DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

COMPILATION OF INTELLIGENCE ON MILITARY HYDROLOGY

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SECTION I

INTRODUCTION

1. Purpose. The purpose of this technical bulletin is to furnish a guide for Commanders and Staffs and for training personnel of special units in studies on military hydrology.

2. Scope. This bulletin describes the types of information needed to estimate the natural and artificial flooding potentials of stream and hydraulic structures, and to provide assistance in planning river crossings and in determining military water supply. It describes a method of compilation and gives examples of the method of presentation of the elements in a readily usable form. The material presented herein is applicable without modification to both atomic and nonatomic warfare.

3. Hydrology. *a.* In broad terms, hydrology is the science that deals with the characteristics of water in its various states, and its relation to human activity. Hydrology concerns itself with the occurrence of water in the earth's atmosphere, on the earth's surface, and in the soil and rock near the earth's surface. Hydraulics, closely related to hydrology, is that branch of engineering concerned with the flow of fluids, especially the flow of water in natural and manmade drainage and transportation systems.

b. Military hydrology includes all aspects of hydrology and hydraulics relating to any aspect of runoff, stream flow, and ground water that may have an important effect on military planning and operations.

c. Some of the duties of the military hydrologist include:

(1) Providing predictions of flood stages, discharges, velocities, depths, and durations, with corresponding data for low and medium stages.

(2) Analyzing river crossing sites for conditions of velocity, depth, and width.

(3) Preparing studies, for Army commanders in areas of operation, on hydrologic and hydraulic factors which affect the operations, such as: occurrence and frequency of floods; normals and extremes of stream flow; channel characteristics at low, medium, and high stages; ice conditions; and operation and effects of hydraulic structures.

(4) Making technical investigations of the feasibility of artificial floods created by breaching of dams, regulation of hydraulic structures to produce streamflow variations, and construction of stillwater barriers and drainage obstacles, as a military weapon.

(5) Analyzing sites for military installations, from the point of view of flood incidence.

(6) Furnishing technical advice on hydraulic features of logistic operations such as surface water supply, power, and navigation.

SECTION II

PRINCIPLES OF COMPILATION

4. General. Hydrologic intelligence, to be of use to military commanders, must be systematically compiled and filed. No specific filing system is presented in this bulletin, but the compiler should follow some orderly method of compilation and maintain standards of uniformity. This section discusses methods for achieving easily usable compilations.

5. Dating. *a.* The collector of any type of intelligence is faced with the problem of logically dating information. In some cases the material may be compiled immediately after personal observation, and the date of preparation of the report will be valid for the information. However, the information may also be gathered from several sources of various dates. In these cases the compiler should, as clearly as possible, indicate the date of each item of information. A third possibility arises when information is collected over a long period of time. Many items of hydrologic information, such as stream discharge data, precipitation data, and maximum stages, change and must be constantly brought 2 up to date. In this case the date of making each entry should be shown.

b. Information may be dated by placing the date in parentheses following each item or by grouping item numbers at the end of the report as being valid for particular dates. This may be accomplished by stating which items were taken from specific reports or documents, whose dates in turn are given. The most convenient but clear method should be used.

6. Sources. *a.* Information, to be of use, must be valid. The compiler should state the source of the information, so that the person using the data can better determine its reliability and accuracy. Personal observations, estimates by local residents, or hearsay information should be labeled as such. Published sources from which data is extracted should be listed, with the name of the author or preparing agency and the date of publication.

b. The person using the data evaluates the reliability of a source and enters this in the compilation using the following standard intelligence terms to express the degree of reliability.

(1) Completely reliable.
(2) Usually reliable.
(3) Fairly reliable.
(4) Not usually reliable.
(5) Unreliable.
(6) Reliability cannot be judged.

c. The person using the data will also make an evaluation of its accuracy. This evaluation will be entered in the compilation using the following standard intelligence terms to express the degree of accuracy.

(1) Confirmed by other sources.
(2) Probably true.
(3) Possibly true.
(4) Doubtful.
(5) Improbable.
(6) Truth cannot be judged.

7. Units of Measure. *a.* Compilation of hydrologic intelligence from original sources in foreign countries will usually require the use of units of measure different from those employed in the United States. It is recommended that data be compiled in whatever units it may appear. The hydrologist can then make whatever conversions are necessary.

b. It is essential that all numerical data be given in specific units of measure to be of use.

c. Elevations should be given in relation to a specific datum, such as feet above mean sea level or meters above the Adriatic Sea (m u A).

8. Illustrative Material. Pictures and diagrams are more expressive and more readily understood than a mass of text. Compilers should therefore include any pertinent graphic material which may be available. Reference should be made to such graphic material under the appropriate subject item. The material should be so labeled as to permit refiling even if separated from the parent compilation.

SECTION III

COMPILATION OF DATA

9. General. *a.* The compilation of hydrologic intelligence may be conducted under varying conditions. On the one hand, the compilation may itself be the subject of a study; on the other, it may be the byproduct of other intelligence endeavors. The objectives of the compiler will dictate the method of presentation to be used. If, for example, the compiler is systematically gathering data on the dams and reservoirs in a given area, he may well find mimeographed cards with spaces ruled for specific entries very useful.

b. This section explains the method used in this bulletin to present examples of compilations for the major subjects covered in section IV, and describes the concepts involved therein.

10. Required Items. The required items listed for the major subject compilations in paragraph 13 through 24 are intended to insure the inclusion of basic data needed by the hydrologist. If these data cannot be obtained, they must be estimated from other sources of information. For instance, if the depth, width, and velocity of a stream at a ferry crossing are not known, the draft of the ferryboat and its course across the stream can be used to obtain an estimate of the stream conditions. Such data may be considered secondary requirements, and should be included in the compilation when needed.

11. Specified Subjects. *a.* Items of information on the following major subjects, of vital concern to the military hydrologist, are shown in section IV with example compilations:

(1) Watersheds.
(2) River and canal channels.
(3) Stream or river gages.
(4) Precipitation gages.
(5) Bridges.
(6) Fords and ferries.
(7) Dams and reservoirs.
(8) Hydroelectric plants.
(9) Flood protection structures.
(10) Navigation locks.
(11) Irrigation projects.
(12) Drainage projects.

b. In many instances it will not be possible or necessary to give information for every subject item listed. In such a case the reason for not giving the

information should be stated as follows, for purposes of this manual only not available (nval) ; not indicated (NI); not pertinent (NP). If information is available and pertinent to the basic subject, but cannot logically be included under any of the prescribed subject items, it should be given in a footnote.

c. Typical pictures, maps, and drawings should be included whenever practicable. (To avoid repetition, graphic material which is pertinent to more than one major subject is included with the first subject to which it pertains and is referenced, but not repeated, in subsequent major subjects.)

SECTION IV

MAJOR SUBJECT COMPILATION

12. General. The major subject compilations of paragraphs 13 through 24 show typical examples of data. The numerical arrangement of items is given in logical sequence, but the compiler is not required to follow this sequence precisely. The major subject compilations of paragraphs 13 through 24 are presented in columnar form. The requirement is stated in the first column and the data is given in the second column.

13. Watersheds. *San Antonio Creek Watershed.*

Item No.	*Requirement*	*Complication*
1	Name of stream draining watershed.	San Antonio Creek.
2	Country or countries, state or province and so on, in which the major item is located.	U. S., Calif.
3	Main river basin in which the subject is located.	Santa Ana River (fig. 1).
4	Name of reference point or the point of lowest elevation on the main stream draining the watershed.	San Antonio Dam.
5	Distance and direction from a city or some other definite geographic reference point.	San Antonio Dam is about 30 mi east of Los Angeles, and about 22 mi west of San Bernardino.
6	Distance from reference (item 4) to river mouth.	About 19 mi.
7	Coordinates of any local grid-coordinate system.	NI.
8	Drainage area of watershed above reference point.	26.7 sq mi.
9	Length and width of watershed.	About 10 mi by 3 mi.
10	Length of streams in watershed.	Figure 2.
	a. main stream.	*a.* about 10 mi.
	b. main tributaries.	*b.* 3 tributaries about 4 mi long each.
	c. lined or improved channels.	*c.* No improved channels.
11	Indicate whether elevations are based on mean sea level or on some other reference.	Feet above mean sea level, 1927 datum.
12	Elevations in watershed.	Figure 3.
	a. Highest point.	*a.* 10,800 ft,
	b. Lowest point.	*b.* 2150 ft.
	c. Mean (do not give average for *a* and *b* above, but mean elevation for the entire watershed).	*c.* about 5,500 ft.
13	Period of record of runoff for watershed. (Give dates for beginning and end of period.)	1931-1945.
14	Runoff from watershed.	
	a. Maximum storm of record and date, if known.	*a.* 10,800 acre-feet, Mar. 1938.
	b. Average annual total, if known.	*b.* NI.
	c. Minimum annual total and year, if known.	*c.* NI.
15	Number and size of natural lakes in watershed. (Give surface area and storage volume of each lake. if known).	None.
16	Number and size of manmade reservoirs in watershed. (Give surface area and storage volume of each reservoir, if known.)	None.
17	Give the following subarea values:	100% mountainous, 50% timber.
	a. Cultivated. *d.* Swampy.	
	b. Hilly. *e.* Timbered.	
	c. Mountainous. *f.* Urban.	

Item No.	*Requirement*	*Complication*
18	Kinds of vegetation and crops in watershed.	Fir, pine, spruce, chaparral, chamiso, scrub oak.
19	Give soil types, their location, and area extent.	Mostly residual coarse, porous, and generally shallow, large areas of weathered bed rock.
20	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	None.
21	Source or sources of data. If different for various items, list numbers in groups corresponding to the source.	"Hydrology, San Antonio Creek above San Antonio Dam," published by the U. S. Engineer Office, Los Angeles, California, 10 May 1946.
22	Reliability of the source or sources of data.	Completely reliable.
23	Accuracy of data.	Probably true.
24	Agency or unit preparing the complication.	Military Hydrology Branch, Washington District CE.
25	Inclose pictures, maps and drawings depicting the location and other features of the major item.	*a.* Stream bed profiles (fig. 1). *b.* Topographic-map (fig. 2). *c.* Elevation-area curves (fig. 3).
26	Date compilation was prepared.	21 Oct. 1953.

14. River and Canal Channels. *Mosel River.*

Item No.	*Requirement*	*Complication*
1	Name of river or canal described.	Mosel River.
2	Limits of the reach of channel described with reference to distance along the course of the river or canal, such as the distance above the mouth of the river.	Koblenz to Cochem (from river mouth to km 51.2) (fig. 4).
3	Country or countries, state or province, and so on, in which the major item is located.	Germany, Rheinland, Pfalz.
4	Main river basin in which the subject is located.	Rhine River.
5	Distance and direction from city or some other definite geographic reference point.	nval.
6	Coordinates of any local grid-coordinate system.	Nord du Guerre: Koblenz L897961 from GSGS 4416-S-2; Cochem L594720 from GSGS 4416-T-1.
7	Indicate whether elevations are based on mean sea level or on some other reference.	NI.
8	Number of channels formed at low, normal, and high stages.	One at all stages.
9	Composition of channel bottom in reach (such as rocky, sandy, or muddy).	Sand and gravel.
10	Composition of banks in reach such as: (rocky, sandy, muddy, overhanging, overgrown with vegetation, and so on. The "left bank" is on the left side facing downstream).	Generally flat, partly steep (1.5m), no dikes, localities and roads partly in flood areas.
11	Channel width at low, normal, and high stages. Show maximum, minimum, and average for reach.	*Low Stages* / *Normal Stages* / *High Stages* max: NI / 170m / NI min: NI / 90m / NI av: NI / 125m / NI
12	Channel width at bank top stage. Show maximum, minimum, and average for reach.	NI.
13	Channel depth at low, normal, and high stages. Show maximum, minimum, and average for reach.	Average depth in reach: 2.3 to 4.3m.
14	Channel depth at bank top stage. Show maximum, minimum, and average for reach.	NI.
15	Current velocity for low, normal, and high stages. Show maximum, minimum, and average for reach. Indicate whether for water surface or for channel cross section.	NI.
16	Current velocity at bank-top stages.	NI.

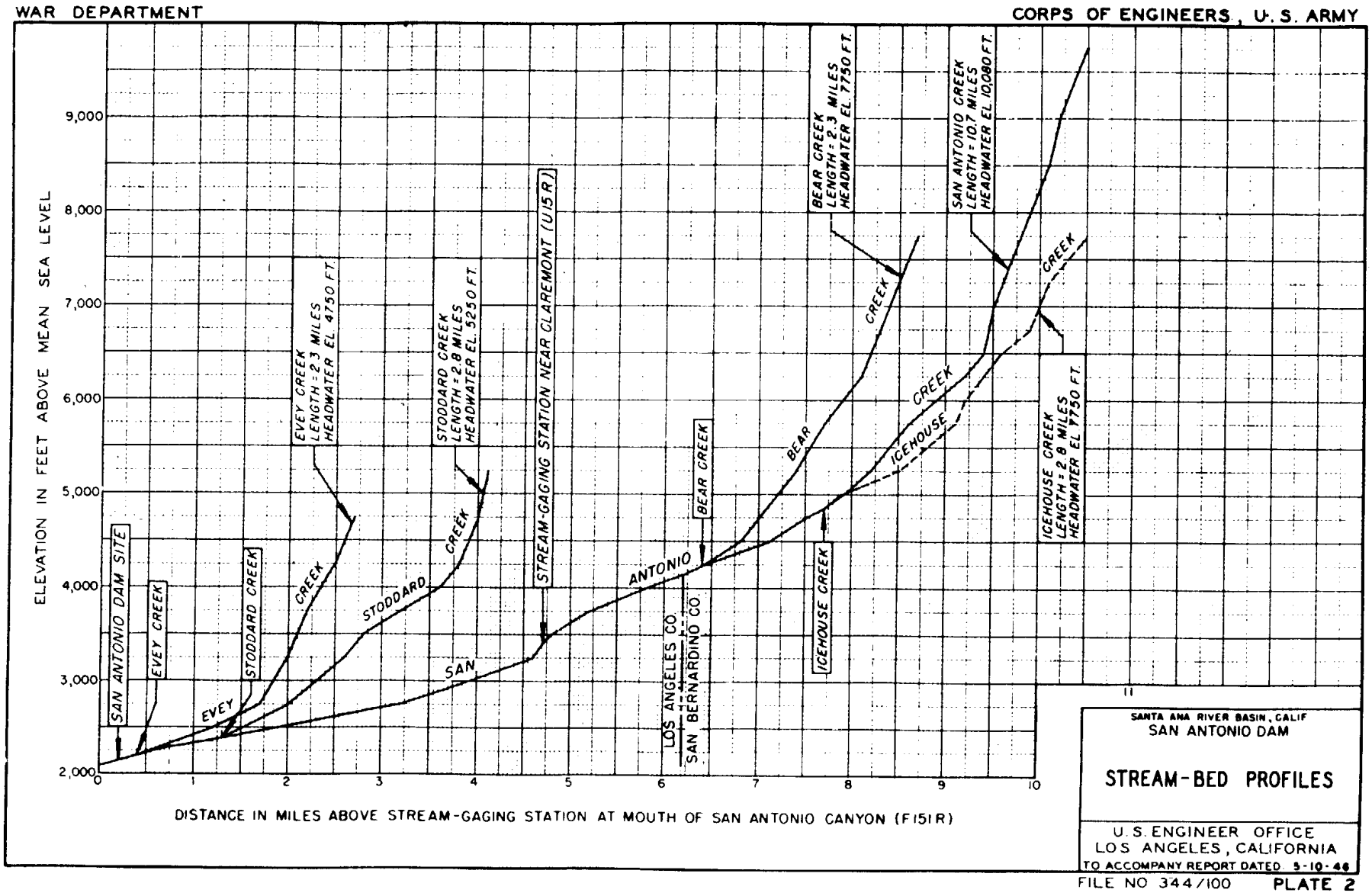


Figure 1. Stream bed profiles in the Santa Ana River basin.

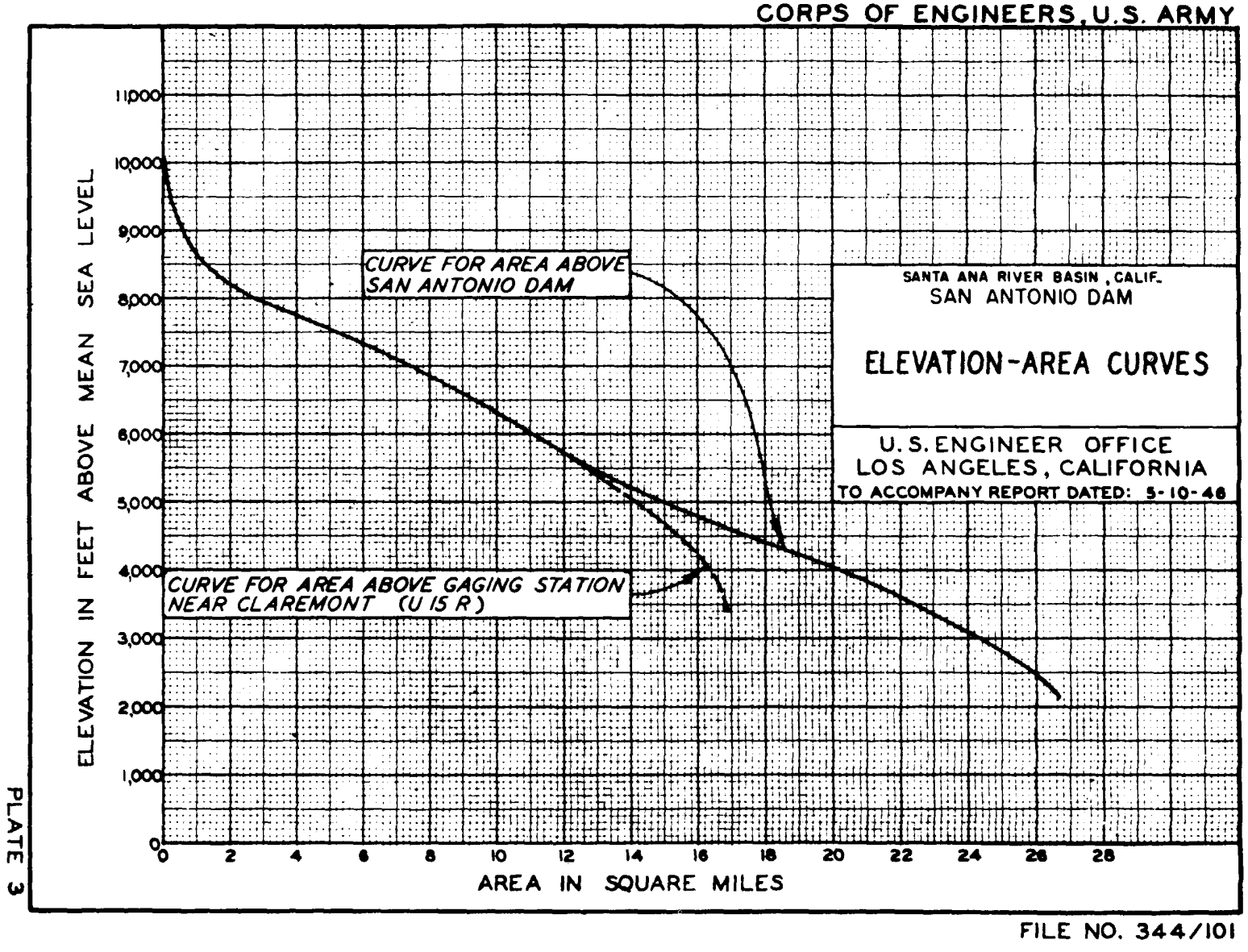


Figure 3. Elevation-area curves for Santa Ana River basin.

Item No.	Requirement	Complication
17	Time the river or canal overflows its banks in reach. (Indicate the months during which floods are likely to occur, also the frequency and duration of over-bank stages.)	NI.
18	Slope of water surface in reach at low, normal, and high stages.	NI.
19	Slope of stream bed in reach.	NI.
20	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	*a.* Navigable channel 40m wide. *b.* Reach contains 13 fords and 21 bridges.
21	Source or sources of data. If different for various items, list item numbers in groups corresponding to the source.	"Highway Bridges of Western Germany," Vol. 4, Strategic Engineering Study No. 130, published by Office, Chief of Engineers, September 1944.
22	Reliability of the source or source data.	Usually reliable.
23	Accuracy of Data.	Probably true.
24	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
25	Inclose pictures, maps and drawings depic ting the location and other features of the major items.	Map of reach (fig. 4).
26	Date compilation was prepared.	23 Oct. 1953.

15. Stream or River Gages. *Hofkirchen.*

Item No.	Requirement	Complication
1	Name and number by which gage is known or identified.	Hofkirchen.
2	Stream on which gage is located.	Danube River.
3	Country or countries, state or province, and so on, in which the major item is located.	Germany, Niederbayern.
4	Main river basin in which the subject is located.	Danube River.
5	Distance and direction from a city or some other definite geographic reference point.	About 32 km above Passau, Germany.
6	Distance from gage to river mouth or some other stream reference point.	2256.7 km above the mouth of the Danube River.
7	Latitude and Longitude of the gage.	48° 41'N, 13- 9'E.
8	Coordinates of any local grid-coordinate system.	NI.
9	Type of gage. (Indicate whether staff, recorder, chainweight, and so on.)	Recorder operated by float.
10	Organization, agency, or military unit which:	
	a. Established the gage and the date.	*a.* 1901. Agency unknown.
	b. Currently operates or keeps records for gage.	*b.* Bavarian office of Hydrology with the Chief Board of Public works in the Ministry of the Interior, Munich, Germany.
11	Location of gage relative to stream. (Indicate on which bank; or, if on a bridge pier, indicate the distance from a bank and whether it is on the upstream or downstream side of the bridge. The "left bank" is on the left facing downstream.)	NI.
12	Drainage area of watershed above gage.	47,544 sq km.
13	Indicate whether elevations are based on mean sea level or on some other reference.	Meters above the Adriatic Sea (GA).
14	Gag datum elevation, or elevation "zero" on the gage.	Elevation 299.623m.
15	Flood stage or elevation at which the stream overflows its banks (based on gage datum shown in item 14 if possible; otherwise based on sea level elevation).	NI.
16	Periods of record of water stage, discharge, and velocity at gage. (Give dates for beginning and end of periods.)	For stage and discharge: 1901 to 1950. For velocity; NI.
17	Give the stages (gage heights), discharges, and velocities of the gage for the following conditions with	

Item No.	Requirement	Complication
	stages based on datum of item 14 (Indicate whether velocities are for water surface or channel cross section)	stage (1941-1950) / discharge (1901-1950) / velocity
	a. Lowest historical and date of occurrence.	NI / NI / NI
	b. Lowest in period of record and date of occurrence.	175 cm (22.24 Sept 1947) / 165 m^3/sec (4 Jan 1909) / NI
	c. Lowest navigable, if applicable.	NI / NI / NI
	d. Mean or average low for period of record.	214cm / 289 m^3/sec / NI
	e. Mean or average for period of record.	306cm / 633 m^3/sec / NI
	f. Mean or average high for period of record.	538cm / 1,820 m^3/sec / NI
	g. Highest navigable, if applicable.	NI / NI / NI
	h. Highest in period of record and date of occurrence.	611cm / 3,000 m^3/sec / NI
	i. Highest historical and date of occurrence.	(28 Nov.1944) / 6,000 m^3/sec / NI
18	Give the mean high monthly, average monthly, and mean low monthly gage heights and discharges.	NI (Mar. 1845)

Month	Mean high: Gage height (1941–1950) (cm)	Mean high: Discharge (1901–1950) (m^3/sec)	Average: Gage height (1941–1950) (cm)	Average: Discharge (1901–1950) (m^3/sec)	Mean low: Gage height (1941–1950) (cm)	Mean low: Discharge (1901–1950) (m^3/sec)
Nov.	338	806	282	517	245	388
Dec.	404	955	291	540	245	363
Jan.	455	1,110	346	631	265	393
Feb.	425	1,110	356	630	299	399
Mar.	417	1,110	336	712	278	477
Apr.	394	1,060	336	729	297	353
May	369	1,050	309	741	275	558
Jun.	380	1,110	312	734	272	530
Jul.	393	1,070	308	686	264	482
Aug.	360	1,000	282	604	245	419
Sep.	312	899	264	565	236	402
Oct.	305	773	255	506	231	375

19	Give the distance upstream or downstream to point where discharge measurements are made at low, normal, and high stages. Also give location of any cableway used in making discharge measurements.	NI.
20	Discharge measurement accuracy (good, fair, poor, and so on) at low, normal, and high stages.	NI
21	Distance upstream or downstream from any dams, weirs, or other control structures which affect the flow of the stream at the gage.	NI.
22	Time when stream is frozen or gage is affected by ice. (Indicate the months during which ice may affect the gage and the duration of ice conditions.)	7 days in 1960 (5 in Jan, 2 in Feb). River was not frozen solid.
23	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	Tables of river discharge and stage, and flow duration curves (fig. 6).
24	Source or sources of data. If different for various items, list item numbers in groups corresponding to the source.	"Deutsches Gewasserkundliches Jahrbuch, Donaugebiet, Abflussjahr 1952" (German Hydrological Yearbook, Danube River Basin, Water-year 1952), published by "Bayer, Landesstelle fuir Gewasserkunde der Obersten Baubehbrde im Staatsministerium des Innern", (Bavarian Office of Hydrology with the Chief of Board of Public Works in the Ministry of the Interior), Munchen (Munich), 1954. All items were obtained from this book and the map contained in it.
25	Reliability of the source or source data.	Completely reliable.

Item No.	*Requirement*	*Complication*
26	Accuracy of data.	Probably true.
27	Agency or unit preparing the compilation.	Military Hydrology Branch. Washington District CE.
28	Inclose pictures, maps and drawings depicting the locations and other features of the major items.	Tables of river discharge and stage and flow duration curves (fig. 5). (Tables of river discharge and stage, and flow duration curves.)
29	Date compilation was prepared.	6 Oct. 1953.

16. Precipitation Gages. *Innsbruck.*

Item No.	*Requirement*	*Complication*
1	Name or number by which gage is known or identified.	Innsbruck.
2	Country or countries, state or province, and so on, in which the precipitation gage is located.	Austria, Salzach.
3	Main river basin in which subject is located.	Danube.
4	Tributary stream basin in which gage is located.	Inn River.
5	Distance and direction from a city or some other definite geographic reference point.	At Innsbruck, Austria.
6	Latitude and longitude of the gage.	47° 15'N, 12° 20'E.
7	Coordinates of any local grid-coordinate system.	NI.
8	Organization, agency, or military unit which:	
	a. Established the gage (and the date).	*a.* Establisher unknown. 195S
	b. Currently operates or keeps records for the gage.	*b.* Austrian Hydrographic Central Bureau (Hydrographischen Zentralbiro).
9	Type of gage. (Indicate whether graduated stick, visual, or recording type, and give manufacturer's name and model number, if possible.)	NI.
10	Diameter of collector ring.	NI.
11	Gage capacity. (The total depth of precipitation the gage will hold before needing to be emptied.)	NI.
12	Frequency of gage readings. (If gage is not a recording type, indicate how often it is usually read: daily, hourly, during storms, and so on.)	NI..
13	Indicate whether elevations are based on mean sea level or on some other reference.	Meters above Adriatic Sea (u A).
14	Elevation of gage.	582m.
15	Period of record of precipitation at gage. (Give dates for beginning and end of period.)	1853-1948.
16	Period of record of snowfall at gage. (Not always applicable. Give dates for beginning and end of period.)	NI.
17	Give the following total precipitation for the periods shown in items 15 and 16:	NI.
	a. Maximum annual total and year of occurrence.	
	b. Maximum annual total and month and year of occurrence.	
	c. Maximum daily total and date of occurrence.	
	d. Maximum hourly total and date of occurrence.	
	e. Average annual total.	
	f. Minimum annual total and year of occurrence.	
18	Give the maximum total, average, and minimum total monthly precipitation for period shown in item 15.	Average monthly precipitation in mm (Period of Record 1896-1930)

Month	mm	Month	mm	Month	mm
Jan.	59	May	81	Sep.	64
Feb.	38	Jun.	104	Oct.	62
Mar.	47	Jul.	120	Nov.	56
Apr.	66	Aug.	124	Dec.	59

Maximum and minimum monthly precipitation. NI.

19	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	Summary charts giving special records of heavy rainfall and snowfall (fig. 6).

Donau — Pegel: Hofkirchen*)

2256,7 km oberhalb der Mündung
PN = NN + 299,623 m. F_N = 47487 km²
Nach mittleren Tageswasserständen

Tägliche Abflüsse (in m³/s)

Tag	Nov	Dez	Jan	Febr	März	April	Mai	Juni	Juli	Aug	Sept	Okt
1.	286	409	336	357	618	1480	731	586	428	306	278	403
2.	268	409	328	354	659	1540	694	574	469	295	266	403
3.	270	400	345	363	563	1580	672	536	403	280	268	403
4.	268	390	381	363	655	1570	699	578	406	268	280	400
5.	273	390	393	351	676	1510	690	606	390	266	298	397
6.	280	390	384	342	759	1390	672	614	363	268	306	403
7.	268	381	375	331	854	1240	681	606	354	266	319	431
8.	270	387	357	334	918	1110	672	586	331	283	336	478
9.	270	384	331	339	907	990	634	594	325	270	444	507
10.	270	390	328	345	828	952	614	646	336	273	521	500
11.	268	409	339	345	769	946	602	672	331	275	507	489
12.	268	412	381	336	881	946	582	606	334	275	496	458
13.	280	438	454	322	1040	957	626	540	342	280	514	428
14.	270	425	708	339	1040	957	712	507	345	273	622	409
15.	275	409	717	378	974	924	750	510	336	270	663	418
16.	293	384	651	400	886	913	681	536	322	263	586	468
17.	308	366	590	393	769	940	630	582	342	275	525	525
18.	328	360	563	387	717	963	582	618	363	317	492	529
19.	331	378	563	372	722	980	525	672	372	317	454	500
20.	319	397	544	357	750	957	521	651	357	336	447	461
21.	303	400	514	375	854	907	551	672	322	354	438	444
22.	303	390	489	393	935	897	544	685	298	363	441	441
23.	325	372	458	393	1190	891	514	626	290	384	425	451
24.	322	366	441	415	1340	886	492	578	293	375	418	468
25.	334	345	425	447	1510	849	476	555	285	360	418	525
26.	357	328	409	451	1620	823	503	551	285	336	406	602
27.	393	325	393	468	1690	828	536	540	280	306	387	722
28.	422	318	381	521	1820	818	555	518	278	319	387	839
29.	444	318	375	582	1860	784	602	489	278	314	384	870
30.	422	322	363		1670	759	634	464	278	303	384	788
31.		325	351		1510		594		280	288		708
Σ	9258	11719	13667	11153	32084	31287	18970	17488	10341	9348	12705	13868

Hauptzahlen

Monatliche Abflüsse von 1952 (m³/s)

am	1.	28.,29.	2.,10.	13.	1.	30.	25.	30.	öfter	6.	3.	5.
NQ	286	319	328	322	618	759	475	454	273	258	263	397
MQ	309	378	441	385	1030	1040	612	583	334	302	424	512
HQ	447	441	745	602	1900	1590	764	703	441	400	681	891
am	29.	13.	14.	29.	28./29.	3.	15.	22.	1.	23.	15.	29.

Monatliche Abflüsse von 1901/1950 (m³/s)

MNQ	380	363	393	399	477	553	558	530	482	419	402	375
MQ	517	540	631	630	712	729	741	734	686	604	565	506
MHQ	806	955	1110	1110	1100	1060	1050	1110	1070	1000	899	773

Abflüsse (m³/s) **und Abflußspenden** (l/s km²)

Winter					Sommer					Jahr				
NQ	MNQ	MQ	MHQ	HQ	NQ	MNQ	MQ	MHQ	HQ	NQ	MNQ	MQ	MHQ	HQ
Nq	MNq	Mq	MHq	Hq	Nq	MNq	Mq	MHq	Hq	Nq	MNq	Mq	MHq	Hq

1952

n 182, ΣQ 109 168				n 184, ΣQ 84 720				n 366, ΣQ 193 988			
256	600	1900		258	460	891		256	530	1900	
5,39	12,6	40,0		5,43	9,69	18,8		5,39	11,2	40,0	

1901/1950

165	312	627	1690	3000	198	339	639	1470	2690	165	289	633	1820	3000
3,47	6,57	13,2	35,6	63,2	4,16	7,13	13,4	30,9	56,6	3,47	6,09	13,3	38,3	63,2

Äußerste Abflüsse und Abflußspenden von 1952

NQ 256 m³/s, Nq 5,39 l/s km² — 1. Nov. 1951
HQ 1900 m³/s, Hq 40,0 l/s km² — 28./29. März

Überhaupt bekannte äußerste Abflüsse und Abflußspenden

NNQ 165 m³/s, NNq 3,47 l/s km² — 4. Jan. 1909
HHQ 6000 m³/s, HHq 126 l/s km² — 31. März 1845

*) Vor 1. 11. 1925 nach Pegel Vilshofen.

Donau — Pegel: Hofkirchen

2256,7 km oberhalb der Mündung
PN = NN + 299,623 m. F_N = 47487 km²
Tagesmittel

Tageswerte (cm)

Tag	Nov	Dez	Jan	Febr	März	April	Mai	Juni	Juli	Aug	Sept	Okt
1.	208	259	234	239	814	461	340	306	262	221	210	254
2.	213	259	281	238	324	470	332	303	256	217	205	254
3.	214	256	237	241	325	475	327	293	254	211	204	254
4.	213	253	249	241	323	473	333	304	255	206	211	253
5.	215	253	253	237	328	466	331	311	250	205	218	252
6.	218	253	250	234	346	450	327	313	241	202	221	254
7.	213	250	247	230	365	428	329	311	238	205	226	263
8.	214	252	241	231	377	408	327	306	230	212	232	277
9.	214	251	232	233	375	390	318	308	228	207	267	285
10.	214	253	221	235	360	383	313	321	232	208	289	283
11.	213	259	235	235	348	382	310	327	230	209	285	280
12.	213	260	249	232	370	382	305	311	231	209	282	271
13.	218	268	272	227	398	384	316	294	234	211	287	262
14.	214	264	337	233	398	384	336	285	235	208	315	256
15.	216	258	339	246	387	378	344	286	232	207	325	259
16.	223	250	322	253	371	376	329	293	227	204	306	274
17.	229	244	307	251	348	381	317	305	234	209	290	290
18.	236	242	300	249	337	385	305	314	241	225	281	291
19.	237	248	300	244	338	388	290	327	244	225	270	283
20.	233	254	295	239	344	384	289	322	239	232	268	272
21.	227	255	287	245	365	375	297	327	227	238	265	267
22.	227	252	280	251	380	373	295	330	218	241	266	266
23.	235	246	271	251	422	372	287	316	215	248	261	269
24.	234	244	266	258	442	371	281	304	216	245	259	274
25.	238	237	261	268	465	364	276	298	213	240	259	290
26.	246	231	256	269	479	359	284	297	213	232	255	310
27.	258	230	251	274	488	360	293	294	211	221	249	338
28.	267	228	247	289	504	358	298	288	208	226	249	362
29.	274	228	245	305	509	351	310	280	208	224	248	368
30.	267	229	241		486	348	318	270	208	220	248	352
31.		230	237		466		308		211	214		335
Σ	6841	7696	8203	7178	12082	11857	9665	9144	7141	6782	7751	8798

Hauptzahlen (cm)

der Monate von 1952

am	1.	28.,29.	2.,10.	13.	1.	30.	25.	30.	öfter	6.	3.	5.
NW	208	228	231	227	314	346	276	270	208	202	204	252
MW	228	248	265	248	390	395	312	305	230	219	258	284
HW	275	269	345	310	514	476	347	334	266	253	329	372
am	29.	13.	14.	29.	28./29.	3.	15.	22.	1.	23.	15.	29.

der Monate von 1941/1950

MNW	245	245	265	299	278	297	275	272	264	245	236	231
MW	282	291	346	356	336	336	309	312	308	282	264	255
MHW	338	404	455	425	417	394	369	380	393	360	312	305

Winter					Sommer					Jahr				
NW	MNW	MW	MHW	HW	NW	MNW	MW	MHW	HW	NW	MNW	MW	MHW	HW

1952

n 182, Σ 53 857				n 184, Σ 49 281				n 366, Σ 103 138			
208	296	514		202	268	372		202	282	514	

1941/1950

182	234	324	516	611	175	224	288	449	550	175	214	306	538	611

Äußerste Wasserstände von 1952

NW 202 cm 6. August — HW (ungeh. / überh.) 514 cm 28./29. März

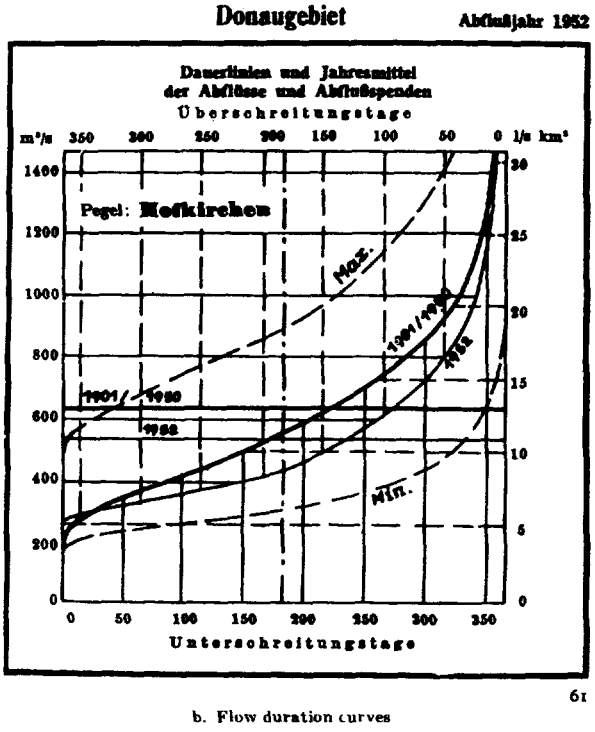
Überhaupt bekannte äußerste Wasserstände

NNW 175 cm 22., 24. Sept. 1947 — HHW (ungeh. / überh.) 611 cm 28. Nov. 1944

Eisverhältnisse 1952: Eisbewegung an 1 Tag

a. Tables of river discharge and stage at Hofkirchen

Figure 5.



b. Flow duration curves

Figure 5 - Continued.

Item No.	*Requirement*	*Complication*
20	Source or sources of data. If different for various items, list item number in groups corresponding to the source.	*a.* "Jahrbuch des Hydrographischen Zentralbilros im Bundesministerium fur Land-und Foretwirtachaft 1948", Wien (Vienna) 1950. All items were extracted from this book except those noted in b below. *b.* "Die Niederschlage in Osterreich, Mittlere Monats und Jahresummen ftir die Jahesreihe 1896-1930 (Normalzahlen)", published by the "Hydrographisches Zentralbfire im Bundesministerium fur Land-und Forstwirtschaft," Wien (Vienna) 1947. Values for item 18 were extracted from this book.
21	Reliability of the source or source data.	Completely reliable.
22	Accuracy of Data.	Probably true.
23	Agency or unit preparing the compilation.	Military Hydrology Branch Washington District CE.
24	Inclosed pictures, maps and drawings depicting the location and other features of the major items.	Summary charts of heavy rainfall and snowfall, (fig. 6).
25	Date compilation was prepared.	8 Oct. 1953.

17. Bridges. *Mosel Deck Bridge at Koblenz.*

Item No.	*Requirement*	*Complication*
1	Name or number by which bridge is known or identified.	Deck bridge over Mosel River at Koblenz (Adolf Hitler Road Bridge).
2	Country or countries, state or province, and so on, in which the major item is located.	Germany, Rheinland, Pfalz.
3	Main river basin in which subject is located.	Rhine River.
4	Stream which bridge crosses.	Mosel River (fig. 4).
5	Distance and direction from a city or some other definite geographic reference point.	Road bridge on Adolf Hitler Road over the Mozel River. (fig. 7).

1948

(RAIN GAGE RECORD)
VERZEICHNIS DER REGENMESSSTELLEN

Nr.	(Gaging place) Messstelle	Land	(Drainage basin) Flussgebiet	Höhe m ü. A.	beob. seit	N.Z. mm
50	Innsbruck T M.Z.A.	T	Inn	582	1853	900

(PRECIPATION—MONTHLY & YEARLY TOTAL & DAILY MAXIMUM IN MILLIMETERS)
MONATS- UND JAHRESSUMMEN UND TAGESMAXIMA
DES NIEDERSCHLAGES IN MILLIMETERN

Nr.	Messstelle	Flussgebiet	Höhe m ü.A.	(av.) N.Z.	(Monthly Rainfall) Monatssummen des Niederschlages												Jahres-summe		Tages-maximum	
					I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	mm	%NZ	mm	Tag
50	Innsbruck	Inn	582	900	91	109	45	46	43	173	115	138	43	29	21	16	869	97	50.4	10.8.

(SURVEY OF HEAVY RAINFALL)
ÜBERSICHT DER STARKREGEN

Nr.	Messstelle	Tag	Vor-Regen		Starkregen				Nach- u. Zwischen-Regen		Anmerkung
			von-bis	h_N mm	von-bis	Dauer Min.	h_N mm	in mm/Min.	von-bis	h_N mm	
50	Innsbruck	14.7.	18.40-18.50	0.1	18.50-19.00	10	8.0	0.8	19.00-20.00	0.9	
		3.8.	17.50-17.58	1.8	17.58-18.01	3	3.9	1.3	18.01-18.40	1.3	
		6.9.	14.56-15.00	0.4	15.00-15.10	10	8.8	0.88	15.10-15.22	1.1	

(SURVEY OF SNOW CONDITIONS IN WINTER 1947/48)
ÜBERSICHT DER SCHNEEVERHALTNISSE IM WINTER 1947/48

Nr.	Messstelle	Fluss-gebiet	Höhe m ü.A.	Datum					Zahl der Tage			Höhe d. neu-Schnees	Grösste Schneehöhe	
				Erster Schnee-Fall	Beginn der Schneebedeckung (a)	Ende der Schneebedeckung (a)	Beginn der Winterdecke (b)	Ende der Winterdecke (b)	mit Schneebedeckung (a)	mit Schneebedeckung (b)	mit Schnee-Fall	cm	cm	Tag
50	Innsbruck	Inn	582	18.11.	19.11. (Intermittant snow cover)	28.2.	5.12. (Continuous snow cover)	25.1.	73	52	31	196	32	22.12.

Figure 6. Summary charts of heavy rainfall and snowfall.

Item No.	Requirement	Complication
6	Distance from bridge to river mouth or some other river reference point.	About 2 km above the mouth of the Mosel River at the Rhine River.
7	Latitude and Longitude of the major item.	50° 22'N, 7° 35'E. (From GSGS Map 4416-S2).
8	Coordinates of any local grid-coordinate system.	Nord du Guerre: L897961, From GSGS Map 4416-S2. (UTM:399580 from AMS M641-S-2).
9	Name or number of roadway or name of railroad which bridge serves. Also give type of traffic carried: (for example, general highway or pedestrian).	Adolf Hitler. Street in Koblenz. Carries general highway and pedestrian traffic.
10	Type of bridge (fixed, suspension, floating, and so on).	Fixed, hinged-deck arch.
11	Military type or load classification.	NI.
12	Date bridge was completed.	1934.
13	Lengths:	Figure 8.
	a. Total (including approaches).	*a.* 843.8m.
	b. Main bridge.	*b.* 338.7m.
	c. Left approach (the "left approach" is on the left side facing downstream).	*c.* 356.0m (approximately) to grade.
	d. Right approach.	*d.* 161.0m (approximately) to grade.
14	Piers.	
	a. Number and size.	*a.* Left approach: 10 Each 0.8m. River span: 2 Each 5m. Right approach: None. Three abutments.
	b. Construction material (wooden and so on).	*b.* All of reinforced concrete.
	c. Distance or span between.	*c.* Spans: Approach: 5 at 15.0m, 5 at 15.6m, 1 at 16.3m, 1 at 11.8m, and 1 at 10.7m. River spans: 1 at 100.0m, i at 105.0m, and 1 at 118.6m.
15	Bridge deck:	
	a. Width and thickness.	*a.* Total width: 18m Roadway: 12m Thickness: NI.
	b. Construction material and pavement type.	*b.* NT.
	c. Provision for movement to pass water borne traffic.	*c.* No provision for movement for waterborne traffic.
16	Composition and condition of approaches (gravel, macadam, rockfill, and so on, and current state of repair).	NI.
17	Indicate whether elevations are based on mean sea level or on some other reference.	Meters above the North Sea.
18	Elevations:	NI.
	a. Top of bridge deck.	
	b. Water surface for highest stream stage of record (HHW) and date of occurrence.	
	c. Highest navigable water surface, if applicable.	
	d. Normal or mean water surface.	
	e. Lowest water surface recorded (LLW) and date of occurrence.	
	f. Bottom of stream.	
19	Bridge clearance ("bridge clearance" is the maximum distance between the water surface of the stream and the underside of the bridge) for high, normal and low stream stages.	*a.* High stage: 9.5m at HHW, 14.0m at high navigable water *b.* Normal stage: 16.4m. *c.* Low stage: NI.
20	Composition of stream bed at bridge site (for example: rocky, muddy, or sandy).	Sand and gravel.
21	Period of record of stream depth at gage. (Give dates beginning and end of period).	NI.
22	Give maximum and average stream depth at bridge for high, normal, and low stages.	

Stage	*Average*	*Maximum*
High	10.5m at HHW	11.5m at HHW
Normal	3.5m	4.5m
Low	NI	NI
High Navigable	6.0m	7.0m

Item No.	*Requirement*	*Complication*
23	Cross sectional area of stream channel at bridge for high, normal, and low stages.	NI.
24	Period of record of current velocity at bridge. (Give dates for beginning and end of period.)	NI.
25	Give current velocity at bridge for high, normal, and low stream stages. (Indicate whether velocities are for water surface or for channel cross section.)	1.0 to 3.0 m/sec (mean); 3.0 m/see (highest, navigable); NI for high and low stages.
26	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	Alinement of bridge is somewhat skewed.
27	Source or sources of data if different for various items, list item numbers in groups corresponding to the source.	"Highway Bridges of Western Germany" Vols 1 & 4, Strategic Engineering Study No. 130, published by office, Chief of Engineers, Sep. 1944.
28	Reliability of source or source data.	Usually reliable.
29	Accuracy of data.	Truth cannot be judged. Compiled during WW II.
30	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
31	Inclose pictures, maps and drawings depicting the location and other features of major items.	a. Map of bridge location on Mosel River (fig. 4) (bound with Mosel River Channel). b. Map showing location of the bridge at Koblenz (fig. 7). c. Section, plan, and cross sections of the bridge (fig. 8).
32	Date compilation was prepared.	22 Oct. 1953.

18. Fords and Ferries. *Hodenhagen Ferry.* (Ferries, as considered in this bulletin, refer only to ferries crossing rivers or waterways, and not to sea or lake ferries.)

Item No.	*Requirement*	*Complication*
1	Name of ford or ferry. (Indicate whether ford or ferry.)	Hodenhagen Ferry.
2	Country or countries, state or province, and so on, in which the major item is located.	Germany, Niedersachsen, Hanover.
3	Main river basin in which the subject is located.	Weser River.
4	Stream forded, or crossed by ferry.	Aller River.
5	Distance and direction from city or some other definite geographic reference point.	About 15 km west of Rethen.
6	Distance from ford or ferry to river mouth or to some other stream-reference point.	At Aller River km 139.3 (below Oebisfelde). 56.3 km above junction with Weser River.
7	Latitude and longitude of the ferry.	52° 54'N, 9° 36'E.
8	Coordinates of any local grid-coordinate system.	EB-48, BB-236, Weser River Navigation System Report, No. 6.
9	Name or number of road or railroad served, and type of traffic using the ford or ferry.	Riedhagen Ahlden Road. General vehicle, horse, and pedestrian traffic.
10	Indicate whether elevations are based on mean sea level or on some other reference.	Based on the North Sea. Expressed in meters as mNN (meters Normal Null).
11	Give the following elevations: *a.* Water surface for highest stream stage of record (HHW), and date of occurrence. *b.* Highest navigable water surface, if applicable. *c.* Normal or mean water surface. *d.* Lowest water surface recorded (LLW), and date of occurrence. *e.* Bottom of stream.	NI.
12	Stream width at ford or ferry at high, normal, and low stages.	*a.* Normal stage: 52ii. *b.* High and low stages: NI.
13	Period of record of stream depth at the ford or ferry. (Give dates of beginning and end of period.)	NI.

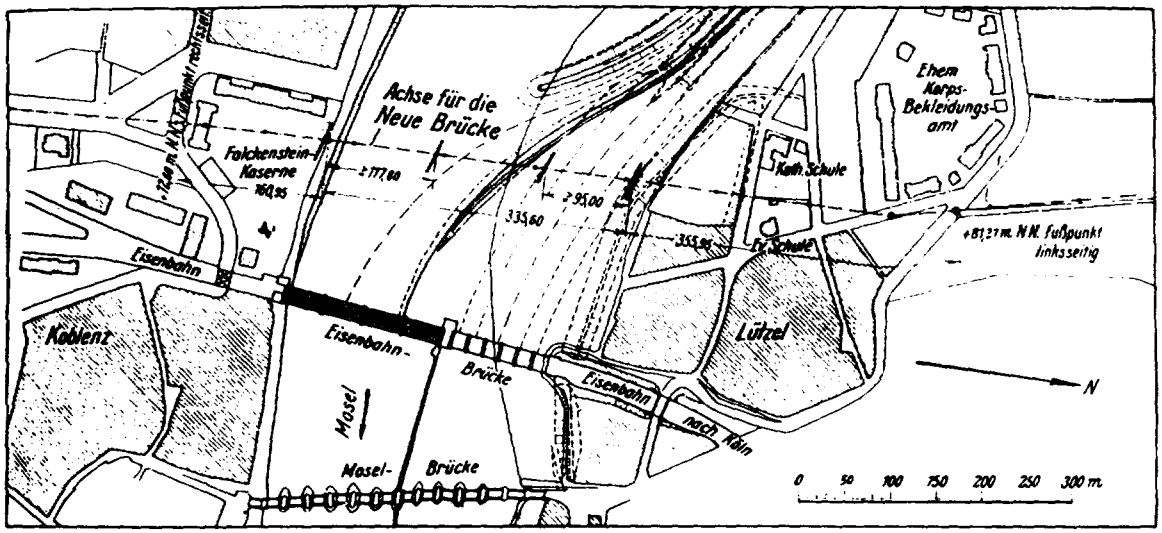


Fig. 546
Map Showing Location of the Deck Bridge Over the Mosel River at Koblenz

Bridge No. wL-19 Map Reference - wL-9095
Map G. S.G.S. 4072 Sheet No. NE. 50/6

V-2927 p.130 (illus) fig. 1 (1934)
GERMANY

Figure 7. Map showing location of deck bridge at Koblenz.

Item No.	*Requirement*	*Complication*		
		Stage	*Maximum*	*Average*
14	Give the maximum and average depth at the ford or ferry for high, normal, and low stages.	High	NI	NI
		Normal	NI	2.6m
		Low	NI	1.5m
15	Period of record of stream velocity at the ford or ferry. (Gives dates for beginning and end of period.)	NI.		
17	Composition of stream bed at the ford or ferry.	NI.		
18	Composition of approaches and their state of repair. ("Left approach" is on the left facing downstream.)	NI.		
19	Time stream cannot be forded or ferryboat cannot be operated due to high or low water, or ice.	NI.		
20	Give the following data for each type of ferryboat.			
	a. Draft (refers to the depth of water required to float the boat when loaded to capacity.	*a.* 0.6m loaded.		
	b. Propelling power. Also indicate if ferry is guided by a cable across the stream.	*b.* Operated by cable and river current ("flying ferry").		
	c. Weight capacity.	*c.* 6 tons (metric).		
21	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	None.		

Item No.	*Requirement*	*Complication*
22	Source or sources of data. If different for various items, list numbers in groups corresponding to the source.	"Zusamniienstellung dur Ubergange in Stromgebiet der Weser und Ems," (Mil Geo), pubs lished by the German High Command, 1939.
23	Reliability of the source or source data.	Usually reliable.
24	Accuracy of data.	Truth cannot be judged (information assembled before World War II).
25	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
26	Inclose pictures, maps and drawings depicting the location and other features of the major items.	None.
27	Date compilation was prepared.	27 Oct. 1953.

19. Dams and Reservoirs. *-Pickwick .Landing Dam.*

Item No.	*Requirement*	*Complication*
1	Name of dam.	Pickwick Landing Dam.
2	Name of reservoir.	Pickwick Landing Reservoir.
3	Country or countries, state or province, and so on, in which the dam is located.	US, Tenn.
4	Country or countries, state or province, and so on, in which the reservoir is located.	US, Tenn, Miss, Ala.
5	Main river basin in which the subject is located.	Tennessee-Ohio-Mississippi (fig. 9).
6	Stream on which dam is located.	Tennessee River.
7	Distance and direction from a city or some other definite geographic reference point.	Dam: 100 air miles east of Memphis, Tenn: 23.5 miles by highway from southern Railway, Mobile & Ohio Railroad, and Illinois Central Railroad, at Corinth, Miss; 35 miles by highway from Mobile & Ohio Railroad, at Selmer, Tenn; 20 miles by highway from Southern Railway at luka, Miss (fig. 10).
8	Distance from dam to river mouth or to some other stream reference point.	206.7 mi.
9	Latitude and longitude of the major item.	35° 4'N, 88° 15'W (from Encyclopedia Britannica Atlas).
10	Coordinates of any local grid-coordinate system.	NI.
11	Date dam was completed and name of the power group to which dam belongs, if any.	Completed in March, 1938. Belongs to the Tennessee Valley Authority (TVA).
12	Purposes of the dam or reservoir, such as: flood control electric power, navigation, water supply and so on.	Electric power, navigation, and flood control.
13	Type of dam and construction material. Indicate whether dam is fixed or movable; whether arch, buttress, or gravity type; and whether made of earthfill, rockfill, concrete masonry, wooden piles, and so on.	Concrete gravity spillway section; earth embankments; concrete bulkhead sections; concrete powerhouse and intake section; concrete lock (fig. 11).
14	Maximum height of dam above valley floor.	113 ft (fig. 12).
15	Total length of dam including abutments and wing dams.	7,715 ft (fig. 12).
16	Tenth of abutments or wings dams.	Refer to item 18.
17	Indicate whether elevations are based on mean sea level or on some other reference.	Feet above mean sea level. Based on 1929 General Adjustment Datum.
18	(Give the following data for each concrete or masonry section.	Figure 12.
	a. Length of section.	*a.* Spillway section, 1,037.5 ft; spillway bulkheads, 103.5 ft; nonoverflow concrete dam, 115 ft; powerhouse intake, 580 ft; lock, 215 ft.
	b. Height above base.	*b.* 105 ft (approximately).
	c. Base thickness.	*c.* Spillway section including apron, 149.25 ft; spillway section excluding apron, 76.54 ft; nonoverflow concrete dam, 63.25 ft.

Item No.	Requirement	Complication
	d. Elevation of top of crest of nonoverflow section.	*d.* 440 ft.
	c. Upstream and downstream slopes.	*e.* Spillway section, ogee-shaped; nonoverflow concrete section: Upstream face 0.5 on 12 to elevation 430; vertical above elevation 430; downstream face 8 on 12 between elevations 330-380, 6 on 12 between elevations 380400, 1.5 on 12 between elevations 400-430, vertical above elevation 430.
	f. Crest width.	*f.* Nonoverflow concrete section, roadway at elevation 440, 20.5 ft; below roadway, elevation 430, 12 ft.
19	Give the following data for each earthfill or rockfill section.	Figures 13 and 14.
	a. Length of section.	*a.* Left (south) embankment: 4,578 ft; right (north) embankment: 977 ft.
	b. Height above base.	*b.* Left: 63 ft (maximum); right: 60 ft (maximum).
	c. Base thickness.	*c.* NI.
	d. Elevation of top or crest of nonoverflow section.	*d.* Left: 435 ft; right: 440 ft.
	e. Upstream and downstream slopes.	*e.* Left: 3 on 1; right: upstream, 3 on 1 downstream, 2 on 1.
	f. Crest width.	*f.* Left: 20 ft; right: 13.75 ft.
20	Give the following data for each type of outlet:	Reservoir regulated by spillway gates (items 22, 23, and 24).
	a. Number and type. (Indicate whether tunnel, conduit, or weir and whether lined or unlined.)	
	b. Location. (Indicate whether outlets are through the mair dam, through an abutment, tunnel around end, and so on.)	
	c. Size and shape. (Indicate whether circular, rectangular, or nonsymmetrical and give width and height or diameter. If nonsymmetrical or horseshoe-shaped, give cross sectional area. If size of tunnel or conduits varies, give size, shape, and length of the segments.)	
	d. Total length.	
	e. Elevations of entrance sill (if rectangular), or entrance centerline (if circular).	
21	Give the following data for each type of outlet gate or valve:	Reservoir regulated by spillway gates (items 22, 23, and 24).
	a. Number and type. (Indicate whether slide, radial, caterpillar, needle valve, and so on.)	
	b. Location. (Indicate whether gates are at outlet entrance, at outlet portal, inside the conduits, and so on.)	
	c. Means used to operate gates (gantry crane, chain lift, screw stem, hydraulic pump, and so on).	
	d. Time required to open one outlet gate or valve.	
	e. Time required to open all outlet gates.	
	f. Size and shape of gates or valves.	
	g. Elevation of outlet gate sill (if rectangular), or gate or valve centerline (if circular).	
	h. Total discharge capacity of one gate or valve and corresponding reservoir water-surface elevation.	
22	Total discharge capacity of:	
	a. Entire outlet works (excluding spillway and hydroelectric plant) for various reservoir water-surface elevations.	*a.* NI.

Item No.	Requirement	Complication
	b. Powerplant at maximum, normal, and minimum pool elevations.	*b.* NI.
23	Give the following data for the spillway:	
	a. Type and location. (Indicate whether uncontrolled, movable crest, or siphon type and whether located in center of dam, on right or left abutsent, on side channel, and so on.)	*a.* Ogee type spillway with crest gates constructed across original river channel.
	b. Crest elevation.	*b.* 378 ft.
	c. Total length including piers.	*c.* 1037.5 ft.
	d. Number and size of piers.	*d.* 21-7.5 ft.
	e. Clear length or total length minus total width of piers.	*e.* 880 ft.
24	Give the following data for each type of spillway gate.	Figures 16.
	a. Number and type. (Indicate whether gates are radial vertical lift, drum, roller, and so on.)	*a.* 22 structural steel, vertical-lift, roller gates; roller bearings for wheels of bottom section, bronze-bushed bearings for wheels of top section, rubber side and bottom seals.
	b. Means used to operate gates (gantry crane, chain lift, and so on).	*b.* Gates operated by 2 traveling gantry cranes with movable trolley; trash hoist on right (north) crane only; gate lifting beam on both cranes.
	c. Time required to open one gate.	*c.* NI.
	d. Time required to open all gates.	*d.* NI.
	e. Sill elevation.	*e.* 378 ft.
	f. Size.	*f.* 40 x 40 ft.
	g. Elevation, top of gates in open position.	*g.* 435.17 ft (top of gate dogs).
	h. Elevation, top of gates in closed position.	*h.* 418 ft (top of gate dogs).
	i. Total discharge capacity of one spillway gate and corresponding reservoir water-surface elevation.	*i.* NI.
25	Total discharge capacity of entire spillway and the corresponding reservoir water-surface elevation.	Figure 16. 750,000 cu ft/sec at elev 430 ft. 650,000 cu ft/sec at elev 418 ft. 460,000 cu ft/see at elev 408 ft.
26	Give tailwater elevations (elevations of the water surface in the stream or basin at the foot of the dam) for:	Figure 16.
	a. Maximum design flood.	*a.* 416 ft.
	b. Maximum flood of record.	*b.* 403 ft.
	c. Normal outflow.	*c.* 358.5 ft.
	d. Minimum outflow.	*d.* 351 ft.
27	Drainage area of watershed above dam.	32,870 sq mi.
28	Give the following storage and elevation data for the reservoir:	Figure 17.
	a. Total gross storage at maximum design reservoir pool and corresponding reservoir-surface elevation.	*a.* 1,187,000 acre-feet at elev 420 (max design pool: elev 430).
	b. Unobtainable or dead storage. (This refers to the volume of water stored at the elevation of the entrance sill of the lowest outlet as indicated in item 20*e*.)	*b.* 72,000 acre-feet at elev 378.
	c. Storage volume at maximum operating pool and correponding reservoir surface elevation.	*c.* 1,091,000 acre-feet at elev 418.
	d. Storage volume at normal operating pool and corresponding reservoir-surface elevation.	*d.* 912,000 acre-feet at elev 414 (normal high water: elev 413).
	c. Storage volume at minimum operating pool and corresponding reservoir-surface elevation	*e.* 673,000 acre-feet at elev 408.
	f. Flood control storage and the corresponding reservoir surface elevations between which the storage space is reserved for flood control.	*f.* 418,000 acre-feet (controlled), elev 408-418.

Item No.	Requirement	Complication
g.	Hydroelectric power storage and the corresponding reservoir surface elevations between which the storage space is reserved for power production.	*g.* Power can be generated at all stages above elev 408.
h.	Irrigation storage and the corresponding reservoir surface elevations between which the storage space is reserved for irrigation.	*h.* NI.
i.	Navigation storage and the corresponding reservoir surface elevations between which the storage space is reserved for low-water regulation.	*i.* 239,000 acre-feet, elev 408-414. (Lock can be operated between elev 408-418.)
j.	Water supply storage and the corresponding reservoir surface elevations between which the storage space is reserved for domestic or industrial water supply.	*j.* None.
k.	Indicate here the purpose, storage volume, and reservoir surface elevations for any storage allocations in the reservoir not covered by the above readings.	*k.* Reservoir is fluctuated for malaria control a maximum of 1 foot between elev 409-414.
l.	Maximum gross storage volume allowable in advance of floods, and the corresponding reservoir surface elevation. (In operating some reservoirs during the flood season, it is customary to keep the pool drawn down to a certain elevation to reduce flood discharge.)	*l.* Elev 408.
m.	Total storage at top of spillway gates in open position as indicated in item 24*g*.	*m.* NI.
n.	Total storage at top of spillway gates in closed position as indicated in item 24*h*.	*n.* 1,091,000 acre-feet at elev 418.
o.	Total storage at spillway crest as indicated in item 23*b*.	*o.* 72,000 acre-feet at elev 378.
29	Give the reservoir surface area, length, and maximum width along the main stream channel at as many of the following pool elevations as possible:	

		Area (approximately)	*Length (channel)*	*Width (maximum.)*
a.	At maximum design pool as indicated in item 28*a*.	*a.* 60,000 acres	52.7 mi	NI
b.	At top of spillway gates in open position as indicated in item 24*g*.	*b.* NI	52.7 mi	NI
c.	At top of spillway gates in closed position as indicated in item 24*h*.	*c.* 46,800 acres	52.7 mi	NI
d.	At spillway crest as indicated in item 23*b*.	*d.* 5,500 acres	52.7 mi	NI
e.	At maximum operating pool as indicated in item 28*c*.	*e.* 46,800 acres	52.7 mi	NI
f.	At normal operating pool as indicated in item 28*d*.	*f.* 42,800 acres	5217 mi	1.27 mi
g.	At minimum operating pool as indicated in item 28*e*.	*g.* 37,000 acres	52.7 mi	NI
h.	At "dead storage" pool indicated in item 20*e* (the elevation of the entrance sill of the lowest outlet).	*h.* 5,500 acres	NI	NI

30	Period of record of stream discharge at the dam site. (Give dates for beginning and end of period.)	*a.* Dam site: 10 Jan, 1935 to 1948; *b.* Gage heights: Florence, Ala (drainage area: 30,800 sq mi): 7 Nov, 1871 to 1948.
31	Give the following peak discharges:	
a.	Maximum design flood at dam site prior to dam construction.	*a.* 750,000 cu ft/sec.
b.	Maximum recorded flood at dam site and date of occurrence.	*b.* 470,000 cu ft/sec (at Florence, Ala), Mar. 1897.
32	Give the average and minimum reservoir inflow per second or per day.	*a.* 56,000 cu ft/sec (1894-1934) *b.* 4,070 cu ft/sec (1925).

Item No.	*Requirement*	*Complication*
33	Give the maximum, average, and minimum discharges of water released at the dam per second or per day.	NI.
34	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	*a.* Shoreline length at elev 414; main shore: 410.8 mi; islands: 85.5 mi; total: 496.3 mi. *b.* Original river area: 9,600 acres. *c.* Uncontrolled storage (elev 418-430): 450,000 acre-feet. *d.* Two 40-foot spillway bulkheads, two 7.5-foot, and one 8.5-foot piers. *e.* Both earth embankments have a 10-foot berm at elev 400. *f.* Freeboard at normal high water (elev 413): left (south) embankment: 22 feet; right (north) embankment: 27 feet.
35	Source o01 sources of data. If different for various items, list item number in groups corresponding to the source.	*a.* "The Pickwick Landing Project," Tech Report No. 3, prepared by the Tennessee Valley Authority, 1941. All items were extracted from this book except those noted in item *b* below. *b.* "Engineering Data, Tennessee Valley Authority Projects, Technical Monograph No. 55" prepared by the Tennessee Valley Authority, Mar. 1948. The following items were extracted from this book: 25; 28*a*, *b*, *d*, *e*, *o*; 29*d*, *h*.
36	Reliability of the source or sources of data.	Completely reliable.
37	Accuracy of data.	Probably true.
38	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
39	Inclose pictures, maps and drawings depicting the location and other features of the major item.	*a.* Map and profile of Tennessee River system (fig. 9). *b.* Map of Pickwick Landing Reservoir and vicinity (fig. 10). *c.* Aerial Photo of Pickwick Landing Dam (fig. 11). *d.* Pickwick Landing dam plan, elevation, and sections (fig. 12). *e.* Pickwick Landing dam south embankment plan and typical sections (fig. 13). *f.* Pickwick Landing dam north embankment plan and typical sections (fig. 14). *g.* Pickwick Landing dam spillway gate sections and elevations (fig. 15). *h.* Pickwick Landing reservoir headwater and tailwater rating curves (fig. 16). *i.* Pickwick Landing Reservoir areas and volumes (fig. 17). *j.* Pickwick Landing Reservoir backwater curves (fig. 18). *k.* Pickwick Landing Reservoir multiple-purpose operations (fig. 19). *l.* Duration of flow curves for Tennessee River (fig. 20). *m.* Flood frequencies at Florence, Ala, by calendar months (fig. 21).
40	Date compilation was prepared.	5 Oct. 1953.

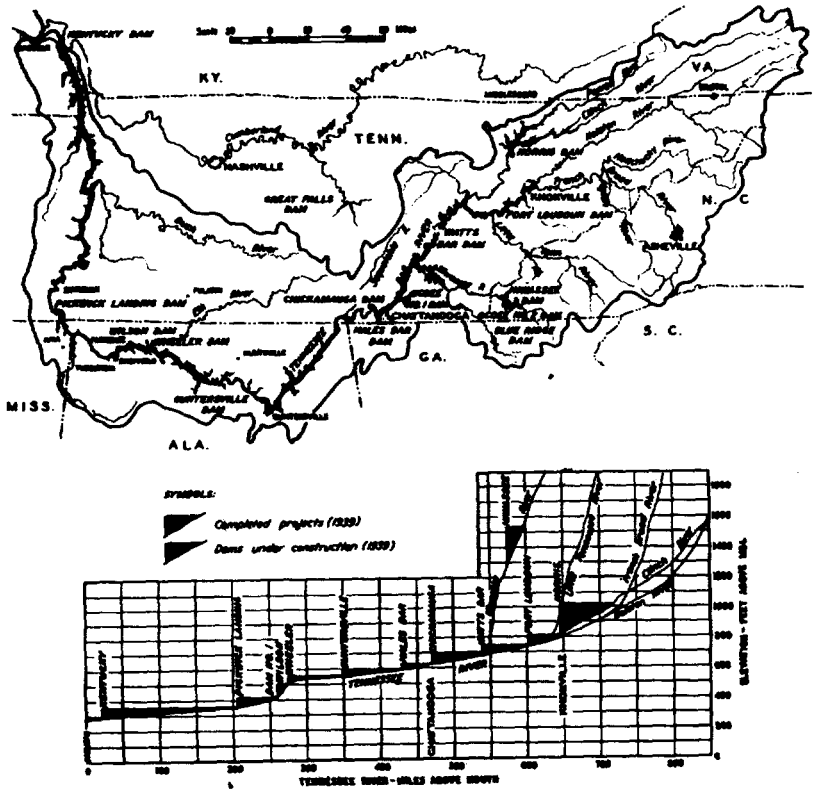


Figure 9. Map and profile of Tennessee River system.

20. Hydroelectric Plan. *Pickwick Landing Project.*

Item No.	*Requirement*	*Complication*
1	Name of hydroelectric plant.	Pickwick Landing Project.
2	Country or countries, state or province, and so on, in which the major item is located.	US Tenn.
3	Main river basin in which the subject is located.	Ohio-Mississippi.
4	Stream on which plant is located.	Tennessee River.
5	Name of dam or reservoir connected with plant.	Pickwick Landing Dam (fig 11 and 12).
6	If plant is one of a group of plants or power give the name of the group.	Tennessee Valley Authority (TVA).
7	Distance and direction from a city or some other definite geographic reference point.	100 air miles east of Memphis, Tenn; 23.5 miles by highway from Southern Railway and Mobile & Ohio RR, at Corinth, Miss; 35 miles by highway from Mobile & Ohio RR, at Selmer, Tenn; 20 miles by highway from Southern Railway at luka, Miss.
8	Distance from plant to river month or some other stream reference point.	206.7 mi.
9	Latitude and longitude of the major item.	36° 4'N, 88° 15'W.
10	Coordinates of any local grid-coordinate system.	NI.
11	Date plant was completed.	Unit 1: 18 Aug. 1938; Unit 2: 29 June 1938; Unit 3: 12 Aug. 1942; Unit 4: 12 June 1942.
12	Present number and capacity of generating unit	4 units, 144,000 kw capacity (ft. 22).
13	Ultimate number and capacity of generating units.	6 units, 216,000 kw capacity.
14	Total discharge at maximum, normal, and minimum operating pools.	12,000 cu ft/sec (each unit) at normal pool, Maximum and minimum operating pools NI.

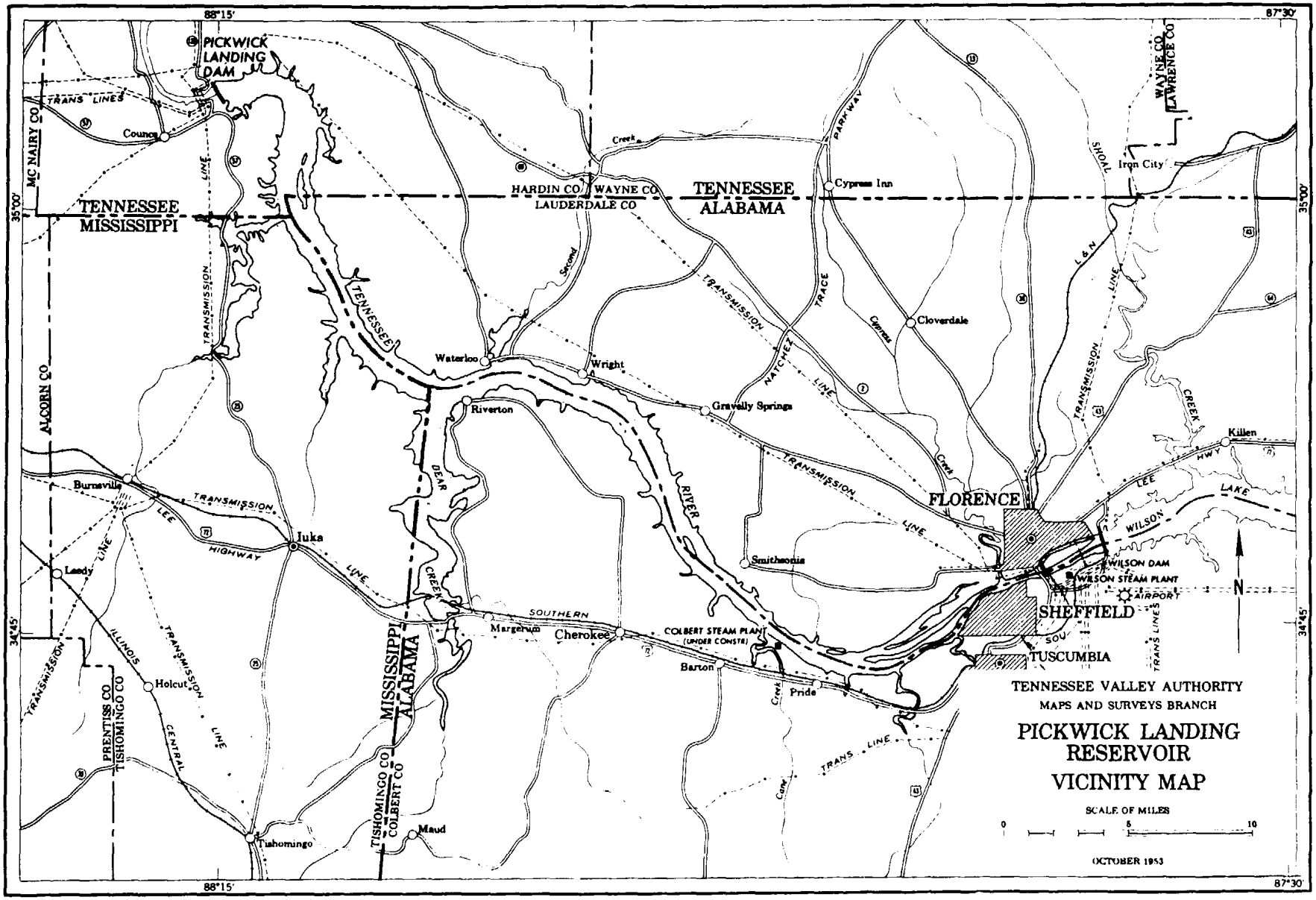


Figure 10. Map of Pickwick Landing Reservoir and vicinity.
AGO 3898A

Figure 11. Aerial photo of Pickwick Landing Dam.

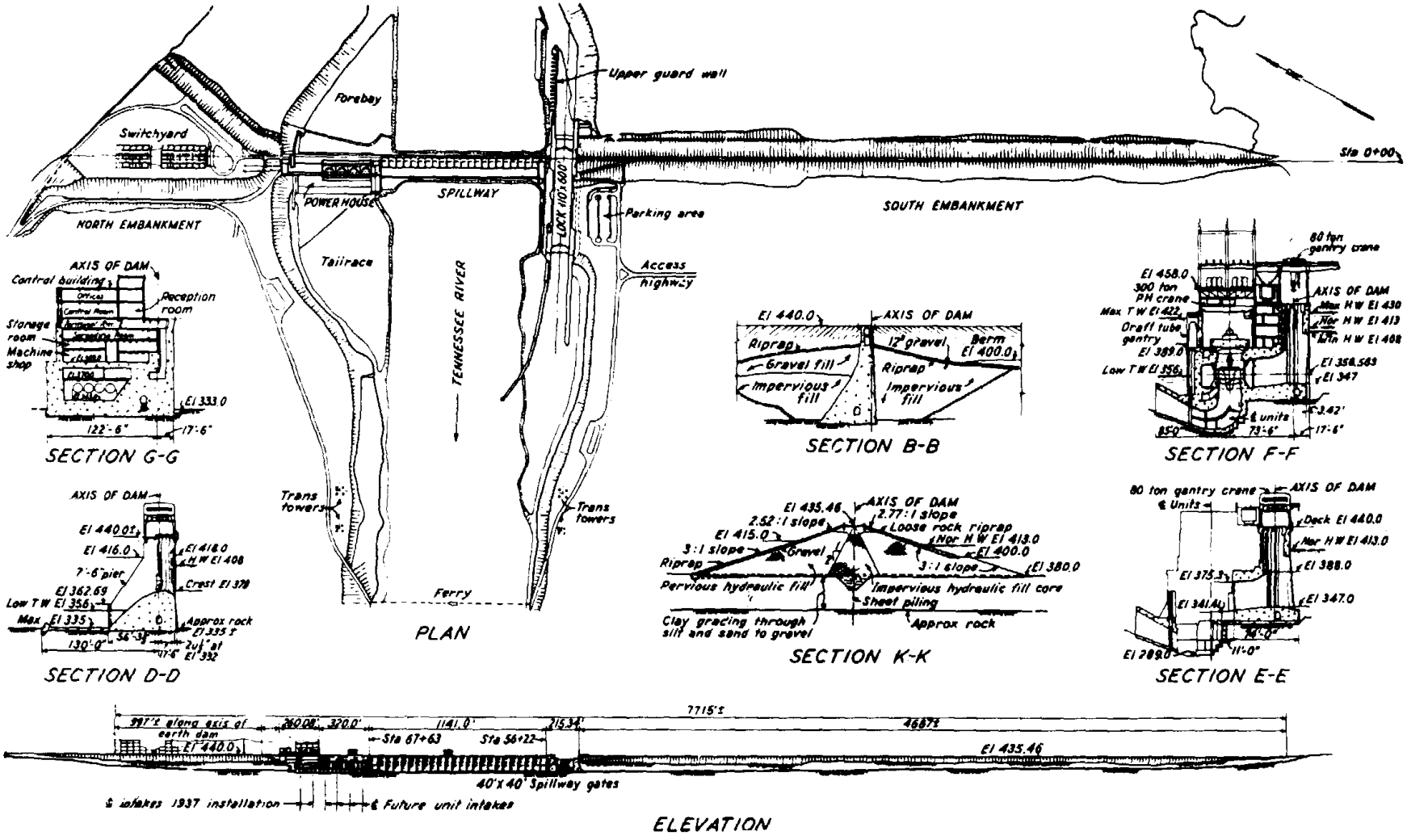


Figure 12. Plan, elevation, and sections of Pickwick Landing Dam.

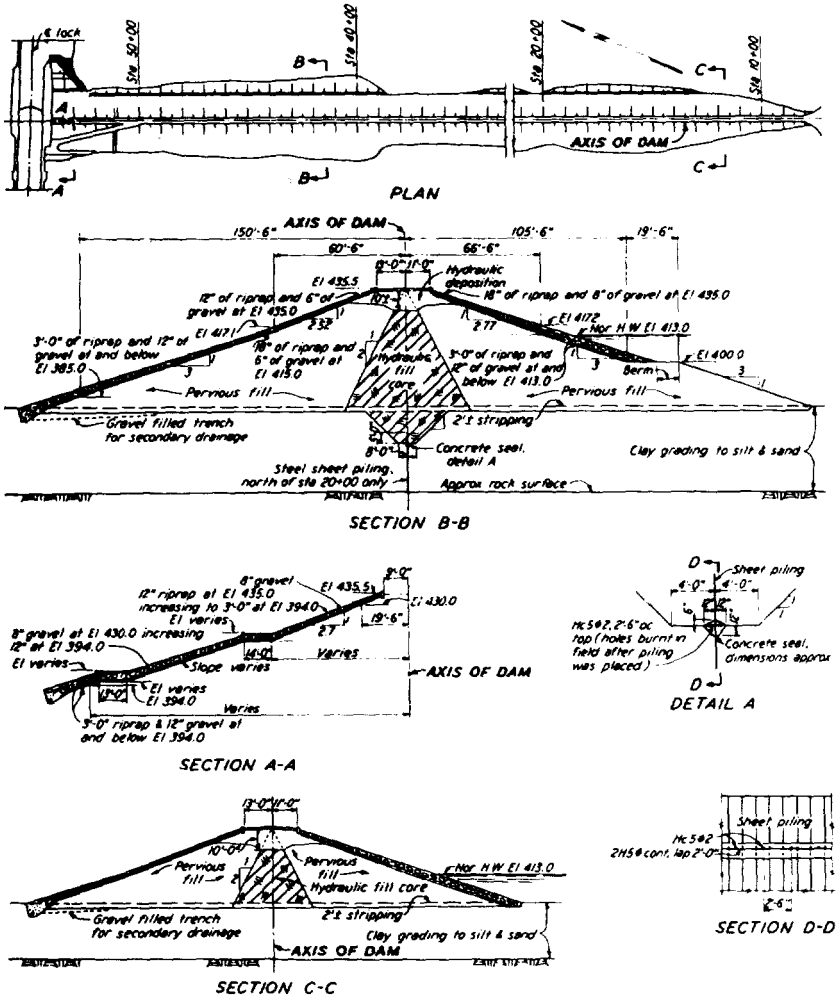


Figure 13. Plan and typical section of Pickwick Landing Dam south embankment.

Item No.	*Requirement*	*Compilation*
15	Give the power-head values for maximum, normal, and minimum operating pools. (Power-head is the difference in elevation between the surface of the impounded water and the water surface in the powerhouse tailrace or channel into which the water from the turbines is discharged.)	*a.* Maximum operating pool: 63 ft (maximum expected). *b.* Normal operating pool: 53 ft. *c.* Minimum operating pool: 5 ft (minimum expected).
16	Type of turbines. (Indicate whether propeller blades are fixed or adjustable and give manufacturer's name and model number, if possible.)	Kaplan adjustable-blade propeller, made by Allis-Chalmers Mfg Co.
17	Give the turbine capacity for maximum, normal, and minimum power-head values.	Figure 23. *a.* Maximum power-head: 55,000 English hp at 47-ft head. *b.* Normal power-head: 48,000 English hp at 43-ft head. *c.* Minimum power-house: NI.
18	Give the following data for penstocks, power tunnels, or power canals: (Penstocks are conduits or tubes which bring water to the turbines of many hydro-electric plants, particularly to plants operating	NP, powerhouse is integrated into dam.

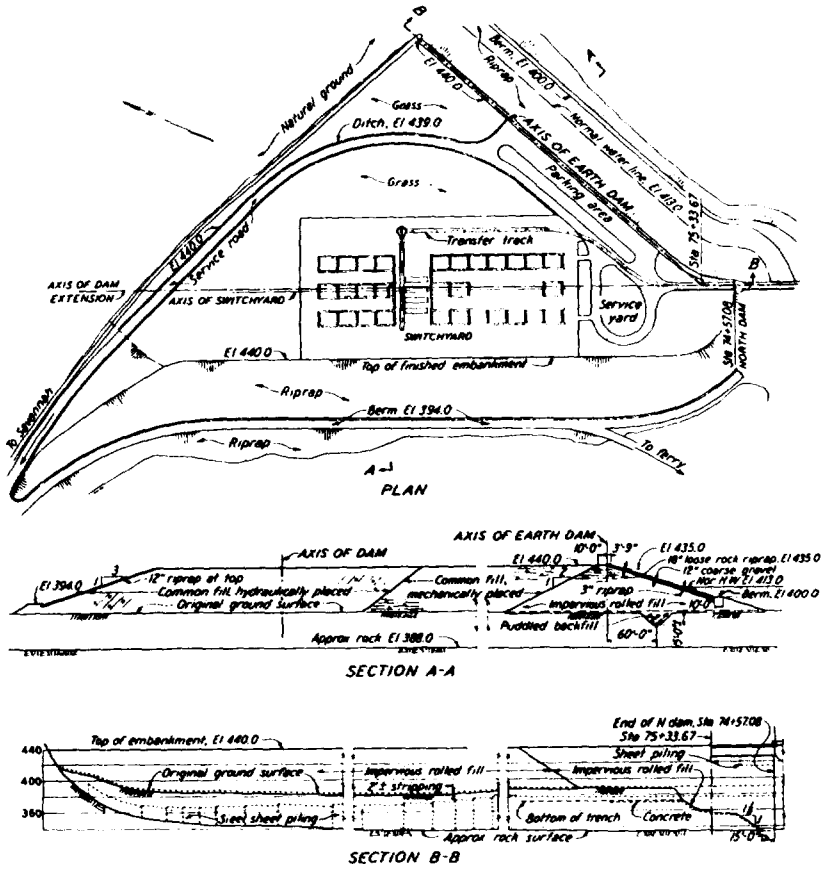


Figure 14. Plan and typical section of Pickwick Landing Dams north embankment.

Item No.	*Requirement*	*Compilation*
	with high power heads or plants located some distance from the dam or reservoir.	
	a. Number and type. (Indicate whether penstock, tunnels, or canal.)	
	b. Location. (Indicate whether penstocks, tunnels, or canals bring water through the dam, around an abutment, and so on or whether they transport water overland or through conduits from the dam or reservoir to the plant.)	
	c. Size and shape. (Indicate whether circular, rectangular, or nonsymmetrical and give width and height or diameter. If nonsymmetrical or horseshoe-shaped, give cross-sectional area. If the size varies, give size, shape, and length of the segments.)	
	d. Total length.	
	e. Total discharge capacity.	
19	Give number, type, and size of intake gates. (Indicate whether gates are sliding, wheeled, radial, caterpillar, valve type, and so on.)	12 (3 per unit) structural steel, vertical-lift roller gates, roller bearings for all wheels. Size of each gate: 18 ft 8 in. by 41 ft (opening); each gate in 2 sections, top section 18 ft 8 in. (clear width) by 17 ft 6 in. bottom section 18 ft 8 in. (clear width) by 24 ft. Operated by same 2 traveling gantry cranes used to operate spillway gates.

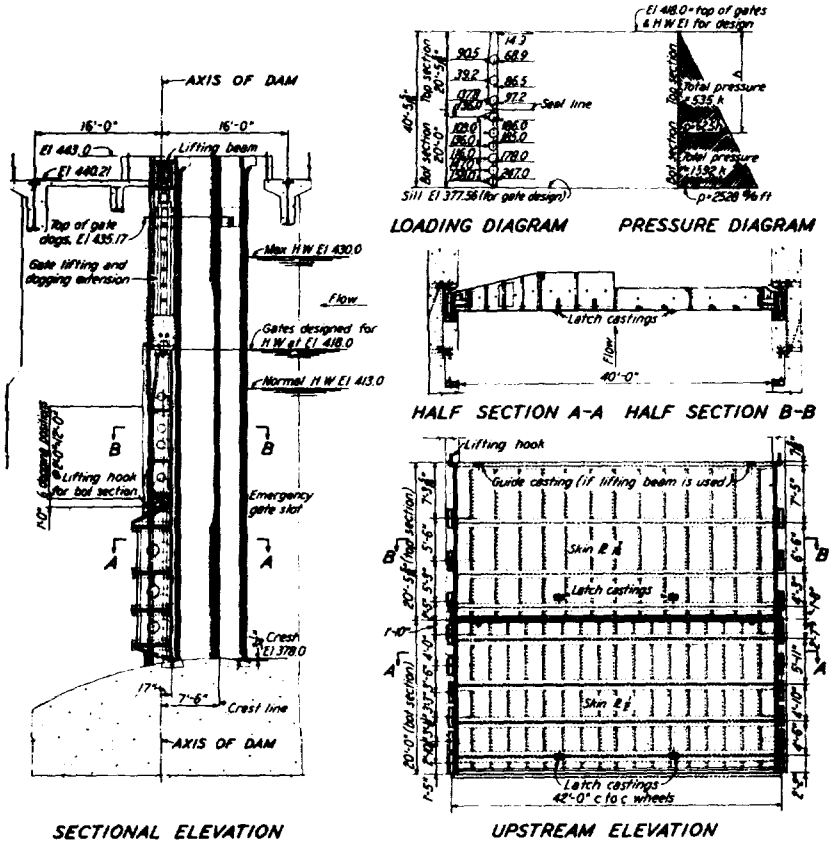
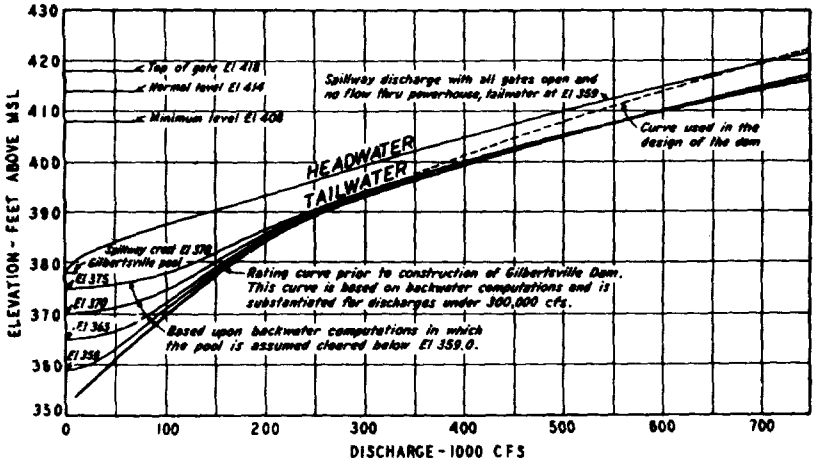


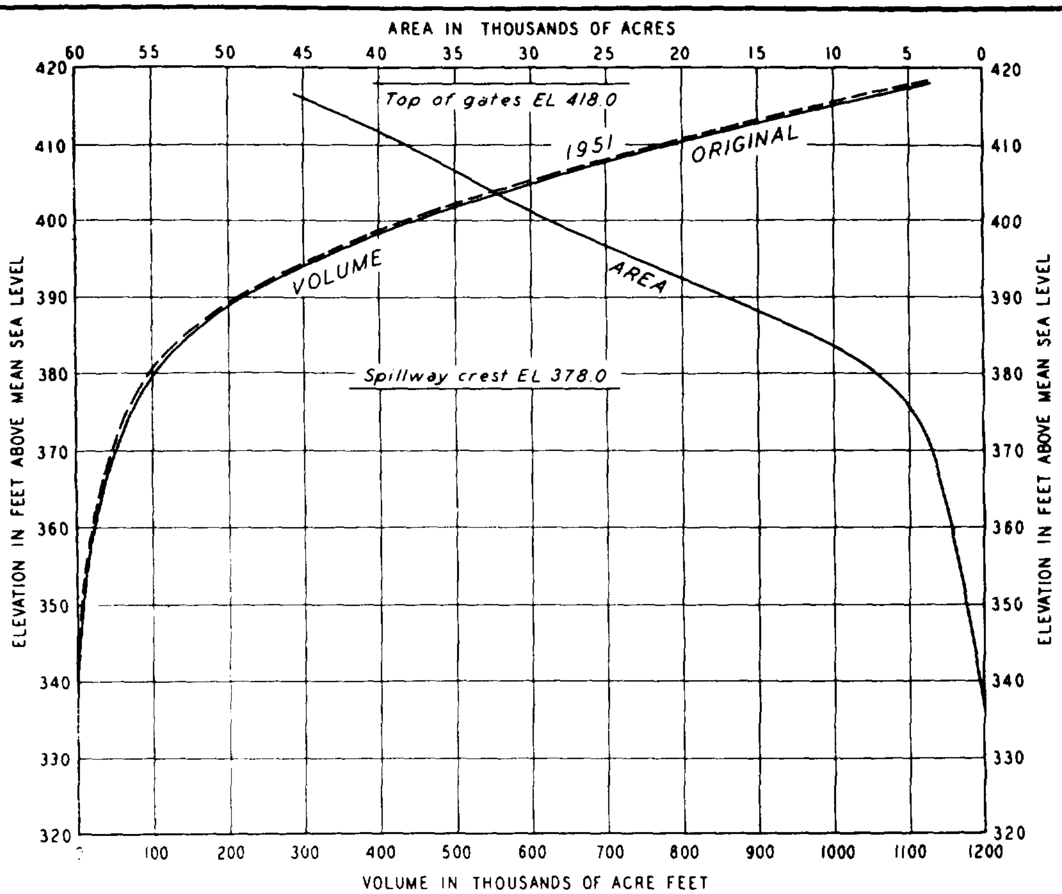
Figure 15. Pickwick Landing Dam spillway gate sections and elevations.



TAILWATER

Maximum design level . . . . . El. 422.0
Maximum level of record (1897) . . . . . El. 405.4
Average (50 percent of average annual flow)
Without Kentucky pool . . . . . El. 357.0
With Kentucky pool at El. 356.5 . . . . . El. 358.5
Minimum expected level:
Without Kentucky pool (12,500 cfs) . . . . . El. 354.2
With Kentucky pool at El. 354.5 (10,000 cfs) . . . El. 355.0

Figure 16. Pickwick Landing Reservoir headwater and tailwater rating curves.



ELEVATION FT	ORIG AREA AC	VOLUMES ORIGINAL AC-FT	1951 AC-FT
418	47,500	1,130,000	1,118,000
414	42,700	949,000	937,000
410	38,300	788,000	775,000
400	28,900	453,000	442,000
390	17,300	224,000	214,000
380	7,270	103,000	95,600
370	3,500	53,200	48,800
360	2,370	25,700	22,600
350	1,310	7,960	6,060
340	332	2,230	428
330	41	70	0
327	0	0	0

NOTES:

The original areas and volumes up to elevation 410 were computed by the contour method from TENNESSEE RIVER SURVEY maps developed by the U.S. Army Engineers which had been corrected so that the contours conformed to the original sediment range cross sections. Above elevation 410 the areas and volumes were determined from TVA land maps.

The 1951 volume was determined by the constant factor method for computing sediment.

Drainage area = 32,820 square miles.
Area of original river in reservoir = 9,581 acres.

This drawing prepared by Hydraulic Data Branch.

Elevations are referred to the USC&GS 1929 adjustment.

TENNESSEE RIVER-MILE 206.7

RESERVOIR AREAS AND VOLUMES

PICKWICK LANDING PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED RECOMMENDED APPROVED

THIS DRAWING SUPERSEDES 4-DA-0-321A1R1

KNOXVILLE 10-5-53 4 DA 1 321G718R

Figure 17. Pickwick Landing Reservoir areas and volumes.

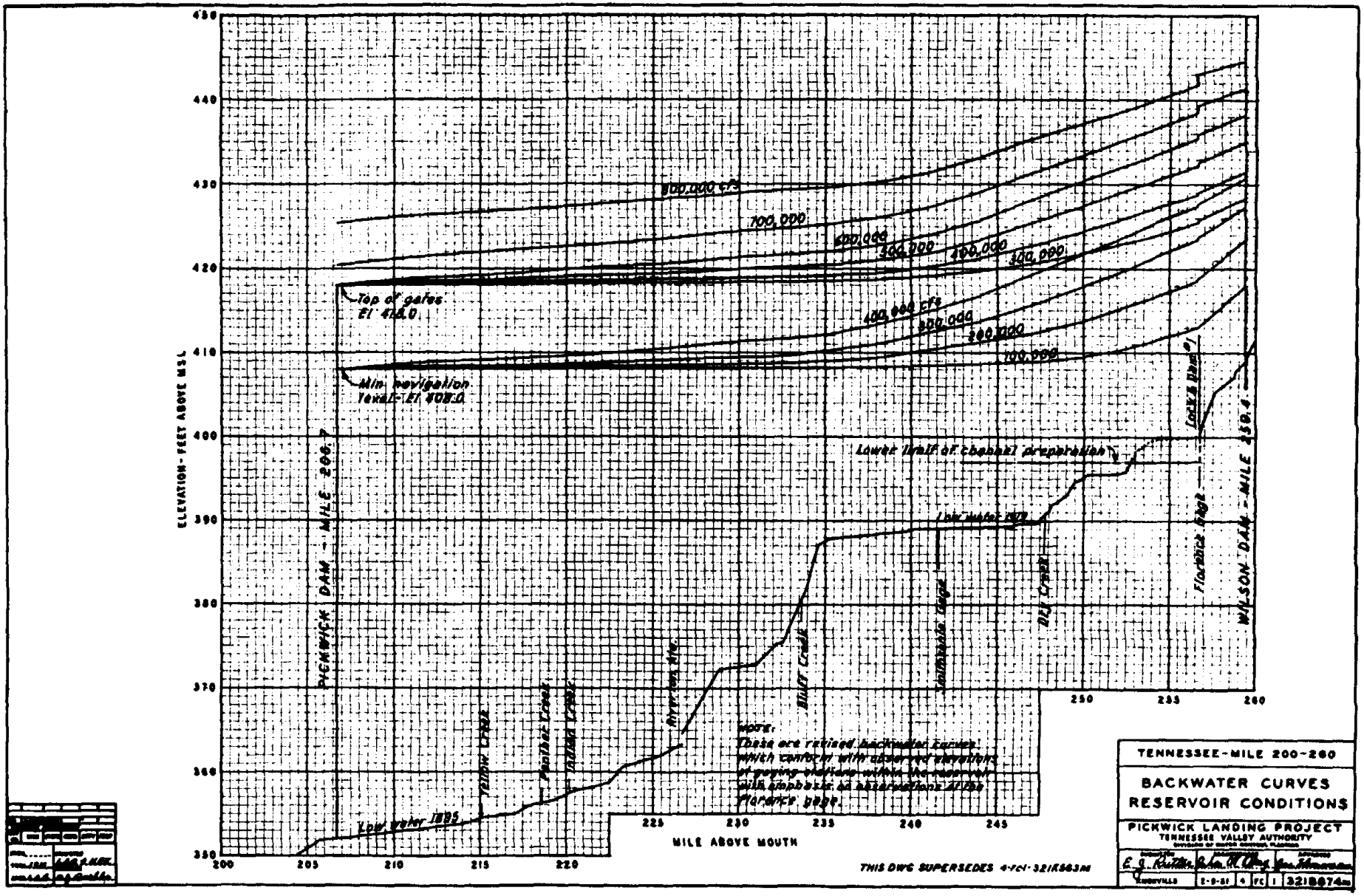


Figure 18. Pickwick Landing Reservoir backwater curves.

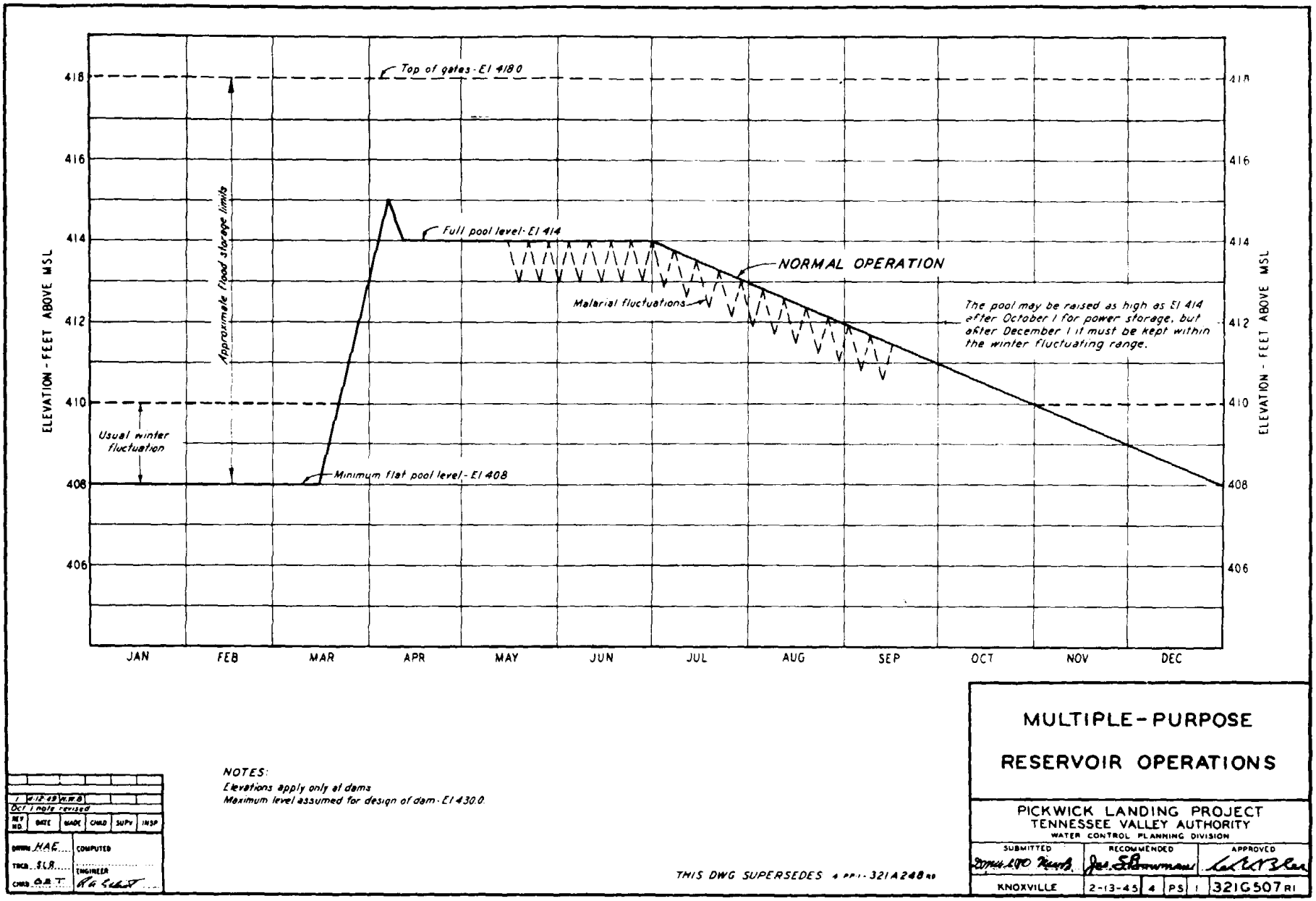


Figure 19. Pickwick Landing Reservoir multiple-purpose operations.

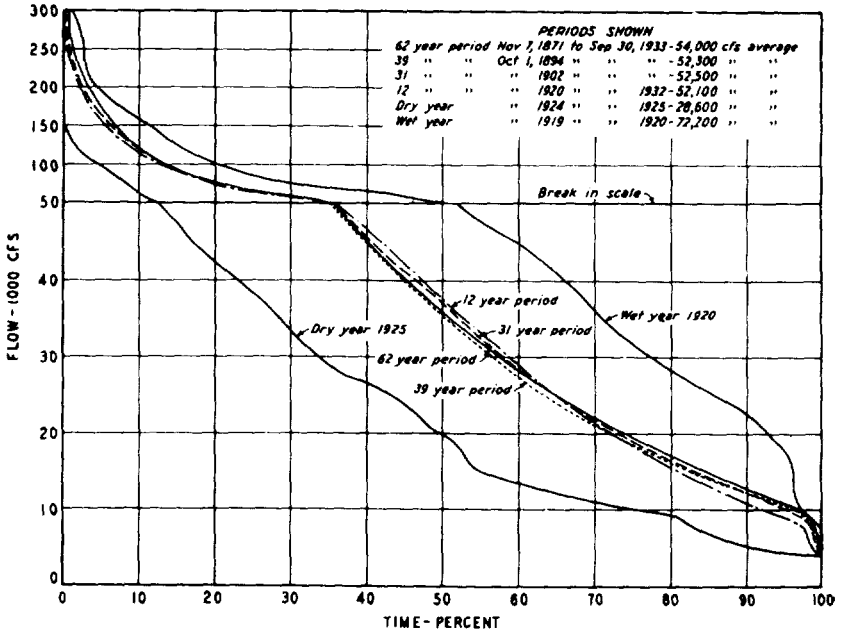


Figure 20. Duration of flow curves for Tennessee River at Florence, Alabama.

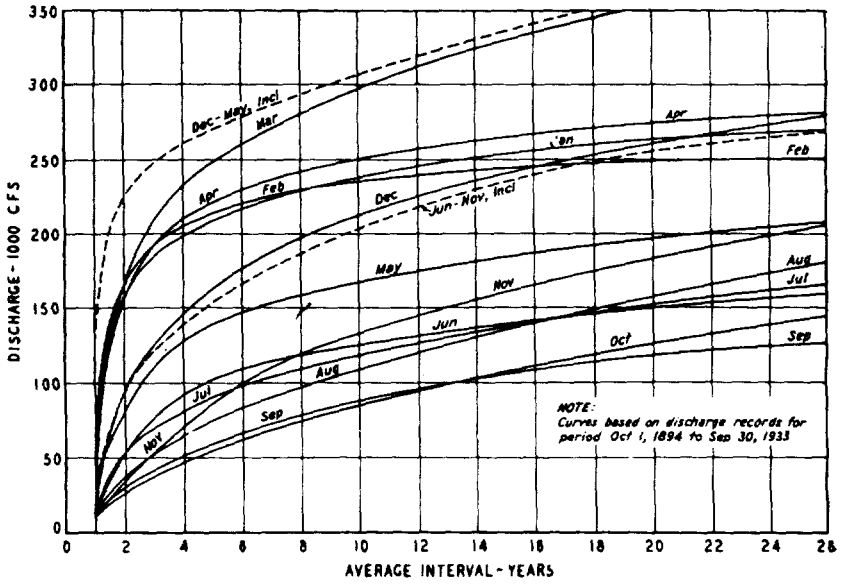


Figure 21. Flood frequencies at Florence, Alabama, by calendar months.

Item No.	*Requirement*	*Compilation*
20	Total discharge capacity of each type of intake gate.	NI.
21	Number, type and size of draft type gates. (Indicate whether gate., are stop-log. sliding, and so on.)	6 (2 sets of 3) structural steel, vertical-lift underbalanced pressure), slide gates. size: single section, 18 ft 8 in. wide (opening) by 21 ft 11 in. high. Operated by unequal-leg traveling gantry crane with fixed hoist (fig. 22).
22	Total discharge capacity of each type of draft tube gate.	NI.

23	Number, type, size, and location of surge tanks. (Indicate whether restricted orifice, throttle, differential type, and so on.)	None.
24	Any information pertinent to the major subject which would not logically be included with any of the items not previously listed.	Powerhouse structure: Reinforced concrete, conventional type with roof over crane and generators. 154-KV line terminal on roof (fig. 22).
25	Source or sources of data. If different for various items, list numbers in groups corresponding to the source.	*a.* "The Pickwick Landing Project, Tech Report No. 3", prepared by the Tennessee Valley Authority (TVA), 1941. All items were extracted from this book except those noted in item *b* below. *b.* "Engineering Data, TVA Projects, Tech Monograph No. 55" prepared by the TVA, March 1948. The following items were extracted from this book: 11 and 14.
26	Reliability of the source or sources of data.	Completely reliable.
27	Accuracy of data.	Probably true.
28	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
29	Inclose pictures, maps and drawings depicting the location and other features of the major item.	*a.* Pickwick Landing dam (aerial photo) (fig. 11). *b.* Pickwick Landing dam: plan elevation, and sections (fig. 12). *c.* Extracted power plant data (fig. 22). *d.* Discharge curves for power units (fig. 23).
30	Date compilation was prepared.	5 Oct. 1953.

21. Flood Protection Structures. *Local Protection Project, Huntington West Virginia*. ("Flood protection structures", in terms of Military Hydrology, are such structures as: levees, dikes, seawalls, flood walls, and so on, but not dams.)

Item No.	*Requirement*	*Compilation*
1	Name of structure or name by which it is identified.	Local Protection Project, Huntington, W Va.
2	Name of geographical area or flood plain protected.	City of Huntington, W Va.
3	Country or countries, state or province, and so on, in which the major item is located.	US W Va.
4	Main river basin in which the subject is located.	Ohio-Mississippi.
5	Name of stream or body of water which causes flooding.	Ohio River.
6	Distance and direction from a city or some other definite geographic reference point.	At Huntington, W Va.
7	Distance from the structure to river mouth or some other stream-reference point. (Not always applicable.)	Ohio River 305 to 313 miles below Pittsburg, Pa.
8	Latitude and longitude of the major item.	38° 24'N, 82° 28'W.
9	Coordinates of any local grid-coordinate system.	NI.
10	Date structure was completed.	21 Dec. 1943.
11	Type of structure and material of which it is constructed (Levee, dike, seawall, and so on, and whether rockfill, masonry, wooden pile, and so on.)	Concrete wall and earth levees.
12	Indicate whether structure is on left bank, right bank, or both banks, if located on a stream. (The "left" bank is on the left looking downstream.)	On left bank of Ohio River (fig. 24).
13	Total length of structure.	Concrete wall: 20,100 ft; Earth levee: 19,400 ft; Total: 39,500 ft.
14	Give maximum, average, and minimum of height of structure above base and thickness at base.	Figure 24. Height Maximum — Concrete wall: 20 ft. Earth levee: 63 ft. Average — Concrete wall: 15 ft. Earth levee: 21 ft.

DAM AND POWER PLANT

DAM

Material and type	Concrete gravity spillway section; concrete powerhouse intake section; navigation look; earth embankments; concrete bulkhead sections
Length	
Spillway section (including 21 - 7.5-ft piers)	1,037.5 ft
Spillway bulkhead (2 - 40-ft bulkheads, 2 - 7-1/2-ft and 1 - 8-1/2-ft piers)	105.5 ft
Earth embankments;	Left (south) bank 4,687 ft
	Right (north) bank 977 ft
North dam (bulkhead)	115 t
Powerhouse and intake	580 ft
Navigation lock	215 ft
Total	7,715 ft
Maximum height (intake section, foundation to top of deck)	113 ft
Maximum width at base:	Spillway section only 76.5 ft
	Including integral apron 149.3 ft
Crest of earth embankments	Left (mouth) bank E1.435.5
	Right (north) bank E1.440.0
Spillway crest, masonry	E1.378.0
Crest gate	22 fixed-wheel lift gates, 40-ft clear opening by 40 ft high in two sections, each 20 ft high; 1 spare
Trash gates	Top half of one crest gate consists of 3 section for operation as trash gates
Traveling cranes	To 80-ton gantries, and lifting beam one with an auxiliary 5-ton trash hoist boom
Maximum flood for spillway design	750,000 cfs
Discharge capacity, Reservoir at E1.418	650,000 cfs
Roadway	Provision for future construction
Foundation	Siliceous limestone

INTAKE

Number	6 (3 bays for each of 6 units)
Dimensions of one rack opening	18.67 ft wide by 58.0 ft high
Gross area at racks	3250 sq ft per unit
Gates	2 sets of 3 each vertical, fixed-wheel gates, clear opening 18.67 ft wide by 42 ft high in 2 sections
Emergency gate	Bottom sections of 3 head gates used for emergency closure
Crane	Same 80-ton gantries used as for spillway

HYDRAULIC TURBINES

Number	4 present; 6 ultimately
Manufacturer	Allis-Chalmers Manufacturing Company
Type	Kaplan type, adjustable-blade propeller, counterclockwise rotation
Rated capacity (each)	48,000 hp at 45-ft net head
Maximum capacity	55,000 hp at 47-ft net head
Efficiency (boat guaranteed)	89.0 percent at 45-ft net head
Discharge at generator rating (43-ft head)	12,000 ofs
Normal speed	8 rpm
Specific speed	163 rpm
Spacing of turbines center to center of unit	80.0 ft
Diameter of runner	292 in.
Vertical distance from distributor center line to draft tube floor	64.6 ft
Elevation center line of distributor	E1, 358.6
Governor	Fly-ball, motor-driven from potential transformers
Weight of heaviest part to be lifted by crane	625,000 lb

DRAFT TUBES

Type	Elbow; 3 openings with horizontal splitter
Horizontal length (center line of turbine to downstream face)	85.0 ft
Net area at outlet opening per unit (3 openings)	1568 sq ft
Gates	2 sets to of 3 each-slide gates, (clear opening) 18 ft by 8 in. by 21 ft 11 in. high
Crane	One 30-ton gantry and lifting beam

TRANSMISSION PLANT

TRANSFORMERS

Generator bank	
Number	4 banks of three
Type	1-phase, outdoor, self-cooled and air-blast oil-insulated, with inert gas seal, Moloney
Rating (each bank)	36,000-kva self-cooled, 48,000-kva air blast, 13.2/161 kv, 60-cycle
Bank to 110-ks switchyard	
Number	2 banks of three
Type	1-phase, outdoor, self-cooled and air-blast, oil-insulated autotransformers with tap changing under load on 154-kv winding, Westinghouse
Rating (each bank)	36,000-kva self-cooled, 48,000-kva forced air cooled 12.45- 115-14kv. 60-cyele, 12.45 -kw winding. 4.500-kva self-cooled and 6,000-kva forced air cooled

SWITCHYARD

154-kv oil circuit breakers	12 General Electric, rated 164-kv, 1,200-ampere, 2,500,000-kva, interrupting capacity, 8-cycle breakers; 2 each on Generators #1 and #2 main transformer banks and autotransformer banks; 1 each on generator #3 and #4 main transformer banks; 1 each on lines to Memphis and Wilson
110-kv oil circuit breakers	4 Pacific Electric, rated 115-kv, 600-ampere, 1,500,000-kva interrupting capacity, 8-cycle breakers; 2 each on to Jackson and Tapelo

POWER STATION

Generating capacity	
Present installation (4 units)	144,000 kw
Ultimate installation provided for (6 units)	216,000 kw
Type of superstructure construction	Reinforced concrete; with steel truss roof; generator high tension switching and take-off structure on roof
Principal outside dimensions	420 ft long by 176 ft wide by 169 ft high
Control building	96.5 ft long by 52.5 ft wide by 45.5 ft high above intake deck
Erecting crane	One 300-ton traveling crane with 2-150-ton main hooks and 2-25-ton auxiliary hooks

GENERATORS

Number or units	4 present, 6 ultimately
Manufacturer	Westinghouse Electric and Manufacturing Company
Type	A-o, vertical shaft, thrust bearings below rotors
Rating (each)	40,000-kva, 36, 000-kw, at 60°C rise
	46,000-kva, 41,400-kw at 80°C rise
	0.9 power factor, 5-phase, 60 cycle, 13,800-volt, 81.8 rpm
Efficiency (guaranteed)	97.2 at 100 percent rated kva
Maximum continuous capacity	46,000-kva at 80°C
Thrust bearing	Kingsbury type. 2,508,500 lb total load
Exciters:	Main. 285-kw, 250-volt, direct-connected
	Pilot. 15-kw 250-volt, direct-connected
Weight or heaviest piece to be lifted by crane	463,000 lb

Figure 22. Extracted power plant data.

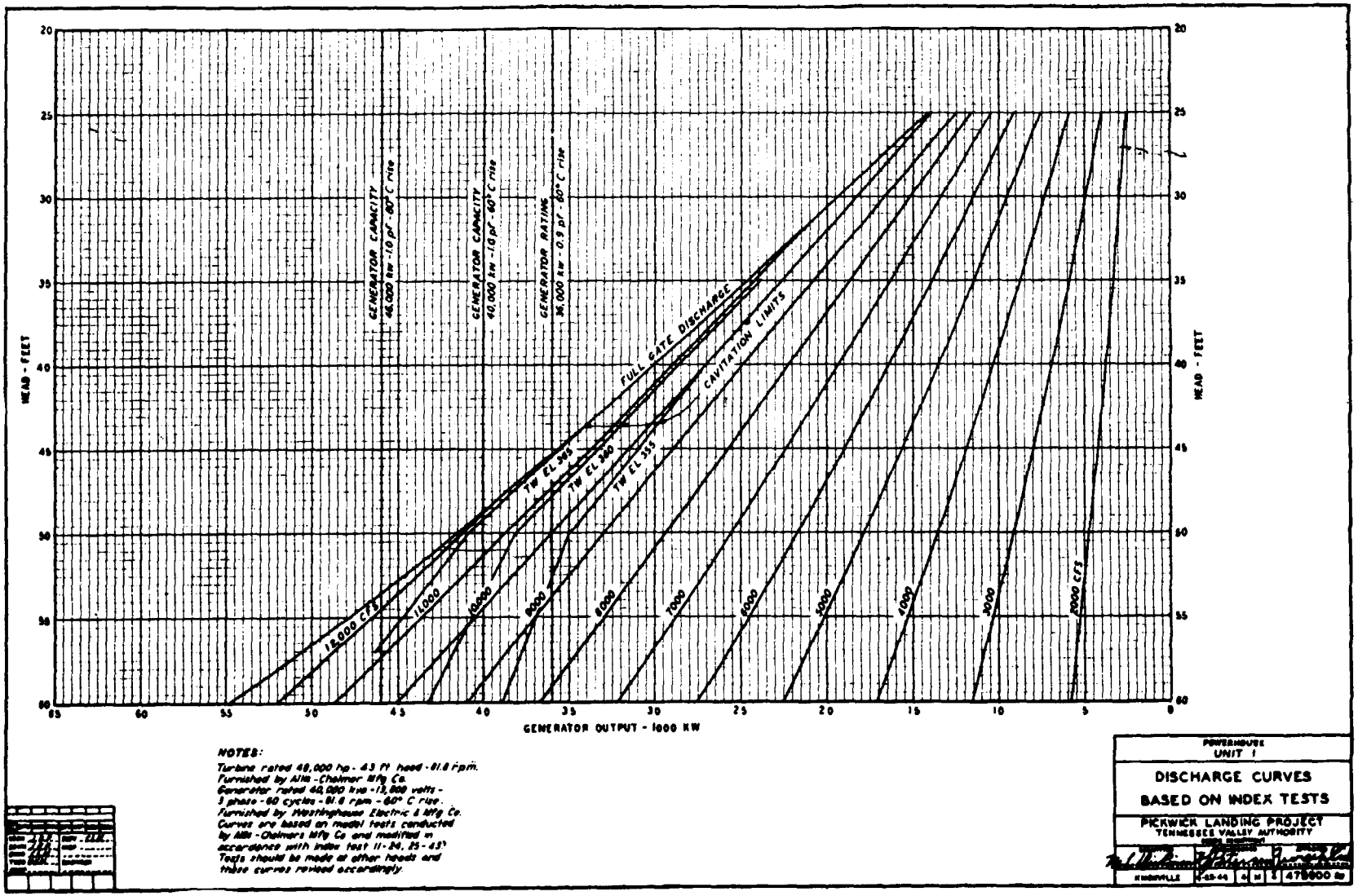
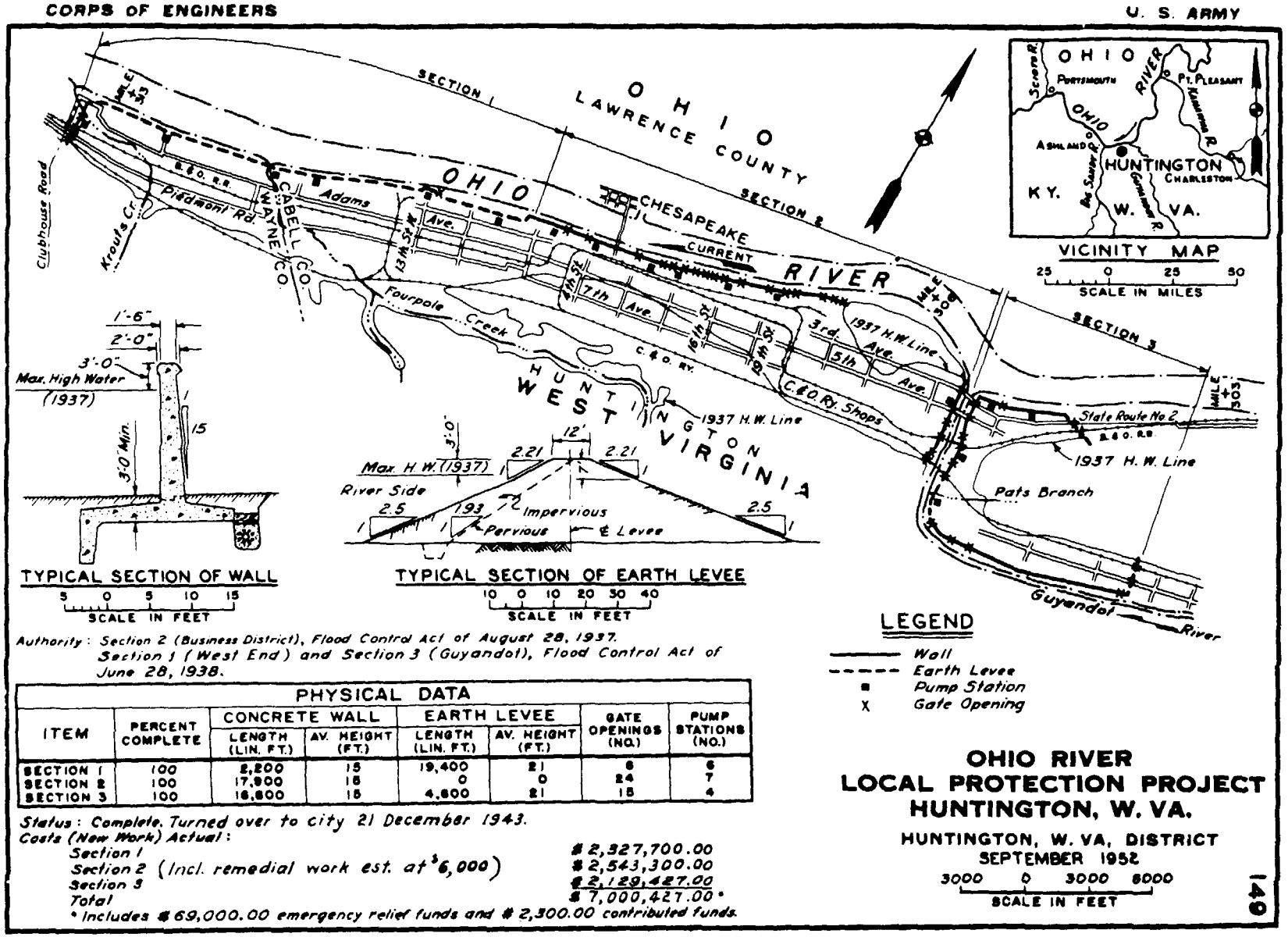


Figure 23. Discharge curves for power units.

Item No.	Requirement	Compilation
		Minimum NI Base thickness Maximum Concrete wall: NI. Earth levee: NI. Average Concrete wall: 2 ft. Earth levee: 140 ft.
15	Indicate whether elevations are based on mean sea level or on some other reference.	Minimum NI Feet above mean sea level.
16	Elevation of top or crest of structure at upstream and downstream ends.	*a.* 565.0 ft at 5th Ave pumping plant. *b.* 561.5 ft (approximately at downstream end).
17	Give the following data for each type of tide or relief gates:	
	a. Number and type. (Indicate whether hinged or sliding type.)	*a.* 29 openings, various sizes, some with trestle gates, some with stoplogs.
	b. Location. (Give distances from ends of structure.)	*b.* NI.
	c. Means used to operate gates. (Indicate.)	*c.* NI.
	d. Time required to open one relief gate.	*d.* NI.
	e. Time required to open all relief gates.	*e.* NI.
	f. Size and shape of gates.	*f.* Average height above sill: 20 ft. Maximum width of openings: 62 ft.
	g. Elevation of gate sill (if rectangular) or gate centerline (if circular).	*g.* NI.
	h. Maximum discharge capacity of one tide or relief gate.	*h.* NI.
18	Total discharge capacity of all relief gates.	NI.
19	Give the following data for each type of pumping plant connected with the structure:	
	a. Number and type. (Indicate whether pumps are powered by oil, coal, electricity, and so on.)	*a.* 13 pumping plants, electrically powered.
	b. Location. (If located on top of structure, give distances from ends of structure. If located inside protected area, give distances and directions from a definite reference point.)	*b.* Plants located on structures at the following approximate Ohio River miles: 305.3, 307.2, 307.7, 308.2, 308.4, 308.8, 309.1, 309.7, 310.3, 311.1, 311.6, 312.6, and 313.2.
	c. Material used in construction of pump houses (wood, masonry, concrete, and so on).	*c.* Reinforced concrete.
	d. Rated discharge capacity of one plant and corresponding head or lift.	*d.* Capacity of plant at mile 305.3: 47,700 gal/min at 38.0 ft head (storm) : 2,800 gal/min at 45.0 ft head (sewage).
20	Total discharge capacity of all pumping plants.	NI.
21	Discharge in stream required to overflow structure. (Not always applicable.)	NI.
22	Frequency that the structure is topped by flood water for example: once in 10 years or once in 25 years).	NI.
23	Total length, width, and area of protected land.	8 miles long by 1.2 miles wide. Approximately 10 sq mi.
24	Area of seep or swampy land behind structure.	None.
25	Elevation of low and high protected ground.	NI.
26	Kinds of vegetation and crops growing in protected area.	None.
27	Kinds and depths of soil in protected area.	NI.
28	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	Top of structure 3 ft above 1937 high water (3 ft free board).
29	Source or sources of data. If different for various items, list numbers in groups corresponding to the source.	*a.* Ohio River Division Conference, Local Protection Projects, May 9 and 10, 1940." published by Huntington District CE. *b.* "Project Maps, Huntington District. September 1952," published by Huntington District CE.



Authority: Section 2 (Business District), Flood Control Act of August 28, 1937. Section 1 (West End) and Section 3 (Guyandot), Flood Control Act of June 28, 1938.

PHYSICAL DATA

ITEM	PERCENT COMPLETE	CONCRETE WALL		EARTH LEVEE		GATE OPENINGS (NO.)	PUMP STATIONS (NO.)
		LENGTH (LIN. FT.)	AV. HEIGHT (FT.)	LENGTH (LIN. FT.)	AV. HEIGHT (FT.)		
SECTION 1	100	2,200	15	19,400	21	6	6
SECTION 2	100	17,900	18	0	0	24	7
SECTION 3	100	16,800	18	4,800	21	18	4

Status: Complete. Turned over to city 21 December 1943.

Costs (New Work) Actual:

Section 1	$ 2,327,700.00
Section 2 (Incl. remedial work est. at $6,000)	$ 2,543,300.00
Section 3	$ 2,129,427.00
Total	$ 7,000,421.00 *

* Includes $ 69,000.00 emergency relief funds and $ 2,300.00 contributed funds.

Figure 24. Location on nap and sections of Ohio River Local Protection Project, Huntington, West Virginia.

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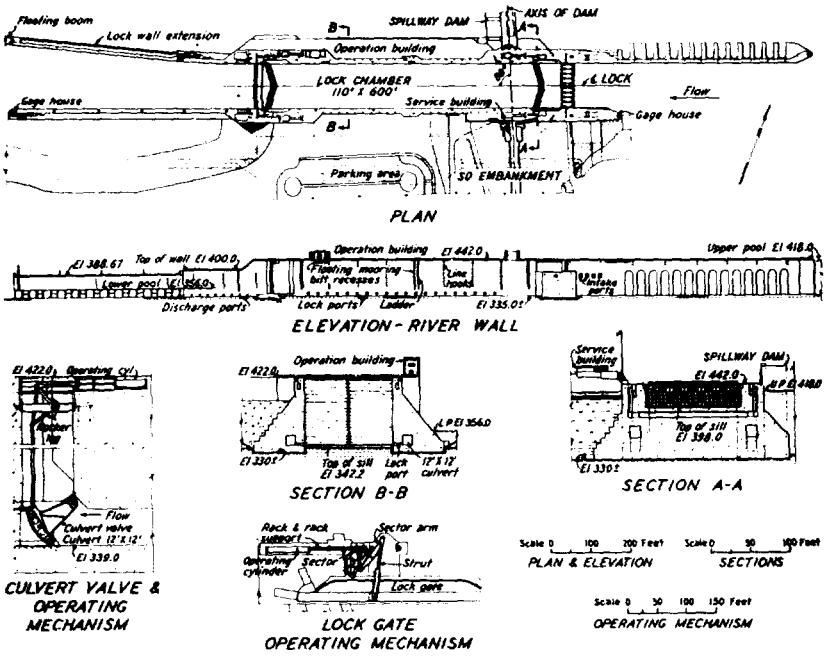
Item No.	*Requirement*	*Compilation*
30	Reliability of the source or sources of data.	Completely reliable.
31	Accuracy of data.	Probably true.
32	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
33	Inclose pictures, maps and drawings depicting the location and other features of the major item.	Location map and sections of Ohio River Local Protection Project, Huntington, W Va. (fig. 24), from item 29*b*.
34	Date compilation was prepared.	18 Nov. 1953.

22. Navigation Locks. *Pickwick Landing.*

Item No.	*Requirement*	*Compilation*
1	Name of lock.	Pickwick Landing Lock.
2	Country or countries, state or province, and so on, in which the major item is located.	US Tenn.
3	Main river basin in which the subject is located.	Ohio-Mississippi.
4	River or canal on which lock is located.	Tennessee River.
5	Name of dam connected with lock.	Pickwick Landing Dam (fig. 12).
6	Distance and direction from a city or some other definite geographic reference point.	100 air mi east of Memphis, Tenn; 23.5 mi by highway from Southern Railway, Mobile & Ohio RR, and Illinois Central RR at Corinth, Miss; 35 mi by highway from Mobile & Ohio RR, at Selmer, Tenn; 20 mi by highway from Southern Railway at luka, Miss.
7	Distance from lock to river mouth or some other stream-reference point.	206.7 mi.
8	Latitude and longitude of the major item.	35° 4'N, 88° 15'W.
9	Coordinates of any local grid-coordinate system.	NI.
10	Date lock was completed.	March 1938.
11	Material of which lock chamber is constructed or lined.	Standard Ohio River concrete gravity type as developed by U. S. Army CE.
12	Inside dimensions of lock chamber.	110 ft by 600 ft. (fig. 25).
13	Give the maximum, normal, and minimum expected lift values. (Lift is the vertical distance the vessels are raised or lowered in the lock chamber.)	Maximum: 63 ft; normal: 56 ft; minimum: NI.
14	Give the minimum depth over upper and lower sills.	Upper: 10 ft; lower: 12 ft.
15	Indicate whether elevations are based on mean sea level or on some other reference.	Feet above mean sea level, 1929 General Adjustment Datum.
16	Give elevations for:	
	a. Upper sill.	*a.* 398.0 ft.
	b. Lower sill.	*b.* 342.2 ft.
	c. Top of chamber wall.	*c.* 422.0 ft.
	d. Top of gates.	*d.* 422.0 ft.
	e. Top of upper guide or approach-channel walls.	*e.* 422.0 ft.
	f. Top of lower guide or approach-channel walls.	*f.* 388.7 ft.
17	Type and size of lock gates and material of which they are made. (Indicate whether gates are single-leaf, double-leaf miter, and so on.)	Double-leaf, hydraulically operated, steel miter gates (fig. 25). *a.* Upstream gates: width: 61 ft 5 3/8 in., center quoin seal to center miter seal; height: 27 ft 9 5/8 in., overall; depth: 4 ft 1/4 in., back to back of angles. *b.* Downstream gates: width: 61 ft 5 3/8 in., center quoin seal to center miter seal; height: 77 ft 4 1/2 in., overall; depth: 7 ft 1/2 in., back to back of angles.
18	Type, size, and construction material of any auxiliary lock gates.	Upper emergency dam: Type: Demountable structural steel gates supported on 10 collapsible A-frame steel bents anchored on foundation on upper miter sill. Operated by: 2 structural steel derricks, 1 on each wall, 22.5 ft mast of latticed channel box. Boom and back leg latticed angle struts.

Item No.	Requirement	Compilation
		Equipped with hand winches, sheaves, and other necessary equipment for raising and lowering the collapsible A frames and for placing or removing dam sections. Lower emergency dam: Type: Structural steel A-frame bents with legs provided with cast-steel bases fitting into castings embedded in lower miter sill. Three 6-in. timber needles on 3 on 12 slope. Operated by: Same derricks provided for upper emergency dam.
19	Give the following data for filling and emptying culverts or sluices:	
	a. Number and location. (Indicate whether culverts are in sides or in bottom of lock chamber.)	*a.* Two culverts (1 on each side), located at bottom of lock walls. Same culverts are used for both filling and emptying. Intake and discharge ports are all in the lock walls. The number of ports is not indicated.
	b. Size and shape.	*b.* Both culverts are 12 by 12 ft.
20	Give the following data for each type of culvert gates or valves:	
	a. Number and type. (Indicate whether radial, sliding, or valve type and means used to operate gates.)	a. One filling and 1 drain valve in each culvert (total 4 valves). All are structural steel segmental (radial) valves, hydraulically operated.
	b. Location. (Indicate whether gates are at upper or lower end of culverts, or at some point in between.)	*b.* All 4 are located in recesses behind the miter gates.
	c. Size and shape of culvert gates or valves.	*c.* Height along chord: 15 ft; width between side seals: 11.8 ft; radius, skin plate to pivot: 16 ft; depth: 3 ft at center, 13 ft; at top and bottom.
21	Give times required to fill and empty lock chamber.	Estimated lockage time is 28 min.
22	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	*a.* Space is provided for a future 60- by 360-foot lock. *b.* Minimum reservoir level to maintain navigation: elevation 408 ft.
23	Source or sources of data. If different for various items, list numbers in groups corresponding to the source.	*a.* "The Pickwick Landing Project, Technical Report No. 3," prepared by the Tennessee Valley Authority (TVA) 1941. All items were extracted from this book except that noted in item *b* below. *b.* "Engineering Data, Tennessee Valley Authority Projects, Technical Monograph No. 55," prepared by TVA, March 1948. Item 14 was extracted from this book.
24	Reliability of the source or source data.	Completely reliable.
25	Accuracy of data.	Probably true.
26	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
27	Inclose pictures, maps and drawings depicting the location and other features of the major items.	*a.* Pickwick Landing dam: plan, elevation, and sections (fig. 12), from item 23*a* (bound with "Dams and Reservoirs"). *b.* Pickwick Landing dam navigation lock plan, elevation, and sections, (fig. 25), from item 23*a*.
28	Date compilation was prepared.	5 Oct. 1953.



NAVIGATION LOCK

Location	At left (south) end of spillway
Lock chamber, clear	110 by 600 ft
Lift: Maximum (El. 355-418)	63 ft
Normal (El. 360-414)	54 ft
Guard sills	Upper El. 398.0; lower El. 342.2
Minimum depth over sills	Upper 10.0 ft; lower 12.0 ft
Top of upper guide and guard walls	El. 422.0
Top of chamber walls	El. 422.0
Top of lower guide and guard walls	El. 400.0
Estimated lockage time (checking to regaining speed)	40 minutes
Provision for future lock	Space provided for 60- by 360-ft lock to left (south) of present lock

NAVIGATION FACILITIES

Length of channel for 9-ft navigable depth (to Lock No. 1)	50.0 sailing miles
Minimum flat pool to maintain 9-ft navigation to Lock and Dam No. 1	El. 408.0
Length of dredged navigable channel:	
Below lock	5.0 miles
Upper end of pool	None

Figure 25. Pickwick Landing dam navigation lock plan, elevation, and sections.

23. Irrigation Projects. All-American Canal System (Boulder Canyon).

Item No.	*Requirement*	*Compilation*
1	Name of project.	An-American Canal System (Boulder Canyon Project).
2	Country or countries, state or province, and so on, in which the major item is located.	U S; California and Arizona (fig. 26).
3	Main river basin in which the subject is located.	Colorado River.
4	Stream, valley or area benefiting from irrigation.	Salton Sea Basin.

Item No.	Requirement	Compilation
5	Name of dams or reservoirs connected with the project.	Hoover Dam and Imperial Dam.
6	Distance and direction from city or some other definite geographic reference point.	About 18 miles northeast of Yuma, Arizona.
7	Latitude and longitude of the major item.	32° 50'N, 114° 25'W.
8	Coordinates of any local grid-coordinate system.	R24E, T 158 (Imperial Dam).
9	Date propect was completed.	First water available, October 1940.
10	Source of irrigation water (river, lake, wells and so on).	Colorado River.
11	Type and location of diversion works. (Indicate whether structure is used exclusively to divert water from the stream or whether it is part of a multiple-purpose structure. Also indicate the kind of construction material. Give distance from struture to irrigated land.)	Diversion dam (Imperial Dam): Located on Colorado River 18 miles NE of Yuma, Arizona, and about 40 miles from nearest corner of irrigable land (fig. 26). Type: Slab and buttress dam, partially founded on piles and partially floating on its foundation. Ogee overflow spillway, gate-controlled canal headings on each end of dam, and a sluiceway at the California end (figs. 27 and 28). Canal headworks: Located adjacent to Calif abutment. Description: Concrete-lined channel, 360 feet wide. Down stream from head gates, the channel is divided into 4 channels directing water into desilting basins.
12	Give the following data for the intake gates:	
	a. Number and type. (Indicate whether slide, radial, stop-log, and so on.)	*a.* Four roller gates.
	b. Size of gates.	*b.* 75 by 23 feet.
	c. Means used to operate gates (chain lift, screw stem, hydraulic pump, and so on).	*c.* NI.
	d. Time required to open one gate.	*d.* NI.
	e. Time required to open all gates.	*e.* NI.
	f. Elevation of gatesill (if rectangular or gate centerline (if circular).	*f.* Elv. 172 ft.
	g. Total discharge capacity of one gate.	*g.* NI.
	h. Total discharge capacity of all gates.	*h.* 15,155 cu ft/sec.
13	Indicate whether elevations are based on mean sea level or on some other reference.	Feet above mean sea level.
14	Give the following data for main water-distribution structures: (Main water-distribution structures divert water from the main canal to secondary canals.)	NI.
	a. Number and type. (Indicate whether gates are hand-operated or power-operated.)	
	b. Location. (Give distances along main canal from intake works.)	
	c. Material of which structures are made (wood, concrete, masonry, and so on).	
15	Give the following data for secondary water-distribution structures: (Secondary water-distribution structures divert water from the secondary canals to main materials.)	NI.
	a. Number and type. (Indicate whether gates are hand-operated or power-operated.)	
	b. Location. (Give distances along secondary canals from main water-distribution structure.)	
	c. Material of which structures are made (wood, concrete, masonry, and so on).	
16	Give the length, width, depth, and discharge capacity for the main canal, secondary canal, main laterals, and main drain ditches.	

Specifications:

	Length	*Width*	*Depth*	*Discharge capacity*
Main canal (All-American Canal)	80 mi	NI	20.6 ft (minimum free-board 6 ft).	Discharge Capacity 2,600 cu ft/sec
Secondary canal (Coachella canal)	145 mi	NI	10.3 ft (minimum free-board 6 ft).	2,500 cu ft/sec
Main laterials	NI	NI	NI	NI
Drain ditches	NI	NI	NI	NI

17	Elevation of mouth of lowest drain ditch.	246 ft (Salton Sea).
18	Give the following data for each type of pumping plant connected with project: *a.* Number and type of pumps. (Indicate whether pumps are powered by oil, coal, electricity, and so on.) *b.* Location. (Give distances and directions from a definite reference point.) *c.* Type of pump house construction (wood, masonry, concrete, and so on). *d.* Rated discharge capacity of plant and corresponding head or lift.	NI.
19	Total discharge capacity of all pumping plants.	NI.
20	Period of record of discharge in stream at point where water is diverted to the irrigation project.	NI.
21	Period of record of volume of water diverted to project.	NI.
22	Give the average monthly volume of water diverted for irrigation for period shown in item 21.	NI.
23	Give the following data for the irrigated land: *a.* Total area. *b.* Width. *c.* Length. *d.* Elevation, highest point irrigated. *e.* Elevation, lowest point irrigated. *f.* Kinds of crops grown. *g.* Kinds of soil.	*a.* 458,000 acres in 1951. *b.* Irregular. *c.* Irregular. *d.* Elev + 400 ft. *e.* Elev - 250 ft. *f.* Crop types: Commercial and truck farming citrus fruits. *g.* Mostly alluvial, ranging from light sandy or silty loams to adobe. In the Coachella Division, soils range from coarse granite sands and gravels to heavy clay loams and clays.
24	Any information pertinent to the major subject which would not logically be included with any of the items previously listed.	None.
25	Source or sources of data. If different for various items, list item numbers in groups corresponding to the source.	"Reclamation Project Data," published by the Bureau of Reclamation, US Dept of Interior, 1948, with 1961 irrigation appendix.
26	Reliability of the source or sources data.	Completely reliable.
27	Accuracy of data.	Probably true.
28	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
29	Inclose pictures, maps and drawings depicting the location and other features of the major items.	*a.* Map of All-American Canal System (fig. 26). *b.* Aerial photo of Imperial Dam (fig. 27). *c.* General plan, elevations, and sections of Imperial Dam (fig. 28).
80	Date compilation was prepared.	8 Oct 1953.

Figure 27. Aerial photo of Imperial Dam.

24. Drainage Projects. *Hamburg and Vierlande Marshland.*

Item No.	*Requirement*	*Compilation*
1	Name of project.	Hamburg and Vierlande Marshland.
2	Country or countries, state or province, and so on, in which the major item is located.	Germany, Hamburg.
3	Main river basin in which subject is located.	Elbe River.
4	Stream or body of water adjacent to project.	Elbe River (fig. 29).
5	Distance and dire-tion from city or some other definite geographic reference point.	The marshland extends for approximately 35 kill from Hamburg southeast to Borghorst.
6	Latitude and longitude of the marshland.	53° 30'N, 10° 10'E (Greenwich Mer).

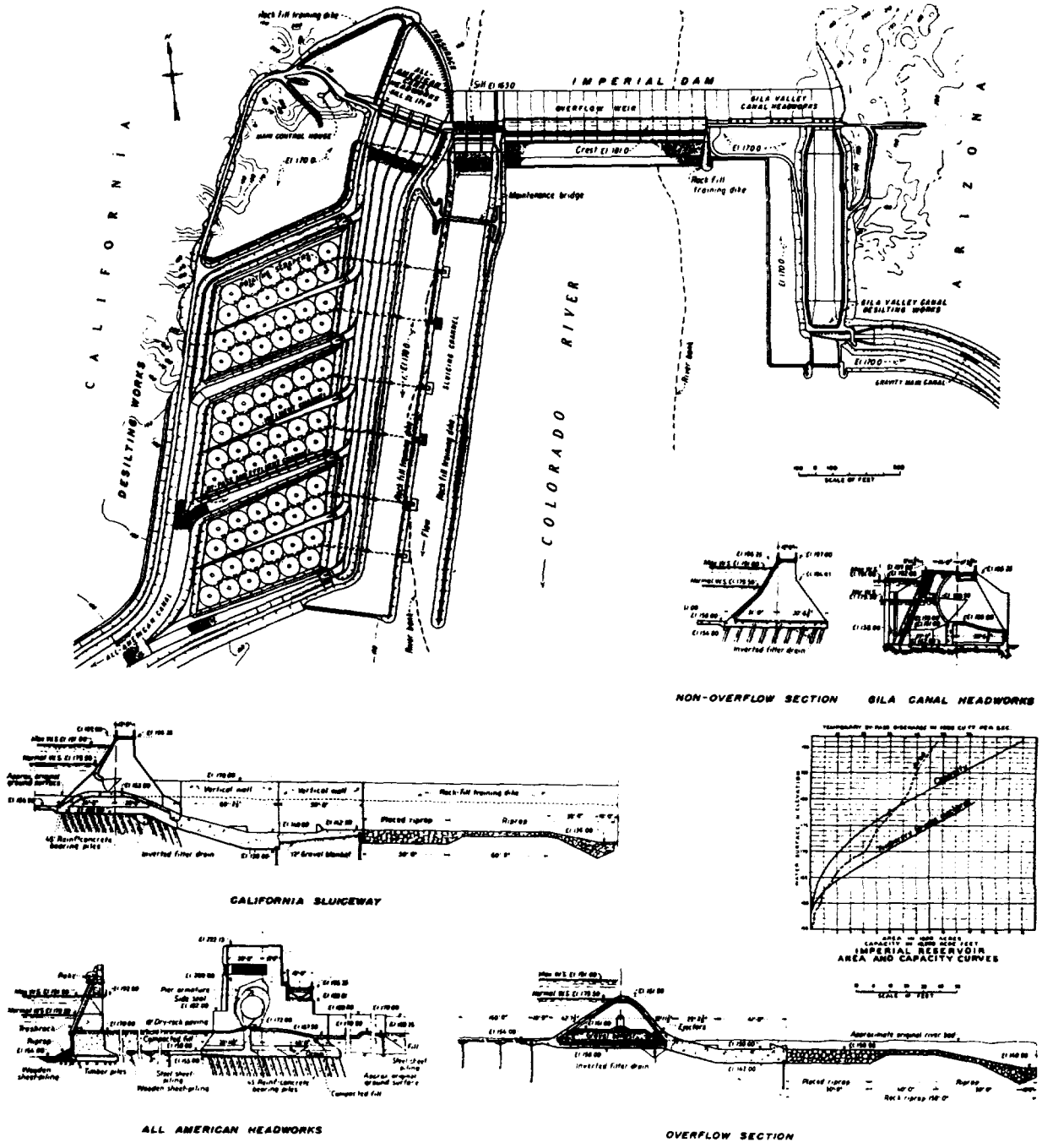
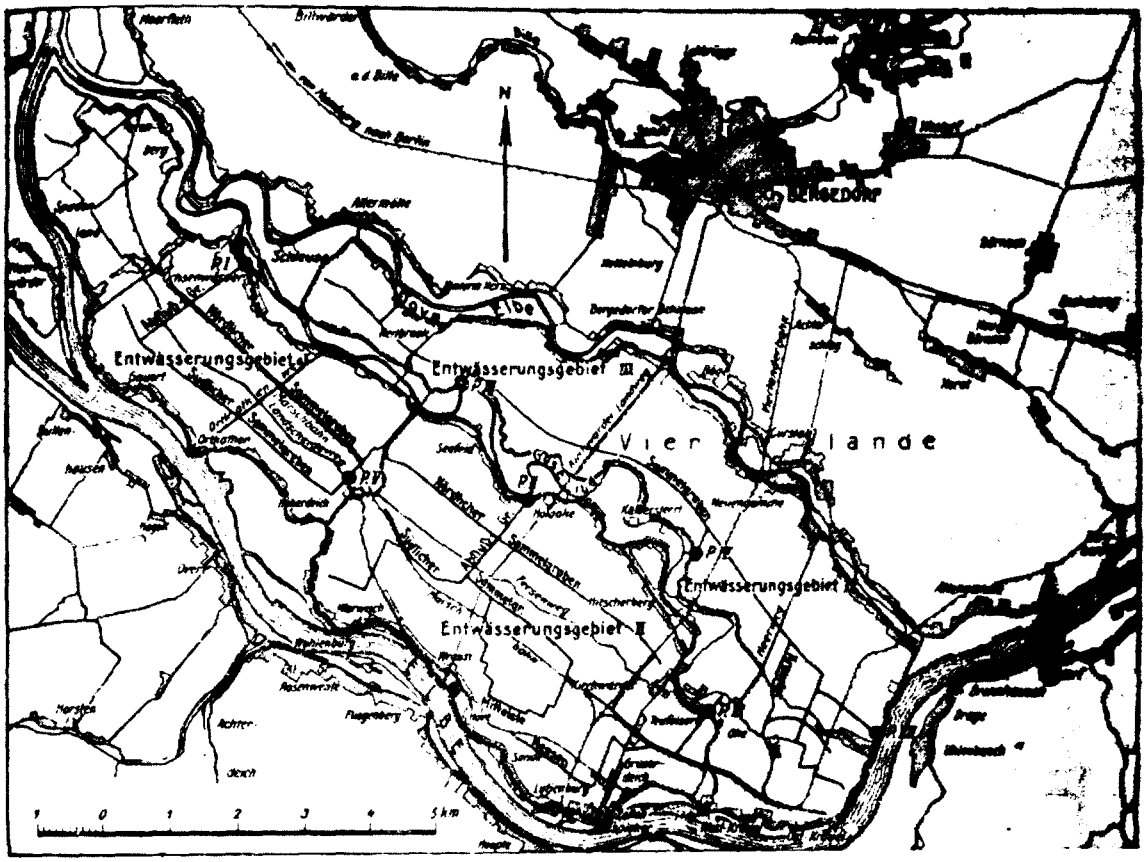


Figure 28. General plan, elevation, and sections of Imperial Dam.

Item No.	*Requirement*	*Compilation*
7	Coordinates of any local grid-coordinate system.	UTM Grid Zone 32U NE 7030-9020 Sheet L-4 AMS Series M641. Germany 1:100,000.
8	Date project was completed.	1926-1928.
9	Source of excess water. (Name of stream or body of water which causes flooding. Indicate whether floodwater travels overland or seeps in below the ground surface.)	Elbe River and tidal flow.

Item No	Requirement	Compilation
10	Means used to remove excess water (drain ditches, pumps, and so on).	Drain ditches and pumps.
11	Indicate whether elevations are based on mean sea level or on some other reference.	Meters above the North sea (mNN).
12	Give the following data for the drained or reclaimed land	
	a. Total area.	*a.* 100 sq km.
	b. Width.	*b.* Varies between 2 and 3 km.
	c. Length.	*c.* 36 km.
	d. Elevation, highest point drained.	*d.* 4.0 mNN.
	e. Elevation, lowest point drained.	*e.* 0.0 mNN.
	f. Kinds of crops grown.	*f.* Gardening.
	g. Kind and depth of soil.	*g.* Geest.
13	Give the following data for the main drain ditches:	Figure 30.
	a. Length.	*a.* 15 Km (approximately).
	b. Width.	*b.* 1.0m at bottom with 1:1.5 side slopes.
	c. Depth.	*c.* 1.0m.
	d. Discharge capacity.	*d.* 7.2 cu m/sec (combined).
14	Elevation of mouth of lowest drain ditch.	-3.54 mNN.
15	Give the following data for each type of pumping plant connected with project:	
	a. Number and types of pumps. (Indicate whether pumps are powered by oil, coal, electricity, and so on.)	*a.* 16 pump units. (Electric)
	b. Location. (Give distance and direction from a definite reference point.)	*b.* The main pumping plant at Ochsenwarder has 4 main units and 3 supplemental units. Three other pumping plants are located SE at intervals of approximately 3 Km on the Gose Elbe, and each has 3 units.
	c. Material used in construction of pumphouse, (wood, concrete, masonry, and so on).	*c.* Concrete and masonry.
	d. Design discharge capacity of plant and corresponding head or lift.	*d.* 7.60 cu m/sec against 2.60 m head. Three supplemental pump units at same location of 0.95 cu m/sec against 2.60 m head.
	e. Number, rating, and voltage of electric pump motors.	*e.* NI.
16	Total discharge capacity of all pumping plants.	7.6 cu m/sec.
17	Period of record of volume of water removed from the area.	1920-1954 (approximately).
18	Give the average monthly volume of water removed from the land for period shown in item 17. (This is not always applicable.)	nval.
19	Any information pertinent to the major subject which should not logically be included with any of the items previously listed.	There are 3 additional pump stations which serve solely for irrigation.
20	Source or sources of data. If different for various items, list item numbers in groups corresponding to the source.	"Die Bautechnik," Heft 53, 7 December 1926.
21	Reliability of the source or source data.	Usually reliable.
22	Accuracy of data.	Probably true.
23	Agency or unit preparing the compilation.	Military Hydrology Branch, Washington District CE.
24	Inclose pictures, maps and drawings depicting the location and other features of major items.	*a.* Plan of the drainage districts of the Hamburg-Vierlande area (fig. 29). *b.* Ditch systems of pumpworks VI and VII and typical ditch cross sections (fig. 30).
25	Date compilation was prepared.	1 June 1954.



PLAN OF THE DRAINAGE DISTRICTS OF THE HAMBURG-VIERLANDE AREA

GLOSSARY

Entwasserungsgebiet	Drainage district
Schleuse	Lock
Abfluss Gr.	Main drainage ditch
Sammelgraben	Lateral drainage ditch
Weg	Path
Bahn	Road

LEGEND

⊙ P II	Pump station
	Road
	Path
	Ditch

Figure 29. Plan of the drainage districts of the Hamberg-Vierlande area.

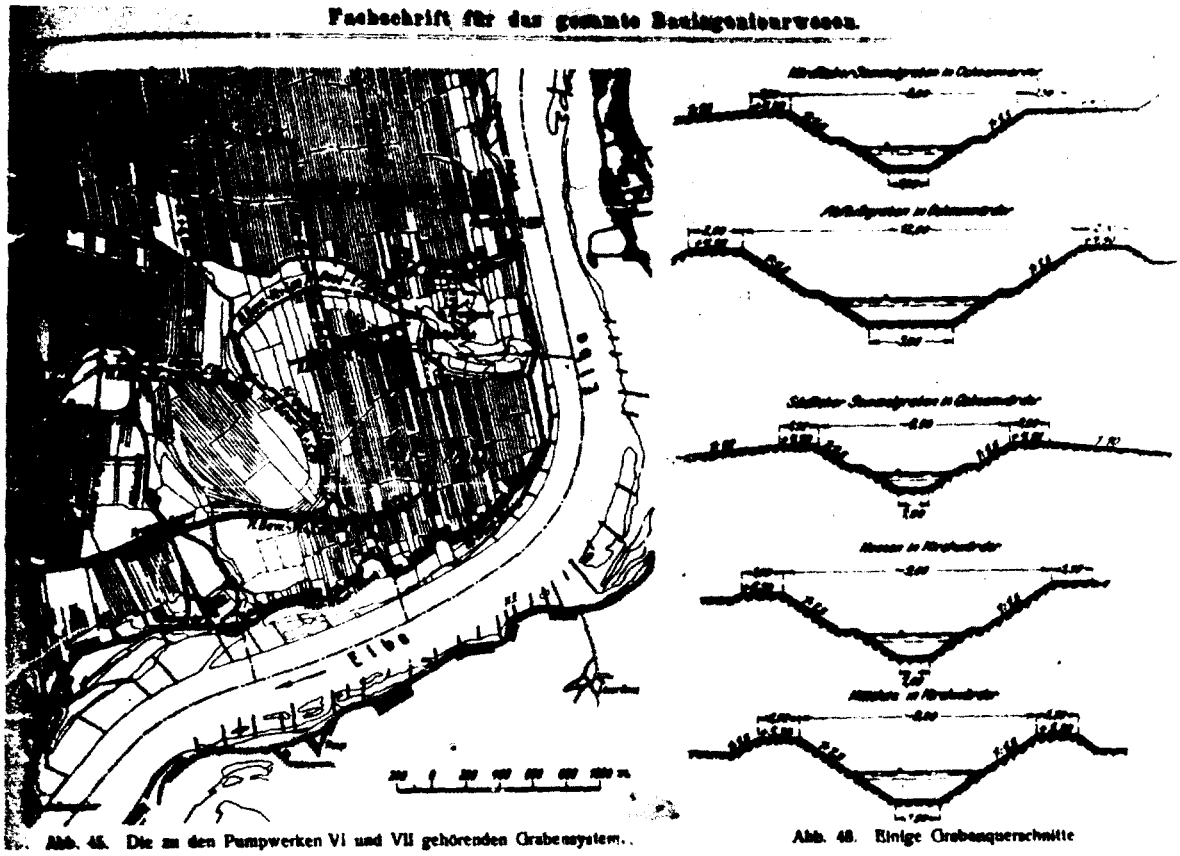


Figure 30. Ditch systems of pumpworks VI and VII and tactical ditch cross sections.

APPENDIX

REFERENCES

TB 5550-1 Flood Prediction Services
TB 5550-3 Flood Prediction Techniques

By Order of *Wilber M. Brucker,* Secretary of the Army:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

Official:

HERBERT M. JONES,
Major General, United States Army,
The Adjutant General.

Distribution:

Active Army:

- ACSI
- DCSLOG
- DCSOPS
- CofEngrs
- USCONARC
- OS Maj Comd
- Armies
- Corps
- Div
- Engr Bn
- USMA
- USACGSC
- USAWC
- Br Svc Sch
- ANS
- Div Engrs
- Dist Engrs
- Units org under fol TOE:
  - 5-500 (IG)
  - 5-500 (IH)
  - 5-500 (IK)

NG: State AG; units-same as Active Army.
USAR: Same as Active Army.
For explanation of abbreviations used, see AR 32050.

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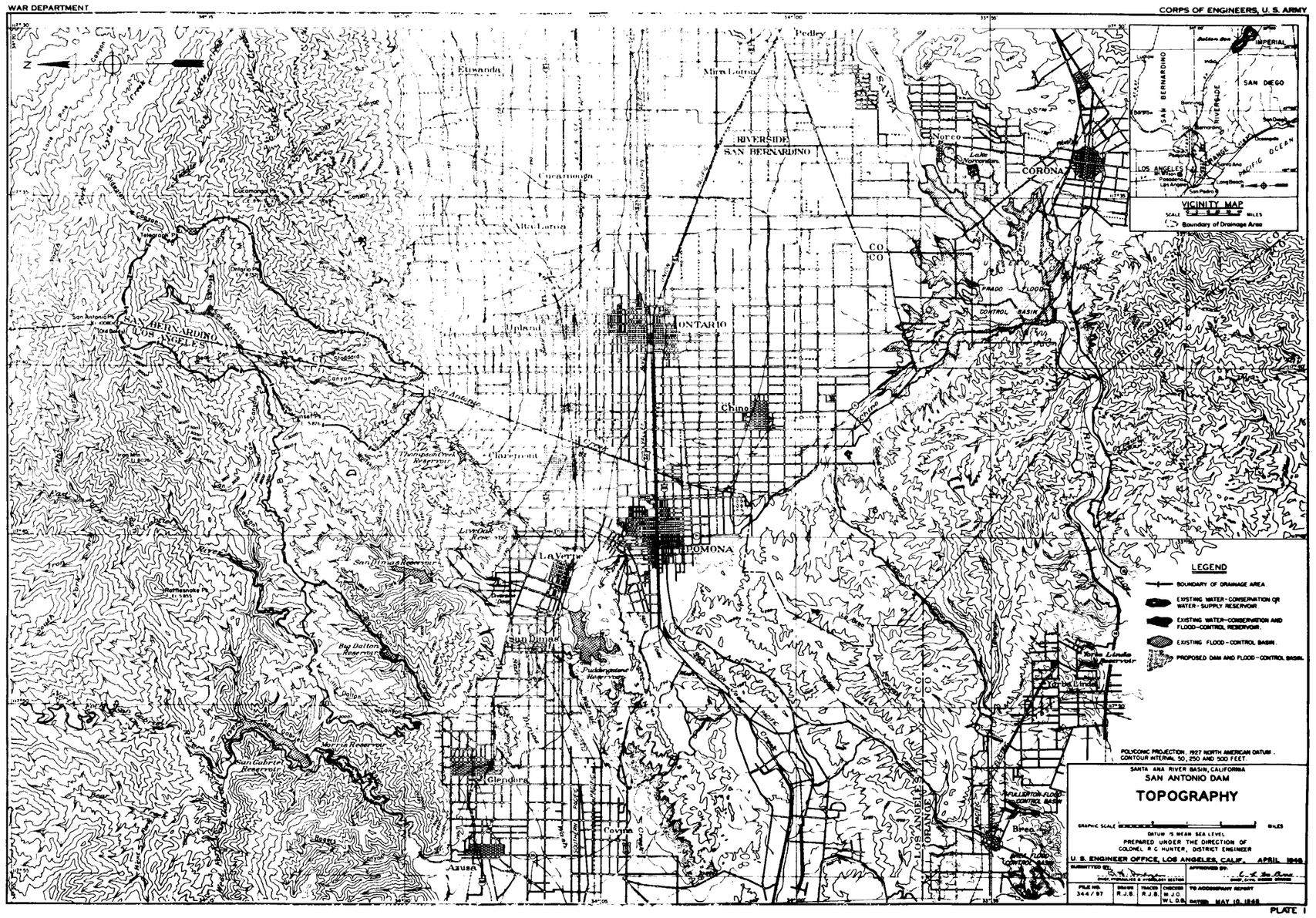

Figure 2. Topographic map of the vicinity of San Antonio Dam

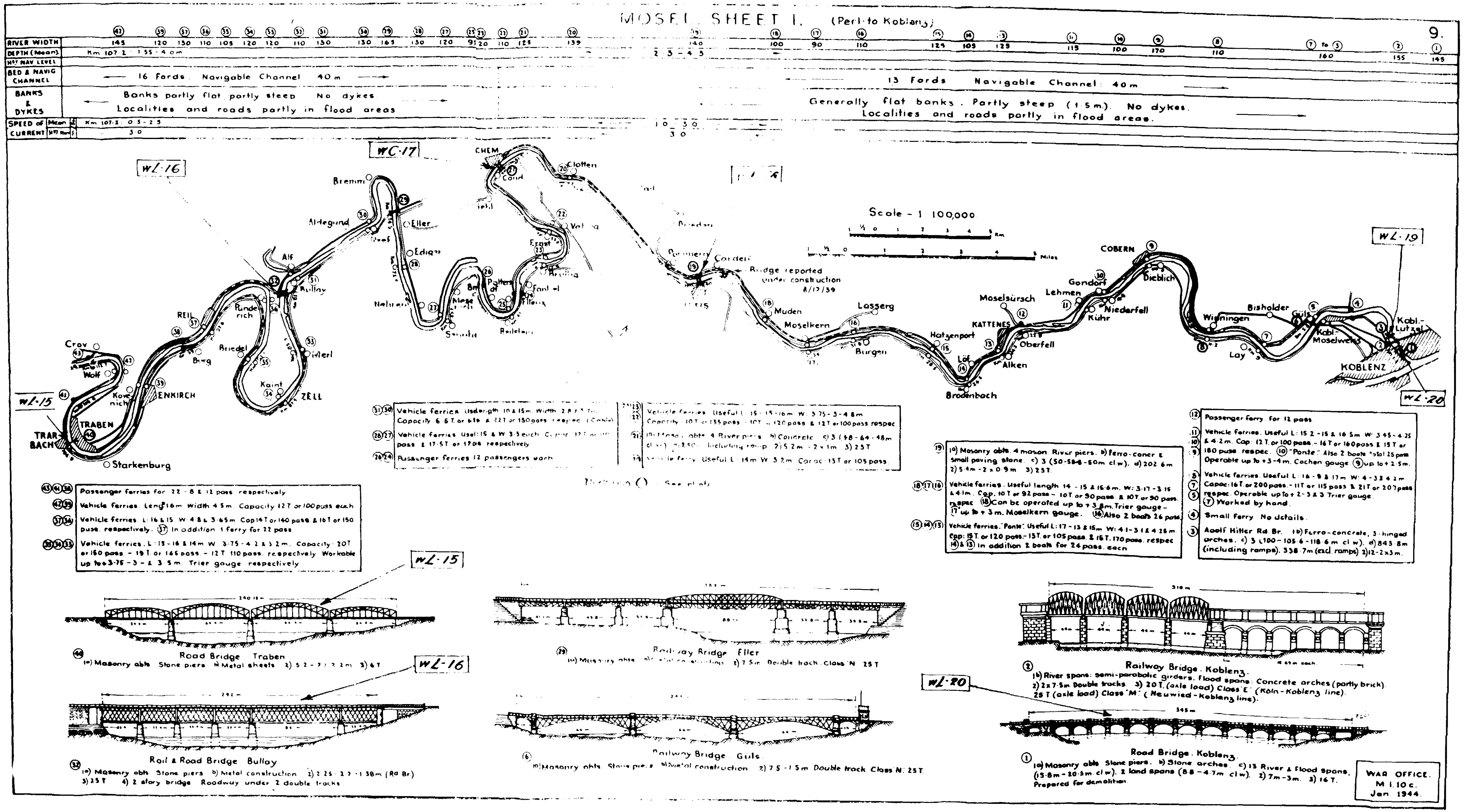

Fig. 534
Map Showing Locations of Bridges Over Mosel River and Elevations of Bridges

Bridge No. wL-15 — Map Reference - wL-5650

Map G.S.G.S. 4072 Sheet No. ME. 48/6

Engineering Details: Total width - 9.6 m.; Width of roadway - 5.2 m.; Total length - 240.15 m.; Spans - 4, (2-64.4 m., 2-54.5 m., steel, through arch); Piers - masonry

V-4615 Pl.9 (illus) (1942)

GERMANY

Figure 4. Map showing reach of Mosel River SW of Koblenz with locations of bridges.

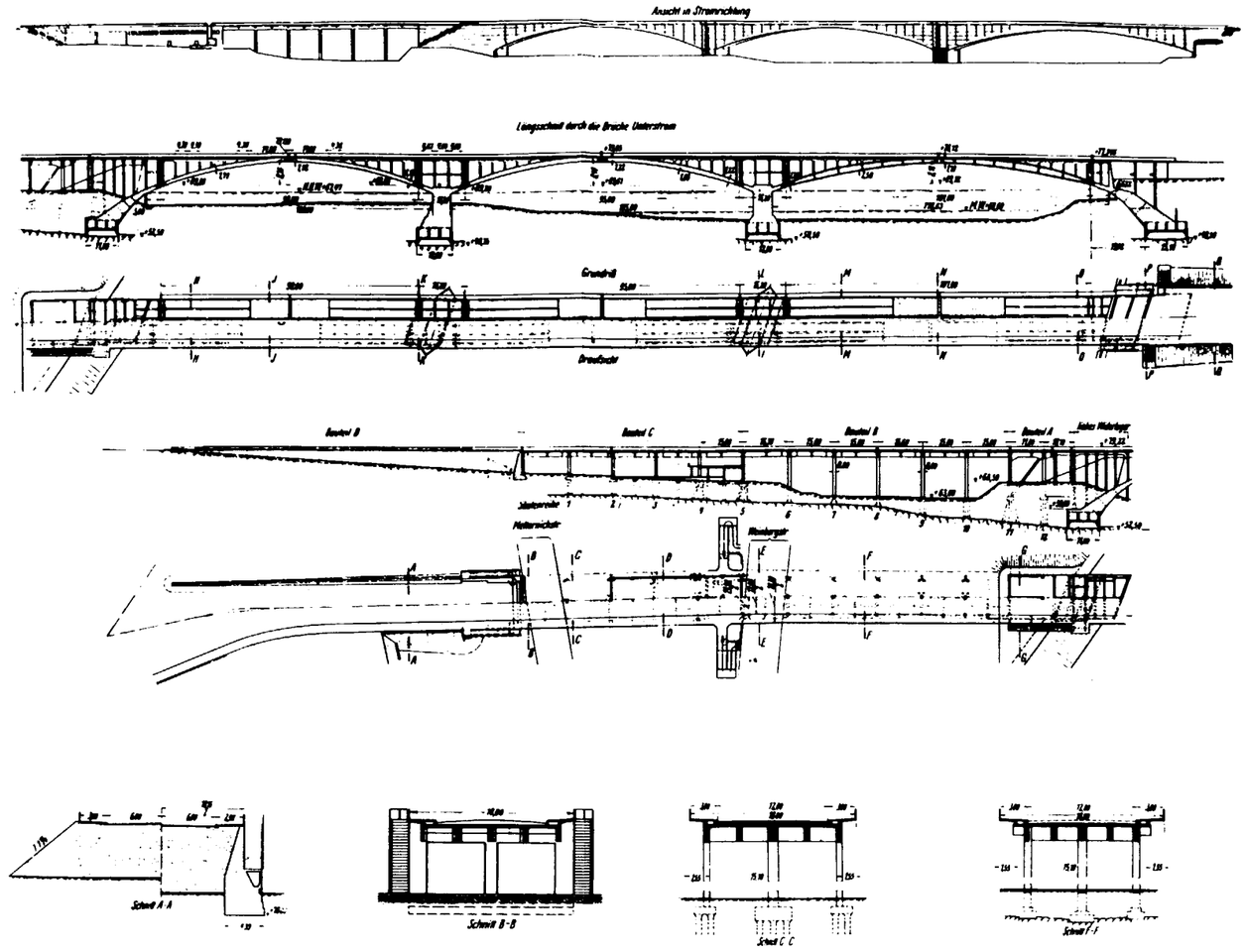

Fig. 542
Longitudinal Section, Plan and Cross Sections
of the Deck Bridge Over the Mosel River
at Koblenz

Bridge No. wL-19 Map Reference - wL-9095

Map G.S.G.S. 4072 Sheet No. NE. 50/6

V-2927 p.202 (illus) fig.3 (1934)

GERMANY

Figure 8. Section, plan, and cross-sections of deck bridge over Mosel River at Koblenz.

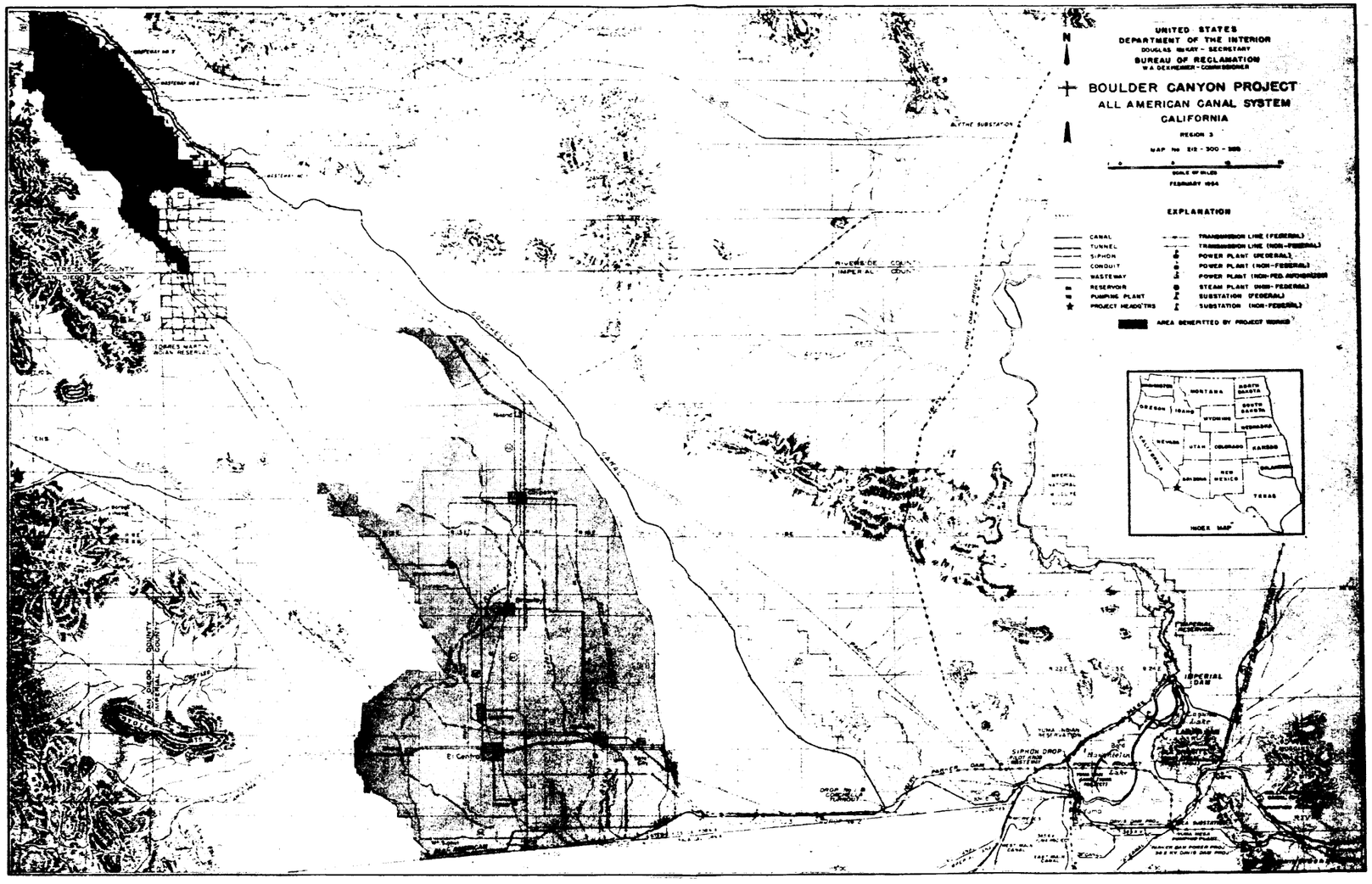

Figure 26. Map of All-American Canal System.

RECOMMENDED CHANGES TO EQUIPMENT TECHNICAL PUBLICATIONS

THEN...JOT DOWN THE DOPE ABOUT IT ON THIS FORM. CAREFULLY TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL.

SOMETHING WRONG WITH PUBLICATION

FROM: (PRINT YOUR UNIT'S COMPLETE ADDRESS)

DATE SENT

PUBLICATION NUMBER	PUBLICATION DATE	PUBLICATION TITLE

BE EXACT PIN-POINT WHERE IT IS

PAGE NO.	PARA-GRAPH	FIGURE NO.	TABLE NO.

IN THIS SPACE, TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT.

PRINTED NAME, GRADE OR TITLE AND TELEPHONE NUMBER	SIGN HERE

DA FORM 1 JUL 79 2028-2

PREVIOUS EDITIONS ARE OBSOLETE.

P.S.--IF YOUR OUTFIT WANTS TO KNOW ABOUT YOUR RECOMMENDATION MAKE A CARBON COPY OF THIS AND GIVE IT TO YOUR HEADQUARTERS.

The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers =.386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 009856-000