HIWASSEE DAM

October 1999

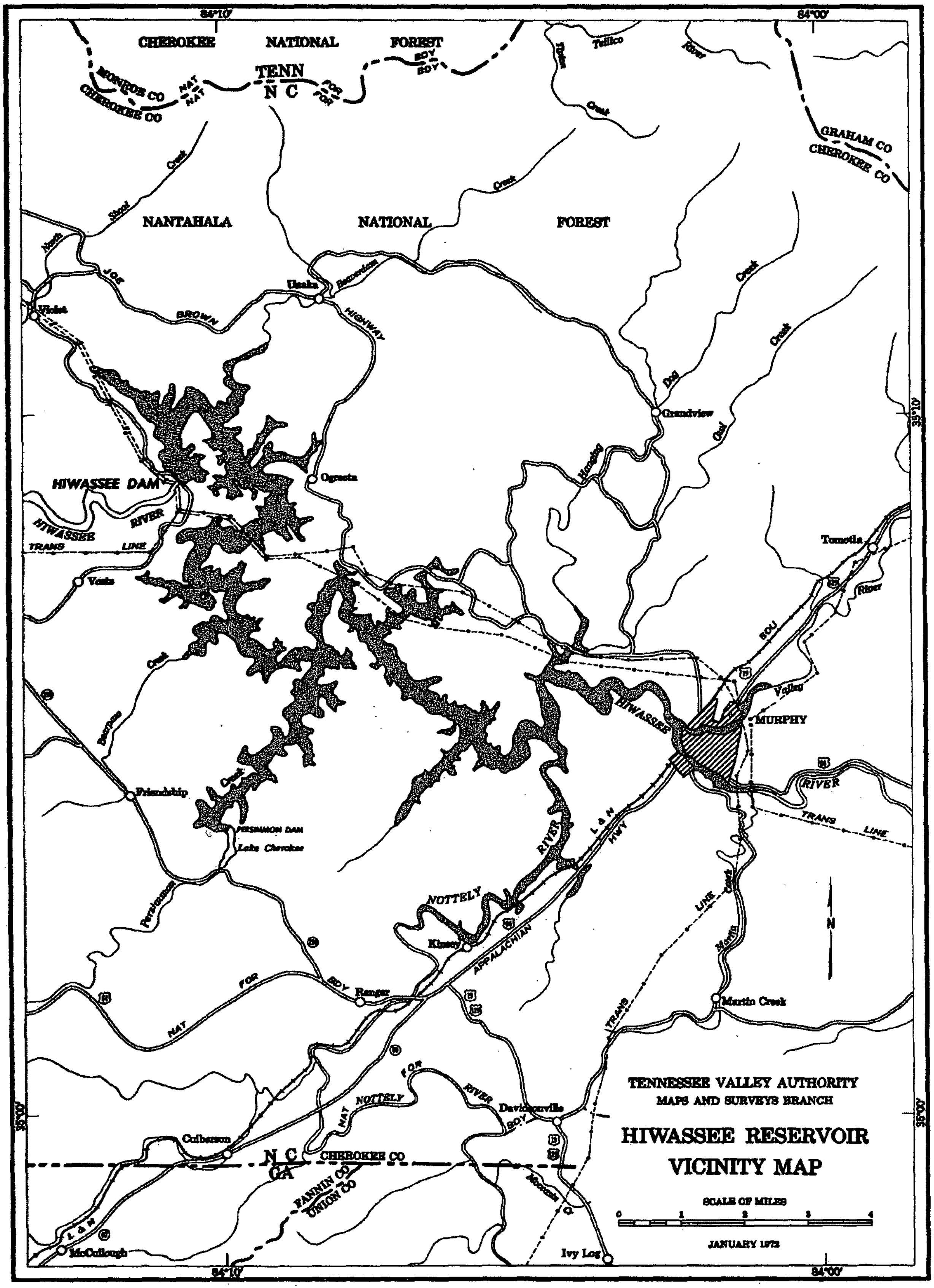
RESERVOIR OPERATION OVERVIEW

Hiwassee is a multipurpose tributary project located on the Hiwassee River in western North Carolina. Hiwassee is operated for many purposes, including flood control, augmentation of flows for navigation and water supply, hydropower production, water quality, recreation, and aquatic ecology. It is a concrete gravity dam with 2 hydroelectric units installed, one of which is a reversible unit capable of pumping water from the tailwater back into the reservoir. Construction originally began in 1936, and the dam was closed in 1940, with one unit placed into operation at that time. In 1956, the second unit was placed into operation.

Hiwassee Reservoir has an annual pool variation of about 62 feet during normal years. This fluctuation is necessary for provide for seasonal flood storage and for economical augmentation of flows during the drier seasons of the year. In abnormally wet or dry years, the fluctuation may be significantly more or less than this. Hiwassee Reservoir is fed by releases from TVA's Nottely and Chatuge Dams in addition to unregulated inflows from the 565 square mile local drainage area.

Table of Contents

Table of Contents (Cont.)



84°10'
84°00'
CHEROKEE NATIONAL FOREST
TENN
N C
MONROE CO
CHEROKEE CO
GRAHAM CO
CHEROKEE CO
NANTAHALA NATIONAL FOREST
JOE BROWN HIGHWAY
Violet
Unaka
Grandview
35°10'
HIWASSEE DAM
HIWASSEE RIVER
TRANS LINE
Vests
Ogreeta
Tomotla
HIWASSEE
MURPHY
RIVER
TRANS LINE
Friendship
PERSIMMON DAM
Lake Cherokee
NOTTELY RIVER
Kinsey
APPALACHIAN HWY
L & N
Ranger
Martin Creek
NAT FOR BDY
Culberson
N C
GA
CHEROKEE CO
FANNIN CO
UNION CO
Davidsonville
McCullough
Ivy Log
35°00'
TENNESSEE VALLEY AUTHORITY
MAPS AND SURVEYS BRANCH
HIWASSEE RESERVOIR
VICINITY MAP
SCALE OF MILES
0 1 2 3 4
JANUARY 1972
N

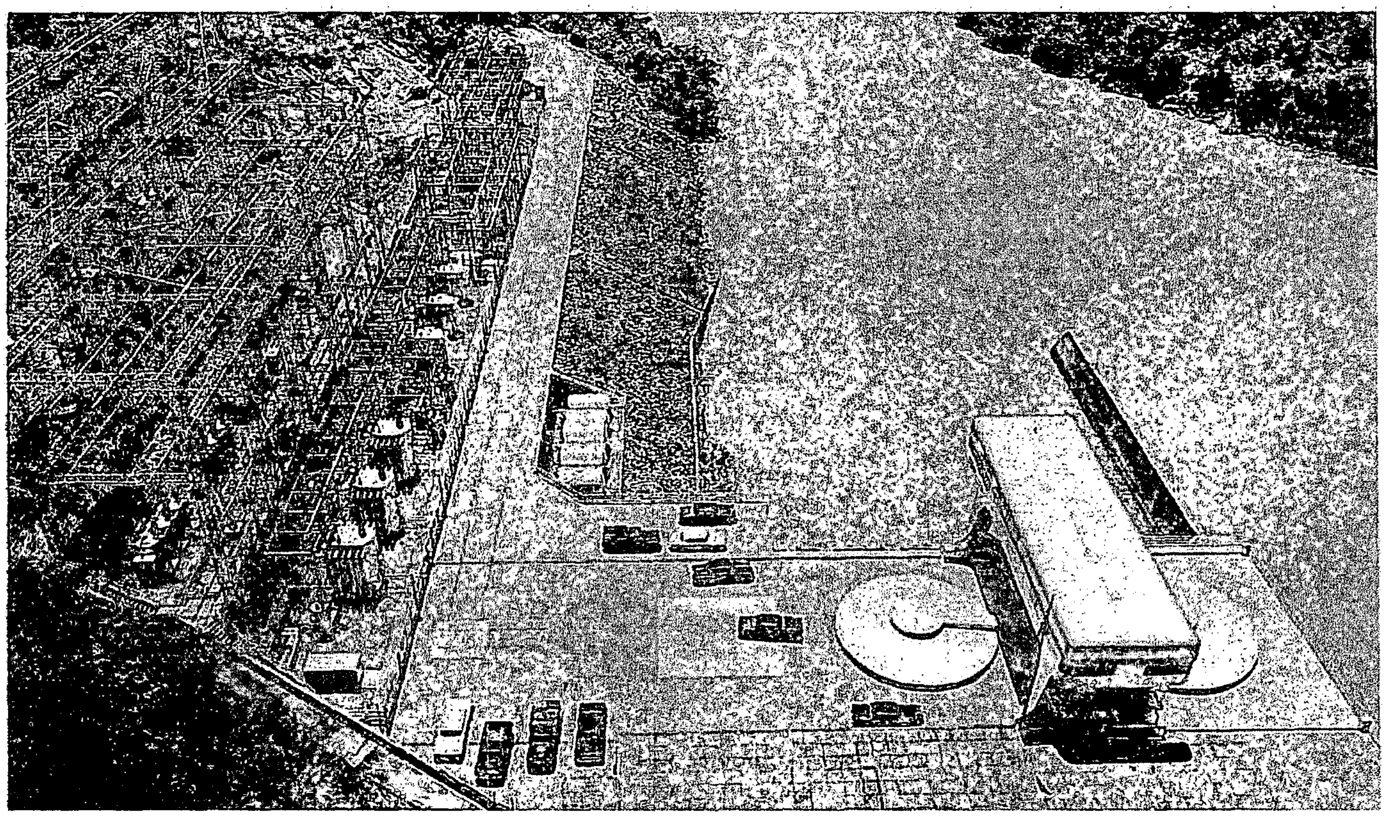


FIGURE 1 - Switchyard and 2-unit powerhouse, 1956

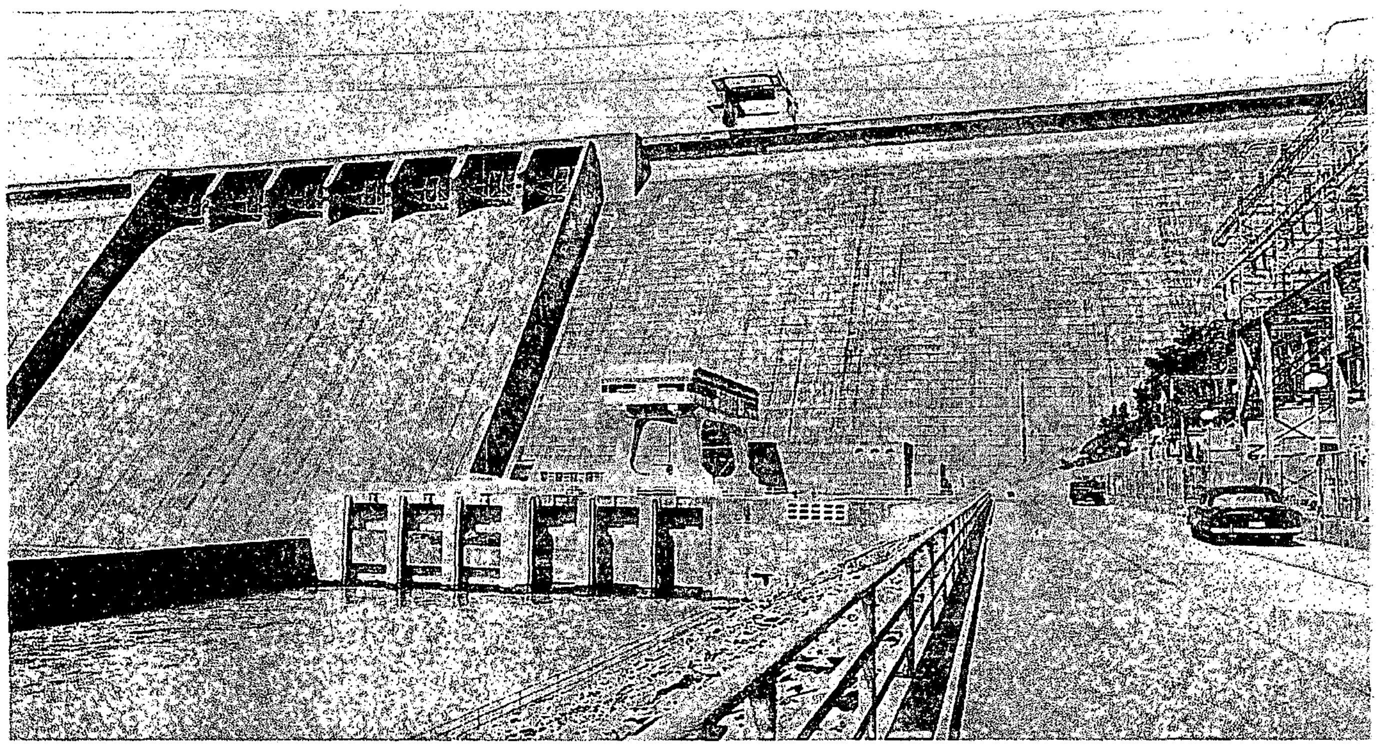


FIGURE 2 - Spillway and powerhouse, 1956

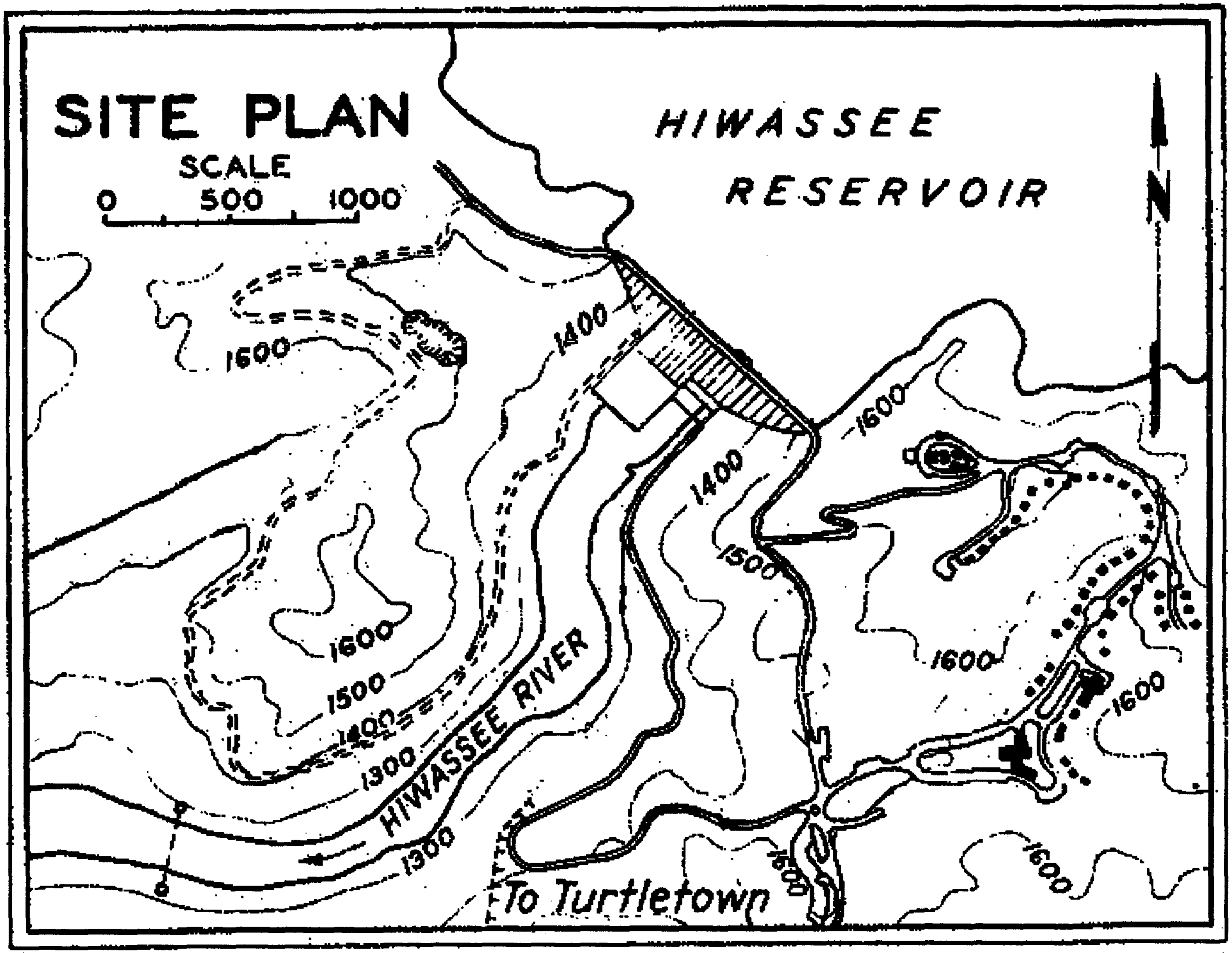

SITE PLAN
SCALE
0 500 1000
HIWASSEE
RESERVOIR
N
1600
1400
1500
1300
HIWASSEE RIVER
To Turtletown

FIGURE 3

FIGURE 4

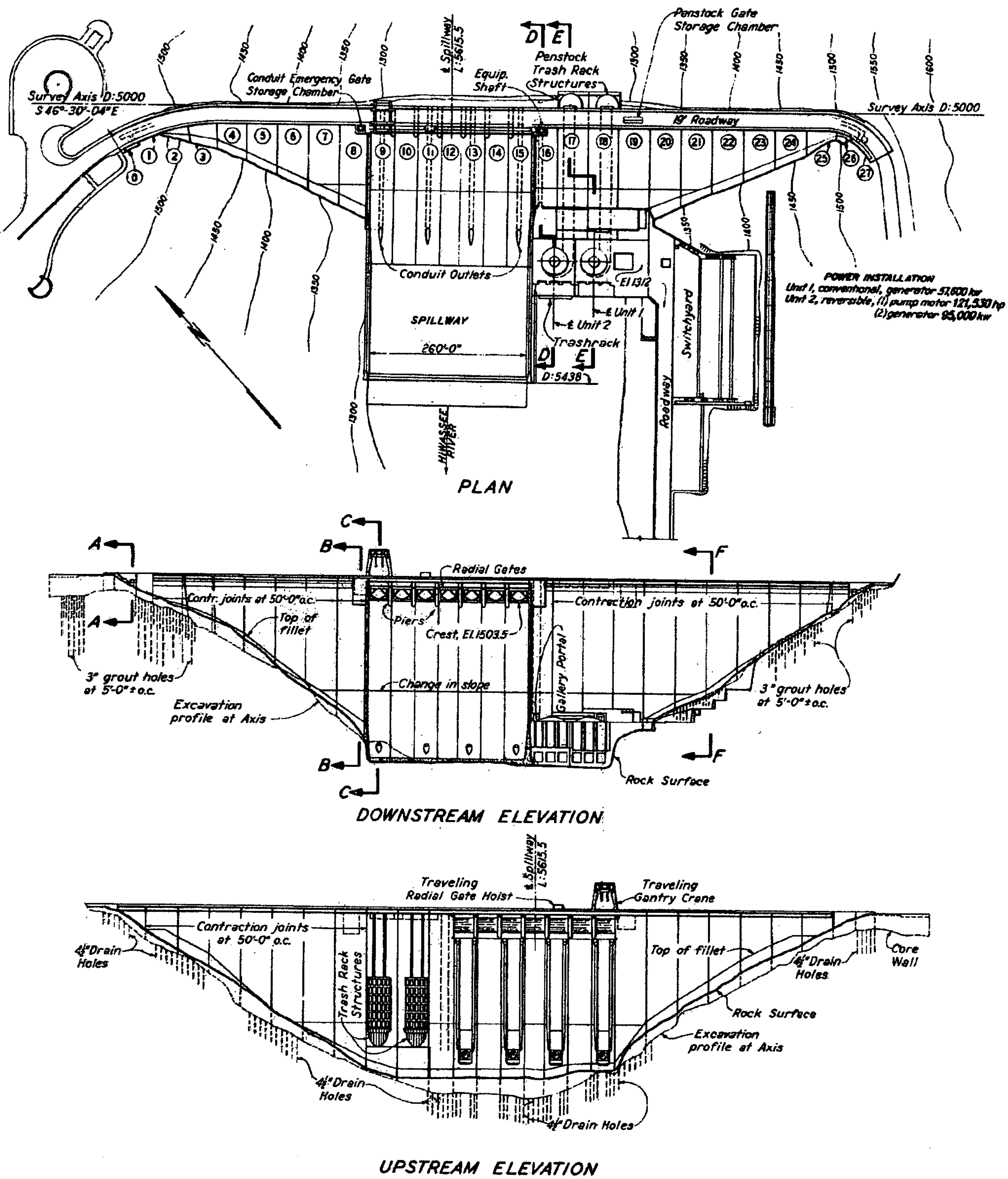
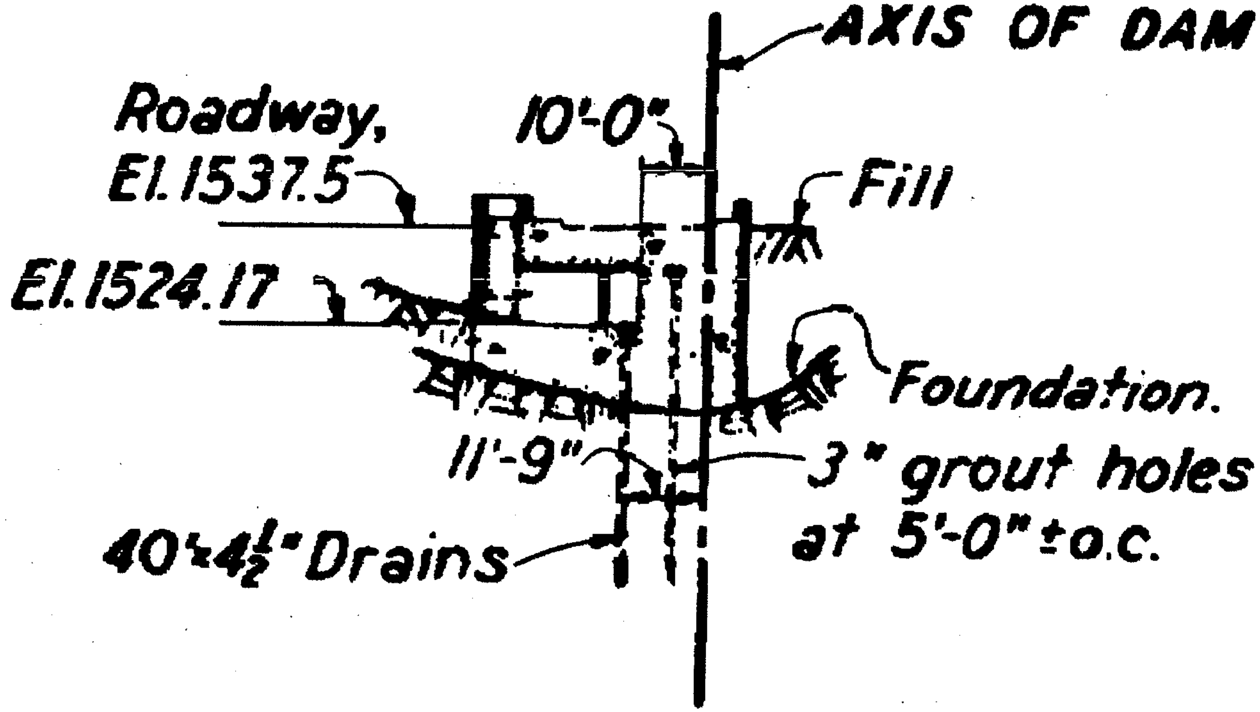

Survey Axis D:5000
S 46°-30'-04"E
Conduit Emergency Gate Storage Chamber
Spillway L:5615.5
Equip. Shaft
Penstock Trash Rack Structures
Penstock Gate Storage Chamber
Survey Axis D:5000
19' Roadway
Conduit Outlets
SPILLWAY
260'-0"
Unit 1
Unit 2
Trashrack
D:5438
El 1312
Switchyard
Roadway
HIWASSEE RIVER
POWER INSTALLATION
Unit 1, conventional, generator 57,600 kw
Unit 2, reversible, (1) pump motor 121,530 hp
(2) generator 95,000 kw
PLAN
Radial Gates
Contr. joints at 50'-0" o.c.
Top of fillet
Piers
Crest, El. 1503.5
Contraction joints at 50'-0" o.c.
Gallery Portal
Change in slope
3" grout holes at 5'-0"± o.c.
Excavation profile at Axis
Rock Surface
DOWNSTREAM ELEVATION
Traveling Radial Gate Hoist
Spillway L:5615.5
Traveling Gantry Crane
Contraction joints at 50'-0" o.c.
Trash Rack Structures
4½" Drain Holes
Top of fillet
Core Wall
Rock Surface
Excavation profile at Axis
4½" Drain Holes
UPSTREAM ELEVATION

Figure 5



SECTION A-A

FIGURE 6

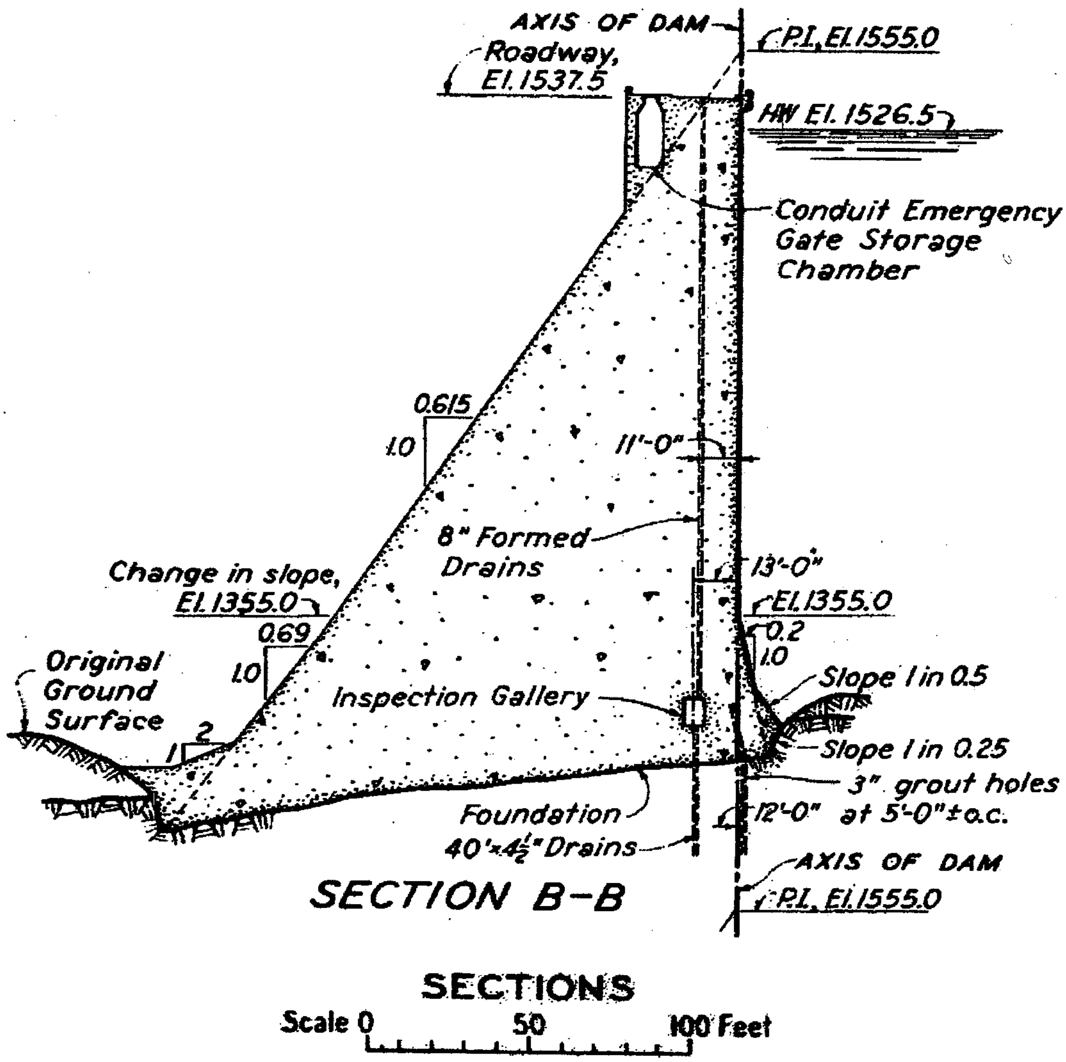
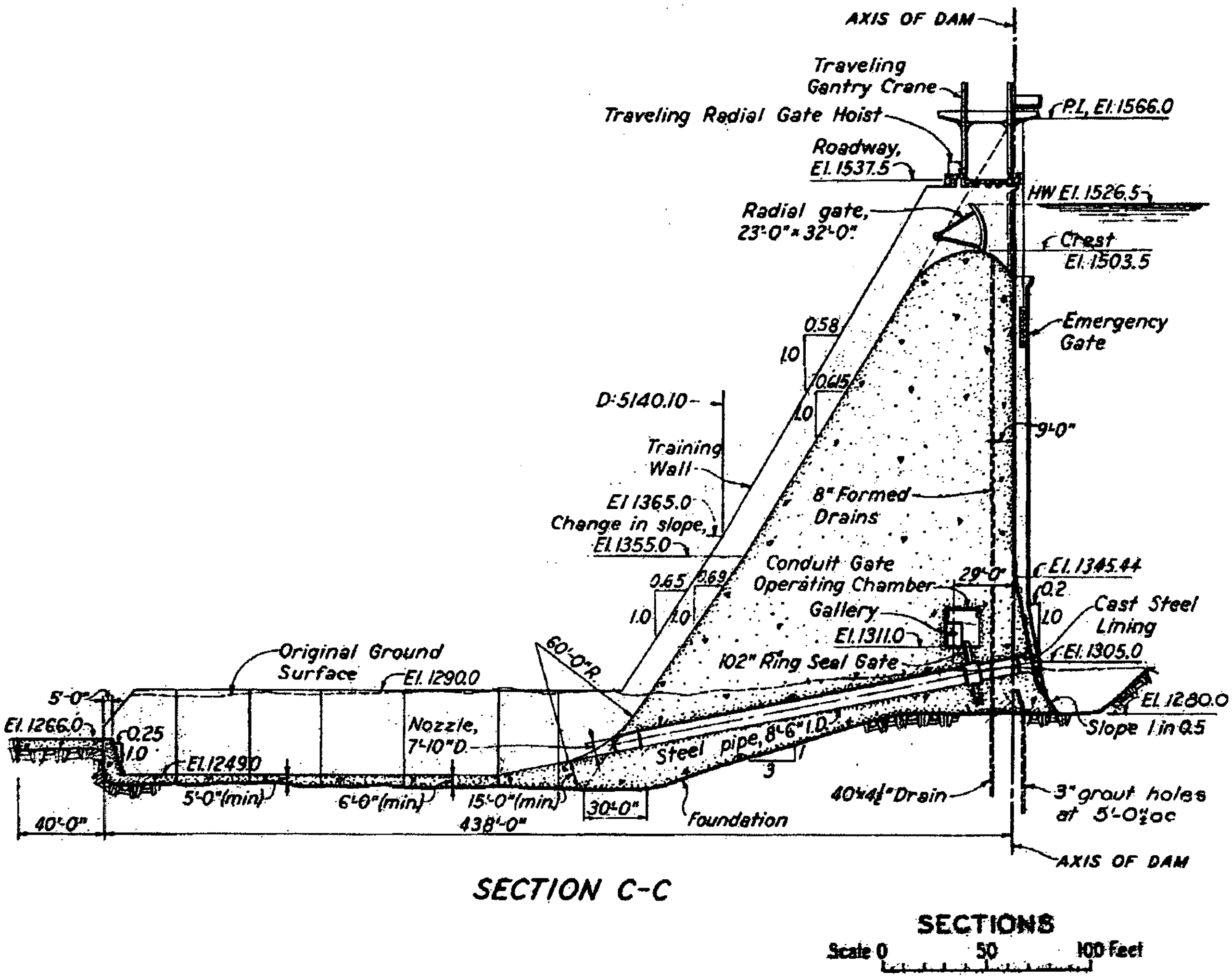
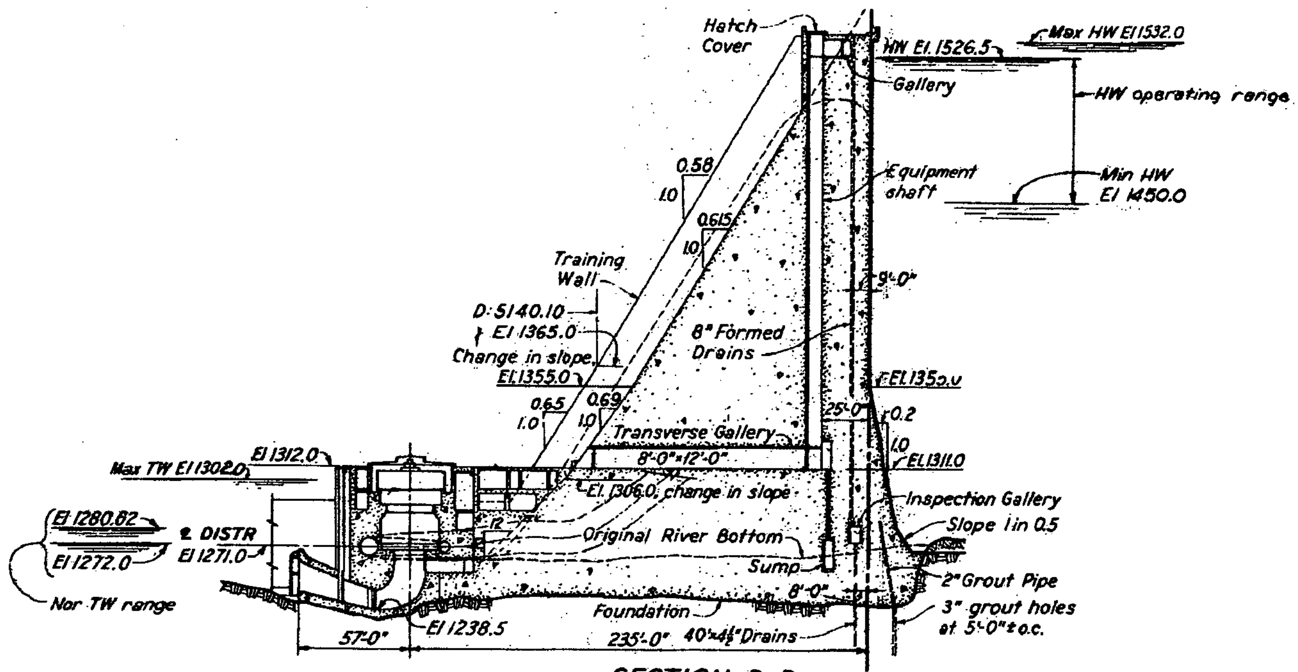

AXIS OF DAM
P.I. El. 1555.0
Roadway, El. 1537.5
HW El. 1526.5
Conduit Emergency Gate Storage Chamber
0.615
1.0
11'-0"
8" Formed Drains
13'-0"
Change in slope, El. 1355.0
El. 1355.0
0.69
1.0
0.2
1.0
Original Ground Surface
Slope 1 in 0.5
Inspection Gallery
2
1
Slope 1 in 0.25
3" grout holes at 5'-0"±o.c.
Foundation
12'-0"
40'×4½" Drains
AXIS OF DAM
P.I. El. 1555.0
SECTION B-B
SECTIONS
Scale 0 50 100 Feet

FIGURE 7



SECTION C-C

FIGURE 8

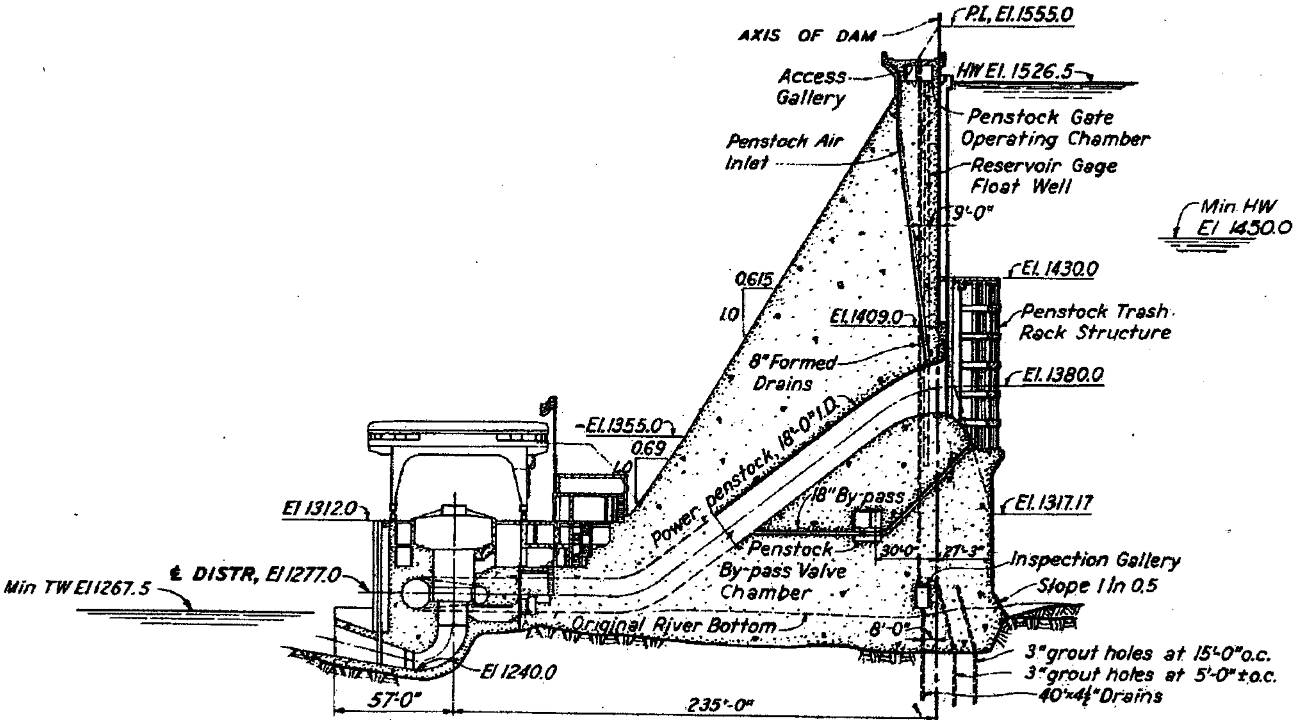


SECTION D-D

SECTIONS

Scale 0 50 100 Feet

FIGURE 9

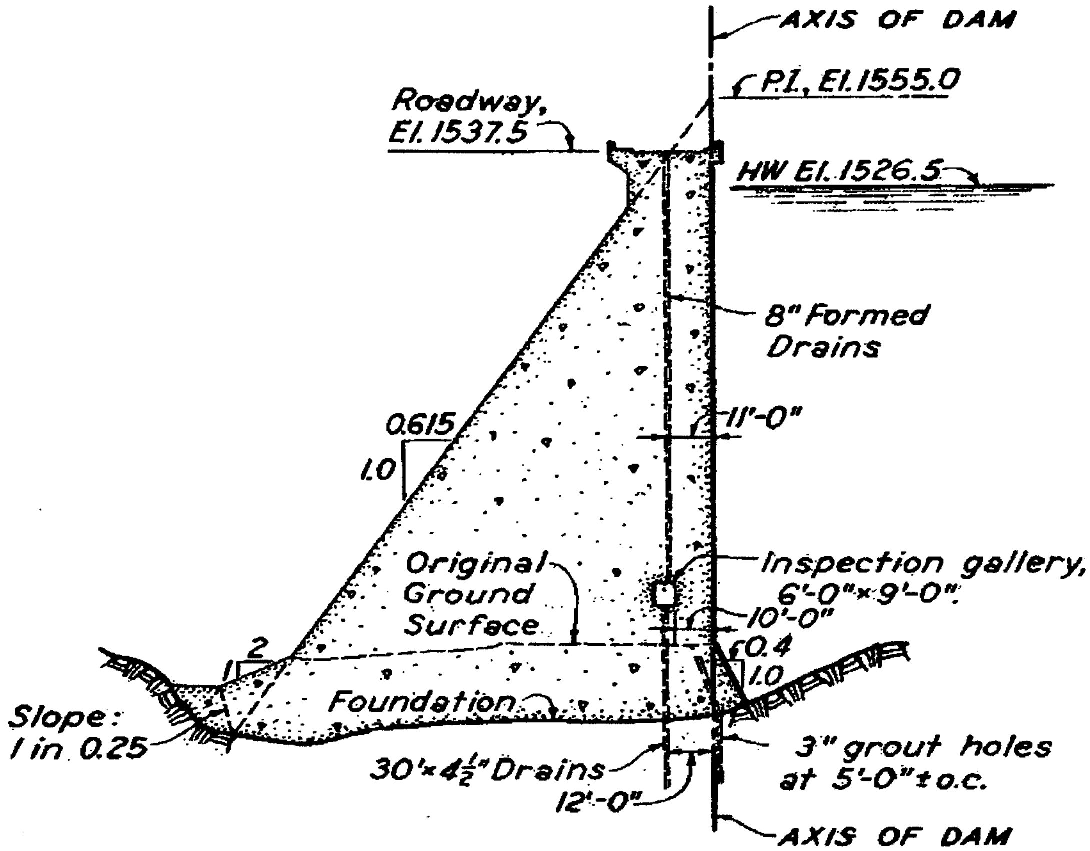


SECTION E-E

SECTIONS

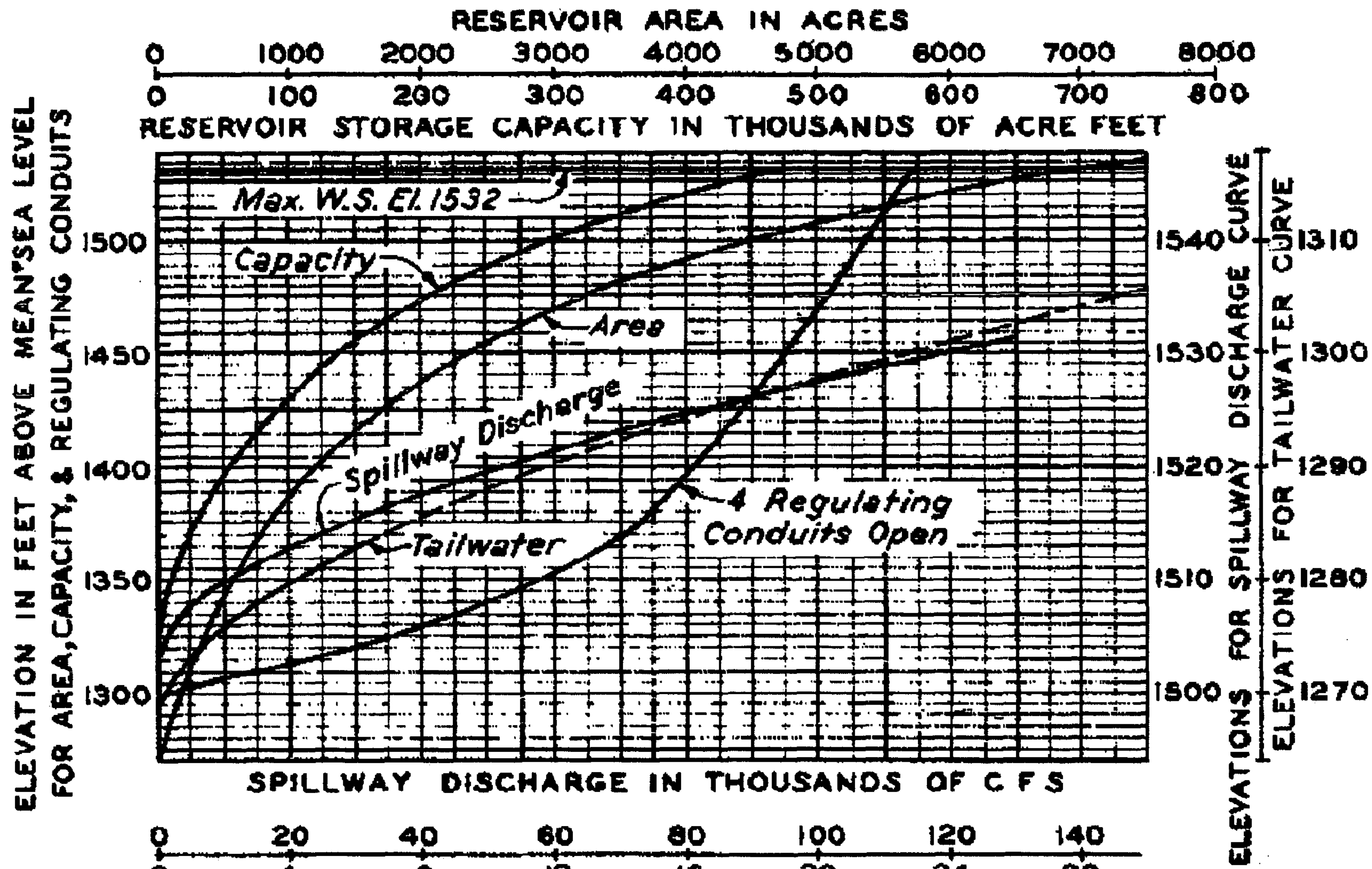
Scale 0 50 100 Feet

FIGURE 10



SECTION F–F

FIGURE 11



DISCHARGE, AREA, CAPACITY, AND TAILWATER CURVES

HIWASSEE PROJECT

SUMMARY OF PRINCIPAL FEATURES

NOTE:

Elevations are based on the U.S.C. & G.S. 1929 Preliminary Adjustment to which the dam is built. To correct to U.S.C. & G.S. 1936 Supplementary Adjustment, subtract 0.62 ft.

LOCATION

On Hiwassee River at river mile 75.8; in Cherokee County, North Carolina; 13.6 miles upstream from Apalachia Station on Louisville and Nashville Railroad; 20 miles downstream from Murphy, North Carolina; 60 air miles south of Knoxville, Tennessee; 60 air miles east of Chattanooga, Tennessee; 100 air miles north of Atlanta, Georgia.

CHRONOLOGY

Authorized by TVA Board of Directors	January 10, 1936
Preliminary construction, including access, started	July 15, 1936
Stripping of south abutment started	November 21, 1936
First cofferdam started	July 13, 1937
First concrete placed	April 20, 1938
Reservoir clearance started	October 24, 1938
Last (third) cofferdam unwatered	January 3, 1939
River flow diverted through sluice ways	April 22, 1939
Reservoir clearance completed	December 12, 1939
Concreting by mixer plant completed	January 31, 1940
Dam closure (ring seal gates closed)	February 8, 1940
Unit 1 in commercial operation	May 21, 1940
Unit 2 authorized by TVA Board of Directors	September 25, 1951
Unit 2 construction began	January 4, 1954
Unit 2 in commercial operation	May 24, 1956
Reservoir releases improvements (Unit 1) - completed	December 1994
Generator and turbine modernization (Unit 2) - completed	December 4, 1998

PROJECT COST

Initial project, including 1 unit	$16,844,042
Addition of unit 2	6,356,211
Reservoir releases improvements (Unit 1)	40,000
Generator and turbine modernization (Unit 2)	14,224,012
Total, including switchyard	$37,464,265

STREAMFLOW

Drainage area at dam:	
Total	968 sq. miles
Uncontrolled (below Chatuge and Nottely Dams)	565 sq. miles
Gaging station discharge records:	
At Hiwassee Dam, September 1934 to September 1943; drainage area	968 sq. miles
Below Appalachia Dam, North Carolina, June 1941 to April 1946; drainage area	1,018 sq. miles
Near Appalachia, Tennessee, January 1914 to December 1922; drainage area	1,038 sq. miles
Near McFarland, Tennessee, October 1942 to date; drainage area	1,136 sq. miles
Gaging station discharge records	
At Reliance, Tennessee, August 1900 to December 1913; February 1919 to September 1926; drainage area	1,181 sq. miles
Near Reliance, Tennessee, October 1926 to September 1948; drainage area	1,223 sq. miles
Maximum natural flow at dam site (1898)	80,000 cfs
Maximum regulated flood since closure (1973)	38,848 cfs
Average unregulated flow at dam site, estimated (1903-2000)	2,020 cfs
Minimum daily natural flow at dam site (1925), approx	145 cfs

RESERVOIR

Counties affected: State of North Carolina	Cherokee
Reservoir land at May 31, 1996:	
Fee simple	5,645 ac.
Easements	31 ac.
Total	5,676 ac.
Transferred	17,432 ac.
Operating levels at dam:	
Probable maximum flood elevation (PMF)	el. 1548.8
500-year flood elevation	el. 1530.0
100-year flood elevation	el. 1529.0
Winter flood guide level	el. 1450.0
Summer flood guide level	el. 1524.5
Maximum used for design (153,000 cfs)	el. 1532.0
Top of gates (area 6,230 ac.)	el. 1526.5
Backwater, length at top of gates level	22.2 miles
Shoreline, length at top of gates level:	
Main shore	161 miles
Islands	2 miles
Total	163 miles
Original river area (to el. 1526 crossing)	1,000 ac.
Storage (flat pool assumption):	
Total volume:	
At top of gates (el. 1526.5)	434,000 ac.-ft
At normal maximum pool (el. 1524.5)	422,000 ac.-ft
At normal minimum pool (el. 1450)	128,000 ac.-ft
Reservation for flood control on:	
January 1 to January 27 (el. 1526.5-1465)	270,100 ac.-ft
March 15 (el. 1526.5-1482)	216,000 ac.-ft
Useful controlled storage (el. 1526.5-1450)	306,000 ac.-ft

TAILWATER

Maximum used for design (130,000 cfs)	el. 1302.0
Maximum known flood (1936)	el. 1286.0
Full plant operation (2 units)	el. 1276.2
One unit operating at best efficiency. Minimum level	el. 1272.0
Minimum level	el. 1272.0

HEAD (Gross)

Maximum static (el. 1526.5-1272)	254.5 ft
Normal maximum operating	(el. 1524.5-1272.5)
Average operating	213.0 ft
Minimum operating	(el. 1415-1278)

RESERVOIR ADJUSTMENTS

Clearing below el. 1528	3,270 ac.
Wiring down below el. 1410	569 ac.
Drainage of isolated pools	395 cu. yd
Highways:	
Access	11.7 miles
State	3.4 miles
County	8.8 miles
Tertiary	3.1 miles
Total	27.0 miles
Railroads	1.7 miles
Bridges (highway 11, railroad 3)	14 bridges
Concrete box culverts	40
Families relocated	261
Graves	571 agreements; 475 removals
Utilities adjusted or constructed	3.0 miles

DAM

Material and type	Concrete gravity nonoverflow dam and spillway
Lengths:	
Nonoverflow dam	1,027 ft
Spillway	260 ft
Cutoff wall, right (north) bank	89 ft
Total	1,376 ft
Maximum height, foundation to deck level	307 ft
Maximum width at base:	
Spillway section only	240 ft
Including apron	493 ft
Deck level	el. 1537.5

DAM (Continued)

Outlet facilities:
- Spillway clear opening (7 openings at 32 ft) .... 224 ft
- Spillway crest level .... el. 1503.5
- Crest gates .... 7 radial gates, 32 ft wide 23 ft high, ... separated by 6-ft-thick piers

Traveling crane .... One 120-ton gantry
Traveling hoist .... One 40-ton hoist
Sluices .... Four 102-in.-dia. Steel-lined outlets with nozzle at outlet end
Centerline sluice inlet .... el. 1305.0
Sluice control:
- Regulating gates .... 4 ring seal gates, screw hoist operated
- Emergency gate .... 1 roller train lift gate on .... face of dam, operated by gantry

Spillway discharge capacity:
- HW el. 1532.0 .... 130,000 cfs
- HW el.1526.5 (top of gates) .... 90,000 cfs

Sluice discharge capacity:
- HW el.1532.0 .... 23,000 cfs
- HW el.1526.5 .... 22,000 cfs

Highway .... 19 ft wide on dam
Foundation .... Rock (graywacke)

POWER FACILITIES

INTAKES

Number 2
Gates .... Two 19-ft-wide by 26-ft-high structural .... steel gates with roller trains
Hoists .... Two 60-ton fixed hoists under roadway in dam
Trashrack structure .... 2 reinforced concrete semicircular towers
Steel trashracks .... 160 sections, 2 ft 7 in. .... wide by 11 ft 3-1/2 in. high
Gross area at racks (per unit) .... 3,050 sq. ft

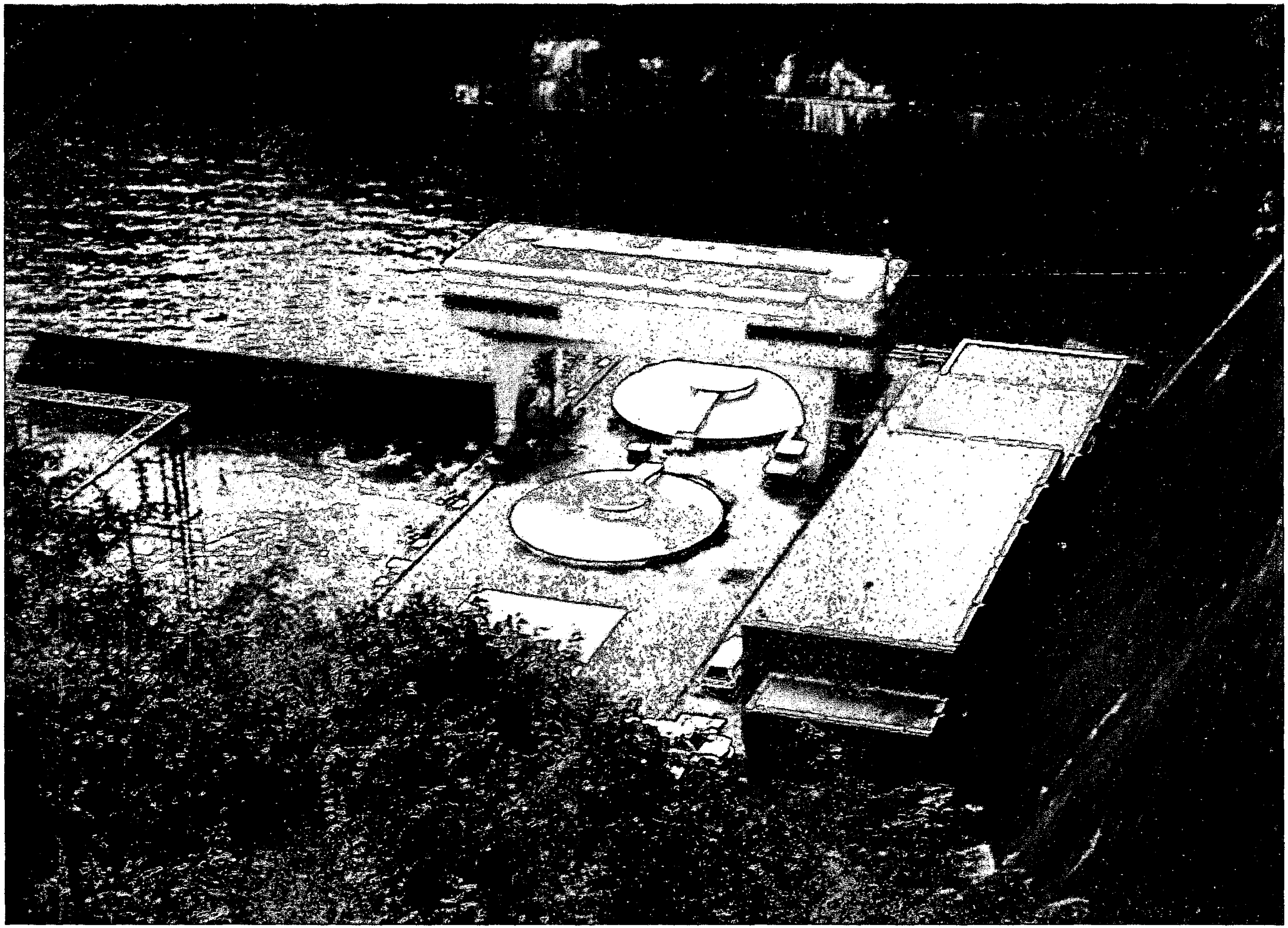
PENSTOCKS

Number 2
Type .... Riveted steel 3/4 in. to 1-3/8 in. thick
Diameter 18
Length .... 217 ft 5 in. for unit 1; 189
.... ft 9-1/2 in. for unit 2
Air vents .... One 30-in.-dia. for each penstock

POWERHOUSE (See Figure 12)

Generating capacity, 2-unit total .... 117,100 kW
Type of construction .... Outdoor; reinforced concrete
.... and structural steel
Principal outside dimensions,
including service bay .... 190 ft long by 89.5 ft wide
.... by 76 ft high
Service bay .... 54.5 ft by 122 ft
Draft tubes:
Type .... Elbow, 3 openings
Horizontal length (centerline of
turbine to downstream face) .... 57.0 ft
Vertical distance from distributor centerline to draft tube floor:
Unit 1 .... 37.0 ft
Unit 2 .... 32.5 ft
Net area at outlet opening:
Unit 1 .... 661 sq. ft
.....Unit 2 .... 1,048 sq. ft
Trashrack at pump unit
(unit 2) .... Gross area 1,641 sq. ft;
.... net area 1,321 sq. ft
Gates .... 1 set of 3 slide gates, 15 ft
.... 4 in. wide by 13 ft high
Gate Hoist .... 25-ton auxiliary hoist on
.... powerhouse gantry
Erecting crane .... 275-ton gantry with two 137-1/2-ton
.... main hooks and two 25-ton auxiliary hoists

FIGURE 12 - Powerhouse and Generating Units, October 1999



POWER FACILITIES (Continued)

HYDRAULIC TURBINE (Unit 1)

Number	1
Manufacturer	Newport News Ship building and Dry Dock Co.
Type	Vertical Francis
Rated capacity	80,000 hp at 190-ft net head
Rated speed	120 rpm
Maximum runaway speed	235 rpm
Specific speed at rating	48
Value of sigma at rating	0.141
Diameter of runner, intake	161 in.
Diameter of runner, discharge	165,187 in.
Centerline to bottom of runner	55.375 in.
Centerline to top of runner	21 in.
Diameter of guide vane circle	189 in.
Diameter of lower pit	19.6 ft
Spacing of turbines, center to center of units	62.08 ft
Governors	Woodward, cabinet actuator type
Weight of rotating parts	Approx. 142,000 lb

PUMP-TURBINE (Unit 2)

Number	1
Manufacturer	Voith Hydro, Inc.

	As Turbine	As Pump
Type	Vertical Francis	Centrifugal
Rated horsepower	130,000	121,530
Rated head	235 ft net	200 ft net
Rated discharge	5,354 cfs	4,835 cfs
Rated speed	105.9 rpm	105.9 rpm
Maximum runaway speed	160 rpm	N/A
Direction of rotation	Clockwise	Counter clockwise
Specific speed at rating	41.5	138.5
Value of sigma at rating	.18	0.22
TW safety factor at rating (ft.)	32	16

POWER FACILITIES (Continued)

PUMP-TURBINE (Unit 2 continued)

Diameter of runner, intake .... 266 in.
Diameter of runner, discharge .... 182 in.
Centerline to bottom of runner .... 72.25 in.
Centerline to top of runner .... 22 in.
Diameter of guide vane circle .... 312 in.
Diameter of lower pit .... 30.0 ft
Spacing of turbines, center to center of units .... 62.08 ft
Governors .... Woodward, cabinet actuator type
Weight of rotating parts .... Approx. 335,000 lb

GENERATORS

Unit 1 Generator:

Manufacturer .... Westinghouse Electric Corp.
Type .... Enclosed, water-cooled, vertical-shaft;
.... vertical cylindrical concrete wall of housing,
.... and removable weather cover, furnished by TVA
Rating .... 64,000 kVA, 57,600 kW, 2864 A, 60 degrees
.... C rise,0.9 pf, 13.8 kV, 3 ph, 60 Hz
Capacity .... 73,600 kVA, 66,240 kW,
.... 3086 A, 80 degrees C rise
Efficiency (tested):
At rated kVA, 1.0 pf .... 98.34 percent
At 75% kVA, 0.9 pf .... 97.79 percent
Flywheel effect:
Calculated .... 60,300,000 lb-ft^2
Tested .... 62,900,000 lb-ft^2
Thrust bearing .... Kingsbury type, dia. 76 in.,
.... max load 540 tons
Neutral reactor .... 0.97 ohm, 6000 A, 1 min

Exciters:
Main .... 275 kW, 250 V
Pilot .... 10 kW, 250 V
Weight of heaviest crane lift, rotor .... 243 tons
Diameter over air housing, less trim .... 454 in.
Top of pilot exciter:
Above stator soleplates .... 153.75 in.
Above turbine floor .... 273.75 in.

POWER FACILITIES (Continued)

GENERATORS (Continued)

Unit 2 Generator-Motor:

Manufacturer .... Allis-Chalmers Manufacturing Co.
Type .... Enclosed, water-cooled, vertical-shaft; vertical
.... cylindrical concrete wall of housing, and
.... removable weather cover, furnished by TVA
Rating as generator .... 100,000 kVA, 95,000 kW, 4184 A, 80 degrees
.... C rise, 0.95 pf lag, 13.8 kV, 3 ph, 60 Hz
Rating as motor .... 121,530 hp, 80 degrees C rise, 0.95 pf lag, 13.5 kV,
Efficiency (guaranteed):
    As generator:
        At 100,000 kVA, 1.0 pf .... 97.7 percent
    As motor:
        At 121,530 hp, 1.0 pf .... 97.6 percent
Flywheel effect .... 82,818,700 $lb\text{-}ft^2$
Thrust bearing .... Kingsbury, dia. 87 in., max.
.... load 683 tons
Neutral transformer .... 75 kVA, 14.4 kV-240 V, 1 ph
Exciters:
    Main .... 350 kW, 250 V
    Pilot .... 20 kW, 250 V

GENERATOR AND TURBINE MODERNIZATION

Unit 1 is scheduled to start on September 10, 2001, and complete on January 26, 2002. The work on unit 2 was completed on December 4, 1998. The principal unit 2 components that were replaced were the runner, instrumentation, generator stator winding, main and pilot exciter, unit 2 start breaker, units 1 and 2 generator breakers, turbine distributor bushings (greaseless), protective relays, current and potential transformers, critical piping and components in the raw water cooling system, proportioning valve and generator coolers. Principal components rehabilitated were the wear ring, bottom ring, brake system, servo motors, wicket gate system, field winding, generator and turbine bearings, and the generator and turbine shafts.

POWER FACILITIES (Continued)

ELECTRIC CONTROLS

From control room in powerhouse:
- Hiwassee generator No. 1 and generator-motor No. 2, transformers, switchyard, sources of auxiliary power, station auxiliaries, and starting of turbine No. 1 and pump-turbine No. 2 by direct control.
- Chatuge hydro plant and switchyard by frequency-shift powerline carrier.
- Nottely hydro plant and switchyard by frequency-shift powerline carrier.
- Apalachia hydro plant and switchyard by frequency-shift powerline carrier

TRANSMISSION PLANT

(See Figure 13 for Single Line Diagram of Main Connections and Figure 14 for photo of Switchyard)

Step-up transformers:
- 1 bank of 3 single-phase, 2-winding transformers, bank 1; bank rated 13.2-161 kV, 56,250 kVA self-cooled, 75,000 kVA forced-air-cooled; Moloney

- 1 bank of 3 single-phase, 2-winding transformers, bank 2; bank rated 6.6/13.2-161 kV, 114,000 kVA forcedoil-air-cooled; 13.2-kV winding tapped at 6.6 kV for starting pump-turbine unit 2; General Electric

Intersystem transformers:
- 1 3-phase, 2-winding transformer, bank 3; rated 13.2-7.2/12.47 kV, 1500 kVA self-cooled; Westinghouse

161-kV circuit breakers:
- 3 1200-A, 2,500,000-kVA, 8/60-Hz, sol, Westinghouse
- 4 1200-A, 3,500,000-kVA, 5/20-Hz, pneu, Westinghouse

14.4-kV circuit breakers:
- 2 .... 600-A, 50,000-kVA sol, General Electric

Structures:
- 6 .... 161-kV switchyard bays, 36 ft wide
- 2 .... delta bus and transformer structures
- 1 .... 26-kV future transformer bay, 22 ft wide
- 2 .... 26-kV transformer bays, 18 ft wide
- 5 .... 12-kV switchyard bays, 11 ft wide

Figure 13

SINGLE LINE DIAGRAM OF MAIN CONNECTIONS

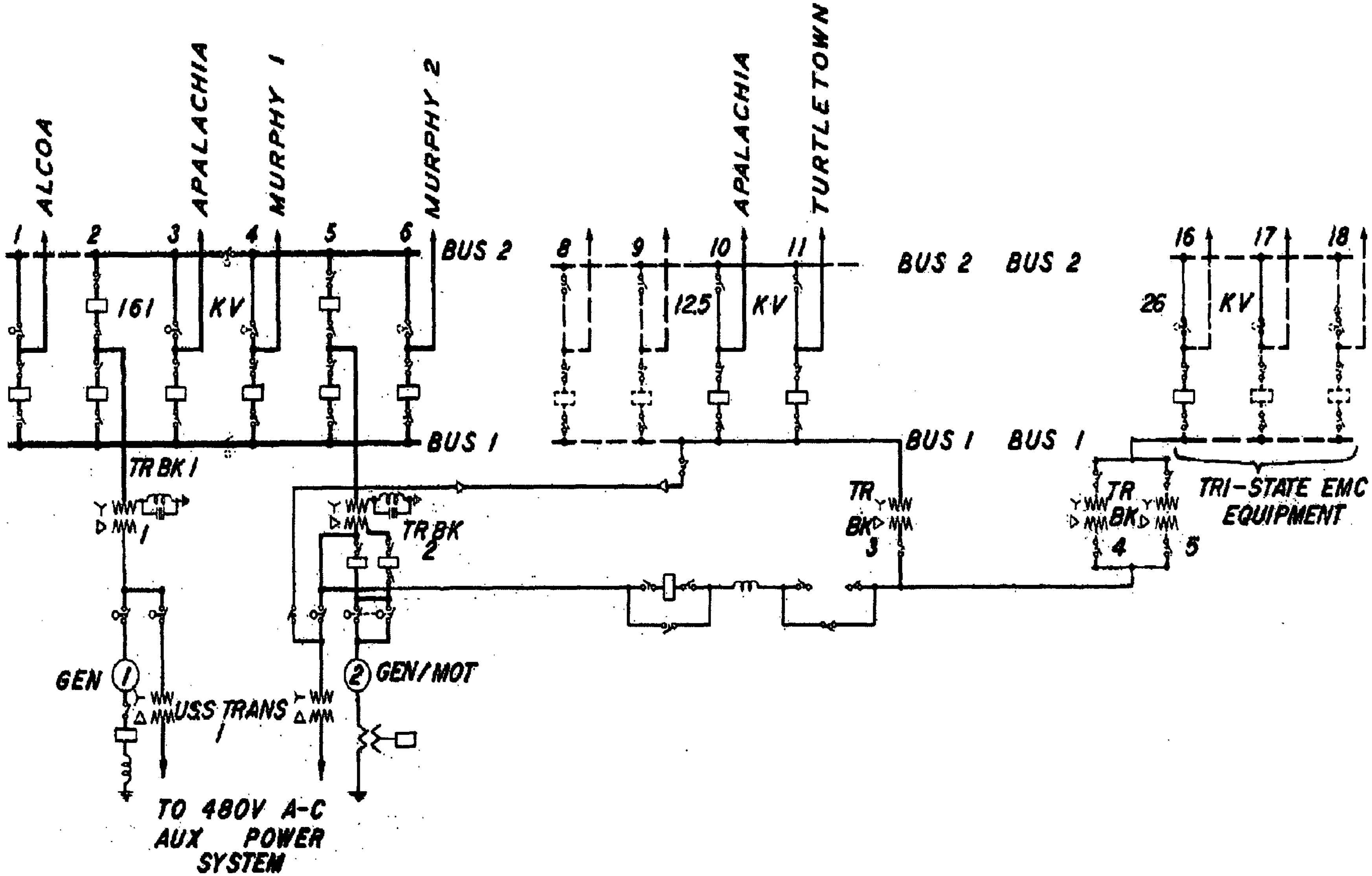
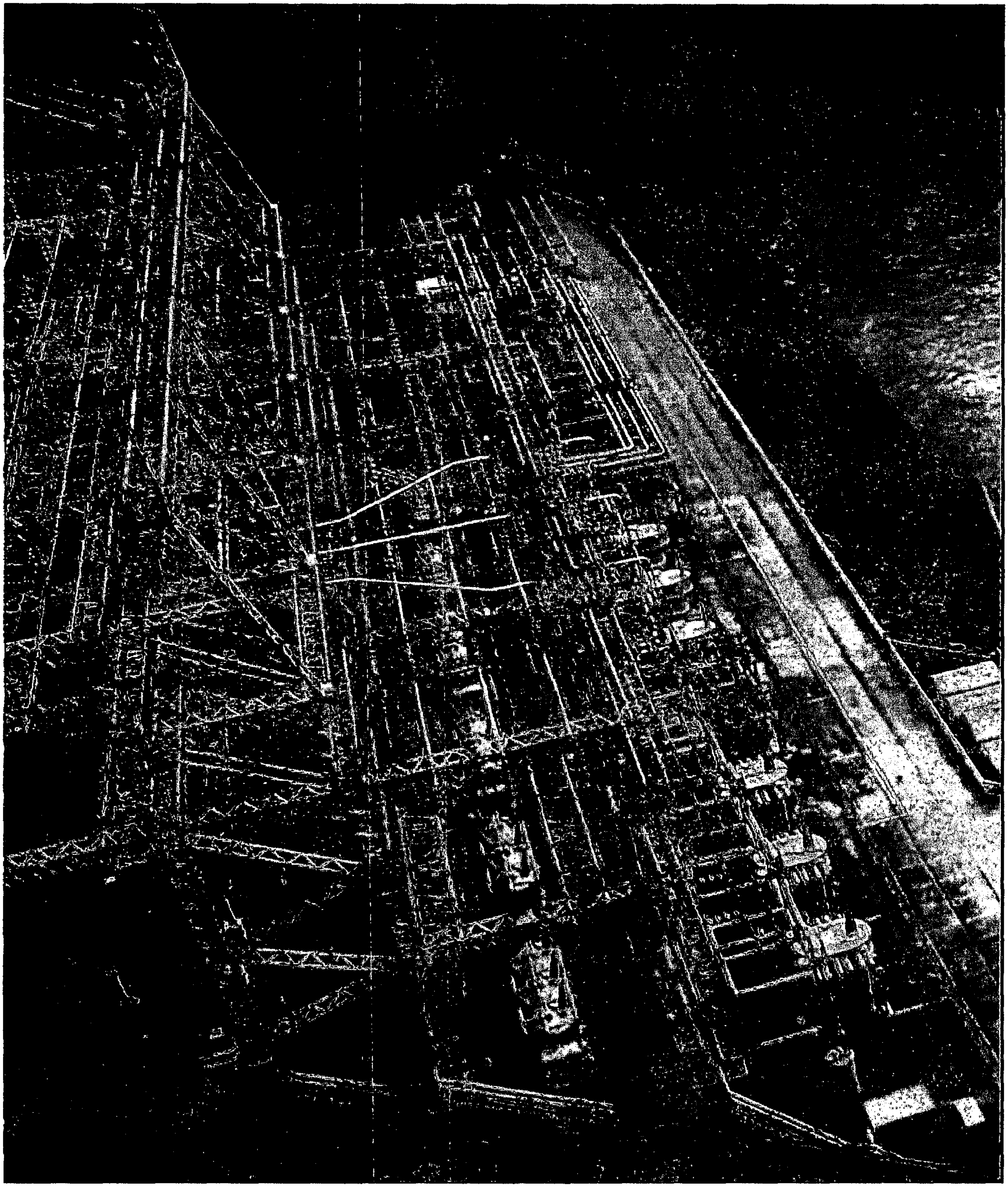


FIGURE 14 - Switchyard, October 1999



TRANSMISSION PLANT DATA

Plant	Location	Phase	Serial Number	MVA Rating 55 degrees	MVA Rating 65 degrees	Voltage kV	Cooling	Tap Changer	Oil Preservation System	Oil Volume Gal.	Configuration	Impedance % H-X	Impedance % H-Y	Impedance % X-Y	Contract Number	Manuf	Year of Manuf
Hiwassee Hydro	Bank 1	A	640278	18.75/25	N/A	161/13.2	OA/FA	DETC	Gas-Blanketed	7530	Wye/Delta	10.65	N/A	N/A	TV-43329	Moloney	1939
Hiwassee Hydro	Bank 1	B	640279	18.75/25	N/A	161/13.2	OA/FA	DETC	Gas-Blanketed	7530	Wye/Delta	10.82	N/A	N/A	TV-43329	Moloney	1939
Hiwassee Hydro	Bank 1	C	640280	18.75/25	N/A	161/13.2	OA/FA	DETC	Gas-Blanketed	7530	Wye/Delta	10.80	N/A	N/A	TV-43329	Moloney	1939
Hiwassee Hydro	Bank 2	A	B959976	38	N/A	161/13.2-6.6	FOA	DETC	Gas-Blanketed	3890	Wye/Delta	14.41	23.20	8.76	C-53-22856	GE	1954
Hiwassee Hydro	Bank 2	B	B959977	38	N/A	161/13.2-6.6	FOA	DETC	Gas-Blanketed	3890	Wye/Delta	14.39	23.08	8.74	C-53-22856	GE	1954
Hiwassee Hydro	Bank 2	C	B959978	38	N/A	161/13.2-6.6	FOA	DETC	Gas-Blanketed	3890	Wye/Delta	14.42	22.90	8.86	C-53-22856	GE	1954

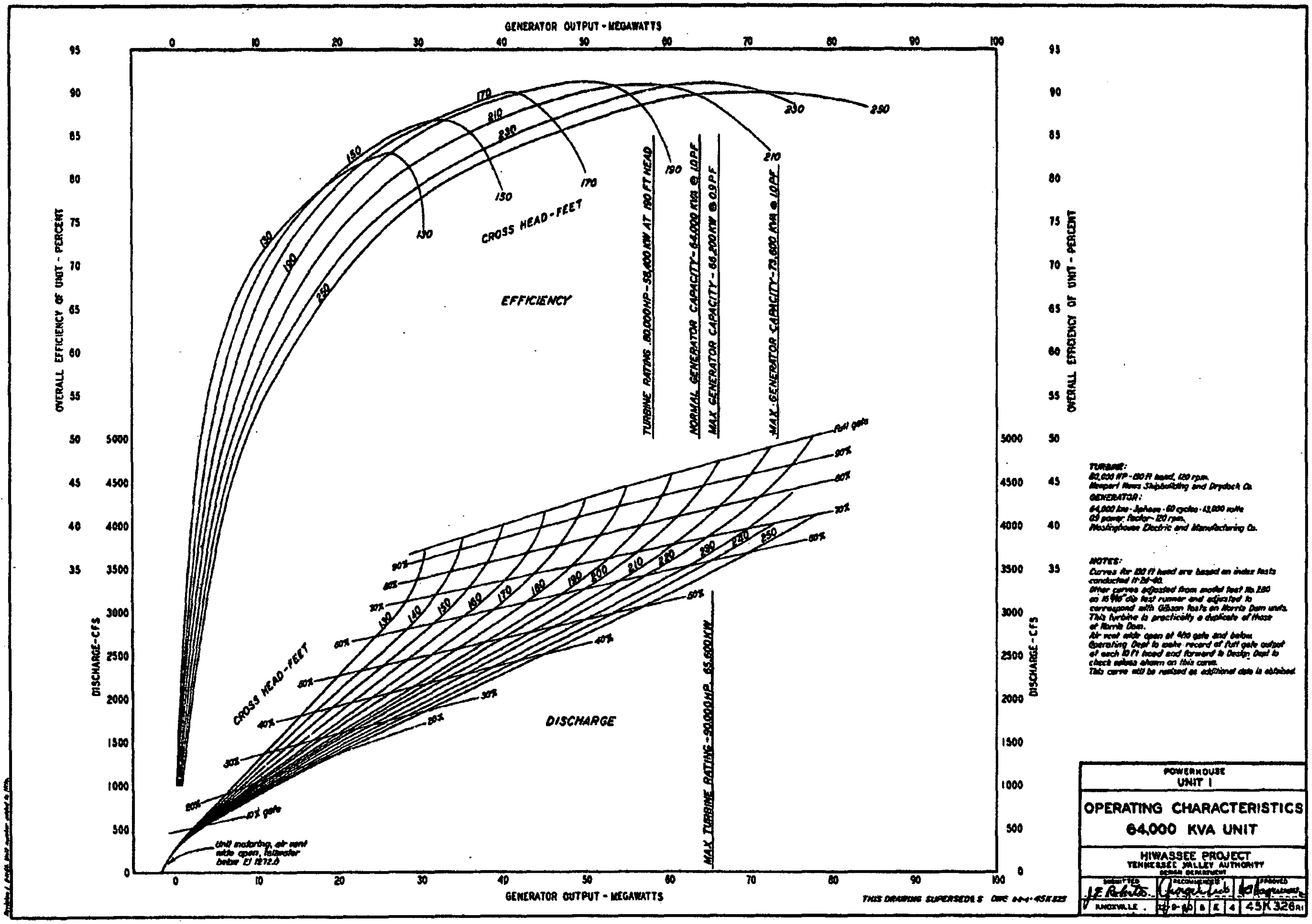
Note: H=High voltage winding
Y=Centered tapped X winding (start winding)
X=Low voltage winding

Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Gross Head (feet)	Best Efficiency Plant Output (mW)	Best Efficiency Turbine Discharge (cfs)	Best Efficiency kW/CFS	Maximum Sustainable Plant Output (mW)	Maximum Sustainable Turbine Discharge (cfs)	Maximum Sustainable kW/CFS
1530	6.75	457.3	253.7	136.0	7,180	18.94	145.0	8,020	18.09
1529	6.69	450.5	252.7	136.0	7,210	18.86	145.0	8,030	18.06
1528	6.63	443.9	251.7	136.0	7,240	18.78	145.0	8,040	18.03
1527	6.58	437.3	250.7	136.0	7,270	18.70	145.0	8,050	18.00
1526	6.54	430.7	249.7	135.9	7,300	18.62	144.9	8,070	17.97
1525	6.48	424.2	248.7	135.9	7,330	18.54	144.9	8,080	17.94
1524	6.40	417.8	247.7	135.9	7,360	18.46	144.9	8,090	17.91
1523	6.31	411.4	246.7	135.9	7,400	18.39	144.9	8,100	17.88
1522	6.20	405.1	245.7	135.9	7,430	18.31	144.9	8,120	17.85
1521	6.08	399.0	244.7	135.9	7,450	18.24	144.9	8,130	17.83
1520	5.94	393.0	243.7	135.9	7,470	18.19	144.9	8,140	17.80
1519	5.79	387.1	242.7	135.9	7,490	18.14	144.9	8,150	17.78
1518	5.66	381.4	241.7	136.0	7,510	18.10	145.0	8,170	17.75
1517	5.54	375.8	240.7	136.0	7,530	18.05	145.0	8,180	17.73
1516	5.44	370.3	239.7	136.0	7,550	18.01	145.0	8,190	17.70
1515	5.35	364.9	238.7	136.0	7,570	17.96	145.0	8,200	17.68
1514	5.27	359.6	237.7	136.0	7,600	17.92	145.0	8,220	17.65
1513	5.20	354.4	236.7	136.1	7,620	17.87	145.1	8,230	17.63
1512	5.15	349.2	235.7	136.1	7,640	17.82	145.1	8,240	17.60
1511	5.10	344.1	234.7	136.1	7,650	17.78	145.1	8,250	17.58
1510	5.08	339.0	233.7	136.1	7,660	17.76	145.1	8,270	17.55
1509	5.05	333.9	232.7	136.1	7,670	17.73	145.1	8,280	17.53
1508	5.02	328.9	231.7	136.0	7,680	17.71	145.1	8,290	17.50
1507	4.99	323.9	230.7	136.0	7,690	17.68	145.1	8,300	17.48
1506	4.96	318.9	229.7	136.0	7,700	17.66	145.2	8,320	17.45
1505	4.92	314.0	228.7	136.0	7,710	17.63	145.2	8,330	17.43
1504	4.87	309.1	227.7	136.0	7,720	17.61	145.2	8,340	17.40
1503	4.82	304.2	226.7	135.9	7,730	17.58	145.2	8,350	17.38
1502	4.77	299.4	225.7	135.9	7,740	17.56	145.2	8,370	17.35
1501	4.72	294.7	224.7	135.7	7,750	17.53	145.1	8,380	17.32
1500	4.66	290.0	223.7	135.2	7,730	17.49	144.9	8,390	17.27
1499	4.59	285.4	222.7	134.6	7,720	17.45	144.7	8,400	17.22
1498	4.53	280.8	221.7	134.0	7,700	17.40	144.5	8,420	17.17
1497	4.46	276.3	220.7	133.5	7,690	17.36	144.3	8,430	17.12
1496	4.39	271.9	219.7	132.9	7,670	17.32	144.1	8,440	17.07
1495	4.31	267.6	218.7	132.3	7,660	17.28	143.9	8,450	17.02
1494	4.23	263.3	217.7	131.7	7,640	17.24	143.7	8,470	16.97
1493	4.15	259.1	216.7	131.2	7,630	17.20	143.5	8,480	16.92
1492	4.07	255.0	215.7	130.6	7,610	17.15	143.2	8,490	16.87
1491	3.99	250.9	214.7	129.9	7,590	17.10	142.8	8,490	16.81
1490	3.90	247.0	213.7	128.9	7,570	17.01	141.7	8,470	16.73
1489	3.82	243.1	212.7	127.8	7,550	16.92	140.5	8,440	16.64

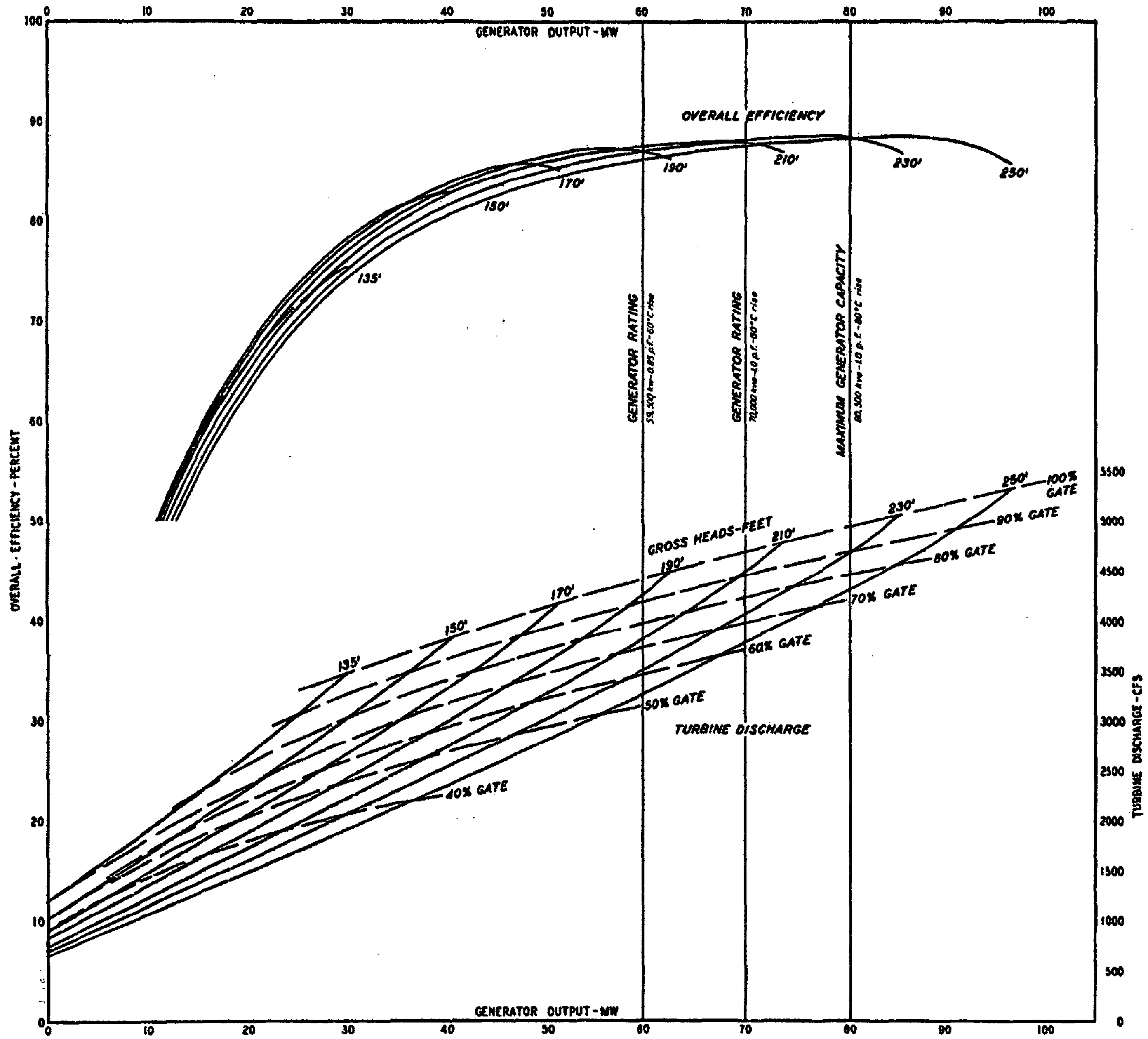
Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Gross Head (feet)	Best Efficiency Plant Output (mW)	Best Efficiency Turbine Discharge (cfs)	Best Efficiency kW/CFS	Maximum Sustainable Plant Output (mW)	Maximum Sustainable Turbine Discharge (cfs)	Maximum Sustainable kW/CFS
1488	3.74	239.4	211.7	126.8	7,530	16.84	139.4	8,420	16.56
1487	3.67	235.7	210.7	125.8	7,500	16.75	138.3	8,390	16.48
1486	3.61	232.0	209.7	124.7	7,480	16.66	137.2	8,370	16.39
1485	3.56	228.4	208.7	123.7	7,460	16.57	136.1	8,340	16.31
1484	3.52	224.9	207.7	122.7	7,440	16.49	135.0	8,320	16.23
1483	3.49	221.4	206.7	121.7	7,420	16.40	133.9	8,290	16.14
1482	3.47	217.9	205.7	120.6	7,390	16.31	132.8	8,270	16.06
1481	3.45	214.4	204.7	119.6	7,370	16.22	131.6	8,240	15.97
1480	3.44	211.0	203.7	118.6	7,360	16.12	130.4	8,220	15.87
1479	3.44	207.6	202.7	117.7	7,340	16.02	129.2	8,190	15.77
1478	3.42	204.1	201.7	116.7	7,330	15.92	128.0	8,170	15.67
1477	3.40	200.7	200.7	115.7	7,310	15.82	126.8	8,140	15.57
1476	3.37	197.3	199.7	114.7	7,290	15.72	125.6	8,120	15.47
1475	3.33	194.0	198.7	113.7	7,280	15.62	124.4	8,090	15.37
1474	3.29	190.7	197.7	112.8	7,260	15.52	123.3	8,070	15.27
1473	3.23	187.4	196.7	111.8	7,250	15.42	122.1	8,040	15.17
1472	3.17	184.2	195.7	110.8	7,230	15.32	120.9	8,020	15.07
1471	3.10	181.1	194.7	109.8	7,220	15.22	119.6	7,990	14.96
1470	3.03	178.0	193.7	108.8	7,200	15.10	118.3	7,970	14.84
1469	2.95	175.0	192.7	107.8	7,190	14.99	117.0	7,940	14.72
1468	2.87	172.1	191.7	106.8	7,180	14.88	115.7	7,920	14.60
1467	2.80	169.3	190.7	105.8	7,160	14.77	114.4	7,890	14.48
1466	2.74	166.5	189.7	104.8	7,150	14.66	113.1	7,870	14.36
1465	2.68	163.8	188.7	103.8	7,140	14.54	111.8	7,840	14.24
1464	2.63	161.1	187.7	102.8	7,130	14.43	110.5	7,820	14.12
1463	2.58	158.5	186.7	101.8	7,110	14.32	109.1	7,790	14.00
1462	2.53	156.0	185.7	100.8	7,100	14.21	107.8	7,770	13.88
1461	2.49	153.5	184.7	99.8	7,080	14.09	106.6	7,740	13.76
1460	2.45	151.0	183.7	98.8	7,070	13.99	105.4	7,720	13.65
1459	2.42	148.6	182.7	97.8	7,050	13.88	104.2	7,690	13.53
1458	2.39	146.2	181.7	96.8	7,030	13.77	103.0	7,670	13.42
1457	2.36	143.8	180.7	95.8	7,010	13.66	101.8	7,640	13.31
1456	2.33	141.4	179.7	94.8	6,990	13.55	100.6	7,620	13.20
1455	2.30	139.1	178.7	93.8	6,970	13.44	99.4	7,590	13.08
1454	2.27	136.9	177.7	92.7	6,950	13.34	98.2	7,570	12.97
1453	2.24	134.6	176.7	91.7	6,940	13.23	97.0	7,540	12.86
1452	2.21	132.4	175.7	90.7	6,920	13.12	95.9	7,520	12.75
1451	2.19	130.2	174.7	89.7	6,900	13.01	94.7	7,490	12.64
1450	2.16	128.0	173.7	88.8	6,880	12.90	93.7	7,470	12.52
1449	2.14	125.8	172.7	87.9	6,860	12.79	92.6	7,440	12.41
1448	2.11	123.7	171.7	87.0	6,840	12.69	91.6	7,420	12.30
1447	2.08	121.6	170.7	86.1	6,820	12.58	90.5	7,390	12.19
1446	2.05	119.6	169.7	85.1	6,800	12.47	89.5	7,370	12.07
1445	2.01	117.5	168.7	84.2	6,780	12.36	88.4	7,340	11.96
1444	1.97	115.5	167.7	83.3	6,760	12.25	87.4	7,320	11.85
1443	1.93	113.6	166.7	82.4	6,740	12.14	86.3	7,290	11.74

				Best Efficiency			Maximum Sustainable		
Elevation (feet)	Area (acre*1000)	Volume (ac-ft*1000)	Gross Head (feet)	Plant Output (mW)	Turbine Discharge (cfs)	kW/CFS	Plant Output (mW)	Turbine Discharge (cfs)	kW/CFS
1442	1.89	111.7	165.7	81.4	6,720	12.04	85.3	7,270	11.62
1441	1.84	109.8	164.7	80.5	6,700	11.93	84.2	7,240	11.51
1440	1.80	108.0	163.7	79.6	6,680	11.82	83.2	7,220	11.40
1439	1.75	106.2	162.7	78.7	6,660	11.71	82.1	7,190	11.29
1438	1.71	104.5	161.7	77.8	6,640	11.60	81.1	7,170	11.17
1437	1.67	102.8	160.7	76.8	6,620	11.50	80.0	7,140	11.06
1436	1.63	101.2	159.7	75.9	6,600	11.39	79.0	7,120	10.95
1435	1.60	99.6	158.7	75.0	6,580	11.28	78.0	7,090	10.84
1434	1.57	98.0	157.7	74.1	6,560	11.17	76.9	7,070	10.72
1433	1.54	96.4	156.7	73.1	6,540	11.06	75.9	7,040	10.61
1432	1.52	94.9	155.7	72.2	6,520	10.95	74.8	7,020	10.50
1431	1.50	93.4	154.7	71.3	6,500	10.85	73.8	6,990	10.39
1430	1.48	91.9	153.7	70.4	6,480	10.74	72.7	6,970	10.27

NOTE: Does not include energy in storage data.



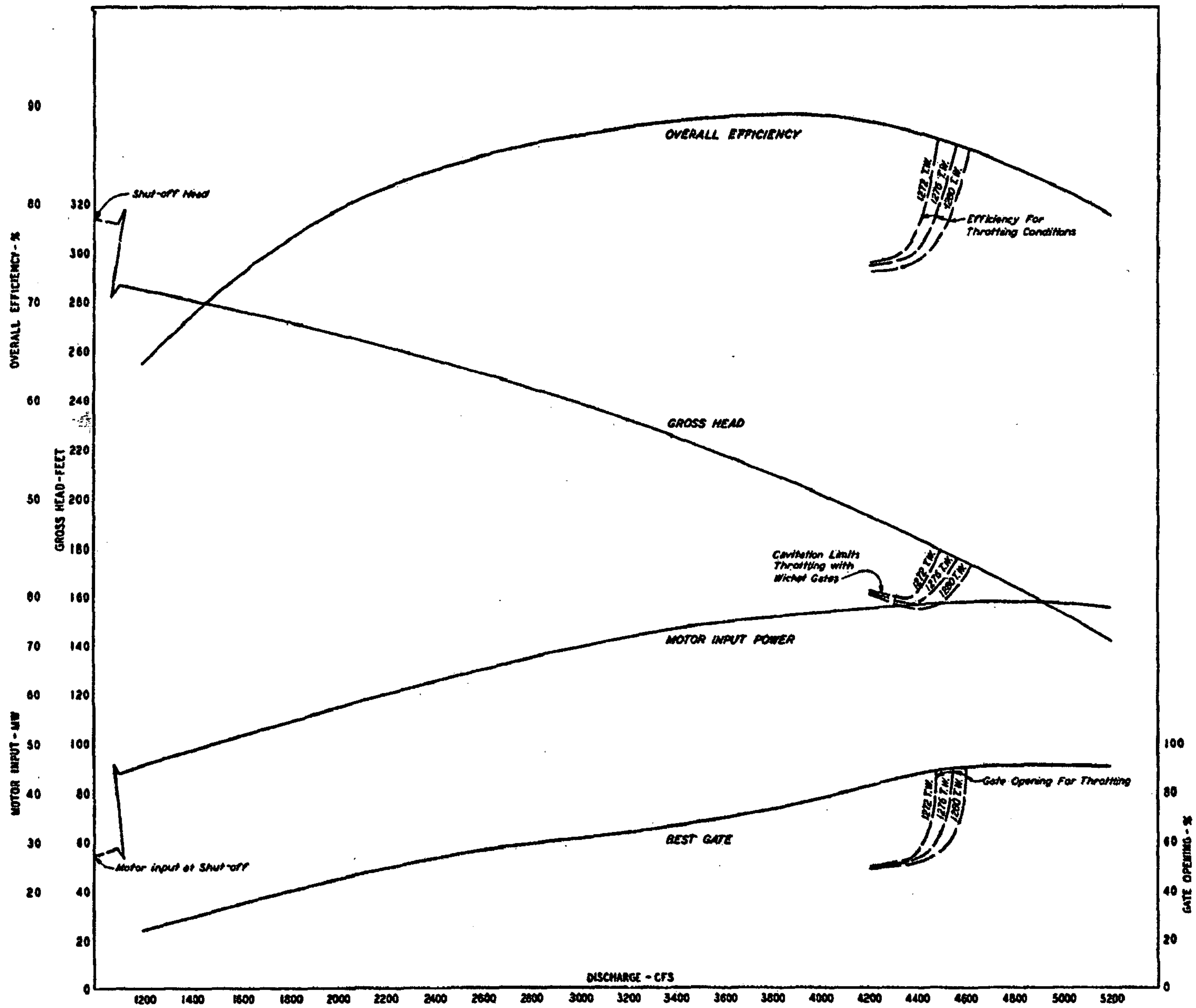
NOTE: This is not representative of the unit after HMODS. Applicable curves will be prepared after field testing is completed.



NOTES:
This curve is based on model test No. 35112 of the Allis-Chalmers Co. and is modified in accordance with the self-velocity test conducted on this unit on 4-2-57 at approximately 195-foot gross head. Generator test efficiencies and measured penstock losses were used in the computations. Test should be made at other heads to check the accuracy of this curve.
TURBINE: 82,000 hp-190-foot net head-105.8 rpm manufactured by The Allis-Chalmers Co., Milwaukee, Wisconsin.
GENERATOR: 70,000 kva-3 phase-60 cycle-0.85 p.f. -60° C rise-manufactured by The Allis-Chalmers Co., Milwaukee, Wisconsin.

POWERHOUSE
UNIT 2
OPERATING CHARACTERISTICS OF PUMP-TURBINE UNIT GENERATING
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN
SUBMITTED | RECOMMENDED | APPROVED
KNOXVILLE 4-10-58 5 M 4 47 K 2864

NOTE: This is not representative of the unit after HMODS. Applicable curves will be prepared after field testing is completed.



NOTES:

This curve is based on model test No. 3912 of the Allis-Chalmers Co., and is modified in accordance with certain data from the test conducted on this unit on 4-8-57 at approximately 195-foot head. Generator test efficiencies and measured penstock losses were used in the computations. Tests should be made at other heads to check the accuracy of this curve. Cavitation limits were determined from the model test data and should be observed in order to prevent pitting of the runner and loss of efficiency.

When the head reaches a value so low that the discharge will normally exceed the cavitation limit, the discharge may be throttled with the wicket gates. Safe discharge values for throttling operation are shown on the head curve, with the corresponding gate openings and efficiency curves.

To determine the operating characteristics for throttling, first determine the safe discharge using the cavitation limits shown, gross head curve, and the tailwater elevation. Then, using the safe discharge and tailwater elevation, determine the proper gate opening and overall efficiency. The input power will be approximately the same as for non-throttling operation.

PUMP: 3900 CFS, 205-foot net head, 105.9 rpm, manufactured by the Allis-Chalmers Mfg. Co. Milwaukee, Wisconsin.

MOTOR: 102,000 hp, 3-phase, 60-cycle, 13,800 volts, 105.9 rpm, manufactured by the Allis-Chalmers Mfg. Co. Milwaukee, Wisconsin.

POWERHOUSE
UNIT 2

OPERATING CHARACTERISTICS OF PUMP-TURBINE UNIT PUMPING

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN

SUBMITTED	RECOMMENDED	APPROVED
KNOXVILLE	4-17-58	5 M 4 47K2865

NOTE: This is not representative of the unit after HMODS. Applicable curves will be prepared after field testing is completed.

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet, except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar years and does not always equal the sum of the days in periods because of extension of periods into adjacent years. Water may be spilled through the spillway and/or the sluiceways. All unmarked spill was through the sluiceways. Maximum hourly average discharge to date was 38,848 cfs at 11 a.m. on 5/28/73. Unit 2-pump turbine available for system use beginning November 1980. *Spillway #Spillway and sluiceway
1940	3407	10/3	0	0	
1941	3467	10/23	0	0	
1942	3753	1/27	0	0	
1943	9653	1/10	4	27	5271---1/7---12; 4840---1/21---3; 4753---1/29---5; 5850---2/7---7
1944	7316	4/27	2	11	*4780---4/2---9; 4063---4/27---2
1945	7856	12/21	2	16	5424---12/23---14; 5056---12/27---2
1946	10801	2/12	8	38	909---1/7---1; 4968---1/10---14; 4822---2/1---4; 4025---2/4---1; 1607---2/6---1; 7826---2/12---12; 2450---2/27---2; 9867---3/10---3
1947	8043	1/24	1	7	4970---1/24---7
1948	9036	12/28	2	6	960---12/10---1; 4872---12/28---5
1949	9382	1/13	7	46	6397---1/11---6; 4877---2/11---3; 4066---2/18---2; 255---7/19---2; #1290---11/19---27; 4933---12/24---3; 4817---12/28---3
1950	4309	2/6	3	13	2138---2/5---6; 1477---2/19---6; 644---3/19---1
1951	4165	12/22	0	0	
1952	4133	1/31	0	0	
1953	3317	2/25	0	0	
1954	9352	1/26	1	3	5038---1/26---3
1955	3418	10/2	0	0	
1956	4165	2/23	0	0	
1957	9080	2/4	0	0	
1958	3689	11/26	0	0	
1959	4575	1/16	0	0	
1960	4015	2/22	0	0	

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet, except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar years and does not always equal the sum of the days in periods because of extension of periods into adjacent years. Water may be spilled through the spillway and/or the sluiceways. All unmarked spill was through the sluiceways. Maximum hourly average discharge to date was 38,848 cfs at 11 a.m. on 5/28/73. Unit 2-pump turbine available for system use beginning November 1980. *Spillway #Spillway and sluiceway
1961	8642	3/9	0	0	
1962	8562	2/28	0	0	
1963	3594	12/9	0	0	
1964	6418	12/30	0	0	
1965	3953	2/1	0	0	
1966	3729	12/31	0	0	
1967	8216	12/25	0	0	
1968	8025	1/10 thru 1/11	0	0	
1969	8448	2/6	0	0	
1970	5038	11/24	0	0	
1971	5302	2/10	0	0	
1972	8388	1/12	0	0	
1973	26333	5/28	1	3	*19007---5/28---3
1974	8727	1/7	0	0	
1975	8122	2/7	0	0	
1976	6068	7/9	0	0	
1977	4549	12/29	0	0	
1978	7485	1/28	0	0	
1979	8231	3/10	0	0	
1980	5798	3/27	0	0	
1981	3690	2/2	0	0	

YEAR	MAXIMUM AVERAGE DAILY DISCHARGE (TURBINE + SPILL)	DATE	NUMBER OF PERIODS	TOTAL DAYS	Volumes are average daily in day-second-feet, except as shown. Maximum spill, date of maximum, and number of days of spill in each spill period, in this order. "Total Days" is for calendar years and does not always equal the sum of the days in periods because of extension of periods into adjacent years. Water may be spilled through the spillway and/or the sluiceways. All unmarked spill was through the sluiceways. Maximum hourly average discharge to date was 38,848 cfs at 11 a.m. on 5/28/73. Unit 2-pump turbine available for system use beginning November 1980. *Spillway #Spillway and sluiceway
1982	8427	1/11	0	0	
1983	7824	12/24	0	0	
1984	10114	5/9	1	3	*1614---5/8---3
1985	3022	9/16	2	2	53---12/23---1; 70---12/30---1
1986	3804	11/24	1	1	103---2/4---1
1987	3596	2/11	0	0	
1988	3017	12/12	0	0	
1989	10726	6/22	1	2	*2519---6/22---2
1990	8374	3/1	0	0	
1991	6665	1/1	0	0	
1992	7692	12/26	0	0	
1993	7598	1/7	0	0	
1994	7800	4/10	1	1	2568---3/30---1
1995	8220	2/21	0	0	
1996	9181	1/29	1	4	5143---1/29---4
1997	6487	3/10	0	0	
1998	7222	1/31	1	3	*1646---5/11---3
1999	3577	8/5	0	0	
2000	3667	11/20	1	1	33---2/7---1

ANNUAL MAXIMUM AND MINIMUM ELEVATIONS

RIVER SCHEDULING
TVA OPERATED RESERVOIR SYSTEM
FROM DATE OF RESERVOIR CLOSURE THROUGH 1999

HIWASSEE

MAXIMUM					MINIMUM				
ORDER	ELEVATION	YEAR	MONTH	DAY	ORDER	ELEVATION	YEAR	MONTH	DAY
1	1528.02	1973	MAY	28	1	1318.40 *	1940	FEB.	8
2	1526.48	1989	JUNE	21	2	1413.41	1948	JAN.	28
3	1526.48	1944	APR.	24	3	1415.86	1956	JAN.	14
4	1526.17	1946	MAY	21	4	1420.07	1959	JAN.	16
5	1526.11	1991	MAY	18	5	1420.48	1941	MAR.	3
6	1526.00	1943	APR.	29	6	1424.13	1947	DEC.	31
7	1525.94	1961	JUNE	22	7	1425.18	1958	DEC.	27
8	1525.81	1976	JULY	7	8	1428.40	1957	JAN.	18
9	1525.67	1949	JULY	23	9	1429.90	1946	DEC.	21
10	1525.58	1984	MAY	9	10	1430.65	1954	DEC.	6
11	1525.09	1980	MAY	31	11	1433.37	1966	JAN.	29
12	1525.03	1996	MAY	30	12	1434.69	1963	DEC.	31
13	1524.85	1950	JULY	29	13	1434.87	1964	JAN.	6
14	1524.59	1983	MAY	23	14	1435.78	1944	DEC.	5
15	1524.59	1942	AUG.	25	15	1436.17	1945	FEB.	9
16	1524.44	1940	JULY	22	16	1436.30	1962	DEC.	24
17	1524.30	1998	JUNE	11	17	1437.95	1960	JAN.	5
18	1524.21	1967	AUG.	27	18	1438.62	1952	DEC.	30
19	1524.13	1947	JULY	7	19	1439.28	1969	JAN.	18
20	1523.92 %	1997	JUNE	21	20	1439.64	1953	JAN.	7
21	1523.83	1979	JUNE	6	21	1440.33	1965	DEC.	30
22	1523.83	1971	AUG.	2	22	1442.17	1955	DEC.	31
23	1523.79	1960	AUG.	13	23	1442.37	1961	JAN.	1
24	1523.79	1964	AUG.	18	24	1442.51	1951	JAN.	5
25	1523.78	1999	JULY	13	25	1442.93	1967	FEB.	16
26	1523.64	1965	JUNE	8	26	1443.44	1970	DEC.	17
27	1523.58	1948	AUG.	9	27	1448.90	1968	DEC.	27
28	1523.54	1951	JULY	9	28	1448.95	1943	DEC.	24
29	1523.29	1955	JUNE	15	29	1449.41	1950	DEC.	31
30	1523.15	1945	AUG.	16	30	1453.70	1971	JAN.	2
31	1523.12	1994	AUG.	25	31	1454.71	1949	DEC.	31
32	1522.98	1992	JULY	4	32	1458.12	1974	DEC.	24
33	1522.75	1958	JULY	26	33	1458.65	1978	DEC.	4
34	1522.49	1954	JUNE	7	34	1459.11	1993	DEC.	3
35	1522.46	1962	MAY	12	35	1459.48	1985	JAN.	25
36	1522.44	1972	MAY	27	36	1459.58	1999	JAN.	2
37	1521.99	1977	MAY	14	37	1459.88	1994	JAN.	6
38	1521.95	1952	JUNE	16	38	1460.31	1998	DEC.	31
39	1521.95	1953	JUNE	8	39	1460.38	1975	DEC.	25
40	1521.90	1993	JUNE	1	40	1461.50	1997	DEC.	18
41	1521.48	1959	AUG.	22	41	1461.85	1942	JAN.	31
42	1521.38	1956	JUNE	15	42	1461.88	1977	FEB.	12
43	1521.03	1957	JUNE	26	43	1462.60 %	1995	JAN.	11
44	1520.79	1990	JUNE	10	44	1464.75 %	1976	DEC.	30
45	1520.47	1974	JUNE	4	45	1464.77	1980	JAN.	8
46	1520.38	1963	JULY	31	46	1465.60	1979	JAN.	1
47	1520.11	1966	JUNE	2	47	1465.90	1981	FEB.	9
48	1519.64	1995	JUNE	28	48	1465.92	1983	FEB.	1
49	1518.66	1968	JUNE	4	49	1466.13	1984	FEB.	14
50	1518.53	1975	MAY	16	50	1466.40	1972	JAN.	3
51	1517.08	1969	JULY	8	51	1466.43	1992	JAN.	31
52	1516.46	1970	JULY	17	52	1466.93	1973	JAN.	4
53	1515.09	1987	JULY	6	53	1468.40	1996	DEC.	28
54	1513.05	1982	AUG.	13	54	1468.87	1990	DEC.	17
55	1511.80	1978	AUG.	26	55	1469.54	1988	DEC.	30
56	1511.37	1941	AUG.	12	56	1471.62	1989	JAN.	1
57	1508.59	1981	JUNE	26	57	1471.88	1986	FEB.	11

ANNUAL MAXIMUM AND MINIMUM ELEVATIONS

RIVER SCHEDULING
TVA OPERATED RESERVOIR SYSTEM
FROM DATE OF RESERVOIR CLOSURE THROUGH 1999

HIWASSEE

MAXIMUM					MINIMUM				
ORDER	ELEVATION	YEAR	MONTH	DAY	ORDER	ELEVATION	YEAR	MONTH	DAY
58	1497.38	1985	AUG.	31	58	1473.67	1987	FEB.	24
59	1497.23	1988	JUNE	2	59	1473.86	1991	JAN.	21
60	1489.62	1986	JUNE	18	60	1476.05	1982	DEC.	31

* CLOSURE
% MIDNIGHT ELEVATION
TOP-OF-GATES ELEVATION 1526.5

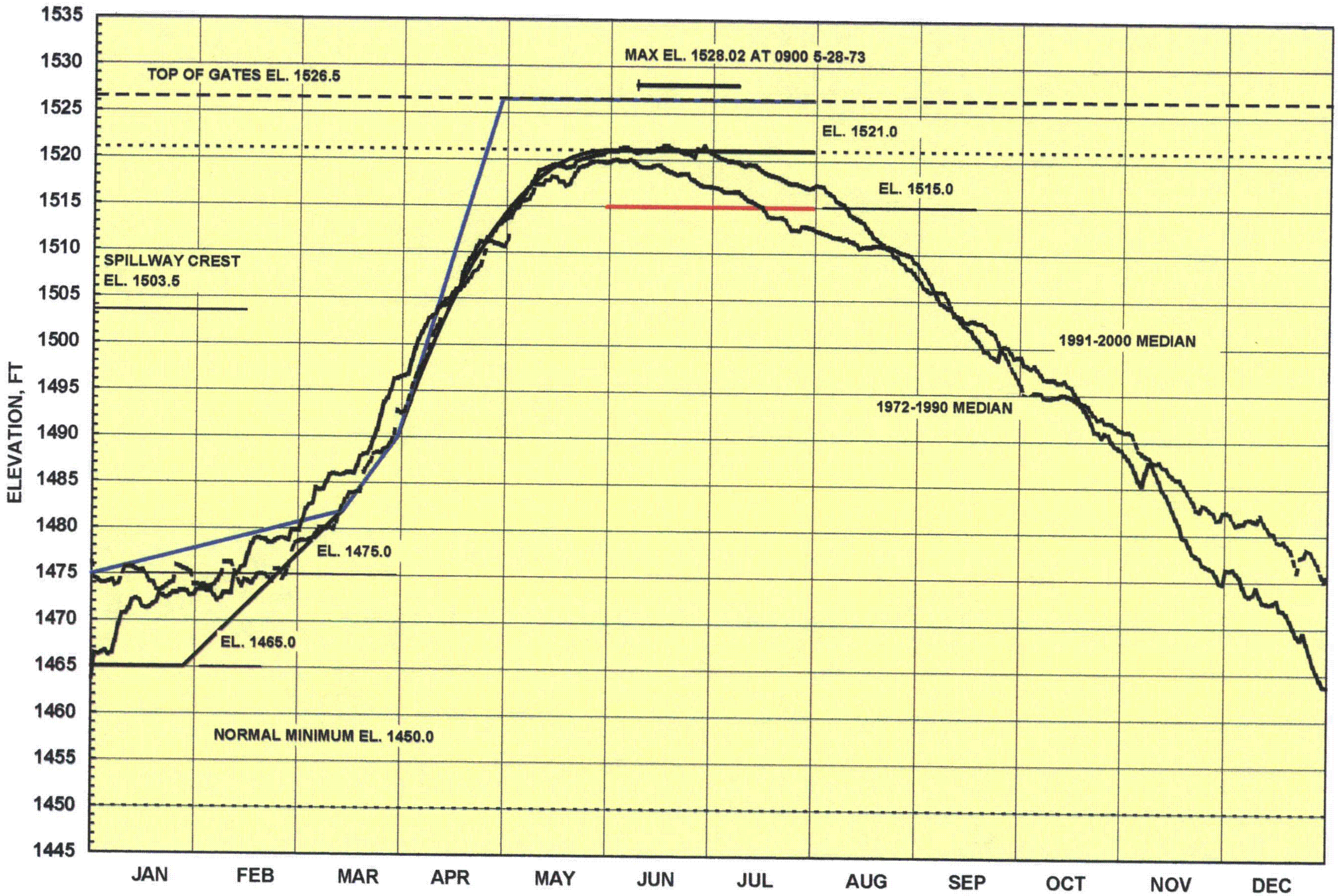
AVERAGE WEEKLY CFS

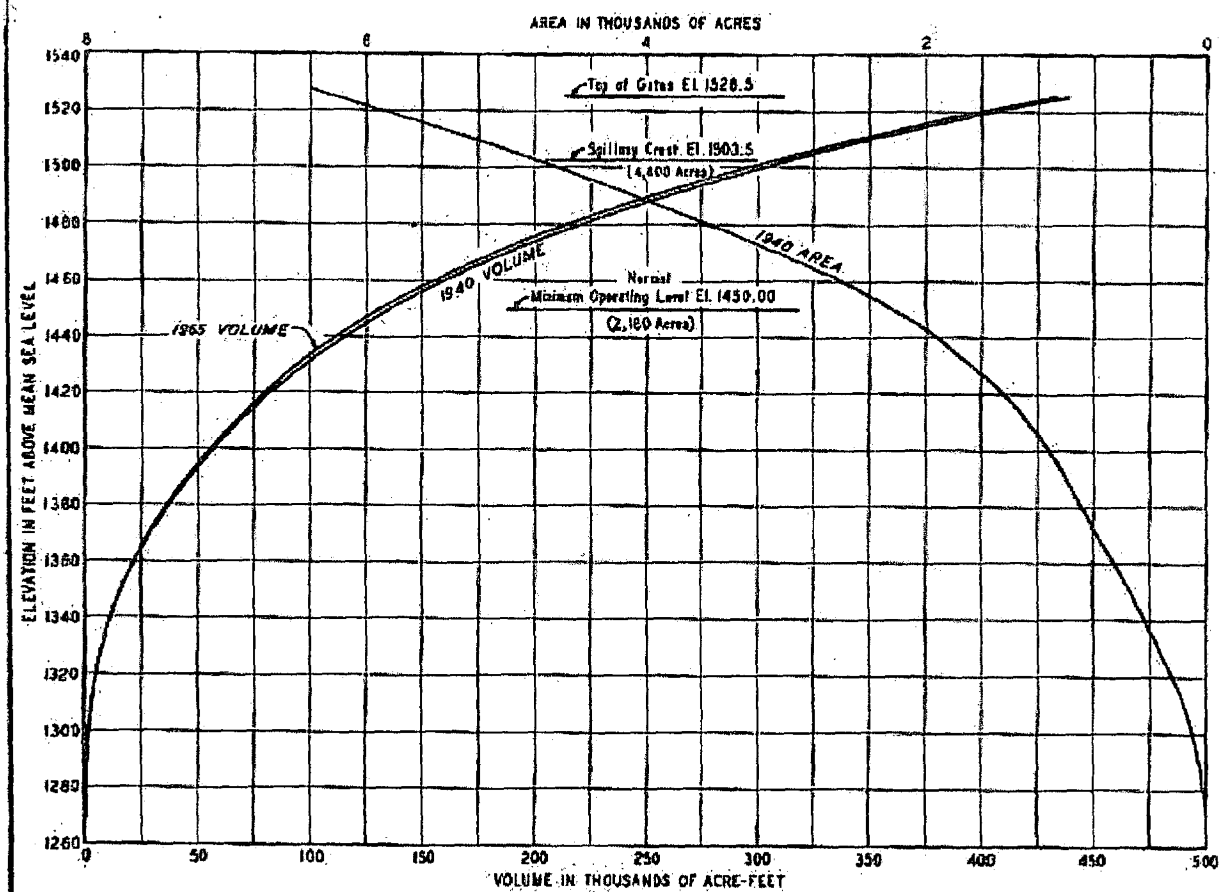
MAXIMUM, MINIMUM, MEDIAN, AND MEAN
Adjusted Flow by Weeks
Hiwassee
Years=1903-2000

WEEK ENDING	WEEK NO.	MAXIMUM	YR	MINIMUM	YR	MEDIAN	MEAN
		AVERAGE WEEKLY CFS					
JAN 7	1	7,970	1937	480	1940	2,240	2,640
JAN 14	2	7,560	1946	533	1981	2,180	2,540
JAN 21	3	13,300	1947	580	1914	2,340	2,810
JAN 28	4	9,400	1954	510	1940	2,610	2,940
FEB 4	5	14,500	1957	460	1940	2,560	3,030
FEB 11	6	10,800	1921	720	1934	2,600	3,140
FEB 18	7	14,200	1990	720	1934	2,780	3,370
FEB 25	8	10,700	1961	740	1941	2,680	3,160
MAR 4	9	12,200	1917	800	1941	2,770	3,240
MAR 11	10	11,200	1917	1,000	1988	2,910	3,370
MAR 18	11	12,600	1990	1,070	1981	2,710	3,500
MAR 25	12	11,800	1917	918	1988	2,840	3,350
APR 1	13	13,800	1994	918	1988	2,840	3,730
APR 8	14	18,000	1920	1,120	1986	2,920	3,530
APR 15	15	9,410	1979	956	1986	2,570	3,010
APR 22	16	6,670	1994	880	1986	2,600	2,730
APR 29	17	5,770	1958	821	1986	2,570	2,580
MAY 6	18	7,050	1984	671	1986	2,230	2,580
MAY 13	19	8,000	1984	671	1986	2,160	2,420
MAY 20	20	8,430	1976	639	1988	1,900	2,110
MAY 27	21	9,350	1909	500	1941	1,830	2,160
JUN 3	22	9,050	1973	391	1988	1,620	1,940
JUN 10	23	8,180	1909	233	1988	1,550	1,860
JUN 17	24	4,920	1989	163	1988	1,470	1,710
JUN 24	25	7,470	1989	347	1988	1,360	1,540
JUL 1	26	4,330	1994	205	1988	1,220	1,510
JUL 8	27	5,250	1989	387	1986	1,250	1,530
JUL 15	28	10,700	1916	314	1986	1,160	1,580
JUL 22	29	6,700	1906	266	1986	1,220	1,470
JUL 29	30	9,100	1938	374	1986	1,130	1,410
AUG 5	31	5,730	1971	166	1986	1,060	1,310
AUG 12	32	4,100	1938	279	1987	1,100	1,260
AUG 19	33	9,830	1920	213	2000	1,050	1,290
AUG 26	34	9,980	1967	240	1925	930	1,220
SEP 2	35	4,480	1967	151	1988	780	1,060
SEP 9	36	6,840	1928	140	1925	817	1,000
SEP 16	37	3,860	1920	150	1925	766	866
SEP 23	38	3,540	1906	160	1925	765	888
SEP 30	39	6,140	1989	270	1925	787	1,040
OCT 7	40	9,270	1964	231	1981	796	1,140
OCT 14	41	3,560	1906	221	2000	752	892
OCT 21	42	3,240	1906	232	1954	755	954
OCT 28	43	2,820	1997	275	1954	820	953
NOV 4	44	8,010	1918	257	1954	835	1,100
NOV 11	45	4,850	1977	360	1931	900	1,110
NOV 18	46	9,680	1929	380	1931	1,000	1,230
NOV 25	47	13,200	1906	469	1981	1,050	1,450
DEC 2	48	7,670	1948	357	1984	1,030	1,500
DEC 9	49	5,740	1983	470	1939	1,540	1,760
DEC 16	50	8,600	1932	430	1939	1,480	1,990
DEC 23	51	8,960	1961	460	1943	1,400	2,130
DEC 31	52	12,400	1932	389	1993	1,930	2,430

AVERAGE FLOW:1903 - 2000 = 2020 CFS

ANNUAL OPERATING CYCLE





ELEV FT	1940 AREA AC	VOLUME AC-FT				
		1940 AC-FT	1947 AC-FT	1953 AC-FT	1958 AC-FT	1965 AC-FT
1,526.5	6,230	440,000	436,000	436,000	434,000	434,000
1,520	5,600	400,000	396,000	395,000	394,000	393,000
1,510	5,140	345,000	341,000	341,000	339,000	339,000
1,500	4,540	296,000	283,000	292,000	291,000	290,000
1,490	3,990	253,000	250,000	249,000	248,000	247,000
1,480	3,460	217,000	214,000	213,000	212,000	211,000
1,470	2,960	184,000	181,000	181,000	179,000	178,000
1,460	2,540	157,000	154,000	153,000	152,000	151,000
1,450	2,180	134,000	131,000	131,000	130,000	128,000
1,440	1,880	113,000	111,000	111,000	110,000	108,000
1,430	1,640	95,800	94,200	93,600	92,800	91,900
1,420	1,410	80,700	79,500	79,300	78,400	77,900
1,410	1,240	67,400	66,300	66,300	68,000	65,600
1,400	1,080	55,800	54,700	55,100	54,700	54,400
1,390	978	45,400	44,500	44,800	45,500	44,200
1,380	868	36,200	35,400	35,700	35,400	35,100
1,370	758	28,100	27,400	27,700	27,400	27,200
1,360	636	21,100	20,500	20,800	20,500	20,300
1,350	527	15,400	14,800	15,200	15,000	14,800
1,340	424	10,700	10,200	10,500	10,400	10,200
1,330	321	8,910	6,580	6,890	6,780	6,610
1,320	223	4,200	3,970	4,070	4,120	4,000
1,310	149	2,400	2,230	2,340	2,300	2,280
1,300	93	1,200	1,120	1,140	1,160	1,150
1,290	52	470	456	450	440	430
1,280	24	110	110	100	100	90
1,270	0	0	0	0	0	0

NOTES:

Reservoir areas were measured on a composite map prepared by the Hydraulic Data Branch with contours drawn at 10' intervals and scale 1" = 500'. The map was prepared from TVA land maps with contours at elevation 1315, 1410, and 1528. Contours were made to conform to elevations of TVA sediment range cross sections which are located at one half to one mile intervals within the reservoir.

Elevations are based on the USC&GS 1929 Preliminary Adjustment. To correct to the USC&GS 1936 Supplementary Adjustment, subtract 0.62 feet.

Area of original river within the reservoir = 1,000 acres.

Drainage area at the dam = 968 square miles.

The 1947 and subsequent volumes were determined by the constant factor method for computing sediment.

Dam closure February 8, 1940.

HIWASSEE RIVER—MILE 75.8

RESERVOIR AREAS AND VOLUMES

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF WATER CONTROL PLANNING

SUBMITTED	RECOMMENDED	APPROVED

THIS DRAWING SUPERSEDES

KNOXVILLE 12-28-82 5 DA 1 321N786 R2

Reservoir Releases Improvements

The aeration system at Hiwassee Reservoir is designed to increase the dissolved oxygen (DO) concentrations of the turbine releases by about 2.5 mg/L. The system is comprised of two parts, a turbine venting system and an oxygen injection system.

Turbine Venting System:

Turbine venting utilizes the vacuum breaker ports on the turbine casing to induce air into the water flowing through the turbine. Baffles over the existing vacuum breaker ports and vacuum breaker system by-pass piping were added on unit 1 to increase air induction. Unit 2 was not a candidate for turbine venting because the turbine setting is too low relative to tailwater to allow negative pressures to develop for inducing air. In late summer or early fall when the downstream DO approaches 6.5 mg/L, turbine venting is initiated by opening the valve on the vacuum breaker line to Unit 1. The valve is typically closed after November 1, when the DO concentration at the downstream monitor exceeds 7.0 mg/L for two consecutive weeks with no oxygen injection. The turbine venting system adds approximately 0.5 mg/L to the Unit 1 discharges, or about 0.25 mg/L at full plant operation.

Oxygen Injection System:

When turbine venting is initiated, the oxygen diffuser system is placed in service. The oxygen flow rate is maintained 24 hours per day, independent of unit operations, providing a constant, aerated pool of water upstream of the turbine intakes to be withdrawn with the onset of generation.. There are three line diffusers that extend approximately 3500 feet upstream of the plant intake, two of which attached to the supply header for operation, one each along the left and right banks. The third line, which is currently inactive, is in the middle of the river channel. Oxygen is injected into the forebay of the reservoir on a continuous basis to aerate the volume of water that is to be withdrawn through the hydroturbines. This oxygen is supplied to the diffuser lines form a bulk liquid oxygen storage facility located 1000 feet downstream of the dam along Hiwassee Dam Road. This facility consists of a 11,000 gallon horizontal liquid oxygen storage tank, 4 evaporators, and various control equipment. The oxygen diffuser system can supply oxygen to both hydro units and is placed in operation by manually opening the isolation valves on the liquid supply line and the pressure build circuit located on the bulk oxygen storage tank. Flow to either diffuser line can be set by adjusting the pressure regulators on the supply header located on the oxygen pad. *(Note: These regulators are due to be replaced in FY 2002 with remotely operated flow control valves which can be operated by River Operations staff in Knoxville.)* Oxygen injection is terminated in the late Fall as the DO exceeds 6.0 mg/L.

CONSTRUCTION DATA

PERSONNEL

	Dam and Reservoir Construction	Dam Construction Only	Unit 2 Addition
Peak employed	1,600	1,200	128
Total man-hours	7,682,640	5,424,683	468,114
Number of injuries	205	141	6
Days lost	16,509	15,589	2,749
Fatalities	2	2	0
Accident frequency	26.7	26.0	12.82
Accident severity	2,149	2,874	5,873

Weight of heaviest crane lift, rotor .... 365.8 tons
Diameter inside air housing .... 514 in.
Top of pilot exciter:
- Above stator soleplates .... 166 in.
- Above generator floor .... 154 in.

HOUSING FACILITIES
(Initial Project)

Semi-permanent houses built 42
Low-cost houses built 73
Dormitories built:
- Staff (48 capacity) 1
- Men (416 total capacity) 4
- Women (32 capacity) 1

Public buildings constructed included a cafeteria (240 seats), hospital (17 beds), community and recreation building, school, gas station, and observation building.

QUANTITIES

	Initial Project	Unit 2 Addition
Dam and power facilities:		
Earth excavation	64,700 cu. yd	
Rock excavation	294,500 cu. yd	125 cu. yd
Unclassified excavation	19,500 cu. yd	
Concrete	792,956 cu. yd	7,830 cu. yd
Structural steel	535 tons	23 tons
Reinforcing steel	1,972 tons	156 tons
Highway and railroad:		
Excavation	960,000 cu. yd	

STAGES	NO	ITEM OR EQUIPMENT	QUANTITY	UNIT	MONTHLY OUTPUT
CONSTRUCTION SERVICES	A	ACCESS ROADS			
	B	CONSTRUCTION PLANT			
	C	CONSTRUCTION POWER			
	D	WATER SUPPLY & SEWAGE DISPOSAL			
CONSTRUCTION PLANT	E	RAILROAD FACILITIES (TURTLETOWN)			
	F	CONSTRUCTION UTILITIES - (WATER - AIR - POWER)			
	G	CONSTRUCTION ROADS & BRIDGES			
	H	SHOP BUILDINGS			
	I	AGGREGATE PLANT (QUARRY, CRUSHING, SCREENING)			
	J	CONCRETE & CEMENT PLANT			
	K	CABLEWAY & CONCRETE DELIVERY TRESTLE			
	L	EMPLOYEE HOUSING UNITS (INCLUDING SERVICES)			
DAM CONSTRUCTION — COFFERDAMS	1	MAIN DAM - COFFERDAMS NOS. 1, 2, (TIMBER CRIB-ROCK FILLED)			
	1A	COFFERDAM NO. 1			
	1B	" NO. 2			
	1C	" NO. 3			
	1F	CLOSURE GATE			
DAM CONSTRUCTION — FOUNDATION EXCAVATION	3	SOUTH ABUTMENT (ABOVE WATER LEVEL)			
	3A	NORTH ABUTMENT (")			
	3B	POWER HOUSE & TAILRACE (ABOVE WATER LEVEL)			
	4	MAIN DAM & SPILLWAY (WITHIN COFFERDAM NO. 1)			
	4A	POWER HOUSE & TAILRACE (" " ")			
	4B	MAIN DAM & SPILLWAY (" " NO. 2)			
	4C	SPILLWAY APRON (WITHIN COFFERDAM NO. 2)			
	5	DOGPAGING FOUNDATION			
	5A	RIVER CHANNEL IMPROVEMENT			
DAM CONSTRUCTION — CONCRETE	6	CONCRETE, OTHER THAN SPECIFIED BELOW			
	7	FOUNDATION CONCRETE (WITHIN COFFERDAM NO. 1)			
	7A	" " (" " NO. 2)			
	8	RAISING PENSTOCK BLOCKS FOR CLOSURE (COFFERDAM NO. 1)			
	9	CLOSURE BLOCKS NOS. 10, 12 & 14 (EL. 1270 TO SLUICEWAY DISCH.)			
	10	6" FORMED DRAINS			
	12A	WATER SEALS (DOWNSTREAM FACE & GALLERIES)			
	12B	" " (UPSTREAM FACE)			
DAM CONSTRUCTION — INSTALLATION EMBEDDED PARTS	16	REGULATING CONDUIT (LINERS)			
	16A	CONDUIT, EMERGENCY GATE SEATS & GUIDES			
	17	PENSTOCKS			
	17A	PENSTOCK GATE SEATS & GUIDES			
	17B	" TRASH RACKS			
	13	SPILLWAY GATE SEATS & BEARINGS			
	14	" BRIDGE GIRDERS			
	15	PENSTOCK BULKHEADS			
DAM CONSTRUCTION — MISCELLANEOUS	81	FOUNDATION DRILLING & GROUTING (GROUT HOLES)			
	84A	GROUTING EXPANSION JOINTS			
	82	CUT-OFF WALLS & ROCK TOP TREATMENT			
	84	CONDUIT, WIRING, ETC. (LIGHTS, POWER & TELEPHONE)			
	85	TESTING INSTRUMENTS, GAGES & DEVICES			
DAM CONSTRUCTION — INSTALLATION GATES & OPERATING EQUIPMENT	42	GATES - SPILLWAY			
	43	" - CONDUIT SERVICE - 4 (102") H.C.C.			
	43A	" - " EMERGENCY, Slide			
	45	" - PENSTOCK INTAKE, Slide			
	47	SPILLWAY GANTRY CRANE			
DAM CONSTRUCTION — POWER HOUSE	75	TESTING			
	6	CONCRETE - SUBSTRUCTURE			
	7	" - SUPERSTRUCTURE & INTERIOR FINISH			
	71	DRAFT TUBES			
	73	TURBINES & GOVERNORS			
	74	GENERATORS & ELECTRICAL EQUIPMENT			
	76	HYDRAULIC EQUIPMENT - TANKS, PIPING, ETC.			
	77	POWERHOUSE CRANE			
	78	POWER HOUSE ACCESSORIES - SUMP PUMPS, DRAFT TUBE CRANE			
GENERAL	91	LAND ACQUISITION			
	92	RESERVOIR CLEARING			
	93	BACKWATER PROTECTION			
	94	HIGHWAY & RAILROAD RELOCATION			
	95	FAMILY REMOVAL & CEMETERY RELOCATION			
	96	UTILITIES			
	97	FILLING RESERVOIR			
	98	SUBSTATION SWITCHYARD - TRANSMISSION LINES			
	99	CONSTRUCTION PLANT DISMANTLING, CLEANUP			

1936 — 1937

J F M A M J J A S O N D J F M A M J J A S O N D

STAGE 1

FISCAL YEAR 1937 — FISCAL YEAR

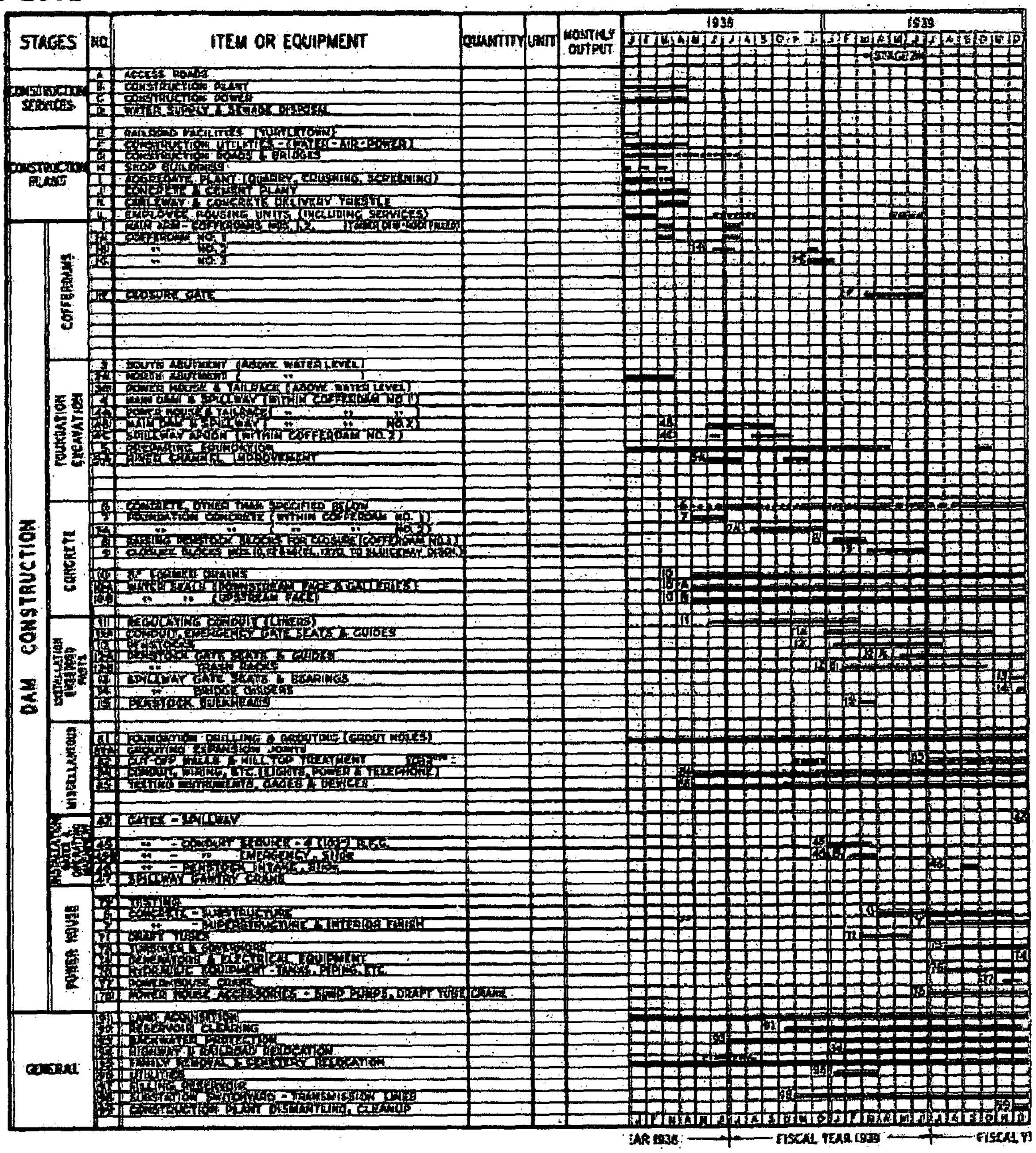
GENERAL

CONSTRUCTION SCHEDULE

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING - CONSTRUCTION DEPARTMENT

SUBMITTED — RECOMMENDED — APPROVED

KNOXVILLE, TENN. 5-28-37 5 KP 3 1102 K6 R7



GENERAL

CONSTRUCTION SCHEDULE

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING CONSTRUCTION DEPARTMENT

SUBMITTED | RECOMMENDED | APPROVED

KNOXVILLE, TENN. 3-20-37 5 CP 3 102K607

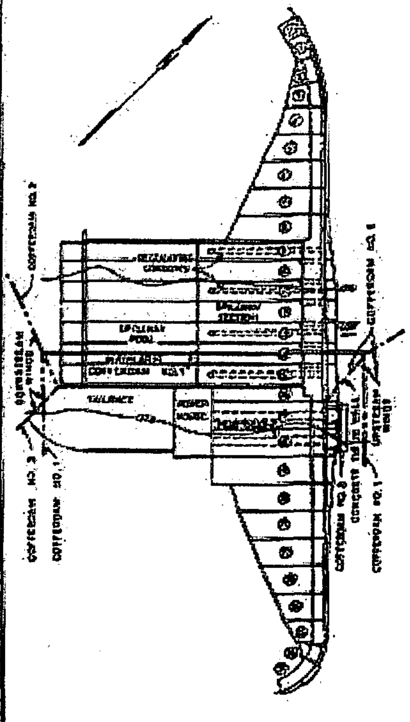
STAGES	NO.	ITEM OR EQUIPMENT	QUANTITY	UNIT	MONTHLY OUTPUT
CONSTRUCTION SERVICES	A	ACCESS ROADS			
	B	CONSTRUCTION PLANT			
	C	CONSTRUCTION POWER			
	D	WATER SUPPLY & SEWAGE DISPOSAL			
CONSTRUCTION PLANT	E	RAILROAD FACILITIES (TURNTABLE)			
	F	CONSTRUCTION UTILITIES - (WATER - AIR - POWER)			
	G	CONSTRUCTION ROADS & BRIDGES			
	H	SHOP BUILDINGS			
	I	AGGREGATE PLANT (QUARRY, CRUSHING, SCREENING)			
	J	CONCRETE & CEMENT PLANT			
	K	CABLEWAY & CONCRETE DELIVERY TRESTLE			
	L	EMPLOYEE HOUSING UNITS (INCLUDING SERVICES)			
DAM CONSTRUCTION — COFFERDAMS	1	MAIN DAM - COFFERDAMS NO. 1, 2, [illegible]			
	1A	COFFERDAM NO. 1			
	1B	" NO. 2			
	1C	" NO. 3			
	1F	CLOSURE GATE			
DAM CONSTRUCTION — FOUNDATION EXCAVATION	3	SOUTH ABUTMENT (ABOVE WATER LEVEL)			
	3A	NORTH ABUTMENT (")			
	3B	POWER HOUSE & TAILRACE (ABOVE WATER LEVEL)			
	4	MAIN DAM & SPILLWAY (WITHIN COFFERDAM NO. 1)			
	4A	POWER HOUSE & TAILRACE (" " ")			
	4B	MAIN DAM & SPILLWAY (" " NO. 2)			
	4C	SPILLWAY APRON (WITHIN COFFERDAM NO. 2)			
	5	PREPARING FOUNDATION			
	5A	RIVER CHANNEL IMPROVEMENT			
DAM CONSTRUCTION — CONCRETE	6	CONCRETE, OTHER THAN SPECIFIED BELOW			
	7	FOUNDATION CONCRETE (WITHIN COFFERDAM NO. 1)			
	7A	" " (" " NO. 2)			
	8	RAISING PORTIONS BLOCKS FOR CLOSURE (COFFERDAM NO. 1)			
	9	CLOSURE BLOCKS NOS. [illegible] (EL. [illegible] TO SLUICEWAY [illegible])			
	10	8" FORMED DRAINS			
	10A	WATER SEALS (DOWNSTREAM FACE & GALLERIES)			
	10B	" " (UPSTREAM FACE)			
DAM CONSTRUCTION — INSTALLATION EMBEDDED PARTS	11	REGULATING CONDUIT (LINERS)			
	11A	CONDUIT, EMERGENCY GATE SEATS & GUIDES			
	12	PENSTOCKS			
	12A	PENSTOCK GATE SEATS & GUIDES			
	12B	" TRASH RACKS			
	13	SPILLWAY GATE SEATS & BEARINGS			
	14	" BRIDGE GIRDERS			
	15	PENSTOCK BULKHEADS			
DAM CONSTRUCTION — MISCELLANEOUS	31	FOUNDATION DRILLING & GROUTING (GROUT HOLES)			
	31A	GROUTING EXPANSION JOINTS			
	32	CUT-OFF WALLS & HILLTOP TREATMENT [illegible]			
	34	CONDUIT, WIRING, ETC. (LIGHTS, POWER & TELEPHONE)			
	35	TESTING INSTRUMENTS, GAGES & DEVICES			
DAM CONSTRUCTION — INSTALLATION GATES & OPERATING MACHINERY	44	GATES - SPILLWAY			
	45	" - CONDUIT SERVICE - 4 [illegible] R.F.C.			
	45A	" " " EMERGENCY - SLIDE			
	46	" - PENSTOCK INTAKE, SLIDE			
	47	SPILLWAY GANTRY CRANE			
DAM CONSTRUCTION — POWER HOUSE	79	TESTING			
	6	CONCRETE - SUBSTRUCTURE			
	7	" - SUPERSTRUCTURE & INTERIOR FINISH			
	71	DRAFT TUBES			
	73	TURBINES & GOVERNORS			
	74	GENERATORS & ELECTRICAL EQUIPMENT			
	76	HYDRAULIC EQUIPMENT - TANKS, PIPING, ETC.			
	77	POWERHOUSE CRANE			
	78	POWER HOUSE ACCESSORIES - SUMP PUMPS, DRAFT TUBE CRANE			
GENERAL	91	LAND ACQUISITION			
	92	RESERVOIR CLEARING			
	93	BACKWATER PROTECTION			
	94	HIGHWAY & RAILROAD RELOCATION			
	95	FAMILY REMOVAL & CEMETERY RELOCATION			
	96	UTILITIES			
	97	FILLING RESERVOIR			
	98	SUBSTATION SWITCHYARD - TRANSMISSION LINES			
	99	CONSTRUCTION PLANT DISMANTLING, CLEANUP			

1940 — J F M A M J J A S O N D — STAGE 3

J F M A M J J A S O N D J F M A M J

YEAR 1940 — FISCAL YEAR 1941

No. 1 Commercial Oper. May 27



PLAN

SCALE

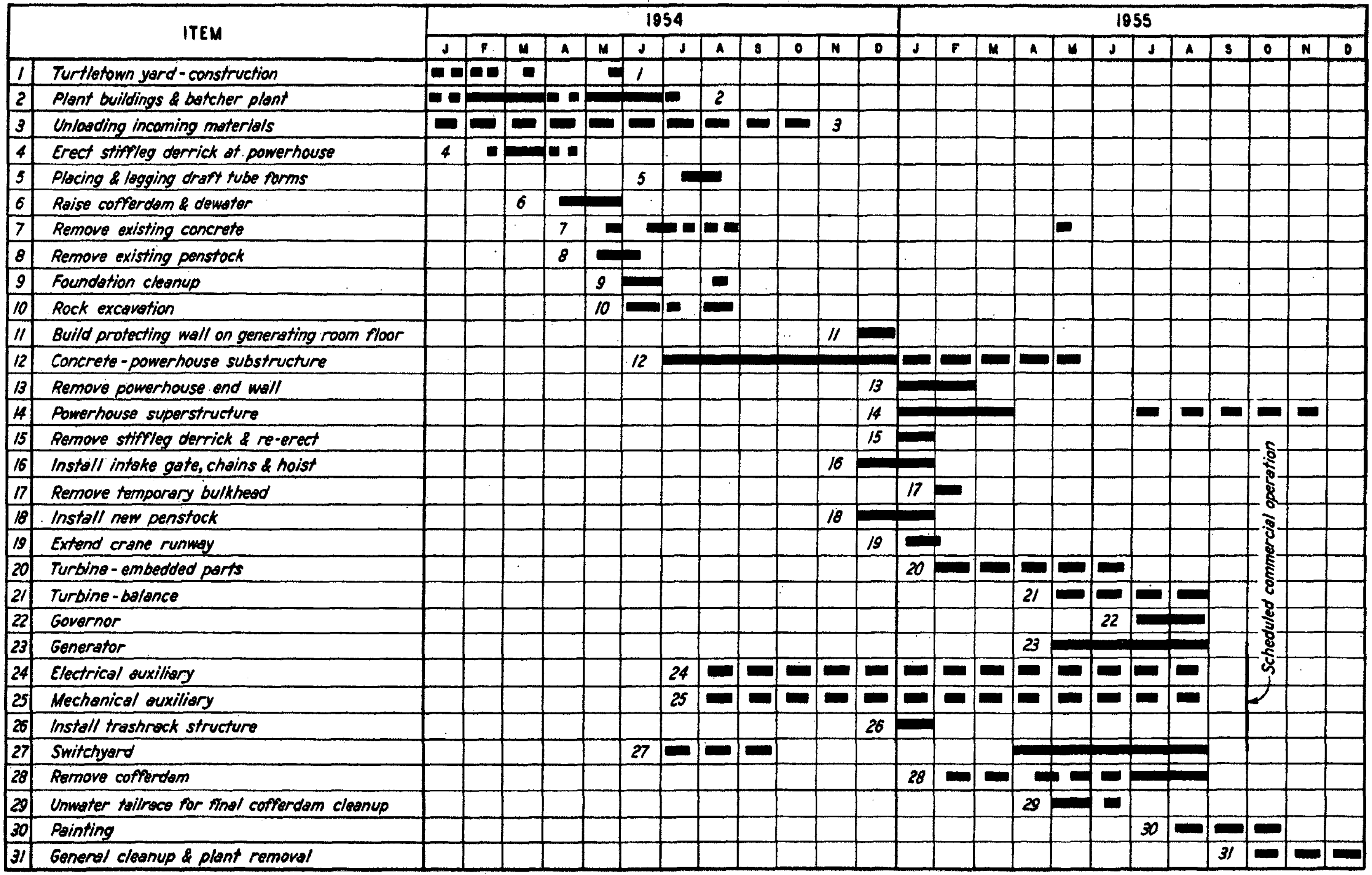
GENERAL

CONSTRUCTION SCHEDULE

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING CONSTRUCTION DEPARTMENT

SUBMITTED | RECOMMENDED | APPROVED

KNOXVILLE, TENN. | 5-26-37 | 1 | 102K6R7



CONSTRUCTION SCHEDULE - UNIT 2

TENNESSEE VALLEY AUTHORITY
RIVER SYSTEM OPERATIONS & ENVIRONMENT
RIVER OPERATIONS

HIWASSEE DAM

SPILLWAY AND SLUICE DISCHARGE TABLES

NOVEMBER 2004

CONTENTS

PART 1

SPILLWAY DISCHARGE TABLES

NOVEMBER 2004

INSTRUCTIONS FOR USE OF TABLES

1. Tables Update

These tables supersede the tables dated September 1996. They differ from those tables only in a few minor details. The September 1996 tables superseded the tables dated March 1991. Those tables were revised to include Gate 1 in the spillway gate arrangements. Gate 1 was previously out of service. The computer code SPILLQ generated the tabulated discharges.

2. Purpose of Tables

These tables provide a means for setting required spillway discharges and for determining the discharge when a specific arrangement of gates is in use. The tabulated discharges are based on test results from scale models.

The specific gate arrangements in the tables were determined by considering erosion data obtained from spillway model studies together with incremental discharge values required for satisfactory spillway operation.

3. Range of Tables

The tables cover a discharge range from 0 to 126,500 cubic feet per second. Headwater elevations range from 1503.5 feet to 1532 feet. The tailwater does not affect the discharge from this spillway.

4. Arrangement of Tables

The discharge tables show spillway discharges in cubic feet per second. Headwater elevations in 0.1-foot increments are shown at the top of each column. The headwater range is indicated at the bottom of each page.

The discharge is tabulated under the headwater elevations for specific arrangements of gate openings, which are indicated by number in the left and right columns of each page. The numbered arrangements are defined in the table of Spillway Gate Arrangements on page 5. Reference to this table and to the drawing showing the location of the gates on page 4 determines the gate opening to which each gate is to be set for any particular discharge given in the tables.

5. Discharge Intervals

The tables have been prepared so that the incremental discharge between the tabulated values for consecutive gate arrangements is generally less than 5 percent of the tabulated discharge. The incremental discharge between tabulated values of consecutive headwater elevations is generally less than 1 percent. These increments are exceeded at low headwater elevations where operation is relatively infrequent. In general, it is possible to set any required discharge within 2-1/2 percent and to know the actual discharge for any given set of conditions within 1 percent. These tolerances are considered acceptable and therefore <u>it will not be necessary to interpolate between values given in these tables</u>.

When the exact headwater elevation does not appear in the tables, the discharge for the headwater elevation closest to it is used. For example, the column headed 1512.2 is used for actual headwater elevations between 1512.15 feet and 1512.24 feet inclusive. When the actual headwater elevation is exactly halfway between tabular values, the larger value is used.

6. Raising and Lowering Gates

A traveling gantry crane raises and lowers the gates using chains attached to the ends of each gate. Gate openings are set by dogging each chain using a dogging arrangement located just below the deck of the dam.

The gate opening positions are defined by the chain link numbers (number of links past the zero links) referenced in the Table of Spillway Gate Arrangements, page 5. The zero links for each gate are identified by wires wrapped around their centers, and the zero positions are indicated in the Table of Spillway Gate Arrangements by a dash (-). To set a gate, it is necessary to count the number of links past the zero link to dog the required link. Gate opening positions are not interchangeable between gates because a given link on one gate will not give the same discharge as the same link on another gate (the actual gate openings are not the same).

An emergency travel hoist powered by a gasoline engine is available for lifting the gates in the event of a power failure.

7. Special Instruction – Preventing Flow Over Top of Spillway Gates When Headwater Elevation is Above 1526.5 feet

If the headwater elevation exceeds 1526.5 feet (actually, 1526.3 feet to provide a 0.2-foot margin of safety) the spillway gates must be set to one of the gate arrangements listed in the tables to prevent flow over the tops of the gates. The minimum gate openings are those corresponding to the lowest numbered gate arrangement for which a discharge value is provided in the tables.

8. Use of Tables

The tables can be used in two ways: (1) to determine the arrangement of gates needed to pass a required discharge at a given headwater elevation, and (2) to determine the discharge for a given arrangement of gates and headwater elevation.

Example 1 – What gate arrangement is necessary to pass a discharge of 36,000 cubic feet per second with the headwater at elevation 1520.62 feet?

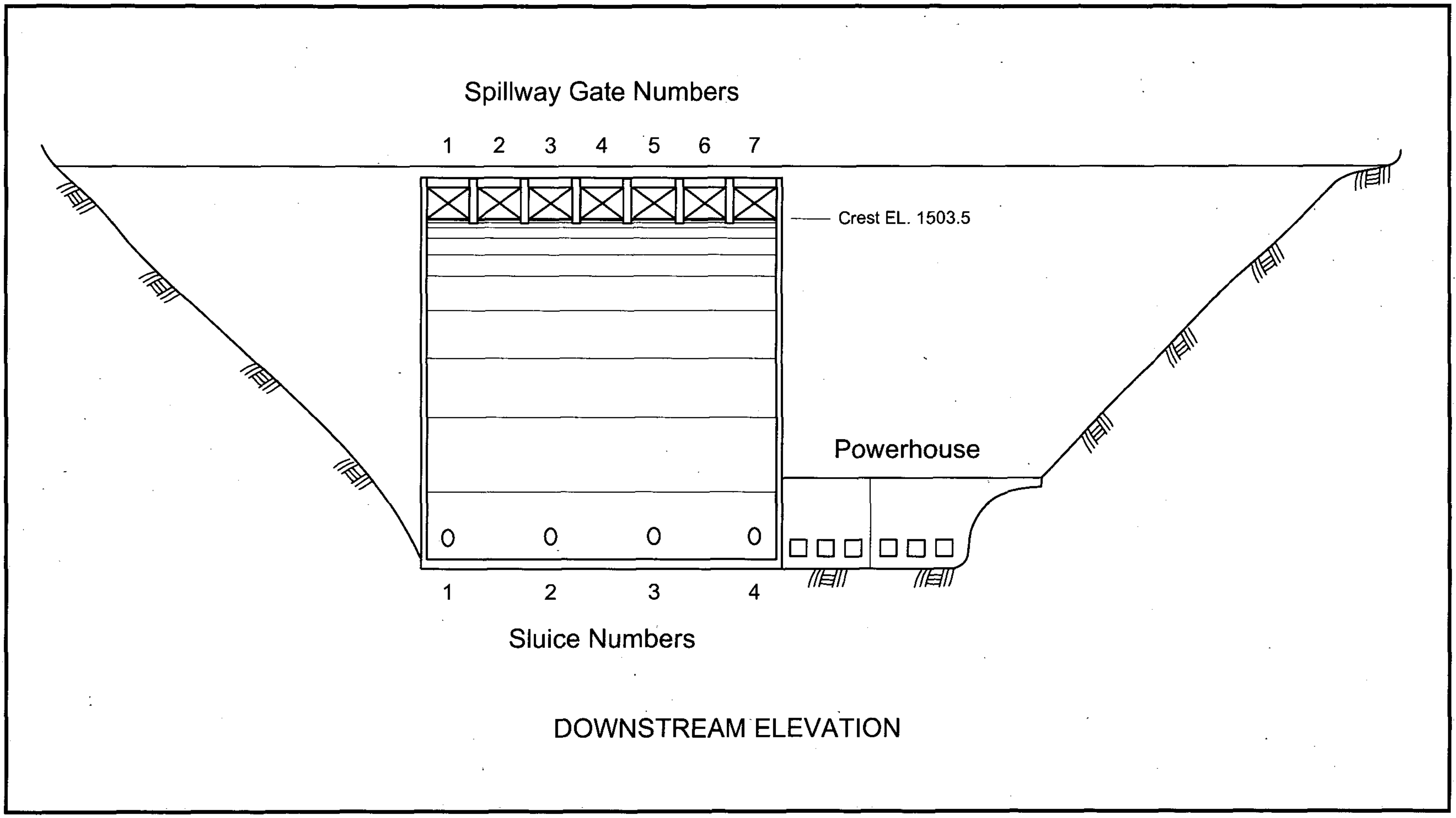
The first step is to find the table in which the headwater elevation appears. Referring to the contents page, we find that headwater elevations between 1519 feet and 1521 feet are found on pages 17 and 18. The headwater elevation closest to 1520.62 feet is 1520.6 feet. In the column headed 1520.6 the discharge nearest to the required 36,000 cubic feet per second is 36,230 cubic feet per second located near the top of page 18. By tracing the horizontal line in which 36,230 cubic feet per second appears, to either side of the page, we find that gate arrangement 54 is the one for producing the discharge closest to 36,000 cubic feet per second at headwater elevation 1520.6 feet. Referring to page 5 it is found that the gates should be set with the gate chains dogged as follows: gates 2 and 4 at chain link number 26; gates 1, 3, 5, 6, and 7 at chain link number 30.

After the gates are set, changes in the headwater elevation may or may not require changes in the gate arrangement to maintain the desired discharge. For example, if the headwater should fall to 1519.14 feet, the discharge will be found in the column headed 1519.1. In this column, the discharge closest to 36,000 cubic feet per second is 36,160 cubic feet per second for gate arrangement 56. To change from gate arrangement 54 to gate arrangement 56, gates 2 and 4 would be opened to chain link number 30.

Example 2 -- Suppose the operating records show that the headwater is at elevation 1522.35 feet, and gate arrangement 47 is in use. The headwater is found on page 19, which is marked "Headwater 1521 to 1523." The elevation given is exactly halfway between elevation 1522.3 feet and 1522.4 feet. The larger value, 1522.4 feet, is used. In the column headed 1522.4 opposite gate arrangement 47, the discharge is found to be 32,750 cubic feet per second.

HIWASSEE DAM

LOCATION OF SPILLWAY GATES AND SLUICE GATES



HIWASSEE DAM

SPILLWAY GATE ARRANGEMENTS

Arrangement Number	Gate Number						
	1	2	3	4	5	6	7
1	-	-	-	-	4	-	-
2	-	-	4	-	4	-	-
3	-	-	4	-	4	-	4
4	4	-	4	-	4	-	4
5	4	-	4	-	4	4	4
6	4	4	4	-	4	4	4
7	4	4	4	4	4	4	4
8	4	4	4	4	6	4	4
9	4	4	6	4	6	4	4
10	4	4	6	4	6	4	6
11	6	4	6	4	6	4	6
12	6	4	6	4	6	6	6
13	6	6	6	4	6	6	6
14	6	6	6	6	6	6	6
15	6	6	6	6	10	6	6
16	6	6	10	6	10	6	6
17	6	6	10	6	10	6	10
18	10	6	10	6	10	6	10
19	10	6	10	6	10	10	10
20	10	10	10	6	10	10	10
21	10	10	10	10	10	10	10
22	10	10	10	10	14	10	10
23	10	10	14	10	14	10	10
24	10	10	14	10	14	10	14
25	14	10	14	10	14	10	14
26	14	10	14	10	14	14	14
27	14	14	14	10	14	14	14
28	14	14	14	14	14	14	14
29	14	14	14	14	18	14	14
30	14	14	18	14	18	14	14

Arrangement Number	Gate Number						
	1	2	3	4	5	6	7
31	14	14	18	14	18	14	18
32	18	14	18	14	18	14	18
33	18	14	18	14	18	18	18
34	18	18	18	14	18	18	18
35	18	18	18	18	18	18	18
36	18	18	18	18	22	18	18
37	18	18	22	18	22	18	18
38	18	18	22	18	22	18	22
39	22	18	22	18	22	18	22
40	22	18	22	18	22	22	22
41	22	22	22	18	22	22	22
42	22	22	22	22	22	22	22
43	22	22	22	22	26	22	22
44	22	22	26	22	26	22	22
45	22	22	26	22	26	22	26
46	26	22	26	22	26	22	26
47	26	22	26	22	26	26	26
48	26	26	26	22	26	26	26
49	26	26	26	26	26	26	26
50	26	26	26	26	30	26	26
51	26	26	30	26	30	26	26
52	26	26	30	26	30	26	30
53	30	26	30	26	30	26	30
54	30	26	30	26	30	30	30
55	30	30	30	26	30	30	30
56	30	30	30	30	30	30	30
57	30	30	30	30	38	30	30
58	30	30	38	30	38	30	30
59	30	30	38	30	38	30	38
60	38	30	38	30	38	30	38

Arrangement Number	Gate Number						
	1	2	3	4	5	6	7
61	38	30	38	30	38	38	38
62	38	38	38	30	38	38	38
63	38	38	38	38	38	38	38
64	38	38	38	38	46	38	38
65	38	38	46	38	46	38	38
66	38	38	46	38	46	38	46
67	46	38	46	38	46	38	46
68	46	38	46	38	46	46	46
69	46	46	46	38	46	46	46
70	46	46	46	46	46	46	46
71	46	46	46	46	54	46	46
72	46	46	54	46	54	46	46
73	46	46	54	46	54	46	54
74	54	46	54	46	54	46	54
75	54	46	54	46	54	54	54
76	54	54	54	46	54	54	54
77	54	54	54	54	54	54	54
78	54	54	54	54	68	54	54
79	54	54	68	54	68	54	54
80	54	54	68	54	68	54	68
81	68	54	68	54	68	54	68
82	68	54	68	54	68	68	68
83	68	68	68	54	68	68	68
84	68	68	68	68	68	68	68

GATE OPENINGS

Figures in columns under each gate number refer to gate chain link number
dash (-) indicates closed gate

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1503.0	1503.1	1503.2	1503.3	1503.4	1503.5	1503.6	1503.7	1503.8	1503.9	1504.0	1504.1	1504.2	1504.3	1504.4	1504.5	1504.6	1504.7	1504.8	1504.9	1505.0	
1	0	0	0	0	0	0	5	10	15	25	35	45	55	70	85	95	100	110	120	130	140	1
2	0	0	0	0	0	0	5	15	30	50	70	90	110	140	170	190	200	220	230	250	260	2
3	0	0	0	0	0	0	10	25	50	75	100	140	170	210	250	280	310	330	350	370	390	3
4	0	0	0	0	0	0	10	35	65	100	140	180	230	280	330	370	400	430	460	490	510	4
5	0	0	0	0	0	0	15	45	80	120	170	230	290	350	410	460	500	540	570	610	640	5
6	0	0	0	0	0	0	20	50	95	150	210	270	340	420	500	560	600	650	690	740	770	6
7	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	650	700	750	810	860	890	7
8	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	650	710	770	830	890	940	8
9	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	660	720	800	870	940	1, 000	9
10	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	660	730	810	890	970	1, 040	10
11	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	670	750	840	930	1, 020	1, 110	11
12	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	680	770	860	960	1, 060	1, 170	12
13	0	0	0	0	0	0	20	60	110	170	240	320	400	490	580	680	780	880	990	1, 100	1, 210	13
14	0	0	0	0	0	0	20	60	110	170	240	320	400	490	590	690	790	910	1, 020	1, 150	1, 270	14
15	0	0	0	0	0	0	20	60	110	170	240	320	400	490	590	690	790	910	1, 020	1, 150	1, 270	15

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGEMENT	HEADWATER ELEVATION																					GATE ARRANGEMENT
	1505.0	1505.1	1505.2	1505.3	1505.4	1505.5	1505.6	1505.7	1505.8	1505.9	1506.0	1506.1	1506.2	1506.3	1506.4	1506.5	1506.6	1506.7	1506.8	1506.9	1507.0	
1	140	140	140	150	150	150	160	160	160	170	170	170	180	180	180	190	190	190	190	200	200	1
2	260	260	270	280	280	290	300	300	310	320	320	330	330	340	350	350	360	360	370	370	380	2
3	390	400	410	430	440	450	460	470	480	480	490	500	510	520	530	540	540	550	560	570	580	3
4	510	530	540	560	570	580	600	610	620	630	650	660	670	680	690	700	710	720	730	740	750	4
5	640	650	670	690	700	720	740	750	770	780	800	810	830	840	850	870	880	890	910	920	930	5
6	770	790	810	840	860	880	890	910	930	950	970	990	1,000	1,020	1,040	1,050	1,070	1,090	1,100	1,120	1,130	6
7	890	920	940	970	990	1,010	1,040	1,060	1,080	1,100	1,120	1,140	1,160	1,180	1,200	1,220	1,240	1,260	1,270	1,290	1,310	7
8	940	980	1,020	1,060	1,100	1,130	1,160	1,190	1,220	1,250	1,280	1,300	1,320	1,350	1,370	1,390	1,410	1,430	1,450	1,470	1,490	8
9	1,000	1,050	1,110	1,170	1,220	1,260	1,300	1,340	1,370	1,410	1,440	1,460	1,490	1,520	1,540	1,570	1,590	1,620	1,640	1,660	1,690	9
10	1,040	1,120	1,190	1,260	1,330	1,380	1,430	1,470	1,520	1,560	1,590	1,620	1,650	1,680	1,710	1,740	1,770	1,790	1,820	1,850	1,870	10
11	1,110	1,190	1,280	1,370	1,450	1,510	1,570	1,620	1,670	1,720	1,750	1,790	1,820	1,850	1,880	1,920	1,950	1,980	2,010	2,040	2,070	11
12	1,170	1,270	1,370	1,480	1,580	1,640	1,700	1,760	1,820	1,870	1,920	1,950	1,990	2,020	2,060	2,090	2,130	2,160	2,200	2,230	2,260	12
13	1,210	1,330	1,450	1,570	1,690	1,760	1,830	1,900	1,960	2,020	2,070	2,110	2,150	2,190	2,230	2,260	2,300	2,340	2,380	2,410	2,450	13
14	1,270	1,400	1,540	1,680	1,810	1,890	1,970	2,040	2,110	2,180	2,230	2,280	2,320	2,360	2,400	2,440	2,480	2,520	2,560	2,600	2,640	14
15	1,270	1,400	1,540	1,680	1,810	1,900	1,990	2,070	2,160	2,240	2,300	2,360	2,430	2,490	2,550	2,610	2,670	2,730	2,800	2,860	2,920	15
16	1,270	1,400	1,540	1,680	1,810	1,910	2,010	2,110	2,210	2,300	2,380	2,460	2,540	2,630	2,710	2,790	2,870	2,960	3,040	3,130	3,210	16
17	1,270	1,400	1,540	1,680	1,810	1,920	2,030	2,140	2,250	2,360	2,450	2,550	2,650	2,750	2,850	2,960	3,060	3,170	3,270	3,380	3,490	17
18	1,270	1,400	1,540	1,680	1,820	1,940	2,050	2,170	2,300	2,420	2,540	2,650	2,770	2,890	3,010	3,140	3,260	3,390	3,520	3,650	3,780	18
19	1,270	1,400	1,540	1,680	1,820	1,950	2,080	2,210	2,350	2,480	2,620	2,750	2,890	3,030	3,170	3,320	3,460	3,610	3,760	3,920	4,070	19
20	1,270	1,400	1,540	1,680	1,820	1,960	2,100	2,240	2,390	2,540	2,690	2,840	3,000	3,160	3,320	3,480	3,650	3,820	3,990	4,170	4,350	20
21	1,270	1,400	1,540	1,680	1,820	1,970	2,120	2,280	2,440	2,600	2,770	2,940	3,120	3,300	3,480	3,660	3,850	4,040	4,240	4,440	4,640	21
22	1,270	1,400	1,540	1,680	1,820	1,970	2,120	2,280	2,440	2,600	2,770	2,940	3,120	3,300	3,480	3,660	3,850	4,040	4,240	4,440	4,640	22
23	1,270	1,400	1,540	1,680	1,820	1,970	2,120	2,280	2,440	2,600	2,770	2,940	3,120	3,300	3,480	3,660	3,850	4,040	4,240	4,440	4,640	23
24	1,270	1,400	1,540	1,680	1,820	1,970	2,120	2,280	2,440	2,600	2,770	2,940	3,120	3,300	3,480	3,660	3,850	4,040	4,240	4,440	4,640	24
25	1,270	1,400	1,540	1,680	1,820	1,970	2,120	2,280	2,440	2,600	2,770	2,940	3,120	3,300	3,480	3,660	3,850	4,040	4,240	4,440	4,640	25

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1507.0	1507.1	1507.2	1507.3	1507.4	1507.5	1507.6	1507.7	1507.8	1507.9	1508.0	1508.1	1508.2	1508.3	1508.4	1508.5	1508.6	1508.7	1508.8	1508.9	1509.0	
1	200	200	200	210	210	210	210	220	220	220	220	230	230	230	230	230	240	240	240	240	250	1
2	380	380	390	390	400	400	400	410	410	420	420	430	430	440	440	440	450	450	460	460	460	2
3	580	580	590	600	610	610	620	630	630	640	650	650	660	670	670	680	680	690	700	700	710	3
4	750	760	770	780	790	800	810	820	830	840	850	850	860	870	880	890	890	900	910	920	930	4
5	930	940	950	970	980	990	1,000	1,010	1,020	1,030	1,040	1,050	1,070	1,080	1,090	1,100	1,110	1,120	1,120	1,130	1,140	5
6	1,130	1,150	1,160	1,170	1,190	1,200	1,220	1,230	1,240	1,260	1,270	1,280	1,290	1,310	1,320	1,330	1,340	1,350	1,370	1,380	1,390	6
7	1,310	1,320	1,340	1,360	1,370	1,390	1,410	1,420	1,440	1,450	1,470	1,480	1,500	1,510	1,530	1,540	1,550	1,570	1,580	1,590	1,610	7
8	1,490	1,510	1,530	1,550	1,570	1,590	1,610	1,630	1,650	1,660	1,680	1,700	1,710	1,730	1,750	1,760	1,780	1,800	1,810	1,830	1,840	8
9	1,690	1,710	1,730	1,760	1,780	1,800	1,820	1,840	1,860	1,880	1,900	1,920	1,940	1,960	1,980	2,000	2,020	2,030	2,050	2,070	2,090	9
10	1,870	1,900	1,920	1,950	1,970	2,000	2,020	2,050	2,070	2,090	2,110	2,140	2,160	2,180	2,200	2,220	2,240	2,260	2,280	2,300	2,320	10
11	2,070	2,100	2,120	2,150	2,180	2,210	2,230	2,260	2,280	2,310	2,330	2,360	2,380	2,410	2,430	2,450	2,480	2,500	2,520	2,550	2,570	11
12	2,260	2,290	2,320	2,350	2,380	2,410	2,440	2,470	2,500	2,530	2,560	2,580	2,610	2,640	2,660	2,690	2,710	2,740	2,760	2,790	2,810	12
13	2,450	2,480	2,520	2,550	2,580	2,610	2,650	2,680	2,710	2,740	2,770	2,800	2,830	2,860	2,880	2,910	2,940	2,970	2,990	3,020	3,050	13
14	2,640	2,680	2,720	2,750	2,790	2,820	2,860	2,890	2,920	2,960	2,990	3,020	3,050	3,080	3,120	3,150	3,180	3,210	3,230	3,260	3,290	14
15	2,920	2,980	3,040	3,100	3,160	3,210	3,250	3,290	3,330	3,370	3,400	3,430	3,470	3,500	3,530	3,570	3,600	3,630	3,660	3,700	3,730	15
16	3,210	3,300	3,380	3,470	3,540	3,590	3,630	3,680	3,720	3,770	3,800	3,840	3,870	3,910	3,940	3,980	4,020	4,050	4,090	4,120	4,160	16
17	3,490	3,600	3,710	3,820	3,910	3,970	4,020	4,080	4,130	4,170	4,210	4,250	4,290	4,320	4,360	4,400	4,440	4,480	4,520	4,560	4,590	17
18	3,780	3,910	4,050	4,180	4,290	4,350	4,410	4,470	4,520	4,570	4,610	4,650	4,690	4,730	4,770	4,810	4,860	4,900	4,940	4,980	5,020	18
19	4,070	4,230	4,390	4,550	4,660	4,730	4,800	4,860	4,920	4,970	5,020	5,060	5,100	5,140	5,180	5,230	5,280	5,320	5,370	5,410	5,460	19
20	4,350	4,530	4,720	4,900	5,040	5,120	5,190	5,260	5,320	5,380	5,430	5,470	5,510	5,550	5,600	5,650	5,700	5,750	5,800	5,840	5,890	20
21	4,640	4,850	5,060	5,270	5,410	5,500	5,570	5,650	5,720	5,780	5,830	5,870	5,920	5,960	6,010	6,060	6,120	6,170	6,220	6,270	6,320	21
22	4,640	4,850	5,060	5,270	5,410	5,510	5,610	5,710	5,800	5,880	5,960	6,030	6,100	6,170	6,250	6,330	6,420	6,500	6,580	6,660	6,740	22
23	4,640	4,850	5,060	5,270	5,430	5,550	5,670	5,790	5,900	6,010	6,110	6,210	6,310	6,410	6,520	6,630	6,740	6,850	6,960	7,070	7,180	23
24	4,640	4,850	5,060	5,270	5,430	5,570	5,710	5,850	5,990	6,120	6,240	6,370	6,500	6,630	6,760	6,900	7,040	7,180	7,320	7,460	7,600	24
25	4,640	4,850	5,060	5,270	5,450	5,610	5,770	5,930	6,090	6,240	6,400	6,550	6,710	6,860	7,030	7,190	7,360	7,530	7,690	7,860	8,030	25
26	4,640	4,850	5,060	5,270	5,470	5,650	5,830	6,010	6,190	6,370	6,550	6,740	6,920	7,100	7,290	7,490	7,680	7,880	8,070	8,270	8,470	26
27	4,640	4,850	5,060	5,270	5,470	5,660	5,860	6,070	6,270	6,480	6,680	6,890	7,100	7,320	7,540	7,760	7,980	8,200	8,430	8,660	8,890	27
28	4,640	4,850	5,060	5,270	5,480	5,700	5,920	6,150	6,380	6,610	6,840	7,080	7,320	7,560	7,800	8,050	8,300	8,550	8,810	9,070	9,330	28
29	4,640	4,850	5,060	5,270	5,480	5,700	5,920	6,150	6,380	6,610	6,840	7,080	7,320	7,560	7,800	8,050	8,300	8,550	8,810	9,070	9,330	29
30	4,640	4,850	5,060	5,270	5,480	5,700	5,920	6,150	6,380	6,610	6,840	7,080	7,320	7,560	7,800	8,050	8,300	8,550	8,810	9,070	9,330	30

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGEMENT	HEADWATER ELEVATION																					GATE ARRANGEMENT
	1509.0	1509.1	1509.2	1509.3	1509.4	1509.5	1509.6	1509.7	1509.8	1509.9	1510.0	1510.1	1510.2	1510.3	1510.4	1510.5	1510.6	1510.7	1510.8	1510.9	1511.0	
1	250	250	250	250	250	250	260	260	260	260	260	270	270	270	270	270	280	280	280	280	280	1
2	460	470	470	470	480	480	480	490	490	500	500	500	510	510	510	520	520	520	530	530	530	2
3	710	710	720	720	730	740	740	750	750	760	760	770	770	780	790	790	800	800	810	810	820	3
4	930	930	940	950	950	960	970	980	980	990	1,000	1,010	1,010	1,020	1,030	1,030	1,040	1,050	1,050	1,060	1,070	4
5	1,140	1,150	1,160	1,170	1,180	1,190	1,200	1,210	1,220	1,220	1,230	1,240	1,250	1,260	1,270	1,280	1,290	1,290	1,300	1,310	1,320	5
6	1,390	1,400	1,410	1,420	1,430	1,440	1,450	1,470	1,480	1,490	1,500	1,510	1,520	1,530	1,540	1,550	1,560	1,570	1,580	1,590	1,600	6
7	1,610	1,620	1,630	1,640	1,660	1,670	1,680	1,700	1,710	1,720	1,730	1,750	1,760	1,770	1,780	1,790	1,810	1,820	1,830	1,840	1,850	7
8	1,840	1,860	1,870	1,890	1,900	1,920	1,930	1,950	1,960	1,970	1,990	2,000	2,020	2,030	2,040	2,060	2,070	2,090	2,100	2,110	2,130	8
9	2,090	2,100	2,120	2,140	2,150	2,170	2,190	2,210	2,220	2,240	2,250	2,270	2,290	2,300	2,320	2,330	2,350	2,370	2,380	2,400	2,410	9
10	2,320	2,340	2,360	2,380	2,400	2,420	2,440	2,450	2,470	2,490	2,510	2,530	2,550	2,560	2,580	2,600	2,620	2,630	2,650	2,670	2,690	10
11	2,570	2,590	2,610	2,630	2,650	2,670	2,690	2,710	2,730	2,750	2,770	2,790	2,810	2,830	2,850	2,870	2,890	2,910	2,930	2,950	2,970	11
12	2,810	2,840	2,860	2,880	2,910	2,930	2,950	2,970	3,000	3,020	3,040	3,060	3,080	3,100	3,120	3,150	3,170	3,190	3,210	3,230	3,250	12
13	3,050	3,070	3,100	3,120	3,150	3,170	3,200	3,220	3,250	3,270	3,300	3,320	3,340	3,360	3,390	3,410	3,430	3,460	3,480	3,500	3,530	13
14	3,290	3,320	3,350	3,380	3,400	3,430	3,460	3,480	3,510	3,530	3,560	3,590	3,610	3,640	3,660	3,690	3,710	3,740	3,760	3,790	3,810	14
15	3,730	3,760	3,790	3,820	3,850	3,880	3,910	3,940	3,970	4,000	4,030	4,060	4,090	4,120	4,150	4,180	4,210	4,240	4,260	4,290	4,320	15
16	4,160	4,190	4,230	4,260	4,290	4,330	4,360	4,400	4,430	4,470	4,500	4,530	4,570	4,600	4,630	4,660	4,700	4,730	4,760	4,790	4,830	16
17	4,590	4,630	4,670	4,700	4,740	4,780	4,820	4,860	4,900	4,930	4,970	5,010	5,040	5,080	5,120	5,150	5,190	5,230	5,260	5,300	5,330	17
18	5,020	5,060	5,100	5,140	5,180	5,230	5,270	5,310	5,350	5,400	5,440	5,480	5,520	5,560	5,600	5,640	5,680	5,720	5,760	5,800	5,840	18
19	5,460	5,500	5,540	5,580	5,630	5,670	5,720	5,770	5,820	5,860	5,910	5,950	6,000	6,040	6,080	6,130	6,170	6,220	6,260	6,300	6,340	19
20	5,890	5,940	5,980	6,020	6,070	6,120	6,180	6,230	6,280	6,330	6,380	6,430	6,480	6,520	6,570	6,620	6,670	6,710	6,760	6,810	6,850	20
21	6,320	6,370	6,420	6,460	6,520	6,570	6,630	6,680	6,740	6,790	6,850	6,900	6,950	7,000	7,050	7,110	7,160	7,210	7,260	7,310	7,360	21
22	6,740	6,820	6,900	6,960	7,020	7,070	7,130	7,190	7,250	7,300	7,350	7,400	7,450	7,500	7,550	7,610	7,660	7,710	7,760	7,810	7,860	22
23	7,180	7,290	7,390	7,450	7,510	7,570	7,630	7,690	7,740	7,800	7,850	7,890	7,940	8,000	8,050	8,100	8,150	8,210	8,260	8,310	8,350	23
24	7,600	7,740	7,860	7,950	8,010	8,070	8,140	8,190	8,250	8,300	8,350	8,390	8,440	8,490	8,550	8,600	8,650	8,700	8,750	8,800	8,850	24
25	8,030	8,210	8,350	8,440	8,500	8,570	8,630	8,690	8,750	8,790	8,840	8,880	8,930	8,980	9,040	9,090	9,150	9,200	9,250	9,300	9,350	25
26	8,470	8,680	8,840	8,930	9,000	9,070	9,130	9,190	9,240	9,290	9,330	9,380	9,420	9,480	9,530	9,590	9,640	9,690	9,740	9,790	9,840	26
27	8,890	9,130	9,320	9,430	9,500	9,570	9,640	9,700	9,750	9,800	9,840	9,880	9,920	9,980	10,030	10,090	10,140	10,190	10,250	10,300	10,340	27
28	9,330	9,600	9,810	9,920	10,000	10,070	10,140	10,200	10,250	10,290	10,330	10,370	10,410	10,470	10,530	10,580	10,640	10,690	10,740	10,790	10,840	28
29	9,330	9,600	9,810	9,940	10,040	10,140	10,240	10,330	10,410	10,490	10,570	10,640	10,720	10,810	10,900	11,000	11,090	11,170	11,260	11,350	11,440	29
30	9,330	9,600	9,820	9,980	10,110	10,240	10,370	10,490	10,610	10,720	10,830	10,940	11,060	11,180	11,310	11,440	11,560	11,690	11,810	11,940	12,040	30
31	9,330	9,600	9,820	9,990	10,150	10,310	10,470	10,630	10,770	10,920	11,070	11,210	11,370	11,530	11,690	11,850	12,010	12,170	12,330	12,490	12,630	31
32	9,330	9,600	9,840	10,040	10,220	10,410	10,600	10,790	10,970	11,150	11,330	11,520	11,700	11,900	12,090	12,290	12,480	12,680	12,880	13,080	13,230	32
33	9,330	9,600	9,850	10,080	10,290	10,510	10,730	10,950	11,160	11,380	11,600	11,820	12,040	12,270	12,500	12,730	12,960	13,190	13,430	13,670	13,840	33
34	9,330	9,600	9,850	10,090	10,340	10,580	10,830	11,080	11,330	11,580	11,830	12,090	12,350	12,610	12,870	13,140	13,410	13,680	13,950	14,220	14,430	34
35	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,040	35
36	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,040	36
37	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,060	37
38	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,060	38
39	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,080	39
40	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,100	40
41	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,100	41
42	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,130	42
43	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,130	43
44	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,130	44
45	9,330	9,600	9,860	10,130	10,410	10,680	10,960	11,240	11,530	11,810	12,100	12,390	12,690	12,980	13,280	13,580	13,890	14,190	14,500	14,810	15,130	45

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1511.0	1511.1	1511.2	1511.3	1511.4	1511.5	1511.6	1511.7	1511.8	1511.9	1512.0	1512.1	1512.2	1512.3	1512.4	1512.5	1512.6	1512.7	1512.8	1512.9	1513.0	
1	280	280	290	290	290	290	290	300	300	300	300	300	300	310	310	310	310	310	310	310	320	1
2	530	540	540	540	550	550	550	560	560	560	570	570	570	580	580	580	580	590	590	590	600	2
3	820	820	830	830	840	840	850	850	860	860	870	870	880	880	890	890	890	900	900	910	910	3
4	1,070	1,070	1,080	1,090	1,090	1,100	1,110	1,110	1,120	1,130	1,130	1,140	1,140	1,150	1,160	1,160	1,170	1,180	1,180	1,190	1,190	4
5	1,320	1,330	1,330	1,340	1,350	1,360	1,370	1,370	1,380	1,390	1,400	1,410	1,410	1,420	1,430	1,440	1,440	1,450	1,460	1,470	1,470	5
6	1,600	1,610	1,620	1,630	1,640	1,650	1,660	1,670	1,680	1,690	1,700	1,710	1,720	1,730	1,740	1,750	1,760	1,760	1,770	1,780	1,790	6
7	1,850	1,860	1,880	1,890	1,900	1,910	1,920	1,930	1,940	1,950	1,970	1,980	1,990	2,000	2,010	2,020	2,030	2,040	2,050	2,060	2,070	7
8	2,130	2,140	2,150	2,170	2,180	2,190	2,210	2,220	2,230	2,240	2,260	2,270	2,280	2,300	2,310	2,320	2,330	2,340	2,360	2,370	2,380	8
9	2,410	2,430	2,440	2,460	2,470	2,490	2,500	2,520	2,530	2,550	2,560	2,570	2,590	2,600	2,620	2,630	2,650	2,660	2,670	2,690	2,700	9
10	2,690	2,700	2,720	2,740	2,750	2,770	2,790	2,800	2,820	2,840	2,850	2,870	2,880	2,900	2,920	2,930	2,950	2,960	2,980	2,990	3,010	10
11	2,970	2,990	3,010	3,030	3,040	3,060	3,080	3,100	3,120	3,140	3,150	3,170	3,190	3,210	3,220	3,240	3,260	3,280	3,290	3,310	3,330	11
12	3,250	3,270	3,300	3,320	3,340	3,360	3,380	3,400	3,420	3,440	3,460	3,480	3,500	3,520	3,530	3,550	3,570	3,590	3,610	3,630	3,650	12
13	3,530	3,550	3,570	3,600	3,620	3,640	3,660	3,680	3,710	3,730	3,750	3,770	3,790	3,810	3,830	3,850	3,870	3,900	3,920	3,940	3,960	13
14	3,810	3,840	3,860	3,890	3,910	3,930	3,960	3,980	4,010	4,030	4,050	4,070	4,100	4,120	4,140	4,170	4,190	4,210	4,230	4,260	4,280	14
15	4,320	4,350	4,380	4,400	4,430	4,460	4,490	4,520	4,540	4,570	4,600	4,620	4,650	4,670	4,700	4,730	4,750	4,780	4,810	4,830	4,860	15
16	4,830	4,860	4,890	4,920	4,950	4,980	5,010	5,040	5,080	5,110	5,140	5,170	5,200	5,230	5,250	5,280	5,310	5,340	5,370	5,400	5,430	16
17	5,330	5,370	5,400	5,440	5,470	5,510	5,540	5,580	5,610	5,640	5,680	5,710	5,750	5,780	5,810	5,850	5,880	5,910	5,940	5,980	6,010	17
18	5,840	5,880	5,910	5,950	5,990	6,030	6,070	6,100	6,140	6,180	6,220	6,250	6,290	6,330	6,360	6,400	6,440	6,470	6,510	6,550	6,580	18
19	6,340	6,380	6,430	6,470	6,510	6,550	6,590	6,630	6,680	6,720	6,760	6,800	6,840	6,880	6,920	6,960	7,000	7,040	7,080	7,120	7,160	19
20	6,850	6,900	6,940	6,990	7,030	7,080	7,120	7,170	7,210	7,260	7,300	7,350	7,390	7,430	7,480	7,520	7,560	7,610	7,650	7,690	7,740	20
21	7,360	7,410	7,450	7,500	7,550	7,600	7,650	7,700	7,750	7,790	7,840	7,890	7,940	7,980	8,030	8,080	8,130	8,170	8,220	8,270	8,310	21
22	7,860	7,910	7,950	8,000	8,050	8,110	8,160	8,210	8,260	8,310	8,360	8,410	8,460	8,510	8,560	8,610	8,660	8,710	8,760	8,810	8,860	22
23	8,350	8,400	8,450	8,500	8,560	8,610	8,670	8,720	8,770	8,820	8,880	8,930	8,980	9,030	9,090	9,140	9,190	9,250	9,300	9,350	9,400	23
24	8,850	8,900	8,950	9,000	9,060	9,120	9,170	9,230	9,280	9,340	9,390	9,450	9,500	9,550	9,610	9,670	9,720	9,780	9,830	9,890	9,940	24
25	9,350	9,390	9,440	9,500	9,560	9,620	9,680	9,740	9,790	9,850	9,910	9,960	10,020	10,080	10,140	10,200	10,250	10,310	10,370	10,430	10,490	25
26	9,840	9,890	9,940	10,000	10,060	10,130	10,190	10,250	10,310	10,360	10,420	10,480	10,540	10,600	10,660	10,730	10,790	10,850	10,910	10,970	11,030	26
27	10,340	10,390	10,440	10,500	10,570	10,630	10,700	10,760	10,820	10,880	10,940	11,000	11,060	11,120	11,190	11,260	11,320	11,390	11,450	11,510	11,580	27
28	10,840	10,890	10,940	11,000	11,070	11,140	11,200	11,270	11,330	11,390	11,460	11,520	11,580	11,650	11,720	11,790	11,850	11,920	11,990	12,050	12,120	28
29	11,440	11,500	11,550	11,620	11,680	11,750	11,810	11,870	11,930	11,990	12,050	12,110	12,170	12,240	12,310	12,370	12,440	12,500	12,570	12,630	12,690	29
30	12,040	12,100	12,160	12,220	12,290	12,350	12,410	12,470	12,530	12,590	12,640	12,700	12,760	12,830	12,890	12,950	13,010	13,080	13,140	13,190	13,260	30
31	12,630	12,710	12,770	12,830	12,890	12,960	13,010	13,070	13,130	13,180	13,230	13,290	13,350	13,410	13,480	13,540	13,590	13,650	13,710	13,760	13,820	31
32	13,230	13,310	13,370	13,430	13,500	13,550	13,610	13,670	13,720	13,770	13,820	13,880	13,940	14,000	14,050	14,110	14,170	14,220	14,280	14,330	14,380	32
33	13,840	13,920	13,980	14,040	14,100	14,160	14,210	14,260	14,310	14,360	14,410	14,470	14,520	14,580	14,640	14,690	14,740	14,800	14,850	14,890	14,950	33
34	14,430	14,530	14,590	14,650	14,710	14,770	14,820	14,870	14,910	14,960	15,010	15,060	15,120	15,170	15,230	15,280	15,330	15,380	15,420	15,470	15,520	34
35	15,040	15,140	15,200	15,260	15,320	15,370	15,420	15,460	15,510	15,550	15,600	15,650	15,700	15,760	15,810	15,860	15,900	15,950	15,990	16,030	16,090	35
36	15,040	15,160	15,260	15,360	15,450	15,540	15,630	15,720	15,800	15,890	15,980	16,070	16,170	16,260	16,350	16,450	16,540	16,630	16,710	16,770	16,830	36
37	15,060	15,220	15,360	15,490	15,620	15,750	15,880	16,010	16,140	16,260	16,390	16,530	16,670	16,800	16,940	17,070	17,210	17,340	17,440	17,500	17,550	37
38	15,060	15,240	15,420	15,590	15,760	15,930	16,100	16,260	16,430	16,600	16,770	16,950	17,130	17,300	17,480	17,660	17,840	18,010	18,160	18,230	18,290	38
39	15,080	15,300	15,510	15,720	15,930	16,140	16,340	16,550	16,760	16,970	17,180	17,400	17,620	17,840	18,060	18,280	18,500	18,720	18,880	18,960	19,010	39
40	15,100	15,360	15,610	15,850	16,100	16,350	16,590	16,840	17,090	17,350	17,600	17,860	18,120	18,380	18,640	18,900	19,170	19,430	19,610	19,680	19,730	40
41	15,100	15,380	15,670	15,950	16,230	16,520	16,810	17,100	17,390	17,680	17,980	18,280	18,580	18,880	19,190	19,490	19,800	20,110	20,330	20,420	20,470	41
42	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,050	21,150	21,200	42
43	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,050	21,180	21,270	43
44	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,090	21,250	21,390	44
45	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,090	21,280	21,460	45
46	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,120	21,360	21,580	46
47	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,150	21,430	21,710	47
48	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,150	21,460	21,780	48
49	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,180	21,540	21,900	49
50	15,130	15,440	15,760	16,080	16,410	16,730	17,060	17,390	17,720	18,060	18,400	18,740	19,080	19,420	19,770	20,120	20,470	20,820	21,180	21,540	21,900	50

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1513.0	1513.1	1513.2	1513.3	1513.4	1513.5	1513.6	1513.7	1513.8	1513.9	1514.0	1514.1	1514.2	1514.3	1514.4	1514.5	1514.6	1514.7	1514.8	1514.9	1515.0	
1	320	320	320	320	320	320	330	330	330	330	330	330	330	340	340	340	340	340	340	350	350	1
2	600	600	600	610	610	610	610	620	620	620	630	630	630	630	640	640	640	650	650	650	650	2
3	910	920	920	930	930	940	940	940	950	950	960	960	970	970	970	980	980	990	990	1,000	1,000	3
4	1,190	1,200	1,210	1,210	1,220	1,220	1,230	1,230	1,240	1,250	1,250	1,260	1,260	1,270	1,270	1,280	1,290	1,290	1,300	1,300	1,310	4
5	1,470	1,480	1,490	1,500	1,500	1,510	1,520	1,520	1,530	1,540	1,550	1,550	1,560	1,570	1,570	1,580	1,590	1,590	1,600	1,610	1,620	5
6	1,790	1,800	1,810	1,820	1,830	1,840	1,840	1,850	1,860	1,870	1,880	1,890	1,900	1,900	1,910	1,920	1,930	1,940	1,950	1,950	1,960	6
7	2,070	2,080	2,090	2,100	2,110	2,120	2,130	2,140	2,150	2,160	2,170	2,180	2,190	2,200	2,210	2,220	2,230	2,240	2,250	2,260	2,270	7
8	2,380	2,390	2,400	2,420	2,430	2,440	2,450	2,460	2,470	2,490	2,500	2,510	2,520	2,530	2,540	2,550	2,560	2,580	2,590	2,600	2,610	8
9	2,700	2,710	2,730	2,740	2,750	2,770	2,780	2,790	2,810	2,820	2,830	2,850	2,860	2,870	2,890	2,900	2,910	2,920	2,940	2,950	2,960	9
10	3,010	3,020	3,040	3,050	3,070	3,080	3,100	3,110	3,130	3,140	3,160	3,170	3,190	3,200	3,220	3,230	3,240	3,260	3,270	3,290	3,300	10
11	3,330	3,350	3,360	3,380	3,400	3,410	3,430	3,450	3,460	3,480	3,490	3,510	3,530	3,540	3,560	3,570	3,590	3,610	3,620	3,640	3,650	11
12	3,650	3,670	3,690	3,700	3,720	3,740	3,760	3,780	3,800	3,810	3,830	3,850	3,870	3,880	3,900	3,920	3,940	3,950	3,970	3,990	4,000	12
13	3,960	3,980	4,000	4,020	4,040	4,060	4,080	4,100	4,120	4,140	4,160	4,170	4,190	4,210	4,230	4,250	4,270	4,290	4,310	4,320	4,340	13
14	4,280	4,300	4,320	4,340	4,360	4,390	4,410	4,430	4,450	4,470	4,490	4,510	4,530	4,550	4,570	4,590	4,610	4,630	4,650	4,670	4,690	14
15	4,860	4,880	4,910	4,930	4,960	4,980	5,010	5,030	5,060	5,080	5,100	5,130	5,150	5,180	5,200	5,220	5,250	5,270	5,290	5,320	5,340	15
16	5,430	5,460	5,490	5,520	5,550	5,570	5,600	5,630	5,660	5,690	5,710	5,740	5,770	5,790	5,820	5,850	5,870	5,900	5,930	5,950	5,980	16
17	6,010	6,040	6,070	6,110	6,140	6,170	6,200	6,230	6,260	6,290	6,320	6,350	6,380	6,410	6,440	6,470	6,500	6,530	6,560	6,590	6,620	17
18	6,580	6,620	6,650	6,690	6,720	6,760	6,790	6,830	6,860	6,900	6,930	6,960	7,000	7,030	7,060	7,100	7,130	7,160	7,190	7,230	7,260	18
19	7,160	7,200	7,240	7,270	7,310	7,350	7,390	7,430	7,460	7,500	7,540	7,570	7,610	7,650	7,680	7,720	7,760	7,790	7,830	7,860	7,900	19
20	7,740	7,780	7,820	7,860	7,910	7,950	7,990	8,030	8,070	8,110	8,150	8,190	8,230	8,270	8,310	8,350	8,390	8,430	8,470	8,500	8,540	20
21	8,310	8,360	8,400	8,450	8,490	8,540	8,580	8,630	8,670	8,710	8,760	8,800	8,840	8,890	8,930	8,970	9,010	9,060	9,100	9,140	9,180	21
22	8,860	8,910	8,950	9,000	9,050	9,100	9,150	9,190	9,240	9,290	9,340	9,380	9,430	9,480	9,520	9,570	9,610	9,660	9,700	9,750	9,790	22
23	9,400	9,450	9,500	9,560	9,610	9,660	9,710	9,760	9,810	9,860	9,920	9,970	10,020	10,060	10,110	10,160	10,210	10,260	10,310	10,360	10,410	23
24	9,940	10,000	10,050	10,110	10,160	10,220	10,270	10,330	10,380	10,440	10,490	10,540	10,600	10,650	10,700	10,760	10,810	10,860	10,910	10,960	11,010	24
25	10,490	10,540	10,600	10,660	10,720	10,780	10,840	10,890	10,950	11,010	11,070	11,120	11,180	11,240	11,290	11,350	11,410	11,460	11,520	11,570	11,620	25
26	11,030	11,090	11,150	11,210	11,280	11,340	11,400	11,460	11,520	11,590	11,650	11,710	11,770	11,830	11,890	11,950	12,000	12,060	12,120	12,180	12,240	26
27	11,580	11,640	11,700	11,770	11,830	11,900	11,970	12,030	12,100	12,160	12,220	12,290	12,350	12,420	12,480	12,540	12,600	12,660	12,730	12,790	12,850	27
28	12,120	12,180	12,250	12,320	12,390	12,460	12,530	12,600	12,670	12,740	12,800	12,870	12,940	13,000	13,070	13,140	13,200	13,270	13,330	13,400	13,460	28
29	12,690	12,750	12,820	12,890	12,960	13,030	13,100	13,170	13,240	13,310	13,370	13,440	13,510	13,580	13,650	13,720	13,780	13,850	13,920	13,980	14,050	29
30	13,260	13,320	13,390	13,460	13,530	13,600	13,670	13,740	13,810	13,870	13,940	14,010	14,080	14,160	14,230	14,300	14,370	14,430	14,500	14,570	14,640	30
31	13,820	13,890	13,960	14,030	14,100	14,170	14,240	14,310	14,370	14,440	14,510	14,580	14,660	14,730	14,800	14,870	14,940	15,020	15,090	15,160	15,230	31
32	14,380	14,450	14,520	14,590	14,660	14,730	14,800	14,870	14,940	15,010	15,080	15,150	15,230	15,300	15,380	15,450	15,520	15,600	15,670	15,740	15,810	32
33	14,950	15,020	15,090	15,160	15,230	15,300	15,370	15,440	15,510	15,570	15,640	15,720	15,800	15,880	15,950	16,030	16,100	16,180	16,250	16,330	16,400	33
34	15,520	15,590	15,660	15,730	15,800	15,870	15,940	16,010	16,080	16,140	16,210	16,290	16,370	16,450	16,530	16,610	16,690	16,760	16,840	16,910	16,990	34
35	16,090	16,160	16,230	16,300	16,370	16,440	16,510	16,580	16,650	16,710	16,780	16,860	16,950	17,030	17,110	17,190	17,270	17,350	17,420	17,500	17,580	35
36	16,830	16,890	16,960	17,030	17,100	17,160	17,220	17,280	17,340	17,410	17,470	17,550	17,630	17,700	17,780	17,850	17,920	17,990	18,060	18,140	18,220	36
37	17,550	17,610	17,680	17,740	17,800	17,860	17,910	17,970	18,030	18,090	18,150	18,220	18,290	18,360	18,430	18,490	18,560	18,630	18,700	18,770	18,850	37
38	18,290	18,350	18,410	18,460	18,520	18,570	18,620	18,670	18,720	18,770	18,840	18,900	18,970	19,030	19,090	19,150	19,210	19,270	19,330	19,410	19,490	38
39	19,010	19,060	19,120	19,170	19,220	19,260	19,310	19,350	19,400	19,450	19,510	19,570	19,620	19,680	19,740	19,790	19,850	19,900	19,960	20,030	20,120	39
40	19,730	19,780	19,830	19,880	19,920	19,960	20,000	20,040	20,080	20,130	20,180	20,240	20,290	20,340	20,390	20,440	20,480	20,530	20,590	20,670	20,750	40
41	20,470	20,520	20,570	20,610	20,640	20,680	20,710	20,740	20,780	20,820	20,870	20,920	20,970	21,010	21,060	21,100	21,140	21,180	21,230	21,300	21,390	41
42	21,200	21,240	21,280	21,320	21,350	21,380	21,400	21,430	21,460	21,500	21,550	21,590	21,630	21,670	21,710	21,740	21,780	21,810	21,860	21,940	22,020	42
43	21,270	21,360	21,450	21,530	21,610	21,690	21,760	21,840	21,920	22,010	22,100	22,200	22,290	22,380	22,470	22,550	22,640	22,690	22,740	22,810	22,880	43
44	21,390	21,530	21,660	21,790	21,920	22,050	22,170	22,290	22,430	22,570	22,710	22,850	22,990	23,130	23,270	23,410	23,510	23,560	23,610	23,670	23,730	44
45	21,460	21,640	21,820	22,000	22,180	22,350	22,530	22,700	22,880	23,070	23,260	23,450	23,640	23,830	24,020	24,210	24,370	24,440	24,480	24,530	24,590	45
46	21,580	21,810	22,040	22,260	22,480	22,710	22,930	23,160	23,390	23,620	23,860	24,100	24,340	24,580	24,820	25,050	25,230	25,300	25,340	25,390	25,430	46
47	21,710	21,980	22,250	22,520	22,790	23,070	23,340	23,620	23,900	24,180	24,470	24,750	25,040	25,330	25,620	25,910	26,110	26,180	26,210	26,250	26,290	47
48	21,780	22,100	22,410	22,730	23,050	23,380	23,700	24,030	24,360	24,690	25,020	25,360	25,700	26,030	26,370	26,720	26,970	27,060	27,090	27,120	27,150	48
49	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,850	27,940	27,960	27,980	28,000	49
50	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,850	27,970	28,050	28,120	28,190	50

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1513.0	1513.1	1513.2	1513.3	1513.4	1513.5	1513.6	1513.7	1513.8	1513.9	1514.0	1514.1	1514.2	1514.3	1514.4	1514.5	1514.6	1514.7	1514.8	1514.9	1515.0	
51	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,880	28,050	28,180	28,310	28,440	51
52	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,880	28,080	28,270	28,450	28,630	52
53	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,910	28,170	28,400	28,640	28,880	53
54	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,940	28,250	28,540	28,830	29,130	54
55	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,940	28,280	28,630	28,970	29,320	55
56	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,970	28,360	28,760	29,160	29,570	56
57	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,970	28,360	28,760	29,160	29,570	57
58	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,970	28,360	28,760	29,160	29,570	58
59	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,970	28,360	28,760	29,160	29,570	59
60	21,900	22,260	22,630	22,990	23,360	23,740	24,110	24,490	24,860	25,240	25,630	26,010	26,400	26,790	27,180	27,570	27,970	28,360	28,760	29,160	29,570	60

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1515.0	1515.1	1515.2	1515.3	1515.4	1515.5	1515.6	1515.7	1515.8	1515.9	1516.0	1516.1	1516.2	1516.3	1516.4	1516.5	1516.6	1516.7	1516.8	1516.9	1517.0	
1	350	350	350	350	350	350	360	360	360	360	360	360	360	370	370	370	370	370	370	370	380	1
2	650	660	660	660	670	670	670	670	680	680	680	680	690	690	690	690	700	700	700	710	710	2
3	1,000	1,010	1,010	1,010	1,020	1,020	1,030	1,030	1,030	1,040	1,040	1,050	1,050	1,060	1,060	1,060	1,070	1,070	1,080	1,080	1,080	3
4	1,310	1,310	1,320	1,320	1,330	1,340	1,340	1,350	1,350	1,360	1,360	1,370	1,370	1,380	1,380	1,390	1,390	1,400	1,410	1,410	1,420	4
5	1,620	1,620	1,630	1,640	1,640	1,650	1,660	1,660	1,670	1,680	1,680	1,690	1,700	1,700	1,710	1,720	1,720	1,730	1,740	1,740	1,750	5
6	1,960	1,970	1,980	1,990	2,000	2,000	2,010	2,020	2,030	2,040	2,050	2,050	2,060	2,070	2,080	2,090	2,090	2,100	2,110	2,120	2,120	6
7	2,270	2,280	2,290	2,300	2,310	2,320	2,330	2,340	2,350	2,360	2,370	2,380	2,380	2,390	2,400	2,410	2,420	2,430	2,440	2,450	2,460	7
8	2,610	2,620	2,630	2,640	2,650	2,670	2,680	2,690	2,700	2,710	2,720	2,730	2,740	2,750	2,760	2,770	2,780	2,790	2,800	2,820	2,830	8
9	2,960	2,970	2,990	3,000	3,010	3,020	3,040	3,050	3,060	3,070	3,090	3,100	3,110	3,120	3,140	3,150	3,160	3,170	3,180	3,200	3,210	9
10	3,300	3,310	3,330	3,340	3,360	3,370	3,380	3,400	3,410	3,430	3,440	3,450	3,470	3,480	3,490	3,510	3,520	3,540	3,550	3,560	3,580	10
11	3,650	3,670	3,680	3,700	3,710	3,730	3,740	3,760	3,780	3,790	3,810	3,820	3,840	3,850	3,870	3,880	3,900	3,910	3,930	3,940	3,960	11
12	4,000	4,020	4,040	4,050	4,070	4,090	4,100	4,120	4,140	4,160	4,170	4,190	4,210	4,220	4,240	4,260	4,270	4,290	4,310	4,320	4,340	12
13	4,340	4,360	4,380	4,400	4,420	4,430	4,450	4,470	4,490	4,510	4,530	4,550	4,560	4,580	4,600	4,620	4,640	4,650	4,670	4,690	4,710	13
14	4,690	4,710	4,730	4,750	4,770	4,790	4,810	4,830	4,850	4,870	4,890	4,910	4,930	4,950	4,970	4,990	5,010	5,030	5,050	5,070	5,090	14
15	5,340	5,360	5,380	5,410	5,430	5,450	5,480	5,500	5,520	5,540	5,570	5,590	5,610	5,630	5,660	5,680	5,700	5,720	5,750	5,770	5,790	15
16	5,980	6,000	6,030	6,060	6,080	6,110	6,130	6,160	6,180	6,210	6,240	6,260	6,290	6,310	6,340	6,360	6,390	6,410	6,430	6,460	6,480	16
17	6,620	6,650	6,680	6,710	6,740	6,760	6,790	6,820	6,850	6,880	6,910	6,940	6,960	6,990	7,020	7,050	7,070	7,100	7,130	7,160	7,180	17
18	7,260	7,290	7,320	7,350	7,390	7,420	7,450	7,480	7,510	7,540	7,570	7,600	7,640	7,670	7,700	7,730	7,760	7,790	7,820	7,850	7,880	18
19	7,900	7,930	7,970	8,000	8,040	8,070	8,110	8,140	8,170	8,210	8,240	8,280	8,310	8,340	8,370	8,410	8,440	8,470	8,510	8,540	8,570	19
20	8,540	8,580	8,620	8,660	8,690	8,730	8,770	8,810	8,840	8,880	8,920	8,950	8,990	9,020	9,060	9,100	9,130	9,170	9,200	9,240	9,270	20
21	9,180	9,220	9,260	9,300	9,340	9,380	9,420	9,460	9,500	9,540	9,580	9,620	9,660	9,700	9,740	9,780	9,820	9,850	9,890	9,930	9,970	21
22	9,790	9,840	9,880	9,930	9,970	10,010	10,060	10,100	10,140	10,180	10,230	10,270	10,310	10,350	10,390	10,440	10,480	10,520	10,560	10,600	10,640	22
23	10,410	10,450	10,500	10,550	10,590	10,640	10,690	10,730	10,780	10,820	10,870	10,920	10,960	11,010	11,050	11,090	11,140	11,180	11,230	11,270	11,320	23
24	11,010	11,070	11,120	11,170	11,220	11,270	11,320	11,360	11,410	11,460	11,510	11,560	11,610	11,650	11,700	11,750	11,800	11,850	11,890	11,940	11,990	24
25	11,620	11,680	11,730	11,790	11,840	11,890	11,940	12,000	12,050	12,100	12,150	12,200	12,250	12,300	12,360	12,410	12,460	12,510	12,560	12,610	12,660	25
26	12,240	12,290	12,350	12,410	12,460	12,520	12,580	12,630	12,690	12,740	12,790	12,850	12,900	12,960	13,010	13,070	13,120	13,170	13,230	13,280	13,330	26
27	12,850	12,910	12,970	13,030	13,090	13,150	13,210	13,260	13,320	13,380	13,440	13,500	13,550	13,610	13,670	13,730	13,780	13,840	13,900	13,950	14,010	27
28	13,460	13,520	13,590	13,650	13,710	13,780	13,840	13,900	13,960	14,020	14,080	14,140	14,200	14,260	14,320	14,380	14,440	14,500	14,560	14,620	14,680	28
29	14,050	14,120	14,180	14,250	14,320	14,380	14,450	14,510	14,580	14,640	14,710	14,770	14,830	14,900	14,960	15,020	15,090	15,150	15,210	15,280	15,340	29
30	14,640	14,710	14,780	14,850	14,920	14,990	15,060	15,130	15,200	15,260	15,330	15,400	15,460	15,530	15,600	15,660	15,730	15,800	15,860	15,930	15,990	30
31	15,230	15,300	15,370	15,450	15,520	15,590	15,670	15,740	15,810	15,880	15,950	16,020	16,090	16,160	16,230	16,300	16,370	16,440	16,510	16,580	16,640	31
32	15,810	15,890	15,970	16,040	16,120	16,200	16,270	16,350	16,420	16,500	16,570	16,640	16,720	16,790	16,860	16,940	17,010	17,080	17,150	17,220	17,300	32
33	16,400	16,480	16,560	16,640	16,720	16,800	16,880	16,960	17,040	17,120	17,200	17,270	17,350	17,430	17,500	17,580	17,650	17,730	17,800	17,880	17,950	33
34	16,990	17,080	17,160	17,240	17,330	17,410	17,490	17,580	17,660	17,740	17,820	17,900	17,980	18,060	18,140	18,220	18,300	18,370	18,450	18,530	18,600	34
35	17,580	17,670	17,760	17,840	17,930	18,020	18,100	18,190	18,280	18,360	18,440	18,530	18,610	18,690	18,780	18,860	18,940	19,020	19,100	19,180	19,260	35
36	18,220	18,310	18,400	18,480	18,570	18,650	18,740	18,820	18,910	18,990	19,080	19,160	19,250	19,330	19,410	19,500	19,580	19,660	19,740	19,830	19,910	36
37	18,850	18,940	19,030	19,110	19,200	19,280	19,360	19,450	19,530	19,620	19,700	19,790	19,880	19,960	20,050	20,130	20,210	20,300	20,380	20,470	20,560	37
38	19,490	19,570	19,660	19,740	19,830	19,910	19,990	20,070	20,160	20,240	20,330	20,420	20,510	20,590	20,680	20,770	20,850	20,940	21,020	21,110	21,200	38
39	20,120	20,200	20,280	20,370	20,450	20,530	20,610	20,690	20,770	20,860	20,950	21,040	21,130	21,220	21,310	21,400	21,480	21,570	21,660	21,750	21,840	39
40	20,750	20,830	20,910	21,000	21,080	21,160	21,240	21,310	21,400	21,490	21,580	21,670	21,760	21,850	21,940	22,030	22,120	22,200	22,290	22,390	22,490	40
41	21,390	21,470	21,550	21,630	21,710	21,790	21,870	21,950	22,030	22,120	22,210	22,310	22,400	22,490	22,580	22,670	22,760	22,850	22,940	23,040	23,140	41
42	22,020	22,100	22,180	22,260	22,340	22,420	22,490	22,570	22,650	22,740	22,840	22,930	23,030	23,120	23,210	23,300	23,390	23,480	23,580	23,680	23,790	42
43	22,880	22,960	23,030	23,100	23,160	23,230	23,290	23,360	23,440	23,520	23,600	23,690	23,770	23,850	23,930	24,010	24,090	24,170	24,270	24,370	24,480	43
44	23,730	23,800	23,860	23,910	23,970	24,020	24,080	24,140	24,210	24,280	24,350	24,430	24,500	24,570	24,640	24,710	24,780	24,870	24,960	25,060	25,160	44
45	24,590	24,640	24,690	24,740	24,780	24,830	24,870	24,920	24,980	25,050	25,110	25,170	25,240	25,290	25,350	25,410	25,470	25,550	25,650	25,750	25,850	45
46	25,430	25,480	25,520	25,550	25,590	25,620	25,650	25,700	25,750	25,800	25,860	25,910	25,960	26,010	26,050	26,100	26,160	26,240	26,330	26,430	26,530	46
47	26,290	26,320	26,350	26,370	26,390	26,410	26,440	26,480	26,520	26,570	26,610	26,650	26,690	26,730	26,760	26,800	26,850	26,930	27,030	27,120	27,220	47
48	27,150	27,170	27,190	27,200	27,220	27,220	27,240	27,270	27,300	27,340	27,370	27,400	27,430	27,460	27,480	27,500	27,550	27,620	27,720	27,810	27,910	48
49	28,000	28,010	28,020	28,020	28,020	28,020	28,030	28,050	28,080	28,100	28,120	28,140	28,160	28,180	28,190	28,200	28,240	28,320	28,410	28,500	28,600	49
50	28,190	28,260	28,330	28,390	28,450	28,500	28,570	28,650	28,740	28,820	28,900	28,970	29,050	29,120	29,200	29,230	29,270	29,350	29,430	29,510	29,590	50

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

HEADWATER ELEVATION

GATE ARRANGE-MENT	1515.0	1515.1	1515.2	1515.3	1515.4	1515.5	1515.6	1515.7	1515.8	1515.9
51	28, 440	28, 570	28, 690	28, 810	28, 930	29, 040	29, 170	29, 300	29, 440	29, 580
52	28, 630	28, 820	28, 990	29, 170	29, 350	29, 520	29, 710	29, 900	30, 100	30, 290
53	28, 880	29, 120	29, 350	29, 590	29, 820	30, 060	30, 300	30, 550	30, 800	31, 050
54	29, 130	29, 420	29, 710	30, 010	30, 300	30, 600	30, 890	31, 200	31, 510	31, 810
55	29, 320	29, 670	30, 020	30, 370	30, 730	31, 080	31, 440	31, 800	32, 160	32, 530
56	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
57	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
58	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
59	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
60	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
61	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
62	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
63	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
64	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290
65	29, 570	29, 970	30, 380	30, 790	31, 200	31, 620	32, 030	32, 450	32, 870	33, 290

1516.0	1516.1	1516.2	1516.3	1516.4	1516.5	1516.6	1516.7	1516.8	1516.9	1517.0	GATE ARRANGE-MENT
29, 720	29, 860	29, 990	30, 120	30, 230	30, 260	30, 300	30, 360	30, 430	30, 500	30, 570	51
30, 480	30, 680	30, 870	31, 060	31, 230	31, 290	31, 330	31, 390	31, 450	31, 500	31, 550	52
31, 300	31, 550	31, 800	32, 060	32, 240	32, 310	32, 340	32, 390	32, 440	32, 490	32, 520	53
32, 120	32, 430	32, 740	33, 050	33, 270	33, 340	33, 370	33, 400	33, 440	33, 480	33, 500	54
32, 900	33, 260	33, 630	34, 000	34, 280	34, 380	34, 410	34, 440	34, 460	34, 490	34, 490	55
33, 720	34, 140	34, 570	35, 000	35, 310	35, 410	35, 430	35, 450	35, 470	35, 480	35, 470	56
33, 720	34, 140	34, 570	35, 000	35, 310	35, 440	35, 520	35, 600	35, 680	35, 750	35, 810	57
33, 720	34, 140	34, 570	35, 000	35, 340	35, 530	35, 670	35, 810	35, 950	36, 080	36, 210	58
33, 720	34, 140	34, 570	35, 000	35, 340	35, 570	35, 770	35, 960	36, 160	36, 350	36, 540	59
33, 720	34, 140	34, 570	35, 000	35, 370	35, 650	35, 910	36, 170	36, 430	36, 690	36, 940	60
33, 720	34, 140	34, 570	35, 000	35, 400	35, 740	36, 060	36, 380	36, 700	37, 020	37, 330	61
33, 720	34, 140	34, 570	35, 000	35, 400	35, 780	36, 160	36, 530	36, 910	37, 290	37, 670	62
33, 720	34, 140	34, 570	35, 000	35, 440	35, 870	36, 310	36, 740	37, 180	37, 630	38, 070	63
33, 720	34, 140	34, 570	35, 000	35, 440	35, 870	36, 310	36, 740	37, 180	37, 630	38, 070	64
33, 720	34, 140	34, 570	35, 000	35, 440	35, 870	36, 310	36, 740	37, 180	37, 630	38, 070	65

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION 1517.0	1517.1	1517.2	1517.3	1517.4	1517.5	1517.6	1517.7	1517.8	1517.9	1518.0	1518.1	1518.2	1518.3	1518.4	1518.5	1518.6	1518.7	1518.8	1518.9	1519.0	GATE ARRANGE-MENT
1	380	380	380	380	380	380	380	380	390	390	390	390	390	390	390	400	400	400	400	400	400	1
2	710	710	710	720	720	720	720	730	730	730	730	740	740	740	740	750	750	750	750	760	760	2
3	1,080	1,090	1,090	1,100	1,100	1,100	1,110	1,110	1,110	1,120	1,120	1,130	1,130	1,130	1,140	1,140	1,140	1,150	1,150	1,160	1,160	3
4	1,420	1,420	1,430	1,430	1,440	1,440	1,450	1,450	1,460	1,460	1,470	1,470	1,480	1,480	1,490	1,490	1,500	1,500	1,510	1,510	1,520	4
5	1,750	1,760	1,760	1,770	1,770	1,780	1,790	1,790	1,800	1,810	1,810	1,820	1,820	1,830	1,840	1,840	1,850	1,850	1,860	1,870	1,870	5
6	2,120	2,130	2,140	2,150	2,160	2,160	2,170	2,180	2,190	2,190	2,200	2,210	2,220	2,220	2,230	2,240	2,250	2,250	2,260	2,270	2,270	6
7	2,460	2,470	2,480	2,480	2,490	2,500	2,510	2,520	2,530	2,540	2,550	2,550	2,560	2,570	2,580	2,590	2,600	2,610	2,610	2,620	2,630	7
8	2,830	2,840	2,850	2,860	2,870	2,880	2,890	2,900	2,910	2,920	2,930	2,940	2,950	2,960	2,970	2,980	2,990	3,000	3,010	3,020	3,030	8
9	3,210	3,220	3,230	3,240	3,250	3,270	3,280	3,290	3,300	3,310	3,320	3,340	3,350	3,360	3,370	3,380	3,390	3,400	3,410	3,430	3,440	9
10	3,580	3,590	3,600	3,610	3,630	3,640	3,650	3,670	3,680	3,690	3,710	3,720	3,730	3,740	3,760	3,770	3,780	3,790	3,810	3,820	3,830	10
11	3,960	3,970	3,990	4,000	4,020	4,030	4,040	4,060	4,070	4,090	4,100	4,120	4,130	4,140	4,160	4,170	4,190	4,200	4,210	4,230	4,240	11
12	4,340	4,350	4,370	4,390	4,400	4,420	4,430	4,450	4,470	4,480	4,500	4,510	4,530	4,540	4,560	4,570	4,590	4,610	4,620	4,640	4,650	12
13	4,710	4,720	4,740	4,760	4,780	4,790	4,810	4,830	4,850	4,860	4,880	4,900	4,910	4,930	4,950	4,960	4,980	5,000	5,010	5,030	5,050	13
14	5,090	5,110	5,130	5,150	5,160	5,180	5,200	5,220	5,240	5,260	5,280	5,290	5,310	5,330	5,350	5,370	5,380	5,400	5,420	5,440	5,460	14
15	5,790	5,810	5,830	5,850	5,880	5,900	5,920	5,940	5,960	5,980	6,000	6,030	6,050	6,070	6,090	6,110	6,130	6,150	6,170	6,190	6,210	15
16	6,480	6,510	6,530	6,560	6,580	6,600	6,630	6,650	6,680	6,700	6,730	6,750	6,770	6,800	6,820	6,840	6,870	6,890	6,920	6,940	6,960	16
17	7,180	7,210	7,240	7,260	7,290	7,320	7,340	7,370	7,400	7,430	7,450	7,480	7,510	7,530	7,560	7,590	7,610	7,640	7,660	7,690	7,720	17
18	7,880	7,910	7,930	7,960	7,990	8,020	8,050	8,080	8,110	8,140	8,170	8,200	8,230	8,260	8,290	8,320	8,350	8,380	8,410	8,430	8,460	18
19	8,570	8,600	8,630	8,670	8,700	8,730	8,760	8,800	8,830	8,860	8,890	8,930	8,960	8,990	9,020	9,050	9,090	9,120	9,150	9,180	9,210	19
20	9,270	9,310	9,340	9,380	9,410	9,450	9,480	9,520	9,550	9,590	9,620	9,660	9,690	9,730	9,760	9,800	9,830	9,870	9,900	9,930	9,970	20
21	9,970	10,000	10,040	10,080	10,120	10,150	10,190	10,230	10,270	10,310	10,350	10,380	10,420	10,460	10,500	10,530	10,570	10,610	10,640	10,680	10,720	21
22	10,640	10,680	10,720	10,760	10,800	10,840	10,880	10,930	10,970	11,010	11,050	11,090	11,130	11,170	11,210	11,250	11,290	11,330	11,370	11,410	11,450	22
23	11,320	11,360	11,400	11,450	11,490	11,530	11,580	11,620	11,660	11,710	11,750	11,790	11,840	11,880	11,920	11,960	12,010	12,050	12,090	12,130	12,170	23
24	11,990	12,030	12,080	12,130	12,170	12,220	12,270	12,310	12,360	12,410	12,450	12,500	12,540	12,590	12,630	12,680	12,720	12,770	12,810	12,860	12,900	24
25	12,660	12,710	12,760	12,810	12,860	12,910	12,960	13,000	13,050	13,100	13,150	13,200	13,250	13,300	13,340	13,390	13,440	13,490	13,530	13,580	13,630	25
26	13,330	13,390	13,440	13,490	13,540	13,600	13,650	13,700	13,750	13,800	13,850	13,910	13,960	14,010	14,060	14,110	14,160	14,210	14,260	14,310	14,360	26
27	14,010	14,060	14,120	14,180	14,230	14,290	14,340	14,390	14,450	14,500	14,560	14,610	14,660	14,720	14,770	14,820	14,880	14,930	14,980	15,030	15,080	27
28	14,680	14,740	14,800	14,860	14,920	14,980	15,030	15,090	15,150	15,200	15,260	15,320	15,370	15,430	15,480	15,540	15,590	15,650	15,700	15,760	15,810	28
29	15,340	15,400	15,460	15,520	15,580	15,640	15,700	15,760	15,820	15,880	15,940	16,000	16,060	16,120	16,180	16,240	16,300	16,350	16,410	16,470	16,530	29
30	15,990	16,060	16,120	16,190	16,250	16,310	16,380	16,440	16,500	16,560	16,630	16,690	16,750	16,810	16,880	16,940	17,000	17,060	17,120	17,180	17,240	30
31	16,640	16,710	16,780	16,850	16,910	16,980	17,040	17,110	17,180	17,240	17,310	17,370	17,440	17,500	17,570	17,630	17,700	17,760	17,830	17,890	17,950	31
32	17,300	17,370	17,440	17,510	17,570	17,640	17,710	17,780	17,850	17,920	17,980	18,050	18,120	18,190	18,260	18,330	18,400	18,460	18,530	18,600	18,660	32
33	17,950	18,020	18,100	18,170	18,240	18,310	18,380	18,460	18,530	18,600	18,670	18,740	18,810	18,880	18,960	19,030	19,100	19,170	19,240	19,310	19,380	33
34	18,600	18,680	18,760	18,830	18,910	18,980	19,060	19,130	19,200	19,280	19,350	19,430	19,500	19,580	19,650	19,730	19,800	19,870	19,950	20,020	20,090	34
35	19,260	19,340	19,420	19,500	19,570	19,650	19,730	19,800	19,880	19,960	20,030	20,110	20,190	20,270	20,350	20,430	20,500	20,580	20,660	20,730	20,810	35
36	19,910	19,990	20,070	20,160	20,240	20,320	20,400	20,480	20,560	20,640	20,720	20,800	20,880	20,960	21,040	21,120	21,210	21,290	21,360	21,440	21,520	36
37	20,560	20,640	20,730	20,810	20,900	20,980	21,070	21,150	21,230	21,320	21,400	21,480	21,570	21,650	21,740	21,820	21,900	21,990	22,070	22,150	22,230	37
38	21,200	21,290	21,380	21,470	21,560	21,650	21,730	21,820	21,910	21,990	22,080	22,170	22,250	22,340	22,430	22,510	22,600	22,680	22,770	22,850	22,940	38
39	21,840	21,940	22,030	22,120	22,210	22,300	22,400	22,490	22,580	22,670	22,760	22,850	22,940	23,030	23,110	23,200	23,290	23,380	23,470	23,550	23,640	39
40	22,490	22,590	22,680	22,780	22,870	22,970	23,060	23,160	23,250	23,340	23,440	23,530	23,620	23,710	23,810	23,900	23,990	24,080	24,170	24,260	24,350	40
41	23,140	23,240	23,340	23,440	23,540	23,640	23,730	23,830	23,930	24,030	24,120	24,220	24,310	24,410	24,500	24,600	24,690	24,780	24,880	24,970	25,060	41
42	23,790	23,890	23,990	24,100	24,200	24,300	24,400	24,500	24,600	24,700	24,800	24,900	25,000	25,100	25,200	25,290	25,390	25,480	25,580	25,670	25,770	42
43	24,480	24,580	24,680	24,780	24,880	24,980	25,080	25,180	25,280	25,380	25,480	25,580	25,680	25,780	25,870	25,970	26,070	26,160	26,260	26,360	26,460	43
44	25,160	25,260	25,360	25,460	25,560	25,660	25,760	25,860	25,960	26,060	26,160	26,260	26,360	26,450	26,550	26,650	26,750	26,850	26,950	27,050	27,150	44
45	25,850	25,950	26,040	26,140	26,230	26,330	26,430	26,530	26,630	26,730	26,830	26,930	27,030	27,130	27,220	27,320	27,420	27,520	27,630	27,730	27,840	45
46	26,530	26,630	26,720	26,810	26,910	27,000	27,100	27,200	27,300	27,400	27,500	27,600	27,700	27,800	27,900	27,990	28,090	28,200	28,310	28,420	28,530	46
47	27,220	27,310	27,400	27,500	27,590	27,680	27,770	27,870	27,980	28,080	28,180	28,280	28,380	28,480	28,580	28,670	28,770	28,890	29,000	29,110	29,220	47
48	27,910	28,000	28,090	28,180	28,270	28,360	28,450	28,550	28,650	28,750	28,860	28,960	29,060	29,150	29,250	29,350	29,450	29,570	29,680	29,800	29,910	48
49	28,600	28,690	28,770	28,860	28,950	29,030	29,120	29,230	29,330	29,430	29,530	29,630	29,730	29,830	29,930	30,030	30,130	30,250	30,370	30,490	30,610	49
50	29,590	29,670	29,740	29,810	29,880	29,960	30,040	30,130	30,220	30,310	30,400	30,490	30,570	30,660	30,740	30,830	30,940	31,050	31,170	31,280	31,400	50

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1517.0	1517.1	1517.2	1517.3	1517.4	1517.5	1517.6	1517.7	1517.8	1517.9	1518.0	1518.1	1518.2	1518.3	1518.4	1518.5	1518.6	1518.7	1518.8	1518.9	1519.0	
51	30, 570	30, 630	30, 690	30, 740	30, 800	30, 870	30, 940	31, 020	31, 090	31, 170	31, 250	31, 320	31, 390	31, 460	31, 540	31, 630	31, 730	31, 840	31, 960	32, 070	32, 180	51
52	31, 550	31, 600	31, 640	31, 690	31, 730	31, 780	31, 850	31, 910	31, 980	32, 040	32, 100	32, 160	32, 220	32, 280	32, 340	32, 430	32, 530	32, 640	32, 740	32, 850	32, 960	52
53	32, 520	32, 550	32, 580	32, 610	32, 640	32, 690	32, 740	32, 790	32, 840	32, 890	32, 940	32, 990	33, 030	33, 080	33, 140	33, 220	33, 320	33, 420	33, 520	33, 630	33, 730	53
54	33, 500	33, 510	33, 530	33, 540	33, 560	33, 600	33, 630	33, 680	33, 720	33, 750	33, 790	33, 820	33, 850	33, 880	33, 940	34, 020	34, 120	34, 210	34, 310	34, 410	34, 510	54
55	34, 490	34, 500	34, 500	34, 490	34, 500	34, 520	34, 550	34, 580	34, 610	34, 630	34, 650	34, 670	34, 690	34, 710	34, 750	34, 820	34, 920	35, 020	35, 110	35, 200	35, 300	55
56	35, 470	35, 460	35, 440	35, 420	35, 420	35, 430	35, 450	35, 470	35, 480	35, 490	35, 500	35, 510	35, 510	35, 520	35, 540	35, 620	35, 720	35, 810	35, 900	35, 990	36, 080	56
57	35, 810	35, 860	35, 910	35, 960	36, 020	36, 100	36, 180	36, 260	36, 340	36, 410	36, 490	36, 560	36, 630	36, 700	36, 800	36, 940	37, 080	37, 230	37, 380	37, 520	37, 670	57
58	36, 210	36, 330	36, 440	36, 560	36, 680	36, 820	36, 970	37, 110	37, 250	37, 390	37, 530	37, 670	37, 810	37, 940	38, 100	38, 290	38, 500	38, 700	38, 900	39, 100	39, 300	58
59	36, 540	36, 720	36, 910	37, 090	37, 280	37, 490	37, 690	37, 900	38, 100	38, 310	38, 510	38, 710	38, 920	39, 120	39, 340	39, 590	39, 850	40, 110	40, 360	40, 620	40, 880	59
60	36, 940	37, 180	37, 430	37, 680	37, 940	38, 200	38, 470	38, 740	39, 010	39, 280	39, 540	39, 810	40, 080	40, 350	40, 630	40, 940	41, 250	41, 560	41, 870	42, 180	42, 500	60
61	37, 330	37, 650	37, 960	38, 280	38, 600	38, 930	39, 260	39, 590	39, 920	40, 250	40, 590	40, 920	41, 260	41, 590	41, 940	42, 300	42, 660	43, 030	43, 400	43, 760	44, 130	61
62	37, 670	38, 050	38, 430	38, 820	39, 200	39, 600	39, 990	40, 380	40, 780	41, 180	41, 580	41, 980	42, 380	42, 780	43, 190	43, 610	44, 030	44, 450	44, 870	45, 300	45, 730	62
63	38, 070	38, 520	38, 960	39, 410	39, 870	40, 320	40, 780	41, 230	41, 690	42, 160	42, 620	43, 090	43, 550	44, 020	44, 490	44, 970	45, 440	45, 920	46, 400	46, 880	47, 360	63
64	38, 070	38, 520	38, 960	39, 410	39, 870	40, 320	40, 780	41, 230	41, 690	42, 160	42, 620	43, 090	43, 550	44, 020	44, 490	44, 970	45, 440	45, 920	46, 400	46, 880	47, 360	64
65	38, 070	38, 520	38, 960	39, 410	39, 870	40, 320	40, 780	41, 230	41, 690	42, 160	42, 620	43, 090	43, 550	44, 020	44, 490	44, 970	45, 440	45, 920	46, 400	46, 880	47, 360	65

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1519.0	1519.1	1519.2	1519.3	1519.4	1519.5	1519.6	1519.7	1519.8	1519.9	1520.0	1520.1	1520.2	1520.3	1520.4	1520.5	1520.6	1520.7	1520.8	1520.9	1521.0	
1	400	400	400	410	410	410	410	410	410	410	410	420	420	420	420	420	420	420	420	430	430	1
2	760	760	760	770	770	770	770	770	780	780	780	780	790	790	790	790	800	800	800	800	800	2
3	1,160	1,160	1,170	1,170	1,170	1,180	1,180	1,190	1,190	1,190	1,200	1,200	1,200	1,210	1,210	1,210	1,220	1,220	1,220	1,230	1,230	3
4	1,520	1,520	1,530	1,530	1,530	1,540	1,540	1,550	1,550	1,560	1,560	1,570	1,570	1,580	1,580	1,590	1,590	1,600	1,600	1,610	1,610	4
5	1,870	1,880	1,880	1,890	1,900	1,900	1,910	1,910	1,920	1,930	1,930	1,940	1,940	1,950	1,950	1,960	1,970	1,970	1,980	1,980	1,990	5
6	2,270	2,280	2,290	2,300	2,300	2,310	2,320	2,330	2,330	2,340	2,350	2,350	2,360	2,370	2,370	2,380	2,390	2,400	2,400	2,410	2,420	6
7	2,630	2,640	2,650	2,660	2,660	2,670	2,680	2,690	2,700	2,710	2,710	2,720	2,730	2,740	2,750	2,750	2,760	2,770	2,780	2,790	2,790	7
8	3,030	3,040	3,050	3,060	3,070	3,080	3,080	3,090	3,100	3,110	3,120	3,130	3,140	3,150	3,160	3,170	3,180	3,190	3,200	3,210	3,220	8
9	3,440	3,450	3,460	3,470	3,480	3,490	3,500	3,510	3,520	3,540	3,550	3,560	3,570	3,580	3,590	3,600	3,610	3,620	3,630	3,640	3,650	9
10	3,830	3,840	3,860	3,870	3,880	3,890	3,910	3,920	3,930	3,940	3,950	3,970	3,980	3,990	4,000	4,010	4,030	4,040	4,050	4,060	4,070	10
11	4,240	4,250	4,270	4,280	4,300	4,310	4,320	4,340	4,350	4,360	4,380	4,390	4,400	4,420	4,430	4,440	4,460	4,470	4,480	4,500	4,510	11
12	4,650	4,670	4,680	4,700	4,710	4,730	4,740	4,760	4,770	4,790	4,800	4,810	4,830	4,840	4,860	4,870	4,890	4,900	4,920	4,930	4,940	12
13	5,050	5,060	5,080	5,100	5,110	5,130	5,140	5,160	5,180	5,190	5,210	5,220	5,240	5,260	5,270	5,290	5,300	5,320	5,330	5,350	5,370	13
14	5,460	5,470	5,490	5,510	5,530	5,540	5,560	5,580	5,600	5,610	5,630	5,650	5,670	5,680	5,700	5,720	5,730	5,750	5,770	5,780	5,800	14
15	6,210	6,230	6,250	6,270	6,290	6,310	6,330	6,350	6,370	6,390	6,410	6,430	6,450	6,470	6,490	6,510	6,530	6,550	6,570	6,590	6,610	15
16	6,960	6,980	7,010	7,030	7,050	7,080	7,100	7,120	7,140	7,170	7,190	7,210	7,230	7,260	7,280	7,300	7,320	7,340	7,370	7,390	7,410	16
17	7,720	7,740	7,770	7,790	7,820	7,840	7,870	7,890	7,920	7,940	7,970	7,990	8,020	8,040	8,070	8,090	8,120	8,140	8,170	8,190	8,220	17
18	8,460	8,490	8,520	8,550	8,580	8,600	8,630	8,660	8,690	8,720	8,740	8,770	8,800	8,830	8,850	8,880	8,910	8,930	8,960	8,990	9,020	18
19	9,210	9,240	9,270	9,310	9,340	9,370	9,400	9,430	9,460	9,490	9,520	9,550	9,580	9,610	9,640	9,670	9,700	9,730	9,760	9,790	9,820	19
20	9,970	10,000	10,040	10,070	10,100	10,140	10,170	10,200	10,240	10,270	10,300	10,330	10,370	10,400	10,430	10,460	10,500	10,530	10,560	10,590	10,620	20
21	10,720	10,750	10,790	10,830	10,860	10,900	10,930	10,970	11,010	11,040	11,080	11,110	11,150	11,180	11,220	11,250	11,290	11,320	11,360	11,390	11,420	21
22	11,450	11,490	11,520	11,560	11,600	11,640	11,680	11,720	11,760	11,790	11,830	11,870	11,910	11,950	11,980	12,020	12,060	12,100	12,130	12,170	12,210	22
23	12,170	12,220	12,260	12,300	12,340	12,380	12,420	12,470	12,510	12,550	12,590	12,630	12,670	12,710	12,750	12,790	12,830	12,870	12,910	12,950	12,990	23
24	12,900	12,940	12,990	13,030	13,080	13,120	13,170	13,210	13,250	13,300	13,340	13,390	13,430	13,470	13,520	13,560	13,600	13,640	13,690	13,730	13,770	24
25	13,630	13,670	13,720	13,770	13,810	13,860	13,910	13,960	14,000	14,050	14,100	14,140	14,190	14,230	14,280	14,330	14,370	14,420	14,460	14,510	14,550	25
26	14,360	14,400	14,450	14,500	14,550	14,600	14,650	14,700	14,750	14,800	14,850	14,900	14,950	15,000	15,050	15,100	15,140	15,190	15,240	15,290	15,330	26
27	15,080	15,140	15,190	15,240	15,290	15,350	15,400	15,450	15,500	15,560	15,610	15,660	15,710	15,760	15,810	15,860	15,920	15,970	16,020	16,070	16,120	27
28	15,810	15,870	15,920	15,980	16,030	16,090	16,140	16,200	16,250	16,310	16,360	16,420	16,470	16,530	16,580	16,630	16,690	16,740	16,800	16,850	16,900	28
29	16,530	16,580	16,640	16,700	16,760	16,820	16,880	16,930	16,990	17,050	17,110	17,160	17,220	17,280	17,330	17,390	17,450	17,500	17,560	17,610	17,670	29
30	17,240	17,300	17,360	17,430	17,490	17,550	17,610	17,670	17,730	17,790	17,850	17,910	17,970	18,030	18,090	18,150	18,210	18,260	18,320	18,380	18,440	30
31	17,950	18,020	18,080	18,140	18,210	18,270	18,340	18,400	18,460	18,530	18,590	18,650	18,710	18,770	18,840	18,900	18,960	19,020	19,080	19,140	19,200	31
32	18,660	18,730	18,800	18,860	18,930	19,000	19,060	19,130	19,200	19,260	19,330	19,390	19,460	19,520	19,590	19,650	19,710	19,780	19,840	19,900	19,970	32
33	19,380	19,450	19,520	19,590	19,660	19,730	19,800	19,870	19,930	20,000	20,070	20,140	20,210	20,270	20,340	20,410	20,470	20,540	20,610	20,670	20,740	33
34	20,090	20,170	20,240	20,310	20,390	20,460	20,530	20,600	20,670	20,740	20,810	20,880	20,950	21,020	21,090	21,160	21,230	21,300	21,370	21,440	21,510	34
35	20,810	20,890	20,960	21,040	21,110	21,190	21,260	21,340	21,410	21,480	21,560	21,630	21,700	21,770	21,850	21,920	21,990	22,060	22,130	22,200	22,270	35
36	21,520	21,600	21,680	21,760	21,830	21,910	21,990	22,070	22,140	22,220	22,290	22,370	22,450	22,520	22,600	22,670	22,740	22,820	22,890	22,970	23,040	36
37	22,230	22,310	22,390	22,470	22,550	22,630	22,710	22,790	22,870	22,950	23,030	23,110	23,180	23,260	23,340	23,420	23,490	23,570	23,650	23,720	23,800	37
38	22,940	23,020	23,100	23,190	23,270	23,350	23,430	23,520	23,600	23,680	23,760	23,840	23,920	24,000	24,080	24,160	24,240	24,320	24,400	24,480	24,560	38
39	23,640	23,730	23,810	23,900	23,980	24,070	24,150	24,240	24,320	24,400	24,490	24,570	24,660	24,740	24,820	24,900	24,990	25,070	25,150	25,230	25,310	39
40	24,350	24,440	24,530	24,610	24,700	24,790	24,870	24,960	25,050	25,130	25,220	25,310	25,390	25,480	25,570	25,650	25,740	25,820	25,900	25,990	26,070	40
41	25,060	25,150	25,240	25,330	25,420	25,510	25,600	25,690	25,780	25,870	25,960	26,050	26,140	26,230	26,310	26,400	26,490	26,580	26,660	26,750	26,840	41
42	25,770	25,860	25,960	26,050	26,140	26,230	26,330	26,420	26,510	26,600	26,690	26,790	26,880	26,970	27,060	27,150	27,240	27,330	27,420	27,510	27,600	42
43	26,460	26,560	26,650	26,750	26,850	26,940	27,040	27,130	27,230	27,320	27,420	27,510	27,610	27,700	27,790	27,890	27,980	28,070	28,160	28,260	28,350	43
44	27,150	27,260	27,360	27,460	27,550	27,650	27,750	27,850	27,950	28,050	28,150	28,240	28,340	28,440	28,530	28,630	28,730	28,820	28,920	29,010	29,110	44
45	27,840	27,940	28,050	28,150	28,250	28,350	28,460	28,560	28,660	28,760	28,860	28,960	29,060	29,160	29,260	29,360	29,460	29,560	29,660	29,750	29,850	45
46	28,530	28,630	28,740	28,850	28,950	29,060	29,170	29,270	29,370	29,480	29,580	29,690	29,790	29,890	30,000	30,100	30,200	30,300	30,400	30,500	30,600	46
47	29,220	29,330	29,440	29,550	29,660	29,770	29,880	29,990	30,100	30,210	30,310	30,420	30,530	30,630	30,740	30,840	30,950	31,050	31,150	31,260	31,360	47
48	29,910	30,030	30,140	30,260	30,370	30,480	30,590	30,700	30,810	30,930	31,040	31,150	31,250	31,360	31,470	31,580	31,690	31,790	31,900	32,010	32,110	48
49	30,610	30,730	30,840	30,960	31,080	31,190	31,310	31,420	31,540	31,650	31,760	31,880	31,990	32,100	32,210	32,320	32,430	32,540	32,650	32,760	32,870	49
50	31,400	31,510	31,620	31,740	31,850	31,960	32,070	32,190	32,300	32,420	32,530	32,640	32,750	32,860	32,970	33,080	33,200	33,310	33,420	33,530	33,640	50

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1519.0	1519.1	1519.2	1519.3	1519.4	1519.5	1519.6	1519.7	1519.8	1519.9	1520.0	1520.1	1520.2	1520.3	1520.4	1520.5	1520.6	1520.7	1520.8	1520.9	1521.0	
51	32,180	32,290	32,390	32,500	32,610	32,720	32,840	32,950	33,060	33,180	33,290	33,400	33,510	33,620	33,730	33,840	33,960	34,070	34,190	34,300	34,410	51
52	32,960	33,060	33,160	33,270	33,370	33,480	33,600	33,710	33,820	33,930	34,040	34,150	34,260	34,370	34,480	34,600	34,710	34,830	34,940	35,060	35,170	52
53	33,730	33,830	33,930	34,020	34,130	34,240	34,350	34,460	34,570	34,680	34,790	34,900	35,010	35,120	35,230	35,350	35,470	35,590	35,700	35,820	35,940	53
54	34,510	34,600	34,700	34,790	34,890	35,000	35,110	35,220	35,330	35,440	35,550	35,660	35,770	35,880	35,990	36,110	36,230	36,350	36,470	36,590	36,710	54
55	35,300	35,390	35,480	35,560	35,660	35,770	35,880	35,990	36,100	36,210	36,320	36,420	36,530	36,640	36,750	36,870	36,990	37,110	37,240	37,360	37,480	55
56	36,080	36,160	36,250	36,330	36,420	36,530	36,640	36,750	36,860	36,970	37,080	37,180	37,290	37,390	37,500	37,630	37,750	37,880	38,000	38,130	38,250	56
57	37,670	37,810	37,950	38,090	38,240	38,410	38,570	38,740	38,900	39,070	39,230	39,350	39,440	39,530	39,630	39,730	39,840	39,940	40,040	40,140	40,240	57
58	39,300	39,500	39,700	39,900	40,110	40,330	40,550	40,770	40,990	41,210	41,390	41,490	41,570	41,640	41,720	41,810	41,890	41,970	42,050	42,120	42,200	58
59	40,880	41,130	41,390	41,650	41,910	42,190	42,460	42,740	43,010	43,290	43,520	43,630	43,690	43,750	43,820	43,890	43,950	44,000	44,060	44,110	44,170	59
60	42,500	42,810	43,120	43,440	43,760	44,090	44,410	44,750	45,080	45,410	45,650	45,750	45,800	45,840	45,890	45,940	45,980	46,010	46,040	46,070	46,110	60
61	44,130	44,500	44,880	45,250	45,620	46,010	46,390	46,780	47,160	47,550	47,810	47,890	47,920	47,960	47,990	48,010	48,030	48,040	48,050	48,050	48,070	61
62	45,730	46,150	46,580	47,010	47,450	47,880	48,320	48,760	49,210	49,650	49,960	50,050	50,070	50,090	50,110	50,120	50,110	50,100	50,080	50,060	50,060	62
63	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,120	52,200	52,200	52,210	52,210	52,190	52,160	52,130	52,090	52,040	52,020	63
64	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,120	52,240	52,320	52,400	52,470	52,530	52,580	52,620	52,660	52,700	52,750	64
65	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,160	52,360	52,510	52,660	52,800	52,940	53,060	53,190	53,310	53,420	53,560	65
66	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,160	52,410	52,630	52,840	53,060	53,270	53,470	53,670	53,870	54,070	54,280	66
67	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,210	52,520	52,810	53,100	53,390	53,680	53,960	54,230	54,510	54,790	55,070	67
68	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,250	52,630	53,000	53,360	53,720	54,080	54,440	54,800	55,160	55,510	55,880	68
69	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,250	52,680	53,120	53,550	53,990	54,420	54,860	55,290	55,730	56,170	56,610	69
70	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,290	52,800	53,300	53,810	54,320	54,830	55,340	55,860	56,380	56,890	57,410	70
71	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,290	52,800	53,300	53,810	54,320	54,830	55,340	55,860	56,380	56,890	57,410	71
72	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,290	52,800	53,300	53,810	54,320	54,830	55,340	55,860	56,380	56,890	57,410	72
73	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,290	52,800	53,300	53,810	54,320	54,830	55,340	55,860	56,380	56,890	57,410	73
74	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,290	52,800	53,300	53,810	54,320	54,830	55,340	55,860	56,380	56,890	57,410	74
75	47,360	47,850	48,330	48,820	49,310	49,800	50,300	50,790	51,290	51,790	52,290	52,800	53,300	53,810	54,320	54,830	55,340	55,860	56,380	56,890	57,410	75

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1521.0	1521.1	1521.2	1521.3	1521.4	1521.5	1521.6	1521.7	1521.8	1521.9	1522.0	1522.1	1522.2	1522.3	1522.4	1522.5	1522.6	1522.7	1522.8	1522.9	1523.0	
1	430	430	430	430	430	430	430	440	440	440	440	440	440	440	440	440	450	450	450	450	450	1
2	800	810	810	810	810	820	820	820	820	830	830	830	830	830	840	840	840	840	840	850	850	2
3	1,230	1,240	1,240	1,240	1,250	1,250	1,250	1,260	1,260	1,260	1,270	1,270	1,270	1,280	1,280	1,280	1,290	1,290	1,290	1,300	1,300	3
4	1,610	1,610	1,620	1,620	1,630	1,630	1,640	1,640	1,650	1,650	1,650	1,660	1,660	1,670	1,670	1,680	1,680	1,690	1,690	1,690	1,700	4
5	1,990	1,990	2,000	2,000	2,010	2,020	2,020	2,030	2,030	2,040	2,040	2,050	2,050	2,060	2,070	2,070	2,080	2,080	2,090	2,090	2,100	5
6	2,420	2,420	2,430	2,440	2,440	2,450	2,460	2,460	2,470	2,480	2,480	2,490	2,500	2,500	2,510	2,520	2,520	2,530	2,540	2,540	2,550	6
7	2,790	2,800	2,810	2,820	2,830	2,830	2,840	2,850	2,860	2,860	2,870	2,880	2,890	2,900	2,900	2,910	2,920	2,930	2,930	2,940	2,950	7
8	3,220	3,220	3,230	3,240	3,250	3,260	3,270	3,280	3,290	3,300	3,310	3,310	3,320	3,330	3,340	3,350	3,360	3,370	3,380	3,380	3,390	8
9	3,650	3,660	3,670	3,680	3,690	3,700	3,710	3,720	3,730	3,740	3,750	3,760	3,770	3,780	3,790	3,800	3,810	3,820	3,830	3,840	3,850	9
10	4,070	4,080	4,100	4,110	4,120	4,130	4,140	4,150	4,160	4,180	4,190	4,200	4,210	4,220	4,230	4,240	4,250	4,270	4,280	4,290	4,300	10
11	4,510	4,520	4,530	4,550	4,560	4,570	4,580	4,600	4,610	4,620	4,640	4,650	4,660	4,670	4,690	4,700	4,710	4,720	4,740	4,750	4,760	11
12	4,940	4,960	4,970	4,990	5,000	5,010	5,030	5,040	5,060	5,070	5,080	5,100	5,110	5,130	5,140	5,150	5,170	5,180	5,190	5,210	5,220	12
13	5,370	5,380	5,400	5,410	5,430	5,440	5,460	5,470	5,490	5,500	5,520	5,530	5,550	5,560	5,580	5,590	5,610	5,620	5,640	5,650	5,670	13
14	5,800	5,820	5,830	5,850	5,870	5,880	5,900	5,920	5,930	5,950	5,970	5,980	6,000	6,020	6,030	6,050	6,060	6,080	6,100	6,110	6,130	14
15	6,610	6,630	6,650	6,670	6,690	6,710	6,720	6,740	6,760	6,780	6,800	6,820	6,840	6,860	6,870	6,890	6,910	6,930	6,950	6,970	6,980	15
16	7,410	7,430	7,450	7,480	7,500	7,520	7,540	7,560	7,580	7,600	7,630	7,650	7,670	7,690	7,710	7,730	7,750	7,770	7,790	7,810	7,830	16
17	8,220	8,240	8,260	8,290	8,310	8,340	8,360	8,380	8,410	8,430	8,460	8,480	8,500	8,530	8,550	8,570	8,600	8,620	8,640	8,670	8,690	17
18	9,020	9,040	9,070	9,100	9,120	9,150	9,170	9,200	9,230	9,250	9,280	9,310	9,330	9,360	9,380	9,410	9,430	9,460	9,480	9,510	9,540	18
19	9,820	9,850	9,870	9,900	9,930	9,960	9,990	10,020	10,050	10,080	10,100	10,130	10,160	10,190	10,220	10,250	10,270	10,300	10,330	10,360	10,380	19
20	10,620	10,660	10,690	10,720	10,750	10,780	10,810	10,840	10,880	10,910	10,940	10,970	11,000	11,030	11,060	11,090	11,120	11,150	11,180	11,210	11,240	20
21	11,420	11,460	11,490	11,530	11,560	11,600	11,630	11,660	11,700	11,730	11,760	11,800	11,830	11,860	11,900	11,930	11,960	11,990	12,030	12,060	12,090	21
22	12,210	12,250	12,280	12,320	12,360	12,390	12,430	12,460	12,500	12,540	12,570	12,610	12,640	12,680	12,720	12,750	12,790	12,820	12,860	12,890	12,930	22
23	12,990	13,030	13,070	13,110	13,150	13,190	13,230	13,270	13,300	13,340	13,380	13,420	13,460	13,500	13,530	13,570	13,610	13,650	13,690	13,720	13,760	23
24	13,770	13,810	13,860	13,900	13,940	13,980	14,020	14,060	14,110	14,150	14,190	14,230	14,270	14,310	14,350	14,390	14,430	14,470	14,510	14,550	14,590	24
25	14,550	14,600	14,640	14,690	14,730	14,770	14,820	14,860	14,910	14,950	14,990	15,040	15,080	15,120	15,170	15,210	15,250	15,300	15,340	15,380	15,420	25
26	15,330	15,380	15,430	15,480	15,520	15,570	15,620	15,660	15,710	15,760	15,800	15,850	15,900	15,940	15,990	16,030	16,080	16,120	16,170	16,210	16,260	26
27	16,120	16,170	16,220	16,270	16,320	16,370	16,420	16,470	16,520	16,560	16,610	16,660	16,710	16,760	16,810	16,850	16,900	16,950	17,000	17,050	17,090	27
28	16,900	16,950	17,010	17,060	17,110	17,160	17,220	17,270	17,320	17,370	17,420	17,470	17,520	17,580	17,630	17,680	17,730	17,780	17,830	17,880	17,930	28
29	17,670	17,730	17,780	17,840	17,890	17,950	18,000	18,060	18,110	18,160	18,220	18,270	18,330	18,380	18,430	18,490	18,540	18,590	18,650	18,700	18,750	29
30	18,440	18,500	18,560	18,610	18,670	18,730	18,790	18,840	18,900	18,960	19,020	19,070	19,130	19,190	19,240	19,300	19,350	19,410	19,460	19,520	19,580	30
31	19,200	19,260	19,330	19,390	19,450	19,510	19,570	19,630	19,690	19,750	19,810	19,870	19,930	19,990	20,040	20,100	20,160	20,220	20,280	20,340	20,390	31
32	19,970	20,030	20,100	20,160	20,220	20,290	20,350	20,410	20,480	20,540	20,600	20,660	20,720	20,790	20,850	20,910	20,970	21,030	21,090	21,150	21,210	32
33	20,740	20,800	20,870	20,940	21,000	21,070	21,140	21,200	21,270	21,330	21,400	21,460	21,530	21,590	21,660	21,720	21,780	21,850	21,910	21,970	22,040	33
34	21,510	21,580	21,640	21,710	21,780	21,850	21,920	21,990	22,060	22,130	22,190	22,260	22,330	22,400	22,460	22,530	22,600	22,660	22,730	22,800	22,860	34
35	22,270	22,350	22,420	22,490	22,560	22,640	22,710	22,780	22,850	22,920	22,990	23,060	23,130	23,200	23,270	23,340	23,410	23,480	23,550	23,620	23,690	35
36	23,040	23,110	23,190	23,260	23,340	23,410	23,480	23,560	23,630	23,700	23,780	23,850	23,920	23,990	24,070	24,140	24,210	24,280	24,350	24,420	24,490	36
37	23,800	23,880	23,950	24,030	24,110	24,180	24,260	24,330	24,410	24,480	24,560	24,630	24,710	24,780	24,850	24,930	25,000	25,070	25,150	25,220	25,300	37
38	24,560	24,640	24,720	24,790	24,870	24,950	25,030	25,110	25,180	25,260	25,340	25,410	25,490	25,570	25,640	25,720	25,790	25,870	25,940	26,020	26,100	38
39	25,310	25,390	25,470	25,560	25,640	25,720	25,800	25,880	25,960	26,030	26,110	26,190	26,270	26,350	26,430	26,500	26,580	26,660	26,740	26,820	26,900	39
40	26,070	26,160	26,240	26,320	26,400	26,490	26,570	26,650	26,730	26,810	26,890	26,980	27,060	27,140	27,220	27,300	27,370	27,450	27,530	27,620	27,700	40
41	26,840	26,920	27,010	27,090	27,180	27,260	27,350	27,430	27,510	27,600	27,680	27,760	27,850	27,930	28,010	28,090	28,170	28,250	28,340	28,420	28,510	41
42	27,600	27,680	27,770	27,860	27,950	28,030	28,120	28,210	28,290	28,380	28,460	28,550	28,630	28,720	28,800	28,880	28,970	29,050	29,130	29,220	29,310	42
43	28,350	28,440	28,530	28,620	28,710	28,800	28,890	28,980	29,060	29,150	29,240	29,330	29,420	29,500	29,590	29,670	29,760	29,850	29,930	30,020	30,110	43
44	29,110	29,200	29,290	29,390	29,480	29,570	29,660	29,750	29,840	29,930	30,030	30,120	30,200	30,290	30,380	30,470	30,560	30,650	30,740	30,830	30,920	44
45	29,850	29,950	30,040	30,140	30,230	30,330	30,420	30,520	30,610	30,700	30,800	30,890	30,980	31,070	31,170	31,260	31,350	31,440	31,530	31,620	31,720	45
46	30,600	30,700	30,800	30,900	31,000	31,090	31,190	31,290	31,380	31,480	31,570	31,670	31,760	31,860	31,950	32,050	32,140	32,230	32,330	32,420	32,520	46
47	31,360	31,460	31,560	31,660	31,760	31,860	31,960	32,060	32,160	32,260	32,360	32,460	32,550	32,650	32,750	32,840	32,940	33,030	33,130	33,230	33,320	47
48	32,110	32,210	32,320	32,420	32,530	32,630	32,730	32,830	32,940	33,040	33,140	33,240	33,340	33,440	33,540	33,640	33,730	33,830	33,930	34,030	34,130	48
49	32,870	32,980	33,080	33,190	33,290	33,400	33,510	33,610	33,710	33,820	33,920	34,030	34,130	34,230	34,330	34,430	34,530	34,630	34,730	34,830	34,930	49
50	33,640	33,750	33,860	33,970	34,080	34,180	34,290	34,400	34,500	34,610	34,720	34,820	34,920	35,030	35,130	35,240	35,340	35,440	35,540	35,640	35,740	50

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1521.0	1521.1	1521.2	1521.3	1521.4	1521.5	1521.6	1521.7	1521.8	1521.9	1522.0	1522.1	1522.2	1522.3	1522.4	1522.5	1522.6	1522.7	1522.8	1522.9	1523.0	
51	34, 410	34, 520	34, 630	34, 740	34, 860	34, 970	35, 070	35, 180	35, 290	35, 400	35, 510	35, 610	35, 720	35, 830	35, 930	36, 040	36, 140	36, 240	36, 350	36, 450	36, 550	51
52	35, 170	35, 290	35, 400	35, 520	35, 630	35, 740	35, 850	35, 960	36, 070	36, 180	36, 290	36, 400	36, 510	36, 620	36, 720	36, 830	36, 940	37, 040	37, 150	37, 250	37, 360	52
53	35, 940	36, 050	36, 170	36, 280	36, 400	36, 510	36, 630	36, 740	36, 850	36, 960	37, 070	37, 190	37, 300	37, 410	37, 510	37, 620	37, 730	37, 840	37, 950	38, 050	38, 160	53
54	36, 710	36, 830	36, 940	37, 060	37, 180	37, 290	37, 410	37, 530	37, 640	37, 750	37, 870	37, 980	38, 090	38, 200	38, 310	38, 420	38, 530	38, 640	38, 750	38, 860	38, 970	54
55	37, 480	37, 600	37, 720	37, 840	37, 960	38, 080	38, 200	38, 310	38, 430	38, 540	38, 660	38, 770	38, 890	39, 000	39, 110	39, 230	39, 340	39, 450	39, 560	39, 670	39, 780	55
56	38, 250	38, 370	38, 500	38, 620	38, 740	38, 860	38, 980	39, 100	39, 220	39, 330	39, 450	39, 570	39, 680	39, 800	39, 910	40, 030	40, 140	40, 250	40, 370	40, 480	40, 590	56
57	40, 240	40, 340	40, 450	40, 550	40, 660	40, 760	40, 860	40, 960	41, 060	41, 160	41, 260	41, 370	41, 480	41, 590	41, 700	41, 810	41, 920	42, 020	42, 130	42, 240	42, 340	57
58	42, 200	42, 290	42, 380	42, 470	42, 550	42, 640	42, 720	42, 800	42, 890	42, 970	43, 050	43, 160	43, 260	43, 370	43, 470	43, 580	43, 680	43, 780	43, 880	43, 980	44, 080	58
59	44, 170	44, 240	44, 310	44, 380	44, 450	44, 520	44, 580	44, 650	44, 710	44, 770	44, 840	44, 940	45, 040	45, 140	45, 240	45, 330	45, 430	45, 530	45, 620	45, 710	45, 810	59
60	46, 110	46, 160	46, 210	46, 270	46, 320	46, 370	46, 420	46, 470	46, 510	46, 550	46, 610	46, 700	46, 800	46, 890	46, 990	47, 080	47, 170	47, 260	47, 350	47, 440	47, 530	60
61	48, 070	48, 100	48, 140	48, 180	48, 210	48, 250	48, 280	48, 310	48, 330	48, 360	48, 410	48, 490	48, 580	48, 670	48, 760	48, 850	48, 930	49, 020	49, 100	49, 180	49, 280	61
62	50, 060	50, 070	50, 100	50, 120	50, 130	50, 150	50, 160	50, 170	50, 180	50, 190	50, 220	50, 290	50, 380	50, 460	50, 540	50, 630	50, 710	50, 790	50, 860	50, 940	51, 030	62
63	52, 020	52, 020	52, 020	52, 030	52, 030	52, 020	52, 020	52, 010	52, 000	51, 990	52, 010	52, 080	52, 160	52, 240	52, 320	52, 390	52, 470	52, 540	52, 610	52, 680	52, 770	63
64	52, 750	52, 830	52, 910	52, 990	53, 060	53, 140	53, 210	53, 280	53, 340	53, 410	53, 510	53, 650	53, 800	53, 940	54, 090	54, 230	54, 380	54, 520	54, 660	54, 800	54, 950	64
65	53, 560	53, 710	53, 860	54, 010	54, 160	54, 310	54, 460	54, 610	54, 760	54, 900	55, 070	55, 280	55, 490	55, 700	55, 920	56, 130	56, 340	56, 550	56, 760	56, 970	57, 190	65
66	54, 280	54, 510	54, 730	54, 960	55, 190	55, 410	55, 640	55, 860	56, 080	56, 310	56, 550	56, 830	57, 110	57, 390	57, 660	57, 940	58, 220	58, 500	58, 780	59, 060	59, 350	66
67	55, 070	55, 370	55, 670	55, 970	56, 270	56, 580	56, 880	57, 180	57, 480	57, 780	58, 100	58, 440	58, 780	59, 120	59, 470	59, 810	60, 160	60, 510	60, 850	61, 200	61, 550	67
68	55, 880	56, 250	56, 620	57, 000	57, 380	57, 750	58, 130	58, 510	58, 890	59, 270	59, 660	60, 060	60, 470	60, 880	61, 300	61, 710	62, 120	62, 540	62, 950	63, 370	63, 790	68
69	56, 610	57, 060	57, 510	57, 960	58, 410	58, 870	59, 320	59, 780	60, 230	60, 690	61, 160	61, 630	62, 110	62, 590	63, 070	63, 550	64, 030	64, 510	65, 000	65, 480	65, 980	69
70	57, 410	57, 940	58, 460	58, 990	59, 510	60, 040	60, 580	61, 110	61, 640	62, 180	62, 720	63, 260	63, 800	64, 350	64, 900	65, 440	65, 990	66, 550	67, 100	67, 660	68, 210	70
71	57, 410	57, 940	58, 460	58, 990	59, 510	60, 040	60, 580	61, 110	61, 640	62, 180	62, 720	63, 260	63, 800	64, 350	64, 900	65, 440	65, 990	66, 550	67, 100	67, 660	68, 210	71
72	57, 410	57, 940	58, 460	58, 990	59, 510	60, 040	60, 580	61, 110	61, 640	62, 180	62, 720	63, 260	63, 800	64, 350	64, 900	65, 440	65, 990	66, 550	67, 100	67, 660	68, 210	72
73	57, 410	57, 940	58, 460	58, 990	59, 510	60, 040	60, 580	61, 110	61, 640	62, 180	62, 720	63, 260	63, 800	64, 350	64, 900	65, 440	65, 990	66, 550	67, 100	67, 660	68, 210	73
74	57, 410	57, 940	58, 460	58, 990	59, 510	60, 040	60, 580	61, 110	61, 640	62, 180	62, 720	63, 260	63, 800	64, 350	64, 900	65, 440	65, 990	66, 550	67, 100	67, 660	68, 210	74
75	57, 410	57, 940	58, 460	58, 990	59, 510	60, 040	60, 580	61, 110	61, 640	62, 180	62, 720	63, 260	63, 800	64, 350	64, 900	65, 440	65, 990	66, 550	67, 100	67, 660	68, 210	75

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1523.0	1523.1	1523.2	1523.3	1523.4	1523.5	1523.6	1523.7	1523.8	1523.9	1524.0	1524.1	1524.2	1524.3	1524.4	1524.5	1524.6	1524.7	1524.8	1524.9	1525.0	
1	450	450	450	450	460	460	460	460	460	460	460	460	460	470	470	470	470	470	470	470	470	1
2	850	850	850	860	860	860	860	860	870	870	870	870	870	880	880	880	880	890	890	890	890	2
3	1,300	1,300	1,310	1,310	1,310	1,320	1,320	1,320	1,330	1,330	1,330	1,340	1,340	1,340	1,350	1,350	1,350	1,350	1,360	1,360	1,360	3
4	1,700	1,700	1,710	1,710	1,720	1,720	1,720	1,730	1,730	1,740	1,740	1,750	1,750	1,750	1,760	1,760	1,770	1,770	1,770	1,780	1,780	4
5	2,100	2,100	2,110	2,110	2,120	2,120	2,130	2,130	2,140	2,150	2,150	2,160	2,160	2,170	2,170	2,180	2,180	2,190	2,190	2,200	2,200	5
6	2,550	2,560	2,560	2,570	2,570	2,580	2,590	2,590	2,600	2,610	2,610	2,620	2,630	2,630	2,640	2,640	2,650	2,660	2,660	2,670	2,680	6
7	2,950	2,960	2,960	2,970	2,980	2,990	2,990	3,000	3,010	3,010	3,020	3,030	3,040	3,040	3,050	3,060	3,070	3,070	3,080	3,090	3,090	7
8	3,390	3,400	3,410	3,420	3,430	3,440	3,450	3,450	3,460	3,470	3,480	3,490	3,500	3,500	3,510	3,520	3,530	3,540	3,550	3,550	3,560	8
9	3,850	3,860	3,870	3,880	3,890	3,900	3,910	3,920	3,930	3,940	3,950	3,960	3,970	3,980	3,990	4,000	4,010	4,020	4,030	4,040	4,050	9
10	4,300	4,310	4,320	4,330	4,340	4,350	4,370	4,380	4,390	4,400	4,410	4,420	4,430	4,440	4,450	4,460	4,470	4,480	4,490	4,500	4,510	10
11	4,760	4,770	4,780	4,800	4,810	4,820	4,830	4,840	4,860	4,870	4,880	4,890	4,900	4,920	4,930	4,940	4,950	4,960	4,980	4,990	5,000	11
12	5,220	5,230	5,250	5,260	5,270	5,290	5,300	5,310	5,330	5,340	5,350	5,370	5,380	5,390	5,410	5,420	5,430	5,450	5,460	5,470	5,480	12
13	5,670	5,680	5,700	5,710	5,720	5,740	5,750	5,770	5,780	5,800	5,810	5,820	5,840	5,850	5,870	5,880	5,900	5,910	5,920	5,940	5,950	13
14	6,130	6,140	6,160	6,170	6,190	6,210	6,220	6,240	6,250	6,270	6,280	6,300	6,310	6,330	6,350	6,360	6,380	6,390	6,410	6,420	6,440	14
15	6,980	7,000	7,020	7,040	7,060	7,080	7,090	7,110	7,130	7,150	7,160	7,180	7,200	7,220	7,240	7,250	7,270	7,290	7,310	7,320	7,340	15
16	7,830	7,850	7,870	7,900	7,920	7,940	7,960	7,980	8,000	8,020	8,040	8,060	8,080	8,100	8,120	8,140	8,160	8,180	8,200	8,220	8,240	16
17	8,690	8,710	8,730	8,760	8,780	8,800	8,830	8,850	8,870	8,890	8,920	8,940	8,960	8,980	9,000	9,030	9,050	9,070	9,090	9,110	9,140	17
18	9,540	9,560	9,590	9,610	9,640	9,660	9,690	9,710	9,740	9,760	9,790	9,810	9,830	9,860	9,880	9,910	9,930	9,960	9,980	10,010	10,030	18
19	10,380	10,410	10,440	10,470	10,490	10,520	10,550	10,580	10,600	10,630	10,660	10,680	10,710	10,740	10,770	10,790	10,820	10,850	10,870	10,900	10,920	19
20	11,240	11,270	11,300	11,330	11,360	11,390	11,420	11,450	11,480	11,510	11,540	11,570	11,600	11,630	11,660	11,680	11,710	11,740	11,770	11,800	11,830	20
21	12,090	12,120	12,160	12,190	12,220	12,250	12,280	12,320	12,350	12,380	12,410	12,440	12,470	12,510	12,540	12,570	12,600	12,630	12,660	12,690	12,720	21
22	12,930	12,960	13,000	13,030	13,070	13,100	13,130	13,170	13,200	13,240	13,270	13,300	13,340	13,370	13,410	13,440	13,470	13,510	13,540	13,570	13,610	22
23	13,760	13,800	13,840	13,870	13,910	13,950	13,980	14,020	14,060	14,090	14,130	14,170	14,200	14,240	14,270	14,310	14,350	14,380	14,420	14,450	14,490	23
24	14,590	14,630	14,670	14,710	14,750	14,790	14,830	14,870	14,910	14,950	14,990	15,020	15,060	15,100	15,140	15,180	15,220	15,260	15,290	15,330	15,370	24
25	15,420	15,470	15,510	15,550	15,590	15,630	15,680	15,720	15,760	15,800	15,840	15,880	15,920	15,960	16,010	16,050	16,090	16,130	16,170	16,210	16,250	25
26	16,260	16,300	16,350	16,390	16,440	16,480	16,530	16,570	16,610	16,660	16,700	16,740	16,790	16,830	16,870	16,920	16,960	17,000	17,050	17,090	17,130	26
27	17,090	17,140	17,190	17,230	17,280	17,330	17,380	17,420	17,470	17,510	17,560	17,610	17,650	17,700	17,740	17,790	17,830	17,880	17,930	17,970	18,020	27
28	17,930	17,980	18,030	18,080	18,130	18,180	18,220	18,270	18,320	18,370	18,420	18,470	18,520	18,560	18,610	18,660	18,710	18,760	18,800	18,850	18,900	28
29	18,750	18,800	18,860	18,910	18,960	19,010	19,060	19,120	19,170	19,220	19,270	19,320	19,370	19,420	19,470	19,520	19,570	19,620	19,670	19,720	19,770	29
30	19,580	19,630	19,690	19,740	19,790	19,850	19,900	19,960	20,010	20,070	20,120	20,170	20,230	20,280	20,330	20,390	20,440	20,490	20,540	20,600	20,650	30
31	20,390	20,450	20,510	20,570	20,620	20,680	20,740	20,790	20,850	20,910	20,960	21,020	21,080	21,130	21,190	21,240	21,300	21,350	21,410	21,460	21,520	31
32	21,210	21,270	21,330	21,390	21,450	21,510	21,570	21,630	21,690	21,750	21,810	21,870	21,930	21,990	22,040	22,100	22,160	22,220	22,280	22,330	22,390	32
33	22,040	22,100	22,160	22,230	22,290	22,350	22,410	22,470	22,540	22,600	22,660	22,720	22,780	22,840	22,900	22,960	23,030	23,090	23,150	23,210	23,270	33
34	22,860	22,930	22,990	23,060	23,120	23,190	23,250	23,320	23,380	23,450	23,510	23,570	23,640	23,700	23,760	23,830	23,890	23,950	24,020	24,080	24,140	34
35	23,690	23,750	23,820	23,890	23,960	24,020	24,090	24,160	24,230	24,290	24,360	24,430	24,490	24,560	24,620	24,690	24,760	24,820	24,890	24,950	25,020	35
36	24,490	24,560	24,630	24,710	24,780	24,850	24,920	24,990	25,060	25,130	25,200	25,260	25,330	25,400	25,470	25,540	25,610	25,680	25,740	25,810	25,880	36
37	25,300	25,370	25,440	25,520	25,590	25,660	25,740	25,810	25,880	25,950	26,030	26,100	26,170	26,240	26,310	26,380	26,450	26,530	26,600	26,670	26,740	37
38	26,100	26,170	26,250	26,330	26,400	26,480	26,550	26,630	26,710	26,780	26,860	26,930	27,000	27,080	27,150	27,230	27,300	27,370	27,450	27,520	27,590	38
39	26,900	26,970	27,050	27,130	27,210	27,290	27,370	27,450	27,520	27,600	27,680	27,760	27,830	27,910	27,990	28,060	28,140	28,220	28,290	28,370	28,440	39
40	27,700	27,780	27,860	27,940	28,030	28,110	28,190	28,270	28,350	28,430	28,510	28,590	28,670	28,750	28,830	28,910	28,990	29,070	29,140	29,220	29,300	40
41	28,510	28,590	28,680	28,760	28,850	28,930	29,010	29,100	29,180	29,260	29,350	29,430	29,510	29,590	29,680	29,760	29,840	29,920	30,000	30,080	30,160	41
42	29,310	29,400	29,490	29,570	29,660	29,750	29,830	29,920	30,010	30,090	30,180	30,260	30,350	30,430	30,520	30,600	30,690	30,770	30,850	30,940	31,020	42
43	30,110	30,200	30,290	30,380	30,470	30,560	30,640	30,730	30,820	30,910	30,990	31,080	31,170	31,250	31,340	31,430	31,510	31,600	31,680	31,770	31,860	43
44	30,920	31,010	31,100	31,190	31,280	31,370	31,460	31,550	31,640	31,730	31,820	31,910	31,990	32,080	32,170	32,250	32,340	32,430	32,520	32,610	32,700	44
45	31,720	31,810	31,900	31,990	32,080	32,170	32,270	32,360	32,450	32,540	32,630	32,720	32,810	32,890	32,980	33,070	33,160	33,250	33,340	33,440	33,530	45
46	32,520	32,610	32,700	32,800	32,890	32,980	33,070	33,170	33,260	33,350	33,440	33,530	33,620	33,710	33,800	33,890	33,980	34,080	34,170	34,270	34,360	46
47	33,320	33,420	33,510	33,610	33,700	33,800	33,890	33,980	34,080	34,170	34,260	34,360	34,450	34,540	34,630	34,720	34,810	34,910	35,010	35,110	35,200	47
48	34,130	34,220	34,320	34,420	34,510	34,610	34,700	34,800	34,890	34,990	35,080	35,170	35,270	35,360	35,450	35,540	35,640	35,740	35,840	35,940	36,040	48
49	34,930	35,030	35,130	35,230	35,330	35,420	35,520	35,620	35,710	35,810	35,900	36,000	36,090	36,190	36,280	36,370	36,470	36,570	36,680	36,780	36,880	49
50	35,740	35,840	35,940	36,040	36,140	36,240	36,340	36,440	36,540	36,640	36,740	36,840	36,930	37,030	37,130	37,220	37,320	37,430	37,530	37,640	37,740	50

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1523.0	1523.1	1523.2	1523.3	1523.4	1523.5	1523.6	1523.7	1523.8	1523.9	1524.0	1524.1	1524.2	1524.3	1524.4	1524.5	1524.6	1524.7	1524.8	1524.9	1525.0	
51	36, 550	36, 660	36, 760	36, 860	36, 960	37, 060	37, 170	37, 270	37, 370	37, 470	37, 570	37, 670	37, 770	37, 870	37, 970	38, 070	38, 170	38, 280	38, 390	38, 490	38, 600	51
52	37, 360	37, 460	37, 560	37, 670	37, 770	37, 870	37, 980	38, 090	38, 190	38, 290	38, 400	38, 500	38, 610	38, 710	38, 810	38, 910	39, 020	39, 120	39, 230	39, 340	39, 450	52
53	38, 160	38, 260	38, 370	38, 470	38, 580	38, 690	38, 790	38, 900	39, 010	39, 120	39, 230	39, 330	39, 440	39, 540	39, 650	39, 750	39, 860	39, 970	40, 080	40, 190	40, 290	53
54	38, 970	39, 080	39, 180	39, 290	39, 400	39, 510	39, 620	39, 730	39, 840	39, 950	40, 060	40, 170	40, 280	40, 390	40, 500	40, 610	40, 710	40, 820	40, 930	41, 040	41, 150	54
55	39, 780	39, 890	40, 000	40, 100	40, 210	40, 330	40, 440	40, 560	40, 670	40, 780	40, 900	41, 010	41, 120	41, 230	41, 340	41, 450	41, 570	41, 680	41, 790	41, 900	42, 010	55
56	40, 590	40, 700	40, 810	40, 920	41, 030	41, 150	41, 270	41, 380	41, 500	41, 620	41, 730	41, 850	41, 960	42, 080	42, 190	42, 300	42, 420	42, 530	42, 640	42, 750	42, 870	56
57	42, 340	42, 450	42, 560	42, 670	42, 780	42, 900	43, 020	43, 130	43, 250	43, 360	43, 480	43, 600	43, 710	43, 830	43, 940	44, 060	44, 170	44, 290	44, 400	44, 520	44, 630	57
58	44, 080	44, 190	44, 310	44, 420	44, 530	44, 640	44, 760	44, 880	44, 990	45, 110	45, 220	45, 340	45, 460	45, 580	45, 690	45, 810	45, 930	46, 040	46, 160	46, 270	46, 390	58
59	45, 810	45, 920	46, 030	46, 150	46, 260	46, 380	46, 490	46, 610	46, 720	46, 830	46, 950	47, 070	47, 190	47, 310	47, 430	47, 540	47, 660	47, 780	47, 900	48, 010	48, 130	59
60	47, 530	47, 640	47, 760	47, 870	47, 980	48, 100	48, 210	48, 330	48, 440	48, 550	48, 670	48, 790	48, 910	49, 030	49, 150	49, 270	49, 390	49, 510	49, 630	49, 750	49, 860	60
61	49, 280	49, 390	49, 500	49, 620	49, 730	49, 840	49, 960	50, 070	50, 180	50, 290	50, 410	50, 530	50, 660	50, 780	50, 900	51, 020	51, 140	51, 260	51, 380	51, 500	51, 620	61
62	51, 030	51, 140	51, 250	51, 370	51, 480	51, 600	51, 710	51, 820	51, 930	52, 040	52, 160	52, 280	52, 410	52, 530	52, 660	52, 780	52, 900	53, 020	53, 140	53, 260	53, 390	62
63	52, 770	52, 880	53, 000	53, 110	53, 230	53, 340	53, 450	53, 560	53, 670	53, 780	53, 900	54, 020	54, 150	54, 280	54, 410	54, 530	54, 650	54, 780	54, 900	55, 020	55, 150	63
64	54, 950	55, 130	55, 310	55, 490	55, 670	55, 850	56, 000	56, 080	56, 170	56, 250	56, 340	56, 440	56, 540	56, 650	56, 750	56, 850	56, 960	57, 060	57, 170	57, 270	57, 380	64
65	57, 190	57, 430	57, 680	57, 920	58, 160	58, 380	58, 510	58, 570	58, 630	58, 680	58, 740	58, 820	58, 900	58, 990	59, 060	59, 140	59, 230	59, 320	59, 410	59, 500	59, 590	65
66	59, 350	59, 650	59, 960	60, 270	60, 570	60, 860	61, 020	61, 050	61, 080	61, 120	61, 150	61, 200	61, 260	61, 320	61, 380	61, 430	61, 500	61, 570	61, 650	61, 720	61, 790	66
67	61, 550	61, 920	62, 290	62, 660	63, 030	63, 360	63, 490	63, 500	63, 510	63, 510	63, 520	63, 550	63, 590	63, 630	63, 660	63, 690	63, 740	63, 800	63, 860	63, 910	63, 960	67
68	63, 790	64, 220	64, 660	65, 090	65, 530	65, 890	66, 000	65, 990	65, 970	65, 950	65, 930	65, 930	65, 950	65, 960	65, 970	65, 990	66, 020	66, 060	66, 100	66, 130	66, 170	68
69	65, 980	66, 470	66, 970	67, 470	67, 970	68, 400	68, 550	68, 510	68, 460	68, 410	68, 370	68, 350	68, 340	68, 330	68, 320	68, 310	68, 320	68, 340	68, 370	68, 390	68, 400	69
70	68, 210	68, 770	69, 330	69, 900	70, 460	70, 930	71, 060	70, 990	70, 920	70, 840	70, 770	70, 730	70, 700	70, 670	70, 630	70, 600	70, 600	70, 600	70, 610	70, 610	70, 610	70
71	68, 210	68, 770	69, 330	69, 900	70, 460	70, 930	71, 080	71, 110	71, 130	71, 150	71, 170	71, 220	71, 280	71, 330	71, 390	71, 440	71, 530	71, 620	71, 710	71, 790	71, 880	71
72	68, 210	68, 770	69, 330	69, 900	70, 460	70, 960	71, 200	71, 320	71, 430	71, 540	71, 660	71, 790	71, 940	72, 080	72, 220	72, 370	72, 530	72, 710	72, 880	73, 050	73, 220	72
73	68, 210	68, 770	69, 330	69, 900	70, 460	70, 960	71, 230	71, 430	71, 640	71, 840	72, 050	72, 280	72, 510	72, 740	72, 970	73, 200	73, 450	73, 710	73, 960	74, 220	74, 470	73
74	68, 210	68, 770	69, 330	69, 900	70, 460	70, 980	71, 340	71, 640	71, 930	72, 230	72, 530	72, 840	73, 160	73, 470	73, 790	74, 110	74, 440	74, 780	75, 120	75, 460	75, 800	74
75	68, 210	68, 770	69, 330	69, 900	70, 460	71, 010	71, 460	71, 840	72, 230	72, 620	73, 010	73, 410	73, 810	74, 220	74, 630	75, 030	75, 450	75, 870	76, 300	76, 720	77, 150	75
76	68, 210	68, 770	69, 330	69, 900	70, 460	71, 010	71, 480	71, 960	72, 440	72, 920	73, 410	73, 900	74, 390	74, 890	75, 380	75, 880	76, 380	76, 890	77, 400	77, 900	78, 410	76
77	68, 210	68, 770	69, 330	69, 900	70, 460	71, 030	71, 600	72, 170	72, 740	73, 320	73, 890	74, 470	75, 050	75, 630	76, 220	76, 800	77, 390	77, 980	78, 570	79, 160	79, 760	77
78	68, 210	68, 770	69, 330	69, 900	70, 460	71, 030	71, 600	72, 170	72, 740	73, 320	73, 890	74, 470	75, 050	75, 630	76, 220	76, 800	77, 390	77, 980	78, 570	79, 160	79, 760	78
79	68, 210	68, 770	69, 330	69, 900	70, 460	71, 030	71, 600	72, 170	72, 740	73, 320	73, 890	74, 470	75, 050	75, 630	76, 220	76, 800	77, 390	77, 980	78, 570	79, 160	79, 760	79
80	68, 210	68, 770	69, 330	69, 900	70, 460	71, 030	71, 600	72, 170	72, 740	73, 320	73, 890	74, 470	75, 050	75, 630	76, 220	76, 800	77, 390	77, 980	78, 570	79, 160	79, 760	80

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1525.0	1525.1	1525.2	1525.3	1525.4	1525.5	1525.6	1525.7	1525.8	1525.9	1526.0	1526.1	1526.2	1526.3	1526.4	1526.5	1526.6	1526.7	1526.8	1526.9	1527.0	
1	470	470	480	480	480	480	480	480	480	480	480	480	490	490								1
2	890	890	900	900	900	900	900	910	910	910	910	910	920	920								2
3	1,360	1,370	1,370	1,370	1,380	1,380	1,380	1,390	1,390	1,390	1,400	1,400	1,400	1,400								3
4	1,780	1,790	1,790	1,790	1,800	1,800	1,810	1,810	1,820	1,820	1,820	1,830	1,830	1,840								4
5	2,200	2,210	2,210	2,220	2,220	2,230	2,230	2,240	2,240	2,250	2,250	2,260	2,260	2,270								5
6	2,680	2,680	2,690	2,690	2,700	2,710	2,710	2,720	2,720	2,730	2,740	2,740	2,750	2,750								6
7	3,090	3,100	3,110	3,120	3,120	3,130	3,140	3,140	3,150	3,160	3,170	3,170	3,180	3,190	3,190	3,200	3,210	3,210				7
8	3,560	3,570	3,580	3,590	3,600	3,600	3,610	3,620	3,630	3,640	3,640	3,650	3,660	3,670	3,680	3,680	3,690	3,700				8
9	4,050	4,060	4,070	4,080	4,080	4,090	4,100	4,110	4,120	4,130	4,140	4,150	4,160	4,170	4,180	4,190	4,200	4,200				9
10	4,510	4,530	4,540	4,550	4,560	4,570	4,580	4,590	4,600	4,610	4,620	4,630	4,640	4,650	4,660	4,670	4,680	4,690				10
11	5,000	5,010	5,020	5,030	5,050	5,060	5,070	5,080	5,090	5,100	5,110	5,130	5,140	5,150	5,160	5,170	5,180	5,190				11
12	5,480	5,500	5,510	5,520	5,530	5,550	5,560	5,570	5,590	5,600	5,610	5,620	5,640	5,650	5,660	5,670	5,690	5,700				12
13	5,950	5,970	5,980	5,990	6,010	6,020	6,030	6,050	6,060	6,080	6,090	6,100	6,120	6,130	6,140	6,160	6,170	6,180				13
14	6,440	6,450	6,470	6,480	6,500	6,510	6,530	6,540	6,560	6,570	6,590	6,600	6,620	6,630	6,640	6,660	6,670	6,690	6,700	6,720	6,730	14
15	7,340	7,360	7,370	7,390	7,410	7,430	7,440	7,460	7,480	7,490	7,510	7,530	7,550	7,560	7,580	7,600	7,610	7,630	7,650	7,660	7,680	15
16	8,240	8,250	8,270	8,290	8,310	8,330	8,350	8,370	8,390	8,410	8,430	8,450	8,470	8,490	8,500	8,520	8,540	8,560	8,580	8,600	8,620	16
17	9,140	9,160	9,180	9,200	9,220	9,240	9,270	9,290	9,310	9,330	9,350	9,370	9,390	9,420	9,440	9,460	9,480	9,500	9,520	9,540	9,560	17
18	10,030	10,050	10,080	10,100	10,120	10,150	10,170	10,200	10,220	10,240	10,270	10,290	10,310	10,340	10,360	10,380	10,410	10,430	10,450	10,480	10,500	18
19	10,920	10,950	10,980	11,000	11,030	11,050	11,080	11,110	11,130	11,160	11,180	11,210	11,240	11,260	11,290	11,310	11,340	11,360	11,390	11,410	11,440	19
20	11,830	11,860	11,880	11,910	11,940	11,970	12,000	12,030	12,050	12,080	12,110	12,140	12,170	12,190	12,220	12,250	12,280	12,300	12,330	12,360	12,390	20
21	12,720	12,750	12,780	12,810	12,850	12,880	12,910	12,940	12,970	13,000	13,030	13,060	13,090	13,120	13,150	13,180	13,210	13,240	13,270	13,300	13,320	21
22	13,610	13,640	13,670	13,710	13,740	13,770	13,800	13,840	13,870	13,900	13,930	13,970	14,000	14,030	14,060	14,100	14,130	14,160	14,190	14,220	14,250	22
23	14,490	14,530	14,560	14,600	14,630	14,670	14,700	14,740	14,770	14,810	14,840	14,880	14,910	14,940	14,980	15,010	15,050	15,080	15,120	15,150	15,180	23
24	15,370	15,410	15,450	15,480	15,520	15,560	15,600	15,630	15,670	15,710	15,740	15,780	15,820	15,850	15,890	15,930	15,960	16,000	16,040	16,070	16,110	24
25	16,250	16,290	16,330	16,370	16,410	16,450	16,490	16,530	16,570	16,610	16,650	16,690	16,720	16,760	16,800	16,840	16,880	16,920	16,960	17,000	17,030	25
26	17,130	17,170	17,220	17,260	17,300	17,340	17,390	17,430	17,470	17,510	17,550	17,590	17,640	17,680	17,720	17,760	17,800	17,840	17,880	17,920	17,960	26
27	18,020	18,060	18,110	18,150	18,190	18,240	18,280	18,330	18,370	18,420	18,460	18,500	18,550	18,590	18,630	18,680	18,720	18,760	18,810	18,850	18,890	27
28	18,900	18,950	18,990	19,040	19,090	19,130	19,180	19,230	19,270	19,320	19,370	19,410	19,460	19,500	19,550	19,600	19,640	19,690	19,730	19,780	19,820	28
29	19,770	19,820	19,870	19,920	19,970	20,020	20,070	20,120	20,170	20,220	20,270	20,310	20,360	20,410	20,460	20,510	20,550	20,600	20,650	20,700	20,750	29
30	20,650	20,700	20,750	20,810	20,860	20,910	20,960	21,010	21,060	21,110	21,170	21,220	21,270	21,320	21,370	21,420	21,470	21,520	21,570	21,620	21,670	30
31	21,520	21,570	21,630	21,680	21,740	21,790	21,850	21,900	21,950	22,010	22,060	22,110	22,170	22,220	22,270	22,330	22,380	22,430	22,480	22,540	22,590	31
32	22,390	22,450	22,500	22,560	22,620	22,670	22,730	22,790	22,840	22,900	22,960	23,010	23,070	23,120	23,180	23,230	23,290	23,340	23,400	23,450	23,510	32
33	23,270	23,330	23,380	23,440	23,500	23,560	23,620	23,680	23,740	23,800	23,860	23,910	23,970	24,030	24,090	24,150	24,200	24,260	24,320	24,370	24,430	33
34	24,140	24,200	24,260	24,330	24,390	24,450	24,510	24,570	24,630	24,690	24,760	24,820	24,880	24,940	25,000	25,060	25,120	25,180	25,240	25,300	25,360	34
35	25,020	25,080	25,150	25,210	25,270	25,340	25,400	25,470	25,530	25,590	25,660	25,720	25,780	25,840	25,910	25,970	26,030	26,090	26,160	26,220	26,280	35
36	25,880	25,950	26,010	26,080	26,150	26,210	26,280	26,350	26,410	26,480	26,540	26,610	26,680	26,740	26,810	26,870	26,940	27,000	27,070	27,130	27,190	36
37	26,740	26,810	26,880	26,950	27,020	27,080	27,150	27,220	27,290	27,360	27,430	27,500	27,560	27,630	27,700	27,770	27,830	27,900	27,970	28,040	28,100	37
38	27,590	27,660	27,740	27,810	27,880	27,950	28,030	28,100	28,170	28,240	28,310	28,380	28,450	28,520	28,590	28,660	28,730	28,800	28,870	28,940	29,010	38
39	28,440	28,520	28,590	28,670	28,740	28,820	28,890	28,970	29,040	29,110	29,190	29,260	29,330	29,410	29,480	29,550	29,620	29,700	29,770	29,840	29,910	39
40	29,300	29,380	29,460	29,530	29,610	29,690	29,770	29,840	29,920	29,990	30,070	30,150	30,220	30,300	30,370	30,450	30,520	30,600	30,670	30,750	30,820	40
41	30,160	30,240	30,320	30,400	30,480	30,560	30,640	30,720	30,800	30,880	30,960	31,040	31,120	31,190	31,270	31,350	31,430	31,500	31,580	31,660	31,730	41
42	31,020	31,100	31,190	31,270	31,350	31,430	31,520	31,600	31,680	31,760	31,840	31,920	32,000	32,080	32,170	32,250	32,330	32,410	32,480	32,560	32,640	42
43	31,860	31,940	32,030	32,110	32,200	32,280	32,370	32,450	32,540	32,620	32,710	32,790	32,870	32,960	33,040	33,120	33,200	33,290	33,370	33,450	33,530	43
44	32,700	32,790	32,880	32,960	33,050	33,140	33,230	33,310	33,400	33,490	33,580	33,660	33,750	33,830	33,920	34,000	34,090	34,180	34,260	34,340	34,430	44
45	33,530	33,620	33,710	33,800	33,890	33,980	34,070	34,160	34,250	34,340	34,430	34,520	34,610	34,700	34,780	34,870	34,960	35,050	35,140	35,220	35,310	45
46	34,360	34,460	34,550	34,640	34,740	34,830	34,920	35,020	35,110	35,200	35,290	35,380	35,470	35,570	35,660	35,750	35,840	35,930	36,020	36,110	36,200	46
47	35,200	35,300	35,400	35,490	35,590	35,690	35,780	35,880	35,970	36,070	36,160	36,260	36,350	36,440	36,540	36,630	36,720	36,820	36,910	37,000	37,090	47
48	36,040	36,140	36,240	36,340	36,440	36,540	36,630	36,730	36,830	36,930	37,020	37,120	37,220	37,310	37,410	37,510	37,600	37,700	37,790	37,890	37,980	48
49	36,880	36,980	37,090	37,190	37,290	37,390	37,490	37,590	37,690	37,790	37,890	37,990	38,090	38,190	38,290	38,390	38,490	38,590	38,680	38,780	38,880	49
50	37,740	37,840	37,950	38,050	38,150	38,250	38,360	38,460	38,560	38,660	38,760	38,860	38,960	39,060	39,160	39,270	39,370	39,470	39,570	39,670	39,770	50

See special instruction for preventing gate overflow on page 3.

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1525.0	1525.1	1525.2	1525.3	1525.4	1525.5	1525.6	1525.7	1525.8	1525.9	1526.0	1526.1	1526.2	1526.3	1526.4	1526.5	1526.6	1526.7	1526.8	1526.9	1527.0	
51	38,600	38,700	38,810	38,910	39,010	39,120	39,220	39,320	39,430	39,530	39,630	39,730	39,840	39,940	40,040	40,140	40,250	40,350	40,450	40,560	40,660	51
52	39,450	39,550	39,660	39,760	39,870	39,970	40,080	40,180	40,290	40,390	40,490	40,590	40,700	40,800	40,900	41,010	41,110	41,220	41,330	41,430	41,540	52
53	40,290	40,400	40,510	40,610	40,720	40,830	40,930	41,040	41,140	41,250	41,350	41,450	41,560	41,660	41,770	41,870	41,980	42,090	42,200	42,310	42,420	53
54	41,150	41,260	41,370	41,480	41,580	41,690	41,800	41,900	42,010	42,110	42,220	42,320	42,430	42,530	42,640	42,750	42,860	42,980	43,090	43,200	43,310	54
55	42,010	42,120	42,230	42,340	42,450	42,550	42,660	42,770	42,880	42,980	43,090	43,190	43,300	43,410	43,510	43,630	43,740	43,860	43,970	44,090	44,200	55
56	42,870	42,980	43,090	43,200	43,310	43,420	43,530	43,630	43,740	43,850	43,960	44,060	44,170	44,280	44,390	44,500	44,620	44,740	44,860	44,970	45,090	56
57	44,630	44,740	44,860	44,970	45,080	45,190	45,300	45,410	45,520	45,630	45,740	45,850	45,960	46,070	46,180	46,300	46,420	46,540	46,650	46,770	46,890	57
58	46,390	46,500	46,620	46,730	46,850	46,960	47,080	47,190	47,300	47,420	47,530	47,640	47,750	47,860	47,970	48,090	48,210	48,330	48,440	48,560	48,680	58
59	48,130	48,250	48,360	48,480	48,600	48,720	48,830	48,950	49,060	49,180	49,290	49,400	49,520	49,630	49,740	49,860	49,980	50,100	50,220	50,330	50,450	59
60	49,860	49,990	50,110	50,230	50,350	50,470	50,580	50,700	50,820	50,940	51,050	51,170	51,280	51,400	51,510	51,630	51,750	51,870	51,980	52,100	52,220	60
61	51,620	51,750	51,870	51,990	52,120	52,240	52,360	52,480	52,600	52,720	52,830	52,950	53,070	53,190	53,300	53,420	53,540	53,660	53,770	53,890	54,010	61
62	53,390	53,510	53,640	53,760	53,890	54,010	54,140	54,260	54,380	54,500	54,620	54,740	54,860	54,980	55,100	55,220	55,330	55,450	55,570	55,690	55,810	62
63	55,150	55,270	55,400	55,530	55,660	55,780	55,910	56,030	56,160	56,280	56,400	56,530	56,650	56,770	56,890	57,010	57,130	57,240	57,360	57,480	57,600	63
64	57,380	57,490	57,600	57,710	57,820	57,920	58,030	58,150	58,260	58,370	58,480	58,590	58,700	58,810	58,920	59,030	59,140	59,250	59,370	59,480	59,600	64
65	59,590	59,680	59,770	59,860	59,940	60,030	60,130	60,240	60,340	60,440	60,540	60,640	60,740	60,840	60,940	61,030	61,140	61,260	61,370	61,480	61,600	65
66	61,790	61,860	61,930	62,000	62,070	62,140	62,220	62,320	62,410	62,500	62,590	62,680	62,770	62,850	62,940	63,030	63,120	63,240	63,350	63,450	63,570	66
67	63,960	64,020	64,070	64,120	64,170	64,220	64,290	64,380	64,460	64,540	64,620	64,700	64,770	64,850	64,920	65,000	65,100	65,210	65,310	65,420	65,530	67
68	66,170	66,200	66,240	66,270	66,300	66,330	66,390	66,470	66,540	66,610	66,680	66,750	66,810	66,880	66,940	67,010	67,100	67,210	67,310	67,420	67,520	68
69	68,400	68,420	68,430	68,450	68,460	68,470	68,520	68,580	68,640	68,700	68,760	68,810	68,870	68,920	68,970	69,030	69,110	69,220	69,320	69,420	69,530	69
70	70,610	70,610	70,600	70,590	70,580	70,580	70,620	70,670	70,720	70,770	70,820	70,860	70,910	70,950	70,990	71,030	71,120	71,220	71,320	71,420	71,520	70
71	71,880	71,960	72,040	72,120	72,200	72,290	72,410	72,540	72,670	72,800	72,930	73,060	73,180	73,310	73,430	73,560	73,730	73,910	74,080	74,260	74,380	71
72	73,220	73,390	73,560	73,730	73,890	74,070	74,270	74,480	74,690	74,900	75,110	75,320	75,530	75,740	75,940	76,160	76,400	76,650	76,900	77,130	77,210	72
73	74,470	74,730	74,980	75,230	75,490	75,750	76,030	76,320	76,610	76,900	77,190	77,480	77,770	78,060	78,350	78,650	78,970	79,290	79,620	79,920	80,030	73
74	75,800	76,140	76,480	76,820	77,160	77,500	77,860	78,230	78,600	78,970	79,340	79,710	80,080	80,450	80,820	81,200	81,600	82,000	82,400	82,740	82,820	74
75	77,150	77,570	78,000	78,420	78,850	79,280	79,720	80,170	80,620	81,070	81,520	81,980	82,430	82,880	83,340	83,800	84,270	84,740	85,220	85,610	85,650	75
76	78,410	78,920	79,440	79,950	80,470	80,980	81,510	82,040	82,570	83,100	83,640	84,170	84,710	85,240	85,780	86,320	86,880	87,430	87,980	88,450	88,510	76
77	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,320	91,340	77
78	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,320	91,400	78
79	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,350	91,540	79
80	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,350	91,590	80
81	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,380	91,730	81
82	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,410	91,880	82
83	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,410	91,930	83
84	79,760	80,360	80,960	81,560	82,160	82,760	83,370	83,980	84,590	85,200	85,820	86,430	87,050	87,670	88,300	88,920	89,550	90,170	90,800	91,440	92,070	84

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1527.0	1527.1	1527.2	1527.3	1527.4	1527.5	1527.6	1527.7	1527.8	1527.9	1528.0	1528.1	1528.2	1528.3	1528.4	1528.5	1528.6	1528.7	1528.8	1528.9	1529.0	
11																						11
12																						12
13																						13
14	6,730	6,750	6,760																			14
15	7,680	7,700	7,710																			15
16	8,620	8,640	8,660																			16
17	9,560	9,580	9,600																			17
18	10,500	10,520	10,550																			18
19	11,440	11,460	11,490																			19
20	12,390	12,410	12,440																			20
21	13,320	13,350	13,380	13,410	13,440	13,470	13,500	13,530	13,560	13,590	13,620											21
22	14,250	14,290	14,320	14,350	14,380	14,410	14,440	14,470	14,510	14,540	14,570											22
23	15,180	15,220	15,250	15,280	15,320	15,350	15,390	15,420	15,450	15,490	15,520											23
24	16,110	16,150	16,180	16,220	16,250	16,290	16,320	16,360	16,400	16,430	16,470											24
25	17,030	17,070	17,110	17,150	17,190	17,220	17,260	17,300	17,340	17,380	17,410											25
26	17,960	18,000	18,040	18,080	18,120	18,170	18,210	18,250	18,290	18,320	18,360											26
27	18,890	18,940	18,980	19,020	19,060	19,110	19,150	19,190	19,230	19,270	19,320											27
28	19,820	19,870	19,910	19,960	20,000	20,050	20,090	20,140	20,180	20,220	20,270	20,310	20,360	20,400	20,440	20,490	20,530	20,570	20,620			28
29	20,750	20,790	20,840	20,890	20,930	20,980	21,030	21,080	21,120	21,170	21,220	21,260	21,310	21,350	21,400	21,450	21,490	21,540	21,580			29
30	21,670	21,720	21,770	21,820	21,870	21,920	21,970	22,020	22,070	22,110	22,160	22,210	22,260	22,310	22,360	22,410	22,450	22,500	22,550			30
31	22,590	22,640	22,690	22,740	22,800	22,850	22,900	22,950	23,000	23,050	23,100	23,160	23,210	23,260	23,310	23,360	23,410	23,460	23,510			31
32	23,510	23,560	23,620	23,670	23,720	23,780	23,830	23,890	23,940	23,990	24,050	24,100	24,150	24,210	24,260	24,310	24,360	24,420	24,470			32
33	24,430	24,490	24,550	24,600	24,660	24,710	24,770	24,830	24,880	24,940	24,990	25,050	25,110	25,160	25,220	25,270	25,330	25,380	25,440			33
34	25,360	25,420	25,470	25,530	25,590	25,650	25,710	25,770	25,830	25,880	25,940	26,000	26,060	26,120	26,170	26,230	26,290	26,340	26,400			34
35	26,280	26,340	26,400	26,460	26,530	26,590	26,650	26,710	26,770	26,830	26,890	26,950	27,010	27,070	27,130	27,190	27,250	27,310	27,370	27,430	27,490	35
36	27,190	27,260	27,320	27,390	27,450	27,510	27,580	27,640	27,700	27,770	27,830	27,890	27,950	28,020	28,080	28,140	28,200	28,260	28,330	28,390	28,450	36
37	28,100	28,170	28,240	28,300	28,370	28,430	28,500	28,570	28,630	28,700	28,760	28,830	28,890	28,960	29,020	29,090	29,150	29,210	29,280	29,340	29,410	37
38	29,010	29,080	29,150	29,220	29,290	29,350	29,420	29,490	29,560	29,630	29,690	29,760	29,830	29,900	29,960	30,030	30,100	30,160	30,230	30,300	30,360	38
39	29,910	29,980	30,050	30,130	30,200	30,270	30,340	30,410	30,480	30,550	30,620	30,690	30,760	30,830	30,900	30,970	31,040	31,110	31,170	31,240	31,310	39
40	30,820	30,890	30,970	31,040	31,120	31,190	31,260	31,340	31,410	31,480	31,550	31,630	31,700	31,770	31,840	31,910	31,980	32,060	32,130	32,200	32,270	40
41	31,730	31,810	31,890	31,960	32,040	32,120	32,190	32,270	32,340	32,420	32,490	32,570	32,640	32,720	32,790	32,860	32,940	33,010	33,080	33,160	33,230	41
42	32,640	32,720	32,800	32,880	32,960	33,040	33,110	33,190	33,270	33,350	33,420	33,500	33,580	33,660	33,730	33,810	33,890	33,960	34,040	34,110	34,190	42
43	33,530	33,610	33,700	33,780	33,860	33,940	34,020	34,100	34,180	34,260	34,340	34,420	34,500	34,580	34,660	34,740	34,820	34,890	34,970	35,050	35,130	43
44	34,430	34,510	34,600	34,680	34,760	34,850	34,930	35,010	35,100	35,180	35,260	35,340	35,430	35,510	35,590	35,670	35,750	35,830	35,910	36,000	36,080	44
45	35,310	35,400	35,480	35,570	35,660	35,740	35,830	35,910	36,000	36,080	36,170	36,250	36,340	36,420	36,510	36,590	36,670	36,760	36,840	36,920	37,010	45
46	36,200	36,290	36,380	36,470	36,550	36,640	36,730	36,820	36,910	37,000	37,080	37,170	37,260	37,340	37,430	37,520	37,600	37,690	37,780	37,860	37,950	46
47	37,090	37,190	37,280	37,370	37,460	37,550	37,640	37,730	37,820	37,910	38,000	38,090	38,180	38,270	38,360	38,450	38,540	38,630	38,720	38,810	38,890	47
48	37,980	38,080	38,170	38,270	38,360	38,450	38,550	38,640	38,730	38,830	38,920	39,010	39,100	39,200	39,290	39,380	39,470	39,560	39,650	39,740	39,830	48
49	38,880	38,980	39,070	39,170	39,270	39,360	39,460	39,560	39,650	39,750	39,840	39,940	40,030	40,130	40,220	40,310	40,410	40,500	40,590	40,690	40,780	49
50	39,770	39,870	39,970	40,070	40,170	40,270	40,370	40,460	40,560	40,660	40,760	40,860	40,950	41,050	41,150	41,240	41,340	41,440	41,530	41,630	41,720	50
51	40,660	40,760	40,870	40,970	41,070	41,170	41,270	41,370	41,480	41,580	41,680	41,780	41,880	41,980	42,080	42,180	42,270	42,370	42,470	42,570	42,670	51
52	41,540	41,650	41,750	41,860	41,960	42,060	42,170	42,270	42,380	42,480	42,580	42,690	42,790	42,890	42,990	43,100	43,200	43,300	43,400	43,500	43,600	52
53	42,420	42,530	42,640	42,740	42,850	42,960	43,070	43,170	43,280	43,390	43,490	43,600	43,700	43,810	43,910	44,020	44,120	44,230	44,330	44,430	44,540	53
54	43,310	43,420	43,530	43,640	43,750	43,860	43,970	44,080	44,190	44,300	44,410	44,520	44,630	44,730	44,840	44,950	45,060	45,160	45,270	45,380	45,480	54
55	44,200	44,310	44,430	44,540	44,650	44,770	44,880	44,990	45,100	45,220	45,330	45,440	45,550	45,660	45,770	45,880	45,990	46,100	46,210	46,320	46,430	55
56	45,090	45,210	45,320	45,440	45,560	45,670	45,790	45,900	46,020	46,130	46,240	46,360	46,470	46,580	46,700	46,810	46,920	47,030	47,150	47,260	47,370	56
57	46,890	47,010	47,130	47,240	47,360	47,480	47,600	47,720	47,840	47,950	48,070	48,190	48,310	48,420	48,540	48,650	48,770	48,880	49,000	49,110	49,230	57
58	48,680	48,800	48,920	49,050	49,170	49,290	49,410	49,540	49,660	49,780	49,900	50,020	50,140	50,260	50,380	50,490	50,610	50,730	50,850	50,970	51,080	58
59	50,450	50,580	50,700	50,830	50,950	51,080	51,200	51,330	51,450	51,580	51,700	51,820	51,950	52,070	52,190	52,310	52,430	52,550	52,670	52,790	52,910	59
60	52,220	52,350	52,480	52,610	52,740	52,870	52,990	53,120	53,250	53,380	53,500	53,630	53,750	53,880	54,000	54,130	54,250	54,380	54,500	54,620	54,750	60

See special instruction for preventing gate overflow on page 3.

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGE-MENT	HEADWATER ELEVATION																					GATE ARRANGE-MENT
	1527.0	1527.1	1527.2	1527.3	1527.4	1527.5	1527.6	1527.7	1527.8	1527.9	1528.0	1528.1	1528.2	1528.3	1528.4	1528.5	1528.6	1528.7	1528.8	1528.9	1529.0	
61	54,010	54,140	54,280	54,410	54,540	54,670	54,810	54,940	55,070	55,200	55,330	55,460	55,590	55,710	55,840	55,970	56,100	56,220	56,350	56,480	56,600	61
62	55,810	55,940	56,080	56,210	56,350	56,490	56,620	56,760	56,890	57,020	57,160	57,290	57,420	57,550	57,680	57,810	57,940	58,070	58,200	58,330	58,460	62
63	57,600	57,740	57,880	58,020	58,160	58,300	58,430	58,570	58,710	58,840	58,980	59,120	59,250	59,390	59,520	59,650	59,790	59,920	60,050	60,180	60,310	63
64	59,600	59,740	59,870	60,000	60,140	60,270	60,400	60,540	60,670	60,800	60,940	61,070	61,200	61,330	61,470	61,600	61,730	61,860	62,000	62,130	62,260	64
65	61,600	61,720	61,850	61,980	62,100	62,230	62,360	62,490	62,620	62,760	62,890	63,020	63,150	63,270	63,400	63,530	63,670	63,800	63,940	64,080	64,210	65
66	63,570	63,690	63,810	63,930	64,050	64,170	64,300	64,430	64,560	64,690	64,810	64,940	65,070	65,190	65,320	65,440	65,580	65,720	65,850	65,990	66,130	66
67	65,530	65,650	65,760	65,880	65,990	66,100	66,220	66,350	66,480	66,610	66,730	66,860	66,980	67,100	67,230	67,350	67,480	67,630	67,770	67,910	68,050	67
68	67,520	67,630	67,740	67,850	67,950	68,060	68,180	68,310	68,430	68,560	68,680	68,800	68,920	69,040	69,160	69,290	69,420	69,570	69,710	69,850	69,990	68
69	69,530	69,630	69,730	69,830	69,930	70,040	70,150	70,270	70,400	70,520	70,640	70,760	70,870	70,990	71,110	71,230	71,360	71,510	71,650	71,800	71,940	69
70	71,520	71,620	71,710	71,810	71,900	72,000	72,110	72,230	72,350	72,470	72,590	72,700	72,820	72,930	73,050	73,160	73,300	73,450	73,600	73,740	73,890	70
71	74,380	74,440	74,500	74,560	74,610	74,680	74,780	74,880	74,980	75,080	75,180	75,290	75,390	75,490	75,590	75,690	75,810	75,940	76,070	76,190	76,320	71
72	77,210	77,240	77,260	77,270	77,300	77,350	77,430	77,520	77,600	77,680	77,770	77,860	77,950	78,030	78,120	78,200	78,300	78,410	78,520	78,620	78,730	72
73	80,030	80,020	80,000	79,980	79,960	79,990	80,060	80,120	80,190	80,250	80,320	80,400	80,470	80,540	80,620	80,690	80,770	80,860	80,950	81,030	81,120	73
74	82,820	82,770	82,710	82,650	82,610	82,620	82,670	82,720	82,760	82,810	82,870	82,930	82,990	83,050	83,100	83,160	83,220	83,290	83,360	83,420	83,490	74
75	85,650	85,560	85,470	85,370	85,290	85,290	85,320	85,350	85,380	85,410	85,450	85,500	85,550	85,590	85,630	85,670	85,720	85,760	85,810	85,850	85,900	75
76	88,510	88,390	88,260	88,120	88,000	87,970	87,990	88,000	88,010	88,020	88,050	88,080	88,110	88,140	88,170	88,200	88,230	88,250	88,280	88,300	88,330	76
77	91,340	91,180	91,010	90,840	90,690	90,650	90,640	90,640	90,630	90,620	90,630	90,650	90,670	90,690	90,700	90,710	90,720	90,730	90,730	90,730	90,740	77
78	91,400	91,350	91,290	91,240	91,200	91,270	91,360	91,440	91,530	91,620	91,730	91,840	91,950	92,060	92,160	92,270	92,370	92,470	92,570	92,670	92,770	78
79	91,540	91,600	91,670	91,730	91,810	91,960	92,150	92,330	92,510	92,690	92,890	93,090	93,290	93,490	93,690	93,890	94,090	94,290	94,480	94,680	94,880	79
80	91,590	91,770	91,940	92,120	92,310	92,570	92,850	93,120	93,400	93,670	93,960	94,260	94,550	94,840	95,130	95,420	95,710	96,000	96,290	96,580	96,880	80
81	91,730	92,020	92,310	92,600	92,910	93,260	93,630	93,990	94,360	94,730	95,110	95,490	95,870	96,250	96,640	97,020	97,400	97,790	98,170	98,550	98,940	81
82	91,880	92,280	92,690	93,100	93,510	93,950	94,410	94,870	95,340	95,800	96,270	96,740	97,220	97,690	98,170	98,640	99,120	99,600	100,100	100,600	101,000	82
83	91,930	92,450	92,970	93,490	94,020	94,580	95,130	95,680	96,240	96,800	97,360	97,930	98,490	99,060	99,630	100,200	100,800	101,300	101,900	102,500	103,100	83
84	92,070	92,710	93,340	93,980	94,630	95,270	95,920	96,570	97,220	97,870	98,520	99,180	99,840	100,500	101,200	101,800	102,500	103,200	103,800	104,500	105,200	84

HIWASSEE DAM
SPILLWAY DISCHARGE
IN CUBIC FEET PER SECOND

HEADWATER ELEVATION

GATE ARRANGE-MENT	1529.0	1529.1	1529.2	1529.3	1529.4	1529.5	1529.6	1529.7	1529.8	1529.9
31										
32										
33										
34										
35	27, 490	27, 540	27, 600	27, 660	27, 720	27, 780	27, 840			
36	28, 450	28, 510	28, 570	28, 630	28, 690	28, 750	28, 810			
37	29, 410	29, 470	29, 530	29, 600	29, 660	29, 720	29, 790			
38	30, 360	30, 430	30, 490	30, 560	30, 620	30, 690	30, 760			
39	31, 310	31, 380	31, 450	31, 520	31, 580	31, 650	31, 720			
40	32, 270	32, 340	32, 410	32, 480	32, 550	32, 620	32, 690			
41	33, 230	33, 300	33, 380	33, 450	33, 520	33, 600	33, 670			
42	34, 190	34, 260	34, 340	34, 410	34, 490	34, 560	34, 640	34, 710	34, 790	34, 860
43	35, 130	35, 210	35, 280	35, 360	35, 440	35, 520	35, 590	35, 670	35, 750	35, 820
44	36, 080	36, 160	36, 240	36, 320	36, 400	36, 480	36, 560	36, 640	36, 710	36, 790
45	37, 010	37, 090	37, 170	37, 260	37, 340	37, 420	37, 500	37, 580	37, 670	37, 750
46	37, 950	38, 030	38, 120	38, 200	38, 290	38, 370	38, 460	38, 540	38, 620	38, 710
47	38, 890	38, 980	39, 070	39, 160	39, 240	39, 330	39, 420	39, 500	39, 590	39, 680
48	39, 830	39, 920	40, 010	40, 100	40, 190	40, 280	40, 370	40, 460	40, 550	40, 640
49	40, 780	40, 870	40, 970	41, 060	41, 150	41, 240	41, 330	41, 430	41, 520	41, 610
50	41, 720	41, 820	41, 910	42, 010	42, 100	42, 200	42, 290	42, 390	42, 480	42, 570
51	42, 670	42, 770	42, 860	42, 960	43, 060	43, 160	43, 250	43, 350	43, 450	43, 540
52	43, 600	43, 700	43, 800	43, 900	44, 000	44, 100	44, 200	44, 300	44, 400	44, 500
53	44, 540	44, 640	44, 740	44, 850	44, 950	45, 050	45, 150	45, 250	45, 360	45, 460
54	45, 480	45, 590	45, 690	45, 800	45, 900	46, 010	46, 110	46, 220	46, 320	46, 430
55	46, 430	46, 530	46, 640	46, 750	46, 860	46, 960	47, 070	47, 180	47, 290	47, 390
56	47, 370	47, 480	47, 590	47, 700	47, 810	47, 920	48, 030	48, 140	48, 250	48, 360
57	49, 230	49, 340	49, 450	49, 570	49, 680	49, 790	49, 910	50, 020	50, 130	50, 240
58	51, 080	51, 200	51, 320	51, 430	51, 550	51, 660	51, 780	51, 890	52, 010	52, 120
59	52, 910	53, 030	53, 150	53, 270	53, 390	53, 510	53, 630	53, 740	53, 860	53, 980
60	54, 750	54, 870	54, 990	55, 110	55, 230	55, 350	55, 470	55, 590	55, 710	55, 830
61	56, 600	56, 730	56, 850	56, 980	57, 100	57, 220	57, 350	57, 470	57, 590	57, 710
62	58, 460	58, 590	58, 710	58, 840	58, 970	59, 090	59, 220	59, 340	59, 470	59, 590
63	60, 310	60, 440	60, 570	60, 700	60, 830	60, 960	61, 090	61, 220	61, 350	61, 470
64	62, 260	62, 400	62, 530	62, 660	62, 790	62, 920	63, 050	63, 180	63, 310	63, 440
65	64, 210	64, 340	64, 480	64, 610	64, 750	64, 880	65, 010	65, 140	65, 270	65, 400
66	66, 130	66, 270	66, 400	66, 540	66, 670	66, 810	66, 940	67, 070	67, 210	67, 340
67	68, 050	68, 180	68, 320	68, 460	68, 600	68, 730	68, 870	69, 000	69, 140	69, 270
68	69, 990	70, 130	70, 270	70, 410	70, 550	70, 690	70, 830	70, 960	71, 100	71, 230
69	71, 940	72, 080	72, 230	72, 370	72, 510	72, 650	72, 790	72, 930	73, 060	73, 200
70	73, 890	74, 030	74, 180	74, 320	74, 460	74, 610	74, 750	74, 890	75, 030	75, 160
71	76, 320	76, 440	76, 570	76, 690	76, 810	76, 940	77, 060	77, 180	77, 290	77, 410
72	78, 730	78, 840	78, 940	79, 040	79, 150	79, 250	79, 350	79, 450	79, 550	79, 650
73	81, 120	81, 200	81, 290	81, 370	81, 460	81, 540	81, 620	81, 700	81, 780	81, 850
74	83, 490	83, 560	83, 620	83, 690	83, 750	83, 810	83, 870	83, 930	83, 990	84, 050
75	85, 900	85, 950	86, 000	86, 040	86, 080	86, 130	86, 170	86, 200	86, 240	86, 280
76	88, 330	88, 360	88, 390	88, 410	88, 430	88, 460	88, 480	88, 490	88, 510	88, 530
77	90, 740	90, 750	90, 760	90, 770	90, 770	90, 770	90, 770	90, 770	90, 760	90, 770
78	92, 770	92, 880	92, 980	93, 090	93, 190	93, 290	93, 380	93, 480	93, 580	93, 680
79	94, 880	95, 080	95, 280	95, 480	95, 680	95, 880	96, 070	96, 270	96, 460	96, 670
80	96, 880	97, 170	97, 470	97, 760	98, 060	98, 350	98, 640	98, 940	99, 230	99, 530
81	98, 940	99, 330	99, 720	100, 100	100, 500	100, 900	101, 300	101, 700	102, 100	102, 500
82	101, 000	101, 500	102, 000	102, 500	103, 000	103, 500	104, 000	104, 500	105, 000	105, 500
83	103, 100	103, 700	104, 200	104, 800	105, 400	106, 000	106, 600	107, 200	107, 800	108, 400
84	105, 200	105, 900	106, 500	107, 200	107, 900	108, 600	109, 300	110, 000	110, 700	111, 400

GATE ARRANGE-MENT	1530.0	1530.1	1530.2	1530.3	1530.4	1530.5	1530.6	1530.7	1530.8	1530.9	1531.0	GATE ARRANGE-MENT
31												31
32												32
33												33
34												34
35												35
36												36
37												37
38												38
39												39
40												40
41												41
42	34, 940	35, 010	35, 080	35, 160								42
43	35, 900	35, 980	36, 050	36, 130								43
44	36, 870	36, 950	37, 030	37, 110								44
45	37, 830	37, 910	37, 990	38, 070								45
46	38, 790	38, 870	38, 960	39, 040								46
47	39, 760	39, 850	39, 930	40, 020								47
48	40, 730	40, 820	40, 900	40, 990								48
49	41, 700	41, 790	41, 880	41, 970	42, 060	42, 150	42, 240	42, 330	42, 420	42, 510		49
50	42, 670	42, 760	42, 850	42, 950	43, 040	43, 130	43, 220	43, 320	43, 410	43, 500		50
51	43, 640	43, 730	43, 830	43, 930	44, 020	44, 120	44, 210	44, 310	44, 400	44, 490		51
52	44, 600	44, 700	44, 790	44, 890	44, 990	45, 090	45, 180	45, 280	45, 380	45, 480		52
53	45, 560	45, 660	45, 760	45, 860	45, 960	46, 060	46, 160	46, 260	46, 360	46, 460		53
54	46, 530	46, 630	46, 740	46, 840	46, 940	47, 040	47, 150	47, 250	47, 350	47, 450		54
55	47, 500	47, 600	47, 710	47, 820	47, 920	48, 030	48, 130	48, 240	48, 340	48, 440		55
56	48, 470	48, 580	48, 690	48, 790	48, 900	49, 010	49, 120	49, 220	49, 330	49, 440	49, 540	56
57	50, 350	50, 470	50, 580	50, 690	50, 810	50, 920	51, 030	51, 140	51, 260	51, 370	51, 480	57
58	52, 240	52, 350	52, 470	52, 590	52, 710	52, 830	52, 950	53, 070	53, 180	53, 300	53, 420	58
59	54, 100	54, 220	54, 340	54, 470	54, 590	54, 710	54, 840	54, 960	55, 080	55, 210	55, 330	59
60	55, 950	56, 080	56, 210	56, 340	56, 470	56, 600	56, 730	56, 860	56, 990	57, 110	57, 240	60
61	57, 840	57, 970	58, 110	58, 240	58, 380	58, 510	58, 650	58, 780	58, 910	59, 050	59, 180	61
62	59, 720	59, 860	60, 000	60, 140	60, 280	60, 420	60, 560	60, 700	60, 840	60, 980	61, 120	62
63	61, 610	61, 750	61, 900	62, 040	62, 190	62, 330	62, 480	62, 620	62, 770	62, 910	63, 050	63
64	63, 570	63, 720	63, 860	64, 010	64, 150	64, 290	64, 440	64, 580	64, 730	64, 870	65, 020	64
65	65, 540	65, 680	65, 820	65, 970	66, 110	66, 250	66, 400	66, 540	66, 690	66, 840	66, 980	65
66	67, 470	67, 620	67, 760	67, 900	68, 040	68, 180	68, 330	68, 470	68, 620	68, 770	68, 920	66
67	69, 410	69, 550	69, 690	69, 830	69, 970	70, 110	70, 250	70, 400	70, 550	70, 700	70, 850	67
68	71, 370	71, 510	71, 650	71, 790	71, 920	72, 060	72, 210	72, 360	72, 510	72, 660	72, 810	68
69	73, 340	73, 480	73, 610	73, 750	73, 890	74, 030	74, 170	74, 320	74, 480	74, 630	74, 780	69
70	75, 300	75, 440	75, 580	75, 710	75, 850	75, 980	76, 130	76, 280	76, 440	76, 590	76, 740	70
71	77, 530	77, 660	77, 790	77, 910	78, 040	78, 170	78, 300	78, 440	78, 580	78, 720	78, 860	71
72	79, 760	79, 880	80, 000	80, 110	80, 230	80, 350	80, 470	80, 600	80, 720	80, 850	80, 980	72
73	81, 950	82, 060	82, 170	82, 280	82, 380	82, 490	82, 610	82, 720	82, 830	82, 950	83, 070	73
74	84, 140	84, 240	84, 340	84, 440	84, 530	84, 630	84, 730	84, 830	84, 930	85, 040	85, 150	74
75	86, 360	86, 450	86, 540	86, 630	86, 720	86, 810	86, 900	86, 990	87, 070	87, 170	87, 280	75
76	88, 600	88, 680	88, 760	88, 840	88, 920	88, 990	89, 070	89, 150	89, 220	89, 300	89, 400	76
77	90, 820	90, 890	90, 970	91, 040	91, 100	91, 170	91, 240	91, 300	91, 360	91, 430	91, 520	77
78	93, 830	94, 000	94, 160	94, 320	94, 480	94, 640	94, 800	94, 950	95, 110	95, 270	95, 450	78
79	96, 910	97, 160	97, 410	97, 660	97, 920	98, 170	98, 420	98, 670	98, 920	99, 170	99, 450	79
80	99, 870	100, 200	100, 500	100, 900	101, 200	101, 600	101, 900	102, 300	102, 600	102, 900	103, 300	80
81	102, 900	103, 300	103, 700	104, 200	104, 600	105, 000	105, 500	105, 900	106, 300	106, 800	107, 200	81
82	106, 000	106, 500	107, 000	107, 500	108, 000	108, 600	109, 100	109, 600	110, 100	110, 700	111, 200	82
83	109, 000	109, 600	110, 200	110, 800	111, 400	112, 000	112, 700	113, 300	113, 900	114, 500	115, 100	83
84	112, 000	112, 700	113, 400	114, 200	114, 900	115, 600	116, 300	117, 000	117, 700	118, 400	119, 100	84

See special instruction for preventing gate overflow on page 3.

HIWASSEE DAM

SPILLWAY DISCHARGE

IN CUBIC FEET PER SECOND

GATE ARRANGEMENT	HEADWATER ELEVATION																					GATE ARRANGEMENT
	1531.0	1531.1	1531.2	1531.3	1531.4	1531.5	1531.6	1531.7	1531.8	1531.9	1532.0	1532.1	1532.2	1532.3	1532.4	1532.5	1532.6	1532.7	1532.8	1532.9	1533.0	
56	49, 540	49, 650	49, 760	49, 860	49, 970	50, 070																56
57	51, 480	51, 590	51, 700	51, 810	51, 920	52, 040																57
58	53, 420	53, 530	53, 650	53, 770	53, 880	54, 000																58
59	55, 330	55, 450	55, 570	55, 690	55, 820	55, 940																59
60	57, 240	57, 370	57, 500	57, 620	57, 750	57, 880																60
61	59, 180	59, 310	59, 440	59, 580	59, 710	59, 840																61
62	61, 120	61, 250	61, 390	61, 530	61, 670	61, 800																62
63	63, 050	63, 200	63, 340	63, 480	63, 620	63, 770	63, 910	64, 050	64, 190	64, 330	64, 470											63
64	65, 020	65, 160	65, 310	65, 450	65, 590	65, 740	65, 880	66, 020	66, 160	66, 300	66, 450											64
65	66, 980	67, 130	67, 270	67, 420	67, 560	67, 700	67, 850	67, 990	68, 130	68, 280	68, 420											65
66	68, 920	69, 060	69, 210	69, 350	69, 500	69, 640	69, 790	69, 930	70, 070	70, 220	70, 360											66
67	70, 850	70, 990	71, 140	71, 290	71, 430	71, 580	71, 720	71, 870	72, 010	72, 160	72, 300											67
68	72, 810	72, 960	73, 110	73, 250	73, 400	73, 550	73, 690	73, 840	73, 980	74, 130	74, 270											68
69	74, 780	74, 930	75, 070	75, 220	75, 370	75, 520	75, 660	75, 810	75, 950	76, 100	76, 240											69
70	76, 740	76, 890	77, 040	77, 190	77, 340	77, 480	77, 630	77, 780	77, 920	78, 070	78, 220											70
71	78, 860	79, 010	79, 150	79, 290	79, 430	79, 570	79, 710	79, 850	79, 990	80, 130	80, 270											71
72	80, 980	81, 120	81, 260	81, 390	81, 530	81, 660	81, 790	81, 930	82, 060	82, 190	82, 330											72
73	83, 070	83, 200	83, 330	83, 460	83, 590	83, 710	83, 840	83, 960	84, 090	84, 210	84, 350											73
74	85, 150	85, 280	85, 400	85, 520	85, 640	85, 760	85, 880	86, 000	86, 110	86, 230	86, 370											74
75	87, 280	87, 390	87, 510	87, 620	87, 730	87, 850	87, 960	88, 070	88, 180	88, 290	88, 430											75
76	89, 400	89, 510	89, 620	89, 730	89, 830	89, 940	90, 040	90, 140	90, 240	90, 350	90, 490											76
77	91, 520	91, 620	91, 730	91, 830	91, 920	92, 020	92, 120	92, 210	92, 310	92, 410	92, 550											77
78	95, 450	95, 650	95, 840	96, 030	96, 220	96, 400	96, 590	96, 780	96, 960	97, 160	97, 390											78
79	99, 450	99, 730	100, 000	100, 300	100, 600	100, 800	101, 100	101, 400	101, 700	102, 000	102, 300											79
80	103, 300	103, 700	104, 000	104, 400	104, 800	105, 100	105, 500	105, 900	106, 300	106, 600	107, 000											80
81	107, 200	107, 700	108, 100	108, 600	109, 000	109, 500	110, 000	110, 400	110, 900	111, 300	111, 800											81
82	111, 200	111, 800	112, 300	112, 800	113, 400	113, 900	114, 500	115, 000	115, 600	116, 200	116, 700											82
83	115, 100	115, 800	116, 400	117, 100	117, 700	118, 300	119, 000	119, 600	120, 300	120, 900	121, 600											83
84	119, 100	119, 900	120, 600	121, 300	122, 000	122, 800	123, 500	124, 200	125, 000	125, 700	126, 500											84

See special instruction for preventing gate overflow on page 3.

PART 2

SLUICE DISCHARGE TABLES

NOVEMBER 2004

INSTRUCTIONS FOR USE OF TABLES

1. Tables Update

These tables supersede the tables dated September 1996. They differ from those tables only in a few minor details. The September 1996 tables superseded the tables dated March 1991. Those tables were revised to reflect the discharge values obtained from SPILLQ, which is a computer code used in TVA software for monitoring spill discharges and determining gate arrangements.

2. Purpose of Tables

These tables provide a means of setting up or determining the discharge through the four spillway sluices in Hiwassee Dam. They give the total discharge in cubic feet per second when the headwater elevation and operating sluices are known. . The discharges are based on coefficients of discharge obtained from prototype measurements.

The combination of sluices operated at any one time was determined to minimize scour on the spillway apron and to reduce the tailwater level below the powerhouse.

3. Arrangement of Tables

The tables give the total discharge of sluice 3; sluices 2 and 4; sluices 1, 3, and 4; and sluices 1, 2, 3, and 4 at full gate openings. Only these combinations of sluices should be used. The locations of the sluices are shown on page 4.

The discharge for each combination of sluices is tabulated for each 1-foot of headwater elevation between elevations 1410 feet and 1532 feet.

The interval between tabulated discharges caused by a change of 1-foot in headwater elevation is so small that <u>it is unnecessary to interpolate between values given in these tables</u>.

HIWASSEE DAM

SLUICE DISCHARGE IN CUBIC FEET PER SECOND

Headwater Elevation	SLUICES OPERATING			
	3	2 & 4	1, 3, & 4	1, 2, 3, & 4
1410	4120	8250	12370	16500
1411	4140	8280	12420	16560
1412	4150	8310	12460	16610
1413	4170	8330	12500	16670
1414	4180	8360	12540	16730
1415	4200	8390	12590	16780
1416	4210	8420	12630	16840
1417	4220	8450	12670	16890
1418	4240	8470	12710	16950
1419	4250	8500	12750	17010
1420	4270	8530	12800	17060
1421	4280	8560	12840	17120
1422	4290	8590	12880	17170
1423	4310	8610	12920	17220
1424	4320	8640	12960	17280
1425	4330	8670	13000	17330
1426	4350	8690	13040	17390
1427	4360	8720	13080	17440
1428	4370	8750	13120	17500
1429	4390	8770	13160	17550
1430	4400	8800	13200	17600
1431	4410	8830	13240	17660
1432	4430	8850	13280	17710
1433	4440	8880	13320	17760
1434	4450	8910	13360	17820

HIWASSEE DAM
SLUICE DISCHARGE IN CUBIC FEET PER SECOND

Headwater Elevation	SLUICES OPERATING			
	3	2 & 4	1, 3, & 4	1, 2, 3, & 4
1435	4470	8930	13400	17870
1436	4480	8960	13440	17920
1437	4490	8990	13480	17970
1438	4510	9010	13520	18030
1439	4520	9040	13560	18080
1440	4530	9060	13600	18130
1441	4550	9090	13640	18180
1442	4560	9120	13670	18230
1443	4570	9140	13710	18280
1444	4580	9170	13750	18340
1445	4600	9190	13790	18390
1446	4610	9220	13830	18440
1447	4620	9240	13870	18490
1448	4630	9270	13900	18540
1449	4650	9300	13940	18590
1450	4660	9320	13980	18640
1451	4670	9350	14020	18690
1452	4690	9370	14060	18740
1453	4700	9400	14090	18790
1454	4710	9420	14130	18840
1455	4720	9450	14170	18890
1456	4740	9470	14210	18940
1457	4750	9500	14240	18990
1458	4760	9520	14280	19040
1459	4770	9540	14320	19090

HIWASSEE DAM
SLUICE DISCHARGE IN CUBIC FEET PER SECOND

Headwater Elevation	SLUICES OPERATING			
	3	2 & 4	1, 3, & 4	1, 2, 3, & 4
1460	4780	9570	14350	19140
1461	4800	9590	14390	19190
1462	4810	9620	14430	19240
1463	4820	9640	14460	19290
1464	4830	9670	14500	19330
1465	4850	9690	14540	19380
1466	4860	9720	14570	19430
1467	4870	9740	14610	19480
1468	4880	9760	14650	19530
1469	4890	9790	14680	19580
1470	4910	9810	14720	19620
1471	4920	9840	14750	19670
1472	4930	9860	14790	19720
1473	4940	9880	14830	19770
1474	4950	9910	14860	19820
1475	4970	9930	14900	19860
1476	4980	9950	14930	19910
1477	4990	9980	14970	19960
1478	5000	10000	15000	20000
1479	5010	10030	15040	20050
1480	5020	10050	15070	20100
1481	5040	10070	15110	20140
1482	5050	10100	15140	20190
1483	5060	10120	15180	20240
1484	5070	10140	15210	20280

HIWASSEE DAM

SLUICE DISCHARGE IN CUBIC FEET PER SECOND

Headwater Elevation	SLUICES OPERATING			
	3	2 & 4	1, 3, & 4	1, 2, 3, & 4
1485	5080	10170	15250	20330
1486	5090	10190	15280	20380
1487	5110	10210	15320	20420
1488	5120	10230	15350	20470
1489	5130	10260	15390	20510
1490	5140	10280	15420	20560
1491	5150	10300	15450	20610
1492	5160	10330	15490	20650
1493	5170	10350	15520	20700
1494	5190	10370	15560	20740
1495	5200	10390	15590	20790
1496	5210	10420	15630	20830
1497	5220	10440	15660	20880
1498	5230	10460	15690	20920
1499	5240	10480	15730	20970
1500	5250	10510	15760	21010
1501	5260	10530	15790	21060
1502	5280	10550	15830	21100
1503	5290	10570	15860	21150
1504	5300	10600	15890	21190
1505	5310	10620	15930	21240
1506	5320	10640	15960	21280
1507	5330	10660	15990	21320
1508	5340	10680	16030	21370
1509	5350	10710	16060	21410

HIWASSEE DAM

SLUICE DISCHARGE IN CUBIC FEET PER SECOND

Headwater Elevation	SLUICES OPERATING			
	3	2 & 4	1, 3, & 4	1, 2, 3, & 4
1510	5360	10730	16090	21460
1511	5380	10750	16130	21500
1512	5390	10770	16160	21540
1513	5400	10790	16190	21590
1514	5410	10820	16220	21630
1515	5420	10840	16260	21670
1516	5430	10860	16290	21720
1517	5440	10880	16320	21760
1518	5450	10900	16350	21800
1519	5460	10920	16390	21850
1520	5470	10950	16420	21890
1521	5480	10970	16450	21930
1522	5490	10990	16480	21980
1523	5500	11010	16510	22020
1524	5520	11030	16550	22060
1525	5530	11050	16580	22100
1526	5540	11070	16610	22150
1527	5550	11090	16640	22190
1528	5560	11120	16670	22230
1529	5570	11140	16710	22270
1530	5580	11160	16740	22320
1531	5590	11180	16770	22360
1532	5600	11200	16800	22400

3. Free earth support analyses which compensate for toe fixity by including a bending moment reduction factor are liable to be misleading; fixed earth support methods should always be used.

4. Design analyses should be suitable for practical design use. In view of the approximations involved in "idealizing" geologic sections and assessing soil properties, design computations should not depend on arithmetical accuracy to several decimal places.

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RATING CURVES FOR FLOW OVER DRUM GATES

By Joseph N. Bradley,[1] A. M. ASCE

With Discussion by Messrs. Guido Wyss; Sam Shulits; Bob Buehler; F. B. Campbell and A. A. McCool; and Joseph N. Bradley

Synopsis

With water becoming more valuable in the western states each year, there is an increasing demand for better methods of measurement and additional rating structures. This condition applies not only to the requirements for main canals and laterals of irrigation works but also to the regulation and measurement of flow at dams. In fact, the need has reached the point at which operators are desirous of metering the flow at nearly all control devices in irrigation systems, and in other water supply or control systems.

The primary purpose of this paper is to point out that there are numerous control structures in existence that will serve a dual purpose—that of a metering station as well as that of a regulating device. Examples of such structures include spillways, with or without gates; outlet works for dams using gates or valves; and canal regulating structures using gates. With the accumulation of information from hydraulic model studies made by the Bureau of Reclamation (USBR), United States Department of the Interior, it is now possible to prepare reasonably accurate rating curves for many such structures without the construction of models and without access to the prototypes. The method is especially useful for the rating of existing structures. This paper describes the method as it applies to the rating of drum gates and the paper is concluded with an engineering example. The method is also applicable to the rating of the Volet gate used in France, the bascule gate manufactured in the United States, and others in which the sector of a circle is hinged at or near the crest of a spillway.

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Introduction

The drum gate is a type of gate that floats in a chamber and is buoyed into position by regulating the water level in that chamber. A medium-sized gate of this type is shown in Fig. 1. To use drum gates as metering devices, it is essential that each gate be equipped with an accurate position indicator. This indicator may consist of an arm or pointer connected directly to one of the gate pins, and is usually located inside an adjacent pier. The scale, which commonly indicates "position of high point of gate," may be a cast-metal arc mounted on the wall under the pointer, or a scale painted on the wall.

This paper presents a method of computing rating curves for all positions of the gate with an accuracy comparable to that which can be obtained from an average current-meter traverse of the river. The information required for rating a drum gate consists of the over-all dimensions of the gate and overflow crest, the information contained in this paper, and the coefficient of discharge

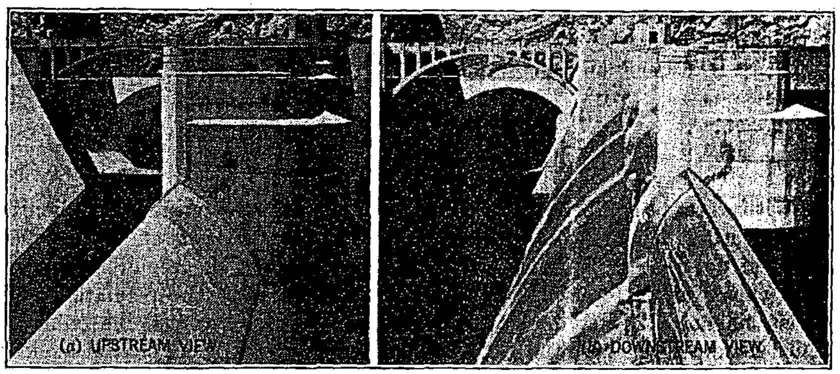


Fig. 1.—Drum Gate, 100 Ft by 16 Ft, at Hoover Dam (Arizona-Nevada)

for any appreciable head on the spillway with the gate in the completely lowered position. Should the coefficient data be lacking, the coefficient of discharge for the designed head can be estimated for nearly any overflow section by a method previously published.[2]

The method of rating described here is not intended to replace the measurements taken at river gaging stations. However, it has the following advantages: (1) The gates can be set in a few minutes to pass a desired discharge and (2) in time of flood, the gaging station may be out of order but the gate calibration is as accurate as usual. The flood that passed over Grand Coulee Dam (Washington) in 1948 is an example. The river gage, in the pier of a bridge downstream, was in error because of a drawdown in the water surface, adjacent to the pier, at the higher flows. Current-meter measurements were also attempted during the flood, but the swiftness of the current and other difficulties rendered these only partially successful. As a result, the discharge at the peak of the flood, which was finally estimated as 638,000

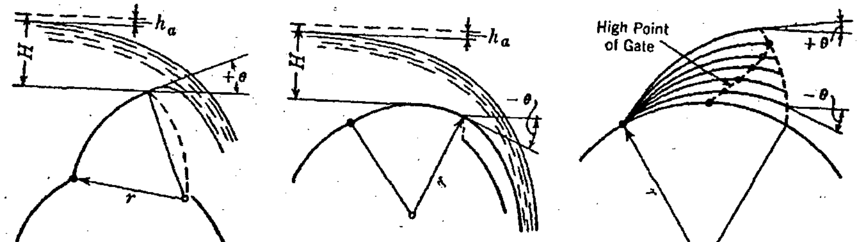
[2] "Discha[illegible]oefficients for Irregular Overfall Spillway Sections," by J. N. Bradley, *Engineering Monograph N*[illegible] Bureau of Reclamation, U. S. Dept. of the Interior, Denver, Colo., March, 1952.

sec-ft, is questionable. Measurement of the flow over the drum gates, which is now possible, would have afforded a continuous record and one that would be as accurate for floods as for normal flows.

Characteristics of the Drum Gate

As a measuring device, the drum gate resembles a sharp-crested weir with a curved upstream face over the greater part of its travel. With an adequate positioning indicator, the drum gate can serve as a very satisfactory metering device.

When the drum gate simulates a sharp-crested weir—that is, when a line drawn tangent to the downstream lip of the gate makes a positive angle with the horizontal, as in Fig. 2(*a*), four principal factors are involved. These factors are H, the total head above the high point of the gate; θ, the angle made by a line drawn tangent to the downstream lip of the gate and the horizontal; r, the radius of the gate or an equivalent radius, should the curvature of the



(*a*) POSITIVE ANGLE, θ (*b*) NEGATIVE ANGLE, θ (*c*) CONTROL POINT

Fig. 2.—Drum-Gate Positions

gate involve a parabola; and C_q, the coefficient of discharge in $Q = C_q L H^{\frac{3}{2}}$, in which Q is the discharge in second-feet, and L is the length of the gate.

The depth of approach was not included as a variable because drum-gate installations studied were for medium and high dams at which approach effects were negligible. When the approach depth, measured below the high point of the gate, is equal to or greater than twice the head on the gate, it has been shown[3] that a further increase in approach depth produces very little increase in the coefficient of discharge. Most drum-gate installations satisfy this condition, especially when the gate is in a raised position. Therefore, with adequate approach depth the four variables H, θ, r, and C_q completely define the flow over this type of gate for positive angles of θ, Fig. 2(*a*).

For negative values of θ, Fig. 2(*b*), the downstream lip of the gate no longer controls the flow. Rather, the control point shifts upstream to the vicinity of the high point of the gate for each setting as illustrated in Fig. 2(*c*), and flow conditions gradually approach those of the free crest (as the gate is lowered). Although other factors enter the problem, the similitude also holds for this case down to an angle of approximately $-15°$.

[3] "Studies of Crests for Overfall Dams," *Bulletin No. 3*, Pt. VI, Boulder Canyon Final Reports, Bureau of Reclamation, U. S. Dept. of the Interior, Denver, Colo., 1948.

Sources of Information

The data for this drum-gate study were obtained from hydraulic models of various sizes and scales. The experiments were performed over a period of about eighteen years. The spillway drum gates tested, the principal dimensions of each, the model scale, the laboratory where the tests were conducted, and other information are given in Table 1. Gates for the first three dams

TABLE 1.—Principal Dimensions of Drum Gates Tested

Dam	No. of gates	Length of gate, in ft	Height of gate, in ft	Radius of gate, in ft	Approach depth, in ft	Maximum head on crest,[a] in ft	Model scale	Hydraulic laboratory
Grand Coulee (Washington)	11	135	28	66.25	360	31.65	1:30	Fort Collins (Colo.)
Bhakra (India)	2	135	28	66.25	410	28	1:80	Customhouse (Denver, Colo.)
Shasta (California)	3	110	28	66.25	460	28	1:68	Customhouse
Hamilton (Texas)	1	300	28	74.17	50	32	1:30	Fort Collins
Hoover, Shape 4-M3[b] (Ariz.-Nev.)	4	100	16	26.8	50	26.6	1:20	Montrose, Colo.
Hoover, Shape 8-M5[b] (Ariz.-Nev.)	4	100	16	36.0	50	26.6	1:20	Montrose
Hoover, Shape 7-C4[b] (Ariz.-Nev.)	4	100	16	26.0	50	26.6	1:60	Fort Collins
Friant (California)	3	100	18	47.0	140	19.0	1:25	Fort Collins
Norris (Tennessee)	3	100	14	34.0	200	27.0	1:72	Fort Collins
Madden (Canal Zone)	4	100	18	30.0	120	30.0	1:72	Fort Collins
Capilano (British Columbia)	1	70	23	71.0	200	23.0	1:60	Denver Federal Center

[a] Gate down. [b] Refers to the shape of the spillway cross section.

listed in the table—Grand Coulee Dam (Washington), Bhakra Dam (India), and Shasta Dam (California)—are identical except for the length and number. The models of each were tested at different times by different personnel. The results of the tests are nearly identical, which fact indicates the consistency possible in this type of test. Although identical gates are of value in indicating the consistency of results, test results on dissimilar gates are desirable because they can give assurance that all factors involved in the establishment of similitude have been considered. The study includes only eleven gates (Table 1), but the dimensions of these vary over a fairly wide range, and the consistency indicated in compiling the results was quite satisfactory.

Cross sections of representative examples of the spillway overflow sections and drum gates listed in Table 1 are shown in Fig. 3. For Hoover Dam, Shape 4-M3 is shown. The data relating the coefficient, C_q, to the head for the model drum gates tested are tabulated in Table 2.

Results of Bazin on Straight Inclined Weirs

The straight inclined weir is comparable to a drum gate, having infinite radius, thus the results of Bazin serve as an introduction to this study.

Bazin, in his classical experiments, studied inclined sharp-crested weirs.[4] The angle of the weir was varied in increments from 14° to 90° with the horizontal, and each weir was 3.7 ft high (vertical dimension). The head on the crest of the weirs ranged from 0.32 ft to 1.48 ft. The results, presented in Fig. 4, show θ plotted against the Bazin coefficient, C_b (in the formula, $Q = C_b L h \sqrt{2 g h}$), in which h does not include the velocity head of approach (h_a). The

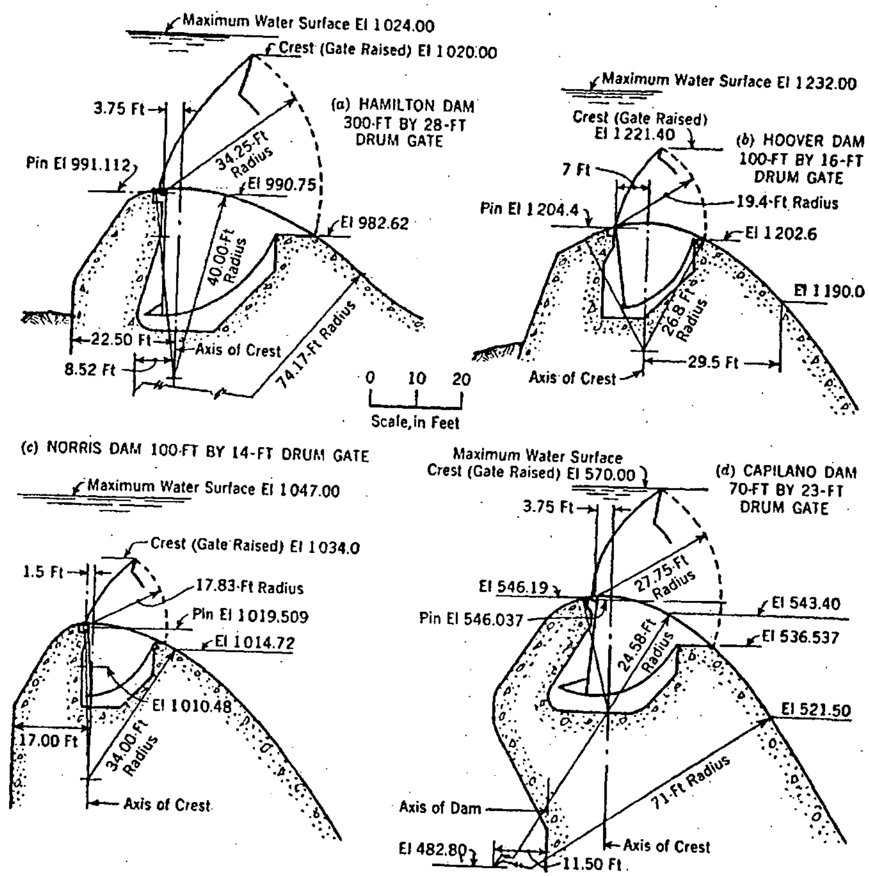


Fig. 3.—Examples of Drum-Gate Cross Sections

angle θ is also plotted with respect to C_q (in the expression, $Q = C_q L H^{3/2}$) in which H is the total head. This latter expression will be used throughout the paper.

By reference to Fig. 4 it can be observed (1) that the coefficient, C_q, varies only slightly with the observed head on the weir, (2) that there is a rather

[4] "Recent Experiments on the Flow of Water over Weirs," by H. Bazin, *Annales des Ponts et Chaussées*, October, 1888. (Translation by Arthur Marichal and John C. Trautwine, Jr., *Proceedings*, Engineers' Club of Philadelphia, Pa., Vol. IX, No. 4, 1892, p. 316.)

TABLE 2.—DRUM-GATE COEFFICIENTS[a]

Grand Coulee Dam (Washington)		Bhakra Dam (India)		Shasta Dam (California)		Hamilton Dam (Texas)	
Reservoir elevation, in feet	Coefficient, C_q	Reservoir elevation, in feet	Coefficient, C_q	Reservoir elevation, in feet	Coefficient, C_q	Total head on gate, in feet	Coefficient, C_q
Gate Elevation[b] 1260.0		Gate Elevation[b] 1552.0		Gate Elevation[b] 1037.0		Gate Elevation[b] 992.0	
1295	3.920	1580	3.680	1075	3.895	35	3.710
1290	3.842	1575	3.645	1070	3.835	30	3.645
1285	3.745	1570	3.550	1065	3.760	25	3.580
1280	3.635	1565	3.420	1060	3.675	20	3.500
1275	3.510	1560	3.275	1055	3.575	15	3.400
1270	3.352	1555	3.120	1050	3.465	10	3.290
1265	3.220			1045	3.335	5	3.160
Gate Elevation 1263.51		Gate Elevation 1557.0		Gate Elevation 1039.0		Gate Elevation 995.52	
1295	3.530	1580	3.430	1075	3.637	30	3.400
1290	3.442	1575	3.380	1070	3.565	25	3.310
1285	3.360	1570	3.295	1065	3.490	20	3.223
1280	3.280	1565	3.170	1060	3.417	15	3.150
1275	3.220	1560	3.040	1055	3.340	10	3.085
1270	3.182			1050	3.250	5	3.010
Gate Elevation 1267.02		Gate Elevation 1562.0		Gate Elevation 1041.0		Gate Elevation 999.0	
1295	3.530	1580	3.550	1075	3.550	25	3.450
1290	3.457	1576	3.355	1070	3.494	20	3.390
1285	3.380	1572	3.290	1065	3.432	15	3.300
1280	3.300	1568	3.345	1060	3.365	10	3.195
1275	3.213	1564	3.465	1055	3.290	5	3.080
1270	3.120						
Gate Elevation 1270.48		Gate Elevation 1567.0		Gate Elevation 1045.0		Gate Elevation 1006.0	
1295	3.600	1580	3.665	1075	3.637	18	3.640
1290	3.530	1577	3.650	1070	3.565	15	3.635
1285	3.462	1573	3.600	1065	3.490	12	3.605
1280	3.410	1570	3.535	1060	3.415	9	3.560
1275	3.375			1055	3.330	6	3.505
				1050	3.220		
Gate Elevation 1274.01		Gate Elevation 1572.0		Gate Elevation 1050.0		Gate Elevation 1013.0	
1300	3.725	1580	3.780	1075	3.717	12	3.718
1295	3.695	1579	3.755	1070	3.670	10	3.690
1290	3.662	1578	3.690	1065	3.615	8	3.645
1285	3.630	1577	3.500	1060	3.560	6	3.595
1280	3.600	1576	3.150	1055	3.495	4	3.530
Gate Elevation 1277.50				Gate Elevation 1055.0		Gate Elevation 1020.0	
1295	3.750			1075	3.854	6	3.630
1290	3.738			1070	3.827	5	3.610
1285	3.740			1065	3.800	4	3.540
1280	3.765			1060	3.780	3.5	3.400
				1055	3.763		
Gate Elevation 1281.02				Gate Elevation 1060.0			
1295	3.730			1075	3.645		
1292	3.708			1072	3.683		
1288	3.705			1069	3.740		
1285	3.725			1066	3.815		
				1063	3.920		
Gate Elevation 1284.50				Gate Elevation 1065.0			
1300	3.840			1076	3.810		
1296	3.830			1074	3.865		
1292	3.875			1072	3.910		
1288	3.950			1070	3.950		
Gate Elevation 1288.0							
1296	3.750						
1294	3.720						
1292	3.670						
1290	3.580						

[a] Coordinates of curves prepared by plotting original data. [b] Gate down.

TABLE 2.[a]—(*Continued*)

Friant Dam (California)		Norris Dam (Tennessee)		Madden Dam (Canal Zone)		Capilano Dam (British Columbia)	
Reservoir elevation, in feet	Coefficient, C_q	Reservoir elevation, in feet	Coefficient, C_q	Total head on gate, in feet	Coefficient, C_q	Reservoir elevation, in feet	Coefficient, C_q
Gate Elevation[b] 560.0		Gate Elevation[b] 1020.0		Gate Elevation[b] 232.0		Gate Elevation[b] 547.0	
580	3.650	1055	3.915	35	3.900	580	3.775
577	3.625	1050	3.845	30	3.770	575	3.705
574	3.550	1045	3.765	25	3.660	570	3.625
571	3.460	1040	3.670	20	3.560	565	3.530
568	3.340	1035	3.550	15	3.460	560	3.415
565	3.175	1030	3.390	10	3.365	555	3.250
562	2.965	1025	3.125	5	3.280		
Gate Elevation 561.5		Gate Elevation 1022.0		Gate Elevation 236.0		Gate Elevation 555.4	
580	3.340	1055	3.785	30	3.810	580	3.615
577	3.300	1050	3.725	25	3.750	577	3.580
574	3.250	1045	3.655	20	3.675	574	3.540
571	3.200	1040	3.570	15	3.590	571	3.485
568	3.125	1035	3.460	10	3.500	568	3.420
564	2.950	1030	3.300	5	3.410	565	3.320
		1025	3.000				
Gate Elevation 563.0		Gate Elevation 1024.0		Gate Elevation 240.0		Gate Elevation 561.1	
580	3.320	1055	3.760	30	3.960	583	3.560
577	3.280	1050	3.720	25	3.890	580	3.530
574	3.240	1045	3.670	20	3.835	577	3.490
571	3.175	1040	3.605	15	3.800	574	3.435
568	3.080	1035	3.520	10	3.775	571	3.355
565	2.960	1030	3.380	5	3.740	568	3.130
		1025	3.000				
Gate Elevation 566.0		Gate Elevation 1026.0		Gate Elevation 245.0		Gate Elevation 568.5	
580	3.450	1055	3.835	25	3.900	583	3.785
577	3.410	1050	3.810	20	3.900	580	3.850
574	3.340	1045	3.780	15	3.890	577	3.890
571	3.240	1040	3.740	10	3.910	574	3.925
568	3.085	1035	3.685	5	3.935		
		1030	3.580				
Gate Elevation 569.0		Gate Elevation 1028.0		Gate Elevation 250.0			
580	3.625	1055	3.890	20	3.750		
578	3.605	1050	3.880	15	3.780		
576	3.575	1045	3.865	10	3.860		
574	3.550	1040	3.845	5	3.980		
572	3.500	1035	3.815				
570	3.400	1030	3.745				
Gate Elevation 572.0		Gate Elevation 1030.0					
580	3.725	1055	3.890				
578	3.720	1050	3.890				
576	3.680	1045	3.885				
574	3.620	1040	3.880				
		1035	3.875				
Gate Elevation 573.0		Gate Elevation 1032.0					
580	3.760	1055	3.870				
578	3.760	1050	3.875				
576	3.765	1045	3.880				
575	3.780	1040	3.895				
574	3.900	1035	3.920				
Gate Elevation 575.0		Gate Elevation 1034.0					
580	3.780	1055	3.815				
578	3.700	1050	3.835				
577	3.840	1045	3.855				
576	3.950	1040	3.885				
		1036	3.945				

[a] Coordinates of curves prepared by plotting original data. [b] Gate down.

TABLE 2.[a]—(*Continued*)

Hoover Dam (Arizona-Nevada) Shape 4-M3		Hoover Dam (Arizona-Nevada) Shape 8-M5		Hoover Dam (Arizona-Nevada) Shape 7-C4	
Total head on gate, in feet	Coefficient, C_q	Total head on gate, in feet	Coefficient, C_q	Total head on gate, in feet	Coefficient, C_q
Gate Elevation[b] 1205.4		Gate Elevation[b] 1205.4		Gate Elevation[b] 1205.4	
26	3.670	28	3.735	26	3.665
22	3.605	25	3.705	22	3.615
18	3.540	20	3.650	18	3.540
14	3.472	15	3.565	14	3.450
10	3.405	10	3.460	10	3.360
6	3.338	5	3.335	6	3.200
Gate Elevation 1209.4		Gate Elevation 1209.4		Gate Elevation 1209.0	
20	3.675	24	3.590	23	3.725
17	3.645	20	3.540	19	3.650
14	3.615	16	3.492	15	3.580
11	3.585	12	3.428	11	3.508
8	3.555	8	3.330	7	3.415
Gate Elevation 1213.4		Gate Elevation 1213.4		Gate Elevation 1213.0	
20	3.880	20	3.765	19	3.800
17	3.875	16	3.765	16	3.845
14	3.875	12	3.725	13	3.825
11	3.870	8	3.668	10	3.750
8	3.870	4	3.600	7	3.640
Gate Elevation 1217.4		Gate Elevation 1217.4		Gate Elevation 1217.0	
14	3.960	15	3.900	15	3.960
12	3.980	12	3.890	13	3.930
10	4.010	9	3.900	11	3.935
8	4.075	6	3.930	9	3.970
				7	4.020
Gate Elevation 1221.4		Gate Elevation 1221.4		Gate Elevation 1221.4	
10	3.890	11	3.830	14	3.815
8	3.930	9	3.840	12	3.820
6	4.020	7	3.875	10	3.823
5	4.100	5	3.935	8	3.825

[a] Coordinates of curves prepared by plotting original data. [b] Gate down.

sharp reversal in the curve when the angle θ approaches 28°, and (3) that the coefficient of discharge is a maximum at this angle. As the angle θ is increased from 28° to 90°, contraction of the jet gradually reduces the coefficient to approximately 3.33, which occurs when the weir is vertical. As θ is decreased from 28° to 0° the coefficient is gradually reduced—either by approach conditions, friction, or both—to that for a broad-crested weir, which may be some value between 2.8 and 3.1. As the principal difference between the drum gate and the straight inclined weir lies in the curvature of the gate, the trends for the two should be similar.

An inconsistency exists in Fig. 4—namely, the coefficient of discharge for a vertical sharp-crested weir should approximate 3.33, but Fig. 4 shows that Bazin obtained 3.45. This conclusion is supported by the fact that the USBR, Ernest W. Schoder, M.ASCE, and Kenneth B. Turner,[5] and others have not

[5] "Precise Weir Measurements," by Ernest W. Schoder and Kenneth B. Turner, *Transactions*, ASCE, Vol. 93, 1929, p. 999.

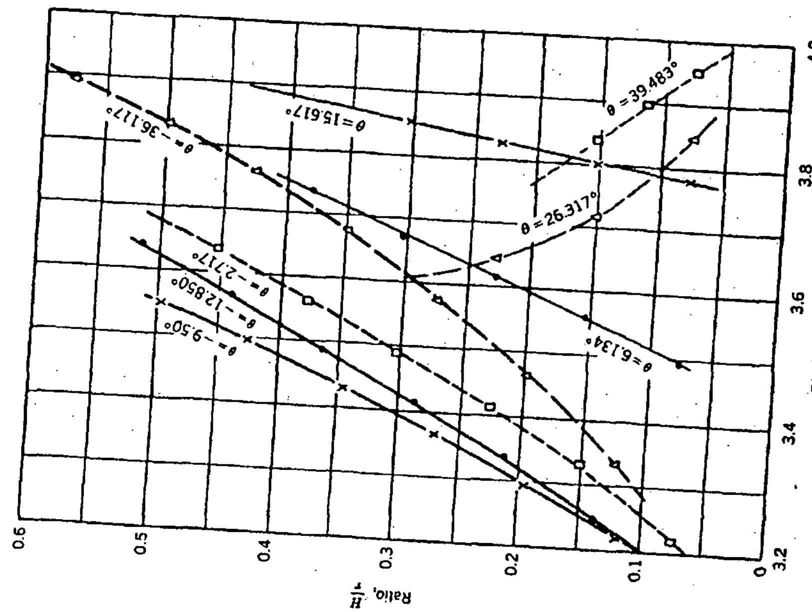


FIG. 5.—DIMENSIONLESS PLOTTING OF DATA FROM MODEL OF SHASTA DAM DRUM GATE

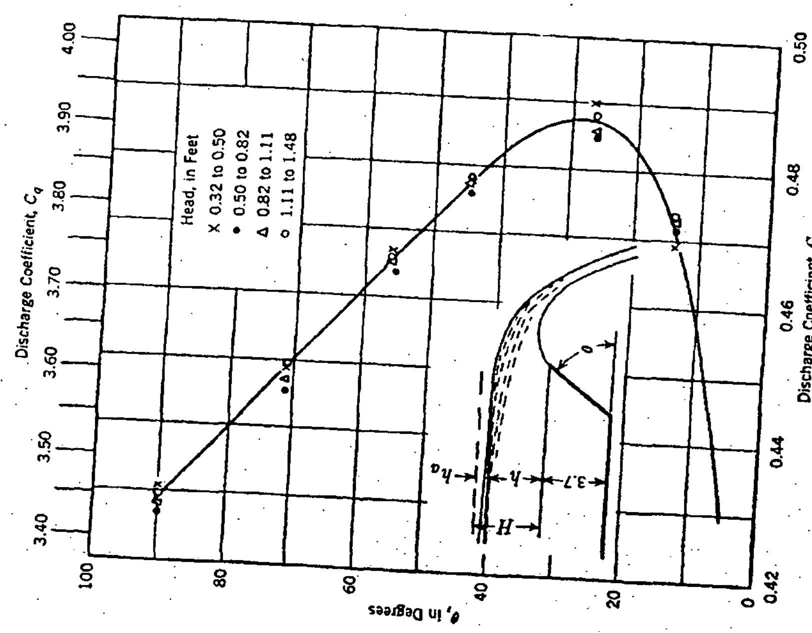


FIG. 4.—RESULTS OF BAZIN'S EXPERIMENTS ON SLOPING WEIRS

been able to check the discharge measurements of Bazin. However, the actual values are not so important for the case at hand as is the significance of the trend.

Method of Combining Test Results

The method for combining results from the eleven drum gates tested (Table 2) consisted of first plotting the coefficient of discharge data separately

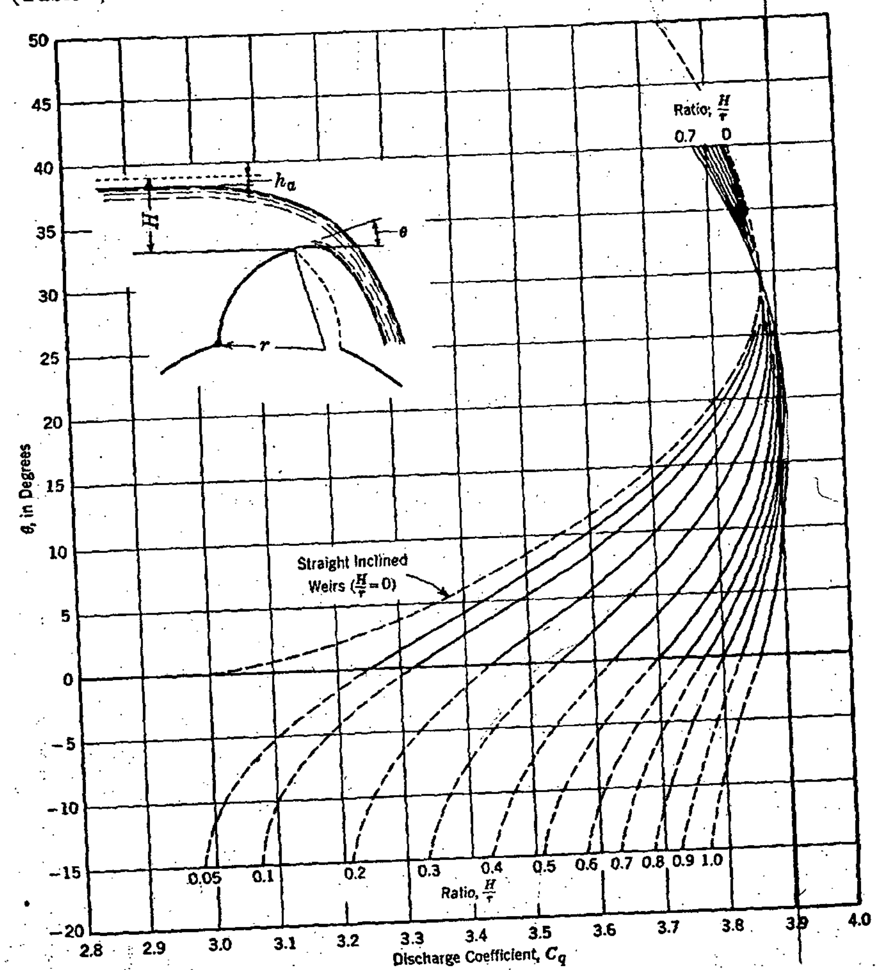


Fig. 6.—General Curves for the Determination of Discharge Coefficients

for each gate as illustrated by the sheet for the Shasta Dam gate (Fig. 5). With the coefficient of discharge as the abscissa and H/r as the ordinate, each curve in Fig. 5 represents a different gate angle θ, which the tangent to the downstream lip of the gate makes with the horizontal. In all cases, H is the

total head, including the velocity head of approach, measured above the high point of the gate, and r is the radius of the gate. In Fig. 5, C_q is based on the relationship, $Q = C_q\, L\, H^{3/2}$. For positive values of θ, the head was measured above the lip of the gate, whereas for negative angles it was observed above the high point, or crest, of the gate proper. The method of measuring the head is illustrated in Fig. 2.

Upon completion of a similar set of curves for each gate tested, the eleven sets of curves were replotted and combined into the chart exhibited as Fig. 6. The results from the various gates showed good general agreement; and the curves in Fig. 6 constitute the general experimental information needed for determining the discharge coefficients for gates in raised or partly raised positions. The supporting points are not shown in Fig. 6, but the individual information for each gate is listed in Table 2.

Analysis of Test Results

The curves in Fig. 6 show a tendency toward reversal, similar to that exhibited by the Bazin curve in Fig. 4, but the points of inflection vary from $\theta = 20°$ to $\theta = 30°$, depending on the value of H/r. Fig. 4 showed the coefficients to vary only slightly with the head, but in this case the coefficients definitely vary with the head.

A matter of significance is the reversal of the (H/r)-order which occurs at 29° (Fig. 6). The coefficient of discharge has but one value, 3.88, when θ approximates 29°; thus, it is insensitive to both the radius and the head on the gate for this angle. The curve for $H/r = 0$ approximates a drum gate of infinite radius and was obtained from the data of Bazin (Fig. 4) by applying a uniform adjustment.

As stated previously, similitude is valid for small negative angles of θ, as well as for positive angles up to 90°; thus, the curves in Fig. 6 are shown and recommended for use down to $\theta = -15°$. As the gate is lowered beyond this angle, the curves double back and converge, finally terminating in the free flow coefficient.

The discharge coefficients in the region between $\theta = -15°$ and the gate completely down are determined by graphical interpolation. Interpolation is accomplished by plotting head-discharge curves for several gate angles between $-15°$ and the maximum positive angle. Also the head-discharge curve is plotted for the free crest. This information is then cross-plotted to obtain values in the transition zone. The method will be explained in the example that follows. It will be discovered that negative angles greater than $-15°$ (with the exception of the free crest) are not particularly important from an operator's standpoint, as a change in gate position has little effect on the discharge in this range.

It must be assumed that the coefficient of discharge is known for at least one value of the head on the free crest (gate completely down) for the particular spillway under consideration. With the coefficient known for one or more heads, the complete coefficient curve for the free crest can be plotted by consulting Fig. 7, in which H_e and C_e are the designed head and the coefficient for the designed head, respectively. This chart was reproduced from a previous publication[2] and represents a curve well supported by tests of some fifty overfall spillway crests having wide variation in shape and operating conditions.

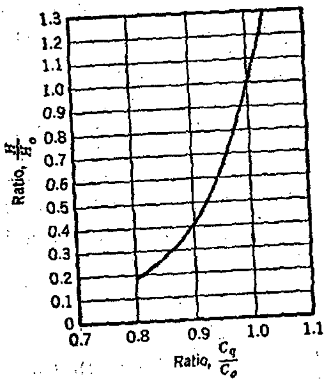


FIG. 7.—COEFFICIENTS OF DISCHARGE FOR OTHER THAN THE DESIGNED HEAD

APPLICATION OF RESULTS

From the plan and section of the Black Canyon Diversion Dam (Idaho), shown in Figs. 8 and 9, assume that it becomes necessary to compute and construct a rating curve for one drum gate for each 0.5 ft of gate elevation. The scale on the gate position indicator is calibrated to show the elevation of the high point of the gate, and the gate has a constant radius of 21.0 ft. The gate is 64 ft long. The coefficient of discharge for the free crest is $C_e = 3.48$ for the designed head (H_e) of 14.5 ft.

With the coefficient of discharge known for free flow at the designed head, the entire free-flow coefficient curve can be established by consulting Fig. 7. The free-flow coefficient curve for Black Canyon Dam spillway (for which $H_e = 14.5$ ft

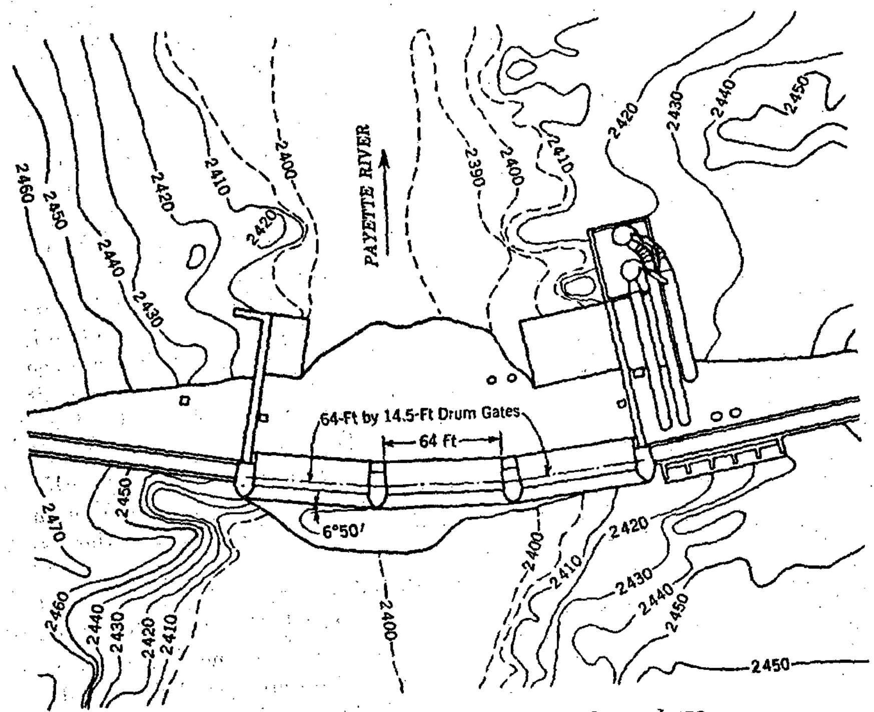


FIG. 8.—PLAN OF BLACK CANYON DIVERSION DAM IN IDAHO

and $C_e = 3.48$) is constructed by arbitrarily assuming several values of H/H_e and reading the corresponding values of C/C_e from Fig. 7. The method is illustrated in Table 3, and the head-coefficient curve for free flow (gate down), obtained in this manner, is shown in Fig. 10.

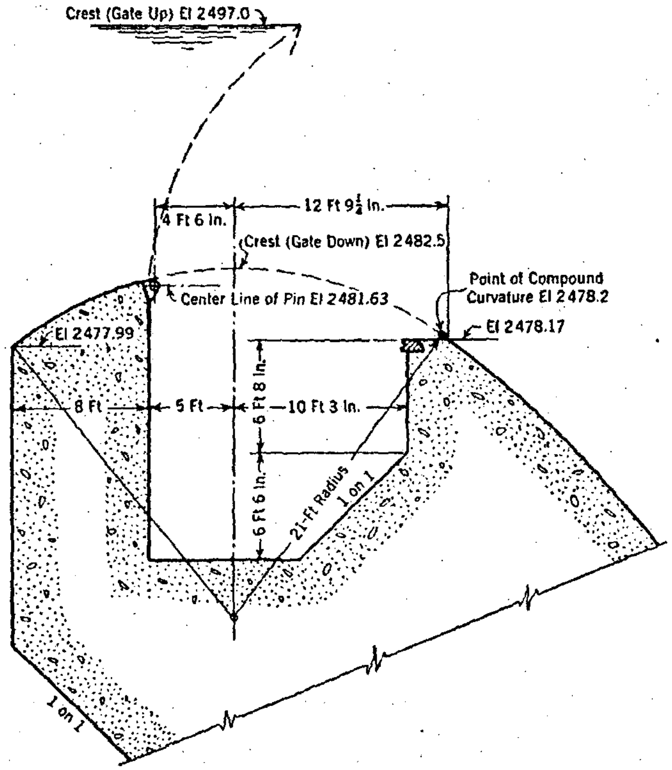


FIG. 9.—SPILLWAY CREST DETAIL, BLACK CANYON DAM IN IDAHO

TABLE 3.—HEAD AND DISCHARGE COMPUTATIONS FOR A FREE CREST (BLACK CANYON DAM IN IDAHO)

Total head, H, in ft (1)	Reservoir elevation, in ft (2)	Ratio,[a] H/H_e (3)	Ratio,[b] C_q/C_e (4)	Coefficient, C_q (5)	Q, in cu ft per sec[c] (6)
17	2499.5	1.172	1.020	3.55	15,950
16	2498.5	1.104	1.012	3.52	14,420
14.5	2497.0	1.0	1.0	3.48	12,296
12	2494.5	0.827	0.980	3.41	9,072
10	2492.5	0.690	0.960	3.34	6,759
8	2490.5	0.552	0.940	3.27	4,736
6	2488.5	0.414	0.905	3.135	2,949
4	2486.5	0.276	0.850	2.957	1,514
3	2485.5	0.207	0.815	2.835	943
2	2484.5	0.138	0.760	2.642	478

[a] $H_e = 14.5$ ft. [b] $C_e = 3.48$. [c] The discharge for one gate: $Q = C_q L H^{\frac{3}{2}}$, in which $L = 64.0$ ft.

Before considering the rating of the spillway with gates in raised positions, it is necessary to construct a diagram such as that shown in Fig. 11 to relate gate elevation to the angle θ for the Black Canyon Dam gate. The tabulation in Fig. 11 shows the angle θ for corresponding elevations of the downstream lip of the gate at intervals of 2 ft.

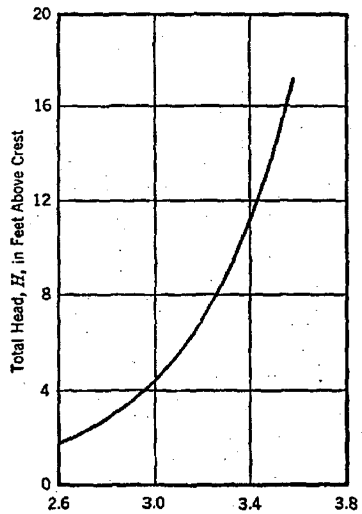


FIG. 10.—HEAD-COEFFICIENT CURVE, BLACK CANYON DAM, IN IDAHO

Beginning with the maximum positive angle of the gate, which is 34.883°, the computations may be begun by choosing a representative number of reservoir elevations as indicated in Col. 2, Table 4. The difference between the reservoir elevation and the high point of the gate (which is the downstream lip in this case) constitutes the total head on the gate, and values of head are recorded in Col. 3. Col. 4 shows these same heads divided by the radius of the gate, which is 21.0 ft.

Entering the curves in Fig. 6 with the values in Col. 4, Table 4, for $\theta = +34.883°$, the discharge coefficients, listed in Col. 5 of the set of computations designated "A," are obtained. The remainder of the procedure outlined in Cols. 6 and 7, Table 4, consists of computing the discharge for one gate from the expression, $Q = C_q L H^{\frac{3}{2}}$. A similar procedure of computation is repeated for other positive angles of θ as in sets B, C, and D of Table 4.

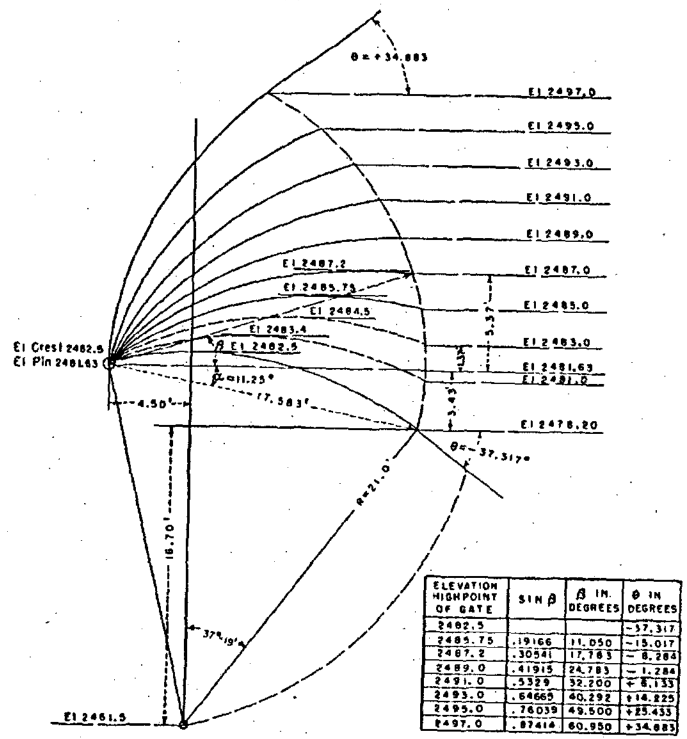
As the angle θ is given negative values, the procedure for determining the discharge remains the same for angles between 0 and $-15°$, except that the head on the gate is measured above the high point rather than above the lip. Discharge computations for negative angles of the gate down to $-15.017°$ are tabulated in E, F, and G of Table 4.

Plotting values of discharge, reservoir elevation, and gate elevation from Table 4 results in the seven curves in Fig. 12 for which the points are denoted by circles. The extreme lower curve, on which the points are identified by x-marks, represents the discharge of the free crest with the gate completely down. The latter values were obtained from Table 3.

The discharge values shown in Fig. 12 are for one gate only. When more than one gate is in operation, the discharges from the separate gates may be totaled providing the gates are each raised the same amount. The experimental models contained from one to four gates (with the exception of that of Grand Coulee Dam, which contained eleven) so a reasonable allowance for pier effect on the discharge is already present in the results.

The intervals between the eight curves identified by points (Fig. 12) are too great for rating purposes, especially the gap between gate elevations, 2485.75 ft and 2482.5 ft. This is remedied by cross-plotting the eight curves

for various constant values of the discharge as shown in Fig. 13. Fortunately, the result is a straight-line variation for any constant value of discharge. The lines in Fig. 13 are not quite parallel and there is no assurance that they will be straight for every drum gate. Nevertheless, this will not detract appreci-



ELEVATION HIGHPOINT OF GATE	SIN β	β IN DEGREES	θ IN DEGREES
2482.5			−37.317
2485.75	.19166	11.050	−15.017
2487.2	.30541	17.763	− 8.284
2489.0	.41915	24.783	− 1.284
2491.0	.5329	32.200	+ 6.133
2493.0	.64665	40.292	+14.225
2495.0	.76039	49.500	+25.433
2497.0	.87414	60.950	+34.883

FIG. 11.—RELATIONSHIP OF GATE ELEVATION TO ANGLE θ

ably from the accuracy obtained. Interpolated information from Fig. 13 is then utilized to construct the additional curves in Fig. 12. If all curves are considered, Fig. 12 shows the completed rating for the Black Canyon Dam spillway for 0.5-ft gate intervals. For intermediate values, straight-line interpolation is permissible.

CONCLUSIONS

This paper has demonstrated how an existing control structure, such as the Black Canyon Dam spillway, can also serve as a rating station. The accuracy of rating curves obtained by the method is estimated to approach that of an average current-meter traverse of the river providing that (1) the gate position indicators are made as large as possible and are accurately calibrated, (2) the reservoir gage can be read to within 0.05 ft, (3) nearly atmospheric pressure exists under the sheet of water after it springs from the gate, and (4) all gates are set at approximately the same elevation.

TABLE 4.—HEAD AND DISCHARGE COMPUTATIONS FOR DRUM GATES IN RAISED POSITIONS

Set (1)	Reservoir elevation, in ft (2)	H, in ft[a] (3)	Ratio, $\frac{H}{r}$ (4)	Coefficients, C_q (5)	$H^{3/2}$, in ft (6)	Q, in cu ft per sec[b] (7)
GATE ELEVATION 2497.0; $\theta = +34.88°$						
A	2498.0	1	0.048	3.86	1	247
	2499.0	2	0.095	3.86	2.828	699
	2500.0	3	0.143	3.86	5.196	1.283
GATE ELEVATION 2495.0; $\theta = +23.43°$						
B	2496.0	1	0.048	3.85	1	246
	2497.0	2	0.095	3.86	2.828	698
	2498.0	3	0.143	3.87	5.196	1,284
	2499.0	4	0.190	3.87	8.00	1,979
	2500.0	5	0.238	3.88	11.18	2,770
GATE ELEVATION 2493.0; $\theta = +14.22°$						
C	2494.0	1	0.048	3.69	1	236
	2495.0	2	0.095	3.73	2.828	675
	2496.0	3	0.143	3.75	5.196	1,247
	2498.0	5	0.238	3.80	11.18	2,719
	2500.0	7	0.333	3.84	18.52	4,552
GATE ELEVATION 2491.0; $\theta = +6.13°$						
D	2492.0	1	0.048	3.47	1	222
	2493.0	2	0.095	3.51	2.828	635
	2494.0	3	0.143	3.57	5.196	1,187
	2496.0	5	0.235	3.63	11.18	2,597
	2498.0	7	0.333	3.70	18.52	4,386
	2500.0	9	0.429	3.77	27.00	6,515
GATE ELEVATION 2489.0; $\theta = -1.28°$						
E	2490.0	1	0.048	3.21	1	205
	2491.0	2	0.095	3.28	2.828	504
	2492.0	3	0.143	3.34	5.196	1,111
	2494.0	5	0.238	3.45	11.18	2,469
	2496.0	7	0.333	3.545	18.52	4,202
	2498.0	9	0.429	3.63	27.00	6.273
	2500.0	11	0.524	3.695	36.48	8.627
GATE ELEVATION 2487.2; $\theta = -8.28°$						
F	2488.0	0.8	0.038	3.02	0.716	138
	2489.0	1.8	0.086	3.10	2.415	479
	2490.0	2.8	0.133	3.17	4.685	950
	2492.0	4.8	0.229	3.31	10.52	2,229
	2494.0	6.8	0.324	3.43	17.73	3,892
	2496.0	8.8	0.419	3.51	26.10	5,863
	2498.0	10.8	0.515	3.58	35.49	8,131
	2500.0	12.8	0.610	3.635	45.79	10,653
GATE ELEVATION 2485.75; $\theta = -15.02°$						
G	2487.0	1.25	0.060	3.00	1.398	268
	2488.0	2.25	0.107	3.07	3.375	663
	2489.0	3.25	0.155	3.15	5.859	1,181
	2491.0	5.25	0.250	3.275	12.03	2,522
	2493.0	7.25	0.345	3.375	19.52	4,216
	2495.0	9.25	0.440	3.465	28.13	6,238
	2497.0	11.25	0.536	3.54	37.73	8,548
	2499.0	13.25	0.631	3.595	48.23	11,097

[a] H is the total head on the gate. [b] The discharge for one gate: $Q = C_q L H^{3/2}$.

In connection with provision (3), the blunt piers on the Black Canyon Dam spillway, Figs. 8 and 9, provide effective aeration under the overfalling sheet of water for all but very small heads with gate completely raised. In the case of provision (4), uniform operation of the gates is also most desirable from the standpoint of stilling basin operation for minimum erosion downstream.

Discharge measurements on the prototype are desirable whenever possible as a check on the accuracy of the foregoing method. Sufficient observations should be taken, however, to establish the fact that the prototype information is consistent and reliable.

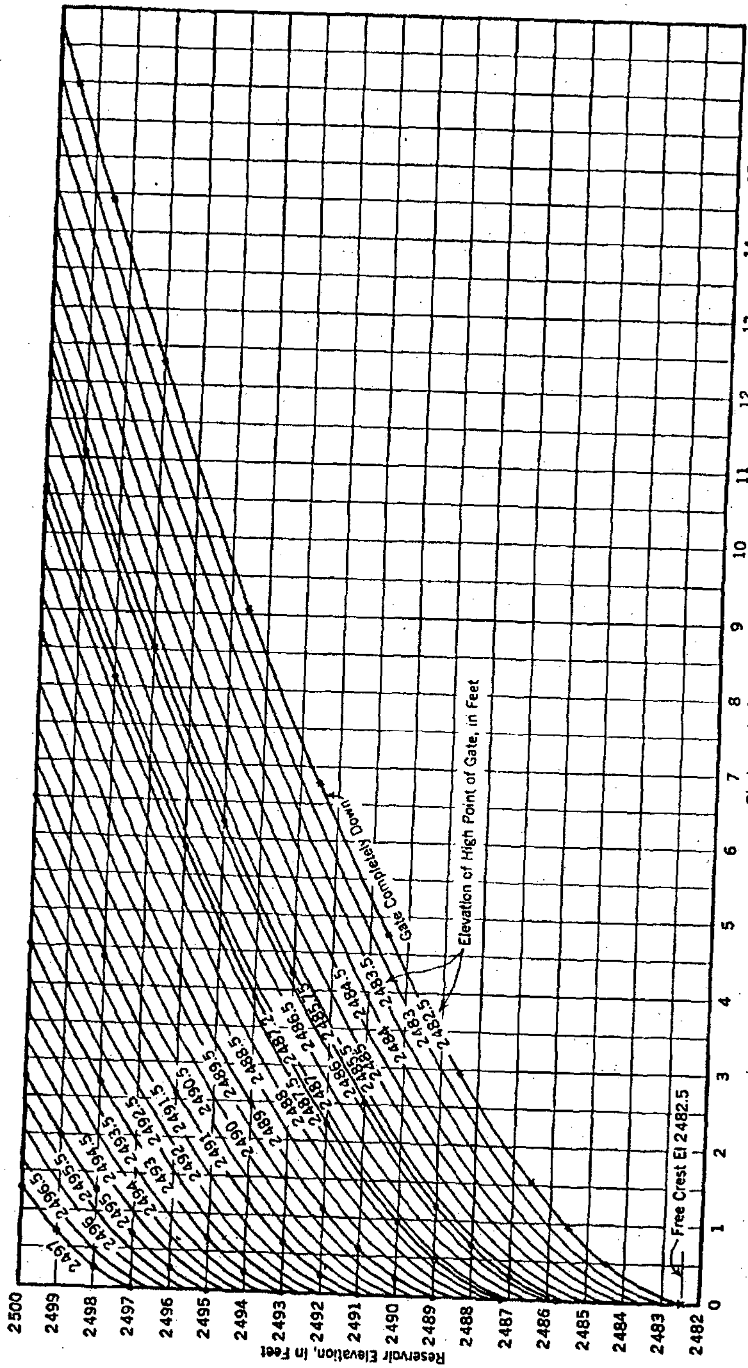


FIG. 12.—RATING CURVES FOR BLACK CANYON DAM DRUM-GATE SPILLWAY IN IDAHO

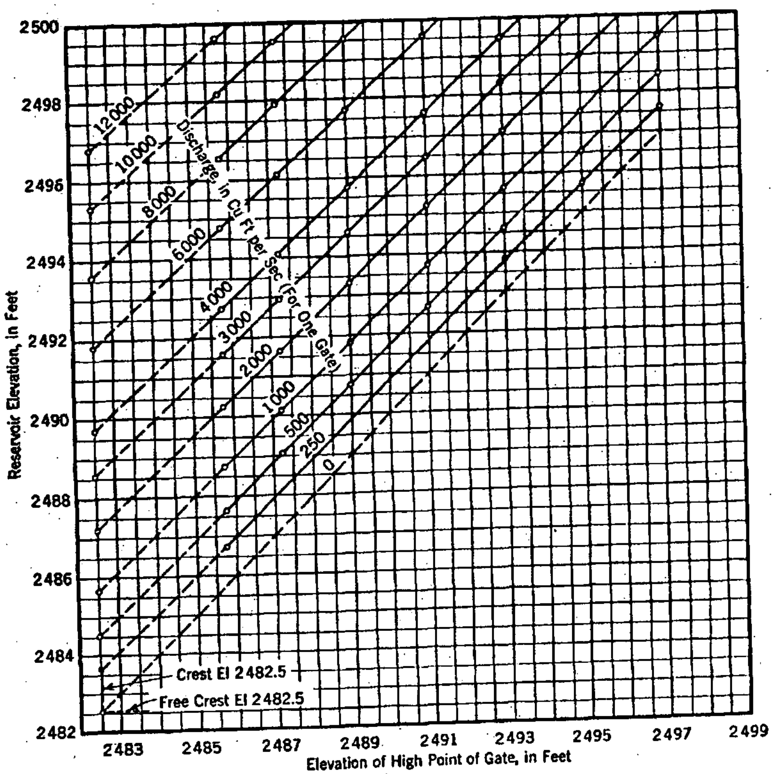


FIG. 13.—CROSS-PLOTTED INITIAL RATING CURVES, BLACK CANYON DAM IN IDAHO

ACKNOWLEDGMENTS

The writer wishes to thank C. E. Blee, M. ASCE, chief engineer of the Tennessee Valley Authority for the use of the data on the Norris Dam Spillway; Hal Birkeland, M. ASCE, of the International Engineering Corporation, for obtaining permission to include the Bhakra and Capilano Dam spillways in the paper; and the chief engineer of the Panama Canal for use of the data on the Madden Dam spillway. The writer is also grateful to the Bureau of Reclamation for the use of the remainder of the experimental information. He also wishes to thank his engineering associates, H. M. Martin, M. ASCE, D. J. Hebert, and A. J. Peterka, A. M. ASCE, for their most helpful comments and suggestions.

DISCUSSION

GUIDO WYSS[6].—The information presented by Mr. Bradley is of utmost value for determining the quantities of discharge over drum gates under various heads for any gate position. This information will permit operators in the field to adjust the gate position from corresponding chart values in such a manner as to obtain the desired flow. The use of drum gates as an actual metering device for spillway quantity discharges is unique and the results obtained are more practicable and reliable than those obtained by stream gaging, especially when this gaging is conducted during periods of high floods.

It would have been interesting if the author had presented an investigation of the flow, profiles of the upper and lower nappe surfaces, as well as the actual water pressures on the upstream plate of the drum gate by use of charts. This would afford an opportunity to obtain the true loading conditions on the gate during the cycle of operation from fully-raised gate to fully-lowered gate. This information would be important in the determination of the buoyancy and loading criteria of the gate structure.

SAM SHULITS,[7] M. ASCE.—An outstanding contribution to the design and operation of drum gates has been presented in this report of the author's work at the USBR. The paper and its complement[2] fill a great need.

Since 1928, when the Freeman Scholarships were established, there has been a tremendous development of hydraulic model research in the laboratories of the United States. Although these laboratories are unexcelled in size and quality, many hydraulic engineers have pondered the procession of models (spillways, stilling pools, and river reaches) in the period from 1928 to 1953 with few, if any, summaries or proposals for design to reduce the dependence on models. In Mr. Bradley's work there is strong evidence that the laboratories will produce correlations and syntheses—not more models.

When it is realized that many of the most famous and productive laboratories in the United States did not exist prior to 1928, the lack of correlation and synthesis for general use is understandable. The hope is that other works of similar quality will be added to engineering literature.

BOB BUEHLER,[8] A. M. ASCE.—An interesting and clever use of data has resulted in a method by which records of gate settings at dams can be made a substitute for missing stream-flow records and can be used to augment existing records. The construction of a dam and reservoir often floods an established stream gage. Unless the gage is replaced below the dam or upstream from the reservoir, subsequent stream flow usually is not accurately known. Sometimes a series of dams (each causing the water to back up to the dam above) prevents continuing established gages at the strategic points where they had been

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located. The less accurate—and more costly—slope stations are not completely satisfactory alternatives to the single-line rating stations.

If the spillway of a dam can be rated with an accuracy comparable to the accuracy obtainable with a gage (as demonstrated by Mr. Bradley for certain spillway types), and if allowance is made for flow through other water outlets such as turbines, locks, and sluices, the structure is then superior in some respects to the gage. For example, the rating of the dam should be permanent, whereas the rating of a gage usually requires frequent checking.

Mr. Bradley's method for rating drum gates not only allows records for ordinary stream flow to be supplemented, but also probably gives a more accurate determination of extreme flood rates than do most gages. He has made an important contribution to the planning and design of drum-gated structures.

The author has presented a method for rating a spillway at all heads provided the coefficient for one appreciable head is known. He also states that a coefficient for the designed head can be estimated for most spillways by a method previously published.[8] The writer, on the other hand, offers a method by which an ogee spillway can be rated, provided its profile shape is known. The method is based on an equation derived by R. N. Brudenell, A. M. ASCE, incidental to studies made on radial gates.[9] Mr. Brudenell's equation is

$$Q = \frac{3.97\, L\, H^{1.62}}{H^{0.12}{}_D} \qquad (1)$$

in which Q is the spillway discharge, in cubic feet per second; L denotes the length of the spillway, in feet; H is the total head on the spillway crest, in feet;

TABLE 5.—FREE DISCHARGES FOR BLACK CANYON DAM IN IDAHO

Total head, in feet	Discharge, in cubic feet per second[a]	Using Eq. 1		Using Fig. 14	
		Discharge, in cubic feet per second	Difference, in percent	Discharge, in cubic feet per second	Difference, in percent
(1)	(2)	(3)	(4)	(5)	(6)
17	15,950	15,847	−0.65	15,910	−0.25
16	14,420	1,4363	−0.39	14,421	−0.01
14.5[b]	12,296	12,247[c]	−0.40	12,296	0
12	9,072	9,013	−0.65	9,049	−0.25
10	6,759	6,708	−0.75	6,735	−0.36
8	4,736	4,673	−1.33	4,692	−0.93
6	2,949	2,932	−0.58	2,944	−0.20
4	1,514	1,521	+0.46	1,527	+0.86
3	943	954	+1.17	958	+1.59
2	478	494	+3.35	496	+3.76

[a] From Col. 6, Table 3. [b] Head at which C_e = 3.48. [c] C_e would be 3.466 for this discharge.

and H_D represents the design head in feet. The design head is that head which produces a standard lower nappe that agrees closely with the spillway profile.

[9] "Flow over Rounded Crests," by R. N. Brudenell, *Engineering News-Record*, July 18, 1935, p. 95.

Eq. 1 was intended to be used with heads greater than $H_D/4$, although the equation has been found to agree closely with model data for somewhat lower heads. Without knowing any coefficients, Eq. 1 gives discharges that agree closely with those obtained by Mr. Bradley for Black Canyon Dam. In the case of Black Canyon Dam, Mr. Bradley used one known coefficient and the curve of Fig. 7. Free-flow discharges computed by the two methods are shown in Cols. 2 and 3, Table 5. The procedure by which Eq. 1 was applied will be described subsequently.

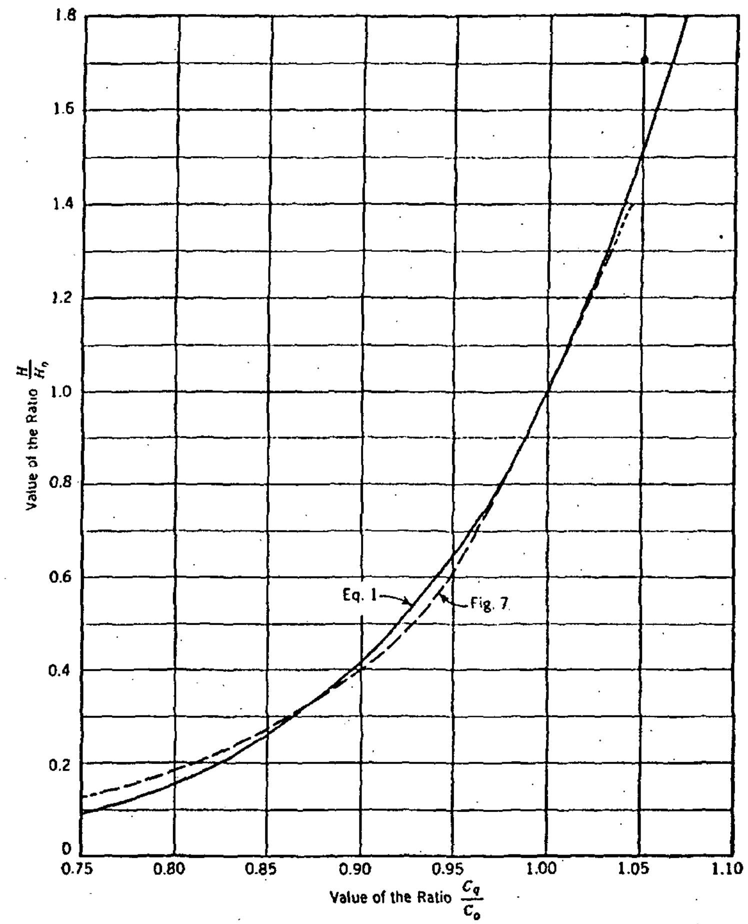


FIG. 14.—COMPARISON OF VALUES OBTAINED FROM FIG. 7 AND EQ. 1

It is assumed that in choosing Black Canyon Dam for his example, the author knew that his method would yield discharges close to known values. The good agreement for all except the low heads shows that, in this example, Eq. 1 (using only the shape of the spillway) also produces suitable results.

This good agreement suggests, too, that there must be a close relationship between the curve in Fig. 7 and a similar curve that can be derived from Eq. 1. To examine the relationship, theoretical discharge coefficients were computed by using

$$Q = C_q \, L \, H^{3/2} \quad \ldots\ldots (2)$$

and Eq. 1, from which

$$C_q = \frac{3.97 \; H^{1.62}}{H^{0.12}{}_D \; H^{3/2}} \quad \ldots\ldots (3)$$

The design head, H_D, was found (by a method to be described subsequently) to be 45 ft for Black Canyon Dam, and this value was used in making the test. Thus, for $H_D = 45$ ft,

$$C_q = \frac{2.5143 \; H^{1.62}}{H^{3/2}} \quad \ldots\ldots (4)$$

For several assumed values of total head, H, varying from 2 ft to 58.5 ft, corresponding C_q-values were computed. The resulting C_q of 3.97 for a head of 45 ft (H_o) was taken arbitrarily as the known coefficient, C_o. Then the (H/H_o) -ratios and the (C_q/C_o)-ratios were computed for all other heads in the assumed range. The resulting curve is the solid line in Fig. 14. The dashed curve is from Fig. 7. The agreement is close—as expected. Still using H_D equal to 45 ft, the remainder of the process was repeated using the coefficient for the 25-ft head as C_o, and then using the coefficient for the 12-ft head as C_o. There was no discernible difference in the curves resulting from the three separate selections. A similar procedure, using H_D equal to 20 ft in Eq. 1, also showed no differences from Fig. 14. It can probably be proved that there should be no difference.

The curve derived from Eq. 1 then was applied to the Black Canyon Dam spillway, assuming (as did the author) that the coefficient is 3.48 at a 14.5-ft head. The resultant free discharges are shown in Col. 5, Table 5.

The free-flow coefficients in Table 2 invite further comparisons with Eq. 1 for the four projects for which spillway profiles are given in Fig. 3. It should be remembered that this comparison tests the use of only the spillway shape as a guide to free discharge for the entire range of heads. Col. 4, Table 6, shows that for appreciable heads the maximum error in the four cases is approximately 2% (Hamilton Dam). Observed coefficients in model tests often scatter as much.

The same coefficients permit testing the curve in Fig. 7 for all eleven spillways. This test is not as severe, however, because it is necessary to assume one known coefficient at which head agreement becomes perfect. At near-by higher and lower heads, large divergences would not be expected. Col. 6, Table 6, shows that for appreciable heads the maximum error is slightly greater than 2% (Hoover Dam, shape 8-M5). The base coefficient selected to obtain C_q from the (C_q/C_o)-ratios is designated by a footnote for each project. These arbitrary selections were made for medium high heads.

The solid-line curve in Fig. 14 also was tested in this manner. The same coefficient at each project was assumed to be known as when the curve in Fig. 7 was tested. Col. 8, Table 6, shows that for appreciable heads the maximum error is slightly more than 2% (Madden Dam).

These comparisons show that the direct application of Eq. 1, Fig. 7 (or Fig. 14) (derived from Eq. 1), all give highly accurate free-flow spillway dis-

TABLE 6.—COMPARISON OF FREE-FLOW SPILLWAY COEFFICIENTS

Total head, in feet	Coefficient obtained from model test	Using Eq. 1		Using Fig. 7		Using Fig. 14	
		C_q	Difference, in percent	C_q	Difference, in percent	C_q	Difference, in percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GRAND COULEE DAM (WASHINGTON)							
35	3.920			3.914	− 0.15	3.902	−0.46
30	3.842			3.831	− 0.29	3.827	−0.39
25	3.745			3.745[a]	0	3.745[a]	0
20	3.635			3.655	+ 0.55	3.651	+0.44
15	3.510			3.550	+ 1.14	3.524	+0.40
10	3.352			3.370	+ 0.54	3.356	+0.12
5	3.220			3.138	− 2.54	3.168	−1.62
BHAKRA DAM (INDIA)							
28	3.680			3.730	+ 1.52	3.732	+1.41
23	3.645			3.645[a]	0	3.645[a]	0
18	3.550			3.547	− 0.08	3.543	−0.20
13	3.420			3.434	+ 0.41	3.404	−0.47
8	3.275			3.215	− 1.83	3.208	−2.04
3	3.120			2.748	−11.92	2.854	−8.53
SHASTA DAM (CALIFORNIA)							
38	3.895			3.910	+ 0.39	3.899	+0.10
33	3.835			3.839	+ 0.10	3.831	−0.10
28	3.760			3.760[a]	0	3.760[a]	0
23	3.675			3.677	+ 0.05	3.674	−0.03
18	3.575			3.591	+ 0.45	3.568	−0.20
13	3.465			3.455	− 0.29	3.429	−1.04
8	3.335			3.215	− 3.60	3.230	−3.15
HAMILTON DAM (TEXAS) H_D = 52 FT							
35	3.710	3.785	+2.02	3.741	+ 0.84	3.730	+0.54
30	3.645	3.716	+1.95	3.662	+ 0.47	3.659	+0.38
25	3.580	3.635	+1.54	3.580[a]	0	3.580[a]	0
20	3.500	3.539	+1.11	3.494	− 0.17	3.490	−0.29
15	3.400	3.420	+0.59	3.394	− 0.18	3.369	−0.91
10	3.290	3.258	−0.97	3.222	− 2.07	3.208	−2.50
5	3.160	2.997	−5.16	3.000	− 5.06	3.029	−4.14
FRIANT DAM (CALIFORNIA)							
20	3.650			3.717	+ 1.84	3.706	+1.53
17	3.625			3.639	+ 0.39	3.632	+0.19
14	3.550			3.550[a]	0	3.550[a]	0
11	3.460			3.458	− 0.06	3.452	−0.23
8	3.340			3.348	+ 0.24	3.319	−0.63
5	3.175			3.142	− 1.04	3.131	−1.38
2	2.965			2.723	− 8.15	2.812	−5.16

[a] Coefficient assumed to be known.

TABLE 6.—(*Continued*)

Total head, in feet (1)	Coefficient obtained from model test (2)	Using Eq. 1: C_e (3)	Using Eq. 1: Difference, in percent (4)	Using Fig. 7: C_e (5)	Using Fig. 7: Difference, in percent (6)	Using Fig. 14: C_e (7)	Using Fig. 14: Difference, in percent (8)
NORRIS DAM (TENNESSEE) H_D = 35 FT							
35	3.915	3.969	+1.38	3.934	+ 0.49	3.923	+0.20
30	3.845	3.897	+1.35	3.852	+ 0.18	3.848	+0.08
25	3.765	3.812	+1.25	3.765[a]	0	3.765[a]	0
20	3.670	3.711	+1.12	3.675	+ 0.14	3.671	+0.03
15	3.550	3.586	+1.01	3.569	+ 0.53	3.543	−0.20
10	3.390	3.416	+0.77	3.388	− 0.06	3.373	−0.50
5	3.125	3.143	+0.58	3.155	+ 0.96	3.185	+1.92
MADDEN DAM (CANAL ZONE)							
35	3.900			3.825	− 1.92	3.814	−2.20
30	3.770			3.744	− 0.69	3.740	−0.80
25	3.660			3.660[a]	0	3.660[a]	0
20	3.560			3.572	+ 0.34	3.568	+0.22
15	3.460			3.470	+ 0.29	3.444	−0.46
10	3.365			3.294	− 2.11	3.279	−2.55
5	3.280			3.067	− 6.49	3.006	−5.01
CAPILANO DAM (BRITISH COLUMBIA) H_D = 48 FT							
33	3.775	3.797	+0.58	3.783	+ 0.21	3.775	0
28	3.705	3.720	+0.40	3.705[a]	0	3.705[a]	0
23	3.625	3.634	+0.25	3.623	− 0.05	3.620	−0.14
18	3.530	3.529	−0.03	3.538	+ 0.23	3.516	−0.40
13	3.415	3.394	−0.62	3.405	− 0.29	3.379	−1.05
8	3.250	3.201	−1.51	3.168	− 2.52	3.183	−2.06
HOOVER DAM (ARIZONA-NEVADA) SHAPE 4-M3, H_D = 50 FT							
26	3.670	3.670	0	3.681	+ 0.30	3.677	+0.19
22	3.605	3.597	−0.22	3.605[a]	0	3.605[a]	0
18	3.540	3.512	−0.79	3.526	− 0.40	3.522	−0.51
14	3.472	3.408	−1.84	3.439	− 0.95	3.414	−1.67
10	3.405	3.273	−3.88	3.306	− 2.01	3.280	−3.67
6	3.338	3.077	−7.82	3.064	− 8.21	3.082	−7.67
HOOVER DAM SHAPE 8-M5							
28	3.735			3.814	+ 2.12	3.800	+1.74
25	3.705			3.752	+ 1.27	3.749	+1.19
20	3.650			3.650[a]	0	3.650[a]	0
15	3.565			3.537	− 0.78	3.530	−0.98
10	3.460			3.387	− 2.11	3.358	−2.94
5	3.335			3.059	− 8.28	3.088	−7.41
HOOVER DAM SHAPE 7-C4							
26	3.665			3.691	+ 0.71	3.687	+0.60
22	3.615			3.615[a]	0	3.615[a]	0
18	3.540			3.535	− 0.14	3.532	−0.23
14	3.450			3.449	− 0.03	3.423	−0.78
10	3.360			3.315	− 1.34	3.290	−2.08
6	3.200			3.073	− 3.97	3.091	−3.41

charges for ogee dams at all but low heads. Eq. 1, applied directly to the spillway shape, has the advantage that no coefficients need be known or estimated in advance.

The comparisons in Table 6 show a tendency toward errors of some importance at low heads when Eq. 1 or its companion curve in Fig. 14 is used, as well as when Fig. 7 is used. In most cases the errors are negative. These errors are of little concern in planning the safety of a structure against extreme floods, or in considering most other operations such as emptying the reservoir. The errors nonetheless affect the analytical rating of drum gates in the lowered or slightly raised positions. The free-flow coefficients help to determine the direction of the general curves at the large negative angles shown in Fig. 6. Free discharges form the base curve of the rating curves in Fig. 12 and help define the curvature of the low ends of the cross-plot curves in Fig. 13. Low to ordinary heads, corresponding to normal stream flow, can exist for a large part of the time at dams whose reservoir capacities are small. Further study of data for low heads might lead to valuable refinements.

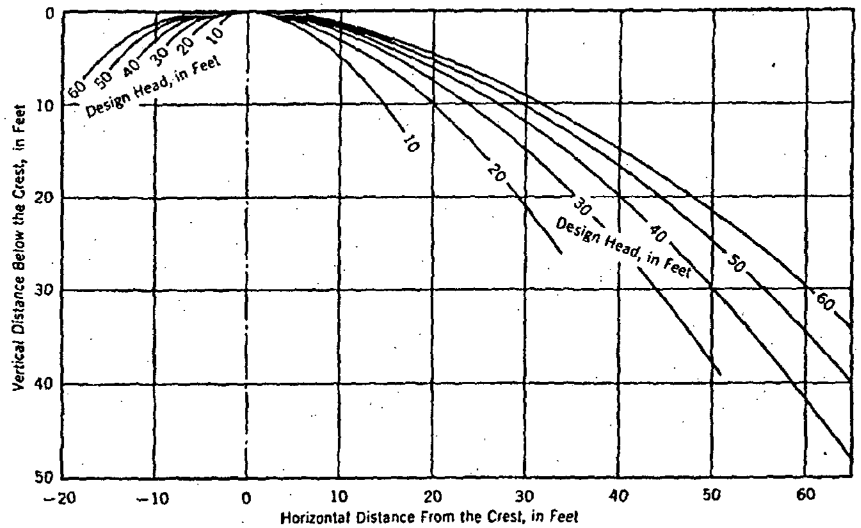


FIG. 15.—STANDARD SPILLWAY SHAPES

Application of Eq. 1.—Since the factor H_D in Eq. 1 represents the head at which a standard lower nappe shape is a reasonable approximation of the spillway shape (as designed or built), it is only necessary to find this head to apply the formula. Spillway coordinates for a standard crest having a vertical upstream face have been used to find this head.[10] These coordinates are shown in Table 7. The last column in Table 7 refers the horizontal (x) coordinates to the spillway crest because this form is the simplest to apply. In Table 7, y is the distance below the crest elevation.

Using these dimensionless coordinates, standard spillway shapes were plotted (Fig. 15) for values of H_D from 10 ft to 60 ft. In Fig. 15 negative

[10] "Hydroelectric Handbook," by William P. Creager and Joel D. Justin, John Wiley & Sons, Inc., New York, N. Y., 2d Ed., 1950, p. 362.

horizontal distances indicate the distance upstream from the crest. The spillway shape as designed or built is then drawn on transparent paper. This paper is laid over Fig. 15, and the value of H_D which gives the best fit is selected. In deciding the best fit it may be found that the profile upstream from the crest indicates one value and the downstream profile indicates a different value. The higher of the two indicated values of H_D should be used. For example, the shape of Black Canyon Dam spillway upstream from the crest indicated a value of approximately 45 ft for H_D. The downstream shape indicated a value of approximately 25 ft. The larger value was used.

TABLE 7.—COORDINATES OF A STANDARD SPILLWAY CREST

Value of $\frac{x}{H_D}$	Value of $\frac{y}{H_D}$	Value of $\frac{x}{H_D}$ referred to crest
0	0.126	−0.3
0.1	0.036	−0.2
0.2	0.007	−0.1
0.3	0	0
0.4	0.007	0.1
0.6	0.063	0.3
0.8	0.153	0.5
1.0	0.267	0.7
1.2	0.410	0.9
1.4	0.590	1.1
1.7	0.920	1.4
2.0	1.31	1.7

The determination of the H_D-value which gives a reasonable fit requires a certain amount of judgment. When the profile upstream from the crest is the criterion, the lip of the dam will sometimes be the determinant. Sometimes, however, the lip droops sharply downward and indicates a lower value than other parts of the upstream profile. When the downstream shape is the criterion, good results have been obtained by assigning a value of H_D based on the average fit in the zone between points on the spillway where tangents range from 20° to 35° from the horizontal. The exact value of H_D is not too important. Since it enters Eq. 1 in the 0.12 power, a difference of 10% in its value affects the discharge by only 1.15%.

The writer's application of Eq. 1 has been limited to fairly high dams. Although the total head used in Eq. 1 should include the approach velocity, the accuracy of Eq. 1 when used for low dams, where approach velocity is large, has not been tested.

So far as is known, the application of standard nappe shapes (for which discharge coefficients are known) to actual spillways on a basis of reasonable best fit was first suggested by W. M. Borlund.[11] Mr. Borlund used a curve of observed C_q-value plotted against H/H_o. In 1942, C. E. Kindsvater, M. ASCE, suggested a similar procedure in which the curve of C_q versus H/H_o was derived from Eq. 1. Mr. Kindsvater's work (not published) should give results comparable to those obtained herein.

The material presented is regarded as an excellent check on that part of Mr. Bradley's work which relates to free discharge over an ogee spillway.

F. B. CAMPBELL,[12] M. ASCE, AND A. A. MCCOOL,[13] J. M. ASCE.—The experimental data on discharge coefficients for flow over drum gates are a welcome addition to the published information on flow over spillways, or the observation and recording of the flow of streams. A paper by Robert E. Horton has been a guide for the estimation of flows over spillways since its publication.[14] The basic information for the discharge over curved crests which fit the under side of a nappe from a sharp-crested weir can be deduced from investigations made by Bazin,[15,16] although the published record of these experiments has not been generally available to engineers in the United States. The investigations conducted by the USBR (proposed by E. W. Lane, M. ASCE) embraced and extended the scope of Bazin's work which is often used as the basis for overflow spillway shapes.[3] Although good estimates for discharge over free-overflow crests can be accomplished rather simply, the problem becomes complicated when flow through partly opened crest gates is involved.

The commonly used types of crest gates are vertical lift gates, tainter or radial gates, and drum gates. The coefficient for a partly opened vertical lift gate depends on the location of the plane of the skin plate or lip with respect to the axis of the curved crest. The discharge coefficient for tainter gates is affected by the radius of the skin plate, the elevation of the trunnion with respect to the crest, and the location of the gate seat with respect to the axis as well as the crest curvature. To complicate any investigations further, observers define the gate opening variously as (1) the length of the arc from the gate seat to the gate lip, (2) the vertical distance from the lip to the face, and (3) the distance from the lip to the face measured normal to the face. The last method is believed to give the proper dimension, whereas the foregoing considerations are geometrical. The effective head for a partly opened vertical lift or tainter gate depends on the pressures on the face of the concrete and the pressures within the issuing jet. The author has given a good outline of the geometrical variables and the head-measurement method for analyzing partly raised drum gates.

The drum gate has the very attractive feature of requiring no mechanical hoisting equipment for operation. Many of the dams constructed by the USBR have spillways controlled by drum gates. For example the Arrowrock Dam in Idaho (constructed in 1915) and the Tieton Dam in Washington (constructed in 1925) are both equipped with drum gates. B. F. Thomas and D. A. Watt credit H. M. Crittenden with the design of what is apparently the first drum gate.[17] The gates were installed in Dam No. 1 on the Osage River in Missouri in 1911. However, the refinements of the modern drum gate have been developed principally by the USBR.

The discharge coefficients presented by the author are based on model studies. There should be opportunity to check the coefficients for relatively low heads with partly raised gates in the prototype by current-meter measure-

[11] "Flow over Rounded Crest Weirs," by W. M. Borlund, thesis presented to the University of Colorado, at Boulder, Colo., in 1938, in partial fulfilment of the requirement for the degree of Master of Science.

[12] Chf. Hydr. Engr., Analysis Branch, Corps of Engrs., U. S. Waterways Experiment Station, Vicksburg, Miss.

[13] Hydr. [illegible], U. S. Waterways Experiment Station, Vicksburg, Miss.

[14] "Weir Experiments, Coefficients and Formulas," by Robert E. Horton, *Water Supply and Irrigation Paper No. 200*, Coast and Geodetic Survey, U. S. Dept. of Commerce, Washington, D. C., 1907 (revision of Paper No. 150).

[15] "Recent Experiments on the Flow of Water over Weirs," by H. Bazin, *Annales des Ponts et Chaussées*, October, 1888. (Translation by Arthur Marichal and John C. Trautwine, Jr., *Proceedings*, Engineers' Club of Philadelphia, Pa., Vol. VII, No. 5, 1890, p. 259.)

[16] *Ibid.*, Vol. IX, No. 3, 1892, p. 231.

[17] "The Improvement of Rivers," by B. F. Thomas and D. A. Watt, John Wiley & Sons, Inc., New York, N. Y., 2d Ed., 1913.

ments. Only on rare occasions with large floods is it possible to verify the coefficients for high prototype heads over the drum gates in the lowered position. The author's mention of the failure to obtain discharge measurements during the 1948 flood over the Grand Coulee Dam spillway emphasizes the importance of this condition. The writers have studied the basic data for high heads over the drum gate in the lowered position.

It becomes evident from a study of Table 2 that the ratio of gate radius to maximum head has a wide range. The writers use the ratio r/H_D, in which H_D is the design head for the spillway. This is the inverse of the ratio used by Mr. Bradley, used so that circular arcs can be traced on dimensionless profiles of x/H_D and y/H_D.

A comparison has been made of the coefficients for various (r/H_D)-values with the gate down. Only the high-overflow sections with negligible velocity of approach were selected from Table 2 for a study of discharge coefficients. Table 8 shows the value of the discharge coefficients for the condition when the drum gate is down. The percentage difference of the coefficient from that of the Madden Dam coefficient is also shown. It is expected that the accuracy of the discharge measurements and thus the coefficient of discharge is less than 1%.

TABLE 8.—COMPARISON OF DISCHARGE COEFFICIENT WITH THE GATE DOWN

Dam	Radius of gate, in feet[a]	Maximum head on crest, in feet[a]	Ratio, $\frac{r}{H_D}$	Coefficient,[b] C_s	Difference, in percent, from Madden Dam
Madden (Canal Zone)	30.0	30.0	1.00	3.77	0.0
Norris (Tennessee)	34.0	27.0	1.26	3.80	0.8
Grand Coulee (Washington)	66.2	31.6	2.09	3.87	2.6
Shasta (California)	66.2	28.0	2.37	3.76	−0.3
Friant (California)	47.0	19.0	2.47	3.64	−3.5
Capilano (British Columbia)	71.0	23.0	3.08	3.62	−4.0

[a] From Table 1. [b] From Table 2.

The dams for which the data are listed in Table 8 are in the approximate chronological order of the time of their design conception.

Because of the increase in the ratio of r/H_D (Table 8), it is of interest to plot the profile for the lower surface of the nappe from a sharp-crested weir with an approach slope of 2 on 3 in terms of x/H_D and y/H_D and to superimpose on it the arcs of circles with radii of r/H_D equal to 1, 2, and 3, as is done in Fig. 16. The center of the radius is located on the axis of the crest. It can be seen that the arc represented by r/H_D equal to 1 is a fair approximation of the true nappe shape. The arcs of r/H_D equal to 2 and 3 indicate a very flat curvature in comparison to the shape of the nappe.

One is tempted to assume, for a crest with a ratio $r/H_D = 3$, that the coefficient would be that for one third the design head of a crest with $4/H_D = 1$.

Model studies for Madden Dam reported by Richard R. Randolph, Jr.,[18] indicate that the coefficient for such a condition is approximately 3.40. Such a coefficient is not in agreement with that for Capilano Dam with r/H_D equal to 3.62 at full head. The lack of agreement does not necessarily vitiate the initial assumption. The difference in the coefficient may be caused by the

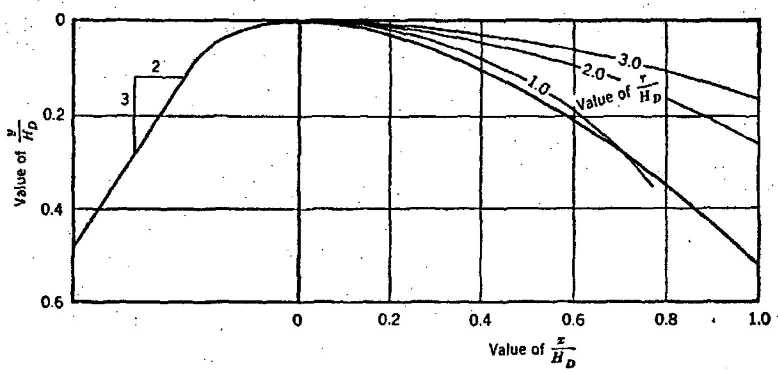


FIG. 16.—LOWER SURFACE OF NAPPE FROM SLOPING WEIR COMPARED WITH CIRCULAR ARCS

difference in shape of the two crests upstream from the circular arc. Furthermore, the scale ratio of the Madden Dam model was only 1:78, and a 10-ft prototype head would be 0.128 ft on the model, which is near the lower limit of reliability for conformity of the discharge coefficient.

JOSEPH N. BRADLEY,[19] A.M. ASCE.—Mr. Shulits' statements regarding the lack of correlation in laboratory studies are well founded, and the writer is in complete agreement with his views.

Mr. Buehler's analysis for the determination of the designed head, H_D, for overflow sections formed by a single radius, or for a shape that conforms closely to a single radius, gives satisfactory results. The comparison of discharge coefficients for free flow over various dams, using Eq. 3 with the method offered in the paper, is gratifying. Mr. Buehler's method certainly has merit because following the determination of H_D, coefficients of discharge can be computed directly for all heads.

Messrs. Campbell and McCool undertook to show that a definite relationship exists between the coefficient of discharge at the designed head and the ratio r/H_D for overflow shapes. This relationship is valid if the overflow shape can be approximated by an arc of a single radius and if the approach conditions are favorable—that is, if the approach depth below the crest is at least twice H_D. This method results in a coefficient of discharge for the designed head only. When overflow sections are encountered where a single radius does not approximate the overflow shape, or when the approach conditions are unusual, an engineering monograph[2] may prove helpful.

[18] "Hydraulic Tests on the Spillway of the Madden Dam," by Richard R. Randolph, Jr., *Transactions*, ASCE, Vol. 103, 1938, p. 1091.

[19] Hydr. Engr., Bureau of Reclamation, U. S. Dept. of the Interior, Denver, Colo.

Mr. Wyss suggested that pressures and water surfaces for drum gates at various positions and reservoir levels would be useful to designers in computing gate loadings. A limited amount of information is available, and this will be presented.

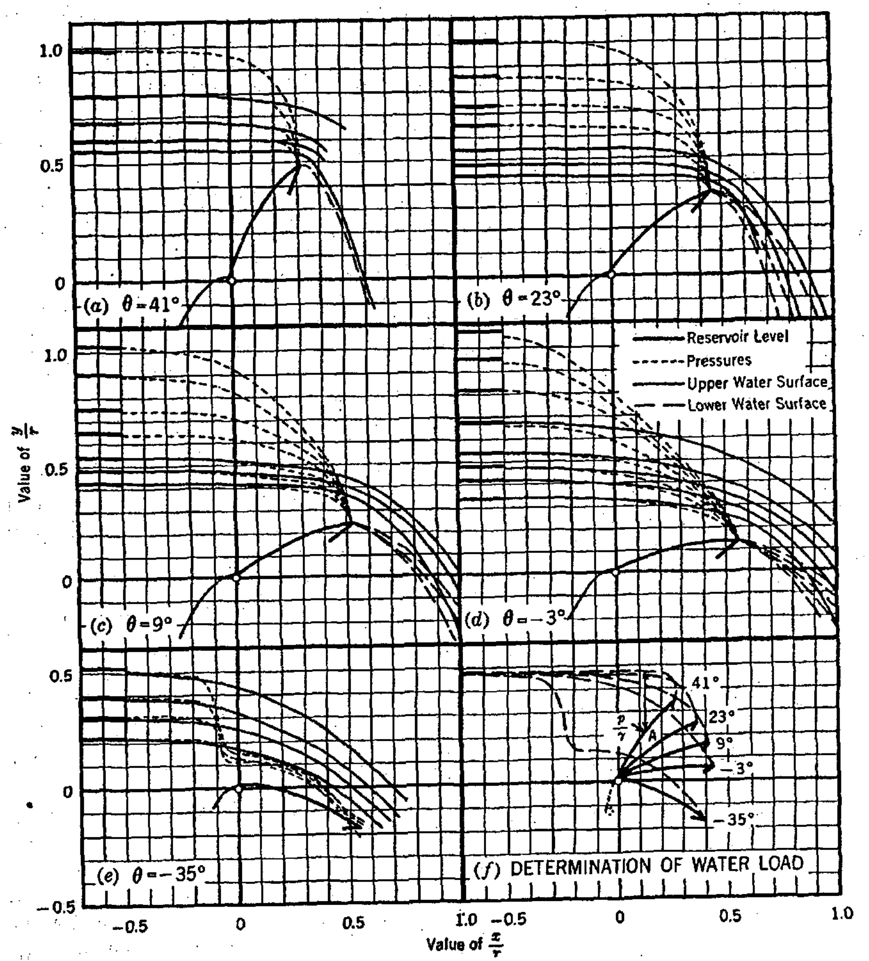


FIG. 17.—PRESSURE AND WATER-SURFACE PROFILES

Because there was good correlation among the discharge coefficients, it was reasoned that the pressures and related flow patterns would also be well correlated through the same variables.

Pressures and water-surface profiles are plotted in dimensionless coordinates (in terms of the radius of the gate) in Fig. 17. Five positions of the gate are shown for various reservoir levels producing flow over the gate. Pressures and water surfaces are shown for some levels whereas only pressures are

available for others. The broken lines represent pressure, measured vertically, for the reservoir levels indicated at the left of the charts. Upper water-surface profiles are shown by solid lines, and lower water-surface profiles are identified by dash lines. The charts represent a composite, in graphical form, of information from model tests performed on the Grand Coulee, Hamilton, Norris, Friant, and Hoover dams.

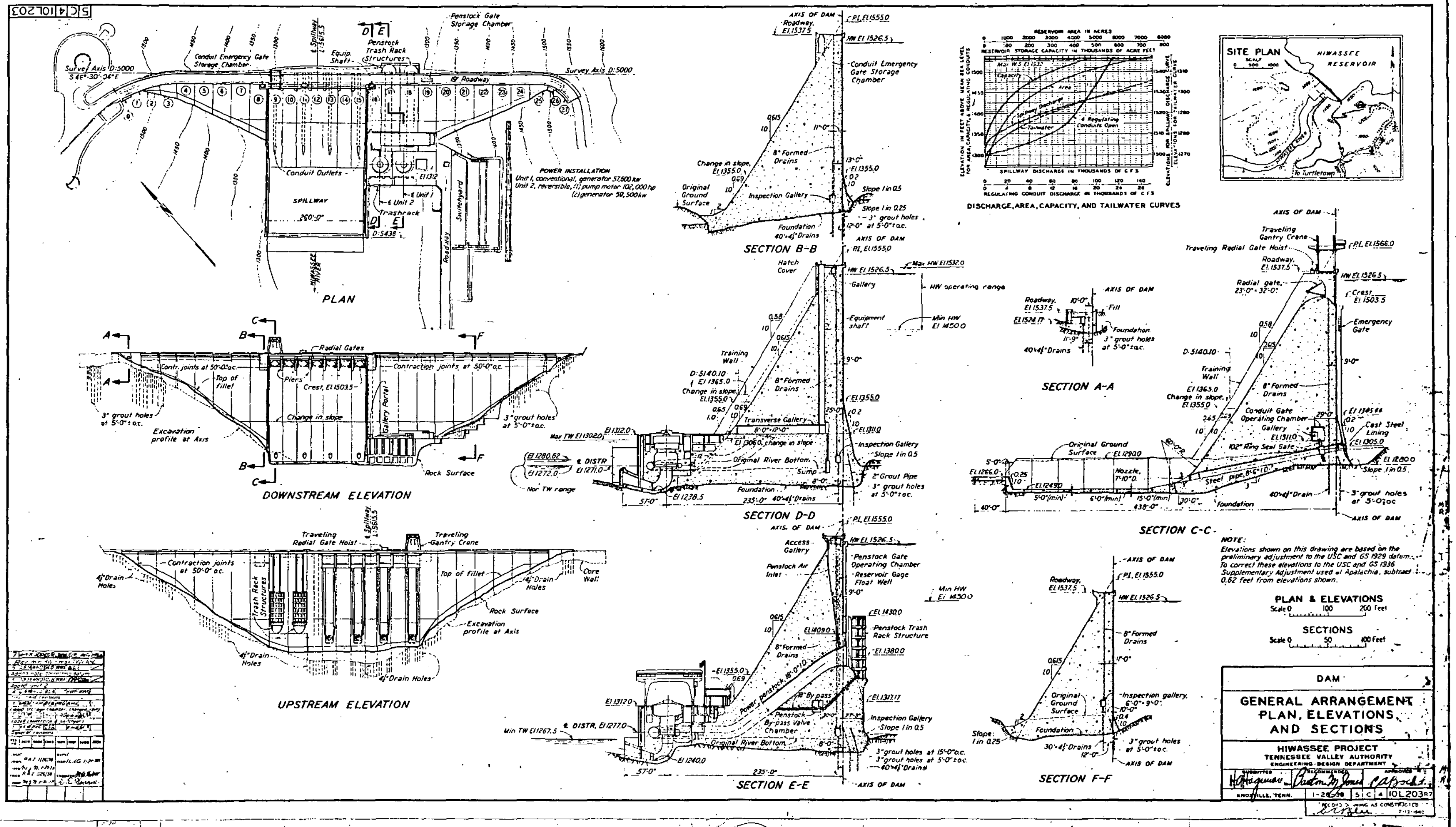
To determine graphically the most adverse water load on a particular gate, it is necessary to investigate the pressures for several gate positions. Assuming that the first position is $\theta = 41°$, the gate is drawn in this position on a piece of transparent paper to the same scale as that used in Fig. 17. The maximum expected reservoir is indicated for this gate position on the left side of the transparent sheet.

The transparent sheet is then placed over Fig. 17(*a*), disregarding the origin of coordinates, and matching only the downstream tips of the two gates. The downstream part of all drum gates, regardless of size or radius, will coincide for any given value of θ. The height of the gate, or length of arc, can be expected to vary; this will have a negligible effect on pressures or water-surface profiles in the majority of cases. Should the gate under investigation differ from the height shown in Fig. 17(*a*), a small increase or decrease in the approach-depth results.

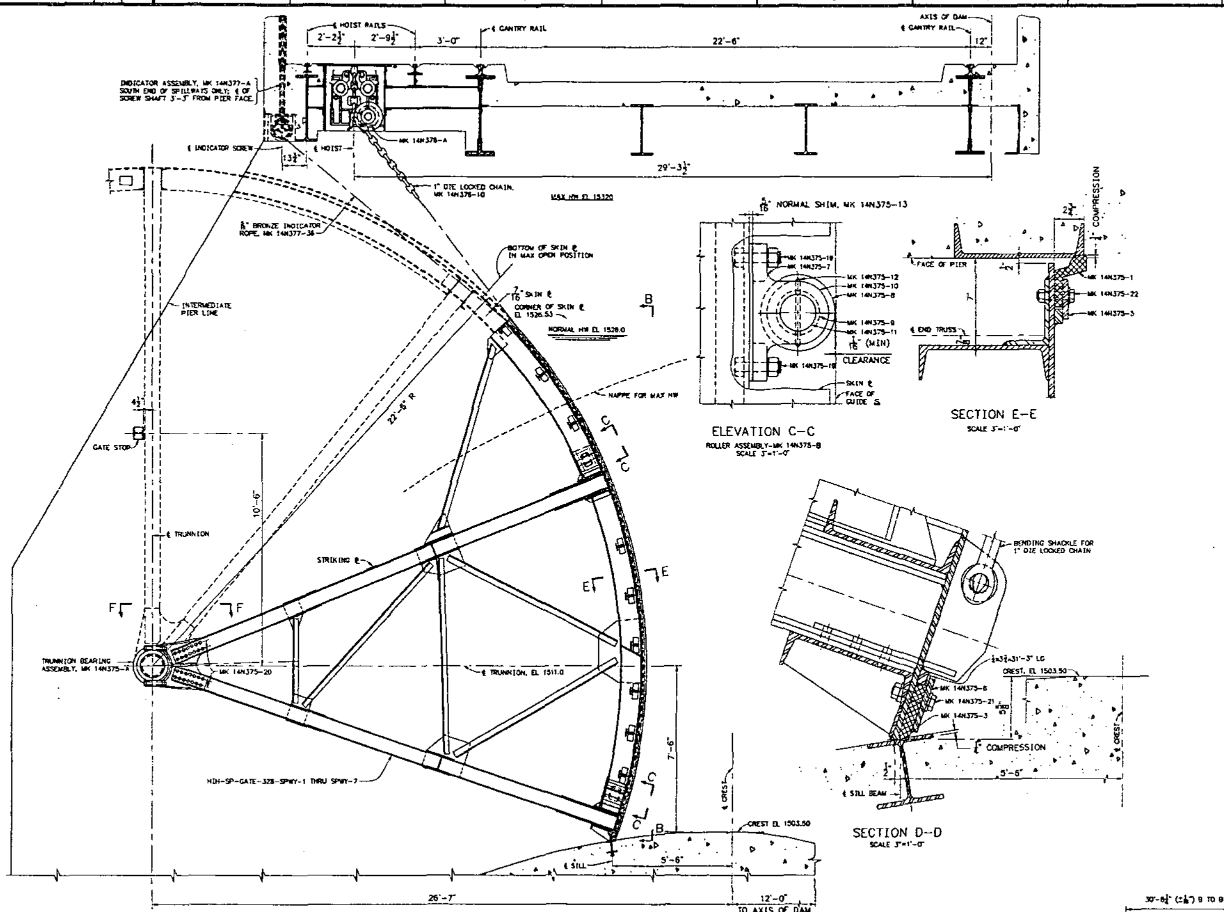
Beginning with the chosen reservoir level, the pressure curve is traced from Fig. 17(*a*) onto the transparent paper. It may be necessary to interpolate between two of the pressure curves. The result will be similar to that shown in Fig. 17(*f*).

A similar procedure is then followed for gate positions of 23°, 9°, −3°, and −35°, utilizing Figs. 17(*b*), 17(*c*), 17(*d*), and 17(*e*), respectively. The result is a composite plot similar to that shown in Fig. 17(*f*). It should be noted that the pressures shown for negative angles of the gate are not as reliable as those for positive angles. Fortunately, the greater water loads occur for positive angles.

Water loads can be determined by scaling the pressures vertically over the gate as indicated by point A in Fig. 17(*f*). If a gate angle other than those shown is desired, interpolation can be made directly on the sheet corresponding to Fig. 17(*f*). Following the establishment of the maximum-pressure curve, values of x/r and y/r are scaled from the sheet corresponding to Fig. 17(*f*) and are transferred to dimensional values by multiplying by r. Should water-surface profiles be desired, the same method of tracing and scaling can be used.



5C4 10L203
PLAN
DOWNSTREAM ELEVATION
UPSTREAM ELEVATION
SECTION B-B
SECTION D-D
SECTION E-E
SECTION A-A
SECTION C-C
SECTION F-F
SITE PLAN
HIWASSEE RESERVOIR
DISCHARGE, AREA, CAPACITY, AND TAILWATER CURVES
POWER INSTALLATION
Unit 1, conventional, generator 57,600 kw
Unit 2, reversible, (1) pump motor 102,000 hp
(2) generator 50,500 kw
NOTE:
Elevations shown on this drawing are based on the preliminary adjustment to the USC and GS 1929 datum. To correct these elevations to the USC and GS 1936 Supplementary Adjustment used at Apalachia, subtract 0.62 feet from elevations shown.
PLAN & ELEVATIONS
Scale 0 100 200 Feet
SECTIONS
Scale 0 50 100 Feet
DAM
GENERAL ARRANGEMENT
PLAN, ELEVATIONS, AND SECTIONS
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING-DESIGN DEPARTMENT
KNOXVILLE, TENN.
5 C 4 10L203 R7



SECTION A–A
EXCEPT INDICATOR AS NOTED
HIH-SP-GATE-328-SPWY-1
THRU
HIH-SP-GATE-328-SPWY-7

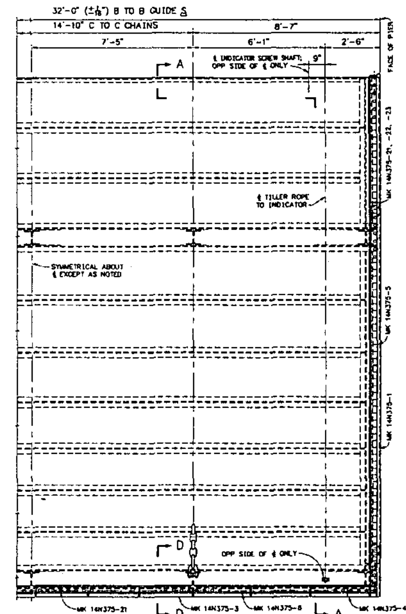
ELEVATION C–C
ROLLER ASSEMBLY–MK 14N375–8
SCALE 3"=1'-0"

SECTION E–E
SCALE 3"=1'-0"

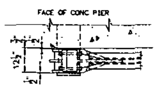
SECTION D–D
SCALE 3"=1'-0"

MATERIAL SPECIFICATIONS							
NO.	MATERIAL	ULTIMATE TENSION	YIELD POINT TENSION	% EL IN 2"	% RED. AREA	SPECIFICATIONS	REMARKS
1	STRUCTURAL STEEL	60/72,000	0.5 TENS.	22		ASTM A-7-36	33,000 MIN YP
2	RIVET STEEL	52/62,000	0.5 TENS.			ASTM A-141-36	28,000 MIN YP
3	BOLT & NUT STEEL					ASTM A-107-36	GRADE 21 OR 22
4	STEEL CASTINGS	70,000	38,000	24	36	ASTM A-27-36T	GRADE B
5	STEEL FORGINGS	75,000	0.5 TENS.	20	33	ASTM A-18-30	CLASS E
6	STEEL FORGINGS	90,000	55,000	20.5	39	ASTM A-18-30	CLASS G
7	STEEL FORGINGS	85,000	55,000	20	41	ASTM A-18-30	CLASS I
8	PHOSPHOR BRZ & GRAPHITE					M-SEE BELOW	
9	BRASS ROD	44,000	18,000	25		ASTM B-16-29	FREE CUTTING *
10	CAST PHOSPHOR BRONZE	25,000	12,000	6		ASTM B-74-32T	
11	ROLLED NAVAL BRASS	60,000	30,000	30		ASTM B-21-29	
12	STEEL					M-SEE BELOW	
13	CAST IRON	35,000				ASTM A-48-36	CLASS 35
14	BRONZE					M-SEE BELOW	
15	SPRING STEEL					M-SEE BELOW	
16	WELDING FILLER METAL					ASTM A-205-37T	GRADE 10
17	RUBBER					M-SEE BELOW	
18	GLASS					M-SEE BELOW	

* PHYSICAL PROPERTIES FROM FEDERAL SPECIFICATIONS QQ-B-611 COMP B.
M-MISCELLANEOUS MATERIALS SHALL BE HIGH CLASS COMMERCIAL GRADES



ELEVATION B–B



SECTION F–F

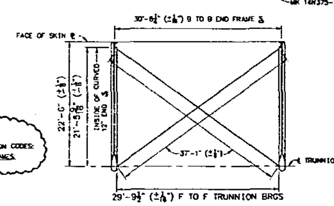
NOTES:

1. GATES TO BE ASSEMBLED AS COMPLETELY AS POSSIBLE AND SECURELY FIELD BOLTED BEFORE RIVETING AND WELDING SEQUENCE OF RIVETING AND WELDING TO BE SUCH AS TO PREVENT DISTORTION OF GATE.
   WELDS OVER ⅜" SHALL BE PEENED.
   FIELD WELDING TO BE IN ACCORDANCE WITH THE CODE FOR FUSION WELDING AND GAS CUTTING IN BUILDING CONSTRUCTION, EDITION OF 1937 OF THE AMERICAN WELDING SOCIETY.
   GATES TO BE CENTERED ON TRUNNION PINS TO GIVE EQUAL COMPRESSION ON SIDE SEALS.
   SEAL JOINTS AND PLUGS TO BE CEMENTED.
   CHAINS TO BE LOWERED THROUGH DECK BEFORE BENDING SHACKLES AND END LINKS ARE ATTACHED. DETACHABLE LINK PINS TO BE DRIVEN AND HEADS SECURED WITH LEAD PLUGS.
   CLEANING AND PAINTING TO BE DONE BY FIELD FORCES.
   GUIDE ROLLER ASSEMBLIES TO BE SHIMMED TO GIVE 1/16" (MIN) CLEARANCE.
   FOR MANUFACTURER'S DETAILS OF RADIAL GATES REFER TO DRAVO/WELL CONSTRUCTION.
   CO FILE, TVA CONTRACT NO. TV-42835.
2. COMPONENT UNID NUMBERING SCHEME:

PLANT	UNIT	FUNCTION	SYSTEM	SEQUENCE NO.
HIH	SP	GATE	328	SPWY-1

3. UNIDS ARE LISTED IN WHOLE ON THIS DRAWING.
4. COMPONENT UNID NUMBERS USE THE FOLLOWING SYSTEM AND FUNCTION CODES:

SYSTEM NUMBERS – SYSTEM NAME:	FUNCTION CODES – FUNCTION CODE NAMES:
328 – SPILLWAY	GATE – GATE



ASSEMBLY TOLERANCES
(FOR ANY RADIAL PLANE)
SCALE ¼"=1'-0"

COMPANION DRAWINGS:
14N373 TO 14N377 INCL

DEC 10 2007

JLW DMC JLW JLW TKM AJS MAC

R 8 | JLW | DMC | JLW | JLW | TKM | RWT | MAC | HY00434-28
DCN HIH-07-41: REVISED FOR CRITICAL STRUCTURES, SYSTEMS & COMPONENTS VERIFICATION
R 7 | 01/29/2004 | SRK | AMR | SRK | VAN | VAN | RWT | MAC
ELECTRONICALLY RESTORED

SCALE: ⅛"=1'-0" EXCEPT AS NOTED

SPILLWAY

GATES & CRANES
RADIAL GATES
ASSEMBLY

DESIGNED BY LAW–CAH | DRAWN BY COW | SUPERVISED BY CAH

HIWASSEE HYDRO PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

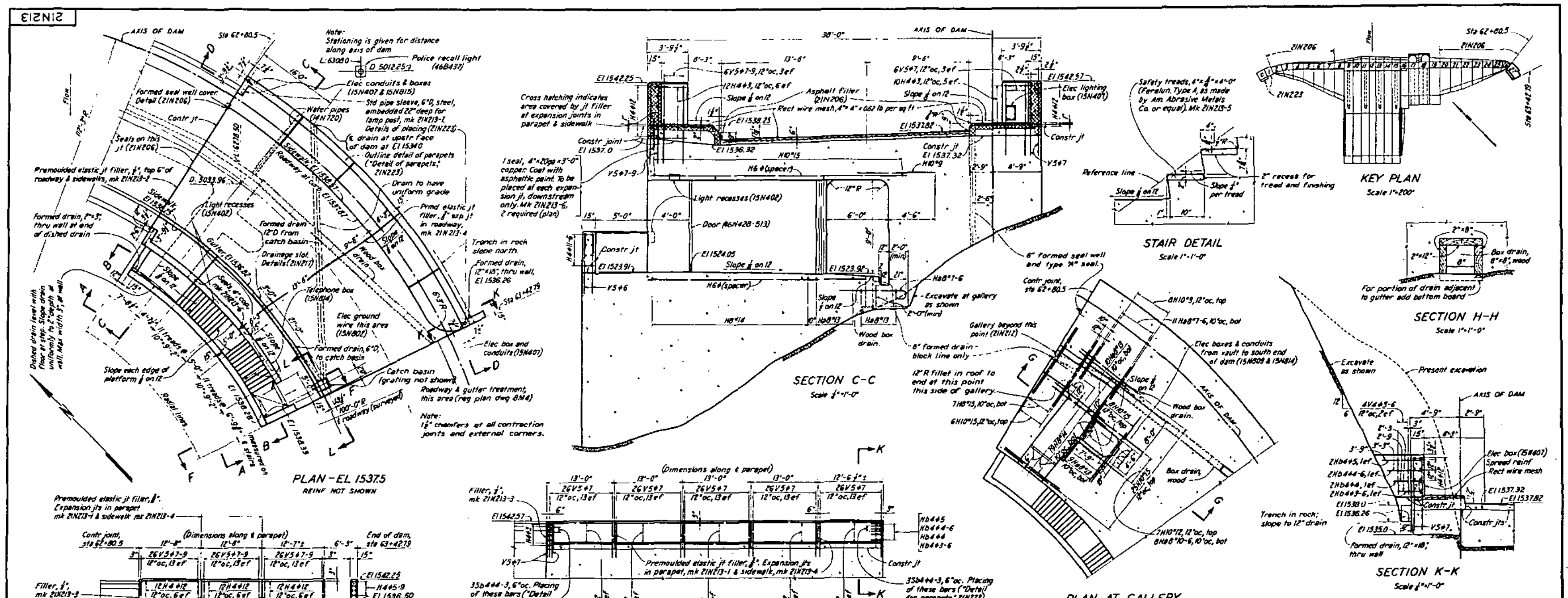
AUTOCAD R14 | 4-21-39 | 5 | M | 14W372 | R 8

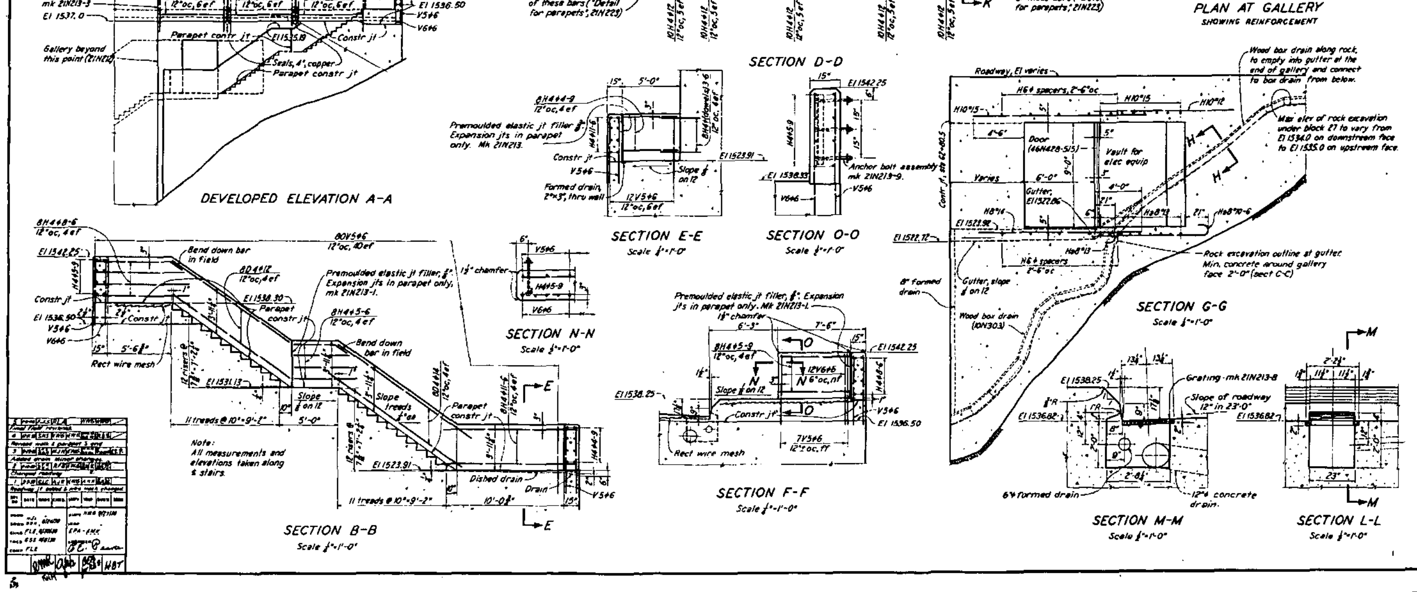
TASK COMPLETED BY: | REV NO.

ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN
AND SUPERSEDES : (14N372 R6)

PLOT FACTOR:24
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY





NOTES:

Concrete in mass of dam to class "C."
Concrete in parapets, sidewalk and roadway surface to be class "A."
Stair wall to be chamfered same as sidewalk parapet.
Concrete finish to be as follows: Roadway - broomed surface; sidewalks and stair treads - pulled trowel finish; top of parapets - wood float finish; inside walkway and stair parapets - special wood form finish; outside walkway and stair parapets - ordinary wood form finish.
All bar marks this dwg to have prefix letter "S."
Bend letter "a" or "b" given to all bent bars.
Dimensions to reinforcement are to ℄ bars.
Min distance from constr joint to reinf to be 6."
280 linear feet of 3/4"φ spacers required for gallery.
Leave stair treads 2" low for finishing.

REFERENCE DRAWINGS:

21DS213 ...ANCHOR BOLTS
21BM213 ...MISC BILL OF MATERIAL
21RS213 ...REINFORCEMENT SCHEDULE
NON-OVERFLOW DAM - NORTH & SOUTH ABUTMENT
21 N 217...CONCRETE - ROADWAY CURVES - OUTLINE
DAM
15 N 402...ELEC LTG - GALLERY & CHAMBERS - EL 1527.0 - EMERGENCY GATE SLOT & STAIRS
15 N 407...ELEC LTG - ROAD & SPILLWAY - PIER WARNING LIGHTS - PLAN, ELEVATION & SECTION
15 N 809...ELEC CONDUIT & GROUNDING - ROAD & VAULTS - PLAN, ELEVATION & SECTIONS
21 N 230...RAILING - PARAPET RAILING & LAMP POSTS

Scale 1/4"=1'-0"
Except as noted

NON-OVERFLOW DAM
SOUTH ABUTMENT

CONCRETE
BLOCK 27 - ROADWAY & GALLERIES
OUTLINE & REINFORCEMENT

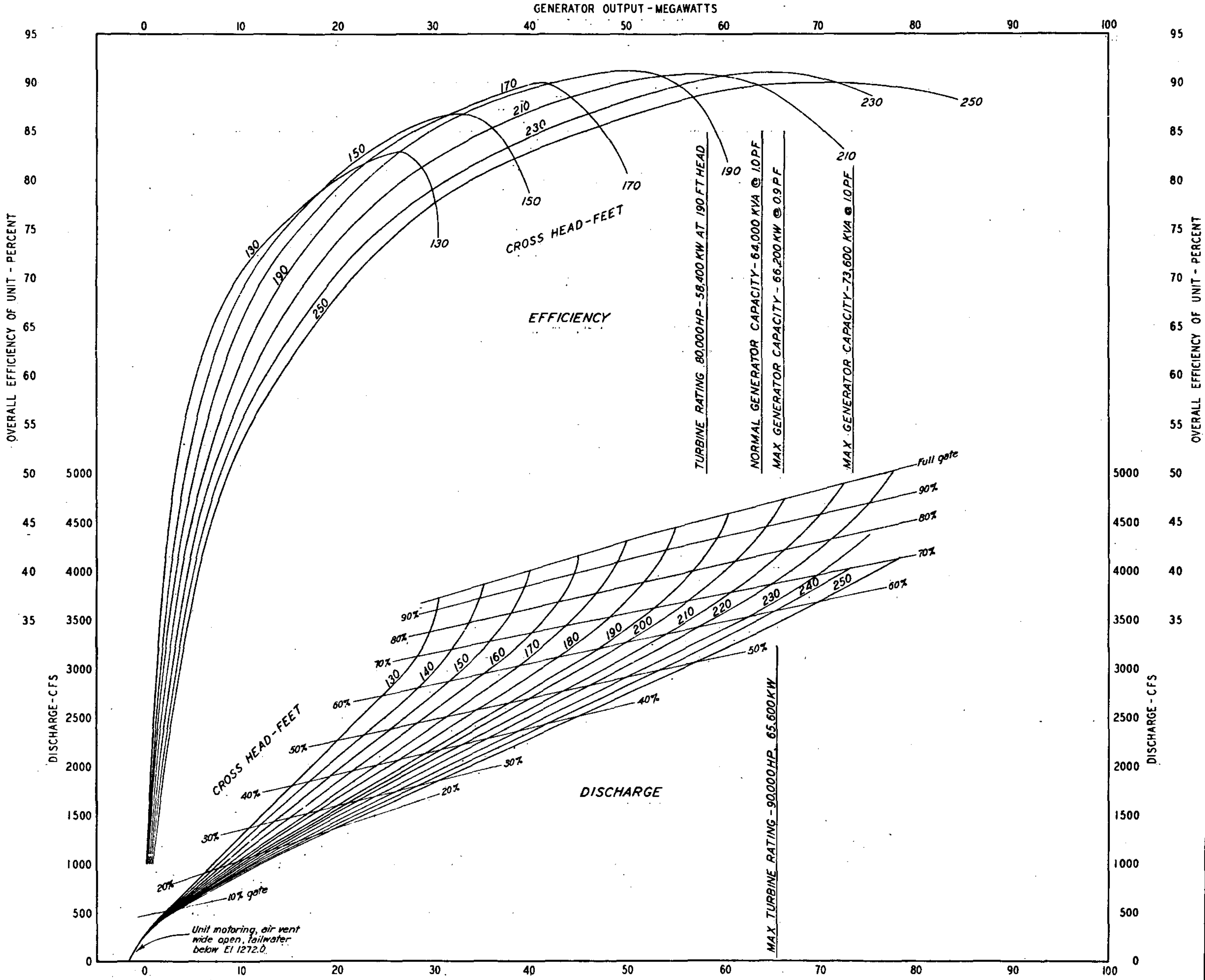
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED
Rose M Riegel	H. A. Hageman	Barton M Jones

KNOXVILLE, TENN. | 9-23-38 | 5 | C | 4 | 21N213 R5

RECORD DRAWING AS CONSTRUCTED 9-30-1940

LISTED C M D.



TURBINE:
80,000 HP - 190 ft head, 120 rpm.
Newport News Shipbuilding and Drydock Co.

GENERATOR:
64,000 kva - 3phase - 60 cycles - 13,000 volts
0.9 power factor - 120 rpm.
Westinghouse Electric and Manufacturing Co.

NOTES:
Curves for 180 ft head are based on index tests conducted 11-24-40.
Other curves adjusted from model test No. 280 on 16 9/16" dia test runner and adjusted to correspond with Gibson tests on Norris Dam units.
This turbine is practically a duplicate of those at Norris Dam.
Air vent wide open at 6/10 gate and below.
Operating Dept to make record of full gate output at each 10 ft head and forward to Design Dept to check values shown on this curve.
This curve will be revised as additional data is obtained.

THIS DRAWING SUPERSEDES DWG 5-E-4-45K325

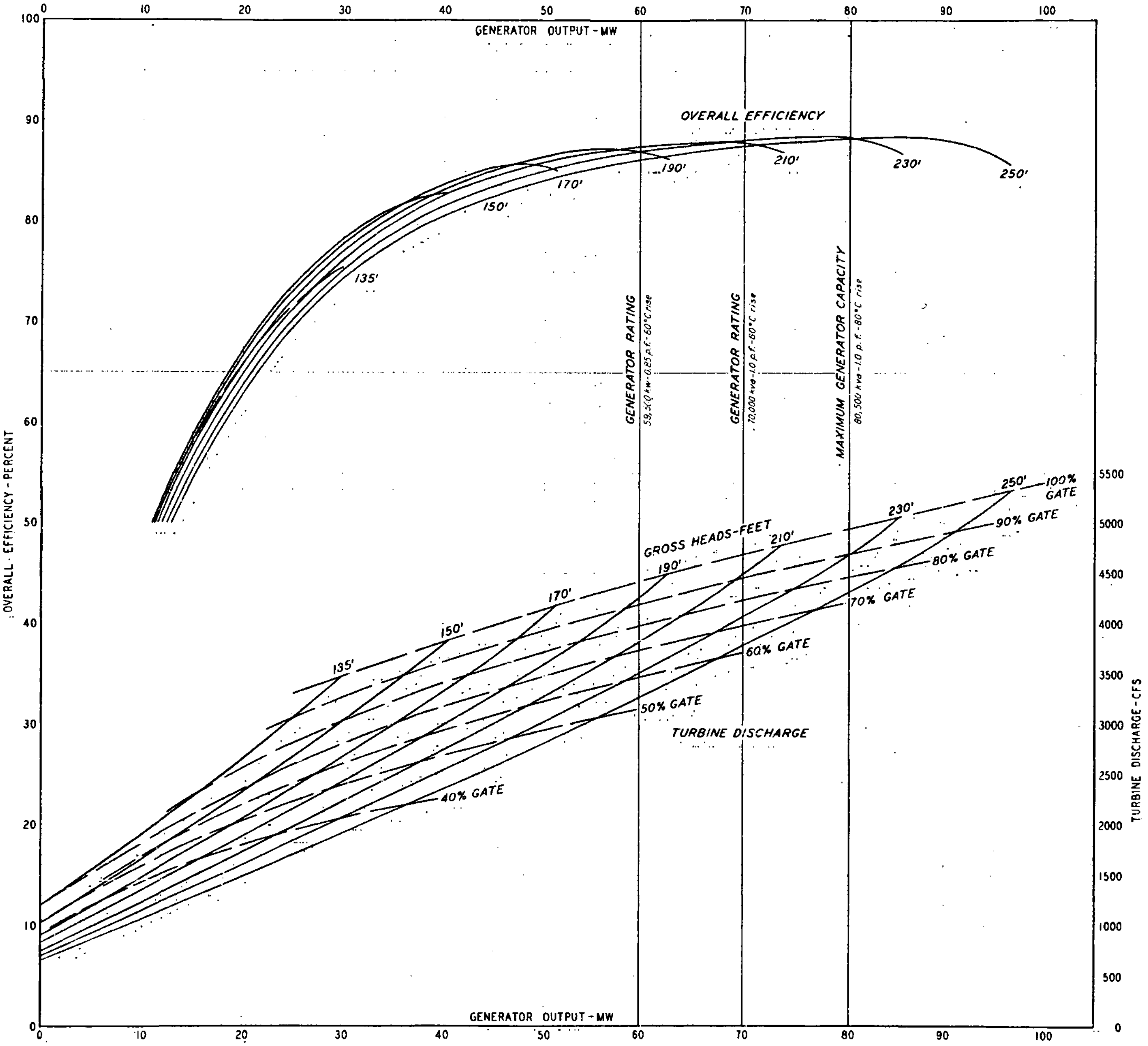
POWERHOUSE
UNIT 1

OPERATING CHARACTERISTICS
64,000 KVA UNIT

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED			
J.F. Roberts	George [illegible]	[illegible]			
KNOXVILLE	12-9-40	5	E	4	45K326R1

Revision 1 5-1-54. Unit number added to title.



NOTES:

This curve is based on model test No. 39112 of the Allis-Chalmers Co. and is modified in accordance with the salt-velocity test conducted on this unit on 4-2-57 at approximately 195-foot gross head. Generator test efficiencies and measured penstock losses were used in the computations. Test should be made at other heads to check the accuracy of this curve.

TURBINE: 80,000 hp-190-foot net head-105.9 rpm manufactured by The Allis-Chalmers Co., Milwaukee, Wisconsin.

GENERATOR: 70,000 kva-3 phase-60 cycle-0.85 p.f.-60°C rise-manufactured by The Allis-Chalmers Co., Milwaukee, Wisconsin.

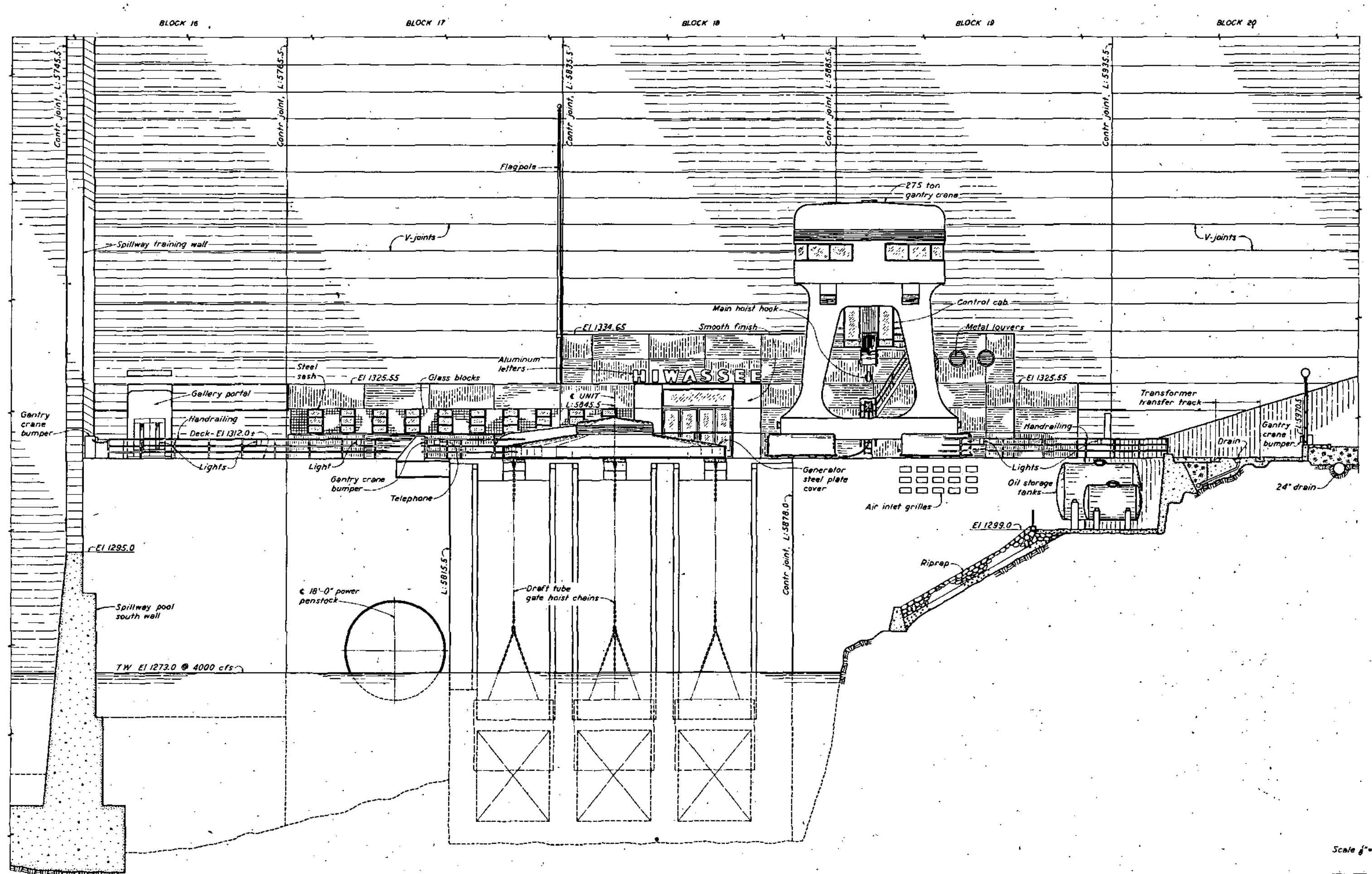
POWERHOUSE
UNIT 2

OPERATING CHARACTERISTICS OF PUMP-TURBINE UNIT GENERATING

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DIVISION OF DESIGN

SUBMITTED	RECOMMENDED	APPROVED			
KNOXVILLE	4-10-58	5	M	4	47 K 2864

46N218



Scale 1/8"=1'-0"

POWERHOUSE

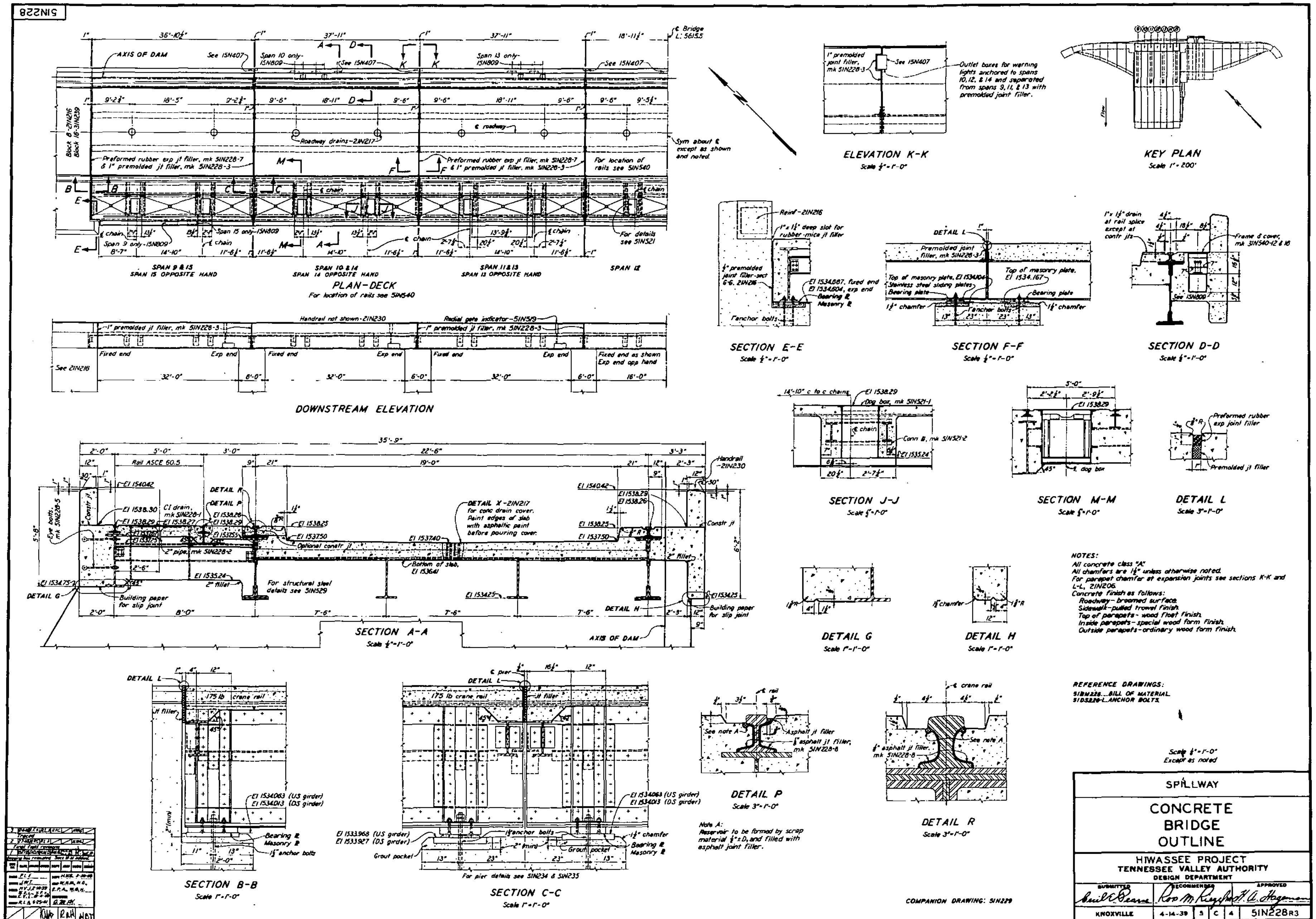
EQUIPMENT
DOWNSTREAM ELEVATION

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED
H.W. Goodhue	H.A. Hageman	T.B. Parker

PROJECT ENGINEER C.C. Bass

KNOXVILLE, TENN. 7-30-40 5 A 4 46N218R



NOTES:
All concrete class "A".
All chamfers are 1½" unless otherwise noted.
For parapet chamfer at expansion joints see sections K-K and L-L, 2IN206.
Concrete finish as follows:
Roadway-broomed surface.
Sidewalk-pulled trowel finish.
Top of parapets- wood float finish.
Inside parapets-special wood form finish.
Outside parapets-ordinary wood form finish.

REFERENCE DRAWINGS:
5IBM228....BILL OF MATERIAL.
5IDS228-1..ANCHOR BOLTS.

Scale ¼"=1'-0"
Except as noted

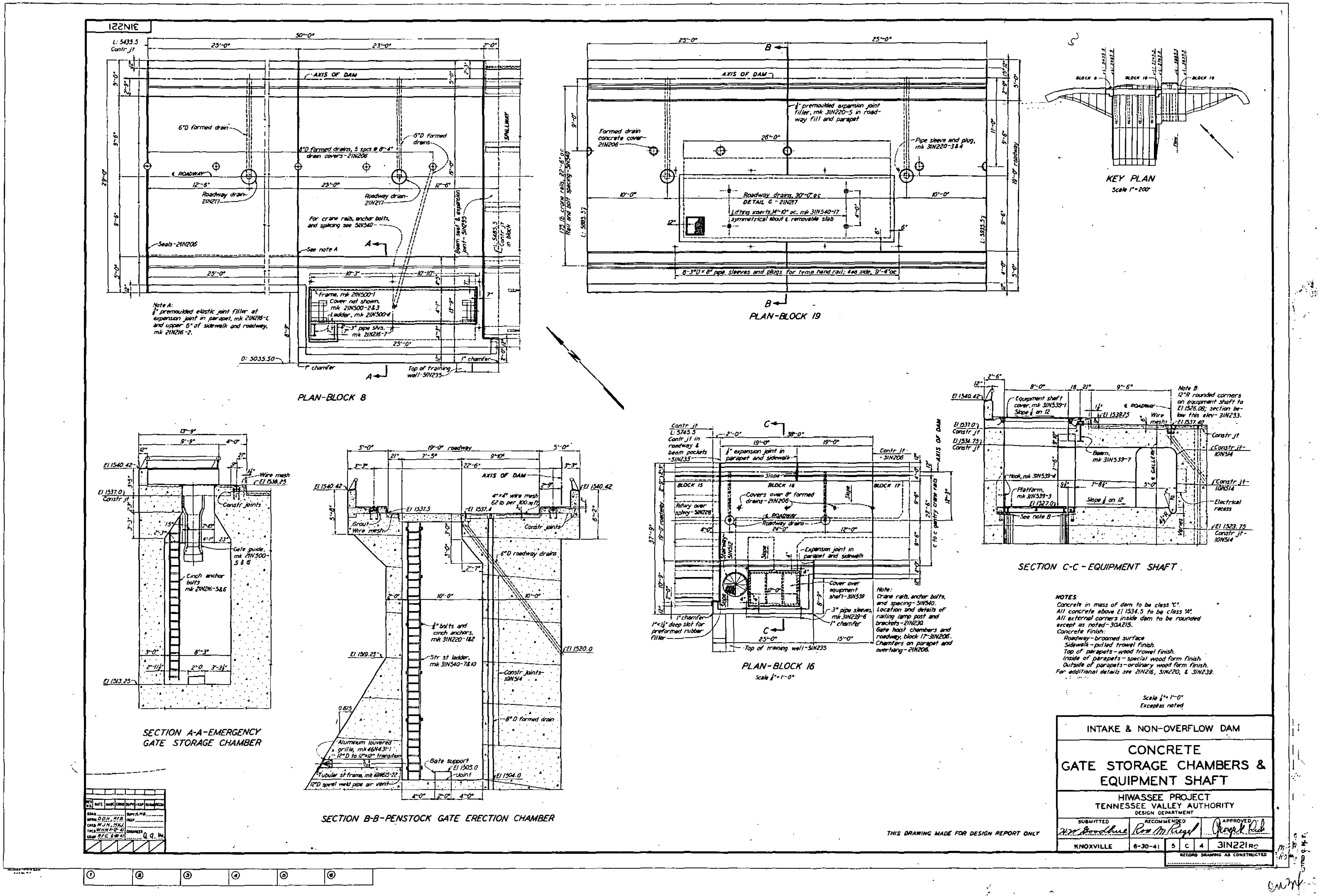
COMPANION DRAWING: 5IN229

SPILLWAY
CONCRETE
BRIDGE
OUTLINE
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT

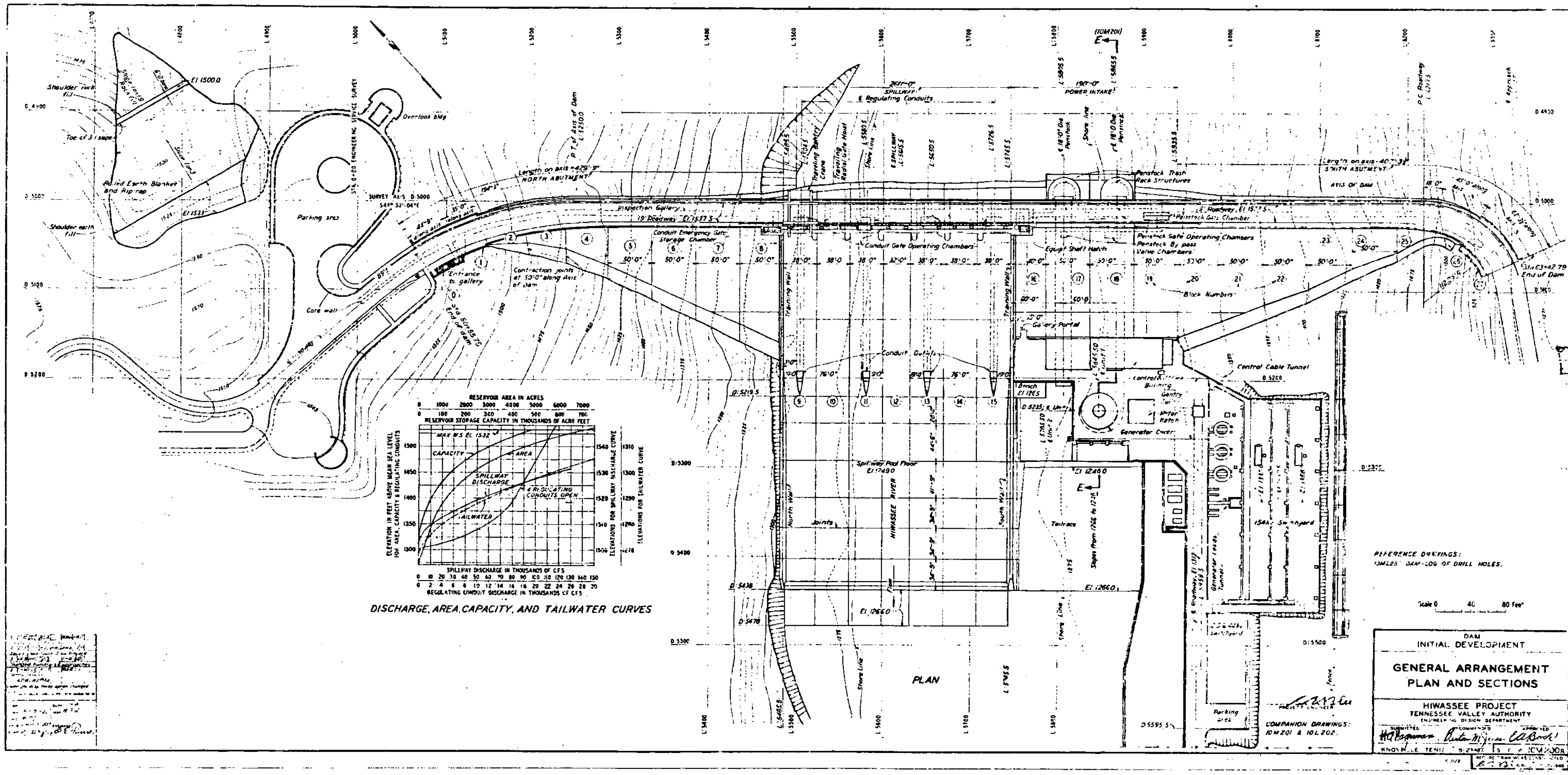
SUBMITTED	RECOMMENDED	APPROVED
Emil Deane	Ross M Riegel	H. A. Hageman

KNOXVILLE 4-14-39 5 C 4 5IN228R3

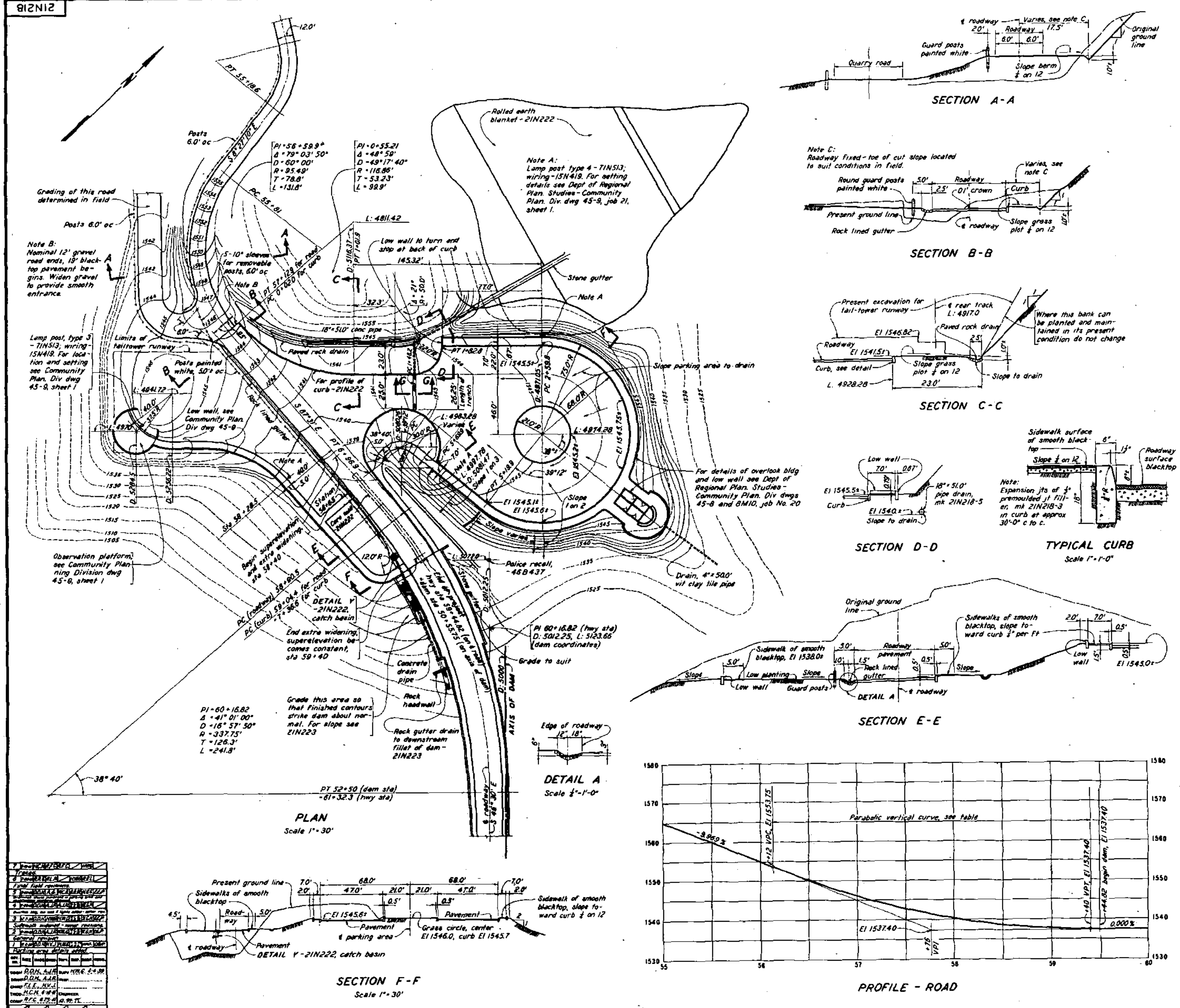
RECORD DRAWING AS CONSTRUCTED



PLAN-BLOCK 8
PLAN-BLOCK 19
KEY PLAN
Scale 1"=200'
SECTION A-A-EMERGENCY GATE STORAGE CHAMBER
SECTION B-B-PENSTOCK GATE ERECTION CHAMBER
PLAN-BLOCK 16
Scale 1/4"=1'-0"
SECTION C-C-EQUIPMENT SHAFT
Note A: 1/2" premoulded elastic joint filler at expansion joint in parapet, mk 21N216-1, and upper 6" of sidewalk and roadway, mk 21N216-2.
Note B: 12"R rounded corners on equipment shaft to El 1526.08; section below this elev-31N233.
Note: Crane rails, anchor bolts, and spacing-51N540. Location and details of railing lamp post and brackets-21N230. Gate hoist chambers and roadway, block 17-31N206. Chamfers on parapet and overhang-21N206.
NOTES:
Concrete in mass of dam to be class "C".
All concrete above El 1534.5 to be class "A".
All external corners inside dam to be rounded except as noted-30A215.
Concrete finish:
Roadway-broomed surface
Sidewalk-pulled trowel finish.
Top of parapets-wood trowel finish.
Inside of parapets-special wood form finish.
Outside of parapets-ordinary wood form finish.
For additional details see 21N216, 31N220, & 31N239.
Scale 1/4"=1'-0"
Except as noted
THIS DRAWING MADE FOR DESIGN REPORT ONLY
INTAKE & NON-OVERFLOW DAM
CONCRETE
GATE STORAGE CHAMBERS & EQUIPMENT SHAFT
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE
6-30-41
31N221RC
RECORD DRAWING AS CONSTRUCTED



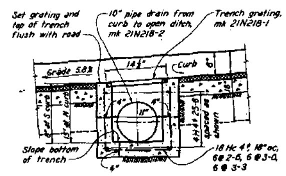
DAM
INITIAL DEVELOPMENT
GENERAL ARRANGEMENT
PLAN AND SECTIONS
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
PLAN
DISCHARGE, AREA, CAPACITY, AND TAILWATER CURVES
RESERVOIR AREA IN ACRES
RESERVOIR STORAGE CAPACITY IN THOUSANDS OF ACRE FEET
SPILLWAY DISCHARGE IN THOUSANDS OF C.F.S.
REGULATING CONDUIT DISCHARGE IN THOUSANDS OF C.F.S.
CAPACITY
AREA
SPILLWAY DISCHARGE
TAILWATER
REFERENCE DRAWINGS:
COMPANION DRAWINGS:
10M201 & 10L202.
Overlook bldg
Parking area
Core wall
Entrance to gallery
Contraction joints
Inspection Gallery
Block Numbers
Conduit Gate Operating Chambers
Penstock Gate Operating Chambers
Penstock Trash Rack Structures
POWER INTAKE
SPILLWAY
Regulating Conduits
Conduit Outlets
Training Wall
Spillway Pool Floor
HIWASSEE RIVER
North Wall
South Wall
Joints
Tailrace
Gallery Portal
Control Cable Tunnel
Generator Cover
Shore Line
NORTH ABUTMENT
SOUTH ABUTMENT
AXIS OF DAM
End of Dam



STATION	LEFT EDGE ELEVATION	LEFT EDGE DIST TO ℄	℄ ROAD ELEVATION	RIGHT EDGE DIST TO ℄	RIGHT EDGE ELEVATION
43+25 VPT	1681.95	6.0'	1682.05	6.0'	1681.95
56+12 VPC	1553.65		1553.75		1553.6
+20			1552.96		
+30			1552.00		
+40			1551.08		
+50			1550.18		
+60			1549.31		
+70			1548.48		
+80			1547.67		
+90			1546.90		
57+00			1546.15		
+10		6.0'	1545.44	6.0'	
+12.9 PT		6.0' - 9.5'		6.0' - 9.5'	
+20		9.5'	1544.76	9.5'	
+30			1544.10		
+40			1543.48		
+50			1542.88		
+60			1542.32		
+70			1541.79		
+80			1541.29		
+90			1540.82		
58+00			1540.38		
+10			1539.87		
+20			1539.59		
+30			1539.24		
+40	1538.82		1538.92	9.5'	1538.82
+50			1538.63	9.56'	
+60	1538.37		1538.37	9.74'	1538.27
+70			1538.14	10.04'	
+80	1538.05		1537.95	10.48'	1537.84
+90			1537.78	11.00'	
+90.5 PC					
59+00	1537.84		1537.64	11.54'	1537.40
+10			1537.54	11.86'	
+20	1537.82		1537.46	12.28'	1537.08
+30			1537.42	12.44'	
+40 VPT	1537.82		1537.40	12.50'	1536.86
+44.82	1537.82	9.5'	1537.40	12.50'	1536.86

0.10' below elevation at ℄

Nominal edge of roadway



SECTION G-G

Scale 1" = 1'-0"

NOTES:

All concrete to be class A.
Roadway and parking area surface to be 6" below curb except as noted; may be varied ±1" where necessary to insure drainage.
Roadway pavement to consist of asphalt prime & seal coats on stabilized base; to be determined by Construction Dept in consultation with Highway Division.
All bar marks on this sheet to have prefix letter N.
Bend letter c given to all bent bars.

REFERENCE DRAWINGS

21BM218....BILL OF MATERIAL
21RS218....REINFORCEMENT BAR DETAILS

Scale 1" = 10'-0"
Except as noted

NON-OVERFLOW DAM
NORTH ABUTMENT

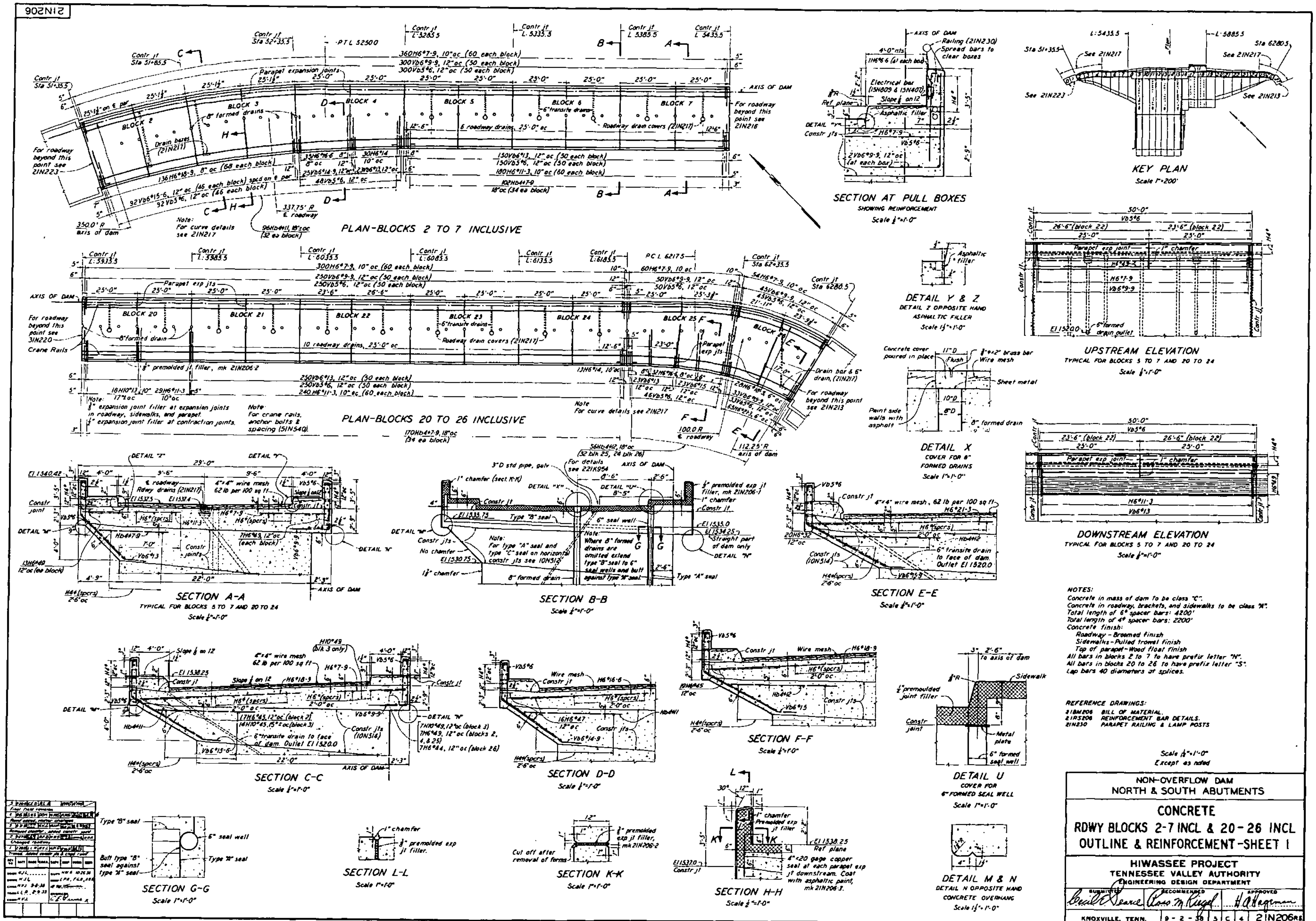
ROADWAY APPROACH
EARTH BLANKET & CORE WALL
SHEET 1

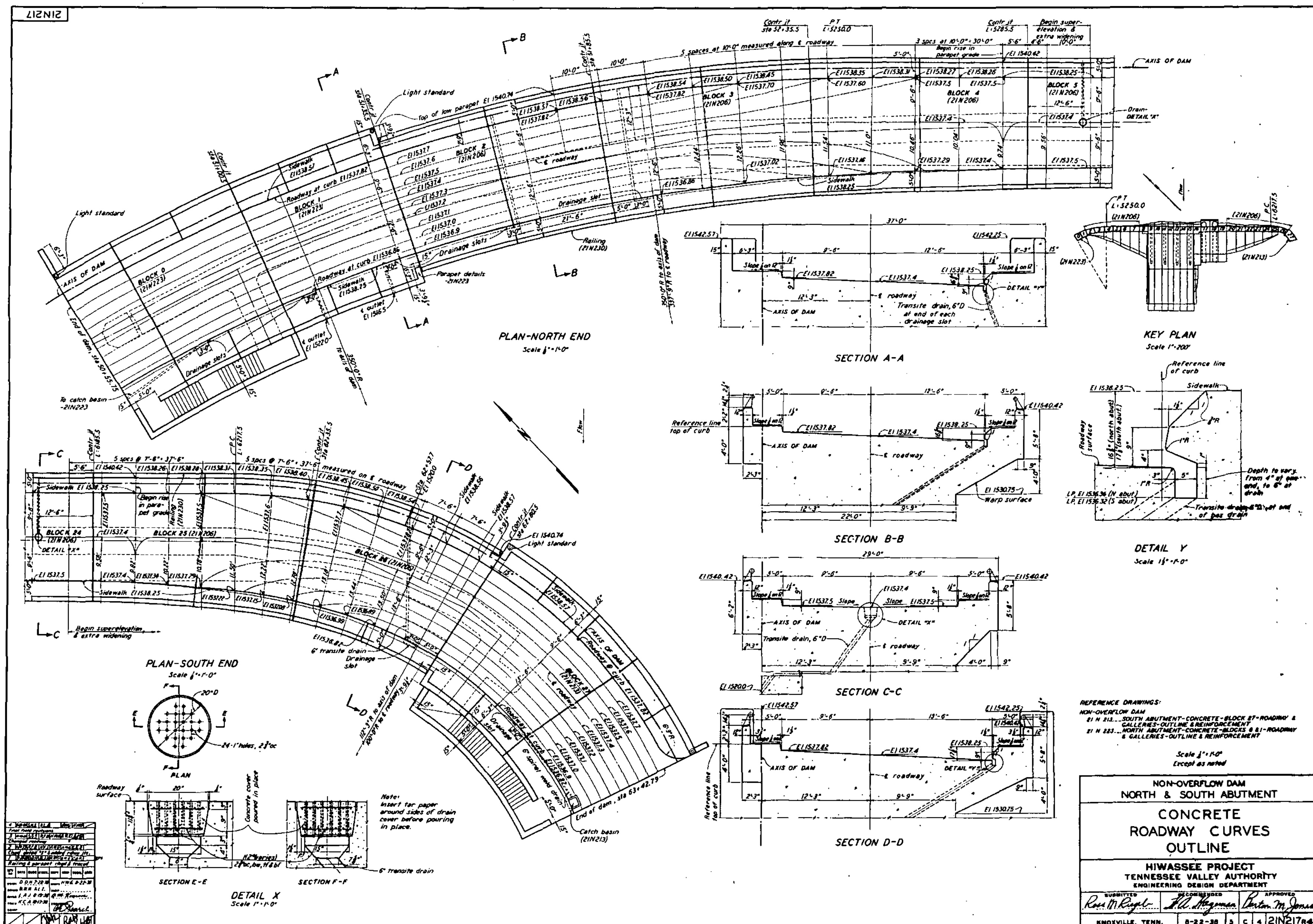
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED
Cecil C. Pearce	Roy M. Riegel	H. A. Hageman

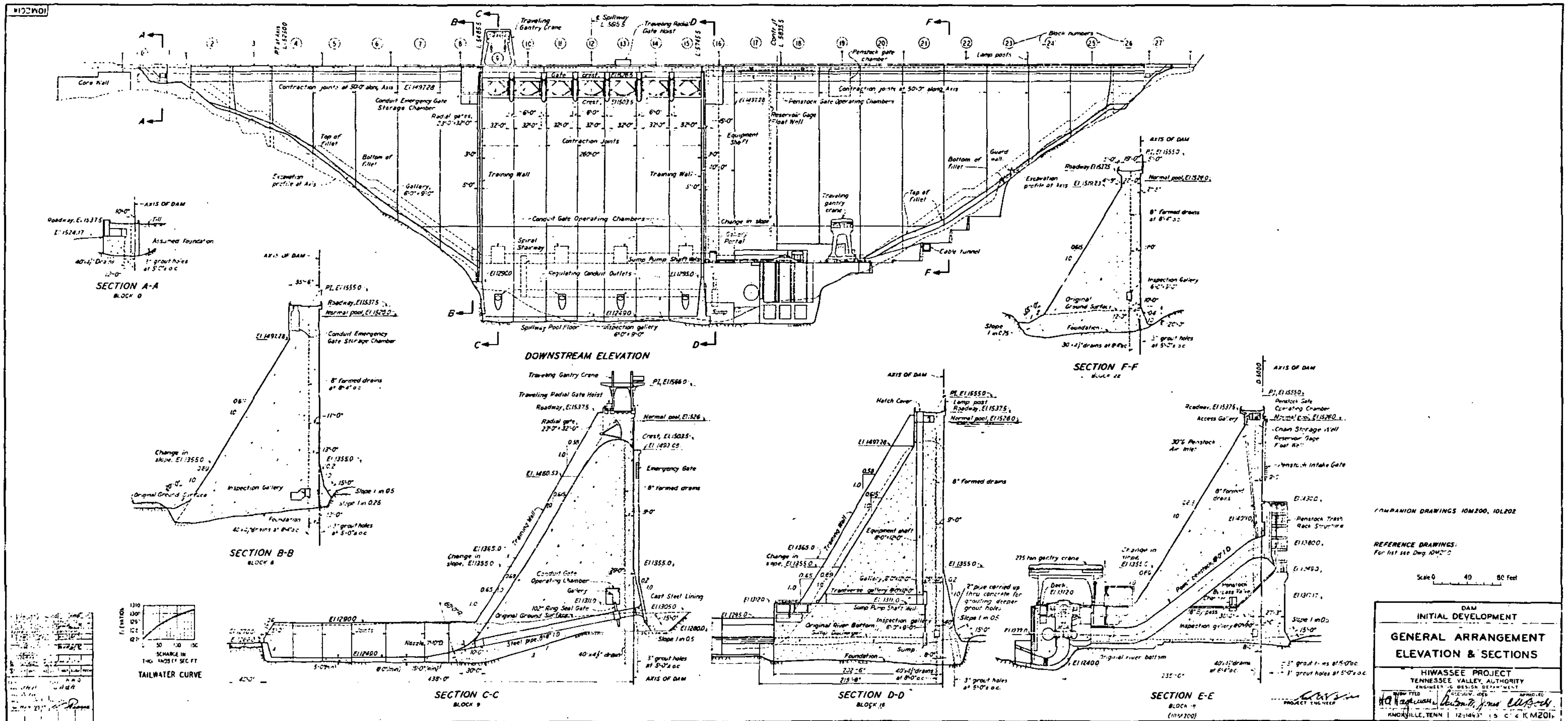
KNOXVILLE	4-5-39	5	C	4	21N218 R7

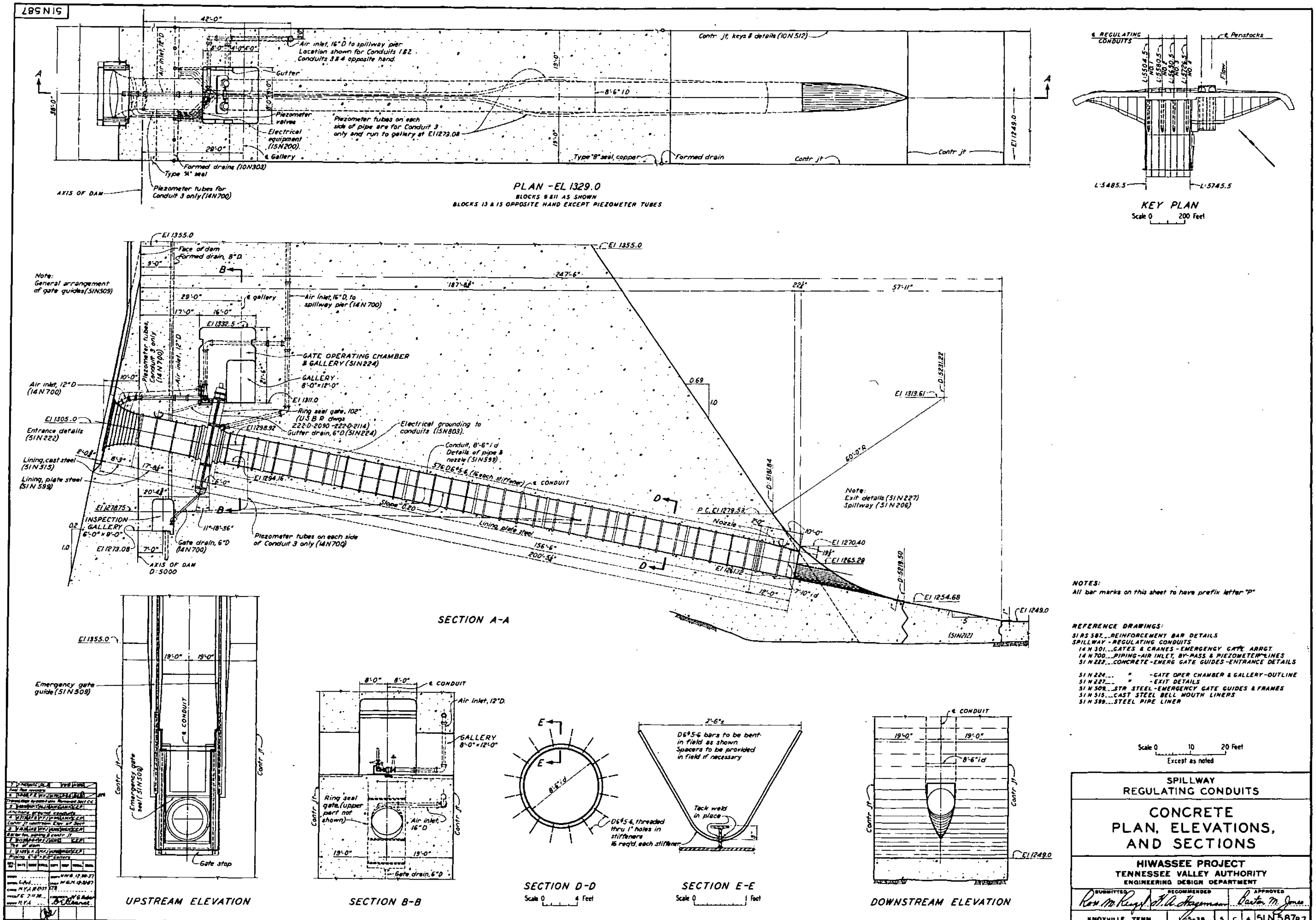
RECORD DRAWING AS CONSTRUCTED 1-10-41

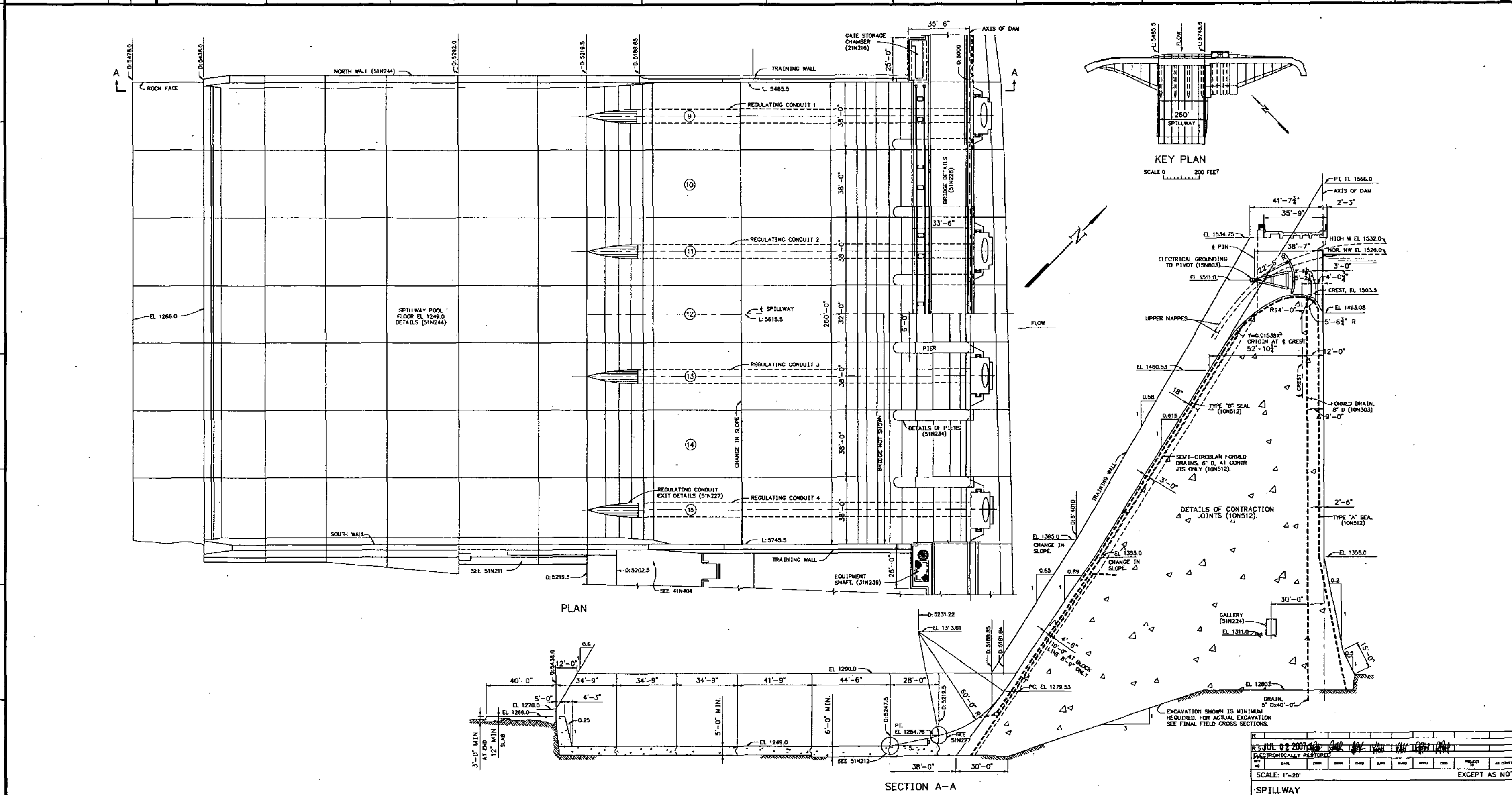

2IN206
PLAN-BLOCKS 2 TO 7 INCLUSIVE
PLAN-BLOCKS 20 TO 26 INCLUSIVE
SECTION AT PULL BOXES
SHOWING REINFORCEMENT
Scale 1/2"=1'-0"
KEY PLAN
Scale 1"=200'
DETAIL Y & Z
DETAIL Z OPPOSITE HAND
ASPHALTIC FILLER
Scale 1 1/2"=1'-0"
UPSTREAM ELEVATION
TYPICAL FOR BLOCKS 5 TO 7 AND 20 TO 24
Scale 1/4"=1'-0"
DETAIL X
COVER FOR 8" FORMED DRAINS
Scale 1"=1'-0"
DOWNSTREAM ELEVATION
TYPICAL FOR BLOCKS 5 TO 7 AND 20 TO 24
Scale 1/4"=1'-0"
SECTION A-A
TYPICAL FOR BLOCKS 5 TO 7 AND 20 TO 24
Scale 1/4"=1'-0"
SECTION B-B
Scale 1/4"=1'-0"
SECTION E-E
Scale 1/4"=1'-0"
NOTES:
Concrete in mass of dam to be class "C".
Concrete in roadway, brackets, and sidewalks to be class "A".
Total length of 6" spacer bars: 4200'
Total length of 4" spacer bars: 2200'
Concrete finish:
Roadway - Broomed finish
Sidewalks - Pulled trowel finish
Top of parapet - Wood float finish
All bars in blocks 2 to 7 to have prefix letter "N".
All bars in blocks 20 to 26 to have prefix letter "S".
Lap bars 40 diameters at splices.
REFERENCE DRAWINGS:
21BM206 BILL OF MATERIAL
21RS206 REINFORCEMENT BAR DETAILS.
21N230 PARAPET RAILING & LAMP POSTS
Scale 1/2"=1'-0"
Except as noted
SECTION C-C
Scale 1/4"=1'-0"
SECTION D-D
Scale 1/4"=1'-0"
SECTION F-F
Scale 1/4"=1'-0"
DETAIL U
COVER FOR 6" FORMED SEAL WELL
Scale 1"=1'-0"
SECTION G-G
Scale 1"=1'-0"
SECTION L-L
Scale 1"=1'-0"
SECTION K-K
Scale 1"=1'-0"
SECTION H-H
Scale 1/2"=1'-0"
DETAIL M & N
DETAIL N OPPOSITE HAND
CONCRETE OVERHANG
Scale 1 1/2"=1'-0"
NON-OVERFLOW DAM
NORTH & SOUTH ABUTMENTS
CONCRETE
RDWY BLOCKS 2-7 INCL & 20-26 INCL
OUTLINE & REINFORCEMENT-SHEET 1
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING DESIGN DEPARTMENT
SUBMITTED
RECOMMENDED
APPROVED
KNOXVILLE, TENN.
9-2-38
2IN206R6



21N217
PLAN-NORTH END
Scale 1/8"=1'-0"
SECTION A-A
KEY PLAN
Scale 1"=200'
SECTION B-B
DETAIL Y
Scale 1 1/2"=1'-0"
PLAN-SOUTH END
Scale 1/8"=1'-0"
SECTION C-C
SECTION D-D
SECTION E-E
DETAIL X
Scale 1"=1'-0"
SECTION F-F
Note: Insert tar paper around sides of drain cover before pouring in place.
REFERENCE DRAWINGS:
NON-OVERFLOW DAM
21 N 213...SOUTH ABUTMENT-CONCRETE-BLOCK 27-ROADWAY & GALLERIES-OUTLINE & REINFORCEMENT
21 N 223...NORTH ABUTMENT-CONCRETE-BLOCKS 0 & 1-ROADWAY & GALLERIES-OUTLINE & REINFORCEMENT
Scale 1/8"=1'-0"
Except as noted
NON-OVERFLOW DAM
NORTH & SOUTH ABUTMENT
CONCRETE
ROADWAY CURVES
OUTLINE
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING DESIGN DEPARTMENT
SUBMITTED
RECOMMENDED
APPROVED
Ross M Riegel
Barton M. Jones
KNOXVILLE, TENN.
8-22-38
5
C
4
21N217R4
RECORD DRAWING AS CONSTRUCTED


DOWNSTREAM ELEVATION
SECTION A-A
BLOCK 0
SECTION B-B
BLOCK 8
SECTION C-C
BLOCK 9
SECTION D-D
BLOCK 18
SECTION E-E
SECTION F-F
TAILWATER CURVE
COMPANION DRAWINGS 10M200, 10L202
REFERENCE DRAWINGS
DAM
INITIAL DEVELOPMENT
GENERAL ARRANGEMENT
ELEVATION & SECTIONS
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENN


51N587
PLAN - EL 1329.0
BLOCKS 9 & 11 AS SHOWN
BLOCKS 13 & 15 OPPOSITE HAND EXCEPT PIEZOMETER TUBES
KEY PLAN
SECTION A-A
UPSTREAM ELEVATION
SECTION B-B
SECTION D-D
SECTION E-E
DOWNSTREAM ELEVATION
Note: General arrangement of gate guides (51N509)
Note: Exit details (51N227) Spillway (51N206)
GATE OPERATING CHAMBER & GALLERY (51N224)
INSPECTION GALLERY 6'-0" x 9'-0"
AXIS OF DAM D: 5000
NOTES:
All bar marks on this sheet to have prefix letter "P"
REFERENCE DRAWINGS:
51RS 587...REINFORCEMENT BAR DETAILS
SPILLWAY - REGULATING CONDUITS
14 N 301...GATES & CRANES - EMERGENCY GATE ARRGT
14 N 700...PIPING-AIR INLET, BY-PASS & PIEZOMETER LINES
51 N 222...CONCRETE-EMERG GATE GUIDES-ENTRANCE DETAILS
51 N 224... " -GATE OPER CHAMBER & GALLERY-OUTLINE
51 N 227... " -EXIT DETAILS
51 N 509...STR STEEL-EMERGENCY GATE GUIDES & FRAMES
51 N 515...CAST STEEL BELL MOUTH LINERS
51 N 599...STEEL PIPE LINER
Scale 0 10 20 Feet
Except as noted
SPILLWAY
REGULATING CONDUITS
CONCRETE
PLAN, ELEVATIONS,
AND SECTIONS
HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
ENGINEERING DESIGN DEPARTMENT
SUBMITTED RECOMMENDED APPROVED
KNOXVILLE, TENN.
51N587R7
RECORD DRAWING AS CONSTRUCTED 7-17-1940



REFERENCE DRAWINGS:

SPILLWAY-SPILLWAY POOL
51N211 ----CONCRETE-SOUTH WALL-OUTLINE-SHEET 1.
51N244 ----CONCRETE-FLOOR & NORTH WALL-OUTLINE & REINF.

SPILLWAY-TRAINING WALLS
51N239 ----CONCRETE-NORTH & SOUTH WALLS-OUTLINE & REINF.

SPILLWAY-REGULATING CONDUITS.
51N587 ----CONCRETE-PLAN, ELEVATIONS, & SECTIONS.

GENERAL
15N803 ----ELECTRICAL CONDUIT & GROUNDING - MAIN GROUND BUSES.

DAM
15N400 ----ELECTRICAL LIGHTING - NORTH & SOUTH TRAINING WALLS.

R 5 JUL 02 2007
ELECTRONICALLY RESTORED

SCALE: 1"=20' EXCEPT AS NOTED

SPILLWAY

CONCRETE
GENERAL PLAN & SECTIONS

DESIGNED BY	DRAWN BY	CHECKED BY	SUPERVISED BY	REVIEWED BY	APPROVED BY	ISSUED BY
F.L.E	F.L.E	L.A.J.	H.W.G			

HIWASSEE PROJECT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

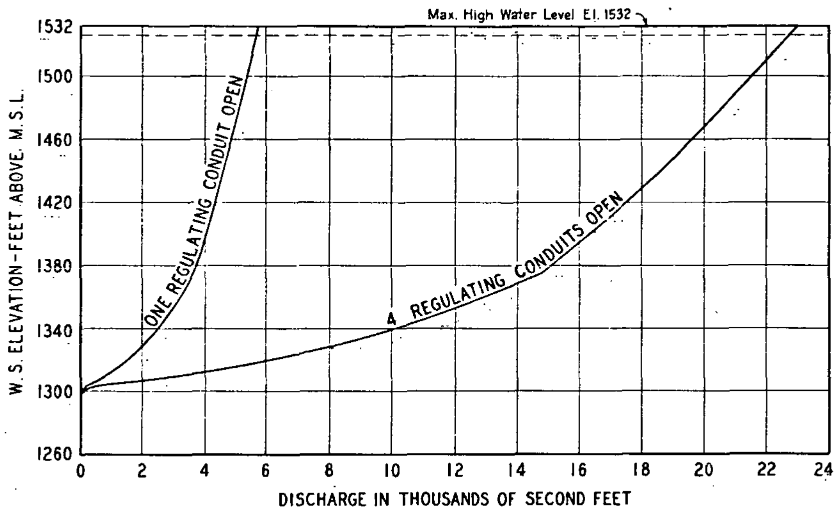
AUTOCAD R00 | DATE 6-24-38 | 5 | C | 51W206 | R 5

ELECTRONICALLY RESTORED DRAWING
THIS DRAWING HAS BEEN COMPLETELY REDRAWN
AND SUPERSEDES :(51N206 R4)

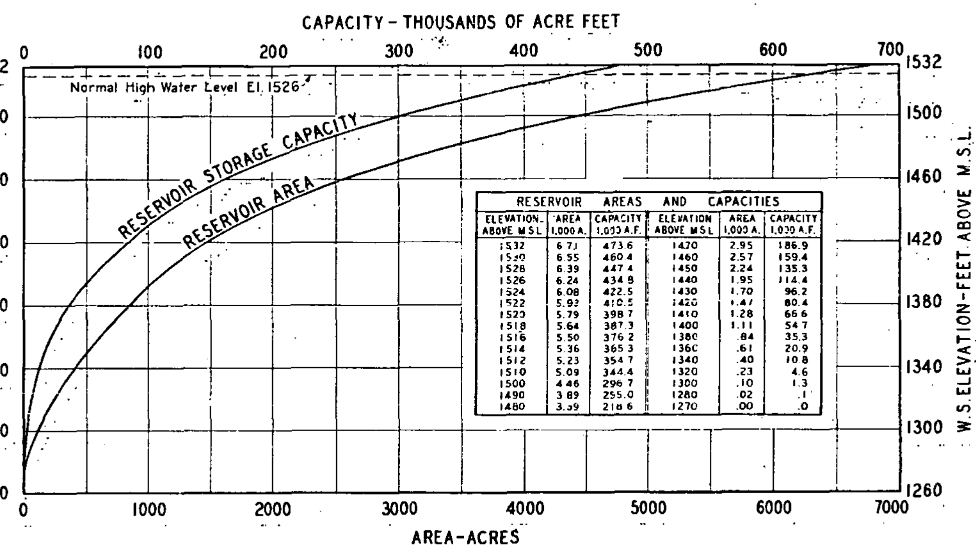
PLOT FACTOR:240
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

TASK COMPLETED BY | REV NO.



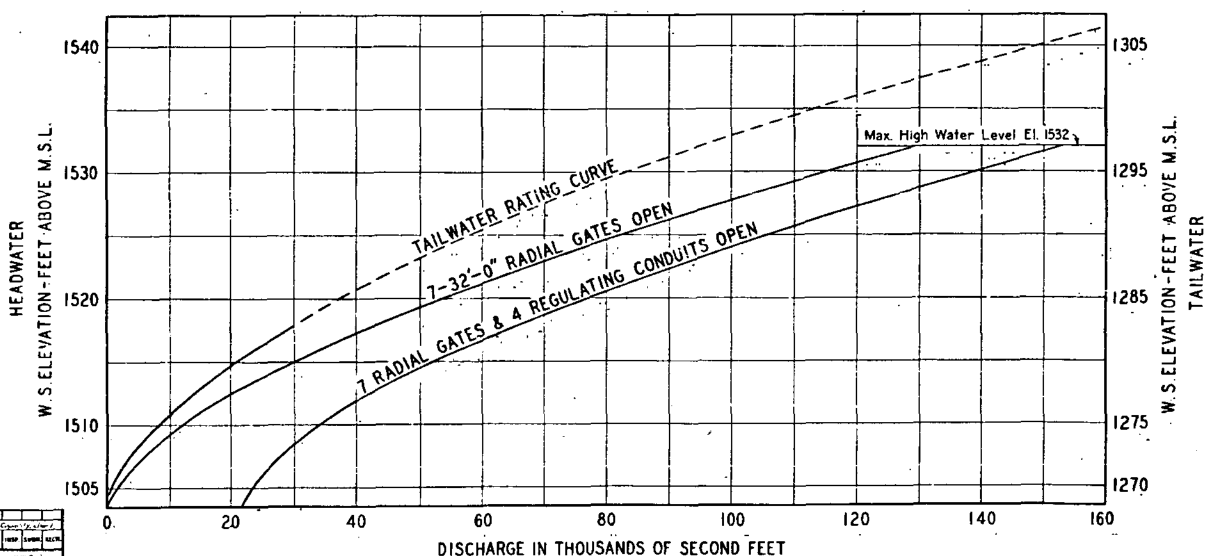
REGULATING CONDUIT



RESERVOIR AREA AND CAPACITY

RESERVOIR AREAS AND CAPACITIES

ELEVATION ABOVE M.S.L.	AREA 1,000 A.	CAPACITY 1,000 A.F.	ELEVATION ABOVE M.S.L.	AREA 1,000 A.	CAPACITY 1,000 A.F.
1532	6.71	473.6	1470	2.95	186.9
1530	6.55	460.4	1460	2.57	159.4
1528	6.39	447.4	1450	2.24	135.3
1526	6.24	434.8	1440	1.95	114.4
1524	6.08	422.5	1430	1.70	96.2
1522	5.93	410.5	1420	1.47	80.4
1520	5.79	398.7	1410	1.28	66.6
1518	5.64	387.3	1400	1.11	54.7
1516	5.50	376.2	1380	.84	35.3
1514	5.36	365.3	1360	.61	20.9
1512	5.23	354.7	1340	.40	10.8
1510	5.09	344.4	1320	.23	4.6
1500	4.46	296.7	1300	.10	1.3
1490	3.89	255.0	1280	.02	.1
1480	3.39	218.6	1270	.00	.0



SPILLWAY AND TAILWATER

EQUATIONS AND ASSUMED LOSSES:

SPILLWAY.

$$Q = \frac{CLH^{1.62}}{D^{0.12}} = 569.36H^{1.62}$$ (R.N. Brudenell, Univ. of Iowa)

Where

C = 3.80 This value determined and the computed discharge checked by model tests in the T.V.A Hydraulic Laboratory.

L = Length of Crest = 224'

D = Design Head on Crest = 28.5'

H = Actual Head on Crest

REGULATING CONDUIT

Entrance Loss $= 0.05\frac{V^2}{2g}$

Friction Loss $= \frac{2.87n^2LV^2}{D^{4/3}}$ (Manning's Formula)

Nozzle Loss $= \left(\frac{1}{C_v^2}-1\right)\frac{V_1^2}{2g}$

Where

V = Velocity in Pipe

V_1 = Velocity at Small End of Nozzle (Dia. = 7'-10")

n = 0.010

L = Length of Straight Pipe = 150.5'

D = Diameter of Pipe = 8'-6"

C_v = 0.98 (King's Handbook of Hydraulics, Pg. 58)

NOTE:

Solid portion of tailwater rating curve is based on actual gage readings; dashed portion is estimated by area-mean depth method.

REFERENCE DRAWINGS:

301 M1 ... Reservoir Areas and Volumes.

C-85365 ... Tailwater Rating Curve.

DAM

HYDRAULICS

AREA, CAPACITY & DISCHARGE CURVES

HIWASSEE PROJECT

TENNESSEE VALLEY AUTHORITY

ENGINEERING DESIGN DEPARTMENT

SUBMITTED	RECOMMENDED	APPROVED
[illegible]	Ross M. Riegel	[illegible]

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