

**MIDDLE COLUMBIA RIVER
PROJECTS**

**WELLS, ROCKY REACH, ROCK
ISLAND, WANAPUM, PRIEST RAPIDS
DAMS**

WATER CONTROL PLAN

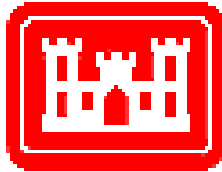


**US Army Corps of Engineers
Northwestern Division**

WATER CONTROL PLAN

MIDDLE COLUMBIA RIVER PROJECTS

**WELLS, ROCKY REACH, ROCK ISLAND, WANAPUM, PRIEST RAPIDS
DAMS**



**U.S. ARMY CORPS OF ENGINEERS, NORTHWESTERN DIVISION
Portland, Oregon**

**DOUGLAS COUNTY PUBLIC UTILITY DISTRICT
East Wenatchee, Washington**

**CHELAN COUNTY PUBLIC UTILITY DISTRICT
Wenatchee, Washington**

**GRANT COUNTY PUBLIC UTILITY DISTRICT
Ephrata, Washington**

JANUARY 2025

FOR OFFICIAL USE ONLY

MIDDLE COLUMBIA BASIN PROJECT PHOTOS



Figure 1. Middle Columbia River Dams (from top left) Wells Dam, Priest Rapids Dam, Wanapum Dam, Rocky Reach Dam.

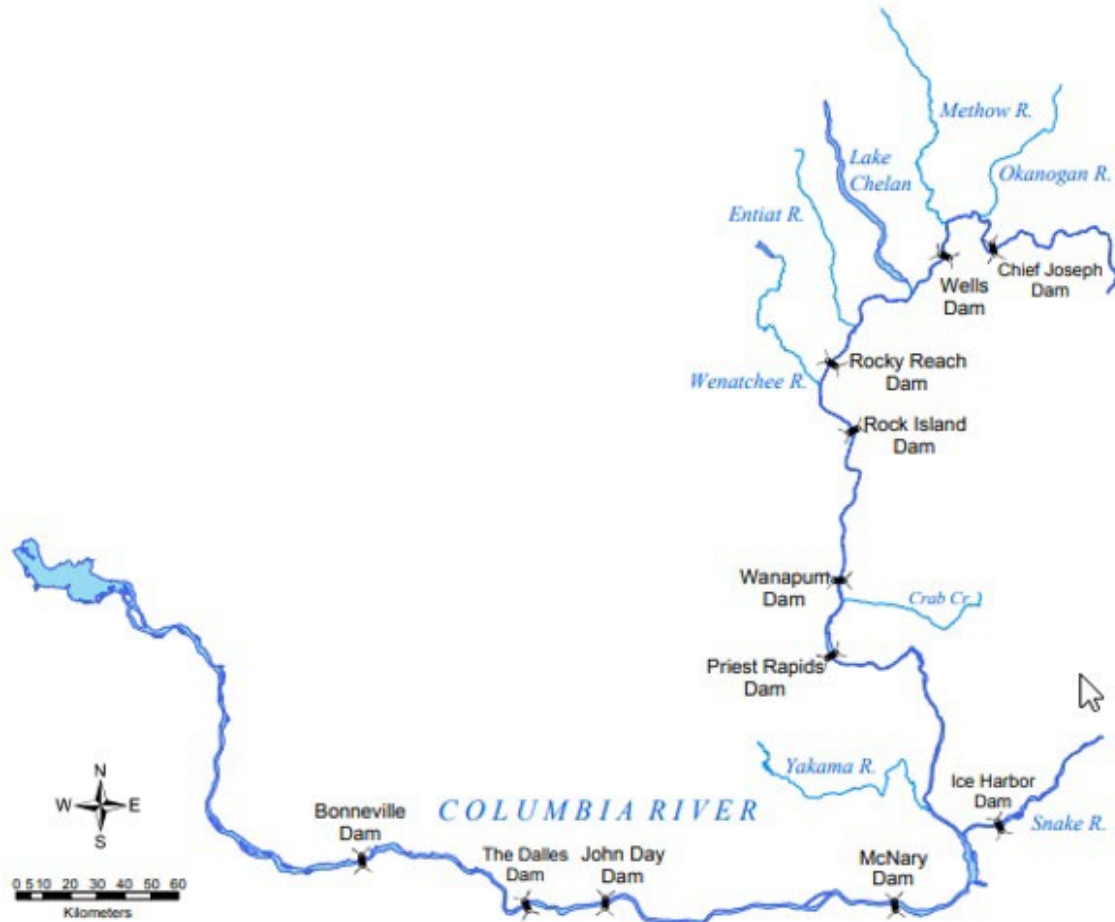


Figure 2. Middle Columbia River and tributaries from Chief Joseph Dam to Bonneville Dam (Adapted from BPA, 2006).

REVISIONS TO THIS PLAN

As a continuing program, portions of this plan may occasionally be revised and updated. Pertinent information will be revised when changes become evident; likewise, changes in the plan of operation or in the project development will be reported. Whenever revisions are made, new pages containing the revised material will be issued to holders of the plan.

NOTICE TO USERS OF THIS PLAN

This water control plan will be published in loose-leaf form and only those portions requiring changes will be revised and distributed. This copy should be preserved in good condition so that inserts can be made to keep the plan current.

REGULATION ASSISTANCE PERSONNEL

In the event that unusual conditions arise during duty or non-duty hours, contact can be made by telephone using the following numbers. The U.S. Army Corps of Engineers will typically contact a project for the following purposes:

- Reservoir Regulation Coordinator: For the coordination or planning of any flood risk management operations.
- System Operations: After issuing flood risk management instructions, to verify that instructions have been received and that it is clear how the project needs to operate.

<u>Wells Dam</u>	Telephone No.:
Douglas County PUD	[REDACTED]
System Operations	[REDACTED]
[REDACTED] Assistant Manager	[REDACTED]
[REDACTED] Energy Analyst – Reservoir Regulation	[REDACTED]
Coordinator	

<u>Rocky Reach Dam and Rock Island Dam</u>	Telephone No.:
Chelan County PUD	[REDACTED]
System Operations	[REDACTED]
[REDACTED] System Operations Manager	[REDACTED]
[REDACTED] Reservoir Regulation Coordinator	[REDACTED]
	[REDACTED]

<u>Wanapum Dam and Priest Rapids Dam</u>	Telephone No.:
Grant County PUD	[REDACTED]
System Operations	[REDACTED]
[REDACTED] Reservoir Regulation Coordinator	[REDACTED]
	[REDACTED]

¹ [REDACTED]

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<p>United States Army Corps of Engineers, Northwestern Division</p> <p><u>Reservoir Control Center, Portland, OR (CENWD-PDW-R)</u></p> <p>Hotline 24hrs/7days</p> <p>██████████ Chief</p> <p>██████████ Lead, Regulation Unit</p>	<p>Telephone No.:</p> <p>██████████</p> <p>██████████████████</p> <p>██████████████████</p>
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MIDDLE COLUMBIA WATER CONTROL PLAN

TABLE OF CONTENTS

MIDDLE COLUMBIA BASIN PROJECT PHOTOS	II
REVISIONS TO THIS PLAN	IV
NOTICE TO USERS OF THIS PLAN	IV
REGULATION ASSISTANCE PERSONNEL	V
MIDDLE COLUMBIA WATER CONTROL PLAN.....	VII
TABLE OF CONTENTS	VII
VERTICAL DATA CONVERSION	VIII
ACRONYMS AND ABBREVIATIONS	IX
PERTINENT DATA	X
SECTION 1. INTRODUCTION.....	1-1
1.01 Authorization	1-1
1.02 Purpose and Scope	1-1
1.03 References.....	1-2
1.04 Project Owners and Operators	1-2
1.05 Regulating Agencies	1-3
SECTION 2. WATER CONTROL PLAN	2-1
2.01 General Objectives.....	2-1
2.02 Constraints	2-1
a Minimum Instantaneous Discharge.....	2-1
b Maximum Hourly and Average Daily Change in Discharge.....	2-2
2.03 Overall Plan for Flood Risk Management	2-6
2.04 Standing Instructions to Project Operators	2-6
a Normal Operating Procedures.....	2-6
b Emergency Operating Procedures.....	2-7
c Data Collection and Reporting.....	2-7
2.05 Flood Risk Management Operations.....	2-7
a Notification and Communication of Flood Risk Management Operations.....	2-7
b Water Control Diagrams.....	2-10
2.06 Flood Emergency Action Plans.....	2-19
a Emergencies	2-19
b Abnormal Condition	2-19
2.07 Deviation from Normal Regulation	2-19
2.08 Rate of Release Change	2-20
2.09 Climate Change.....	2-20
EXHIBITS	
A. Climate Change Analysis.....	A-1

VERTICAL DATA CONVERSION

Elevations in this Water Control Plan are given in feet in the vertical datum NGVD29. The following table lists the vertical datum conversions used to convert elevations from feet (NGVD29) to feet (NAVD88) at selected locations. To convert from feet (NGVD29) to feet (NAVD88), add the vertical datum conversion (feet) to the NGVD29 elevation. Datum conversions were calculated using the Online Vertical Datum Transformation Tool from the National Geodetic Survey of the National Oceanic and Atmospheric Administration (NOAA) and modified as needed based on feedback from the project specific PUDs.

<u>Project/Dam</u>	<u>Vertical Datum Conversion (feet)</u>
Wells	3.996
Rocky Reach	3.760 ²
Rock Island	3.700 ²
Wanapum (Priest Rapids Project)	3.546
Priest Rapids	3.507

² Vertical datum conversions provided by Chelan PUD.

ACRONYMS AND ABBREVIATIONS

AF	Acre-feet
CBT	Columbia Basin Telecommunications Network
CENWD-PDW	Water Management, USACE, Northwestern Division
CENWD-PDW-R	Reservoir Control Center, Northwestern Division
CFS	Cubic Feet per Second
KCFS	Thousand Cubic Feet per Second
EAP	Emergency Action Plan
EI	Elevation
FRM	Flood Risk Management
NWD	Northwestern Division, U.S. Army Corps of Engineers
NWP	Portland District, U.S. Army Corps of Engineers
PUD	Public Utility District
RCC	Reservoir Control Center
USACE	U.S. Army Corps of Engineers
WCP	Water Control Plan

PERTINENT DATA
WELLS DAM

LOCATION OF DAMSITE

County, State..... Douglas, Washington
 River Columbia
 Distance above mouth of Columbia River 515.6 miles
 Owner..... Douglas County PUD No. 1
 Type of Project..... Run-of-River
 Authorized Purpose..... Flood risk management, irrigation, water supply, hydropower, and recreation

HYDROLOGIC DATA

USGS Gage, 12450700 COLUMBIA RIVER BELOW WELLS DAM, WA :
 Drainage Area 86,100 sq. mi

HYDRAULIC DATA

Maximum regulated pool (surcharge)..... 791.0³
 Maximum normal pool..... 781.0
 Minimum normal pool 771.0
 Minimum pool..... 767.0⁴
 Flood risk management minimum pool 771.0⁵
 Flood risk management maximum pool..... 781.0⁵
 Minimum Regulated Discharge Requirement..... 0 cfs
 Minimum Generation Requirement..... 16,000 cfs⁶
 Maximum Outflow Capacity (powerhouse)..... 220,000 cfs
 Spillway Design Capacity (791 ft) 1,180,000 cfs

RESERVOIR STORAGE

GROSS STORAGE (acre-feet)

<u>Pool Name</u>	<u>Elevation</u>	
Minimum Physical.....	767.0 ft.....	207,000
Minimum Normal Regulated.....	771.0 ft.....	236,000
Maximum Normal Regulated.....	781.0 ft.....	331,200
Maximum Regulated (Surcharge).....	791.0 ft.....	N/A

Usable Storage (acre-feet)

Normal Minimum Pool to Maximum Authorized Pool (El. 771 to 781 ft)..... 95,200

³ Maximum regulated pool (surcharge) and minimum pool are referenced from the project data included in CRT 49 (2002).

⁴ While a minimum pool of 767 ft is physically possible, it would render the adult fish facilities and hatchery water intake gate inoperable. These structures operate properly within the normal maximum and minimum pool elevation range of 781 ft and 771 ft.

⁵ Flood risk management storage space required for replacement of Lost Valley storage vary by year and are established by NWD. Minimum and maximum FRM pool elevations are 771 ft and 781 ft, respectively.

⁶ Minimum discharge is equivalent to the flow of 16 kcfs through one generating unit at minimum net head of 50 ft. (Turbine units are able to generate power at 48 ft of net head but that operation is damaging from a mechanical standpoint.) One unit is needed for station service power. A minimum of 2.2 kcfs is needed for the juvenile fish bypass system (April – August).

ROCKY REACH DAM

LOCATION OF DAMSITE

County, State.....Chelan, Washington
RiverColumbia
Distance above mouth of Columbia River 473.7 miles
Owner..... Chelan County PUD No. 1
Type of Project.....Run-of-River
Authorized PurposeFlood risk management, hydropower, irrigation, water supply, and recreation

HYDROLOGIC DATA

USGS Gage, USGS 12453700 Columbia River at Rocky Reach Dam, WA:
Drainage Area 87,800 sq. mi

HYDRAULIC DATA

Maximum regulated pool (surcharge).....710.0 ft
Maximum normal pool.....707.0 ft
Minimum normal pool703.0 ft
Minimum FRM pool..... 703.0 ft⁷
Maximum FRM pool710.0 ft⁷
Minimum Regulated Discharge Requirement..... 0 cfs
Minimum Generation Requirement..... see⁸
Hydraulic capacity (powerhouse)..... 201,000 cfs
Spillway and Powerhouse Design Capacity (710.0 ft)..... 1,100,000 cfs

RESERVOIR STORAGE

ACTIVE STORAGE (acre-feet)²

<u>Pool Name</u>	<u>Elevation</u>	
Minimum Normal	703.0 ft	0
Maximum Normal.....	707.0 ft	36,400
Maximum Regulated.....	710.0 ft	66,000

Usable Storage (acre-feet)

Minimum Normal Reservoir to Maximum Regulated Reservoir (El. 703 to 710 ft) 66,000

⁷ Flood risk management storage space required for replacement of Lost Valley storage vary by year and are established by NWD. Minimum and maximum FRM pool elevations are 703.0 ft and 710.0 ft, respectively.

⁸ Approximate flow through one generating unit for station service power for most of year (~September 1 – March 31) is 6,000 cfs. It is desired that this minimum flow is increased to 25,000 cfs total (two units at 12,500 cfs each) from ~ April 1 through August 31 for operation of the Juvenile Fish Bypass System.

⁹ Storage capacity values are all based on the approximate average annual flow rate of 100,000 cfs.

ROCK ISLAND DAM

LOCATION OF DAMSITE

County, State.....Chelan, Washington
RiverColumbia
Distance above mouth of Columbia River 453.4 miles
Owner..... Chelan County PUD No. 1
Type of Project.....Run-of-River
Authorized Purpose Hydropower, irrigation, and recreation

HYDROLOGIC DATA

USGS Gage, USGS 12462600 Columbia River below Rock Island Dam, WA:
Drainage Area 89,400 sq. mi

HYDRAULIC DATA

Maximum regulated pool (surcharge).....613.0 ft
Normal maximum pool613.0 ft
Normal minimum pool..... 609.0 ft¹⁰
Minimum Regulated Discharge Requirement..... 0 cfs
Minimum Generation Requirement..... 6,000 cfs¹¹
Hydraulic capacity (powerhouse)..... 220,000 cfs
Spillway Design Capacity (613.0 ft).....821,000 cfs¹²

RESERVOIR STORAGE

ACTIVE STORAGE (acre-feet)

<u>Pool Name</u>	<u>Elevation</u>	
Minimum Normal	609.0 ft	0
Maximum Normal/Regulated.....	613.0 ft	12,189

Usable Storage

Minimum Normal Reservoir to Maximum Regulated Reservoir.....N/A¹³

¹⁰ The following are additional operational considerations for Rock Island:

- 1) Fish ladders will not function, and no power generation is possible at tailwater elevation below 562.6 ft.
- 2) Turbine units are able to generate power between 50 to 20 ft of net head. Turbines will shutdown due to low net head at flows above 500,000 cfs.
- 3) A minimum river flow of 200,000 cfs is required to keep RI adult fishway entrances operable (above El 562.6 ft) if Wanapum Forebay is at 539 ft.

¹¹ Approximate flow through one generating unit for station service power.

¹² Approximately 240,000 cfs is controlled with all fixed hoist operators available. Three (3) weeks are required to reach full spillway capacity.

¹³ Rock Island has no useable storage authorized for flood risk management.

WANAPUM DAM

LOCATION OF DAMSITE

County, State.....Grant, Washington
RiverColumbia
Distance above mouth of Columbia River 415.8 miles
Owner..... Grant County PUD No. 2
Type of Project.....Run-of-River
Authorized Purpose Flood risk management, hydropower, and recreation

HYDROLOGIC DATA

Drainage Area 90,900 sq. mi

HYDRAULIC DATA

Maximum regulated pool (surcharge)..... 573.5 ft¹⁴
Maximum normal pool.....571.5 ft
Minimum normal pool560.0 ft
Minimum pool..... 539.0 ft¹⁵
Flood risk management pool..... see¹⁶
Minimum Regulated Discharge Requirement..... 0 cfs
Minimum Generation Requirement..... 8,700 cfs
Hydraulic capacity (powerhouse)..... 178,000 cfs
Spillway Design Capacity (573.5 ft).....1,410,000 cfs

RESERVOIR STORAGE

<u>Pool Name</u>	<u>Elevation</u>	<u>GROSS STORAGE (acre-feet)</u>	
		<u>(250 kcfs)</u>	<u>(450 kcfs)</u>
Minimum Pool.....	539.0 ft	212,800	245,800
Minimum Normal Regulated	560.0 ft	436,100	455,800
Maximum Normal Regulated.....	571.5 ft	593,000	605,500
Maximum Regulated (Surcharge).....	573.5 ft	621,800	634,000

Usable Storage (acre-feet)

Minimum Normal to Maximum Normal (El. 560 to 571.5 ft, at 250 kcfs)..... 156,900
Minimum Normal to Maximum Regulated (Surcharge) (El. 560 to 573.5 ft, at 250 kcfs)..... 185,700

¹⁵ Fish ladders will not function (below 560 ft) and power generation may be limited at minimum pool elevation of 539.0 ft. Maximum spillway capacity reduced to 460,000 cfs when operated at the minimum pool elevation of 539.0 ft.

¹⁶ Flood risk management storage space required for replacement of Lost Valley storage are established by NWD for the Priest Rapids Project (Priest Rapids and Wanapum Dams) and vary by year. The composite FRM space may be exchanged between Priest Rapids and Wanapum Dams.

PRIEST RAPIDS DAM

LOCATION OF DAMSITE

County, State.....Grant, Washington
 RiverColumbia
 Distance above mouth of Columbia River 397.1 miles
 Owner..... Grant County PUD No. 2
 Type of Project.....Run-of-River
 Authorized Purpose Flood risk management, hydropower, and recreation

HYDROLOGIC DATA

USGS Gage, USGS 12472000 Columbia River Below Priest Rapids Dam, WA:

Drainage Area 96,000 sq. mi

HYDRAULIC DATA

Maximum regulated pool (surcharge).....491.5 ft
 Maximum normal pool.....488.0 ft
 Minimum normal pool481.5 ft
 Minimum pool..... 465.0 ft¹⁷
 Flood risk management..... see¹⁸
 Minimum Regulated Discharge Requirement.....36,000 cfs¹⁹
 Minimum Generation Requirement..... 10,900 cfs
 Hydraulic capacity (powerhouse)..... 180,000 cfs
 Spillway Design Capacity (491.5 ft).....1,334,000 cfs

RESERVOIR STORAGE

GROSS STORAGE (acre-feet)

<u>Pool Name</u>	<u>Elevation</u>	<u>(250 kcfs) (450 kcfs)</u>	
Minimum Pool.....	465.0 ft	99,000	128,400
Minimum Normal	481.5 ft	172,400	196,100
Maximum Normal.....	488.0 ft	212,500	233,500
Maximum Regulated (Surcharge).....	491.5 ft	236,900	256,400

Usable Storage (acre-feet)

Minimum Normal to Maximum Normal (El. 481.5 to 488 ft, at 250 kcfs)..... 40,100
 Minimum Normal to Maximum Regulated (Surcharge) (El. 481.5 to 491.5 ft, at 250 kcfs) 64,500

¹⁷ Fish ladders will not function, and no power generation is anticipated below 481.5 ft, so there would be impacts to both with the project drafted to a minimum pool elevation of 465.0 ft. Maximum spillway capacity is reduced to 520,000 cfs when operated at the minimum pool elevation of 465.0 ft.

¹⁸ Flood risk management storage space required for replacement of Lost Valley storage are established by NWD for the Priest Rapids Project (Priest Rapids and Wanapum Dams) and vary by year. The composite FRM space may be exchanged between Priest Rapids and Wanapum Dams.

¹⁹ Minimum release will not be less than 36,000 cfs for water supply at Hanford Works, except when conditions are beyond the project control.

SECTION 1. INTRODUCTION

1.01 Authorization

This water control plan is prepared in accordance with applicable policies, regulations, and laws regarding the preparation of Water Control Plans including the following:

- **ER 1110-2-240, Water Control Management, paragraph 2-4.c.(3)**, dated 30 May 2016, which assigns to District Engineers the responsibility for development of plans and manuals for operation of reservoirs.
- **EM 1110-2-3600, Management of Water Control Systems**, dated 10 October 2017, which provides technical guidance on management and operation of water control systems and general guidance on content of Water Control Manuals (WCM) and Water Control Plans (WCP).
- **ER 1110-2-8156, Preparation of Water Control Manuals**, dated 30 September 2018, which provides specifications on WCM content and format.
- **NWDR 1110-2-6, Deviation Requests for Approved Water Control Manuals**, dated 20 June 2023, provides guidelines concerning deviations from approved WCMs and WCPs and delegates deviation authority to the chief, Columbia Basin Water Management Division (CENWD-PDW).

1.02 Purpose and Scope

This water control plan serves as a reference source for higher authority and documents the guidelines and procedures by which Douglas County PUD, Chelan County PUD, and Grant

County PUD will operate Wells Dam, Rocky Reach Dam, Priest Rapids Dam, and Wanapum Dam for flood risk management of the Columbia River System.

Guidelines for project regulation are presented including operational criteria and targets and communication protocol. Detailed procedures and equipment descriptions involved in the physical operation and maintenance of the project are not part of this document.

1.03 References

USACE, 2004. Columbia Basin Telecommunications (CBT) User’s Manual. Portland.

1.04 Project Owners and Operators

Project	Owner
Wells Dam	Douglas County PUD No. 1
Rocky Reach Dam	Chelan County PUD No. 1
Rock Island Dam	Chelan County PUD No. 1
Priest Rapids and Wanapum Dams	Grant County PUD No. 2

Each project is staffed on a continuous basis with on-site project offices at the addresses below:

Wells Dam:

Wells Hydroelectric Project – Project Office
485 Azwell Road, Chelan, WA 98816

Rocky Reach Dam:

Rocky Reach Dam Project Office
5000 Hwy 97A, Wenatchee WA, 98801

Rock Island Dam:

Rock Island Dam Project Office
1050 State Route 28, Rock Island, WA 98850

Wanapum Dam:

Hydro Office Building
14352 Highway 243 South
Beverly, WA 99321

Priest Rapids Dam

Hydro Office Building
14352 Highway 243 South
Beverly, WA 99321

1.05 Regulating Agencies

Wells Dam: Regulation for all project purposes is performed by Douglas County PUD:

1151 Valley Mall Parkway
East Wenatchee, WA 98802

The U.S. Army Corps of Engineers will manage a limited amount of space at Wells Dam for flood risk management. This guidance is issued from NWD.

Rocky Reach Dam and Rock Island Dam: Regulation for all project purposes is performed by Chelan County PUD:

203 Olds Station Rd.

Wenatchee, WA 98801

The U.S. Army Corps of Engineers will manage a limited amount of space at Rocky Reach Dam for flood risk management. This guidance is issued from NWD.

Priest Rapids Project (includes both Wanapum and Priest Rapids Dams): Regulation for all project purposes is performed by Grant County PUD:

30 C St SW

Ephrata, WA 98823

The U.S. Army Corps of Engineers will manage a limited amount of space at Priest Rapids Project for flood risk management. This guidance is issued from NWD.

SECTION 2. WATER CONTROL PLAN

2.01 General Objectives

This water control plan for the Middle Columbia Projects documents the guidelines and procedures established for the regulation of storage for flood risk management as part of the comprehensive plan for operating the Columbia River System. NWD actively coordinates and manages reservoir operations throughout the Columbia River Basin with the goal of reducing peak river flows and stages both locally and downstream of the Middle Columbia Projects.

Regulation of the reservoirs frequently involves a variety of conflicting needs, interests, and constraints that require balanced decisions to achieve acceptable project regulation. Project regulation is the responsibility of each project's owner. Direction regarding regulation of the storage managed and operated for flood risk management is issued from NWD to each PUD. NWD has direct involvement in project regulation during periods when coordinated operations are necessary for system flood risk management. Project operators receive direction and oversight from their respective PUD for maintaining daily reservoir elevation targets including the necessary water flow calculations and gate operations required in this process.

2.02 Constraints

Project constraints and limitations are addressed below:

a Minimum Instantaneous Discharge:

Releases from Priest Rapids Dam must not prevent a minimum flow of 36,000 cfs downstream for water supply at Hanford Works, except when conditions are beyond the project control.

b Maximum Hourly and Average Daily Change in Discharge

Wells -

Table 1. Wells Dam Emergency Action Plan (EAP) Discharge Capabilities

	0-15 Minutes	0-2.5 Hours	0-5 Hours	0-12 Hours	0-60 Hours	0-60 Hours
Gates	Open Lower Spillway Gates	Gantry Cranes - Full Open - 1 & 11 – Jumped Gates	Gantry Cranes - Open 2 & 10	Remove Upper Leaf Gate	Remove Upper Gate Leaf - All Remaining Gates	Idle PH - Evacuate
1		44.3	44.3	98	98	98
2	2.2	2.2	44.3	98	98	98
3	44.3	46.7	46.7	46.7	98	98
4	44.3	46.7	46.7	46.7	98	98
5	44.3	46.7	46.7	46.7	98	98
6	44.3	46.7	46.7	46.7	98	98
7	44.3	46.7	46.7	46.7	98	98
8	44.3	46.7	46.7	46.7	98	98
9	44.3	46.7	46.7	46.7	98	98
10	2.2	2.2	44.3	98	98	98
11		44.3	44.3	98	98	98
PH	150	150	150	150	150	0
TOTAL (kcf/s)	465	570	654	869	1228	1078

Note: The above table provides discharge capabilities from the Wells EAP, which does not consider any operational restrictions from middle Columbia projects downstream of Wells.

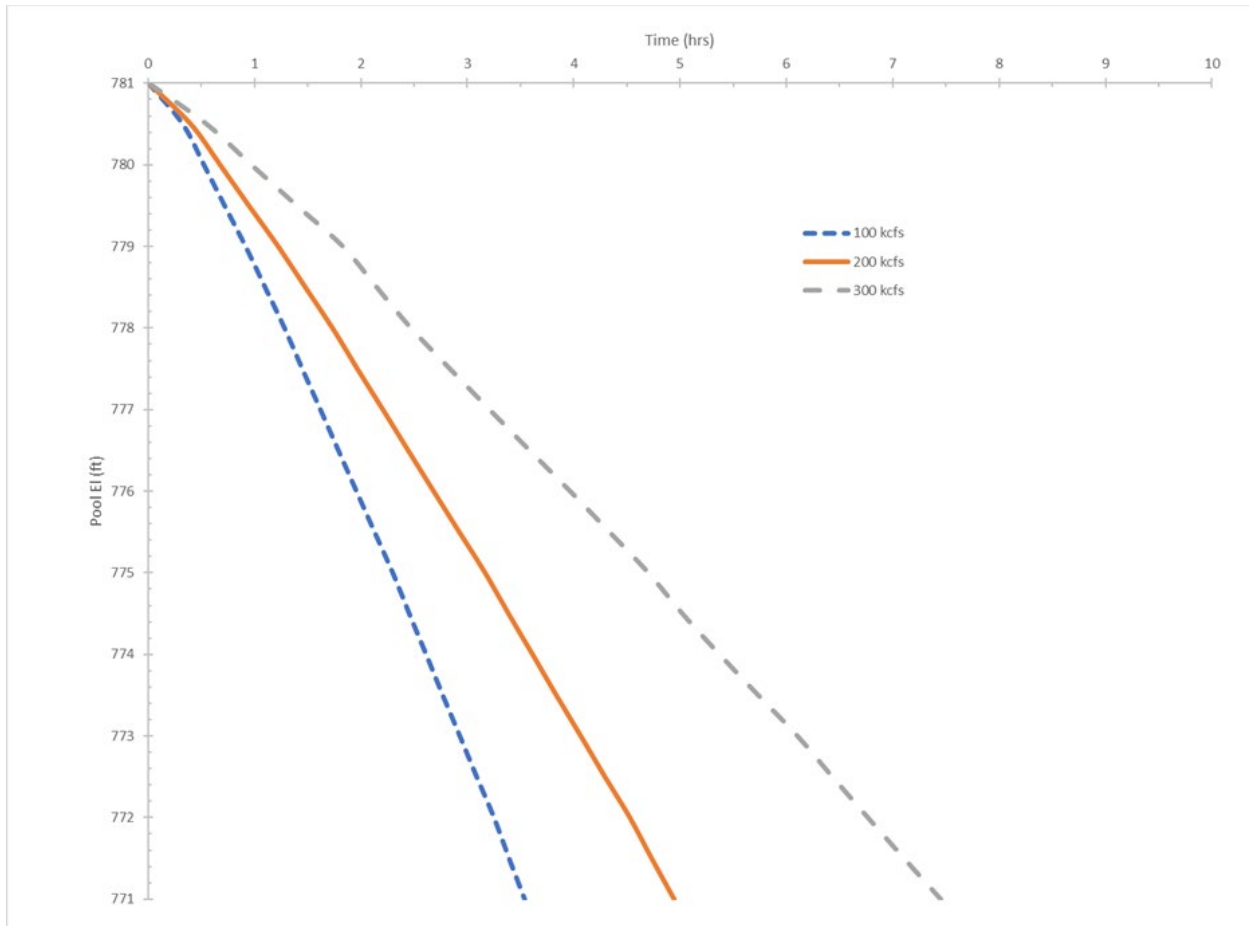


Figure 3. Wells Reservoir Drawdown Rate

Note: Estimates are for three levels of base river flow (100, 200, and 300 kcfs). Analyses assume that 7 spillway gates are opened within 15 minutes to pass 44.3 kcfs each and that 8 units are operating at an average flow of 18.75 kcfs each.

Table 2. Forebay Operating Chart for High Flows at Wells Dam

Chief Joseph Dam Flow + Side Flow (kcfs)	Maximum Forebay Elevation (ft)
450	775.6
500	774.8
550	773.9
600	773.1

In addition, refill at Wells Dam should be managed to ensure that the City of Pateros hydro-logger remains below elevation 781.7 ft.

Rocky Reach – Maximum discharge at 707 ft elevation is 980 kcfs, and this can be reached within as little as 2 hours of spill being initiated.

Rock Island – Maximum spillway discharge (600 kcfs at elevation 604.5 ft; 704 kcfs at elevation 609.0 ft; 821 kcfs at elevation 613.0 ft) can be reached in approximately twenty-one (21) days under normal conditions and could take longer in the event of an earthquake or other unforeseen circumstance. Flows over 821 kcfs will result in headwater exceedance and incremental overtopping consequences. The maximum spillway discharge of 960 kcfs results in a reservoir surcharge to 618.9 ft elevation, which corresponds to the elevation at top of the upstream parapet wall. Expected spillway response times are provided in Table 3, where a best response time assumes no issues and the expected response time accounts for risk-based adjustments.

The project staff would evacuate when headwater elevation rises between 614 and 615 ft²⁰.

Table 3. Best and Expected Spillway Response Times at Rock Island Dam

Spillway Discharge (kcfs)	Best Response Time (hours)	Expected Response Time (hours)
220	0.5	0.5
400	75	120
600	313	500

For Rock Island inflows greater than 440 kcfs, progressively lower headwater elevations are

²⁰ When the Rock Island headwater elevation exceeds 615 ft, flooding of the spillway deck commences. Overtopping of the left abutment occurs starting at elevation 616.5 ft. Tailwater elevations of 583.9 ft and 593.9 ft commences flooding of the tailrace deck of Powerhouse 1 and Powerhouse 2, respectively.

maintained to minimize localized flooding²¹ until an inflow of 610 kcfs is reached (Table 4). This will lower the backwater profile upstream of the project.

Table 4. Forebay Operating Chart for High Flows at Rock Island

Rock Island Inflow (kcfs)	Maximum Forebay Elevation
440	613.0
450	612.5
464	611.8
500	608.0
600	604.5

Turbine units are able to generate power between 50 to 20 ft of net head. Turbines will shut down due to low net head at flows above 500,000 cfs. Rock Island spillway operational changes for high flows/discharges require significant resources and time to implement. Depending on advance notification, this transfer of flow from the powerhouse to the spillway could take anywhere from multiple hours to days.

Wanapum – Spillway Maximum = 1.41 million cfs; Powerhouse Maximum Capacity = 178,000 cfs

Refill rate should be limited to 3 feet per day or 21.25 kcfs differential at Wanapum to permit enough time for necessary surveillance and monitoring activities of the embankments for dam safety purposes. This refill rate constraint is only applicable for elevations below 560 ft.

²¹ Backwater is expected to exceed project boundary limits in the vicinity of the Wenatchee River confluence and the City of Wenatchee when Rock Island inflow exceeds 440 kcfs. These areas are expected to experience flooding along low-lying shoreline areas as flows exceed 500 kcfs.

Priest Rapids – Spillway Maximum = 1.334 million cfs; Powerhouse Maximum Capacity = 180,000 cfs

Refill rate should be limited to 3 feet per day or 11.25 kcfs differential at Priest Rapids to permit enough time for necessary surveillance and monitoring activities of the embankments for dam safety purposes. This refill rate constraint is only applicable for elevations below 481.5 ft.

2.03 Overall Plan for Flood Risk Management

Flood risk management is accomplished through coordinated operation of the storage reservoirs throughout the basin. At the Middle Columbia Projects, storage operations are conducted under guidance provided by NWD. In this flood risk management operation, the reservoirs are drafted prior to the forecasted flood peak to make flood storage space available for refill of the reservoir to reduce the flood peak.

2.04 Standing Instructions to Project Operators

Operation of the physical facilities to accomplish FRM objectives as directed by Columbia Basin Water Management is the responsibility of the PUD project personnel. Such operation will be in accordance with each project's operation and maintenance manuals.

a Normal Operating Procedures The projects are normally staffed 24/7 year-round. Middle Columbia hydro project Control Room operators will only implement reservoir regulation instructions received from their respective PUD (Douglas, Chelan, or Grant County PUD). For flood risk management operations, regulation instructions are provided to PUDs directly from CENWD-PDW-R via the Columbia Basin Telecommunications Network (CBT) and further coordinated via a telephone conversation prior to issuance of the instructions sent via the CBT.

The instructions will also be sent to email addresses designated by the PUDs.

b Emergency Operating Procedures Emergency operating procedures are intended to cover situations in which an immediate response is required by operations personnel in a life safety emergency or to mitigate a potentially catastrophic situation such as an uncontrolled release of water. A loss of communication situation may also require implementation of emergency operating procedures if an operational response is needed sooner than communications can be restored. If an emergency develops requiring immediate action to protect human life or prevent damage to the project, the control room operator should take appropriate action following guidance in the individual project's Emergency Action Plan.

c Data Collection and Reporting

Project operators shall continue to collect and report operational data as described in the CBT User's Manual (USACE, 2004). Data includes, but is not limited to, forebay elevation, tailwater elevation, storage, outflow discharge, spillway outflow discharge, generation, water temperature, barometric pressure, and total dissolved gas.

2.05 Flood Risk Management Operations

Guidelines for flood risk management operations are provided below.

a Notification and Communication of Flood Risk Management Operations

(1) Initial Notification

The PUDs will initially be notified by CENWD-PDW of the potential need to draft the Middle Columbia Projects for spring FRM by approximately the first week of April or as soon as possible. The potential of drafting the projects is based on hydrologic forecasts of probable

regulated peak flow at The Dalles (for determining the drafts at Wells and Rocky Reach) and probable regulated inflow to Priest Rapids Dam (for determining the drafts at Wanapum/Priest Rapids).

Although this WCP is focused on spring snowmelt flooding, operations during winter floods caused by short-duration atmospheric river events may be needed. CENWD-PDW may request assistance from the Middle Columbia Projects, such as smoothing releases or limiting drafting, to make it more feasible to achieve the desired winter FRM operation in the Lower Columbia River. Details of the expected operations required for flood risk management will be furnished to the PUDs by CENWD-PDW-R based on real-time conditions and forecasts. Project operating ranges are considered in real-time operations of projects. While every endeavor will be made to forewarn the project operators of impending operations, this may not always be possible in the event of an emergency due to the sudden onset of the event.

(2) Drawdown

The initiation of drawdown at Wells and Rocky Reach will occur no earlier than two weeks before the predicted date on which the regulated flow at The Dalles is forecasted to equal or exceed 500,000 cfs and at least three days before the total storage space is to be made available. At Wanapum and Priest Rapids, drawdown will be initiated at least three days before the total storage space is to be made available.

Drawdown guidance provided by CENWD-PDW-R will include project forebay elevation constraints in accordance with Water Control Diagrams (Figures 4-6), the day on which that space is required to be available, and project outflow guidance. Drawdown initiation instructions will be based on the latest forecasts available and may be revised as forecasts are updated. As the flood season progresses, USACE will update peak flow forecasts and the PUD may be

directed to increase or decrease the amount of storage provided accordingly, if it is possible to do so. The draft requirement, specified by the forebay elevation instructions, shall be maintained until directed by CENWD-PDW-R to commence refill of these projects.

(3) Refill

The initiation of refill will be based on the latest forecasts available and coordinated reservoir operations modeling performed at CENWD-PDW. Projects may be instructed to refill concurrently or sequentially from upstream to downstream, depending on conditions.

During the refill operation for flood risk management, CENWD-PDW-R will specify outflow or elevation constraints with a specified range for each project.

(4) System Flood Operation

Flood flows within the Columbia system may continue after the Middle Columbia Projects have completed their refill operation. In order to limit downstream flooding, Middle Columbia Projects may not draft below their elevation achieved at the end of the refill operation until the Columbia system flood operation has ended, as indicated by CENWD-PDW-R or unless otherwise directed by CENWD-PDW-R.

(5) Additional Considerations for Priest Rapids and Wanapum Dams

While this document provides operational guidance to satisfy Priest Rapids Project FRM space requirements primarily at Wanapum Dam, Grant PUD may provide FRM storage space at either Wanapum or Priest Rapids Dams as available. The allocation of the FRM space between Wanapum Dam and Priest Rapids Dam may be coordinated between Grant PUD and USACE.

b Water Control Diagrams

Flood risk management operation requirements are presented in Water Control Diagrams for the Wells, Rocky Reach, and Priest Rapids projects (Figure 4 through Figure 6). The diagrams include drawdown and refill elevations required for various hydrologic conditions over the duration of the flood season. The diagrams are supplemented with Table 5 through Table 8 that include equivalent storages for each elevation. An approximate summary of total Middle Columbia River project FRM space available is shown in Table 9.

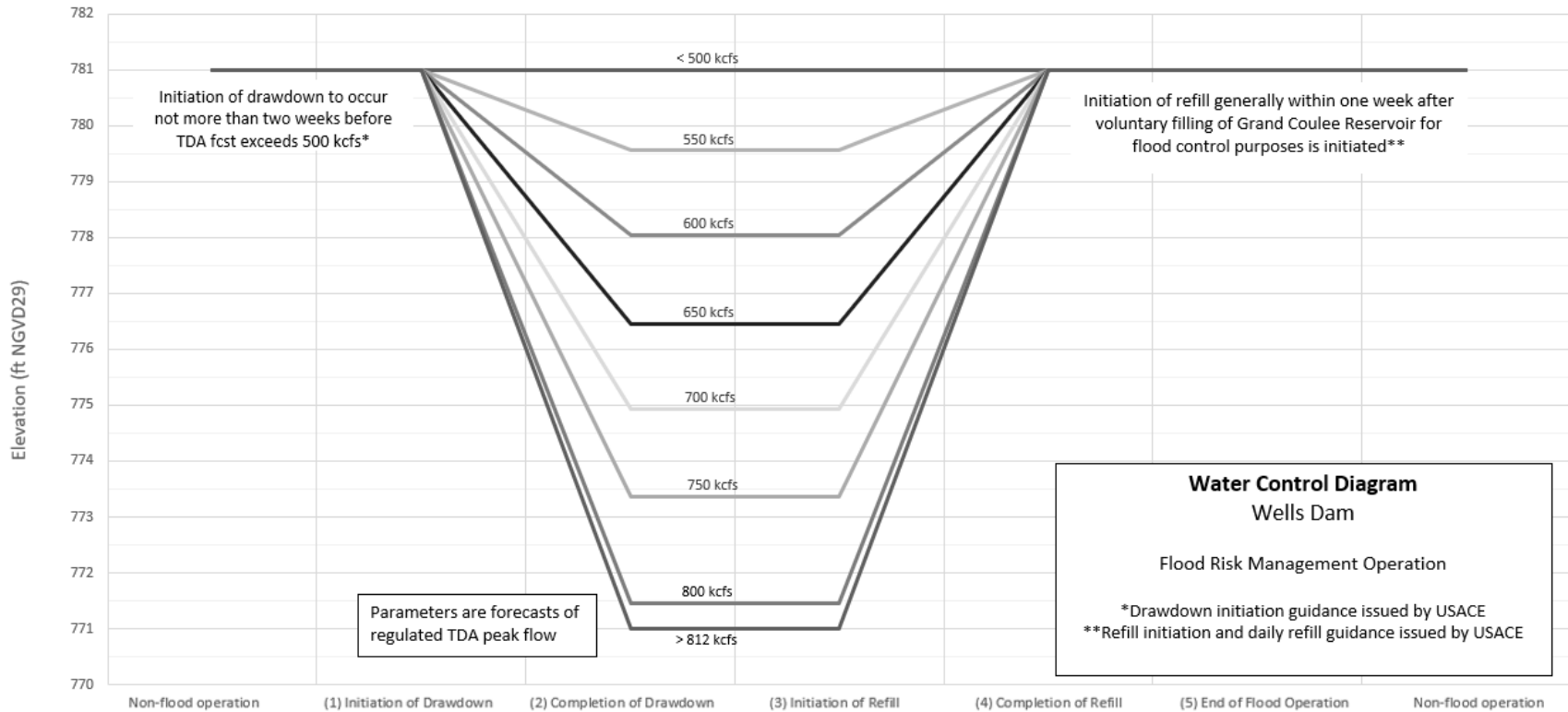


Figure 4. Wells Water Control Diagram

Note: The forecasted regulated peak flow parameter does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.

Table 5. Wells Dam Storage Space Requirements

Projected Regulated Flow At The Dalles ¹ (kcfs)	Storage Replacement Requirement /Available ² (kaf)	Draft Requirement (ft)
500	0.0	781.0
550	10.4	779.6
600	20.8	778.0
650	31.3	776.5
700	41.7	774.9
750	52.1	773.4
758	53.6	773.1
800	62.5	771.4
812	64.9	771.0
850	72.9/63.8	771.0
900	83.3/62.6	771.0
950	93.8/61.5	771.0
1000	104.2/60.5	771.0

1. The projected regulated peak flow does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.
2. The Lost Valley Replacement Requirement exceeds the space available when The Dalles inflow exceeds 812 kcfs. FRM space available in the reservoir decreases as Wells Project inflows exceed 487 kcfs (approx. 812 kcfs at The Dalles) due to the hydraulic characteristics of the river channel (slope storage).

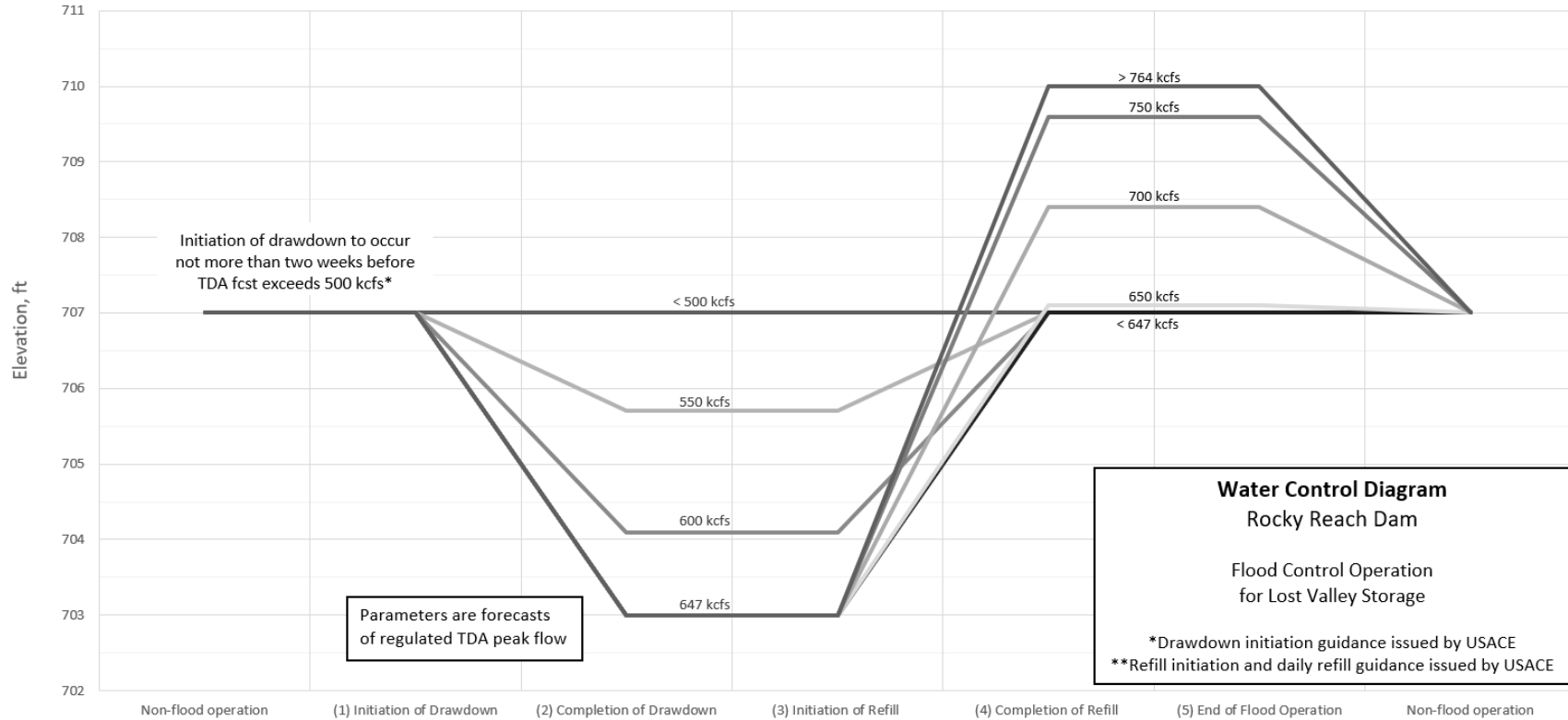


Figure 5. Rocky Reach Water Control Diagram

Note: The forecasted regulated peak flow parameter does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.

Table 6. Rocky Reach Dam Storage Space Requirement

Projected Regulated Peak Flow At The Dalles ¹ (kcfs)	Storage Replacement Requirement /Available ² (kaf)	Draft Requirement (ft)	Refill Target (ft)
500	0.0	707.0	707.0
550	10.0	705.7	707.0
600	20.0	704.1	707.0
647	29.3	703.0	707.0
650	30.0	703.0	707.1
700	40.0	703.0	708.4
750	50.0	703.0	709.6
764	52.8	703.0	710.0
800	60.0/52.5	703.0	710.0
850	70.0/52.0	703.0	710.0
900	80.0/51.5	703.0	710.0
950	90.0/50.9	703.0	710.0
1000	100.0/50.4	703.0	710.0

1. Projected regulated peak flow does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.
2. The Lost Valley Replacement Requirement exceeds the space available when The Dalles inflow exceeds 764 kcfs. FRM space available in the reservoir decreases as Rocky Reach Project inflows exceed 458 kcfs (approx. 764 kcfs at The Dalles) due to the hydraulic characteristics of the river channel (slope storage).

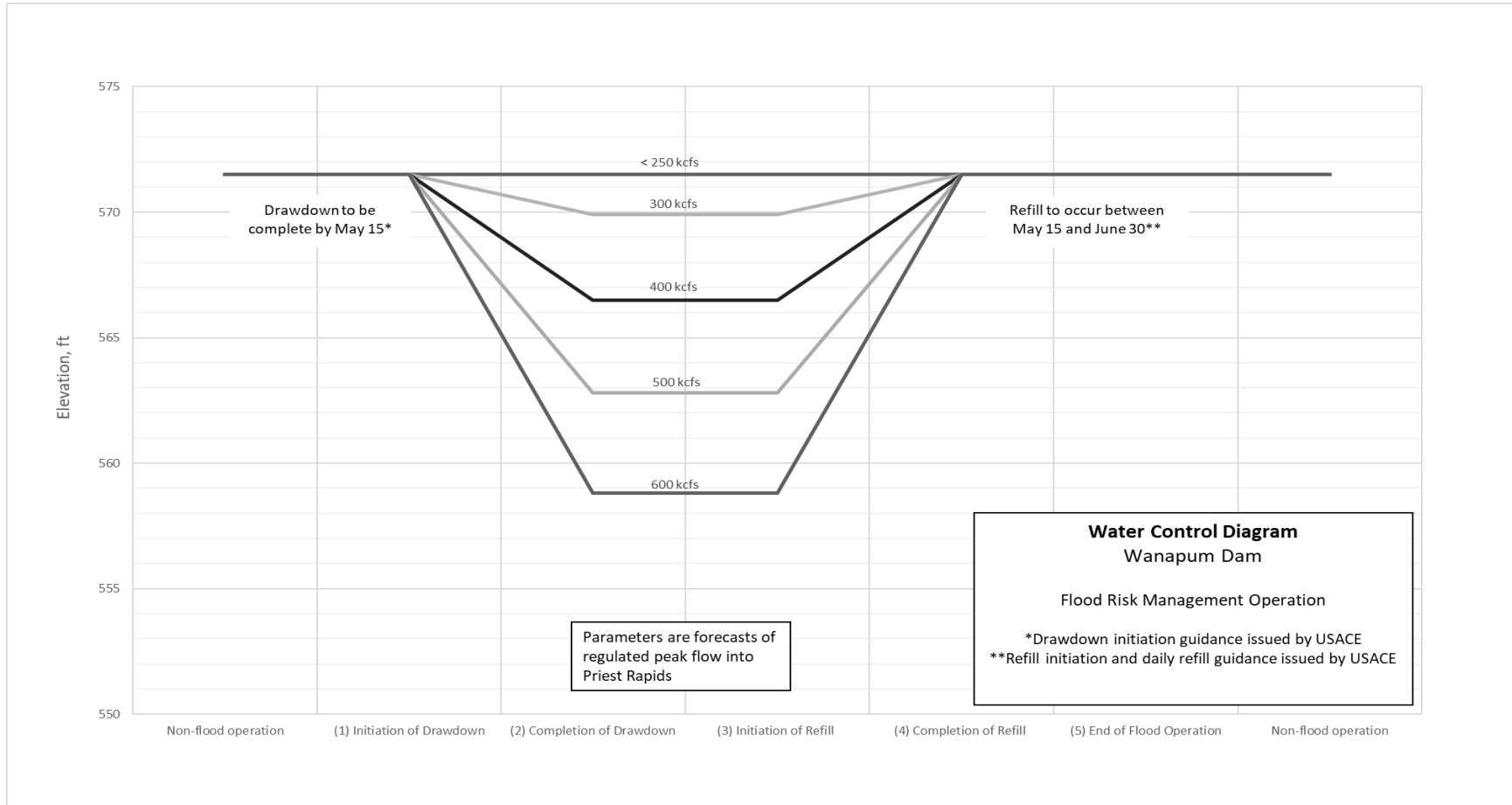


Figure 6. Wanapum Water Control Diagram

Note 1: The Water Control Diagram above reflects the condition that all the Lost Valley storage space is provided at Wanapum Dam. Storage space may be provided in either or both Wanapum and Priest Rapids reservoirs as available. Grant County PUD may exchange a portion of the space required from Wanapum to Priest Rapids in coordination with CENWD-PDW-R at the initiation of drawdown.

Note 2: The forecasted regulated peak flow parameter does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.

Table 7. Wanapum Dam Storage Replacement Requirements

Projected Regulated Peak Inflow To Priest Rapids ^{1,2} (kcfs)	Storage Replacement Requirement (kaf) ³	Draft Requirement (ft) ³	Refill Target (ft)
250	0.0	571.5	571.5
300	22.5	569.9	571.5
350	45.0	568.2	571.5
400	67.5	566.5	571.5
450	90.0	564.6	571.5
500	112.5	562.8	571.5
550	135.0	560.8	571.5
600	157.5	558.8	571.5

1. The Lost Valley Replacement Requirement for Wanapum is based on the peak inflow to Priest Rapids rather than The Dalles.
2. The projected regulated peak inflow does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.
3. The Water Control Diagram above reflects the condition that all the flood storage space is provided at Wanapum Dam. Storage space may be provided in either or both Wanapum and Priest Rapids reservoirs as available. Grant Co. PUD may exchange a portion of the space required from Wanapum to Priest Rapids in coordination with CENWD-PDW-R at the initiation of drawdown.

Table 8. Priest Rapids Project (Wanapum and Priest Rapids Dams) Estimated Space Available¹

Projected Regulated Peak Inflow To Priest Rapids ² (kcfs)	Priest Rapids Space Available Between 481.5 ft and 488.0 ft ³ (kaf)	Wanapum Space Available Between 560.0 ft and 571.5 ft ⁴ (kaf)	Total Wanapum and Priest Rapids Space Available Within Normal Operating Range ⁵ (kaf)
250	36.5	154.0	190.5
300	35.6	152.4	188.0
350	34.8	150.8	185.6
400	34.1	149.2	183.3
450	33.6	147.5	181.1
500	33.1	145.9	179.1
570	32.7	143.7	176.4
600	32.5	142.8	175.3
650	32.4	141.2	173.6
700	32.4	139.6	172.0

1. This table may be used to determine space exchange from Wanapum to Priest Rapids Dam.
2. The projected regulated peak inflow does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.
3. The Priest Rapids space available is shown within the project's normal operating range (481.5 ft to 488.0 ft).
4. The Wanapum space available is shown within the project's normal operating range (560.0 ft to 571.5 ft).
5. The total space available within the projects' normal operating range is constrained by physical limitations, such as sloped storage effects at higher inflows.

Table 9. Approximate Summary of Total Middle Columbia River Project Lost Valley Storage Space

Projected Regulated Peak Flow at The Dalles (kcfs) ^{1,2}	Wells Dam Lost Valley Storage Space (kaf)	Rocky Reach Dam Lost Valley Storage Space (kaf)	Priest Rapids Project Lost Valley Storage Space (kaf)	Total Middle Columbia River Project Lost Valley Storage Space (kaf)
500	0.0	0.0	22.5	22.5
550	10.4	10.0	36.0	56.4
600	20.8	20.0	49.5	90.3
650	31.3	30.0	63.0	124.3
700	41.7	40.0	76.5	158.2
750	52.1	50.0	90.0	192.1
800	62.5	52.5	103.5	218.5
850	63.8	52.0	117.0	232.8
900	62.6	51.5	130.5	244.6
950	61.5	50.9	144.0	256.4
1000	60.5	50.4	157.5	268.4

1. The FRM requirements for Wells and Rocky Reach are based on projections of regulated peak flows at The Dalles. The Priest Rapids Project requirements are based on projections of regulated peak inflows to Priest Rapids. This table assumes that Priest Rapids inflows are 60% of the regulated flows at The Dalles, for purposes of this summary.
2. Projected regulated peak flow does not include regulation effects from Canadian storage being operated pursuant to a Columbia River Treaty Article IV(3) call.

2.06 Flood Emergency Action Plans

a Emergencies

In the event the project's structural integrity is or could be threatened or if outflows will or could endanger downstream human life or property, the procedures outlined in the individual project's "Emergency Action Plan" (EAP), are to be followed.

b Abnormal Condition

Should condition(s) occur or appear to be developing, other than those described in the Emergency Action Plan, which require operational modification, the Project Engineer, or powerhouse operator will promptly contact the PUD Regulation Assistance Personnel to report the field conditions and receive instructions. NWD and other parties upstream and downstream of the project that are possibly affected by the condition, will also be informed as soon as possible. When immediate action is required to protect life and valuable property, the Project Engineer or powerhouse operator will not wait for instruction.

2.07 Deviation from Normal Regulation

Some deviation from normal operation and regulation can be expected periodically and can be planned or unplanned. The need for planned deviations can occur for a variety of reasons. Construction activities typically account for the majority of these requests and can include construction at a project or locations upstream or downstream with varied purposes such as utility stream crossings, bridge work, and major construction contracts. Other reasons for planned deviations could include maintenance work, operations related to habitat work or for fisheries purposes, or other purposes. Potential deviations from this Water Control Plan,

including changes in gate and operating pool availability during flood season (April – June) will be considered on a case-by-case basis before being submitted to NWD for requested approval. NWDR 1110-2-6, Deviation Requests for Approved Water Control Manuals, provides guidelines concerning deviations from approved WCMs/WCPs. Policy guidance does allow immediate water management actions to occur absent an approved deviation request in emergency situations, details are provided in NWDR 1110-2-6.

2.08 Rate of Release Change

All reservoir releases at the Middle Columbia Projects are subject to the condition that no release shall be made at rates or in a manner that would be inconsistent with operating rules and regulations required for the purpose of protecting the dam and critical project features from damage, excluding force majeure events and circumstances beyond reasonable control.

2.09 Climate Change

The ER 1110-2-240, dated 30 May 2016, states that water control management policies and procedures shall be evaluated for adaptation to climate change. There is a consensus among climate scientists that changes in long-term climate and weather patterns are likely in the Columbia River Basin. Climate change has implications for reservoir regulation and flood risk management in the Middle Columbia. In particular, a change in the timing of the regulated annual peak at The Dalles may necessitate re-evaluation of the beginning of the spring refill period specified for the Priest Rapids Project. Under future climate change scenarios, the median projection of the regulated annual peak flow at The Dalles occurs prior to May 15, starting in the 2050s (Exhibit A). Many of the operations described in this Plan allow adaptation for climate change.

EXHIBIT A. CLIMATE CHANGE ANALYSIS

The effects of a warming climate will have an influence on the timing of seasonal snowmelt runoff. Historically, the peak of the snowmelt runoff freshet of the Columbia River occurred after the May 15 start of refill period specified for Priest Rapids Project. As global and regional temperatures continue to rise, the center of timing of spring snowmelt runoff is expected to occur earlier in spring (RMJOC, 2018; RMJOC, 2020).

The Columbia River Management Joint Operating Committee (RMJOC) developed climate and hydrological projections for the period of 1951-2099. USACE used these projections in reservoir modeling to simulate regulated streamflow in the reservoir system under current operating assumptions. The model simulations include 160 different projections of regulated flow from 1951-2099. 80 of these projections represent a condition of high greenhouse gas (GHG) emissions (RCP 8.5). The remaining 80 projections represent a scenario that includes assumptions of reductions of global GHG emissions by the end of the 21st century (RCP 4.5).

The timing of the annual maximum spring regulated streamflow of the Columbia River at the Dalles Dam, Oregon is projected to occur earlier (Figure E-1). More than half of the projections indicate that under the moderate GHG emissions scenario (RCP 4.5) the timing of the spring peak flow could occur before May 15 by the 2050s decade (Figure E-1a). Under the higher GHG emissions scenario, half of the projections indicate that this could begin to occur in the 2040s and shift to occurring in late April or early March by the end of the century.

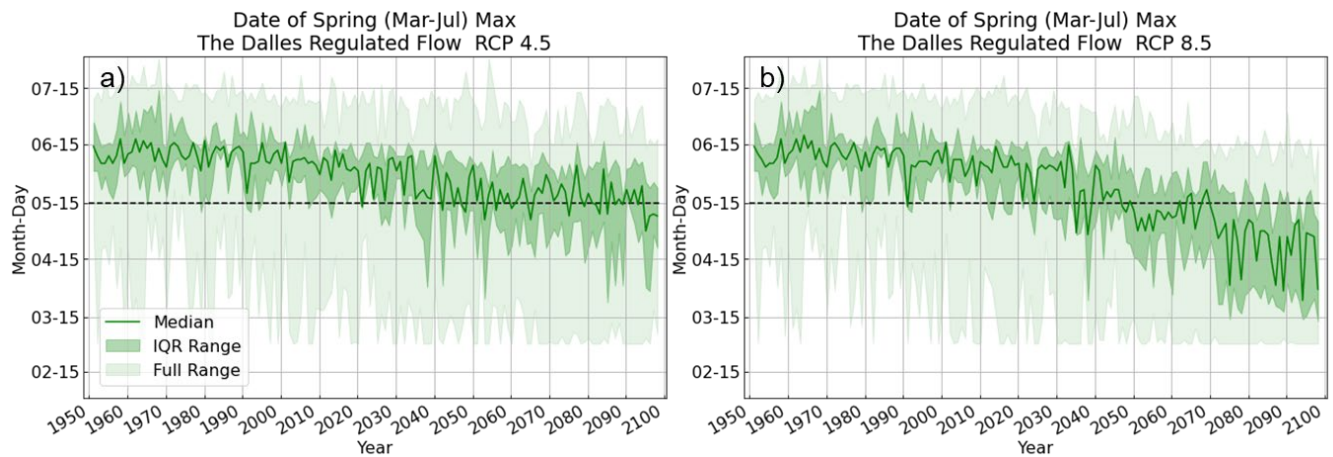


Figure E-1: Simulated date of annual maximum March-July regulated streamflow of the Columbia River at the Dalles Dam, Oregon for a moderate greenhouse gas emissions scenario (a), and a high greenhouse gas emissions scenario (b). The light green shaded area indicates the full range of projections. The dark green shaded area indicates the interquartile range of the ranges. The dark green line represents the median of the projections.

References

RMJOC, 2018. Climate and Hydrology Datasets for RMJOC Long-Term Planning Studies: Second Edition (RMJOC-II), Part I: Hydroclimate Projections and Analyses. Portland, OR: River Management Joint Operating Committee.

<https://www.bpa.gov/p/Generation/Hydro/hydro/cc/RMJOC-II-Report-Part-I.pdf>.

RMJOC, 2020. Climate and Hydrology Datasets for RMJOC Long-Term Planning Studies: Second Edition (RMJOC-II), Part II: Columbia River Reservoir Regulation and Operations—Modeling and Analyses. Portland, OR: River Management Joint Operating Committee.

https://www.bpa.gov/p/Generation/Hydro/Documents/RMJOC-II_Part_II.PDF