CELRH-EC-WM

05 Jan 2010
Schray/5604

Memorandum for Resource Managers and Water Control Manual holders

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Reference CELRH-EC-WM Memorandum to Kent Browning, dated 20 January 2004, Subject: Modification of Huntington District Water Control Reporting Procedures.

2. The referenced memorandum modifies certain reporting procedures. Since that memorandum was issued, improvements in technology have resulted in the National Weather Service providing detailed snow analyses data in graphical maps via the internet. This data satisfies Water Managements needs, and therefore an additional modification is necessary.

3. Modify Instructions to Dam Tender, Section 2 – Precipitation at Project, sub-section: Snow Depth and Moisture Content:

Replace the section in its entirety with the following:

"Report snow data to Water Management only when directed to do so. Measure and record the water content of the snow at least as often as indicated below.

(1) Each day when rain falls on existing snow cover

(2) Twice a week on Mondays and Thursdays when there is snow cover on the ground if condition (1) does not require more frequent measurement.

4. This change in reporting instructions does not modify the Project's requirement to store this data on site.

5. This memorandum shall be placed in the front of the Water Control Manual to document the change.

Timothy W. Curran, P.E.
Chief, Water Management Section

CELRH-EC-WM

11 June 2007
Schray/5604

Memorandum for Resource Managers and Water Control Manual holders

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Reference CELRH-EC-WM Memorandum to Kent Browning, dated 20 January 2004, Subject: Modification of Huntington District Water Control Reporting Procedures.

2. The referenced memorandum modifies certain reporting procedures, and this memorandum makes an additional change. Some Water Control Manuals have been revised with the new procedures the "Instructions to Resource Manager" or "Instructions to Dam Tender" section. Manuals that have not been revised should have the referenced memorandum placed in the front of the manual. Make handwritten changes to the memorandum or the Water Control Manual, as appropriate. This memorandum shall be placed in the front of the Water Control Manual to document the change.

3. Modify Instructions to Dam Tender, Section 4 – Regular Reports, sub-section: Weekly Precipitation Report, second and third sentences:

Replace the text "This report must be filled out and transmitted every Monday morning by 0800 hours. If Monday is a holiday, it shall be filled out on the next work day by 0800 hrs." with "This report is no longer required to be completed on a weekly basis. It shall only be filled out and submitted if required by special directive."

Timothy W. Curran, P.E.
Chief, Water Management Section

3/16/04
Clu

CELRH-EC-WM

20 January 2004
Schray/5604

Memorandum for Kent Browning, OR Water Management POC.

Subject: Modification of Huntington District Water Control Reporting Procedures.

1. Please distribute this memorandum to all Huntington District Flood Control Project Managers, direct them to place this memorandum in the front of the Water Control Manual, and make notes in the text which has been superseded.

2. As directed by the QC, EC-WM is implementing the recommendations of the Reservoir Reporting Process Action Team. As such, the following changes shall be made to the water control manuals and the associated processes:

The following sections are modified as noted.

Instructions to Dam Tender, Section 2 - Precipitation at Project, sub-section: Snow Depth and Moisture Content

Measure and report to EC-WM by 0900 hours the water content of the snow at least as often as indicated below.

(1) Each day when rain falls on existing snow cover

(2) Twice a week, on Mondays and Thursdays, when there is snow cover on the ground if condition (1) does not require more frequent measurements.

Instructions to Dam Tender, Section 2 - Precipitation at Ohio River Network Stations

Reports to the National Weather Service are carried out by agreement between the Project and the Weather Service and at their direction. The project is not required to gather or submit any additional data to Water Management beyond what is described previously in section 2 and what is detailed in section 4.

Sub-Sections a, b, and c are therefore no longer relevant except as to describe how to gather and provide data to the National Weather Service.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Weekly Report, ORH 14

This section is rescinded in its entirety and is replaced by sub-section: Historical Files.

Projects are required to maintain a permanent hard copy at the project of all water control data required for daily operation. This data shall be comprised of the information the project has historically gathered using the ORH 14 and 13 reports and shall be gathered at 0730 on days when the project is staffed, at other times as directed by the Schedule for Reading Gages and the Project Manager and when data is requested by Water Management Section. It shall include but not be limited to: Precipitation, Current Weather conditions, Lake Stage Levels, Outflow Stage Levels, Gate Settings, Gate Operations and time performed, Snowfall, Snow on the Ground, Total Moisture Content as directed in Section 2, and all Upstream and Downstream gauge readings which are utilized by project personnel for gate operation decision making.

This information may be maintained either on the historical reports or a new project developed format.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Daily Morning Report

This sub-section is modified to note that: Generation and transmission of the daily morning report (also call the intranet report which replaced the ORH-13 Daily report) is only required when requested by the Water Management Section. Automatic daily transmissions are no longer necessary.

Note: Atwood, Bolivar, Clendening, Piedmont, Tappan, and Tom Jenkins are still required to report all gate operations to EC-WM by phone. Extra emphasis will be placed on these phone calls as Water Management will no longer be able to look up the previous day's gate operations every morning.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Gate Operations Report

This sub-section is modified to note that: Generation and transmission of the gate operations report is only required when requested by the Water Management Section. Neither daily transmissions nor transmissions after every gate operation are necessary any longer.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Weekly Precipitation Report

This sub-section shall be added after the Water Quality Report sub-section.

A fourth report available from the Index Page is the Weekly Precipitation Report. This report must be filled out and transmitted every Monday morning by 0800 hours. If Monday is a holiday, it shall be filled out on the next work day by

0800 hours.

Upon accessing the Weekly Precip Report link on the Index Page, fill in the daily precipitation for the past week. When all data for the week is filled in, save the spread sheet and exit. This record will be saved for the entire year and can be viewed through the link used to modify it.

On days when the project is not staffed, place a "NS" in that day's field and report the combined day's precipitation in the next day when the project is staffed. I.e. If the project does not staff the weekend, place a "NS" in the field for Saturday and Sunday and report the 72 hour precipitation record on Monday morning.

Instructions to Dam Tender, Section 4 - Regular Reports, sub-section: Additional Comments

This sub-section shall be added after the Weekly Precipitation Report sub-section.

A fifth link available on the Index Page is the Additional Comments link. It shall be used when ever the Project has special information or questions that it wants to bring to the immediate attention of the Water Management team. Snow Moisture shall be reported using this link.

Upon accessing the Additional Comments link on the Index page, a blank email to the Water Management Team will be generated. Please note in the subject line, the nature of the issue and then provide supplemental data in the text block of the message. After the email has been completed click on the submit/send button to send the message.

Instructions to Dam Tender, Schedule for Reading Gages

The last sentence of the top paragraph "Stream gages and the precipitation gage (all gages) shall be read at least as often as shown in the table below", shall be replaced with: "Reading and recording of gages shall be carried out as defined under Schedule A except when gage levels/precipitation are such that the Resource Manager or their Acting anticipates that problems may result, at which point the relevant schedule B, C, or D shall be followed for reading and recording of all required gages. Transmission of project gage data will be at the request of EC-WM.

Modify the chart as follows:

SL, SO, and DCO shall be read in all schedules monthly as a check

Modify the footnotes as follows:

(1) When any one of the conditions listed under schedule A, B, C is exceeded and problems are anticipated, place the next higher schedule into effect. When conditions are such that would place schedules C or D into effect, notify by phone one of the Water Control personnel.

Timothy W. Curran, P.E.
Chief, Water Management Section

CF:EC-WH

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

27 January 2003

REPLY TO
ATTENTION OF:

Engineering & Construction Division
Water Resources Engineering Branch

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Updates for the East Lynn Lake Water Control Manual

1. EC-WW has identified outdated information in the referenced Water Control Manual.

2. Please replace the following pages with the attached pages: 7-2 (main text), Plate Nos. 7-3, 5-2, and 5-3 (Plate Section), 1-3 (Exhibit B, Instructions to Damtender).

3. Any question should be directed to Mr. Charles Brown at [redacted]

4. Place this page in the front of the manual.

Encl

ALFRED L. BRANCH, JR., P.E.
Chief, Engineering & Construction Division

CELRD-ET-W (2)
CELRH-OR
CELRH-OR-ELT (2)
CELRH-OR- BSA
CELRH-EC-WW (2)
CELRH-EC-WH

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
502 EIGHTH STREET
HUNTINGTON, WEST VIRGINIA 25701-2070

REPLY TO
ATTENTION OF

CELRH-EC-W (11110-2-1403a) 6 February 2001

MEMORANDUM FOR Commander, Great Lakes and Ohio River Division,
ATTN: CELRD-ET-W

SUBJECT: Water Control Manual for East Lynn Lake

Forwarded herewith are two copies of the subject manual for your retention.

ALFRED L. BRANCH, JR., P.E.
Chief, Engineering & Construction Division

2 Encl

Copies Furnished:
CELRH-OR
CELRH-OR-ELT (2)
CELRH-OR-BSA
CELRH-EC-WW (2)
CELRH-EC-WH

U.S. ARMY ENGINEER DISTRICT, HUNTINGTON
CORPS OF ENGINEERS
HUNTINGTON, WEST VIRGINIA

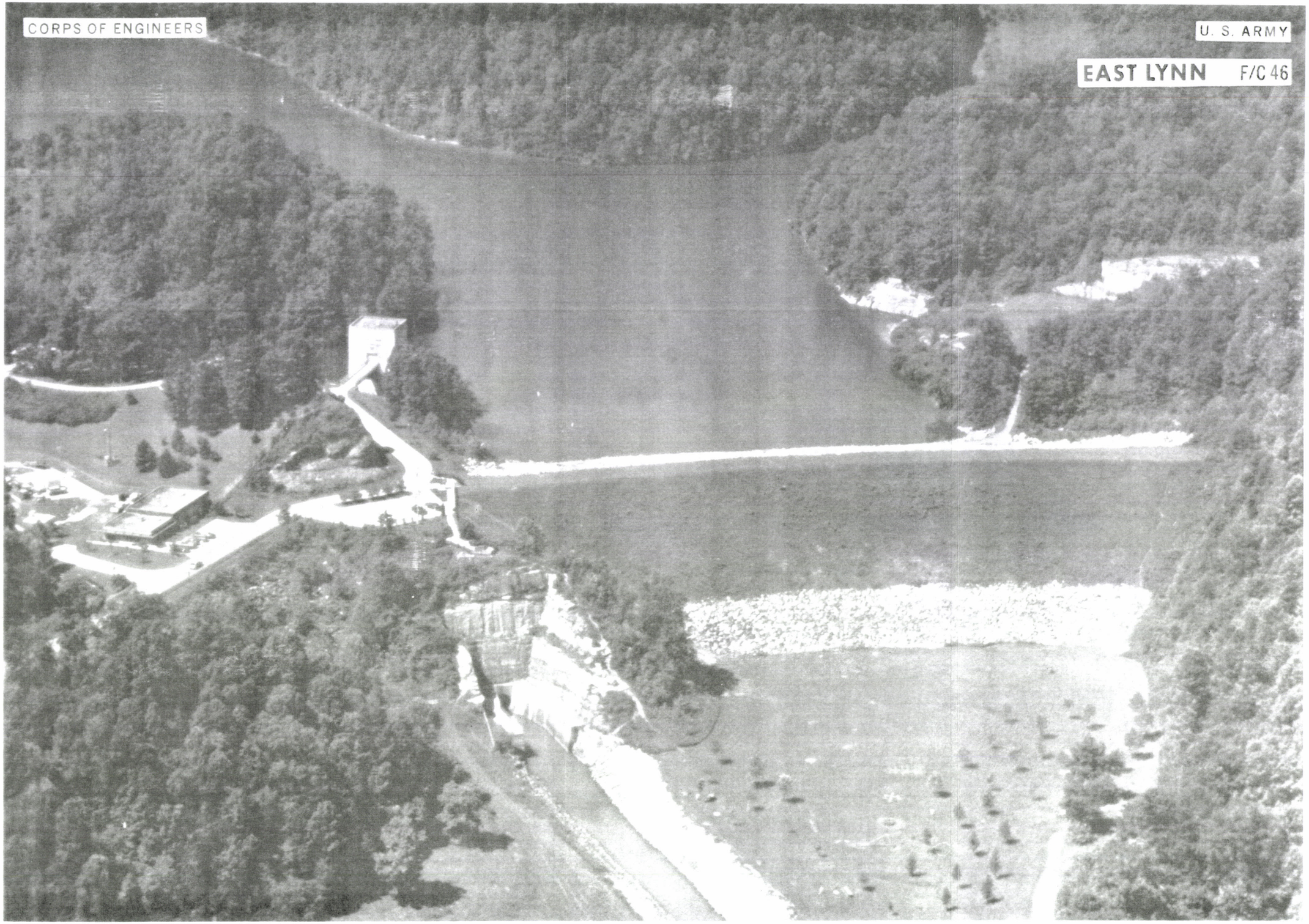
EAST FORK OF TWELVEPOLE CREEK BASIN
WEST VIRGINIA

PROJECT MANUAL
FOR WATER CONTROL MANAGEMENT
EAST LYNN LAKE – TWELVEPOLE CREEK

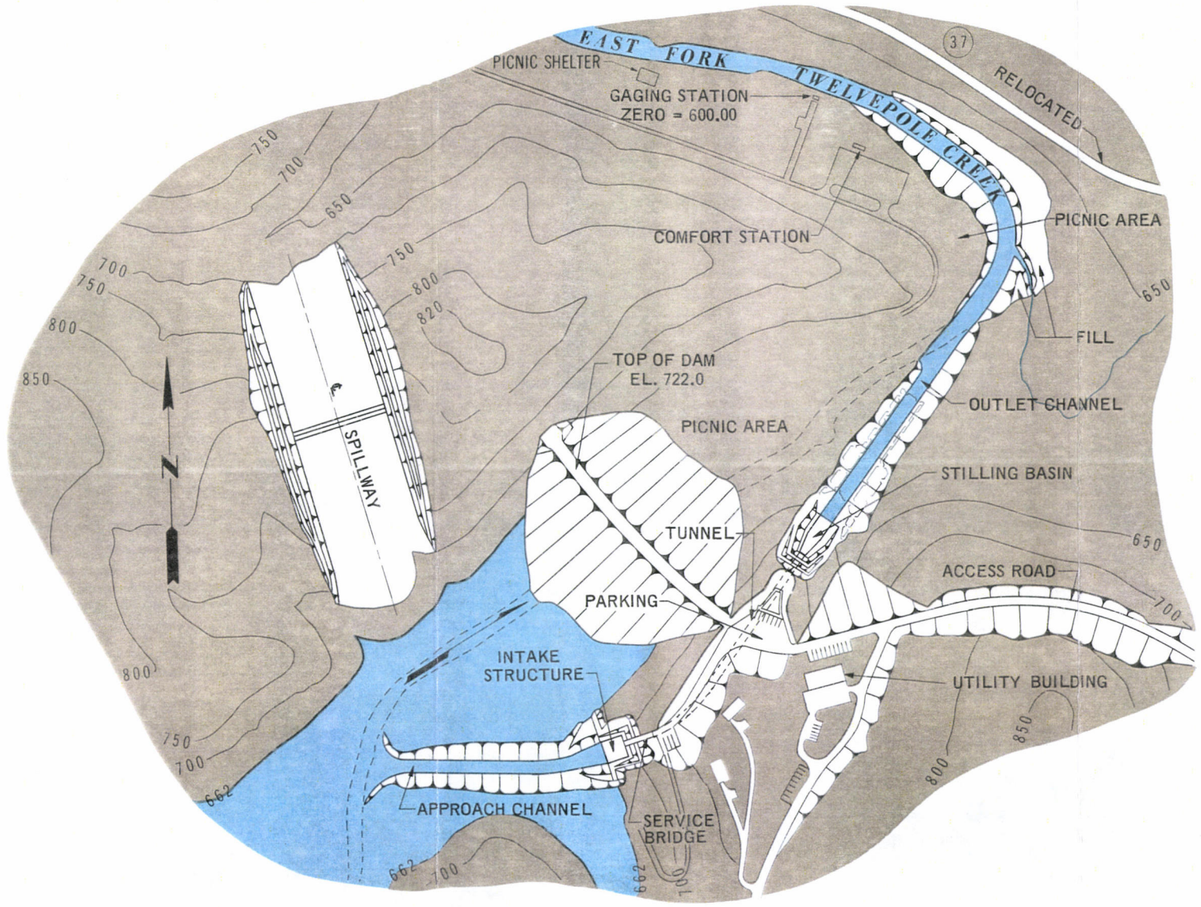
PREPARED BY
CORPS OF ENGINEERS
HUNTINGTON DISTRICT
WATER RESOURCES ENGINEERING BRANCH

JANUARY 2001

EAST LYNN LAKE


CORPS OF ENGINEERS
U. S. ARMY
EAST LYNN F/C 46

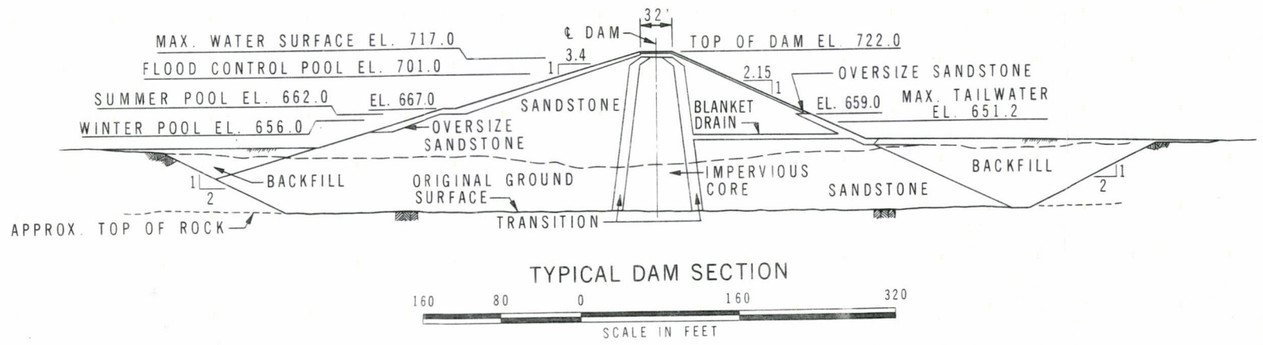
EAST LYNN F/C 46-A



PLAN

350 175 0 350 700

SCALE IN FEET



TYPICAL DAM SECTION

160 80 0 160 320

SCALE IN FEET

VICINITY MAP

50 0 50 100 150

SCALE IN MILES

TWELVEPOLE CREEK

EAST LYNN LAKE PROJECT

DAM AND SPILLWAY

PLAN AND SECTION

HUNTINGTON DISTRICT, HUNTINGTON, W. VA.

Revised: 30 SEPTEMBER 1988

NOTICE TO USERS OF THIS MANUAL

Regulations require that this Water Control Manual be published in a hard backed 3-ring binder with the text in loose leaf form. In this way, only those sections or parts thereof requiring changes need be revised and printed. Therefore, this copy should be preserved in good condition in order that single page inserts can be made to keep the manual current. Changes to individual pages must carry the date of revision, which is the Great Lakes and Ohio River Divisions' approval date.

REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during non-duty hours, communications can be achieved by contacting, in the order listed, one of the following.

CORPS OF ENGINEERS
Big Sandy Area Office,
Louisa, Kentucky
[redacted], Area Manager

Normal Work Hours, [redacted]
Night, weekend, Holiday, NWS observers
Person-to-Person, at home
[redacted] [redacted]

KEY EMERGENCY CONTACTS

Huntington District Office, Water Resources Engineering Branch
Normal Work Hours, Nights,
Weekends, and Holidays [redacted]

DISTRICT PERSONNEL	Party Office	Telephone Residence
Water Resources Engineering Branch		
[redacted]	Water Control Section	[redacted]
[redacted],	Water Control Section	[redacted]
[redacted] Chief, Water Resources Engineering Branch		[redacted]

Pertinent telephone numbers that may be of value during a flood emergency are listed below:

Other Agencies

U. S. Geological Survey
Charleston, WV [redacted]

Night, Weekend, Holidays
[redacted] [redacted]

National Weather Service
W. S. Forecast Office
Charleston, WV [redacted]

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HUNTINGTON DISTRICT REPORTS
BY
WATER RESOURCES ENGINEERING BRANCH

PERIODIC REPORTS - Computer reports keyed to forms formerly completed by hand as follows:

Daily Computer report of observed and forecast stages and flows including:

- Morning reservoir pool elevation, outflow, outflow temperature and three-day pool and outflow forecast.

- 24-hour rainfall, morning stage, flow and five-day flow forecast at Ohio River tributary gage points.

Weekly Reservoir effects at Ohio River tributary gage points.

Monthly Record of District reservoirs available on request.

Annually Summary of significant reservoir regulation activities for the year and of programs proposed for the following year.

SPECIAL REPORTS

Daily or more frequent briefing of District Engineer and Chief Engineer during flood or other emergencies containing hydrologic, meteorologic, and operational information, when and as requested.

Information relevant to flooded area or situation to the Emergency Operations Center (when functioning) such as pertinent data about the area, copies of reservoir morning and extra reports, relay of any verbal reports, relevant NWS zone forecasts and special bulletins, and computer-generated isohyetal map of the District.

Reports on reservoir operations to OCE during flood emergencies including inflow, outflow, pool elevation, predicted crest, and maximum storage utilization to date.

Post-flood reports.
Budget requests for water control management activities to OCE.
Snow-melt runoff and flood potential letter report to OCE.

Narrative summaries of major drought or low-flow conditions likely to call for regulations of District reservoirs.

Master plans for water control data systems and significant revisions thereto are submitted to HQDA (DAEN-CWE-HY) Washington, DC 20314, for review and approval of engineering.

PERTINENT DATA

EAST LYNN LAKE, WEST VIRGINIA

LOCATION OF DAM: Six air miles south-southeast of Wayne, county seat of Wayne County, West Virginia. On East Fork of Twelvepole Creek; 10.0 miles above the mouth of East Fork and 42.0 miles above the mouth of Twelvepole.

DRAINAGE AREA ABOVE DAM: 133 Square miles.

DAM: Type - rolled earthfill, maximum height 113' above streambed, top length 652'.

SPILLWAY: Uncontrolled saddle spillway, crest length 230'.

OUTLET WORKS: Intake structure, 13' diameter concrete lined, circular tunnel 625' in length, outlet monolith and transition. Flow regulated by three 5’8" x 10'0" sluices with hydraulically operated slide gates. Low-flow system has two 4'x3' inlets, one each at invert elevations 658 and 649, with discharge controlled by a 30" hydraulically operated gate valve.

LAND ACQUIRED: Fee - 24,821 acres
Easement 23.4 acres

TWELVEPOLE CREEK BASIN
WEST VIRGINIA

PROJECT MANUAL
FOR
WATER CONTROL MANAGEMENT

EAST LYNN LAKE - EAST FORK OF TWELVEPOLE CREEK

SECTION I - INTRODUCTION

1-01 PROJECT AUTHORIZATION

East Lynn Lake was authorized by the Flood Control Act of 1962, H.R. 13273, Public Law No. 87-874, 87th Congress, second session. The project was authorized for flood control and allied purposes which include water conservation for general recreation and fish and wildlife management. Inclusion of storage for water quality control was authorized by the Federal Water Pollution Control Act of 1948 as amended under Section 2 of Public Law 87-88, July 1961.

1-02 AUTHORITY, PURPOSE AND SCOPE OF WATER CONTROL MANUAL

This manual is prepared in accordance with ER 1110-2-8156, dated 31 August 1995, ER 1110-2-240, dated 8 October 1982, and ETL 1110-2-251, dated 14 March 1980, which provides for submission of regulation manuals in accordance with instructions contained in "Guide for Preparing Water Control Manuals" as prepared by SWD, dated October 1977.

The purpose of this manual is to furnish detailed schedules for the regulation of East Lynn Lake. The manual will serve two functions; first as documentation of the plan for water control, and second, as a reference source for higher authority and for office and field personnel responsible for water control management throughout the life of the project. The manual additionally contains background information necessary for understanding the objectives and application of the water management schedules, as well as results of optimal simulation of project operation for specific purposes and conditions.

1-03 RELATED MANUALS AND REPORTS

	Title	Date
1.	Twelvepole Creek Survey Report, Chief of Engineers to Congress under authority of Section 10, Flood Control Act of May 1928.	June 1933
2.	Survey Report on Ohio River, House Document No. 306. 74th Congress, First Session.	August 1935

3. Committee Document No. 1, 75th Congress, 1st session. — February 1937

4. Twelvepole Creek Survey Report, House Document No. 520, 87th Congress , 2nd session. — December 1961

5. Design Memoranda:

No. 1	Highway Relocation, State Route 37 Part 1 and Public Use Access	June 1964
No. 2	Site Selection	March 1964
No. 3	General Design Memorandum	January 1965
No. 4a	Preliminary Master Plan	April 1965
No. 4b	Public Use Plan - Part of Master Plan	May 1969
No. 5	Real Estate - Damsite and State Route 37 - Part 1	December 1965
No. 6	Geology and Soils	June 1965
No. 7	Dam, Spillway and Outlet Works	July 1965
No. 7a	Supplement - Dam, Spillway and Outlet Works	April 1966
No. 8	Concrete Aggregates	May 1965
No. 9	Relocations - Highways Rt. 37, Part II	April 1965
No. 10	Real Estate - Reservoir Part II	July 1965
No. 11	Real Estate - Part III	June 1967
No. 12	Relocations - Utilities, Power and Telephone	December 1967
No. 13	Relocations - Schools	August 1966
No. 14	Reservoir Clearing	March 1966
No. 15	Relocations - Pipelines	November 1968
No. 16	Sediment Range Layout	January 1977
No. 16	Supplement No. 1 – Report on 1980 sediment reconnaissance	March 1982
No. 16	Supplement No. 2 - Report on 1985 sediment reconnaissance	June 1987

No. 16	Supplement No. 3 - Report on 1997 sediment reconnaissance	September 1999
6.	Preliminary Project Manual for Water Control Management East Lynn Lake.	January 1978
7.	Periodic Inspection, East Lynn Lake	
	Report No. 1	November 1970
	Report No. 2	May 1972
	Report No. 3	April 1976
	Report No. 4	April 1981
	Report No. 5	May 1986
	Report No. 6	April 1991
	Report No. 7	Nov 1996
8.	Operations and Maintenance Manual	February 1973
9.	Instrumentation, East Lynn Lake Annual Report No. 1	March 1979
10.	Final Environmental Impact Statement	December 1974
11.	Appendices to the Master Plan	
	Appendix A Resource Management Plan	August 1978
	Appendix B Forest Management Plan	March 1974
	Appendix C Forest Fire Control Plan	September 1975
	Appendix D Fish and Wildlife Management	November 1977
	Appendix E Safety Plan	July 1977

1/ Not Authorized
* Month of Court Clearance

1-04 PROJECT OWNER

The United States Government has full title, ownership, and fee control of all Huntington District, Corps of Engineers reservoir and lake lands, including East Lynn Lake. The United States Government reimbursed the private property owners for most of the surrounding land and now owns the dam and operating structures.

1-05 OPERATING AGENCY

East Lynn Lake is staffed, attended, and operated continuously by the Huntington District, Corps of Engineers.

The mailing address is:
East Lynn Lake
HC85 Box 35C
East Lynn, W.V. 25512

The Resource Manager(damtender) is:
[redacted]
Box 143
Wayne, West Virginia 25570

Commercial [redacted]

Home phone [redacted]

The Huntington District, Water Resources Engineering Branch has various responsibilities as specified in Ohio River Division Regulation 1110-2-27, dated 12 January 1976. These responsibilities include the primary overall water control management of all Huntington District projects, technical evaluations of performance of these projects, and developing plans and manuals for the reservoir systems within the District, such as the East Lynn Lake Project. An index map of the Huntington District and locations of all Corps of Engineers Flood Control Projects is shown on Plate No. 1-1.

Guidelines for routine operations under identified conditions are included in standard operation instructions. Special Directives issued and signed by the Chief of the Water Control Section provide direction for operations needed for all other situations, low-flow control, or flood regulation. Any operations which might deviate from the approved water control plan as presented in this manual are coordinated with the Great Lakes and Ohio River Division Water Management Branch.

1-06 REGULATING AGENCY

The operating and regulating responsibility is exercised under the following regulations:

(1) EM1110-2-3600, 30 November 1987,
Subject: Management of Water Control Systems.

(2) ER1110-2-1400,DAEN-CWE-Y, 24 April 1970,
Subject: Reservoir Control Centers.

(3) ER1110-2-240,DAEN-CWE-Y, 8 October l982,
Subject: Reservoir Control Centers.

(4) ORDR 1110-2-27, 12 January 1976,
Subject: Water Control Management Activities.

(5) ER1130-2-415, DAEN-CWE-Y, 28 October1976,
Subject: Water Quality Data Collection, Interpretation, and Application Activities.

(6) ORDR1110-2-26, 5 February 1979, ORDED-W,
Subject: Water Quality Investigations and Control Activities.

(7) ER 1110-2-208, DAEN-CWE-Y, 30 July 1979,
Subject: Water Control Management.

SECTION II - DESCRIPTION OF PROJECT

2-01 LOCATION

East Lynn Dam is located on East Fork of Twelvepole Creek in Wayne County about 10 miles above the mouth of East Fork of Twelvepole Creek, about 22 air miles southeast of Huntington, West Virginia, about six air miles south-southeast of Wayne, West Virginia, and about 12 air miles east of Louisa, Kentucky. The dam site is on East Fork of Twelvepole Creek about two miles south and upstream of the village of East Lynn, West Virginia, and about 900 feet south and upstream of the mouth of Laurel Creek.

The dam is located in the central portion of Wayne County, and the lake lies entirely within Wayne County, West Virginia, approximately in the center of an elongated, irregularly shaped drainage basin which lies generally in a north-south direction. The Twelvepole Creek Basin Drainage Basin Map, Plate No. 2-1, shows the location of the project, along with other important streams and highways. Plate No. 2-2 shows the general layout of the dam and the project area, while Plate No. 2-3 shows the more detailed layout and plans for of the dam and spillway. Project details appear on Supplementary Pertinent Data Sheets in the back.

2-02 PROJECT PURPOSES

a. General. East Lynn Lake was authorized by the Flood Control Act of 1962, H.R. 13273, Public Law No. 87-874, 87th Congress, second session in a comprehensive plan for the Ohio River Basin. The project was authorized for flood control and allied purposes which include water conservation for general recreation, water supply, water quality, and fish and wildlife management. Inclusion of storage and planning for recreation and surplus water was authorized by the Flood Control Act of 1944, Public Law 78-534. Inclusion of storage and planning for fish and wildlife was authorized by the Fish and Wildlife Coordination Act of 1958, Public Law 85-624. Inclusion of storage for water quality control was authorized by the Federal Water Pollution Control Act of 1948 as amended under Section 2 of Public Law 87-88, July 1961. Inclusion of storage and planning for water supply was authorized by the Federal Water Act of 1958. Benefits from specific project purposes serve not only local interests in the Twelvepole Creek Basin, but are widespread throughout the Ohio River Basin.

b. Flood Control. The extent of headwater flooding and resultant damages in the Twelvepole Creek Basin are directly due to the rugged topography of the basin and relatively low capacity of stream channels. The irregular winding ridges and deep narrow valleys are conducive to rapid runoff and rapid rises in the stream, whose brush and tree-grown banks restrict flow. Headwater floods of major proportions have occurred throughout the basin in all seasons. The lower 10 miles of Twelvepole Creek are usually capable of containing moderate headwater floods within banks, but are subject to backwater inundation from Ohio River floods which occur mostly during late winter and early spring. Benefits in this backwater area are considered part of the Ohio River benefits.

TABLE No. 2-1

EAST LYNN LAKE PERTINENT DATA

Pool	Surface Elevation NGVD	Area Acres	Backwater Stream Miles	Storage Acre-feet Net	Storage Acre-feet Gross	Inches runoff Net	Inches runoff Gross
Year-Round Storage:							
Minimum	656	823	11.4	11,700	11,700	1.6	1.6
Seasonal Storage (summer) Recreation/water Quality Control	662	1005	12.7	5,500	17,200	0.8	2.4
Flood Control Storage*							
Winter	701	2351	17.0	70,800+	82,500	10.0	11.6
Summer	701	2351	17.0	65,300#	82,500	9.2	11.6
TOTAL	701	2351	17.0	82,500	82,500	11.6	11.6

* At maximum pool elevation 701 feet NGVD
\+ Between elevations 656 and 701 feet NGVD
\# Between elevations 662 and 701 feet NGVD

Storage capacity in East Lynn Lake between spillway crest elevation 701 feet NGVD and seasonal pool elevation 662 feet NGVD, is 65,300 acre-feet, which contains 9.2 inches of runoff from the drainage area above the dam. Storage capacity between spillway crest elevation 701 feet NGVD and minimum pool elevation 656 feet NGVD, 70,800 acre-feet, contains 10.0 inches of runoff. East Lynn Lake pool data is shown on Table No. 2-1 shown above. Flood protection is nearly complete between the dam and the forks of Twelvepole Creek at Elmwood. Substantial protection along Twelvepole Creek is provided by the combination of East Lynn and Beech Fork Lake regulation.

The principal flood control benefits provided by East Lynn Lake in the Twelvepole Creek Basin accrue to residential areas and summer camps, including a residential area in the town of Wayne, and to agricultural areas. East Lynn Lake also assists in the reduction of flooding on the Ohio River below the mouth of Twelvepole Creek. Along the Ohio River, the industrial development is mostly outside the flood walls and levees of Huntington and Ceredo-Kenova while the major parts of the cities are inside the flood walls. Accordingly, this industrial development and some towns and cities suffer from floods of all stages.

Flooding in the basin is the direct result of either summer-type or winter-type storms, with those caused by winter storms being the more frequent. Summer rains usually result from thunderstorms of conventional frontal activity of convectional or orographic origin. They are usually confined to relatively small areas and are of short duration with high intensity with the greatest probability of occurrence in June or July. Precipitation in late fall, winter, and early spring generally results from the passage of a low pressure system over the basin, usually in a northeastward direction.

Occasional stagnation and stationary developments produce prolonged precipitation. The average annual snowfall over the East Lynn Lake drainage basin is about 21 inches and represents only a minor portion of the total average annual precipitation. Floods in the Twelvepole Creek Basin are of short duration, seldom remaining above flood stage for more than 24 to 36 hours unless flooding in the lower reaches is prolonged by backwater from the Ohio River.

c. Recreation. The recreation purpose can be stated as the realization of the full recreational potential for the project. This purpose was implemented by planning for a well-balanced recreational complex. Planning followed guidance contained in EM 1130-2-302 and in comments by West Virginia Division of Natural Resources, Bureau of Outdoor Recreation, Federal Water Pollution Control Administration (EPA), and U.S. Fish and Wildlife Service. East Lynn Lake was planned to supply the following activities: picnicking, hiking, camping, sightseeing, nature observance, hunting, low-speed boating, and fishing. The original basic visitation figure for recreation planning, 300,000, was quickly exceeded by the 515,000 people in 1972. Recreation sites to support these activities are listed in Table No. 2-2, page 2-11.

1. Lake. Prior to the construction of the East Lynn and Beech Fork Lake projects the Twelvepole Creek Basin did not have a sizable body of water available for full recreational utilization by the public. The area was significantly lacking in non-urban, public recreation facilities and there was an apparent need for such facilities. All East Lynn lake recreation sites were located with respect to the seasonal pool elevation of 662 feet NGVD and to utilize natural features appropriate for the desired activities. The Visitor's Center, Boat Launch, and Marina Area are accessible by automobile from relocated State Route 37 connecting with US Rt. 10 and running down the right descending side of the lake to East Lynn, Armilda, Elmwood, and Wayne, and then to US Rt. 152 north to I-64.

2. Downstream. The two original downstream recreational sites were the Tailwater Fishing Area and Laurel Creek. The Tailwater Fishing area is located downstream from the dam and provides picnicking and fisherman access. The Laurel Creek area was designed for primitive camping, but was closed because of funding. The Tailwater Fishing area is accessed by automobile from State relocated Route 37 running from East Lynn, Armilda, Elmwood to Wayne.

3. Management. The Corps of Engineers has responsibility for maintenance and management of all fee-owned land and water areas of the East Lynn Lake project, including all equipment and structures, except telephones and the marina concession. Corps personnel collect camping fees and enforce campground rules and regulations under Title 36, Code of Federal Regulations. By contract with the Wayne County Sheriff's Department, from mid-May through mid-September the Sheriff provides eight hours of area patrol daily and Sunday, to handle the more serious infractions. The Corps of Engineers proposed four lake zones that were approved by the joint commission of West Virginia Division of Natural Resources and Corps of Engineers personnel. The

four zones delineated are, Boats Prohibited, Idling-No Wake Speed, Unlimited Speed, and Hazardous Area. The West Virginia Division of Natural Resources administers state boating, fishing and hunting regulations on the project water and land areas.

d. Fish and Wildlife Conservation. Generally, the goals under this project purpose are the long-term health of populations of plants and animals native to the project area and the maximum sustained enjoyment of these populations by the public. Programs to promote fulfillment of these goals were developed in coordination with the U.S. Fish and Wildlife Service and the West Virginia Division of Natural Resources. The recommendations of these two agencies influenced fish and wildlife conservation plans put into effect at the project.

1. Fisheries. Prior to project construction fisheries in East Fork of Twelvepole Creek were of low value. The U.S. Fish and Wildlife Service conservation and development report for East Lynn Lake attributed the low value to irregular stream flows, low fertility of the water, and high turbidity. Both the USGS stream gage near East Lynn and the USGS gage at Wayne, West Virginia, are representative of the area, and both have reported very low figures of less than 1.0 cfs for 5 to 35 days during a four year study period before dam construction. The near East Lynn station reported a record low-flow of zero for an 18 day period in September 1964. These protracted low-flow conditions often lead to stagnated stream conditions. Both the Wayne and East Lynn stations were adopted as outflow and control stations, respectively, for the Twelvepole Creek Basin. Prior to construction of the dam the stream supported a small number of smallmouth bass, various sunfish, and bullhead catfish. Fisherman use of the stream above the dam site was about 240 man-days and use in the downstream reach from the dam to East Lynn averaged 100 fisherman-days per year.

Conditions in stream reaches above seasonal pool elevation have not been affected by Corps ownership; however, the Fish and Wildlife Service report a projected fisherman use of the downstream reach as 1,000 man-days per year after the project due to more stable water flows and better access. Greater use of the downstream reach after dam construction can be attributed to better access, more stable flows, both flood and drought, decreases in turbidity, increases in available food material (plankton and forage size fish lost from the pool through the intakes of the selective withdrawal system) and the presence of some catchable size game fish similarly lost from the pool into the tailwater. Because the project can be operated to stabilize flows by moderating storm impacts and because it functions to reduce turbidity downstream, the post-impoundment downstream waters provide a better habitat during most spawning periods for forage and sport species. Additionally, plankton loss from the lake provides an increase in available food material for fry during this critical period in their life cycle, which probably increases both survival and growth rates of species spawned in this area. Estimated fisherman use for the downstream fishery after completion of the project is 6,350 man-days per year.

Populations of largemouth and spotted bass, crappy, bluegill and other sunfish and channel catfish should develop in the lake by natural reproduction. West Virginia Division of Natural Resources has stocked the lake with walleye pike, channel catfish, largemouth bass, and black crappie.

Conditions in stream reaches above the seasonal pool elevation have not been affected by Corps ownership; however, the Fish and Wildlife Service report projected fisherman use on the lake to average around 16,000 fisherman-days per year. The lake fishery will be maintained and improved by the placement of fish attracters and by maintaining areas where standing timber has not been destroyed.

2. Wildlife Resources and Management. The U.S. Fish and Wildlife Service reported that principal game species in the land to be purchased for the project consist of gray and fox squirrels, cottontails, ruffed grouse, bobwhites, raccoons, and white-tailed deer. Trapping activity in the basin is insignificant. The report contained estimates that the area provided annual hunter use of 13,500 man-days for small game, and about 1,500 man/days for White-tailed deer. It is expected that hunting pressure will not change materially over the period of analysis. The low to moderate hunter use of the project area is a result of the poor habitat for wildlife. Most of the bottom lands and adjacent hillsides are cleared and were heavily grazed. General wildlife population for the East Fork of Twelve Pole Creek is shown on Table No. 2-3, page 2-11.

In November of 1983, the Department of the Army granted license to the West Virginia Division of Natural Resources to use and occupy a large block of land in the East Lynn Lake project area for fish, wildlife and forest management purposes. The license duration was for a period of twenty years.

A large number of activities take place each year at East Lynn Lake to improve the wildlife habitat and populations. During each summer, after animals have produced young and the young are old enough to maneuver for themselves, approximately 100 acres of bottom land are strip mowed and another 100 aces planted in strips to provide improved habitat and food for both game and non-game species in various stages of succession. Other management practices include, providing fields supporting highly desirable foods; managing abandoned roads for wildlife purposes; managing woodlands to provide optimum habitat for indigenous wildlife species through implementation of agriculture practices which maximize vegetative diversity; building and placing nesting boxes for waterfowl, denning mammals and various birds where it has been determined that these devices will overcome deficiencies in the existing habitat; and conducting surveys for populations of endangered species. Operations personnel also maintain established fruit trees by pruning and controlling pests and disease and generally supervise the project lands. By the fall of 1981 some 57,000 seedlings had been planted in undeveloped and barren areas for production of animal cover and browse and for reforestation. Fire trails and access roads have been laid out and improved as needed.

e. Low–Flow and Temperature Control. Purposes of the low-flow control system are to provide adequate control of volume and quality of discharged water up to the capacity of the control valves and to moderate summer flood discharges. The 30-inch control valve provide a finer outflow control than one of the 5’8” by 10’6” bottom sluice gates. This facilitates metering discharges to desired flow and thus conserves dry weather inflows for maintenance of the pool elevation for recreation interests.

The low-flow control system was designed with the understanding that the lake would be stratified during the summer, with warm, oxygenated water on the surface and colder water with very little or no oxygen on the bottom. Therefore, two gated upper level inlets were placed in the intake structure. These are 4’x 3’ gated openings with inverts at elevation 649 and 658 feet NGVD, 13 feet and 4 feet, respectively, below conservation pool elevation 662 feet NGVD. They allow withdrawal of water from any level or combination of levels, or from any combination of levels and either or both of the bottom sluices. In this manner, a wide range of temperature adjusted outflows is available to provide for the needs of the downstream aquatic environment.

At seasonal pool elevation of 662 feet NGVD there is enough water to provide an augmented flow of about 150 cfs. This upper layer of water is 15-20 degrees warmer than the bottom water, and it is well saturated with oxygen; therefore, it is a much better quality water than the bottom water, and is to be used to warm and refresh the sluice discharge of the summer releases. Exercise of the water quality factor of the low-flow control purpose largely meets the need of downstream aquatic communities for normal habitat, particularly as to temperature, dissolved oxygen and chemical sediment. (See 7-05a(2) for discussion of the potential for iron hydroxide fouling of downstream benthic habitat.) The natural water temperature for the time of year is desirable and is incorporated in the operations criteria as explained in para 7-07b.

f. Special Purposes. Within the sphere of project influence, a wide range of public needs involving water flow or stage become special purposes that are evaluated for translation into regulation. The expressed need may be for a low stage downstream to allow a search for a drowning victim, fording, or construction work; medium stage for a sporting event such as canoeing; a high stage due to an emergency in the lake area or an important construction need requiring drawdown; or any of a multitude of other situations generating a request for special operation. Emergency needs are met as quickly as possible, however, requests for deviation from normal regulation must be evaluated with respect to the hydrometeorological outlook and the other project purposes and must be coordinated with the Water Control Center in the Division Office. After evaluation and coordination, the Chief of the Water Control Section either directs regulation to answer the need or denies the request. Following the operation ORD form 1018R, Record of Deviation from Approved Plan, is used to make a report to LRD for records purposes.

2-03 PHYSICAL COMPONENTS

a. Embankment. Founded on bedrock, the dam is rockfill with an impervious core of sandy clay with scattered sandstone fragments and boulders. The upstream and downstream shells with outer slopes 1 on 2.15, were constructed of rolled sandstone from spillway excavation and quarry tailings. Each shell is separated from the impervious core by a 10-foot wide transition zone of graded, crushed stone designed as a filter. A grout curtain extends below the impervious core about 60 feet vertically into the bedrock of the valley floor and about 25 feet perpendicularly into the bedrock of the abutments. Embankment plan is shown on Plate No. 2-3 and Embankment Sections are on Plate No. 2-4.

Principal dimensions of the embankment are as follows:

Crest Length	638 feet
Maximum Height (Elev. of top - 722)	162 feet
Height above Natural Streambed	113 feet
Crest Width	32 feet
Maximum Width at Toe of Slopes	720 feet
Approximate Width at Natural Streambed	520 feet

b. Spillway. The spillway, an uncontrolled broad-crested type, was excavated in the left valley wall about 400 feet upstream from the axis of the dam. It is cut through the mainly sandstone rock and is unlined. However, it features a concrete sill constructed in and flush with the floor in order to maintain crest elevation at 701 feet NGVD in the event of scour of the floor rock. Discharge from the spillway enters a natural ravine and is returned to East Fork about one-half mile below the dam. Crest length is 230 feet and maximum width of cut is about 835 feet. Spillway plan and profile are shown on Plate No. 2-5 and Spillway sections are on Plate No. 2-6.

Storage capacity in East Lynn Lake between spillway crest elevation and summer conservation pool elevation, 65,300 acre-feet, will contain 9.2 inches of runoff from the drainage area above the dam and storage capacity between spillway and minimum pool elevation, 70,800 acre-feet, will contain 10.0 inches runoff. Regulation of this storage capacity enables the project to provide nearly complete flood protection along East Fork to the mouth and substantial protection along Twelvepole Creek below the mouth of East Fork. Project pool data are shown on Table No. 2-1, page 2-2.

c. Outlet Works. The outlet works consist of an approach channel, intake structure, tunnel transition, 13 feet diameter tunnel, stilling basin, outlet channel, and service bridge. The intake structure is a rectangular concrete dry-well, 154.5 feet high. The substructure is 52.2 feet square and houses three 5'8"x10'0" conduits, a low-flow system, a gate chamber and trash rack. A service platform seven feet above the 662 feet NGVD elevation of seasonal pool is the upper limit of the substructure. Interior dimensions are 38 feet by 22 feet. Plate No. 2-7 shows the Outlet Works Plan and Profile.

The operating chamber atop the substructure is rectangular with inside dimensions of 37 feet by 18 feet except at wall recesses and projections. This chamber contains the hydraulic operators for the 6'8"x10'6" slide gates, hydraulic control system, elevator landing, access manholes, float well clean-out, water supply clean-out, access to the valve chambers of the low-flow system, and drainage sump. Floors are provided at elevations 669.0, 682.04, 695.08, 708.54 and 722.0 feet NGVD. The low-flow system consists of two low-flow inlets, an intake well and a 30-inch bypass pipe. An isometric view of the intake structure is shown in Plate No. 2-8 and sectional plan views in Plate Nos. 2-9, 2-10, and 2-11. Selected views of the low-flow system are shown on Plate No. 2-12. Detailed layout for the Approach Channel, Outlet Tunnel, Outlet Channel, and Stilling Basin are shown on Plate Nos. 2-13, 2-14, 2-15, and 2-16.

d. Operating Machinery. Operating machinery for purposes of water control consists of control gates and associated mechanisms.

(1) Slide Gates. The three - 6’8"x10'6" high pressure slide gates are designed structurally to withstand and operate under the head of the maximum flood control pool at elevation 701 feet NGVD without exceeding normal design stresses. The gates are controlled from the operating floor at elevation 722 feet NGVD, with auxiliary controls provided in the operating chamber at elevation 636 feet NGVD. Each gate assembly consists of gate frames, gate leaf, seal strips, gate leaf stem, hoist, cylinders and pistons for hydraulic operation, gate bonnet and bonnet cover, remote leaf position indicator, semi-automatic gate hanger and accessories. A wheeled emergency bulkhead for stopping flow to either gate is of structural steel construction and is handled by the overhead service crane.

(2) Low-flow System. The low-flow intake well is located in the right side of the intake structure facing downstream and extends vertically from elevation 620.5 feet NGVD to the service platform. Water enters the well through two-4'0"x3'0" inlets with inverts at elevations 649 and 658 feet NGVD, respectively. Each inlet has a 4'6"x3'6" hydraulically operated, unseating type, slide gate for control, which is designed for operation in only fully-open or fully-closed position. The hydraulic operators for the slide gates are mounted on the service platform at elevations 669 feet NGVD and are controlled from either the operating floor or operating chamber of the intake structure. Each inlet is provided with bulkhead guides for installation of trash screens or bulkheads. Lifting, placing and servicing of the trash screens and bulkheads will be accomplished by use of a portable "A" frame and chain hoist. The inlets are located so that water can be drawn from near the surface of either permanent or seasonal pool. A 30" diameter pipe controlled by a 30" flat bottomed valve discharges water from the low-flow well into the right-hand main conduit down-stream from slide gate SR. Select views of the Low-Flow system are shown on Plate 2-12.

(3) Auxiliary Power Unit. The standby power unit consists of a diesel engine directly connected to a 30 KW alternating current generator, both mounted on a common base. The engine is water cooled

and easily started by its battery. The power is sufficient for conceivable emergency needs.

2-04 RELATED CONTROL FACILILITIES

East Lynn Lake is closely linked for control purposes with nearby Beech Fork Lake. Beech Fork Lake is much smaller than East Lynn Lake and located on Beech Fork of Twelvepole Creek about 3.7 miles above the mouth of Beech Fork, 16.4 miles above the confluence of Twelvepole Creek at Ceredo, WV, and about 2 miles southeast of the village of Lavalette, WV. During flood conditions the two reservoirs usually maintain close contact with each other in order to achieve better water control management for the Twelvepole Creek Basin and the Ohio River. For control purposes the two Twelvepole Creek flood control projects are usually assigned with the same Water Control Section Forecaster as the adjacent Big and Little Sandy River Basins.

2-05 RESERVOIR DESCRIPTION

The lake lies entirely within Wayne County, West Virginia, at the lower northern end of an elongated, irregularly shaped drainage basin which lies generally in a north-south direction. Situated in the Kanawha Section of the maturely dissected Appalachian Plateau physiographic province, the area is characterized by gentle to moderate relief, steep sided valleys, narrow flood plains on alternate sides of meandering river valleys, and a general appearance of ruggedness. The lake more than covers the flood plain over about 1/2 length of the lake up the main stem and lower tributaries; thus, in many areas the lake sides are wooded hills which rise out of the water in picturesque manner. However, open, less hilly areas suitable for camping and other recreational pursuits exist farther up many of the tributaries and on the main stem above Cove Creek.

The lake is a dendritic, elongated ellipse in shape. At seasonal elevation 662 feet NGVD it extends up East Fork 12.7 miles, has long arms up Lick Creek, Rich Creek, and Brushy Creek, and has a surface area of 1,005 acres. The reservoir controls runoff from the drainage area and provides virtual freedom from headwater flooding along East Fork below the dam and substantial protection along Twelvepole Creek.

The highway network in and adjacent to the reservoir area consists of paved macadam roads, gravel-surfaced roads, and graded dirt roads following an irregular pattern of streams, ridges, and tops of cliffs. The major access route is from I-64 crossing the mouth of Twelvepole Creek at Huntington. I-64 leads to U.S. Route 152 running south from Huntington along Twelvepole Creek to Wayne, where it intersects U.S. Route 37 which continues on south to East Lynn, the dam, and on to US Rt. 10. The state highways are under the jurisdiction of the West Virginia, Department of Highways, and the county roads are under the jurisdiction of the Fiscal Courts of Wayne County. Geographic and other general location features are shown on the Drainage Basin Map shown as Plate No. 2-1.

2-06 REAL ESTATE ACQUISITION

Since approval of the Survey Report, the dam was moved upstream 0.4 mile; land acquisition criteria were changed; and access-reduction effects reevaluated, all of which required more land acquisition. The last two factors were predominant in the increase in fee purchases to 24,821 acres (95 acres in easement). The new criteria required purchase of real estate horizontally beyond the spillway crest elevation instead of beyond conservation pool elevation.

Access reevaluation studies determined which lands were left without adequate access and where provision of such access would cost more than acquisition. In this case they were purchased. The largest block of such properties, 11,000 acres which were cutoff by the relocation of State Route 37 to the eastern side of the lake, extends to the ridge of the western divide between the dam and Milam Creek. The taking included all lands required for construction, sites designated for public use, rights-of-way for relocated highways, and the above mentioned 11,000 acres cutoff by relocation of SR 37.

In accordance with the approved plan of coal lands acquisition, the Corps acquired fee to the coal at the damsite and in areas where the merchantable coal seam outcrops below maximum flood control pool level, i.e., spillway crest elevation. Some coal lands were deprived of economical and direct transportation routes, thus increasing potential mining costs and extending indefinitely the deferred mining period. In such cases, costs of subordination approached purchase cost and it was considered to be in the best interest of the Government to acquire fee to that coal. In areas where existing primary access will remain even though subject to more frequent flooding, it was considered that extraction of the coal could be expected to occur in a normal manner. Where such conditions existed, coal lands were subordinated.

In general, all oil and gas interests in the entire area acquired were reserved and subordinated. An estimated 20 of the 38 known wells below spillway elevation were abandoned because of flooding. All other wells but two that were located in road construction were allowed to remain in operation on condition that the basic public access routes were maintained in passable condition.

2-07 RECREATION AND PUBLIC USE FACILITIES

East Lynn Lake recreational sites in operational condition in the fall of 1981 and those proposed for future development are listed in Table No. 2-2, below. Future sites will be constructed as joint funding is arranged with another governmental agency such as West Virginia Division of Natural Resources. Site locations are shown on the Plan of Development or Land Use Plan, Plate No. 2-17.

TABLE NO. 2-2

RECREATION SITES AT EAST LYNN LAKE

Name	Status
Fisherman's Access	Complete
Overlook Point	Complete
Dam Overlook	Complete
Lake Side Marina Area	Complete
Lick Creek Boat Launch	Complete
East Fork Boat Launch	Complete
East Fork Campground	Complete
Laurel Creek Primitive Camping	Discontinued

TABLE NO. 2-3

GAME SPECIES AT EAST LYNN LAKE PROJECT

Species	Present Population	Present Use
Ruffed Grouse	Low - Moderate	Low-Moderate
Eastern Cottontail	Moderate	High
Mourning Dove	Low	Moderate
Eastern Gray Squirrel	Moderate	High
Raccoon	Low-Moderate	Moderate-High
White-Tail Deer	Moderate	High
Groundhog	High	Moderate
Waterfowl	Low	Low-Moderate
Fox	High	High
Bobwhite Quail	Low-Moderate	Moderate

SECTION III - GENERAL HISTORY OF THE TWELVEPOLE CREEK BASIN

3-01 AUTHORIZATION

The East Lynn Lake project became eligible for construction by the Corps of Engineers as a unit in the comprehensive plan for flood control in the Ohio River Basin as a result of the Flood Control Act of 1962, H.R. 13273, Public Law 87-874, 87th Congress, 2nd Session. Legislative authority includes the authorizing act; the Flood Control Act of 1944, as amended; the Fish and Wildlife Coordination Act of 1958; the Forest Conservation Act as amended; the Federal Water Project Recreation Act; and, the Water Resources Planning Act. The Flood Control Act of 1962, 87th Congress, Second Session authorized East Lynn Lake on East Fork of Twelvepole Creek for flood control, general recreation, fish and wildlife enhancement, and allied purposes. The general map of the Corps of Engineers, Huntington District showing the Twelvepole Creek Basin is shown as Plate No. 1-1, and the entire Twelvepole Creek Basin is shown on Plate No. 2-1.

3-02 GENERAL BACKGROUND HISTORY

The history and development of the water resources of the Ohio River-Twelvepole Creek began even before the European explorers discovered America. Centuries later as the self-sufficient hardy settlers slowly extended up Twelvepole Creek, or came over the mountains, the strong need for food, security, protection, transportation, and future access to eastern cities for markets and imports became apparent. This led to the first trail marking, clearing, crude wagon paths, ferries, wells, forts, and rare new villages. From these early settlements and growth came the dependence and use of the surface waterways for personal, farm and city consumption, basic transportation, and primitive water power.

The new settlers or the old Indians of the Twelvepole Creek Basin did not cause the annual spring floods or fall droughts. The first damaging floods were there long before settlement, but very little record was made of these events. The first major Ohio River recorded floods were at Fort Pitt or Pittsburgh in 1762 and 1763, and Cincinnati in 1773, 1792, and 1793. The terrible floods of the previous century are recorded in old newspaper stories and military records; and were all very destructive at East Lynn, Wayne, Lavalette and Ceredo, and to agriculture and farm lands all along the valley. The floods usually came about every two or three years with the record flood in February 1861. Lesser floods came in August 1875, March 1907, March 1913, March 1917, January 1918, December 1926, March 1929, May 1932, March 1934, February 1939, January 1946, February 1948, March 1955, January 1957, May 1958, March 1963, April 1977, and November 1981.

The early leaders quickly saw the obvious need for safe water access and supply, flood protection or control, open river channels, and water resource development along the narrow floodplain of the Twelvepole Creek valley as the tiny communities grew from a wilderness. It appears that the first known settler in the upper Twelvepole Creek Basin may have been Thomas Patrick Napier, who came over the divide from the Big Sandy River near present day Fort Gay.

Water management in the Twelvepole Creek Basin played a crucial role

in economic development. As in most basins, the twin problems of excess water during floods and inadequate water supply in the summer for personal, urban, and industrial development had to be solved. Although the potential for severe flooding in the Twelvepole Creek basin had long been recognized, federal investigations made prior to the 1930's were generally concerned with improvements for commercial navigation. In the 1920's and 30's, it became even more apparent that major flooding events were basin-wide problems that could not be controlled by communities or local protection structures.

During these years the country found itself in the midst of a very severe stock market crash and worldwide economic depression and at the same time came a very severe drought. The 1930-31 record drought, one of the most severe in the basin history, nearly destroyed the basins agriculture base. These two crisis, financial shortage and water drought, were drastic, and they in turn created wide support for any organized emergency water management by any agency. Upstream farms and mines experienced severe water shortages, and the Wayne water public water system could not function during the drought. Further downstream very low streamflow contributed to pollution problems, and led to the haunting fear that water shortages might stifle the coal industry's recovery, expansion, and growth even more than the 1929-33 world economic depression. Later in 1932 the Huntington District, Corps of Engineers "308 Report" came to essentially this conclusion for any large water project in any major basin, "The total costs would far exceed local financial resources." The only apparent solution was massive Federal aid, which was not readily available.

Because of the depressed economy at the time, it appeared that extensive Federal aid for flood control, would be possible only on the Mississippi River. However, the election of a president, political party, and congress who were more receptive to proposals for public works programs and water resources development opened the door for the needed assistance. The severe droughts of 1930, 1931, and 1934; and the 1926, 1927, 1929, 1930, and 1933 floods; coupled with the national economic and financial recovery crisis; and the 1932 and 1934 elections culminated in a broader public support for Federal Public Works program, which included the adoption of a national flood control policy independent of the policy of navigation improvement. One of the early acts of the new administration in 1933 was to organize the Public Works Administration for emergency means of combating unemployment. The gradual overall economic recovery began and many people credited the increased public works programs for partially assisting the national growth and recovery.

The Ohio River Basin was first evaluated in 1933 in the "308" report (House Document No. 245, Seventy-fourth Congress, first session) with 39 reservoirs proposed in the Ohio River Basin to provide flood control for the Mississippi River. During the same congressional session, the Ohio River "308" report (House Document No. 306) presented a plan for controlling floods on the Ohio River and lower Mississippi Valley. The first report on the Twelvepole Creek Basin for flood control was submitted by the Chief of Engineers on 16 June 1933 to the Secretary of the War for transmission to congress under authority of Section 10 of the Flood Control Act of 15 May 1928. The report concluded that a flood control plan for Twelvepole Creek was not justified. It would be thirty more years before any reservoir would be authorized for construction in the Twelvepole Creek Basin.

While this was transpiring another report was submitted by the Chief of Engineers on 14 August 1935 on the Ohio River, but not published until 1936, House Document No. 306, 74th Congress, first session - the unprinted Ohio River "308 Report. This report planned for a total of 39 flood control reservoirs to be built for the Ohio River Basin and its tributaries. This report closed with an unfavorable recommendation for the East Lynn reservoir in the Twelvepole Creek Basin.

The record Ohio Valley flood of January 1937 established the need for a comprehensive plan for flood control in the Ohio River Basin including the Twelvepole Creek Basin. House Document No.1, 75th Congress, lst Session, presented a number of flood control reservoirs and local protection projects in the Ohio River Basin, but there was no recommendation for the construction of East Lynn Lake.

During 1937, basin-wide investigations were conducted to modify and enlarge the comprehensive plan for flood control in the Ohio River Basin, as set forth in the Flood Control Committee Document No. 1 which included a review of House Document 306. As a result of this review of House Document No. 306, the Ohio River Division Engineer prepared a report setting forth a revised and enlarged flood-relief plan for the Ohio River and major tributaries. This report, "Comprehensive Flood-Control Plan for the Ohio River Basin," dated 12 November 1937, had a full plan of flood control projects, but again East Lynn Reservoir was not recommended for construction.

Within a few days an unpublished report compiled by the Great Lakes and Ohio River Division Engineer recommended the addition of East Lynn Dam to the comprehensive flood control plan for the Ohio River Basin. This report was a review, addition, and amplification of the above mentioned House Flood Control Committee Document No. 1.

The record Ohio Valley flood of 1937 was not a tremendous damaging flood on Twelvepole Creek, but it was soon followed by the basin record flood of January – February 1939. Before any action was taken concerning this flood came the surprise intervention of Pearl Harbor and World War II, which postponed any further planning or reservoir construction for the duration of the war. World War II consumed all national effort and all federal money went to war plans and production. However, during the intervening war years the first preliminary plans for the Twelvepole Creek project was changed somewhat and updated.

The Corps of Engineers was requested by House Resolution adopted 13 June 1956 to review reports on Twelvepole Creek to determine whether improvement in the interest of flood control was advisable at that time. Potential reservoir sites were selected for study utilizing the following considerations: location and effectiveness with regard to areas of flood damage; physical and practical capacities with respect to drainage areas controlled; improvements in the reservoir areas which would affect project costs; and the possibilities for multiple purpose development for other uses such as water supply, pollution abatement and recreation. The Survey Report which followed was published as House Document No. 520, 87th Congress, 2nd Session, 1962. This report considered a 3-reservoir system consisting of the originally authorized East Lynn Project on East Fork, Cabwaylingo Reservoir on West Fork, and Beech Fork Reservoir on Beech Fork about

3.3 miles above its mouth.

3-03 PROJECT FORMULATION AND DESIGN

Investigation of flood control storage requirements were made with a view toward providing sufficient storage capacity to effectively control not only historic floods but also floods which might reasonably be expected to occur in the future. Stage records from 1915 to date demonstrate that flooding is not restricted to any one season but that floods may occur in any month in the year. Most flood damages in the Twelvepole Creek Basin have occurred at the Village of East Lynn on East Fork, in the residential section of Wayne located on the flood plain of the main stem and to residential and farm properties below Wayne. The reach of Twelvepole Creek between mile 10 and mile 25 is flooded by a combination of headwater and Ohio River floods, while the reach from mile 10 to the mouth is restricted to Ohio River backwater flooding. Flood damage along the Ohio River below the mouth of Twelvepole Creek was a continuing problem, the alleviation of which was to be attained only by the construction of tributary reservoirs.

As indicated by the synopsis above of Corps of Engineers flood control reports presented to Congress, regular attempts were made over a period of some 30 years to secure flood protection for the Town of East Lynn and points below. In addition to East Fork and Twelvepole Creek benefits, all the reports counted flood control benefits along the Ohio River below Twelvepole Creek and these became more decisive in economic justification as industrial development along the Ohio River continued.

The system of three reservoirs was economically justified by a benefit-to-cost ratio of 1.5 to 1; however, when the Cabwaylingo Reservoir was considered incrementally it was not economically justified because of a 0.9 to 1 benefit-to-cost ratio. Therefore, the Cabwaylingo Reservoir was dropped from consideration and the Survey Report recommended construction of the East Lynn Reservoir and authorization of the Beech Fork Reservoir. The two reservoir system was economically justified by a solid benefit-cost ratio of 1.7 to 1.

The recommended size and scope of the East Lynn Lake Project was determined by maximization, where applicable, of the net benefits of joint operation with Beech Fork Lake, the other authorized reservoir project in the Twelvepole Creek Basin. All major phases of water resources development were considered in establishing the scope of the project including flood control, water supply, water quality control, hydroelectric power, fish and wildlife enhancement, and general recreation. Federal agencies were requested to conduct studies and report their findings of the need for project features other than flood control. The Federal Water Pollution Control Administration (now EPA) stated that allocation of storage was not warranted for industrial or municipal water supply or for streamflow regulation for water quality control. The Federal Power Commission stated that provision of hydroelectric power was not warranted. The Bureau of Outdoor Recreation concurred with the Corps plan to provide facilities for a major water recreation complex at East Lynn Lake and noted the agreement of the Corps plan with the regional recreation concept of West Virginia Division of Natural Resources. Conflict between purposes

within the project was resolved by economic efficiency criteria.

As proposed in the Survey Report, the East Lynn Dam was of rolled earth fill located on the East Fork of Twelvepole Creek 1.3 miles south of the community of East Lynn and controlled a drainage area of 138 square miles. Design Memorandum No. 2, Site Selection, recommended moving the dam upstream around a bend and above the mouth of Laurel Creek with the resultant loss of five square miles of drainage area. The relocation of the damsite was recommended because the alignment of the spillway ravine would direct high velocity, turbulent spillway discharge toward the downstream toe of the dam and the valley floor adjacent to the dam; the streambed consisted of a 60-foot deep bed of alluvium materials susceptible to scour; and the reach of the valley was too short to permit the dam to be shifted a safe distance upstream in the same reach. Design Memorandum No. 2 was approved by OCE on 11 March 1964.

To retain the same amount of control in inches of runoff as had been planned in the project document, the new elevation-storage relationship resulting from the moving of the damsite and the results of the new reservoir topographic survey dictated an adjustment of pool levels. A permanent conservation pool was established at elevation 656.0 feet NGVD. A seasonal pool was established at elevation 662.0 feet NGVD during April through October to provide for recreation and fish and wildlife conservation.

The new dam location and new acquisition criteria required purchase of more land than had been foreseen in the Survey Report. In all, 24,821 acres were acquired in fee and 95 acres in easement.

A supplement to Design Memorandum No. 7, Dam, Spillway and Outlet Works, submitted in January 1966, changed the type of dam from an earth embankment founded on valley alluvium to a rockfill dam founded on bedrock. The change in type of dam required a change in spillway width from 140 feet to 230 feet, and the top elevation of the dam was lowered from 725 feet to 722 feet NGVD.

The intake structure height was decreased three feet to correspond to the change in the top of dam elevation. The spillway crest was located at elevation 701 feet NGVD.

3-04 CONSTRUCTION

Construction began in June 1965 with the contract for the outlet works which included the intake structure. The embankment was begun in July 1968 and the outlet works completed in March 1969. Spillway excavation was performed concurrently with construction of the embankment since the excavated material was largely used in the embankment and the work was included in the embankment contract. The embankment was released for beneficial use in November 1970 and all construction of that item finished in April 1971.

The relocations program began in July 1965 with relocation of State Route 37 around the embankment construction site. In all 32.0 miles of roads were abandoned and 12.70 miles relocated and constructed, including two new highway bridges. In order to provide power to all project uses and relocated uses, 28.4 miles of powerline were

abandoned and removed and 6.1 miles constructed.

Telephone service relocations included abandoning and removing 24.4 miles of telephone line and constructing 18.6 miles. Changes in the school system in Wayne County due to the project resulted in abandonment of 11 schools and the Corps of Engineers constructing two new ones. The relocations program additionally included relocating 26 cemeteries containing 1,203 graves, abandoning 19.2 miles of gas pipeline, and constructing 12.6 miles of new line. The program was complete in January 1973.

Phase I construction of recreation facilities included those for three of major areas, Lakeside marina and boat launch, Lick Creek boat launch and East Fork campground and boat launch. Work was started in December 1970. Below Dam Access, the other major recreation area, Dam Overlook and Overlook Point were included in the Building and Grounds Contract, which was started in December 1971. Work on the Phase I contract was completed in September 1973 and on the Buildings and Grounds Contract in November 1973. All the initial recreation areas were completed for public use by the landscaping which was performed under a separate contract beginning in January 1973 and being completed in December 1973. Because of high usage of the Lakeside marina and boat launch, the parking lot was enlarged by contract work which was begun in February 1974 and completed in December 1974. Additional restrooms (pre-fabricated) were provided by a contractor through the Louisville District between May and October 1976. The latest contract for initial construction of recreation facilities at East Lynn Lake included extensive development of day-use facilities in the old borrow area and expansion of the East Fork Campground. Work was begun in October 1979 and completed in June 1981.

Based on a maximum flood control elevation of 701.0 feet NGVD, flood storage allocations of 70,800 acre-feet in winter and 65,300 acre-feet in summer will control all known floods in the East Fork drainage basin. This amount of storage will limit the outflow from the Standard Project Flood to 25,000 cfs.

Requirement for a storage volume to serve as winter habitat for aquatic communities in the lake and space for accumulation of sediment is met by a minimum pool with surface elevation of 656.0 feet NGVD, a surface area of 823 acres, and a volume of 11,700 acre-feet. Area and Capacity Tables for East Lynn Lake, along with Percent of Storage Utilization Tables and Spillway Release Curves are found in Section VII.

The summary and final phase of Twelvepole Creek water resources development is that many public and private groups now use the water of Twelvepole Creek for personnel and municipal use.

The exploration, settlement, and expansion of the rugged Twelvepole Creek began both before and after the American Revolution over 200 years ago. The economic, industrial, and water resources expansion and development of the basin began immediately and continues today. The future of the Twelvepole Creek and southern West Virginia will always be linked with extensive water resources and mineral

development.

3-05 RELATED PROJECTS

As previously mentioned Beech Fork and East Lynn lakes are the only flood control projects in the Twelvepole Creek Basin. These two lakes are operated in conjunction with the six lakes in the Big Sandy River Basin and Grayson Lake in the Little Sandy Basin. These lakes are operated in such a manner that releases of stored waters from the reservoirs, with proper allowance for time of travel, will not cause stages in excess of the control stages. Gates are closed and all reservoir inflow stored for partial control of Ohio River floods when a crest stage above 50 feet at Huntington Lock 28, is forecast by the National Weather Service. Operation for reduction of Ohio River floods continues until the Ohio River at Huntington has crested and fallen 1 foot and further recession is indicated. Times of beginning and ending of reservoir operation are based on the estimated time of water travel from the various dam sites to the mouth of Twelvepole Creek. At the end of the regulation period, outflows are gradually increased to the bankfull channel capacity below the dams and maintained at that rate until the flood storage is released, or until river stages at key stations require further storage operation.

3-06 REGULATION PROBLEMS

When the East Lynn Lake project began operations, there was little or no regulation problems during the first major flood. However, additional flooding often produced flashy outflow from Laurel Creek, a small tributary stream just below the dam. This flashy outflow flooding often placed back water on the USGS outflow gage, thereby giving a false reading for dam releases. To alleviate this situation the outflow is often estimated from the gate opening, not the gage reading. Another problem arose in a private dwelling about a mile below the dam. An elderly lady had a floor furnace installed, and the contractor installed the furnace at or near the level of the maximum channel capacity level. In order to prevent additional furnace flooding and grief to the family, the Water Control Section tries to hold the winter outflow below the flood damage level in or near her floor furnace.

AUTHORIZED AND PROPOSED FLOOD CONTROL PROJECTS

(a) Lake Projects. The only previously authorized - nonfunded lake project in the Twelvepole Creek was Cabwaylingo Reservoir. This project has since been deauthorized and at the present time there are no authorized lake projects in the Twelvepole Creek Basin.

(b) Local Protection Projects. There are no currently authorized or proposed large or small local protection projects at this time in the Twelvepole Creek Basin. Local protection or channel improvement projects have been studied and built at Ceredo and Kenova.

(c) Future Studies. Future studies of the Twelvepole Creek include the possibility that the basin will be reviewed on a regular basis for possible water resources and recreational development. The Corps of Engineers has made or contracted flood plain studies for many counties in the State of West Virginia and Virginia and the basin. These include Flood Insurance Studies, Frequency Profile Studies, Inundation layouts, and Dam Break studies. The future of the Twelvepole Creek Basin will hopefully be improved by the FEMA or Flood Plain Protection Program.

The source of the personal water in the Twelvepole Creek Basin is largely surface. The largest consumer unit is the city of Wayne, which is supplied by the upper forks of Twelvepole Creek and East Lynn Lake. The water supply plant for the city of Wayne produces 0.5 mgd for water consumption. This very basic need for municipal water supply (80GPD per person) is expected to increase somewhat to .7 mgd by the end of the century. The combined effort of safe water treatment and sewerage treatment plants has reduced the number of deaths from Typhoid fever remarkably. There is little need for irrigation projects within the watershed; precipitation is marginally adequate for agricultural demands. However, there is still a need for additional water supply during a dry summer for optimum crop growth in the watershed.

In addition all of the counties in the Twelvepole Basin have participated in the Department of Housing and Urban Development (HUD) Flood Plain Insurance Study program for unincorporated areas. The counties of Cabell, Wayne, Lincoln, Logan, Boone, Mingo, Wyoming, and Raleigh have requested that all of the major streams be studied and mapped on a detailed basis for profiles, frequencies, and floodways; and the smaller streams on an approximate basis. Furthermore, all of the incorporated cities and villages have participated in the program.

SECTION IV - WATERSHED CHARACTERISTICS

4-01 LOCATION AND GENERAL CHARACTERISTICS

The Twelvepole Creek Basin lies in southwestern West Virginia within the Counties of Cabell, Wayne, Lincoln and Mingo. East Fork of Twelvepole Creek lies in the southeastern portion of the Twelvepole Creek Basin in Wayne and Mingo Counties and drains 172 square miles. The basin is quiet elongated and irregular in shape; about 30 miles long with a maximum width of 9 miles; with its major axis in a general northwest-southeast direction. The lake itself lies entirely within Wayne County, West Virginia, at the lower northern end of an elongated, irregularly shaped drainage basin which lies generally in a north-south direction. The reservoir controls runoff from the drainage area and provides virtual freedom from headwater flooding along East Fork below the dam and substantial protection along Twelvepole Creek.

The lake is a dendritic, elongated ellipse in shape. At seasonal elevation 662 feet NGVD it extends up East Fork 12.7 miles, has long arms up Lick Creek, Rich Creek, and Brushy Creek, and has a surface area of 1,005 acres. The lake more than covers the flood plain over about 1/2 length of the lake up the main stem and lower tributaries; thus, in many areas the lake sides are wooded hills which rise out of the water in picturesque manner. However, open, less hilly areas suitable for camping and other recreational pursuits exist farther up many of the tributaries and on the main stem above Cove Creek. Project details appear in Supplementary Pertinent Data, Plate No.2-17.

East Fork of Twelvepole Creek rises about 8 miles northwest of Logan, West Virginia, and flows about 50 stream miles to join with West Fork near Wayne to form Twelvepole Creek. It has a drainage area of 172 square miles of hilly to mountainous terrain. The stream valley ranges from little more than stream width at the source to about 2,600 feet at the mouth or forks, averaging about 500 feet in width. The stream width ranges from just a few feet at the source to about 40 feet at the mouth, where the stream banks are about 10 to 15 feet high. Elevations range from 1,260 feet, above NGVD, in the headwaters to 585 feet NGVD at the forks. Twelvepole Creek is formed by the junction of East and West Forks about 0.8 mile south of the Town of Wayne from where it flows in a northerly direction for 31.7 miles to its confluence with the Ohio River between Ceredo and Huntington, 313.3 miles below Pittsburgh, Pennsylvania. Channel widths range from about 40 feet at the junction of the forks above Wayne to about 50 feet at the mouth. The valley width averages 1,500 feet from the junction above Wayne to about Mile 13 where it narrows to an average of 600 feet from there to the Route 60 bridge, here it widens sharply to about 4000 feet. Flows at the USGS gage at Wayne, 29.2 miles above the mouth, have varied from 0.1 to 22,700 cubic feet per second with an average runoff of about one cubic foot per second per square mile of drainage area. Drainage areas for East Fork of Twelvepole Creek and the principal tributaries are listed on the next page in Table No. 4-1. The East Lynn area map is shown on Plate No. 4-1, and Streambed

profiles of East Fork of Twelvepole Creek and the principal tributaries are shown on Plate No. 4-2.

4-02 TOPOGRAPHY

The East Lynn watershed lies within the maturely dissected Appalachian Plateau of the Kanawha physiographic province. This physical section is characterized by a mature plateau of fine texture with moderate to strong relief. Numerous hills and ridges ranging in elevation from 800 to 1500 feet NGVD are capped with near level resistant rock strata which manifests an ancient plateau. The older streams are entrenched from 400 to 450 feet below the plateau level and meander in narrow valleys between moderately steep walls. The flood plains are represented by narrow alluvial strips on alternate sides of meandering streams at several levels. The two upper tributaries, East Fork and West Fork, have similar characteristics as to length and steepness both being about 50 miles long and having a fall of 13.5 feet per mile and 13.0 feet per mile respectively.

TABLE NO. 4-1

DRAINAGE AREAS OF EAST FORK OF TWELVEPOLE CREEK
AND PRINCIPAL TRIBUTARIES OF TWELVEPOLE CREEK

Stream	Location	Stream (Miles)	Drainage Area Sq. Mi.
East Fork	at Eloise(DUNM4Gage)	28.0	38.52
East Fork	above mouth of Kiah Cr	22.5	54.42
Kiah Creek	at Mouth	0.0	30.93
East Fork	above mouth of Cove Cr	18.7	87.68
Cove Creek	at mouth	0.0	6.51
East Fork	above mouth of Rich Cr	14.5	101.14
Rich Creek	at mouth	0.0	10.92
East Fork	above mouth of Lick Cr	13.2	113.18
Lick Creek	at mouth	0.0	11.69
East Fork	at dam site	10.4	133.1
East Fork	at mouth	0.0	171.9
West Fork	at mouth	0.0	114.8
Twelvepole Creek	at Forks	31.7	286.7
Twelvepole Creek	at Wayne	30.8	300.4
Beech Fork	at Dam	3.7	79.0
Beech Fork	at mouth	0.0	83.2
Twelvepole Creek	at Beech Fork	12.7	401.5
Twelvepole Creek	at Mouth	0.0	442.3

4-03 GEOLOGY AND SOILS

The East Lynn Basin is underlain by sedimentary strata of Pennsylvanian age. Sedimentation took place upon a broad, constantly subsiding basin and great thickness of shallow water sediments were accumulated. The bedrock in descending geologic order consists of 3 series, the Conemaugh, Allegheny, and Pottsville which are conformable, lying upon one another in parallel order.

The Conemaugh Series constitutes bedrock in the basin's ridges above approximate elevation 850 and is underlain by 225 to 350 feet of rock comprising the Allegheny Series. Beneath the Allegheny Series, the Pottsville Series varies in thickness from 250 to 2000 feet. The three series consist of a monotonous succession of sandstone, shale, and coals with an occasional thin limestone stratum. The coal beds included in these strata range from the Waynesburg through the Pocahontas seams and represent most of the mineable coal in the State, although of relative unimportance in the Twelvepole Creek Basin.

The principal structural feature of the Southern Appalachian area is the Pittsburgh Basin, a part of the Appalachian Geosyncline, extending from southwestern Pennsylvania to southwestern West Virginia and into Kentucky. Great thicknesses of shallow-water and marine sediments were deposited in this basin. At the close of the Paleozoic Era, horizontal pressures originating from the Appalachian Mountains orogenic activity were exerted on the basin sediments and formed gentle anticline-syncline folded topography, striking from the northeast to the southwest quadrant. These folds are expressed in the East Lynn area as the Parkersburg Syncline, the Doane Anticline and the Queens Ridge Syncline. The East Lynn dam is located on the western limb of the Doane Anticline and the rock strata at the dam dip 1° south, 45° west, or 92 feet per mile upstream. No faulting is known to occur in the area.

Observation of rock outcrops in the basin show that sandstone and shale vary widely in resistance to weathering. The sandstones are generally very resistant; the Lower Freeport, East Lynn, and Homewood sandstone form prominent bluffs in certain areas. The shale invariably weather rapidly on exposure, especially where they are not sandy or interbedded with siltstone and sandstone laminations. Differential weathering occurs when sandstone and pure shale are in contact, with the shale often undermining the overlying sandstone.

The valley slopes are steep throughout the lake area above the flood plain; the overburden cover on the slopes averages 3 to 10 feet. Erosion of the weathered rocks keeps pace with disintegration by weathering so that thick accumulations of residual soils do not exist.

The U.S. Soil Conservation Service mapped the soils at East Lynn Lake identifying and characterizing specific soil types. The soils developed in old stream deposits washed from soils that were developed on acid shale, siltstone and sandstone. Surface materials were characterized as fine and either sandy or silty loam, while all but two had less permeable sub-soils characterized as clay loam or clay.

Nearly all soils were rated as "good" to "excellent" for growing trees and farming, if drainage is supplied where not natural. In a comprehensive grouping of the soils of the entire drainage basin, the Soil Conservation Service places them in the "Gilpin-Upshur" series which has a fairly high clay or silt content.

4-04 EROSION AND SEDIMENT YIELD

Most of the upper Twelvepole Creek Basin is wooded and consists largely of second-growth timber. Only a small portion, approximately 10% of the basin, is cultivated or cleared for urban development. The East Lynn Lake project is located within productive coal and natural gas fields.

Data prepared by the Soil Conservation Service indicates that large areas of Twelvepole Creek Basin have experienced severe erosion such that topsoil is almost non-existent in many areas. Much of the area has been burnt over, farmed and allowed to revert to forest and that approximately 90% of the basin is covered by forest. The Soil Conservation Service erosion map shows that the Kiah Creek Section has sustained "moderate" erosion and the next section to the south about half and half "moderate" and "severe" erosion with some small areas shown as "slight."

The U.S. Geological Survey in April 1979 began a 3-year study of chemical and physical characteristics of the runoff from Twelvepole Creek Basin including suspended sediment. The two major inflows to East Lynn Lake, East Fork and Kiah Creek and 3 stations on West Fork are included from the upper part of the basin. Since discharge is one of the parameters, study results will provide base line information from which to observe and understand changes.

Ever increasing energy needs and increasing emphasis on coal production to fill those needs point toward future mining in the basin. The character and effect of scrutiny of mining applications and operations by relevant authorities will affect quantities of sediment entering streams from this source and thence, the Corps lakes in the basin.

4-05 WATER QUALITY

East Lynn Lake is dendritic in shape with an elongated irregularly shaped drainage basin. This shape gives an average hydraulic residence time through the lake of approximately 42 days based on summer pool elevation of 662-feet NGVD. This could be as long as a year during time of low-flow and as short as a day during times of high flow.

During the majority of the recreation season, the lake is stratified with warmer, oxygenated water in the upper levels (epilimnion) and colder water, devoid of oxygen in the lower levels (hypolimnion). Iron and manganese levels in the hypolimnion are present at high concentrations due to the anoxic conditions and existing watershed

problems. In terms of major ions and descriptive parameters, inflow water at East Lynn Lake is characteristic of the predominately non-calcareous nature of the watershed. Specific conductance, alkalinity, and hardness are all low. As examples: the water is classified as soft (Durfor and Becker, 1964), has low concentrations of dissolved materials, and has little inherent capacity to resist shifts in pH. Taken together, these facts indicate that the water is very delicately poised with respect to quality changes and is especially susceptible to suspended solid and pH problems.

The major industry in the basin is coal mining. Others include extraction of gas and oil, timbering, and farming. Although unproven coal seams underlie the lake area, coal production was unimportant before 1978. In early 1979 a large deep mine began operation 2-3 miles from the town of East Lynn with an anticipated production of 2 million tons per year.

Water quality data collected by the Corps of Engineers from 1973 to 1999 indicated that water quality in the basin reflects the watershed conditions.

4-06 CLIMATE

a. General. The climate of the East Lynn Basin is temperate and includes the usual seasonal variations in temperature. The entire basin is affected by frontal air-mass activity, and is subject to both continental polar and maritime tropical air-masses. Frequent and rapid changes in weather occur due to the passage of fronts associated with general low-pressure areas. The prevailing wind direction is from the southwest.

b. Temperature. One station located within the basin, Cabwaylingo State Forest, had 13 years of temperature records until it was discontinued in 1961. However, Huntington, adjacent to the basin, has records extending 90 years to the present. Temperature has varied at Huntington from -24°F in February 1899 to 108°F in July 1930. The mean annual temperature for the entire basin is about 55 degrees. The growing season, or the period between the last killing frost of spring to the first killing frost of autumn, averages six months, usually from mid-April to mid-October. The latter portion of the Huntington record is at Huntington Airport, which is within the basin and slightly closer to the basin projects. This portion is included in the Temperature and Precipitation Summary Tables for Twelvepole Creek Basin presented as Table No. 4-2 and Table No. 4-3, in Table Section.

c. Precipitation. The normal annual precipitation over the basin averages approximately 43.5 inches. The Twelvepole Creek Basin is drained by a direct tributary to the Ohio River, and extends generally north and south. Consequently, the basin lies in the normal path of major storms in this area. Meteorological conditions likely to produce major flooding in the basin develop into two types: the summer-type confined to the period of the year from late May to early November, with the greatest probability of occurrence during June or

July; and the late winter or early spring type, most likely to occur during March or April. Summer rains usually result from thunderstorms of conventional frontal activity of convectional or orographic origin. They are usually confined to relatively small areas and are of short duration with high intensity rates. The late winter or early spring storm is different from the summer-type storm, due to its lower and more evenly distributed rainfall over a greater area. Consistent precipitation in the late fall, winter and early spring generally results from the passage of a low-pressure system over the basin. Occasional stagnation and stationary development produce prolonged precipitation. The direction of travel of the storm system is usually north-eastward. A comparison of area precipitation and natural flows at the East Lynn project during the March 1967 flood and that of July 1980 illustrates a major difference between effects of winter and summer storms.

TABLE NO. 4-4

TWELVEPOLE CREEK AREA PRECIPITATION
DURING MARCH 1967 AND JULY 1980

STATION	March 1967				R.F.	July 1980				R.F.
Tri-State	4	5	6	7	Total	8	9	10	11	Total
Airport	T	1.40	2.54	0.23	4.17	0.54	T	2.94	-	3.48
Dunlow	0.05	0.10	1.95	0.18	2.23	-	0.72	1.12	0.58	2.42
Hamlin	T	-	1.83	2.00	3.83	-	0.83	1.03	1.30	3.16
Branchland	-	-	2.13	2.05	4.18	-	0.68	2.02	1.02	3.72
			East Lynn Lake			-	1.75	1.69	2.74	6.18
			Beech Fork Lake			-	0.72	2.42	0.75	3.89

Table No. 4-4 previous page, contains rainfall amounts recorded by the four area weather stations reporting during both events and that recorded at the two projects in July 1980. Natural flows computed for East Lynn Lake as produced by the two sequences of rainfall are included in Table No. 4-5 below, which is followed by discussion of the events.

Total rainfall reported at the four area stations is not radically lower for the 1980 event than in 1967. Also, the rainfall recorded at the projects indicates the possibility of other higher, unrecorded, rainfall amounts in the two drainage basins during the latter event. In March 1967 a widespread, relatively warm rain fell on snow covering the upper 2/3 of the Ohio River Basin. This augmented the runoff over frozen soil and produced the 61 foot Ohio River stage at Ashland, KY. Some of the 1967 rain fell rapidly, 0.83 inch between 0300 and 0600 on 6 March at Griffithsville, WV and 1.13 inches between 0700 and 1000 at Huntington Airport on 5 March.

However, these values are dwarfed by the 2.42 inches recorded in 4 hours at Beech Fork Lake on 10 July 1980 and the 1.69 inches during the same period at East Lynn Lake. These heavy rains falling on summer vegetation and receptive soil produced the comparatively flashy

natural hydrograph at East Lynn Lake given in Table No. 4-5 below, showing the peak 6-hour average value of 3,870 cfs in 1980 while the corresponding value was 1,113 cfs for Beech Fork Lake in 1980.

TABLE NO. 4-5

NATURAL FLOWS AT EAST LYNN LAKE CAUSED BY RAINFALL OF TABLE NO. 4-4

March 1967 Natural flows - cfs			July 1980 Natural flows - cfs.		
Date	Time	East Lynn	Date	Time	East Lynn
6	0730	2725	9	1930	270
	1330	3745		0130	431
	1930	4400	10	0730	601
	0130	5900		1330	1565
7	0730	6200		1930	3870
	1330	6400		0130	3295
	1930	6100	11	0730	1631
	0130	5600		1330	826
8	0730	4600		1930	486
	1330	3775		0130	330
	1930	2500	12	0730	258
	0130	1962		1330	356
9	0730	1730		1930	757

This runoff is contrasted with the 6400 cfs peak 6-hour average of the broader natural hydrograph in Table No. 4-5 above, for East Lynn Lake during the 1967 event and the corresponding value of 2,570 cfs at Beech Fork Lake for the same year.

Meteorological studies indicate that the summer-type storm has possibilities of producing the maximum flood. However, meteorological records show that winter and spring storms occur more frequently and produce more major floods than those which occur during the summer and fall months. Average annual snowfall over the basin is about 20 inches, but represents only a minor portion of the total annual precipitation. Average monthly and annual snowfall data are listed in Table No. 4-3, in Table section.

d. Evaporation and Wind. Evaporation losses occurring at East Lynn Lake were calculated from Technical Paper No. 37, published by the National Weather Service from data obtained jointly by the Weather Service, Corps of Engineers and other organizations. The evaporation record at Clarksburg for May through October 1930 was used to determine hypothetical maximum seasonal loss. Records at Dewey Lake and Buckhorn Lake in Eastern Kentucky were used to determine average values for monthly, seasonal, and annual evaporation losses from the lake which are shown below in Lake Evaporation Losses - Summary, Table No. 4-6, next page.

Annual average wind direction over the Twelvepole Creek Basin is southwesterly. Southerly winds, however, prevail from July through October; change to southwesterly during November and December; and become near-westerly in January and February. The direction then gradually becomes, and remains, southwesterly during March, April, May and June. During the seasonal period of maximum evaporation, the lowest monthly average wind speed, 4 mph, occurs in August and the highest, 7 mph in May.*

TABLE No. 4-6

LAKE EVAPORATION LOSSES - SUMMARY

Maximum Seasonal Evaporation (1930) - inches (1) 26.0
Average Annual Evaporation - inches (1) 27.4
Average Seasonal Evaporation (May-Oct) - inches (1) 20.0

	Average monthly evaporation losses	
Month	Inches (1)	Ac-ft (2)
May	3.55	297
June	3.90	327
July	4.21	353
August	3.66	307
September	2.72	228
October	1.98	166
Seasonal total	20.02	1678

(1) Vertical distance
(2) 1 inch loss from seasonal pool surface area (elevation 662.0) = 83.8 acre-feet.

*Information on wind direction and speed is taken from "Climatic Atlas of the United States," June 1968, published by Environmental Science Services Administration of the US Department of Commerce.

4-07 STORMS AND FLOODS

a. General. Flood occurrences are not limited to any month, although winter and spring floods are more frequent. Summer-type storms have occurred over the basin, producing local floods without affecting adjacent areas. The upper portion of Twelvepole Creek Basin is subject to headwater floods, whereas the lower portion is subject to backwater from Ohio River floods as well as headwater floods or a combination of both. Ohio River floods, which inundate lands as far as 23 miles upstream from the mouth of Twelvepole Creek, are usually caused by the more wide spread, winter-type storms which occur between December and April. Winter storms are generally of longer duration, lasting up to three weeks.

The topography of the basin, consisting of winding, narrow-crested ridges and deep narrow valleys, is conducive to rapid concentration of runoff, resulting in fast rises of the stream. Floods on Twelvepole Creek are of short duration, seldom remaining above flood stage for

more than 24 to 36 hours, unless flooding in the lower reaches is prolonged by backwater from the Ohio River.

Table No. 4-7 below, shows the degree of backwater effect of the largest Ohio River floods beginning with January 1937 according to the LRD adopted frequency profiles.

TABLE No. 4-7
OHIO RIVER BACKWATER EFFECTS ON TWELVEPOLE CREEK

Flood Date	Peak Stage Lock 28 Feet	Elevation at mouth Feet, NGVD	Distance (Back Water) Miles	Frequency (Period-Years) Natural	Modified
January 1937	69.5	558.9	25.1	700	68.0
January 1943	60.1	549.7	21.5	71	8.2
April 1948	61.6	550.9	22.2	82	11.4
May 1958	55.3	544.8	20.0	14.3	4.0
February 1962	56.0	545.5	20.3	17.0	4.4
March 1967	56.4	545.9	20.4	18.8	4.7
December 1978	54.0	543.8	19.6	10.5	3.3
February 1979	53.8	543.5	19.5	10.0	3.2

The flooding characteristics of the basin is described by the list of highest annual floods for water years 1925 through 1997 in Table No. 4-8 page 4-11, Twelvepole Creek at Wayne, West Virginia, High Water Data. For clarity, water year has been changed to calendar year where appropriate. In December 1966 the Wayne gage was moved to a location below town near the high school. In order that flows and stages be comparable, flows occurring before December 1966 have been adjusted to the larger drainage area and applied to USGS Rating No. 09 of the new gage. Stages after the gage was moved, but before regulation of the lake, are recorded peaks and were applied to ratings current at time of occurrence for flows given. Flow after beginning regulation in March 1972 are computed naturals and were applied to ratings relevant to time of occurrence for stages shown.

b. Storm and Flood of June 1928. The flood of 30 June 1928 is the fourth highest of record on Twelvepole Creek at Wayne and was about equal to or slightly higher than the flood of February 1939 in the upper and lower reaches. Flooding was caused by heavy rainfall over the watershed, especially in the upper portion where the stream gradients are very steep. Previous to the main storm on 28-29 June, almost daily shower activity had thoroughly saturated the soil, greatly increasing the runoff possibilities. Rainfall at Wayne measured 2.94 inches for the 48-hour period. South of the basin, Logan measured 3.67 inches and Kermit measured 5.60 inches for the same period.

From extension of USGS Rating No. 9 printed June 3, 1981 principal damage in the basin occurred in the narrow and tortuous valley of East Fork between Wayne and Stiltner, West Virginia. The area is sparsely

populated with mountain farmers and coal miners and there were no lives lost or people injured. The damage between Wayne and the mouth of Twelvepole Creek was slight except in the low portion of the town of Wayne where considerable damage resulted. The maximum stage during the 1928 flood at Wayne was 28.3 feet on the then existing gage and corresponded to a stream discharge of 14,000 cfs, as estimated by the United States Geological Survey. This is equivalent to 14,430 cfs and 31.8 feet at the current gage site.

c. Storm and Flood of January-February 1939. The flood of January-February 1939 was the greatest flood of record in the Twelvepole Creek Basin. The flood was caused by two distinct storms. On 29 January, the first storm released approximately 1.5 inches of rainfall over the basin which saturated the soil and caused the streams to rise. The second storm occurred during the period of 1-3 February and resulted in rainfall averaging approximately 4.0 inches occurring over the basin above East Lynn dam site. The rainfall gage at Wayne measured 2.84 inches and heavier amounts probably fell at upstream points. This was the most destructive flood known to have occurred in Twelvepole Creek Basin. The flood reached a crest stage of 31.0 feet at Wayne with an estimated discharge of 22,000 cfs. Transposed to the new gage below Wayne, these values would be 39.9 feet (according to extension of rating No. 9) and 22,660 cfs.

d. Storm and Flood of April-May 1958. Two periods of moderate to heavy rainfall over Ohio and West Virginia portions of the Ohio River Basin caused this flood. Light to moderate rain over most of the area from 20-24 April moistened the soil thus setting up conditions for flooding from later rainfall. The first storm, with moderate to heavy rainfall released 1.0-2.2 inches in Ohio and 2.0-3.5 inches in West Virginia. Branchland measured 3.0 inches, Cabwaylingo State Forest, 2.6 inches, and Huntington, 2.8 inches in this period. Light rain in West Virginia kept the soil moist between the storms. The second storm, beginning 3 May in Ohio and 4 May in West Virginia, released 2-4 inches over the area. Branchland measured 3.3 inches, Cabwaylingo State Forest, 3.7 inches and Huntington, 3.6 inches. Twelvepole Creek at Wayne crested at 18.8 feet early on 29 April and at 19.4 feet mid-morning on 8 May. These stages transposed to the new gage below Wayne would be 22.6 feet and 23.3 feet respectively. The Ohio River at Ashland crested below flood stage on 1 May and at 59.0 feet on 9 May.

e. Storm and Flood of February 1962. The flood of February 1962 is the third largest flood of record on Twelvepole Creek at Wayne. The storm moved into the Ohio Valley during the night of 25 February causing heavy general rains. As the storm moved to a position south of the Ohio River and over the Twelvepole Creek Basin, wave action developed along the cold front. Excessive downpours occurred in thunderstorms during the night of 26 February and continued through 27 February, ending on 28 February.

TABLE NO. 4-8

TWELVEPOLE CREEK AT WAYNE, WEST VIRGINIA HIGH WATER DATA

Date	*Gage Height-Feet	*Discharge-cfs
2 Feb 1939	39.9	22660
9 Dec 1978	39.1	#21800
22 Feb 1962	33.5	16330
30 Jun 1928	31.8	14420
30 Dec 1942	31.6	14100
2 Feb 1951	30.9	13400
5 Mar 1955	29.8	12370
1 Feb 1950	29.7	12260
12 Mar 1935	29.7	12250
11 Jan 1974	29.6	#12120
5 Apr 1977	29.5	#12060
26 Jan 1978	28.4	#10990
28 Nov 1973	28.1	#11100
26 Feb 1972	28.2	#10800
30 Jan 1932	27.7	10400
14 Apr 1948	27.6	10300
23 Mar 1952	27.6	10300
8 Mar 1967	27.6	10300
4 Mar 1997	27.3	#10000
29 Mar 1975	26.6	#9450
22 Jan 1926	26.4	9280
19 Mar 1933	25.7	8780
14 Mar 1956	25.6	8700
8 Jan 1946	25.3	8530
13 Mar 1968	25.0	8400
21 Mar 1976	24.5	#7990
22 Dec 1926	24.4	7940
27 Dec 1928	24.4	7920
14 Dec 1956	23.7	7500
6 Apr 1936	23.5	7420
24 Aug 1942	23.4	7370
28 Mar 1965	23.4	7340
8 May 1958	23.3	7250
31 Dec 1969	23.1	7140
12 Aug 1938	23.0	7100
12 Apr 1944	22.9	7060
13 Mar 1963	21.9	6460
2 Feb 1945	21.4	6290
12 May 1925	21.3	6140
15 Jul 1961	20.8	5920
19 May 1995	19.9	#5470
18 Oct 1929	19.7	5340
23 Jan 1937	19.6	5300
6 Feb 1971	19.5	5250
31 Mar 1940	18.6	4800
20 Apr 1964	18.3	4630
4 Mar 1934	17.7	4380
16 Feb 1949	17.4	4250
1 May 1966	16.9	4050
23 Apr 1931	16.2	3800
21 Jan 1947	15.7	3590
8 Jan 1953	15.5	3500
19 Apr 1969	14.1	3000
13 Apr 1959	13.8	2890
26 Feb 1960	12.6	2450

* Natural Flows

computed flows

Twenty-four hour rainfall amounts over Twelvepole Creek Basin approached 3 inches. During the period 25-26 February, Logan measured 3.75 inches; Branchland, 4.41 inches; Hamlin, 4.03 inches; Huntington, 3.36 inches; and Louisa, KY, 4.43 inches. Twelvepole Creek at Wayne reached a crest stage of 29.46 feet with a corresponding crest flow of 15,900 cfs. Transposed to the new gage, these values would be 33.6 feet and 13,330 cfs. Runoff from the drainage area above Wayne was approximately 3.9 inches.

f. Storm and Flood of March 1967. Two different kinds of weather patterns caused this flood which was, more correctly, two floods 8 days apart. Moderate to heavy rains melted snow lying on frozen ground and the runoff caused general flooding of tributaries and main stem Ohio River. Preceded by a warming trend of 3 March, 2.0-3.5 inches of rain fell over eastern and southeastern Ohio on 4 and 5 March and turned into snow on 6 and 7 March. From 2.0 to 4.5 inches, mostly rain, fell in the Ohio River Basin areas of West Virginia during the period. Griffithsville, WV, about 20 miles northeast of the East Lynn dam site, measured 3.4 inches, Logan, 2.6 inches and Huntington Airport, 4.2 inches.

Twelvepole Creek at Wayne crested at 27.6 feet at 0310 8 March and the Ohio River at Ashland crested above 61 feet on 9 March. During the night of 13-14 March, thunderstorms in the Ohio River Basin portions of Ohio and West Virginia, changing to moderate and heavy rain on 14 and 15 March, then to snow on 16 and 17 March, caused local flooding and slight flooding on the Ohio River. Griffithsville, WV, measured 2.6 inches, Logan, 1.4 inches and Huntington Airport, 2.1 inches over the period 13-17 March. Twelvepole Creek at Wayne rose to a broad crest at 18.2 feet about 2300 hours on 15 March. The Ohio River crested above 54 feet at Ashland on 17 March.

g. Flood of April 1977. Runoff causing the flood of April 1977 came from a series of disturbances that moved across the Twelve Pole Creek Basin beginning late in March with 0.60 inches of rainfall on 30 March. Rain was intermittent through the evening of 2 April with about 0.5 inches falling, then began in earnest and accumulated more than 2.55 inches at the dam site before tapering off on 5 April. The project was in operation near winter pool or elevation 658 feet NGVD; therefore, the slide gates were closed at the beginning of the flood. Twelvepole Creek at Wayne crested at 18.7 feet around 0400 hours on 5 April and the morning report (0800 hours) indicated local flooding at Wayne and in Lavalette. The outflow gage had read 2.8 feet, but the gate reductions produced very little change. The only conclusion was that the outflow gage was being affected by backwater from Laurel Creek. Thus, even though the outflow gage showed no change, the gate discharge based on the rating curves decreased from approximately 240 cfs to around 40 cfs. This flood caused the pool level to rise from elevation 658.0 feet NGVD to about 673.0 feet NGVD. By 14 April the pool gradually reduced to normal summer pool, elevation 662.0 feet NGVD. The summer pool was acquired on the recession of the flood.

The computed natural flow at the dam site peaked at nearly 8,300 cfs on 5 April at about 0200 hours and would have produced a stage of about 30.0 feet on the outflow gage. The computed peak natural flow at the Wayne gage was about 12,060 cfs with a modified recorded crest of about 4,860 cfs. Reduction due to the operation of East Lynn Lake was around 17 feet on the outflow gage, and about 10.8 feet at Wayne.

h. Storm and Flood of December 1978. The early storm causing this flood began on 3 and 4 December with about 2.15 inches of rainfall above the East Lynn Dam which caused all streams and lake inflow to rise. Three days later on 7 December the main storm struck the basin with heavy rains beginning at 1000 hours at both projects. East Lynn Lake recorded 5.82 inches for the two days fall and Beach Fork Lake, had 4.75 inches over the same period. These amounts and the approximate seven inches reported in the West Fork Basin would have produced a near record crest of 39.1 feet for Twelvepole Creek at Wayne, but the operation of East Lynn Dam in its first big flood reduced the flood crest about 11.2 feet. The East Lynn pool crested on 12 December at elevation 684.52 feet NGVD; utilizing about 48.1 percent of the available flood storage.

i. Storm and Flood of January 1979. The flood of January 1979 came on the heels of the extremely damaging storm and flood that occurred in December 1978. The light intermittent winter rain began over the New Years holiday and accumulated nearly 3.0 inches by 15 January. More rain began falling around 2300 hours on 19 January and ended 5 days later with an accumulation at the project of 3.81 inches at East Lynn Lake. East Lynn Lake had a computed natural crest of 4,300 cfs on 21 January, the pool crest came on 22 January afternoon at about 667.0 feet, and a maximum outflow of about 2,100 cfs 26 January. East Lynn Lake was operated to reduce flooding at Wayne and on down Twelvepole Creek. The accumulated storage was released at below channel capacity rate to provide a slow drawdown requested by the Geotechnical Branch.

j. Storm and Flood of March 1997. The month of February preceding the storm of March 1997 was a very dry month, with only 0.57 inches of rainfall in the last half, or 14 days of the month. Therefore, there was no antecedent rainfall to saturate the ground. The extra heavy storm was able to do this and more. There was very heavy rainfall every day for a 7-day storm of about 7.0 inches of rain with over 6 inches of runoff, and even heavier rainfall below the dam and Wayne. The major storm began about midnight on 1 March with 4.45 inches of rainfall, followed the next 3 days with .68, .49, and .54 additional inches of rainfall. Then came three more days of .33, .24, and .15 inches of lighter rain. When runoff began from the heavy rains early on 1 March, the lake level was at elevation 656.35 feet NGVD at 0730 hours and was being held there for the winter flood season. The lake level began to rise that morning, and on through the afternoon and night as the inflow increased rapidly above the channel capacity discharge. The project was already closed to the near minimum flow because of maintaining the winter conservation pool.

The East Lynn Lake level crested at 684.55 feet NGVD the pool of record, storing 48,634 acre-feet of flood water, equivalent to about 52 percent storage utilization. Table No. 4-8, page 4-11, shows the natural and modified computed crests of Twelvepole Creek at Wayne to the regulation by East Lynn Lake.

4-08 RUNOFF CHARACTERISTICS

The headwater portion of the East Lynn Basin is characterized by narrow valleys with steeply sloping sides. Runoff from these slopes is flashy and tends to collect rapidly in the stream channels causing rapid fluctuation of stream stages. Infiltration losses are generally low due to the relatively shallow depth of soil of high clay content. Large areas have been subject to such severe erosion that topsoil is nearly non-existent. Basin runoff is highest during the winter months when storm rainfall may be augmented by snow melt and when frozen or saturated ground results in low infiltration rates. Runoff is lowest during the late summer and early fall when the ground is dry and infiltration rates are high. However, precipitation during these months may be quite heavy from strong summer thunderstorms of sufficient intensity to more than compensate for the seasonal increase in infiltration. Consequently, the critical season for major flooding occurrences in this area is the summer season (July through September). Table No. 4-9, next page, presents average normal, maximum and minimum monthly runoff from the watershed upstream from East Lynn damsite, based on observed records from USGS gages; 21 years of Twelvepole Creek at Wayne before construction, and 9 years East Fork near East Lynn and 8 years below East Lynn Dam after construction. The values are jointly compiled for comparison purposes. The most obvious comparison is in the summer months when East Lynn Lake prevents the re-occurrence of a severe 1930-31 drought.

The major tributary to Twelvepole Creek other than East Fork is West Fork, which drains 114.8 square miles as compared to the 171.9 square miles drained by East Fork. The two forks are roughly the same length, 51.8 miles for West Fork and 49.6 miles for East Fork and both have the same 672 feet of fall from source to confluence at Wayne.

The natural times of concentration for major floods of the two streams may have near similar values with East Fork the slightly longer because of the greater length of its tributaries. Time of concentration for major floods of the portion of the Twelvepole Creek Basin above the pre-1967 site of the Wayne gage varied from 39 to 54 hours. Flood time of travel from East Lynn Dam to Wayne is approximately 3 hours.

TABLE NO. 4-9

MONTHLY AVERAGE RUNOFF
EAST FORK OF TWELVEPOLE CREEK
AT EAST LYNN DAMSITE

	Normal average flow				Maximum average flow				Minimum average flow			
Month	#CFS	-RO	*CFS	-RO	#CFS	-RO	*CFS	-RO	#CFS	-RO	*CFS	-RO
January	255	2.21	343	2.97	669	5.80	775	6.71	13.8	0.12	18.3	.16
February	359	2.81	318	2.51	677	5.31	612	4.83	34.5	0.27	15.4	.12
March	340	2.95	370	3.21	677	5.30	763	6.61	112	0.97	62	.53
April	266	2.23	290	2.43	575	4.32	590	4.93	73	.617	10	.08
May	169	1.47	202	1.75	515	4.47	602	5.22	19.4	0.17	18	.16
June	83	0.70	75	0.63	452	3.79	459	3.85	2.86	0.02	13.6	.1
July	57	0.49	58	0.50	177	1.53	358	3.10	.776	.007	12.5	.1
August	26	0.23	38	0.33	66	0.58	229	1.99	.554	.005	12.1	.1
September	34	0.29	33	0.28	412	3.46	177	1.49	.286	.002	11.0	.1
October	21	0.18	27	0.23	120	1.04	153	1.33	.044	.0004	11.1	.1
November	67	0.56	88	0.74	343	2.88	406	3.41	.286	.002	11.0	.1
December	156	1.36	201	1.74	493	4.27	848	7.34	2.77	0.02	11.2	.1
ANNUAL 1916-1962	#152	15.48			#292	29.83			#59.4	6.06		
1962-1979	*177	17.42			*327	33.4			*69.	7.04		

Location	Years
#Twelvepole Creek at Wayne, WV	1916-1917; 1929-1931; 1947-1962
*East Fork near East Lynn, WV	1962-1967
*East Fork below dam	1968-1979

4-09 CHANNEL AND FLOODWAY CHARACTERISTICS

The regulation channel capacity, or control flow, in East Fork below East Lynn Lake is about 2,500 cfs winter and summer; whereas the control flow in Twelvepole Creek at Wayne is less in summer than winter to accommodate farming in the flood plain. Respective summer and winter control flows are 4,500 cfs and 6,500 cfs according to the gage below Wayne, West Virginia, which is the only gage on Twelvepole Creek. The rating is fairly stable at the present location since December 1966, having varied no more than 10% at the stage corresponding to 6,500 cfs discharge. Ratings are checked frequently by USGS so that regulations personnel always have up-to-date ratings. Flood time of travel of East Lynn Lake discharge to the junction of Beech Fork at Lavalette is six (6) hours and three (3) hours additional to the Ohio River.

Twelvepole Creek follows a zigzag course over its approximate 32 mile length with stable banks and generally low turbidity except after hard rains, particularly in summer. The stream bed is mostly sand and gravel and varies in width from 40 feet at the junction of East Fork and West Fork to 180 feet at the mouth. The valley width is about 1500 feet from the junction to mile 13 where it narrows to about 600 feet and continues at that width to the mouth, where it suddenly widens out to about 2500 feet.

4-10 ECONOMIC DATA

a. Population. Except for a part of Ceredo, the Twelvepole Creek Basin contains only one concentrated population center, the town of Wayne which had a population of 1,295 in 1980. The total population of the basin was approximately 30,400 in 1980 with 7.5 percent of the total located in urban areas. Table No. 4-10 below shows the basin population by partial counties.

TABLE No. 4-10

POPULATION OF TWELVEPOLE CREEK BASIN BY PARTIAL COUNTIES

	Population				Percent increase
County	1980	1970	1960	1950	1950 to 1980
Wayne	23,800	19,900	20,600	20,500	16.1
Mingo	4,080	3,610	4,390	5,160	-20.9
Lincoln	1,580	1,300	1,400	1,550	1.9
Cabell	940	960	1,020	950	- 1.1
Total	30,400	25,800	27,410	28,160	8.0

During the decade ending in 1980, the total population of Wayne County increased to 46,021, an increase of 22.5 percent. Although agriculture has sharply declined since the mid-1950's, the drainage area controlled by the East Lynn Dam remains rural.

A convenient index of the economy of the East Lynn Lake drainage area is the population trend in Grant District of Wayne County, whose east and west boundaries virtually coincide with the basin limits. The population of the district in 1940 was 2,017; in 1950, 2,131; and in 1960, 1,418, the latter representing a one-third drop in a decade. By 1970, what with the population loss incident to the development of the lake project, the district had been combined with Stonewall District, which adjoined Grant on the north. Stonewall District dropped from 3,608 in 1960 to 2,966 in 1970, an apparent loss of 18 percent. On a combined basis (Stonewall District and Grant District together) the loss was 41 percent, only partially attributable to population displacement associated with the development of the lake project. Between 1970 and 1980, the number of housing units in Stonewall District increased about 35% from 947 to 1,304 units and the district population increased about 25% from 2,966 to 3,697.

b. Industry and Agriculture. The major industry in the basin is coal mining. Others are extraction of gas and oil, timbering and farming with a large portion of the working population commuting outside the basin for employment. There are many producing oil and gas wells in the basin. Although unproven coal seams underlie the reservoir area, coal production was of minor importance before 1978 consisting of family supply and other sporadic drift mine and surface mine operations. In that year, a surface mine opened near Kirk on West Fork of Twelvepole Creek. In mid-1981 there remained some 7 or 8

years work in the acreage under permit, at their average rate of production. In early 1979 a large deep mine began operations 2-3 miles from the town of East Lynn up Right Fork of Camp Creek. Eventual production of 2 million tons per year is anticipated. In 1981 a small deep mine opened at Radnor also on West Fork.

There were 344 farms in Wayne County in 1969, averaging 132 acres, which made up 14% of the land area. Commercial farms numbered 106, of which 72 percent had sales of under $2,500 and 8 percent had sales of $10,000 or more. Crop growing is confined generally to the narrow bottom lands, the steeper hillsides being utilized for pasture and timber growing.

c. Flood Damages. Areas subject to flooding from East Lynn Dam along East Fork to the junction with West Fork consist predominantly of small farms and the small community of East Lynn. Areas subject to flooding on the main stem downstream from the junction of East and West Forks consist of small farms, residential developments and summer camps, including a residential subdivision of the Town of Wayne. During studies for the Twelvepole Creek Basin Survey Report, engineers from the Huntington District office performed a detailed damage survey for the areas and reaches which would be protected by the East Lynn and Beech Fork projects. The engineers constructed a flood profile for the maximum flood (a combination of the June 1928 and the February 1939 floods) for the main stream and East Fork. Using these profiles, they estimated damages for the maximum flood and for floods having crest elevations 5 feet above and 5 feet below the maximum flood.

Then, by use of stage-damage curves prepared from the flood damage surveys and stage frequency curves, the average annual damage values were developed for the principal areas summarized below.

These three average annual damage values were updated from "Annual Damages" are shown in Survey Report-Twelvepole Creek Basin West Virginia, for Flood Control and Allied Purposes. They were updated as explained below Table No. 4-11, page 4-19, for table values and can be further updated according to the method described there for further use. Average annual farm crop damages of $860 along East Fork and $745 along Twelvepole Creek between Wayne and Lavalette update to $2,075 and $1,795 respectively but were not included because small by comparison. Also developed during the Survey Report studies were tables showing crop and non-crop damages based on water level as recorded at the Wayne gage. Later the gage was moved to the current site below Wayne and the stage-damage relationship moved and accommodated to the new gage location. Crop damages, to growing crops and/or stored crops, occur only during crop season, 16 April through 30 November. However, non-crop damages, which include all other flood damages, may occur at any time of year. Values for both categories per foot of gage height appear in Table No. 4-11, page 4-19. Non-crop damages were updated to December 1981 by considering the difference in gage location discussed above and in paragraph 4-07a, escalation of construction costs between June 1961 and December 1981, and 3% annual growth in the flood plain through June 1973 which was the last month before flood insurance requirements took affect. Table values can be

updated in the future by applying an appropriate ratio of "U.S. 20 Cities Average" construction cost index from Engineering News-Record. Crop damages were updated considering gage location and change in farm prices between 4th quarter 1960 and 4th quarter 1981. Price information came from Survey of Current Business a publication of U.S. Department of Commerce, Bureau of Economic Analysis and further updating of table values above can be accomplished by applying an appropriate ratio of "Prices Received by Farmers" from the publication.

Average Annual Damages - Reach	Updated to December 1981
East Fork, damsite to junction with West Fork	$280,800
Twelvepole Creek at Wayne	251,600
Twelvepole Creek, Wayne to Lavalette	51,600

Potential flood damages along Twelvepole Creek caused by backwater from the Ohio River were estimated by a contractor for the Corps of Engineers as one part of a five-part study of the counties abutting the Ohio River from mile 290.3 to mile 366.3. From investigations beginning in June 1975, damage data were tabulated for each of 4 hypothetical floods under each of 14 categories in each of 47 reaches. The peak elevations of a 20-year frequency, 50 year frequency, 100 year frequency, and 700 year frequency (Jan 1937) flood were chosen to cover a large range of severity of flooding possible under present day conditions. Table No. 4-11 next page, contains results of the study updated to December 1981.

TABLE NO. 4-11

TWELVEPOLE CREEK FLOOD DAMAGES, CROP AND NON-CROP
Stages At New Gage Below Wayne

Crop 1000$	Storage feet	Non-Crop 1000$
0	18	0
23	19	90
39	20	140
54	21	180
71	22	230
89	23	300
112	24	390
146	25	530
221	26	810
373	27	1,230
500	28	1,710
625	29	2,320
744	30	3,660
864	31	5,170
984	32	6,290
1,105	33	7,420
1,228	34	8,490
1,350	35	9.480
1,472	36	10,120
	37	10,490
	38	10,800
	39	11,100

SECTION V - DATA COLLECTION AND COMMUNICATIONS NETWORKS

5-01 GENERAL

Data collection and communication has been accomplished in the past largely by manual methods. For example, observers reporting precipitation to projects or the National Weather Service (NWS) by telephone, observers and/or project personnel obtaining stream gage readings from telemarks over telephone lines and verbal submission of daily reports over the district radio network.

Recently, the Water Resources Engineering Branch acquired a computer to be programmed and used as a District Water Control System. Since that time, numerous changes have been made in the methods of data collection with anticipated future improvements to take place as to data collection, analysis and use.

All daily reservoir reports are now received through the Water Control System via INTRANET. Each project is equipped with a computer terminal. The project report is entered into the terminal and then transmitted directly to the Water Control computer. The district radio network is still used as backup when needed.

Data from NWS is received by the water control system via network connection. Project data is also disseminated back to NWS by the water control system.

Data Collection Platforms (DCPs) have been installed throughout the district at various stream gaging and precipitation stations. Installations at stations in the Twelvepole Creek Basin are described in Table Nos. 5-1 and 5-2. The DCPs transmit hydrometeorological data, via the Geostationary Operational Environmental Satellite (GOES), to various receive sites. The data is then obtained directly by the District Water Control System for processing. Some stream gaging stations have voice DCPs, capable of answering a telephonic call and responding with the current updated information by synthesized voice.

All the data entered into the Water Control System is stored in a data base and used by water control software programs, allowing more timely and efficient water management decisions and generation of required reports.

5-02 HYDROMETEOROLOGICAL STATIONS

a. Stream gaging. Several stream gaging stations, designed for the collection of hydrologic data are located at strategic sites in the Twelvepole Creek Basin. Data from these stations are necessary for execution of the water control plan.

(1) Stream Cooperative Program. The Corps of Engineers participates in the U.S. Geological Survey's Federal-State Cooperative Water Resources Program under which the Survey installs, rates, and maintains the gages at locations desired by the cooperating entity, except at Corps projects where the lake and outflow gages are originally installed by the Corps. Under the program, the Survey maintains six stations in the Twelvepole Creek Basin: Eloise near Dunlow, East Lynn Lake, East Fork below East Lynn Dam, Twelvepole Creek at Wayne, Beech Fork Lake, and Beech Fork below Beech Fork Dam.

Gage locations are shown in Plate No. 5-1, Hydrologic Network; and pertinent data about them is listed in Table No. 5-1, Table section, Stream Gage Data. Plate Nos. 5-2 and 5-3 are Stage–Discharge Tables for the East Fork of Twelvepole Creek below East Lynn Lake and Twelvepole Creek below Wayne, gage. Flow Frequency Curves for Twelvepole Creek at Wayne and East Fork below East Lynn Lake are shown on Plate Nos. 5-4 and 5-5. The Frequency Duration Curves for East Lynn Lake and Twelvepole Creek near Wayne are shown on Plate Nos. 5-6 and 5-7.

(2) Collecting and Reporting Facilities. Early-model stage detection devices, i.e. staff sections and wire weight gages, are now used as primary references for setting modern measuring and recording instruments. Strip chart recorders provide a graphical record of stream stage and a backup for Analog-to-Digital Recorder (ADR) devices. Shaft encoders are now being used to digitally record water levels. The data collection platforms mentioned above have been installed at basin gages as listed in Table No. 5-1, Table section. The platforms store stage and precipitation data and, every four hours, transmit to the LRD computer downlink via the GOES satellite. The Water Resources Engineering Branch Water Control System receives data automatically from the LRD water control system on an hourly basis.

Another type of DCP is now available that has the capability of reporting in response to a telephone query from a computer or terminal. The query can be initiated any time from the Water Control System, project office or the home of a selected individual during off duty hours. The voice synthesizer gives stage as "level" to 0.1 feet when dialed. These DCP's can also dump to a computer terminal giving several readings over a period of hours. These DCP's are being installed at critical locations such as inflow, lake and outflow stations, along with some control point stations.

(3) Reports. Currently, morning reports from the East Lynn Lake project containing stage, precipitation, operational and temperature data, are received in the Water Control Section as computer printouts from the Water Control System. Stage data are converted to flow, and the values are used in the forecasting process. Frequency of reporting is dependent on the degree of urgency imposed by the weather and/or flooding conditions. The frequency ranges from daily (5 days per week) at about 0730 hours under Normal Condition to hourly under Major Flood Condition when the lake level approaches or threatens spillway elevation.

(4) Maintenance. Routine daily first level maintenance for all mechanical stream gaging equipment in the Twelvepole Creek Basin will be performed by the assigned project personnel. Advanced higher level maintenance, particularly for any electronic equipment malfunction, will be performed by a Corps trained technician. The nearest advanced technician is:

U.S. Army, Corps Of Engineers
Resident Engineer
Robert C. Byrd Locks
P.O. Box 9
Apple Grove, West Virginia 25502
Attn: [redacted]
Water Quality Laboratory
Telephone [redacted]

b. Precipitation Stations.

(1) ORN Program. The Ohio River Reporting Network, a division-wide cooperative program with the National Weather Service, involves interchanges of information between the Weather Service and the Corps of Engineers that utilize the respective installations and experience of the two agencies. The Corps requests locations and the Weather Service recruits, trains, equips, pays the observers; and records all submitted data. The Weather Service also provides weather and stream stage data, Ohio River and tributary forecasts, regular and requested special forecasts, radar and other special reports on request. In addition to reimbursing NWS for direct costs on Corps behalf; the Huntington District provides NWS with all precipitation, snow cover, and stage information received in the Water Resources Engineering Branch from reservoir reports. Also included are three-day pool and outflow forecasts, and depth reports from the Corps of Engineers Snow Cover Reconnaissance. The extent and intensity of the ORN program is shown by the fact that the project morning report data are usually very accurate and comprehensive.

(2) Collecting and Reporting Facilities. Normal equipment is the 8-inch Standard Rain Gage (SRG) with a metal support. The station at Wayne has this type of gage. The data is accessed by the water control system as needed. At unattended stations, the "tipping bucket" measuring gage is interfaced to a DCP. The DCP receives the signal from the gage and transmits it to the computer downlink via the GOES satellite. Station locations are shown on the Hydrologic Network Map, Plate No. 5-1, and data collection protocols and communications equipment utilized at each are listed in Table No. 5-2, in Table section, Precipitation Gage Data.

(3) Reports. Project personnel transmit morning report data by micro-computer to Water Control Section Intranet Servers. LRD water control system accesses AFOS through NWS River Forecast Center in Wilmington and includes this data in the hourly disseminations to the District water control system. Use of the data from these reports and data exchanged with the NWS is as described below.

While primary dependence is on morning report information, Water Control Section personnel use Weather Service data, available between 0900 and 0930 hours, in forecasting and computing average precipitation over the basin, area, and District. The data is used to fill in, by implication, for missing data and for confirmation or refutation of doubtful readings. Weather Service coverage of areas lacking Corps projects, when plotted on the District Isohyetal Map, provides basis for better understanding of storm movement and areal intensity, which contributes to improved water management decisions. Radar images on the NWS screen at Charleston, WV, and Wilmington, Ohio, provide valuable information for regulation and forecasting. The NWS Hydrologist analyzes for position, direction, speed and estimated precipitation amounts in storms and relays this analysis by telephone on request. Ohio River and tributary stage and forecasts provided by the NWS are used to answer telephone calls from the public and particularly from local barging concerns.

A large portion of the total precipitation information received by NWS comes through the cooperative ORN program. Complete District morning report data accessed from the Water Resources Engineering Branch mini computer (water control system) is reorganized by NWS personnel into downstream format and inserted into the NWS Eastern data bank. The data is widely used by NWS elements such as those producing short,

medium and long range forecasts, infiltration indices and the River Forecast Center in Wilmington, which produces Ohio River and tributary stage and flow forecasts. The Charleston office utilizes the data early in the midmorning weather report including any updating forecast that may be indicated.

Data from the unattended, tipping bucket precipitation stations, which are served by DCPs, are collected and processed in the Water Control System along with stage data from the DCP reported stream gages. The primary mode of receiving data is from the DCPs mentioned above. Morning reports from East Lynn Lake project personnel is via computer terminal over telephone lines directly into the water control system. Radio is the primary mode of emergency backup communication between the District Office and projects. Standard procedures require radios to be turned on at all times during working hours. During military emergency or national disaster, the Emergency Operations Manager may assign protected commercial telephone lines or special radio frequencies to Big Sandy River projects. The radio backup is via the Communication Section operator typist in the District Office.

The DCP satellite system described above currently provides complete backup, through redundancy, of lake and outflow stage data collection and reporting. Precipitation data are similarly duplicated at the Beech Fork Lake Project.

(4) Maintenance. Routine daily first level maintenance for all mechanical stream gaging equipment in the Twelvepole Creek Basin will be performed by the assigned project personnel. Advanced higher level maintenance, particularly for any electronic equipment malfunction, will be performed by a Corps trained technician. The nearest advanced technician is:

U.S. Army, Corps Of Engineers
Resident Engineer
Robert C. Byrd Locks
P.O. Box 9
Apple Grove, West Virginia 25502
Attn: [redacted]
Water Quality Laboratory
Telephone [redacted]

5-03 WATER QUALITY STATIONS

a. Facilities. A network of thirty-eight water-quality-sampling stations was established at East Lynn Lake. Primary stations located on the lake are shown in Plate No. 5-7. All primary stations within the basin are described in Table No. 5-3, next page.

b. Reporting. Water quality data collected at East Lynn Lake is used to meet such objectives as:

(1) Establish baseline conditions and monitor subsequent changes; Identify water quality environmental problems; Study special problems or develop criteria for such solutions as modification of reservoir regulation procedures aimed at controlling or enhancing environmental conditions and meeting water quality objectives; and Provide a database adequate for understanding project conditions and for coordination with state agencies in regard to implementing any needed watershed pollution control.

TABLE NO. 5-3

Description by Location of East Lynn Lake
Primary Water Quality Sampling Stations

Station	Distance From the Dam	
ELT0001	0.1	Miles Below
ELT0002	0.1	Miles Above
ELT0003	12.7	Miles Above
ELT0005	6.0	Miles Above
ELT0007	9.8	Miles Above
ELT0009	0.9	Miles Above
ELT0010	2.6	Miles Above
ELT0011	10.6	Miles Above
ELT0012	1.8	Miles Above
ELT0013	7.7	Miles Above
ELT0014	4.0	Miles Above
ELT0016	1.7	Miles Above
ELT0017	1.2	Miles Above
ELT0018	2.2	Miles Above
ELT0019	3.3	Miles Above
ELT0020	4.2	Miles Above
ELT0021	7.2	Miles Above
ELT0022	6.2	Miles Above
ELT0023	7.1	Miles Above
ELT0029	6.4	Miles Above
ELT0030	12.4	Miles Above
ELT0031	14.4	Miles Above
ELT0032	15.2	Miles Above
ELT0044	8.6	Miles Above
ELT0052	6.8	Miles Above
ELT0053	2.9	Miles Above
ELT0054	7.9	Miles Above
ELT0055	2.9	Miles Above
ELT0056	4.8	Miles Above

Parameters to be measured, frequency of collection, and number of data collection stations at any one time are determined by specific project conditions. The water quality program design for East Lynn Lake was structured to describe the various factors affecting water quality over the long term. Data collected are used for applications such as identification of trends indicating problem conditions and reporting existing conditions. Basic studies consist of 5 essential components:

(1) In-situ measurements to evaluate distribution of various properties

(2) Wet chemistry and various types of solids for both immediate and long-term use

(3) Indirect but rapidly obtainable indicators of productivity such as chlorophyll and carbon

(4) Benthic organisms to monitor long-term quality of streams

(5) Other biological measurements such as plankton and seston

Standard physical/chemical tests and reasons for testing are presented in Table No. 5-4, next page 5-6.

TABLE NO. 5-4

Standard Physical/Chemical Tests

Type of Test	Reason for Testing
Calcium (Ca) Magnesium (Mg) Sodium (Na) Potassium (K)	Major Cations - Ionic Balance, ratios and relationships
Sulfate (SO4) Chloride (Cl)	Major Anions - Ionic Balance, ratios and relationships
Nitrogen (N) Nitrate + Nitrite Ammonia Total Kjeldahl	Nutrient
Total Organic Carbon (TOC)	Nutrient
Phosphorous (P) Total Filterable	Nutrient
Solids Total Suspended Dissolved	Equivalent Ambient Values, Correlation with optical measurements
Hardness	Evaluate buffer capacity and Alkalinity characteristics
Metals Iron (Fe) Manganese (Mn)	Important for hypolimnetic and outflow evaluations during stratification
Dissolved Oxygen Temperature pH Specific Conductance	insitu parameters used to evaluate conditions for project operation

c. Maintenance. Sediment and water samples are collected from East Lynn Lake once every 5 years. Water samples are also collected every 10 years each month for the months April through September.

During emergency or under adverse conditions, water quality samples are collected on an as-needed basis. In all cases data are collected for one or more of the following reasons:

(1) long term analysis
(2) problem identification or solution
(3) cause and effect relationships
(4) mathematical modeling
(5) predictive capability

Present sampling programs are oriented toward existing or potential effects and are structured to describe various factors that affect water quality.

5-04 SEDIMENT STATIONS

a. General. In order to monitor and assist in carrying out the authorized purposes of flood control, recreation, and fish and wildlife conservation at East Lynn Lake, a sediment monitoring program has been established at East Lynn Lake.

The program designed for East Lynn Lake has been structured to measure and describe, either separately or in combination, the various factors affecting sedimentation. Results are used for project regulation activities, and to safeguard the integrity of project purposes. The program is described as follows.

b. Lake.

(1) Facilities. Sediment range monuments for 31 sediment ranges were established at East Lynn Lake as part of an aerial photography, ground control, and mapping contract during the summer of 1963. The sediment ranges established above East Lynn Dam site were designated category ”A” ranges and they were marked with monuments referenced to the existing triangulation control system or to permanent land marks. The ground profile of each range was measured at that time and fourteen years later the sediment range was published by the Chief of Engineers as East Lynn Design Memorandum No. 16. During the design phase of the project the original damsite was moved about 3.4 miles upstream, about 0.1 miles upstream of the mouth of Laurel Creek to the present site. This site move was about five years after the project was authorized and placed eight of the original ranges below the new dam, with 23 original ranges still above the damsite. The first five sediment ranges on East Fork of Twelvepole Creek were re-designated as category “C” ranges and the three ranges on Laurel Creek were deleted from the sediment network. This left a network of 28 ranges which was renumbered, and later at the time of the first re-survey it was revised, enlarged, and again renumbered to provide for better sediment monitoring. In 1980 Five new ranges were established at key spots of the pool area; and the monuments of ranges 9L-10R and 12L–11R were combined, thus creating seven additional ranges. In addition three of the original ranges were destroyed by the construction process and were reset. The sediment network was then renumbered. The two new combination ranges were designated 4-A and 6-A, and the five new ranges were 1-A, 13-A, 15-A, 17-A, and 26–A. The 30 lake or category "A" ranges are shown on Plate No. 5-8.

The current sediment range network now consists of 35 ranges; 30-“A” ranges upstream of the dam and 5-“C” ranges downstream of the dam. The five downstream ranges below the dam were numbered C-1, C-2, C-3, C-4, and C-5. Sediment range data is listed on Table No. 5-5, page 5-9.

(2) Reporting. In order to monitor the rate of deposition of sediment in the lake, reconnaissance scope survey of selected ranges are conducted every five years unless an earlier survey is indicated by natural causes, such as a major flood or by increased sediment producing activities in the basin. A memorandum or report will be prepared following each reconnaissance or detailed survey. The existing ground profiles along the original network of 31 sediment ranges at East Lynn Lake were taken during the summer of 1963. The first step for reporting and monitoring the sediment network was the certification and adoption of the sediment range network which was published in January 1977 as Design Memorandum No. 16.

The winter pool was reached for the first time on 1 February 1972 and full regulation began. The first re-survey of 12 selected original sediment ranges located within the seasonal pool was conducted in July 1980. The sediment ranges re-surveyed were 1-C, 3-C, 4-A, 6-A, 9-A, 11-A, 14-A, 21-A, 23-A, 24-A, 25-A, and 27-A. An early investigation revealed that ranges 1-C, 4-A, and 11-A were completely distorted by construction activity and had to be reestablished or reset. In addition the monuments of ranges 9L-10R and 12L–11R were combined, thus creating two additional ranges. Furthermore, five new sediment ranges were established as part of this 1980 re-survey to complete the sediment range network, and the sediment range network was then renumbered. These new sediment ranges were numbered 1-A, 4-A, 6-A, 13-A, 15-A, 17-A, and 26–A. The water depth along the ranges was determined by using a fathometer, but horizontal control was not maintained. Stream bottom profiles, as determined by the minimum elevation point of the sediment range profiles of the 17 ranges, 12 resurveyed and five new, are presented on Plate No. 5-9. The first re-survey for East Lynn Lake found that that for the 8.33 year period between beginning of water storage and the mean date of re-survey the rate of deposition was 0.18 acre-feet of sediment per square mile of contributing drainage area.

This rate was much smaller than the 0.696 acre-foot per square mile used in the early computations of sediment storage capacity requirements. The obvious conclusion was this rate of sedimentation was not detrimental to the effective management of the lake for authorized purposes, and if continued would lengthen the life expectancy of the minimum pool for sediment storage. The report closed with a recommendation that a reconnaissance scope sediment re-survey be conducted in FY 1985 to determine the need of a more detailed sedimentation survey. Plate No. 5-9 is a plot of the minimum elevation points of the East Lynn sediment ranges.

A selected range sedimentation survey was conducted at East Lynn Lake with the mean date of survey being 23 June 1985. Re-surveyed profiles were obtained at 14 sediment ranges in the seasonal pool area upstream of the dam. The sediment ranges investigated were 1-A, 9-A, 11-A, 13-A, 14-A, 15-A, 20-A, 21-A, 22-A, 23-A, 24-A, 25-A, 26-A, and 27-A. The locations of the sediment ranges are shown on Plate No. 5-8. Profiles for the sediment ranges for the 1963, 1980, and 1985 surveys along East Fork of Twelvepole Creek are shown on Plate No. 5-9 and profiles of the tributary streams are shown as Plate No. 5-9. The water depth along the ranges was determined by using a fathometer, but horizontal control was not maintained. Sedimentation is indicated by the profiles at sediment ranges 13-A and 27-A, but this appears to be localized since the investigation of the bottom profiles at the other ranges indicated very little change. A comparison of the data from the June 1985 sedimentation re-survey to the previous ground profiles at the 14 sediment ranges indicates that sedimentation in the seasonal pool area at East Lynn Lake is not excessive.

The report closed with a recommendation that a reconnaissance scope sediment re-survey be conducted in FY 1990 to determine the need of a more detailed sedimentation survey. This survey was postponed several times until FY 1997.

TABLE NO. 5-5

DESCRIPTION AND LOCATION OF
EAST LYNN LAKE
SEDIMENT RANGE MONITORING STATIONS

	Range	East Fork Mile Point		Distance Above or Below Dam		
	Dam Site	10.0		Even		
1.	I ELT 1-A	10.175		0.175	Miles	Above
2.	1 ELT 2-A	10.586		0.586	Miles	Above
3.	1 ELT 3-A	10.617		0.617	Miles	Above
4.	1 ELT 4-A	11.529		1.529	Miles	Above
5.	1 ELT 5-A	11.566		1.566	Miles	Above
6.	1 ELT 6-A	12.887		2.887	Miles	Above
7.	1 ELT 7-A	12.971		2.971	Miles	Above
B.	1 ELT 8-A	14.448		4.448	Miles	Above
9.	1 ELT 9-A	16.342		6.342	Miles	Above
10.	I ELT 10-A	17.576		7.576	Miles	Above
11.	I ELT 11-A	18.699		8.699	Miles	Above
12.	1 ELT 12-A	18.881		8.881	Miles	Above
13.	1 ELT 13-A	20.149		10.149	Miles	Above
14.	1 ELT 14-A	21.300		11.300	Miles	Above
15.	1 ELT T5-A	22.164		12.164	Miles	Above
16.	1 ELT T6-A	22.875		12.875	Miles	Above
17.	1 ELT T7-A	24.026		14.026	Miles	Above
18.	1 ELT T8-A	24.815		14.815	Miles	Above
19.	1 ELT T9-A	26.441		16.441	Miles	Above
20.	1 ELT 20-A	11.530	Brushy Cr.	1.584	Miles	Above
21.	1 ELT 21-A	11.530	Brushy Cr.	2.828	Miles	Above
22.	1 ELT 22-A	12.960	Lick Cr.	3.006	Miles	Above
23.	1 ELT 23-A	12.960	Lick Cr.	4.754	Miles	Above
24.	1 ELT 24-A	12.960	Lick Cr.	6.250	Miles	Above
25.	1 ELT 25-A	14.256	Rich Cr.	4.427	Miles	Above
26.	1 ELT 26-A	14.256	Rich Cr.	6.202	Miles	Above
27.	1 ELT 27-A	18.928	Cove Cr.	9.804	Miles	Above
28.	1 ELT 28-A	22.834	Kiah Cr.	12.894	Miles	Above
29.	1 ELT 29-A	22.834	Kiah Cr.	14.492	Miles	Above
30.	1 ELT 30-A	22.834	Kiah Cr.	15.401	Miles	Above
31.	1 ELT 5-C	7.00		3.00	Miles	Below
32.	1 ELT 4-C	7.75		2.25	Miles	Below
33.	1 ELT 3-c	9.25		0.75	Miles	Below
34.	1 ELT 2-C	9.80		1,000	Feet	Below
35.	1 ELT 1-C	9.90		500	Feet	Below

During 1997 a re-survey of eight sediment ranges within the seasonal pool was made with the mean date of re-survey being 20 April 1997. The sediment ranges surveyed were 6-A, 9-A, 14-A, 21-A, 23-A, 24-A, 25-A, and 27-A. These eight ranges were part of a survey conducted by the Water Quality Section, Water Resources Engineering Branch, of the Huntington District. The 1997 sediment re-survey data was processed and published by the Fuller, Mossbarger, Scott, and May Engineers, Inc in September 1999.

The Water Quality Section used a new method of surveying entitled the Global Positioning System(GPS) in differential mode to determine the horizontal coordinates of each data point on a cross section across the lake. The horizontal coordinates are then translated into stationing along a sediment range. The vertical component of the data point is obtained with a Raytheon fathometer model DE719D MK2 and is

translated into elevation data. Cross sections were obtained with 500 feet or less distance between them within the seasonal pool area of the lake. These cross sections duplicated or included the eight listed sediment ranges. The volume of computed sediment for the 1997 survey was computed as 488 acre-feet. This amount gives an annual sediment rate of 19.4 acre-feet, or 0.15 acre-feet per square mile of drainage area. A comparison of the data from the April 1997 sedimentation re-survey to the previous ground profiles at the 8 sediment ranges indicates that sedimentation in the seasonal pool area at East Lynn Lake is not excessive. Plate No. 5-9 is a plot of the lowermost point of the East Lynn sediment ranges for each sediment survey.

(3) Maintenance. Project personnel and the survey party members should regularly and periodically check the sediment range markers so the damaged monuments can be replaced and any obscuring undergrowth can be removed.

c. Downstream.

(1) Facilities. After a multipurpose dam has been constructed and placed in operation, flow characteristics downstream are different from the natural, and the discharge carries generally less silt than did the natural stream. These factors together can cause unpredictable channel changes due to both degradation and aggradation, and the changes can cause anxiety in downstream property owners where they occur. In order to monitor any such changes that may occur, the Corps normally installs and surveys sediment ranges along the stream below the dam and designates them category "C" ranges.

After the establishment of the original sediment range network the damsite was moved about 3.4 miles upstream, about 0.1 miles upstream of the mouth of Laurel Creek to the present site. This site move during the design phase placed eight of the ranges below the new dam, with 23 original ranges still above the damsite. The five sediment ranges on East Fork of Twelvepole Creek were re-designated as category “C” ranges and the three ranges on Laurel Creek were deleted from the network. The sediment range network now consists of 35 ranges as shown on Plate No. 5-8, with five category “ C” ranges.

(2) Reporting. In order to determine the character and extent of any channel changes below the dam, monitoring of the downstream ranges is carried out by field survey methods on a selective basis at the time of a sedimentation reconnaissance or during a detailed survey. A detailed survey may be performed when recommended by a reconnaissance scope effort or in the event of the lodging of a complaint about a channel change.

(3) Maintenance. As with the lake sediment ranges, periodic maintenance of downstream sediment range markers, by the project personnel and by the survey party at the time of the lake sediment survey should take place.

5-05 COMMUNICATION NETWORK

Communication between East Lynn Lake, the Big Sandy Area Office, the District Office, etc., is carried primarily by telephone (FTS). District radio network provides a backup when telephone service is interrupted. Data collection platforms (DCPs) are installed at stream gaging stations and precipitation stations for collection of hydrometeorological data. Many of the DCPs can be accessed by phone

and data retrieved by the water control system, the portable terminal at the project office or by listening to the synthesized voice. Plate No. 5-10 graphically illustrates the communication network throughout the Twelvepole Creek Basin.

5-06 COMMUNICATION WITH PROJECTS

Telephone is the primary mode for most communication between the Water Resources Engineering Branch and the multipurpose projects and area offices and between projects and respective area offices. Lines of communication for the Twelvepole Creek Basin are illustrated on Plate No. 5-11. District Radio is used for secondary backup communication, while mobile radio, State Police, courier, etc. is utilized during an emergency when neither the telephone or district radio is operational. Inter-project communication is mostly by radio with some telephone for privacy. Water Control Section personnel use the telephone to request and receive additional operations information and weather information and to give operational guidance and directives. The U.S. Postal Service is utilized for letter reports from projects to the Water Resources Engineering Branch, other voluminous or detailed information, pictorial material, confirmation of Special Directives, and any other formal communication between the Water Resources Engineering Branch and the projects. Occasional visits to the projects afford an opportunity for office and project personnel to discuss ideas, problems, new procedures, etc.

5-07 COMMUNICATIONS WITH OTHERS

a. District Staff. Major flood conditions may require daily or more frequent briefings for key staff members. During floods or other disasters when the Emergency Operations Center is in operation, Water Control Section personnel distribute copies of all reports received for critical and adjoining areas to the Center, District Engineer, Chief Engineer and Executive Officer. Storm analysis and critical situations and operational information are provided to pertinent key staff as determined to be informational or necessary. The Public Affairs Office is kept advised to ensure proper public notification.

b. Operations And Readiness Division. The Water Resources Engineering Branch, has no regular communication with Operations and Readiness Division except as mentioned above when the Emergency Operations Center is in operation. When storms occur in the district or high precipitation is shown on a NWS Quantitative Precipitation Forecast, Water Resources Branch telephones to pass on the information. Frequently EMD personnel will visit the Water Control Section in person for further briefing. When EMD personnel learn of approaching storms in or near the Huntington District, they visit Water Control Section for evaluation and determination of impact. During these meetings, all involved participants view Quantitative Precipitation Forecasts, NWS forecasts, District isohyetal (precipitation) Maps, morning reports, and all current information, etc.

c. Great Lakes and Ohio River Division Water Management Branch. All normal communications between the Water Resources Engineering Branch and the Water Control Section to the Great Lakes and Ohio River Division Water Management Branch are carried by telephone lines and the U.S. mails. Radio is used as backup in emergency situations.

Telephone conversation communicates most items of short information and discussion while voluminous reports, confirmations, plans, blueprints and other pictorial material are sent by mail. A weekly report of reservoir holdouts, flood data and the Monthly Report are included in the "report" material mentioned above. When desired, pictorial, handwritten or printed material can be transmitted in a matter of minutes over telephone lines by facsimile machine. Personnel of the District Water Control Section insert stage and flow information on weekdays into a computer file for accessing by Water Control personnel. The first group of information so transferred is from ORH Form 2347A, the reservoir morning report, and consists of pool elevations and outflow for each reservoir. The second group of information, from ORD Form 85, consists of morning stage, 24-hour rainfall, and flow at District gages on the Ohio River and lowermost gages on main tributaries, and forecast flows in the tributaries for the next five days. The third and last item thus transmitted, ORH Form 2347B, is a 3-day forecast of pool elevations and discharges for the reservoirs. All other communication with the Water Control Center, other than mail correspondence, is by telephone. Water Resources Engineering Branch briefs Water Control personnel who call three times weekly, normally Monday, Wednesday, and Friday, for an update on any and all special operations in the district. A Report of Deviation, revised operation at East Lynn Lake outside the approved plan of regulation.

d. Operations Division Area Office. Administration of the East Lynn Lake project is placed under the Big Sandy area office at Louisa, Kentucky. Normal communication between Water Resources Engineering Branch and the Area Office is by telephone, mail transfer of disposition forms, reports, maps, drawings and other pictorial material, and occasional visits by Water Resources Engineering Branch personnel. Emergency communication is by radio.

e. National Weather Service. Communication with National Weather Service (NWS) begins with cooperative arrangements for the LRN program discussed earlier in 5-02 b(1). Under the program, satellite platform information and data is shared. Communication from such ORN platforms is by INTRANET. The Water Resources Engineering Branch has implemented a direct link between the District Water Control System and the NWS Automated Field Operating System (AFOS) after AFOS becomes fully operational. The system speeds-up and improves data handling within NWS by reducing the amount of manual repetition and transcription with its attendant possible errors. AFOS and the link with the District Water Control System should improve the quality of data for NWS and speed its acquisition by Water Resources Branch for use in regulation decisions.

f. U.S. Geological Survey. Communication between Water Resources Engineering Branch and U.S. Geological Survey (USGS) is varied and affected by the meshing of interests of the two entities. A large portion of the communication surrounds the stream cooperative program discussed in 5-02a(1) involving telephone discussion and mailed information on gage location, ratings, and rating extensions. Telephone requests are made by Water Control Section for the USGS to repair a gage critical to regulation of a reservoir in flood condition. Occasional meetings between USGS personnel and Water Resources Branch personnel are held as needed at convenient times and locations to discuss the program.

The USGS keeps the flow record for the continental United States. The USGS conducts studies of sediment carried by streams. These study results are available electronically to the Water Control System by accessing the USGS data bank or by mail in answer to spoken or written request. The USGS compiles drainage areas and lengths of streams in a basin and binds them into paperback volumes.

g. State and Local Agencies. The Water Resources Engineering Branch coordinates with the West Virginia Division of Natural Resources about regulation for authorized purposes including timing of spring filling and fall drawdown. Other concerns include fish and wildlife enchancement, recreation activities, and probable height of a rise. During an emergency, the West Virginia Division of Natural Resources's representative in the West Virginia Office of Emergency Services is contacted.

Huntington District Water Quality Section personnel meet with Department fisheries personnel in the winter to seek their input and comments on the proposed District water sampling and testing program for the coming season. In certain instances, Water Resources Engineering Branch or the Division confirms telephone conversations or transmits information and data by mail.

The Huntington District Water Quality Section maintains contact, during the period of lake stratification, with the West Virginia Division of Natural Resources by mailing to the assigned contact point copies of the weekly water quality profile for East Lynn Lake. If a potentially or currently serious situation develops, the Water Quality Section chief telephones the Department Fisheries Biologist assigned to East Lynn Lake to advise and discuss the situation. If necessary, the Water Quality Section may begin a special study to determine the cause and/or remedy. Any time an unusual water quality situation occurs, an investigation is made into causes and ramifications to the extent warranted by the situation and the availability of manpower.

East Lynn Lake personnel coordinate in person and by telephone with Department personnel concerning the forest fire protection agreement with the Forestry Division, stocking of the lake and tailwaters, enforcement of fish and game licensing, and boating safety. The State Highway Department coordinates details of road maintenance with the project office by telephone and in person. The West Virginia State park ranger staff provides law enforcement at the East Lynn Lake area.

County offices with which project personnel communicate are the Sheriff's and Health Departments, the first in conjunction with assistance with the state ranger staff, and the second concerning periodic inspections of the Marina in compliance with provisions of the Corps of Engineers lease.

h. General Public and Commercial Interests. The Water Resources Engineering Branch receives telephone calls from the general public about East Lynn Lake; some concern timing of filling in spring or drawdown in fall, and others concern fishing information.

The project offices answer many calls on such subjects as water surface area, maximum and average depth, extent of drawdown, and shoreline length of the lake, temperature of the lake and outflow, water clarity, and fishing success. Others concern locations of picnic and other recreational areas, and downstream flooding

potential. An information tape updated by project personnel answers a published telephone number at East Lynn Lake. The tape gives such data as lake and outflow levels and temperatures, water clarity and sometimes fishing success.

Neither the project nor Water Control Section Branch receives any calls from commercial interests except that the project does advise the Marina operator of probable height of a rise and timing of pool filling and drawdown.

There are no interests downstream from the dam that are vulnerable to flooding at discharge rates up to the channel capacity. However, in order to advise recreators below the dam of impending increases in outflow, a discharge warning horn is sounded at the outlet works whenever the total gate opening is to be increased. Water Level Warnings at Project Lake Areas, Table No. 5-6, in Table section, lists communication by project personnel concerning actual or potential highwater situations and filling and drawdown operations.

SECTION VI - HYDROLOGIC FORECASTS

6-01 GENERAL

Hydrologic forecasts of lake elevations and stream flows in East Lynn Lake and the Twelvepole Creek Basin are vitally important for Water Control Management as these forecasts provide information which enable the optimal regulation of the projects. These forecasts are conducted under low-flow, normal flow and flood flow conditions and are primarily developed by the Corps of Engineers and the National Weather Service on a daily basis.

a. Corps of Engineers.

(1) District Office. In accordance with ORDR 1110-2-27, dated 12 January 1976, Subject: Water Control Management Activities, the Water Control Section performs water control management activities for multi-purpose projects throughout the Huntington District. These activities include the preparation of forecasts for lake inflows, lake levels, project outflows, water quality, outflow temperature, and flows at downstream stations to ensure the safe and efficient operation of the district projects. River forecasts prepared by the Corps of Engineers are generally used for its own responsibilities and are not normally issued to the general public unless the National Weather Service is willing to make the release or agrees to such a release.

(2) Division Office. The Water Management Branch at the Great Lakes and Ohio River Division Office utilizes the 5-day tributary forecasts prepared by the individual districts to derive its own 5-day flow forecasts for stations along the Ohio River.

b. National Weather Service. The National Weather Service (NWS) has the official responsibility for preparing forecasts of Ohio River stages and flows, and for transmitting data, forecasts, watches, and warnings to users and the general public. NWS also collects and evaluates weather data from a variety of sources to prepare short and long-term weather forecasts.

6-02 FLOOD CONDITION FORECAST

a. Requirements. Whenever "flood threat" conditions approach, as defined by the Schedule for Reading Gages, forecasting effort primarily focuses on area rainfall, downstream flood control points, and the lake elevation. The forecast is computed using one hour data and it normally takes one hour to complete the forecast of the Twelvepole Creek Basin. The model is executed repeatedly during the flood event as additional data becomes available. The forecast data is used to predict the anticipated pool crest, downstream flood crests, necessary storage releases, and probable duration of flood period. The reservoir storage data used in the forecast model program is summarized in Table No. 6-1 next page. The control stages and flows for the Twelvepole Creek Basin are summarized in Table 6-2 next page. The detailed drainage areas for the Twelvepole Creek Basin are listed in Table No. 6-3 on page 6-4.

TABLE NO. 6-1

EAST LYNN LAKE ELEVATIONS AND STORAGES

Pool	Surface Elevation NGVD	Area Acres	Backwater Stream Miles	Storage Acre-feet Net	Storage Acre-feet Gross	Inches runoff Net	Inches runoff Gross
Year-Round Storage:							
Minimum	656	823	11.4	11,700	11,700	1.6	1.6
Seasonal Storage (summer) Recreation Water Quality Control	662	1005	12.7	5,500	17,200	0.8	2.4
Flood Control Storage*							
50% Storage	684	1766	15.0	35,960	47,663	5.1	6.7
Winter	701	2351	17.0	70,800+	82,500	10.0	11.6
Summer	701	2351	17.0	65,300#	82,500	9.2	11.6
TOTAL	701	2351	17.0	82,500	82,500	11.6	11.6

* At maximum pool elevation
\+ Between elevations 656 and 701
\# Between elevations 662 and 701

b. Methods. In order to achieve the most efficient water control management possible, a real-time computer model, developed for Water Resources Engineering Branch by the Hydrologic Engineering Center (HEC), Davis, California, was adapted and calibrated for use in management of the Twelvepole Creek Basin. The model, the major part of the District water control system, uses real time data from the Corps of Engineers' satellite-platform network in and adjacent to the basin, in conjunction with the tables used to interpret this data. The modeling process includes reviewing and editing of all data, estimation of future flows, development and review of multiple lake outflow plans, and determining the optimal method of operation to decrease downstream flooding while still insuring the projects viability.

TABLE NO. 6-2

CONTROL STAGES AND TRAVEL TIMES

Station	Stream	MIANO (16 Apr-30 Nov) Stage Feet	MIANO (16 Apr-30 Nov) Flow cfs	DEMIA (1 Dec-15 Apr) Stage Feet	DEMIA (1 Dec-15 Apr) Flow cfs	Time of Travel Hours
Outflow Gage	East Fork of Twelvepole	12.1	2380	12.1	2380	0.25
Wayne	Twelvepole	18.0	4500	22.0	6500	3
Ashland	Ohio River	52.0		52.0		30*

* Operational time prior to crest stage in excess of 52 feet.

A typical sequence of events leading to water control management decisions is described as follows:

1. Satellite data, both stage and precipitation, are received from the LRD downlink, decoded and added to the resident data base. This is done automatically each hour.

2. Observed precipitation and stage data are reviewed graphically to insure integrity. Any necessary corrections are made and any missing data are added when available from supplementary sources.

3. The precipitation-runoff model is executed based on observed data up to the time of forecast. If precipitation is occurring at the time of forecast then future precipitation is considered in the model execution at the request of Division.

4. The small basin hydrograph forecast are then reviewed and modified if necessary. The second part of the model is then executed to route, blend and combine flows. The flows are reviewed, the lake outflows modified if necessary, and the second part of the model is recomputed.

5. Step 3 is repeated to obtain subsequent forecasts that consider any additional precipitation (QPF), special regulation or other hypothetical analyses that may be required.

The real time modeling program makes extensive use of small-area unit hydrographs, infiltration rates, discharge rating tables, routing coefficients, and graphical review of flood hydrographs and profiles. The computer program assimilates the total precipitation over a 3-day time period and analyzes the storm in detail. By using predetermined basin rainfall infiltration rates and runoff percentages the program computes the antecedent rainfall, base flow, and storm runoff. By applying the computed storm runoff to the appropriate unit-hydrographs a computed hydrograph is developed. The computer then uses routing coefficients with routing and combining methods to route the flood downstream and through East Lynn Lake. With this computer program and practical experience the Water Control Section is able to produce a reliable forecast for the Twelvepole Creek Basin. Table No. 6-3 is an example of the various small areas above and below East Lynn Lake which small-area unit hydrographs were developed. The adopted 3–Hour unit hydrographs for key points in the East Fork – Twelvepole Creek Basin are shown on Table No. 6-4, page 6-7; and the discharge rating table for the outflow gage is shown in the next chapter.

Stream and lake forecasting is accomplished with data stored and processed through the Ohio River Reporting Network. This network is a division-wide cooperative program with the National Weather Service, which involves interchanges of information between the Weather Service and the Corps of Engineers that utilize the respective installations and experience of the two agencies. All weather stations in the Twelvepole Creek Basin are automated DCP stations. The Weather Service also provides weather and stream stage data, Ohio River and tributary forecasts, regular and requested special forecasts, radar and other special reports on request.

TABLE NO. 6-3

DRAINAGE AREAS OF EAST FORK OF TWELVEPOLE CREEK
AND PRINCIPAL TRIBUTARIES OF TWELVEPOLE CREEK

Stream	Location	Stream (Miles)	Drainage Area Sq. Mi.
East Fork	at Eloise(DUNM4Gage)	28.0	38.52
East Fork	above mouth of Kiah Creek	22.5	54.42
Kiah Creek	at Mouth	0.0	30.93
East Fork at	Forecast Area No. 1	33.0	71.6
East Fork	above mouth of Cove Creek	18.7	87.68
Cove Creek	at mouth	0.0	6.51
East Fork	above mouth of Rich Creek	14.5	101.14
Rich Creek	at mouth	0.0	10.92
East Fork	above mouth of Lick Creek	13.2	113.18
Lick Creek	at mouth	0.0	11.69
East Fork at	Forecast Area No. 2	26.0	57.8
East Fork	at dam site	10.4	133.1
East Fork	at mouth	0.0	171.9
West Fork	at mouth	0.0	114.8
Twelvepole Creek	at Forks	31.7	286.7
Twelvepole Creek	at Wayne	30.8	300.4
Beech Fork	at Dam	3.7	79.0
Beech Fork	at mouth	0.0	83.2
Twelvepole Creek	at Beech Fork	12.7	401.5
Twelvepole Creek	at Mouth	0.0	442.3

In addition to reimbursing NWS for direct costs on Corps behalf, the Huntington District provides NWS with all precipitation, snow cover, and stage information received in the Water Resources Engineering Branch from reservoir reports. Also included are three day pool and outflow forecasts, and depth reports from the Twelvepole Creek Basin projects areas. The extent and intensity of the ORN program is shown by the fact that in addition to the project morning report data, all data received by NWS in the Twelvepole Creek Basin are from Corps financed satellite stations.

The data collection platforms mentioned above store stage and precipitation data and, every four hours, transmit to the LRD computer downlink via the GOES satellite. The Water Resources Engineering Branch Water Control System receives data automatically from the LRD water control system on an hourly basis. All the data entered into the Water Control System is stored in a data base and used by water control software programs, allowing more timely and efficient water management decisions and generation of required reports.

While primary dependence is on morning report information, Water Control Section personnel use Weather Service data, available between 0900 and 0930 hours, in forecasting and computing average precipitation over the basin, area, and District. The data is used to fill in, by implication, for missing data and for confirmation or refutation of doubtful readings. Weather Service coverage of areas lacking Corps projects, when plotted on the District Isohyetal Map, provides basis for better understanding of storm movement and areal intensity, which contributes to improved water management decisions. Radar images on the NWS screen at Charleston and Wilmington provide valuable information for regulation and forecasting. The NWS Hydrologist analyzes for position, direction, speed and estimated precipitation amounts in storms and relays this analysis by telephone on request. Ohio River and tributary stage and forecasts provided by the NWS are used to answer telephone calls from the public and particularly from local barging concerns. Data from NWS is received by the water control system via network connection. Project data is also disseminated back to NWS by the water control system.

6-03 CONSERVATION PURPOSE FORECASTS

a. Requirements. Conservation forecasts are executed in conjunction with the flood control forecast. They are executed on a daily basis for the next five days and on a weekly basis for the next 30 days. The main focus of the conservation forecast is to maintain seasonal pool at East Lynn Lake in order to provide fish and wildlife habitat, recreation, and water supply. At the present time, operations for water temperature and quality are based on observations rather than forecast.

b. Methods. The methods and procedures for non-flood streamflow projection are the same as mentioned previously for the flood forecasting except the concern of the modeler is the low flow analysis. The repetitive process is utilized to operate the reservoir in order to provide downstream low-flow requirements and then to evaluate their impact on the lake pool.

6-04 LONG RANGE FORECASTING

a. Requirements. Long range forecasts assist the Huntington District and the Great Lakes and Ohio River Division in water control management in the Twelvepole Creek Basin. Long range forecast of a dry spring can allow earlier than normal filling during late winter or early spring to reach summer conservation pool levels in time for the beginning of the recreational season. If a drought is projected, conservation pool may be raised to store additional water for later release downstream. Long-range forecasts are required by the Division Headquarters Water Management Branch (WMB) as they utilize it to inform the Mississippi Valley Division (MVD) of probable future conditions and to suggest specific items of water control management to the districts.

b. Methods. The Water Control Section produces a weekly 30-day forecast utilizing the same method as used for flood forecast. This forecast assumes no future rain. Lower than normal precipitation forecasts are produced by the Nation Weather Service.

6-05 DROUGHT FORECASTS

a. Requirements. No forecast requirements at this time, the Huntington District is dependent on the National Weather Service for drought forecast.

b. Methods. The long range and conservation forecast address all forecasting concerns that would be raised by a drought. No extra forecast activities are undertaken at this time.

c. Reference Documents. Many of the basic documents for drought forecast are in Water Resources Engineering Branch files for the Huntington District, Huntington, WV. These files contain records prepared by the West Virginia Division of Natural Resources and the West Virginia USGS for past drought periods, Water Availability Studies for the Twelvepole Creek Basin, and the Ohio River Basin Comprehensive Study, prepared by the Great Lakes and Ohio River Division, Cincinnati, Ohio. The national and state weekly drought forecasts are included with the Palmer Index summaries for the current and preceding drought periods. During a drought period the low-flow records and reference books are used to prepare a weekly drought information bulletin for distribution to all concerned groups.

6-06 NORMAL CONDITION FORECASTS

a. Requirements. Normal conditions, as defined by the Schedule for Reading Gages, Exhibit B, cover all hydrologic conditions from drought to the beginning of high water conditions labeled "Flood Threat." The various conditions are based on the quantity of water a project is required to handle in comparison with design quantities. Other forecasts that are used for management of the East Lynn Lake project include water quality and outflow temperature. The Water Control Center in the Great Lakes and Ohio River Division Office requires daily 3-day pool-and-outflow forecasts and a 5-day forecast of tributary inflows to the Ohio River in order to implement its 5-day forecast of flow in the Ohio River and into the Mississippi River.

b. Methods. The forecast procedures described in paragraph 6-04 are used to produce forecasts for normal ranges of flows. A basin forecaster, assigned to the Twelvepole Creek Basin, utilizes the Water Control System computer model each day and couples the results from the model with knowledge and experience with the basin to produce the required daily forecasts. The computerized forecast is then made available for distribution to interested parties and groups.

(1) Low-Flows - The procedures outlined in 6-04 are used in low-flow conditions. If forecasts indicate a continued low-flow condition leading to a drawdown of the lake level below seasonal pool, the Damtender is appraised of the condition. Marina operators and other affected parties are in turn notified of the changing situation by the Damtender.

(2) Water Quality - Routine water quality sampling has shown that concentrations of manganese and iron are present in the lower portions of East Lynn Lake. These constituents are not harmful, but when released downstream under summer stratification conditions they can cause taste and odor problems. The results of chemical tests on water samples are not returned soon enough for emulation purposes; however, the concentration of manganese and iron are known to increase with the depletion of oxygen in the lower lake portions during

stratification. Therefore, the weekly dissolved oxygen profiles taken during the summer months are used as a forecast of weekly conditions within the pool and as an indicator of when releases should be confined to the upper level selective withdrawal outlets.

(3) Temperature - During stratification periods, daily outflow temperatures are monitored and the selective withdrawal gates are adjusted in an effort to maintain water release temperatures within ±2°F of the natural stream temperature. Weekly temperature profiles are used as an indicator of weekly temperature conditions in the lake. If the trend of the outflow temperature appears to soon exceed allowable criteria, gate adjustments are made to offset the trend and remain within allowable temperature limits.

TABLE NO. 6-4
ADOPTED THREE-HOUR UNIT-HDROGRAPHS FOR
PRINCIPAL POINTS FOR EAST LYNN LAKE

Time Hours	Natural Unit Graph	Inflow Unit Graph	1-A Pool Head	#2 Around Pool	#3 Pool Area
3-hours	133.1	133.1	71.6	57.8	3.7
0	0	0	0	0	0
3	260	900	220	201	790
6	636	1350	510	453	
9	1099	1900	900	705	
12	1600	2300	1400	911	
15	2159	2900	1820	1041	
18	2550	3250	2010	1102	
21	2863	3200	1860	1121	
24	2926	2940	1510	1069	
27	2608	2130	1180	957	
30	2179	1750	890	780	
33	1808	1400	670	644	
36	1489	1150	510	523	
39	1224	900	390	434	
42	954	740	300	364	
45	742	540	240	294	
48	559	445	190	233	
51	458	345	150	182	
54	362	260	120	154	
57	291	200	100	131	
60	236	170	80	112	
63	188	150	60	89	
66	149	110	45	75	
69	120	90	35	61	
72	101	80	25	51	
75	82	60	20	42	
78	63	50	15	33	
81	53	40	10	23	
84	48	30	5	17	
87	38	20	0	13	
90	29			8	
93	24			5	
96	19				
99	14				
102	10				
105	5				
102	0				

SECTION VII WATER CONTROL PLAN

7-01 GENERAL OBJECTIVES

In accordance with ER 1110-2-240 and ORDR 1110-2-27, the plan of water control management and regulation as discussed in the subsequent paragraphs reflects optimal consideration of each project purpose, namely flood control, lake and downstream recreation, and fish and wildlife conservation. In developing the plan of regulation, the following general requirements were considered and evaluated in relation to the overall effective water control management plan for the project, the Twelvepole Creek Basin and the Ohio River Basin. The water control plan utilizes the Area Capacity, Percent Storage, and "O" gage rating tables shown as Plate Nos. 7-1, 7-2, and 7-3, respectively. Plate Nos. 7-4, 7-5, and 7-6 are Spillway Release, Slide Gate, and low-flow system curves used for water control management.

a. Prevention or reduction of serious flood damages to communities, crops, and properties below the dam along East Fork and Twelvepole Creek to the greatest extent consistent with safe operation of the project.

b. Prevention or reduction of serious flood damages below Wayne along Twelvepole Creek and to reduce flood crests on the Ohio River at Ashland, Kentucky.

c. Maintenance of minimum discharge of 10 cfs which is designed to be adequate to sustain downstream aquatic environment.

d. Maintenance of minimum pool below elevation 656.0 feet NGVD to support fish populations, to provide minimum discharge as required, and for sediment reserve.

e. Maintenance of seasonal pool elevation 662.0 feet NGVD for recreation and fish and wildlife conservation subject to flood control, water quality control, and minimum discharge purposes. The year-round overall pool storage and release schedule is shown on the East Lynn Rule Curve for Regulation, Plate No. 7-7.

f. Establishment of maximum allowable discharge to avoid downstream damage during flood releases.

g. During minor rises when releases are less than downstream channel capacity, limitation of release rates to the maximum flow that would have occurred if the project had not been constructed.

h. Controlling discharge temperature to add downstream aquatic communities in maintaining normal states of equilibrium.

i. Sensitivity to reasonable requests for operational changes from other agencies.

j. Concern for safety and well-being of humans, fish and wildlife, and all man-made structures and property at both recreation sites and downstream channel banks in pool rises and releases.

k. Limitation of the rate of change of stage at the outflow station to a value no greater than that which would occur naturally.

7-02 MAJOR CONSTRAINTS

Operation of East Lynn Lake must be within the confines or constraints of the East Lynn – Twelvepole Creek Water Control plan. The various project purposes may at times strongly conflict, therefore priorities must be established and followed. Flood control is the primary project purpose, but this function can be inhibited by restrictions on the hourly rate of gate change, the lack of storage volume because of construction in the lake area, or the inability to discharge storage as quickly as planned because of floodplain encroachment or downstream construction. Activation of the summer recreation function and maintaining the recreation pool can be inhibited by restrictions on inflow due to lack of upstream rainfall or high priority water supply releases.

Operational limitations for flood control, recreation, water supply, low-flow and water quality, and fish and wildlife conservation are listed below.

Pool Level Elevation NGVD -	Streambed	612.0	zero storage
Minimum Pool	656.0	11,710	acre-feet - Gross
Summer Recreation	662.0	17,190	acre-feet - Gross
Maximum Flood Control Pool	701.0	82,500	acre-feet - Gross
Maximum Surcharge Level	717.0	124,860	acre-feet - Gross
Top of Dam	722.0		

Gate Change Maximum Rate - 1.0 feet per hour on Outflow gage.
Spillway maximum flow - 717.0 NGVD Outflow - 41,000 cfs
Minimum Winter Outflow – 10 cfs or 1.42 foot stage on “O” gage
Minimum Winter Outflow – 10 cfs or 1.42 foot stage on “O” gage
Maximum low-flow system rate – 160 cfs or 3.05 feet on “O” gage

Winter release rate w/out directive – 1,075 cfs, 7.4 ft on “O” gage*
Summer release rate w/out directive – 1,075 cfs, 7.4 ft on “O” gage*

Maximum outflow WITH A SPECIAL DIRECTIVE from Water Control Section *

Winter	2,380	12.1 feet on “O” gage
Summer	2,380	12.1 feet on “O” gage

7-03 OVERALL WATER CONTROL PLAN

East Lynn Lake is part of the flood control system of the Ohio River Basin as well as the Twelvepole Creek Basin. Regulation procedures are therefore very closely coordinated with the other basin project (Beech Fork), and with the flood control system of the entire Ohio River Basin to the fullest extent possible. Although it is possible to have a

heavy thunderstorm over only one of the reservoirs, ordinarily both will be operated for all major storms. The purpose of this coordination is to maintain a roughly equivalent utilization of flood control storage capacity between the projects. In this way, the ability of the reservoir system to meet potential flood threats will be maximized. Operation is also correlated to the fullest extent possible with the operation of lakes on other Ohio River tributaries while giving due consideration to local concerns and requirements. In order to accomplish the seasonal goals and missions of East Lynn Lake several conflicting interests must be fully considered. Due consideration must also be given to local concerns and requirements.

Most of the conflicting interests and purposes were resolved by practical planning and allocation of the lake storage volume into pools as listed on Table No. 2-1, page 2-2. The total storage capacity of East Lynn Lake is estimated to be 82,500 acre-feet. During the detailed project planning phase this storage was divided and allocated for various project purposes based on a maximum efficiency basis. Storage capacity allocation in the lake for minimum pool includes year-round equivalent storage volume for sediment accumulation, provision of minimum flow during an unusually dry winter, and satisfactory winter habitat for the large population of fish. The sedimentation pool was established at elevation 656.0 feet NGVD, containing 11,700 acre-feet of storage and covering 823 acres. Based on data from other reservoirs in the basins adjacent to East Lynn Lake the sediment storage was estimated to be adequate to contain 148 years accumulation of sediment. The remainder of the allocated pool storage, or the difference between maximum flood control pool storage, elevation 701.0 feet NGVD, and the sediment pool storage, elevation 656.0 feet NGVD, is 70,800 acre-feet, equivalent to 10.0 inches of runoff from the drainage area above the dam. The detailed review of the storage allocation established the year round minimum pool at elevation 656.0 NGVD, the same as the sediment pool level, and the summer recreation Pool at elevation 662.0 NGVD covering 1,005 acres and storing 5,500 acre-feet of water. The remaining storage to elevation 701.0 feet NGVD, 65,300 acre-feet or 9.2 inches runoff, was allocated for flood control.

7-04 STANDING INSTRUCTIONS TO DAMTENDER

East Lynn Lake Damtender (Resource Manager) and staff operate the project in accordance with general instructions and Special Directives issued by the Water Control Section.

a. General Instructions. The general instructions apply at all times except when superseded by Special Directives which will be applicable for a specific operation or period of time. General instructions provide for routine reservoir regulation including discharge limit at project initiative, details of gate operation technique, collection and transmission of hydrologic and streamflow data. Included are reservoir regulation procedures at the start of a flood before contact can be made with the District office, and emergency regulation in the event all communications fail during a flood. These instructions are contained in Exhibit B, "Instructions

to the Damtender", East Lynn Lake, along with plates and schedules pertaining to their use.

Emergency flood level observations are established by “The Schedule for Reading Gages”, Plate No. 3-1, Exhibit B. This plan is designed to insure that any necessary gate operation will be promptly executed and that special reports will be initiated by the damtender before reservoir and stream conditions reach critical limits. The usual frequency for making changes in gate operations, under normal conditions, varies from no change to 2 changes daily, and under flood conditions, to 4 or more changes daily. If extra work is required after normal duty hours for the collection and transmission of hydrologic data, and for the execution of necessary gate operations, any necessary overtime is authorized.

b. Special Directives. Special Directives are issued normally by telephone and confirmed by mail to record all substantive guidance given the project by the Water Control Section pertaining to water control activities not covered by the general instructions. The following list of subjects or purposes of Special Directives is representative of types issued.

1. Flood control

(a) Outflow reduction for Twelvepole Basin streams or Ohio River control.

(b) Release flood storage and adjustments in rate of release.

(c) Above channel capacity discharge when inflow hydrograph is greater than available storage capacity.

2. Low-flow - release less than minimum flow to avoid loss of pool in extreme dry weather.

3. Special regulation for:

(a) Construction activity downstream affected by flow.

(b) Crossing East Fork below dam on old roadbeds.

(c) Stream clean-up activities.

(d) Emergency - Drowning or pollutant spill

(e) Special pool levels for fish spawning.

(f) Above seasonal pool levels for drought relief in summer and fall.

(g) Stocking tailwaters - stable flow 24-48 hours.

(h) Complete closure for inspection on emergency or periodic basis.

4. Temperature control-inlet gate operations and low-flow valve adjustments.

5. Spring filling, fall drawdown - beginning and adjustments to discharge rate in order to control rate of rise or fall in lake level.

6. Begin and terminate temperature - dissolved oxygen profiles in the lake.

7. Changes in general instructions.

8. Any and all other pertinent operations deemed necessary by the Water Control Section.

c. Regulations. The above mentioned general instructions and Special Directives are written in accordance with the following regulations:

1. ER1110-2-1400, DAEN-CWE-Y 24 April 1970, Subject: Reservoir Control Centers.

2. ORDR 1110-2-27, 12 January 1976, Subject: Water Control Management Activities.

3. ER1110-2-240, DAEN-CWE-Y, 24 April 1970, Subject: Reservoir Control centers.

4. ER 1130-2-415, DAEN-CWE-Y, 28 October 1976, Subject: Water Quality Data Collection, Interpretation and Application Activities.

5. ORDR 1110-2-26, 5 February 1979, ORDED-W, Subject: Water Quality Investigations and Control Activities.

6. ER1110-2-208, DAEN-CWE-Y, 30 July 1979, Subject: Water Control Management.

7-05 FLOOD CONTROL

The primary objective of East Lynn Lake is to reduce downstream flood damage by storing excessive runoff from major storms. Flood damages occurring along East Fork to East Lynn, to the forks of Twelvepole Creek, and then on down Twelvepole Creek to Wayne, and on to Lavalette and the Ohio River primarily involve residences, utilities, highways, and commercial and extractive industries; damages to agriculture is slight. The most valuable agricultural products are livestock, which sustain only slight damage from flooding. Greatest flood damages in the past have occurred to residences in the communities of Wayne and Lavalette, as well as individual residences along the river. Furthermore, the villages of Lavalette and Shoals are both subject to headwater flooding from Twelvepole Creek and backwater flooding from the Ohio River.

a. Requirements. The operation of East Lynn Lake is best accomplished by not exceeding the control stages on East Fork, Twelvepole Creek, and the Ohio River, shown in Table 7-1, below. Control stages were established by close correlation with damage survey curves and result in only minimal damage in the control areas.

Control stages at the outflow gage were established by a channel capacity investigation during the flood of April 1977. A stage of 12.1 feet does not endanger any buildings, other structures, or access roads; higher stages were deemed potentially dangerous during release of stored water. Summer control stage at the "O" gage has been set at 12.1 feet. These control levels require a SPECIAL DIRECTIVE from the Water Control Section. Table 7-1, below, shows the control stages and flows at key river stations below East Lynn Lake.

TABLE 7-1
CONTROL STAGES AND FLOWS
AT KEY STATIONS

	Crop Season 1/		Non-Crop Season 2/		Cumulative
	Stage	Flow	Stage	Flow	Travel Time, Dam
Station	Feet	cfs	Feet	cfs	to Station Hours
Outflow Gage	12.1	2380	12.1	2380	0.25
Wayne	18.0	4500	22.0	6500	3
Ashland	52.0		52.0		30*

1/ 16 April through 30 November
2/ 1 December through 15 April
* Operational time prior to crest stage in excess of 52 feet.

b. Normal Plan.

The plan of operation is based on having adequate flood forecasting and flood warning systems in effect. Stream flow and lake data are obtained from the data collection platform-satellite network and the East Lynn morning report. Precipitation amounts in and near the East Lynn Basin on the morning report come from the project gages. Additional precipitation data are received through the platform-satellite system and from NWS in Charleston. Using this data Water Control Section personnel prepare a detailed analysis of current and forecast rainfall, soil and foliage conditions, and stream stage data as input to the water control system. Lake and stream stage forecasts are then prepared for the key downstream control stations. These forecasts are then used by the Water Control Section to operate the lake and issue special directives utilizing the following operational guidelines. These forecasts are supplemented by the forecasts from the NWS River Forecast Center in Wilmington.

During flood events, the following operation will provide for effective management of the project to meet downstream flood control objectives.

(1) It is desirable to empty the lake of flood storage as soon as possible, considering any special operations, in view of the possibility of a major flood occurring at a time when the lake is partly filled.

(2) All inflow is to be released at discharge rates up to that causing a stage at the "O" gage not to exceed 12.1 feet (2,380 cfs) except when critical flood conditions prevail or are predicted at downstream control points, when the lake level is being raised or lowered seasonally, or when Water Control Section has directed special releases.

(3) All inflow will be stored, subject to the minimum flow requirement, which would contribute to stages in excess of the designated control stages along East Fork and Twelvepole Creek, as listed in Table No. 7-1, previous page.

(4) All inflow will be stored, subject to the minimum flow requirement, from 30 hours in advance of the predicted time of reaching a forecast crest stage in excess of 52 feet on the Ohio River at Ashland, Kentucky. After a complete assessment of Ohio River conditions and trends of continued falling stages, releases of flood storage from East Lynn Lake will be scheduled so as not to add to flood crests on the Ohio River at Ashland, Kentucky.

(5) If the river stage at Ashland is not indicative of flooding conditions further downstream along the Ohio River, guidance from LRD Water Control Center may suggest the storage of inflow in order to provide some benefit to these downstream areas. In such special cases, Water Control Section will make a complete assessment of all current and anticipated hydrologic conditions in the Twelvepole Creek Basin to devise an operational scheme which will benefit the downstream Ohio River areas and not prove detrimental to Twelvepole Creek flood control objectives.

(6) Release of accumulated flood storage is based on determinations by the Water Control Section after a complete evaluation of all hydrologic conditions which impact effective management of the project for optimal flood control benefits. The Water Control Section will evaluate each individual flood event, including consideration of percentage utilization of storage between the Twelvepole reservoirs and issue Special Directives for release of stored flood waters.

(7) Slide gates will be regulated, so that the rate of change of stage at the outflow gage will not exceed one(1) foot per hour except when closing for flood control. Plate Nos. 7-5 and 7-6 are used for slide gate operation and low-flow control releases.

(8) The water control plan for major floods provides for increases in reservoir outflow when there are indications that the available storage will be insufficient to completely control the flood. Reservoir regulation will ordinarily be based on the forecast inflow hydrograph as predicted from reports of rainfall depths above

the dam, relationship of the inflow unit hydrograph to the updated inflow hydrograph calculated from pool change and outflow values, and the updated inflow hydrograph. After the inflow hydrograph has been computed, the necessary outflow will be determined in order to use all the available storage. If the required discharge is equal to or greater than the downstream channel capacity, it is imperative that the outflow be increased, if possible, to the required value as soon as possible in order to avoid the necessity for releasing even greater flows at a later time. If the required outflow is considerably less than channel capacity, it may be desirable to delay reservoir releases to prevent synchronization of the outflow with peak flows from uncontrolled areas below the dam.

c. Emergency Plan. Emergency operations are used in the rare event that all communications between East Lynn Lake and the Huntington District Office are disrupted. In this rare event, the Water Control Section will utilize all available data, e.g. satellite platform data, to keep informed of project conditions and to be prepared to resume regulation instructions when communication is restored. The Damtender will assume regulation of the lake during the communication blackout, and follow the measures listed below. In addition, the Damtender will immediately make every effort to reestablish communications with the Water Control Section of the District Office.

In the event of failure of normal means of communication (radio and telephone), and the lake level is above elevation 687.0 feet NGVD and rising, the emergency plan as detailed in Exhibit B, Instructions to the Damtender will apply. A constant check shall be made on the lake level by reading the lake "L" gage every hour, on the hour, and the rise in pool level computed for the previous hour. Should the rate of rise in lake level indicate to the project manager that the available storage capacity of the project may be insufficient to completely control a given flood, thus gate settings greater than those being maintained from previous instructions are required, recheck the latest Special Directive and prepare to make an Emergency gate movement. After making the necessary gate movement, continue all efforts to contact the Water Control Section for guidance in making future gate movements and follow the following guidelines.

7-06 RECREATION

a. Lake

(1) Requirements. Recreation requirements for a multi-purpose project like East Lynn Lake may be described in terms of usage by the public of the facilities provided. Table No. 7-2, next page, for the calendar year 1980 shows observed and estimated numbers of visitors and recreation activity by facility type.

Recreational activities in the lake area begin with fishing in March which increases through the spring filling in April and in May continuing heavy through summer and fall. Boating begins in late

April and increases through May with the opening of camping on 1 May. Water skiing is popular when the water is warm. None of these activities requires special regulation.

For all recreation purposes it is desirable to maintain the pool level as nearly constant as possible. Rapid fluctuation of pool level can produce anxiety in visitors for lack of information as to cause, and concern as to the possible impact of the fluctuation. Instability of banks and hillsides can cause failure and slippage upon rapid drawdown of lakes during release of flood storage. Stability testing was therefore necessary during the planning phase in order to predict stability of banks against pool drawdown at various rates. The studies indicated that any bank slippage during drawdown from spillway elevation to minimum pool elevation would be minimal or non-existent at the maximum channel capacity rate of discharge with zero inflow.

High water levels change the view from normal and cause anxiety to boat operators due to danger from newly inundated obstacles or potential snags near lake edges and cove areas. High levels also cause difficulty in launching and retrieving boats, the difficulty increasing as rising water levels greatly exceed the elevation of the top of the ramp. Special techniques are required when the water surface is near the top of the ramp or higher. Top of ramp elevations are 666.8 feet NGVD at campground area No. 5, 667.0 feet NGVD at Lakeside and East Fork Main Launch, and 667.1 feet NGVD at Lick Creek. High water levels can put camping and day use areas out of commission by flooding access roads, sanitary facilities or grounds. The various areas within East Fork Campground begin flooding between elevations 665 feet and 670 feet NGVD and comfort stations between 669 feet and 674.5 feet NGVD.

Lowered levels, i.e. below seasonal elevation 662.0 feet NGVD, may occur during dry years due to the minimum discharge. Deep drawdown may cause snagging problems due to previously well covered objects being closer to the surface. When it occurs, it is likely to last longer than high levels and require setting buoys and/or other actions.

TABLE NO. 7-2
PUBLIC USE OF RECREATION FACILITIES

Type Facility	Activity	Visitor Participation
Boat Launch	Boating	34,800
	Fishing	107,400
	Skiing	1,900
Overlooks, Information Center, Trail	Sightseeing	231,000
Beach	Swimming	31,400
Managed Woodland	Hunting	19,300
Day Use Areas	Picnicking	53,500
Campground, Tent, Trailer	Overnight Camping	16,700
	TOTAL	496,000

(2) Control Plan. The water control plan for lake area recreation is to hold the pool level as close as possible to the seasonal elevation, 662 feet NGVD throughout the recreation season. This requires close attention to the normal flood control plan which is to pass inflow up to downstream channel capacity. This procedure prevents unnecessary buildup of lake level and thus sponsors full enjoyment of lake-centered activities. However, at times heavy rains may run off to an extent requiring reduction of discharge to prevent downstream flooding and consequent rise in lake level. Such a reduction in outflow during the recreation season may infrequently be occasioned by an Ohio River flood or by an emergency downstream. Part of the plan of regulation is the daily determination of a 3-day forecast of lake elevation and outflow rate. This information is available to project personnel for their use and understanding and for dissemination to the general public and the marina operator.

During planning of the project, it was determined that if the lake were drawn down from spillway elevation at the channel capacity rate of discharge, bank slippage would be non-existent or minimal and of no consequence to lake recreation.

b. Downstream.

(1) Requirements. Fishing begins at the tailwaters in February with the first stocking of trout, which continues monthly through May. Afterward, fishing is sporadic and anglers fish further downstream opposite the Fisherman's Access Parking Lot and picnic tables. Picnicking is not affected by regulation, but fishing is affected due to the high velocity of large discharges through the narrow channel. The rapid flow pulls a line downstream and to the bank too quickly for pleasure or success and most anglers prefer not to fish there when the stage at the "O" gage is at about 8 feet or above. Channel capacity discharge does not pose any threat to visitors or property at either the Fisherman's Access or the Laurel Creek Primitive Camping Area.

Project personnel must maintain an awareness of downstream usage of East Fork for both recreation and other purposes since safety of these interests is of prime importance to lake regulation. Any interest accustomed to using the stream at low water should be notified of impending high discharges.

(2) Control Plan. In order to be aware of downstream activities, project personnel make occasional surveys, during both low water and high water, to observe potentially hazardous situations. In the future, if a family depends on low-flow in East Fork for stream fording requiring occasional regulation for their convenience as was the case during early years of operation, project personnel would warn them of impending high discharges. With the interest of downstream safety of life and property and integrity of stream banks, the water control plan limits the rate of increase or decrease of discharge a change in stage at the "O" gage of 1.0 feet per hour. Emergency measures may exceed this rate of change. If a spillway flood should occur, project personnel would evacuate downstream recreation areas,

including Laurel Creek Primitive Camping, and remove any equipment which could be injured by high discharge.

7-07 LOW-FLOW AND WATER QUALITY

a. Requirements. Prior to construction of East Lynn Lake, summer flows in East Fork at the dam site often decreased to less than 1 cfs, nearly zero, and occasionally remained there for a week or more, creating stagnant or near stagnant conditions that were harmful to fish and food chain organisms. Modern new environmental policies were developed to resolve these severe problems, and these national policies and guidelines were soon applied regionally to the Twelvepole Creek Basin.

In accordance with the new national environmental policy objectives, water quality evaluation and reporting of water quality control activities are a required part of the overall water quality control management activity at East Lynn Lake. Responsibility for quality of impounded waters was assigned to the Corps of Engineers by Public Law 87-88, enacted by Congress on 20 July 1961. The Chief of Engineers delegated this responsibility to the various divisions as an ongoing function. Guidelines for water quality activities associated with water control management were established and described in ER 1130-2-415.

Stream fisheries need flowing, oxygenated water at normal temperatures. In order to fill this need provisions were made to increase flows below the dam and regulate outflow temperatures for fisheries benefit. The discharge rate was selected after a study to determine the maximum rate that does not exceed the maximum acceptable drawdown in the driest year. The West Virginia Division of Natural Resources, Department of Fish and Game, has worked with the Corps to develop optimum outflow temperatures and allowable ranges of variation for use at East Lynn Lake. These guidelines have been correlated with natural stream temperatures.

b. Water Quality Plan. Water quality control has two major aspects: flow augmentation for downstream needs and low-flow temperature adjustments. Water quality augmentation needs for East Lynn Lake were evaluated by the Federal Water Pollution Control Administration (later changed to EPA).

(1) Selective Withdrawal System. The low-flow selective withdrawal system was designed for a lake that stratifies during the summer, with warm, oxygenated water in the epilimnion and colder water with little or no oxygen in the hypolimnion. The low-flow selective withdrawal system is normally used to maintain the designated minimum flow, up to the capacity of the low-flow system, but, it may also be used as a fine tuning control on the quantity of discharge from the slide gate system. The selective withdrawal system further provides a wide range of water temperatures downstream, and adequate control of volume and quality of discharged water up to the capacity of the control valves. The low-flow system dimensions are discussed in Section II main text.

As previously mentioned the low-flow well has an upper and lower inlet window. Inlets provided in the selective withdrawal system, with inverts at 4 feet and 17 feet depths in the seasonal pool, are used to release water through the inlet likely to produce the highest quality water as indicated by weekly temperature-dissolved oxygen profiles in the lake. One upper level inlets was placed at elevation 658.0 feet NGVD, one lower inlet was placed at elevation 649.0 feet NGVD. These low-flow gates allow withdrawal of water from either level, or simultaneously from both levels, or a mixture of the two. In this manner a wide range of temperature adjusted high quality outflow water is provided for the needs of the downstream aquatic environment.

(2) Low-Flow Release. Low-flow augmentation meets the need of downstream aquatic communities or normal habitat, particularly with regard to temperature, dissolved oxygen, and chemical sediment. The minimum continuous flow rate selected by the State of West Virginia for downstream fisheries maintenance was 10.0 cfs. This discharge is to be maintained at all times, even during closure for flood control. The discharge rate was selected after a study to determine the maximum rate that does not exceed the maximum acceptable pool drawdown in the driest year. Routine release volumes through the Low-Flow Gate as shown on Slide Gate Rating Curve, Plate No. 7-5, and the Low-Flow Gate Rating extension curves for both intakes on Plate No. 7-6. Maximum capacity of each low-flow control well with both inlets open is about 215 cfs, or 430 cfs using both wells, with slight adjustment for pool elevation. The Rule Curve for Reservoir Regulation, Plate No. 7-7, is normally followed for all low-flow release from the lake.

(3) Temperature Profiling. Outflow water temperature regulation is possible through the use of the selective withdrawal system. The State of West Virginia Division of Natural Resources, Department of Fish and Game, has worked with the Corps to develop optimum outflow temperatures and allowable ranges of variation for use at East Lynn Lake. These guidelines have been correlated with natural stream temperatures. Regulation of outflow temperature requires a current assessment of lake temperatures and levels of dissolved oxygen available for withdrawal. Weekly temperature and dissolved oxygen profiles must be taken in the lake during the seasonal stratification period. Visual reference to the appropriate profile and the temperature regulation curve will frequently indicate an obvious choice of one level for withdrawal. At times, however, mixing water from more than one level will be necessary to release outflow water near the natural water temperature. Consideration of dissolved oxygen levels may also affect proper gate selection. The Fish Spawning Schedule is shown on Plate No. 7-8 and the Outflow Temperature Objective Curve is on Plate No. 7-9.

Project personnel take data on Monday for a temperature dissolved oxygen profile of the lake, which includes temperature and dissolved oxygen concentration at the surface and at 2-foot depth intervals to the bottom. This data is transmitted to the Water Control Section where it is computer plotted to produce the Water quality Assessment. Water Quality Personnel use this assessment in conjunction with daily outflow temperature and Outflow Temperature Objective, Plate No. 7-8,

to determine which combination of the selective withdrawal inlets to use to obtain the desired temperature downstream. If the bottom water has a dissolved oxygen concentration of 1.0 milligrams per liter or greater, it may be carefully metered through a slide gate into the outflow. At these times, the discharge must be monitored in the stilling basin for the possible appearance of red-iron hydroxide see 7-07b color in the water and/or the smell of hydrogen sulfide. The regulation scheme is transmitted to the project as a Special Directive.

7-08 FISH AND WILDLIFE CONSERVATION

a. Requirements.

(1) Lake. In accordance with the WV State Code, the West Virginia Department of Natural Resources has responsibility for conservation of fish and wildlife and boating safety at both Twelvepole Creek Basin projects. The Department shares the Corps conservation goal of the long-term well-being of the populations of water and land species of plant and animal life common to the area and the maximum sustained enjoyment of these populations by the public, as stated in sub-section 4-04. Conservation requirements in the lake are met by various features of the Department management program which includes stocking the lake, imposing size limits as necessary, monitoring populations, reproductive success and size distribution within species, maintaining a conservation officer at the lake to conduct creel surveys and fishermen interviews and administer licensing regulations for sport fishermen.

Fish need a stable pool for spawning; but at other times the level is of small consequence except as drawdown may expose normal cover. Spawning times vary, but, during an average spring, all species spawn at East Lynn Lake between the 3rd week in April and the 3rd week in June. The ideal Fish Spawning schedules for East Lynn Lake are shown on Plate No. 7-8. Land animals who live near the lake for water supply are aided by a stable pool level.

Dry weather drawdown exposes muddy lake sides and the slight erosion of boat waves can produce turbid water conditions an appreciable distance from the bank. This is the normally fertile littoral area into which anglers cast. Many fisherman believe fishing success suffers under such conditions due to difficulty fishes have in seeing the lures.

(2) Downstream. Needs of the downstream aquatic community for habitat maintenance, i.e., continuous flow of clean water at proper temperature, constitutes the conservation needs as to reservoir outflow. Fisheries Section of Wildlife Division of West Virginia Division of Natural Resources provided guideline curves of maximum, minimum, and optimum temperatures for warm water fisheries and the Water Control Section drew a smooth curve of target outflow temperature. This curve is shown, with 2°F± upper and lower limit companion curves, in "Outflow Temperature Objective," Plate No. 7-9.

Lower food chain members which live on the bottom are dependent on clean rocks, gravel and sand for normal habitat. Silt and iron hydroxide, particularly under summer low-flow conditions, can coat this habitat making it unsuitable. This suppresses that basic portion of the food chain and depresses populations of higher members until the habitat is improved, as by flushing, and populations of lower members reestablished. Water in lower zones of the lake, subject to reducing conditions common during stratification, contains iron which is soluble in the reduced state. When this water is released and aerated in the stilling basin, the iron is changed to insoluble oxide by oxidation and hydrolyzed to the hydroxide mentioned above.

Desires of anglers for trout fishing are partially met by the West Virginia Division of Natural Resources below East Lynn Lake during late winter and spring months. The Division maintains a put-and-take rainbow trout fishery at about the 20th of February, March, April, and May each year. No particular discharge rate is required for the stocking operation; however, the discharge at time of stocking is maintained 24-48 hours after the event.

b. Control Plan. As explained in subparagraph 7-05 b, the normal mode of regulation for both recreation and flood control, with the guiding principle of conserving storage capacity for possible early flood control needs, fosters a stable pool; however, downstream flooding may require gate closure and consequent pool rise.

The Water Control Section exhibits flexibility in spring filling on behalf of fish spawning. When the West Virginia Division of Natural Resources requests maintenance of a special pool level during a spawn, Water Control Section normally will honor the request if it does not interfere with other project purposes. The Water Control Section acceded to the Division request in April 1975 for a 1.3 foot higher pool level through 30 June of that year to foster growth of zoo plankton around newly covered marginal grasses as additional food supply for young-of-the-year fry. The Water Control Section would consider a request from the Division for holding an intermediate pool level during a spawning period and then raising the level to the seasonal elevation, 662.0 feet NGVD, later on. During a normal filling operation, lake discharge is held at between 15 and 20 cfs to provide more than minimum flow for downstream fishery benefits.

The minimum discharge sufficient for aquatic habitat maintenance downstream without lowering the seasonal pool too far in dry years is 10 cfs. This minimum continuous flow rate was selected by the State of West Virginia for downstream fisheries maintenance after a study to determine the maximum rate that does not exceed the maximum acceptable pool drawdown in the driest year. This discharge is to be maintained at all times, even during closure for flood control, hopefully without lowering the seasonal pool more than six inches, except in dry years, extreme drought, or other emergency condition. In extremely dry years, the Water Control Section personnel may direct reduction of discharge to inflow volumes after assessing all hydro-meteorological and recreational factors.

This flow, or the equivalent stage at the outflow "O" gage, is maintained as a minimum at all times, by the low-flow selective withdrawal system. The low-flow system was designed for a lake that stratifies during the summer, and is normally used to maintain the designated minimum flow, but it may also be used as a fine tuning control on the quantity of discharge from the slide gate system. The selective withdrawal system further provides a wide range of water temperatures downstream, and adequate control of volume and quality of discharged water up to the capacity of the control valve. The low-flow gates allow withdrawal of water from either shallow or deep water level, or simultaneously from both levels for a mixture of the two. In this manner a wide range of temperature adjusted high quality outflow water is provided for the needs of the downstream aquatic environment to achieve a designated discharge and/or outflow temperature requirement. Maximum capacity of the low-flow control system with both inlets and the 30" valve open is about 143 cfs, with slight adjustment for pool elevation.

Routine release volumes through the Slide Gates are shown on Slide Gate Rating Curve, Plate No. 7-5, and the Low-Flow Gate rating extension for both intakes on Plate No. 7-6. The Rule Curve for Reservoir Regulation, Plate No. 7-7, is normally followed for lake operation.

7-09 WATER SUPPLY

East Lynn Lake provides water for downstream fish and wildlife, low-flow augmentation, and local water supply at Wayne. At East Lynn Lake these functions have been combined into one purpose. For this purpose the lake has been partitioned accordingly. The Wayne Water Supply Company draws their water from Twelvepole Creek fed by the outflow of East Lynn Lake and the West Fork of Twelvepole Creek. The minimum summer outflow of 10 cfs is now considered adequate for the Wayne municipal water system.

a. Requirements. Prior to construction of East Lynn Lake, summer flows in East Fork and Twelvepole Creek below the dam site often decreased to less than 1 cfs, nearly zero, and occasionally remained there for a week or more, creating stagnant or near stagnant conditions that were harmful to fish and food chain organisms. Stream fisheries need flowing, oxygenated water at normal temperatures. In order to fill this need provisions were made to increase flows below the dam and regulate outflow temperatures for fisheries benefit. Modern new environmental policies were developed to resolve these severe problems.

When the first modern new environmental policies were developed nationwide they were soon applied regionally to the Twelvepole Creek Basin to resolve water shortage problems. Therefore, a guaranteed continuous minimum flow is a project purposes required of East Lynn Lake for the State of West Virginia. The discharge rate for fishery and water supply maintenance of 10.0 cfs was selected after a study to determine the maximum rate that does not exceed the maximum acceptable drawdown in the driest year. This discharge is to be maintained at all times, even during closure for flood control. The summer water supply

and recreation pool of 662 feet MGVD and the winter minimum pool of 656 feet NGVD were planned to supply an estimated need of 10 cfs continuously for the State of West Virginia.

The East Lynn Lake low-flow system is used for all releases up to the capacity of the system. Routine release volumes through the Low-Flow Gates are shown on Low-Flow Gate Rating Curve, Plate No. 7-2, and the Low-Flow Gate rating extension for both intakes on Plate No. 7-3. Maximum capacity of the low-flow control system with both inlets open and the 30“ outlet valve open is about 143 cfs, with slight adjustment for pool elevation.

b. Storage Allocations. The total storage capacity of East Lynn Lake is estimated to be 82,500 acre-feet. This storage was divided and allocated for various purposes during the planning of the project.

1. Requirements.

a. Minimum Pool. Storage capacity allocation in the lake for minimum pool includes year-round equivalent storage volume for sediment accumulation, provision of minimum flow during an unusually dry winter, and satisfactory winter habitat for the large population of fish. Sediment storage was estimated to contain 92 years accumulation of sediment based on data from other reservoirs in the basins adjacent to East Lynn Lake. The minimum pool was established at elevation 656 feet NGVD, containing 11,700 acre-feet of storage and covering 823 acres. The remainder of the allocated pool storage, or the difference between maximum flood control pool storage, elevation 701.0 feet NGVD, and the minimum pool storage, elevation 656.0 feet NGVD, is 70,800 acre-feet. This large volume of storage is equivalent to 10.0 inches of runoff from the drainage area above the dam. It was divided by maintaining the minimum pool at 656.0 feet NGVD and placing the summer Recreation Pool at elevation 662.0 NGVD, and the remaining storage to elevation 701.0 feet NGVD is for flood control.

b. Summer Water Supply And Recreation Pool. In order to provide for maximum recreation during late spring, summer and early fall, the summer recreation and water supply pool was established at elevation 662.0 feet NGVD and covering 1005 acres. This pool contains 17,200 acre-feet of water, which supports aquatic life, recreational activities high in monetary benefits, and provides the 10 cfs minimum flow during dry periods to maintain and support water supply. The storage volume between the maximum flood control elevation 701.0 feet NGVD and the Summer Recreation/Water Supply pool elevation 662.0 feet NGVD, volume is 65,300 acre-feet, which is equivalent to 9.2 inches of rainfall and runoff over the entire drainage basin above the dam. Minimum temperature and quality requirements of discharge for downstream fishery habitat are met through use of the multilevel release capability of the outlet work.

c. Winter Water Supply Pool And Recreation. During the winter months of December through March, East Lynn Lake is maintained at elevation 656 feet NGVD. The winter water supply and recreation pool covers 823 acres and stores 11,700 acre-feet of water, which supports

aquatic life, winter recreational activities high in monetary benefits, and provides the 10 cfs minimum flow during the winter dry periods. The difference in volume or storage between the maximum flood control elevation 701 feet NGVD and the winter pool elevation 656 feet NGVD is 70,800 acre-feet, which is about 10 inches of rainfall over the entire drainage basin above the dam.

2. Control Plan. On or about 1 April, when the normal flood season has passed, the Water Control Section directs the beginning of filling. It is desirable for the lake level to reach 662.0 feet NGVD soon as possible after 1 April in order to maximize recreation benefits and to facilitate activities of early spawning fish. These benefits would be quickly produced by reducing outflow to a minimum discharge of 10 cfs. In a dry season, the filling directive specifies the minimum flow required at the outflow gage. During an exceptional dry season the West Virginia Division of Natural Resources may report to the Water Control Section that the outflow is inadequate for the spawning season and request more water. The request is fulfilled by retarding the filling rate or holding the pool temporarily at some elevation between 656.0 and 662.0 feet NGVD. Special Directives from the Water Control Section supply guidance to the project for these water control actions.

When pool elevation 662 feet NGVD is reached, it is maintained, subject to flood control and minimum flow requirements, throughout the recreation season. If suggested by CELRD, the Water Control Section may direct storage of water above elevation 662 feet NGVD for later release to augment flows in the Ohio River or Mississippi River.

Around 1 September, the Water Control Section assesses all hydrometerological and recreational factors and determines whether to maintain the pool at seasonal level for continued recreation benefit or to begin releasing water after Labor Day for downstream beneficial use. In any case, drawdown is begun by 1 November and completed by 30 November. The Water Control Section issues appropriate directives to the Damtender for beginning drawdown including initial "O" gage setting with equivalent discharge value and as frequently as necessary thereafter to maintain the desired schedule for pool elevations, all subject to maximum allowable discharge and flood control operation. Winter water supply pool level at elevation 656.0 feet NGVD is maintained through the flood season until 1 April, subject to regulation for flood control and minimum flow requirements.

7-10 HYDROELECTRIC POWER - N.A.

7-11 NAVIGATION – N.A.

7-12 DROUGHT CONTINGENCY PLAN - See ANNEX I

7-13 FLOOD EMERGENCY ACTION PLANS

Extremely high lake levels and/or sudden release of large volumes of water or any emergency condition affecting operation of East Lynn Lake could result in a hazard to life and/or nearby property. Early identification of the existence or potential for occurrence of such conditions is essential as a basis for initiating emergency operations and/or repairs and for issuing appropriate notifications to higher authority and potentially affected parties.

a. Definitions.

(1) Pre-Emergency. A Pre-Emergency condition occurs when some impending or existing threat to the safe operation of the dam or lake is identified, but no significant hazard to life or property is expected to occur. Pre-Emergency declaration is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

(2) Emergency. An Emergency condition occurs when a significant hazard to life and/or property is possible or certain to occur. Conditions justifying declaration of an Emergency condition may be imminent or longer term. An Emergency condition declaration requires notification of others and issuance of warnings to evacuate potentially hazardous areas.

b. Declaration of Pre-Emergency and Emergency Conditions. Pre-Emergency and Emergency declarations will be made by the District Engineer. The Chiefs of the Engineering-Construction Division, Water Resources Engineering Branch, Geotechnical Branch, Design Branch, Operational and Readiness Division and the Emergency Management Branch will provide input onto the decision making process.

(1) Responsibility. The District is responsible for the declaration of "Pre-Emergency" or "Emergency" conditions in all but extreme cases where the loss of communications or the speed of onset of a situation prevents the Dam Operator from conferring with the District.

(2) Conditions Warranting Declaration. Not every situation requiring the declaration of a Pre-Emergency or an Emergency condition can be specified. All personnel must exercise proper initiative and judgement, and each situation is evaluated individually on the basis of all relevant factors.

c. Pre-Emergency. Examples of circumstances warranting declaration of a Pre-Emergency condition include:

(1) Malfunction of flood control gate system during flood operations which impedes release of water and creates potential for spillway flow.

(2) Minor seepage problems including: unexplained increases or decreases in amount, cloudy appearance of seepage or presence of fines, development of new seepage areas as indicated by soft, boggy areas or new or lush vegetation, and substantial unexplained fluctuation in piezometer readings.

(3) Minor slope failures including: tension cracks at crest or in slopes of embankment, small bulges in slopes or in foundation near toe of slope, small depressions or sags in crest or slopes, changes in horizontal crest alignment, and gullies forming in or near embankment or junction of the embankment or abutments.

(4) Threats of sabotage or occurrence of sabotage of non-critical project features.

d. Emergency. Examples of conditions warranting declaration of an Emergency condition include:

(1) Emergency Drawdown. Extremely high lake levels and/or sudden release of large volumes of water or any emergency condition affecting operation of East Lynn Lake could result in a hazard to life and/or nearby property. Early identification of the existence or potential for occurrence of such conditions is essential as a basis for initiating emergency drawdown operations and/or repairs and for issuing appropriate notifications to higher authority and potentially affected parties. If evacuation of the minimum pool below elevation 656 feet NGVD, or lower is ever required, it will be accomplished by using the three slide gates as shown on the Emergency Drawdown Schedule for East Lynn Lake, shown in the next chapter.

(2) Major seepage problems including: large increases in piezometer readings movement of large amounts of material in existing or new seeps, pipes in embankment or foundation materials, slippage at higher elevations on downstream face of dam or in abutment areas, and big increases in normal seepage amounts (especially when associated with movement of material from embankment or foundation).

(3) Major slope failures including: appreciable depressions or sloughs in the crest or slopes of the dam or bulges in the slopes or foundation, large gullies developing and continuing to erode in the embankment or at the junction of the embankment and abutments, displacement of structures or instrumentation on the dam and continuing expansion of tension cracks after their appearance on the dam crest or slope.

(4) Threats of sabotage or occurrence of sabotage to critical project features.

e. Action upon declaration.

(1) Project Damtender

(i) Monitor telephones on 24-hour basis;

(ii) Notify key personnel in Big Sandy Area Office;

(iii) Notify District Dam Safety Officer (Chief of Engineering-Construction Division);

(iv) Maintain 24-hour monitoring surveillance of situation responsible for declaration;

(v) Perform non-routine observations and tasks as directed by District; and

(vi) If Area Office personnel cannot be contacted, notify key personnel, Table No. 7-3, page 7-18.

(2) Big Sandy River Basin Area Manager

(i) Monitor telephones on 24-hour basis;

(ii) Notify key personnel, Table No. 7-3, page 7-18;

(iii) Place all personnel on standby for emergency duty.

(3) District

(i) Activate Emergency Operations Center;

(ii) Monitor telephones on 24-hour basis;

(iii) Test radio communications;

(iv) Place key staff on emergency duty;

(v) Provide detailed instructions to Damtender for any needed non-routine observations and tests;

(vi) Dispatch personnel to dam site as required to provide expert evaluation of situation and to assist Damtender as needed; and

(vii) Make any necessary notifications concerning declared situation.

f. Communications System

(1) Normal. Communications between the District, Damtender (Resource Manager), and Big Sandy Area Office will be by telephone. Telephones at the project office, Big Sandy Area Office and District Emergency Operations Center will be manned on a 24-hour basis whenever a Pre-Emergency or Emergency condition is in effect at East Lynn Lake or at another site that can be affected by operation of East Lynn Lake. Office and home phone numbers of key Huntington District, East Lynn

Lake, Big Sandy Area Office and other federal agency personnel are listed in Table No. 7-3, page 7-18.

(2) Alternate. The radio communications network between the District Office, project office, and Big Sandy Area Office will be used to backup telephone communications. Radios at the project office, Big Sandy Area Office and District Emergency Operations Center will be manned on a 24-hour basis whenever telephone service is disrupted while a Pre-Emergency or Emergency condition is in effect at East Lynn Lake or at another site that can be affected by operation of East Lynn Lake. Radio frequencies and call letters for pertinent parties are listed in Table No. 7-3, page 7-18.

(3) Disaster Blackout. During a situation when both radio and telephone communications between the District Office and the Big Sandy Area Office or project office is lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are listed in Table No. 7-3, page 7-18, along with information for telephone and radio contacts.

g. Notification Plan.

Extreme conditions affecting operation of East Lynn Lake could result in a hazard to life and/or property due to high lake levels and/or sudden release of large volumes of water. Should an emergency drawdown of East Lynn Lake become necessary the Emergency Drawdown Schedule for the lake shown in the next chapter will be followed.

TABLE NO. 7-3
KEY EMERGENCY CONTACTS

Party DISTRICT PERSONNEL	Telephone Office	Residence	Radio Frequency	Call Letters
Water Resources Engineering Branch			multi	[redacted]
[redacted] Chief, Water Control Section		* [redacted]		
[redacted] Water Control Section		[redacted]		
[redacted] Water Control Section		[redacted]		
[redacted] Chief, Water Resources Engineering Branch		* [redacted]		*unlisted

NOTE: All the above numbers can be found on the C of E Intranet, including cell phone numbers. Located at [redacted]

Huntington District Office - Water Resources Engineering Branch
Normal Work Hours - 0700 to 1600 [redacted]
Nights, Weekends,
and Holidays

Pertinent telephone numbers which may be of value during flood emergency are listed below:

East Lynn Lake Project Office

[redacted] -Project Manger
Commercial [redacted]

Gate Operating Personnel — Home Telephone Number

	Commercial	
[redacted]		[redacted]

OTHER AGENCIES

U. S. Geological Survey	Commercial	[redacted]	[redacted]
Night, Weekend, Holiday [redacted]	Commercial		[redacted]
National Weather Service U.S. Forecast Office, Charleston, WV	Commercial		[redacted]

7-14 OTHER PLANS

The Water Resources Engineering Branch has prepared Inundation Maps for East Lynn Lake that delineate the areas both upstream and downstream of the dam that have potential for flooding in the highly unlikely event of an enormous flood of the Spillway Design Flood category or a large release of water. The maps were prepared in accordance with ER 1130-2-419, with the possibility of dam failure and dam retention. The maps also show the time factors associated with the movement of the hypothetical flood waves downstream of the dam. The effects of dam failure while the pool is being maintained at maximum flood control elevation and while at seasonal elevation were also modeled as part of the inundation studies but were not delineated on the maps. Flood profiles for all four conditions have been prepared as part of a Study Summary Report and are on file in the Water Resources Engineering Branch. Computation efforts were accomplished using the dam break computer program programs developed by the National Weather Service. U.S. Geological Survey Quadrangle maps were used as a base in developing the inundation map plates.

The East Lynn Lake inundation maps have been provided to the district Emergency Management Branch for use in developing an Emergency Plan for East Lynn Lake and for contact with State and local authorities. The State and local authorities are provided the maps for their use in developing evacuation plans for the affected areas.

7-15 DEVIATION FROM NORMAL OPERATIONS

The Huntington District Engineer is occasionally requested to deviate from the normal regulation of East Lynn Lake. Approval and notification procedures are required when deviations from the normal water control plan are necessary. Prior approval for major deviations is required from the Division Engineer except as noted below. Deviation requests normally fall into the following categories:

a. Emergencies. The most common emergency requiring special regulation is a drowning downstream; decreased flow may be needed while searching for the victim or increased flow to dislodge the body. Other common emergencies occurring at a project are accidental insertion of a pollutant into a stream that requires flushing, chemical spills, treatment plan failures and other temporary pollution problems. Water control actions necessary to abate the problem are taken immediately unless such action would create equal or worse conditions. Districts must inform their division office as soon as practicable and prepare written confirmation of the deviation and description of the cause and furnish it to the division water control manager. Divisions may develop forms to facilitate the reporting of emergency deviations.

b. Unplanned Minor Deviations. There are unplanned instances that create a temporary need for minor deviations from the normal regulation plan, although they are not considered emergencies. Construction work, major or minor, accounts for the major portion of

these incidents and typical examples include bridge work, and major construction contracts, pipeline changes or repair, utility stream crossings, boat dock work, or testing of a finished facility that may have various and changing flow requirements. Deviations are sometimes necessary to carry out maintenance and inspection of facilities. Requests for changes in release rates generally involve time periods ranging from a few hours to a few days.

Each request for minor deviation is evaluated on its own merits. Consideration must be given to upstream watershed conditions, potential flood threat, condition of the lake, and alternative measures that can be taken. In the interest of maintaining good public relations, requests generally are complied with, providing there are no foreseen adverse effects on the overall regulation of the project (or projects) for the authorized purposes. Approval for minor deviations are normally coordinated at the project and District level, with a post operation written report showing the deviation and conditions on ORD Form 1018-R revised. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or tele-facsimile to the division for review by the division water control manager. The approval for any minor deviation is by the Water Control Section and the Reservoir Manager(Damtender).

c. Planned Major Deviations. Prior approval for major deviations is required from the Division Engineer except as noted below. Either increase or decrease in outflow may be requested by other government agencies, including State and local, or by higher authority within the Corps of Engineers.

Each condition should be analyzed on its merits. Sufficient data on flood potential, lake and watershed conditions, possible alternative measures, benefits to be expected, and probable effects on other authorized and useful purposes, together with the district recommendation, will be presented by letter or tele-facsimile to the division for review and approval. Except in case of emergency, confirmation of a major deviation is necessary from the Great Lakes and Ohio River Water Control Center before the Water Control Section may grant a request. In order for the Water Resources Engineering Branch and Division Office to gage the advisability of compliance with a request, the Water Control Section must investigate upstream watershed conditions, potential flood threat, impact on other project purposes, condition of the lake, and possible alternatives. The following list contains most of the types of major deviations commonly requested.

(1) Anticipated drought periods may require additional water storage in the lake for later release into the river system for downstream benefit.

(2) Special pool level for fishery enhancement. Measures such as holding a specific higher pool level during and after the spawning period to foster recruitment may be requested by State

Fisheries Biologists to benefit populations of certain species or the entire fishery.

(3) All requests for special releases from Corps lakes for recreation such as canoeing, whitewater, or other special releases will be referred to the Huntington District, Water Control Section of the Engineering-Construction Division for evaluation.

7-16 RATE OF RELEASE CHANGE

The East Lynn Lake outflow is to be regulated in such a manner that the rate of release and the resulting stream level does not change more than 1.0 foot per hour on the Outflow “O” gage.

7-17 NOTIFICATION OF IMPENDING RELEASES

The Damtender (Resource Manager) at East Lynn Lake will keep informed and inform the Water Resources Engineering Branch of all developments upstream and downstream along East Fork to Wayne. Arrangements should be made with the Water Resources Engineering Branch for public notification of water release operations that are of an unusual nature or substantially different from the established release pattern whenever such releases might cause damage to equipment or facilities located downstream. The objective of this program is to afford those likely to be affected an opportunity to take appropriate remedial action in advance of the arrival of the releases to prevent damage to or loss of property. Warnings of any unusual releases will be transmitted downstream by project personnel in person and by telephone.

The Corps of Engineers Emergency Operations Manager will devise a plan, in consultation with State and local authorities, to accomplish least-loss evacuation of the inundated areas within the probable time available. Important public service messages concerning regulation of the lake are handled by the Public Affairs Office and disseminated via radio, newspapers, and television. News of impending gate opening operations is transmitted to persons downstream, primarily anglers, by means of the Below Project Warning System which consists of a warning horn remotely controlled from the project office. At East Lynn Lake, the horn is installed on the top of the dam, and is audible for a one mile radius.

SECTION VIII - RESULTS OF WATER CONTROL PLAN

8-01 GENERAL

The results of regulation for the authorized purposes of flood control, recreation, and fish and wildlife conservation are presented in the following paragraphs and plates of this section. Flood control benefits are discussed in sub-section 8-02 and stage and flow reductions for various floods are listed in Table Nos. 8-1, page 8-4, and Table No. 8-2, page 8-5. Regulations for various hypothetical design floods and for representative actual floods have demonstrated the capability of the project to control and pass runoff from the drainage basin. The same capability is described in probability terms by Frequency of Filling, Plate No. 8-1, and Duration of Filling, Plate No. 8-2. Plate No. 8-1 shows that the lake is likely to be filled to spillway elevation, 701.0 feet NGVD, once in 330 years. Some of the effects of regulation on recreation and fish and wildlife are discussed.

Recently, the Water Control Section completed a district–wide study involving simulation of project operations from 1950-1998. These regulated hydrographs for East Lynn Lake, from 1978 when operation of the project began, to 1998 are on file in the Water Control Section.

8-02 FLOOD CONTROL

East Lynn Lake controls 133 square miles or 44.3 percent of the total drainage area above the Wayne gage and is only three hours flood travel time above the gage. Therefore, regulation of the project has been effective in almost eliminating flood damages along East Fork to the mouth just above the Town of Wayne and in greatly reducing damages in the residential area below Wayne and to summer homes and agricultural lands along Twelvepole Creek further below Wayne. Application of the adopted water control plan to two hypothetical floods, three historical floods and one large recent flood as it occurred, are discussed in subsequent paragraphs.

a. Hypothetical Floods. Two hypothetical floods developed in the Water Resources Engineering appendix to the General Design Memorandum (May 1964) consist of the following:

(1) Spillway Design Flood

(2) Standard Project Flood

The spillway design flood is the basis for determination of the spillway capacity required to provide safety of the dam during the most critical flood runoff over the basin. The standard project flood constitutes a standard for design of structures that will provide a high degree of protection as determined by flood potentialities of the drainage area involved without regard to economic or physical limitations. This critical storm often comes during August when

rainfall is normally of higher intensity but shorter duration than in a winter-type storm.

(1) Spillway Design Flood. Estimates of this storm and flood were made in accordance with EM 1110-2-1405 using probable maximum rainfall shown in Hydrometerological Report No. 33. A 48-hour storm in August was chosen as most critical. Operation for the flood is shown in Plate No. 8-3. At the onset of the storm it was assumed that the pool would be half full, or at elevation 685.22 feet NGVD. The reservoir would be closed to minimum discharge for downstream control until hour 44 when the pool level reached elevation 701 feet NGVD and spillway discharge began. The slide gates would be gradually opened when the pool level reached the guide taking line at elevation 706 feet. At hour-58 the pool would reach maximum elevation 716.9 feet NGVD with a maximum combined spillway and slide gate discharge of 47,000 cfs. When the pool receded to elevation 706 feet NGVD, the slide gates would be closed, and reservoir discharge limited to that flowing over the spillway. When the pool receded to spillway elevation, slide gate control would be resumed in accordance with downstream control stages. Channel capacity flow would be released as soon as possible and maintained until the pool level receded to seasonal elevation 662 feet NGVD. Maximum pool storage at the crest would be 124,570 acre feet.

When the Dam Safety Assurance program was initiated for the Huntington District in 1982 the East Lynn Lake spillway was evaluated by using the SDF reviewed in the previous paragraph based on EM 1110-2-1405 using probable maximum rainfall shown in Hydrometerological Report No. 33. However, the initial flood control pool was raised from half–pool to maximum flood control pool elevation 701 feet NGVD. The operation of the reservoir is very similar with the pool reaching the maximum elevation 717.0 feet NGVD at hour 58 with a maximum combined spillway and slide gate discharge of 47,000 cfs. Current Corps of Engineers criteria specify that the SDF be based on the runoff from the Probable Maximum Precipitation (PMP), as indicated in Hydrometeorological Reports 51 and 52. Additional criteria from the Ohio River and Great Lakes Division requires a preliminary rainfall equal to 37 percent of the basic storm. Probable Maximum Precipitation (PMP) is again defined as the theoretically greatest depth of precipitation for a given duration that is physically possible over a particular drainage area at a certain time of year. Because the East Lynn Lake was one of the more recently completed projects it has not been tested with a SDF based on Hydrometerological Report 51 and 52 with the ORD-GL preliminary storm. However, it is currently on a list of new dams to be tested for hydrologic deficiency using the current Hydrometerological 51 and 52 under the Dam Safety Assurance Program. When this study is completed the operation hydrograph and the results will be distributed to all concerned.

(2) Standard Project Flood. This theoretical flood would result from a storm probably in July or August designed to equal the worst combination of meteorologic and hydrologic conditions considered reasonably characteristic of the area. Generalized rainfall criteria and procedures outlined in EM 1110-2-1411 were used for this storm.

A review of summer-type storms indicated that a minimum infiltration rate of 0.05 inch per hour might be experienced and this value was adopted in determining the rainfall excess. Based on studies of streamflow records for Twelvepole Creek Basin, a base-flow of 1 cfs per square mile was adopted. Operation of East Lynn Lake for the flood is shown in Plate No. 8-4. At the start of the flood, the lake would have been regulated to maintain seasonal elevation, 662 feet NGVD. At hour 57, when heavy rainfall and rising stream stages indicated that the 18-foot control stage at Wayne would soon be exceeded, the slide gates would be closed to minimum discharge of 10 cfs. At hour 95 the pool level would reach spillway elevation, 701 feet NGVD. The pool would rise to the maximum elevation, 705.76 feet NGVD, storage of 94,110 acre feet, at approximately hour 118 and the discharge over the spillway would peak at 3,200 cfs. The pool would recede to spillway elevation by hour 192 and reservoir drawdown would continue toward seasonal elevation, 662.0 feet, NGVD through the slide gates as rapidly, up to channel capacity discharge of 2,530 cfs, as downstream controls allowed.

b. Representative Floods.

(1) General. The historical floods which were selected for illustration of the water control plan are the floods of June 1928, February 1939 and February 1945. The flood of December 1978 was selected since it exhibits regulation of a large flood according to the water control plan, Shown below are the effects of East Lynn regulation on the 12 selected Ohio River floods. The flood of June 1928 was caused by an unusual 48-hour storm with widespread heavy rains affecting several basins in addition to the Twelvepole Basin. Stages and damages rivaled the flood of record for the basin in upper and lower reaches. The flood of February 1939, largest flood ever recorded at Wayne, stemmed from two separate storms, the first setting up soil conditions for the second and larger storm. An average total of approximately 5.5 inches of rain fell over the basin in a 5-day period. The flood of February-March 1945 is representative of a situation requiring a lengthy period of closure for Ohio River control which dwarfed the local need. Rainfall in the Twelvepole Basin, as measured at Wayne, totaled five inches in two segments over a 6-day period and the stage at Wayne approached flood stage following each segment.

The flood of December 1978, second largest recorded for the basin, was the first large flood for the new East Lynn project. Before the Ohio River approached flood stage, East Lynn Lake had been closed to minimum flow for tributary control and the reduction in flow reduced the stage at Wayne 11.2 feet. Reductions at Wayne for representative floods occurring before beginning operation in March 1972 and most appreciable rises thereafter are listed in Table No. 8-1, next page. These values and those in Table No. 5-8 High Water Data at Wayne page 5-6, indicate that regulation of the lake would have prevented major flooding in the reach below Wayne for most of the historical floods.

TABLE NO. 8-1
FLOOD REDUCTION AT WAYNE PRODUCED BY REGULATION OF EAST LYNN LAKE

Flood	Natural Flow * (cfs)	Natural Stage (feet)	Modified Flow* (cfs)	Modified Stage (feet)	Reduction by East Lynn (feet)
February 1939	22,660	39.9	12,800	30.3	9.6
December 1978	21,800	39.1	10,500	27.9	11.2
February 1962	16,350	33.6	8,780	25.7	7.9
March 1997	16,000	33.3	10,000	27.3	6.0
June 1928	14,430	31.8	7,260	23.3	8.5
December 1942	14,100	31.6	7,470	23.6	8.0
February 1951	13,400	30.9	6,710	22.4	8.5
January 1974	12,400	29.7	6,000	20.2	9.5
April 1977	12,060	29.5	4,860	18.7	10.8
November 1973	11,100	28.1	5,410	19.0	9.1
May 1974	11,000	28.0	6,200	20.6	7.4
January 1978	10,990	28.4	6,000	21.0	7.4
March 29, 1975	9,450	26.6	5,590	20.2	6.4
March 12, 1975	7,740	24.1	4,850	18.7	5.4
April 1975	7,710	24.0	4,220	17.3	6.7
March 1976	7,990	24.5	4,000	16.8	7.7
April 1978	7,800	24.1	3,800	16.3	7.8
January 1979	7,300	23.3	3,800	16.2	7.1
February 1945	6,290	21.4	4,950	18.9	2.5
April 1973	6,150	20.5	4,110	16.4	4.1

(2) Flood of June 1928. This flood was caused by an unusual storm for the time of year. The duration and extent were more like a winter-type storm and it affected several basins. Almost daily rains had saturated soil conditions for greater than normal runoff prior to the main storm of 28 and 29 June and 2.94 inches of rainfall were measured at Wayne for the two days. East Lynn Lake was not yet built, but, the flood has been reconstituted with a flood operation as shown on Plate Nos. 8-5 and 8-6. At the onset, the pool was assumed to be at elevation 662.1 NGVD. On the early morning of 28 June, rainfall would have already occurred and the pool would be rising slowly. Outflow would be increased twice during the day for pool control; then one last safe increase not to exceed the natural would be made at 1800 hours. Heavy precipitation during the night would cause the lake level and the stage at Wayne to rise more rapidly.

The next morning, on 29 June, the Water Control Section would issue a Special Directive to open gates to effect a discharge of 1,960 cfs at the maximum allowable rate, that which causes a change of stage of 1.0 foot per hour at the "O" gage. The purpose would be to release as much storage as possible safely before closing for downstream control. The stage at Wayne would continue rising and a Special Directive would be issued to close at the maximum rate to minimum flow, 10 cfs, beginning at 1500 hours on 29 June. At 0830 hours on 30 June the stage at Wayne would peak at 23.26 feet, 5.26 feet above crop-season control stage. The natural stage would have risen to a peak at 31.76 feet indicating a reduction of 8.50 feet effected by East Lynn Lake regulation.

Since the Ohio River would not be involved, a Special Directive would be issued at 1600 hours on 30 June, when recession at the Wayne gage was certain to continue, to open to 723 cfs, which could be achieved by four hourly gate operations before nightfall. The lake would crest at about midnight when the inflow receded below the 723 cfs outflow. That discharge would be held until the next morning, 1 July, and increases in discharge resumed at the maximum rate to the maximum allowable outflow, 2,520 cfs, in order to release flood storage. The lake at the crest elevation, 674.77 feet NGVD, would have utilized 23.85 percent of the available storage above seasonal elevation, 662.0 feet NGVD.

TABLE NO. 8-2

REDUCTIONS FOR SELECTED FLOODS
ON OHIO RIVER AT ASHLAND, KENTUCKY

Flood	Modified Stage (feet) (1)	Modified Stage Due to East Lynn Lake (feet)	Reductions Attributed to East Lynn Lake (feet)
January 1927	53.70	53.61	0.09
March 1933	55.70	55.68	0.02
March 1936	55.90	55.77	0.13
January 1937	64.00	63.87	0.13
February 1939	55.20	55.12	0.08
April 1940	55.70	55.66	0.04
December 1942	60.20	60.16	0.04
March 1945	59.40	59.36	0.04
April 1948	62.10	62.04	0.06
January 1950	46.80	46.80	0.00
January 1952	55.30	55.22	0.08
March 1955	57.90	57.80	0.10

(1) As modified by Group "A" reservoirs (existing, under construction or advanced planning, FY 1965).

(3) Flood of January-February 1939. The flood of February 1939 was the greatest flood of record in the Twelvepole Creek Basin. The flood was result of two distinct storms, which have been reconstituted. Steady rainfall of 29 January averaging 1.5 inches over the East Lynn Lake drainage basin, ran off sufficiently to cause inflow to the lake to peak at more than 4200 cfs at midnight and other streams to rise quickly. More rainfall began again barely two days later, 1 to 3 February with rapid runoff. If the same storms were to occur under the same conditions with East Lynn Lake in operation, regulation would be as shown in Plate No. 8-7 and 8-8. The first storm inflow would be passed until early on the 30th when a Special Directive would be issued by the Water Control Section to close to minimum flow, 10 cfs, at the maximum allowable rate, 1.0 foot per hour at the "O" gage, in order to avoid possible flooding at Wayne. At 1500 hours that day a Special Directive would be issued to increase discharge at the maximum rate until 1700 hours and to maintain that discharge rate through the night in order to release accumulated

storage. The directive would also order outflow increases to begin again similarly at 0700 hours the next day and continue until channel capacity outflow, 2520 cfs was reached and that outflow be maintained until the lake level approached minimum elevation, 656 feet NGVD or flood control operation became necessary. Discharge would be reduced on the afternoon of 1 February in order to prevent drawing the pool below minimum elevation during the night. Because of heavy rains, lake inflow and streams would be rising in the afternoon of 2 February and a staffing decision would be made to close beginning at 1800 hours instead of maintaining staff through the night to watch for the expected strong rise at Wayne. A Special Directive would be issued to close to minimum flow at the maximum rate. The Ohio River would crest at Ashland at 60.5 feet at 1900 hours on 5 February, which would require beginning closure for flood control at 0800 on 4 February. However, the dam would still be closed for Wayne and then remain closed for the Ohio River after the crest until a thorough hydrometeorological investigation showed continued recession to be a certainty. At noon on 6 February a Special Directive would be issued to open at the maximum rate to 1,000 cfs, to maintain this discharge until 0700 on the next day and then continue opening similarly to maximum channel capacity discharge, 2,520 cfs, and maintain until the lake level neared minimum elevation, 656.0 feet. The lake would have crested at 674.61 at approximately 1600 hours on 6 February and 29.42% of available storage would have been utilized at that time. Modified discharge at Wayne would have peaked at 12,800 cfs, gage height 30.30 feet according to rating No. 9 at the new gage, with the lake discharge at 10 cfs. The natural peak flow was 22,660 cfs, and would be equivalent to gage height 39.9 feet indicating a reduction of 9.6 feet through regulation by the project.

(4) Flood of February-March 1945. This flood was a much greater Ohio River flood than a Twelvepole Creek flood. Snowfall inside the Twelvepole Creek Basin for December (1944) January and February was much lighter than the fall over much of the Ohio River Basin above Ashland, Kentucky. Record low temperatures and record snowfall in Ohio during December and January, together with similar, but not as extreme, conditions in West Virginia prepared the Ohio River Basin for the flood. Then a warming trend began in the latter half of February and led into an abnormally warm March. Melting snows, coupled with heavy rains beginning 26 February in southern Ohio and portions of West Virginia in the Ohio River Basin, sent the Ohio River, by 1 March, above flood stage from Marietta to Cincinnati. The river continued rising a week or more and reached stages higher than in any previous flood, except those in 1913 and 1937, causing large damages in unprotected areas. The reconstituted flood operation at East Lynn Lake is shown on Plate No. 8-9 and 8-10. At the onset the lake level would have been regulated at or near the minimum pool elevation, 656 feet NGVD, until the morning of 26 February when a rising pool would require increased outflow. Gate openings would be increased through 1800 hours, darkness preventing a 1900 hour operation. On the following morning, 27 February, outflow would be increased by Special Directive at the standard rate, 1.0 foot per hour change in stage at the "O" gage, until the natural flow was reached; and, this discharge, 1,960 cfs, would be maintained until 1000 hours

on 1 March. Because of heavy rains in the area, rising streams and lake inflow, and a NWS forecast of potential flooding at Wayne, a plan to reduce discharge to 1,210 cfs would occur and a Special Directive would be issued accordingly. The modified stage at Wayne would rise to 18.9 feet, which is 3.1 feet below winter control stage and the highest stage reached during the flood. The natural stage would reach 21.4 feet on that occasion. The stage at Wayne would have fallen by morning on the next day, 2 March, and further recession indicated. Therefore, to release storage, a Special Directive would be issued to increase outflow at standard rate to 2,220 cfs until further flooding threatened or the pool receded to elevation 656 feet. The Ohio River would be rising and the NWS prediction would be for a crest six feet above flood stage at 1700 hours on 4 March necessitating closure at 0600 hours on 3 March. Rainfall becoming heavier and rapidly rising inflow and other streams would indicate possible flooding at Wayne. Therefore to avoid unnecessary staffing after regular hours, Water Control Section would direct decrease in outflow at standard rate to 968 cfs. The same directive would include instruction to resume closing operations to minimum discharge, 10 cfs, for the Ohio River at 0600 hours the next day, 3 March. The timing of beginning closure for the Ohio River would be based on the pre-crest operational lead time 30 hours required by the water control plan. Gates would be set for 10 cfs. discharge through the first crest and the second crest, which would occur at noon on 9 March. After a thorough hydrometeorological investigation, a Special Directive would be issued for 0600 hours on 10 March to increase discharge at the standard rate to maximum channel capacity, 12.6 feet stage at the "O" gage, in order to release accumulated storage. The pool would crest at 0700 hours at elevation 671.33 feet NGVD at which stage 23.0 percent of available storage is utilized.

(5) Flood of April 1977. Runoff causing the flood of April 1977 came from a series of disturbances that moved across the Twelvepole Creek Basin beginning late in March with 0.60 inches of rainfall on 30 March. Rain was intermittent through the evening of 2 April with about 0.5 inches falling, then began in earnest and accumulated more than 2.55 inches at the dam site before tapering off on 5 April. The project was in operation near winter pool or elevation 658 feet NGVD, therefore, the slide gates were closed with an outflow of about 20 cfs from the low-flow valve at the beginning of the flood. Twelvepole Creek at Wayne crested at 18.7 feet around 0400 hours on 5 April and the morning report (0800 hours) indicated local flooding at Wayne and in Lavalette. When the rain began the low-flow valve was open about 3 inches, (stage of 1.75 feet or 20 cfs) and this was gradually increased until the valve was fully open with one slide gate about 0.5 feet(240 cfs) on 4 April. The slide gate was closed the next day, and the low-flow valve was reduced to about 3 inches to reduce outflow. The outflow gage had read 2.8 feet, but the gate reductions produced very little change. The only conclusion was that the outflow gage was being affected by backwater from Lynn Creek. Thus, even though the outflow gage showed no change, the gate discharge based on the rating curves decreased from approximately 240 cfs to around 40 cfs. Two days later two slide gates were reopened to about 5.0 feet to release the flood water. This flood caused the pool

level to rise from elevation 658.0 feet NGVD to about 673.0 feet NGVD. By 14 April the pool gradually reduced to normal summer pool, elevation 662.0 feet NGVD, which required slide gate closings. The summer pool was acquired on the recession of the flood; the reservoir was then operated by opening the low-flow valve about 7 inches.

The natural flow at the dam site peaked at around 8,300 cfs on 5 April at about 0200 hours and would have produced a stage of about 30.0 feet on the outflow gage. The computed peak natural flow at the Wayne gage was about 12,060 cfs with a modified recorded crest of about 4,860 cfs. Reduction due to the operation of East Lynn Lake was around 17 feet on the outflow gage, and about 10.8 feet at Wayne.

(6) Flood of December 1978. As in the case of the January-February 1939 flood of record soil conditions in the Twelvepole Creek Basin were prepared for high percentage runoff by previous rainfall. Rains of 3 and 4 December caused streams and lake inflow to rise. Three days later on 7 December the main storm struck the basin with heavy rains beginning at 1000 hours at both projects. East Lynn Lake recorded 5.52 inches for the two day rainfall and Beech Fork Lake, 4.75 inches over the same period. These amounts and the approximate seven inches reported in the West Fork Basin would have sent the Twelvepole Creek stage at Wayne to the second highest stage of record if East Lynn Lake had not been in operation. Flood operation for the flood is shown in Plate No. 8-11 and 8-12.

When runoff began from the first heavy rains on 7 December, the pool had been gradually receding from the previous rise and was at about elevation 657.10 feet NGVD. It began to rise after noon when the inflow exceeded the outflow which was approximately 435 cfs. The gate setting was held until 0730 hours on 8 December when the Damtender (Resource Manager) followed standing instructions and made the first of two gate operations to control the pool, the second being made at 0830. Between 1100 and 1200 hours the stage at Wayne was nearly stationary; but, considering the unusually heavy rains reported in the West Fork Basin and the rapidly increasing inflow to the lake, it was certain that the plateau in Wayne stage was only temporary and would soon be followed by a strong rise. Therefore a Special Directive was issued to close at the maximum rate of 1.0 feet per hour change in stage at the "O" gage until minimum discharge was established. Lake inflow peaked in the early morning of 9 December at 13,350 cfs, the highest inflow yet experienced at the project. With only minimum flow from the lake, the Twelvepole Creek stage at the Wayne gage reached control stage at 2200 hours on 8 December and peaked in early afternoon the following day at 27.88 feet, 10,500 cfs. The natural stage would have been 39.1 feet, 11.2 feet higher than if the East Lynn project had not been operating. The Ohio River rose to a crest at 0700 hours on 11 December at 57.8 feet but the project was already closed for Twelvepole control. Minimum flow was discharged through the period until a thorough hydrometeorologic investigation had been completed to ascertain safety of opening. At 0915 on 12 December a Special Directive was issued to open gradually to a discharge rate of 2,350 cfs in order to release flood storage. Inflow was low and was quickly exceeded by the outflow; therefore, the lake level crested

between 1000 hours and 1100 hours. The crest elevation, 684.55 feet NGVD, was the lake elevation of record for the project through calendar year 1981. At this elevation, 52.1 percent of available storage was utilized.

(7) Flood of March 1997. The month of February preceding the storm of March 1997 was a very dry month, with only 0.57 inches of rainfall in the last half, or 14 days of the month. Therefore, there was no antecedent rainfall to saturate the ground. The extra heavy storm was able to do this and more. There was very heavy rainfall every day for a 7-day storm of about 7.0 inches of rain with over 6 inches of runoff, and even heavier rainfall below the dam and Wayne. The major storm began about midnight on 1 March with 4.45 inches of rainfall, followed the next 3 days with 0.68, 0.49, and 0.54 additional inches of rainfall. Then came three more days of 0.33, 0.24, and 0.15 inches of lighter rain. When runoff began from the heavy rains early on 1 March, the lake level was at elevation 656.35 feet NGVD at 0730 hours and was being held there for the winter flood season. The lake level began to rise that morning, and on through the afternoon and night as the inflow increased rapidly above the channel capacity discharge. The project was already closed to the near minimum flow because of maintaining the winter conservation pool. The Ohio River was rising at Ashland and was forecast to reach 55 feet there at 1900 hours on 2 March, with a crest at 62.2 feet late on 4 March. Operational time of 30 hours closure before the Ohio River reaches the 52 feet flood crest stage at Ashland would have required closing East Lynn Lake at approximately 1200 hours on 3 March.

The Twelvepole Creek stage at Wayne crested at 27.3 feet at 1200 hours on 2 March and for Lavalette at 30.6 feet at 1530 hours on 2 March. The 4.6 feet reduction in stage produced by timely closure of the dam prevented a peak stage of 35.7 feet which would have caused enormous damage, estimated at $3 million dollars. Twelvepole Creek receded below control stage in the afternoon of 3 March. The East Lynn Lake level crested at 684.55 feet NGVD the pool of record, storing 48,634 acre-feet of flood water, equivalent to about 52 percent storage utilization. Table No. 4-8, page 4-11, shows the natural and modified computed crests of Twelvepole Creek at Wayne to the regulation by East Lynn Lake. By 6 March, the Ohio River had fallen about three feet and continued recession was assured; therefore a Special Directive was issued to East Lynn Lake at 0820 to gradually increase discharge to channel capacity in order to release flood storage. Actual discharge for 12.1 feet on the “O” gage varies with the rating.

c. Benefits. Financial results, or annual monetary benefits of operation of the lake for the three (3) project purposes were updated as necessary and are shown graphically in Benefits of Operation for Authorized Purposes, Plate No. 8-13. Updating of flood control benefits, both in the Twelvepole Creek Basin and along the Ohio River, is described in paragraph 4-10c, based on 1981 values. The flood control values shown, $523,600 per year in Twelvepole Basin and $509,600 per year along the Ohio River, constitute damages prevented by regulation of the lake, which greatly reduce average annual damages

that would be occurring in Twelvepole Basin ($584,000) if the project were not operating.

8-03 RECREATION

The recreation purpose is the realization of the full recreational potential for the project. When considered with the overall complex of reservoirs (both existing and proposed) within the area, East Lynn Lake naturally lends itself to camping and fishing. These features are enhanced by the existence of frequent embayment areas, minor pool drawdown and suitable highway access along the east (right hand descending) side of the lake. The original scheme of development was to provide facilities sufficient to meet public demand for the first few years and rely on joint financing with another agency for additional sites as needed. However, predicted early annual visitation of 300,000 was far exceeded by the 515,122 visits recorded in 1972. The annual visitations at East Lynn Lake are shown on Table No. 8-3, next page. Over use of the facilities was creating an undesirable impact on the natural and recreational environment at the lake; therefore, certain camping, picnicking, and sightseeing facilities, originally designed as "Future," were provided. Though not detailed, the changes are reflected in the "Complete" status in Table No. 2-2.

All recreational sites were located with respect to seasonal pool elevation 662 feet NGVD and to utilize natural features appropriate for the desired activities. Initial sites and Overlook Point are accessible by automobile from relocated Route 37, which is on the right descending side of the lake. In order to be authorized for construction, any future site requires cost sharing by another governmental agency. Pool rises due to flood control operations tend to diminish recreation benefits and they may have had an effect on the above figures. The lake level begins to affect camping at elevations above 662 feet NGVD. Within this elevation range water comes into campsites in Laurel Creek Campgrounds and threatens the electrical systems. These and other flooding elevations at recreation sites are shown in Table No. 8-4, page 8-12, with probable frequency of occurrence. Plate No. 8-1, Frequency of Filling, shows the probable time between occurrences of elevations of the pool and Plate No. 8-2, Duration of Filling, shows the probable length of time of each occurrence.

Table No. 8-3

VISITATIONS AT EAST LYNN LAKE

Year	Visitations
1972	515,100
1973	580,700
1974	581,700
1975	651,000
1976	572,300
1977	636,900
1978	512,800
1979	503,800
1980	500,900
1981	530,600
1982	515,100
1983	580,700
1984	581,700
1985	651,000
1986	572,300
1987	636,900
1988	512,800
1989	503,800
1990	500,900
1991	530,600
1992	572,300
1993	636,900
1994	512,800
1995	503,800
1996	500,900
1997	530,600

The Corps of Engineers has responsibility for maintenance and management of all fee-owned land and water areas of the East Lynn project, including all equipment and structures, except telephones and the marina concession. Corps personnel collect camping fees and enforce campground rules and regulations under Title 36, Code of Federal Regulations. By contract with the Wayne County Sheriff's Department, from mid-May through mid-September the Sheriff provides eight hours of duty patrol daily and 16 hours on weekends, to handle the more serious infractions.

Lake zones were proposed by the Corps of Engineers and approved by the joint commission of West Virginia Division of Natural Resources and Corps of Engineers personnel. Four zones are delineated, Boats Prohibited, Idling-No Wake Speed, Unlimited Speed, and Hazardous Area. The Corps of Engineers under Title 36 regulations, and the above Department under State law, cooperatively enforce these zones and other boating safety regulations.

TABLE NO. 8-4

FLOODING ELEVATIONS AND FREQUENCIES AT EAST LYNN LAKE RECREATION SITES

Area	Item	Flooding Elevation Feet NGVD	Frequency, years of Occurrence
Dam Overlook	Maximum pool elevation		N/A
Overlook Point	Area and all features above		N/A
Lakeside Marina	Parking lot, mostly flooded	670.0	2.0
Parking lot,	majority useable	668.0	1.7
Lower restroom,	walkway	668.5	1.8
Lower restroom,	floor	669.0	1.9
Floating store and boat slips	disconnect utilities	667.0	1.6
Top of launch ramp		667.0	1.6
Picnic area,	upper restroom floor	679.0	12.0
Access road,	low point	671.6	2.6
Lick Creek Boat Launch	Restroom	676.0	6.8
	Parking lot	668.0	1.7
	Center line of road (Access closed when floods)	668.0	1.7
	Top of launch ramp	667.1	1.6
East Fork Campground	Access road above Cove Creek, low point	667.0	1.6
Maximum water surface elevation for planned fording of low point in access road		667.5	1.7
East Fork Boat Launch,	top of ramp	667.0	1.6
Road between Boat launch and Area No. 1		667.2	1.6
Area No. 1,	several campsites begin flooding	665.0-665.5	1.4
Nos. 1 & 2,	lowest parking pads begin flooding	666.1	1.5
Area No. 1,	restroom floor	669.0	1.9
Area No. 2,	restroom	672.0	2.9
Area No. 2,	boat launch	669.2	1.9
Road between Areas Nos. 1 & 2		667.0	1.6
Area No. 3,	low point, turn-around circle	668.5	1.8
Area No. 3,	restroom	672.0	2.9
Area No. 4,	low point, end of pavement	667.0	1.6
Area No. 4,	restroom	672.5	3.1
Area No. 5,	low point, turn-around circle	667.1	1.6
Area No. 5,	restroom	671.5	2.5
Area No. 5,	boat launch	666.8	1.6
Area No. 6,	low point in entrance road	668.7	1.8
Area No. 6,	restroom	674.5	5.0

High water levels affect boating by causing difficulty in launching and recovery, which increases as the water level approaches the top of the ramp. Special techniques are required when the level is above the ramp top. Plate No. 8-1 shows a 10-year exceedence interval for a pool elevation of 678 feet NGVD which is above the top of ramp elevation at both the East Lynn boat launch and at the Laurel boat launch. Newly inundated obstacles cause anxiety and potential danger to boaters and water skiers. Hiking is not affected by pool levels up to flood control pool elevation, 701.0 feet NGVD.

Drawdown of the lake during dry weather due to the 10 cfs minimum discharge will occur infrequently, but any significant drawdown will produce detriments to recreation interests. Such items as mud slicks, vegetation uncovering, unsightly shorelines, concessionaire-related problems, and boating restrictions will occur as the pool level is lowered. Low pool levels are expected to be of longer duration when they do occur and may require placing of bouys and/or other warning devices. Hiking, picnicking and camping are largely unaffected by drawdown.

Planning of recreation activities followed guidance contained in EM 1130-2-302, in comments by West Virginia Department of Natural Resources, and by two divisions of the U. S. Department of Interior, i.e., Fish and Wildlife Service and National Park Service. U.S. Senate Document 86 was also followed in assigning the benefit value of $1.00 per visitor-day common during that period. Currently, U.S. Water Resources Council "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies", dated March 1983, may be used to assign benefit values. The Principles give points of incremental value based on characteristics of recreation possibilities in comparison with the ideal and availability of alternative facilities. Points thus determined for East Lynn Lake indicate $3.10/visitor-day for general recreation and $3.50/day for fishing or hunting. The average annual visitation for the last 10 years at East Lynn Lake is 530,540, from Table No. 8-3, page 8-11, accordingly the average annual general recreation benefits were computed to $1,645,000. Therefore, the value of general recreation benefits for calendar year 1998 is shown as $1,645,000 in Benefits of Operation for Authorized Purposes, Plate No. 8-9.

8-04 WATER QUALITY

Special Problems. The most significant water quality problem affecting East Lynn Lake was related to excessive levels of iron and manganese in the lake hypolimnion during summer and fall seasons. This caused problems when trying to meet temperature objectives in the tailwater. During fall turnover, the high concentrations of iron in the lake mixed with the rest of the lake. It was not unusual to see orange streaks in the lake at that time.

Data Interpretation and Results. An interdisciplinary approach is used to evaluate the physics, chemistry, and biology of inflow streams, the lake, and the outflow. The following interpretations are based on data collected between 1973 and 1999.

Physical/Chemical. The chemical composition of water may be defined by grouping substances, which compose the dissolved solids. Relationships among groups of chemicals determine the type of water. In terms of major ions and descriptive parameters, water in East Lynn Lake is classified as borderline calcium carbonate. This represents a balanced condition, but it is a borderline case.

Biological. In a freshwater community, algae are the primary producers. They serve as the basis of the food chain and are the primary food source for most aquatic animals. The quantity and types of algae present in a stream or lake is dependent upon many factors, such as temperature, oxygen, light, nutrients and flow. All freshwater algae contain the green pigment chlorophyll. Therefore, measuring chlorophyll can monitor the productivity of aquatic habitats. Algal productivity was low in headwaters streams with an average chlorophyll concentration of 2.6 ug/l. Productivity on the lake was considered normal with an average chlorophyll concentrations of 6.5 ug/l.

Impounded waters are in more or less dynamic states. The governing factor in water quality development is the temporal and spatial behavior of the density of this water. In most fresh water systems, water temperature is the predominant factor in determining density. Temperature variations in water masses are capable of creating strata of water of greatly different characteristics. Such differing characteristics have direct implications with regard to lake-releases.

Normal lake structure will typically cycle from a mixed condition (Temperature same from top to bottom) to a stratified or layered condition (Temperature changes with depth). This is the result of thermal energy from the atmosphere gained and lost during the year. During the winter months most lakes maintain a nearly constant temperature and are considered mixed or isothermal. In the spring, under normal conditions, the lake stratifies and remains so until November. At that time the lake mixes and becomes isothermal again. During spring as air temperatures start to warm, so do surface water temperatures. This creates a surface layer called the epilimnion. Water temperatures near the bottom remain cool because they are not exposed to the sunlight or warmer air temperatures. This layer is called the hypolimnion. The layer in the middle is referred to as the metalimnion or transition layer. During fall when air temperatures start to cool the surface water temperature also cools and mixes with water below at the same temperature. This process continues until water temperature in the epilimnion is the same as the hypolimnion and the lake is once again mixed.

East Lynn Lake remains nearly isothermal during the winter months. In the spring the lake stratifies and remains so until October. At that time the lake mixes and becomes isothermal again. The lake has a long average retention time of 42 days, which directly affects the stratification pattern. As shown in Plate No. 7-11, there is a strong thermal stratification pattern. Specific conductance does not indicate any density layers in the lake resulting in interflows through the lake during the summer months. Thus water entering the lake remains there for about 1.5 months before it is released to the downstream area. This is an average number. Water remains in the lake longer in the summer during times of low-flow and shorter in the spring during times of high flow.

Dissolved oxygen levels are extremely important in water quality characterization. They depend on the physical, chemical, and biological activities that occur in water. Dissolved oxygen saturation limits are directly related to temperature. Thermal stratification can result in zones that exhibit greatly different characteristics. In well-mixed epilimnetic waters, relatively high levels of dissolved oxygen occur and water is usually of acceptable quality. Water in the hypolimnion may become void of oxygen as a result of various oxygen demanding processes. Therefore, a concomitant decrease in water quality can occur after stratification becomes established. Concentrations of dissolved oxygen in East Lynn Lake remained constant throughout the water column after fall mixing completed, sometime in October, and remained so until around April when the lake would normally stratify. At that time, dissolved oxygen levels in the hypolimnion declined rapidly until anoxic conditions were reached. Mechanical mixing of the lake will reduce thermal stratification, but not chemical stratification. Under normal conditions, dissolved oxygen remained above 5.0 mg/l in the epilimnion, declined rapidly in the metalimnion, and dropped to 0.0 mg/l in the hypolimnion. This meant that about 80% of the lake had oxygen levels above 5 mg/l. Mechanical mixing provided some of improvement, but, not enough to warrant the cost of the mixing and the changes to the tailwater area. Dissolved oxygen is one of the key parameters for fishing and this represented the maximum amount of lake available for fishing during most of the stratification season. Plate No. 8-11 shows typical dissolved oxygen concentrations during the summer months with and without mechanical mixing.

East Fork of Twelvepole, Kiah Creek and Lick Creek are the major inflows to East Lynn Lake. Dissolved oxygen concentrations of these inflows averaged 97% saturation. Average values in the tailwater averaged 98% saturation. The outflow system was designed to allow some regulation of the quality of the water during low-flow conditions. The data indicated similar conditions between the tailwater and headwater areas.

Concentrations of nutrients in a lake are an indicator of productivity. Low productivity results in fewer littoral plants and low density of phytoplankton, whereas highly productive lakes are characterized by littoral plants and abundant phytoplankton populations. The amount of productivity is directly related to the lake fishery. Sufficient quantities of phosphorous, nitrogen, and carbon are needed to have a productive lake. East Lynn Lake is considered productive with phosphorous as the limiting nutrient. Nutrients are transported with sediments. As water enters a lake, its velocity decreases and the sediments settle to the bottom. Because of this phenomena, it is common to see algal blooms at the upper end of a lake. Phosphorous concentrations averaged 0.03 mg/l in the inflows and 0.03 mg/l in the outflow which indicates that there was available phosphorous in the tailwaters.

The pH is a measure of the hydrogen ion concentration. It can be raised by adding a base or removing carbon dioxide from a solution such as in photosynthetic assimilation. By definition, pH ranges from

1 to 14 and a pH value of 7.0 is considered neutral. Average pH values found in the database for headwater stations were around 7.0 and in the tailwater was 6.7. The average numbers indicate neutral conditions in the headwater and a slightly acidic conditions in the tailwater. Long-term trends indicate no significant pattern in pH values over the entire watershed.

While pH is a measure of concentration, alkalinity is a measure of capacity. The capacity of a solution to neutralize acids or bases is called buffering capacity. Average alkalinity, a factor buffering pH, was around 19 mg/l CaCO3 in the headwaters and 29 mg/l CaCO3 in the tailwaters. These are low numbers and indicate very little buffering capacity to resist shifts in pH within the basin. As stated above, there are changes in average pH from headwater to tailwater.

Water hardness is the sum of calcium and magnesium concentrations expressed in terms of mg/l calcium carbonate. It is largely a result of geological formations at the water source. Calcium and magnesium form an insoluble residue with soap and leave deposits on surfaces that come in contact with the water. The ring around a bathtub is a well-known example of these deposits. Detergents were introduced to reduce this problem. High hardness (hard water) results in high soap consumption as well as objectionable scale in heating vessels and pipes. Public acceptance of hardness varies. Many consumers will object to water harder than 150 mg/l calcium carbonate (Water Supply and Pollution control). Average water hardness at the main inflows was 54 mg/l calcium carbonate and was 28 mg/l calcium carbonate in the tailwater. This range is classified as soft based on U.S. Geological Survey classifications.

Iron is an abundant element on the earth, but usually occurs as an insoluble form in water and at low concentrations. Concentrations of iron in the headwaters of East Lynn Lake averaged 892 ug/l. This average increased to 1405 ug/l in the tailwaters, most likely due to the fact, that releases from the lake are unregulated for water quality during storm events. The amount of water available in the epilimnion to dilute water in the hypolimnion is not sufficient to lower the iron levels below 1000 ug/l, which is the West Virginia standard. During the stratification season, iron levels remained below 1000 ug/l in the lake epilimnion and metalimnion, but exceeded 9000 ug/l in the hypolimnion Plate No. 8-22. This was the result of anaerobic conditions in the hypolimnion during that season. High levels of iron imply a potential problem for the aquatic community. Releases from the hypolimnion could cause impacts to the tailwater area. Regulating these releases prevents the high concentrations of iron in the tailwaters most of the time. Orange staining on the banks indicates that the releases cannot be regulated 100% of the time. Long-term trends indicated no significant changes in iron concentrations.

Concentrations of manganese in the headwaters were well below a standard of 1000 ug/l; averaging about 99 ug/l. During lake stratification, manganese levels were above 2000 ug/l in the hypolimnion (Plate No. 8-22). The high concentrations of manganese in

the hypolimnion were not reflected in tailwater readings. This was the result of regulating releases using the selective withdrawal structure. Average manganese levels in the tailwater area averaged 475 ug/l. Long term trends indicated no significant change in manganese concentrations.

Freshwater macroinvertebrates (aquatic insects and worms, crayfish, mussels, etc.) serve as a useful tool for evaluating environmental impacts that occur over time. Because of their limited mobility and their relatively long life span, these organisms are subjected to the environmental conditions of their immediate aquatic habitat. Benthic invertebrates have been used as an assessment parameter to evaluate the overall water quality conditions of East Fork at the main inflow station (ELT-31), the outflow station below the dam (ELT-01), and the secondary inflow stations on Lick Creek (ELT-05) and Kiah Creek (ELT-32).

OVERALL QUALITY RATING: OQR is derived from the BMWP score and the ASPT. The BMWP (Biological Monitoring Working Party) was designed to give a broad indication of the biological condition of rivers and streams. Identification of organisms, from macroinvertebrate samples, is made to the family level. Each family is given a score, between 1 and 10, depending on their susceptibility to pollution. Taxa least tolerant, such as families of mayflies and stoneflies, are given the highest scores. The BMWP score is the sum of the family scores. The BMWP score is then divided by the number of families to produce the Average Score Per Taxon (ASPT). The calculated BMWP score (X) and ASPT (Y) are then give a rating between 1 and 7, depending on whether the site or station is classed as a habitat-rich riffle, or a habitat-poor riffle/pool. The overall quality rating is derived as OQR=X+Y/2. OQR was based on benthic samples collected from 1977 through 1994.

RESULTS: The OQR and interpretation for the above stations are presented in Plate No. 8-18. The inflow stations on Kiah Creek and Lick Creek had good quality, while East Fork had moderate to good quality. The outflow is poor, primarily due to high dissolved iron and manganese concentrations discharged periodically from the lake.

The most common groups of Macroinvertebrates collected in the benthic samples from the outflow station were Hydras (19%), caddisflies (28%) and midges (37%). Stoneflies and mayflies were rare, accounting for only one percent of the total. The net-spinners of family Hydropsychidae were the dominate caddisflies. The common groups collected at the inflow stations were: Lick Creek -- stoneflies (24%), mayflies (30%), caddisflies (11%), and midges (16%); Kiah Creek -- stoneflies (10%), mayflies (37%), caddisflies (21%), and midges (10%); and East Fork -- stoneflies (5%), mayflies (34%), caddisflies (24%), and midges (12%).

8-05 FISH AND WILDLIFE

In broad terms the goals included under this project purpose are the long-term well being of populations of the plant and animal species native to the project area and the maximum sustained enjoyment of

these populations by the public. Programs to promote fulfillment of these goals were developed in coordination with U. S. Fish and Wildlife Service and the West Virginia Division of Natural Resources. The recommendations of these two agencies influenced fish and wildlife conservation plans put into effect at the project.

Effects of water control management on fish and wildlife are those associated with pool level fluctuations in the lake area and those of the outflow on downstream fisheries. Spawning season, usually from the third week in April through the third week in June, is a time when these fluctuations are critical. When the pool level builds up two feet or more during rainfall runoff and is returned to seasonal elevation, 662.0 feet NGVD, in from two to five days, spawning success suffers among black bass and other species. Black bass numbers reported by West Virginia Division of Natural Resources, Fisheries Section, in their continuing study of fisheries in East Lynn Lake, seem to reflect the often reported positive correlation between pool stability and spawning success.

The correlation was noted particularly with regard to the largemouth variety which is the black bass species most caught in the lake. Rotenone treatment of a cove and electro fishing along several banks produces counts of largemouth bass along with other species. Numbers of young-of-the-year largemouth bass counted were always in rough proportion to the degree of stability of the pool, or in inverse proportion to the amount of variation in pool level. Thus, total largemouth bass counted by cove rotenone and electro fishing methods were 77 and 118 respectively in 1976 and 1980 when there was no appreciable variation. Conversely, in 1978 and 1979 when spawning-period pool rises were 7 feet, 2 feet, 2 feet, 3 feet and 4 feet spread over the two spawning seasons, counts of young-of-the-year largemouth bass were 39 and 43 respectively in the two years. In 1977 when the pool variation was 1.5 feet in late April, the count was 56. For the majority of 3 recreation seasons, 1975-1977, the seasonal pool was held 1.3 to 1.5 feet higher than the normal 662.0 feet NGVD, the first year at the request of West Virginia Division of Natural Resources. Rationale of the proposal was that the area available for spawning would be increased and food supply and cover increased for the newly hatched fishes.

Stratification effects on the lake fishery stem from the difference between values of temperature and concentration of dissolved oxygen in upper and lower levels in the water column discussed in sub-section 7-04. Low temperatures and concentrations occur at lower levels and higher values at upper levels. Fish species seek out their most desirable habitat. West Virginia Division of Natural Resources stocked walleye pike hoping they would thrive and reproduce; however they prefer cooler water than is available in the lake in summer with sufficient dissolved oxygen. Therefore they migrated out of the lake mostly through the outlet works - in search of more desirable habitat. During the period of most severe stratification, the depth of water containing desirable oxygen concentration becomes shallower in the deepest areas of the lake. Then fish migrate up-lake to shallower

areas resulting in a temporary lateral displacement of populations within the lake.

Major benefits to wildlife of Corps occupancy of lands purchased, but not submerged or utilized for recreation areas, were claimed for fire control efforts and the vegetation changes occurring during reversion of farm lands to forest. The District Forester stated the range to be healthy for forest animals. The 100 acres of low lands cropped and 100 acres brush-hogged are broken up into approximately 20 plots each and distributed for maximum effect. These plots and the approximate 57,000 seedling trees planted for browse and reforestation purposes are probably contributing to increases in small game, deer, and other animal populations. The State Wildlife Biologist in charge of the Twelvepole Basin stated that grouse populations were good and deer herds were growing rapidly, as shown on Table No. 8-5, next page.

The eggs and young of the year of ground-nesting birds, small mammals and reptiles are lost during a rise of 10-15 feet, those closest to the lake during smaller rises. Such a rise also kills the herbaceous vegetation which is the food source of small mammals; however, losses of these animals are not as critical due to their fecundity. The State Wildlife Biologist for Twelvepole Basin stated that although these rises do reduce the carrying capacity, there has been little observable adverse effect of flood regulation on poolside wildlife.

Also, there has been negligible effect of drought-caused drawdown on fish and wildlife. Muddy banks cause turbidity in nearby water due to the lapping of water against the bank. Many fisherman believe this lessens the catch because fishes have difficulty seeing the bait or lure. There have been no expressions of this concern at the East Lynn project including the 1973 season when the only appreciable drawdown occurred. The walleye migration mentioned above has been a part of the fish losses from the lake through the outlet works. Many of the losses occur from the minimum pool, which crowds fishes into about 68% of seasonal volume, during cold weather when they are lethargic and more likely to be drawn by a sudden current. Most fishes pass through the outlet works apparently unscathed but usually do not remain in the tailwaters long before proceeding downstream because their numbers exceed the carrying capacity of the tailwater habitat.

Extremes of high and low flows downstream from the dam are not as great as before the project (Plate No. 5-3, 1 year frequency natural flow at the damsite is 4,100 cfs; but the lesser flushing action of channel capacity discharge, 2,520 cfs, for several days while releasing flood storage has similar effects. In either case, temporarily, fish populations are displaced and food supplies diminished. The minimum discharge helps maintain the downstream fishery against the increased fishing pressure. The State Fisheries Biologist in charge stated his opinion that the major adverse effect of high discharges from the lake is the frustration of fishermen at the tailwaters because of the fast current pulling their lines downstream too quickly.

Temperature of the downstream aquatic habitat has been controlled fairly smoothly along the Outflow Temperature Regulation Curves of Plate No. 8-14. Since the curves were designed to approximate optimum temperatures for the warm water fishes common in area streams, this factor of the habitat has been much more favorable to native species than if temperature control were not practiced and outflow was limited to bottom discharge. The State Fisheries Biologist in charge remarked that although they had not evaluated the downstream fishery, it was probably in better condition than before construction of the dam.

East Lynn Lake fishing and hunting opportunities were recently analyzed according to U.S. Water Resources Council "Procedures" of December 1979 (See paragraph 8-04a later revised) and the analysis yielded points indicating $3.50/visitor-day benefits for fishing or hunting at the project. The portion of total recreation visitation at East Lynn Lake in calendar year 1998 determined to be involved in fishing or hunting was 114,900. Therefore, the fish and wildlife benefit for the year is $402,500 shown in Benefits of Operation for Authorized Purposes, Plate No. 8-13.

TABLE NO. 8-5

GAME SPECIES AT EAST LYNN LAKE PROJECT

Species	Present Population	Present Use
Ruffed Grouse	Low - Moderate	Low-Moderate
Eastern Cottontail	Moderate	High
Mourning Dove	Low	Moderate
Eastern Gray Squirrel	Moderate	High
Raccoon	Low-Moderate	Moderate-High
White-Tail Deer	Moderate	High
Groundhog	High	Moderate
Waterfowl	Low	Low-Moderate
Fox	High	High
Bobwhite Quail	Low-Moderate	Moderate

8-06 WATER SUPPLY

Prior to construction of East Lynn Lake, summer flows in East Fork below the dam site often decreased to less than 1 cfs, nearly zero, and occasionally remained there for a week or more, creating foul stagnant or near stagnant conditions that were harmful to fish and food chain organisms. Stream fisheries need flowing, oxygenated water at normal temperatures. When the first modern new environmental policies were developed nationwide they were soon applied regionally to the Twelvepole Creek Basin to resolve water shortage problems. Accordingly, East Lynn Lake was planned to provide water for both low-flow augmentation and municipal water supply, and the two functions have been combined into one purpose. The lake was designed and partitioned to guarantee the summer water supply and recreation pool of 662 feet MGVD and the winter minimum pool of 656.0 feet NGVD that would supply

an estimated need of 10 cfs continuously for the State of West Virginia. This rate was selected after a study to determine the maximum rate that does not exceed the maximum acceptable drawdown in the driest year, and this discharge is to be maintained at all times, even during closure for flood control.

East Lynn Lake inflow normally exceeds the design minimum discharge of 10 cfs plus the evaporation except during the driest periods. The increase in minimum flow below the dam discussed in 7-03a is the basis of the statement in 8-05 of benefit to the fisheries downstream, and is a large benefit to the fisheries downstream. The characteristic downstream low-flow in dry periods is indicative of very low inflows at those times, and when coupled with evaporation from the 1005 acre summer lake may cause lowered lake levels in dry weather.

Maintaining the summer pool level has been possible most of the time; however, during the long dry spring and summer of 1999 the seasonal pool could only be raised to elevation 661.8 feet NGVD by Memorial Day. The pool hovered near this level until the hot summer drought caused a loss of about one foot. Near the end of July a strong summer storm raised the pool to near elevation 663 feet NGVD and the pool hovered near elevation 662 feet NGVD until the time arrived for the winter drawdown. The pool elevations in Table No. 2-1 page 2-2, are predicated on projections of historic hydrologic conditions and the assumption that the entire allocated water supply storage will be utilized daily. It should be noted, however, that for the East Lynn Lake Project, water for the user area generally is properly regulated, making related drawdown conditions much more suited to recreational activities.

8-07 HYDROELECTRIC POWER - N.A.

8-08 NAVIGATION - N.A.

8-09 DROUGHT CONTINGENCY PLANS - N.A.

8-10 EMERGENCY DRAWDOWN

When reservoir discharge is limited to no-damage channel capacity of 2,380 cfs and inflow is constant at 370 cfs (2.76 cfs per square mile of controlled drainage area), the time required to empty the flood control pool at elevation 701.0 feet NGVD to seasonal elevation 662.0 feet NGVD, is 16.25 days. The time required to empty the flood control pool to minimum elevation, 656 feet, is 17.6 days with the same inflow and outflow. In both cases, channel conditions downstream are assumed capable of accommodating the discharge without damage. With the same inflow and all slide gates fully open, the emptying time to elevation 656 feet NGVD would be 6.4 days. An emergency drawdown schedule for East Lynn Lake is shown on Plate No. 8-17. Should emergency drawdown become necessary, various procedures such as surveillance of the dam or notification of key personnel may be placed into effect, depending upon the cause and its severity.

Detailed information concerning these emergency actions are found in the Flood Emergency Plan for East Lynn Lake.

8-11 SPECIAL PURPOSE RELEASES

A wide range of people needs involving water flow or stage within the sphere of project influence become special purposes which are evaluated for translation into regulation. The expressed need may be for a low stage downstream to allow search for a drowning victim or for fording, or construction work. It may be a medium stage for a sporting event such as canoeing, a high stage answering an emergency in the lake area or an important construction need requiring drawdown, or any of a multitude of other situations generating a request for special operation. Emergency needs are met as quickly as possible; however, requests for deviation from normal regulation must be evaluated with respect to the hydrometeorological outlook and with respect to the impact on other project purposes and must be coordinated with Reservoir Control Center in the Division Office. After evaluation and coordination, the Water Control Section Chief either directs regulation to answer the need or denies the request. Form ORD 1018R, Record of Deviation from Approved Plan, is used for special purpose regulation requests.

Examples of deviations from the approved plan of regulation which might be requested and granted were listed in sub-section 7-07. Those types from the list which have occurred at the East Lynn project are for reduced outflow to allow fording East Fork below the dam, search for a drowning victim, and construction work in the channel downstream. Higher than normal lake levels have been held for two different reasons during summer periods. They were for fishery enhancement and for downstream drought-flow augmentation. Each of the special purpose deviations from approved plan accomplished its desired effect except the one for fishery enhancement discussed in sub-section 8-05. None of them adversely impacted any authorized purpose.

8-12 FREQUENCIES AND DURATIONS

a. Natural Discharge Frequency and Duration at the Outflow Gage. The natural discharge-frequency curve for East Fork of Twelvepole Creek at the East Lynn Lake outflow gage was developed on a regional basis in accordance with methods outlined in "Statistical Methods in Hydrology", by Leo R. Beard dated January 1962 and Bulletin 17A, "Guidelines for Determining Flood Flow Frequency", published by the United States Water Resources Council and dated March 1976. A Log-Pearson Type III distribution was fitted to the annual event series at gaging stations in the Twelvepole Creek and surrounding river basins. This enabled generalized relationships to be derived which relate frequency curve characteristics, mean, standard deviation and skew, to individual basin factors. These data were utilized to make flow frequency estimates for the project drainage area.

The curve derived by plotting probable maximum flow to be expected at the damsite against exceedence interval in years, is shown as Plate No. 5-2. Flow values for certain exceedence intervals from 1 year to 1000 years are given in Table No. 8-6 below, Frequency Summary, East Fork at East Lynn Lake Outflow Gage, All Seasons, Natural.

TABLE NO. 8-6

FREQUENCY SUMMARY
EAST FORK AT EAST LYNN LAKE OUTFLOW GAGE
ALL SEASONS - NATURAL

Exceedence Interval Years	Discharge cfs
1000	19,500
500	18,000
200	16,000
100	14,400
50	13,000
20	10,900
10	9,300
5	7,700
2	5,600
1	4,100

Since March 1972, flows in East Fork have been regulated by East Lynn Lake. A computer study of the duration of flow at the outflow gage was conducted using the U.S. Geological Survey record of flow past the gage for the period March 1972 through 1978. Percent of total elapsed time during which the flow was at or above certain selected values was calculated. These flow values were then plotted against the percent of time as calculated for the full year and for each month to produce Annual and Monthly Flow Duration below East Lynn Lake, Plate No. 5-4.

b. Pool Elevation Frequency and Duration. All significant flows for the period of record at Wayne, West Virginia were tabulated and hydrographs reconstituted for the damsite or obtained by drainage-area ratio. The hydrographs were routed through the lake following the approved plan of water control and the peak pool elevation noted. Using the graphical analysis method described in Beard's work mentioned in 8-10a above, the pool elevation frequency was estimated and is shown in Frequency of Filling, Plate No 8-1. Deviation from the minimum elevation, 656 feet NGVD, was plotted as pool elevation probable of occurrence on the average once in a number of years, which is the exceedence interval, against the interval. Selected exceedence intervals with the respective maximum pool elevation expected to occur (on the average), once in that interval are listed in Table No. 8-7 Frequency Summary, East Lynn Lake Pool Elevation Deviation, next page.

TABLE NO. 8-7

FREQUENCY SUMMARY EAST LYNN LAKE
POOL ELEVATION DEVIATION - ALL SEASONS

Exceedence Interval Years	Elevation Feet NGVD
332	701.0
200	696.0
100	691.0
50	686.8
20	681.9
10	678.0
5	674.5
2	670.0
1	663.7

Pool elevation hydrographs produced when the above floods were routed through the lake were measured for amplitude (duration in days) at certain specified elevations and these tabulated by elevation. The total number of days tallied for each elevation for all the floods of the period of record was divided by the number of years of record, 65, to obtain average number of days per year at or above the elevation. The "Average" curve in Duration of Filling, Plate No. 8-2 was derived by plotting these average number of days values against the respective elevations. Amplitudes at specific elevations of the curve with the highest peak were plotted against the elevations to obtain the "Maximum Number of Days for Period of Record."

c. Control Station - Wayne, West Virginia. The natural frequency of Twelvepole Creek below Wayne was estimated using nearly the same methods and techniques of data handling and calculation as were used for East Fork at the damsite. The major difference was that a 55-year record existed for the Wayne gage, making unnecessary the regional approach used for ungaged areas. The moving of the gage in December 1966 from the upper edge of Wayne to below town, adding 9 square miles of drainage area, required adjusting the flow data accordingly. Actual peaks occurring at the gage since the East Lynn project went into operation were increased by the routed lake reductions to produce natural flows. Maximum natural flows expected to occur, on the average, once in a certain period of years, which is the exceedence interval, were plotted against the respective intervals to produce the "Natural" curve of Natural and Modified Flow Frequency Curves, All Seasons, Plate No. 5-3. Flows for selected exceedence intervals from 1 year to 1000 years are included in Table No. 8-8 Frequency Summary, Twelvepole Creek at Wayne, West Virginia, All Seasons - Natural Condition, shown on the next page.

In order to estimate modified frequencies, representative floods from the record prior to beginning operation of the East Lynn project were routed through the lake and reductions routed to the Wayne gage. These were applied to the actual (natural) and the resulting modified peaks

noted. Reductions of East Fork flows effected by the East Lynn project since March 1972 were routed to Wayne and added to the actual (modified) flows to produce the natural. The peak modified flow for each event was plotted against the peak natural flow for the event. The most representative smooth curve, to be known as the "Correlation Curve," was drawn among the points, the upper end of the curve being defined by the natural and modified of the Standard Project Flood.

TABLE NO. 8-8

FREQUENCY SUMMARY
TWELVEPOLE CREEK BELOW WAYNE, WEST VIRGINIA
ALL SEASONS

Natural Condition		Modified Condition	
Exceedence Interval Years	Discharge CFS	Exceedence Interval Years	Discharge CFS
1,000	35,500	1,000	18,600
500	31,700	500	16,700
200	27,400	200	14,500
100	24,200	100	12,800
50	21,200	50	11,200
20	17,300	20	9,200
10	14,500	10	7,700
5	11,600	5	6,200
2	8,100	2	4,550
1	6,100	1	4,000

Any point on the Correlation Curve gives, for the peak natural flow specified, the probable peak flow to be experienced at the Wayne gage because of East Lynn Lake control of East Fork flows; and exceedence intervals of modified flows are the same as those of the corresponding natural flows. Therefore, intervals of selected natural flows were plotted against their corresponding modified flows to produce the "Modified" curve of Plate No. 5-3. In order to estimate the frequency of high flows at Wayne during the crop season, the same methods and techniques of data handling and calculation were used as in the determination of the all seasons or annual frequency for the natural condition at Wayne described above. The data were limited to those of the period 15 April to 31 October each year of the record. Flows for selected intervals are listed in Table No. 8-9, Frequency Summary, Twelvepole Creek at Wayne, West Virginia, Crop Season - Natural Condition, next page. A study of duration of flow at the Wayne gage was performed for the period beginning with the commencement of regulation of flow in East Fork by East Lynn Lake in March 1972 and ending with the year 1978. Using the U.S. Geological Survey record of flow at the gaging station, the percent of total elapsed time during which the flow was at or above certain specified values was calculated by computer. These flow values were then plotted against the respective percent of time calculated for the entire year and for each month, to produce Annual and Monthly Flow Duration at Wayne Control Gage, Plate No. 5-5.

TABLE NO. 8-9

FREQUENCY SUMMARY
TWELVEPOLE CREEK BELOW WAYNE, WEST VIRGINIA
CROP SEASON - NATURAL

Exceedence Interval Years	Discharge CFS
1000	24,700
500	21,800
200	18,100
100	15,600
50	13,300
20	10,400
10	8,400
5	6,600
2	4,600
1	3,300

SECTION IX - WATER CONTROL MANAGEMENT

9-01 RESPONSIBILITIES AND ORGANIZATION

a. Corps of Engineers. General authorities for allocation and regulation of reservoir storage in projects owned and operated by the Corps of Engineers are contained in legislative authorization Acts and referenced project documents. These public laws and project documents usually contain provisions for development of water control plans, and appropriate revisions thereto, under the discretionary authority of the Chief of Engineers. Some modifications in project operation are permitted under congressional enactments subsequent to original project authorization; regardless, East Lynn Lake is fully owned and operated by the U.S. Government. The Huntington District, Corps of Engineers is the operating agency under administrative control of the Big Sandy Area office within the Operations and Readiness Division.

b. OCE Role in Water Control Activities. OCE will establish policies and guidelines applicable to all field offices and for such actions as are necessary to assure a reasonable degree of consistency in basic policies and practices in all Division areas. Assistance will be provided to field offices during emergencies and upon special request.

c. Great Lakes and Ohio River Division. The Division Engineer has primary responsibility and authority for direct action with respect to all phases of reservoir regulation, including: (a) basic policies, criteria, and concepts that determine operating plans; (b) technical evaluations; (c) field operation; and (d) review and approval of reservoir regulation plans and manuals and related activities. The Division Office will coordinate water control management activities associated with interdistrict, interdivision and interagency water resource needs. As established in accordance with ER 1110-2-1400, the Great Lakes and Ohio River Division Water Control Center is responsible for administration of the Division Engineer's policy for water control management.

d. Huntington District. The District Engineer has the primary responsibility for: (a) general management of reservoir regulation activities within their respective areas; (b) technical evaluations and performance of operations associated therewith; and (c) developing plans and manuals required for reservoirs and interrelated systems within their respective district area. The Water Control Section, within Engineering-Construction Division, is the responsible element for all water control activities which include the following reservoir project functions.

(1) Flood Control;
(2) Regulation of flows for water supply and water quality control;
(3) Navigation stage regulation;
(4) Hydropower;
(5) Recreation;

(6) Fish and Wildlife enhancement;
(7) Alleviation of sediment and erosion problems affected by reservoirs.

Water control plans include coordinated reservoir regulation schedules for project/system operation and such additional provisions as may be required to collect, analyze and disseminate basic data, prepare detailed operating instructions, assure project safety and carry out regulation of projects in an appropriate manner. Water control plans will be developed utilizing objectives and specific provisions of project authorizing legislation and applicable Corps of Engineers reports. They will include any applicable authorities established after project construction. All water control plans will be prepared with appropriate consideration to all applicable congressional acts relating to operation of Federal facilities. Included are the Fish and Wildlife Coordination Act (P.L. 85-624), Federal Water Project Recreation Act - Uniform Policies (P.L. 89-72), National Environmental Policy Act of 1969 (P.L. 91-190), and Clean Water Act of 1977 (P.L. 95-217). Thorough analysis and testing studies will be made as necessary to establish the optimum water control plans possible within prevailing constraints.

Water Resources Engineering Branch is further delegated the responsibility to coordinate the operation of specific projects with Federal and State agencies, local entities, and the general public. The Division Engineer, ATTN: CELRD-EC-W, is advised, as soon as possible, of any coordination activities which may require a study, public hearing, or revision in operating plans. Districts are required to alert the Division Engineer, ATTN: CELRD-EC-W, of any significant deviations from routine regulation plans. The communication mode for the advisory is commensurate with the urgency of the situation and is transmitted before the district implements a plan of action. An organizational chart is shown on Plate No. 9-1 for Water Control Management in the Twelvepole Creek Basin. As shown on the chart, the Recreation-Resource Management Branch and the Big Sandy Area Office are responsible for supervision of the operation and maintenance of the dam and operations area at East Lynn Lake. The Damtender (Resource Manager) at each project regulates the project in accordance with general instructions and Special Directives issued by the Water Control Section. General instructions are included in "Instructions to the Damtender", Exhibit B of this manual. Special Directives are issued and signed by the Chief, Water Control Section, for dissemination through the Project Office, as necessary to efficiently regulate the project for optimal water control management for all project purposes.

During <u>normal operations</u>, the Water Control Section of the Water Resources Engineering Branch are involved in the following activities pertaining to water control management:

(1) Routine regulation of the lakes and dissemination of pertinent data.

(2) Investigations and refinement of regulation procedures such as analysis of past floods, channel investigations, improvement of forecasting, and planning programs with other agencies.

(3) Training personnel in flood control duties with visits to projects and instructing Water Resources Engineering Branch personnel from other sections.

(4) Development and application of mathematical modeling to complex reservoir systems.

(5) Operation of the Branch hydrologic data collection and water control management system, including computers and field equipment.

(6) Developing and conducting effective public information programs to inform and educate the public regarding Corps of Engineers' water control management activities.

(7) Preparing and submitting reports on lake regulations such as daily reports, weekly reports, monthly reports, annual reports, weekly briefings, and post-flood reports.

(8) Preparing and updating water control manuals for individual projects and master manuals for basins.

During flood or other emergencies, Water Resources Engineering Branch personnel are responsible for the following activities in regard to water control management:

(1) Evaluation and dissemination of current and forecast hydrologic, hydraulic and meteorologic data.

(2) Presentation of storm and flood analysis to the District Engineer and pertinent staff members.

(3) Providing liaison personnel to support Emergency Operations Center when it is operational.

(4) Regulation of all projects and systems in accordance with approved plans.

(5) Furnishing information to others such as reports to higher authority, status to Emergency Operations Center and data to Public Affairs Office.

During a FLOOD EMERGENCY SITUATION the lines of communication between the various office elements are shown on Plate No. 9-2. Details and responsibilities of other elements are indicated in the overall district plan in the Emergency Operations Center Plan and ER 500-1-1, ER 500-2-1 and all annexes to these two ER's.

During normal non-flood periods, water control management activity is accomplished by personnel of the Water Control Section. During flood conditions and other emergencies, assistance of other Water Resources Engineering Branch personnel may be required to maintain effective water control management within the Huntington District. The area affected and magnitude of the flood determines the number of people engaged in each particular activity and assigned to each sub-basin or major river basin.

The National Weather Service and project personnel are provided with a list of names of Water Resources Engineering Branch personnel and home telephone numbers with instructions to contact them during off-duty hours if unusual conditions occur or a project is in a particular reporting schedule. During emergency conditions or flood regulation, Water Resources Engineering Branch staff are available from 18 to 24 hours daily, depending on the magnitude of a particular event. At each project, responsible personnel are on duty or on call at all times.

e. Other Federal Agencies. The National Weather Service and the U.S. Geological Survey cooperate and coordinate activity with the Water Resources Engineering Branch in regard to accumulation of rainfall and streamflow data, as well as river forecasts and discharge measurements. The Corps of Engineers is required by the Fish and Wildlife Coordination Act (48 Stat. as amended) to coordinate all plans affecting Fish and Wildlife with the U.S. Fish and Wildlife Service. The service is required to present the plans to the relevant State Agency, in this case, the West Virginia Division of Natural Resources, for their comments and recommendations. The Service then presents a combined report to the Corps including its comments and recommendations and those of the West Virginia Division of Natural Resources.

The Huntington District also works in cooperation with other Federal, State, local and private organizations and agencies, as has been illustrated throughout this report. A summary of the major relationships is shown on Plate No. 9-3.

f. Local and State Agencies. No local or state agency has funding or operational responsibilities in the Huntington District multipurpose reservoirs except in leased recreational areas. The State of West Virginia constitutionally holds in trust all wild animal life in the state on both public and private lands, and all aquatic life in public waters. The State Division of Natural Resources, as mandated by State Code, has the responsibility for conservation of fish and wildlife and for boating safety at the project lakes. The Game Protection Division of the Department of Natural Resources enforces hunting regulations and licenses on the reservoir lands.
The State has undertaken fish management at the project lakes and the Corps of Engineers cooperates in the lake level manipulation and maintenance of downstream flow requirements to enhance fisheries management.

g. Private Organizations. There are no private interests presently involved with East Lynn Lake or any of the adjacent Big Sandy or Twelvepole Basin lakes.

9-02 INTERAGENCY COORDINATION AND COOPERATION

a. National Weather Service. An agreement between the National Weather Service (NWS) and The Corps of Engineers provides for collection and dissemination of current precipitation data for the Ohio River Basin. By joint agreement, the NWS installs, maintains and operates all stations in the Ohio River Network, except those operated by the Corps of Engineer personnel at flood-control and navigation projects. Where there is a mutual need for the data, station costs are shared by both the NWS and the Corps of Engineers. Costs of stations required for reservoir regulation are borne entirely by the Corps of Engineers. In either case, an annual transfer of funds from the Corps of Engineers to NWS is made to cover the required expenditures. As described in paragraph 6-02b, NWS provides a range of tributary stage information and forecasts. The Corps reciprocates, providing NWS with all precipitation, snow cover, and stage information from reservoir and other reports, pool level and outflow forecasts, and depth reports from the District Snow Cover Reconnaissance.

b. U.S. Geological Survey. The Cooperative Stream Gaging Program was established about 1940 through cooperative arrangements between the Corps of Engineers and the USGS in order that sufficient stream flow water would be available to meet special needs in connection with the Corps water resources responsibilities. This is in keeping with the Chief of Engineers policy of fully utilizing the facilities and services of other Federal Agencies in obtaining many types of basic data. Accordingly, arrangements were made for the Geological Survey to operate specific stations for the Corps on an advance of funds basis. Although the Corps of Engineers requires the basic data, many other Federal, State, and private agencies and individuals interested use the water data. The data are published by the survey assuring maximum availability and use of all data.

The Geological Survey coordination and cooperation with the Corps, described in paragraph 6-20a, provides the Water Resources Engineering Branch with a system for obtaining reliable stage and flow information which is necessary for efficient water control management.

The annual program is formulated by the Water Resources Engineering branch in collaboration with appropriate District Chiefs of the Geological Survey. The Corps of Engineers and the local representative of the U.S. Geological Survey determine the necessary stations to provide the data for publication and the Corps is requested to furnish an estimate of the costs of installing and/or operating each station. The District Engineer forwards the selected program through the Division Engineer to the Chief of Engineers. Any supplemental instructions of a current nature necessary in connection

with preparation of the report are issued annually by the Chief of Engineers.

c. West Virginia Division of Natural Resources. Functional agreements, meetings, and contacts with various divisions of the Department of Natural Resources are discussed below. They are important to operation of the project in accordance with project purposes and with the recommendations of the West Virginia Division of Natural Resources and the U.S. Fish and Wildlife Service.

The West Virginia Division of Natural Resources maintains an Office of Corps Liaison for the purpose of coordinating special releases from Corps Lakes for recreational or other purposes. This office receives all requests for special regulation and, after examining the request and appending to it any WVDNR comments, sends the request to the District Office. Using the Corps based guidance policies and criteria a determination is then made, and this decision is then sent back to the WVDNR to coordinate with the organization making the request.

The Water Control Section cooperates with the Recreation and Parks Division of West Virginia Division of Natural Resources by manipulation lake levels as needed.

The Huntington District cooperates with the Fisheries Section of the Division of Wildlife of the West Virginia Division of Natural Resources in lake level manipulation by making special efforts to maintain constant pool elevations during April, May, June for spawning benefit.

The West Virginia Department of Forestry at Charleston, all project lake Corps Personnel, and project lake state park personnel cooperates in fire-fighting activities to suppress fires that threaten or are burning on project lands. Project personnel cooperates by taking training in fire suppression techniques, reporting such fires to the WVDNR District Forester, fighting the fires before State personnel arrive and by assisting their suppression efforts after arrival.

The Parks and Recreation Division will enforce the Boating safety and water regulations, while hunting and fishing licensure procedure enforcement is by the Division of Wildlife. There is frequent day-to-day contact between project personnel and West Virginia Division of Natural Resources personnel through much of the year.

d. Other State, Federal, Local or Private Agencies. The Corps of Engineers receives requests for information, aid, or cooperation from many parties or groups. All legitimate responsible requests from Federal, State, local, or private organizations receive appropriate attention and consideration. Accuracy of information transmitted and the proper level or amount of aid or cooperation given is commanded by District policy. Huntington District reacts quickly in disaster situations, allocating material and man power when needs are in Corps areas of responsibility and expertise. In certain cases, such as potential downstream flooding concerns or emergency complications involving regulation of East Lynn Lake, the District Emergency

Operations Manager coordinates with the West Virginia Disaster Services Agency. An example of cooperation with a State entity is an occasion when the Corps studies damages and reconstruction costs due to a flood or other disaster for the office of the Governor to use in applying for Federal assistance.

In accord with the Corps of Engineers statutory responsibility for operation of its reservoirs in the public interest, the Great Lakes and Ohio River Division Engineer organized the Reservoir Operation Coordinating Group for the Ohio River Basin as a vehicle for perceiving, interpreting, and prioritizing that interest. The Group is composed of the twelve basin states, the Tennessee Valley Authority, six Federal Agencies, and two regional commissions, which are Ohio River Oriented. The Group meets three times yearly and provides a mechanism for a two-way communication through various levels of government and among various agencies of government and other organizations, which serve the public. Meetings of the Group have the stated mission of bringing focus to the publics varied interests in reservoir regulation and accordingly perfecting that regulation to the maximum extent possible.

Water Control Section personnel will send to each meeting a report which summarizes hydrologic and meteorologic situations in the district for the preceding three month or six month period highlighting pertinent events, flood control activity, and special operations by each project.

e. Press Releases. Huntington District Office and the National Weather Service, coordinate in forecasting flood stages. Local press is provided with information of flood forecasts as furnished by the National Weather Services (officially responsible for issuing flood warnings). This information will be supplemented by the Corps with available information on observed conditions and with technical advise to enable local interests, within the limits of their capabilities, to obtain optimum flood protection, and to perform rescue and relief functions.

The District Office releases various other items to the press for public dissemination. Some of these are in the public interest such as drawdown announcements or notification of a change in or opening of a new facility or service at a reservoir. Some releases are to enlist public cooperation and some, such as reports of flood damages saved by regulation of certain reservoirs, are to inform the public of the benefits derived from Corps-built projects.

9-03 INTERAGENCY AGREEMENTS, MEETINGS AND ORGANIZATIONS

Agreements among the Corps of Engineers, the U.S. Geological Survey, and the National Weather Service are mentioned and outlined in paragraphs 6-02a and b. An annual meeting is held with each of the State branches of the Geological Survey cooperating in the Stream Gaging Program. The Corps and Weather Service mutually agree upon

scheduling of meetings concerning the Ohio River Network on an as-needed basis.

In the interest of fire protection for visitors, employees, property and animal and plant life, the District executed a memorandum of understanding covering all Corps reservoir projects in West Virginia with the West Virginia Division of Natural Resources to be administered by the Division of Forestry. The understanding includes cooperative warning and suppression of fires on or threatening Corps owned lands, West Virginia Division of Natural Resources maintenance of a standard cache of fire-fighting tools at the project, and payment by the Corps of extinguishment costs incurred by the West Virginia Division of Natural Resources.

The Great Lakes and Ohio River Division Water Management Branch holds a quarterly meeting of the Reservoir Operations Coordinating Group. The meeting is normally attended by representatives of Federal, Regional, and State agencies and commissions; along with Corps representatives of District and Division reservoir regulation elements. The purpose of the meeting is to exchange information and views on regional water resource concerns.

9-04 HUNTINGTON DISTRICT REPORTS

Table No. 9-1 back of section at back contains a listing of the various Periodic and Special reports provided by the District Water Resources Engineering Branch.

a. Periodic.

(1) Daily. Districts are required to report current hydrologic data daily as prescribed by the Division Office. A daily report is prepared five days per week by the Water Control Section of Water Resources Engineering Branch and, when staffing is provided, as under flooding conditions, on Saturdays, Sundays and holidays. It is prepared as detailed in sub-section 4-1b Instructions to Damtender and inserted into a computer file. After review, the report is sent over a leased line to the LRD water control system. The transmission includes morning lake elevation, rate and temperature of outflow, and 3-day forecast of lake and outflow for all reservoir projects. Ohio River morning stages and 24-hour rainfall, morning stage and flow and 5-day flow forecast for Ohio River tributary gage points complete the transmission and the report. The report items are prepared in accordance with ORDER 1110-2-20, CHORD-ED-W lt, 10 Jul 69, CHORD-ED-W lt, 23 Jan 67, and ORDER 1110-2-17.

Daily or more frequent briefings of the District Engineer and Chief Engineer containing pertinent hydrologic and meteorologic information are made during flood or other emergencies.

In carrying out water control activities, Corps of Engineers personnel must recognize and observe the legal responsibility of the National Weather Service (NWS) and the National Oceanic and Atmospheric

Administration (NOAA) for issuing weather forecasts and flood warnings, including river discharges and stages. River forecasts prepared by the Corps of Engineers in the execution of its responsibilities should not be released to the general public, unless the NWS is willing to make the release or agrees to such dissemination. However, release to interested parties of factual information on current storms or river conditions and properly quoted NWS forecasts is permissible. District offices are encouraged to provide assistance to communities and individuals regarding the impact of forecasted floods. Typical advice would be to provide approximate water surface elevations at locations upstream and downstream of the NWS forecasting stream gages. Announcement of anticipated changes in reservoir release rates as far in advance as possible to the general public is the responsibility of Corps of Engineers' water control managers for projects under their jurisdiction.

(2) Weekly. Each week a list of 24-hour reservoir effects at tributary gage points is transmitted to CELRD. The list, which gives flows in cfs held out from or added to the natural flow, shows the data for the entire week. All of the key gage points are reported for the East Lynn Lake, Twelvepole Creek, and Ohio River Basin. The main stem points are located at Wayne, Lavalette, and Huntington, West Virginia.

During any flood, drought or other emergency involving reservoirs, the Ohio River or other streams in the District, the Water resources Engineering Branch provides all available information to the District Engineer, Chief of Engineers and interested elements as frequently as necessary.

(3) Monthly. Engineer Regulation No. 1110-2-240, dated 8 October 1982 requires that a monthly record of reservoirs operated by the District be promptly prepared by the Water Control Section according to 33 CFR 208.11 and maintained in tabular form readily available for transmittal to the Chief of Engineers or others on request.

(4) Quarterly Reservoir Operations. Each District provides a quarterly review of meteorological influences and water control management activities to each of the four yearly meetings of the Reservoir Operations Coordinating Group. Huntington District personnel of the Water Control Section summarize and compare weather experienced with long-term normals and actual streamflows to mean annual values. They describe seasonal features of operation such as spring filling, summer outflow temperature control or fall drawdown, frozen lakes and effect of river ice on navigation, in addition to any significant flood control operations and damages prevented.

(5) Annual. The Division Engineer is required by ORDR 1110-2-27 and CEORD-ED-W Ltr, 30 Sep l977 to submit to OCE for approval an annual report on reservoir regulation activities of significance during the fiscal year ending and programs proposed for the year following. This report summarizes the water control activities throughout the Ohio River Basin. Therefore district input

is mandatory. The following documentation of district programs and activities is requested by 1 November of each year:

(a) A brief summary highlighting the significant accomplishments attributed to each reservoir during the preceding fiscal year.

(b) Reservoir regulation manual submission schedule.

(c) Concise report on major accomplishments concerning personnel, training, model application, ADP use, data reporting and analysis, and general improvements in reservoir regulation activities.

By Executive Order 12088, the President ordered the head of each Executive Agency to be responsible for ensuring that all necessary actions are taken for prevention, control, and abatement of environmental pollution with respect to Federal facilities and activities under control of the agency. An annual Division Water Quality report is required by ORDR-2-26. The report is submitted in two parts. The first part addresses the division Water Quality management plan while the second part presents specific project information. A major objective of this report is to summarize information pertinent to overall water management responsibilities. An Annual Water Quality Report by Districts to LRD includes narrative and tabular summaries of water quality activities and conditions in the Districts. The District report contains a synopsis of activities, specific cases of interest, improvements during the year, and plans for future emphasis. The tabular portion includes an overview of water quality activities, an overview of water quality conditions, specific water quality control actions in coordination with the Water Control Section, aimed at identification or solution of problems and problems requiring special studies with schedules for executing the studies. The annual water quality report is submitted by 1 December of each year.

b. Special Reports.

(1) Reports on Reservoir Operations During Flood Emergencies. Information on reservoir operations to be included in reports submitted to the Chief of Engineers during flood emergencies in accordance with ER 500-1-1 include rate of inflow and outflow in cfs, reservoir levels, predicted maximum level and anticipated date, and percent of flood control storage utilized to date. Maximum use should be made of computerized communication facilities in reporting project status to DAEN-CWO-E/CWE-HY in accordance with the requirements of ER 500-1-1.

(2) Post-Flood Report. Information on the operation of the affected reservoirs is gathered in accordance with ER 500-1-1. This report provides details on antecedent meteorologic and hydrologic conditions, description of the performance of the dam and appurtenant works, detailed analysis of the operating procedures, and effects of reservoir operation on Twelvepole Creek and the Ohio River. Reservoir

effects include evaluation of the stage reductions at key stations and estimates of damages prevented. Conclusions are discussed with regard to adequacy of operating technique, performance of structures, and benefits derived from operations during the flood. The outline of a typical post flood report is given below.

I- Authority, Purpose And Scope
II- Basin Description
Impact of Flood

III- General Precipitation
Storms and Reservoirs
IV- Damages and Flooding

V- Antecedent Rainfall
Storm Rainfall and Runoff
VI- General Method of Operation
Emergency and Standing Instructions
Flood Control Operations during Storms
Special Operations
Operations during Release Period
Results of Operation
Flood Damages Eliminated

VII- Computer Programs Utilized
Special Flood Activity

(3) Fiscal year budget requests. Fiscal year budget requests for water control management activities are prepared and submitted to the Office of the Chief of Engineers in accordance with requirements established in Engineer Circular on Annual Budget Requests for Civil Works Activities. The total annual costs of all activities and facilities that support the water control functions (excluding physical operation of projects, but including flood control and regulation of navigation projects subject to 33 CFR 208.11) are reported. Information on the Water Control Data Systems and associated Communications Category of the Plant Replacement and Improvement Program is submitted with the annual budget. Reporting is in accordance with an Engineer Regulation and the annual Engineer Circular on Civil Works Operations and Maintenance, General Program.

(4) The Chief of Engineers. The Chief of Engineers and staff require information to respond to inquiries from members of Congress and others regarding runoff potentials. Therefore, the Division Engineer submits a snowmelt runoff and flood potential letter report covering the snow accumulation and runoff period, beginning generally in February and continuing monthly, until the potential no longer exists. Dispatch of supplemental reports is determined by the urgencies of situations as they occur. The reports are forwarded as soon as hydrologic data are available, but not later than the 10^{th} of the month. For further information on reporting refer to ER 500-1-1.

(5) Major drought situations. During major droughts or extreme low-flow conditions, narrative summaries of the situation should be furnished to alert the Chief of Engineers regarding the possibility of serious runoff deficiencies that are likely to precipitate actions associated with Corps of Engineers' reservoirs.

(6) Master Plans. Division water control managers will develop Master plans for water control data systems and significant revisions thereto. They are submitted to HQDA (DAEN-CWE-HY) Washington, DC 20314, for review and approval of engineering aspects. Engineering approval does not constitute funding approval. After engineering approval is obtained, equipment in the master plan is eligible for consideration in the funding processes described in ER 1125-2-301 and Engineering Circulars on the Annual Budget Request for Civil Works Activities. Master plans are maintained current and are updated as necessary to meet needs.

Modified master plans are submitted by 1 February if revisions are required to include equipment not previously approved or for changes in scope or approach. Submittal by the February date allows adequate time for OCE review and approval prior to annual budget submittals.

(7) Miscellaneous. Any additional or pertinent reports required from higher authority will be promptly compiled and transmitted.

TABLE NO. 9-1

HUNTINGTON DISTRICT REPORTS
BY
WATER RESOURCES ENGINEERING BRANCH

PERIODIC REPORTS - Computer reports keyed to forms formerly completed by hand as follows:

Daily - Computer reports of observed and forecast stages and flows including:

- Morning reservoir pool elevation, outflow, outflow temperature and three-day pool and outflow forecast.

- 24-hour rainfall, morning stage, flow and five-day flow forecasts at Ohio River tributary gage points.

Weekly Reservoir effects at Ohio River tributary gage points.

Monthly Records of District reservoirs available on request.

Annually Summary of significant reservoir regulation activities for the year and of programs proposed for the following year.

SPECIAL REPORTS

Daily or more frequent briefing of District Engineer and Chief Engineer during flood or other emergencies containing hydrologic, meteorologic, and operational information, when and as requested.

Information relevant to flooded area or situation to the Emergency Operations Center (when functioning) such as pertinent data about the area, copies of reservoir morning and extra reports, relay of any verbal reports, relevant NWS zone forecasts and special bulletins, and computer generated isohyetal maps of the District.

Reports on reservoir operations to OCE during flood emergencies including inflow, outflow, pool elevation, predicted crest, and maximum storage utilization to date.

Post-flood reports.

Budget requests for water control management activities to OCE.
Snowmelt runoff and flood potential reports to OCE.

Narrative summaries of major drought or low-flow conditions likely to require special regulation of District reservoirs.

Master plans for water control data systems and significant revisions thereto are submitted to HQDA (DAEN-CWE-HY) Washington, DC 20314, for review and approval of engineering.

Table No. 4-2

TEMPERATURE SUMMARY - TWELVEPOLE CREEK BASIN

STATION	Yrs. of Record	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Maximum Temperature - Degrees F.														
Cabwaylingo State Forest, W.V.	13	79	78	90	90	101	98	102	101	101	93	85	78	102
Huntington, W.V. Airport	20	74	79	85	90	92	95	99	100	96	86	82	76	100
Minimum Temperture - Degrees F.														
Cabwaylingo State Forest, W.V.	13	-9	-10	0	18	28	41	46	43	32	15	5	-3	-10
Huntington, W.V. Airport	20	-15	-6	-2	22	27	40	46	43	35	16	8	-5	-15
Average Monthly and Annual Temperature - Degrees F.														
Cabwaylingo State Forest, W.V.	13	36.8	39.3	43.9	55.5	63.6	70.7	74.6	72.2	67.2	56.1	43.7	36.8	53.7
Huntington, W.V. Airport	20	31.4	34.2	45.8	55.3	63.8	71.1	74.7	73.7	67.6	55.9	45.9	36.7	54.6
Average Maximum Monthly and Annual Temperature - Degrees F.														
Cabwaylingo State Forest, W.V.	13	45.7	51.6	57.1	71.4	78.5	84.0	87.7	87.1	82.9	69.8	58.2	48.6	67.8
Huntington, W.V. Airport	20	40.0	43.4	56.2	66.8	75.3	82.0	84.8	83.6	77.8	67.0	55.1	45.1	64.8
Average Minimum Monthly and Annual Temperture - Degrees F.														
Cabwaylingo State Forest, W.V.	13	23.7	26.1	30.4	45.4	48.2	56.5	61.3	54.3	47.7	36.0	30.4	24.5	40.1
Huntington, W.V. Airport	20	22.9	25.1	35.3	43.8	52.3	60.1	64.7	63.8	57.3	44.7	36.6	28.4	44.6

Table No. 4-3

PRECIPITATION SUMMARY - TWELVEPOLE CREEK BASIN

STATION	Yrs. of Record	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Maximum Monthly and Annual Precipitation.														
Cabwaylingo State Park, W.V.		10.62	9.07	9.81	7.50	7.43	9.49	10.40	7.35	9.81	6.54	5.83	7.02	63.25
Huntington, W.V. Airport		6.37	5.66	7.54	6.56	9.26	8.43	8.57	6.86	5.64	5.54	5.17	8.69	53.87
Minimum Monthly and Annual Precipitation														
Cabwaylingo State Park, W.V.		1.84	1.72	1.29	2.11	2.24	1.99	1.24	2.30	0.82	0.26	1.53	1.64	39.11
Huntington, W.V. Airport		1.12	0.53	1.12	0.74	0.93	0.41	1.37	0.68	0.58	T	0.73	0.31	29.99
Average Monthly and Annual Precipitation														
Cabwaylingo State Park, W.V.		4.85	4.03	4.59	4.17	4.52	4.73	5.44	3.99	3.54	2.74	2.82	3.78	48.16
Huntington, W.V. Airport		3.07	2.62	4.07	3.55	3.88	3.53	4.73	3.92	3.04	2.64	2.98	3.18	41.10
Average Monthly and Annual Snowfall														
Cabwaylingo State Park, W.V.	Incomplete Record													
Huntington, W.V. Airport		9.2	7.3	3.5	0.1						T	1.5	3.6	25.2

TABLE NO. 5-1

EAST LYNN BASIN
STREAMGAGING NETWORK - PERTINENT DATA

Stream and Station	Zero Gage Elevation Feet NGVD	Drainage area Sq. Mi.	Date Established Mo./Yr.	Existing Station Facilities	Proposed Equipment	Method of Obtaining Data
East Fork of Twelvepole Creek (near) Dunlow, WV N	710.00	38.2	12/64	Stevens continuous recorder called strip chart, an Analog-to-digital recorder, called ADR, data collection platform (shortened to DCP). Other gages include a tape and staff, a tipping bucket precipitation gage, and a water temperature probe.		Project personnel or computer call DCP and include readings in regular and extra reports. DCP transmits mits to downlink via GOES satellite and data retrieved by Water Control System(WCS).
East Fork of Twelvepole Creek at East Lynn Lake	NGVD	133	3/72	Strip chart, ADR, DCP. Other gage include a tape and staff. Remotes to office.	DCP capable of responding to computer via land line.	Project personnel view digital readout and include readings in regular and extra reports. DCP transmits via GOES statel-lite to downlink and data retrieved by WCS.
East Fork of Twelvepole Creek below East Lynn Lake	600.00	138	4/67	ADR, DCP with digital reading remoted to project office. Other gages include a tape and staff, a tipping bucket precipitation gage and a water temp-erature probe.	DCP capable of responding to computer via land line.	Project personnel view digital readout and include readings in regular and extra reports. DCP transmits via GOES satel-lite to downlink and data retrieved by WCS.
Twelvepole Creek below Wayne, WV	560.00	300	12/66*	Strip chart, ADR, DCP. Other gages include a tape, staff, and a wire weight gage and a tipping bucket precipitation gage.		Project personnel or computer call DCP and include readings in regular and extra reports. Reservoir Control personnel call DCP in flood time. DCP transmits via GOES satellite to downlink and data retrieved water control system.

* Originally established July 1915 upstream at Wayne (291 sq. mi.).
Record intermittent: Water years - 1916-17, 1929-31, 1947-66.

Table No. 5-2

PRECIPITATION STATIONS IN AND NEAR
EAST LYNN BASIN - PERTINENT DATA

Record From	Station	Equipment	Method of Obtaining Data	Reporting Criteria
7/69	Dingess (1)	8-inch rain gage	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	
	Dingess (2)	Tipping bucket gage, ADR and, data collection platform (shortened to "platform")	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	Data collection interval 60 minutes.
7/69	Dunlow (1)	8-inch rain gage	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	
8/80	Dunlow (2)*	Tipping bucket gage with heater, ADR, and platform	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	Data collection interval keyed to cam of water-stage recorder, 30 minute update.

Table No. 5-2 (Cont'd)

Record From	Station	Equipment	Method of Obtaining Data	Reporting Criteria
7/69	Genoa (1)	8 inch rain gage	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	
7/69	Ranger (1)	8 inch rain gage	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	
1/71	East Lynn Project (1)	8 inch rain gage	Project personnel gage collector and include reading in morning report. Extra reports by telephone.	Daily at 0730 amount of precipitation collected in previous 24 hours. Extra at 1330 if 0.5 inch or more collected after 0730.
9/80	East Lynn Project Outflow (2)	Tipping bucket gage with heater, ADR, and platform	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	Data collection interval keyed to cam of water stage recorder, 30 minute update.

Table No. 5-2 (Cont'd)

Record From	Station	Equipment	Method of Obtaining Data	Reporting Criteria
6/72	Wayne-State Highway Garage	8 inch rain gage	Garage personnel, gage the collector and transmit reading over Highway Network, thence to Water Resources Engineering Branch mini-computer via National Weather Service, Charleston.	About 1 inch collected in 24 hours prior to 0700 hours.
8/80	Wayne (2)**	Tipping bucket gage with heater, ADR, and platform	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	Data collection interval keyed to cam of water-stage recorder, 30 minute update.
4/82	Nestlow (2)	Tipping bucket gage with heater, ADR, and platform	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	Data collection interval 60 minutes.
11/72	Beech Fork Project (1)	8 inch rain gage	Project personnel include in morning report. Extra reports by telephone.	Daily at 0730, amount of precipitation collected in previous 24 hours. Extra at 1330 if 0.5 inch or more collected after 0730.
3/82	Beech Fork Project, Intake Structure (2)	Tipping bucket gage with heater, ADR, and platform	Platform transmits via satellite to receiver each 4 hours. Water control system retrieves data.	Data collection interval keyed to cam of water stage recorder, 60 minute update.

Table No. 5-2 (Cont'd)

Record From	Station	Equipment	Method of Obtaining Data	Reporting Criteria
1/61	Huntington Airport	8 inch weighing main gage with strip-chart recorder. Tipping bucket rain gage with digital counter.	Weather Service personnel insert readings to Synoptic Reporting System, Suitland, MD, via the Kansas City office. Charleston Weather Service accesses Suitland for the readings and includes with other data inserted to the water-control system.	Full report from weighing gage, checking with tipping bucket, at 0700, 1300, 1900 and 0100 hours. Report from tipping bucket gage at 1000, 1600, 2200, and 0400 hours.

(1) Ohio River Network, cooperative with National Weather Service.
(2) Installation, maintenance, and ownership by Corps of Engineers.
* At U.S. Geological Survey gaging station on East Fork near Dunlow (inflow station).
** At U.S. Geological Survey gaging station on Twelvepole Creek below Wayne.

Table No. 5-6

WATER LEVEL WARNINGS AT EAST LYNN LAKE AREAS

Project	Party Warned	Manner of Issuance	Criterion	Action Taken	Telephone Number
East Lynn Lake	Campers at East Fork Campground	Spoken in person	Fast rising pool at elevation 665.0	Evacuate campground off access road.	
East Lynn Lake	Campers at East Fork Campground	Spoken in person	Slow-rising or stable pool between elevations 665.0 and 667.1	Direct affected campers to higher ground	
East Lynn Lake	Campers at East Fork Campground	Spoken in person	Slow-rising pool at elevation 667.3	Evacuate campground. Chain off access road.	
East Lynn Lake	Marina Operator	Telephone	Pool elevation 667 feet during recreation season with likelihood of further rise.	Operator disconnect fuel, water, and electric lines.	[redacted]
East Lynn Lake	Marina Operator	Telephone	Beginning drawdown earlier than 1 November	Adjust winches as necessary. Continue operations until low temperature stops business. Then top off gasoline fuel tanks and disconnect fuel and water lines.	[redacted]
East Lynn Lake	None		Beginning drawdown on 1 November	Marina closing operation dis- Disconnect fuel and water lines. Top off fuel tanks. Turn off electric power but do not disconnect on behalf of weekend users of docked boats. Adjust winches as necessary.	[redacted]

Table No. 5-6 (Cont'd)

WATER LEVEL WARNINGS AT EAST LYNN LAKE AREAS

Project	Party Warned	Manner of Issuance	Criterion	Action Taken	Telephone Number
East Lynn Lake	Marina Operator	Telephone	Winter flood forecast with pool height to 664 or higher	Operator disconnect electric supply line at or below elevation 667. Adjust winches as necessary.	
East Lynn Lake	None		Beginning filling on or near 1 April	Operator adjust winches as necessary.	
East Lynn Lake	Lick Creek Boat Launch users	Spoken in person	Pool elevation 666 feet msl.	Evacuate. Set portable barricades.	
East Lynn Lake	Downstream recreators	Discharge Warning Horn	Any increase in gate aperture.	Parents assure child safety.	

PERTINENT DATA

EAST LYNN LAKE, WEST VIRGINIA

LOCATION OF DAM: Six air miles south-southeast of Wayne, seat of Wayne County, West Virginia. On East Fork of Twelvepole Creek: 10.0 miles above the mouth of East Fork and 42.0 miles above the mouth of Twelvepole.

AUTHORITY: Flood control act of 1938.

PURPOSES SERVED: Flood control, recreation, fish and wildlife conservation.

DAM: Type-rolled earthfill, maximum height 113' above streambed, top length 652'.

SPILLWAY: Uncontrolled saddle spillway, crest length 230'.

OUTLET WORKS: Intake structure, 13' diameter concrete lined, circular tunnel 625' in length, outlet monolith and transition. Flow regulated by three 5'8"x10'0" hydraulically operated slide gates. Low-flow system has two 4'x3' inlets, one each at invert elevations 658 and 649, with discharge controlled by a 30" hydraulically operated gate valve.

OTHER STRUCTURES: None

RESERVOIR DESIGN FLOOD PEAK FLOW: 25,700 CFS.

MAXIMUM FLOW OF RECORD AT DAMSITE: 10,400 CFS (feb 39)

DRAINAGE AREA ABOVE DAM: 133 Square Miles.

Pertinent data (cont'd)

RESERVOIR DATA: Streambed elevation at dam: 612 feet NGVD.

Pool	Surface Elevation (Ft above Sea level)	Surface Area (Acres)	Backwater along Main Stream (Miles)	Capacity Ac Ft Thousands) Net	Capacity Ac Ft Thousands) Gross	Inches of runoff Net	Inches of runoff Gross
Year Round Storage:							
Minimum	656	823		11.7	11.7	1.6	1.6
Seasonal Storage (Summer):	663.0	1005	12.7	5.5	17.2	0.8	2.4
Flood Control Storage*							
Winter	701	2351		+70.8	82.5	10.0	11.6
Summer	701	2351		++65.3	82.5	9.2	11.6
Total	701	2351		82.5	82.5	11.6	11.6

*At maximum pool level.
+Between elevations 656 and 701.
++Between elevations 662 and 701.

NET LAND USE: Fee - 24,821 acres
Easement 23.4 acres

STATUS: The Project is complete.

COST: Estimated construction $37,026,000

U.S. ARMY
CORPS OF ENGINEERS
HUNTINGTON DISTRICT

HUNTINGTON, WEST VIRGINIA

TWELVEPOLE CREEK BASIN
WEST VIRGINIA

PROJECT MANUAL
FOR
WATER CONTROL MANAGEMENT
EAST LYNN LAKE – TWELVEPOLE CREEK

INSTRUCTIONS TO DAMTENDER
EAST LYNN LAKE
JANUARY 2001

EXHIBIT B

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INSTRUCTIONS TO DAMTENDER
EAST LYNN LAKE

SECTION I - GENERAL OPERATION INSTRUCTIONS

1-01 GENERAL

Follow instructions in this Section at all times except when other operations are required by Special Directives issued by the Water Control Section of the Huntington District Office.

a. In order to maintain downstream aquatic environment, maintain an outflow of 10 cfs (a stage of 1.42 feet on the "O" outflow gage) at all times, including periods of closure for flood control.

b. Instructions contained in Special Directives will be applicable for a specific operation or for a stated period of time. After the instructions specified have been executed, resume operations in accordance with the following general instructions.

1-02 GATE REGULATION TECHNIQUE

a. General. Facilities provided for water control include three slide gates for sluice discharges, two upper level inlets for low flow discharges, and the emergency spillway. Speed of movement of the gates is fully controlled by hydraulic machinery. Sequence and manner of operation, where applicable, appear in subsequent paragraphs. The gates are to be operated in order to avoid a change in stage at the "O" gage greater than 1.0 foot per hour, except under a Special Directive from the Water Control Section, or in emergency conditions, under provisions of sub-section 1-06.

The three 5'8" X 10'0" slide gate openings have inverts at elevation 616.0 feet NGVD, facing downstream are designated slide left-SL, slide center- SC, and slide right-SR.

The two low-flow inlets are designated I4 and I13 and have inverts at elevations 658 feet and 649 feet NGVD, respectively. The 4ft by 3ft inlets open into a dry well that empties at the bottom by a pipe leading to the right hand sluice downstream from SR. Flow through the pipe is controlled by a 30-inch diameter gate valve designated LFC. A stage of approximately 3.05 feet at the "O" gage, equivalent discharge 154 cfs, can be maintained through the open LFC if the lake level is at elevation 662 feet NGVD, with slightly larger flows when the lake level is at higher elevations. During the period of lake stratification, when the lake level is below elevation 667 feet NGVD, the low-flow system is used for all releases except for small flows through a slide gate which may be required for additional discharge above system capacity required for pool control, or as required by a Special Directive.

However, with only one intake open, do not exceed the appropriate openings for LFC on Plate No. 1-4 and 1-5. This safety precaution is to avoid possible damage or harm to the intake valve.

b. Slide Gates. The three rectangular 6'8" X 10'6" slide gates, are designated slide left, SL, slide center, SC, and slide right, SR, facing downstream, and have inverts at elevation 616.0 feet NGVD. Plate Nos. I-1, I-2, and I-3 are respectively, tabulations of settings of one single gate, plus combinations of one or two slide gates SL, SC, or SR with corresponding stages and discharges at the "O" gage while the lake is at various elevations. Using these settings and ratings, the approximate gate openings required to maintain a designated stage at the "O" gage can be determined.

When the flow at the "O" gage has stabilized after making a gate change, only minor adjustments should be necessary to maintain the designated stage at the "O" gage. Operate the gates in rotation, so as to approximately equalize wear on the mechanisms. However; when releasing bottom water through a slide gate in conjunction with the low-flow system, utilize SL or SC since the low-flow discharge enters the right hand sluice.

c. Low-Flow System. The low-flow system is designed for use primarily during periods of lake stratification in the interest of water quality and downstream temperature control but may be used at any other time the pool level is below elevation 667 feet NGVD. The two 3ft by 4ft rectangular low-flow inlets previously mentioned above, I-4 and I-13, have inverts respectively 4 feet and 13 feet below the lake surface at seasonal elevation 662 feet NGVD. They are utilized to release water from those respective depths in the pool to meet downstream quality and temperature requirements as outlined in sub-section 1-04 below and for pool control. I4 and I13 are not designed for partial openings and are to be used in only fully open or fully closed position. Plate No. 1-4 and No. 1-5 present approximate LFC valve openings necessary to effect specified stages at the "O" gage and equivalent rates of discharge from the lake at various elevations. The maximum flow through the selective withdrawal system with one or both intake gate open is about 170 cfs; this safety precaution prevents possible high-velocity damage to the gate.

When given an intake gate designation, I-4 or I-13, and outflow stage, refer to Plate 1-4 or Plate No. 1-5 for setting of LFC. When the flow at the “O” gage has stabilized, only minor adjustment of LFC should be necessary to maintain the desired stage. When the pool rises to the level of the platform, elevation 667 feet, the low-flow control valve, LFC, must be closed and not be reopened until the lake has receded to the elevation 667 feet NGVD to avoid possible damage. This safety procedure is to prevent any damage to the gratings over the well, which could be closed by partial clogging by debris and/or vortex action.

Water Quality Section directs all regulation for temperature and water quality control. Water Quality personnel compare the target temperature from the Outflow Temperature Objective, Plate No. 7-9 main text, with the latest water quality profile and hourly outflow temperature readings. From these values a scheme of regulation is devised to meet the target temperature with the best available water.

Elevations of inlets and desired discharge volume are considered along with temperature and dissolved oxygen concentration of the water at each inlet elevation.

The Water Quality Section directs all regulation for temperature and water quality control. When given an intake gate designation, I4 or I13, and outflow stage, refer to Plate 1-4 or Plate No. 1-5 for setting of LFC. When the flow at the "O" gage has stabilized, only minor adjustment of LFC should be necessary to maintain the desired stage.

In order to support downstream aquatic environment continuous year-round minimum outflows of 10 cfs, (1.42 feet on the “O” outflow gage) are maintained; provided there is sufficient storage available above the lower limiting rule curve. The maximum and minimum controlling out flows and stages for the Twelvepole Creek Basin, with and without a Special Directive, are shown below on Table No. 1-1.

TABLE NO. 1-1
CONTROL STAGES AND TRAVEL TIMES

		MIANO (16 Apr-30 Nov)		DEMIA (1 Dec-15 Apr)		Time of
Station	Stream	Stage Feet	Flow cfs	Stage Feet	Flow cfs	Travel Hours
MINIMUM AT ALL TIMES IF AVAILABLE						
East Lynn	East Fk “O”	1.42	10	1.42	10	.25
WITHOUT A SPECIAL DIRECTIVE FROM WATER CONTROL SECTION						
East Lynn	East Fk “O”	7.4	1,075	7.4	1,075	.25
WITH A SPECIAL DIRECTIVE FROM WATER CONTROL SECTION						
East Lynn	East Fk ”O”	12.1	2,380	12.1	2,380	.25
Wayne	Twelvepole	18.0	4,500	22.0	6,500	3
Ashland	Ohio River	52.0	-	52.0	-	30

Plate Nos. I-4 and I–5 contain data for discharge with one and/or two Low-Flow inlets (I-4 and I-13) open with varying pool elevations, respectively. However, with only one intake open, do not exceed the appropriate openings for LFC shown on Plate No. 1-4 or 1-5. This safety precaution is to avoid possible damage or harm to the intake gate.

When the pool rises to the level of the platform, elevation 667 feet NGVD, the low-flow control valve, LFC, must be closed and not be reopened until the lake has receded to elevation 667 feet NGVD to avoid possible damage.

1-03 ROUTINE OPERATION

The Rule Curves for Reservoir Regulation, Plate No. 7-7 main text, shows two main elevations, 656 feet NGVD(DEMIA)* and 662 feet NGVD (MIANO)*, at which to hold the lake level during winter and recreation seasons, respectively, barring flood control operation, Special Directive or drought.

Under normal conditions as defined in Plate No. 3-1, designated project staff as listed in Section IV of these instructions are responsible for reservoir regulation to maintain the pool level at or near designated elevations by operating the slide gates to effect discharges up to 1,190 cfs, equal to 7.4 feet on the "O" gage, as necessary. If unable to prevent the pool level from rising 2 feet above designated elevation, telephone the Water Control Section for instructions except under communications failure as outlined in sub-section 1-06 below.

Operation during dry weather will probably result in pool elevations between the upper and lower limiting rule curves. Water Quality releases will be reduced to actual inflow or minimum flow, whichever is greater, when the lake level recedes to the intermediate rule curve. In case of prolonged drought, which would normally occur during the recreation season, the minimum flow could be continued to when the lake level falls to nearly 656 feet NGVD, which constitutes the lower limiting rule curve. At this point the Water Control Section will determine whether to continue discharging the stated 10 cfs flow or to reduce to a lower value.

Special instructions will be issued about 1 April to begin raising the lake level to seasonal pool elevation 662 feet NGVD. Filling will be accomplished within 15 days if inflow is sufficient. The Water Control Section will direct beginning of drawdown in the fall after Labor Day and no later than 1 November. Minimum pool elevation 656 feet NGVD is always reached by 1 December subject to flood regulation or special purpose regulation covered by Special Directive. The directive covering drawdown includes a schedule of desired pool elevations. The Water Control Section will assess current and anticipated hydrologic conditions and determine the optimal usage of impounded seasonal storage during the drawdown period. Seasonal pool may be maintained beyond Labor Day to accommodate recreational interests or draw down for de beneficial down-stream usage during less than normal conditions.

*Acronyms for “1 December to mid-April” and “mid-April through November 30”.

1-04 REGULATION FOR OUTFLOW TEMPERATURE WATER QUALITY CONTROL

Outflow from East Lynn Lake will be regulated to maintain minimum flow requirements as presented in the Storage and Release Schedule shown as Plate No. 7-8, main text. A continuous minimum flow of 10 cfs will generally be maintained below the dam at all times.

The Storage and Release Schedule is allocated to provide for the minimum year-round release of 10 cfs, however, if the pool level falls too low, the normal allocation can not provide for a minimum release of 10 cfs throughout the year.

Should the pool level recede to elevation 656.0 feet NGVD, the lower limit of summer pool, there is no longer any provision for maintaining the 10 cfs minimum flow. In this event the Water Control Section will determine a release schedule to provide as much flow below the dam as would have occurred under natural conditions.

The Water Control Section personnel will schedule withdrawal from one or more levels to achieve the required outflow rate in the desired temperature range and transmit this guidance as necessary for implementation. Any and all gate changes for temperature control will be covered by Special Directive. Plate No. 7-9, main text, is the Outflow Temperature Objective Curve, while Plate No. 8-14, main text, shows the Outflow Temperature Recorded Data.

1-05 REGULATION FOR EAST FORK, TWELVEPOLE CREEK, AND OHIO RIVER

During reservoir regulation activity for flood control, outflow corresponding to a stage of 12.1 feet on the "O" gage, 2,380 cfs, does not cause appreciable damage downstream under conditions of light rainfall. However, when there is moderate to heavy rainfall downstream, 2,380 cfs discharge contributes to damage at points of stricture in Lynn Creek, East Fork, and below Wayne on Twelvepole Creek. Therefore, the 2,380 cfs outflow can only be used with a SPECIAL DIRECTIVE FROM THE WATER CONTROL SECTION. Project personnel should frequently visit the Lynn Creek site when there is significant rainfall if large releases are being made. The crop-season control stage at the Wayne gage is 18.0 feet (4,500 cfs) and 22.0 feet (6,500 cfs) in winter season. Telephone reference to the gage will allow determination, considering the three-hour water travel time from the dam to the gage, of necessity and timing of regulation to control flooding of farms or the residential area below Wayne. If flooding at either location is threatened, reduce outflow enough to relieve the flooding and notify the Water Control Section immediately. During rainfall and/or snowmelt, the Water Control Section will issue Special Directives for discharge reduction to prevent or reduce flooding at Wayne.

Releases of all types of operation shall not exceed a stage at the "O" outflow gage of 7.4 feet or 1,190 cfs without a SPECIAL DIRECTIVE FROM THE WATER CONTROL SECTION. Under flooding conditions the Water Control Section may issue a special directive for any outflow up to 2,380 cfs or 12.1 feet of stage, or even higher if an emergency situation requires this action.

The Water Control Section bases regulation for the Ohio River at Ashland on stage forecasts and water travel time from the project to the Ohio River and issues Special Directives for regulation of the lake for Ohio River control.

All inflow is stored, subject to minimum flow requirements, from 30 hours in advance of the predicted time of reaching a forecast crest stage of 52 feet on the Ohio River at Ashland, Kentucky. Releases are timed so as not to add to the crest at Ashland or at other stations downstream along the Ohio River.

1-06 OPERATION DURING COMMUNICATION FAILURE

During flood periods, make every effort to contact the Water Control Section. See telephone listings in Section IV of these instructions. If both telephone and radio facilities fail, solicit the cooperation of the Sheriff's Department, amateur radio operators and State Police. Failing all contact for 2 hours in a critical situation, dispatch a messenger by truck or auto to Huntington District Office for guidance. If all roads are blocked, place the following procedures into effect.

a. If East Lynn Lake was under Special Directive when communications failed, follow the instructions contained in the Special Directive until:

(1) The specific operation given in the directive has been completed, or

(2) Twenty-four hours have elapsed since last contact with the Water Control Section, or

(3) Sufficient rainfall or snowmelt occurs which causes the lake or streams in the vicinity to rise rapidly.

b. Whenever any of the foregoing conditions, 1, 2, or 3 occurs or if not under Special Directive and either of conditions 2 or 3 applies, follow operating instructions contained in sub-sections 1-03, 1-04, or 1-05, whichever is applicable.

1-07 EMERGENCY OPERATION

Whenever the lake level is above elevation 680.0 feet NGVD and rising, a constant check shall be made on the rate of rise of the lake level. The lake "L" gage shall be read every hour, on the hour, and rise in pool level computed for the previous hour. Should the rate of rise in lake level indicate to the project manager that the available storage capacity of the project may be insufficient to completely control the current flood, recheck the latest Special Directive and contact the Water Control Section immediately for operating instructions. In the rare event of failure of normal means of communication (radio and telephone), continuous and vigorous effort shall be made to contact the Water Control Section as described in Paragraph 1-06. If contact with the Water Control Section has been lost for three-hours or more, and lake level is approaching elevation 696.0 feet NGVD, the East Lynn project personnel are hereby authorized to gradually increase the outflow up to channel capacity, 12.1 feet on the "O" gage, in order to stabilize the pool.

Downstream damage warning is based on the house built on pillars up Lynn Creek during periods of high runoff. If the vertical distance between the bottom of the house and the water surface is one foot or less, reduce outflow or withhold further increases until Lynn Creek flow has reduced sufficiently.

In any Emergency Situation, when communication is lost, the Project Manager is further authorized to make any additional gate movements as required, Without a Special Directive from the Water Control Section.

If the pool level rises to elevation 700.0 feet NGVD, full channel capacity discharge must be maintained regardless of downstream conditions, or the resultant rate of rise on the stage of the ”O” gage. When emergency spillway discharge becomes appreciable, it causes back-water on the "O" gage, which gives a false stage reading. Therefore, the same slide gate settings necessary to establish channel capacity without spillway discharge, approximately 2.8 feet setting of each of the three slide gates, shall be maintained with increasing spillway discharge. After making the required gate movement, recheck the latest Special Directive, continue all efforts to contact the Water Control Section for guidance in making future gate movements, and follow the following guidelines.

(1) Emergency operation shall be based on the last readings taken and no attempt shall be made to make up for any missed operation step(s). The required slide gate settings shall be executed as soon as the Project Manager has determined that the reservoir cannot adequately control the current flood.

(2) One hour after the previous reading, the lake gage shall be read again, the new rate of rise computed and if necessary any new gate movement will be executed by the Project Manager. The hourly intervals of gage readings, computations, and gate settings should continue until the lake level crests.

(3) If the pool continues to rise to elevation 705.0 feet NGVD, gradually open the slide gates so that they will be fully open when the pool level approaches elevation 706 feet NGVD, the elevation of the Real Estate Taking Line.

(4) Assuming both continued pool rise and communication failure, when the lake has crested and recedes to elevation 706.0 feet NGVD, gradually reduce the gate settings to those used to discharge channel capacity through the slide gates without backwater from the spillway. These settings should be in effect by the time the pool recedes to elevation 705 feet NGVD. During the recession, maintain approximate channel capacity for the season as the lake approaches elevation 700.0 feet NGVD. At this point renew consideration for downstream flooding conditions at Lynn Creek in discharge and channel capacity; that is reduce discharge to a rate that does not cause flooding below the dam. Continue drawdown at channel capacity discharge, as possibly modified by Lynn Creek flooding, until the lake level reaches elevation 696 feet NGVD. Then adjust outflow to maintain pool at that approximate elevation until communication is reestablished and the Water Control Section is able to give guidance to begin drawdown operation.

(5) If the pool level crests below spillway elevation 701.0 feet NGVD gradually close the sluice gates as necessary to maintain the crest pool level until ordered by special directive to begin drawdown operation.

(6) If the lake level is at or above maximum flood control elevation of 701.0 and a second storm and rise occurs, the instructions outlined in the above paragraphs shall be followed. The same operation listed above shall be executed without delay and as often as necessary to control the flood.

The Water Control Section shall be contacted immediately, and each hour thereafter, for consultation relative to operations undertaken and anticipated, other than periods of emergency operation. If unable to contact Water Control Section within one hour, continue operation conforming to the above instructions until the lake level crests or until the slide gates are fully open.

1-08 PUBLIC NOTIFICATION OF UNUSUAL RELEASES

Operation of reservoir projects during major floods has on occasion resulted in water releases being made which damaged privately owned equipment or facilities located downstream and caused claims or damage suits to be filed against the government. To minimize the possibility of such claims or suits, East Lynn Lake Damtender (Resource Manager) must stay informed and inform the Water Control Section all developments along East Fork between the dam and its confluence with Twelvepole Creek and along Twelvepole Creek between the confluence and Lavalette. If required by unusual release patterns, obtain directions from the Water Control Section which will coordinate the release with Public Affairs Office for public notification procedures.

Unusual release patterns include closure for maintenance purposes, special increases or decreases for downstream requests and requirements, and emergency, above channel capacity, discharges.

Notification of large releases is to afford those likely to be affected an opportunity to take remedial measures in advance of the arrival of the release so as to prevent damage to or loss of their property.

EAST LYNN LAKE

DISCHARGE AND CORRESPONDING GATE OPENING IN FEET FOR 1 GATE*

Discharge in c.f.s.	Reservoir Elevation - Feet above NGVD																			
	656	657	658	659	660	661	662	663	665	666	669	674	679	684	689	694	699	704	709	714
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
50	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
75	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
100	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
200	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.6	0.6
300	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0	1.0	1.0
400	2.1	2.0	1.9	1.9	1.9	1.9	1.8	1.8	1.8	1.8	1.8	1.7	1.6	1.6	1.5	1.4	1.4	1.3	1.3	1.2
500	2.6	2.6	2.5	2.4	2.4	2.4	2.4	2.3	2.3	2.2	2.2	2.1	2.0	2.0	1.8	1.8	1.8	1.7	1.6	1.5
600	3.1	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.8	2.8	2.7	2.7	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8
700	3.5	3.5	3.4	3.4	3.4	3.3	3.3	3.3	3.2	3.2	3.2	3.1	3.0	2.8	2.7	2.6	2.5	2.4	2.3	2.1
800	4.0	3.9	3.8	3.8	3.8	3.8	3.7	3.7	3.6	3.6	3.6	3.5	3.4	3.2	3.1	3.0	2.9	2.8	2.6	2.5
900	4.5	4.4	4.3	4.3	4.2	4.2	4.1	4.1	4.0	4.0	4.0	3.8	3.7	3.5	3.4	3.3	3.2	3.1	3.0	2.8
1000	5.0	4.9	4.8	4.8	4.7	4.6	4.6	4.5	4.5	4.4	4.4	4.2	4.0	3.9	3.7	3.6	3.5	3.4	3.2	3.1
1200	6.0	5.9	5.8	5.7	5.7	5.6	5.5	5.4	5.4	5.3	5.2	5.1	4.9	4.6	4.4	4.3	4.1	4.0	3.8	3.6
1400	6.9	6.8	6.7	6.6	6.5	6.5	6.4	6.3	6.2	6.1	6.0	5.9	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.1
1600	7.8	7.7	7.6	7.5	7.4	7.3	7.2	7.1	7.0	7.0	6.9	6.7	6.3	6.1	5.8	5.6	5.5	5.3	5.0	4.7
1800	8.7	8.6	8.4	8.3	8.2	8.2	8.0	7.9	7.8	7.7	7.6	7.4	7.1	6.8	6.5	6.3	6.1	5.9	5.6	5.3
2000	9.8	9.6	9.4	9.2	9.1	9.1	8.8	8.7	8.6	8.5	8.4	8.2	7.8	7.5	7.2	7.0	6.7	6.5	6.1	5.8
2200						10.0	9.8	9.7	9.6	9.4	9.3	9.1	8.5	8.2	7.8	7.6	7.3	7.1	6.7	6.4
2400												9.9	9.2	8.8	8.5	8.2	7.9	7.7	7.3	6.9
2600														9.6	9.1	8.8	8.5	8.3	7.8	7.4
2800															9.9	9.4	9.1	8.8	8.3	7.9
3000																	9.8	9.4	8.8	8.4
3200																			9.4	8.9
3400																				9.4

Plate No. 1-1

* Only one gate is required to make the necessary releases as tabulated above, however, rotational use of the three gates is desirable.

EAST LYNN LAKE

DISCHARGE AND CORRESPONDING GATE OPENING IN FEET FOR 1 GATE --- WITH 1 GATE FULLY OPEN

Discharge in c.f.s.	Reservoir Elevation - Feet above NGVD																		
	656	657	658	659	660	661	662	663	665	666	669	674	679	684	689	694	699	704	709	714
2200	0.8	0.7	0.5	0.3	0.1															
2400	1.8	1.6	1.4	1.3	1.1	1.0	0.8	0.6	0.5	0.3	0.2									
2600	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.5	1.4	1.2	1.1	0.7	0.1							
2800	3.8	3.6	3.4	3.2	3.0	2.9	2.6	2.5	2.3	2.1	2.0	1.6	1.0	0.4						
3000	4.8	4.6	4.4	4.2	4.0	3.8	3.6	3.4	3.2	3.0	2.9	2.4	1.8	1.2	0.6	0.2				
3200	5.8	5.6	5.3	5.1	4.9	4.7	4.5	4.3	4.1	4.0	3.8	3.3	2.6	2.0	1.4	0.9	0.5	0.1		
3400	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.1	3.4	2.9	2.1	1.6	1.2	0.8	0.1	
3600	7.7	7.4	7.1	6.9	6.7	6.5	6.3	6.0	5.8	5.7	5.4	5.0	4.2	3.5	2.9	2.4	1.8	1.5	0.7	0.1
3300	8.7	8.4	8.1	7.8	7.6	7.3	7.1	6.9	6.7	6.5	6.3	5.8	5.0	4.2	3.6	3.1	2.5	2.3	1.4	0.7
4000	9.7	9.3	9.1	8.7	8.5	8.2	8.0	7.7	7.5	7.3	7.1	6.5	5.7	5.0	4.3	3.7	3.3	2.8	2.0	1.3
4200				9.7	9.4	9.1	8.9	8.6	8.3	8.1	7.9	7.3	6.5	5.7	5.0	4.4	3.9	3.4	2.6	1.9
4400							9.8	9.5	9.2	9.0	8.7	8.1	7.2	6.4	5.7	5.1	4.6	4.1	3.2	2.7
4600										9.8	9.6	8.9	7.9	7.1	6.4	5.8	5.2	4.7	3.8	3.1
4800												9.7	8.7	7.8	7.1	6.4	5.9	5.4	4.4	3.6
5000													9.4	8.5	7.8	7.1	6.5	6.0	5.0	4.2
5200														9.3	8.4	7.7	7.1	6.6	5.6	4.7
5400														10.0	9.1	8.4	7.7	7.2	6.2	5.4
5600															9.8	9.0	8.3	7.7	6.7	5.9
5800																9.7	9.0	8.3	7.3	6.4
6000																	9.6	8.9	7.8	6.9
6200																		9.5	8.4	7.4
6400																			9.0	8.0
6600																			9.6	8.5
6800																				9.0
7000																				9.6

Plate No. 1-2

EAST LYNN LAKE

DISCHARGE AND CORRESPONDING GATE OPENING IN FEET FOR 1 GATE --- WITH 2 GATES FULLY OPEN

Reservoir Elevation - Feet above NGVD

Discharge in c.f.s.	656	657	658	659	660	661	662	663	665	666	669	674	679	684	689	694	699	704	709	714
4100	0.8	0.4	0.1																	
4160	1.9	1.5	1.2	0.7	0.4	0.1														
4220	3.1	2.7	2.3	1.8	1.4	1.1	0.8	0.4	0.1											
4280	4.2	3.8	3.5	2.9	2.5	2.2	1.8	1.5	1.1	0.8	0.5									
4360	5.9	4.9	4.4	4.0	3.6	3.2	2.9	2.5	2.1	1.8	1.5	0.6								
4430	8.7	7.6	6.4	5.3	4.7	4.3	3.9	3.5	3.2	2.8	2.5	1.5	0.2							
4500			9.1	8.0	6.9	5.9	5.0	4.6	4.2	3.9	3.5	2.5	1.1							
4600					9.5	8.5	7.4	6.5	5.6	4.9	4.5	3.5	2.0	0.8						
4800							10.0	9.0	8.1	7.1	6.2	4.4	3.0	1.7	0.6					
5000										9.5	8.7	6.0	3.9	2.6	1.4	0.4				
5250												8.3	4.8	3.5	2.3	1.2	0.3			
5500													6.7	4.3	3.1	2.1	1.1	0.2		
5620													8.9	5.5	4.0	2.9	1.9	1.0		
5750														7.6	4.8	3.7	2.7	1.8	0.2	
5870														9.7	6.5	4.5	3.4	2.5	0.9	
6000															8.5	5.8	4.2	3.2	1.6	0.2
6250																7.7	5.0	4.0	2.2	0.8
6375																9.5	6.8	4.8	2.9	1.4
6500																	8.6	6.1	3.6	2.1
6750																		8.0	4.3	2.7
6900																		9.6	5.0	3.3
																			6.6	4.0
																			8.2	4.6
																			9.8	5.5
																				7.0

Plate No. 1-3

EAST LYNN LAKE
OUTFLOW STAGE, DISCHARGE AND CORRESPONDING LOW FLOW
VALVE OPENINGS IN INCHES WITH LOW FLOW INTAKE (I13)
OPEN AT ELEVATION 649.0

OUTFLOW STAGE ft	DISCHARGE c.f.s.	LAKE ELEVATION IN FEET ABOVE NGVD							
		656	658	660	662	663	664	665	666
1.0	0	0	0	0	0	0	0	0	0
1.1	2	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1
1.2	3	0.4	0.3	0.3	0.2	0.2	0.1	0.1	0.1
1.3	5	0.7	0.7	0.7	0.6	0.5	0.4	0.4	0.3
1.4	7	1.1	1.1	1.1	1.0	1.0	0.9	0.8	0.8
1.5	10	1.6	1.6	1.5	1.3	1.2	1.2	1.2	1.1
1.6	14	2.1	2.1	2.0	2.0	2.0	2.0	2.0	1.9
1.7	18	2.8	2.7	2.7	2.5	2.4	2.2	2.2	2.2
1.8	23	3.6	3.4	3.2	3.2	3.1	3.1	3.1	3.0
1.9	28	4.3	4.2	4.1	4.0	4.0	3.9	3.9	3.9
2.0	34	5.2	5.1	5.0	4.9	4.8	4.6	4.5	4.3
2.2	49	7.7	7.5	7.3	7.1	7.0	6.9	6.8	6.7
2.4	67	10.6	10.3	10.0	9.7	9.6	9.4	9.3	9.2
2.6	89	14.5	14.2	13.8	13.4	13.0	12.8	12.7	12.5
2.8	115	19.5	18.7	18.1	17.6	17.3	16.9	16.5	16.3
3.0	146		OPEN	27.0	24.2	24.4	23.7	23.0	22.7
3.2	160							OPEN	OPEN

CORPS OF ENGINEERS U. S. ARMY

Plate No. 1-4

EAST LYNN LAKE
OUTFLOW STAGE, DISCHARGE AND CORRESPONDING LOW
FLOW VALVE OPENINGS IN INCHES WITH LOW FLOW
INTAKE (I4) OPEN AT ELEVATION 658.0

OUTFLOW STAGE ft	DISCHARGE c.f.s.	LAKE ELEVATION IN FEET ABOVE NGVD											
		660	662	663	664	665	666						
1.0	0	0	0	0	0	0	0						
1.1	2	0.2	0.1	0.1	0.1	0.1	0.1						
1.2	3	0.3	0.2	0.2	0.1	0.1	0.1						
1.3	5	0.7	0.6	0.5	0.4	0.4	0.3						
1.4	7	1.1	1.0	1.0	0.9	0.8	0.8						
1.5	10	1.5	1.3	1.2	1.2	1.2	1.1						
1.6	14	2.0	2.0	2.0	2.0	2.0	1.9						
1.7	18	2.7	2.5	2.4	2.2	2.2	2.2						
1.8	23	3.2	3.2	3.1	3.1	3.1	3.0						
1.9	28	4.1	4.0	4.0	3.9	3.9	3.9						
2.0	34		4.9	4.8	4.6	4.5	4.3						
2.2	49		7.1	7.0	6.9	6.8	6.7						
2.4	67		9.7	9.6	9.4	9.3	9.2						
2.6	89		13.4	13.0	12.8	12.7	12.5						
2.8	115		17.6	17.3	16.9	16.5	16.3						
3.0	146		OPEN	24.4	23.7	23.0	22.7						
3.2	160												

CORPS OF ENGINEERS U. S. ARMY

Plate No. 1-5

SECTION II - COLLECTION OF HYDROMETOROLOGIC DATA

2-01 PRECIPITATION AT EAST LYNN LAKE

a. General. Obtain precipitation data by direct observation of the rain gage at the damsite, and by telephonic reports from other precipitation stations in or near Twelvepole Creek Basin. Instructions for preparation and transmission of hydrologic reports are contained in Section IV.

b. Official Precipitation Gage. The standard National Weather Service (non-recording) rain gage at the damsite is designated as the gage for official use.

c. Regular Readings. Measure and discard precipitation contained in the standard gage about 0700 hours or 0730 hours daily. Observe and record the times of beginning and ending of precipitation. The times of beginning and ending may be read from the recorder chart of the recording precipitation gage when "unknown" or "during night." Instructions for the preparation and transmission of precipitation reports are contained in Section IV. These instructions are for Corps of Engineers purposes and are not to be considered as superseding observation instructions received from the National Weather Service.

d. Extra and Special Readings. Take special readings of the precipitation gage when requested by the Water Control Section or extra readings whenever required by Schedule for Reading Gages, Plate No. 3-1, next section. When taking these readings, do not empty the gage at any time except the regular time. Report the rainfall which has fallen since the regular time of reading even though a portion of it may have been reported in a previous extra reading. The regular reading on the morning following any extra readings should always include the amounts reported in the extra readings. Instructions pertaining to the transmission of extra and special precipitation readings are contained in Section IV.

e. Satellite Platform Stations. Electronic control data collection instruments, called platforms, receive data from gages and transmit it every four hours to a Geostationery Operational and Environmental Satellite, which in turn relays the signal to a computer downlink. The Water Control Section retrieves this data by use of the Automated Data Collection Operating System.

For more detail on Satellite Platform Stations see Section V main text. Currently, after receiving morning reports from the reservoirs, INTRANET retrieves data of the second 4-hourly transmission during Normal Condition and from all six transmissions of the day during Flood Threat or higher conditions. In the near future INTRANET will routinely retrieve data from all transmissions even while receiving reports and maintain in a data base.

Project personnel will be able to selectively access the data base for either the latest reading or a range of recent readings from one station or from all stations listed in the table below for precipitation and those in Table No. 3-2 for stage data. The portable computer terminal assigned to the project will be used for these retrievals from the office or from the dwelling of authorized personnel. The mechanics of accessing will be provided when system programming is complete. Reporting information on platform-satellite precipitation stations either current or soon to be in operation in Twelvepole Creek Basin is listed below.

TABLE NO. 2-1

PRECIPITATION PLATFORM COMMUNICATION INFORMATION

Location	Equip-ment	Channel No.	Update Interval	Transmit Time, local	Data Transmitted	Frequency of Transmission
Wayne Gage	1/	55E	30 min 2/	0719	P3/, S4/	5/
Beech Fork Lake, Top of Intake Structure	1/	55E	60 min 2/	0721	P, S	5/
Nestlow	1/	6/	60 min	6/	P	5/
East Lynn L. Outflow station	1/	55E	30 min 2/	0716	P, S	5/
Eloise near Dunlow Inflow Station	1/	6/	60 min	6/	S	5/

P Precipitation
S Stage

1/ Precipitation equipment same at all platform reported stations: tipping-bucket gage analog-to-digital recorder (ADR), and platform.

2/ Keyed to cam of water stage recorder.

3/ Precipitation in inches.

4/ Stream stage in feet above gage zero or lake elevation in feet above NGVD.

5/ Each four hours before and after "transmit time."

6/ Available after installation.

g. Snow Depth and Moisture Content. During the winter snow fall, make regular measurements of snowfall and snow depth about 0700 or 0730 hours daily, when it occurs. Measurements of the water content of the snow on the ground are required in order to determine the amount of water which may run off during a warm spell or with any wind and rainfall which may occur. To determine the water content of the snow, obtain a representative snow sample at an undisturbed location by forcing the outside container of the rain gage through the snow to the ground surface. Then, using a shovel or thin sheet of metal to hold the snow cover within the container, remove the container from the ground. The water content of the sample can be measured by placing the outside container in a vessel of warm water, and then pouring the melted snow into the inside container of the gage for a reading with the measuring stick. On no account should the vessel containing the snow be exposed to extreme heat because of the possibility of loss by evaporation. Measure water content of the snow at least as often as indicated below.

(1) Each day when any new snowfall occurs.

(2) Each day when rain falls on existing snow cover.

(3) Twice a week when there is snow cover if neither condition (1) nor (2) requires more frequent measurements.

Instructions for the preparation and transmission of reports pertaining to snowfall, snow depth, and moisture content of snow cover are contained in Section IV.

2-02 PRECIPITATION AT OHIO RIVER NETWORK STATIONS

a. Ohio River Network Stations. The Ohio River Network, abbreviated O.R.N., includes precipitation stations and stations reporting both precipitation and stage. Presently the only station located in the East Lynn Drainage basin is the project station itself. Project personnel perform the gaging and reporting duties of an observer. The station reports both precipitation and lake elevation with the code symbol ELTM4, which indicates the location on the District Isohyetal Map. All relevant stations with their code symbols and reporting criteria are listed on Table No. 2-2, next page.

b. Reporting criteria. The Project reports daily regardless of the amount of precipitation collected and makes subsequent reports according to criteria contained in the Schedule for Reading Gages, Plate No. 3-1, and as requested by the Water Control Section.

TABLE NO. 2-2

O.R.N. STATIONS
TYPE PRECIPITATION

STATION	SYMBOL	DATA	CRITERION	OBSERVER	TELEPHONE
East Lynn Lake	ELTM4	P,S	Hourly	Project Personnel	849-2355
Dingess	DINN4	P	0.5"	Satellite Platform	
Eloise-Dunlow	DUNM4	S	0.5"	Satellite Platform	
Ranger	RANM5	P	0.5"	Satellite Platform	
Wayne	WAYM4	S,P,T	1.0"	Satellite Platform	

P Precipitation
S Stage
T Temperature

c. Method of reporting. All precipitation data for the Twelvepole Creek Basin is now collected by Satellite Platform Stations, which utilize the Huntington District INTRANET system. Readings are reported by about 0800 hours as part of the regular or extra reports on work days. In previous years paid observers made their reports to East Lynn Lake by collect telephone call. These observers have been now replaced by the Satellite Platform Stations, which report electronically to the Huntington District INTRANET system.

2-03 OUTFLOW TEMPERATURE AND TEMPERATURE-DISSOLVED OXYGEN PROFILES

Tailwater temperature is transmitted to the project office and is read and recorded from the dial to the approximate nearest 0.1 degree celsius. Weekly temperature and dissolved oxygen profiles are to be taken in the lake on Monday during periods of stratification. The Water Control Section will issue Special Directives each year concerning the location and the time periods for the profiles. Project personnel have been provided with instrumentation necessary and Water Quality field personnel have given instruction in the use of the equipment.

Send profile data in a supplemental report to INTRANET Monday afternoon or include it as supplemental data on the report for Tuesday morning. Soon after receipt of the data, INTRANET is directed to plot it into the Water Quality Assessment. The daily outflow temperature, along with the Assessment and target temperature from Outflow Temperature Regulation Curves, Plate No. 1-4, is used by Water Control Section in determining proper operation of the low-flow system for outflow temperature control. Special directives are issued for these operations.

SECTION III - COLLECTION OF STREAMFLOW DATA

3-01 GENERAL

Obtain river and lake stage data by observing in the project office read-outs of the lake and outflow gages and by interrogating surrounding telemark gages. The necessary frequency for reading the gages at the project and for obtaining reports from the telemark stations is set forth in the "Schedule for Reading Gages," Plate No. 3-1, which is bound at the end of this section. Instructions regarding the transmission of regular, extra and special reports of gage readings are contained in Section IV.

3-02 GAGES PERTINENT TO REGULATION OF EAST LYNN LAKE

a. Gage Listing. Information about gages of importance to operation of the project appear in Table No. 3-1 next page. Communication information on platform reported gaging stations appear in Table No. 3-2, page number 3-3.

b. Reading and recording gage heights. All gage readings must be listed in the records in order that complete data on the effect of the lake on natural flows will be available. Record lake gage readings in terms of elevation NGVD, but record all other gage readings in stage. The necessary frequency for reading gages is set forth in the "Schedule for Reading Gages," Plate No. 3-1 at the end of this section. Gage datum are listed in the table above.

3-03 TELEPHONIC GAGES

In order to facilitate collection of stage information, telephonic answering devices known as Telemarks are provided for the stream gages at Eloise near Dunlow and Wayne, which are too distant to be remote to the project office. The lake and outflow gages are remote into the project office. To obtain reports from Telemark gages, call the telephone number assigned to the station and then count the number of buzzes or tones in each group of signals. The first signal indicates the stage in tens of feet, the second in feet, the third in tenths of a foot, and the fourth signal in hundredths of a foot. A long buzz indicates a zero. The telephone numbers of the Telemark gages are classified as "Restricted" in order to avoid indiscriminate calls by unauthorized persons. The necessary frequency for obtaining reports from the Telemark gages is set forth in "Schedule for Reading Gages," Plate 3-1, at the end of this section.

Instructions pertaining to transmission of regular, extra and special reports of gage readings are contained in Section IV. Telephone numbers and code symbols assigned to Telemark gages to be called by project personnel appear in Table No. 3-3, page number 3-4.

TABLE No. 3-1
PERTINENT GAGE DATA

Gage	Location	Code Symbol	Equip-ment	Reference Gages		Recorder	Visual Indicator	Datum of Gage
				Staff	Other			
Lake	Intake Structure	L	-	SL	TL	*RL	VL	612.00
Ouflow	1,700 feet below dam	O	-	SO	TO	*RO	VO	610.00
Inflow	Nr. Dunlow, W.Va.	DUNM4	TM	SI	TI	*RI	-	710.00
Twelvepole Creek Control	Below Wayne, W.Va.	WAYM4	TM	SW	TW	*RW	-	560.00
Ohio River	5.4 mi. bel. Big Sandy River at mi. 322.5		TM	SA	TA	*RA	-	481.03

S Staff
T Tape
M Telemark
* ADR (Analog to digital recorder)

TABLE No. 3-2

GAGING PLATFORM COMMUNICATION INFORMATION

Gage	Location	Data	Channel No.	Update Interval	Transmit Time, local	Frequency of Transmission
Lake	Intake Structure	E	55E	60 min.	0717	*
Outflow	1,700 ft below dam	SP	55E	30 min.	0716	*
Inflow	- Eloise nr. Dunlow, WV	S	55E	30 min.	0714	*
Wayne	Below Wayne, WV	SP	55E	30 min.	0719	*
Ohio River	5.4 mi. below Big Sandy River	S	67E	60 min.	0722	*

E elevation in feet above NGVD.
S stage
P precipitation
* platform transmits each 4 hours beforehand and after transmit time

3-04 DATA COLLECTION

Future collection of data will be accomplished automatically. Present gaging stations, as well as the precipitation stations listed in Table No. 2-1, are equipped with satellite platforms and transmit to the satellite - downlink - INTRANET system as described in paragraph 5-02a(2) in Section V in the main text of this manual. Later, INTRANET will automatically poll satellite downlinks to collect data from the platforms. After development and installation of landline platforms, also described in paragraph 5-02a(2), INTRANET will poll them additionally for stage, precipitation and/or water quality data. The collected data will be placed into files according to project areas.

Project personnel, by use of a portable terminal will be able to access all data pertaining to their project area by placing a single telephone call (eventually a WATS call) and signing on to INTRANET. During non-duty hours, evenings, weekends and holidays, personnel will have the option of accessing landline platforms directly from their place of abode. Landline platforms will be installed at primary locations such as lake, inflow and outflow stations and key downstream control stations.

INTRANET will provide a means of monitoring project and stream conditions around the clock for both office and project personnel, eliminate unnecessary trips to unmanned projects and provide real-time data for use in water control management.

TABLE No. 3-3

STREAM GAGE TELEPHONE NUMBERS

Gage	Symbol	Exchange	Telephone Number
Eloise near Dunlow East Fork	DUNM4	Wayne	[redacted]
Twelvepole Creek. Below Wayne	WAYM4	Wayne	[redacted]

SCHEDULE FOR READING GAGES
EAST LYNN LAKE

Always read and record the regular stream gages. VL or SL and VO or SO immediately before each gate operation except when they have been read within the last hour with no intervening gate operation. Also read them one hour after completion of any operation. However, when operating the gates almost continuously, the gages need not be read before and after each individual operation, but readings taken at one-hour intervals, including readings before the first and after the last gate operation, will be sufficient. If the recorders are operating properly, the above-mentioned gage heights may be read from the charts at the time of the next reading. Read all gages at least as often as shown in the following table.

	SCHEDULE A(1) Normal Condition		SCHEDULE B(1) Flood Threat		SCHEDULE C(1) Flood Condition		SCHEDULE D Major Flood Condition	
CONDITIONS	Crop* Season	Non-crop** Season	Crop Season	Non-crop Season	Crop Season	Non-crop Season	Crop Season	Non-crop Season
Lake Elevation	Below 665.0	Below 660.0	665.0-678.0	660.0-678.0	687.0-696.0(4)	678.0-696.0(4)	Above 696.0(4)	Above 696.0(4)
Stage at "0" Gage	Below 6.70(6)	Below 6.70(6)	6.70-9.80(6)	6.70-9.80(6)	9.80-12.6(6)	9.80-12.6(6)	Above 12.6(6)	Above 12.6(6)
Precipitation within 24 hours	Less than 0.75	Less than 0.50	0.75-1.25	0.50-1.00	1.25-1.50	1.00-2.50	Above 2.50	Above 2.50
Dunlow Telemark	Below 6.90	Below 7.20	6.90-10.60	7.20-10.70	10.60-13.00	10.70-13.00		
Wayne Telemark	Below 9.20	Below 10.70	9.20-13.80	10.70-14.50	13.80-18.00	14.50-18.00		
READ GAGES								
VL and VO (2) RL and RO Charts	At 0730 & 1330(3) Readings for 0730, 1330, 1930 & 0130(5)		At 0730 & 1330 Readings for 0730, 1330, 1930 & 0130(5)		At 0730, 1330, 1930 & 0130 Readings for 0730, 1330, 1930 & 0130(5)		At 3 hour intervals(4) Readings for 0730, 1330, 1930 & 0130(5)	
Outflow temperature	Daily at 0730		Daily at 0730		Daily at 0730		Daily at 0730	
Dunlow Telemark	Daily at 0730		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	
Wayne Telemark	Daily at 0730		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	
SL, TL, SO and TO	Twice weekly (as check)		Twice weekly (as check)		Twice weekly (as check)		Twice weekly (as check)	
Precipitation gage	At 0730		At 0730 & 1330		At 0730, 1330, 1930 & 0130		At 3 hour intervals	

(1) When any one of the conditions listed under Schedules A, B or C is exceeded, place the next higher schedule into effect immediately and notify by person-to-person telephone call one of the Hydrology and Hydraulics Branch personnel listed on page ____ of this Annex.
(2) When the visual indicators are not operating properly, read the staff gages.
(3) Take readings on week days regularly and on Saturday and Sunday by special arrangement.
(4) Whenever the reservoir level is between elevation 696 and 701 and rising or at elevation 701 or above, read inflow, lake, and downstream gages hourly.
(5) The 1330, 1930 and 0130 readings on weekdays and all readings for Saturday and Sunday may be obtained from the recorder charts at the time of the next scheduled reading of visual gages. If necessary to obtain the readings desired, roll the chart back and, after taking readings, return to the proper position--all according to instructions contained in Exhibit No. III-2.
(6) All releases above a stage of 6.70 feet are to be covered by Special Directive.
(7) If precipitation has occurred since the morning reading and amounted to 0.20" in winter or 0.50" in summer, or if snowmelt has occurred sufficiently to cause a rise in streams or inflow, read the lake and inflow gages by 1500 hours and transmit the information to Hydraulics Branch by telephone or by radio if necessary.

Once a particular schedule is in effect, follow that schedule for a minimum of 24 hours before placing a lower schedule into effect or until such time that conditions require the use of a higher schedule. The foregoing table lists the minimum number of gage readings required. All gage readings made in addition to those required by the foregoing table must be recorded.

* Crop season - 16 April through 30 November
**Non-crop season - 1 December through 15 April

CHART HANDLING INSTRUCTIONS
Obtaining Weekend and Holiday Readings
From Stevens Strip Chart Recorders

STEVENS TYPE AP, TYPE A-71 OR A-35 RECORDER

1. First lift the lid or remove dust cover.
2. Lift pen from chart and secure pen in holder off paper position.
3. Facing Stevens recorder grasp knurled knob on the take up roll located in the rear of the recorder and to the left of the recorder paper. Turn knurled knob clockwise until enough paper is showing to obtain sufficient readings being careful paper does not come in contact with pen.
4. Record weekend and Holiday readings.
5. After sufficient readings have been obtained, grasp knurled knob, turn counterclockwise until slack is out of paper. Lower pen back on chart. If pen is off more than 1 hour, reset for correct time. To reset, grasp the knurled disc which is located on the right-hand side of the recorder just beneath the knurled knob of the supply cylinder. Pull the disc out to the right and rotate it until the paper is free. Advance paper until chart shows the correct time. Rotate the knurled disc to its normal location and push back in place to the left.
6. If you reset for time, make notation on chart.

STEVENS PAV-C OR CAV-C RECORDER

1. Face recorder and open recorder door.
2. Remove pen from chart by turning pen arm positioning screw clockwise.
3. Run the chart upward by moving and turning the knurled disk on the right end of the take up roller, upward, until enough record is showing to obtain readings. Be careful paper doesn't come in contact with pen.
4. Record week end and Holiday readings.
5. After readings are obtained,run the chart downward by turning the knurled disk on the right end of the take up roll, downward, until paper slack is removed and pen time is correct. Hold the chart in place; at the same time place a finger under the spiral spring belt, lift outward from the wall slightly stretching the belt, then release. Paper will stay taut.
6. Place pen back on the chart by turning pen arm positioning screw counter-clockwise.
7. If pen is off more than 1 hour, reset for time. To reset, run chart downward until pen shows correct time on the chart. Holding chart in place lift outward spiral spring belt, stretching slightly, then release belt.
8. If you reset for time, make a notation on chart. Include in notation time, date, stage from counter, etc.

SECTION IV - INSTRUCTIONS FOR COMPLETION AND TRANSMISSION OF REPORTS

4-01 REGULAR REPORTS.

a. Weekly Report, ORH Form 14. To reduce the probability of error in transcribing data from other forms, enter gage readings through the week on a copy of Form 14. Lake and outflow gage readings will be obtained for every six hours (0130, 0730, 1330 and 1930) during periods when the project is attended and recorded on the form. This new reporting program was installed at the dam in May 1998, as a fully computerized three page, menu-driven master data sheet which is virtually self-explanatory, with a convenient auto-prompt feature easily completed by filling the empty data boxes.

The Schedule for Reading Gages, Plate No. 3-1, defines conditions for taking more frequent readings of gages. After entering each of the readings on the form, check the accuracy of the readings as recorded. If doubt arises, investigate to the extent necessary to be certain of the readings. During normal conditions, if the 1930 and 0130 readings have not been recorded on the form, take them from the recorder charts when taking the 0730 Project Report readings. After any period in which the project was not attended, obtain all missing readings from the recorder charts and record on Form 14. See Plate 3-2 for instructions on how to turn back charts to obtain missed readings and the proper method to reset the gage after doing so. On Monday morning, or Tuesday if the project was not attended on Monday, record any missed readings along with the 0730 readings. Check the accuracy of the data on the typed original compared to the handwritten form. Mail the original typed form to the District Office marked “Attention Water Resources Engineering Branch.” Begin a new Form 14. A sample Form 14, Plate No. 4-1, is included at the end of this section.

b. Daily Morning Report. The regular morning readings at the project, including precipitation, readings of the lake “L” gage, outflow “O” gage, gate positions, river stages and gate operations shall be recorded each day. After recording, the data will be transmitted via the internet to the District INTRANET System for the Water Resources Engineering Branch by approximately 0800 hours on each day in which the project is attended. The proper manner of reporting the data is shown in a printout of a Project Data Input Form found at the end of this section as Plate No. 4-2.

Transmit reports for Saturdays, Sundays, and Holidays on which the project is attended as on regular work days. Transmit reports for unattended days after transmission of the current report for the first working day which follows. In each regular or extra Daily Morning Report, also include any telephonic readings made since the previous Project Information report.

If conditions are such that the daily report cannot be transmitted to the District Intranet System by 0830 hours, transmit the report by telephone or fax to Water Resources Engineering Branch, then enter the data into the computerized report form when it becomes available.

There is a water quality function at East Lynn Lake. During periods of lake stratification the weekly temperature-dissolved oxygen profile and water quality data are included in a separate report. Instructions relative to recording and transmission of the report are as follows:

(1) Logging On. Open the web browser or the (Microsoft (Internet Explorer) to the following address: (http://wcds-a.orh.usace.army.mil/ELT/index.htm). This Index Page contains links to information pertaining to East Lynn Lake. The Data Submission Reports vary for each project, and report forms for one project cannot be substituted for another project. The East Lynn Lake assigned PASSWORD is required for data submission. Follow the example on Plate No. 4-2.

(2) Three reports can be accessed from the Index Page: The Daily Project Report (also called the Morning Report), the Gate Operations Report, and the Water Quality Report. Click on the picture or on the Report name to access a report.

(3) When the Daily Project Report Page has been accessed, indicate if this is a new or a revised report. Check the date/time group.

(4) The first table, Current Project Info, is used to record general information about the project at the time of the report.

(5) Column 1 - Station Abbreviation. This column identifies the lake station. The first three letters comprise the abbreviation of the station name and the last letter and figure are a key to its location on the District Isohyetal Map. This five-digit group constitutes the abbreviation for the station and should always be used.

These station names have been coded into the web page and cannot be changed at the project. If there are any difficulties in relation to this, please contact the Water Control Section.

(6) Column 2 - Precipitation. Record the amount of precipitation (to the nearest 1/100 inch) since the last report.

(7) Column 3 - Lake Elevation. Use this column for reporting the lake “L” gage, in feet above NGVD, to the nearest hundredth foot. Please include decimal points.

(8) Column 4 - Outflow Stage. Use this column for reporting the stage at the “O” gage, to the nearest hundredth foot. This is the stage reading of the gage.

(9) Column 5 - Flow. This column can be used to record the outflow if it becomes necessary. At this point, this field is unavailable.

(10) Columns 6 and 7 - Snow and Water Equivalent. Report the depth of snow cover and its water content in these columns. Where a station does not make this report or no precipitation has been reported, send 0.00. Record the snow depth in inches to the nearest hundredth. Indicate a trace by OOT. Report the figures for snowfall and snow cover since the previous report.

(11) Columns 8 - Weather Description. The drop down menu in this column is used to report the weather conditions at the time of the Project Report observation, in accordance with the following code:

0 - Unchanged	6 - Drizzle	12 - Snow Flurries
1 - Clear	7 - Light Rain	13 - Light Snow
2 - Partly cloudy		8 - Moderate Rain
3 - Cloudy	9 - Heavy Rain	14 - Moderate Snow
4 - Light Fog or Mist	10 - Sleet, Freezing Rain	15 - Heavy Snow
5 - Heavy Fog or Mist	12 - Hail	16 - Missing

(12) The second table, Current Gate Settings, is used to record gate settings at the time of the report. SO1, SO2, and SO3 are the logo’s for the left, center, and right slide gates, respectively. Column 2 is used for the left slide gate SL, column 3 is used for the middle slide gate SC, and column four is used to report the right slide gate, SR. Each gate opening is reported to the nearest tenth of a foot. Transmission of the openings for each gate shall consist of a 3-digit number with a decimal point. If the gate is closed, 0.0 is reported.

(13) Columns 5 and 6 - Low-Flow Intake Gates. Use these separate columns to report the fully open or fully closed positions of the two low-flow inlets, IL-4 and IR-13. Follow the example in Plate No. 4-2

(14) Column 7 – Low-Flow Valve. Use this column for reporting the amount of opening, in inches, of the 30 inch low-flow valve, LFC. Report valve openings to the nearest inch. For example, report 6.7 inches of valve opening as 7.0 and 9 inches as 9.0. If the valve is closed, send 0.0.

(15) Additional Station Information - Report the precipitation in inches to the nearest hundredths and the stage in feet to the nearest hundredths for the gages at Wane(WAYM4), and Dunlow(DUNM4).

(16) Supplementary Data - Report additional data in message form at the end of the INTRANET report. Include any or all of the following in such messages:

(a) Precipitation and snow cover amounts when either is ten (10) inches or more.

(b) Moisture content of snow cover.

(c) Precipitation at the dam during the past 24 hours, when greater than one (1) inch, by 6-hour periods. A password is necessary to submit the Operational Report to the WCDS-A computer. The same password is used for the Morning Report and the Gate Operations Report (see Para. 4.02.15). If the report is submitted with the proper password, a confirmation screen will be transmitted back to the terminal. If the information is correct, click on the 'Correct' button at the top of the page. The information will be entered into a permanent record. Follow the example in Plate No. 4-2.

Records can be viewed through the East Lynn Lake web page at (http://wcds-a.orh.usace.army.mil/dbases/briefing/ELT.htm). See the example in Plate No. 4-2.

(17) Password. Each project has a unique password needed to submit the report the WCDS-A system. If this password is missing or incorrect, attempts to submit the Project Report will be unsuccessful. Use the 'back arrow' on the browser to get back to the Project Report Page to attempt to submit the form with the correct password. While the information being submitted is not classified, the password should be protected to keep unauthorized personnel from gaining access to .mil domain computer systems. Questions about the password should be directed to the Water Control Section.

(18) After all the project information has been recorded, click on the 'Submit' button to send the report to WCDS-A or 'Clear Form' to clear all the information out of the form and start over.

(19) If the password was correct, a SHEF compatible report will be sent back to the computer terminal. Information can be checked before the final submission. If there is any incorrect data on the report, use the browser's 'back button' to return to the Project Report Page to correct the information. If the information is correct, click on the 'Correct' button at the top of the page. At this point, the report is sent to the WCDS-A computer for permanent storage.

This report can be accessed through the East Lynn Lake web page (http://wcds-a.orh.usace.army.mil/dbases/ELT/reports/) under Gate Operations or through a link to the Index Page. The reports are stored as ASCII text and may be printed to keep as a hard copy.

(20) The second report accessed from the Index Page is the Gate Operations Report. This report is used to record information about gate operations. Each gate operation should be recorded at the time it occurs. If several gate operations are performed within a short period of time, up to 6 (six) gate operations may be reported on a single form. Choose the Gate ID from a drop down menu. Transmit all gate valve operations since the previous report. Enter the data on the report in the following manner with the first entry for a new report. Use column one through six, successively for gate designation, initial gate opening, final gate opening, date, beginning time, and ending time. See the example in Plate No. 4-2.

(21) The second section, Additional Comments, gives an unlimited field to record any comments relevant to the Gate Operations Report which have not been covered previously.

(22) The third report available from the Index Page is the Water Quality Report. This report is used during the seasons in which the lake is subject to stratification. Monitoring begins when a special directive is sent by Water Control Section at the request of Water Quality Section. Report Water Quality data in accordance with the special directive. Monitoring ends when the lake is no longer stratified.

Water Quality Section will request Water Control Section issue a special directive ending monitoring when it is no longer necessary.

(23) The first table in the Water Quality Report has fields referring to conditions at the time the water quality sampling was performed. Record the date and time, the lake elevation in feet to the nearest hundredth, and the weather conditions.

(24) The second table is used to record water quality data at the outflow gage on the surface. Record the water temperature in degrees Celsius, the Dissolved Oxygen (D.O.) content in mg/ml, the water condition, turbidity in n.tu and pH.

(25) The third table is used to record water quality at various depths. The first column records the depth water depth, from the surface, in meters. This field is populated for the convenience of the data transcriber, but can be changed if conditions warrant. The second column records the water temperature in degrees Celsius. The third column records the Dissolve Oxygen (D.O.) content in mg/ml.

The fourth column records the water condition. The fifth column records turbidity in n.tu. The sixth column records the pH. Not all of these readings will be taken at every recording session at every depth.

(26) Below the table recording the water conditions, there is an unlimited field to provide additional comments.

(27) As in the Project Report, a password is necessary to submit the Water Quality Report to the WCDS-A computer. The same password is used to the Project Report and the Water Quality Report (see Para. 4.02.15). If the report is submitted with the proper password, a confirmation screen will be transmitted back to the terminal. If the information is correct, click on the 'Correct' button at the top of the page. The information will be entered into a permanent record.

This record can be viewed through the East Lynn Lake web page at (http://wcds-a.orh.usace.army.mil/dbases/reports/waterqual.txt). This arrangement is illustrated in Plate No. 4-3 at the end of this section.

4-02 EXTRA REPORTS.

Always transmit extra reports, as indicated by the Schedule for Reading gages, Plate No. 3-1, to INTRANET over the project computer terminal in the same way as the regular Project Information report. If project personnel are unable to transmit the report over the computer terminal, telephone the report in to Water Control Section. Failing this attempt, telephone the report to one of the Water Resources Engineering Branch personnel listed below in paragraph 4-03c.

4-03 SPECIAL REPORTS.

a. Reporting Criteria. Special reports include any report not regularly scheduled or called for by the Schedule for Reading Gages. A special report should be made when an event occurs concerning the project that Water Resources Engineering Branch should have knowledge of or when requested by the Branch.

b. Special Report Data. The following types of occurrences or information are examples of occasions for or subjects of special reports.

(1) Extraordinary meteorological event such as a tornado or blizzard, or heavy precipitation after 0730 hours.
(2) Gate positions and/or operations.
(3) Flooding upstream or downstream.

(4) Request for special operation.
(5) Catastrophe such as drowning.
(6) Unusual or abnormal water quality condition in the lake, inflow streams or downstream a reasonable distance from the dam.

(7) Moisture content of snow.
(8) Outflow temperature and/or air temperature at time other than 0730 hours.
(9) Local weather forecast.

c. Transmission of Special Reports. All special reports should be made at any time of day or night, including weekends and holidays, or when requested by the Water Control Section. During office hours, submit them by telephone; however, if it is impossible by telephone, utilize the District radio network.

When making telephone calls after hours or during weekends or holidays, unless advised that the Water Control Section will be on duty, place a person-to-person call to one of the following Water Resources Engineering Branch personnel, in the order listed on the next page.

4-04 RADIO AS STANDBY COMMUNICATION.

Keep the radio turned on at all times when anyone is on duty at the project office, including overtime periods, since a District Office operator is sometimes on duty outside of regular office hours. Also, messages may be relayed through other projects. When there is difficulty in transmitting reports to INTRANET via telephone, attempt to transmit by radio either direct to the District Office or by relay through another project which has contact with the District Office.

TABLE NO. 4-1

DIRECTORY OF KEY PERSONNEL

Water Resources Engineering Branch	Home Telephone Number
[redacted]	*[redacted]
Chief, Water Control Section	*unlisted
[redacted]	[redacted]
Water Control Section	
[redacted]	[redacted]
Water Control Section	
[redacted]	*[redacted]
Chief, Water Resources Engineering Branch	*unlisted

Huntington District Office - Water Resources Engineering Branch

Normal Work Hours 0700 to 1600 hrs		[redacted]
Nights, Weekends, and Holidays	Additional Extensions	[redacted]

NOTE: All the above numbers can be found on the Intranet. Including cell phone numbers. Located at [redacted]

Pertinent telephone numbers which may be of value during flood emergency are listed below:

East Lynn Lake Project Office

Project Manager [redacted]	Commercial Home phone	[redacted]

Gate Operating Personnel	Commercial	Home Telephone Number
[redacted]	[redacted]	[redacted]

OTHER AGENCIES

U. S. Geological Survey Charleston, West Virginia	Commercial	[redacted] Ext. [redacted]
Nights, Weekend, Holiday [redacted]	Commercial	[redacted]
National Weather Service U.S. Forecast Office, Charleston, WV	Commercial	[redacted]

4-05 LETTER REPORTS

a. General. All letter reports pertaining to water control management will be addressed to the District Engineer, Attention: Water Control Section (CELRH-WW).

b. Downstream Channel Conditions. At the request of the Water Control Section, inspection of critical areas downstream from the dam will be made for conditions listed below to observe encroachment on the channel, indiscreet utilization of low-lying areas, and flooding conditions, as follows:

(1) During flood periods when maintaining the maximum allowable (for the season) stage on the "O" gage, downstream to the Town of East Lynn.

(2) As workload permits during or immediately following periods of unusual storage releases, through the residential area below Wayne, West Virginia.

(3) If complaints of flooding are received, notify the Water Control Section immediately, then make an inspection of the specific area as soon as practicable.

(4) At any other times, as requested by the Water Control Section, and under (3) above, the essential items to note and report are: (a) persons or communities involved, (b) nature of complaint, and (c) extent and depth of flooding. A letter report, containing pictures, cross sections or sketches, will be made of the findings as soon as practicable. If immediate action appears necessary, a brief initial report will be made via telephone to the Water Control Section.

c. Lake Area Conditions. During periods of lake storage above seasonal pool elevation, inspections shall be made within the lake area. Essential items to look for and observe are bank slippage and effects of wind and wave erosion.

d. Low-Flow Releases. During periods of low-flow release, downstream observations shall be made of stream depth, fish and wildlife, water odor, and discoloration, if any, as directed by the Water Control Section. Stream gages, rain gages and temperature equipment shall be periodically checked for proper functioning and performance or when directed by the Water Control Section. During periods of stratification, outflow temperature requirements will be maintained according to directives issued by the Water Control Section.

e. Functioning of the Dam. Functioning of the dam shall be observed at all times, including performance of gates, valves, machinery and outlet structure and the presence of any leakage. Following a flood storage period in which the lake level exceeds elevation 684 feet NGVD, or when requested by the Water Control Section for a particular use, a letter report will be submitted as soon as practicable listing observations by project personnel.

f. Water Quality Reports. Any unusual water conditions should be reported to the Water Control Section:

(1) Floating debris, oil, scum and other floating materials from municipal, industrial, or other discharges such as from agricultural practices in such amounts that they are unsightly or detrimental to wildlife or public health.

(2) Unusual color, odor or other conditions in such degree as to be a nuisance.

(3) Any fish kills, plankton blooms or insects to the degree that they are a nuisance should be reported.

(4) The Water Control Section should be informed concerning application of chemicals to the water or to surrounding land. This includes fertilizers or pesticides.

RESERVOIR WEEKLY REPORT

ELT Cont---

REPORTS CONTROL SYMBOL ORHED-H-2

STATION Mar. 29, 1982

WEEK ENDING Apr. 5, 1982

GAGE RECORDS

DATE	TIME		GAGES		
	START	END	VL	VO	WAYM4
	1000	1002	662.35	613.20	
	1102		662.37	613.76	
	1330		662.41	613.76	
	1930		662.48	613.74	
5	0130		662.57	613.72	
	0730		662.63	613.71	0700
	0830		662.65	613.72	

GATE OPERATING RECORD

GATE NO.	AMT. OF OPENING		PURPOSE
	INITIAL	FINAL	
SO1	006	010	Maint Pool

CHECK READINGS

DATE	TIME	VL	RL	TL	SL
30	0730	657.10	657.11	657.11	657.11
2	0730	660.27	660.26	660.27	660.27

DATE	TIME	VO	RO	TO	SO
30	0730	613.58	613.58	613.58	613.58
2	0730	611.92	611.92	611.92	611.92

FINAL POSITION OF GATES

Sluice gate No. 1 Open 010

Sluice Gates No. 2-3 Closed

Outflow Intake No.1 Closed

Lowflow Intake No. 2 Closed

Lowflow Valve Closed

SIGNATURE

Bertha Faucher

for Harold R. Shepard-Res.Mgr.

ORH FORM 1 DEC 78: 14

EDITION OF 1 NOV 72 MAY BE USED

Plate No. 4-1

EAST LYNN LAKE

PROJECT INFORMATION

USE THE MOUSE OR TAB TO MOVE BETWEEN FIELDS
ENTER WILL SUBMIT THE FORM

This file is a New submission.

DATE	TIME
05 Nov 99	0730

CURRENT PROJECT INFO

COE ID	PRECIP (IN)	POOL ELEV (FT-MSL)	TAIL WATER STAGE (FT)	FLOW (KCFS)	SNOW DEPTH (IN)	WATER EQUIVILENT (IN)	WE. CONI
ELTM4	0	650	1.0	0	0.0	0.0	0 Unchang

CURRENT GATE SETTINGS

GATE	S01	S02	S03	I4	I13	LFC
SETTING	.00	.00	.00	OPEN	OPEN	.00

ADDITIONAL STATION INFORMATION

COE ID	PRECIP (IN)	STAGE (FT)
WAYM4	0	0.0
DUMN4	0	0.0
LATL 4	0	0.0

You submitted the following information for this New report:

CORRECT! If this is correct, please click here

Use the BACK button on the browser to return to the data entry page to make corrections

```
.B COEELT E 0730/PPP/HG/QR/HP/HT/QT/SD/SW
:
: PROJECT REPORT FOR EAST LYNN LAKE                                    FRI 05 Nov 1999
0933
:
:STANDARD PROJECT DATA----------------------------------------------------------------------------------------
--------------
:     ID            PRECIP       POOL       TAILWATER              SNOW       WATER
        WEATHER
:COE/SHEF          (IN)          ELEV       STAGE       FLOW   DEPTH       EQUIV
      CODE/DESCRIPTION
:ELTM4        0///          650/          1.0/          M/       0.0/          0.0:       0
Unchanged
:
:GATE SETTINGS------------------------------------------------------------------------------------------------
----------------
: S01=.00      /S02=.00      /S03=.00      /I4=OPEN      /I13=OPEN      /LFC=.00
:
:STATION DATA-------------------------------------------------------------------------------------------------
---------------
:     ID                        PRECIP      TAILWATER
:COE/SHEF                       (IN)          ELEV
:WAYM4:XXXXX       0730/        0///           0.0/                    WAYNE WV
:DUMN4:XXXXX       0730/        0///           0.0/                    DUNLOW WV
:LVTL4:XXXXX       0730/        0///           0.0/                    LAVALETTE
WV
.END
```

EAST LYNN LAKE

GATE OPERATIONS

This file is a New submission.

GATE ID	VALUE		DATE	TIME	
	Start	End		Start	End
S01	0	0	5 Nov 99	0700	0705

ADDITIONAL COMMENTS

PLEASE ENTER THE EAST LYNN PASSWORD:

Submit These Gate Operations

Clear Form

CLICK HERE TO RETURN TO EAST LYNN LAKE HOME PAGE (WILL NOT SAVE DATA)

EAST LYNN LAKE

Lake Quality Report

USE THE MOUSE OR TAB TO MOVE BETWEEN FIELDS
THE ENTER KEY WILL SUBMIT THE DATA

This file is a New submission.

DATE	TIME	LAKE ELEV (FT)	WEATHER
5 Nov 99	0730	660.00	0 Unchanged

DEPTH (M)	TEMP (C)	D.O.	COND	TURB	pH
OUTFLOW					

DEPTH (M)	TEMP (C)	D.O.	COND	TURB	pH
0.0					
1.0					
2.0					
3.0					
4.0					
5.0					
6.0					
7.0					
8.0					
9.0					

10.0					
12.0					
14.0					
16.0					
18.0					
20.0					

ADDITIONAL COMMENTS

PLEASE ENTER THE EAST LYNN PASSWORD:

SUBMIT DATA

CLEAR FORM

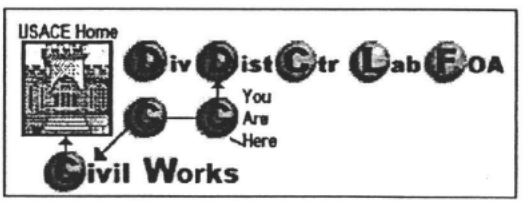
CLICK HERE TO RETURN TO EAST LYNN LAKE HOME PAGE (WILL NOT SAVE DATA)

The POC for this page:

[redacted] *CELRH-EC-WW*

Huntington, WV

Send Email to Water Resources



Date last modified: 23 Apr 99 at 0720

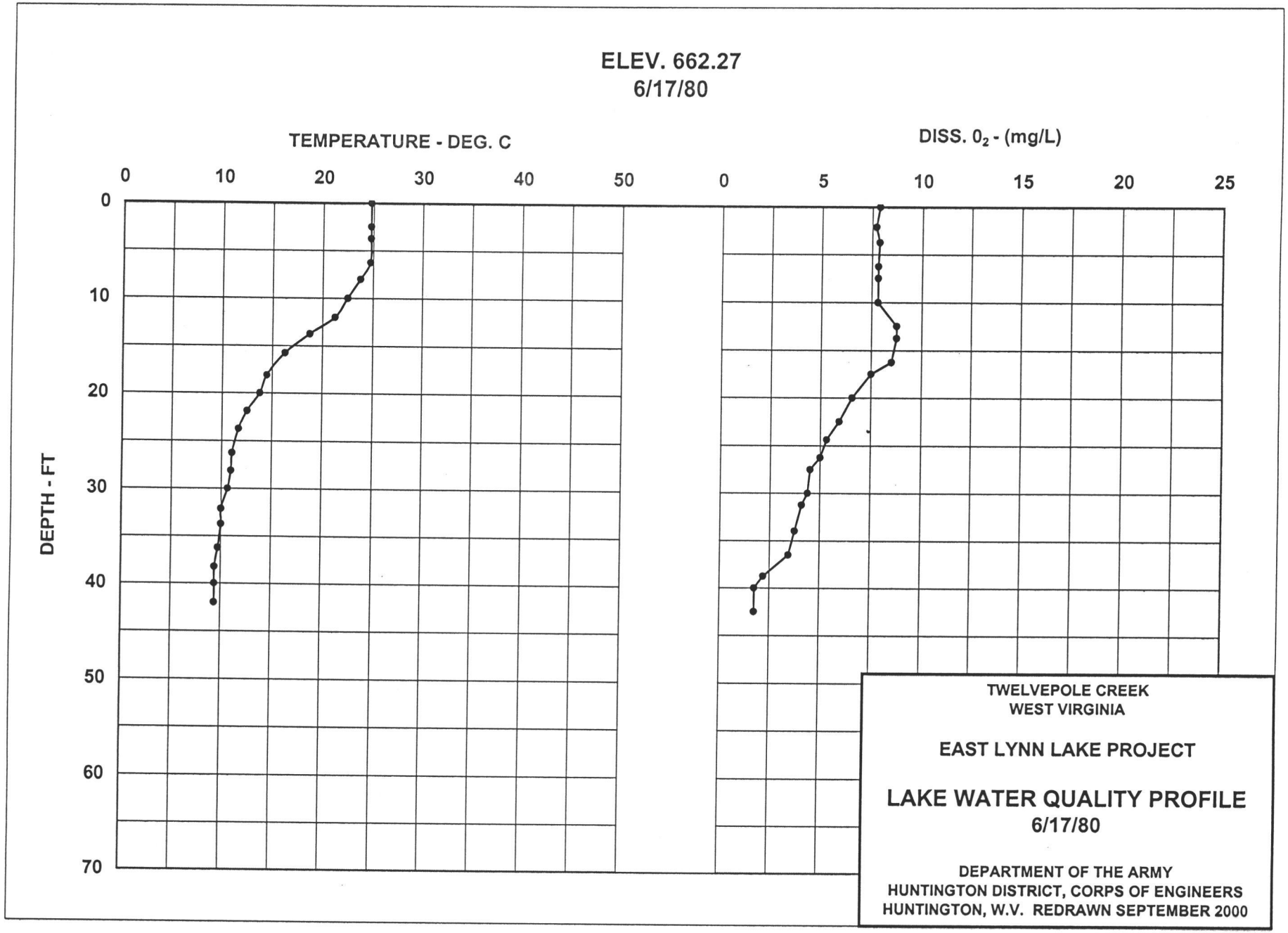
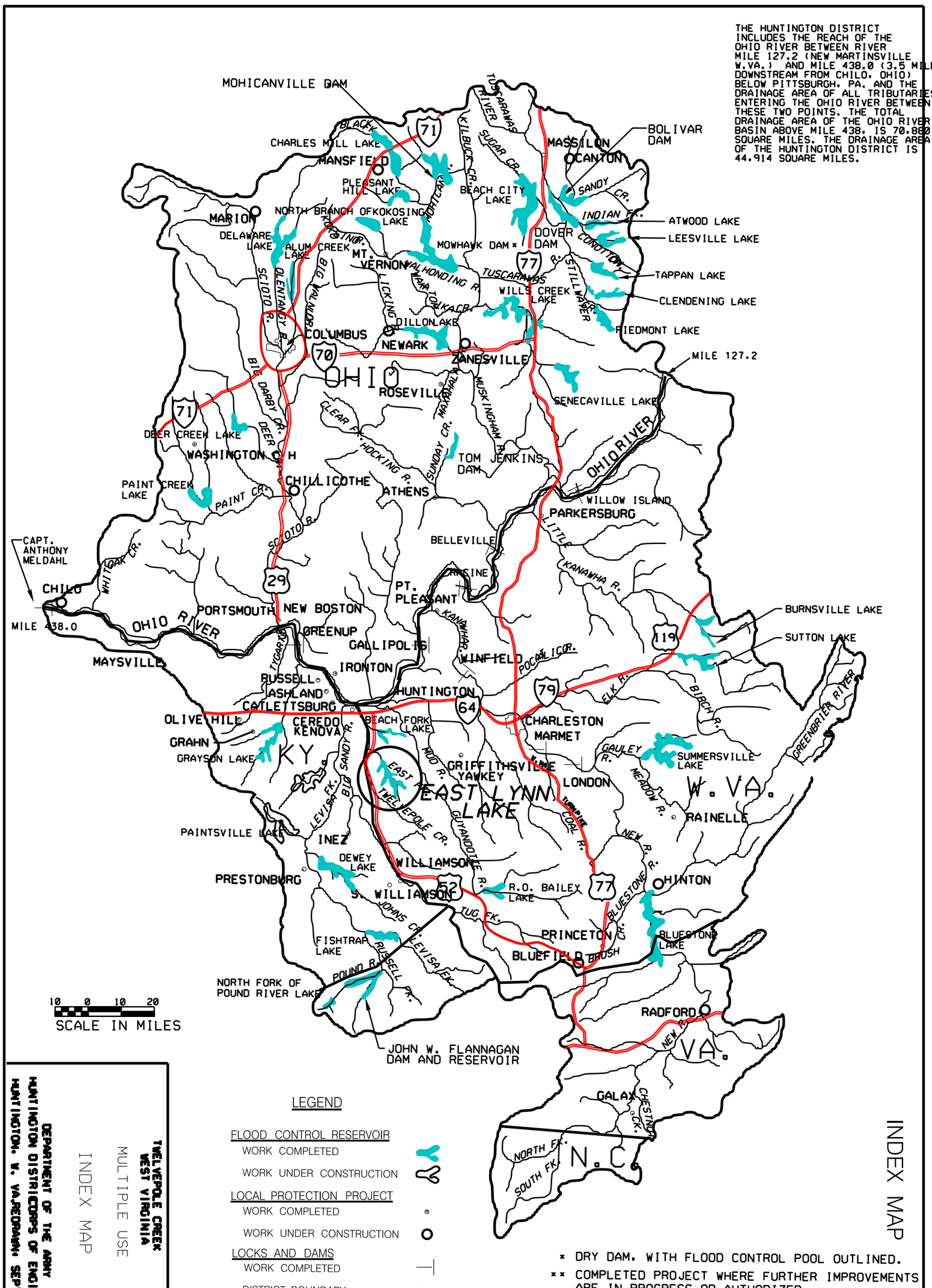


PLATE NO. 4-3

PLATE NO. 4-3

UPON APPROVAL OF NEPA DOCUMENTATION, THE DROUGHT CONTINGENCY PLAN WILL BE FURNISHED FOR ENCLOSURE IN THE WATER CONTROL MANUALS.



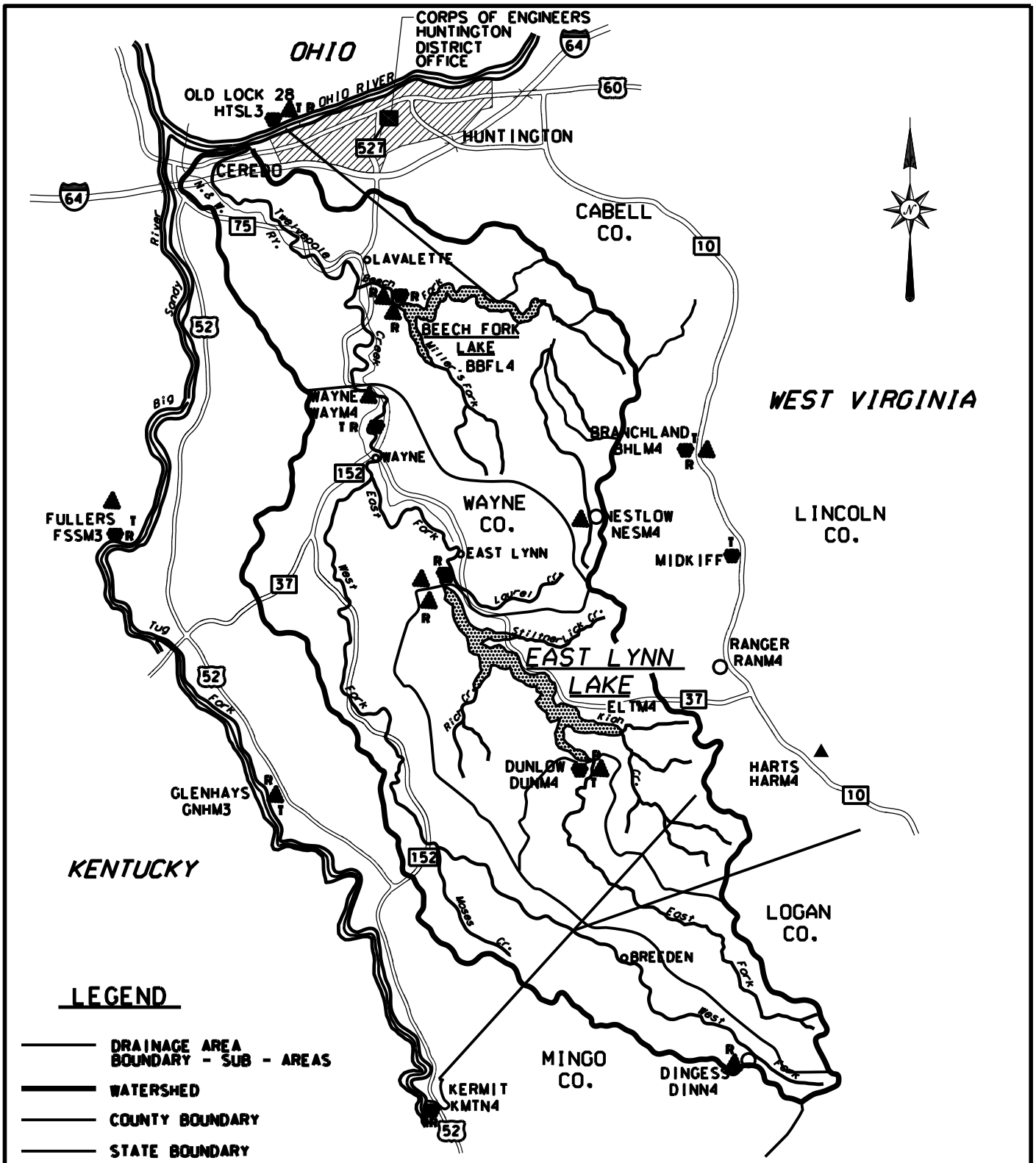
TWELVEPOLE CREEK
WEST VIRGINIA

MULTIPLE USE

INDEX MAP

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA.-REDRAWN, SEPT. 2000

PLATE NO. 1-1



TWELVEPOLE CREEK BASIN
WEST VIRGINIA

EAST LYNN LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-1

GENERAL NOTES

1. PLANS ARE DRAWN ON THE WEST VIRGINIA STATE PLANE COORDINATE SYSTEM, SOUTH ZONE, BASED ON THE LAMBERT CONFORMAL CONIC PROJECTION, WHICH IS THE 1927 NORTH AMERICAN U.S.C.G.S. DATUM. VERTICAL CONTROL IS BASED ON MEAN SEA LEVEL DATUM OF 1929.

2. ALL PROPERTY WITHIN THE WORK AREA SHOWN ON THIS DRAWING (EXCEPT THAT RESERVED FOR CONSTRUCTION UNDER THIS OR ANY EXISTING CONTRACT) IS AVAILABLE TO THE CONTRACTOR FOR PLANT ERECTION AND OTHER TEMPORARY PROJECT FACILITIES. SUCH UTILIZATION, INCLUDING PROPOSED ALTERATIONS OF EXISTING TOPOGRAPHY, PHYSICAL FEATURES OR FACILITIES, SHALL BE SUBJECT TO APPROVAL BY THE CONTRACTING OFFICER.

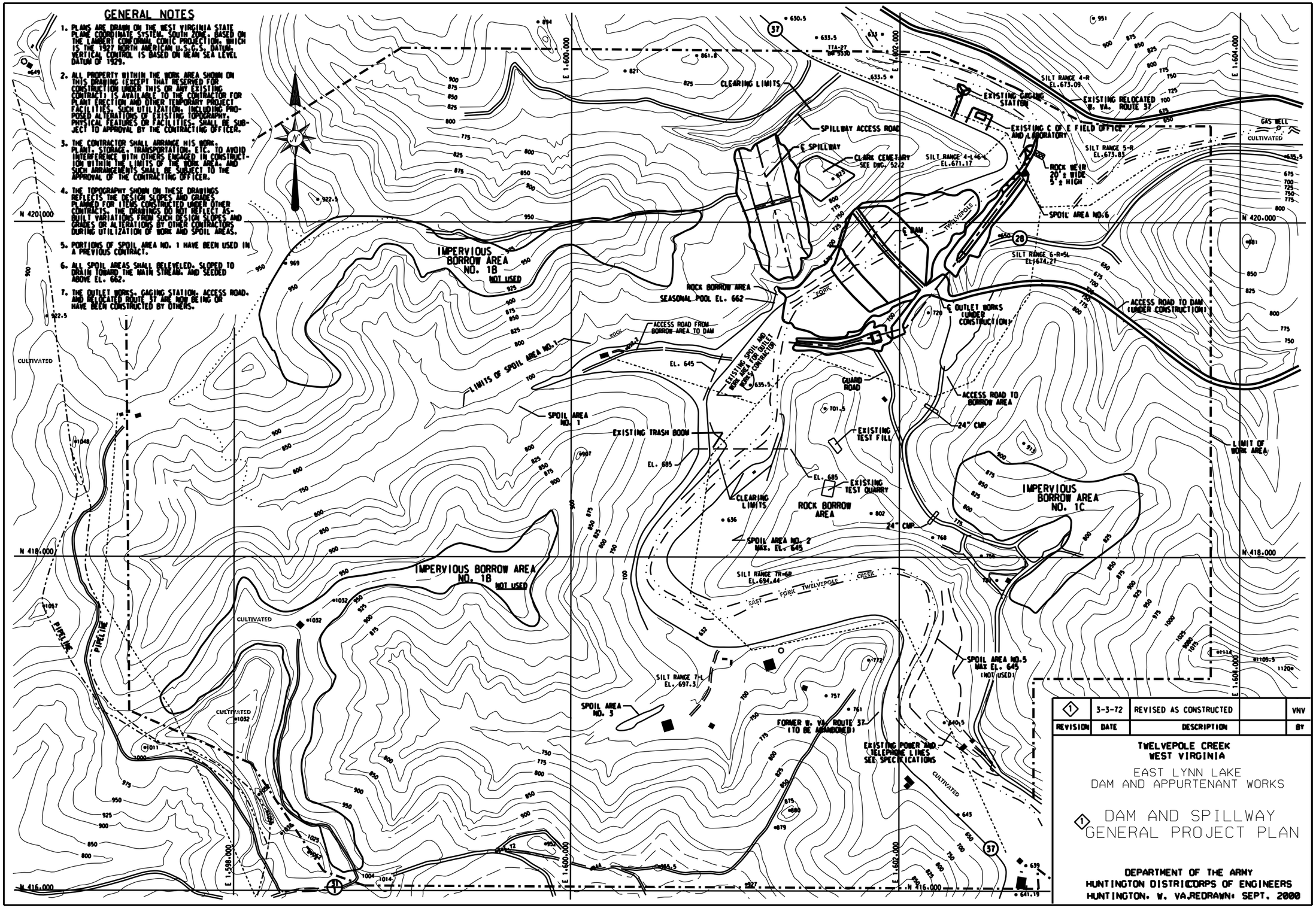
3. THE CONTRACTOR SHALL ARRANGE HIS WORK, PLANT, STORAGE, TRANSPORTATION, ETC. TO AVOID INTERFERENCE WITH OTHERS ENGAGED IN CONSTRUCTION WITHIN THE LIMITS OF THE WORK AREA, AND SUCH ARRANGEMENTS SHALL BE SUBJECT TO THE APPROVAL OF THE CONTRACTING OFFICER.

4. THE TOPOGRAPHY SHOWN ON THESE DRAWINGS REFLECTS THE DESIGN SLOPES AND GRADES PLANNED FOR ITEMS CONSTRUCTED UNDER OTHER CONTRACTS. THE DRAWINGS DO NOT REFLECT AS-BUILT VARIATIONS FROM SUCH DESIGN SLOPES AND GRADES OR ALTERATIONS BY OTHER CONTRACTORS DURING UTILIZATION OF WORK AND SPOIL AREAS.

5. PORTIONS OF SPOIL AREA NO. 1 HAVE BEEN USED IN A PREVIOUS CONTRACT.

6. ALL SPOIL AREAS SHALL BE LEVELED, SLOPED TO DRAIN TOWARD THE MAIN STREAM, AND SEEDED ABOVE EL. 662.

7. THE OUTLET WORKS, GAGING STATION, ACCESS ROAD, AND RELOCATED ROUTE 37 ARE NOW BEING OR HAVE BEEN CONSTRUCTED BY OTHERS.



REVISION	DATE	DESCRIPTION		BY
1	3-3-72	REVISED AS CONSTRUCTED		VNV

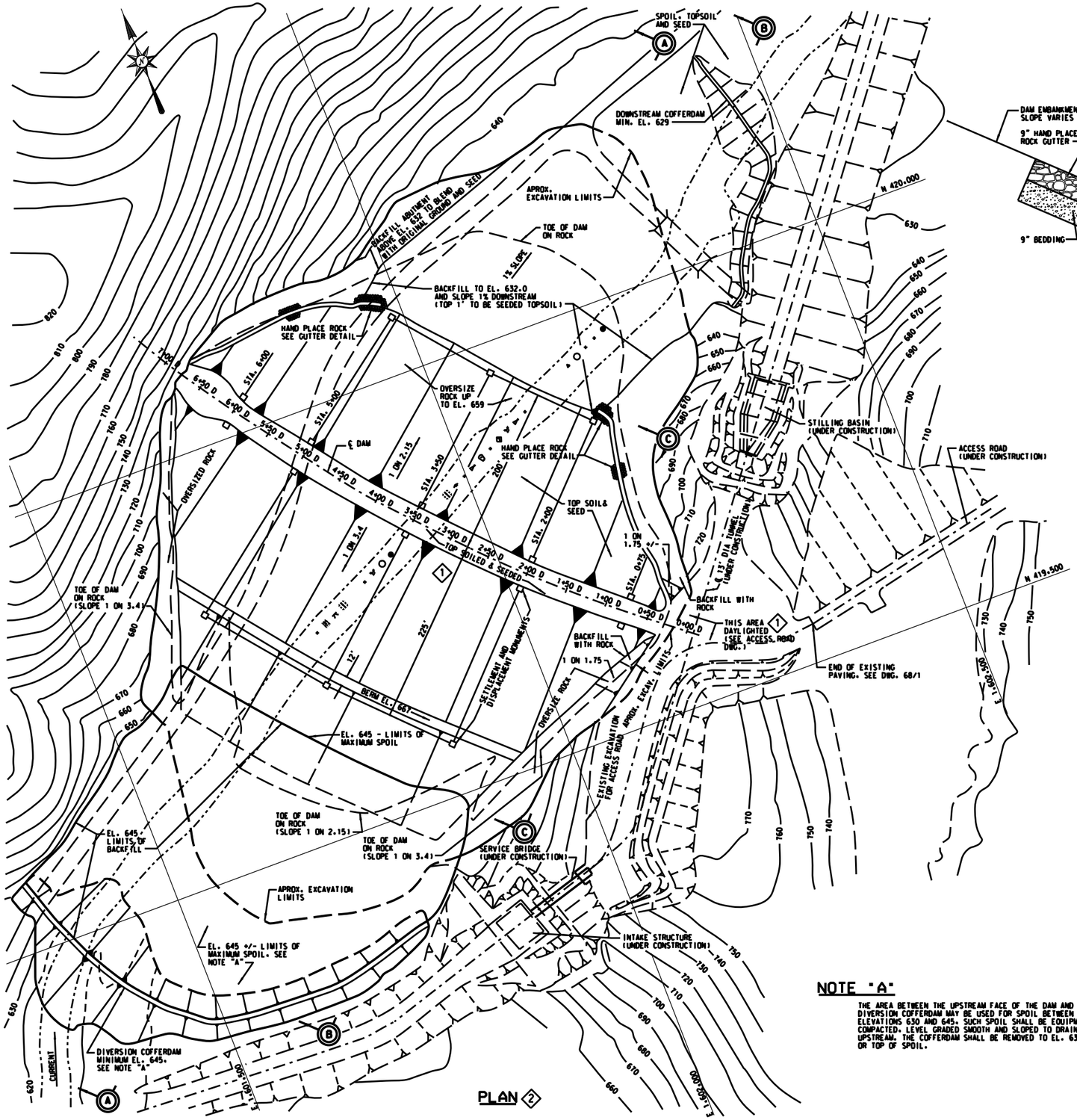
TWELVEPOLE CREEK
WEST VIRGINIA

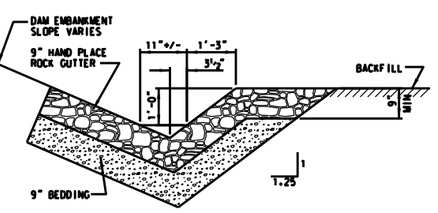
EAST LYNN LAKE
DAM AND APPURTENANT WORKS

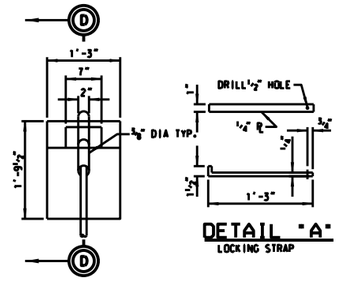
1 DAM AND SPILLWAY GENERAL PROJECT PLAN

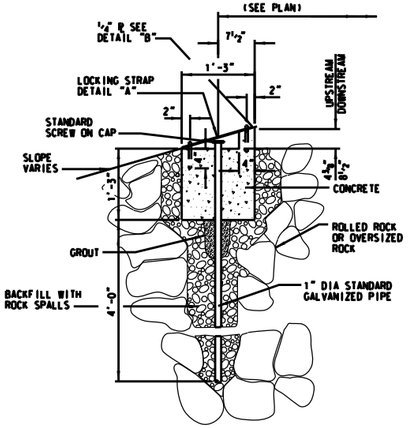
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICCORPS OF ENGINEERS
HUNTINGTON, W. VA.REDRAWN: SEPT. 2000

PLATE NO. 2-2









SECTION D-D

SETTLEMENT AND DISPLACEMENT MONUMENT

NOTES

1. FOR LAYOUT PLAN. SEE DWG. 52/3.
2. FOR SECTIONS A-A, B-B, C-C AND DETAILS OF EMBANKMENT. SEE DWG. 52/13.
3. FOR SITE PLAN. SEE DWG. 52/2.
4.
5. FOR FOUNDATION EXCAVATION OF DAM. SEE DWGS. 52/10, 52/11 AND 52/13.

NOTE "A"

THE AREA BETWEEN THE UPSTREAM FACE OF THE DAM AND THE DIVERSION COFFERDAM MAY BE USED FOR SPOIL BETWEEN ELEVATIONS 630 AND 645. SUCH SPOIL SHALL BE EQUIPMENT COMPACTED. LEVEL GRADED SMOOTH AND SLOPED TO DRAIN UPSTREAM. THE COFFERDAM SHALL BE REMOVED TO EL. 630 OR TOP OF SPOIL.

REVISION	DATE	DESCRIPTION	BY
2	3-3-72	REVISED AS CONSTRUCTED	VNV
1	7-9-70	DELETE ACCESS ROAD PAVING. PAVING AND GUARDRAIL ACROSS TOP OF DAM. AND EXTEND CHAIN LINK FENCE	GAB

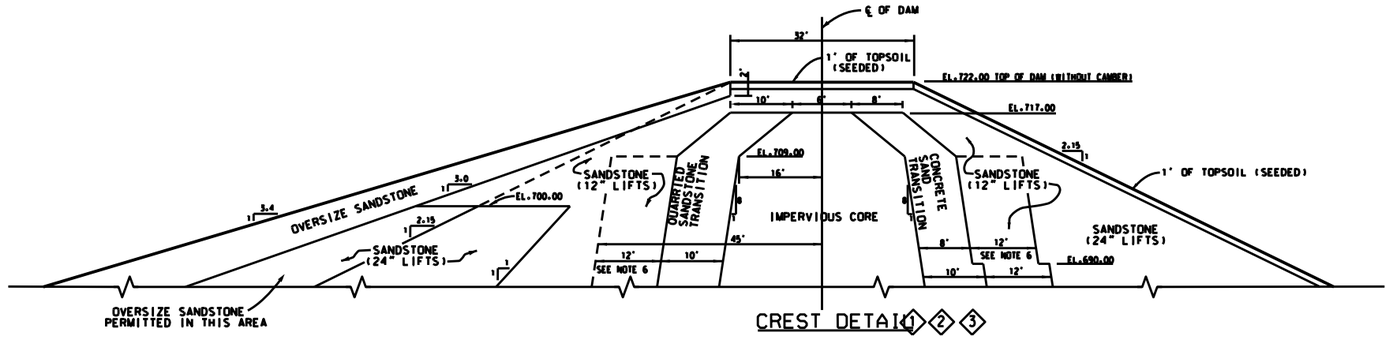
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE
DAM AND APPURTENANT WORKS
DAM
PLAN

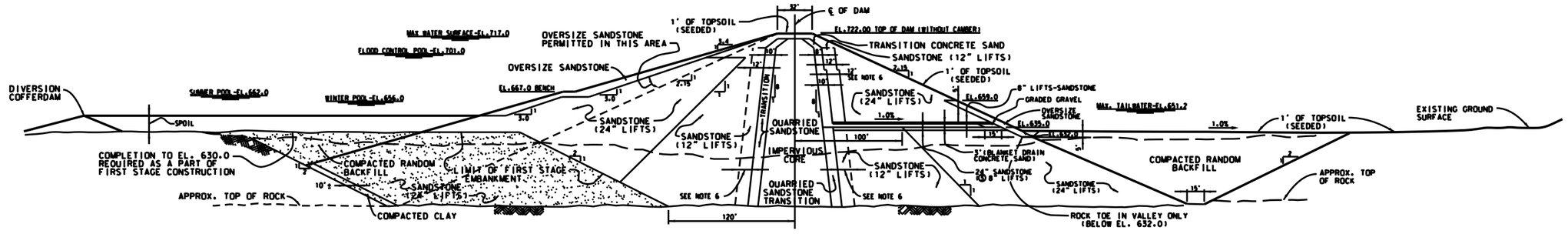
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-3

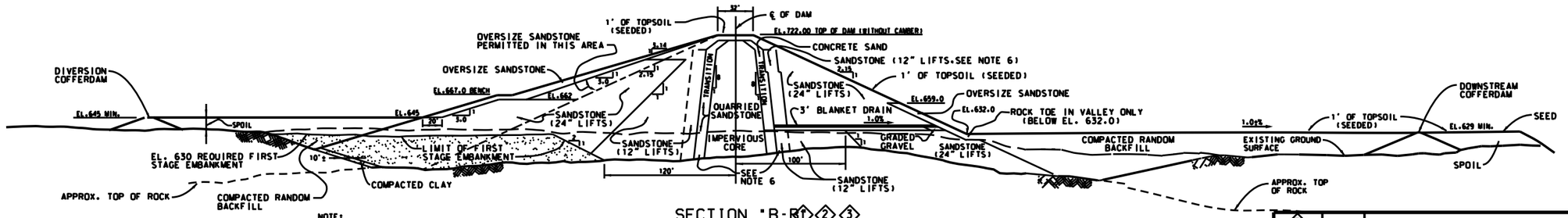


CREST DETAIL 1 2 3



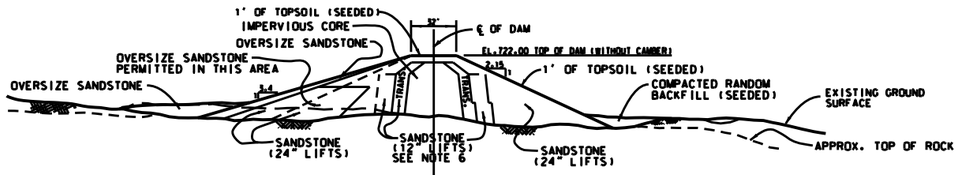
SECTION "A-A" 1 2 3
(TYPICAL FOR VALLEY FLOOR)

NOTE:
ON THE ABUTMENTS, ABOVE EL. 635, PLACE BLANKET DRAIN DIRECTLY ON FOUNDATION ROCK. TERMINATE BLANKET AT EL. 650.



NOTE:
ABOVE EL. 630 ON BOTH ABUTMENTS THE ENTIRE EMBANKMENT, INCLUDING THAT PART BETWEEN THE 1 ON 2.15 AND 1 ON 3.4 SLOPES, SHALL BE FOUNDED ON BEDROCK.

SECTION "B-B" 1 2 3
(TYPICAL FOR VALLEY FLOOR)



SECTION "C-C" 1 2 3
(TYPICAL FOR ABUTMENT)

NOTES

1. FOR LOCATION OF SECTIONS. SEE DWGS. 52/10 & 52/12.
2. FOR GROUTING. SEE DWG. 52/11.
3. FOR PLAN. SEE DWG. 52/12
4. FOR FOUNDATION EXCAVATION. SEE DWGS. 52/10 & 52/11.
5. FOR SITE PLAN. SEE DWG. 52/2.
6. FOR A DISTANCE OF 12' ADJACENT TO EACH TRANSITION ZONE BELOW EL. 709.0. ALL ROCKS LARGER THAN 12" IN LENGTH, BREADTH OR THICKNESS SHALL BE REMOVED.
7. SEE SPECIFICATIONS FOR SPECIAL REQUIREMENTS FOR CONTROL OF GROUNDWATER TO PROTECT STABILITY OF EXCAVATION SLOPES AND AS A PRECEDENT TO EMBANKMENT PLACEMENT.
8. FOR DATA ON PROTECTION AGAINST OVERTOPPING. SEE DWG. 14/1.
9. THE BEST QUALITY IMPERVIOUS BORROW, ESSENTIALLY FREE OF ROCK FRAGMENTS, SHALL BE USED ADJACENT TO THE FOUNDATION AND ABUTMENT.

2 10.
11.

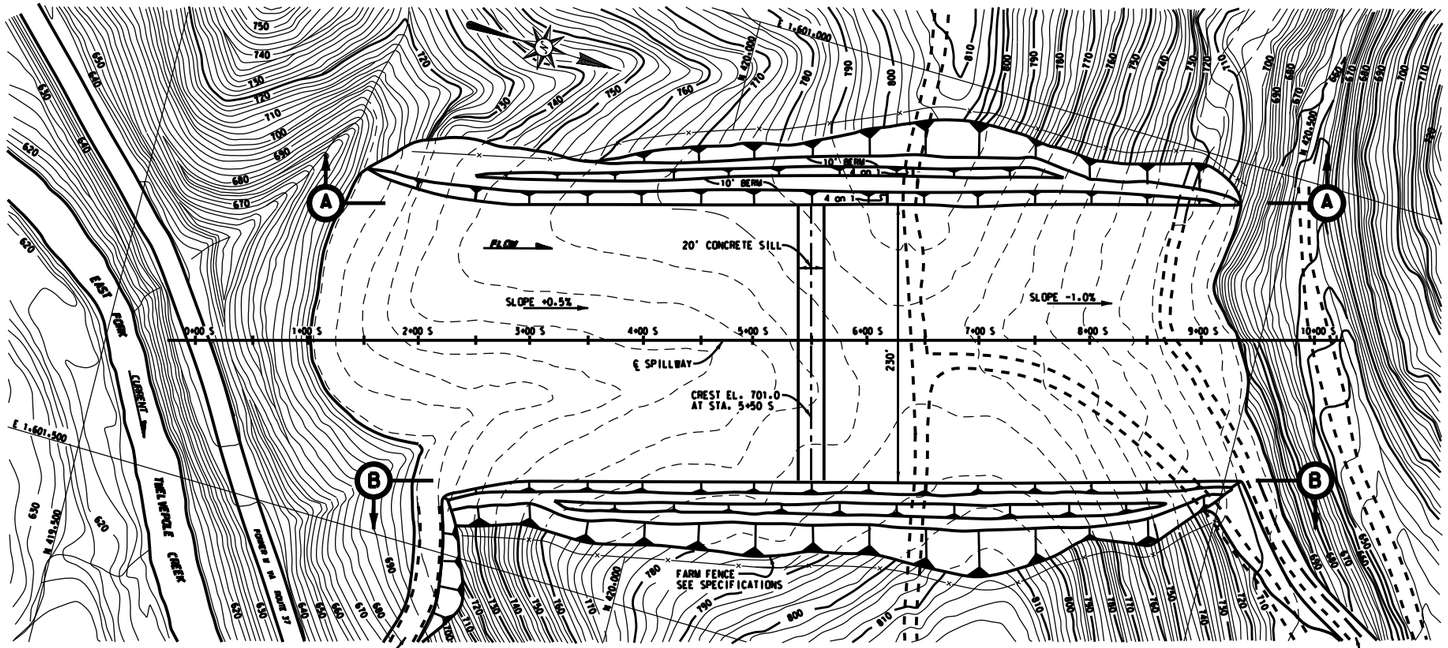
REVISION	DATE	DESCRIPTION	BY
3	3-3-72	REVISED AS CONSTRUCTED	VNV
2	7-9-70	DELETE ACCESS ROAD PAVING. PAVING & GUARDRAIL ACROSS TOP OF DAM & EXTEND CHAIN LINK FENCE	GAB
1	4-5-72	MATERIAL ZONES. DOWNSTREAM FACE	GAB

TWELVEPOLE CREEK
WEST VIRGINIA

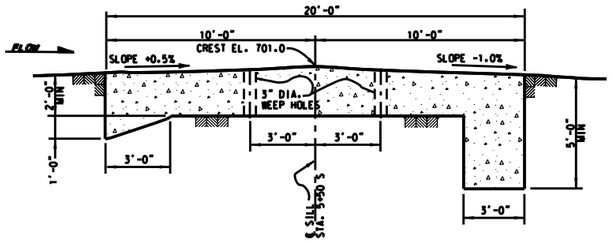
EAST LYNN LAKE
DAM AND APPURTENANT WORKS

DAM
SECTIONS

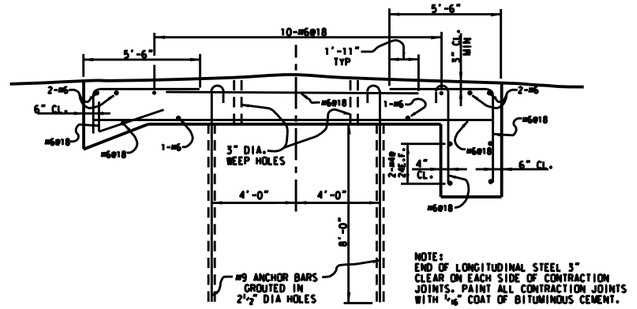
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 1999



① PLAN

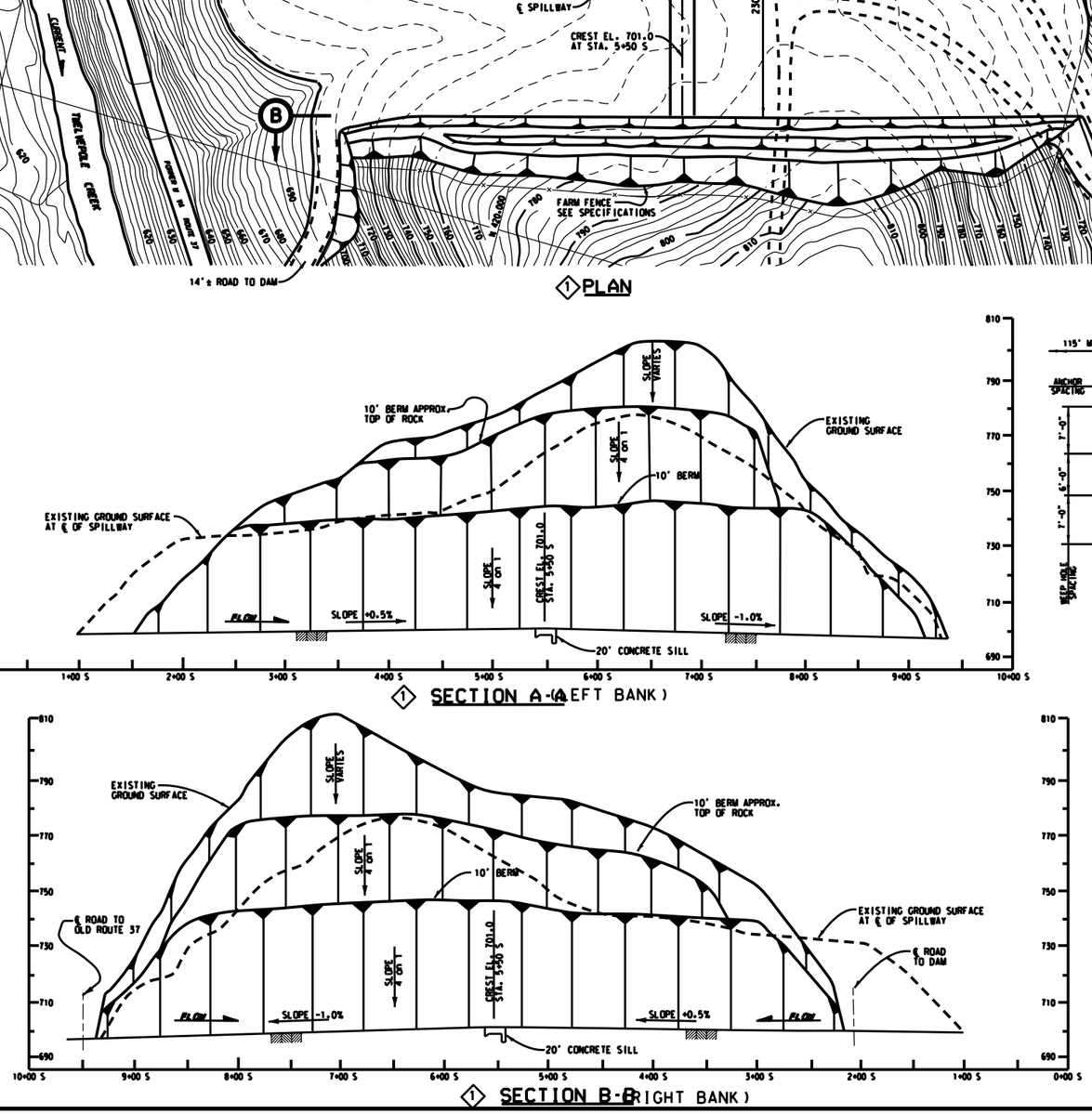


① SECTION C-C

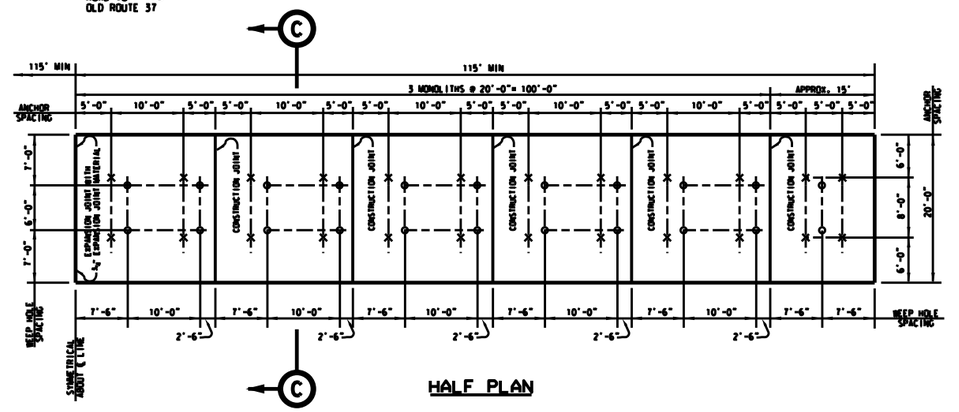


① REINFORCING DETAIL

① SECTION A-A (LEFT BANK)



① SECTION B-B (RIGHT BANK)



HALF PLAN

SPILLWAY SILL

NOTES:

1. FOR SITE PLAN, SEE DWG. 52/2
2. FOR SECTIONS THRU SPILLWAY, SEE DWG. 52/21
3. ALL FOUNDATION WEEPHOLES SHALL BE FORMED IN CONCRETE AND BACKFILLED WITH PEA GRAVEL.
4. FOR LAYOUT PLAN, SEE DWG. 52/3

EXCAVATION NOTES

1. DETAILS OF EXCAVATION MAY BE MODIFIED BY THE CONTRACTING OFFICER TO ACCOMODATE THE GEOLOGICAL CONDITIONS REVEALED DURING EXCAVATION.
2. ALL BERM ELEVATIONS SHOWN ON THE DRAWING ARE APPROXIMATE
3. ALL ROCK SURFACES EXPOSED IN THE SPILLWAY EXCAVATION SHALL BE FORMED BY PRESPLITTING.

① CONCRETE DESIGN STRENGTHS

(MINIMUM 28 DAY COMPRESIVE STRENGTHS [f'c] OF CONCRETE)

1. ALL CONCRETE IN THIS CONTRACT- 2,500 P.S.I.

REVISION	DATE	DESCRIPTION	BY
①	3-3-72	REVISED AS CONSTRUCTED	VNK

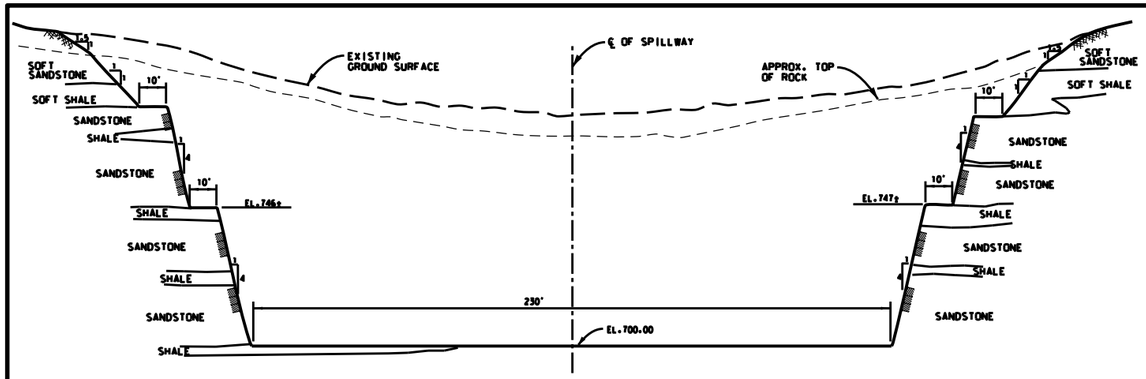
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE
DAM AND APPURTENANT WORKS

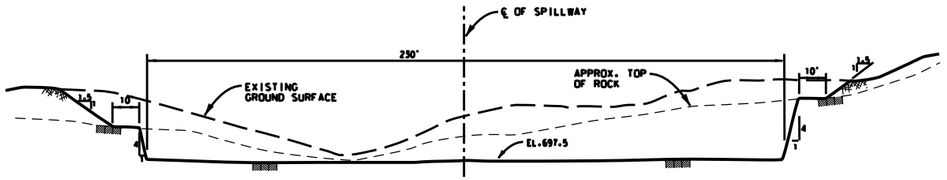
SPILLWAY
PLAN AND PROFILE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

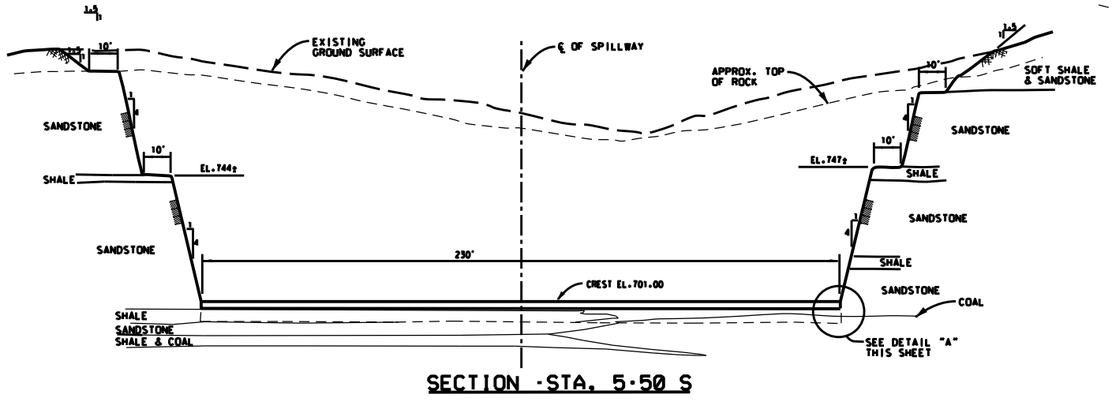
PLATE NO. 2-5



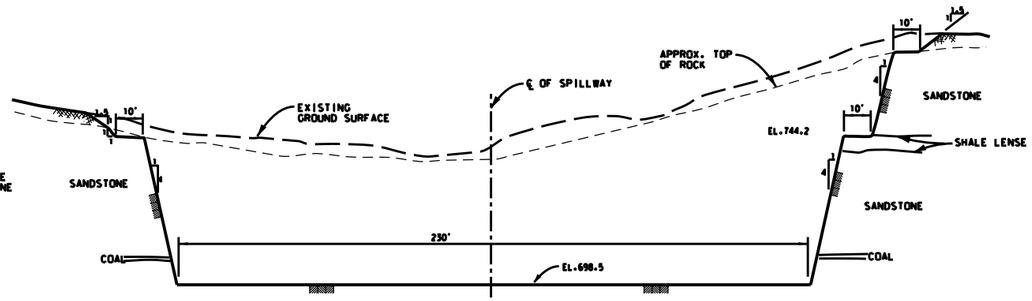
SECTION -STA. 6+50 S



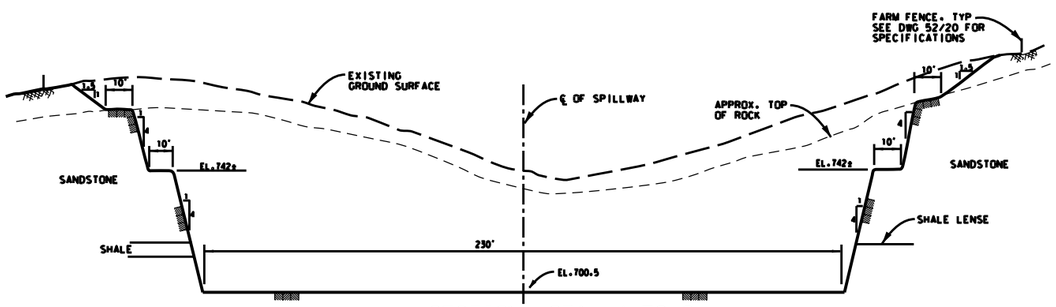
SECTION -STA. 9+00 S



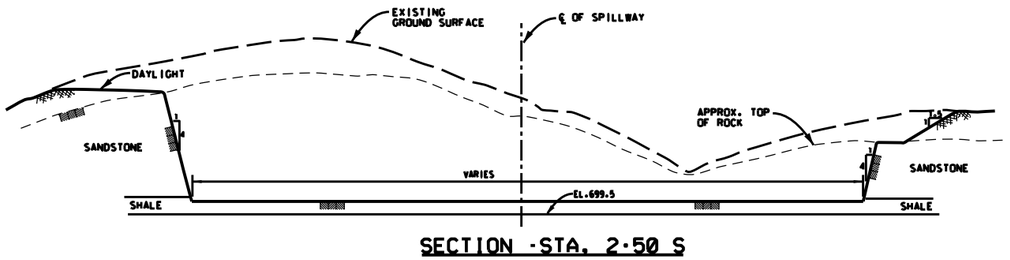
SECTION -STA. 5+50 S



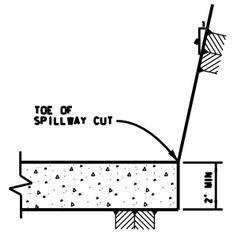
SECTION -STA. 8+00 S



SECTION -STA. 4+50 S



SECTION -STA. 2+50 S



DETAIL "A"

NOTES

1. FOR LOCATION OF SECTIONS SHOWN ON THIS SHEET. SEE DWG. 52/20.
2. FOR DETAILS OF SPILLWAY SILL. SEE DWG. 52/20

REVISION	DATE	DESCRIPTION	BY

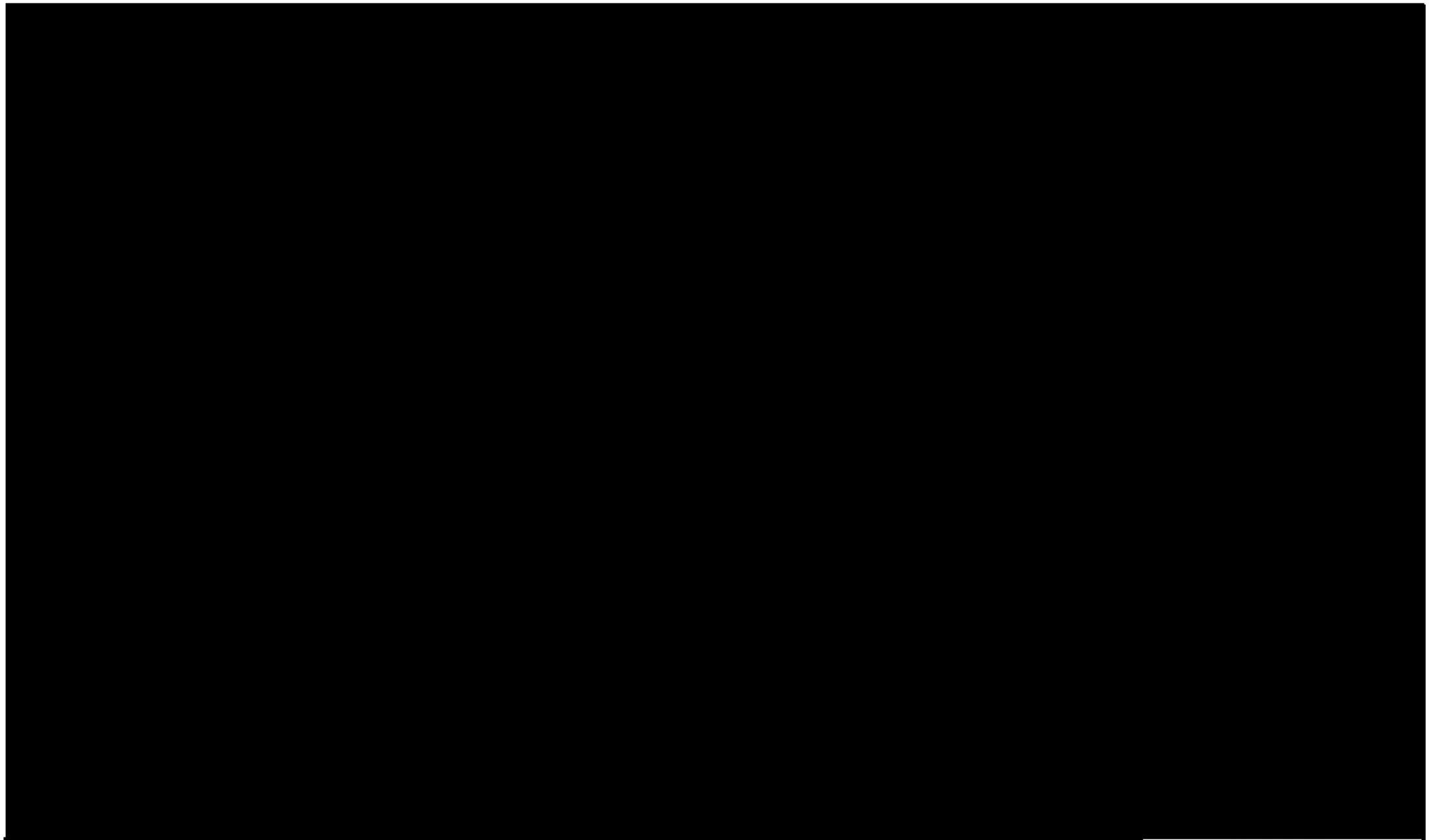
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE
DAM AND APPURTENANT WORKS

SPILLWAY SECTIONS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT. CORPS OF ENGINEERS
HUNTINGTON. W. VA. REDRAWN: SEPT. 1999

PLATE NO. 2-6



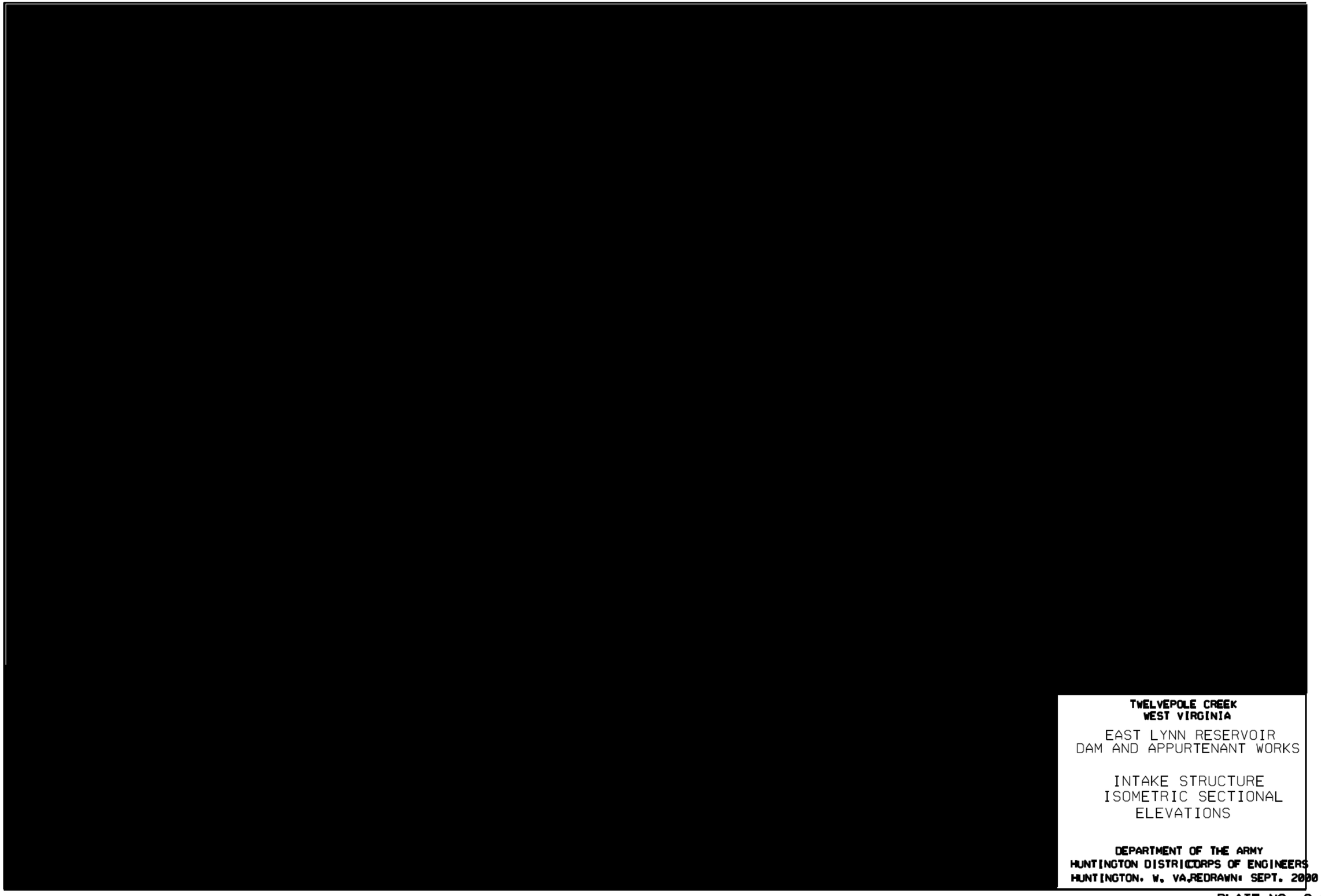
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE
DAM AND APPURTENANT WORKS

OUTLET WORKS
PLAN AND PROFILE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-7



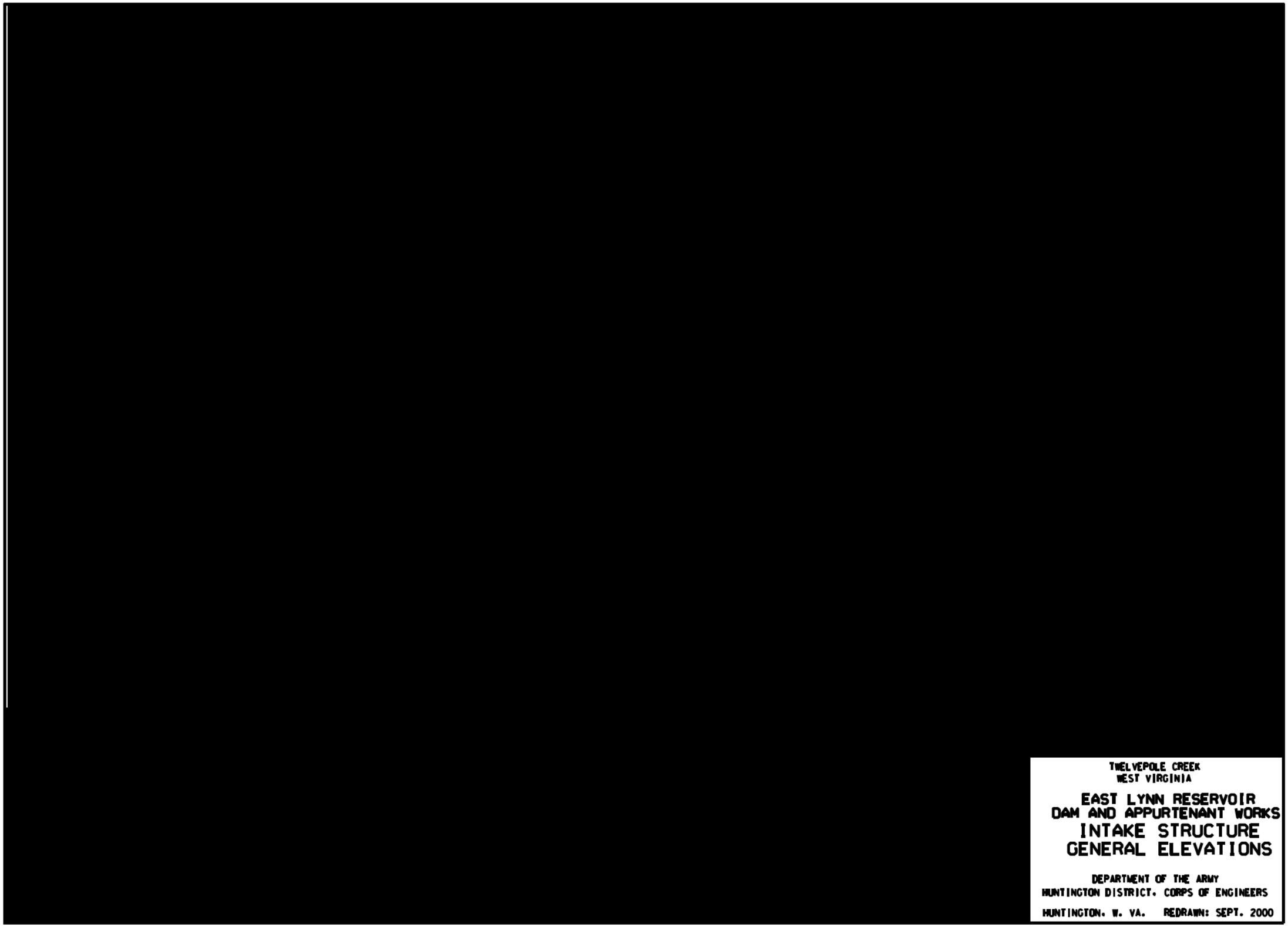
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM AND APPURTENANT WORKS

INTAKE STRUCTURE
ISOMETRIC SECTIONAL
ELEVATIONS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICCORPS OF ENGINEERS
HUNTINGTON, W. VA.REDRAWN: SEPT. 2000

PLATE NO. 2-8



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM AND APPURTENANT WORKS
INTAKE STRUCTURE
GENERAL ELEVATIONS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

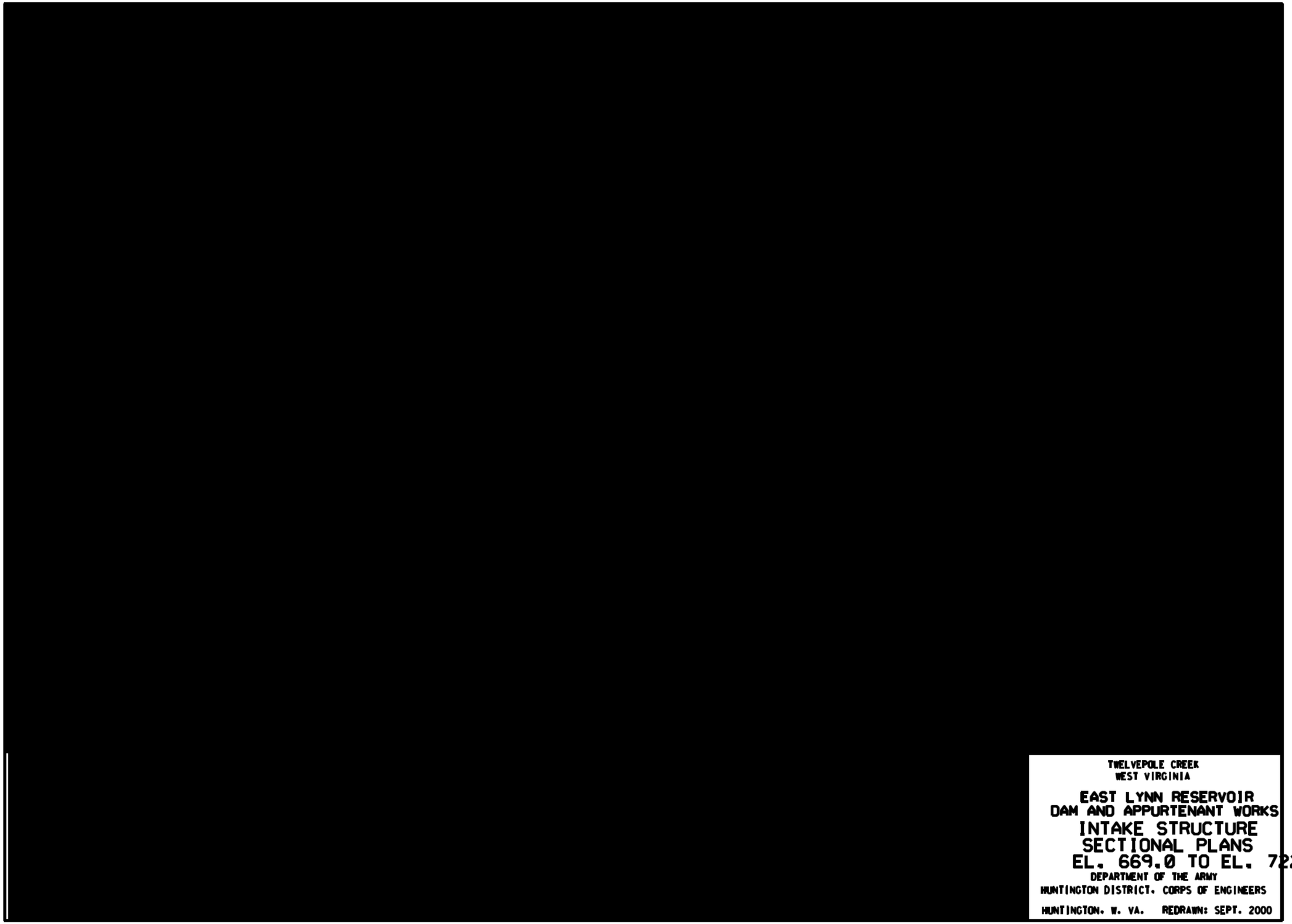
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM AND APPURTENANT WORKS
INTAKE STRUCTURE
SECTIONAL PLANS
EL. 606.0 TO EL. 669.0

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-10



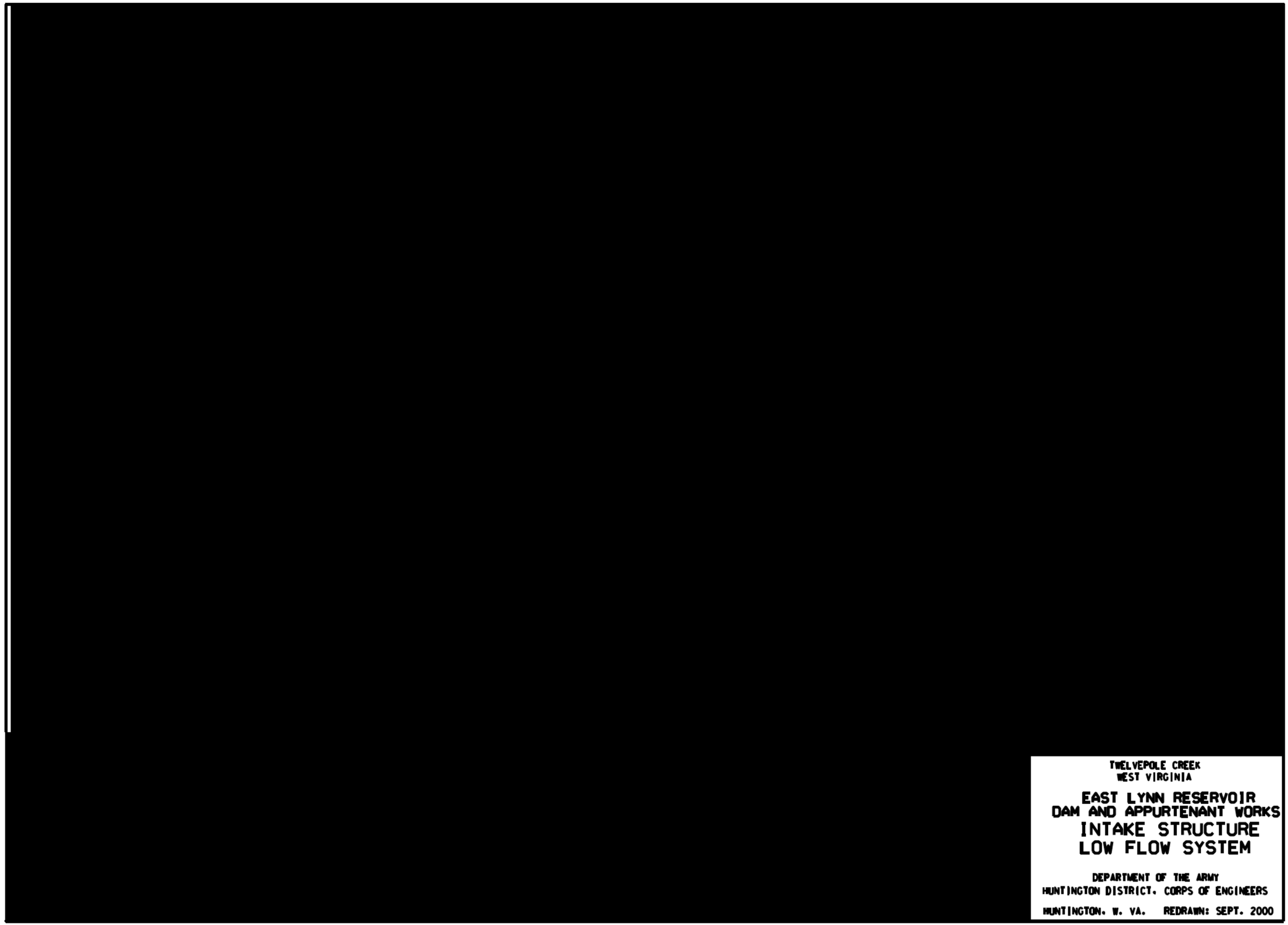
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM AND APPURTENANT WORKS
INTAKE STRUCTURE
SECTIONAL PLANS
EL. 669.0 TO EL. 722.0

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-11



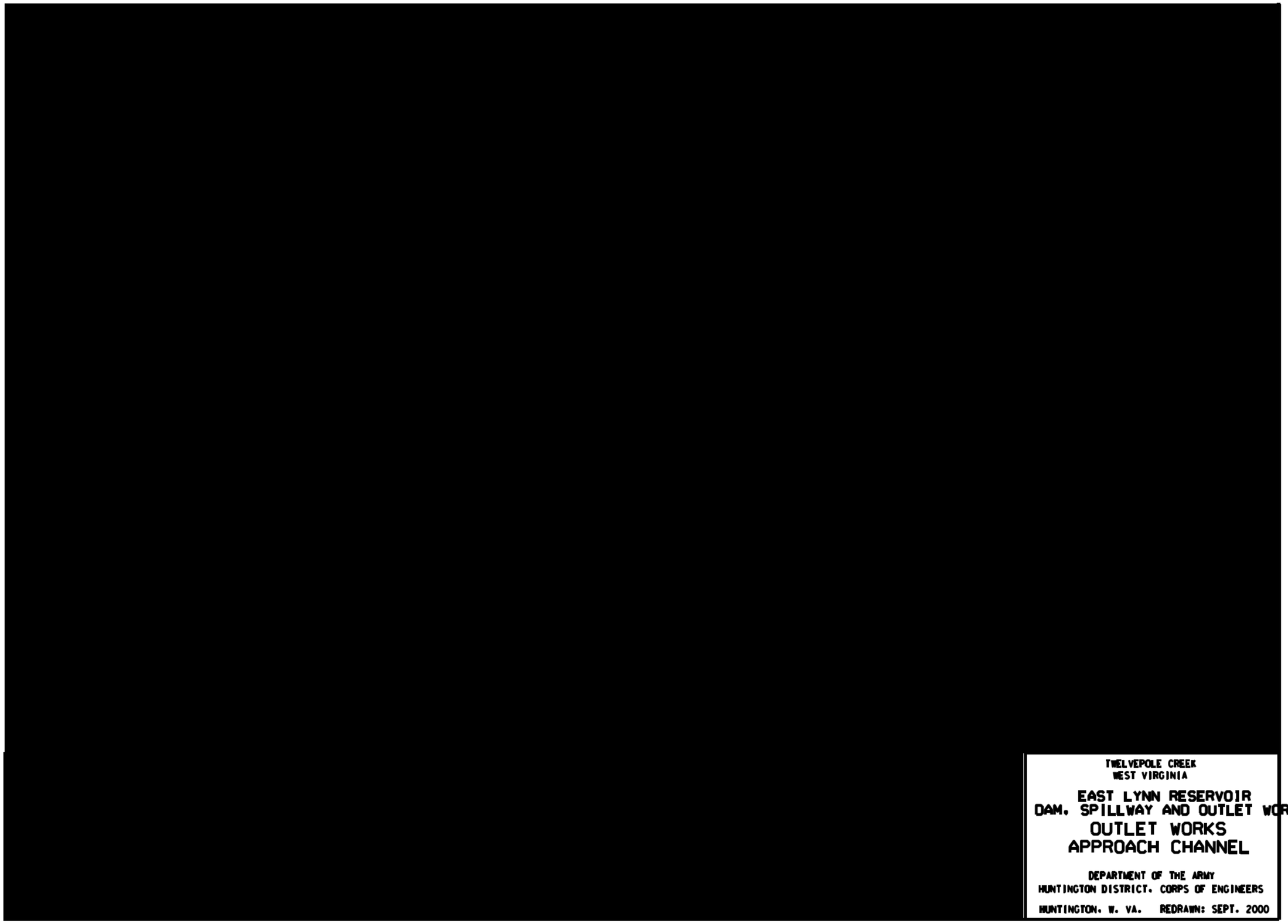
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM AND APPURTENANT WORKS
INTAKE STRUCTURE
LOW FLOW SYSTEM

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-12



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM, SPILLWAY AND OUTLET WORKS

OUTLET WORKS
APPROACH CHANNEL

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR PROJECT

TUNNEL AND TRANSITION DETAILS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-14

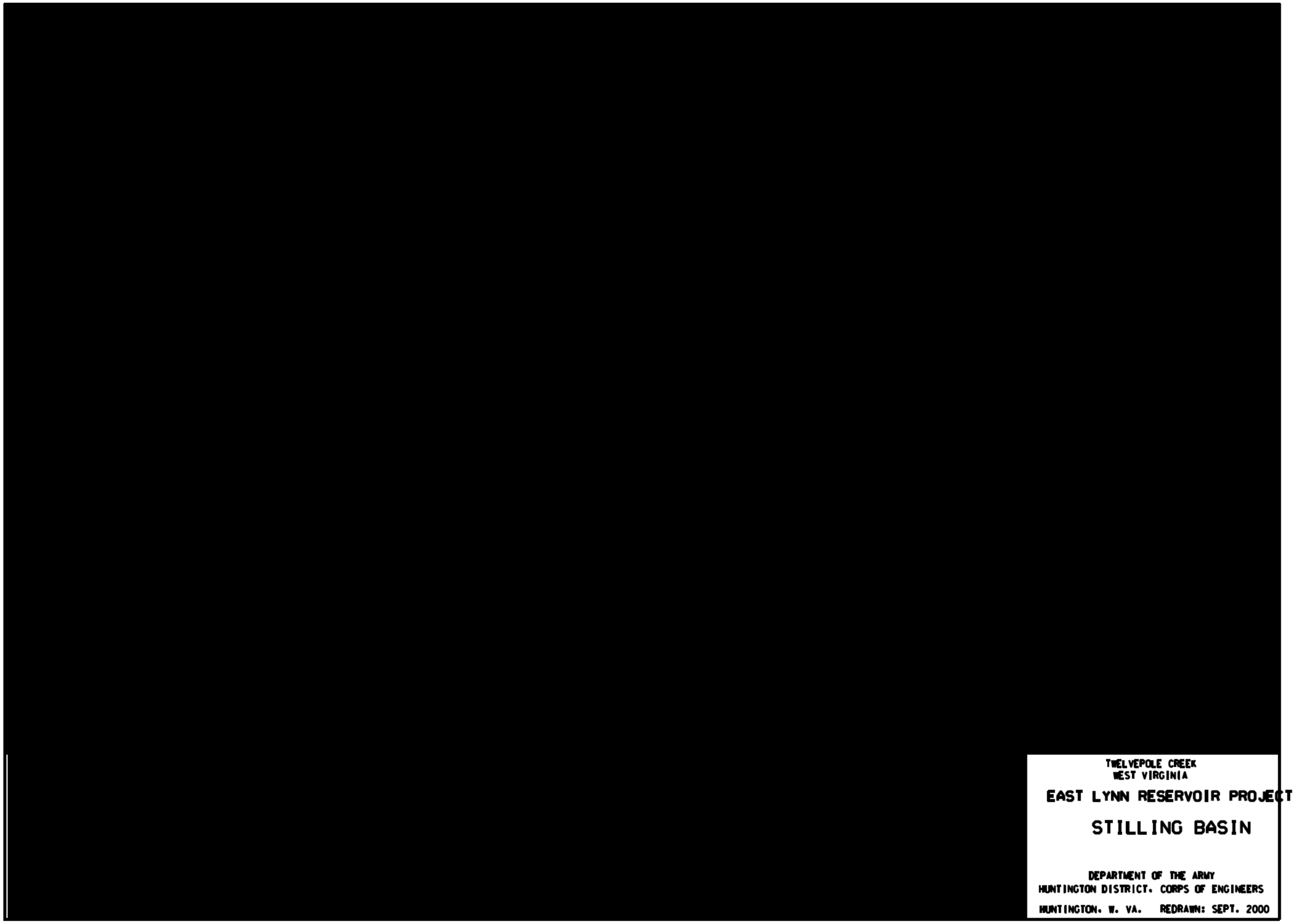
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR
DAM, SPILLWAY AND OUTLET WORKS
OUTLET WORKS
OUTLET CHANNEL

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-15



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR PROJECT

STILLING BASIN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS

HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

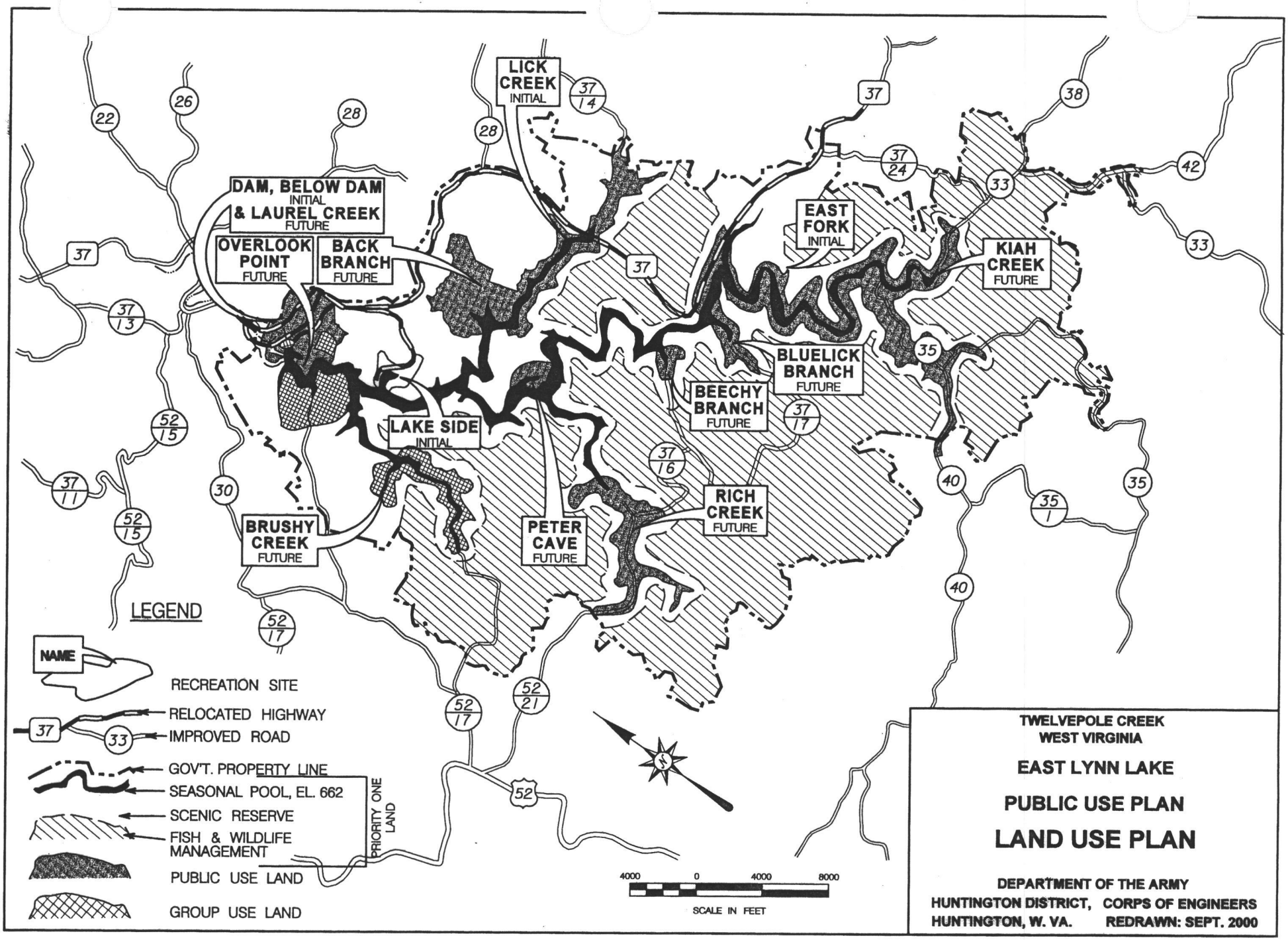

LICK CREEK INITIAL
DAM, BELOW DAM INITIAL & LAUREL CREEK FUTURE
OVERLOOK POINT FUTURE
BACK BRANCH FUTURE
EAST FORK INITIAL
KIAH CREEK FUTURE
BLUELICK BRANCH FUTURE
BEECHY BRANCH FUTURE
LAKE SIDE INITIAL
RICH CREEK FUTURE
BRUSHY CREEK FUTURE
PETER CAVE FUTURE
LEGEND
NAME
RECREATION SITE
RELOCATED HIGHWAY
IMPROVED ROAD
GOV'T. PROPERTY LINE
SEASONAL POOL, EL. 662
SCENIC RESERVE
FISH & WILDLIFE MANAGEMENT
PUBLIC USE LAND
GROUP USE LAND
PRIORITY ONE LAND
4000 0 4000 8000
SCALE IN FEET
TWELVEPOLE CREEK
WEST VIRGINIA
EAST LYNN LAKE
PUBLIC USE PLAN
LAND USE PLAN
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 2-17

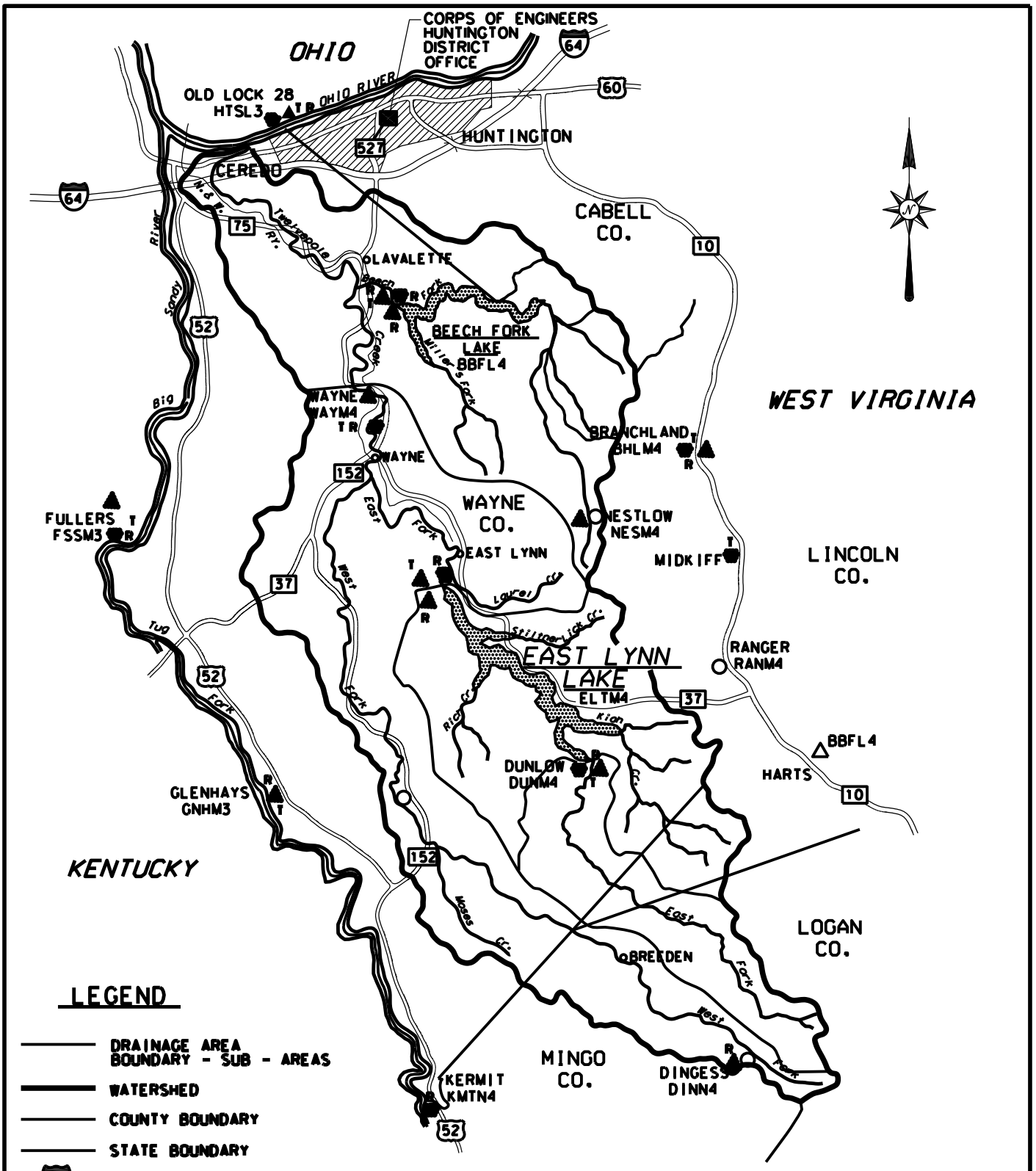
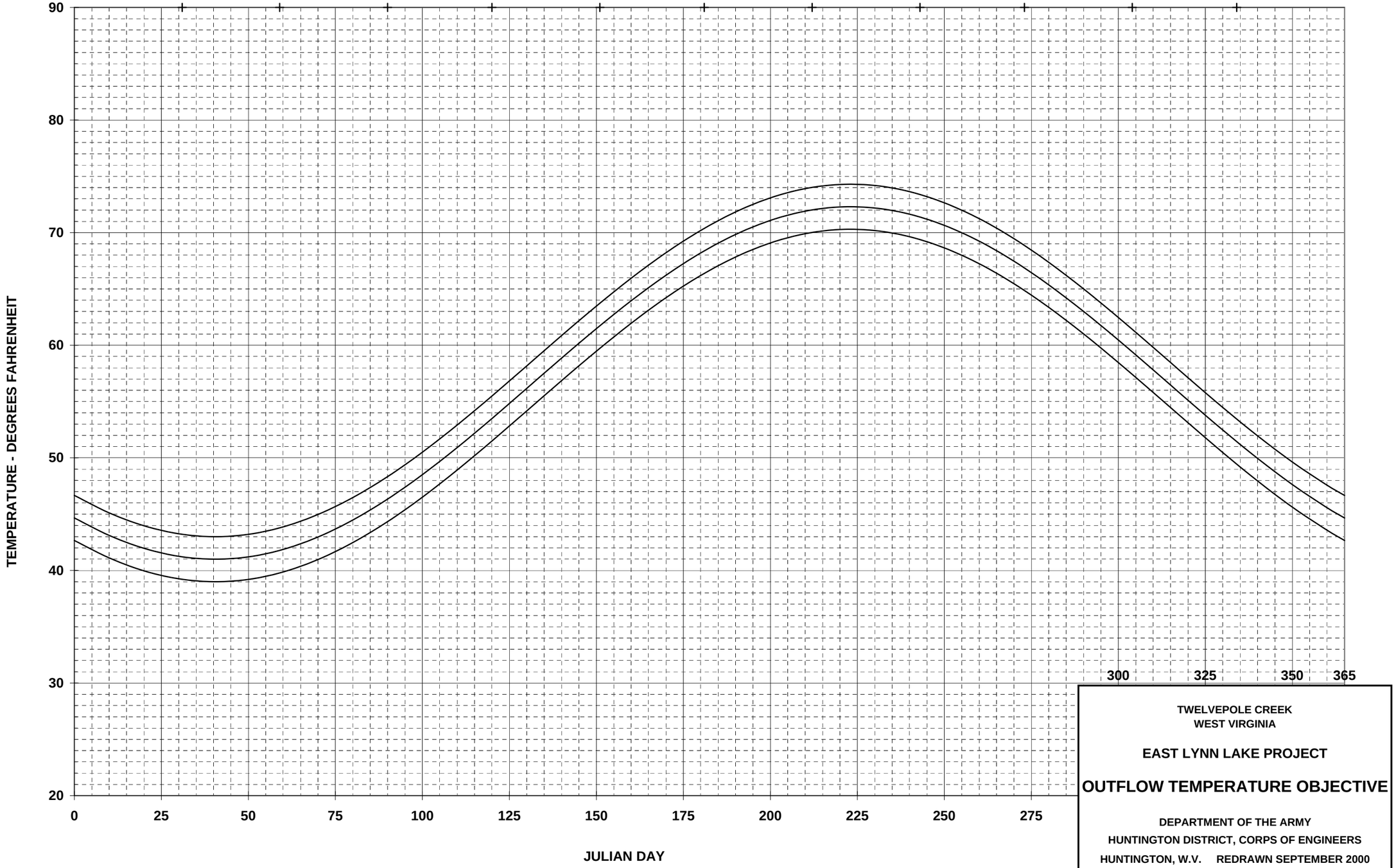

CORPS OF ENGINEERS
HUNTINGTON
DISTRICT
OFFICE
OHIO
OLD LOCK 28
HTSL3
OHIO RIVER
HUNTINGTON
CERENO
CABELL
CO.
OLAVALETTE
BEECH FORK
LAKE
BBFL4
WEST VIRGINIA
WAYNE
WAYM4
WAYNE
BRANCHLAND
BHLM4
WAYNE
CO.
FULLERS
FSSM3
NESTLOW
NESM4
EAST LYNN
MIDKIFF
LINCOLN
CO.
EAST LYNN
LAKE
ELTM4
RANGER
RANM4
BBFL4
HARTS
DUNLOW
DUNM4
GLENHAYS
GNHM3
KENTUCKY
LOGAN
CO.
BREEDEN
MINGO
CO.
KERMIT
KMTN4
DINGESS
DINN4
Sandy River
Twelvepole Cr.
Big Fork
Tug Fork
Beech Fork
Wills Fork
East Fork
West Fork
Laurel Cr.
Stillwater Cr.
Rich Cr.
Rich
Mases Cr.
East Fork
West Fork
64
60
527
75
52
10
37
152
LEGEND
DRAINAGE AREA BOUNDARY - SUB - AREAS
WATERSHED
COUNTY BOUNDARY
STATE BOUNDARY
INTERSTATE HIGHWAY
U.S. HIGHWAY
STATE HIGHWAY
T TELEMARK
R RECORDING GAGE
SATELLITE DATA PLATFORM (EXISTING)
LANDLINE DATA PLATFORM (PLANNED)
DISCHARGE STATION U.S.G.S.
PRECIPITATION STATION N.W.S.
3 0 3 6
Scale in Miles
TWELVEPOLE CREEK BASIN
WEST VIRGINIA
EAST LYNN LAKE
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 4-1



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

OUTFLOW TEMPERATURE OBJECTIVE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 1-4

ELEVATION IN FEET ABOVE M.S.L.

1280
1240
1200
1160
1120
1080
1040
1000
960
920
880
840
800
760
720
680
640
600
560

41.91 DAM
43.3 BRUSHY CREEK
44.7 LICK CREEK
46.0 RICH CREEK
50.2 COVE CREEK
54.0 KIAH CREEK

BRUSHY CREEK
LICK CREEK
RICH CREEK
COVE CREEK
KIAH CREEK
EAST FORK

FLOOD CONTROL POOL EL. 701
PERMANENT POOL EL. 656

32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80

MILES ABOVE THE MOUTH OF TWELVEPOLE CREEK

TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR PROJECT

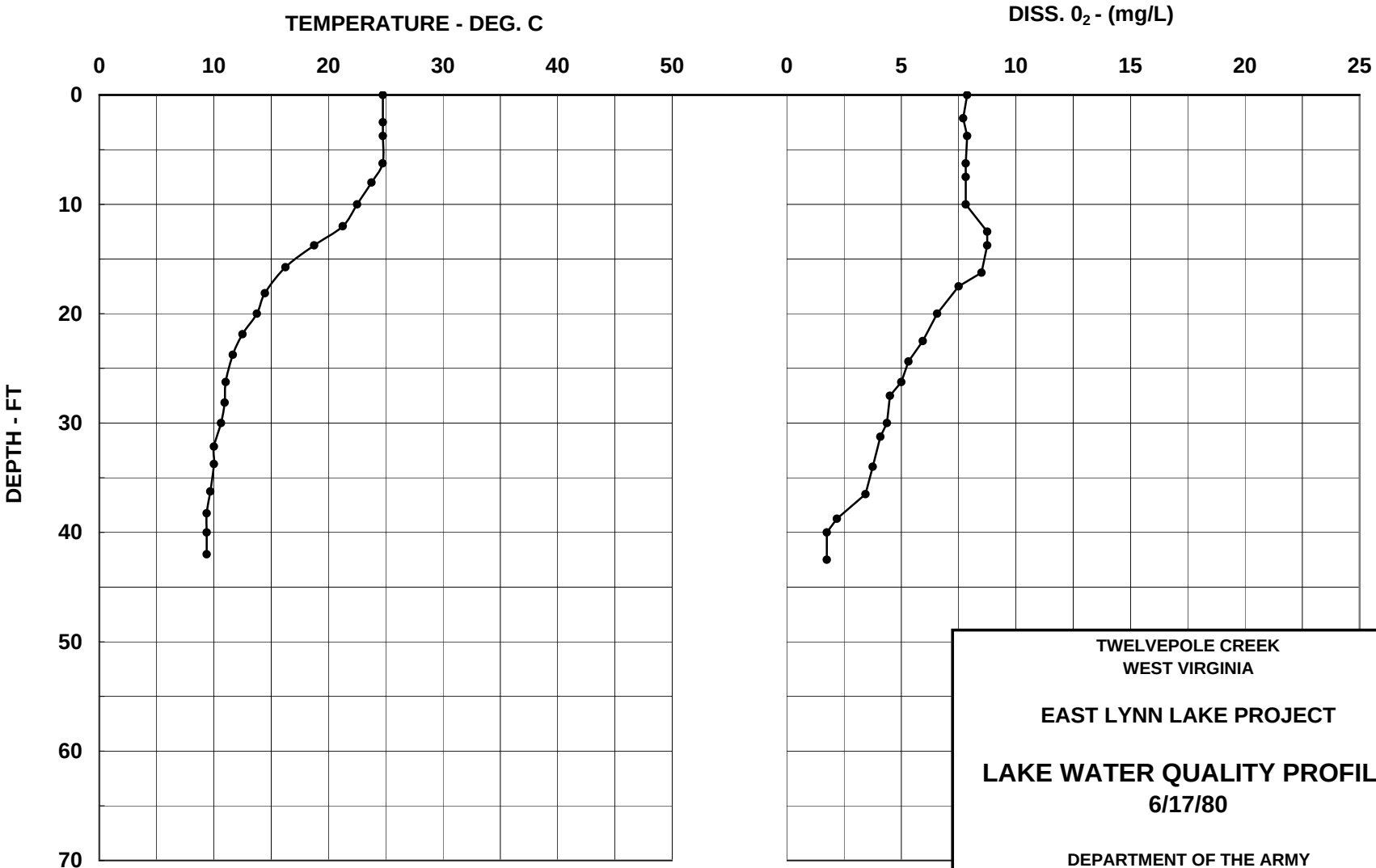
STREAM PROFILES

SCALES AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 4-2

ELEV. 662.27
6/17/80



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

LAKE WATER QUALITY PROFILE
6/17/80

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 4-3

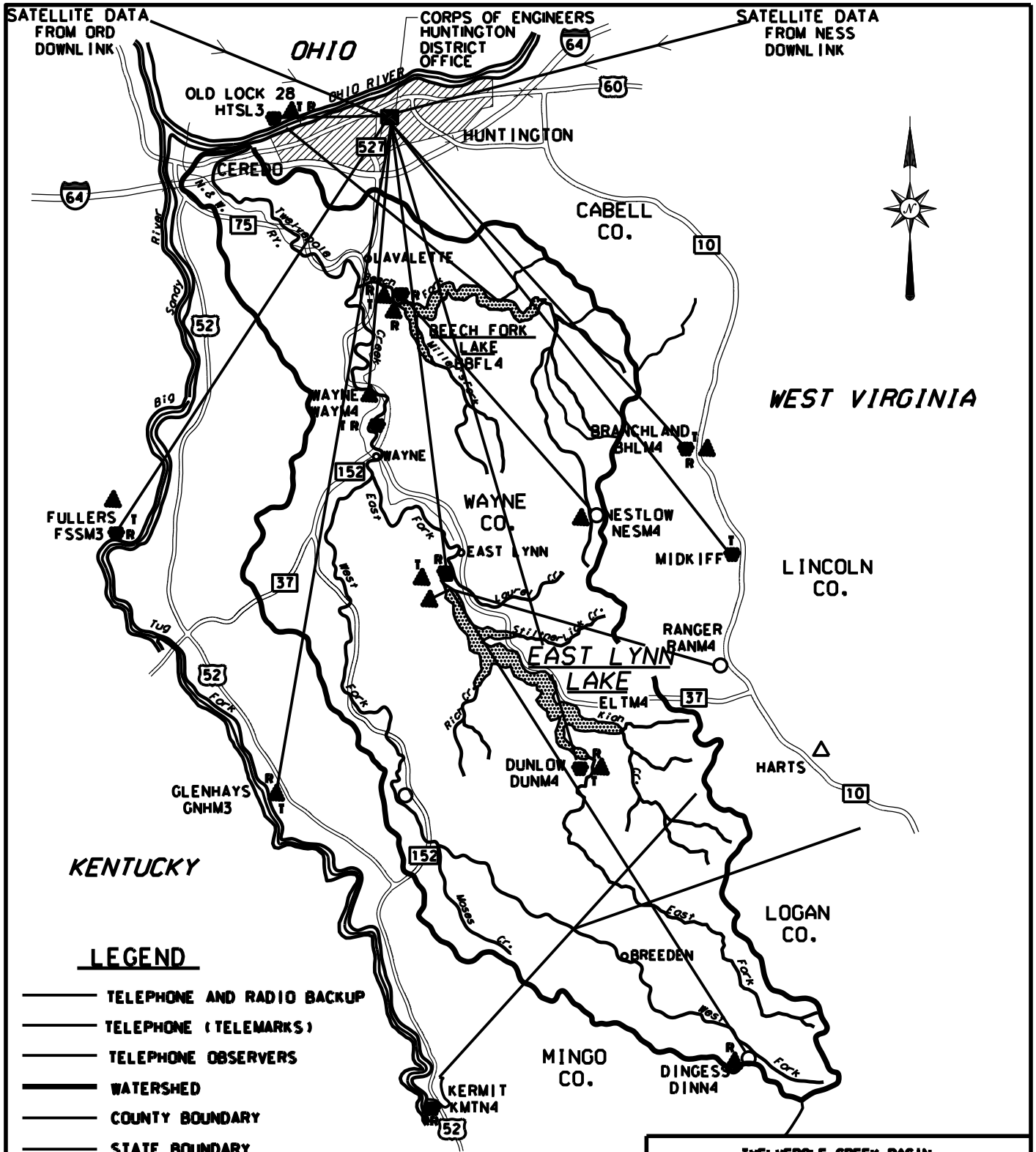

SATELLITE DATA FROM ORD DOWNLINK
CORPS OF ENGINEERS HUNTINGTON DISTRICT OFFICE
SATELLITE DATA FROM NESS DOWNLINK
OHIO
OHIO RIVER
OLD LOCK 28 HTSL3
HUNTINGTON
CERREDO
CABELL CO.
GUYANDOTTE R.
GUYANDOTTE
BEECH FORK LAKE BBFL4
WAYNE WAYM4
WAYNE
WAYNE CO.
WEST VIRGINIA
BRANCHLAND BHLM4
NESTLOW NESM4
MIDKIFF
LINCOLN CO.
FULLERS FSSM3
EAST LYNN
RANGER RANM4
EAST LYNN LAKE
ELTM4
DUNLOW DUNM4
HARTS
GLENHAYS GNHM3
KENTUCKY
LOGAN CO.
BREEDEN
MINGO CO.
DINGESS DINN4
KERMIT KMTN4
LEGEND
TELEPHONE AND RADIO BACKUP
TELEPHONE (TELEMARKS)
TELEPHONE OBSERVERS
WATERSHED
COUNTY BOUNDARY
STATE BOUNDARY
INTERSTATE HIGHWAY
U.S. HIGHWAY
STATE HIGHWAY
T TELEMARK
R RECORDING GAGE
SATELLITE DATA PLATFORM (EXISTING)
LANDLINE DATA PLATFORM (PLANNED)
DISCHARGE STATION U.S.G.S.
PRECIPITATION STATION N.W.S.
3 0 3 6
Scale in Miles
TWELVEPOLE CREEK BASIN
WEST VIRGINIA
EAST LYNN LAKE
HYDROLOGIC NETWORK
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 5-1

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SUR - WATER RESOURCES DIVISION

EXPANDED RATING TABLE TYPE: LINEAR

03206790

DATE PROCESSED: 03-19-2001 @ 16:09 BY bctaylor

EAST FORK TWELVEPOLE CREEK BELOW EAST LYNN DAM DD: 2 TYPE: 001 RATING NO: 0017

NO OFFSETS USED START DATE/TIME: 10-01-1995 (0001)

SAME AS RATING NO. 16 BELOW 1.2 FT AND ABOVE 12 FT

INPUT VALUE	GAGE HEIGHT (STANDARD PRECISION) .0	.1	.2	.3	.4	.5	.6	.7	.8	.9	DIFF IN Y PER UNIT
1.0	1.0*	2.0*	3.9*	6.6*	9.5*	13.00*	16.90*	21.50*	27.00*	33.00*	39.00
2.0	40.00*	47.50*	56.00*	66.00	76.00	86.00	96.00*	107.00*	120.00*	133.00*	107.00
3.0	147.00	161.00	175.00*	190.00	205.00	220.00	235.00	250.00*	270.00	290.00	163.00
4.0	310.00*	325.00*	345.00	365.00	385.00*	400.00*	420.00	440.00	460.00	480.00	190.00
5.0	500.00*	525.00*	545.00*	570.00	595.00*	615.00*	640.00*	660.00	680.00	700.00*	225.00
6.0	725.00	750.00	775.00	800.00	825.00	850.00	875.00	900.00	925.00	950.00	250.00
7.0	975.00	1000.00	1025.00	1050.00	1075.00	1100.00	1125.00	1150.00	1175.00	1200.00	250.00
8.0	1225.00	1250.00	1275.00	1300.00	1325.00	1350.00	1375.00	1400.00	1425.00	1450.00	250.00
9.0	1475.00	1500.00	1525.00	1550.00	1575.00	1600.00*	1630.00	1660.00	1690.00	1720.00	275.00
10.0	1750.00	1780.00	1810.00	1840.00	1870.00	1900.00	1930.00	1960.00	1990.00	2020.00	300.00
11.0	2050.00	2080.00	2110.00	2140.00	2170.00	2200.00	2230.00	2260.00	2290.00	2320.00	300.00
12.0	2350.00*	2375.00	2400.00	2425.00	2450.00	2475.00	2500.00	2525.00	2550.00	2575.00	250.00
13.0	2600.00	2625.00	2650.00	2675.00	2700.00	2725.00	2750.00	2775.00	2800.00	2825.00	250.00
14.0	2850.00	2875.00	2900.00	2925.00	2950.00	2975.00	3000.00	3025.00	3050.00	3075.00	250.00
15.0	3100.00*	3130.00	3160.00	3190.00	3220.00	3250.00	3280.00	3310.00	3340.00	3370.00	300.00
16.0	3400.00	3430.00	3460.00	3490.00	3520.00	3550.00	3580.00	3610.00	3640.00	3670.00	300.00
17.0	3700.00	3730.00	3760.00	3790.00	3820.00	3850.00	3880.00	3910.00	3940.00	3970.00	300.00
18.0	4000.00	4030.00	4060.00	4090.00	4120.00	4150.00	4180.00	4210.00	4240.00	4270.00	300.00
19.0	4300.00	4330.00	4360.00	4390.00	4420.00	4450.00	4480.00	4510.00	4540.00	4570.00	300.00
20.0	4600.00	4630.00	4660.00	4690.00	4720.00	4750.00	4780.00	4810.00	4840.00	4870.00	300.00
21.0	4900.00	4930.00	4960.00	4990.00	5020.00	5050.00	5080.00	5110.00	5140.00	5170.00	300.00*
22.0	5200.00*										

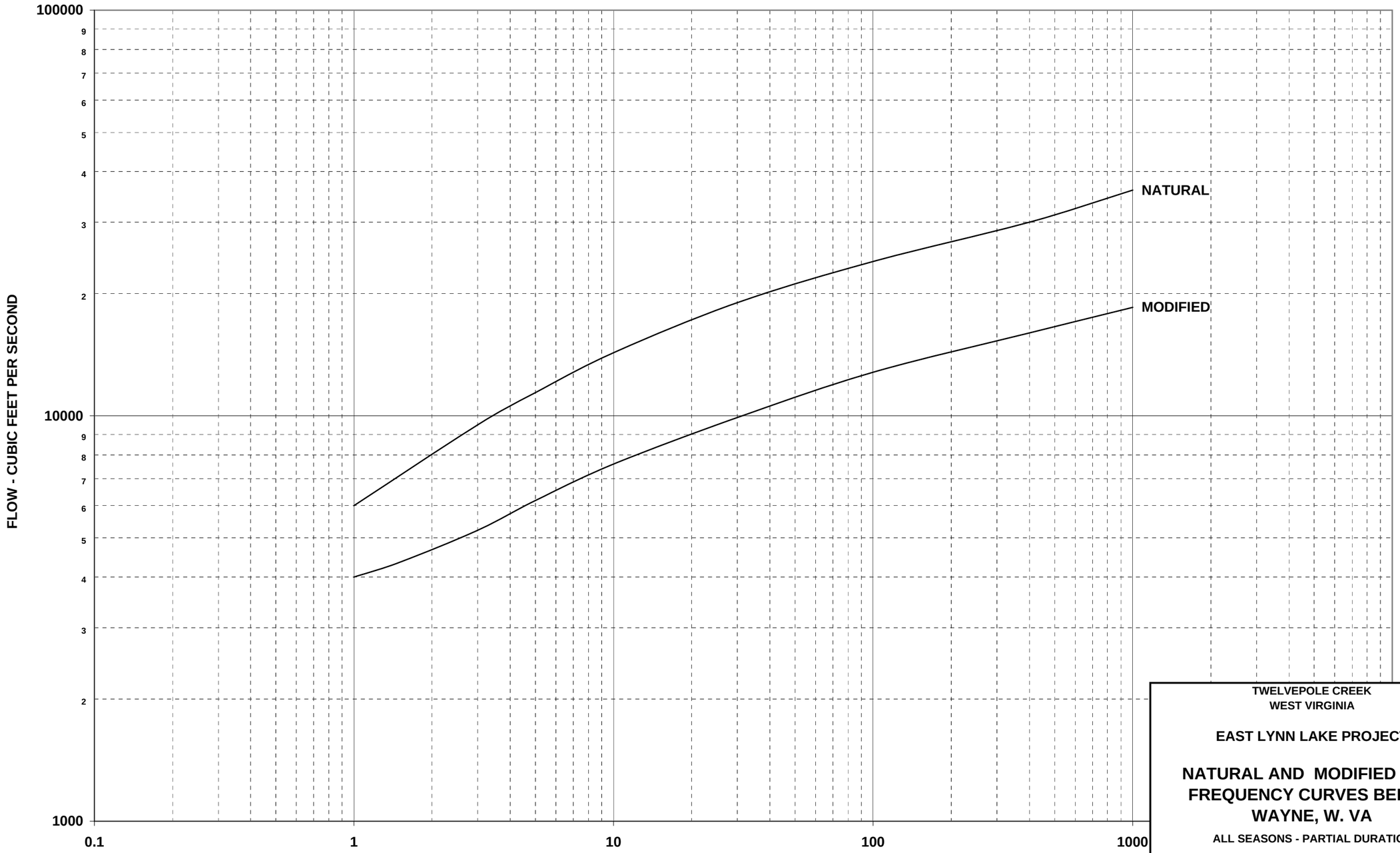
PLATE NO. 5-2

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SUR - WATER RESOURCES DIVISION
EXPANDED RATING TABLE
TYPE: LINEAR

03207020
DATE PROCESSED: 03-19-2001 @ 16:09 BY bctaylor
TWELVEPOLE CREEK BELOW WAYNE, WV
DD: 2 TYPE: 001 RATING NO: 10
NO OFFSETS USED
START DATE/TIME: 02-09-1982 (0001)

INPUT VALUE	GAGE HEIGHT (STANDARD PRECISION) .0	.1	.2	.3	.4	.5	.6	.7	.8	.9	DIFF IN Y PER UNIT
3.0	.00*	.80*	2.2*	4.0*	6.4*	9.8*	13.50*	18.00*	24.00	30.00*	38.00
4.0	38.00*	46.00*	56.00	66.00*	78.00*	92.00	106.00	120.00*	135.00	150.00	127.00
5.0	165.00	180.00*	200.00	220.00	240.00	260.00	280.00*	305.00	330.00	355.00	215.00
6.0	380.00	405.00	430.00	455.00	480.00	505.00	530.00	555.00	580.00*	610.00	260.00
7.0	640.00	670.00	700.00	730.00	760.00	790.00	820.00	850.00	880.00	910.00	300.00
8.0	940.00	970.00	1000.00	1030.00	1060.00	1090.00	1120.00	1150.00	1180.00	1210.00	300.00
9.0	1240.00	1270.00	1300.00	1330.00	1360.00	1390.00	1420.00	1450.00	1480.00*	1515.00	310.00
10.0	1550.00	1585.00	1620.00	1655.00	1690.00	1725.00	1760.00	1795.00	1830.00	1865.00	350.00
11.0	1900.00	1935.00	1970.00	2005.00	2040.00	2075.00	2110.00	2145.00	2180.00	2215.00	350.00
12.0	2250.00	2285.00	2320.00	2355.00	2390.00	2425.00	2460.00	2495.00	2530.00	2565.00	350.00
13.0	2600.00	2635.00	2670.00	2705.00	2740.00	2775.00	2810.00	2845.00	2880.00	2915.00	350.00
14.0	2950.00	2985.00	3020.00	3055.00	3090.00	3125.00	3160.00	3195.00	3230.00	3265.00	350.00
15.0	3300.00*	3340.00	3380.00	3420.00	3460.00	3500.00	3540.00	3580.00	3620.00	3660.00	400.00
16.0	3700.00	3740.00	3780.00	3820.00	3860.00	3900.00	3940.00	3980.00	4020.00	4060.00	400.00
17.0	4100.00	4140.00	4180.00	4220.00	4260.00	4300.00	4340.00	4380.00	4420.00	4460.00	400.00
18.0	4500.00*	4550.00	4600.00	4650.00	4700.00	4750.00	4800.00	4850.00	4900.00	4950.00	500.00
19.0	5000.00	5050.00	5100.00	5150.00	5200.00	5250.00	5300.00	5350.00	5400.00	5450.00	500.00
20.0	5500.00	5550.00	5600.00	5650.00	5700.00	5750.00	5800.00	5850.00	5900.00	5950.00	500.00
21.0	6000.00	6050.00	6100.00	6150.00	6200.00	6250.00	6300.00	6350.00	6400.00	6450.00	500.00
22.0	6500.00*	6560.00	6620.00	6680.00	6740.00	6800.00	6860.00	6920.00	6980.00	7040.00	600.00
23.0	7100.00	7160.00	7220.00	7280.00	7340.00	7400.00	7460.00	7520.00	7580.00	7640.00	600.00
24.0	7700.00	7760.00	7820.00	7880.00	7940.00	8000.00	8060.00	8120.00	8180.00	8240.00	600.00
25.0	8300.00*	8370.00	8440.00	8510.00	8580.00	8650.00	8720.00	8790.00	8860.00	8930.00	700.00
26.0	9000.00*	9080.00	9160.00	9240.00	9320.00	9400.00	9480.00	9560.00	9640.00	9720.00	800.00
27.0	9800.00	9880.00	9960.00	10040.00	10120.00	10200.00	10280.00	10360.00	10440.00	10520.00	800.00
28.0	10600.00*	10690.00	10780.00	10870.00	10960.00	11050.00	11140.00	11230.00	11320.00	11410.00	900.00
29.0	11500.00*	11600.00	11700.00	11800.00	11900.00	12000.00	12100.00	12200.00	12300.00	12400.00	1000.00
30.0	12500.00	12600.00	12700.00	12800.00	12900.00	13000.00	13100.00	13200.00	13300.00	13400.00	1000.00
31.0	13500.00*	13610.00	13720.00	13830.00	13940.00	14050.00	14160.00	14270.00	14380.00	14490.00	1100.00
32.0	14600.00	14710.00	14820.00	14930.00	15040.00	15150.00	15260.00	15370.00	15480.00	15590.00	1100.00*
33.0	15700.00*										

PLATE NO. 5-3



TWELVEPOLE CREEK
WEST VIRGINIA

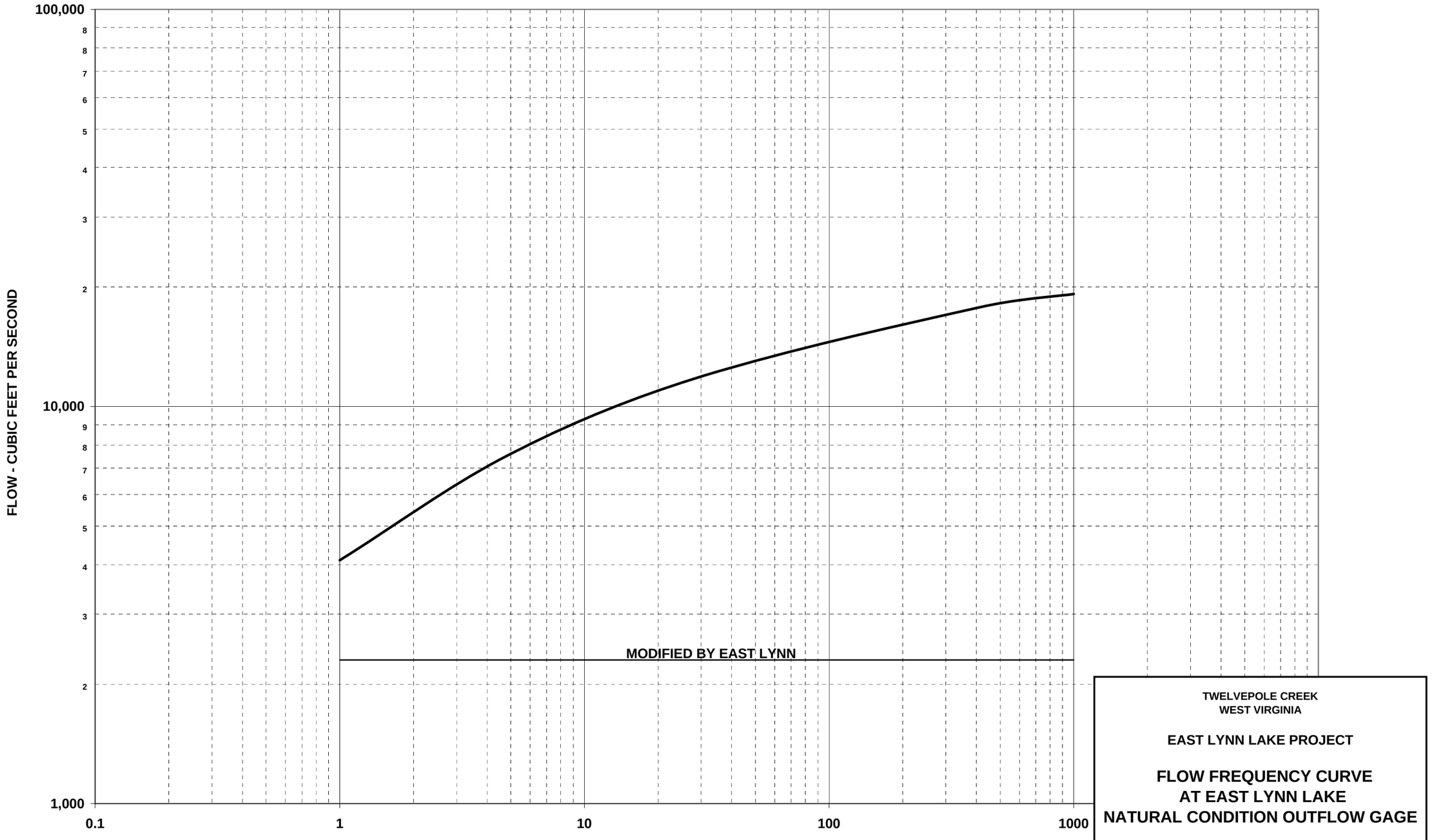
EAST LYNN LAKE PROJECT

NATURAL AND MODIFIED FLOW FREQUENCY CURVES BELOW WAYNE, W. VA

ALL SEASONS - PARTIAL DURATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 5-4



TWELVEPOLE CREEK
WEST VIRGINIA

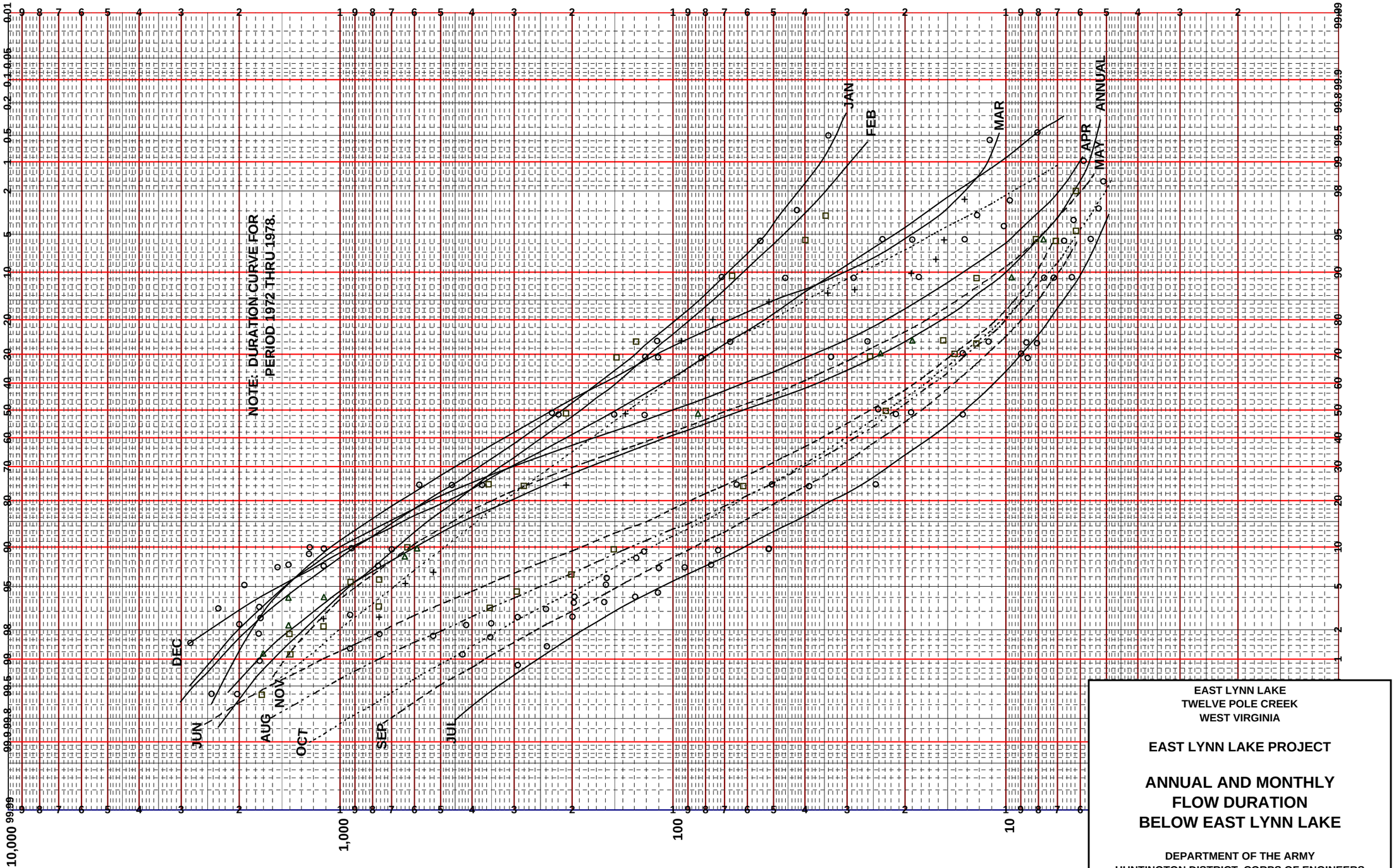
EAST LYNN LAKE PROJECT

FLOW FREQUENCY CURVE
AT EAST LYNN LAKE
NATURAL CONDITION OUTFLOW GAGE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 5-5

PROBABILITY X FOUR 3½ INCH LOGARITHMIC CYCLES



EAST LYNN LAKE
TWELVE POLE CREEK
WEST VIRGINIA

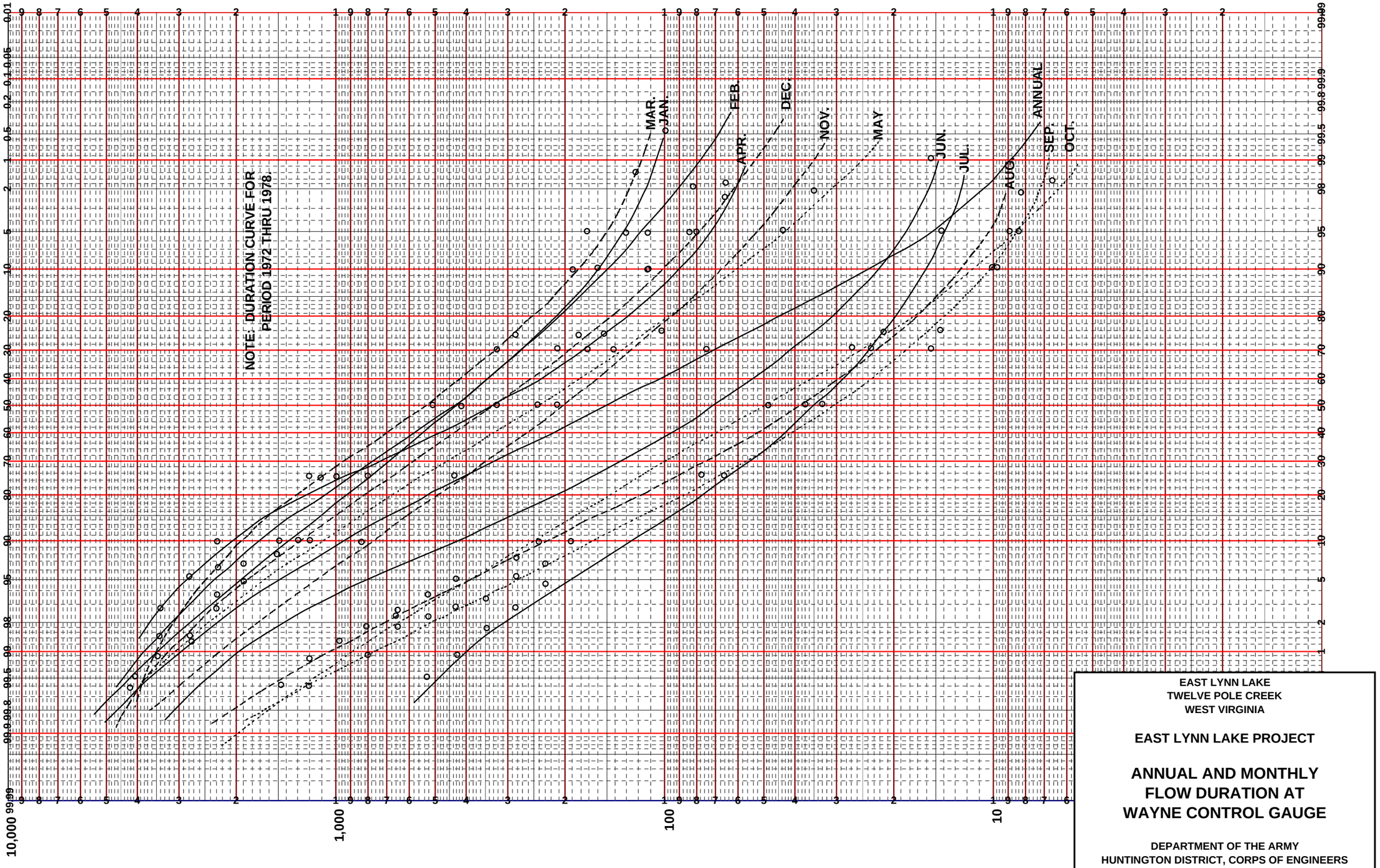
EAST LYNN LAKE PROJECT

ANNUAL AND MONTHLY FLOW DURATION BELOW EAST LYNN LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON W. VA. REDRAWN SEPTEMBER 2000

PLATE NO. 5-6

PROBABILITY X FOUR 3½ INCH LOGARITHMIC CYCLES



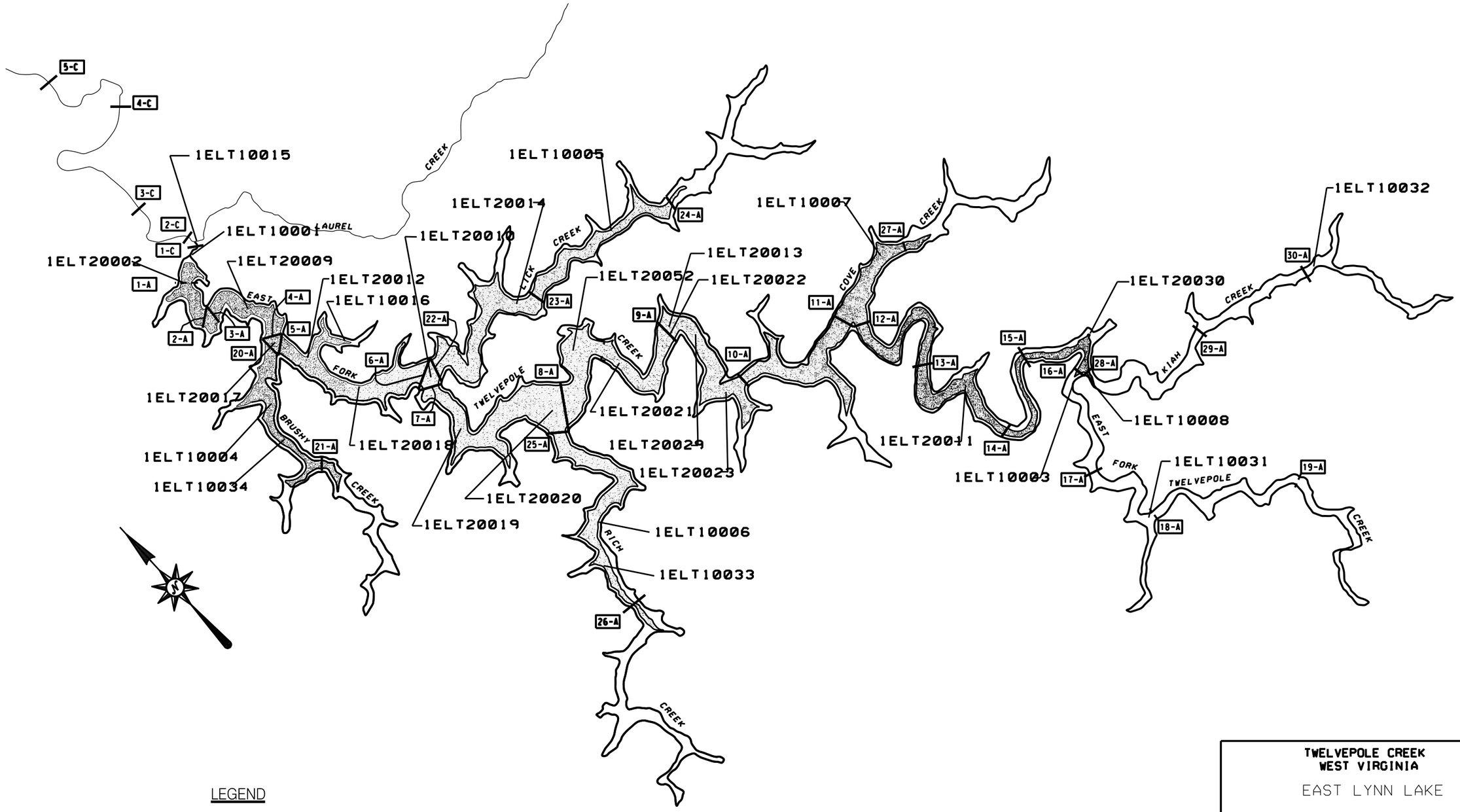
EAST LYNN LAKE
TWELVE POLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

ANNUAL AND MONTHLY FLOW DURATION AT WAYNE CONTROL GAUGE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON W. VA. REDRAWN SEPTEMBER 2000

PLATE NO. 5-7



LEGEND

TOP OF FLOOD CONTROL POOL = ELEVATION 701.0

SEASONAL POOL = ELEVATION 662.0

EXISTING SEDIMENT RANGE

PROPOSED SEDIMENT RANGE

4000 0 4000 8000 12000

SCALE IN FEET

TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE

SEDIMENT RANGE
INDEX MAP

WATER QUALITY
SAMPLING STATIONS

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 5-8

DISTANCE BELOW DAM IN MILES

DISTANCE ABOVE DAM IN MILES

ELEVATION IN FEET ABOVE NGVD

SEASONAL POOL EL. 662

MINIMUM POOL EL. 656

ORIGINAL

1980 RESURVEY

1997 SURVEY

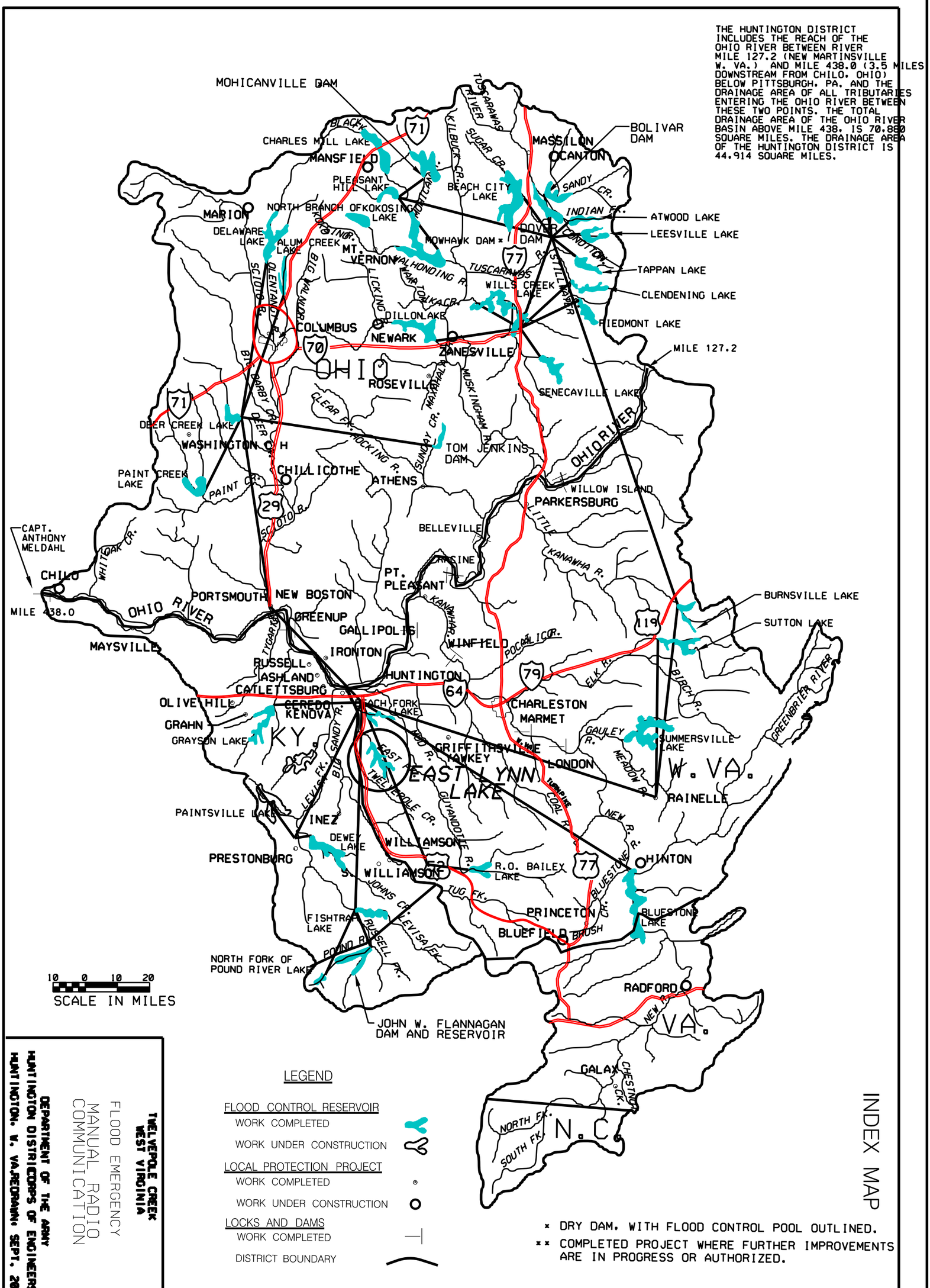
OHIO RIVER BASIN
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

SEDIMENT RANGE BOTTOM PROFILE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 5-9



TWELVEPOLE CREEK
WEST VIRGINIA

FLOOD EMERGENCY
MANUAL RADIO
COMMUNICATION

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2009

PLATE NO. 5-10

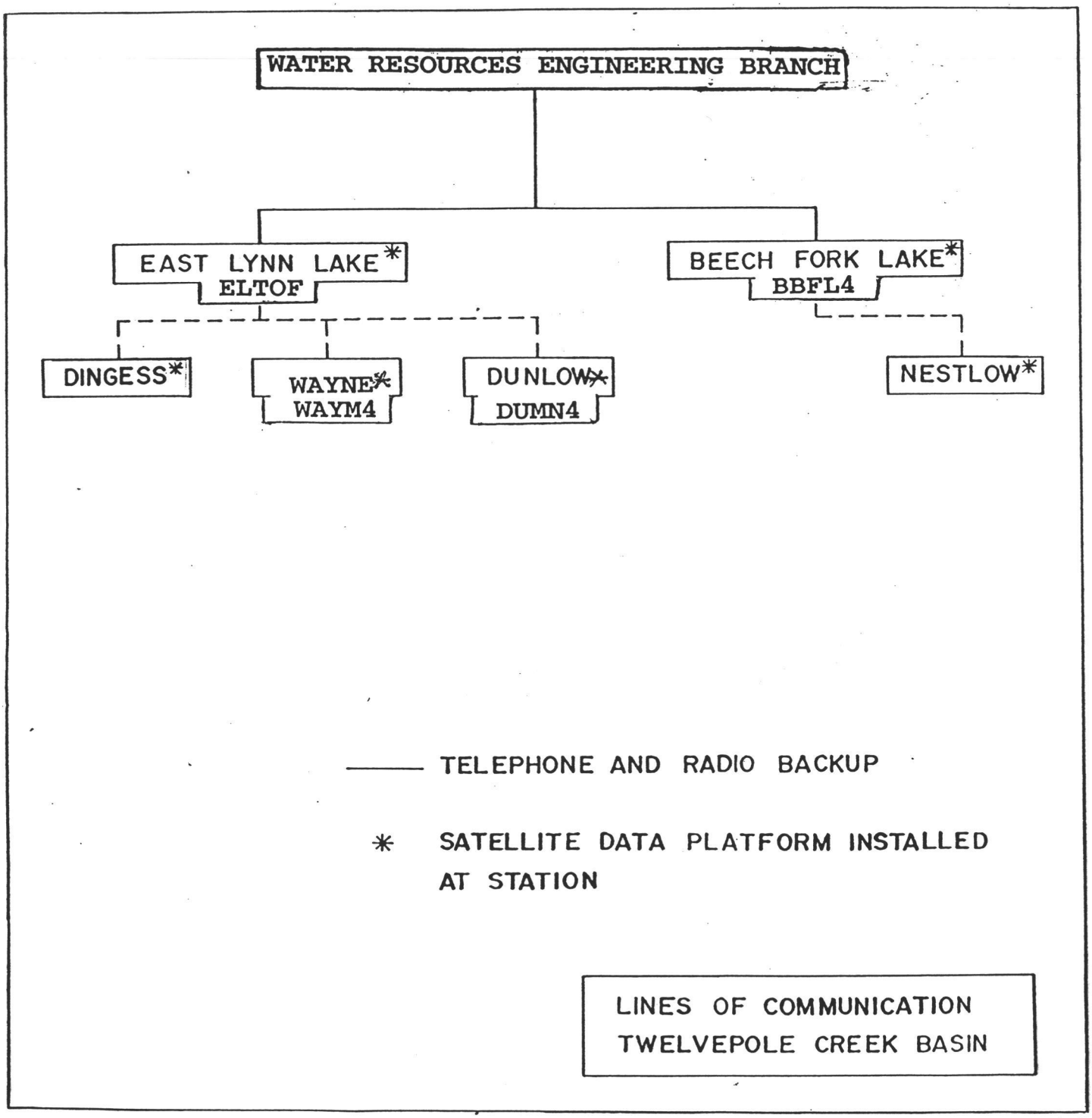

WATER RESOURCES ENGINEERING BRANCH
EAST LYNN LAKE*
ELTOF
BEECH FORK LAKE*
BBFL4
DINGESS*
WAYNE*
WAYM4
DUNLOW*
DUMN4
NESTLOW*
TELEPHONE AND RADIO BACKUP
* SATELLITE DATA PLATFORM INSTALLED AT STATION
LINES OF COMMUNICATION
TWELVEPOLE CREEK BASIN

Plate No. 5-11

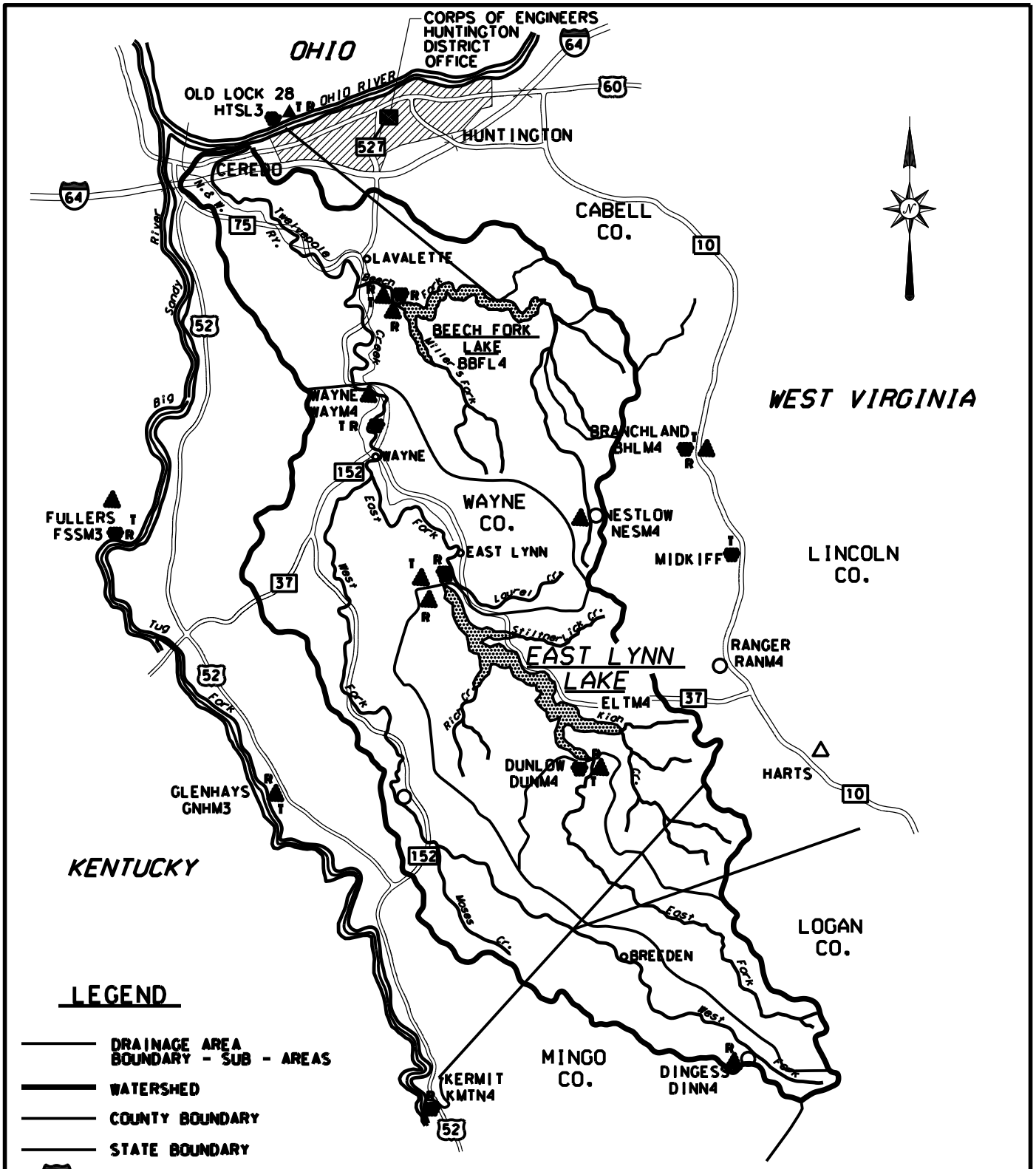

CORPS OF ENGINEERS
HUNTINGTON
DISTRICT
OFFICE
OHIO
OLD LOCK 28
HTSL3
OHIO RIVER
HUNTINGTON
CERELO
CABELL
CO.
WEST VIRGINIA
LAVALETTE
BEECH FORK
LAKE
BBFL4
WAYNE
WAYM4
WAYNE
BRANCHLAND
BHLM4
FULLERS
FSSM3
WAYNE
CO.
NESTLOW
NESM4
EAST LYNN
MIDKIFF
LINCOLN
CO.
EAST LYNN
LAKE
ELTM4
RANGER
RANM4
DUNLOW
DUNM4
HARTS
GLENHAYS
GNHM3
KENTUCKY
LOGAN
CO.
BREEDEN
KERMIT
KMTN4
MINGO
CO.
DINGESS
DINN4
LEGEND
DRAINAGE AREA BOUNDARY - SUB - AREAS
WATERSHED
COUNTY BOUNDARY
STATE BOUNDARY
INTERSTATE HIGHWAY
U.S. HIGHWAY
STATE HIGHWAY
TELEMARK
RECORDING GAGE
SATELLITE DATA PLATFORM (EXISTING)
LANDLINE DATA PLATFORM (PLANNED)
DISCHARGE STATION U.S.G.S.
PRECIPITATION STATION N.W.S.
3 0 3 6
Scale in Miles
TWELVEPOLE CREEK BASIN
WEST VIRGINIA
EAST LYNN LAKE
DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT CORPS OF ENGINEERS
HUNTINGTON, W. VA. REDRAWN: SEPT. 2000

PLATE NO. 6-1

EAST LYNN LAKE - TWELVEPOLE CREEK

BASIN NETWORK CONFIGURATION

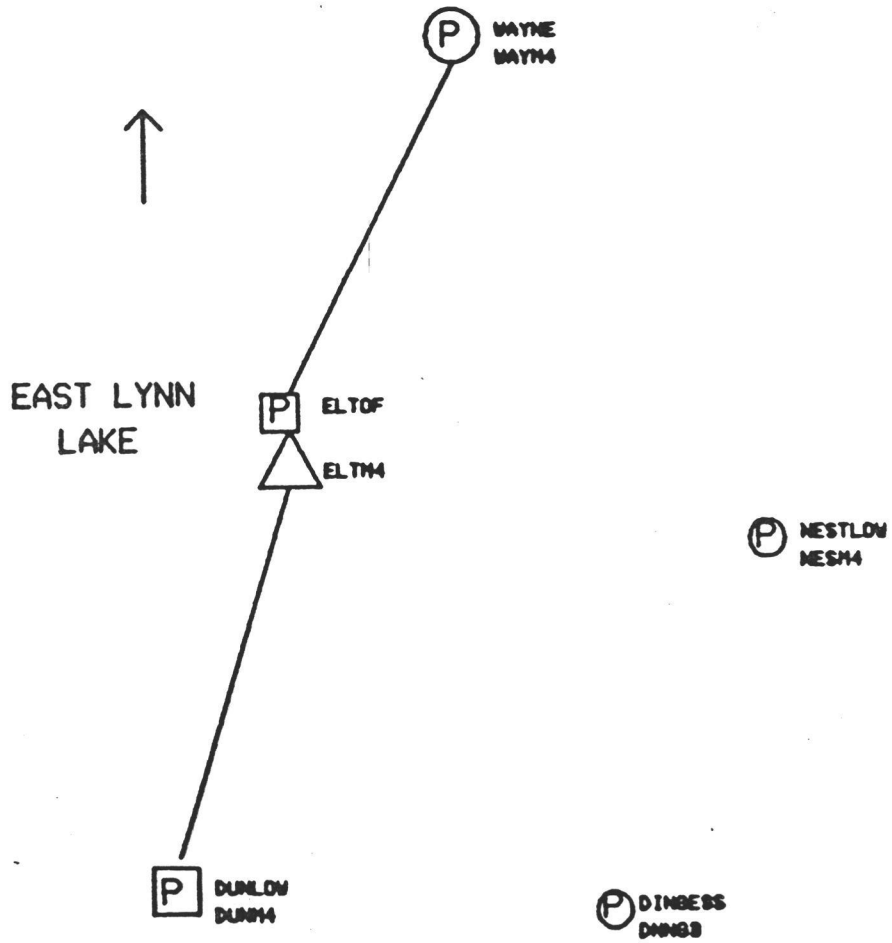


Plate No. 6-2

EAST LYNN LAKE
TWELVEPOLE CREEK

AREA AND CAPACITY TABLES

DRAINAGE AREA 133 SQ. MI. 1 IN. RUNOFF = 7092 AC. FT.

POOL ELEV.	CAPACITY		AREA ACRES	POOL ELEV.	CAPACITY		AREA ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
612	0	0.00	0	633	816	0.11	133
613	.5	0.00	1	634	962	0.14	160
614	2	0.00	2	635	1137	0.16	189
615	5	0.00	4	636	1341	0.19	219
616	10	0.00	6	637	1576	0.22	250
617	17	0.00	8	638	1840	0.26	279
618	26	0.00	11	639	2134	0.30	309
619	38	0.00	13	640	2458	0.35	339
620	53	0.00	17	641	2811	0.40	368
621	72	0.01	21	642	3194	0.45	398
622	94	0.01	25	643	3607	0.51	427
623	122	0.02	30	644	4048	0.57	456
624	155	0.02	36	645	4518	0.64	484
625	194	0.03	42	646	5017	0.71	513
626	239	0.03	49	647	5545	0.78	543
627	292	0.04	57	648	6104	0.86	574
628	353	0.05	65	649	6694	0.94	606
629	423	0.06	74	650	7315	1.03	638
630	501	0.07	83	651	7970	1.12	670
631	590	0.08	96	652	8656	1.22	702
632	694	0.10	111	653	9373	1.32	733

EAST LYNN LAKE
TWELVEPOLE CREEK

AREA AND CAPACITY TABLES

DRAINAGE AREA 133 SQ. MI.

1 IN. RUNOFF = 7092 AC. FT.

POOL ELEV.	CAPACITY		AREA ACRES	POOL ELEV.	CAPACITY		AREA ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
654	10121	1.43	763	675	33102	4.67	1458
655	10899	1.54	793	676	34579	4.86	1496
656	11707	1.65	823	677	36094	5.08	1533
657	12545	1.77	853	678	37645	5.30	1569
658	13413	1.89	883	679	39231	5.53	1603
659	14311	2.01	913	680	40851	5.76	1638
660	15239	2.15	943	681	42506	5.99	1671
661	16198	2.28	974	682	44193	6.23	1704
662	17187	2.42	1005	683	45913	6.47	1735
663	18209	2.57	1037	684	47663	6.73	1766
664	19261	2.72	1069	685	49444	6.97	1795
665	20347	2.87	1102	686	51255	7.23	1826
666	21465	3.02	1135	687	53095	7.47	1857
667	22617	3.19	1169	688	54969	7.73	1890
668	23803	3.35	1203	689	56877	8.00	1924
669	25025	3.53	1238	690	58818	8.28	1959
670	26280	3.70	1273	691	60795	8.57	1994
671	27571	3.87	1309	692	62806	8.85	2029
672	28898	4.07	1345	693	64852	9.15	2064
673	30261	4.26	1382	694	66934	9.44	2099
674	31662	4.47	1420	695	69050	9.74	2134

EAST LYNN LAKE
TWELVEPOLE CREEK

AREA AND CAPACITY TABLES

DRAINAGE AREA 133 SQ. MI.

1 IN. RUNOFF = 7092 AC. FT.

POOL ELEV.	CAPACITY		AREA ACRES	POOL ELEV.	CAPACITY		AREA ACRES
	AC. FT.	INCHES			AC. FT.	INCHES	
696	71201	10.02	2169	717	124862	17.58	2951
697	73389	10.34	2205	718	127833	18.00	2990
698	75612	10.63	2241	719	130843	18.43	3030
699	77871	10.95	2278	720	133893	18.86	3070
700	80167	11.30	2314	721	136982	19.30	3110
701	82500	11.63	2351	722	140113	19.74	3151
702	84870	11.94	2388	723	143285	20.20	3192
703	87276	12.27	2424	724	146498	20.65	3234
704	89719	12.65	2461	725	149754	21.10	3277
705	92198	12.96	2497	726	153052	21.56	3320
706	94714	13.35	2534	727	156394	22.00	3364
707	97267	13.70	2571				
708	99856	14.05	2608				
709	102483	14.45	2646				
710	105148	14.83	2683				
711	107850	15.20	2721				
712	110590	15.61	2759				
713	113368	15.98	2797				
714	116184	16.38	2835				
715	119038	16.80	2873				
716	121931	17.17	2912				

EAST LYNN

PERCENT STORAGE UTILIZATION - SUMMER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
662	0.00	0.15	0.31	0.46	0.62	0.78	0.93	1.09	1.25	1.40
663	1.56	1.72	1.88	2.04	2.20	2.36	2.52	2.69	2.85	3.01
664	3.18	3.34	3.50	3.67	3.83	4.00	4.17	4.33	4.50	4.67
665	4.84	5.01	5.18	5.35	5.52	5.69	5.86	6.03	6.20	6.38
666	6.55	6.72	6.90	7.07	7.25	7.43	7.60	7.78	7.96	8.14
667	8.31	8.49	8.67	8.85	9.03	9.22	9.40	9.58	9.76	9.95
668	10.13	10.31	10.50	10.69	10.87	11.06	11.25	11.43	11.62	11.81
669	12.00	12.19	12.38	12.57	12.76	12.95	13.15	13.34	13.53	13.73
670	13.92	14.12	14.31	14.51	14.71	14.90	15.10	15.30	15.50	15.70
671	15.90	16.10	16.30	16.50	16.70	16.91	17.11	17.31	17.52	17.72
672	17.93	18.14	18.34	18.55	18.76	18.97	19.18	19.39	19.60	19.81
673	20.02	20.23	20.44	20.66	20.87	21.08	21.30	21.51	21.73	21.95
674	22.16	22.38	22.60	22.82	23.04	23.26	23.48	23.70	23.92	24.14
675	24.37	24.59	24.82	25.04	25.27	25.49	25.72	25.95	26.17	26.40
676	26.63	26.86	27.09	27.32	27.55	27.78	28.01	28.25	28.48	28.71
677	28.95	29.18	29.42	29.66	29.89	30.13	30.37	30.60	30.84	31.08
678	31.32	31.56	31.80	32.05	32.29	32.53	32.77	33.02	33.26	33.51
679	33.75	34.00	34.24	34.49	34.74	34.99	35.23	35.48	35.73	35.98
680	36.23	36.48	36.73	36.99	37.24	37.49	37.75	38.00	38.26	38.51
681	38.77	39.02	39.28	39.54	39.79	40.05	40.31	40.57	40.83	41.09
682	41.35	41.61	41.87	42.14	42.40	42.66	42.92	43.19	43.45	43.72
683	43.98	44.25	44.51	44.78	45.05	45.32	45.58	45.85	46.12	46.39
684	46.66	46.93	47.20	47.48	47.75	48.02	48.29	48.57	48.84	49.11
685	49.39	49.66	49.94	50.22	50.49	50.77	51.05	51.32	51.60	51.88
686	52.16	52.44	52.72	53.00	53.28	53.56	53.85	54.13	54.41	54.70
687	54.98	55.27	55.55	55.84	56.12	56.41	56.70	56.98	57.27	57.56
688	57.85	58.14	58.43	58.72	59.01	59.30	59.60	59.89	60.18	60.48
689	60.77	61.07	61.36	61.66	61.95	62.25	62.55	62.85	63.14	63.44
690	63.74	64.04	64.34	64.65	64.95	65.25	65.55	65.86	66.16	66.46
691	66.77	67.08	67.38	67.69	67.99	68.30	68.61	68.92	69.23	69.54
692	69.85	70.16	70.47	70.78	71.10	71.41	71.72	72.04	72.35	72.67
693	72.98	73.30	73.62	73.93	74.25	74.57	74.89	75.21	75.53	75.85
694	76.17	76.49	76.81	77.14	77.46	77.78	78.11	78.43	78.76	79.08
695	79.41	79.74	80.06	80.39	80.72	81.05	81.38	81.71	82.04	82.37
696	82.70	83.04	83.37	83.70	84.04	84.37	84.71	85.04	85.38	85.72
697	86.05	86.39	86.73	87.07	87.41	87.75	88.09	88.43	88.77	89.11
698	89.46	89.80	90.14	90.49	90.83	91.18	91.53	91.87	92.22	92.57
699	92.92	93.27	93.62	93.97	94.32	94.67	95.02	95.37	95.73	96.08
700	96.43	96.79	97.14	97.50	97.85	98.21	98.57	98.93	99.28	99.64

EAST L

PERCENT STORAGE UTILIZATION - SUMMER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
701	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

EAST LYNN

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
656	0.00	0.12	0.23	0.35	0.47	0.59	0.71	0.82	0.94	1.06
657	1.18	1.30	1.43	1.55	1.67	1.79	1.91	2.04	2.16	2.29
658	2.41	2.53	2.66	2.79	2.91	3.04	3.17	3.29	3.42	3.55
659	3.68	3.81	3.94	4.07	4.20	4.33	4.46	4.59	4.72	4.86
660	4.99	5.12	5.26	5.39	5.53	5.66	5.80	5.93	6.07	6.21
661	6.34	6.48	6.62	6.76	6.90	7.04	7.18	7.32	7.46	7.60
662	7.74	7.88	8.03	8.17	8.31	8.46	8.60	8.75	8.89	9.04
663	9.18	9.33	9.48	9.63	9.77	9.92	10.07	10.22	10.37	10.52
664	10.67	10.82	10.97	11.13	11.28	11.43	11.58	11.74	11.89	12.05
665	12.20	12.36	12.52	12.67	12.83	12.99	13.15	13.30	13.46	13.62
666	13.78	13.94	14.11	14.27	14.43	14.59	14.75	14.92	15.08	15.25
667	15.41	15.58	15.74	15.91	16.08	16.24	16.41	16.58	16.75	16.92
668	17.09	17.26	17.43	17.60	17.77	17.94	18.12	18.29	18.46	18.64
669	18.81	18.99	19.16	19.34	19.51	19.69	19.87	20.05	20.22	20.40
670	20.58	20.76	20.94	21.13	21.31	21.49	21.67	21.85	22.04	22.22
671	22.41	22.59	22.78	22.96	23.15	23.34	23.53	23.71	23.90	24.09
672	24.28	24.47	24.66	24.85	25.05	25.24	25.43	25.62	25.82	26.01
673	26.21	26.40	26.60	26.80	26.99	27.19	27.39	27.59	27.79	27.99
674	28.19	28.39	28.59	28.79	28.99	29.20	29.40	29.60	29.81	30.01
675	30.22	30.43	30.63	30.84	31.05	31.26	31.47	31.68	31.89	32.10
676	32.31	32.52	32.73	32.94	33.16	33.37	33.58	33.80	34.01	34.23
677	34.45	34.66	34.88	35.10	35.32	35.53	35.75	35.97	36.19	36.41
678	36.64	36.86	37.08	37.30	37.53	37.75	37.97	38.20	38.42	38.65
679	38.88	39.10	39.33	39.56	39.79	40.01	40.24	40.47	40.70	40.93
680	41.16	41.40	41.63	41.86	42.09	42.33	42.56	42.80	43.03	43.27
681	43.50	43.74	43.97	44.21	44.45	44.69	44.93	45.17	45.41	45.65
682	45.89	46.13	46.37	46.61	46.85	47.09	47.34	47.58	47.82	48.07
683	48.31	48.56	48.80	49.05	49.30	49.54	49.79	50.04	50.29	50.54
684	50.79	51.04	51.29	51.51	51.79	52.04	52.29	52.54	52.79	53.05
685	53.30	53.55	53.81	54.06	54.32	54.57	54.83	55.09	55.34	55.60
686	55.86	56.12	56.37	56.63	56.89	57.15	57.41	57.67	57.94	58.20
687	58.46	58.72	58.98	59.25	59.51	59.78	60.04	60.31	60.57	60.84
688	61.10	61.37	61.64	61.91	62.18	62.45	62.72	62.99	63.26	63.53
689	63.80	64.07	64.34	64.62	64.89	65.16	65.44	65.71	65.99	66.26
690	66.54	66.82	67.10	67.37	67.65	67.93	68.21	68.49	68.77	69.05
691	69.33	69.62	69.90	70.18	70.46	70.75	71.03	71.32	71.60	71.89
692	72.17	72.46	72.75	73.04	73.32	73.61	73.90	74.19	74.48	74.77
693	75.07	75.36	75.65	75.94	76.24	76.53	76.82	77.12	77.41	77.71
694	78.00	78.30	78.60	78.90	79.19	79.49	79.79	80.09	80.39	80.69
695	80.99	81.30	81.60	81.90	82.20	82.51	82.81	83.12	83.42	83.73

Plate No. 7-2
Sheet 3 of 4

EAST L

PERCENT STORAGE UTILIZATION - WINTER

ELEV	.0	.1	.2	.3	.4	.5	.6	.7	.8	.9
696	84.03	84.34	84.65	84.95	85.26	85.57	85.88	86.19	86.50	86.81
697	87.12	87.43	87.75	88.06	88.37	88.69	89.00	89.31	89.63	89.95
698	90.26	90.58	90.90	91.21	91.53	91.85	92.17	92.49	92.81	93.13
699	93.45	93.78	94.10	94.42	94.74	95.07	95.39	95.72	96.04	96.37
700	96.70	97.02	97.35	97.68	98.01	98.34	98.67	99.00	99.33	99.66
701	99.99	100.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Plate No. 7-2

Sheet 4 of 4

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SUR - WATER RESOURCES DIVISION

EXPANDED RATING TABLE

TYPE: LINEAR

03206790

DATE PROCESSED: 03-19-2001 @ 16:09 BY bctaylor

EAST FORK TWELVEPOLE CREEK BELOW EAST LYNN DAM

DD: 2 TYPE: 001 RATING NO: 0017

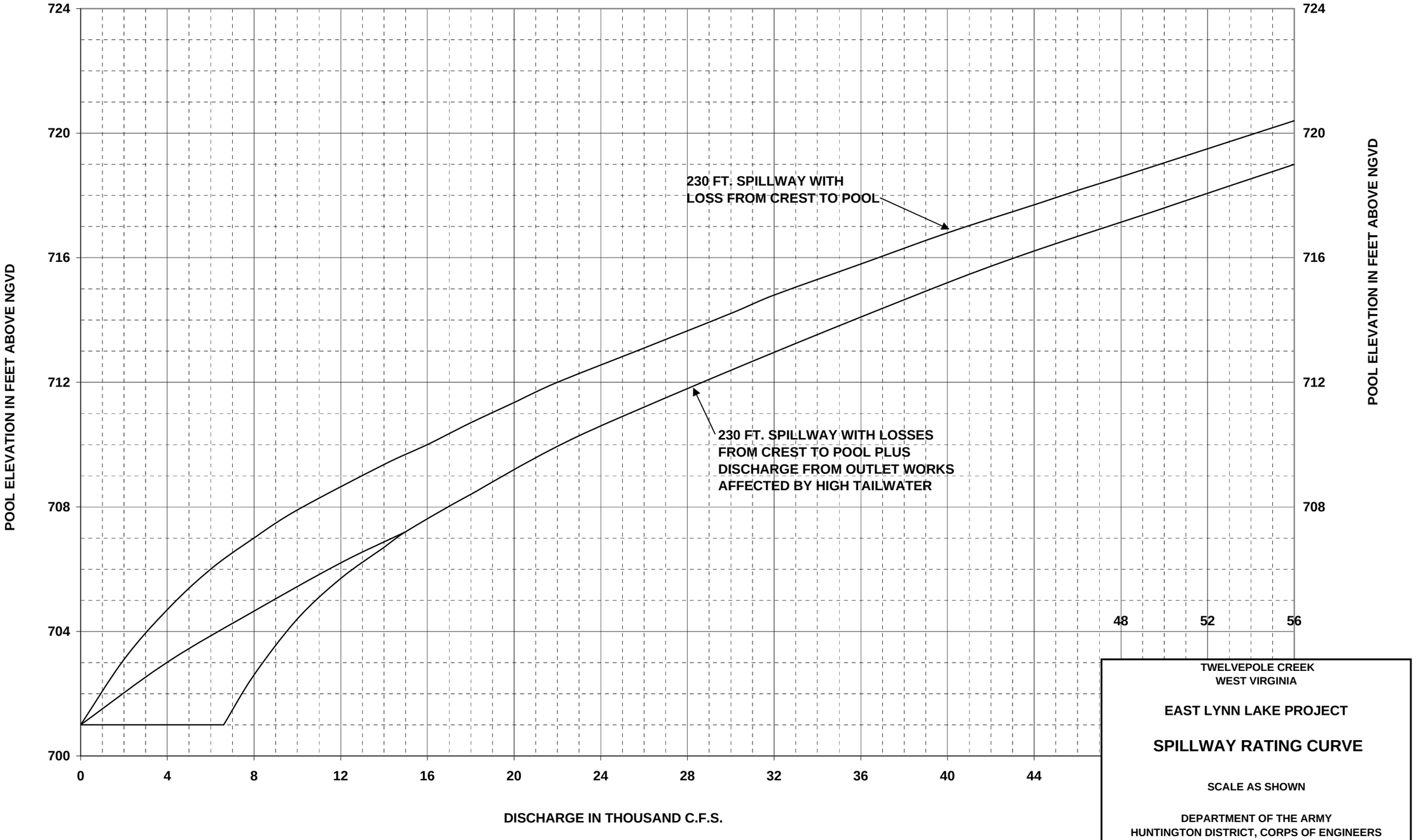
NO OFFSETS USED

START DATE/TIME: 10-01-1995 (0001)

SAME AS RATING NO. 16 BELOW 1.2 FT AND ABOVE 12 FT

INPUT VALUE	GAGE HEIGHT (STANDARD PRECISION) .0	.1	.2	.3	.4	.5	.6	.7	.8	.9	DIFF IN Y PER UNIT
1.0	1.0*	2.0*	3.9*	6.6*	9.5*	13.00*	16.90*	21.50*	27.00*	33.00*	39.00
2.0	40.00*	47.50*	56.00*	66.00	76.00	86.00	96.00*	107.00*	120.00*	133.00*	107.00
3.0	147.00	161.00	175.00*	190.00	205.00	220.00	235.00	250.00*	270.00	290.00	163.00
4.0	310.00*	325.00*	345.00	365.00	385.00*	400.00*	420.00	440.00	460.00	480.00	190.00
5.0	500.00*	525.00*	545.00*	570.00	595.00*	615.00*	640.00*	660.00	680.00	700.00*	225.00
6.0	725.00	750.00	775.00	800.00	825.00	850.00	875.00	900.00	925.00	950.00	250.00
7.0	975.00	1000.00	1025.00	1050.00	1075.00	1100.00	1125.00	1150.00	1175.00	1200.00	250.00
8.0	1225.00	1250.00	1275.00	1300.00	1325.00	1350.00	1375.00	1400.00	1425.00	1450.00	250.00
9.0	1475.00	1500.00	1525.00	1550.00	1575.00	1600.00*	1630.00	1660.00	1690.00	1720.00	275.00
10.0	1750.00	1780.00	1810.00	1840.00	1870.00	1900.00	1930.00	1960.00	1990.00	2020.00	300.00
11.0	2050.00	2080.00	2110.00	2140.00	2170.00	2200.00	2230.00	2260.00	2290.00	2320.00	300.00
12.0	2350.00*	2375.00	2400.00	2425.00	2450.00	2475.00	2500.00	2525.00	2550.00	2575.00	250.00
13.0	2600.00	2625.00	2650.00	2675.00	2700.00	2725.00	2750.00	2775.00	2800.00	2825.00	250.00
14.0	2850.00	2875.00	2900.00	2925.00	2950.00	2975.00	3000.00	3025.00	3050.00	3075.00	250.00
15.0	3100.00*	3130.00	3160.00	3190.00	3220.00	3250.00	3280.00	3310.00	3340.00	3370.00	300.00
16.0	3400.00	3430.00	3460.00	3490.00	3520.00	3550.00	3580.00	3610.00	3640.00	3670.00	300.00
17.0	3700.00	3730.00	3760.00	3790.00	3820.00	3850.00	3880.00	3910.00	3940.00	3970.00	300.00
18.0	4000.00	4030.00	4060.00	4090.00	4120.00	4150.00	4180.00	4210.00	4240.00	4270.00	300.00
19.0	4300.00	4330.00	4360.00	4390.00	4420.00	4450.00	4480.00	4510.00	4540.00	4570.00	300.00
20.0	4600.00	4630.00	4660.00	4690.00	4720.00	4750.00	4780.00	4810.00	4840.00	4870.00	300.00
21.0	4900.00	4930.00	4960.00	4990.00	5020.00	5050.00	5080.00	5110.00	5140.00	5170.00	300.00*
22.0	5200.00*										

PLATE NO. 7-3



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

SPILLWAY RATING CURVE

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 7-4

NOTES
1. 3 SLUICE GATES 5'-8"x10'-0"
2. TUNNEL DIAMETER 13'-0"

1 FT.
2 FT.
3 FT.
4 FT.
5 FT.
6 FT.
7 FT.
8 FT.
9 FT.
ONE GATE FULLY OPEN 10 FT.
SPILLWAY CREST ELEV 701.0
TWO GATES FULLY OPEN
THREE GATES FULLY OPEN
SEASONAL POOL ELEV 662.0
MINIMUM POOL ELEV 656.0

POOL ELEVATION IN FEET ABOVE NGVD

710
700
690
680
670
660
650

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70

DISCHARGE IN HUNDRED C.F.S.

TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

SLIDE GATE RATING CURVE
ONE GATE-PARTIAL OPENINGS

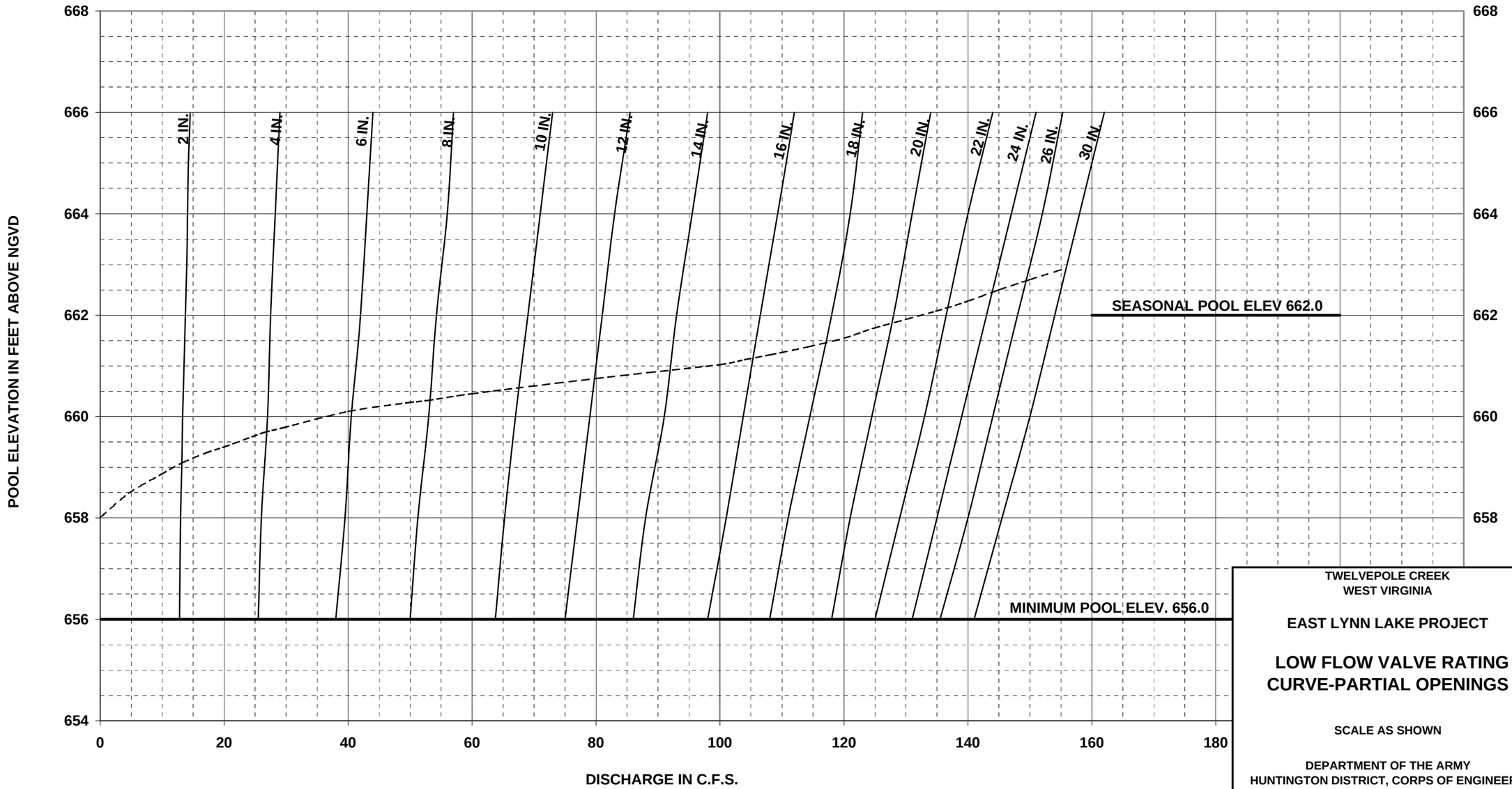
SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 7-5

NOTES

1. 2- 4'0" x 3'0" LOW FLOW INTAKES AT ELEV. 658.0 AND 649.0 CONTROLLED BY 30" FLAT BOTTOM GATE VALVE.
2. WHEN OPERATING WITH ONLY THE LOW FLOW INTAKE AT ELEV. 658.0 OPEN. USE THE PARTIAL OPENING CURVES ABOVE THE DASHED LINE ONLY.
3. WHEN OPERATING WITH ONLY THE LOW FLOW INTAKE AT ELEV. 649.0 OPEN. USE THE FULL RANGE OF THE PARTIAL OPENING CURVES.



TWELVEPOLE CREEK
WEST VIRGINIA

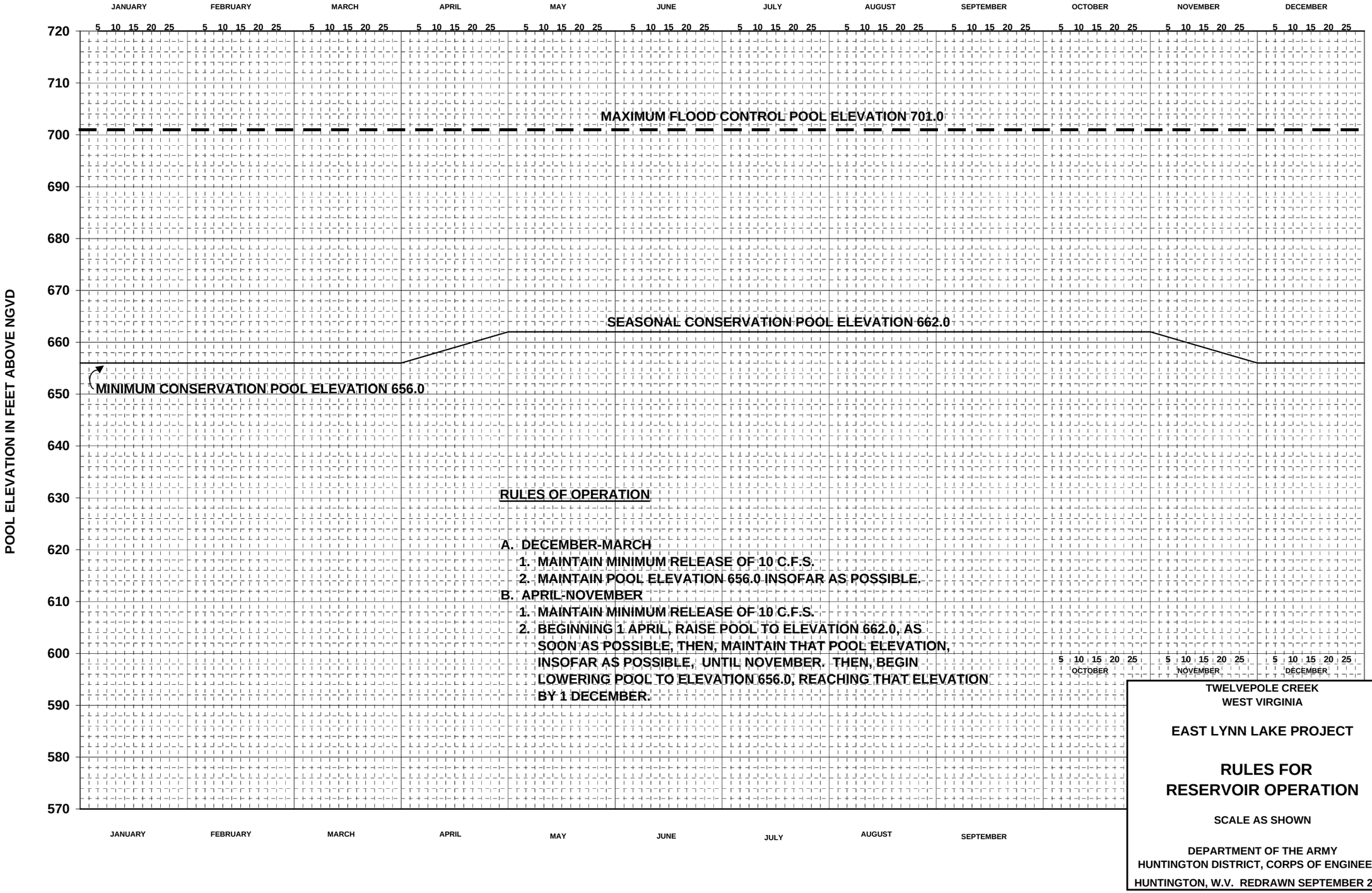
EAST LYNN LAKE PROJECT

LOW FLOW VALVE RATING CURVE-PARTIAL OPENINGS

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 7-6



RULES OF OPERATION

A. DECEMBER-MARCH
   1. MAINTAIN MINIMUM RELEASE OF 10 C.F.S.
   2. MAINTAIN POOL ELEVATION 656.0 INSOFAR AS POSSIBLE.
B. APRIL-NOVEMBER
   1. MAINTAIN MINIMUM RELEASE OF 10 C.F.S.
   2. BEGINNING 1 APRIL, RAISE POOL TO ELEVATION 662.0, AS SOON AS POSSIBLE, THEN, MAINTAIN THAT POOL ELEVATION, INSOFAR AS POSSIBLE, UNTIL NOVEMBER. THEN, BEGIN LOWERING POOL TO ELEVATION 656.0, REACHING THAT ELEVATION BY 1 DECEMBER.

TWELVEPOLE CREEK
WEST VIRGINIA

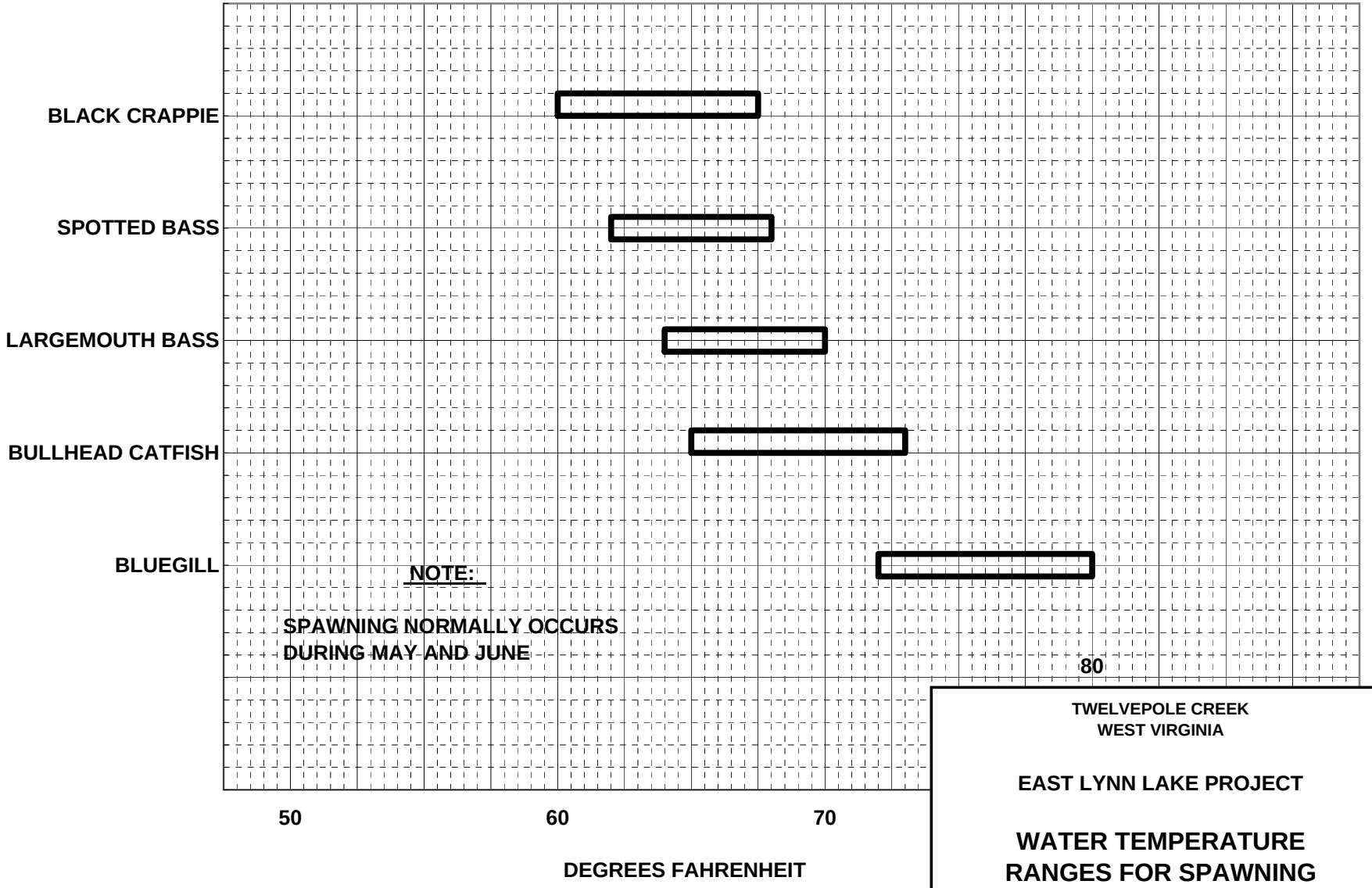
EAST LYNN LAKE PROJECT

RULES FOR RESERVOIR OPERATION

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO.7-7



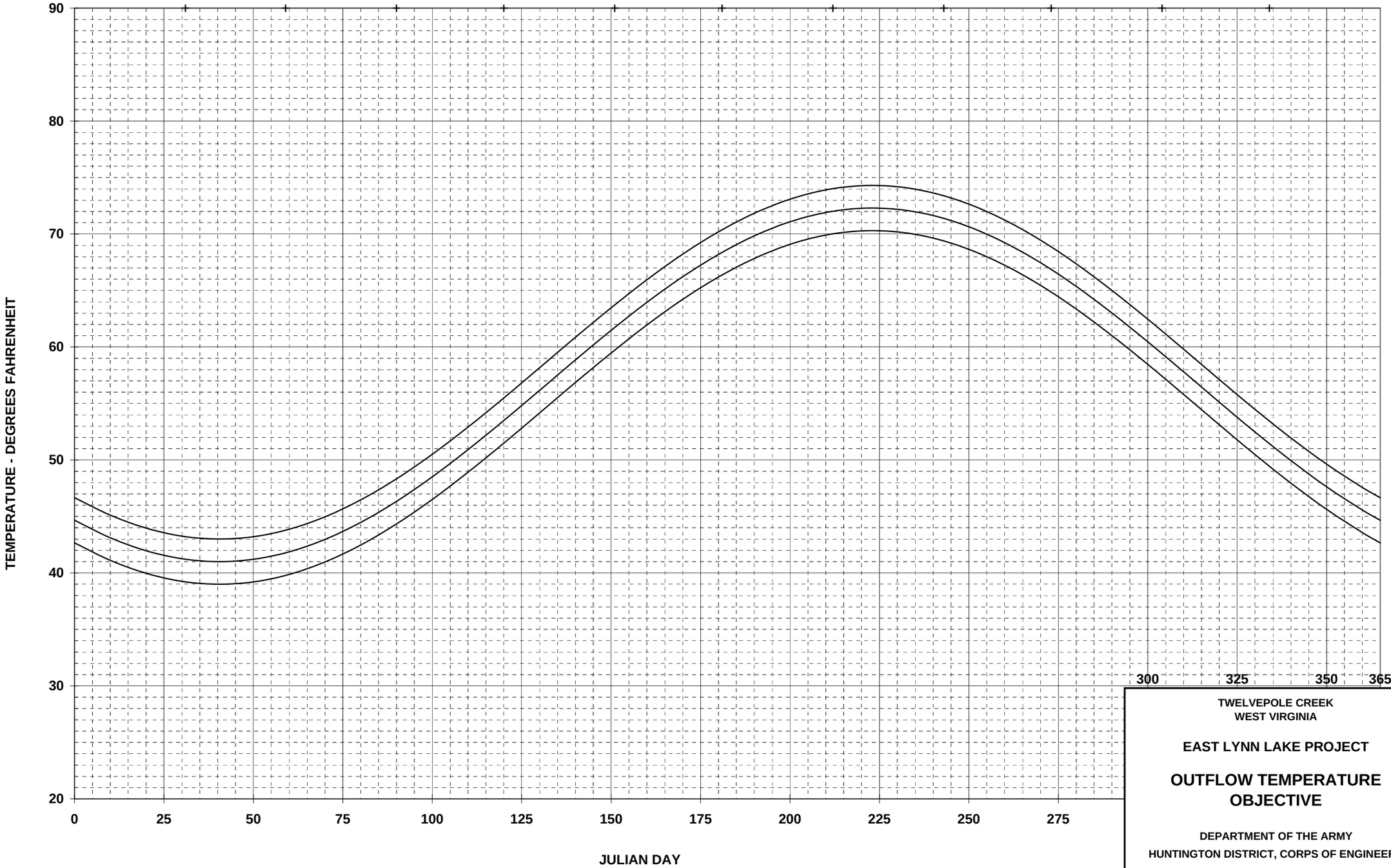
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

WATER TEMPERATURE RANGES FOR SPAWNING

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 7-8



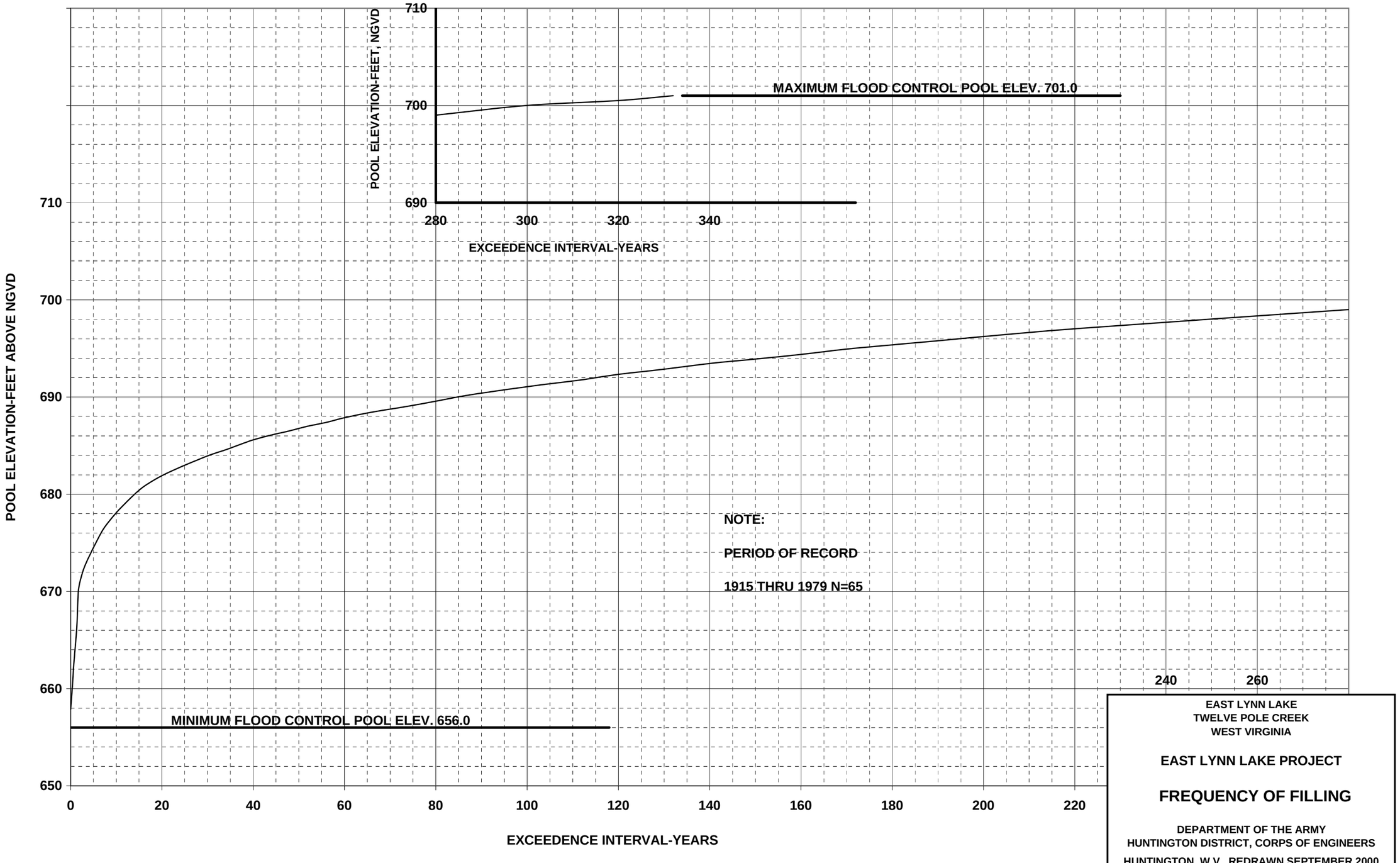
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

OUTFLOW TEMPERATURE OBJECTIVE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 7-9



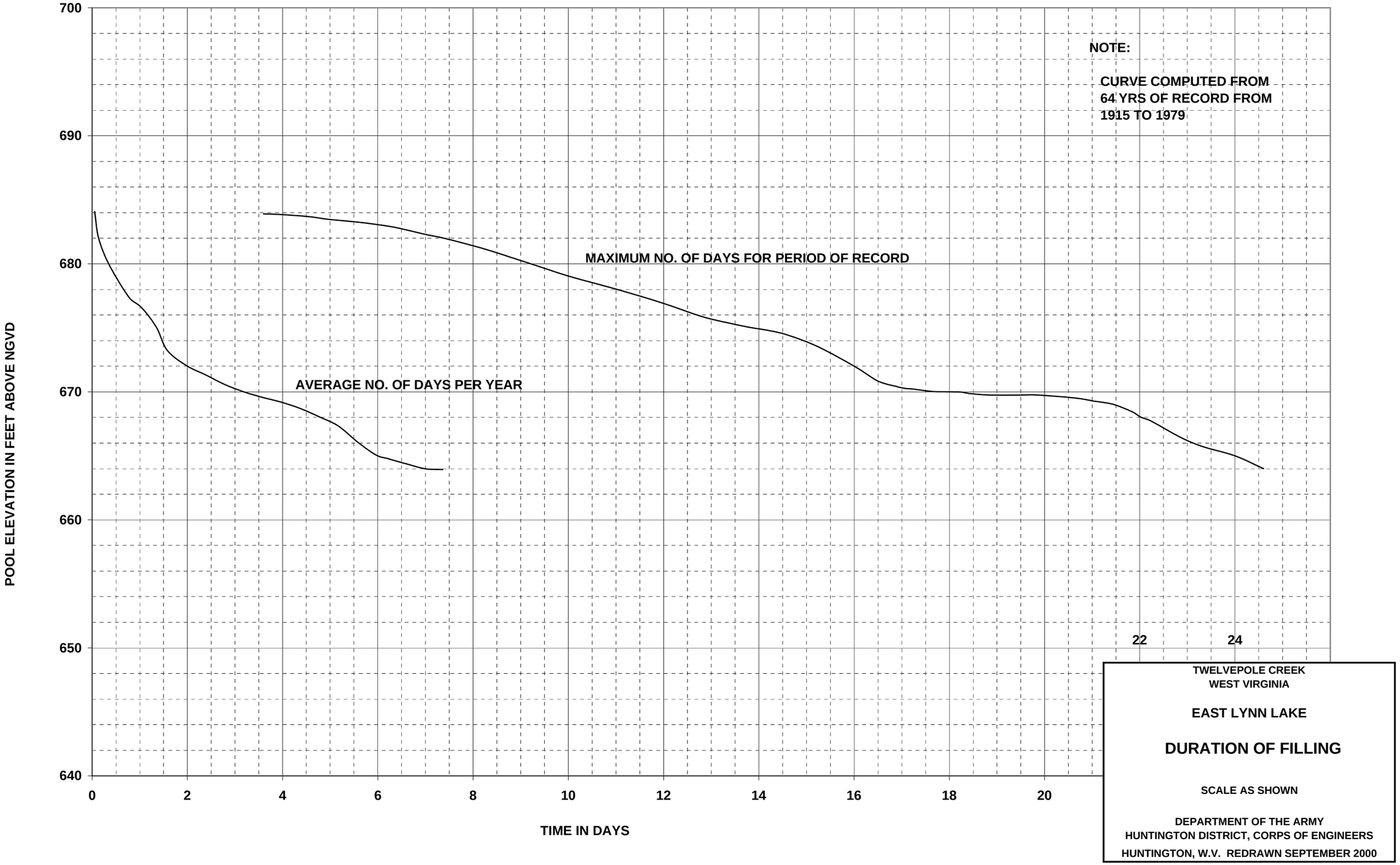
EAST LYNN LAKE
TWELVE POLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FREQUENCY OF FILLING

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-1



TWELVEPOLE CREEK
WEST VIRGINIA

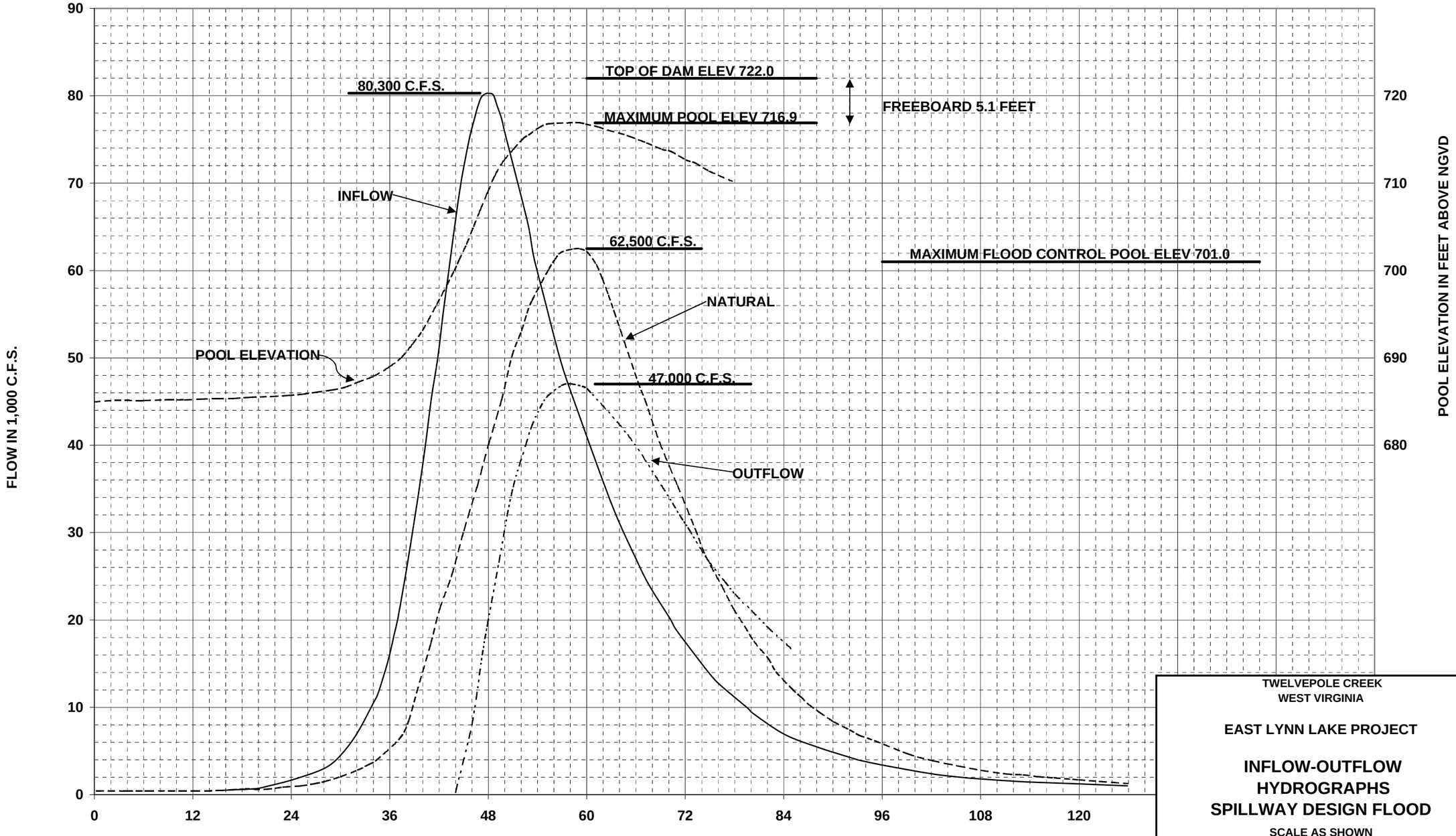
EAST LYNN LAKE

DURATION OF FILLING

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-2



TWELVEPOLE CREEK
WEST VIRGINIA

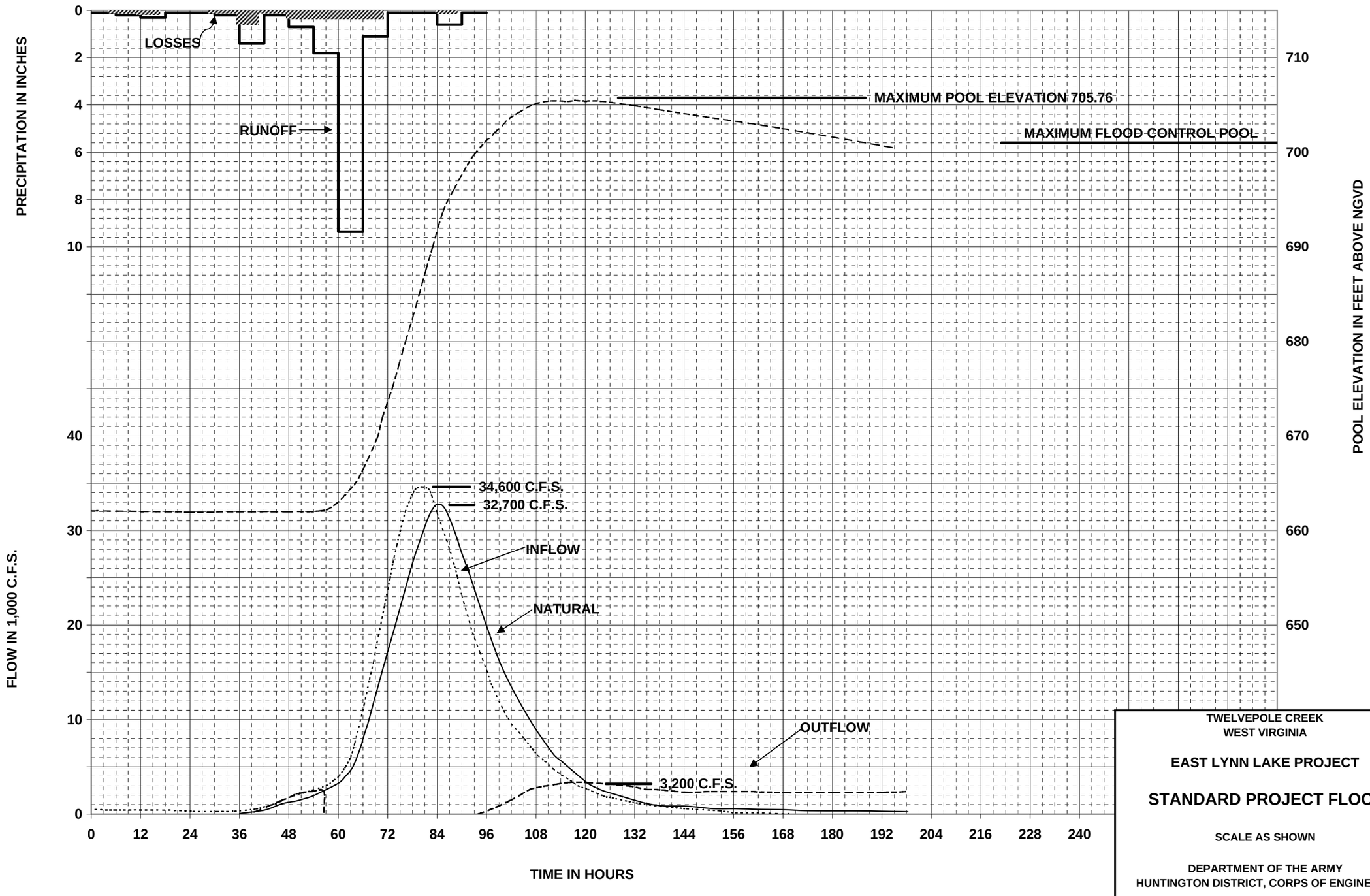
EAST LYNN LAKE PROJECT

INFLOW-OUTFLOW HYDROGRAPHS SPILLWAY DESIGN FLOOD

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-3



TWELVEPOLE CREEK
WEST VIRGINIA

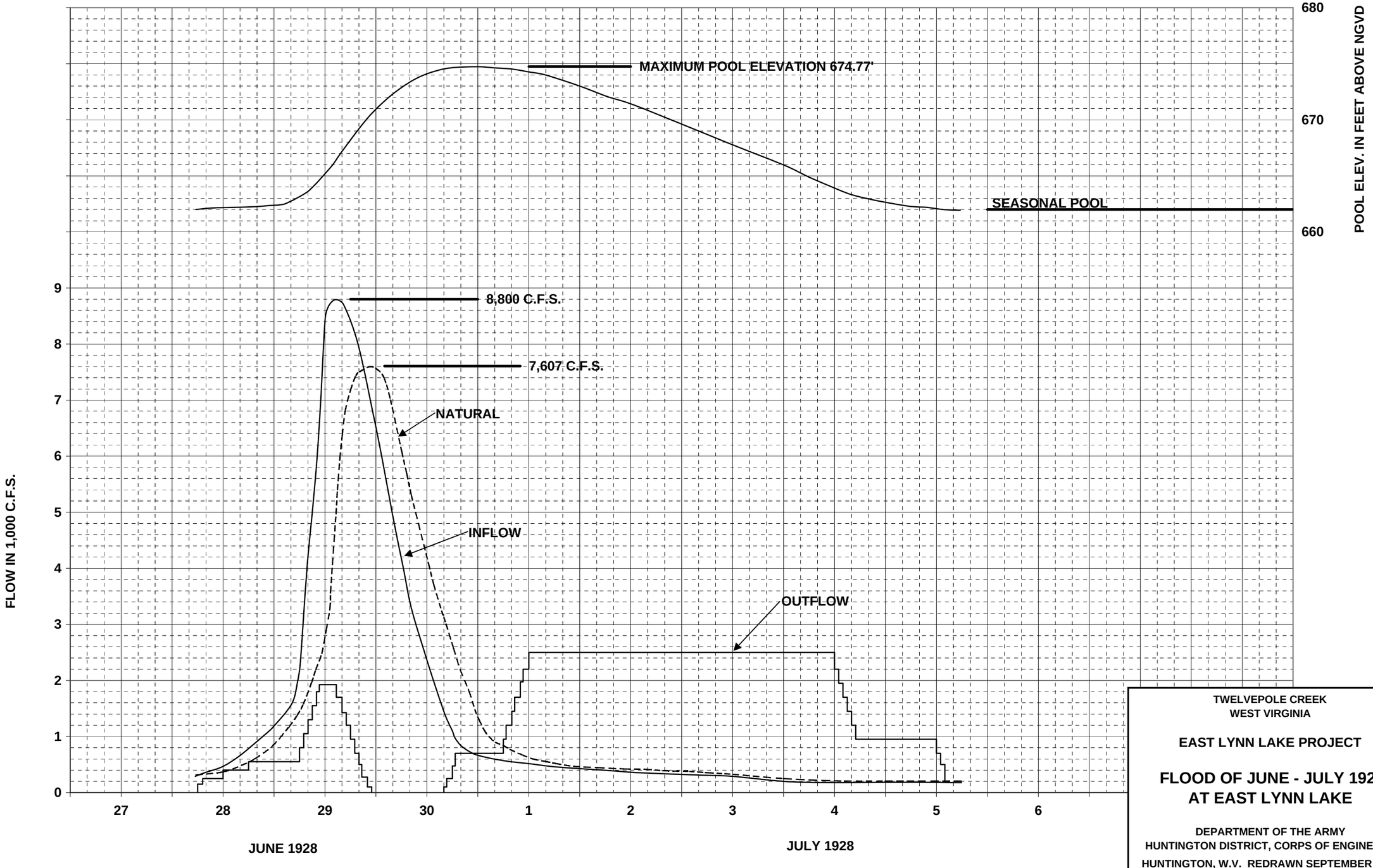
EAST LYNN LAKE PROJECT

STANDARD PROJECT FLOOD

SCALE AS SHOWN

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-4



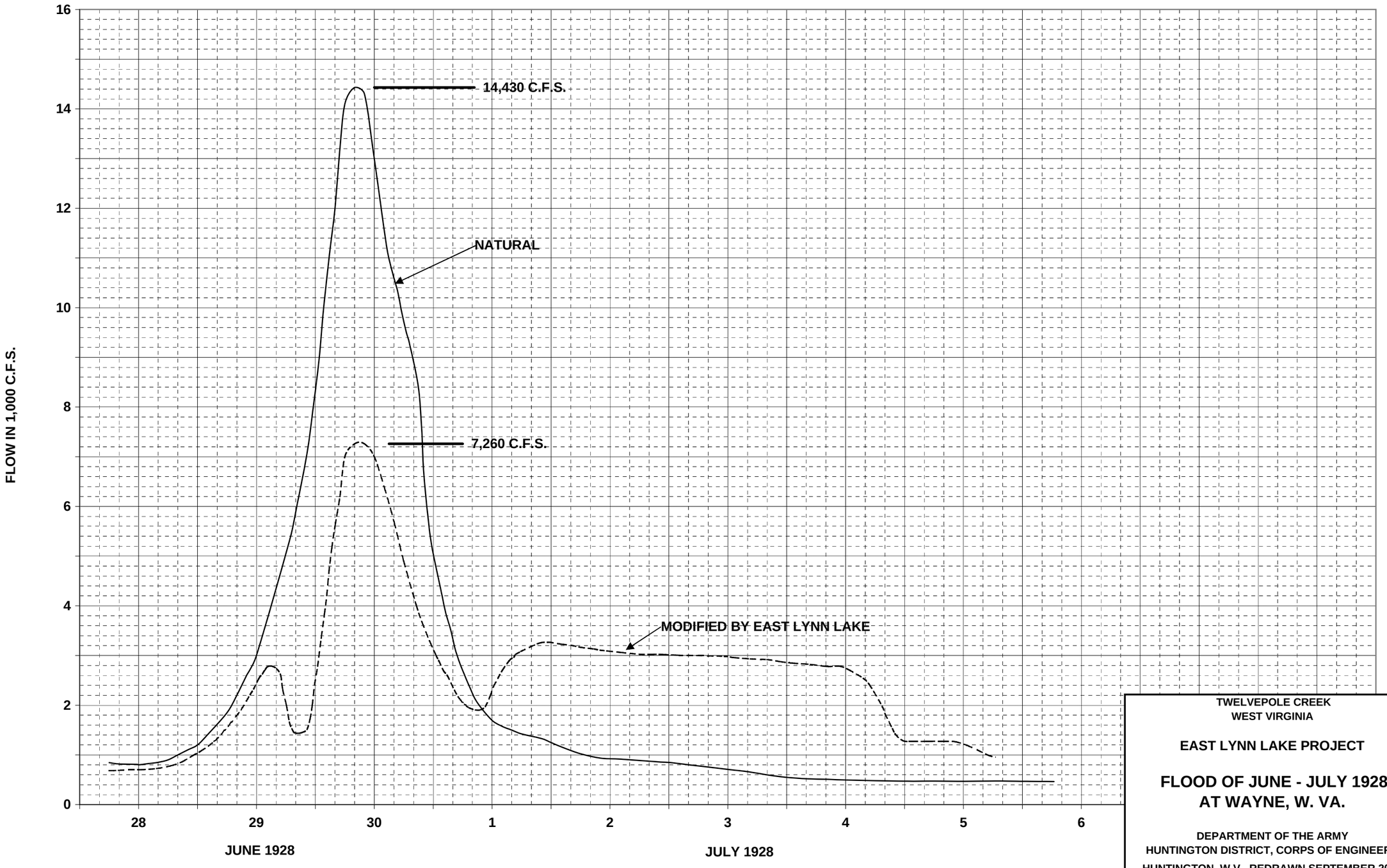
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF JUNE - JULY 1928
AT EAST LYNN LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-5



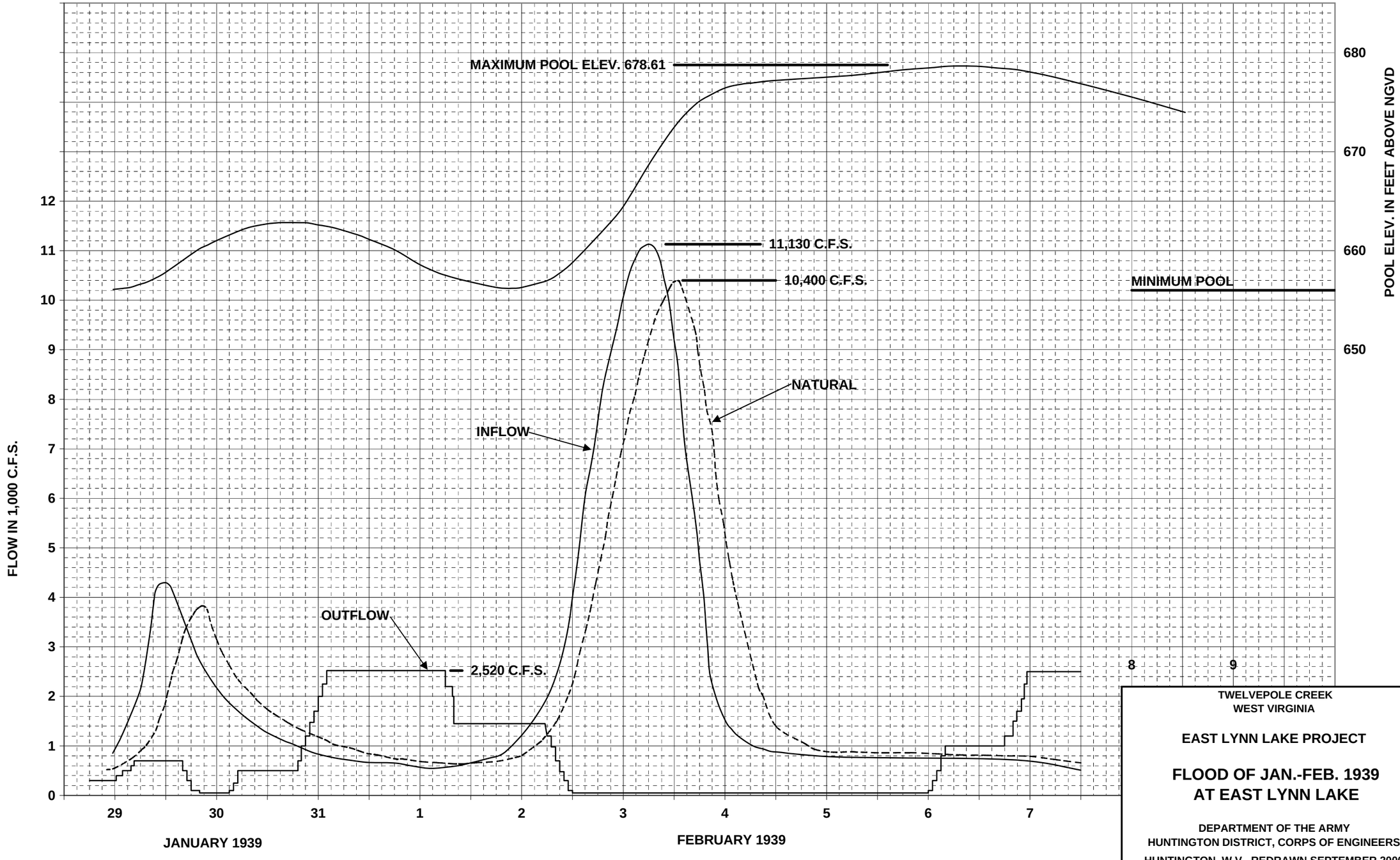
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF JUNE - JULY 1928
AT WAYNE, W. VA.

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-6



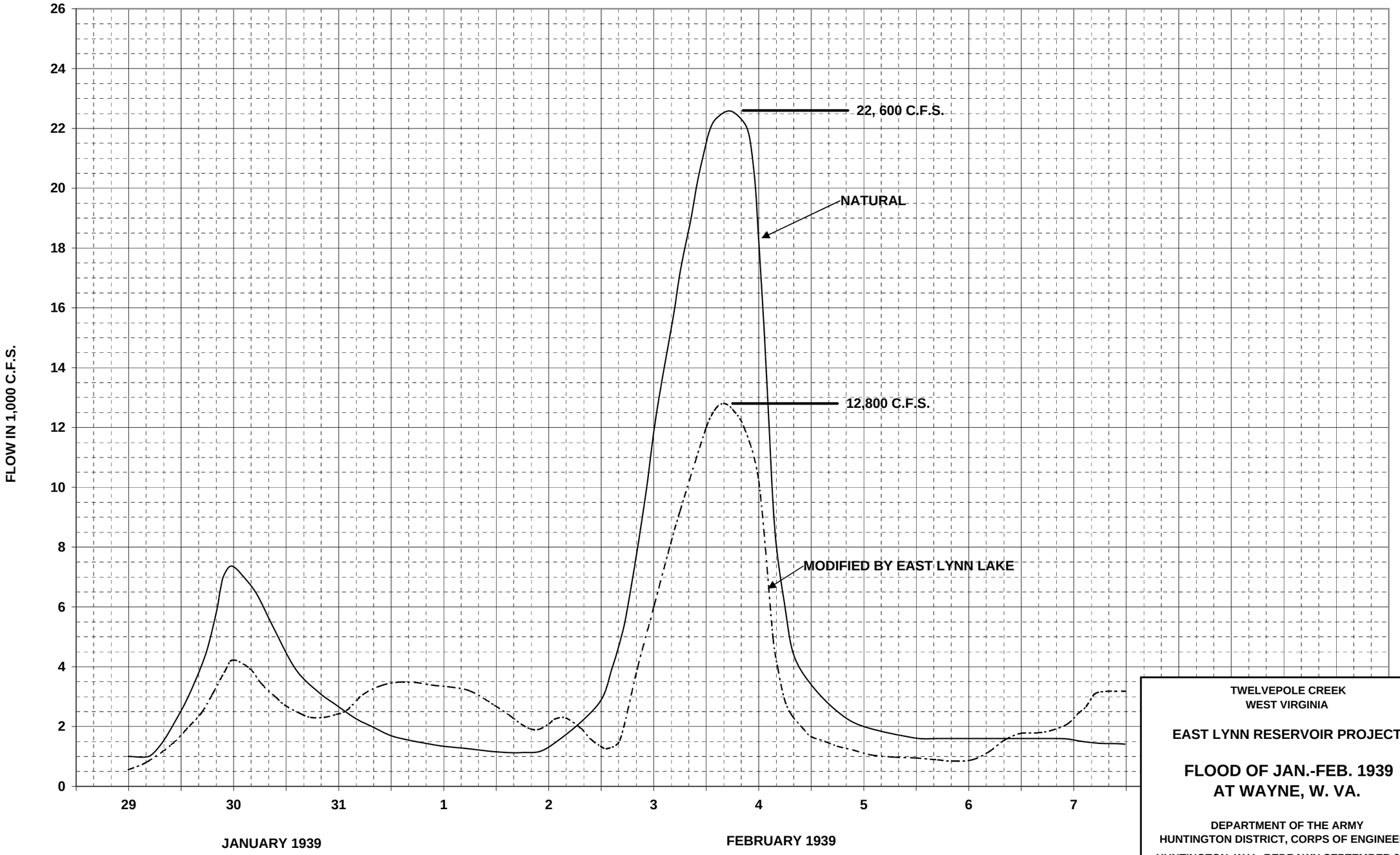
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF JAN.-FEB. 1939
AT EAST LYNN LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-7



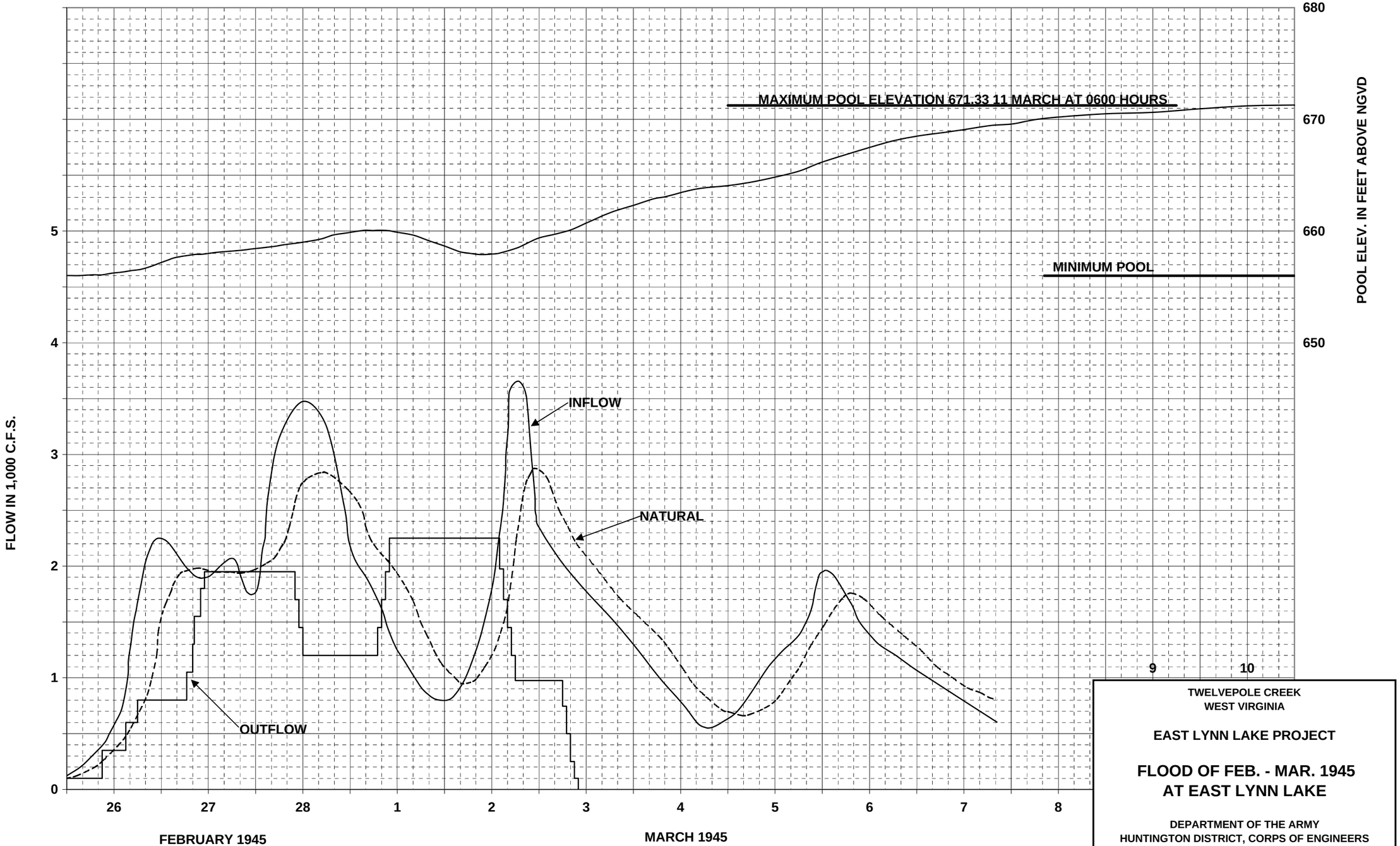
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN RESERVOIR PROJECT

FLOOD OF JAN.-FEB. 1939
AT WAYNE, W. VA.

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-8



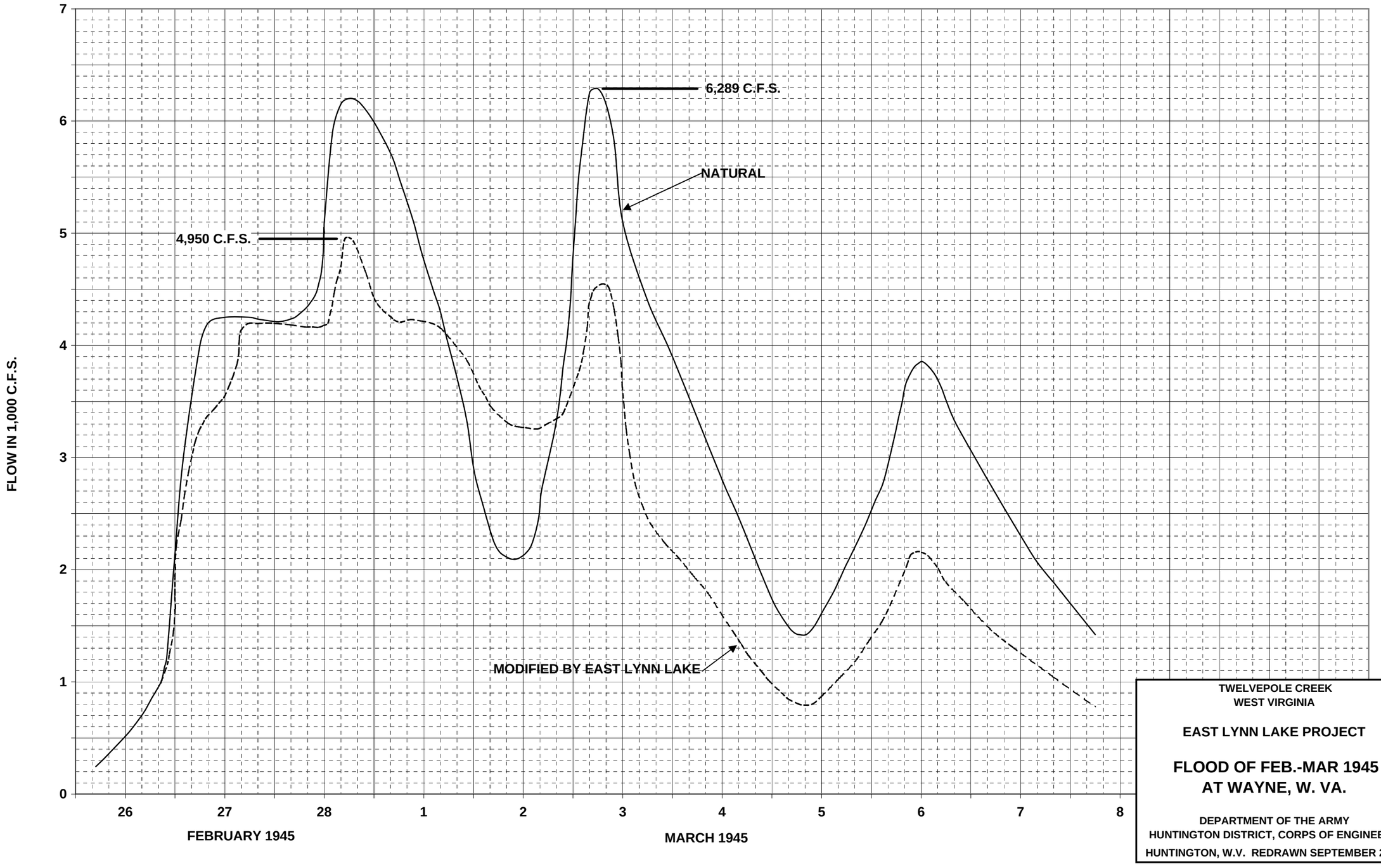
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF FEB. - MAR. 1945
AT EAST LYNN LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-9



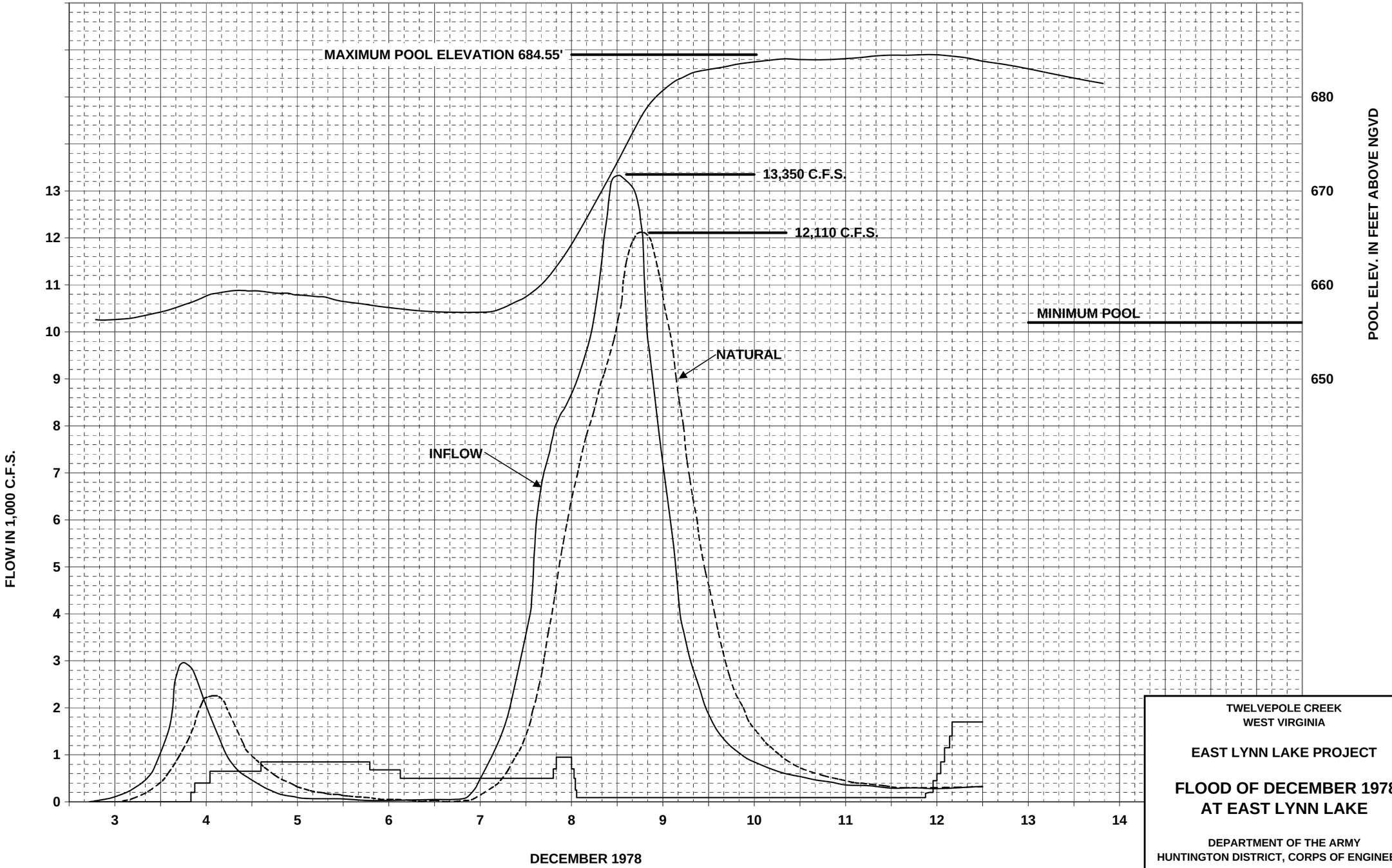
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF FEB.-MAR 1945
AT WAYNE, W. VA.

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-10



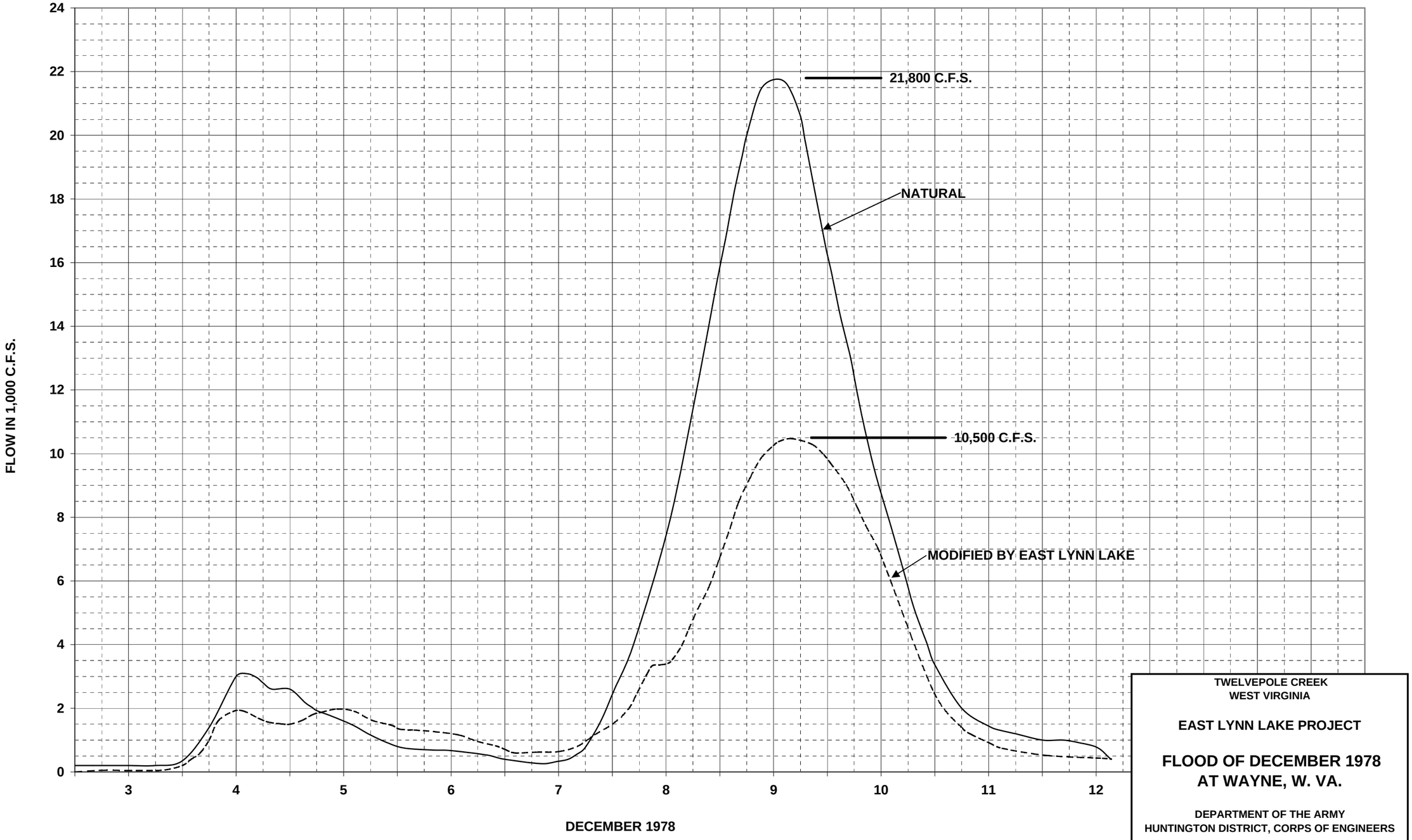
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF DECEMBER 1978
AT EAST LYNN LAKE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-11



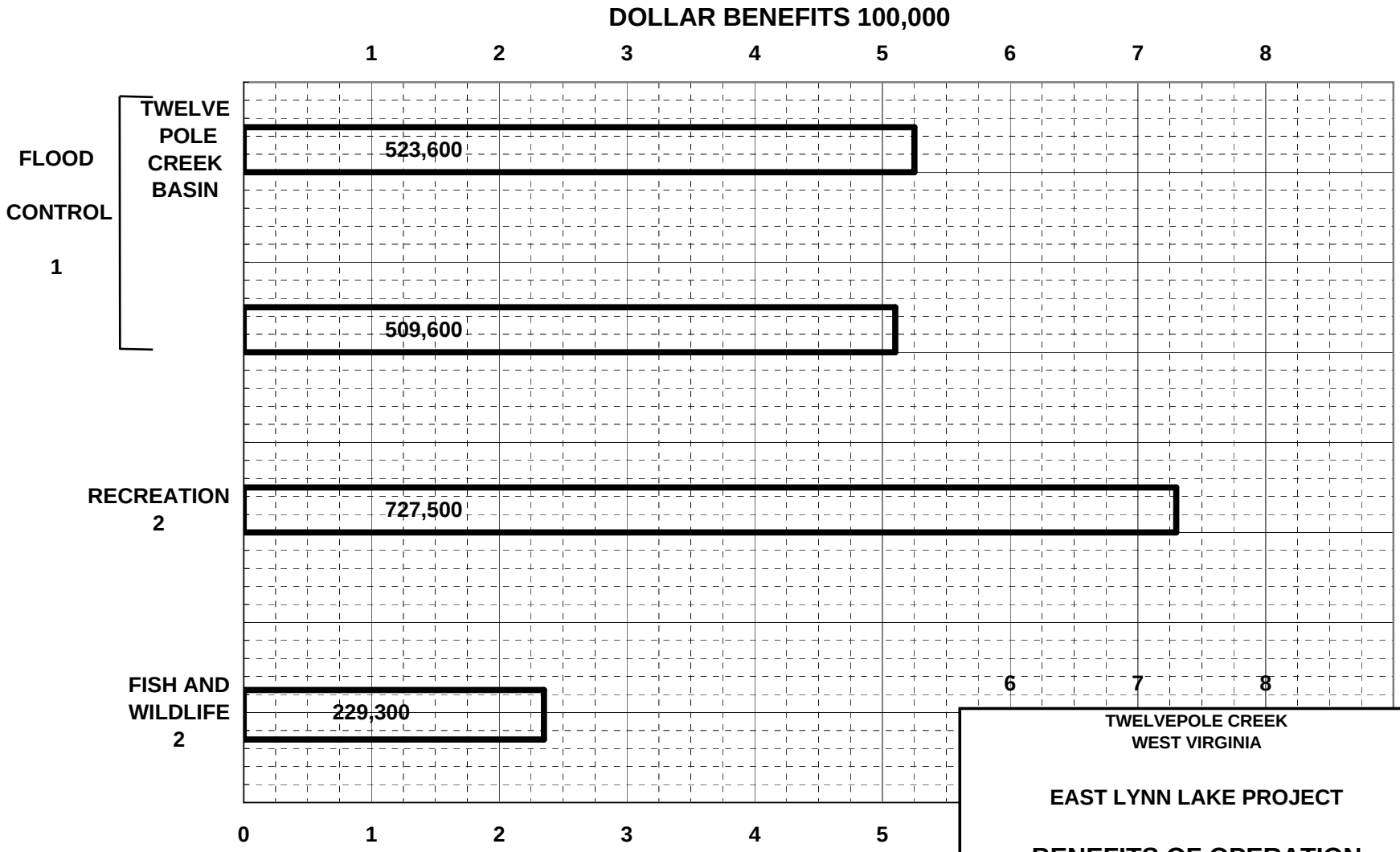
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

FLOOD OF DECEMBER 1978
AT WAYNE, W. VA.

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-12



1. AVERAGE ANNUAL BENEFITS DECEMBER 1981 VALUATION

2. BASED ON 1981 VISITATIONS

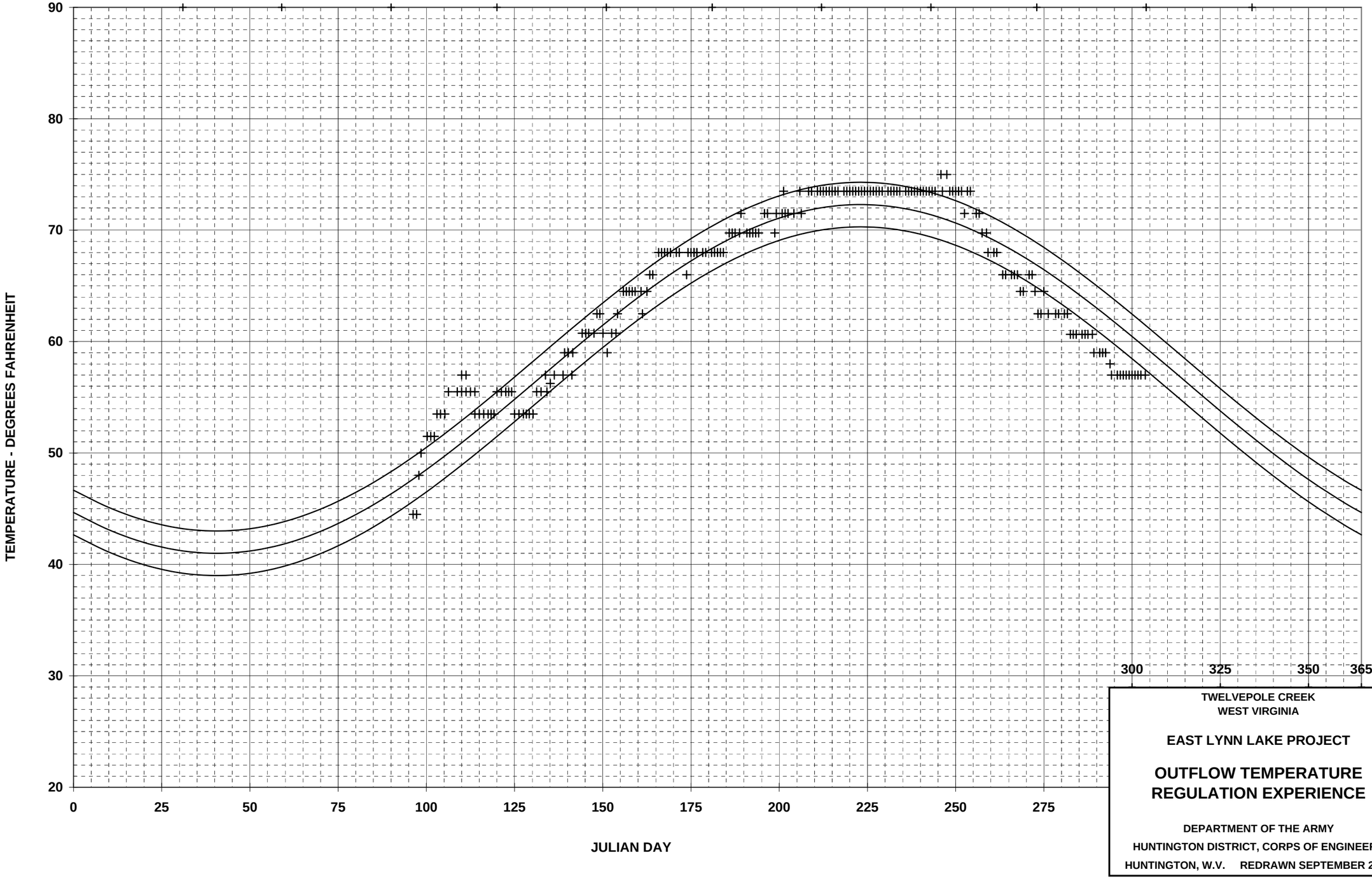
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

BENEFITS OF OPERATION FOR AUTHORIZED PURPOSE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-13



TWELVEPOLE CREEK
WEST VIRGINIA

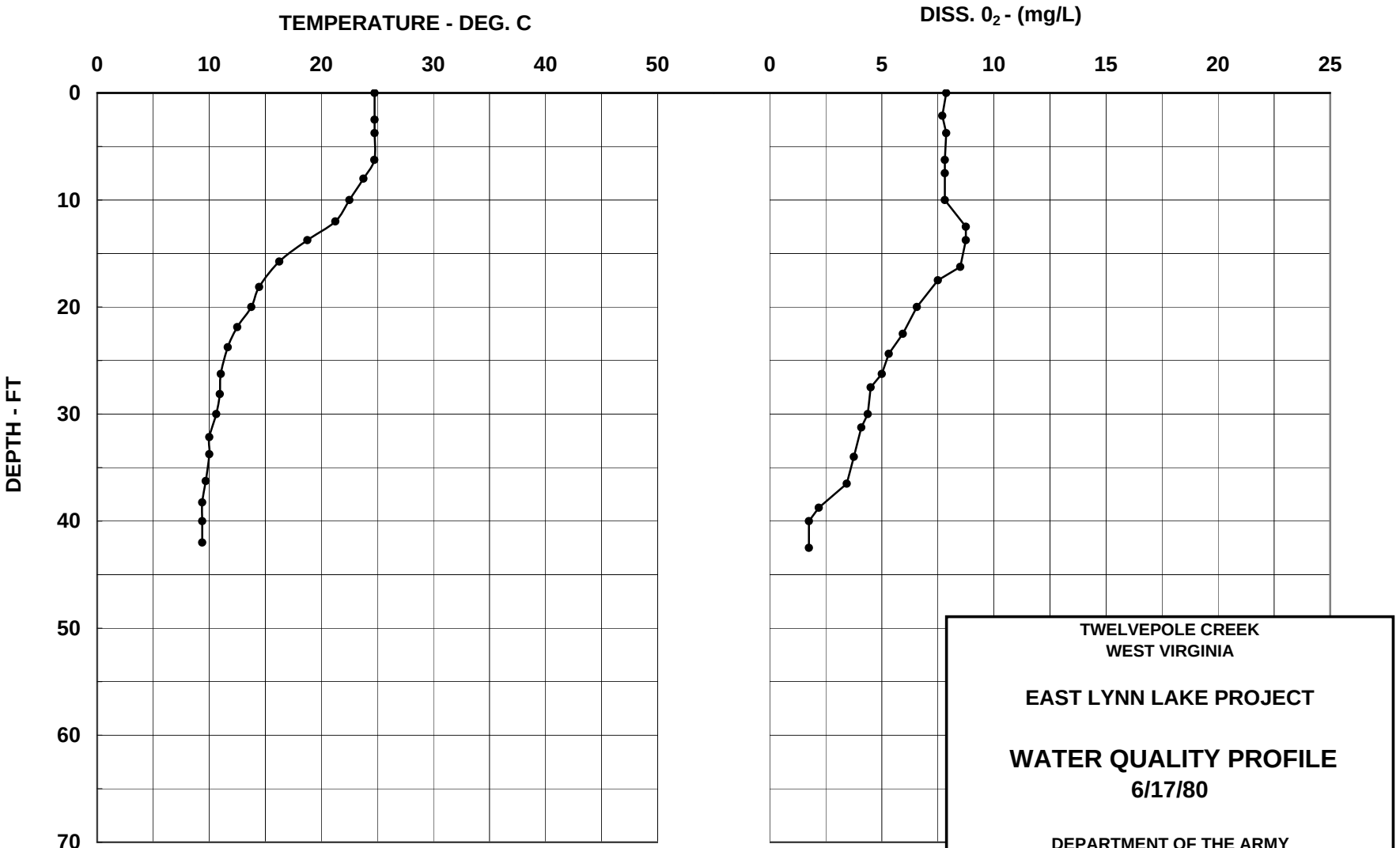
EAST LYNN LAKE PROJECT

OUTFLOW TEMPERATURE REGULATION EXPERIENCE

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-14

ELEV. 662.27
6/17/80



TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

WATER QUALITY PROFILE
6/17/80

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-15

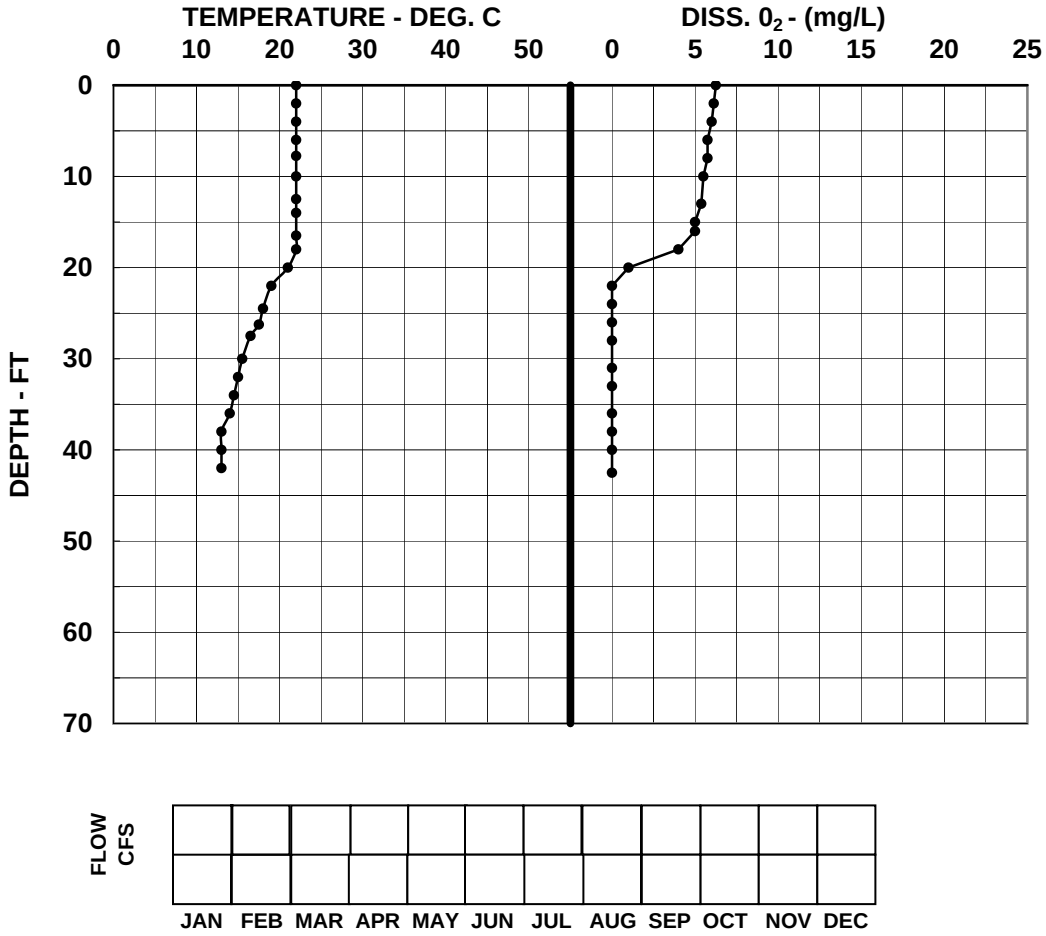
PERTINENT INFORMATION

SEASONAL POOL ELEV. (MSL)…….....662.00
CURRENT LAKE ELEVATION…….....649.00
LAKE ELEV. DURING SAMPLING.……662.49
OUTFLOW TEMPERATURE.....……22.00
OUTFLOW D.O.....……989.00

TWO LOW FLOW INTAKES AT INV EL 858 & 649 FT. THREE BOTTOM SLUICE GATES AT EL 616 FT.

WATER QUALITY ASSESSMENT

LOCATION OF MEASUREMENT	CONDITION OF WATER	QUALITY CONSIDERATIONS CURRENT	POTENTIAL
LAKE			
0-15	GOOD		
15-20	FAIR TO POOR	TRANSITION ZONE	LOW D.O.
20-BOTTOM	POOR	ANOXIC WAT. METALS	ANOXIC WAT. METALS
OUTFLOW	GOOD TO FAIR	TEMP	



1. BASED ON THE SUBJECTIVE 3-MEMBER CLASSIFICATION SCHEME: GOOD-FAIR-POOR

   X1=DEPTH OF PRIMARY $\Delta T/\Delta Z$: 25 FT

   X2=DEPTH OF SECONDARY $\Delta T/\Delta Z$: NA FT

   X3=DEPTH AT WHICH D.O.=5.0 mg/L: 15 FT

   X4=DEPTH AT WHICH D.O.=1.0 mg/L: 20 FT

2. COMMENTS:
   LAKE STARTS TO MIX. ANOXIC WATER & METALS IN HYPOLIM. WATER RELEASED FROM 649 FT. OUTFLOW TEMP IS HIGHER THAN RULE CURVE

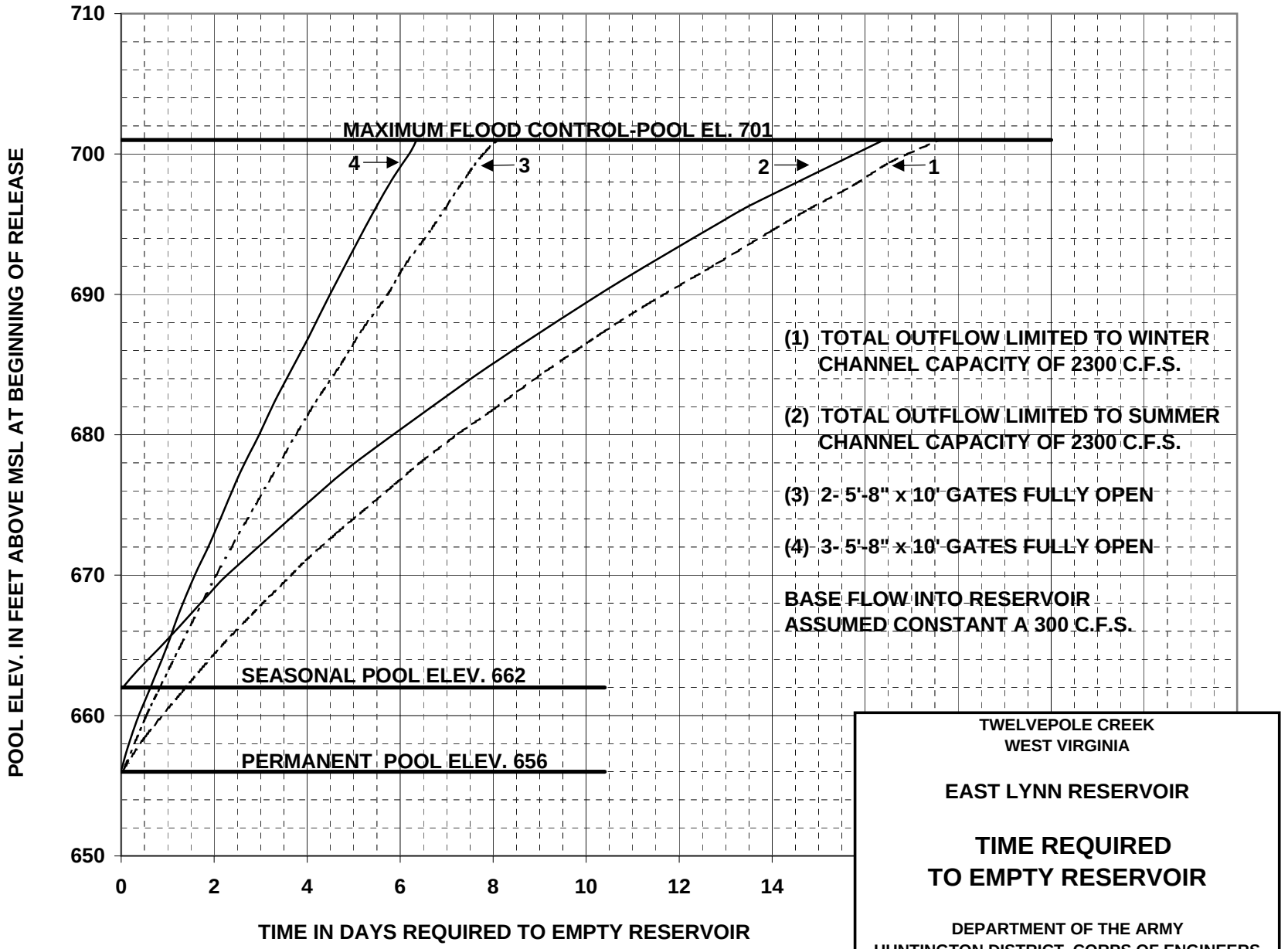
TWELVEPOLE CREEK
WEST VIRGINIA

EAST LYNN LAKE PROJECT

LAKE WATER QUALITY PROFILE
09/29/80

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-16



TWELVEPOLE CREEK
WEST VIRGINIA

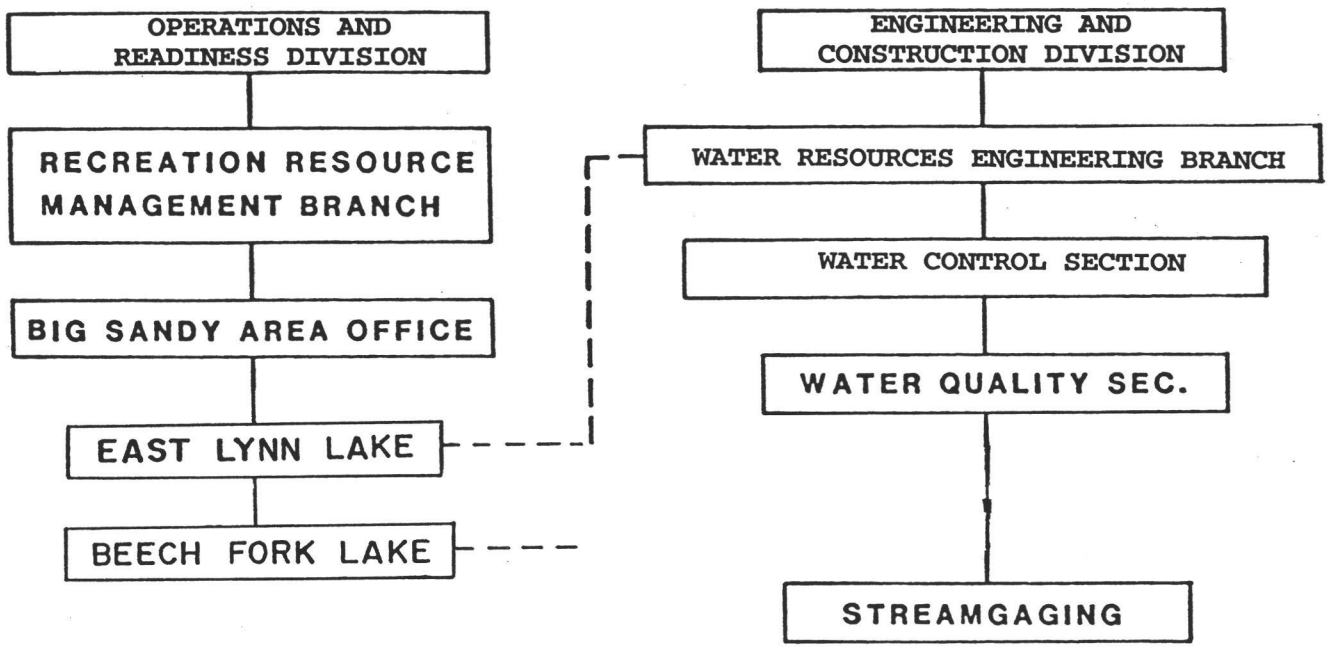
EAST LYNN RESERVOIR

TIME REQUIRED TO EMPTY RESERVOIR

DEPARTMENT OF THE ARMY
HUNTINGTON DISTRICT, CORPS OF ENGINEERS
HUNTINGTON, W.V. REDRAWN SEPTEMBER 2000

PLATE NO. 8-17

WATER CONTROL MANAGEMENT
TWELVEPOLE CREEK BASIN
NORMAL ORGANIZATION



WATER CONTROL MANAGEMENT
NORMAL ORGANIZATION

Plate No. 9-1

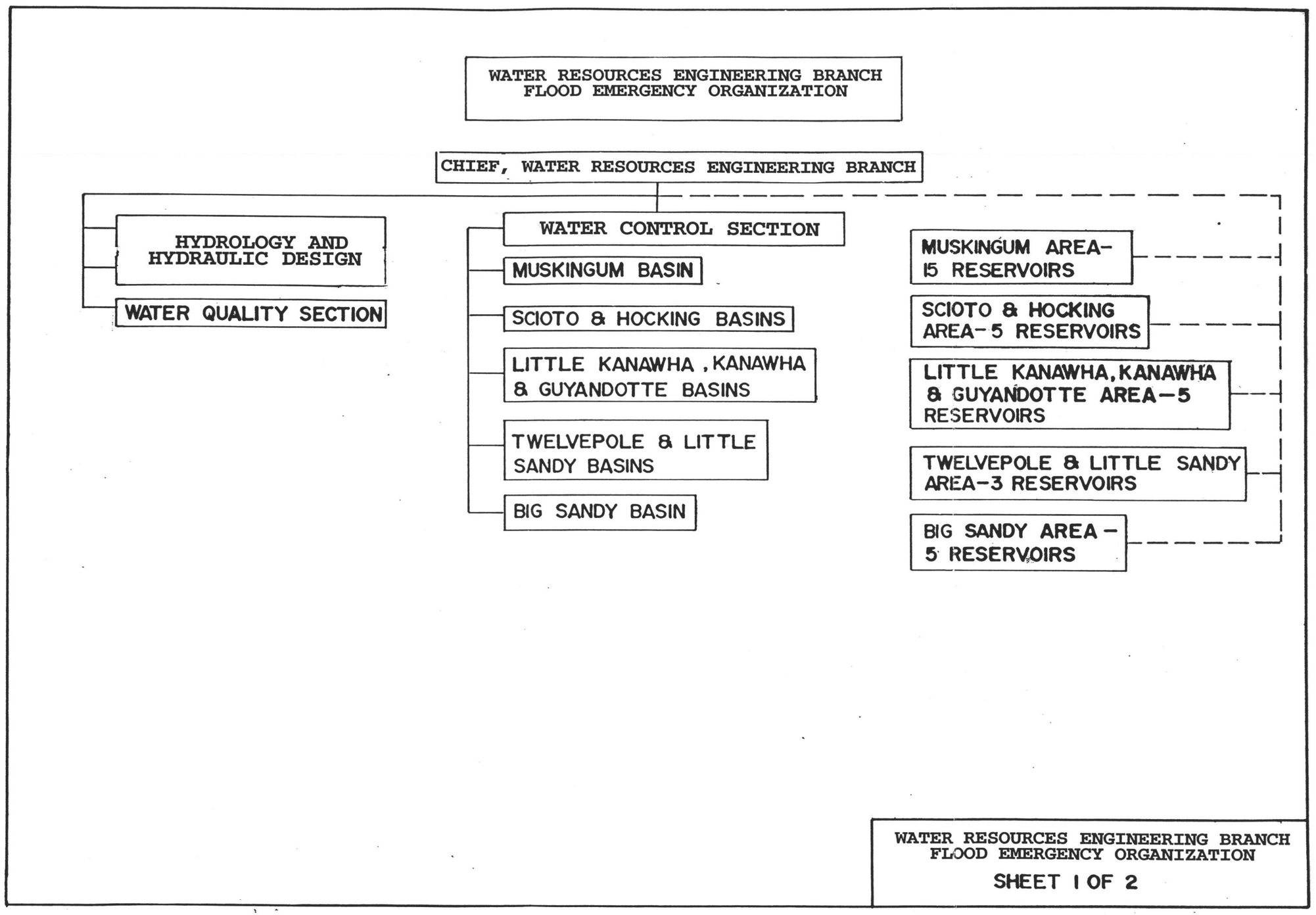
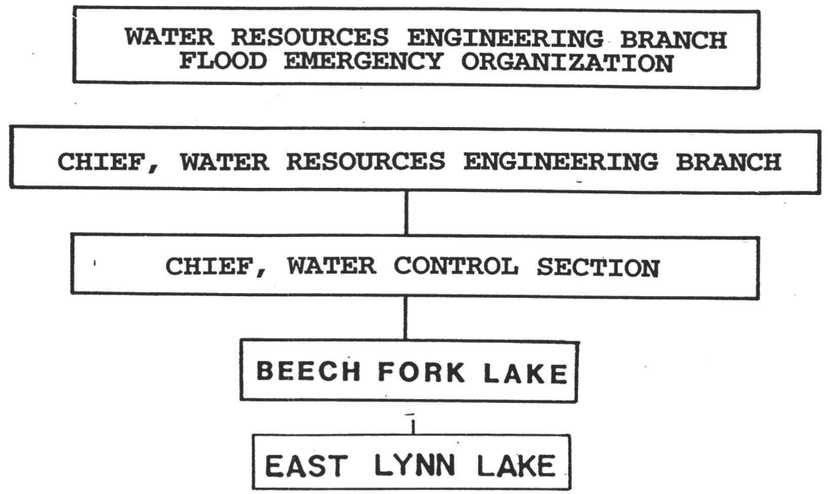

WATER RESOURCES ENGINEERING BRANCH
FLOOD EMERGENCY ORGANIZATION
CHIEF, WATER RESOURCES ENGINEERING BRANCH
HYDROLOGY AND HYDRAULIC DESIGN
WATER QUALITY SECTION
WATER CONTROL SECTION
MUSKINGUM BASIN
SCIOTO & HOCKING BASINS
LITTLE KANAWHA, KANAWHA & GUYANDOTTE BASINS
TWELVEPOLE & LITTLE SANDY BASINS
BIG SANDY BASIN
MUSKINGUM AREA-15 RESERVOIRS
SCIOTO & HOCKING AREA-5 RESERVOIRS
LITTLE KANAWHA, KANAWHA & GUYANDOTTE AREA-5 RESERVOIRS
TWELVEPOLE & LITTLE SANDY AREA-3 RESERVOIRS
BIG SANDY AREA-5 RESERVOIRS
WATER RESOURCES ENGINEERING BRANCH
FLOOD EMERGENCY ORGANIZATION
SHEET 1 OF 2

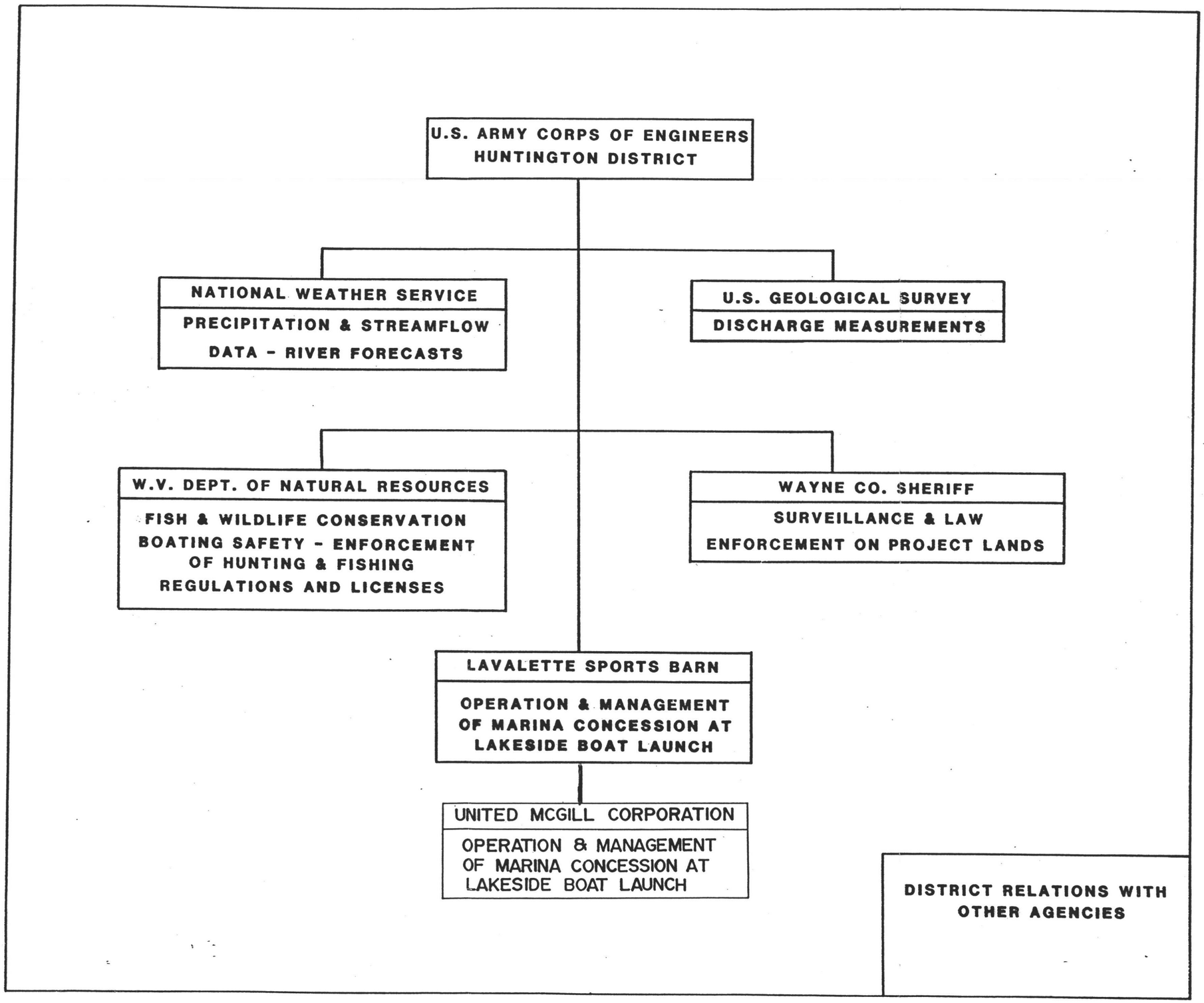
Plate No. 9-2



WATER RESOURCES ENGINEERING BRANCH
FLOOD EMERGENCY ORGANIZATION

SHEET 2 OF 2

Plate No. 9-2


U.S. ARMY CORPS OF ENGINEERS
HUNTINGTON DISTRICT
NATIONAL WEATHER SERVICE
PRECIPITATION & STREAMFLOW
DATA - RIVER FORECASTS
U.S. GEOLOGICAL SURVEY
DISCHARGE MEASUREMENTS
W.V. DEPT. OF NATURAL RESOURCES
FISH & WILDLIFE CONSERVATION
BOATING SAFETY - ENFORCEMENT
OF HUNTING & FISHING
REGULATIONS AND LICENSES
WAYNE CO. SHERIFF
SURVEILLANCE & LAW
ENFORCEMENT ON PROJECT LANDS
LAVALETTE SPORTS BARN
OPERATION & MANAGEMENT
OF MARINA CONCESSION AT
LAKESIDE BOAT LAUNCH
UNITED MCGILL CORPORATION
OPERATION & MANAGEMENT
OF MARINA CONCESSION AT
LAKESIDE BOAT LAUNCH
DISTRICT RELATIONS WITH
OTHER AGENCIES