,051	2,053	2,055	2,058	2,060	2,062	2,064	2,067	2,069	2,071
2,468.6	2,073	2,076	2,078	2,080	2,083	2,085	2,087	2,089	2,092	2,094
2,468.7	2,096	2,098	2,101	2,103	2,105	2,108	2,110	2,112	2,114	2,117
2,468.8	2,119	2,121	2,123	2,126	2,128	2,130	2,133	2,135	2,137	2,139
2,468.9	2,142	2,144	2,146	2,148	2,151	2,153	2,155	2,157	2,160	2,162
2,469.0	2,164	2,167	2,169	2,171	2,174	2,176	2,178	2,181	2,183	2,186
2,469.1	2,188	2,190	2,193	2,195	2,197	2,200	2,202	2,204	2,207	2,209
2,469.2	2,212	2,214	2,216	2,219	2,221	2,223	2,226	2,228	2,230	2,233
2,469.3	2,235	2,238	2,240	2,242	2,245	2,247	2,249	2,252	2,254	2,256
2,469.4	2,259	2,261	2,264	2,266	2,268	2,271	2,273	2,275	2,278	2,280
2,469.5	2,282	2,285	2,287	2,290	2,292	2,294	2,297	2,299	2,301	2,304
2,469.6	2,306	2,308	2,311	2,313	2,316	2,318	2,320	2,323	2,325	2,327
2,469.7	2,330	2,332	2,334	2,337	2,339	2,342	2,344	2,346	2,349	2,351
2,469.8	2,353	2,356	2,358	2,360	2,363	2,365	2,368	2,370	2,372	2,375
2,469.9	2,377	2,379	2,382	2,384	2,386	2,389	2,391	2,394	2,396	2,398
2,470.0	2,401	2,403	2,406	2,408	2,411	2,413	2,415	2,418	2,420	2,423
2,470.1	2,425	2,428	2,430	2,433	2,435	2,438	2,440	2,443	2,445	2,448
2,470.2	2,450	2,453	2,455	2,458	2,460	2,462	2,465	2,467	2,470	2,472
2,470.3	2,475	2,477	2,480	2,482	2,485	2,487	2,490	2,492	2,495	2,497
2,470.4	2,500	2,502	2,504	2,507	2,509	2,512	2,514	2,517	2,519	2,522

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Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,470.5	2,524	2,527	2,529	2,532	2,534	2,537	2,539	2,542	2,544	2,547
2,470.6	2,549	2,551	2,554	2,556	2,559	2,561	2,564	2,566	2,569	2,571
2,470.7	2,574	2,576	2,579	2,581	2,584	2,586	2,589	2,591	2,594	2,596
2,470.8	2,598	2,601	2,603	2,606	2,608	2,611	2,613	2,616	2,618	2,621
2,470.9	2,623	2,626	2,628	2,631	2,633	2,636	2,638	2,640	2,643	2,645
2,471.0	2,648	2,651	2,653	2,656	2,658	2,661	2,664	2,666	2,669	2,671
2,471.1	2,674	2,677	2,679	2,682	2,684	2,687	2,689	2,692	2,695	2,697
2,471.2	2,700	2,702	2,705	2,708	2,710	2,713	2,715	2,718	2,721	2,723
2,471.3	2,726	2,728	2,731	2,734	2,736	2,739	2,741	2,744	2,747	2,749
2,471.4	2,752	2,754	2,757	2,760	2,762	2,765	2,767	2,770	2,773	2,775
2,471.5	2,778	2,780	2,783	2,786	2,788	2,791	2,793	2,796	2,799	2,801
2,471.6	2,804	2,806	2,809	2,812	2,814	2,817	2,819	2,822	2,825	2,827
2,471.7	2,830	2,832	2,835	2,838	2,840	2,843	2,845	2,848	2,851	2,853
2,471.8	2,856	2,858	2,861	2,864	2,866	2,869	2,871	2,874	2,877	2,879
2,471.9	2,882	2,884	2,887	2,890	2,892	2,895	2,897	2,900	2,903	2,905
2,472.0	2,908	2,911	2,913	2,916	2,919	2,921	2,924	2,927	2,930	2,932
2,472.1	2,935	2,938	2,941	2,943	2,946	2,949	2,951	2,954	2,957	2,960
2,472.2	2,962	2,965	2,968	2,971	2,973	2,976	2,979	2,981	2,984	2,987
2,472.3	2,990	2,992	2,995	2,998	3,001	3,003	3,006	3,009	3,012	3,014
2,472.4	3,017	3,020	3,022	3,025	3,028	3,031	3,033	3,036	3,039	3,042
2,472.5	3,044	3,047	3,050	3,052	3,055	3,058	3,061	3,063	3,066	3,069
2,472.6	3,072	3,074	3,077	3,080	3,082	3,085	3,088	3,091	3,093	3,096
2,472.7	3,099	3,102	3,104	3,107	3,110	3,112	3,115	3,118	3,121	3,123
2,472.8	3,126	3,129	3,132	3,134	3,137	3,140	3,142	3,145	3,148	3,151
2,472.9	3,153	3,156	3,159	3,162	3,164	3,167	3,170	3,173	3,175	3,178
2,473.0	3,181	3,184	3,186	3,189	3,192	3,195	3,198	3,201	3,204	3,206
2,473.1	3,209	3,212	3,215	3,218	3,221	3,224	3,227	3,229	3,232	3,235
2,473.2	3,238	3,241	3,244	3,247	3,249	3,252	3,255	3,258	3,261	3,264
2,473.3	3,267	3,269	3,272	3,275	3,278	3,281	3,284	3,287	3,289	3,292
2,473.4	3,295	3,298	3,301	3,304	3,307	3,310	3,312	3,315	3,318	3,321
2,473.5	3,324	3,327	3,330	3,332	3,335	3,338	3,341	3,344	3,347	3,350
2,473.6	3,352	3,355	3,358	3,361	3,364	3,367	3,370	3,373	3,375	3,378
2,473.7	3,381	3,384	3,387	3,390	3,393	3,395	3,398	3,401	3,404	3,407
2,473.8	3,410	3,413	3,415	3,418	3,421	3,424	3,427	3,430	3,433	3,436
2,473.9	3,438	3,441	3,444	3,447	3,450	3,453	3,456	3,458	3,461	3,464

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Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,474.0	3,467	3,470	3,473	3,476	3,479	3,482	3,485	3,488	3,491	3,494
2,474.1	3,497	3,500	3,503	3,506	3,509	3,512	3,515	3,518	3,521	3,524
2,474.2	3,527	3,530	3,533	3,536	3,539	3,542	3,545	3,548	3,551	3,554
2,474.3	3,557	3,560	3,563	3,566	3,569	3,572	3,575	3,578	3,581	3,584
2,474.4	3,587	3,590	3,593	3,596	3,599	3,602	3,605	3,608	3,611	3,614
2,474.5	3,617	3,620	3,623	3,626	3,629	3,632	3,635	3,638	3,641	3,644
2,474.6	3,647	3,650	3,653	3,656	3,659	3,662	3,665	3,668	3,671	3,674
2,474.7	3,677	3,680	3,683	3,686	3,689	3,692	3,695	3,698	3,701	3,704
2,474.8	3,707	3,710	3,713	3,716	3,719	3,722	3,725	3,728	3,731	3,734
2,474.9	3,737	3,740	3,743	3,746	3,749	3,752	3,755	3,758	3,761	3,764
2,475.0	3,767	3,770	3,773	3,776	3,780	3,763	3,786	3,789	3,792	3,795
2,475.1	3,798	3,801	3,805	3,808	3,811	3,814	3,617	3,820	3,823	3,826
2,475.2	3,829	3,833	3,836	3,839	3,842	3,845	3,848	3,851	3,854	3,858
2,475.3	3,861	3,864	3,867	3,870	3,873	3,876	3,879	3,882	3,886	3,889
2,475.4	3,892	3,895	3,898	3,901	3,904	3,907	3,911	3,914	3,917	3,920
2,475.5	3,923	3,926	3,929	3,932	3,936	3,939	3,942	3,945	3,948	3,951
2,475.6	3,954	3,957	3,960	3,964	3,967	3,970	3,973	3,976	3,979	3,982
2,475.7	3,985	3,989	3,992	3,995	3,998	4,001	4,004	4,007	4,010	4,013
2,475.8	4,017	4,020	4,023	4,026	4,029	4,032	4,035	4,038	4,042	4,045
2,475.9	4,048	4,051	4,054	4,057	4,060	4,063	4,067	4,070	4,073	4,076
2,476.0	4,079	4,082	4,085	4,089	4,092	4,095	4,098	4,102	4,105	4,108
2,476.1	4,111	4,114	4,118	4,121	4,124	4,127	4,130	4,134	4,137	4,140
2,476.2	4,143	4,147	4,150	4,153	4,156	4,159	4,163	4,166	4,169	4,172
2,476.3	4,176	4,179	4,182	4,185	4,188	4,192	4,195	4,198	4,201	4,204
2,476.4	4,208	4,211	4,214	4,217	4,221	4,224	4,227	4,230	4,233	4,237
2,476.5	4,240	4,243	4,246	4,250	4,253	4,256	4,259	4,262	4,266	4,269
2,476.6	4,272	4,275	4,278	4,282	4,285	4,288	4,291	4,295	4,298	4,301
2,476.7	4,304	4,307	4,311	4,314	4,317	4,320	4,324	4,327	4,330	4,333
2,476.8	4,336	4,340	4,343	4,346	4,349	4,352	4,356	4,359	4,362	4,365
2,476.9	4,369	4,372	4,375	4,378	4,381	4,385	4,388	4,391	4,394	4,398
2,477.0	4,401	4,404	4,407	4,411	4,414	4,417	4,421	4,424	4,427	4,431
2,477.1	4,434	4,437	4,441	4,444	4,447	4,450	4,454	4,457	4,460	4,464
2,477.2	4,467	4,470	4,474	4,477	4,480	4,484	4,487	4,490	4,494	4,497
2,477.3	4,500	4,504	4,507	4,510	4,513	4,517	4,520	4,523	4,527	4,530
2,477.4	4,533	4,537	4,540	4,543	4,547	4,550	4,553	4,557	4,560	4,563

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Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,477.5	4,567	4,570	4,573	4,577	4,580	4,583	4,586	4,590	4,593	4,596
2,477.6	4,600	4,603	4,606	4,610	4,613	4,616	4,620	4,623	4,626	4,630
2,477.7	4,633	4,636	4,640	4,643	4,646	4,649	4,653	4,656	4,659	4,663
2,477.8	4,666	4,669	4,673	4,676	4,679	4,683	4,686	4,689	4,693	4,696
2,477.9	4,699	4,703	4,706	4,709	4,712	4,716	4,719	4,722	4,726	4,729
2,478.0	4,732	4,736	4,739	4,743	4,746	4,749	4,753	4,756	4,760	4,763
2,478.1	4,767	4,770	4,773	4,777	4,780	4,784	4,787	4,790	4,794	4,797
2,478.2	4,801	4,804	4,808	4,811	4,814	4,818	4,821	4,825	4,828	4,831
2,478.3	4,835	4,838	4,842	4,845	4,849	4,852	4,855	4,859	4,862	4,866
2,478.4	4,869	4,872	4,876	4,879	4,883	4,886	4,890	4,893	4,896	4,900
2,478.5	4,903	4,907	4,910	4,913	4,917	4,920	4,924	4,927	4,931	4,934
2,478.6	4,937	4,941	4,944	4,948	4,951	4,954	4,958	4,961	4,965	4,968
2,478.7	4,972	4,975	4,978	4,982	4,985	4,989	4,992	4,995	4,999	5,002
2,478.8	5,006	5,009	5,013	5,016	5,019	5,023	5,026	5,030	5,033	5,036
2,478.9	5,040	5,043	5,047	5,050	5,054	5,057	5,060	5,064	5,067	5,071
2,479.0	5,074	5,078	5,081	5,085	5,088	5,092	5,095	5,099	5,102	5,106
2,479.1	5,109	5,113	5,116	5,120	5,123	5,127	5,130	5,134	5,137	5,141
2,479.2	5,144	5,148	5,151	5,155	5,159	5,162	5,166	5,169	5,173	5,176
2,479.3	5,180	5,183	5,187	5,190	5,194	5,197	5,201	5,204	5,208	5,211
2,479.4	5,215	5,218	5,222	5,225	5,229	5,232	5,236	5,239	5,243	5,247
2,479.5	5,250	5,254	5,257	5,261	5,264	5,268	5,271	5,275	5,278	5,282
2,479.6	5,285	5,289	5,292	5,296	5,299	5,303	5,306	5,310	5,313	5,317
2,479.7	5,320	5,324	5,327	5,331	5,334	5,338	5,342	5,345	5,349	5,352
2,479.8	5,356	5,359	5,363	5,366	5,370	5,373	5,377	5,380	5,384	5,387
2,479.9	5,391	5,394	5,398	5,401	5,405	5,408	5,412	5,415	5,419	5,422
2,480.0	5,426	5,430	5,433	5,437	5,441	5,444	5,448	5,452	5,455	5,459
2,480.1	5,463	5,466	5,470	5,473	5,477	5,481	5,484	5,488	5,492	5,495
2,480.2	5,499	5,503	5,506	5,510	5,514	5,517	5,521	5,525	5,528	5,532
2,480.3	5,536	5,539	5,543	5,547	5,550	5,554	5,558	5,561	5,565	5,569
2,480.4	5,572	5,576	5,579	5,583	5,587	5,590	5,594	5,598	5,601	5,605
2,480.5	5,609	5,612	5,616	5,620	5,623	5,627	5,631	5,634	5,638	5,642
2,480.6	5,645	5,649	5,653	5,656	5,660	5,664	5,667	5,671	5,675	5,678
2,480.7	5,682	5,686	5,689	5,693	5,696	5,700	5,704	5,707	5,711	5,715
2,480.8	5,718	5,722	5,726	5,729	5,733	5,737	5,740	5,744	5,748	5,751
2,480.9	5,755	5,759	5,762	5,766	5,770	5,773	5,777	5,781	5,784	5,788

Sheet 7 of 20
Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,481.0	5,792	5,795	5,799	5,803	5,807	5,811	5,815	5,818	5,822	5,826
2,481.1	5,830	5,834	5,837	5,841	5,845	5,849	5,853	5,857	5,860	5,864
2,481.2	5,868	5,872	5,876	5,880	5,883	5,887	5,891	5,895	5,899	5,903
2,481.3	5,906	5,910	5,914	5,918	5,922	5,926	5,929	5,933	5,937	5,941
2,481.4	5,945	5,949	5,952	5,956	5,960	5,964	5,968	5,972	5,975	5,979
2,481.5	5,983	5,987	5,991	5,995	5,998	6,002	6,006	6,010	6,014	6,017
2,481.6	6,021	6,025	6,029	6,033	6,037	6,040	6,044	6,048	6,052	6,056
2,481.7	6,060	6,063	6,067	6,071	6,075	6,079	6,083	6,086	6,090	6,094
2,481.8	6,098	6,102	6,106	6,109	6,113	6,117	6,121	6,125	6,129	6,132
2,481.9	6,136	6,140	6,144	6,148	6,152	6,155	6,159	6,163	6,167	6,171
2,482.0	6,175	6,179	6,183	6,187	6,191	6,195	6,199	6,203	6,207	6,211
2,482.1	6,215	6,219	6,223	6,227	6,231	6,235	6,239	6,243	6,247	6,251
2,482.2	6,255	6,259	6,263	6,267	6,271	6,275	6,279	6,283	6,287	6,291
2,482.3	6,295	6,299	6,303	6,307	6,311	6,315	6,319	6,323	6,327	6,331
2,482.4	6,335	6,339	6,343	6,347	6,351	6,355	6,359	6,363	6,367	6,371
2,482.5	6,375	6,379	6,383	6,387	6,391	6,395	6,399	6,403	6,407	6,411
2,482.6	6,415	6,419	6,423	6,427	6,431	6,435	6,439	6,443	6,447	6,451
2,482.7	6,455	6,459	6,463	6,467	6,471	6,475	6,479	6,483	6,487	6,491
2,482.8	6,495	6,499	6,503	6,507	6,511	6,515	6,519	6,523	6,527	6,531
2,482.9	6,535	6,539	6,543	6,547	6,551	6,555	6,559	6,563	6,567	6,571
2,483.0	6,575	6,580	6,584	6,588	6,592	6,596	6,601	6,605	6,609	6,613
2,483.1	6,617	6,622	6,626	6,630	6,634	6,638	6,643	6,647	6,651	6,655
2,483.2	6,659	6,664	6,668	6,672	6,676	6,680	6,685	6,689	6,693	6,697
2,483.3	6,701	6,706	6,710	6,714	6,718	6,722	6,727	6,731	6,735	6,739
2,483.4	6,743	6,747	6,752	6,756	6,760	6,764	6,768	6,773	6,777	6,781
2,483.5	6,785	6,789	6,794	6,798	6,802	6,806	6,810	6,815	6,819	6,823
2,483.6	6,827	6,831	6,836	6,840	6,844	6,848	6,852	6,857	6,861	6,865
2,483.7	6,869	6,873	6,878	6,882	6,886	6,890	6,894	6,898	6,903	6,907
2,483.8	6,911	6,915	6,919	6,924	6,928	6,932	6,936	6,940	6,945	6,949
2,483.9	6,953	6,957	6,961	6,966	6,970	6,974	6,978	6,982	6,987	6,991
2,484.0	6,995	6,999	7,004	7,008	7,012	7,017	7,021	7,026	7,030	7,034
2,484.1	7,039	7,043	7,048	7,052	7,056	7,061	7,065	7,070	7,074	7,078
2,484.2	7,083	7,087	7,091	7,096	7,100	7,105	7,109	7,113	7,118	7,122
2,484.3	7,127	7,131	7,135	7,140	7,144	7,148	7,153	7,157	7,162	7,166
2,484.4	7,170	7,175	7,179	7,184	7,188	7,192	7,197	7,201	7,205	7,210

December 17, 1964

Table 8 Sheet 8 of 26

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,484.5	7,214	7,219	7,223	7,227	7,232	7,236	7,241	7,245	7,249	7,254
2,484.6	7,258	7,262	7,267	7,271	7,276	7,280	7,284	7,289	7,293	7,298
2,484.7	7,302	7,306	7,311	7,315	7,319	7,324	7,328	7,333	7,337	7,341
2,484.8	7,346	7,350	7,355	7,359	7,363	7,368	7,372	7,376	7,381	7,385
2,484.9	7,390	7,394	7,398	7,403	7,407	7,412	7,416	7,420	7,425	7,429
2,485.0	7,433	7,438	7,443	7,447	7,452	7,456	7,461	7,466	7,470	7,475
2,485.1	7,479	7,484	7,488	7,493	7,498	7,502	7,507	7,511	7,516	7,521
2,485.2	7,525	7,530	7,534	7,539	7,543	7,548	7,553	7,557	7,562	7,566
2,485.3	7,571	7,575	7,580	7,585	7,589	7,594	7,598	7,603	7,608	7,612
2,485.4	7,617	7,621	7,626	7,630	7,635	7,640	7,644	7,649	7,653	7,658
2,485.5	7,663	7,667	7,672	7,676	7,681	7,685	7,690	7,695	7,699	7,704
2,485.6	7,708	7,713	7,717	7,722	7,727	7,731	7,736	7,740	7,745	7,750
2,485.7	7,754	7,759	7,763	7,768	7,772	7,777	7,782	7,786	7,791	7,795
2,485.8	7,800	7,805	7,809	7,814	7,818	7,823	7,827	7,832	7,837	7,841
2,485.9	7,846	7,850	7,855	7,860	7,864	7,869	7,873	7,878	7,882	7,887
2,486.0	7,892	7,896	7,901	7,906	7,911	7,916	7,920	7,925	7,930	7,935
2,486.1	7,939	7,944	7,949	7,954	7,959	7,963	7,968	7,973	7,978	7,982
2,486.2	7,987	7,992	7,997	8,002	8,006	8,011	8,016	8,021	8,026	8,030
2,486.3	8,035	8,040	8,045	8,049	8,054	8,059	8,064	8,069	8,073	8,078
2,486.4	8,083	8,088	8,092	8,097	8,102	8,107	8,112	8,116	8,121	8,126
2,486.5	8,131	8,136	8,140	8,145	8,150	8,155	8,159	8,164	8,169	8,174
2,486.6	8,179	8,183	8,188	8,193	8,198	8,203	8,207	8,212	8,217	8,222
2,486.7	8,226	8,231	8,236	8,241	8,246	8,250	8,255	8,260	8,265	8,269
2,486.8	8,274	8,279	8,284	8,289	8,293	8,298	8,303	8,308	8,313	8,317
2,486.9	8,322	8,327	8,332	8,336	8,341	8,346	8,351	8,356	8,360	8,365
2,487.0	8,370	8,375	8,380	8,385	8,390	8,395	8,400	8,405	8,410	8,415
2,487.1	8,420	8,425	8,430	8,435	8,440	8,445	8,450	8,455	8,460	8,465
2,487.2	8,470	8,475	8,480	8,485	8,490	8,495	8,500	8,505	8,510	8,515
2,487.3	8,520	8,525	8,530	8,535	8,540	8,545	8,550	8,555	8,560	8,565
2,487.4	8,570	8,575	8,580	8,585	8,590	8,595	8,600	8,605	8,610	8,615
2,487.5	8,619	8,624	8,629	8,634	8,639	8,644	8,649	8,654	8,659	8,664
2,487.6	8,669	8,674	8,679	8,684	8,689	8,694	8,699	8,704	8,709	8,714
2,487.7	8,719	8,724	8,729	8,734	8,739	8,744	8,749	8,754	8,759	8,764
2,487.8	8,769	8,774	8,779	8,784	8,789	8,794	8,799	8,804	8,809	8,814
2,487.9	8,819	8,824	8,829	8,834	8,839	8,844	8,849	8,854	8,859	8,864

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Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,488.0	8,869	8,874	8,879	8,885	8,890	8,895	8,900	8,906	8,911	8,916
2,488.1	8,921	8,926	8,932	8,937	8,942	8,947	8,952	8,958	8,963	8,968
2,488.2	8,973	8,978	8,984	8,989	8,994	8,999	9,004	9,010	9,015	9,020
2,488.3	9,025	9,030	9,036	9,041	9,046	9,051	9,056	9,062	9,067	9,072
2,488.4	9,077	9,082	9,088	9,093	9,098	9,103	9,108	9,114	9,119	9,124
2,488.5	9,129	9,135	9,140	9,145	9,150	9,155	9,161	9,166	9,171	9,176
2,488.6	9,181	9,187	9,192	9,197	9,202	9,207	9,213	9,218	9,223	9,228
2,488.7	9,233	9,239	9,244	9,249	9,254	9,259	9,265	9,270	9,275	9,280
2,488.8	9,285	9,291	9,296	9,301	9,306	9,311	9,317	9,322	9,327	9,332
2,488.9	9,338	9,343	9,348	9,353	9,358	9,364	9,369	9,374	9,379	9,384
2,489.0	9,390	9,395	9,400	9,406	9,411	9,417	9,422	9,428	9,433	9,438
2,489.1	9,444	9,449	9,455	9,460	9,466	9,471	9,476	9,482	9,487	9,493
2,489.2	9,498	9,503	9,509	9,514	9,520	9,525	9,531	9,536	9,541	9,547
2,489.3	9,552	9,558	9,563	9,569	9,574	9,579	9,585	9,590	9,596	9,601
2,489.4	9,607	9,612	9,617	9,623	9,628	9,634	9,639	9,645	9,650	9,655
2,489.5	9,661	9,666	9,672	9,677	9,682	9,688	9,693	9,699	9,704	9,710
2,489.6	9,715	9,720	9,726	9,731	9,737	9,742	9,748	9,753	9,758	9,764
2,489.7	9,769	9,775	9,780	9,786	9,791	9,796	9,802	9,807	9,813	9,818
2,489.8	9,823	9,829	9,834	9,840	9,845	9,851	9,856	9,861	9,867	9,872
2,489.9	9,878	9,883	9,889	9,894	9,899	9,905	9,910	9,916	9,921	9,927
2,490.0	9,932	9,938	9,943	9,949	9,954	9,960	9,966	9,971	9,977	9,983
2,490.1	9,988	9,994	9,999	10,005	10,011	10,016	10,022	10,027	10,033	10,039
2,490.2	10,044	10,050	10,056	10,061	10,067	10,072	10,078	10,084	10,089	10,095
2,490.3	10,100	10,106	10,112	10,117	10,123	10,129	10,134	10,140	10,145	10,151
2,490.4	10,157	10,162	10,168	10,173	10,179	10,185	10,190	10,196	10,202	10,207
2,490.5	10,213	10,218	10,224	10,230	10,235	10,241	10,246	10,252	10,258	10,263
2,490.6	10,269	10,274	10,280	10,286	10,291	10,297	10,303	10,308	10,314	10,319
2,490.7	10,325	10,331	10,336	10,342	10,347	10,353	10,359	10,364	10,370	10,376
2,490.8	10,381	10,387	10,392	10,398	10,404	10,409	10,415	10,420	10,426	10,432
2,490.9	10,437	10,443	10,449	10,454	10,460	10,465	10,471	10,477	10,482	10,488
2,491.0	10,493	10,499	10,505	10,511	10,517	10,522	10,528	10,534	10,540	10,545
2,491.1	10,551	10,557	10,563	10,569	10,574	10,580	10,586	10,592	10,597	10,603
2,491.2	10,609	10,615	10,620	10,626	10,632	10,638	10,644	10,649	10,655	10,661
2,491.3	10,667	10,672	10,678	10,684	10,690	10,695	10,701	10,707	10,713	10,719
2,491.4	10,724	10,730	10,736	10,742	10,747	10,753	10,759	10,765	10,771	10,776

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Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,491.5	10,782	10,788	10,794	10,799	10,805	10,811	10,817	10,822	10,828	10,834
2,491.6	10,840	10,846	10,851	10,857	10,863	10,869	10,874	10,880	10,886	10,892
2,491.7	10,898	10,903	10,909	10,915	10,921	10,926	10,932	10,938	10,944	10,949
2,491.8	10,955	10,961	10,967	10,973	10,978	10,984	10,990	10,996	11,001	11,007
2,491.9	11,013	11,019	11,024	11,030	11,036	11,042	11,048	11,053	11,059	11,065
2,492.0	11,071	11,077	11,083	11,089	11,094	11,100	11,106	11,112	11,118	11,124
2,492.1	11,130	11,136	11,142	11,148	11,154	11,160	11,166	11,172	11,178	11,183
2,492.2	11,189	11,195	11,201	11,207	11,213	11,219	11,225	11,231	11,237	11,243
2,492.3	11,249	11,255	11,261	11,267	11,272	11,278	11,284	11,290	11,296	11,302
2,492.4	11,308	11,314	11,320	11,326	11,332	11,338	11,344	11,350	11,356	11,361
2,492.5	11,367	11,373	11,379	11,385	11,391	11,397	11,403	11,409	11,415	11,421
2,492.6	11,427	11,433	11,439	11,445	11,450	11,456	11,462	11,468	11,474	11,480
2,492.7	11,486	11,492	11,498	11,504	11,510	11,516	11,522	11,528	11,534	11,539
2,492.8	11,545	11,551	11,557	11,563	11,569	11,575	11,581	11,587	11,593	11,599
2,492.9	11,605	11,611	11,617	11,623	11,628	11,634	11,640	11,646	11,652	11,658
2,493.0	11,664	11,670	11,676	11,682	11,689	11,695	11,701	11,707	11,713	11,719
2,493.1	11,725	11,731	11,737	11,743	11,749	11,756	11,762	11,768	11,774	11,780
2,493.2	11,786	11,792	11,798	11,804	11,810	11,817	11,823	11,829	11,835	11,841
2,493.3	11,847	11,853	11,859	11,865	11,871	11,877	11,884	11,890	11,896	11,902
2,493.4	11,908	11,914	11,920	11,926	11,932	11,938	11,945	11,951	11,957	11,963
2,493.5	11,969	11,975	11,981	11,987	11,993	11,999	12,005	12,012	12,018	12,024
2,493.6	12,030	12,036	12,042	12,048	12,054	12,060	12,066	12,073	12,079	12,085
2,493.7	12,091	12,097	12,103	12,109	12,115	12,121	12,127	12,134	12,140	12,146
2,493.8	12,152	12,158	12,164	12,170	12,176	12,182	12,188	12,194	12,201	12,207
2,493.9	12,213	12,219	12,225	12,231	12,237	12,243	12,249	12,255	12,262	12,268
2,494.0	12,274	12,280	12,286	12,293	12,299	12,305	12,311	12,318	12,324	12,330
2,494.1	12,336	12,343	12,349	12,355	12,361	12,368	12,374	12,380	12,386	12,393
2,494.2	12,399	12,405	12,411	12,418	12,424	12,430	12,437	12,443	12,449	12,455
2,494.3	12,462	12,468	12,474	12,480	12,487	12,493	12,499	12,505	12,512	12,518
2,494.4	12,524	12,530	12,537	12,543	12,549	12,555	12,562	12,568	12,574	12,581
2,494.5	12,587	12,593	12,599	12,606	12,612	12,618	12,624	12,631	12,637	12,643
2,494.6	12,649	12,656	12,662	12,668	12,674	12,681	12,687	12,693	12,699	12,706
2,494.7	12,712	12,718	12,725	12,731	12,737	12,743	12,750	12,756	12,762	12,768
2,494.8	12,775	12,781	12,787	12,793	12,800	12,806	12,812	12,818	12,825	12,831
2,494.9	12,837	12,843	12,850	12,856	12,862	12,869	12,875	12,881	12,887	12,894

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,495.0	12,900	12,906	12,913	12,919	12,926	12,932	12,938	12,945	12,951	12,958
2,495.1	12,964	12,971	12,977	12,983	12,990	12,996	13,003	13,009	13,016	13,022
2,495.2	13,028	13,035	13,041	13,048	13,054	13,061	13,067	13,073	13,080	13,086
2,495.3	13,093	13,099	13,106	13,112	13,118	13,125	13,131	13,138	13,144	13,151
2,495.4	13,157	13,164	13,170	13,176	13,183	13,189	13,196	13,202	13,209	13,215
2,495.5	13,221	13,228	13,234	13,241	13,247	13,254	13,260	13,266	13,273	13,279
2,495.6	13,286	13,292	13,299	13,305	13,311	13,318	13,324	13,331	13,337	13,344
2,495.7	13,350	13,356	13,363	13,369	13,376	13,382	13,389	13,395	13,401	13,408
2,495.8	13,414	13,421	13,427	13,434	13,440	13,446	13,453	13,459	13,466	13,472
2,495.9	13,479	13,485	13,491	13,498	13,504	13,511	13,517	13,524	13,530	13,536
2,496.0	13,543	13,550	13,556	13,563	13,569	13,576	13,583	13,589	13,596	13,602
2,496.1	13,609	13,616	13,622	13,629	13,635	13,642	13,649	13,655	13,662	13,668
2,496.2	13,675	13,682	13,688	13,695	13,701	13,708	13,715	13,721	13,728	13,734
2,496.3	13,741	13,748	13,754	13,761	13,767	13,774	13,781	13,787	13,794	13,800
2,496.4	13,807	13,814	13,820	13,827	13,833	13,840	13,847	13,853	13,860	13,866
2,496.5	13,873	13,880	13,886	13,893	13,899	13,906	13,913	13,919	13,926	13,932
2,496.6	13,939	13,946	13,952	13,959	13,966	13,972	13,979	13,985	13,992	13,999
2,496.7	14,005	14,012	14,018	14,025	14,032	14,038	14,045	14,051	14,058	14,065
2,496.8	14,071	14,078	14,084	14,091	14,098	14,104	14,111	14,117	14,124	14,131
2,496.9	14,137	14,144	14,150	14,157	14,164	14,170	14,177	14,183	14,190	14,197
2,497.0	14,203	14,210	14,217	14,224	14,230	14,237	14,244	14,251	14,258	14,264
2,497.1	14,271	14,278	14,285	14,291	14,298	14,305	14,312	14,319	14,325	14,332
2,497.2	14,339	14,346	14,352	14,359	14,366	14,373	14,380	14,386	14,393	14,400
2,497.3	14,407	14,413	14,420	14,427	14,434	14,441	14,447	14,454	14,461	14,468
2,497.4	14,474	14,481	14,488	14,495	14,502	14,508	14,515	14,522	14,529	14,535
2,497.5	14,542	14,549	14,556	14,563	14,569	14,576	14,583	14,590	14,596	14,603
2,497.6	14,610	14,617	14,624	14,630	14,637	14,644	14,651	14,657	14,664	14,671
2,497.7	14,678	14,685	14,691	14,698	14,705	14,712	14,718	14,725	14,732	14,739
2,497.8	14,746	14,752	14,759	14,766	14,773	14,780	14,786	14,793	14,800	14,807
2,497.9	14,813	14,820	14,827	14,834	14,841	14,847	14,854	14,861	14,868	14,874
2,498.0	14,881	14,888	14,895	14,902	14,909	14,916	14,923	14,930	14,937	14,944
2,498.1	14,951	14,958	14,965	14,972	14,979	14,986	14,993	14,999	15,006	15,013
2,498.2	15,020	15,027	15,034	15,041	15,048	15,055	15,062	15,069	15,076	15,083
2,498.3	15,090	15,097	15,104	15,111	15,118	15,125	15,132	15,139	15,146	15,153
2,498.4	15,160	15,166	15,173	15,180	15,187	15,194	15,201	15,208	15,215	15,222

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Table 8

December 17, 1964

BULLY CREEK RES, Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,498.5	15,229	15,236	15,243	15,250	15,257	15,264	15,271	15,278	15,285	15,292
2,498.6	15,299	15,306	15,313	15,320	15,326	15,333	15,340	15,347	15,354	15,361
2,498.7	15,368	15,375	15,382	15,389	15,396	15,403	15,410	15,417	15,424	15,431
2,498.8	15,438	15,445	15,452	15,459	15,466	15,473	15,480	15,486	15,493	15,500
2,498.9	15,507	15,514	15,521	15,528	15,535	15,542	15,549	15,556	15,563	15,570
2,499.0	15,577	15,584	15,591	15,598	15,606	15,613	15,620	15,627	15,634	15,641
2,499.1	15,648	15,655	15,663	15,670	15,677	15,684	15,691	15,698	15,705	15,713
2,499.2	15,720	15,727	15,734	15,741	15,748	15,755	15,763	15,770	15,777	15,784
2,499.3	15,791	15,798	15,805	15,812	15,820	15,827	15,834	15,841	15,848	15,855
2,499.4	15,862	15,870	15,877	15,884	15,891	15,898	15,905	15,912	15,920	15,927
2,499.5	15,934	15,941	15,948	15,955	15,962	15,970	15,977	15,984	15,991	15,998
2,499.6	16,005	16,012	16,019	16,027	16,034	16,041	16,048	16,055	16,062	16,069
2,499.7	16,077	16,084	16,091	16,098	16,105	16,112	16,119	16,127	16,134	16,141
2,499.8	16,148	16,155	16,162	16,169	16,176	16,184	16,191	16,198	16,205	16,212
2,499.9	16,219	16,226	16,234	16,241	16,248	16,255	16,262	16,269	16,276	16,284
2,500.0	16,291	16,298	16,305	16,313	16,320	16,327	16,335	16,342	16,349	16,357
2,500.1	16,364	16,371	16,379	16,386	16,393	16,400	16,408	16,415	16,422	16,430
2,500.2	16,437	16,444	16,452	16,459	16,466	16,474	16,481	16,488	16,496	16,503
2,500.3	16,510	16,518	16,525	16,532	16,539	16,547	16,554	16,561	16,569	16,576
2,500.4	16,583	16,591	16,598	16,605	16,613	16,620	16,627	16,635	16,642	16,649
2,500.5	16,656	16,664	16,671	16,678	16,686	16,693	16,700	16,708	16,715	16,722
2,500.6	16,730	16,737	16,744	16,752	16,759	16,766	16,774	16,781	16,788	16,795
2,500.7	16,803	16,810	16,817	16,825	16,832	16,839	16,847	16,854	16,861	16,869
2,500.8	16,876	16,883	16,891	16,898	16,905	16,913	16,920	16,927	16,934	16,942
2,500.9	16,949	16,956	16,964	16,971	16,978	16,986	16,993	17,000	17,008	17,015
2,501.0	17,022	17,030	17,037	17,045	17,052	17,060	17,067	17,075	17,082	17,090
2,501.1	17,097	17,105	17,112	17,120	17,127	17,135	17,142	17,150	17,157	17,165
2,501.2	17,172	17,180	17,187	17,195	17,202	17,210	17,217	17,225	17,232	17,240
2,501.3	17,247	17,255	17,262	17,270	17,277	17,285	17,292	17,299	17,307	17,314
2,501.4	17,322	17,329	17,337	17,344	17,352	17,359	17,367	17,374	17,382	17,389
2,501.5	17,397	17,404	17,412	17,419	17,427	17,434	17,442	17,449	17,457	17,464
2,501.6	17,472	17,479	17,487	17,494	17,502	17,509	17,517	17,524	17,532	17,539
2,501.7	17,547	17,554	17,562	17,569	17,577	17,584	17,592	17,599	17,607	17,614
2,501.8	17,622	17,629	17,637	17,644	17,652	17,659	17,667	17,674	17,682	17,689
2,501.9	17,697	17,704	17,712	17,719	17,726	17,734	17,741	17,749	17,756	17,764

December 17, 1964

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BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,502.0	17,772	17,779	17,787	17,795	17,802	17,810	17,818	17,825	17,833	17,841
2,502.1	17,848	17,856	17,864	17,871	17,879	17,887	17,894	17,902	17,910	17,917
2,502.2	17,925	17,933	17,940	17,948	17,956	17,963	17,971	17,979	17,986	17,994
2,502.3	18,002	18,009	18,017	18,025	18,032	18,040	18,048	18,055	18,063	18,071
2,502.4	18,078	18,086	18,094	18,101	18,109	18,117	18,124	18,132	18,140	18,147
2,502.5	18,155	18,163	18,170	18,178	18,186	18,193	18,201	18,209	18,216	18,224
2,502.6	18,232	18,239	18,247	18,255	18,262	18,270	18,278	18,285	18,293	18,301
2,502.7	18,308	18,316	18,324	18,331	18,339	18,347	18,354	18,362	18,370	18,377
2,502.8	18,385	18,393	18,400	18,408	18,416	18,423	18,431	18,439	18,446	18,454
2,502.9	18,462	18,469	18,477	18,485	18,492	18,500	18,508	18,515	18,523	18,531
2,503.0	18,538	18,546	18,554	18,562	18,570	18,578	18,586	18,593	18,601	18,609
2,503.1	18,617	18,625	18,633	18,641	18,648	18,656	18,664	18,672	18,680	18,688
2,503.2	18,695	18,703	18,711	18,719	18,727	18,735	18,743	18,750	18,758	18,766
2,503.3	18,774	18,782	18,790	18,797	18,805	18,813	18,821	18,829	18,837	18,845
2,503.4	18,852	18,860	18,868	18,876	18,884	18,892	18,900	18,907	18,915	18,923
2,503.5	18,931	18,939	18,947	18,954	18,962	18,970	18,978	18,986	18,994	19,002
2,503.6	19,009	19,017	19,025	19,033	19,041	19,049	19,057	19,064	19,072	19,080
2,503.7	19,088	19,096	19,104	19,111	19,119	19,127	19,135	19,143	19,151	19,159
2,503.8	19,166	19,174	19,182	19,190	19,198	19,206	19,213	19,221	19,229	19,237
2,503.9	19,245	19,253	19,261	19,268	19,276	19,284	19,292	19,300	19,308	19,316
2,504.0	19,323	19,331	19,339	19,348	19,356	19,364	19,372	19,380	19,388	19,396
2,504.1	19,404	19,412	19,420	19,428	19,436	19,444	19,452	19,460	19,468	19,476
2,504.2	19,484	19,492	19,500	19,508	19,516	19,524	19,532	19,540	19,548	19,556
2,504.3	19,564	19,572	19,580	19,588	19,596	19,605	19,613	19,621	19,629	19,637
2,504.4	19,645	19,653	19,661	19,669	19,677	19,685	19,693	19,701	19,709	19,717
2,504.5	19,725	19,733	19,741	19,749	19,757	19,765	19,773	19,781	19,789	19,797
2,504.6	19,805	19,813	19,821	19,829	19,837	19,845	19,853	19,861	19,870	19,878
2,504.7	19,886	19,894	19,902	19,910	19,918	19,926	19,934	19,942	19,950	19,958
2,504.8	19,966	19,974	19,982	19,990	19,998	20,006	20,014	20,022	20,030	20,038
2,504.9	20,046	20,054	20,062	20,070	20,078	20,086	20,094	20,102	20,110	20,118
2,505.0	20,127	20,135	20,143	20,151	20,159	20,168	20,176	20,184	20,192	20,200
2,505.1	20,208	20,217	20,225	20,233	20,241	20,249	20,258	20,266	20,274	20,282
2,505.2	20,290	20,299	20,307	20,315	20,323	20,331	20,340	20,348	20,356	20,364
2,505.3	20,372	20,381	20,389	20,397	20,405	20,413	20,422	20,430	20,438	20,446
2,505.4	20,454	20,462	20,471	20,479	20,487	20,495	20,503	20,512	20,520	20,528

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Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,505.5	20,536	20,544	20,553	20,561	20,569	20,577	20,585	20,594	20,602	20,610
2,505.6	20,618	20,626	20,635	20,643	20,651	20,659	20,667	20,675	20,684	20,692
2,505.7	20,700	20,708	20,716	20,725	20,733	20,741	20,749	20,757	20,766	20,774
2,505.8	20,782	20,790	20,798	20,807	20,815	20,823	20,831	20,839	20,848	20,856
2,505.9	20,864	20,872	20,880	20,889	20,897	20,905	20,913	20,921	20,929	20,938
2,506.0	20,946	20,954	20,963	20,971	20,979	20,988	20,996	21,004	21,013	21,021
2,506.1	21,029	21,038	21,046	21,054	21,063	21,071	21,079	21,088	21,096	21,104
2,506.2	21,113	21,121	21,129	21,138	21,146	21,154	21,163	21,171	21,179	21,188
2,506.3	21,196	21,204	21,213	21,221	21,229	21,238	21,246	21,254	21,263	21,271
2,506.4	21,279	21,288	21,296	21,304	21,313	21,321	21,329	21,338	21,346	21,354
2,506.5	21,363	21,371	21,379	21,388	21,396	21,404	21,413	21,421	21,429	21,438
2,506.6	21,446	21,454	21,463	21,471	21,479	21,488	21,496	21,504	21,513	21,521
2,506.7	21,529	21,538	21,546	21,554	21,563	21,571	21,579	21,588	21,596	21,604
2,506.8	21,613	21,621	21,629	21,638	21,646	21,654	21,663	21,671	21,679	21,688
2,506.9	21,696	21,705	21,713	21,721	21,730	21,738	21,746	21,755	21,763	21,771
2,507.0	21,780	21,788	21,796	21,805	21,813	21,822	21,830	21,839	21,847	21,856
2,507.1	21,864	21,873	21,881	21,890	21,898	21,907	21,915	21,924	21,932	21,941
2,507.2	21,949	21,958	21,966	21,975	21,983	21,992	22,000	22,008	22,017	22,025
2,507.3	22,034	22,042	22,051	22,059	22,068	22,076	22,085	22,093	22,102	22,110
2,507.4	22,119	22,127	22,136	22,144	22,153	22,161	22,170	22,178	22,187	22,195
2,507.5	22,203	22,212	22,220	22,229	22,237	22,246	22,254	22,263	22,271	22,280
2,507.6	22,288	22,297	22,305	22,314	22,322	22,331	22,339	22,348	22,356	22,365
2,507.7	22,373	22,382	22,390	22,398	22,407	22,415	22,424	22,432	22,441	22,449
2,507.8	22,458	22,466	22,475	22,483	22,492	22,500	22,509	22,517	22,526	22,534
2,507.9	22,543	22,551	22,560	22,568	22,577	22,585	22,594	22,602	22,610	22,619
2,508.0	22,627	22,636	22,645	22,653	22,662	22,671	22,679	22,688	22,696	22,705
2,508.1	22,714	22,722	22,731	22,740	22,748	22,757	22,765	22,774	22,783	22,791
2,508.2	22,800	22,809	22,817	22,826	22,834	22,843	22,852	22,860	22,869	22,877
2,508.3	22,886	22,895	22,903	22,912	22,921	22,929	22,938	22,946	22,955	22,964
2,508.4	22,972	22,981	22,990	22,998	23,007	23,015	23,024	23,033	23,041	23,050
2,508.5	23,059	23,067	23,076	23,084	23,093	23,102	23,110	23,119	23,128	23,136
2,508.6	23,145	23,153	23,162	23,171	23,179	23,188	23,196	23,205	23,214	23,222
2,508.7	23,231	23,240	23,248	23,257	23,265	23,274	23,283	23,291	23,300	23,309
2,508.8	23,317	23,326	23,334	23,343	23,352	23,360	23,369	23,378	23,386	23,395
2,508.9	23,403	23,412	23,421	23,429	23,438	23,447	23,455	23,464	23,472	23,481

December 17, 1964

Table 8 Sheet 15 of 26

BULLY CREEK RES, Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,509.0	23,490	23,499	23,507	23,516	23,525	23,534	23,542	23,551	23,560	23,569
2,509.1	23,577	23,586	23,595	23,604	23,612	23,621	23,630	23,639	23,648	23,656
2,509.2	23,665	23,674	23,683	23,691	23,700	23,709	23,718	23,726	23,735	23,744
2,509.3	23,753	23,762	23,770	23,779	23,788	23,797	23,805	23,814	23,823	23,832
2,509.4	23,840	23,849	23,858	23,867	23,875	23,884	23,893	23,902	23,911	23,919
2,509.5	23,928	23,937	23,946	23,954	23,963	23,972	23,981	23,989	23,998	24,007
2,509.6	24,016	24,025	24,033	24,042	24,051	24,060	24,068	24,077	24,086	24,095
2,509.7	24,103	24,112	24,121	24,130	24,138	24,147	24,156	24,165	24,174	24,182
2,509.8	24,191	24,200	24,209	24,217	24,226	24,235	24,244	24,252	24,261	24,270
2,509.9	24,279	24,288	24,296	24,305	24,314	24,323	24,331	24,340	24,349	24,358
2,510.0	24,366	24,375	24,384	24,393	24,402	24,411	24,420	24,429	24,438	24,447
2,510.1	24,456	24,465	24,474	24,483	24,491	24,500	24,509	24,518	24,527	24,536
2,510.2	24,545	24,554	24,563	24,572	24,581	24,590	24,599	24,607	24,616	24,625
2,510.3	24,634	24,643	24,652	24,661	24,670	24,679	24,688	24,697	24,706	24,715
2,510.4	24,723	24,732	24,741	24,750	24,759	24,768	24,777	24,786	24,795	24,804
2,510.5	24,813	24,822	24,831	24,839	24,848	24,857	24,866	24,875	24,884	24,893
2,510.6	24,902	24,911	24,920	24,929	24,938	24,947	24,955	24,964	24,973	24,982
2,510.7	24,991	25,000	25,009	25,018	25,027	25,036	25,045	25,054	25,063	25,071
2,510.8	25,080	25,089	25,098	25,107	25,116	25,125	25,134	25,143	25,152	25,161
2,510.9	25,170	25,179	25,188	25,196	25,205	25,214	25,223	25,232	25,241	25,250
2,511.0	25,259	25,268	25,277	25,286	25,295	25,304	25,314	25,323	25,332	25,341
2,511.1	25,350	25,359	25,368	25,377	25,386	25,395	25,404	25,414	25,423	25,432
2,511.2	25,441	25,450	25,459	25,468	25,477	25,486	25,495	25,505	25,514	25,523
2,511.3	25,532	25,541	25,550	25,559	25,568	25,577	25,586	25,595	25,605	25,614
2,511.4	25,623	25,632	25,641	25,650	25,659	25,668	25,677	25,686	25,696	25,705
2,511.5	25,714	25,723	25,732	25,741	25,750	25,759	25,768	25,777	25,786	25,796
2,511.6	25,805	25,814	25,823	25,832	25,841	25,850	25,859	25,868	25,877	25,887
2,511.7	25,896	25,905	25,914	25,923	25,932	25,941	25,950	25,959	25,968	25,977
2,511.8	25,987	25,996	26,005	26,014	26,023	26,032	26,041	26,050	26,059	26,068
2,511.9	26,078	26,087	26,096	26,105	26,114	26,123	26,132	26,141	26,150	26,159
2,512.0	26,168	26,178	26,187	26,196	26,206	26,215	26,224	26,233	26,243	26,252
2,512.1	26,261	26,270	26,280	26,289	26,298	26,307	26,317	26,326	26,335	26,345
2,512.2	26,354	26,363	26,372	26,382	26,391	26,400	26,409	26,419	26,428	26,437
2,512.3	26,446	26,456	26,465	26,474	26,484	26,493	26,502	26,511	26,521	26,530
2,512.4	26,539	26,548	26,558	26,567	26,576	26,585	26,595	26,604	26,613	26,623

Sheet 11 of 20
Table 8

December 17, 1964

BULLY CREEK RES, Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,512.5	26,632	26,641	26,650	26,660	26,669	26,678	26,687	26,697	26,706	26,715
2,512.6	26,724	26,734	26,743	26,752	26,762	26,771	26,780	26,789	26,799	26,808
2,512.7	26,817	26,826	26,836	26,845	26,854	26,863	26,873	26,882	26,891	26,900
2,512.8	26,910	26,919	26,928	26,938	26,947	26,956	26,965	26,975	26,984	26,993
2,512.9	27,002	27,012	27,021	27,030	27,039	27,049	27,058	27,067	27,077	27,086
2,513.0	27,095	27,105	27,114	27,123	27,133	27,142	27,152	27,161	27,171	27,180
2,513.1	27,190	27,199	27,208	27,218	27,227	27,237	27,246	27,256	27,265	27,274
2,513.2	27,284	27,293	27,303	27,312	27,322	27,331	27,341	27,350	27,359	27,369
2,513.3	27,378	27,388	27,397	27,407	27,416	27,425	27,435	27,444	27,454	27,463
2,513.4	27,473	27,482	27,492	27,501	27,510	27,520	27,529	27,539	27,548	27,558
2,513.5	27,567	27,577	27,586	27,595	27,605	27,614	27,624	27,633	27,643	27,652
2,513.6	27,661	27,671	27,680	27,690	27,699	27,709	27,718	27,728	27,737	27,746
2,513.7	27,756	27,765	27,775	27,784	27,794	27,803	27,812	27,822	27,831	27,841
2,513.8	27,850	27,860	27,869	27,879	27,888	27,897	27,907	27,916	27,926	27,935
2,513.9	27,945	27,954	27,964	27,973	27,982	27,992	28,001	28,011	28,020	28,030
2,514.0	28,039	28,049	28,058	28,068	28,078	28,087	28,097	28,106	28,116	28,126
2,514.1	28,135	28,145	28,154	28,164	28,174	28,183	28,193	28,202	28,212	28,222
2,514.2	28,231	28,241	28,251	28,260	28,270	28,279	28,289	28,299	28,308	28,318
2,514.3	28,327	28,337	28,347	28,356	28,366	28,376	28,385	28,395	28,404	28,414
2,514.4	28,424	28,433	28,443	28,452	28,462	28,472	28,481	28,491	28,500	28,510
2,514.5	28,520	28,529	28,539	28,549	28,558	28,568	28,577	28,587	28,597	28,606
2,514.6	28,616	28,625	28,635	28,645	28,654	28,664	28,674	28,683	28,693	28,702
2,514.7	28,712	28,722	28,731	28,741	28,750	28,760	28,770	28,779	28,789	28,798
2,514.8	28,808	28,818	28,827	28,837	28,847	28,856	28,866	28,875	28,885	28,895
2,514.9	28,904	28,914	28,923	28,933	28,943	28,952	28,962	28,972	28,981	28,991
2,515.0	29,000	29,010	29,020	29,030	29,040	29,049	29,059	29,069	29,079	29,088
2,515.1	29,098	29,108	29,118	29,128	29,137	29,147	29,157	29,167	29,176	29,186
2,515.2	29,196	29,206	29,215	29,225	29,235	29,245	29,255	29,264	29,274	29,284
2,515.3	29,294	29,303	29,313	29,323	29,333	29,343	29,352	29,362	29,372	29,382
2,515.4	29,391	29,401	29,411	29,421	29,431	29,440	29,450	29,460	29,470	29,479
2,515.5	29,489	29,499	29,509	29,519	29,528	29,538	29,548	29,558	29,567	29,577
2,515.6	29,587	29,597	29,606	29,616	29,626	29,636	29,646	29,655	29,665	29,675
2,515.7	29,685	29,694	29,704	29,714	29,724	29,734	29,743	29,753	29,763	29,773
2,515.8	29,782	29,792	29,802	29,812	29,822	29,831	29,841	29,851	29,861	29,870
2,515.9	29,880	29,890	29,900	29,910	29,919	29,929	29,939	29,949	29,958	29,968

Sheet 11 of 20
Table 8

December 17, 1964

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,516.0	29,978	29,988	29,998	30,008	30,018	30,028	30,038	30,047	30,057	30,067
2,516.1	30,077	30,087	30,097	30,107	30,117	30,127	30,137	30,147	30,157	30,167
2,516.2	30,176	30,186	30,196	30,206	30,216	30,226	30,236	30,246	30,256	30,266
2,516.3	30,276	30,286	30,296	30,305	30,315	30,325	30,335	30,345	30,355	30,365
2,516.4	30,375	30,385	30,395	30,405	30,415	30,425	30,434	30,444	30,454	30,464
2,516.5	30,474	30,484	30,494	30,504	30,514	30,524	30,534	30,544	30,554	30,563
2,516.6	30,573	30,583	30,593	30,603	30,613	30,623	30,633	30,643	30,653	30,663
2,516.7	30,673	30,683	30,692	30,702	30,712	30,722	30,732	30,742	30,752	30,762
2,516.8	30,772	30,782	30,792	30,802	30,812	30,822	30,831	30,841	30,851	30,861
2,516.9	30,871	30,881	30,891	30,901	30,911	30,921	30,931	30,941	30,951	30,960
2,517.0	30,970	30,980	30,991	31,001	31,011	31,021	31,031	31,041	31,051	31,061
2,517.1	31,071	31,081	31,091	31,101	31,111	31,122	31,132	31,142	31,152	31,162
2,517.2	31,172	31,182	31,192	31,202	31,212	31,222	31,232	31,242	31,252	31,263
2,517.3	31,273	31,283	31,293	31,303	31,313	31,323	31,333	31,343	31,353	31,363
2,517.4	31,373	31,385	31,394	31,404	31,414	31,424	31,434	31,444	31,454	31,464
2,517.5	31,474	31,484	31,494	31,504	31,514	31,524	31,535	31,545	31,555	31,565
2,517.6	31,575	31,585	31,595	31,605	31,615	31,625	31,635	31,645	31,655	31,666
2,517.7	31,676	31,686	31,696	31,706	31,716	31,726	31,736	31,746	31,756	31,766
2,517.8	31,776	31,786	31,796	31,807	31,817	31,827	31,837	31,847	31,857	31,867
2,517.9	31,877	31,887	31,897	31,907	31,917	31,927	31,938	31,948	31,958	31,968
2,518.0	31,978	31,988	31,998	32,008	32,019	32,029	32,039	32,049	32,060	32,070
2,518.1	32,080	32,090	32,100	32,111	32,121	32,131	32,141	32,152	32,162	32,172
2,518.2	32,182	32,193	32,203	32,213	32,223	32,233	32,244	32,254	32,264	32,274
2,518.3	32,285	32,295	32,305	32,315	32,325	32,336	32,346	32,356	32,366	32,377
2,518.4	32,387	32,397	32,407	32,417	32,428	32,438	32,448	32,458	32,469	32,479
2,518.5	32,489	32,499	32,509	32,520	32,530	32,540	32,550	32,561	32,571	32,581
2,518.6	32,591	32,601	32,612	32,622	32,632	32,642	32,653	32,663	32,673	32,683
2,518.7	32,693	32,704	32,714	32,724	32,734	32,745	32,755	32,765	32,775	32,786
2,518.8	32,796	32,806	32,816	32,826	32,837	32,847	32,857	32,867	32,878	32,888
2,518.9	32,898	32,908	32,918	32,929	32,939	32,949	32,959	32,970	32,980	32,990
2,519.0	33,000	33,011	33,021	33,031	33,042	33,052	33,063	33,073	33,083	33,094
2,519.1	33,104	33,114	33,125	33,135	33,146	33,156	33,166	33,177	33,187	33,197
2,519.2	33,208	33,218	33,229	33,239	33,249	33,260	33,270	33,280	33,291	33,301
2,519.3	33,312	33,322	33,332	33,343	33,353	33,363	33,374	33,384	33,395	33,405
2,519.4	33,415	33,426	33,436	33,446	33,457	33,467	33,478	33,488	33,498	33,509

Note: Surcharge capacity above spillway crest (elevation 2516)

December 17, 1964

Sheet 18 of 20
Table 8

BULLY CREEK RES, Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2,519.5	33,519	33,529	33,540	33,550	33,561	33,571	33,581	33,592	33,602	33,612
2,519.6	33,625	33,633	33,644	33,654	33,664	33,675	33,685	33,695	33,706	33,716
2,519.7	33,727	33,737	33,747	33,758	33,768	33,778	33,789	33,799	33,810	33,820
2,519.8	33,830	33,841	33,851	33,861	33,872	33,882	33,893	33,903	33,913	33,924
2,519.9	33,934	33,944	33,955	33,965	33,976	33,986	33,996	34,007	34,017	34,027
2,520.0	34,038	34,048	34,059	34,069	34,080	34,090	34,101	34,112	34,122	34,133
2,520.1	34,143	34,154	34,164	34,175	34,185	34,196	34,206	34,217	34,227	34,238
2,520.2	34,248	34,259	34,269	34,280	34,290	34,301	34,312	34,322	34,333	34,343
2,520.3	34,354	34,364	34,375	34,385	34,396	34,406	34,417	34,427	34,438	34,448
2,520.4	34,459	34,469	34,480	34,490	34,501	34,511	34,522	34,533	34,543	34,554
2,520.5	34,564	34,575	34,585	34,596	34,606	34,617	34,627	34,638	34,648	34,659
2,520.6	34,669	34,680	34,690	34,701	34,711	34,722	34,733	34,743	34,754	34,764
2,520.7	34,775	34,785	34,796	34,806	34,817	34,827	34,838	34,848	34,859	34,869
2,520.8	34,880	34,890	34,901	34,911	34,922	34,933	34,943	34,954	34,964	34,975
2,520.9	34,985	34,996	35,006	35,017	35,027	35,038	35,048	35,059	35,069	35,080
2,521.0	35,090	35,101	35,112	35,123	35,133	35,144	35,155	35,165	35,176	35,187
2,521.1	35,197	35,208	35,219	35,229	35,240	35,251	35,261	35,272	35,283	35,293
2,521.2	35,304	35,315	35,325	35,336	35,347	35,357	35,368	35,379	35,389	35,400
2,521.3	35,411	35,421	35,432	35,443	35,454	35,464	35,475	35,486	35,496	35,507
2,521.4	35,518	35,528	35,539	35,550	35,560	35,571	35,582	35,592	35,603	35,614
2,521.5	35,624	35,635	35,646	35,656	35,667	35,678	35,688	35,699	35,710	35,720
2,521.6	35,731	35,742	35,752	35,763	35,774	35,784	35,795	35,806	35,817	35,827
2,521.7	35,836	35,849	35,859	35,870	35,881	35,891	35,902	35,913	35,923	35,934
2,521.8	35,945	35,955	35,966	35,977	35,987	35,998	36,009	36,019	36,030	36,041
2,521.9	36,051	36,062	36,073	36,083	36,094	36,105	36,115	36,126	36,137	36,148
2,522.0	36,158	36,169	36,180	36,191	36,202	36,212	36,223	36,234	36,245	36,256
2,522.1	36,267	36,277	36,288	36,299	36,310	36,321	36,331	36,342	36,353	36,364
2,522.2	36,375	36,386	36,396	36,407	36,418	36,429	36,440	36,451	36,461	36,472
2,522.3	36,483	36,494	36,505	36,516	36,526	36,537	36,548	36,559	36,570	36,581
2,522.4	36,591	36,602	36,613	36,624	36,635	36,645	36,656	36,667	36,678	36,689
2,522.5	36,700	36,710	36,721	36,732	36,743	36,754	36,765	36,775	36,786	36,797
2,522.6	36,808	36,819	36,830	36,840	36,851	36,862	36,873	36,884	36,895	36,905
2,522.7	36,916	36,927	36,938	36,949	36,959	36,970	36,981	36,992	37,003	37,014
2,522.8	37,024	37,035	37,046	37,057	37,068	37,079	37,089	37,100	37,111	37,122
2,522.9	37,133	37,144	37,154	37,165	37,176	37,187	37,198	37,209	37,219	37,230

December 17, 1964

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Table 8

BULLY CREEK RES. Active Storage Capacity (Acre Feet)

ELEV.	.00	.01	.02	.03.	.04	.05	.06	.07	.08	.09
2,523.0	37,241									

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Table 8

December 17, 1964

9-210 PROVISIONAL

OFFICE OF THE STATE ENGINEER

WATER RESOURCES DEPARTMENT

File No 6750.00

Rating table for Malheur River below Warmsprings Reservoir, near Riverside, Oreg.

....., from Oct. 1, 1962, to 5, 19....., from ....., 19....., to ....., 19.....

Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference	Gage height	Discharge	Difference
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
2.00			4.00	178	37	.00			.00			.00			.00			.00		
.10			.10	215	40	.10			.10			.10			.10			.10		
.20			.20	255	1	.20			.20			.20			.20			.20		
.30			.30	295	40	.30			.30			.30			.30			.30		
.40			.40	335	45	.40			.40			.40			.40			.40		
.50	0		.50	380	1	.50			.50			.50			.50			.50		
.60	0.1	0.9	.60	425	1	.60			.60			.60			.60			.60		
.70	1.0	2.0	.70	470	45	.70			.70			.70			.70			.70		
.80	3	3	.80	515	45	.80			.80			.80			.80			.80		
.90	6	4	.90	560	50	.90			.90			.90			.90			.90		
3.00	10	5	5.00	610		.00			.00			.00			.00			.00		
.10	15	6	.10			.10			.10			.10			.10			.10		
.20	21	8	.20			.20			.20			.20			.20			.20		
.30	29	9	.30			.30			.30			.30			.30			.30		
.40	38	13	.40			.40			.40			.40			.40			.40		
.50	51	17	.50			.50			.50			.50			.50			.50		
.60	68	22	.60			.60			.60			.60			.60			.60		
.70	90	25	.70			.70			.70			.70			.70			.70		
.80	115	30	.80			.80			.80			.80			.80			.80		
.90	145	33	.90			.90			.90			.90			.90			.90		

Table 9

This table is applicable for open-channel conditions. It is based on ... discharge measurements made during 213-220

..... and is well-defined between ..... cfs and ..... cfs.

Comp by GW date 1-6-6

Ckd by WRB date 1-7-6

Table No. 2

RATING TABLE

DATES TABLE IS APPLICABLE — FROM: — TO: — FILE NR.:

STREAM: North Fork Malheur

LOCATION: at Beulah, Oregon

NR. OF MEASUREMENTS: — PERIOD MEASUREMENTS MADE: —

THIS TABLE IS NOT APPLICABLE FOR ICE OR OBSTRUCTED CHANNEL CONDITIONS

GAGE HT. Feet	DISCHARGE Cfs	DIFFERENCE Cfs	GAGE HT. Feet	DISCHARGE Cfs	DIFFERENCE Cfs	GAGE HT. Feet	DISCHARGE Cfs	DIFFERENCE Cfs	GAGE HT. Feet	DISCHARGE Cfs	DIFFERENCE Cfs	GAGE HT. Feet	DISCHARGE Cfs	DIFFERENCE Cfs
1.00			3.00	350	30	.00			.00			.00		
.10			.10	380	30	.10			.10			.10		
.20			.20	410	30	.20			.20			.20		
.30			.30	440		.30			.30			.30		
.40	27	10	.40			.40			.40			.40		
.50	37	11	.50			.50			.50			.50		
.60	48	12	.60			.60			.60			.60		
.70	60	14	.70			.70			.70			.70		
.80	74	15	.80			.80			.80			.80		
.90	89	17	.90			.90			.90			.90		
2.00	106	20	.00			.00			.00			.00		
.10	126	21	.10			.10			.10			.10		
.20	147	21	.20			.20			.20			.20		
.30	168	22	.30			.30			.30			.30		
.40	190	25	.40			.40			.40			.40		
.50	215	25	.50			.50			.50			.50		
.60	240	25	.60			.60			.60			.60		
.70	265	25	.70			.70			.70			.70		
.80	290	30	.80			.80			.80			.80		
.90	320	30	.90			.90			.90			.90		

THIS TABLE IS — WELL DEFINED BETWEEN — CFS AND — CFS

GAGE DATUM — FT. MSL

PERCENT LIMITS, USE HALF TENTHS BETWEEN — FEET AND — FEET, HUNDREDTHS BELOW AND TENTHS ABOVE.

REMARKS

DATE | COMPUTED BY | CHECKED BY

G36191

REPLACES ALL SIMILAR LOCAL FORMS WHICH ARE OBSOLETE

Table 10

9-21

OFFICE OF THE ENGINEER
WATER RESOURCES DEPARTMENT

File No. 2-00.00

Rating table for Malheur River at Little Valley, near Hope, Oreg.

....., from ....., 19....., to ....., 19....., from ....., 19....., to ....., 19.....

Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs
1.00			3.00	365	50	5.00	1,900	120	7.00	4560		9.00			11.00			.00		
.10			.10	415	55	.10			.10			.10			.10			.10		
.20			.20	470	1	.20			.20			.20			.20			.20		
.30			.30	525	55	.30			.30			.30			.30			.30		
.40			.40	580	60	.40		120	.40			.40			.40			.40		
.50			.50	640	1	.50	2500	130	.50			.50			.50			.50		
.60	13	8	.60	700	60	.60			.60			.60			.60			.60		
.70	21	10	.70	760	70	.70			.70			.70			.70			.70		
.80	31	12	.80	830	1	.80			.80			.80			.80			.80		
.90	43	15	.90	900	70	.90			.90			.90			.90			.90		
2.00	58	18	4.00	970	80	6.00	3150	130	8.00			10.00			.00			.00		
.10	76	20	.10	1050	1	.10		140	.10			.10			.10			.10		
.20	96	23	.20	1130	80	.20			.20			.20			.20			.20		
.30	119	26	.30	1210	90	.30			.30			.30			.30			.30		
.40	145	28	.40	1300	1	.40			.40			.40			.40			.40		
.50	173	32	.50	1390	90	.50	3840		.50			.50			.50			.50		
.60	205	35	.60	1480	100	.60			.60			.60			.60			.60		
.70	240	40	.70	1580	100	.70		140	.70			.70			.70			.70		
.80	280	40	.80	1680	110	.80		150	.80			.80			.80			.80		
.90	320	45	.90	1790	110	.90		150	.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on 10 discharge measurements made during 4-15 - 4-24

..... and is ..... well-defined between ..... cfs and ..... cfs.

Above 5.0 ft Same as table 3

Comp by CRK date 6-24-

Ckd by GLB date 8-31-6

Table No. 4

Provisional Rating for Bully Creek at Warmsprings near Vale Ore

from April, 1964, to ...., 19...., from ...., 19...., to ...., 19....

Gage height	Discharge	Differ-ence	Gage height	Discharge	Differ-ence	Gage height	Discharge	Differ-ence	Gage height	Discharge	Differ-ence	Gage height	Discharge	Differ-ence	Gage height	Discharge	Differ-ence
Feet	cfs	cfs	Feet	cfs	cfs	Feet	cfs	cfs	Feet	cfs	cfs	Feet	cfs	cfs	Feet	cfs	cfs
.00			2.00	127	28	.00			.00			.00			.00		
.10			.10	155	32	.10			.10			.10			.10		
.20			.20	187	37	.20			.20			.20			.20		
.30			.30	224	42	.30			.30			.30			.30		
.40			.40	266	44	.40			.40			.40			.40		
.50			.50	310	50	.50			.50			.50			.50		
.60			.60	360	55	.60			.60			.60			.60		
.70			.70	415	60	.70			.70			.70			.70		
.80			.80	475	65	.80			.80			.80			.80		
.90			.90	540		.90			.90			.90			.90		
1.00			3.00			.00			.00			.00			.00		
.10	4.0	2.1	.10			.10			.10			.10			.10		
.20	9.9	6.6	.20			.20			.20			.20			.20		
.30	16.5	8.0	.30			.30			.30			.30			.30		
.40	25.5	10.5	.40			.40			.40			.40			.40		
.50	36	12	.50			.50			.50			.50			.50		
.60	49	13	.60			.60			.60			.60			.60		
.70	62	13	.70			.70			.70			.70			.70		
.80	82	21	.80			.80			.80			.80			.80		
.90	103	21	.90			.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on .... discharge measurements made during ....

Comp by MLG date [illegible]
Ckd by .... date ....
Table No. 2

COO 000708

Table 2

OFFICE ...TATE ENGINEER

WATER RESOURCES DEPARTMENT

13-22

Rating table for Malheur River below Nevada Dam, nr Vale

..... from Noon April 3 1964, to ....., 19....., from ....., 19....., to ....., 19...

Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	Differences	Gage height	Discharge	D
Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	Cfs	Feet	Cfs	
.00			.00			.00			.00			.00			.00			.00		
.10			.10			.10			.10			.10			.10			.10	2	
.20			.20			.20			.20			.20			.20			.20		
.30			.30			.30			.30			.30			.30			.30		
.40			.40			.40			.40			.40			.40			.40		
.50	18	7	.50			.50			.50			.50			.50			.50		
.60	25	11	.60			.60			.60			.60			.60			.60		
.70	36	12	.70			.70			.70			.70			.70			.70		
.80	48	13	.80			.80			.80			.80			.80			.80		
.90	61	15	.90			.90			.90			.90			.90			.90		
1.00	76	16	.00			.00			.00			.00			.00			.00		
.10	92	18	.10			.10			.10			.10			.10			.10		
.20	110	19	.20			.20			.20			.20			.20			.20		
.30	129	20	.30			.30			.30			.30			.30			.30		
.40	149	22	.40			.40			.40			.40			.40			.40		
.50	171	22	.50			.50			.50			.50			.50			.50		
.60	193		.60			.60			.60			.60			.60			.60		
.70			.70			.70			.70			.70			.70			.70		
.80			.80			.80			.80			.80			.80			.80		
.90			.90			.90			.90			.90			.90			.90		

This table is applicable for open-channel conditions. It is based on ..... discharge measurements made during .....

..... and is ..... well defined between ..... cfs and ..... cfs.

Comp by CAC date 8

Ckd by ..... date .....

Table No. 4

Table 13

EVAPORATION DATA IN INCHES

WARM SPRINGS RESERVOIR

Year	April	May	June	July	August	Sep.	October
1927		3.35	8.94	12.60	10.93	5.85	
1928		9.40	9.30	13.16	11.58	7.89	
1929		8.81	9.08	15.11	13.61	6.86	
1930	5.91	7.55	10.57	13.87	11.38	6.47	
1931	5.72	10.13	10.77	14.79	12.69	7.54	
1932	5.13	8.38	10.31	14.56	12.33	8.62	
1933	5.81	7.07	11.95	15.65	11.75	8.05	
1934	6.90	10.20	9.67	14.10	11.71	7.57	
1935	4.71	8.78	10.97	12.51	11.61	8.20	
1936	6.24	8.94	9.10	12.36	11.27	6.52	
1937	4.88	9.00	8.74	13.10	10.94	7.12	
1938	5.01	6.90	9.42	10.98	10.85		
1939	6.51	8.96	9.27	12.36	11.38	7.14	
1940	4.59	8.81	11.75	12.57	11.69	5.13	
1941	4.20	6.40	7.36	10.69	8.02	4.55	
1942	4.23	5.07	7.65	11.04	9.12		
1943	4.60	6.48	6.64	11.12	10.10	6.78	2.37
1944	4.42	8.35	6.87	10.81	10.02	6.04	
1945	5.15	5.50	7.94	12.21	10.28	6.40	
1946	5.16	7.35	8.39	10.62	9.89	5.69	
1947	4.97	8.49	6.93	10.40	9.18	5.43	2.36
1948			7.77	10.74	9.40	6.64	3.22
1949	6.44	7.51	10.21	12.65	9.68	7.20	
1950	5.57	8.05	7.74		9.26	5.70	3.68
1951		7.03	8.97	11.71	9.00	6.44	2.66
1952		6.00	6.66	8.84	9.60	5.84	4.00
1953	4.53	5.27	6.15	10.14	7.94	6.19	3.67
1954	6.11	8.76	7.64	12.60	8.70	7.16	4.22
1955		7.61	10.52	10.68	10.64	6.42	3.71
1956		6.47	8.68	11.20	8.80	6.39	
1957	4.56	4.79	8.44	11.99	10.16	7.37	2.50
1958		9.07	7.72	11.87	11.19	7.05	4.50
1959		6.22	10.12	13.48	10.94	5.64	
1960		6.45	10.60	13.78	10.41	8.11	
Mean	5.28	7.52	8.83	12.11	10.29	6.68	3.35
Std.Dev.	0.79	1.46	1.59	1.57	1.24	0.95	0.77
Maximum	6.90	10.20	11.95	15.65	12.69	8.62	4.50
Minimum	4.20	4.79	6.15	8.84	7.94	4.55	2.36

TABLE 14

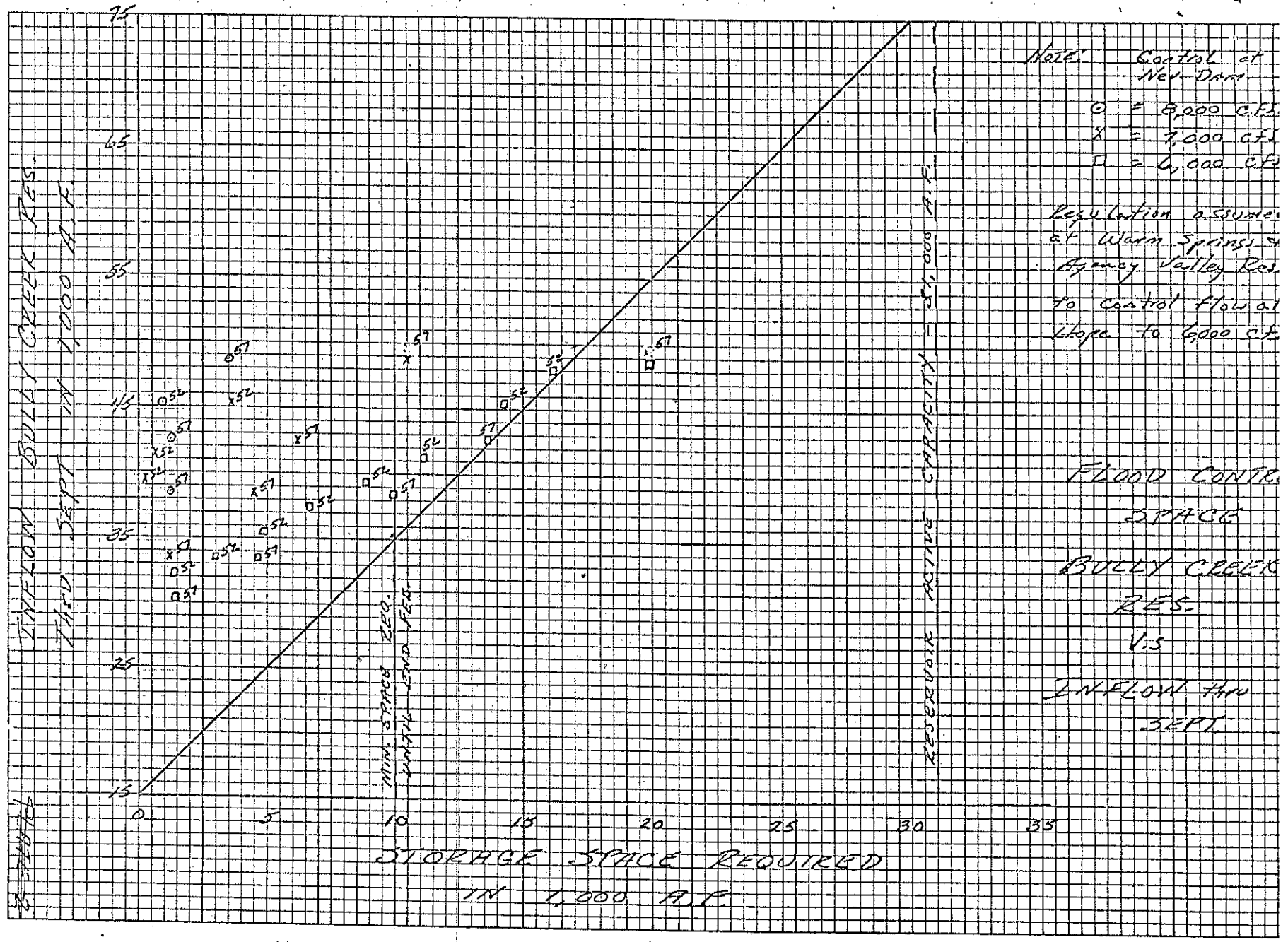
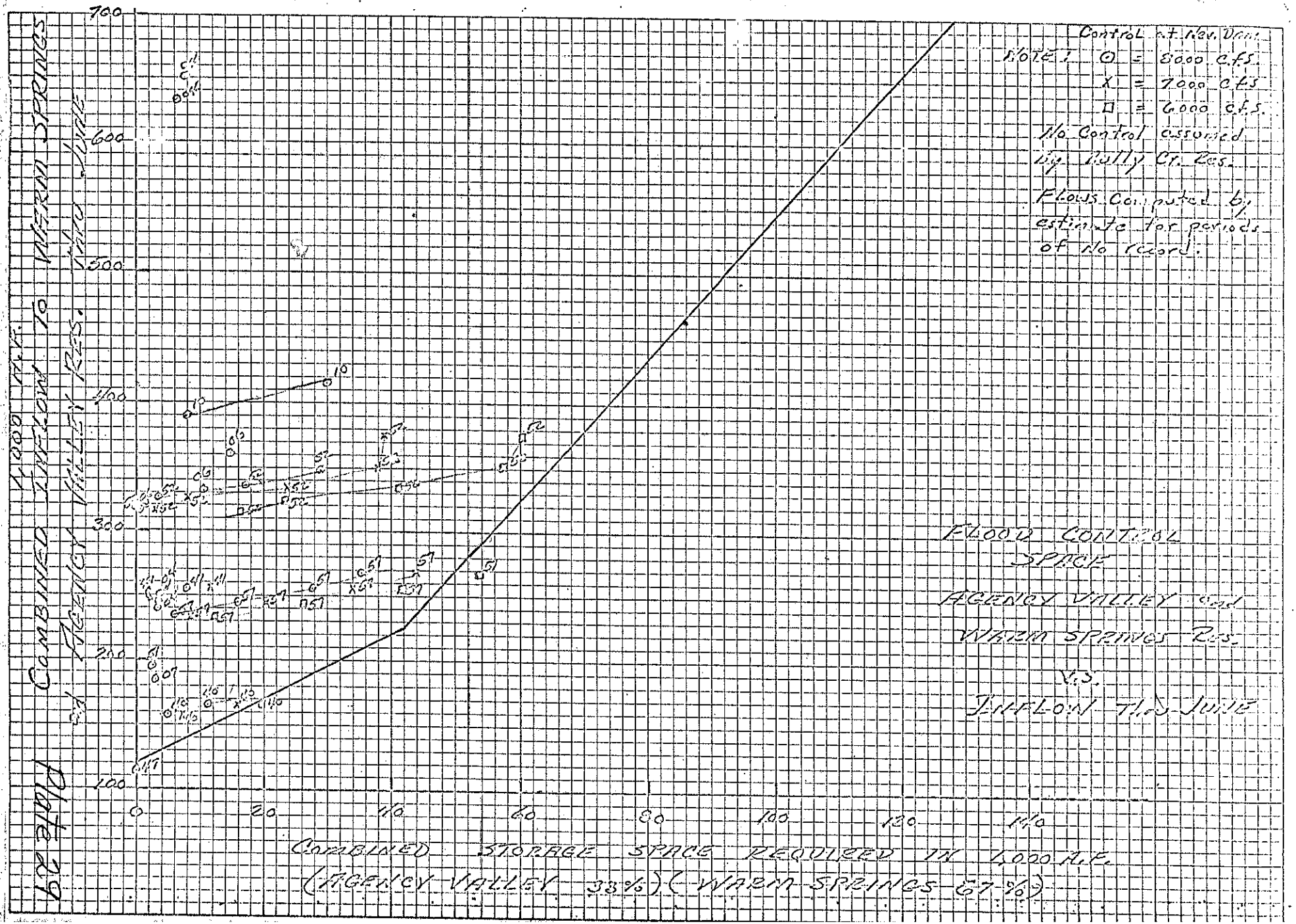


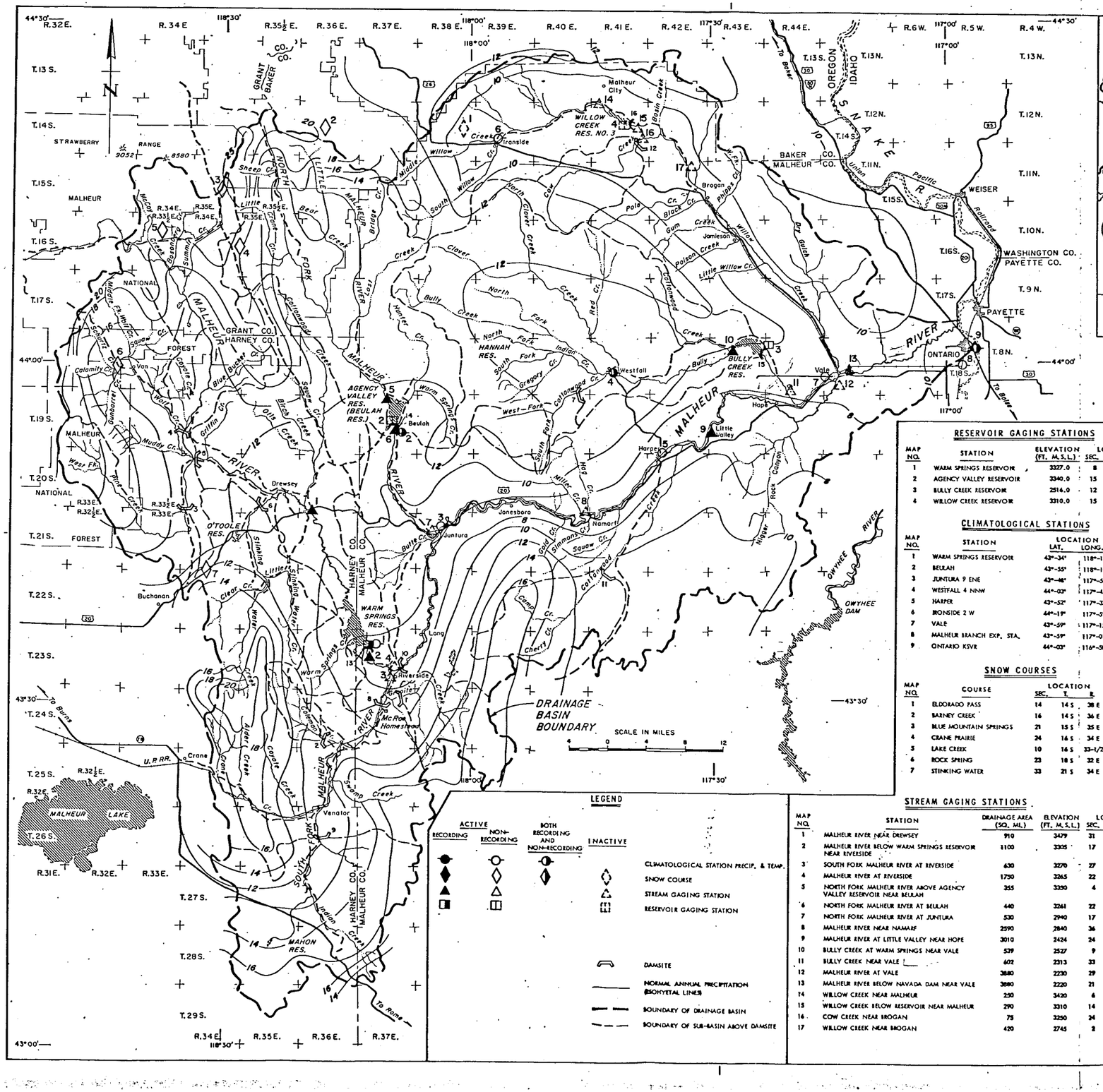
Plate 28

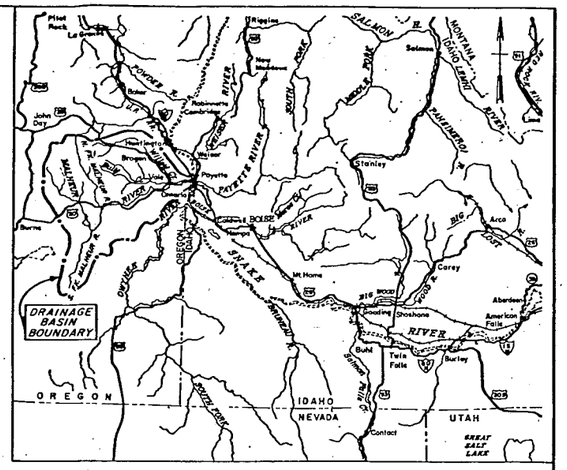
2-2



CORPS OF ENGINEERS

U. S. ARMY





VICINITY MAP

SCALE IN MILES
40 0 40

RESERVOIR GAGING STATIONS

MAP NO.	STATION	ELEVATION (FT. M.S.L.)	LOCATION SEC.	T	R
1	WARM SPRINGS RESERVOIR	3327.0	8	23 S	37 E
2	AGENCY VALLEY RESERVOIR	3340.0	15	19 S	37 E
3	BULLY CREEK RESERVOIR	2516.0	12	18 S	43 E
4	WILLOW CREEK RESERVOIR	3310.0	15	14 S	41 E

CLIMATOLOGICAL STATIONS

MAP NO.	STATION	LOCATION LAT.	LONG.	ELEVATION (FT. M.S.L.)
1	WARM SPRINGS RESERVOIR	43°-34'	118°-12'	3336
2	BEULAH	43°-55'	118°-10'	3277
3	JUNTURA 9 ENE	43°-48'	117°-56'	2828
4	WESTFALL 4 NNW	44°-03'	117°-45'	3140
5	HARPER	43°-52'	117°-37'	2510
6	IRONSIDE 2 W	44°-19'	117°-59'	3915
7	VALE	43°-59'	117°-15'	2240
8	MALHEUR BRANCH EXP. STA.	43°-59'	117°-01'	2230
9	ONTARIO KSVR	44°-03'	116°-58'	2145

SNOW COURSES

MAP NO.	COURSE	LOCATION SEC.	T	R	ELEVATION (FT. M.S.L.)
1	ELDORADO PASS	14	14 S	38 E	4660
2	BARNEY CREEK	16	14 S	36 E	5950
3	BLUE MOUNTAIN SPRINGS	21	15 S	35 E	5900
4	CRANE PRAIRIE	24	16 S	34 E	5375
5	LAKE CREEK	10	16 S	33-1/2E	5120
6	ROCK SPRING	23	18 S	32 E	5100
7	STINKING WATER	33	21 S	34 E	4800

STREAM GAGING STATIONS

MAP NO.	STATION	DRAINAGE AREA (SQ. MI.)	ELEVATION (FT. M.S.L.)	LOCATION SEC.	T.	R.
1	MALHEUR RIVER NEAR DREWSEY	910	3479	31	20 S	36 E
2	MALHEUR RIVER BELOW WARM SPRINGS RESERVOIR NEAR RIVERSIDE	1100	3305	17	23 S	37 E
3	SOUTH FORK MALHEUR RIVER AT RIVERSIDE	630	3270	27	23 S	37 E
4	MALHEUR RIVER AT RIVERSIDE	1750	3265	22	23 S	37 E
5	NORTH FORK MALHEUR RIVER ABOVE AGENCY VALLEY RESERVOIR NEAR BEULAH	355	3350	4	19 S	37 E
6	NORTH FORK MALHEUR RIVER AT BEULAH	440	3261	22	19 S	37 E
7	NORTH FORK MALHEUR RIVER AT JUNTURA	530	2940	17	21 S	38 E
8	MALHEUR RIVER NEAR NAMARF	2590	2840	36	20 S	40 E
9	MALHEUR RIVER AT LITTLE VALLEY NEAR HOPE	3010	2424	24	19 S	42 E
10	BULLY CREEK AT WARM SPRINGS NEAR VALE	539	2527	9	18 S	43 E
11	BULLY CREEK NEAR VALE	602	2313	33	18 S	44 E
12	MALHEUR RIVER AT VALE	3880	2230	29	18 S	45 E
13	MALHEUR RIVER BELOW NAVADA DAM NEAR VALE	3880	2220	21	18 S	45 E
14	WILLOW CREEK NEAR MALHEUR	250	3420	6	14 S	41 E
15	WILLOW CREEK BELOW RESERVOIR NEAR MALHEUR	290	3310	14	14 S	41 E
16	COW CREEK NEAR BROGAN	75	3250	24	14 S	41 E
17	WILLOW CREEK NEAR BROGAN	420	2745	2	15 S	42 E

DAMSITE DATA

SITE NUMBER	STREAM	DRAINAGE BASIN ELEVATIONS MINIMUM	MAXIMUM	MEAN	DRAINAGE AREA	AVERAGE ANNUAL PRECIPITATION 1/	LOCATIONS SECTION	TOWNSHIP	RANGE
1	GRANITE CREEK	3400	5700	4500	112	14	2	24S	37E
2	COLEMAN CREEK	3500	5700	4800	27	13	28	24S	36E
3	PINE CREEK	3800	6600	5200	106	16	31	20S	34E
4	MALHEUR RIVER	3600	8800	5500	230	19	19	19S	34E
5	MALHEUR RIVER	3600	8800	5200	543	15	5	20S	34E
6	STINKING WATER CREEK	3500	5700	4500	175	14	33	20S	35E
7	COTTONWOOD CREEK	3200	5000	4100	53	12	35	18S	40E
8	SOUTH FORK MALHEUR	3400	6000	4300	550	14	9	24S	37E
9	SOUTH FORK MALHEUR	3800	6000	4500	232	13	21	26S	36E
10	MALHEUR RIVER	3400	8800	4700	1720	15	23	23S	37E
11	COTTONWOOD CREEK	3300	5700	4470	99	14	5	22S	41E
12	COW CREEK	3400	6500	4520	76	11	26	14S	41E
13	MALHEUR (WARM SPRINGS DAM) 3/	3400	8800	4700	1100	15	8	23S	37E
14	NORTH FORK MALHEUR (AGENCY VALLEY DAM) 3/	3300	8000	5000	440	14	15	19S	37E
15	BULLY CREEK (BULLY CREEK RESERVOIR) 3/	2500	6000	4000	570	12	12	18S	43E
16	WILLOW CREEK (RESERVOIR #3) 3/	3310	7800	4430	290	11	15	14S	41E

NOTES:

1/. AVERAGE ANNUAL PRECIPITATION OF DRAINAGE AREA ABOVE DAMSITE.

2/. EXISTING RESERVOIR.

GENERAL NOTES:

1. COMPILED FROM A.M.S. MAPS DATED 1953.
2. TOTAL DRAINAGE AREA IS 4680 SQ. MI. NORMAL ANNUAL PRECIPITATION FOR BASIN IS 12 INCHES.

DIVISION	DATE	DESCRIPTION	BY

U.S. ARMY ENGINEER DISTRICT
WALLA WALLA, WASHINGTON

DESIGNED R. Couch
DRAWN E. Johnson
CHECKED R. Conroy
SUPERVISED
CHIEF, DATA CONT. SECT.

MALHEUR RIVER & TRIBUTARIES
OREGON

DRAINAGE BASIN MAP

SUBMITTED
CHIEF, PLANNING BRANCH

APPROVED
COLONEL, C.E. DISTRICT ENGINEER

DATE 3/28/60

RECOMMENDED
CHIEF, ENGINEERING DIVISION

SCALE AS SHOWN

INV. NO. ENG.

FILE NO.

SHEET

PLATE 1

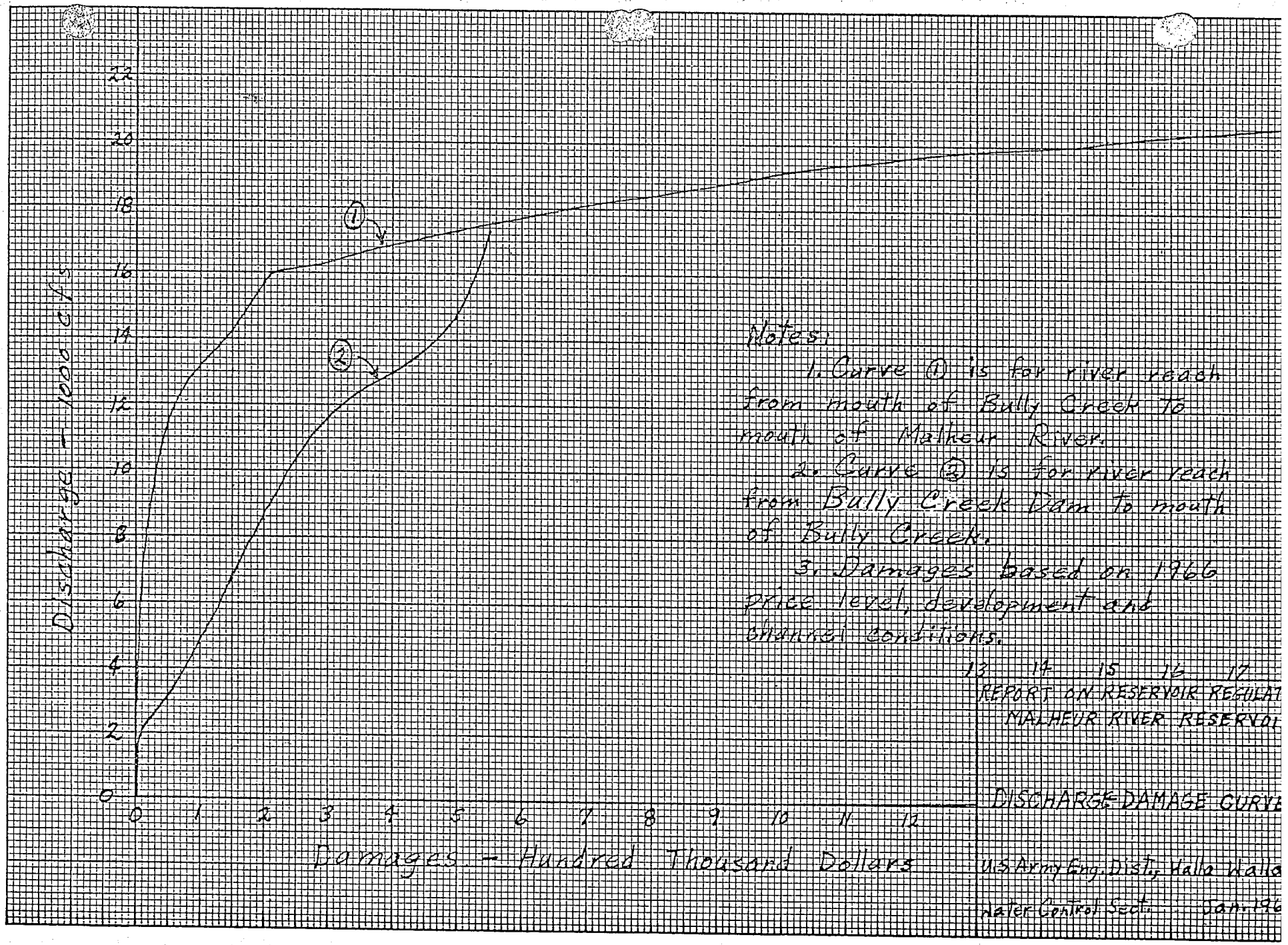
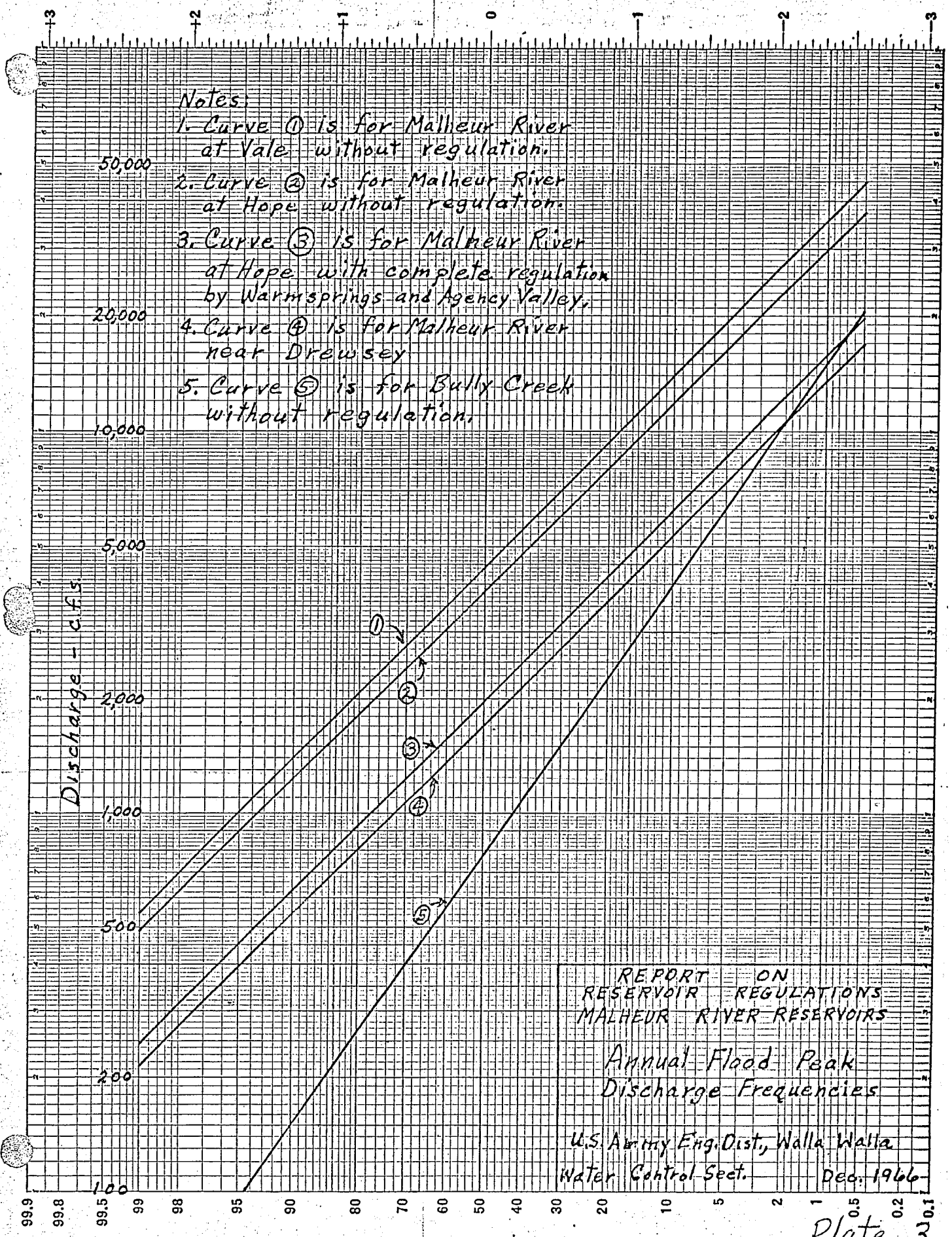

Stage - Feet - Above MSL
0
2
4
6
8
10
12
14
16
18
20
22
0 1 2 3 4 5 6 7 8 9 10 11 12
Damages - Hundred Thousand Dollars
①
②
Notes:
1. Curve ① is for river reach from mouth of Bully Creek To mouth of Malheur River.
2. Curve ② is for river reach from Bully Creek Dam to mouth of Bully Creek.
3. Damages based on 1966 price level, development and channel conditions.
13 14 15 16 17
REPORT ON RESERVOIR REGULAT
MALHEUR RIVER RESERVOI
DISCHARGE-DAMAGE CURVE
U.S Army Eng. Dist, Walla Walla
Water Control Sect. Jan. 196

Plate 2


+3
+2
+1
0
1
2
3
Notes:
1. Curve ① is for Malheur River at Vale without regulation.
2. Curve ② is for Malheur River at Hope without regulation.
3. Curve ③ is for Malheur River at Hope with complete regulation by Warmsprings and Agency Valley.
4. Curve ④ is for Malheur River near Drewsey
5. Curve ⑤ is for Bully Creek without regulation.
50,000
20,000
10,000
5,000
2,000
1,000
500
200
100
Discharge - cfs
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
0.1
REPORT ON RESERVOIR REGULATIONS
MALHEUR RIVER RESERVOIRS
Annual Flood Peak Discharge Frequencies
U.S. Army Eng. Dist., Walla Walla
Water Control Sect. Dec. 1966
Plate 3

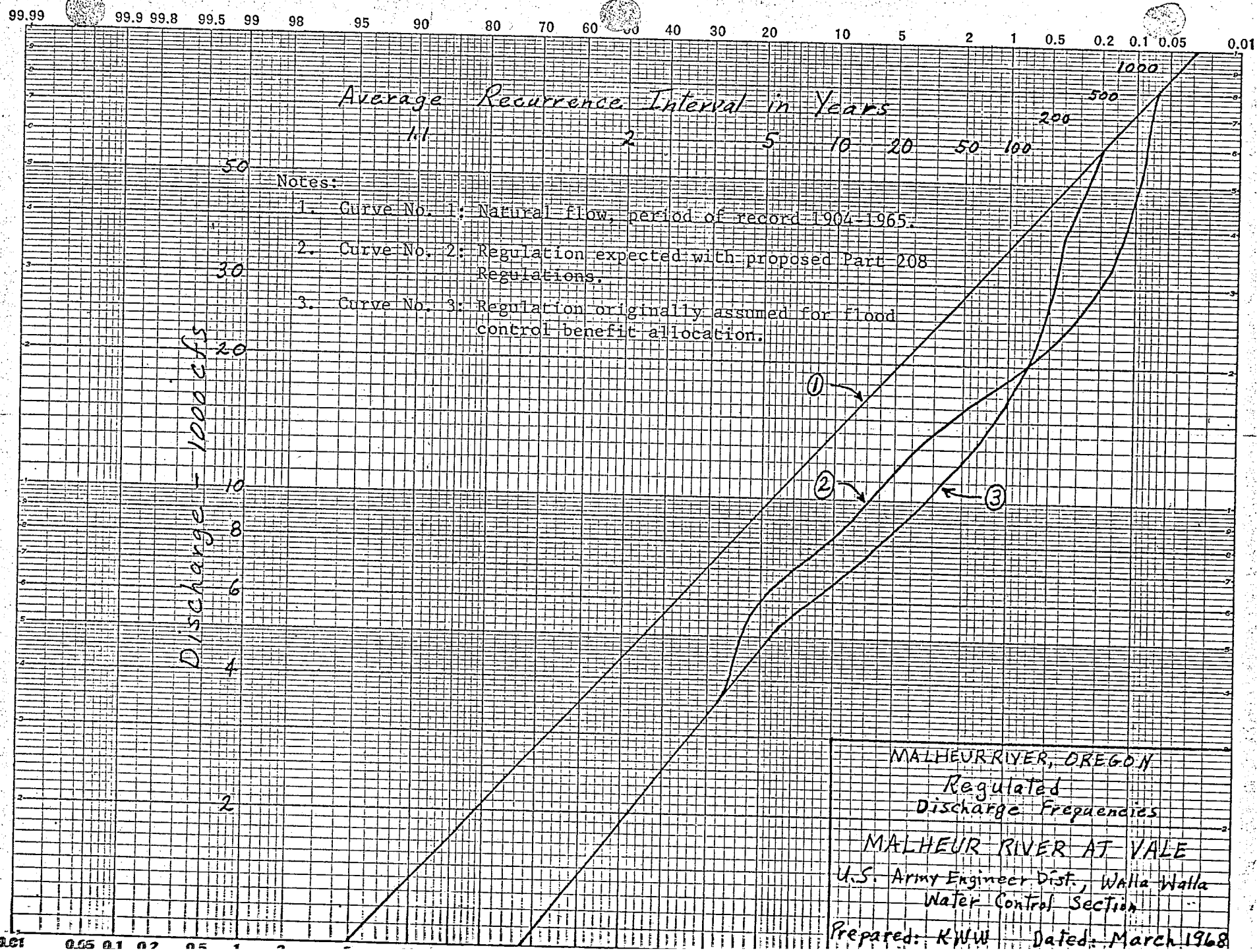
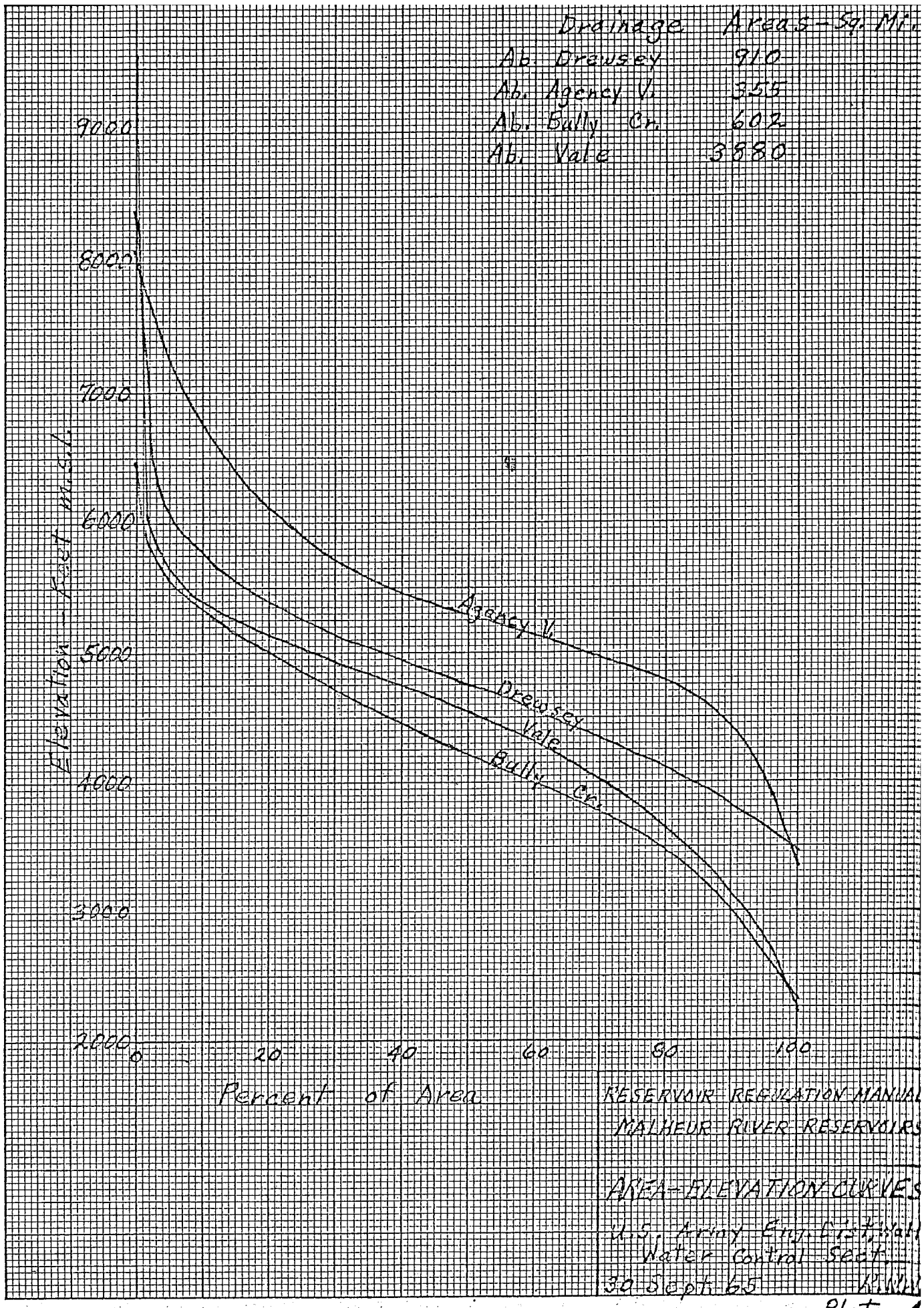

99.99 99.9 99.8 99.5 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
Average Recurrence Interval in Years
1.1 2 5 10 20 50 100 200 500 1000
50 30 20 10 8 6 4 2
Discharge - 1000 cfs
Notes:
1. Curve No. 1: Natural flow, period of record 1904-1965.
2. Curve No. 2: Regulation expected with proposed Part 208 Regulations.
3. Curve No. 3: Regulation originally assumed for flood control benefit allocation.
①
②
③
MALHEUR RIVER, OREGON
Regulated
Discharge Frequencies
MALHEUR RIVER AT VALE
U.S. Army Engineer Dist., Walla Walla
Water Control Section
Prepared: KWW Dated: March 1968

Plate 31

Drainage Areas – Sq. Mi.	
Ab. Drewsey	910
Ab. Agency V.	355
Ab. Bully Cr.	602
Ab. Vale	3580



RESERVOIR REGULATION MANUAL
MALHEUR RIVER RESERVOIRS

AREA-ELEVATION CURVES

U.S. Army Eng. District
Water Control Sect.
30 Sept 65 KPW

Plate 4

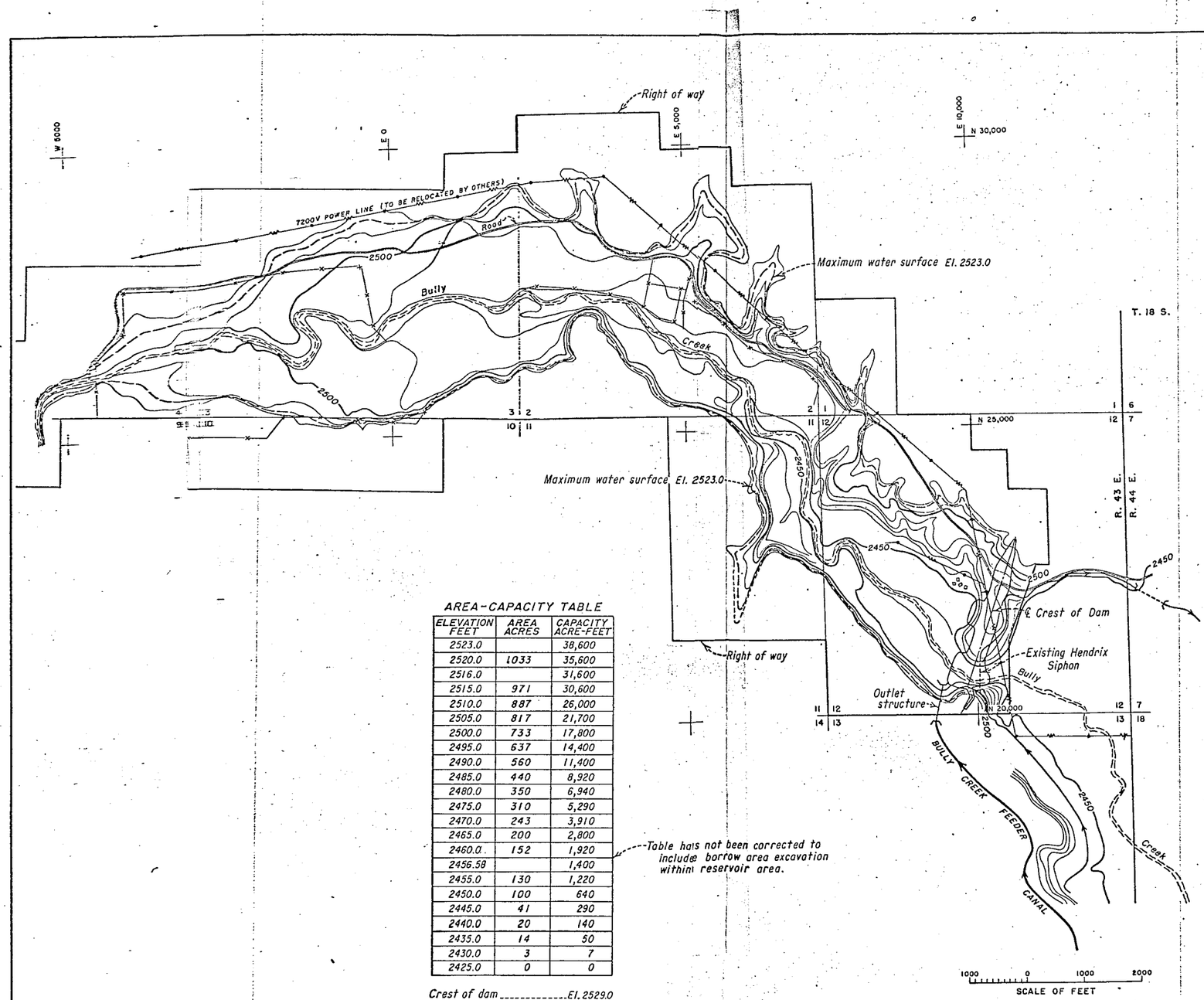
[redacted]

Plate 5

Plate 6

[redacted]

[redacted]



AREA-CAPACITY TABLE

ELEVATION FEET	AREA ACRES	CAPACITY ACRE-FEET
2523.0		38,600
2520.0	1033	35,600
2516.0		31,600
2515.0	971	30,600
2510.0	887	26,000
2505.0	817	21,700
2500.0	733	17,800
2495.0	637	14,400
2490.0	560	11,400
2485.0	440	8,920
2480.0	350	6,940
2475.0	310	5,290
2470.0	243	3,910
2465.0	200	2,800
2460.0	152	1,920
2456.58		1,400
2455.0	130	1,220
2450.0	100	640
2445.0	41	290
2440.0	20	140
2435.0	14	50
2430.0	3	7
2425.0	0	0

Table has not been corrected to include borrow area excavation within reservoir area.

Crest of dam ..... El. 2529.0
Maximum water surface ... El. 2523.0
Top of joint use pool ..... El. 2516.0
Minimum water surface ... El. 2456.58

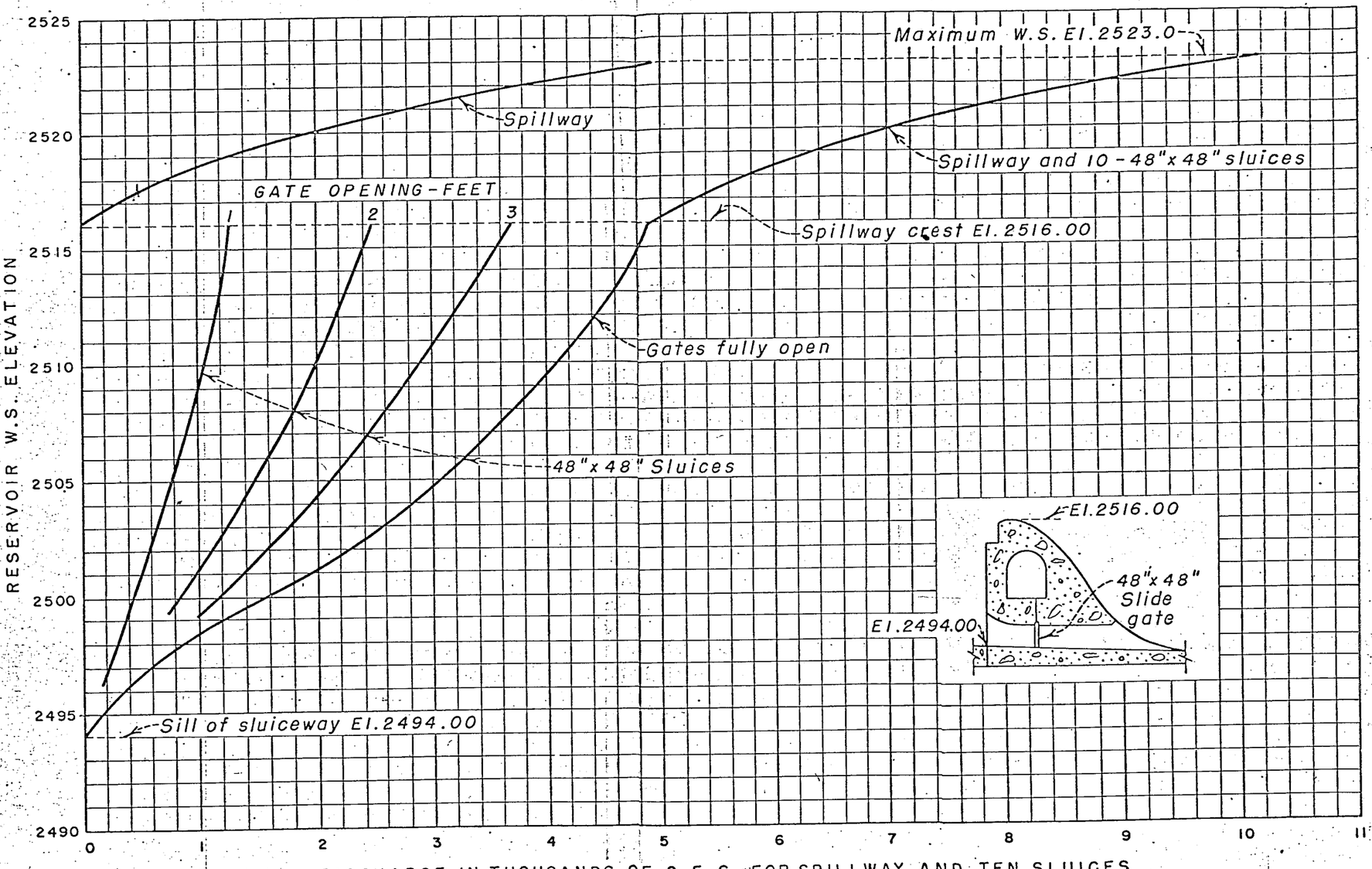
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
VALE PROJECT - OREGON

BULLY CREEK DAM
RESERVOIR TOPOGRAPHY

DRAWN ..... SUBMITTED Amkurtz
TRACED W.W.S. RECOMMENDED Fred C. Walker
CHECKED RKB APPROVED R. J. Farrow, CHIEF DAMS BRANCH

DENVER, COLORADO, DECEMBER 27, 1961 | 126-D-462

Plate 10



NOTES

Discharges are computed values. Any variation in discharges from these curves as determined by measurement of flow downstream from the spillway should be reported to the Chief Engineer.

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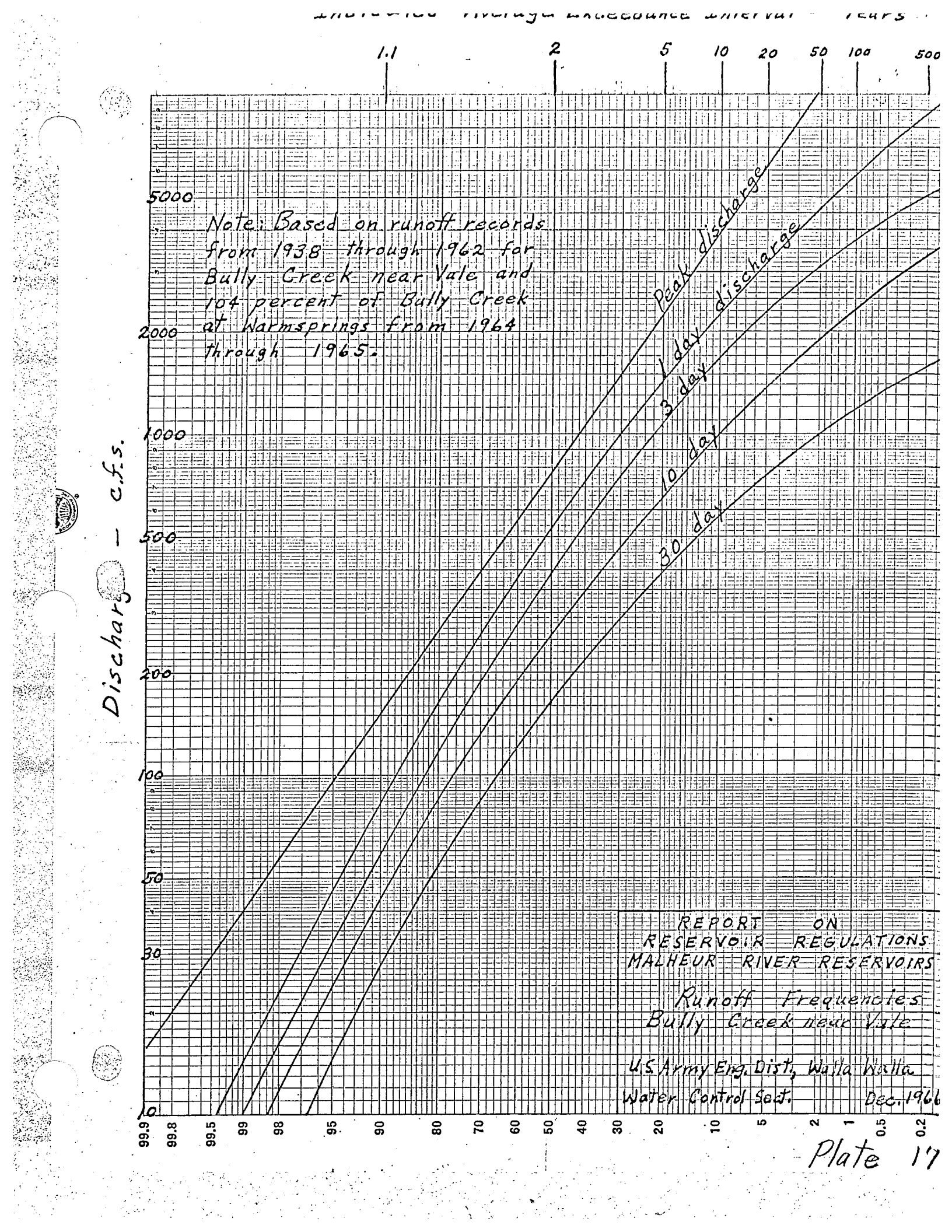
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
VALE PROJECT - OREGON

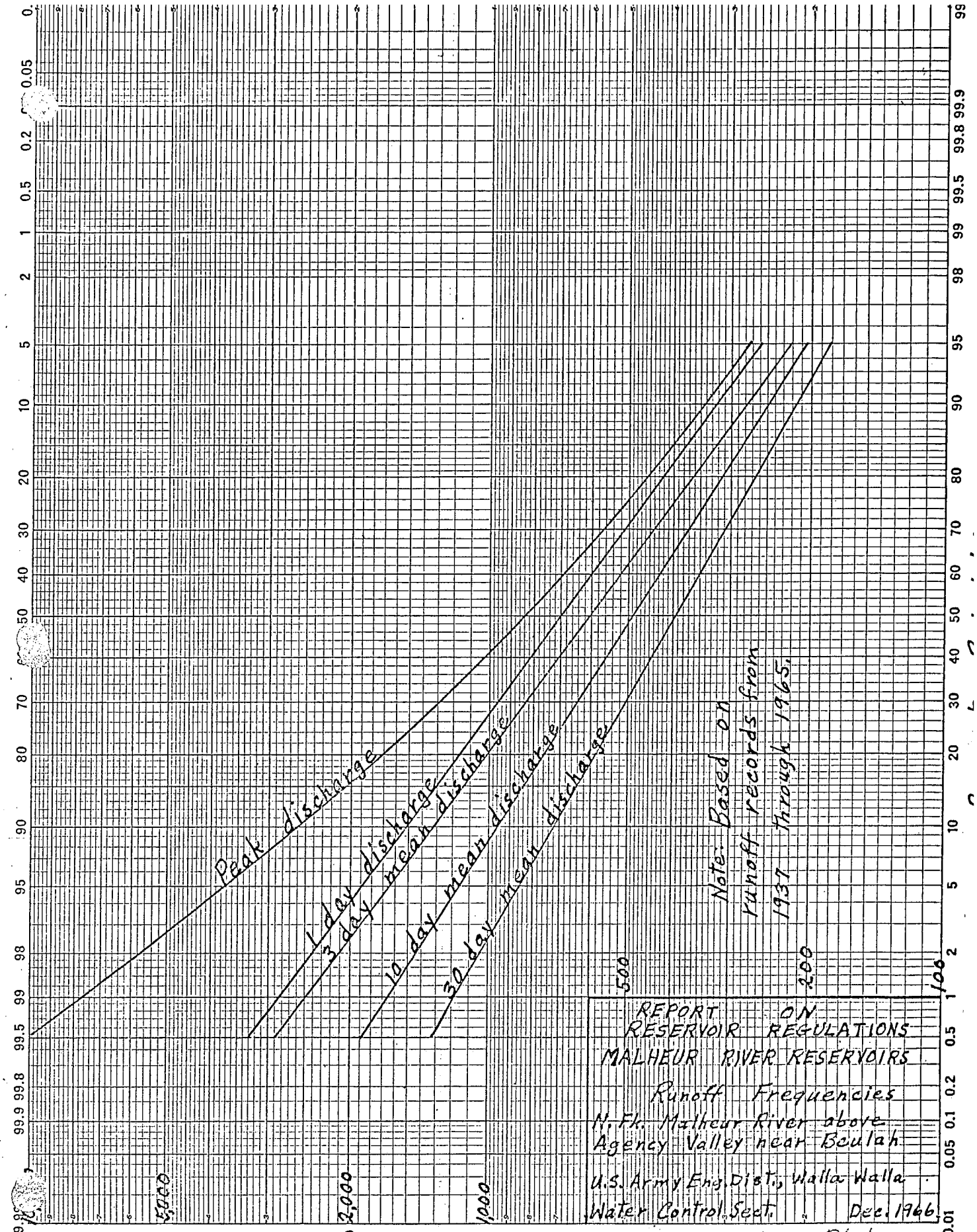
BULLY CREEK DAM
SPILLWAY
DISCHARGE CURVES

DRAWN S.W.G. SUBMITTED R.W. Whitney
TRACED W.G.C. RECOMMENDED R.J. Par
CHECKED R.L.B. APPROVED Jim Parma
As CHIEF DESIGN. E

DENVER, COLORADO, MARCH 1, 1963 | 126-D-5

Plate 11


Indicated Average Recurrence Interval - Years
1.1
2
5
10
20
50
100
500
5000
2000
1000
500
200
100
50
30
10
Discharge - c.f.s.
Note: Based on runoff records from 1938 through 1962 for Bully Creek near Vale and 104 percent of Bully Creek at Warmsprings from 1964 through 1965.
Peak discharge
1 day discharge
3 day
10 day
30 day
99.9
99.8
99.5
99
98
95
90
80
70
60
50
40
30
20
10
5
2
1
0.5
0.2
REPORT ON
RESERVOIR REGULATIONS
MALHEUR RIVER RESERVOIRS
Runoff Frequencies
Bully Creek near Vale
U.S. Army Eng. Dist., Walla Walla
Water Control Sect.
Dec. 1966
Plate 17


Peak discharge
1 day discharge
3 day mean discharge
10 day mean discharge
30 day mean discharge
Note: Based on runoff records from 1937 through 1965.
REPORT ON
RESERVOIR REGULATIONS
MALHEUR RIVER RESERVOIRS
Runoff Frequencies
N. Fk. Malheur River above
Agency Valley near Beulah
U.S. Army Eng. Dist., Walla Walla
Water Control Sect. Dec. 1966
Discharge - c.f.s.
Plate 18

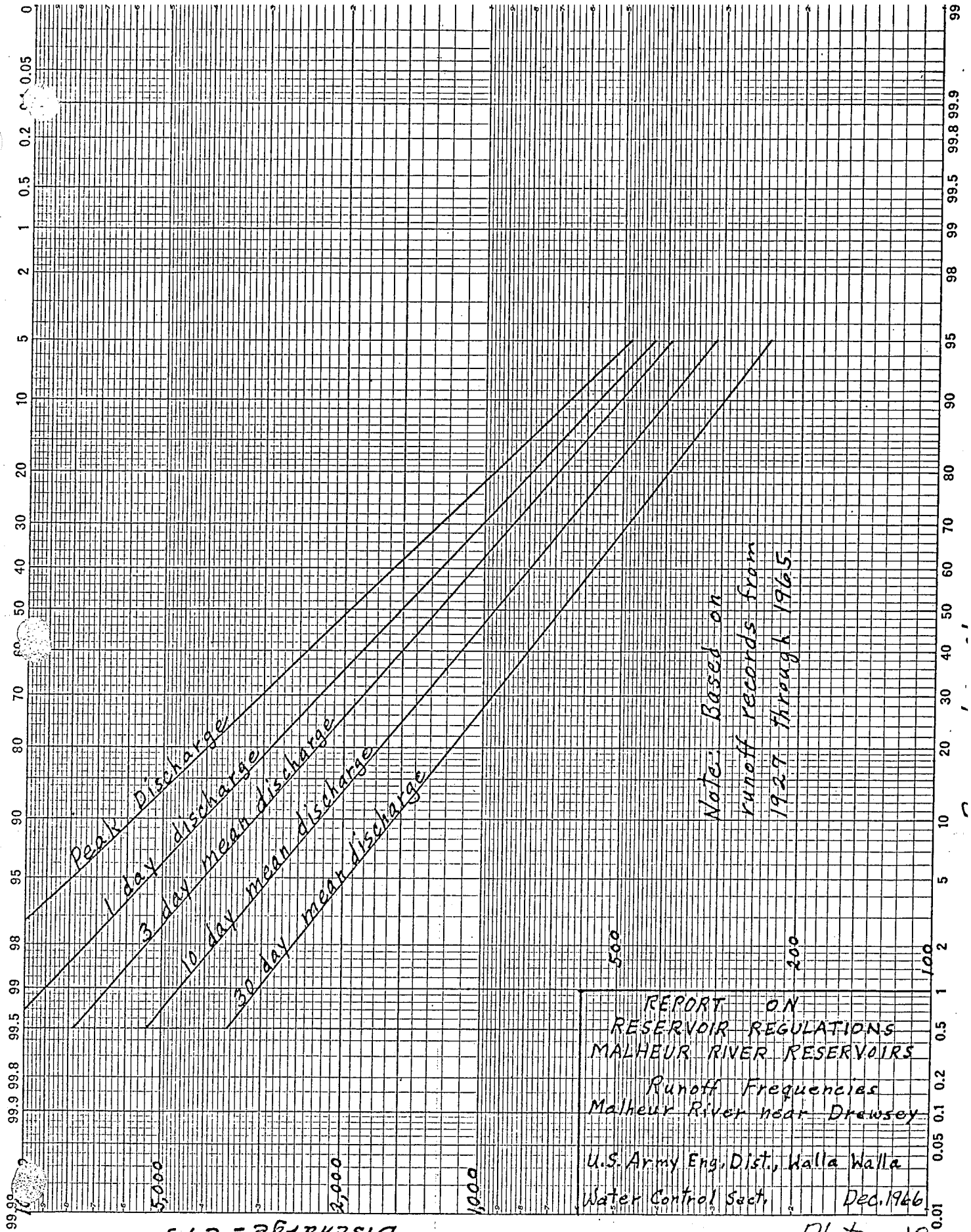
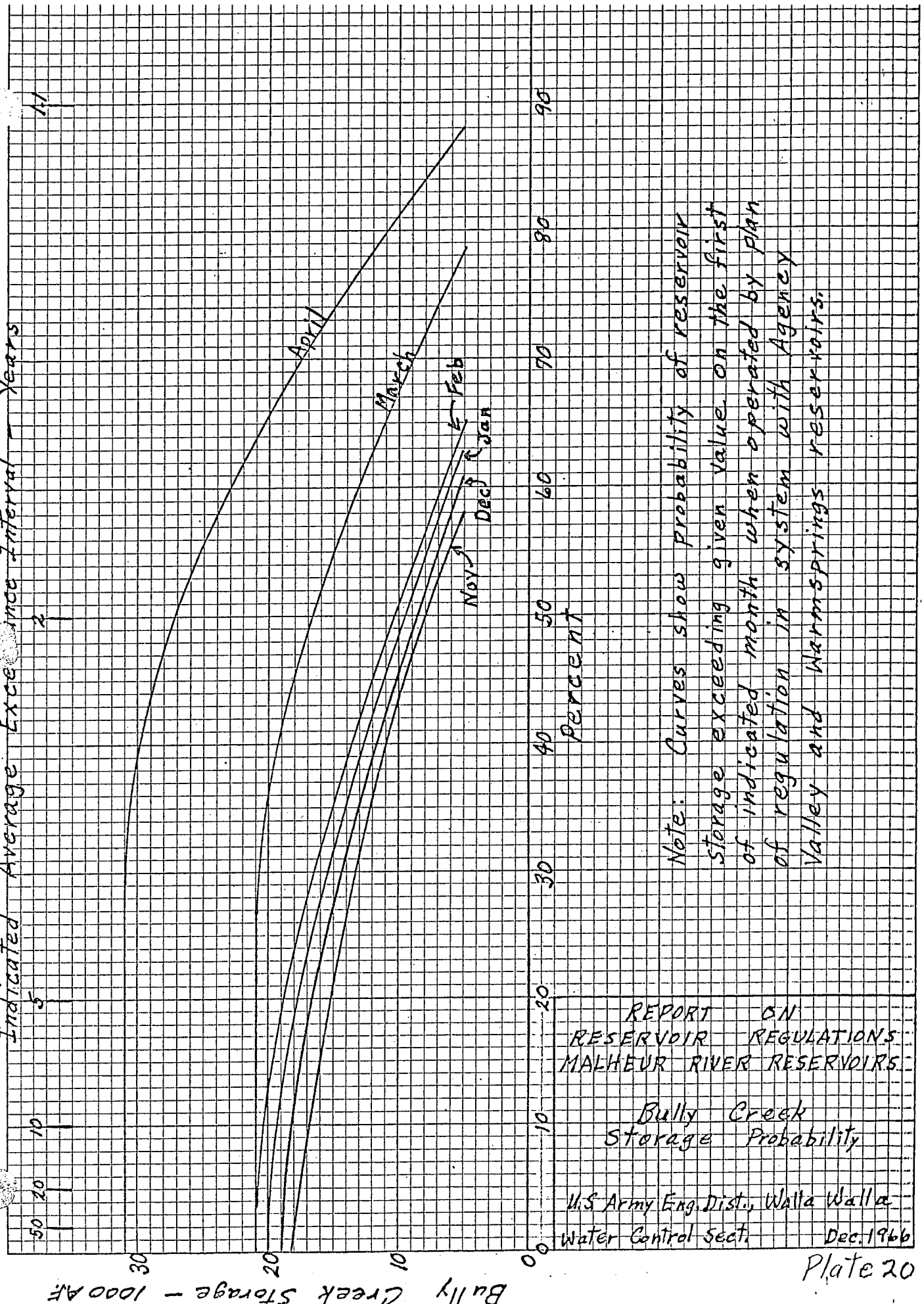
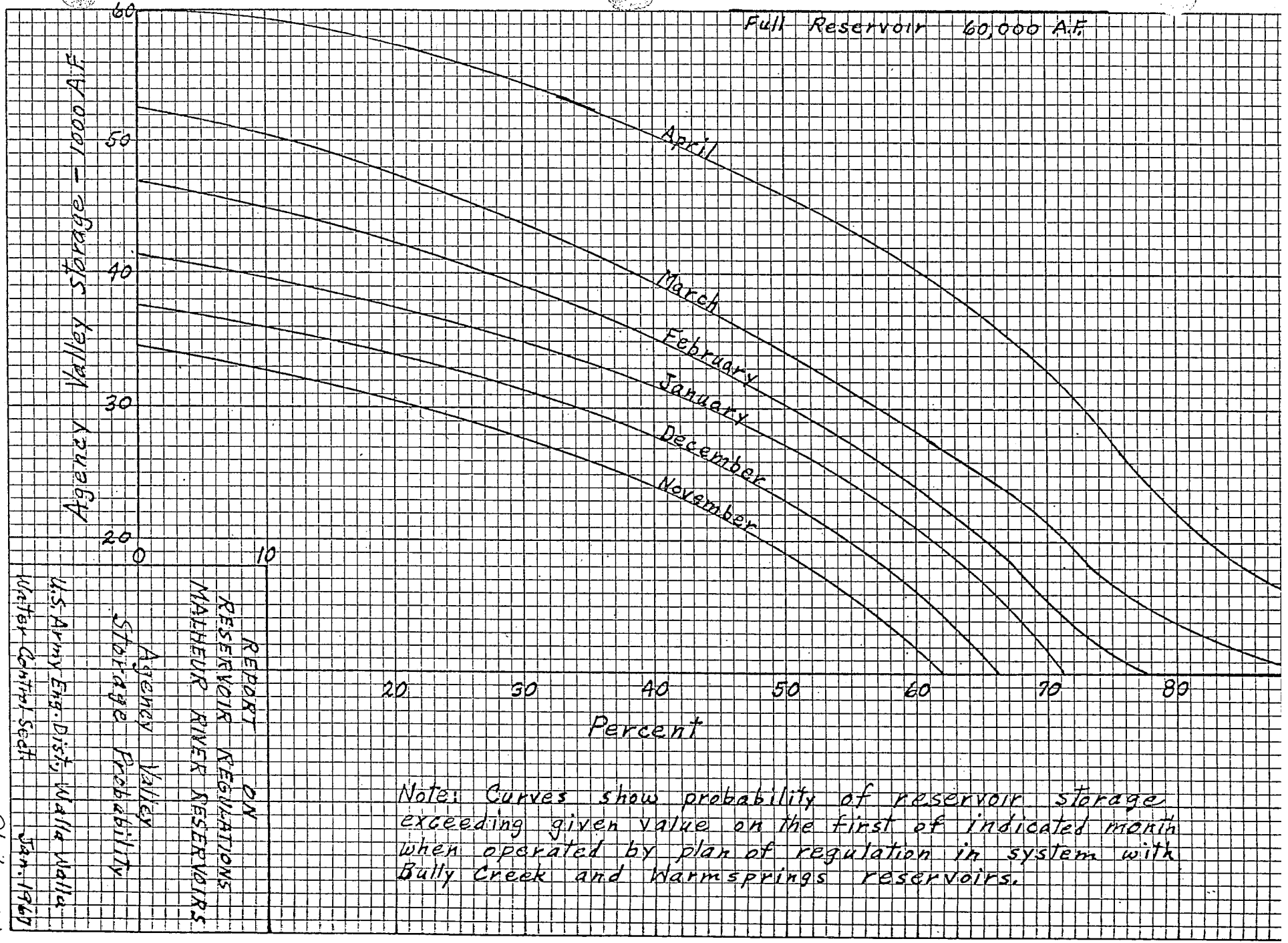

Peak discharge
1 day discharge
3 day mean discharge
10 day mean discharge
30 day mean discharge
Note: Based on runoff records from 1929 through 1965.
500
200
100
5,000
2,000
1,000
Discharge - cfs
REPORT ON
RESERVOIR REGULATIONS
MALHEUR RIVER RESERVOIRS
Runoff Frequencies
Malheur River near Drewsey
U.S. Army Eng. Dist., Walla Walla
Water Control Sect.
Dec. 1966

Plate 19



KEUFFEL & ESSER CO.

KEUFFEL & ESSER CO.



Note: Curves show probability of reservoir storage exceeding given value on the first of indicated month when operated by plan of regulation in system with Bully Creek and Warmsprings reservoirs.

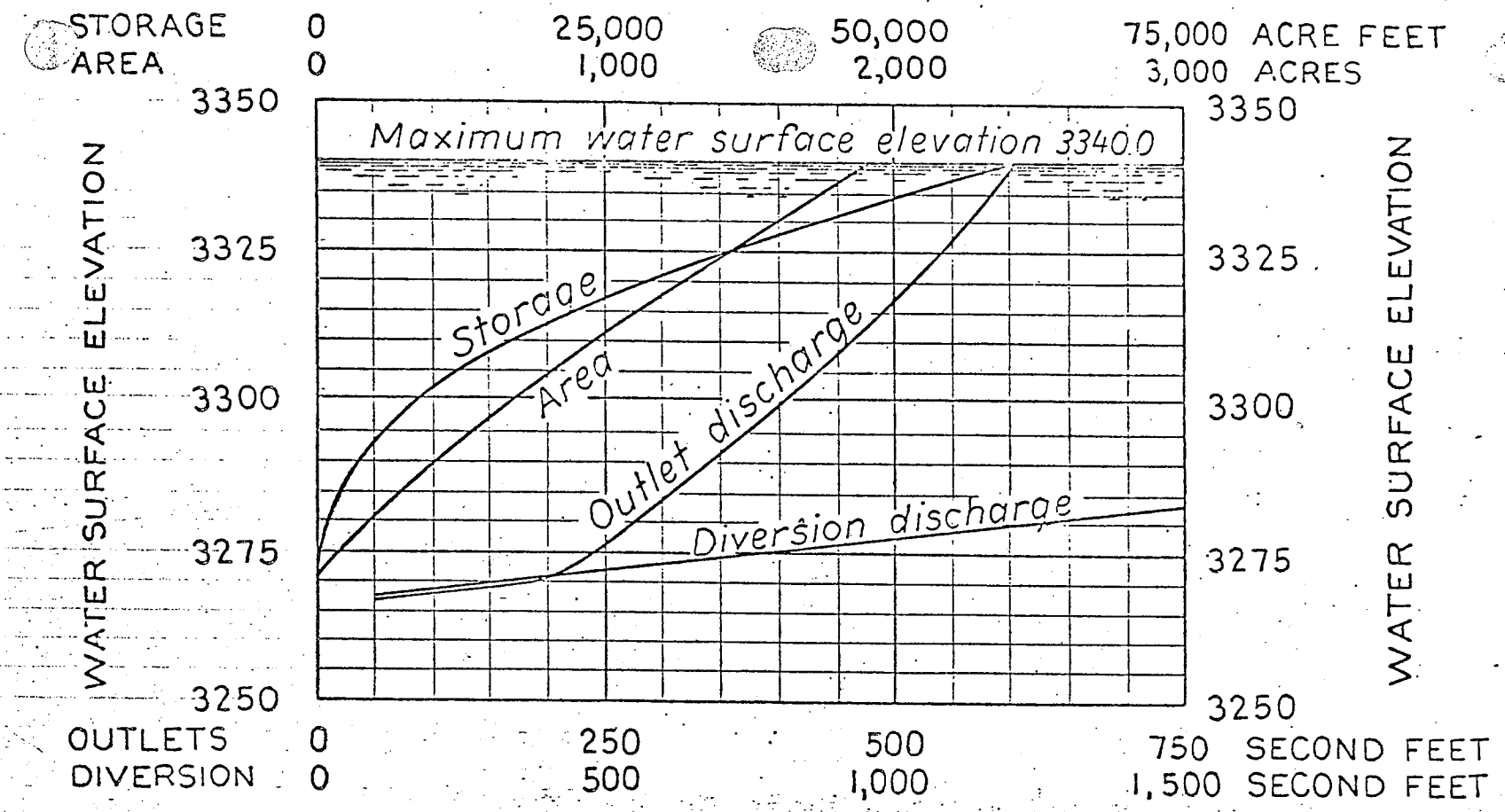
REPORT ON RESERVOIR REGULATIONS MALHEUR RIVER RESERVOIRS

Agency Valley Storage Probability

U.S. Army Eng. Dist., Walla Walla Water Control Sect.

Jan. 1967

Plate 21



STORAGE - AREA - DISCHARGE CURVES

BUREAU OF RECLAMATION

VALE PROJECT - OREGON

RECORD DRAWING

AGENCY VALLEY DAM

GENERAL PLAN AND SECTIONS

REV. 6-24-36

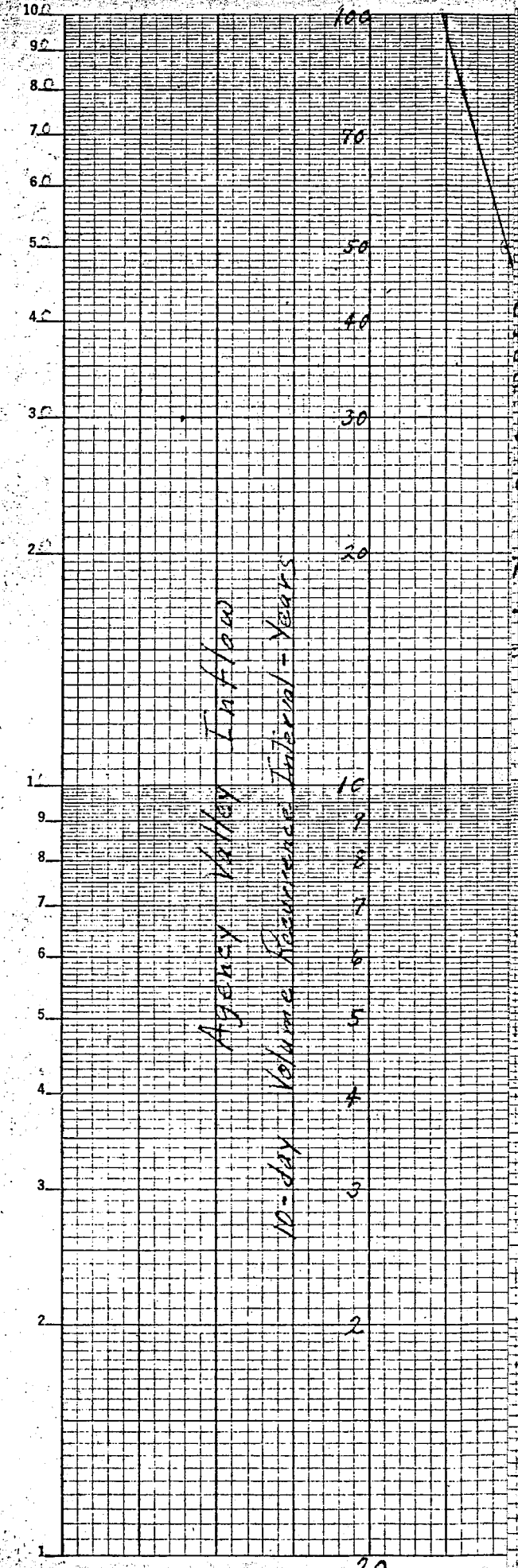
DRAWN: D.R.M. SUBMITTED: B. K. Steele

TRACED: P.M.W. RECOMMENDED: J. L. Savage

CHECKED: R.B.S. F.F.S. APPROVED: A. J. Taylor

DENVER, COLO. DEC. 7, 1933

Plate 22

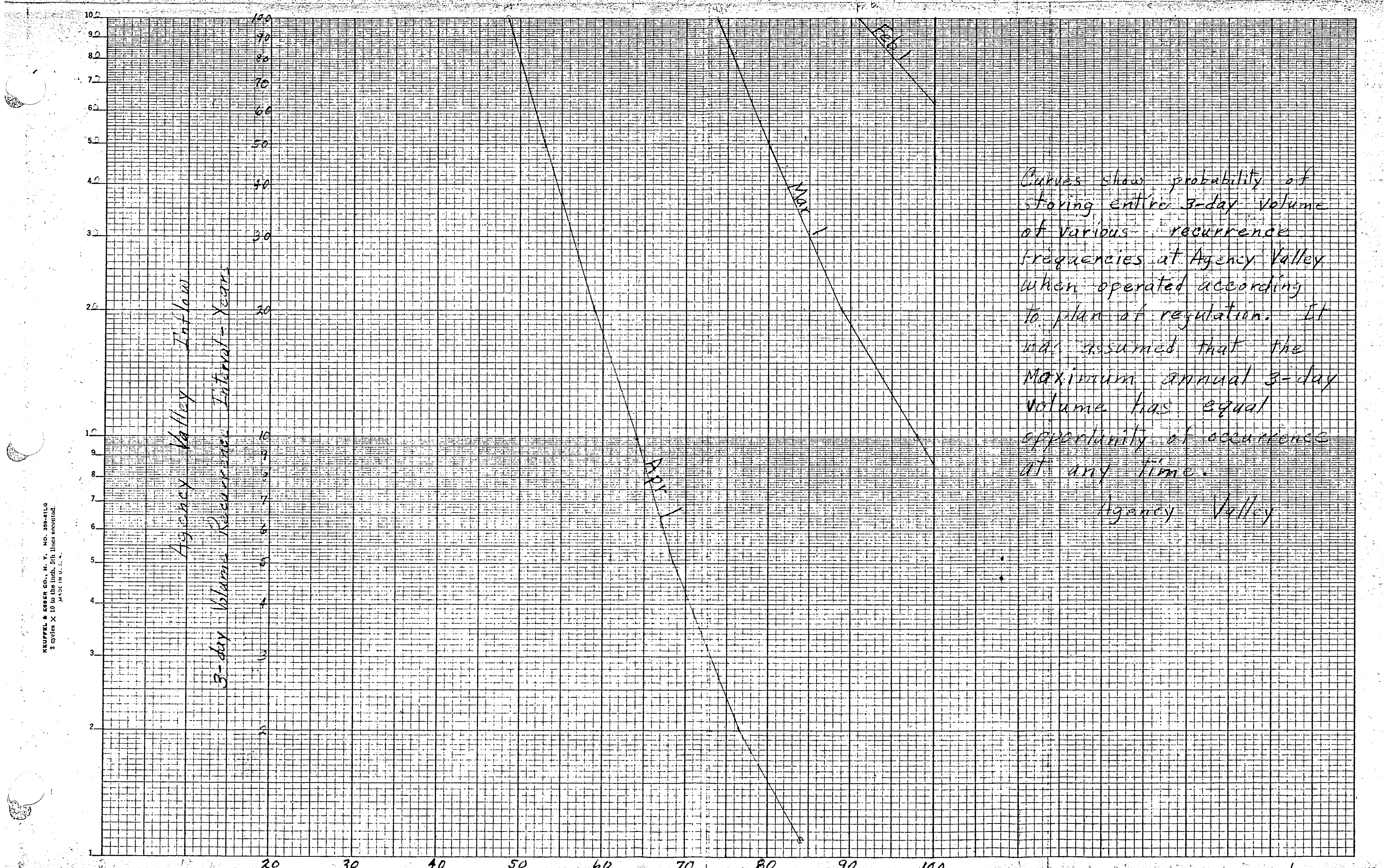


urves show probability of
ering entire 10-day volume
f various recurrence
equencies at Agency Valley
en operated according to plan
regulation. It was assumed
t the maximum annual
-day volume has equal
ortunity of occurrence
any time.

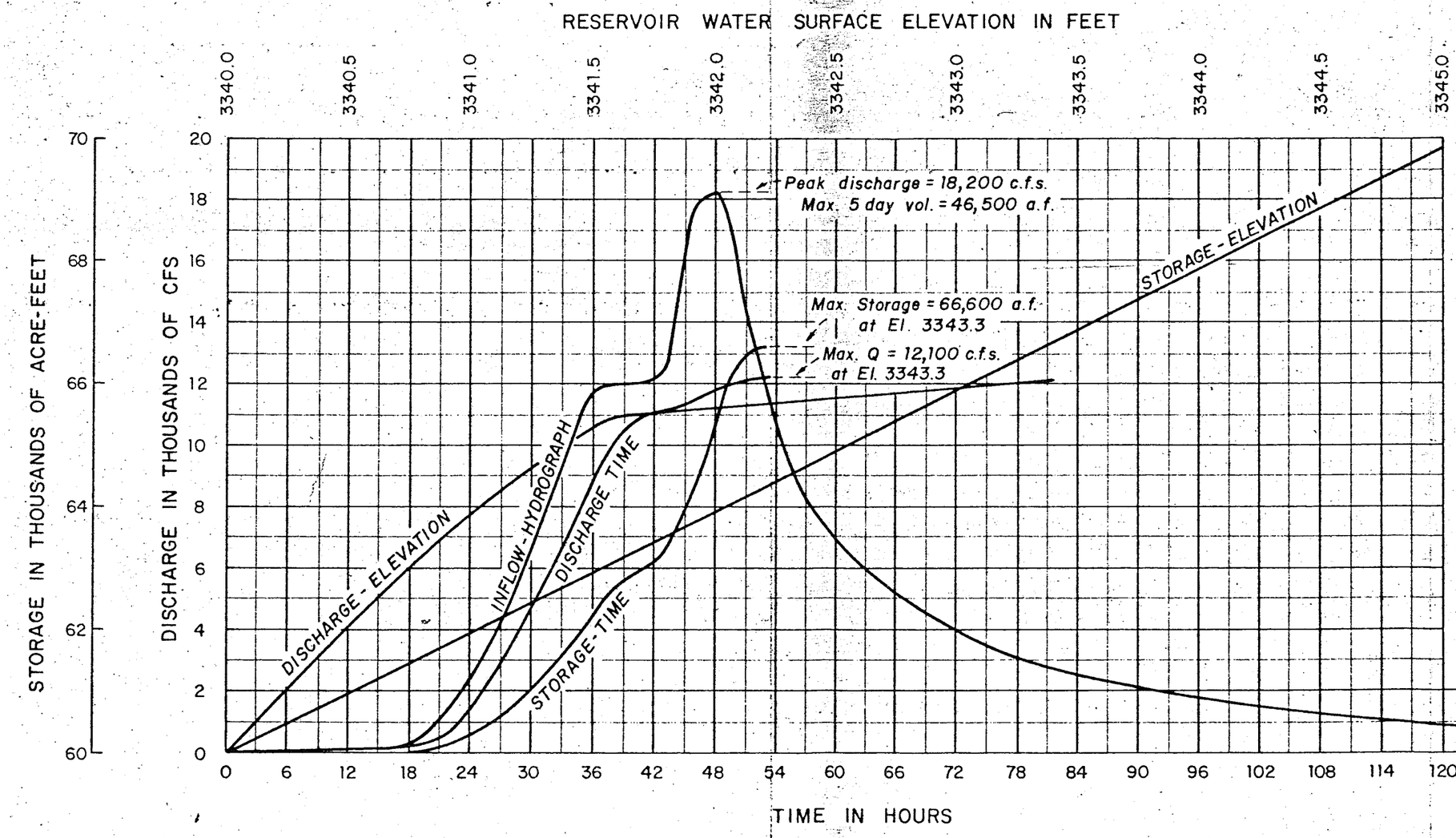
Agency Valley

KEUFFEL & ESSER CO., N. Y. NO. 359-61LG
2 cycles X 10 to the inch, 5th lines accented.
MADE IN U. S. A.

Plate 23



Agency Valley Inflow
3-day Volume Recurrence Interval - Years
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
Feb 1
Mar 1
Apr 1
20
30
40
50
60
70
80
90
100
Curves show probability of storing entire 3-day volume of various recurrence frequencies at Agency Valley when operated according to plan of regulation. It was assumed that the Maximum annual 3-day volume has equal opportunity of occurrence at any time.
Agency Valley
KEUFFEL & ESSER CO., N. Y. NO. 359-61LG
2 cycles × 10 to the inch, 5th lines accented.
MADE IN U.S.A.



This flood routing is for spillway structure shown on Dwg. 126-D-185.

In routing this inflow design flood, the reservoir level was assumed at the top of the spillway gates, elevation 3340, at the beginning of the flood. The spillway gates were raised on a fixed ratio (7to1) of gate opening to rise in reservoir level above elevation 3340. The outlet works were assumed closed while spillway was in use. The gates were throttled to a maximum discharge of 12,100 c.f.s.

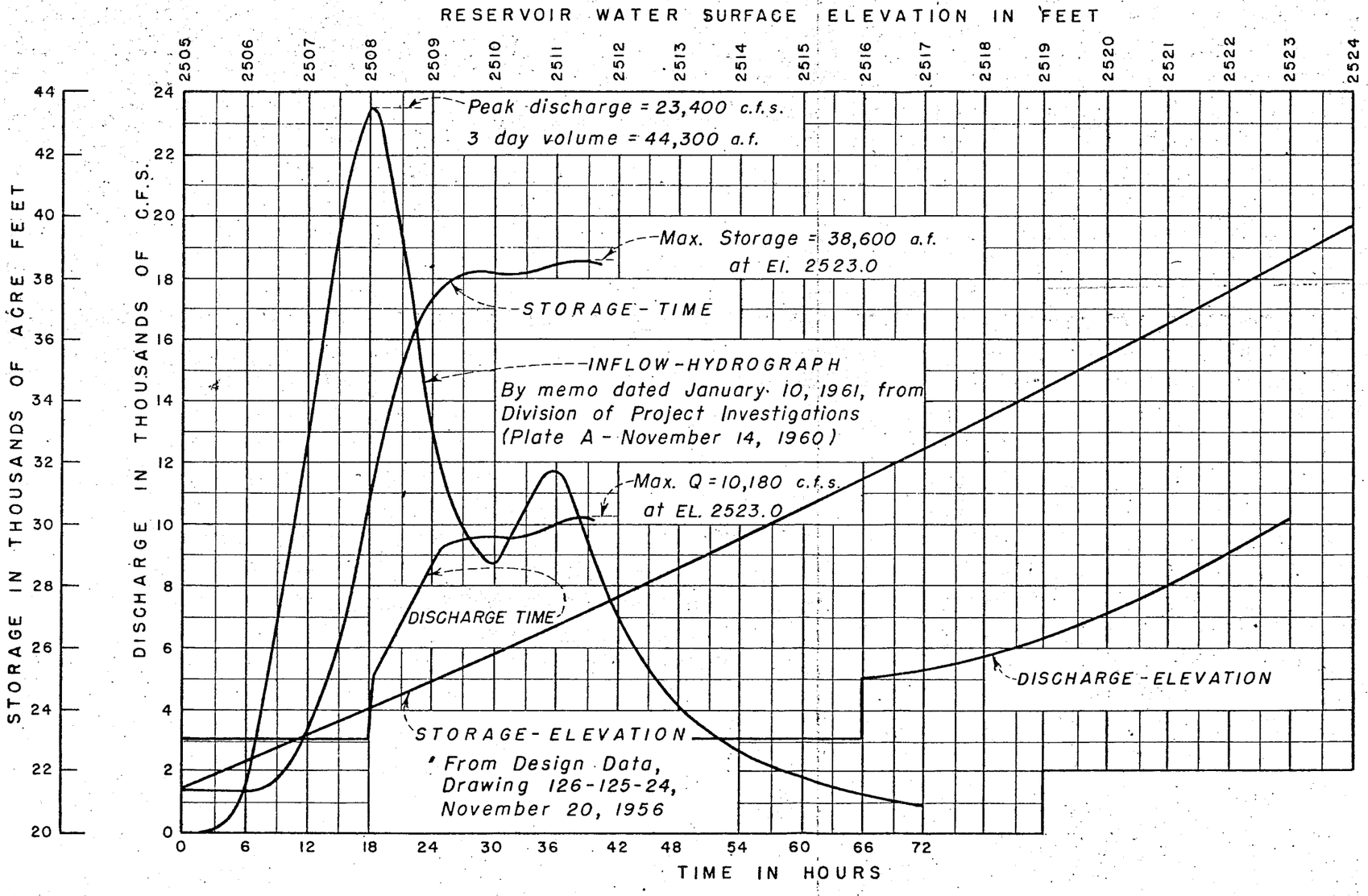
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
VALE PROJECT - OREGON

AGENCY VALLEY DAM

FLOOD ROUTING

DRAWN	SUBMITTED
TRACED D.L.A.	RECOMMENDED
CHECKED	APPROVED
BOISE, IDA. FEB. 23, 1968	126-100-52

Plate 25



NOTES

This flood routing is for spillway structure on Dwg. 126-D-403

This flood routing utilizes the capacities of both the spillway and the sluices. It is assumed that 10,000 acre feet of joint-use storage space is available at beginning of inflow design flood. Sluiceway releases are limited to 3,000 c.f.s. during filling of joint-use storage space. At reservoir W.S. El. 2516.0, sluiceway gates are fully opened.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
VALE PROJECT - OREGON

BULLY CREEK DAM
FLOOD ROUTING

DRAWN S.W.G. SUBMITTED A.H. Austin
TRACED A.J.A. RECOMMENDED R.W. Whinnery
CHECKED R.L.B. APPROVED R.J. Larsen
CHIEF, DAMS BRANCH

DENVER, COLO., OCT. 11, 1963 | 126-D-506

RESERVOIR WATER SURFACE - ELEVATION IN FEET

3393. 3394. 3395 3396 3397 3398 3399 3400 3401 3402 3403 3404 3405 3406

STORAGE IN THOUSANDS OF ACRE FEET

208 202 196 190 184 178 172 166 160 154 148 142 136 130

DISCHARGE IN THOUSANDS OF C.F.S.

39 36 33 30 27 24 21 18 15 12 9 6 3 0

Peak discharge = 13,500 c.f.s.
5 Day volume = 105,400 a.f.

Max. storage = 192,300 a.f. at El. 3406.3

INFLOW - HYDROGRAPH

STORAGE - TIME

STORAGE - ELEVATION

Max Q = 13,500 c.f.s. at El. 3406.3

DISCHARGE - TIME

DISCHARGE - ELEVATION

0 6 12 18 24 30 36 42 48 54 60 66 72 78 84 90 96 102 108 114 120 126 132 138 144

TIME IN HOURS

NOTES

This flood routing utilizes reservoir storage and the capacities of the outlets and the spillway (all flashboards removed).

The reservoir is assumed drawn down to elevation 3393.65 when the maximum inflow to the flood enters the reservoir. The outlets are of such size that outlets equals inflow and the reservoir is held at elevation 3393.65 for as long as possible thereafter with the outlets fully opened. The flood begins to fill the available storage space. Outlets only are discharging between elevations 3393.65 and 3401 (crest of spillway). Above elevation 3401, both the spillway (all flashboards removed) and outlets are discharging.

Maximum reservoir elevation reached in routing the flood is elevation 3406.3 at a discharge of 13,500 c.f.s.

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

VALE PROJECT - OREGON

WARM SPRINGS DAM

FLOOD ROUTING

DRAWN D.L.B. SUBMITTED

TRACED RECOMMENDED

CHECKED A.L.R. APPROVED

DENVER, COLORADO, MAY 1933

126-D223-4

Plate 27

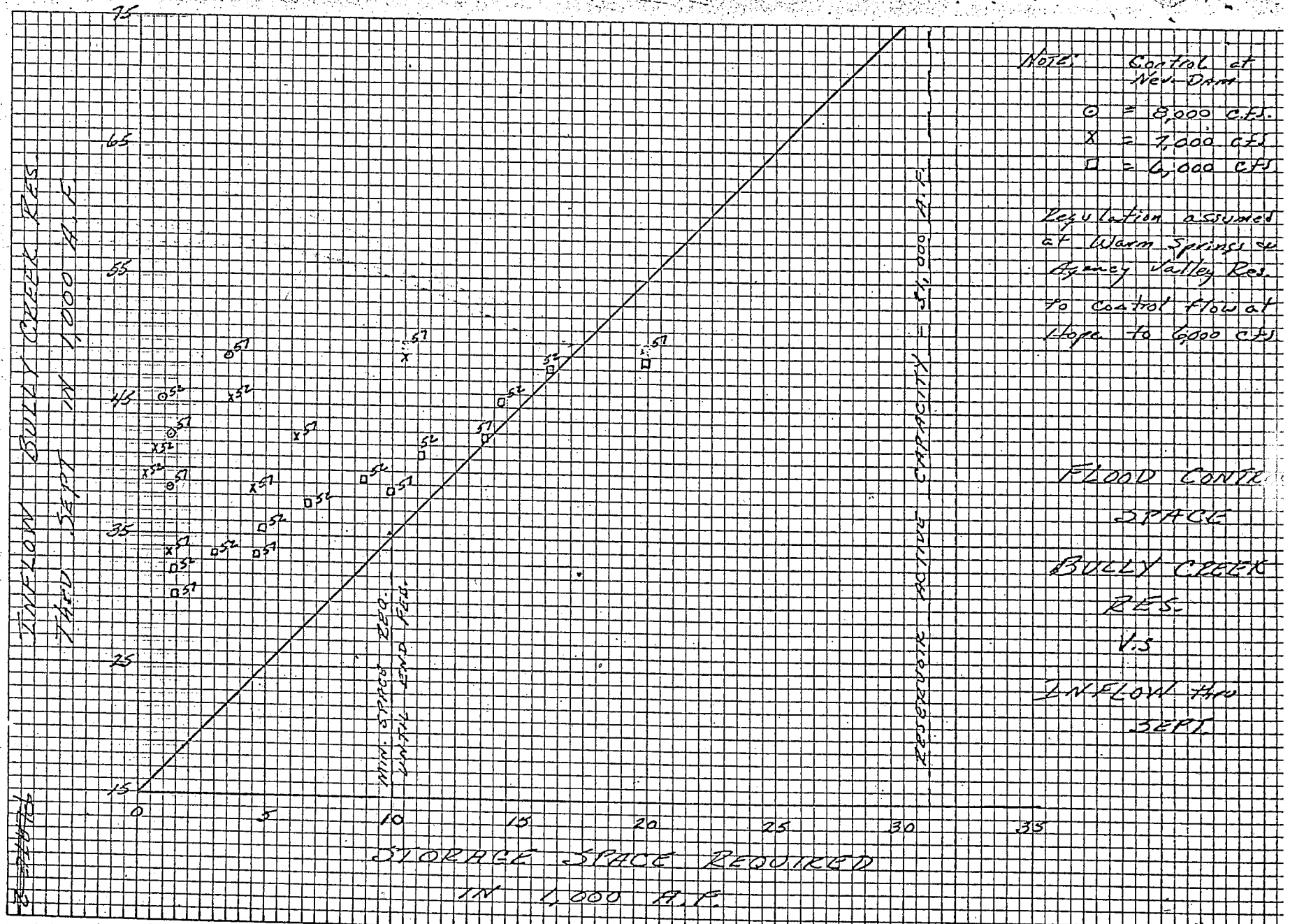
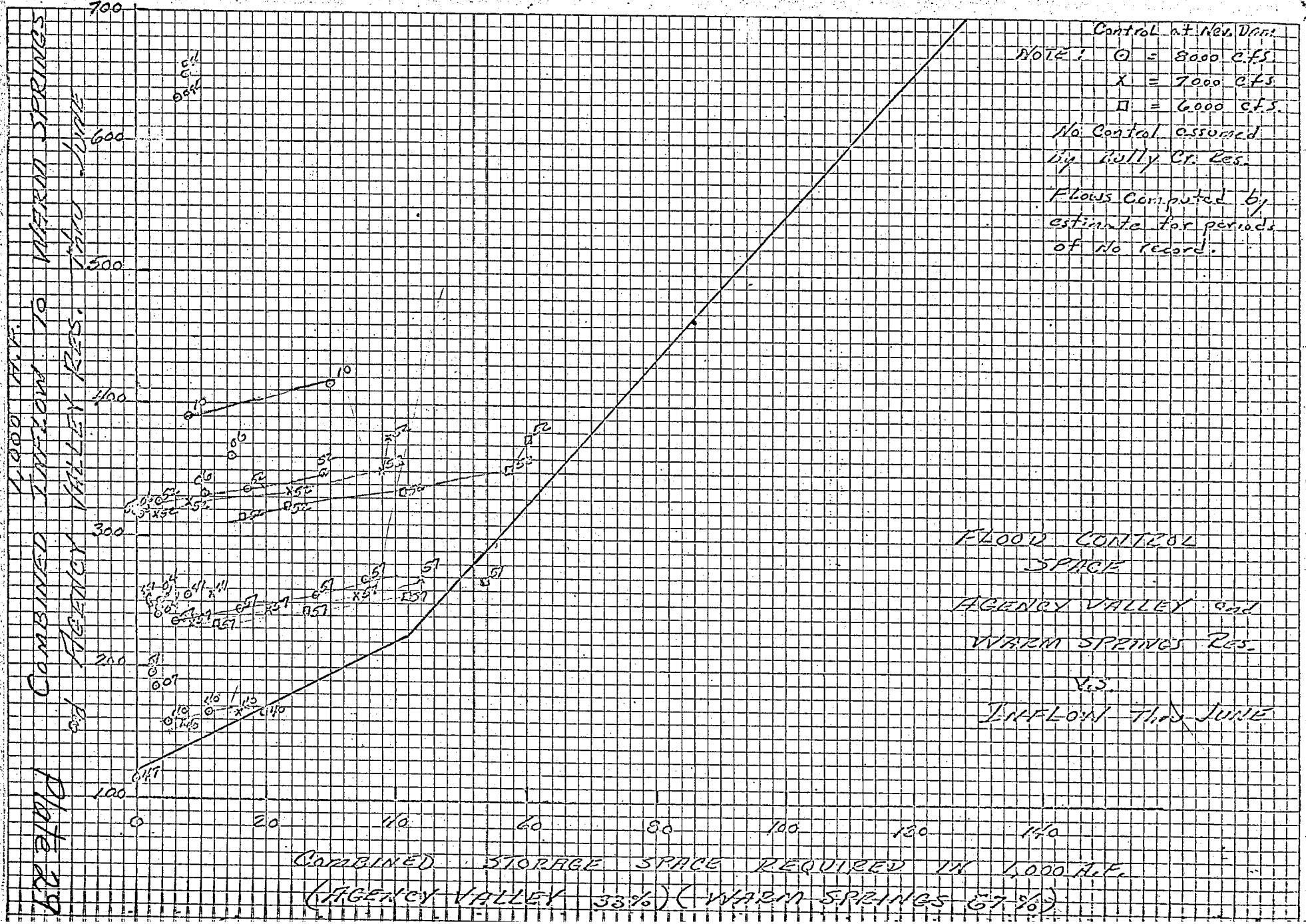
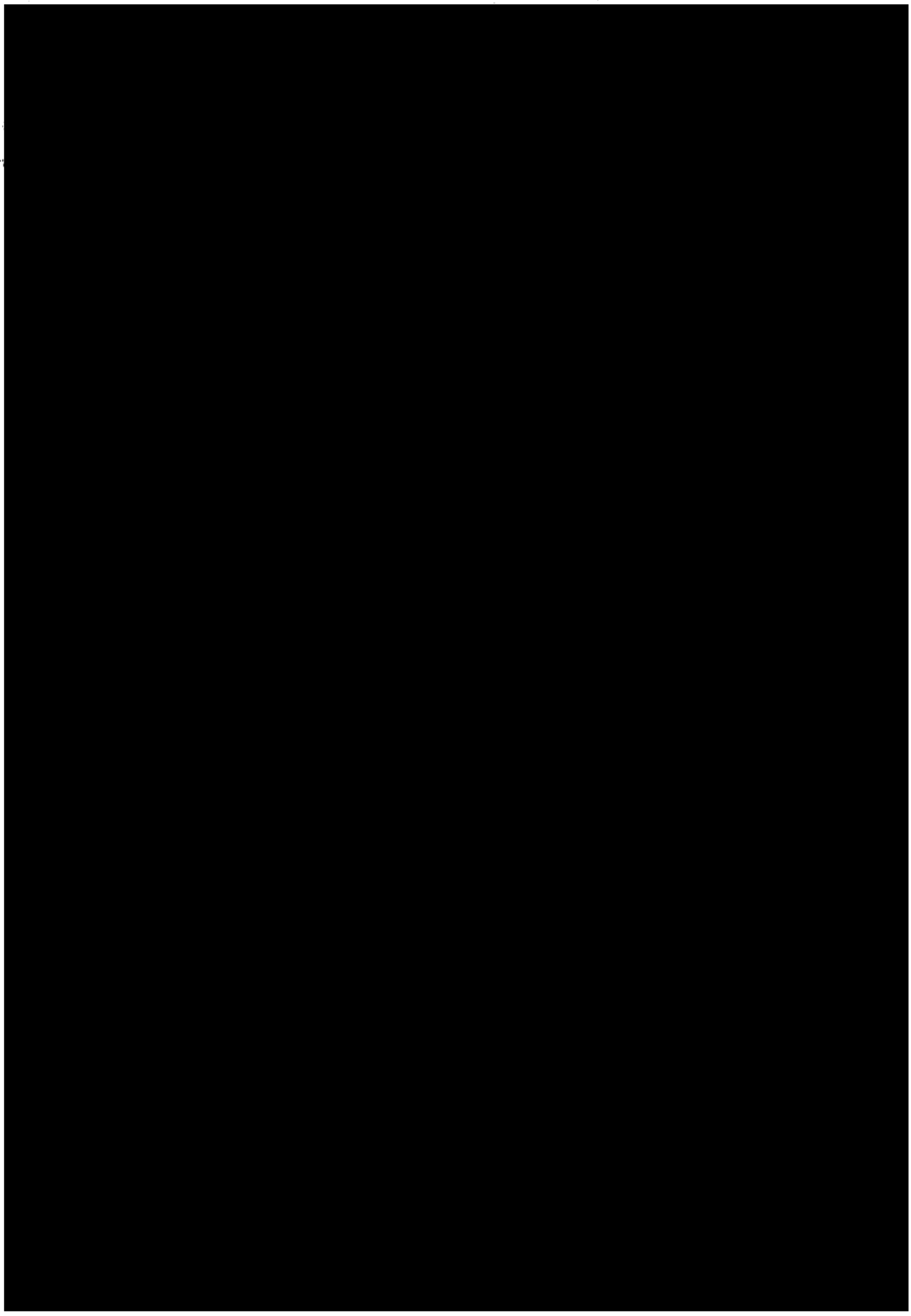
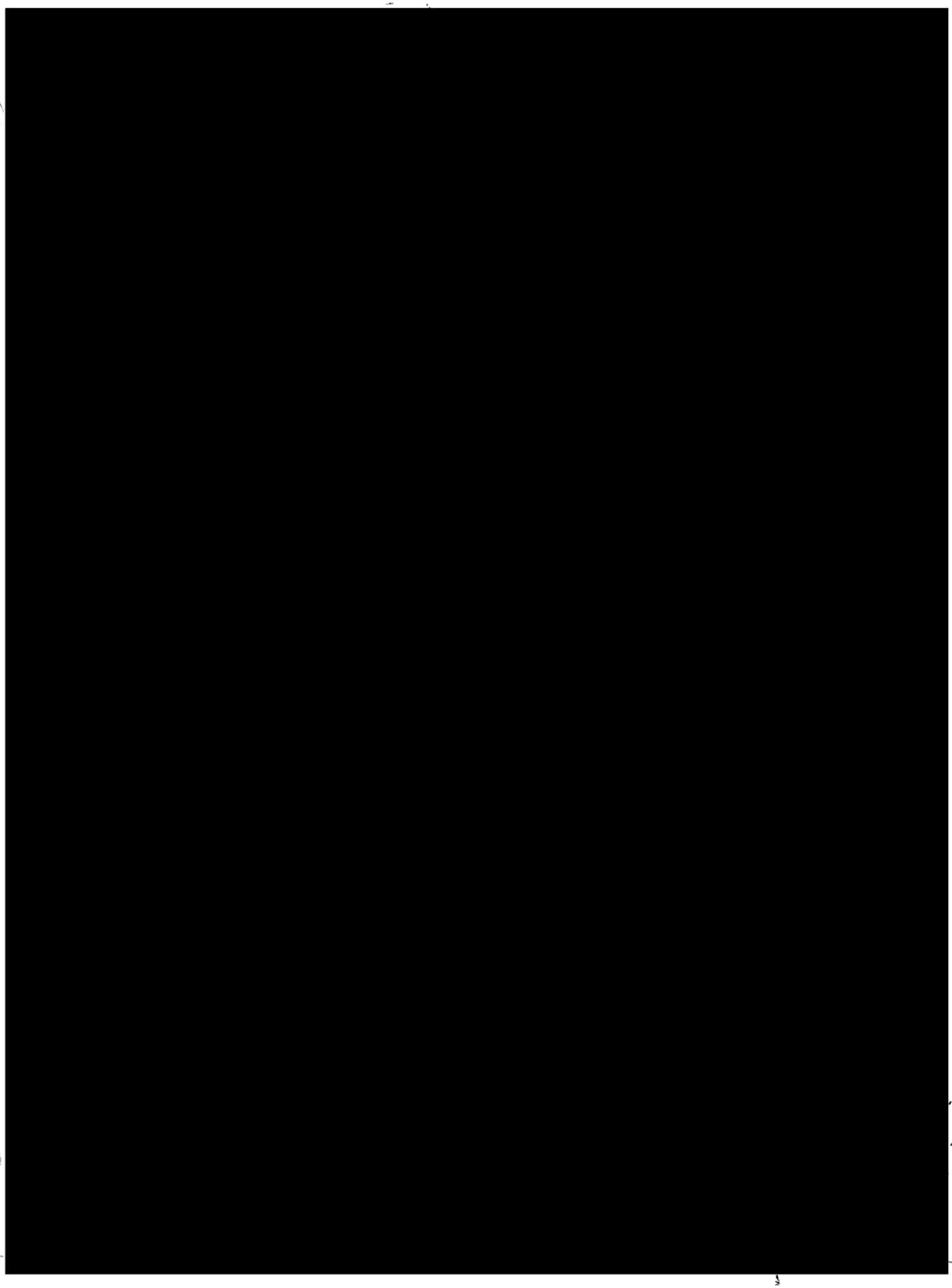
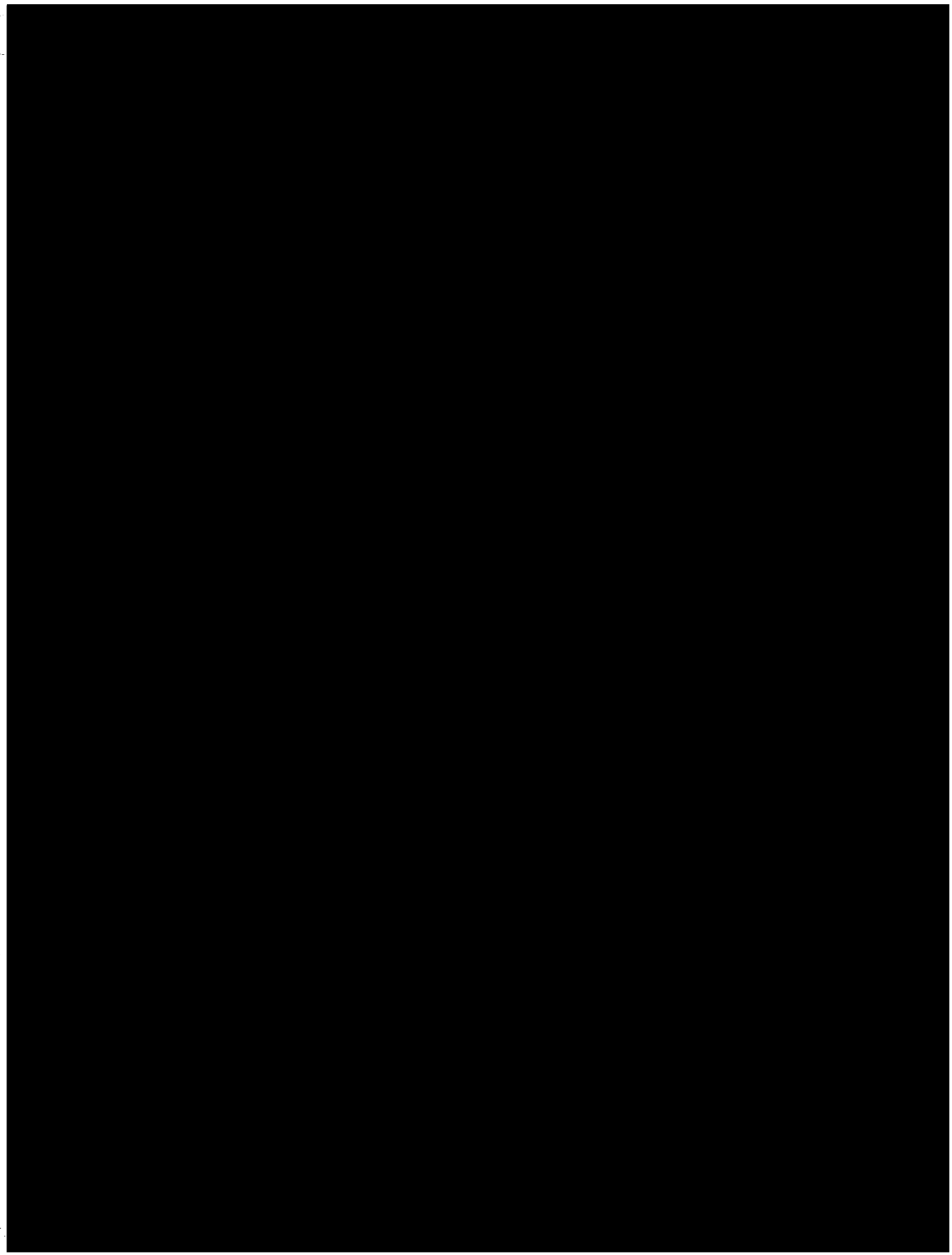


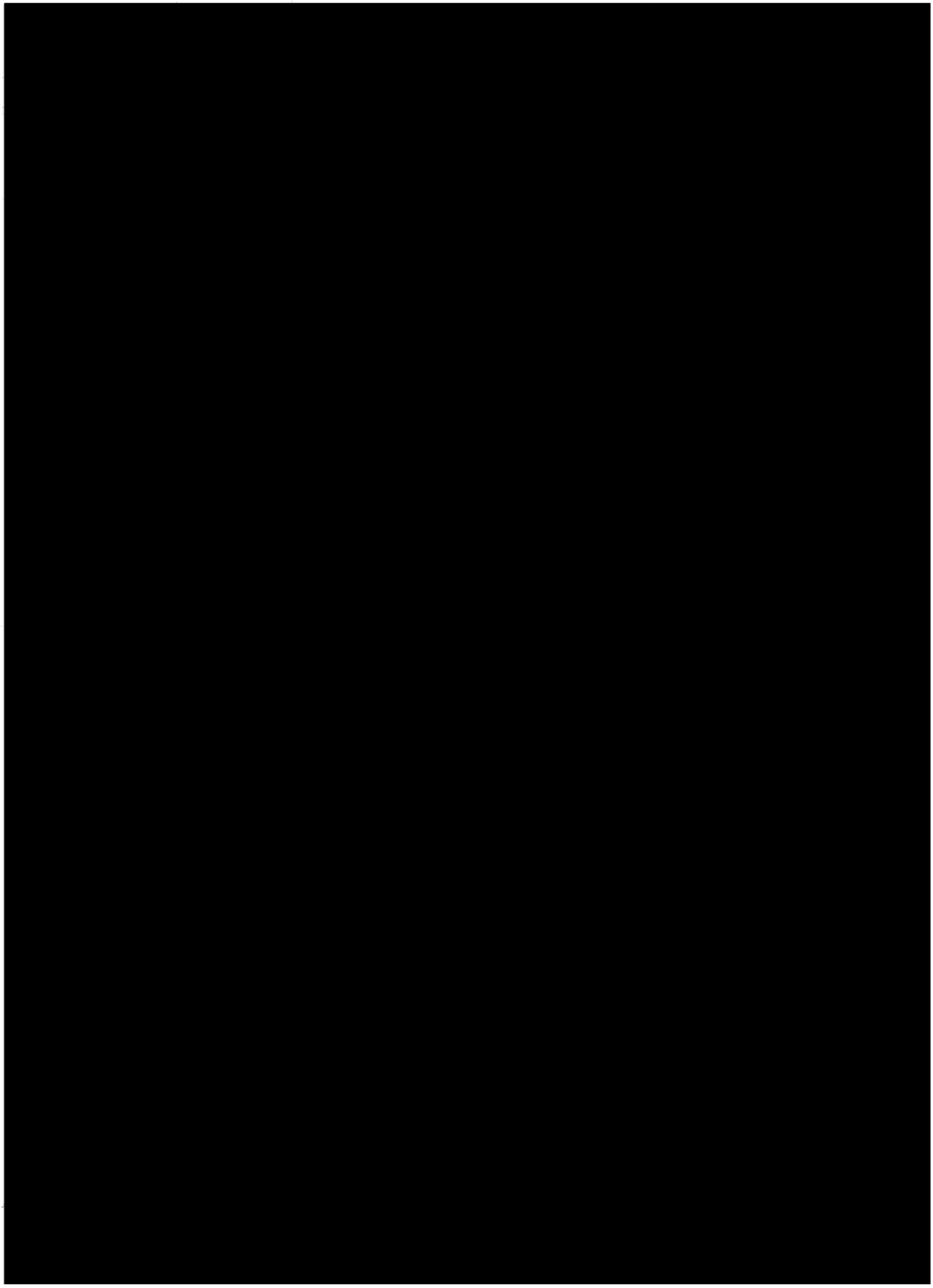
Plate 28

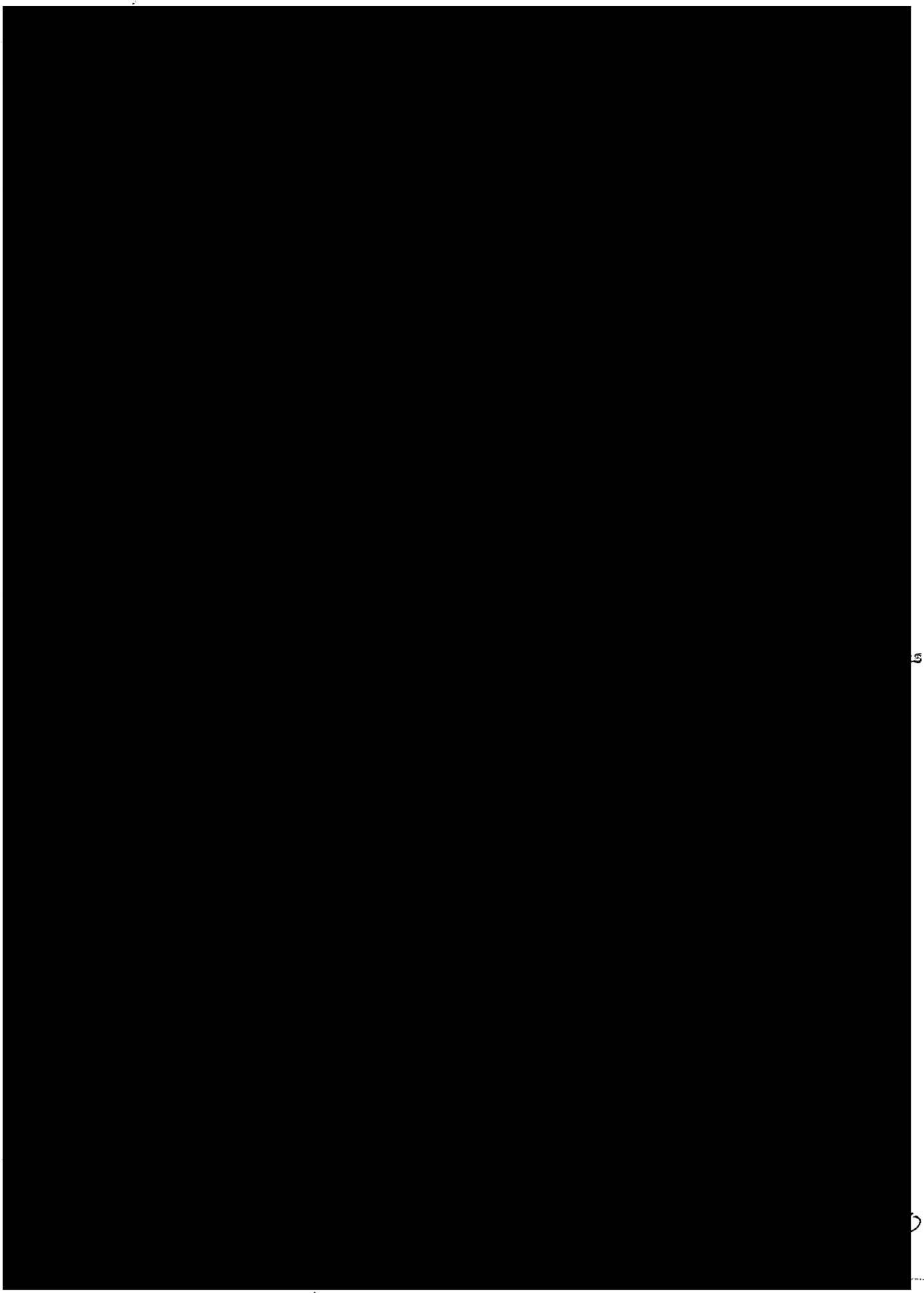












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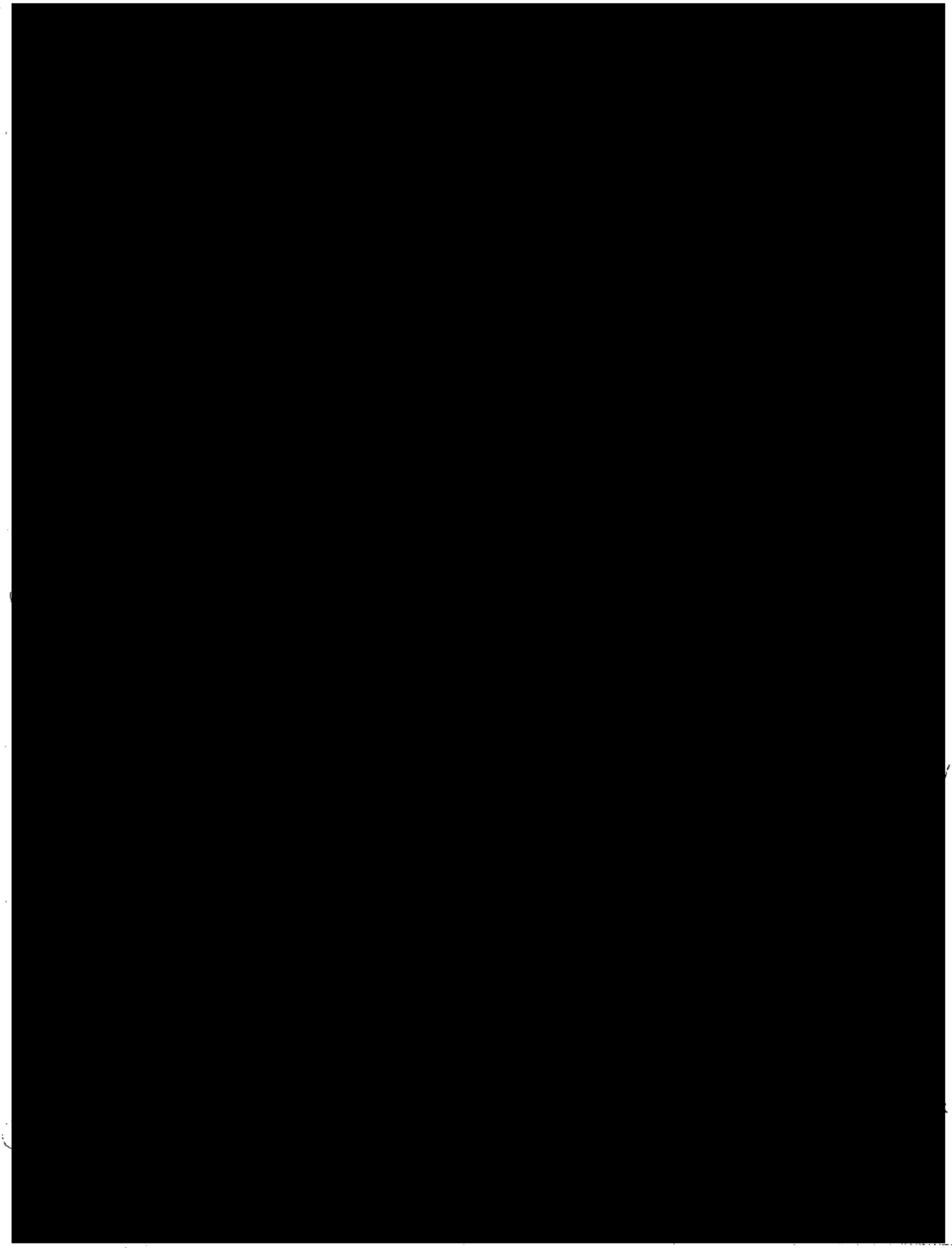

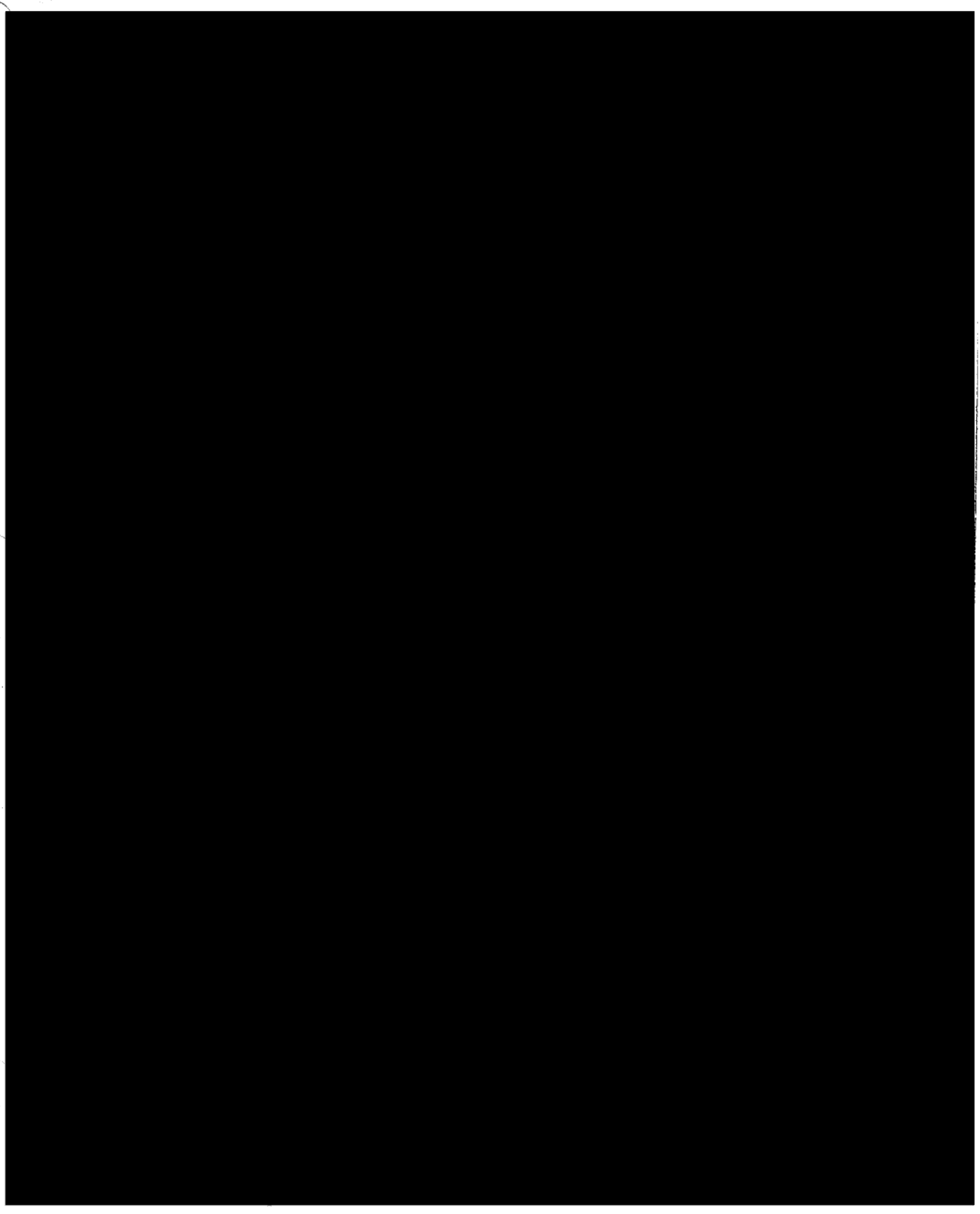

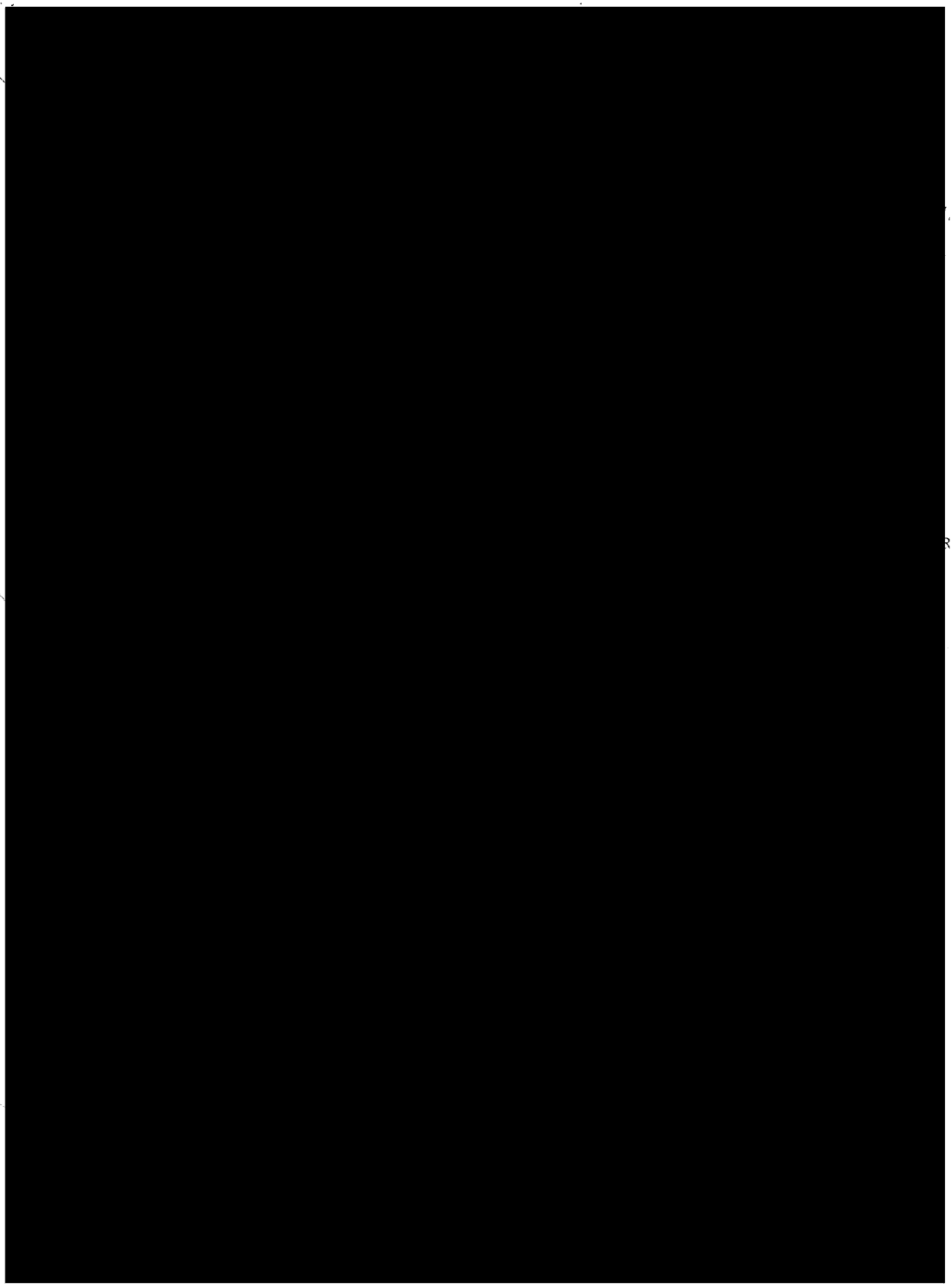

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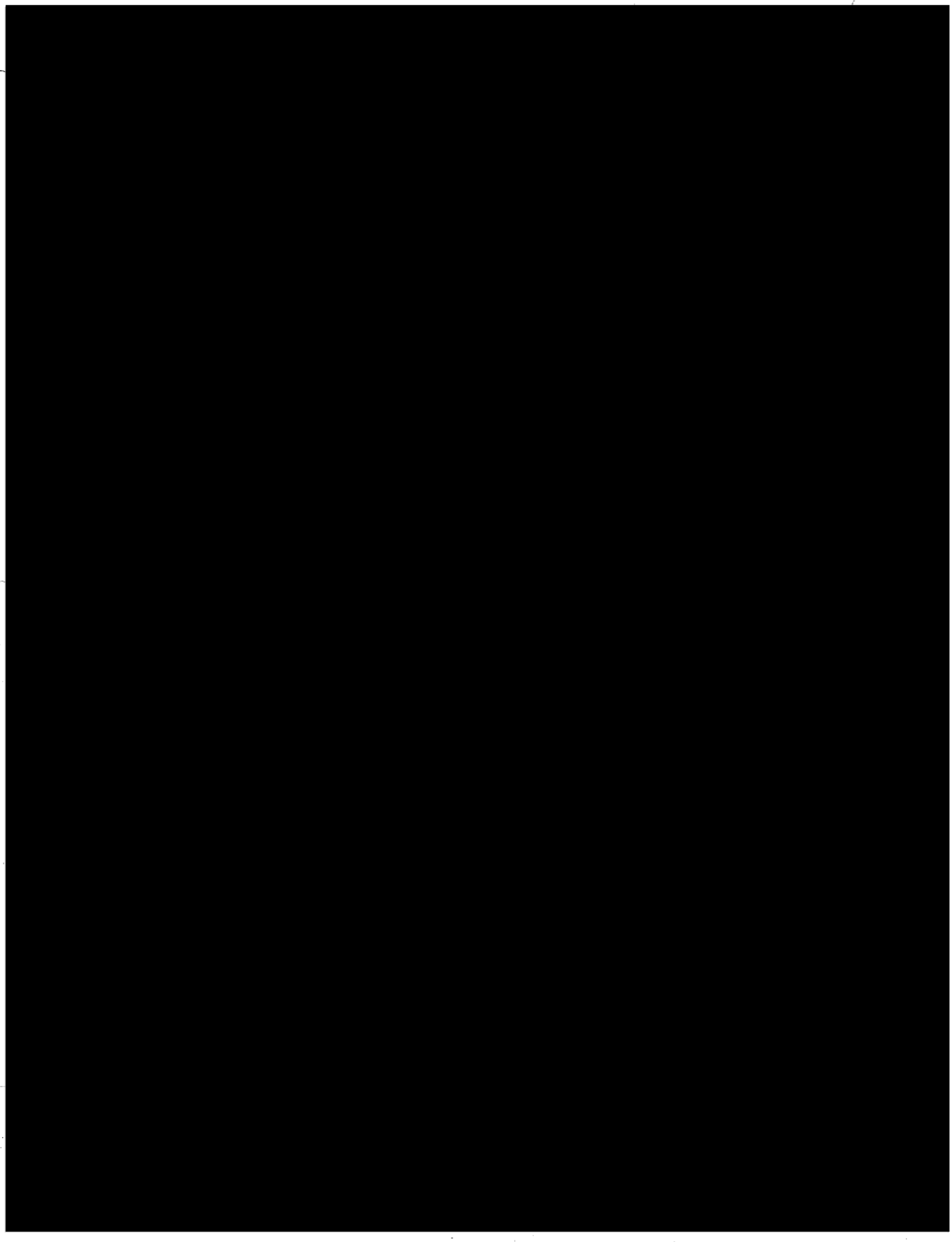
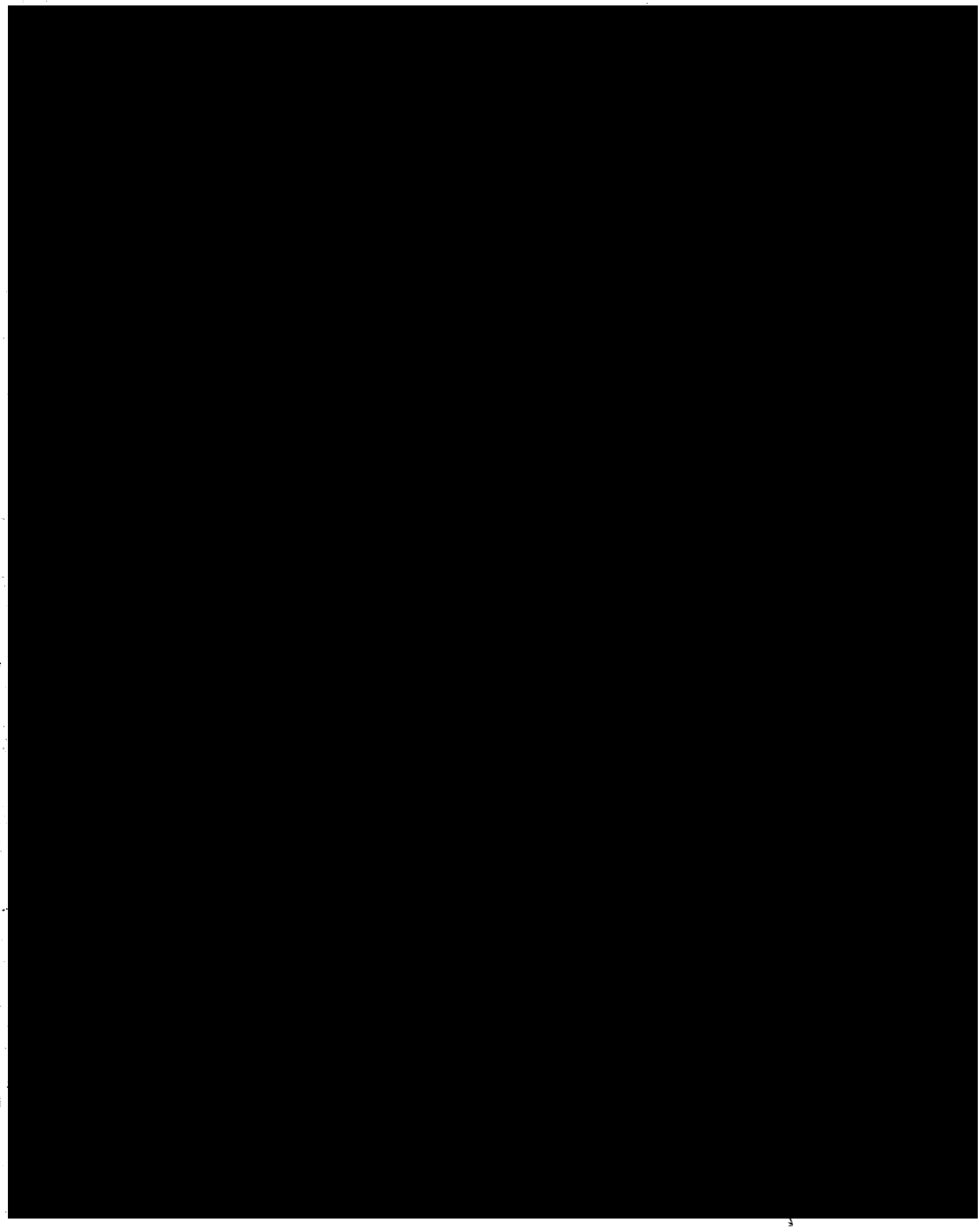
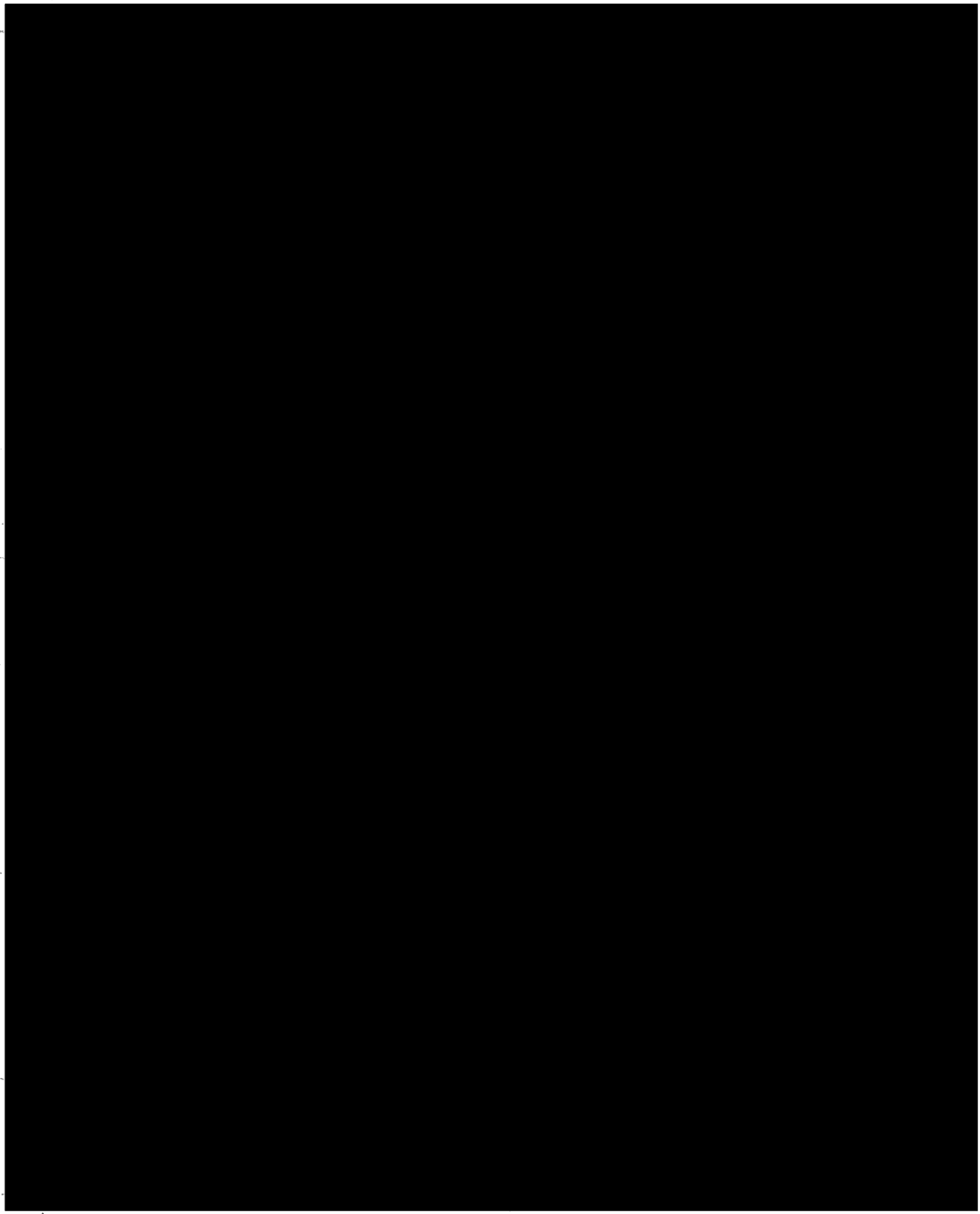
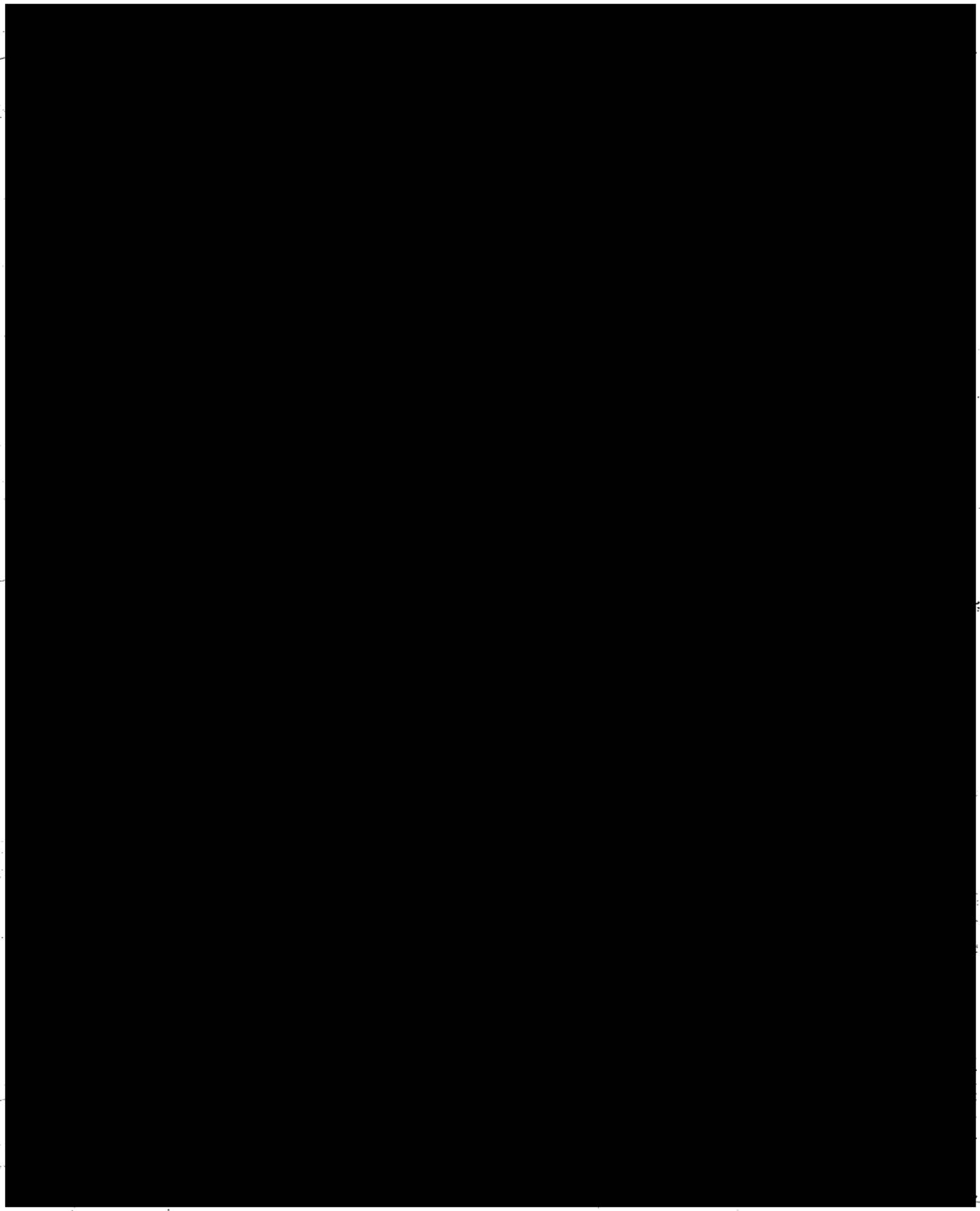




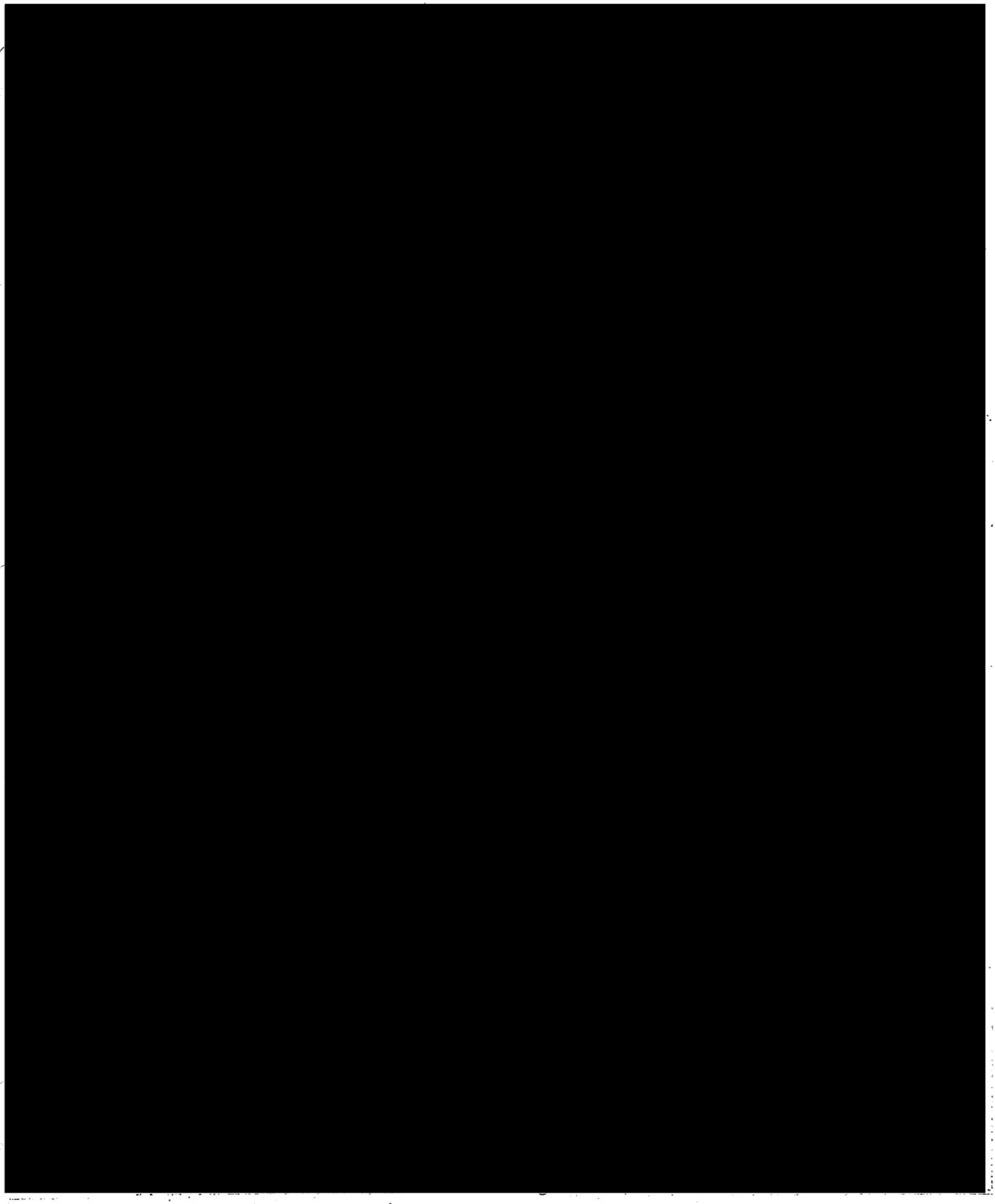


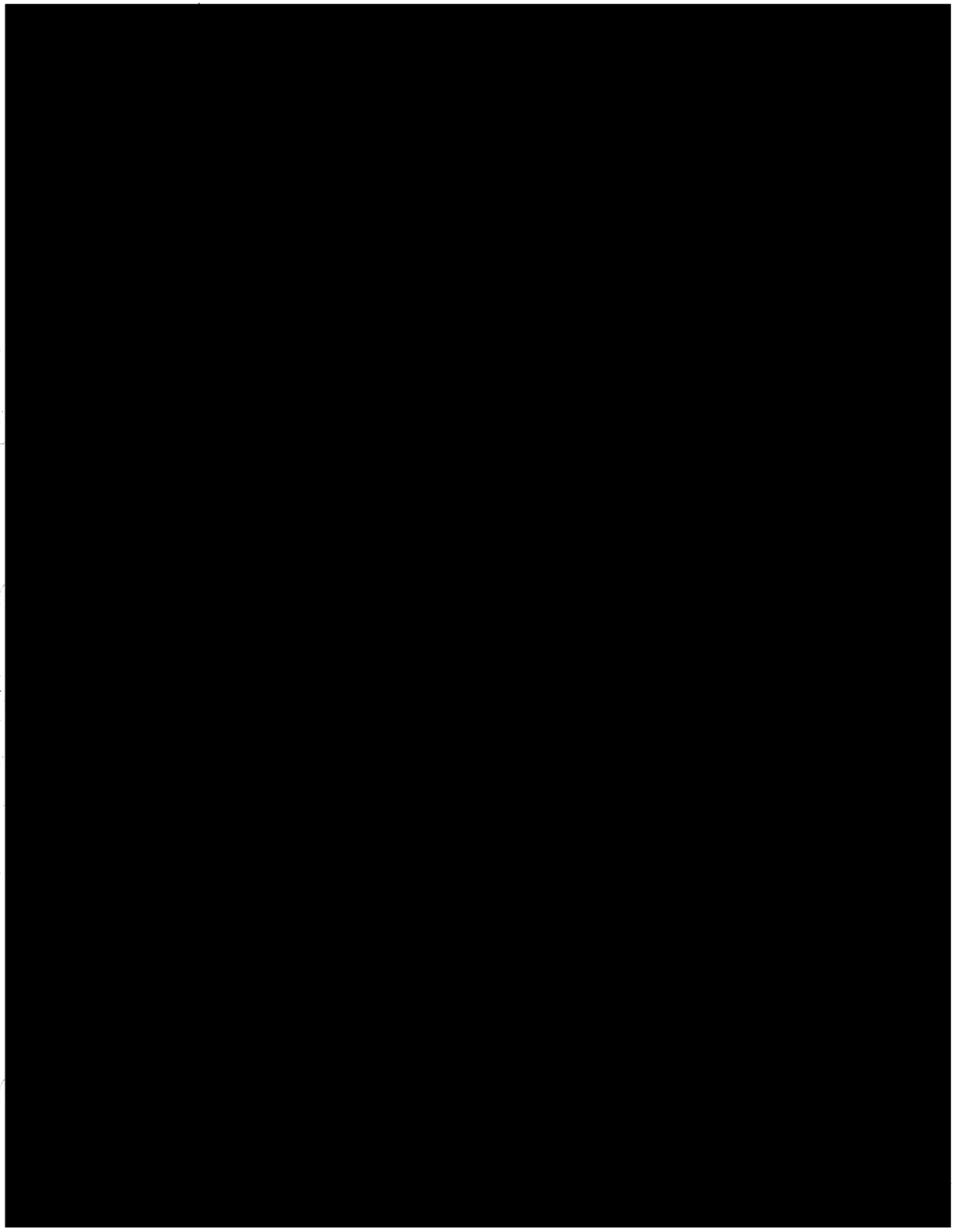
[redacted]

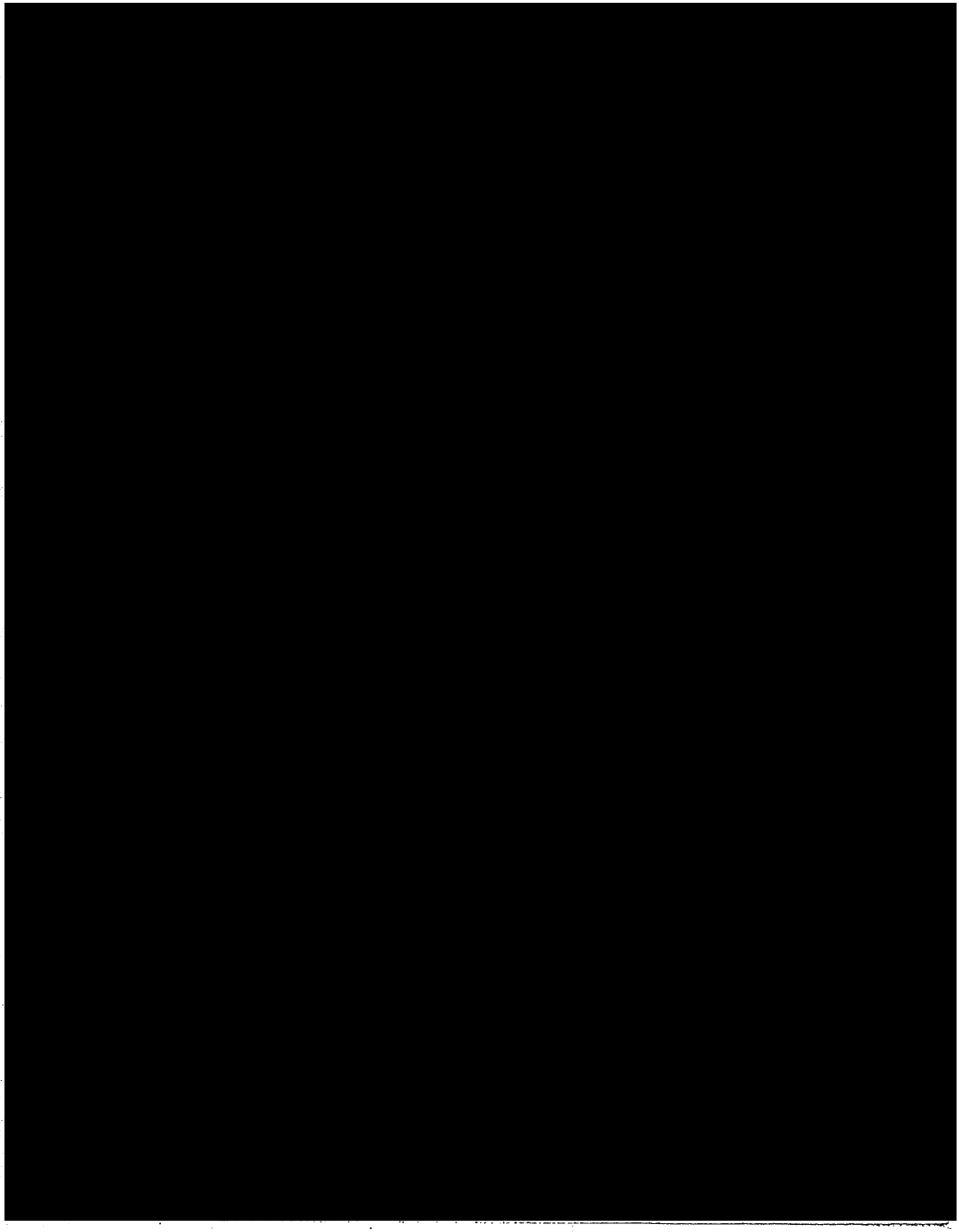


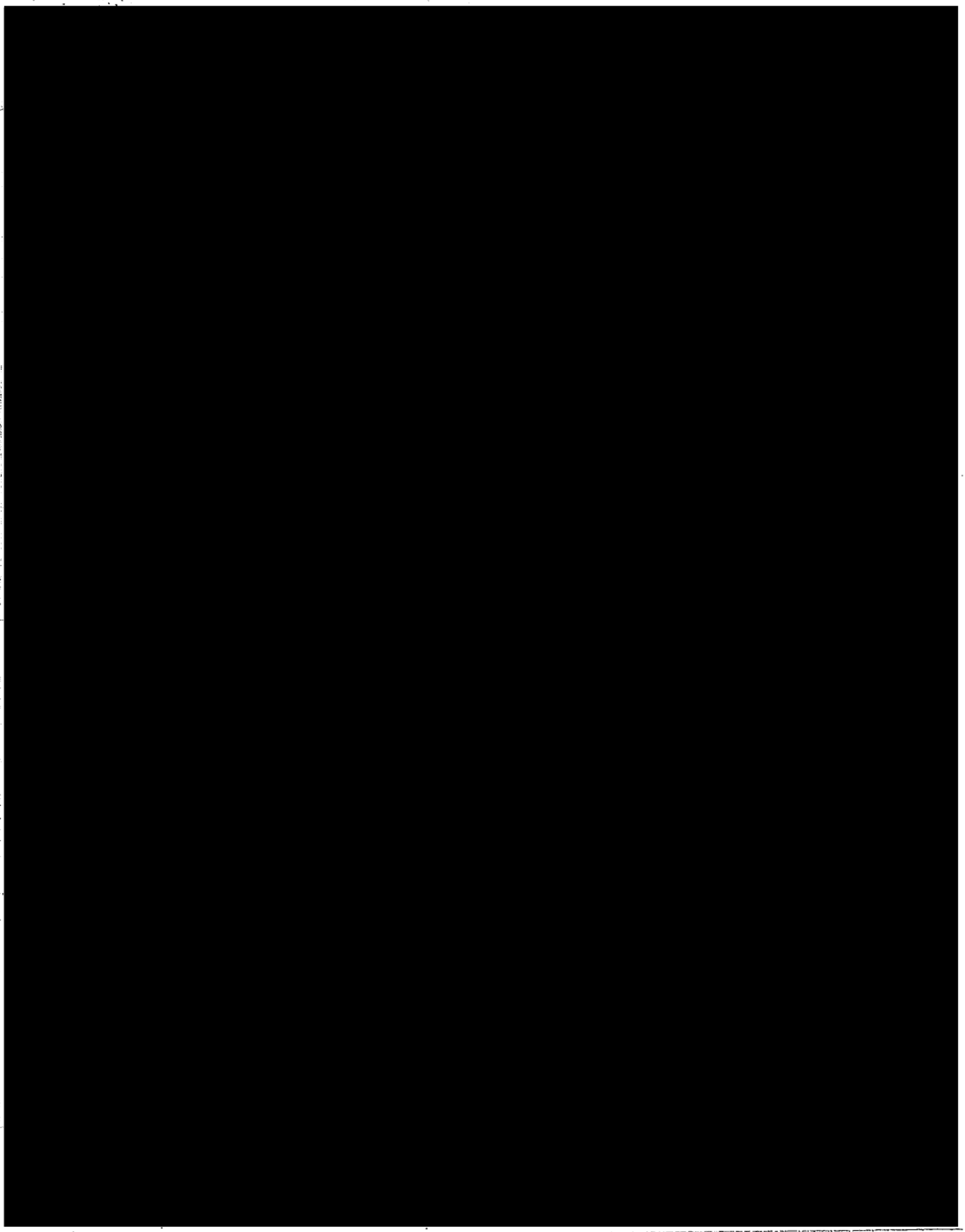
[redacted]

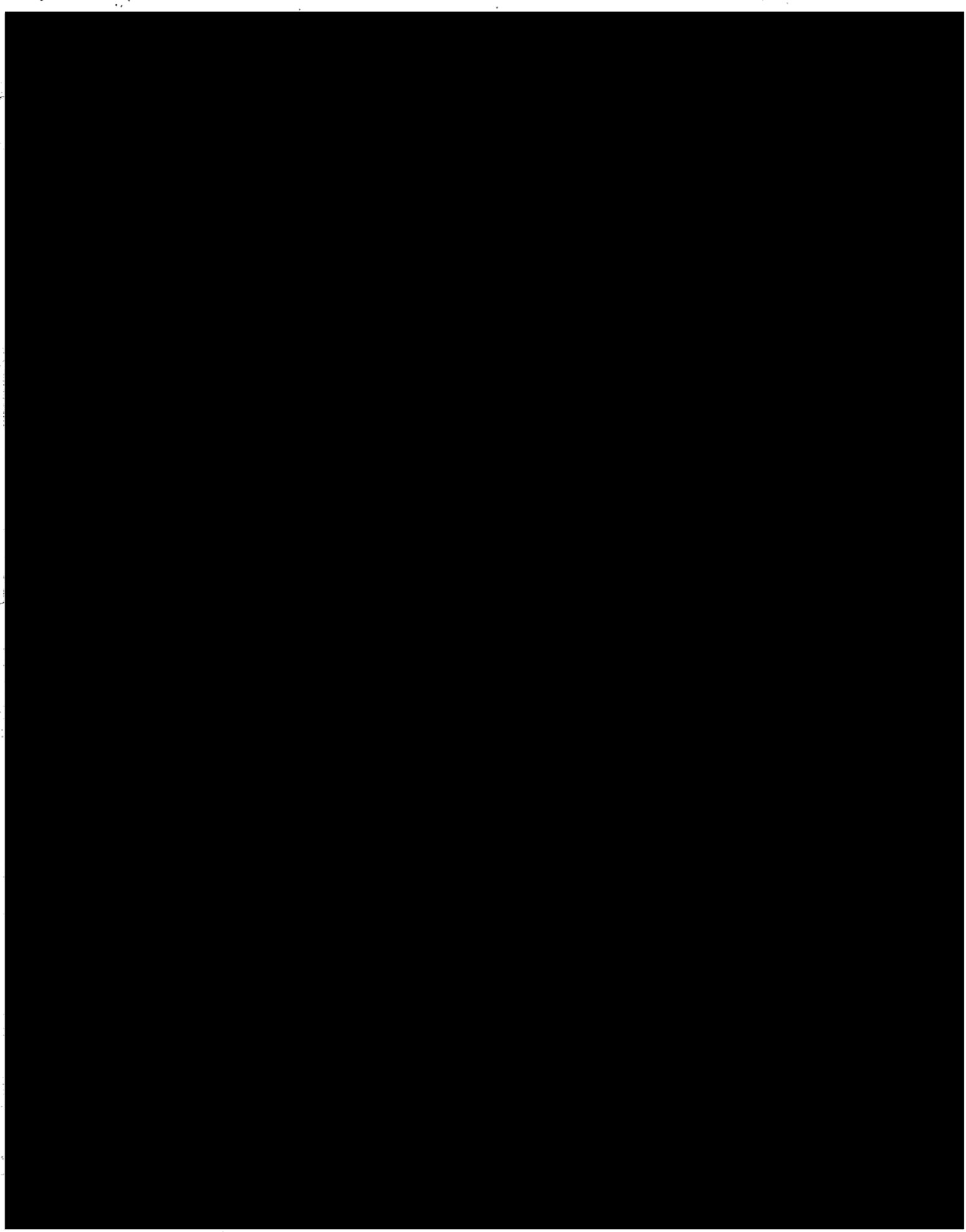
[redacted]

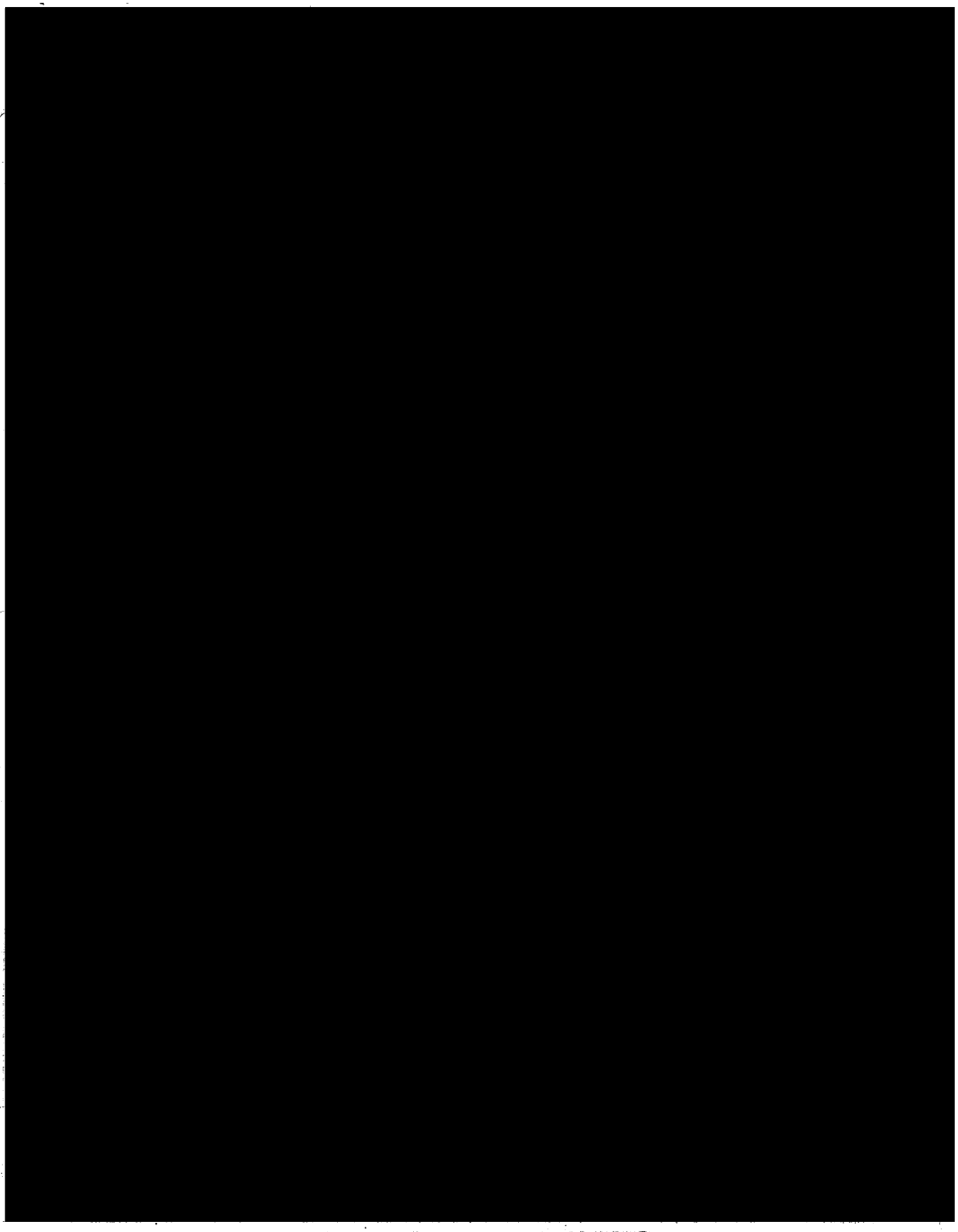












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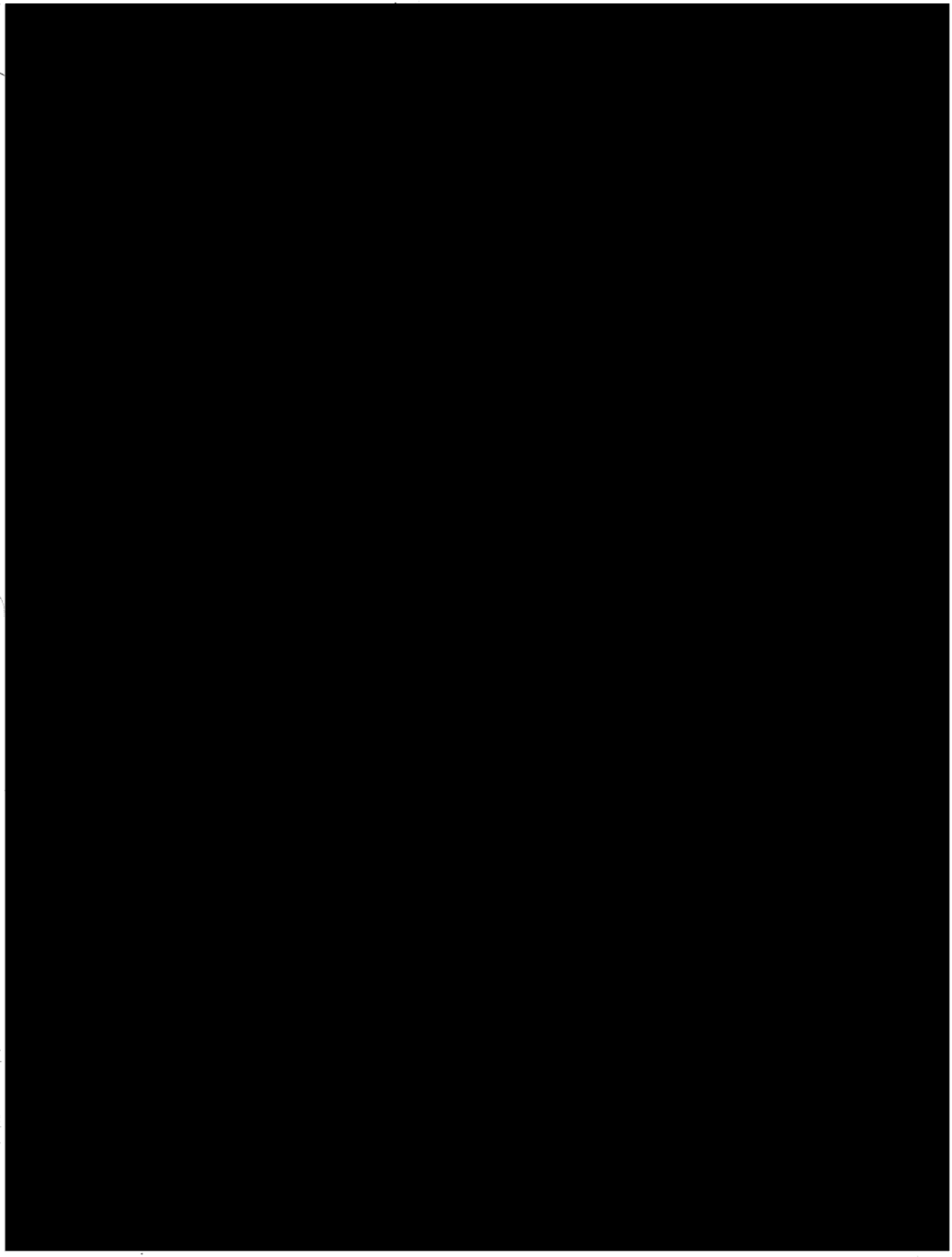

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APPENDIX B

RUNOFF VOLUME

FORECAST PROCEDURES

MALHEUR RIVER RESERVOIRS UNREGULATED FLOW
VOLUME FORECAST PROCEDURE
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
PACIFIC NORTHWEST REGION

THE BUREAU OF RECLAMATION FORECAST PROCEDURE CONSISTS OF A MULTIPLE REGRESSION EQUATION OF THE FOLLOWING FORM:

$$Y = K + C1(X1) + C2(X2) + C3(X3) + C4(X4)$$

WHERE,

Y = FORECASTED RUNOFF VOLUME FOR THE PERIOD 1 DECEMBER THROUGH 30 JUNE IN 1000'S OF ACRE FEET (KAF).

X1 = INDEX OF OBSERVED RUNOFF VOLUME FOR THE PERIOD 1 OCTOBER THROUGH 30 NOVEMBER IN KAF.

X2 = INDEX OF OBSERVED/EXPECTED TOTAL MONTHLY PRECIPITATION IN INCHES FOR THE 1 OCTOBER THROUGH FEBUARY TIME PERIOD.

X3 = INDEX OF OBSERVED/EXPECTED 1 MARCH SNOW WATER CONTENT IN INCHES.

X4 = INDEX OF OBSERVED/EXPECTED TOTAL MONTHLY PRECIPITATION FOR THE PERIOD 1 MARCH THROUGH 30 JUNE IN INCHES.

C1, C2, C3, C4, K = COEFFICIENTS OF REGRESSION.

THE REGRESSION EQUATION IS FOR THE 1 OCTOBER THROUGH 31 JULY FORECAST PERIOD ONLY. TO FORECAST OTHER TIME PERIODS, SUBTRACT OBSERVED RUNOFF, 1 OCTOBER THROUGH DATE, FROM THE EQUATION RESULT. THE VARIABLES X1 THROUGH X4 ARE COMPUTED USING PROCEDURES ON PAGE B-1 SHEETS 2 AND 3.

1985 MALHEUR RIVER RESERVOIRS UNREGULATED FLOW VOLUME FORECAST PROCEDURE

1 = OCT.-NOV. ANTECEDENT RUNOFF BULLY CREEK RESERVOIR INFLOW (KAF):

OCT	NOV
_____	_____

X1 = TOTAL OCT.-NOV. R.O. =_____ (KAF)
(ENTER X1 ON PAGE B-1, SHEET 5)

X2 = OCT.-FEB. PRECIPITATION (INCHES) (1):

STATION	WGHT	OCT	NOV	DEC	JAN	FEB
BEULAH (BEU)	3.00					
BURNS WSO (BNOO)	2.00					
VALE (VAEO)	1.00					
WARM SPRINGS (WAR)	1.00					
(A)=TOTALS		_____	_____	_____	_____	_____
(B)=WEIGHT (WGHT)		1.00	1.00	1.00	1.00	1.00
(A*B)=WGHT TOTALS		_____	_____	_____	_____	_____

X2 = TOTAL WGHT OCT.-FEB. PRECIPITATION =_____ INCHE
(ENTER X2 ON PAGE B-1, SHEET 5)

(1) REFER TO TABLE 2, PAGE B-1, SHEET 4

X3 = MAR. 1 SNOW (INCHES):

STATION	WGHT (A)	OBSERVED WATER CONTENT (INCHES) (B)	NORMAL SNOW WATER ACCUM. (2) DATE-1 MAR (C)	EXPECTED 1 MARCH TOTAL WATER CONTENT (D)=(B)*(C)	WGHT 1 MARCH WATER CONTEN (INCHES) (D)*(A)
BLUE MTN SPR. (BLPO)	3.00				
IDLEWILD CAMP (IDCO)	1.00				
IZEE SUMMIT (IZSO)	1.00				
LAKE CREEK (LKCO)	2.00				
ROCK SPRING (RCSO)	1.00				
STARR RIDGE (STRO)	1.00				

X3 = TOTAL WGHT 1 MAR. WATER CONTENT =_____ INCHES
(ENTER X3 ON PAGE B-1, SHEET 5)

(2) REFER TO TABLE 1, PAGE B-1, SHEET 4

X4 = MAR.-JUNE PRECIPITATION (INCHES) (3)

STATION	WGHT	MAR	APR	MAY	JUNE
BEULAH (BEU)	3.00				
BURNS WSO (BNOO)	2.00				
VALE (VAEO)	1.00				
WARM SPRINGS (WAR)	1.00				
(A)=TOTALS		____	____	____	____
(B)=WGHT		1.00	1.00	1.00	0.50
(A)*(B)=WGHT TOTALS		____	____	____	____

X4 = TOTAL WGHT MAR.-JUNE PRECIPITATION =_____ INCHE
(ENTER X4 ON PAGE B-1, SHEET 4)

(3) REFER TO TABLE 2, PAGE B-1, SHEET 4

	BEULAH OBSERVED RUNOFF 1 DEC.-DATE		WARM SPRINGS OBSERVED RUNOFF 1 DEC.-DATE		BULLY CREEK OBSERVED RUNOFF 1 DEC.-DATE	
MONTH	RUNOFF	SUM R.O. (4)	RUNOFF	SUM R.O.	RUNOFF	SUM R.O.
DEC						
JAN						
APR						
MAY						

(4) ENTER SUM R.O. 1 OCT-DATE FROM PAGE B-1, SHEET 5

TABLE 1

STATION	NORMAL SNOW WATER ACCUMULATION (DATE-1 MARCH) (INCHES)	
	1 JAN	1 FEB
BLUE MTN SPRINGS (BLPO)	8.24	3.30
IDLE WILD CAMP (IDCO)	3.10	0.90
IZEE SUMMIT (IZSO)	3.60	1.40
LAKE CREEK (LKCO)	5.57	2.71
ROCK SPRING (RCSO)	3.55	1.40
STARR RIDGE (STRO)	2.90	0.80

TABLE 2

STATION	EXPECTED MONTHLY PRECIPITATION (INCHES)					
	JAN	FEB	MAR	APR	MAY	JUNE
BEULAH (BEU)	1.46	1.03	1.01	0.70	1.09	1.09
BURNS WSO (BNOO)	1.60	1.15	1.15	1.12	0.70	0.98
VALE (VAEO)	1.18	0.79	0.73	0.64	1.06	0.88
WARM SPRINGS (WAR)	1.25	0.46	0.64	0.65	0.60	1.60

1985 MALHEUR RIVER RESERVOIRS UNREGULATED FLOW VOLUME FORECAST PROCEDURE

FORECAST PERIOD _____ FORECAST DATE _____

1. FOR BEULAH:

1 DECEMBER THROUGH 30 JUNE VOLUME FORECAST

$$Y1 = (-68.09) + (20.4757)X1 + (1.4669)X2 + (0.6854)X3 + (1.0821)X4$$

$$Y1 = (-68.09) + (20.4757)\_\_ + (1.4661)\_\_ + (0.6854)\_\_$$

$$+ (1.0821)\_\_$$

Y1 = _____ KAF (BEULAH INFLOW)

NOTE: X1, X2, X3, AND X4 VALUES FOR INSERTION INTO THE ABOVE EQUATION ARE COMPUTED ON SHEETS 2 AND 3.

FORECAST DATE THROUGH 30 JUNE VOLUME FORECAST

Y (DATE–31 JULY) = Y1 (1 OCT. – 31 JULY) – OBSERVED RUNOFF IN KAF (1 DEC. – DATE)

Y (DATE–31 JULY) = _____ – _____

Y (DATE–31 JULY) = _____ KAF (BEULAH INFLOW)

2. FOR WARM SPRINGS:

1 DECEMBER THROUGH 30 JUNE VOLUME FORECAST

$$Y1 = (-168.03) + (40.5660)X1 + (2.8529)X2 + (1.3312)X3 + (2.3842)X4$$

$$Y1 = (-168.03) + (40.5660)\_\_ + (2.8529)\_\_ + (1.3312)\_\_$$

$$+ (2.3842)\_\_$$

Y1 = _____ KAF (WARM SPRINGS INFLOW)

NOTE: X1, X2, X3, AND X4 VALUES FOR INSERTION INTO THE ABOVE EQUATION ARE COMPUTED ON SHEETS 2 AND 3.

1985 MALHEUR RIVER RESERVOIRS UNREGULATED FLOW VOLUME FORECAST PROCEDURE

FORECAST DATE THROUGH 31 JULY VOLUME FORECAST

Y (DATE-31 JULY) = Y1 (1 OCT. - 31 JULY) - OBSERVED RUNOFF IN KAF
(1 DEC. - DATE)

Y (DATE-31 JULY) = _____ - _____
= _____ KAF (WARM SPRINGS INFLOW)

3. FOR BULLY CREEK:

1 DECEMBER THROUGH 30 JUNE VOLUME FORECAST

$$Y1 = (-63.66) + (23.0267)X1 + (0.9830)X2 + (0.2159)X3 + (0.6917)X4$$

$$Y1 = (-63.66) + (23.0267)\_\_\_\_\_ + (0.9830)\_\_\_\_\_ + (0.2159)\_\_\_\_\_$$

$$+ (0.6917)\_\_\_\_$$

Y1 = _____ KAF (BULLY CREEK INFLOW)

NOTE: X1, X2, X3, AND X4 VALUES FOR INSERTION INTO THE ABOVE EQUATION ARE COMPUTED ON SHEETS 2 AND 3.

FORECAST DATE THROUGH 31 JULY VOLUME FORECAST

Y (DATE-31 JULY) = Y1 (1 OCT. - 31 JULY) - OBSERVED RUNOFF IN KAF
(1 DEC. - DATE)

Y (DATE-31 JULY) = _____ - _____

Y (DATE-31 JULY) = _____ KAF (BULLY CREEK INFLOW)