

DEPARTMENT OF THE ARMY  
U.S. Army Corps of Engineers  
Washington, DC 20314-1000

ER 1110-2-8156

CECW-CE

Regulation  
No. 1110-2-8156

30 September 2018

Engineering and Design  
PREPARATION OF WATER CONTROL MANUALS

1. Purpose. The purpose of this regulation is to standardize the format, content, and procedures to be followed in the preparation of water control manuals prepared by the U.S. Army Corps of Engineers (USACE).
2. Applicability. This regulation applies to all Headquarters, United States Army Corps of Engineers (HQUSACE) elements, Major Subordinate Commands (MSC), districts, laboratories, and separate field operating activities having civil works responsibilities and activities related to or affecting water control management.
3. Distribution Statement. Approved for public release; distribution is unlimited.
4. References.
  - a. Engineer Regulation (ER) 1110-2-240, Water Control Management.  
[https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER\\_1110-2-240.pdf](https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-240.pdf)
  - b. ER 1110-2-1156, Safety of Dams – Policy and Procedures.  
[https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er\\_1110-2-1156.pdf](https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/er_1110-2-1156.pdf)
  - c. ER 1110-2-1941, Drought Contingency Plans.  
[https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER\\_1110-2-1941.pdf](https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-1941.pdf)
  - d. ER 1110-2-8154, Water Quality Management.  
[https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER\\_1110-2-8154.pdf](https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-8154.pdf)
  - e. ER 1110-2-8160, Policies for Referencing Project Elevation Grads to Nationwide Vertical Datums.  
[https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER\\_1110-2-8160.pdf](https://www.publications.usace.army.mil/Portals/76/Publications/EngineerRegulations/ER_1110-2-8160.pdf)

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\* This ER supersedes ER 1110-2-8156 dated 31 August 1995.

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f. Engineer Manual (EM) 1110-2-3600, Management of Water Control Systems.  
[https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM\\_1110-2-3600.pdf](https://www.publications.usace.army.mil/Portals/76/Publications/EngineerManuals/EM_1110-2-3600.pdf)

5. Background. Basic policy concerning water control management is set forth in ER 1110-2-240. It is the policy of the Chief of Engineers that water control manuals and associated water control plans be continually reviewed, updated, and adjusted as needed to ensure that the best use is made of available water resources. Guidance on the development of water control plans is contained in EM 1110-2-3600.

FOR THE COMMANDER:

Appendix A: Preparation of Water Control Manuals



KIRK E. GIBBS  
COL, EN  
Chief of Staff

## APPENDIX A

### Preparation of Water Control Manuals

#### A-1. General.

a. The main purpose of a Water Control Manual (WCM) is for day-to-day use in water management under variable conditions that may affect a project or a system. The WCM should provide a reference source on project issues, authorities, data, schedules, and all other information necessary to regulate a project. The WCM also provides a format to document the effects and benefits of project purposes, which may be used to improve the water control plan and provide a basis for structural modifications. A project's water control plan should prescribe operations for authorized project purposes to accomplish those purposes to the greatest extent possible while seeking to minimize the risk to public safety and is the guide for water release decisions for a project. Therefore, appreciable effort should be made to ensure the manual is concise and informative. EM 1110-2-3600, *Management of Water Control Systems* (Reference 4f) provides background on objectives, requirements, and types of content for management of a broad spectrum of water management projects. This ER provides guidance on the format and content of WCMs for "individual" water resource projects and for basinwide ("master") water control manuals.

b. The required WCM chapter titles were chosen to enable a full understanding of the federal project (Chapters 1, 2, 3); its water control plan (Chapters 7, 8); and water management related information (Chapters 4, 5, 6) which is supported by various pertinent data, tables, exhibits, plates, appendices, and annexes, as necessary. The WCM should include descriptions of structures and water management conditions that constitute an integral part of a project such as re-regulation, pumpback, or diversion facilities. The water control plan for a separate neighboring project within the same system should be presented in a separate manual. (NOTE: This is not applicable to Master WCMs.) The scope of certain chapters or topics in WCMs for individual projects may be less extensive for those projects within basins or systems for which water control master manuals are either available or planned for the near future (when hydrologic forecasting or water control management objectives are broad area tasks), provided these subjects are adequately presented in the master manual. For example, consider a water control master manual that documents operation of a system of locks and dams with respect to forecasted flows. The WCM for one of the locks may refer to the master manual for operation based on forecasted flows in lieu of presenting an unnecessary duplication of information contained in the master manual.

c. A separate manual, or appendix to a master manual, is prepared for each water control management project for the user's convenience during real-time applications. Appropriate cross-referencing between a master manual and appendices (individual project manuals or plans, as required) can serve to reduce the duplication of information regarding specific subjects. ER 1110-2-240, *Water Control Management* (Reference 4a), provides guidance on update intervals for water control plans and water control manuals. As a minimum, Chapter 7 of the water

control manual should be updated following any change to the water control plan. Complete updates should be considered at regular intervals to incorporate additional hydrologic data and any other new information. If the manual is still current, the review of the manual should be documented and the date updated to reflect the current status.

A-2. General Content. The standardized format and content herein include chapter titles, topics, subtopics, and pertinent data applicable to many types of projects requiring manuals. The chapter titles must always be used, regardless of scope, while a limited amount of flexibility may be employed in the selection of topics and subtopics. The format and content as presented in this ER are intended for individual water control manuals and “master” water control manuals for Type IV projects (reservoirs, lakes, major diversion structures, pumping stations, and floodways) or Type III projects (reregulating structures, locks and dams, and completely uncontrolled projects) that are part of a water resource system (Reference 4f). The primary reason for preparing a separate manual or an appendix to a master manual for a water management project is to facilitate the use of specific information such as instructions, plates, tables, diagrams, and charts.

A-3. Editorial Guidance. The following editorial guidance should be used in the preparation of manuals:

- a. Use of the term "water control regulation" should be restricted to either: (1) water control management procedures and decisions that normally are made by regulating engineers (hydrologic or hydraulic, preferably licensed or supervised by licensed), or (2) legal rules or other guidance (e.g., References 4a-f).
- b. Use of the term "operation" should be restricted to physical manipulation of spillway gates, outlet works, or other structural features and instrumentation associated with that are part of the projects.
- c. Use of the term "project operator(s)" refers to the individual (or individuals) who have the responsibility for the physical "operation" of the project. The project operator is also known as the “damtender”.
- d. Tables that are one page or less in size will be dispersed throughout the text. To facilitate reading the text, tables longer than one page should normally be included in a section following Chapter 9, before the Exhibits. Although these tables are located separately, the numbering system should be the same as for tables dispersed through the text (i.e., 2-3, 2-4).
- e. Number pages by chapter so that future revisions will not affect page numbers of other chapters. For example, pages in Chapter 2 would be numbered 2-1, 2-2, 2-3, etc.
- f. Plate and table numbers should correspond to chapter numbers where first referenced. Example: Plate 1-1, 1-2, 1-3, 2-1, 2-2, etc.

- g. Title block on plates should be readily readable when the manual is opened, with the preferred location in the lower right-hand corner.
- h. Scales used on plates should be divided into units of 1, 2, 5, or multiples of 10 per inch. The scale selected should be easy to read and usable for actual water management decisions.
- i. Numbering and updating manuals: Use sequential numbering or an alternative method of tracking version control of manual updates.
- j. Revised pages should be dated to show revision date. Revised pages should be noted to highlight only those pages where content has changed. When inserting revised pages that exceed original content, supplement numbering using an alpha-numeric system such as 2-3a and 2-3b to replace the original page 2-3. The remainder of text will not be noted as revised.
- k. Vertical Datum Reference: All new and revised water management documentation should follow the vertical datum policy in ER 1110-2-8160, Policies for Referencing Project Elevation Grades to Nationwide Vertical Datum. Consistent datum must be used throughout the water control manual and be clearly identified.
- l. English units will be used throughout the water control manual. Metric equivalencies may be provided for clarification when deemed appropriate.
- m. Based on the guidance in ER 1110-2-240 (Reference 4a), digital copies of the manual should be furnished to Division and/or Headquarters, U.S. Army Corps of Engineers. Manuals will be posted to a central repository for internal and external use. The Water Control Manual at the central repository will be considered the official manual and will be kept current at all times.

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A-4. Organizational Structure of Individual Water Control Manuals. The primary content and structure must be consistent for all water control manuals. The following organizational structure provides chapter titles and order within the document for an individual project.

U.S. Army Corps of Engineers (District/Division Name)	
(Date of Issue or Revision)	
Table of Contents	
	<u>Page</u>
Title Page (See Section A-5)	i
Photograph (See Section A-6)	ii
Record of Changes (See Section A-7)	iii
Notice to Users of This Manual (See Section A-8)	iii
Table of Contents (See Section A-9)	iv
Unit Conversions (Addressing vertical datum and metric equivalency)	v
Definitions and Common Terminology	vi
Pertinent Data (See Section A-10)	vii
Text of Manual (Starts with Chapter 1-9, followed by Tables, Exhibits, Plates and Supplementary Pertinent Data: See Sections A-11 through A-24)	1-1

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	1—INTRODUCTION (See Section A-11)	
1-01	Authorization for Manual	1-1
1-02	Purpose and Scope	1-1
1-03	Related Manuals and Reports	1-1
1-04	Project Owner	1-1
1-05	Operating Agency	1-1
1-06	Regulating Agency	1-1
1-07	Vertical Datum	1-1
	2—DESCRIPTION OF PROJECT (See Section A-12)	
2-01	Location	2-1
2-02	Purpose	2-1
2-03	Physical Components	2-1
2-04	Related Control Facilities	2-1
2-05	Real Estate Acquisition	2-1
2-06	Public Facilities	2-2

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	3— HISTORY OF PROJECT (See Section A-13)	
3-01	Authorization for Project	3-1
3-02	Planning and Design	3-1
3-03	Construction	3-1
3-04	Related Projects	3-1
3-05	Dam Safety History/Issues (Only Include in Manual Updates)	3-1
3-06	Principal Regulation Issues	3-1
3-07	Modifications to Regulations	3-1
	4—WATERSHED CHARACTERISTICS (See Section A-14)	
4-01	General Characteristics	4-1
4-02	Topography	4-1
4-03	Geology and Soils	4-1
4-04	Sediment	4-1
4-05	Climate	4-1
4-06	Storms and Floods	4-1
4-07	Runoff Characteristics	4-1
4-08	Water Quality	4-1
4-09	Channel and Floodway Characteristics	4-1
4-10	Upstream Structures	4-1
4-11	Downstream Structures	4-1
4-12	Economic Data	4-1
	Population	4-2
	Agriculture	4-2
	Industry	4-2
	Flood Damages	4-2
	5—DATA COLLECTION AND COMMUNICATION NETWORKS (See Section A-15)	
5-01	Hydrometeorologic Stations	5-1
	Facilities	5-1
	Reporting	5-1
	Maintenance	5-1
5-02	Water Quality Stations	5-1
	Facilities	5-1
	Reporting	5-1
	Maintenance	5-1
5-03	Sediment Stations	5-1

<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	Facilities	5-1
	Reporting	5-1
	Maintenance	5-1
5-04	Recording Hydrologic Data	5-1
5-05	Communication Network	5-2
5-06	Communication with Project Between Regulating Office and Project Office	5-2
	Between Regulating/Project Office and Others	5-2
5-07	Project Reporting Instructions	5-2
5-08	Warnings	5-2
	6— HYDROLOGIC FORECASTS (See Section A-16)	
6-01	General	6-1
	Role of USACE	6-1
	Role of Other Agencies	6-1
6-02	Flood Condition Forecasts	6-1
	Requirements	6-1
	Methods	6-1
6-03	Conservation Purpose Forecasts	6-2
	Requirements	6-2
	Methods	6-2
6-04	Long-Range Forecasts	6-2
	Requirements	6-2
	Methods	6-2
6-05	Drought Forecast	6-2
	Requirements	6-2
	Methods	6-2
6-06	Water Quality Forecasting	6-3
	Requirements	6-3
	Methods	6-3
	7—WATER CONTROL PLAN (See Section A-17)	
7-01	General Objectives	7-1
7-02	Constraints	7-1
7-03	Overall Plan for Water Control Management	7-1
7-04	Standing Instructions to Project Operator	7-1
7-05	Flood Risk Management	7-1
7-06	Recreation	7-2
7-07	Water Quality	7-2



<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
7-08	Fish and Wildlife	7-2
7-09	Water Conservation/Water Supply	7-2
7-10	Hydroelectric Power	7-3
7-11	Navigation	7-3
7-12	Drought Contingency Plans	7-3
7-13	Flood Emergency Action Plans	7-3
7-14	Other	7-3
7-15	Deviation from Normal Regulation	7-4
7-16	Rate of Release Change	7-4
8— EFFECT OF WATER CONTROL PLAN (See Section A-18)		
8-01	General	8-1
8-02	Flood Risk Management	8-1
	Spillway Design Flood	8-1
	Inflow Design Flood	8-1
	Reservoir Design Flood	8-1
	Other Floods (Threshold Flood, SPF, etc.)	8-1
8-03	Recreation	8-2
8-04	Water Quality	8-2
8-05	Fish and Wildlife	8-2
8-06	Water Conservation/Water Supply	8-2
8-07	Hydroelectric Power	8-2
8-08	Navigation	8-2
8-09	Drought Contingency Plans	8-3
8-10	Flood Emergency Action Plans	8-3
8-11	Frequencies	8-3
	Peak Inflow Probability	8-3
	Pool Elevation Duration and Frequency	8-3
	Key Control Points	8-3
8-12	Other Studies	
	Examples of Regulation	8-3
	Channel and Floodway Improvement	8-3
	Miscellaneous Studies	8-3
9— WATER CONTROL MANAGEMENT (See Section A-19)		
9-01	Responsibilities and Organization	9-1
	USACE	9-1
	Other Federal Agencies	9-1
	State, County and Local Agencies	9-1

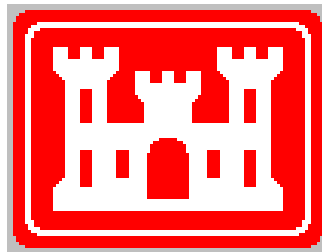
<u>Paragraph</u>	<u>Title</u>	<u>Page</u>
	Private Organizations	9-1
9-02	Interagency Coordination	9-2
	Local press and USACE Bulletins	9-2
	National Weather Service	9-2
	U.S. Geological Survey	9-2
	Power Marketing Agency	9-2
	Other Federal, State, or Local Agencies	9-2
9-03	Interagency Agreements	9-2
9-04	Commissions, River Authorities, Compacts, and Committees	9-2
9-05	Non-Federal Hydropower	9-2
9-06	Reports	9-2
NOTE	Additional subparagraphs or appendices may be included in Chapter 9 or following Chapter 9 to adequately define or clarify each section.	
TABLES	See Section A-20 (All tables longer than one page)	T-1
EXHIBITS	(See Section A-21)	E-1
	Supplementary Pertinent Data (See Section A-22)	E-1
	Formal Agreements	E-2
	Standing Instructions to Project Operator (See Section A-23)	E-3
PLATES	(See Section A-24)	P-1

A-5. Sample Title Page.

**WATER CONTROL MANUAL**

**PROJECT NAME LAKE**

**Project River Basin**



**U.S. ARMY CORPS OF ENGINEERS**  
**APPROPRIATE DISTRICT/DIVISION**  
**CITY, STATE**

**NOTE: MSC should also be noted when appropriate. For Section 7 Projects:  
Owner should be included on cover sheet.**

**7 July 2015**

**DISTRIBUTION STATEMENT B: Distribution authorized to U.S. Government agencies only due to the sensitivity of reservoir regulation plans, 5 December 2012. Non-U.S. Government agency requests shall be referred to the U.S. Army Corps of Engineers, Appropriate District/Division, Chief of Water Management, Address of District/Division Office.**

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A-6. Photograph.

a. Include a choice photograph of the dam and reservoir or a composite of photos on one page showing spillways, outlet works, energy dissipators, exit channels, power facilities, overflow embankments, fuse plugs, and other pertinent control structures.

b. If additional photographs are desired, include on separate pages.

A-7. Record of Changes. All changes to the water control manual must be documented in a consistent manner. A brief narrative description of significant changes will be included in the front section of the publication identifying if this is a complete update or which components of the manual were changed and date of revisions. Pages within manual will also indicate revision information.

A-8. Notice to Users of This Manual. A notice should be located on the page following the photograph as shown in the following example:

NOTICE TO USERS OF THIS MANUAL

Regulations specify that this Water Control Manual be published in digital form in the central repository located at the following link:

<https://maps.crrel.usace.army.mil/apex/f?p=875>

The Water Control Manual at the central repository will be considered the official manual and will be kept current at all times. Instructions and information to upload or document the review status of the Water Control Manual, as per ER 1110-2-240, in the central repository portal can be found under the help tab in the portal.

It is not unexpected that USACE Corporate Information may move the central repository link to a new location. This information will be shared with all offices if a situation occurs by the HQUSACE.

REGULATION ASSISTANCE PROCEDURES

In the event that unusual conditions arise during non-duty hours, communication can be achieved by contacting appropriate water management personnel (provide a telephone and email listing including both office and mobile cell phone numbers). Supplemental communication plans may be referenced or included in appendices.

A-9. Table of Contents.

a. Table of Contents should follow the regulation assistance procedures. A sample of the minimum required content is included in Section A-4.

b. The table of contents should be followed by a list of all unit conversions that address vertical datum and metric equivalency. If necessary, it may be appropriate to provide a simple graphic depicting datum relationships.

c. The list of unit conversions should be followed by a list of definitions and common terminology used in the manual.

A-10. Pertinent Data. The pertinent data shown here should be limited to approximately one page with additional information relating to water management tabulated in Supplementary Pertinent Data, Exhibit A. The information presented in this section of the manual should include the following information: (specific guidance to be provided by Division).

a. Location (state, county, river, and river mile).

b. Drainage area above the dam site and the uncontrolled areas above any major control points downstream; 1 inch of runoff = “\_\_\_” or “X” acre-feet.

c. Type, length, height, top width of dam, dikes, and tidal barriers; type and size of all discharge facilities; spillway, outlet works, water supply pipes, penstocks, and locks.

d. Government-owned land and easements.

e. Pertinent elevations with corresponding reservoir areas, incremental and cumulative storage and discharge capacities of spillway and outlet works for maximum pool, top induced surcharge, top flood control pool, top conservation pool, top inactive pool, invert lowest intake, and streambed. Also indicate the volumes of sediment reserve, dead storage, and the range of any seasonal joint use or comingled storage reservations, when applicable. All documentation should follow the vertical datum policy in ER 1110-2-8160, Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums. Consistent datum must be used throughout the water control manual and be clearly identified.

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A-11. Guide for Narrative Development; Chapter 1—Introduction.

CHAPTER 1

Introduction

1-01. Authorization for Manual. Cite applicable policies, regulations or laws regarding preparation of manual such as ER 1110-2-240, 33 CFR 208.11 and 33 CFR 222.5 and where applicable Section 7 of the Flood Control Act of 1944 (33 U.S.C. 709).

1-02. Purpose and Scope. Include brief discussion of purpose and scope of manual (use language in ER 1110-2-240). Refer to guidance in EM 1110-2-3600 and this ER on scope and content.

1-03. Related Manuals and Reports. Discuss master manual and other project manuals in same system; list of prior reports pertinent to project such as design memorandums, master plans, and emergency plans. History of approval documentation may be inserted in this section or maintained under separate documents management system.

1-04. Project Owner. Name of agency.

1-05. Operating Agency. Note whether dam is attended continuously or part-time (specify period of attendance); damtender living nearby, name, office phone, damtender also operating other structures (reregulation, diversion, other) by remote control/manually; a non-USACE owned project with physical operation and maintenance officially performed by USACE.

1-06. Regulating Agencies. Discuss USACE direct and indirect responsibility for various project purposes including hydrologic forecasts; cite authority of USACE (owner, Section 7 Regulation, through FERC, non-USACE project with regulation officially performed by USACE, other); phone and address of regulating office if non-USACE (see Chapter 7 for details).

1-07 Vertical Datum. Describe what datum was used for the design and construction of the project (sometimes NGVD29, many times a "local" or "local project" datum). ER 1110-2-8160, *Policies for Referencing Project Elevation Grades to Nationwide Vertical Datums*, provides specific datum requirements. If something other than NAVD88 (current standard) is being used as the datum, a table should be included that associates the local datum to NAVD88.

A-12. Guide for Narrative Development; Chapter 2— Description of Project.

CHAPTER 2

Description of Project

2-01. Location. Stream, river mile, latitude/longitude at center of dam, basin, state, county, nearby community.

2-02. Purpose. Concise paragraph stating (not explaining) authorized purposes and incidental benefits.

a. Those assigned by Congress initially in the legislation authorizing the project construction.

b. Those subsequently assigned by Congress in law(s) specific to the project.

c. Those contained in or derived from general Congressional acts applicable to Corps reservoirs, which are implemented consistent with the specifically authorized project purposes, including where applicable:

(1) Section 4 of the Flood Control Act of 1944, as amended (16 U.S.C. 460d) and the Federal Water Project Recreation Act of 1965, as amended (16 U.S.C. 460l-12 *et seq.*) (recreation, fish, and wildlife);

(2) Fish and Wildlife Coordination Act of 1958, as amended (16 U.S.C. 661 *et seq.*);

(3) Water Supply Act of 1958, as amended (43 U.S.C. 390b);

(4) Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*); and

(5) Sections 1116, 1117, and 1118 of the Water Resources Act of 2016 (Title I of P.L. 114-322) (water supply conservation).

d. Incidental benefits—those which accrue to any purpose other than an authorized purpose incidentally to the management for the authorized purposes.

2-03. Physical Components. Describe components—structural in general, hydraulic in particular—including operating machinery. Show subparagraphs for embankment, dikes, barriers, spillway, outlet works, hydroelectric power facilities, water supply facilities, etc. Discuss multilevel outlets for water quality control.

2-04. Related Control Facilities. Describe integrated components of subject project (e.g., re-regulation, diversion, pumpback, local protection, or other structures).

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2-05. Real Estate Acquisition. Describe fee and easement holdings in reservoir area, downstream channels, etc. Show backwater curves (profiles), if appropriate.

2-06. Public Facilities. Include number and type of public use sites; contour map showing location of sites, especially campsites, islands, and trailer parks upstream and downstream of damsite (see Chapter 5 for flood warning facilities). If the list is considered too extensive for inclusion in main body of the manual, it can be included in an appendix or supplemental pertinent data section of the manual.



A-13. Guide for Narrative Development; Chapter 3—History of Project.

CHAPTER 3

History of Project

3-01. Authorization for Project. Cite Congressional legislation applicable to project formulation (i.e., Flood Control Act, House Document, Public Laws, etc.) (project document).

3-02. Planning and Design. Provide a brief history of planning and design.

3-03. Construction. Provide significant dates such as start of construction, diversion, deliberate impoundment, filling of conservation, and start of hydropower generation (may be shown in a table). Discussion should also include dates of significant structural modifications that affect reservoir operations.

3-04. Related Projects. Describe other projects (USACE and non-USACE) in same system that affect water control objectives. Clearly identify ownerships and name changes over time.

3-05. Dam Safety History/Issues. Updates to Water Control Manuals should include a brief summary of the dam safety history of the project including any outstanding concerns and Interim Risk Reduction Measures (IRRM) that have been implemented. A diagram and/or table describing the modeling assumptions and critical storage and discharge for various flood loading scenarios such as normal high pool, normal low pool, should be provided in this section or in supplementary pertinent data.

3-06. Principal Regulation Issues. Describe problems associated with regulation since project completion such as: erosion, boils, severe leakage, embankment overtopping or failure, structural hydraulic malfunction, ground water table, flooding, non-damaging channel capacity (examples), and encroachment. (Some of this information can probably be presented in tabular form.) Provide plate showing area of encroachment or channel deterioration. Possibly add a statement associated with changes in regulation associated with societal issues, such as unapproved encroachment within the flood zone.

3-07. Modifications to Regulations. Provide a brief history of changes to the water control plan due to change in needs and conditions since project formulation.

A-14. Guide for Narrative Development; Chapter 4—Watershed Characteristics.

CHAPTER 4

Watershed Characteristics

- 4-01. General Characteristics. Include total and contributing drainage area: slope, shape, elevation range, vegetation, tributaries, and possible damage centers caused by high pool or backwater.
- 4-02. Topography. Provide a description of the basin's general topography and how it influences the runoff behavior.
- 4-03. Geology and Soils. Provide a description of the basin's general geology and soils and how it influences the runoff behavior and performance of the project.
- 4-04. Sediment. Discuss erosion and sediment production in watershed. Need to include sediment aggradation in reservoir reducing storage, aggradation in headwaters impacting purposes such as water supply intakes and/or recreation, as well as sediment degradation below project if it is affecting the outlet structures, such as the spillway slab.
- 4-05. Climate. Provide a general description of climate over the watershed. Use tables to show extreme and average values by month. Show watershed average or representative stations. Include paragraphs on temperature, precipitation, snow, evaporation, and wind. To assess the effects of observed and projected climate change, a qualitative assessment of hydrologic trends including variability and potential non-stationarities would be appropriate. Basin-wide planning should be formulated with considerations of future climate change impacts.
- 4-06. Storms and Floods. Describe types of storms and floods (thunderstorms, hurricanes, etc.), time of year, major floods of record, and damages (limit to a few major floods; in most cases, no more than top 10 floods of record).
- 4-07. Runoff Characteristics. Describe runoff related to mountain and plains snow, antecedent rain, initial losses, time of concentration, monthly and annual streamflow distribution at key points, graphical display of record, seasonal variations, low flow, high flow, and tabulation of monthly and annual inflow volume at project for period of record (also monthly inflow frequency curves or tables).
- 4-08. Water Quality. Provide a description of water quality characteristics of the watershed and effects on management of the reservoir. Describe the effects of agriculture and industry in the basin on water quality of the reservoir.
- 4-09. Channel and Floodway Characteristics. Address channel and floodway characteristics downstream including: shape, condition, capacity, improvements, stability, tributaries,

encroachments, alignment, water surface profiles, also description of damage centers and key control points, time of water travel (show graphically on plate or tabular form), overbank, dikes, levees, control structures, and discharge rating curves for key stations.

4-10. Upstream Structures. Describe any upstream structures including drainage area and regulation responsible parties. A map of structure location is desirable.

4-11. Downstream Structures. Describe any downstream structures including drainage area and regulation responsible parties. A map of structure location is desirable.

4-12. Economic Data. Provide available economic data for watershed; may be tabular with brief descriptions.

- a. Population. Include population data for counties and major towns in watershed.
- b. Agriculture. Provide brief description of agriculture in watershed and valley below the project, value, and types of agricultural products.
- c. Industry. Provide description and value of industrial activity in watershed and valley below project.
- d. Flood Damages. Include average annual damages incurred and prevented, stage-damage curves for downstream reaches which are affected by this project (reaches affected by several projects should be shown in master manual). Curves would show stage versus structural damage and stage versus acres flooded. The basis for the estimated damages should be clearly identified.

A-15. Guide for Narrative Development; Chapter 5—Data Collection and Communications Network

CHAPTER 5

Data Collection and Communication Networks

5-01. Hydrometeorological Stations.

a. Facilities. Show locations of facilities on a single map or maps as needed and provide Corps Water Management System (CWMS) identification, NESDIS identification and latitude/longitude, include U.S. Geological Survey (USGS) or National Weather Service (NWS) or other agency station numbers, types of stations (reporting, staff gauge, satellite, etc.), inflow, outflow, water level, precipitation, ground water, evaporation, snowpack, designate key stations, automated/manual status, automatic data processing compatibility, general adequacy of hydrometeorologic information available on a real time basis, reliability, and reference chapters regarding hydrologic forecasting, and management. Links to applicable USGS, NWS and other appropriate agencies websites for gage data, radar data, QPF, etc. should be provided.

b. Reporting. Describe stations reporting directly to office including reporting criteria, method, how reports from other stations are obtained, measurements, summary of activities during normal day-to-day and flood emergencies, reference instructions to project operator in back of manual, hydrologic/meteorologic measurements, and reporting. Data transmitted to USGS, NWS, national water management data dissemination and/or other agency websites should be noted along with description of automated or manual reporting procedures. If project morning reports are available, an example should be provided in this section.

c. Maintenance. Describe maintenance arrangements: who to contact for repair, etc.

5-02. Water Quality Stations.

a. Facilities. Describe location, number, and type of stations. Locations should be included on map discussed in Section 5-01.a.

b. Reporting. Same type of information as in paragraph 5-01.b.

c. Maintenance. Same type of information as in paragraph 5-01.c.

5-03. Sediment Stations.

a. Facilities. Describe location, number, and type of stations. Locations should be included on map discussed in Section 5-01.a.

b. Reporting. Same type of information as in paragraph 5-01.b.

c. Maintenance. Same type of information as in paragraph 5-01.c.

5-04. Recording Hydrologic Data. Hydrologic data is collected and processed on the district's Water Management System. The collected and processed data is stored in the district's CWMS database. The CWMS database then serves as the district's data repository of both real-time and historical data for this project. The real-time data is used in assessing the hydrometeorologic conditions of the project's watershed as well as to run forecasts and decision support models used by the water managers to assist in the daily regulation of project releases.

5-05. Communication Network. Provide physical description of main and secondary voice and data networks, showing diagram of network standby facilities and reliability. Discuss general status, type, and adequacy of data transmission, emergency warning and remote control, time of interrogation, emergency standby, and reliability. The description should include a graphic depiction and details of the Continuity of Operations Plan in the event primary system is not available. Information regarding the communication network should be obtained and coordinated with appropriate IT community, such as ACE-IT.

5-06. Communication with Project.

a. Between Regulating Office and Project Office. Describe direct or indirect mode of communication for normal day-to-day operation, flood warning, emergency regulation, supporting all project purposes and other releases; (reference Management, Chapter 9, and exhibit on Standing Instructions to Damtender). Chart showing direct and indirect lines of communication is recommended.

b. Between Regulating/Project Office and Others. List areas requiring flood warning, type of warning facilities, recreation areas, campsites (upstream/downstream), floodway/plain encroachment, remote control or re-regulation, diversion, and related structures of another agency. Identify responsible parties to address these requirements.

5-07. Project Reporting Instructions. Provide instructions for reporting hydrologic data, items affecting release of water, confirmation of change in releases as instructed, complaints, operating machinery failure, or out-of-service times for maintenance.

5-08. Warnings. Describe responsibility for issuing various types of warnings associated with high/low discharges and high/low pool levels. Operational procedures, phone numbers, locations, etc. should be shown in a table. Include instructions for providing warnings of discharge changes.

A-16. Guide for Narrative Development; Chapter 6— Hydrologic Forecasts.

CHAPTER 6

Hydrologic Forecasts

6-01. General. Discuss streamflow, reservoir level, and water quality prediction or forecasting.

a. Role of USACE. Discuss direct/indirect responsibility, prediction capability, role of District/Division Office, role of project operator (damtender), and cooperation with NWS regarding forecasting. Clarify whether USACE has any official responsibility to provide forecasts to the public or non-federal agencies versus making internal forecasts for operational decision making. Recognizing that NWS has official responsibility to provide forecasts to the public, USACE project releases may directly impact stream forecasts and it is appropriate in some cases for USACE to issue forecasts for consideration by other agencies.

b. Role of Other Agencies. Discuss responsibility of other agencies including prediction capability and any short-range or long-range assistance by USACE (also see paragraph 9-02).

6-02. Flood Condition Forecasts.

a. Requirements. Discuss time required to compute flow hydrograph, time increment of forecast ordinates, key hydrologic and control point stations, use of data in general, interpretation of flood risk management diagrams, long-term inflow forecasts from both plains and mountain snowpack, consideration of uncontrolled runoff toward target flow at control stations, and target storage levels in the reservoir.

b. Methods. Discuss methods and procedures of hydrologic forecasting, use of meteorologic and hydrologic data, snowmelt modeling, upstream/downstream flow, unit hydrograph, Antecedent Precipitation Index (API), stage-discharge relations, nomographs, rainfall-runoff relations, computer applications, relationship with NWS regarding forecasting (include sample of forecast), and sample of computer application program and how to access. Describe use of Corps Water Management System (CWMS) Automated Information System (AIS) running on the Water Management Enterprise System (WMES) including hardware, software, suite of models and communication resources that supports the District/Division real-time water control mission (Reference 4a). Describe use of CWMS for operational decision making by providing the capability to simulate different forecast scenarios and evaluate impacts on authorized project purposes.

6-03. Conservation Purpose Forecasts.

a. Requirements. Describe applicable conservation forecasts supporting hourly/daily/weekly hydropower, mosquito control, fish spawning, special recreation events, water

supply/quality needs, support for groundwater recharge, water temperature, dissolved oxygen, and other needs.

b. Methods. Describe applicable methods and procedures for non-flood streamflow synthesis, snowmelt modeling, water release temperature or dissolved oxygen, use of meteorological and hydrologic data, computer applications, repetitive period for predicting, and sample of computer application program and how to access. Discuss use of CWMS for operational decision making by providing the capability to simulate different forecast scenarios and evaluate impacts on authorized purposes.

#### 6-04. Long-Range Forecasts.

a. Requirements. Discuss long-range streamflow synthesis, joint use or seasonal flood risk management/conservation storage utilization and reservation, snowpack, runoff and irrigation requirements. Information associated with release scheduling, pool level predictions for recreation, ecological conditions, monthly/seasonal hydropower scheduling, reservoir turnover, nesting grounds, fishing, water supply/quality needs, support for groundwater recharge, drought conditions regarding water rights, navigation interest, and low flow conditions should be included.

b. Methods. Describe methods and procedures for both flood risk management and conservation, seasonal outlook/forecast, use of historical climatological data, snowpack surveys, repetitive period for predicting, use of hydrologic data, reliability of predictions, consideration of uncontrolled runoff in target flow at control point, computer applications. Discuss use of CWMS operational decision making by providing the capability to simulate different forecast scenarios and evaluate impacts on authorized purposes.

#### 6-05. Drought Forecast.

a. Requirements. Similar to information required in paragraph 6-04a. Planning should rely on the best available and actionable scientific information about observed and expected hydrologic changes that impact drought.

b. Methods. Similar to information needed in paragraph 6-04.b. Strategies should be formulated with consideration of both severity and duration of future potential droughts. A qualitative assessment of hydrologic trends including variability and potential non-stationarities should be considered as a minimum. Refer to Civil Works Technical Report CWTS 2015-11, Recent U.S. Climate Change and Hydrology Literature Applicable to U.S. Army Corps of Engineers Missions—Water Resources Region 13, Rio Grande; and Civil Works Technical Report CWTS 2015-15, USACE Drought Contingency Planning in the Context of Climate Change; and Reference 4c for guidance regarding methodology and content.

#### 6-06. Water Quality Forecasting.

a. Requirements. Water quality forecasting should rely on the best available information such as observed and expected meteorologic, hydrologic, and water quality conditions. Discuss water quality considerations as it relates to all water control management decisions. This includes reference to such documents as Water Quality Management Plans, water control plans, and basin master manuals. Discuss how water quality considerations and/or objectives relate to operational considerations for flood risk management, drought, and conservation seasons. Describe how the water quality monitoring and data evaluation programs inform meeting water quality objectives, evaluate performance, enable understanding and associated trends, and are used in water quality computer modeling.

b. Methods. Describe methods and procedures for water quality forecasting for operations that are utilized during flood risk management, conservation, and drought seasons. This includes the integration of other model output for use as input in water quality computer models. This could include hydrologic, hydraulic, and reservoir forecasts produced by a CWMS implementation for the watershed. Discuss the use of water quality methods and models used to forecast water quality in the upper watershed, reservoirs, and riverine environment. Discuss the use of models in operational decision making by providing the capability to simulate different operational scenarios and evaluate impacts on water quality objectives and other authorized purposes.



A-17. Guide for Narrative Development; Chapter 7—Water Control Plan.

CHAPTER 7

Water Control Plan

7-01. General Objectives. Describe overall objectives and in general terms how the water control plan meets purposes as stated in paragraph 2-02. A primary objective of this section is to describe how the project is regulated under normal conditions, “Normal Regulation.” Normal describes project regulations necessary for routine integration of the purposes described in 2-02 under non-flood, non-drought, and all other non-emergencies. The principle of normal regulation is to create a reference condition from which approved deviations are implemented. Definition of normal regulation must be a collaborative effort between the regulating district and its approving MSC. Normal regulation that has regulating criteria too narrowly defined will induce an excessive amount of deviations. Alternatively, a normal regulation that has few or broad regulating criteria may result in an operation that does not maximize project benefits.

7-02. Constraints. Describe physical constraints including uncorrected malfunctions, gate change limitations, structural and hydraulic design limitations, discharge constraints associated with inoperative gates, low pool level intake and water supply outlet limitations, reservoir area limitations associated with high pool levels such as backwater into upstream structures, leaks in levees, embankment boils, and required movement of facilities. Discuss constraints associated with legal, political, social, and major conflicts between purposes and reference master manual for description of system constraints.

7-03. Overall Plan for Water Control Management. In general terms, discuss consideration and treatment of coordinated system regulation among purposes and with other projects; compatibility among purposes, examples of comprehensive regulation for flood risk management/conservation; storage yield limitations, (see following paragraphs in this chapter for details).

7-04. Standing Instructions to Project Operator (Damtender). Documentation in this section should reference exhibit, which is included in back of manual. These instructions describe regulations during normal conditions, during communication outage, and unforeseen emergency events when communications with the regulating office are interrupted. Instructions should pertain to part or all of the following aspects: conservation regulation, normal flood regulation, emergency regulation; instructions during loss of communication for flood and non-flood conditions; public flood warning; data collection; and reporting of data and regulation. As an example, special instructions should be provided regarding operations with threat to life immediately downstream of the dam and operations, supporting the recovery of a body from a drowning incident when applicable (See Section A-23, Sample Content of Standing Instructions to Project Operators).

7-05. Flood Risk Management. This section should provide discussion of normal and emergency regulations including detailed explanation of release scheduling procedures during flood emergency, modelling requirements, role of Corps Water Control Management, relative emphasis upon controlling peak outflow or pool level and backwater, use of seasonal or joint use storage, regulation with respect to storage zones including surcharge, use of streamflow predictions, forecasting total flow downstream, reference exhibits—Spillway Design Flood (SDF), SPF, maximum flood of record, other—and any special concerns for safety. In particular, a release schedule or water control diagram (should be table or plate, see EM 1110-2-3600) must be provided; for Section 7 projects (non-USACE owned) the schedule or diagram will be approved/signed by Division commanders (or their designees) and the project owner. A complete discussion of the decision process used to determine gate openings should be included along with discussion of constraints, such as upstream/downstream encroachments, storage limitations (lack of, surcharge only, joint use, seasonal), inadequate warning facilities, non-damaging channel capacity, low-water crossings, weak channel banks, physical discharge capability, and integrated regulations with other project/purposes.

7-06. Recreation. Discussion should include information regarding any operational objectives for recreation special releases for whitewater boat racing, canoe racing, and other. Constraints on recreation releases associated with droughts, floods, long-term/frequent inundation, rapid pool rise, pool fluctuation for hydropower, muddy banks, bank erosion, high turbidity, planned seasonal fluctuations, high-velocity downstream, and prolonged flood releases should be addressed in the discussion.

7-07. Water Quality. Discussion should include the water quality role of USACE, if any, derived from the project's existing statutory authorities and appropriations. Unless specifically authorized by Congress for a particular project, USACE is not responsible for treating or otherwise abating water pollution problems caused by other parties where those parties have, or are likely to have, a legal responsibility for remediation or other regulatory or compliance responsibility. This section can describe any short-term release scheduling, long-range release planning, multilevel releasing, and regulation undertaken within existing project authorities and appropriations to meet a project's statutory project purposes. Information should be included on any specific regulation activities or techniques that are to be carried on continuously or periodically to meet any particular federal objective stated in a legally actionable document by an outside federal resource agency, such as in a Biological Opinion produced by the U.S. Fish and Wildlife Service.

7-08. Fish and Wildlife. The Water Control Plan should address accomplishment of fish and wildlife objectives by re-regulation for other purposes, fluctuation of pool level for spawning or waterfowl, temperature control, cold water fishery, and multilevel releasing. Constraints, such as lack of allocated storage, conflict with other project purposes, flood/drought operations, undesirable water quality, single-level intake and water rights should be included in the discussion. Identify any Biological Opinions that exist or are in force that may introduce regulation constraints or implementation impacts.

7-09. Water Conservation/Water Supply. Discussion should include any operations supporting water supply and water conservation efforts, including groundwater recharge, operational releases to stream or withdrawal from reservoir for municipal/industrial/irrigation usage. Water supply agreements should be referenced, along with discussion of low flow requirements, fish and wildlife, water rights, storage space and yield, role of USACE, short-term release scheduling, long-range release planning, storage utilization. If applicable, an accounting method for storage and water use for multiple uses of conservation storage should be identified with examples of regulation exhibits.

7-10. Hydroelectric Power. Hydropower considerations (federal and non-federal), such as installed capacity, peaking, load factor, plant factor, minimum requirements for generation, contracts for primary and secondary energy, and restrictions during flood periods should be discussed in this section. The role of Corps, short-term generation (hourly, daily, weekly), long-range scheduling, typical hourly/daily/ weekly/monthly/seasonal or annual generation schedule, signed agreements with non-federal hydropower developers at USACE projects, use of synthesized streamflow, snowpack surveys, pumpback operation, coordination with re-regulation structure, and utilization of storage/pondage are topics which should be addressed. Constraints to hydropower operations, such as overload limitation, storage, inflow, flood releases, tailwater conditions, ice jams, head limitation on pool, release fluctuation, absence of re-regulation structure, coordination with downstream re-regulation, conflict with navigation, pumpback rate, and water quality (temperature, oxygen) regulation with other projects are topics that should be included in the discussion.

7-11. Navigation. Regulation in support of navigation should include discussion of release fluctuation and scheduling, lock filling and emptying procedure, aids to navigation and constraints to accomplishing this project purpose, such as releases for other purposes, critical high/low flow rates, sediment, dredging, lock size, lack of storage allocation for navigation releases, and integrated regulation with other projects.

7-12. Drought Contingency Plans. Development of a Drought Contingency Plan (DCP) is required as per ER 1110-2-1941 (Reference 4c). The plan is an integral part of the WCM and will be included in the WCM. The DCP may be included in this section or a brief summary provided in this section of the manual with details in the appendices.

7-13. Flood Emergency Action Plans. Descriptions, completion dates, and physical location of plans (can be attached as an addendum to the manual or be a stand-alone document) if properly referenced in manual. Emergency dewatering options should be included in the Flood Emergency Action Plan.

7-14. Other. Describe regulations associated with health and welfare, mosquito control, debris control, low flow, ice jams, special or emergency drawdown, upstream/downstream ground water table, releasing to aid construction upstream/downstream, toxic and hazardous spills, and other regulations as appropriate.

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7-15. Deviation from Normal Regulation. As stated in ER 1110-2-240 (Reference 4a), all water control manuals must contain provisions authorizing the operating agency to deviate from operations prescribed by the project's approved water control plan when necessary to alleviate critical situations or possibly to realize increased benefits during an operation season without significantly affecting the fulfillment of the project's authorized purposes. Deviations generally fall into three categories: Planned deviations, unplanned deviations, and emergency deviations. The deviation process as defined in ER 1110-2-240 (Reference 4a) and applicable MSC deviation regulations must be followed in all cases. The process should be described in this section along with any specific considerations associated with the subject project.

7-16. Rate of Release Change. Show the normal allowable rate of increase and decrease in releases.

A-18. Guide for Narrative Development; Chapter 8—Effect of Water Control Plan.

CHAPTER 8

Effect of Water Control Plan

8-01. General. Discuss the overall effects and benefits from the project. It should be noted that this chapter addresses the effects and benefits of the water control plan and should not restate the plan itself. Efforts should be made to minimize redundancy between Chapter 7 and Chapter 8.

8-02. Flood Risk Management.

a. Spillway Design Flood (SDF). Provide general description, routing, total volume, stored volume, peak inflow, duration, maximum discharge, and maximum pool for SDF (show plate).

b. Inflow Design Flood (IDF). Provide general description, routing, precipitation assumptions, total volume, stored volume, duration, maximum discharge, peak inflow, maximum pool, percent flood storage, or quantity surcharge storage utilized for IDF (show plate) as defined by ER 1110-8-2 (FR).

c. Reservoir Design Flood (RDF). RDF represents the maximum flood that the reservoir was originally designed to control under assumed conditions of operation. For new reservoirs the RDF would be the same as the IDF. For existing reservoirs where the IDF has been updated, the RDF may be different.

d. Other Floods. Describe threshold flood (the maximum flood that the reservoir can safely control under current conditions of operation), Standard Project Flood (SPF) and other floods pertinent to management of the project. Include general description, routing, total volume, stored volume, comparison with IDF, flood of record or RDF, peak inflow/outflow, maximum pool, and surcharge storage utilized. In cases where the original design hydrograph has been superseded, all hydrographs should be plotted on the same plate in the WCM, and a detailed description of what the different hydrographs represent (including the reasoning that supported the revision of the original hydrograph) should be included. Care must be taken to only include either the originally approved design elements or approved elements that have superseded the original design. Intermediate products, e.g., "cursory" updates that are not subject to an ATR, should not be included. Studies providing updates to Probable Maximum Precipitation (PMP) should also be included in this section.

8-03. Recreation. Discuss effects and benefits, both current and projected.

8-04. Water Quality. Discuss effects and benefits, both current and projected.

8-05. Fish and Wildlife. Discuss effects and benefits, both current and projected.

8-06. Water Conservation/Water Supply. Discuss effects and benefits, both current and

projected.

8-07. Hydroelectric Power. Discuss effects and benefits, both current and projected.

8-08. Navigation. Discuss effects and benefits, both current and projected.

8-09. Drought Contingency Plans. The Drought Contingency Plan will pre-determine a set of operational decisions or a framework of operational decisions to implement in times of drought, to ensure the continuity of operations and avoid the need for processing deviations.

8-10. Flood Emergency Action Plans. Discuss effects and benefits.

8-11. Frequencies.

a. Inflow Probability. Provide graph and table showing annual chance exceedance of peak inflow and inflow volumes for key durations.

b. Pool Elevation Duration and Frequency. Provide assessment of duration and frequency estimates above and below top of conservation pool; include graph with curves based on top of conservation pool as datum. Show one curve for frequency and one for duration extrapolated to represent IDF conditions. Provide a plot of pool elevation for period of record and a table of annual peak discharges.

c. Key Control Points. Provide stage/discharge curves, and frequency/duration curves (show bank-full, damage zones) for key control points in system.

8-12. Other Studies.

a. Examples of Regulation. Discuss studies used to develop and test regulation plan, yield analysis, criteria, data utilized, interpretations, integrated system regulation, new projects, seasonal storage investigations, hydrologic forecasting techniques, any model development, and other related studies.

b. Channel and Floodway Improvement. Include discussion of flood plain management studies and reports, encroachment, increase/decrease in channel capacity, (see Management, Chapter 9), and seasonal channel capacity. Reference and discuss sample regulation exhibit, integration with other projects, and other related studies.

c. Miscellaneous Studies. Specific studies addressing water quality, water quality monitoring, hydrologic, hydraulic design, climate change, sediment deposition, portfolio risk assessment, and cultural resources should be identified and brief discussion of content /results provided.

A-19. Guide for Narrative Development; Chapter 9—Water Control Management.

CHAPTER 9

Water Control Management

9-01. Responsibilities and Organization.

a. USACE. Describe responsibilities of owner/operator/regulator or combination thereof with respect to project operations/regulation; specify whether regulation responsibility is direct (day-to-day regulation), or indirect (interagency agreement, advisory capacity by request); differentiate between regulatory responsibility for various project purposes when applicable; role of USACE when responsibility is indirect for both regulation and hydrologic forecasts (advisory/assistance/consultant); organizational chart, brief explanation of operation and maintenance responsibility; reference instructions to project operator in back of this manual, interagency coordination activities (see paragraph 9-02 and also Communications, Chapter 5); and reporting to higher authority.

b. Other Federal Agencies. Provide explanation of responsibilities similar to paragraph 9-01.a, such as Bureau of Reclamation project but USACE indirectly/directly prescribes real-time flood risk management and/or navigation regulation; or USACE project but Bureau indirectly/directly prescribes regulation for irrigation. Those projects falling under Section 7 of the Flood Control Act of 1944 will be operated according to approved agreements and water control plans as described in ER 1110-10-240 and EM 1110-2-3600 (References 4a and 4f, respectively).

c. State, County, and Local Agencies. Furnish information similar to that comprised in paragraphs 9-01.a and b; serve in participating capacity through coordinated activities (see paragraph 9-02).

d. Private Organizations. Furnish information similar to that in paragraphs 9-01.a, b, and c; reservoirs containing hydropower/flood risk management storage; project requiring coordinated regulation with neighboring federal projects; flood risk management and/or navigation regulations prescribed by USACE; local flood risk reduction projects having regulatory outlets (detention storage, bypass channel, and others); regulation/operation is prescribed/ performed by USACE.

9-02. Interagency Coordination. Describe coordination with press, community leaders, and other federal, state, or local agencies concerning water control plan, flood fighting, special events, etc., as discussed in ER 1110-2-240 (Reference 4a).

a. Local Press and Corps Bulletins. Provide explanation of coordination with local press for releases of public interest regarding conservation and flood aspects, gate closure, navigation season, reservoir levels, and other. Include discussion of publication of news release bulletins

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regarding status of reservoirs concerning navigation, public use, agricultural harvesting, and flood emergency. USACE must avoid any conflict with NWS responsibilities for public notification as delegated by Congress.

b. National Weather Service. Describe coordination in data collection and providing forecasts of streamflow, precipitation, runoff, etc. (see paragraph 6-01), real-time and long-range forecasts, and exchange of data.

c. U.S. Geological Survey. Describe coordination in data collection, gauge maintenance, sampling programs, streamflow measurement, etc.

d. Power Marketing Agency. Describe release schedules for hydro-electric power generation, monthly meetings or power allocation, etc.

e. Other Federal, State, or Local Agencies. Describe coordination (routine or random) with Bureau of Reclamation, Environmental Protection Agency, State, private, and owners of non-Corps projects which directly affect Corps regulation.

9-03. Interagency Agreements. Discuss formulation or modification of interagency agreements such as Drought Contingency operations, Section 7 Regulations; power contracts, field working agreements, memorandums of understanding, and other (reference exhibit).

9-04. Commissions, River Authorities, Compacts, and Committees. Describe title and concise function of institutional group (officially established) who share interest in river basin water control activities; hydroelectric power marketing; seasonal outlook regarding water supply (municipal, industrial, irrigation); storage utilization in general; federal, state, or local participating agencies; and other.

9-05. Non-Federal Hydropower. Describe non-federal hydropower facility at USACE project, including information and explanation of responsibilities similar to that comprised in paragraph 9-01.a. Reference all agreement documents (i.e., MOUs, MOAs, etc.) that define the Corps responsibilities to real-time flood risk management regulation at the Corps project.

9-06. Reports. Describe monthly charts, short-term hydrologic reports, emergency regulation reports, graphical and tabular summaries. Flood situation reports, quarterly, seasonal, or annual reports, including hydrologic forecasts (also post-flood reports). Suggest tabulation to show report, when required, form number, regulation requiring report.

NOTE: Additional subparagraphs or appendices may be included in Chapter 9 or following Chapter 9 to adequately define or clarify each section.



A-20. Tables. Disperse tables which are one page or less in size throughout the text. Include all tabulations over one page in this section to facilitate narrative continuity within the text. Include tables showing elevation versus area and elevation versus capacity in increments that support reasonably accurate interpolation of values between increments. These tables should cover elevation ranges from bottom of the reservoir to maximum pool as a minimum and should extend to top of dam if information is available.

A-21. Exhibits. NOTE: Label the following items as exhibits instead of appendices, reserving the latter term to tie individual manuals with master manuals. The number of exhibits will vary from project to project. "Standing Instructions to Project Operators (Damtenders)" is normally the last exhibit to allow extraction for use by project operators as needed.

a. Supplementary Pertinent Data. Normally this would be the first exhibit following the section for tables that exceed one page in size. This exhibit may be extensive, but should be limited to aspects pertinent to water control (see Section A-22). Note that this section should not be redundant to the Pertinent Data section of the water control manual (although it may prove beneficial to have some information repeated for clarity), but it should supplement information for the subject project and surrounding projects that might impact project operations.

b. Formal Agreements. NOTE: To conserve space it may be desirable to show only the portion of the contract pertinent to water control (e.g., omit payment schedules). Examples are:

- (1) Water Supply Contracts;
- (2) Power License Contracts;
- (3) Memorandums of Understanding;
- (4) Field Working Agreement;
- (5) Section 7 Flood Risk Management Regulations;

(6) Letters from other agencies or minutes of requesting commissions acknowledging or concurring in important or unusual aspects of the water control plan; and

- (7) Non-Federal Hydropower MOU/MOAs.

c. Standing Instructions to Project Operators (Damtenders). Standing Instructions to the Project Operator for Water Control are written in compliance with EM-1110-2-3600, Management of Water Control Systems, (Reference 4f) and with ER-1110-2-240 Water Control Management, (Reference 4a). A copy of these Standing Instructions must be kept on hand at the project site at all times. A sample outline for content of the standing instructions is included in Section A-23. Any deviation from the Standing Instructions will require approval of the District Commander.

A-22. Sample Exhibit—Supplementary Pertinent Data.

a. Several pertinent items are worthy of inclusion in this portion of the manual as it provides a compact ready reference source and facilitates quick orientation of important aspects relative to water management. Much information in this exhibit may be better presented in the "text" of the manual. However, the contrary is also true (i.e., pertinent data should be used to document many aspects related to water management that do not warrant narration to expedite compilation and to avoid unnecessary wordiness of the text).

b. A few items which constitute brief tables in themselves may be more suitably dispersed within the text to accompany related discussions. However, abbreviated repetition of many items in the text is acceptable, since this exhibit will provide an overview of the project.

Item	Description or Quantity & Units
GENERAL INFORMATION	
Other names of project	In addition to that on cover
Location	Basin, stream, river mile, state
Project Type	Dam and reservoir, detention dam, natural lake with gated outlet, hurricane barrier, control structure downstream of main dam, re-regulation, diversion, flood closure, or other
Water Management Objectives	Describe authorized purposes and other general objectives of project operation
Project Owner	Agency name
Operating Logistics	Physical operation, on site/remote operation, working hours of operation (weekdays, weekends, nights, normal/flood emergency conditions)
Water Management Agency	Agency directly responsible for hydrologic forecasts, streamflow prediction and/or day-to-day release selection; also specify when USACE is indirectly responsible, by interagency agreement, for regulation regarding certain project purposes

Item	Description or Quantity & Units
<i>Code of Federal Regulations</i> , Title 33 (applies to Section 7 projects)	Part 208, date of publication in the Federal Register
Federal Power Commission License	License number, date of contract
Water supply agreements	Contract number, agency, storage, rates, date of contract
Other formal agreements	Titles of compacts, commissions, committees, etc.
Project cost	Estimated construction cost
Closure date	When did the project become functional?
Special project features	Attendant control facilities (e.g., fish ladder, fish hatchery regulation structure, pumpback facility, unique aspects, and other)
RESERVOIR, LAKE OR POOL	
Table of pertinent elements with corresponding incremental storage (acre-feet and inches), cumulative capacity and area corresponding to:	Top of dam, maximum design pool, top-induced surcharge, top flood control pool, top conservation pool, inactive pool, and top dead storage
Real estate taking line for fee title	Elevation; purchased real estate
Real estate taking line for easement	Elevation; purchased easement
Range of clearing	Upper and lower elevations

Item	Description or Quantity & Units
Pool elevation corresponding to discharge capability of maximum non-damaging flow rate downstream	State the discharge and name of location of damage center or damage centers
Reservoir length at top of conservation pool	Miles
Shoreline length at top of conservation pool	Miles
Safety aspects, possibly requiring warning	Low lying recreational areas and camp sites in reservoir and downstream with pool guide criteria and limiting discharge criteria for islands, peninsulas, highways, bridges, morning glory spillways, vicinity of energy dissipators, power outlet, downstream channel; wave action, debris, ice, backwater, other
Emergency drawdown	Provision for storage evacuation, invert elevation, and type of lowest outlet usable for drawdown, minimum time required to empty, quantity of storage impossible to evacuate without pumping, siphoning, or evaporation
Project facilities in reservoir area	Table showing elevation versus facilities, structures, lands, parks, docks, game and fish structures, and vegetation affected by high or low pool levels
Project facilities in downstream area	Table showing discharge versus facilities, structures, lands, and vegetation affected by outflow downstream of structure
HYDROLOGY	
Drainage area	Total contributing watershed area
Table with data for probable maximum, standard project, threshold and other design floods showing:	Maximum water surface elevation, peak inflow, total storm runoff, stored flood volume, maximum outflow of flood, seasonal distinction, and distribution of precipitation/storm type

Item	Description or Quantity & Units
Climate	Arid, semiarid, moderate, humid, temperate
Storm types	Cloudburst, hurricane, tropical rain, snow, and other
Flood season	Time of year
Low flow season	Time of year
Minimum daily flow and date of occurrence	Project inflow at dam site, considering pre- and post-project hydrologic records (show years of record in parenthesis)
Minimum monthly flow and date	Same as above
Minimum annual flow and year	Same as above
Average annual flow	Same as above
Maximum daily flow and date	Same as above
Maximum monthly flow and date	Same as above
Maximum annual flow and year	Same as above
Maximum instantaneous flow and date	Same as above
Maximum flood volume and date	Same as above
Name and location of key streamflow stations	Upstream and downstream of dam site to facilitate release determination
Type of meteorological data recorded at dam site	Manual and automatic, including pool, tailwater, climatic, and water quality data

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Item	Description or Quantity & Units
Number of precipitation stations used in hydrologic forecasting	Differentiate between manual and automatic recording/reporting
Number of SNOTEL stations	Geographic locations
Number of snow courses	Normal date of maximum snowpack
Number of sediment ranges	Upstream and downstream of dam site, annual basis, or other
<b>EMBANKMENTS, DIKES, LEVEES, AND TIDAL BARRIERS</b>	
Location	All structures associated with the project except those downstream of dam site (See CONTROL POINTS/RIVER REACHES for structures located downstream)
Purpose	Protection of agriculture, community, structures, and against loss of life, other
Type	Overflow/non-overflow, embankment, levee, dike, flood barrier, other
Type of fill	Including core
Slope protection	Riprap, grassed, upstream/downstream, face, channel, toe protection, none
Height	Feet, toe to top of structure
Length	Feet/miles
Top elevation	Design elevation and actual elevation if survey has been performed
Percent exceedance frequency flood which will overtop structure	When less than 1 percent, state that flood magnitude inflow volume is XX times larger than the 1 percent exceedance frequency flood.

Item	Description or Quantity & Units
Design flood	Frequency, discharge
Freeboard	Minimum residual
Flood closure structure	Location, elevation/stage at lowest level and at top of added protection (sandbagging, stoplogs), recurrence interval for both
Method of activation	Automatic, manual, and by whom
Critical swellhead	Maximum head without failure if overflow type, and corresponding recurrence interval
Fuse plug	Critical pool elevation and recurrence interval to activate
Associate pumping/siphon station	Location/capacity
Seepage rate at design pool	
Usage/access	Is structure used as roadway or access
Elevation of toe	Elevation
<b>SPILLWAY</b>	
Location	All structures associated with the project except those downstream of dam site (See CONTROL POINTS/RIVER REACHES for structures located downstream)
Type	Controlled, uncontrolled, chute, ogee, broad-crested, notch, emergency concrete, rock, perched saddle, other
Crest elevation	Elevation
Net overflow length	Feet
Number and size of gates	Feet/Inches
Type of gates	Tainter, drum, stoplogs

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Item	Description or Quantity & Units
Top of gate elevation	In closed position
Induced surcharge	Feet above top of flood control pool
Design head	Feet
Maximum discharge capacity	Cubic feet per second (cfs)
Bridge deck elevation	Top of bridge (feet)
Type energy dissipator	Stilling basin, flip bucket, etc.
Automated Gates- Elevation to initiate gate raise	Elevation
Automated Gates- Elevation where gates are fully open	Elevation
Automated Gates- Elevation that causes gates to lower	Elevation
Time required to open/close all gates	Consider downstream conditions
Type emergency closure/ time requirement	Days/hours/minutes
Recurrence interval of pool attaining crest elevation	When crest is within the range of allocated flood risk management storage
Spillway activation	Number of post-project (actual) overflow events and dates
<b>OUTLET FACILITIES</b>	



Item	Description or Quantity & Units
Location	All structures associated with the project except those downstream of dam site (See CONTROL POINTS/RIVER REACHES for structures located downstream)
Purpose	Flood risk management, hurricane, water supply, irrigation, low flow, other
Type outlet	Circular, rectangular, horseshoe, bypass, gate in a gate, pipe, partially/entirely uncontrolled, floodwall opening, or other
Size of outlet	Feet/inches
Type of service gate or valve	
Number and size of gates and valves	Feet/inches
Entrance invert elevation	Elevation
Multilevel intake elevations	Elevation
Discharge at pertinent elevations	Bottom and top of conservation pools, top of flood control pool
Minimum pool elevation when inoperative	When is gate closure required?
Minimum time required to open/close service gates	Considering downstream conditions
Type emergency closure and time requirements	Days/hours/minutes
Type of energy dissipator	
<b>HYDROELECTRIC POWER FACILITIES</b>	
Location	

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Item	Description or Quantity & Units
Type	Storage, peaking, run-of-river, pumpback, or other
Installed capacity	Megawatts
Number/type and capacity of units	Design and overload, reversible
Power-on-line data	By units
Provision for future	Date of installation (if known) capacity, number of bays anticipated
Plant factor	
Load factor	Normal plan for generation, seasonable if applicable
Number and size of penstocks	When multiple powerhouses are involved, delineate penstocks associated with each powerhouse.
Turbine discharge	Rated capacity at design head for each unit, at top of power pool, and at top of flood control pool
Design head	Feet
Maximum gross head for power	Feet
Average net head	Feet
Minimum flow required for generation	By months if variable
Drawdown	Minimum elevation and head
Minimum head	Head below which the units are inoperative
Annual firm Energy-Critical drawdown	Hydrologic streamflow record

Item	Description or Quantity & Units
Minimum peaking capability	Include time on line
Dependable capacity	
Average annual energy	
Specific hydroelectric power storage or pondage	Volume, feet of pondage, or none
Comingled, joint use, or seasonal storage	Show in time table if variable
Critical tailwater elevation	Above or below units which are inoperative
Discharge at pertinent elevations	Regarding hydropower and flood risk management
Pumpback capability	Maximum rate and volume per normal pumping cycle
Type of emergency closure and time required	Maximum rate and volume per normal pumping cycle
Type of energy dissipator	
Constraints	Downstream channel capacity, minimum time on line as plant, minimum time on line per unit, normal time on line, maximum rate of pool drawdown (feet/day), surge wave height and rate
LOCK	
Location	
Elevations	Upper pool (normal, minimum, maximum); lower pool (normal, maximum); top of lock walls; upper guide and guard walls; top of lower guide and guard walls; upper sill; lower sill; chamber floor; miter gate and top girder; approach channel upstream and downstream

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Item	Description or Quantity & Units
Dimensions	Chamber width, chamber length (usable and between pintles), lift normal, depth above lower sill, height of upper and lower gate, minimum cushion depth in chamber, guide wall and guard wall lengths (upstream and downstream), width top of guide and guard walls, width top of chamber wall, culvert size
Type and dimensions of culvert valves	Feet/inches
Minimum submergence of culvert valves	Feet/inches
Lock filling time	For top of navigation pool levels, other
Lock emptying time	For top of navigation pool levels, other
Average annual tows/tonnage	
Minimum monthly tows/tonnage, record and date	
Maximum elevation permitting navigation	
Freeboard on lower guide wall when lock becomes inoperative	Feet/inches
Number of inoperative incidents due to high flow and date of most recent event (also low flow events)	
Type of emergency closure and time required	Days/hours/minutes

Item	Description or Quantity & Units
Leakage rate at normal pool	
<b>CONTROL POINTS/RIVER REACHES</b>	
Location	Downstream of dam site only, name, river mile, nearby community, highway bridge
Purpose of control	Potential damage center, water quality, low flow, water rights, municipal, industrial, irrigation, fish, navigation, or other
Channel/floodway description	Main channel, diversion channel, flood relief bypass, acres easement/purchased land, high/low velocity, riprap, bed/bank stability, well-/ill-defined, bed transmissibility
Uncontrolled drainage area	Total/contributing to control point
Treatment of uncontrolled target flow	Contributes/does not contribute to flood risk management/conservation runoff
Target flow rate (s)	Seasonal if applicable, flood risk management and conservation purposes
Time for water travel	From dam site to control point, through reaches between control points
Table showing discharge, stage and recurrence interval for:	(1) top of banks, (2) maximum non-damaging stage, (3) minor damage stage, (4) significant damage stage, (5) regulating discharge(s) (restrictive stage or flow rate applicable during integrated system regulation), (6) maximum, (7) record based on project conditions, (8) regulating discharge (s) (target flows) for flood risk management during project formulation of authorized plan, and (9) flowage easement/fee
Monitoring provisions	Type of data obtained and used, communication with regulating office, with damtender (automatic reporting/manual reporting)
Channel usage	Navigation, canoe racing, common water contact sports, fishing, spawning beds, or other

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Item	Description or Quantity & Units
Safety aspects possibly requiring warning	Bank sloughing, high-velocity flow, backwater, debris, encroachments, campsites, low water crossing highways, rapid rise from turbines
Dikes or levees downstream	Overflow/non-overflow type, design flow rate, (furnish pertinent data similar to that required for embankments)
Related control structures	Type of structure (re-regulation, diversion, overflow weir, flood closure, other) associated with channel or floodway
Location	All control structures downstream of main project associated with channel or floodway
Purpose	Re-regulation, diversion, overflow weir, flood closure, or other control structure
Type	Brief description, number and size of gates, weir, culvert, siphon opening in dike/levee
Flow passage	Elevation and height above streambed, weir crest elevation
Pertinent discharge capacity	Design rate, other
Regulation	Reference regulatory instructions which should be included with this manual as an appendix (or exhibit) or compiled under separate cover
Regulating agency	Office responsible for release selection and recommended flow passage in general; telephone and address if non-USACE
Operation	Agency responsible for physical operation of gates, stoplogs, sandbags, pumping facilities, other manual remote operations; name, address, and phone number of damtender

A-23. Sample Content of Standing Instructions to Project Operators.

STANDING INSTRUCTIONS TO THE PROJECT OPERATOR FOR WATER CONTROL  
PROJECT "XXXXXX"

1. Background and Responsibilities.

a. General Information. This section should be used to provide a brief statement of background and responsibilities. All information can be extracted from the main WCM. The general information sub-section, as a minimum, should include the following information:

"These Standing Instructions to the Project Operator for Water Control are written in compliance with Paragraph 9-2 of EM-1110-2-3600 (Engineering and Design, Management of Water Control Systems) and with ER-1110-2-240 (Engineering and Design, Water Control Management). A copy of these Standing Instructions must be kept on hand at the project site at all times. Any deviation from the Standing Instructions will require approval of the District Commander.

b. Project Purposes. This section should state the authorized purposes considered in the operation of the project.

"Project XXXXXX is operated for flood risk management, navigation, hydropower, recreation, fish and wildlife conservation, water quality and water supply. Water Control actions are in support of these project purposes and for purposes of the XXXXXX River System."

c. Chain of Command. This section should simply describe the chain of command for regulation of the project. Typically, it would state that the Project Operator is responsible to the Water Control Manager for all water control actions.

d. Structure. This section should provide a brief description of location of the project.

e. Operation and Maintenance (O&M). This section should describe who is responsible for O&M activities.

f. Role of the Project Operator(s). This section should clearly identify the Project operator(s) and division of operational responsibilities for operational components, such as powerhouse and spillway gates.

(1) Normal Conditions (dependent on day-to-day instruction). This section should describe the process/procedures for normal condition. Typically, this would include communications between the Water Control Manager and the Project Operator. The description should include the frequency and type of communications utilized. The Water Control Manager will normally coordinate the daily water control actions regarding gate releases with the Project Operator.

(2) Emergency Conditions (flood, drought, or special operations). This section describes process/procedures for emergency conditions. During emergency conditions, the Project Operator will be instructed by the Water Control Manager on a daily or hourly basis for all water control actions. In the event that communications with the Water Control Manager are cut off, the Project Operator will continue to follow the Water Control Plan and contact the Water Control Manager as soon as communication is reestablished. In the event that flooding occurs and communications with Water Control Manager are cut off, the Project Operator will use the standing instructions as a guide until communications with the Water Control Manager are restored. If communication is lost after some instructions are issued, follow those instructions as long as they are applicable.

(a) Discussion should include minimum and maximum releases and critical gage information with complete description of objective controlled conditions. Gate operations should be described for a full range of flow conditions including any forecasts or observed conditions necessary for making operational decisions.

(b) In the event that no forecast or observed data at the USGS gages can be obtained, default operations should be described. Normally, operational decisions are related to observed conditions, such as rising pool, and falling pool.

## 2. Data Collection and Reporting.

a. General. This section should identify reporting requirements, such as hourly pool elevation, tailwater elevation, turbine discharge, spillway discharge, capacity, and general project status on the computer and have it accessible to the Water Control Manager by computer network.

b. Daily Reporting. Specific items which must be reported, including time, frequency, method of reporting, and extent of dissemination of reports should be identified.

c. Gage Verification. Gage verification procedure should be described. The Project Operator should perform gage reading verifications by providing the pool level automated instrumentation gage reading and staff gage readings.

d. Regional Hydro-meteorological Conditions. Consideration of regional hydro-meteorological conditions for standing instructions should be described. Normally, the Project Operator will be informed by the Water Control Manager of any regional hydro-meteorological conditions that may impact water control actions. In the event, communications are disrupted, what procedure will be used to obtain information.

## 3. Water Control Action and Reporting.



a. Normal Conditions. This section should describe actions taken during normal conditions. The Project Operator should follow the Project XXXXXX Water Control Manual for normal water control actions and will report directly to the Water Control Manager.

b. Emergency Conditions. This section should describe actions taken during emergency conditions. The Project Operator will follow the instructions from the Water Control Manager if available. If needed, the Project Operator will follow the standing instructions for gate settings to achieve the desired release rate.

c. Inquiries. The procedure for addressing inquiries should be identified. Normally, all significant inquiries received by the Project Operator from citizens, constituents, or interest groups regarding water control procedures or actions must be referred directly to the Water Control Manager as soon as practicable.

d. Water Control Problems. The procedure to address water control problems should be included in the standing instructions. Normally the Project Operator must immediately notify the Water Control Manager, by the most rapid means available, in the event that an operational malfunction, erosion, or other incident occurs that could impact project integrity in general or water control capability in particular.

e. Potential Spillway Discharge. Procedures for notification of potential spillway discharges should be addressed in the standing instructions. Communication plans should be developed to identify personnel responsible for notification of local emergency management offices of the situation. It is the normally the responsibility of the local emergency management authorities to contact residents that could be affected by the discharge.

A-24. Plates. NOTE: As appropriate, considering utility (need, clarity, and conciseness) and avoiding repetition, preferably in the order of treatment in the manual. A list of plates is included for use as a check in preparing plates. The list should be adjusted by adding or deleting plates, according to need, covering all features of the project pertinent to water control.

Chapter	Plate
CHAPTER 2	Location and Vicinity Map General Plan and Sections Sediment Ranges Embankment Outlet works Spillway Hydroelectric Power Facilities Water Supply Facilities Facilities for Water Quality or Temperature Control Related Control Facilities Real Estate Map Backwater Curves Public Use Sites
CHAPTER 3	Neighboring Projects Areas of Encroachment
CHAPTER 4	Stream Profiles Inflow Frequency: Volume by Month Flow Duration Curves Inflow Hydrographs Crest Travel Time Stage Damage Curves: Structural and Acres
CHAPTER 5	Hydrologic Network Communication Network Lines of Communication Organization Chart Forms and Reporting Instructions (As Needed)
CHAPTER 6	Unit Hydrographs Rainfall-Runoff Relation Curves (API) Sample API Printout Sample Runoff Printout Forecasting Reaches Routing Template or Recession Curves Soil Moisture Curves Index Area

Chapter	Plate
CHAPTER 7	Release Schedule or Water Control Diagram (Transitional Pool or Seasonal Pool Guide) Emergency Release Schedule Spillway Gate Regulation (Surcharge) Curves, Inflow vs. Outflow Area-Capacity Curves Evaporation Curves Outlet Rating Curves: Full and Partial Gate Openings Conduits Spillway Low Flow Tailwater Rating Curve Intake Sluices: Rating Curve Pool Elevation vs. Time (Yearly Regulation) Objective Temperature Curve Fish Spawn: Growing Calendar, Elevation Turbine Performance Curves: Gross Head vs. KW vs. Discharge (Show Outer Limits) Hydroelectric Power Rule Curve Energy in Storage Hydrographs of Critical Period Indicating Firm Yield Navigation Charts
CHAPTER 8	Spillway Design Flood Routing (Normal and Emergency) Standard Project Flood Routing (Normal and Emergency) Other Major Floods Peak Inflow Frequency Volume Inflow Frequency Pool Elevation Probability Duration Curve (Pool Elevation) Pool Elevation: Period of Record Routing and Actual Since Beginning of Operation Frequency Curves at Key Index Stations Stage Discharge Curves for Control Key Index Stations

A-25. Outline for Preparing Master Water Control Manual. Similar to individual project water control manuals, water control master manuals are prepared to document the overall system water control plan to facilitate regulation. A master manual should be prepared when the scope and complexity of a system of interrelated projects are significant. Aspects to consider whether preparation of a master manual is necessary are whether the reservoir operations are based on system criteria, general hydrometeorology, network data collection, common forecasting points, complexity and objectives of the system water control plan, and management responsibilities shared by multiple districts, divisions, or other requirements. For example, a system of reservoirs with a common control point could have a water control master manual. Appropriate cross-referencing between a master manual and appendixes (individual project manuals or plans, as required) can serve to reduce the duplication of information regarding specific subjects. All charts, graphs, diagrams, and other items pertaining to individual projects should be presented in the individual project manuals as appendixes to the master manual. Required outline for preparing master water control manuals follows:

OUTLINE FOR PREPARING MASTER WATER CONTROL MANUALS	
Title Page	
Photographs of Project	
Notice to Users of This Manual	
Regulation Assistance Procedures	
Unit Conversions (Addressing Vertical Datum and Metric Equivalency)	
Definitions and Common Terminology	
Table of Contents	
Pertinent Data	
Text of Manual (Chapters 1–9)	
CHAPTER 1	Introduction
CHAPTER 2	Basin Description and Characteristics
CHAPTER 3	General History of Basin
CHAPTER 4	Description of Projects

CHAPTER 5 Data Collection and Communication Networks

CHAPTER 6 System Hydrologic Forecasts

CHAPTER 7 System Water Control Plan

CHAPTER 8 Effect of System Water Control Plan

CHAPTER 9 System Water Control Management

NOTE: This outline is intended for preparation of Master Water Control Manuals. The format and content as presented in Section A-4. Organizational Structure of Individual Water Control Manuals should be used for guidelines for individual project manuals. The chapter titles above should always be used; however, additional chapters may be added as required. Discretion may be employed in the selection of topics and subtopics within the chapter headings as they relate to the basin/watershed.