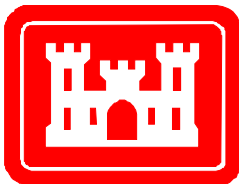

US Army Corps of Engineers
Portland District

Willamette Basin Review Feasibility Study

APPENDIX E

ResSim Analysis for 2008 Baseline Flow Dataset

June 2018

Appendix E

Willamette Basin Review – ResSim

Analysis for 2008 Baseline Flow Dataset

This report documents the HEC-ResSim simulation that is the Baseline model for the Willamette Basin Review (WBR). This is the simulation that represents the "without project" alternative in the study, and it is also the simulation used for the analysis computing the stored water volume needed from the Willamette reservoirs to support the BiOp (Biological Opinion) flows. This Baseline simulation is often referred to as the Baseline "Model", since the operation sets used in the simulation model the Willamette system operations by USACE.

This report documents the ResSim program inputs, such as the reach routing and the physical parameters, and also the specific operation sets and rules at each of the Willamette projects used in the Baseline. The alternatives analyzed for the WBR Feasibility Study will then be described within the Feasibility report as differences from the Baseline model presented here.

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1 Introduction

The U.S. Army Corps of Engineers Portland District (Corps) owns and operates thirteen multi-purpose projects in the Willamette Valley which are operated as a system, not as independent entities. All projects in the basin share the various functions included in an overall water resources management plan designed to provide flood damage reduction, hydropower generation, irrigation, navigation, recreation, and water quality throughout the basin. This system of reservoirs is modeled in the program HEC-ResSim to define a Baseline description of the system operation for the Willamette Basin Review (WBR). The identification of a Baseline is important when assessing alternatives with the WBR Feasibility Study, as it provides a point of reference for comparison and for weighing potential benefits and impacts of those alternatives. This Baseline analysis is the "without project" alternative in the WBR Feasibility Study.

CENWP developed a routing model of the Willamette Basin over a number of years, using the Reservoir System Simulation Program HEC-ResSim. This program was created by the USACE office HEC, the Hydrologic Engineering Center, in the Institute for Water Resources. The ResSim software simulates reservoir operations as programed by the user and is a powerful decision support tool for modelers performing reservoir project studies. The CENWP office uses the ResSim program for many Willamette Basin studies, adapting the reservoir operation rule sets as needed for each particular study.

Purpose of Report –The purpose of this report is to fully document the ResSim analysis details used for the "without project" alternative, which is referred to simply as the "Baseline" or the "Baseline Model" throughout this report.

Purpose of the Baseline Simulation –The purpose of the Baseline simulation is to obtain quantitative results for reservoir operations and regulated streamflows using a formalized set of operational rules for each dam that is used as a proxy for real-time reservoir regulation decisions. Most importantly, the Baseline is not meant to reproduce observed data, since the model does not take into account any of the special operations, repairs, or forecasting information available to the water management team in real-time. Furthermore, the model uses a flow dataset spanning more years than the dams have been built. The power of the Baseline is that the same set of rules are applied without bias for each year of the flow dataset, providing a spread of regulated streamflows and reservoir levels that generally mimics what could have happened.

Use of the Baseline Simulation Results –The results of the Baseline simulation are used to determine statistical information on: reservoir storage, elevation, and outflows; the frequency that regulated flows meet or do not meet target values; and the number of years when obligations cannot be met due to lack of enough water in the system. These results are the point of reference for comparison to simulations of any alternatives to the Baseline in order to quantify changes that may result from alternatives.

What the Baseline Is Not –It is also important to understand what the Baseline is not. The Baseline is not a real-time water management tool, and does not use forecasts such as the availability of snow pack or inflow predictions from the weather service. In water management at CENWP, every year has a

unique conservation plan developed, and in low water years, there are drought contingency plans developed with coordinating agencies. The Baseline results will differ more from real-time regulation the drier the year, since the program models every day consecutively without the benefit of looking ahead for a whole season.

Study Area – An image of the ResSim network for the WBR Baseline is shown in Figure 1.1 defining the study area. The outlined gray area is the whole Willamette Basin. The major river of the basin is the Willamette River, which flows northward from the southern end of the basin until it meets the Columbia River at its northern end. The ResSim model includes all thirteen of the Corps dams, all river reaches with Corps dams, and selected control points from the southern end of the basin to Oregon City above Willamette Falls (which is the upper-right most red dot outlined with a white circle). The flow dataset used for analysis includes all of the surface water from the southern end of the basin to (and including) Oregon City above the Falls. The portion of the Willamette River flowing through Portland, Oregon, is downstream of Willamette Falls and is not included in the reservoir model, and neither is any flow coming into the river downstream of the Falls. The Willamette River below the Falls has a tidal influence that cannot be modeled in ResSim.

In Figure 1.1, the green and orange lines represent part of the Watershed, which is the fundamental building block of the reservoir model, outlining the streams in the smaller sub-basins (green) and the larger streambeds (orange). There are calculation points (green dots) that are also part of the watershed. The reservoir network is superimposed over the watershed. In the network image below, the dark blue lines are the river reaches that are analyzed in simulations, and these are superimposed on the orange streamlines of the watershed. Only the river reaches controlled by the USACE dams in the basin are modeled (shown in dark blue), leaving tributaries out of USACE control like the Tualatin River and the Calapooia River as orange lines. A river reach that isn't modeled means that there are no computation points for flow on that reach – the inflows from those reaches are still included in the flow dataset. The modeled river reaches are connected at junction points (shown as red dots, which are superimposed over some of the green dots), with the red dots outlined by squares representing the control points. Junctions outlined with a white circle have a flow component specified in simulations, and junctions with a square around them indicate a location used for downstream flow control in rules. The thirteen Corps dams are input as reservoirs and shown as light blue, with the smallest reservoirs (Foster and Big Cliff) not visible at the scale of the figure.

Figure 1.1. ResSim network for the Baseline simulation.

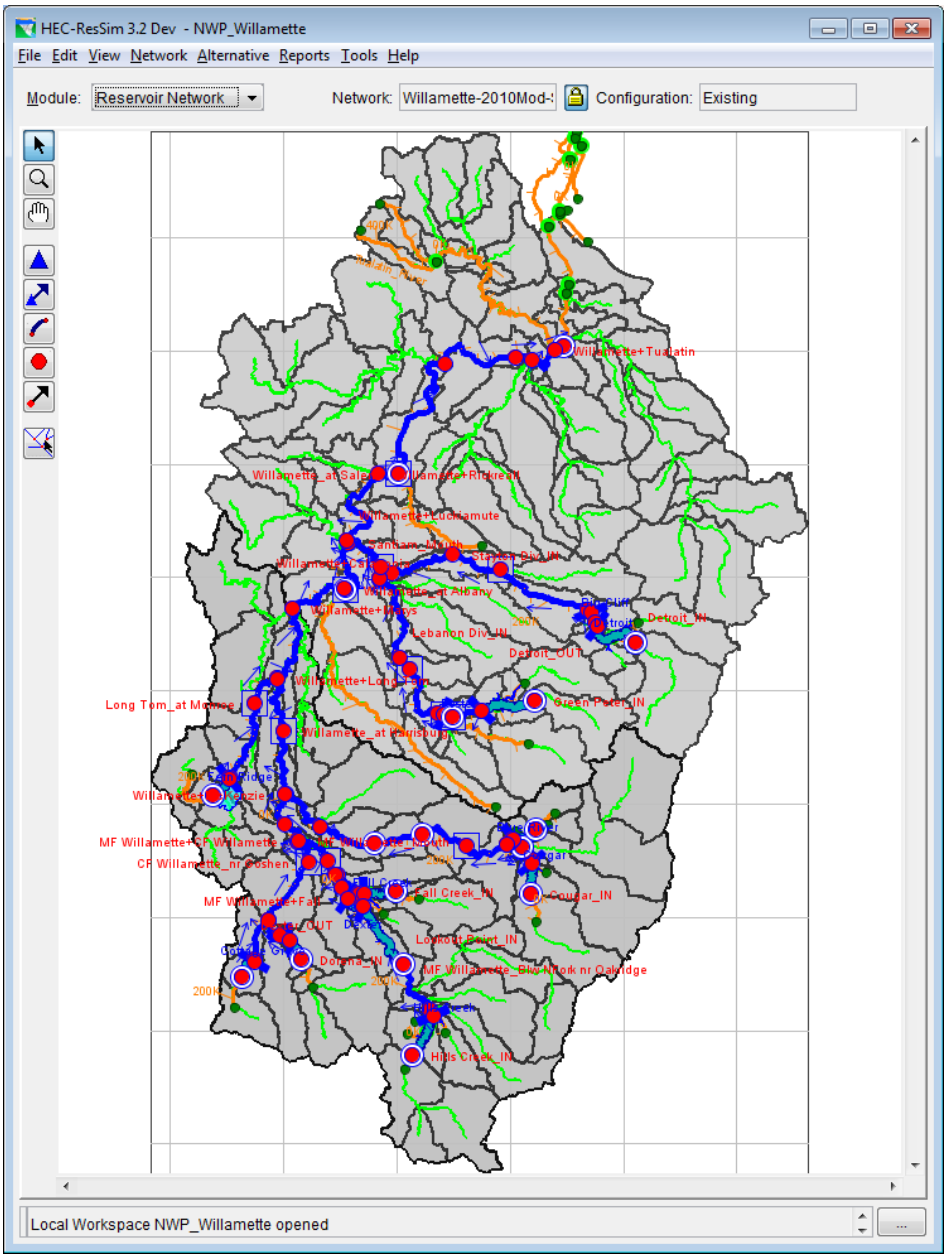


Table 1.1 below lists the specifics of the Baseline simulation described in this report. The version of ResSim used is specified first, then the watershed, network, and configuration are listed. The alternative is made of the operation set used for each project, the initial conditions used (the lookback elevations and flows), and the specification of any time series to be used. The simulation is the specified starting and ending dates, the lookback date, the alternative used, and the time step used. Note that the project names in the table below are given by their three letter descriptions used in the water management reservoir regulation section (DET=Detroit, BCL=Big Cliff, GPR=Green Peter, FOS=Foster, CGR=Cougar, BLU=Blue River, HCR=Hills Creek, LOP=Lookout Point, DEX=Dexter, FAL=Fall Creek, COT=Cottage Grove, DOR=Dorena, and FRN=Fern Ridge).

Table 1.1. Summary of the Specifics for the Baseline Simulation.

ResSim Version	HEC-ResSim_3.2.0.1197_Dev_Build_64-bit
Watershed	NWP_Willamette
Network	Willamette-2010Mod-SSARR
Configuration	Existing
Alternative	BetBase
Inflow File Name	Final Flows WBR – from 2010 Mod Flows and Hybrids.dss
Rule Curve File	Willamette_Rule_Curves.dss
External Variables File	Water Year Type for 2010 Mod Flows.dss
Simulation Name	Baseline-14April2017
Simulation Start	04 Oct 1928 at 2400
Simulation Lookback	01 Oct 1928 at 2400
Simulation Ending	30 Sep 2008 at 2400
Time Step	1 day

Project	**Operation Set**	**Lookback Elevation**	**Lookback Flows (cfs)**
DET	DET better Baseline	Rule Curve	Power Plant 1500.0, Spillway and ROs 0.0
BCL	IRRM and Early Imp	1193.0 ft	Power Plant 1500.0, Spillway 0.0
GPR	Better GPR Baseline	Rule Curve	Power Plant 1500.0, Spillway and RO 0.0
FOS	Better FOS Baseline	Rule Curve	Power Plant 1500.0, Spillway 0.0
CGR	FIS Flood OPs & Early Imp	Rule Curve	Power Plant 400.0, Spillway and RO 0.0
BLU	FIS Flood OPs & Early Imp	Rule Curve	RO 50.0, Spillway 0.0
HCR	FIS Flood OPs & Early Imp	Rule Curve	Power Plant 400.0, Spillway and ROs 0.0
LOP	FIS Flood OPs & Early Imp	Rule Curve	Power Plant 1200.0, Spillway and ROs 0.0
DEX	Early Imp	693.0 ft	Power Plant 1200.0, Spillway 0.0
FAL	FIS and Early Imp 728	Rule Curve	RO 200.0, Spillway 0.0
COT	FIS Flood OPs & Early Imp	Rule Curve	RO 50.0, Spillway 0.0
DOR	FIS Flood OPs & Early Imp	Rule Curve	RO 100.0, Spillway 0.0
FRN	Improved Baseline	Rule Curve	RO 30.0, Spillway and Sluice Gate 0.0

Note that the Lookback flows coincide with the minimum tributary flow of each project for the beginning of October, and the outlet for the release corresponds with the release allocation specified later in Section 4.

The following sections of this report are organized as follows:

Section 2 – A brief description of the flow dataset used. This dataset is fully described in another report, "Willamette Basin Review – Flow Dataset Used for ResSim Analyses", but some general comments about the dataset are provided here. This dataset remains constant throughout the evaluation of any alternatives for the Feasibility report as well. Some details about water year types (basically dry to wet years) are provided, and water year types are integral to the alternative assessments in the WBR Feasibility report.

Section 3 – Baseline details of the ResSim model related to the watershed/network/and configuration. This includes physical parameter descriptions for each dam, the reach routings used, and a description of the flow dataset used. This section represents the model setup of details that will not change through any alternatives evaluated for the Feasibility report.

Section 4 – General ResSim operations and Willamette Basin reservoir regulation goals are described in this section. Downstream control measures that affect multiple dam operations are included in this section. The Biological Opinion (BiOp) requirements for the basin will also be described here.

Sections 5 to 15 – The operation sets (which consists of reservoir zones and rules) for the eleven storage projects in the Willamette are covered in these sections. The order the projects are described is consistent the BiOp water volume computation report (Appendix C WBR – Calculation of Water Volumes Required to Meet Willamette BiOp Minimum Flows for April through October), which is Blue River, Cougar, Dorena, Cottage Grove, Fall Creek, Hills Creek, Lookout Point (with Dexter), Fern Ridge, Green Peter, Foster, and Detroit (with Big Cliff).

Section 16 – A brief review of the Baseline results will be provided in this section. This section lays the foundation for how alternatives will be assessed, relative to the Baseline, and provides some descriptions of the methodology used to summarize the results from 80 years of simulated regulation.

Section 17 – Conclusions and summaries regarding the Baseline simulation for the WBR, including some comments about the limitations of the model for winter season results.

2 The Period of Record Flows Used for Analyses

This section provides a brief discussion of the flow dataset used for the model simulation and a discussion of the water year types in this Period of Record (POR), which are designations for wet through dry years.

2.1 Reservoir Inflows and Local Flows

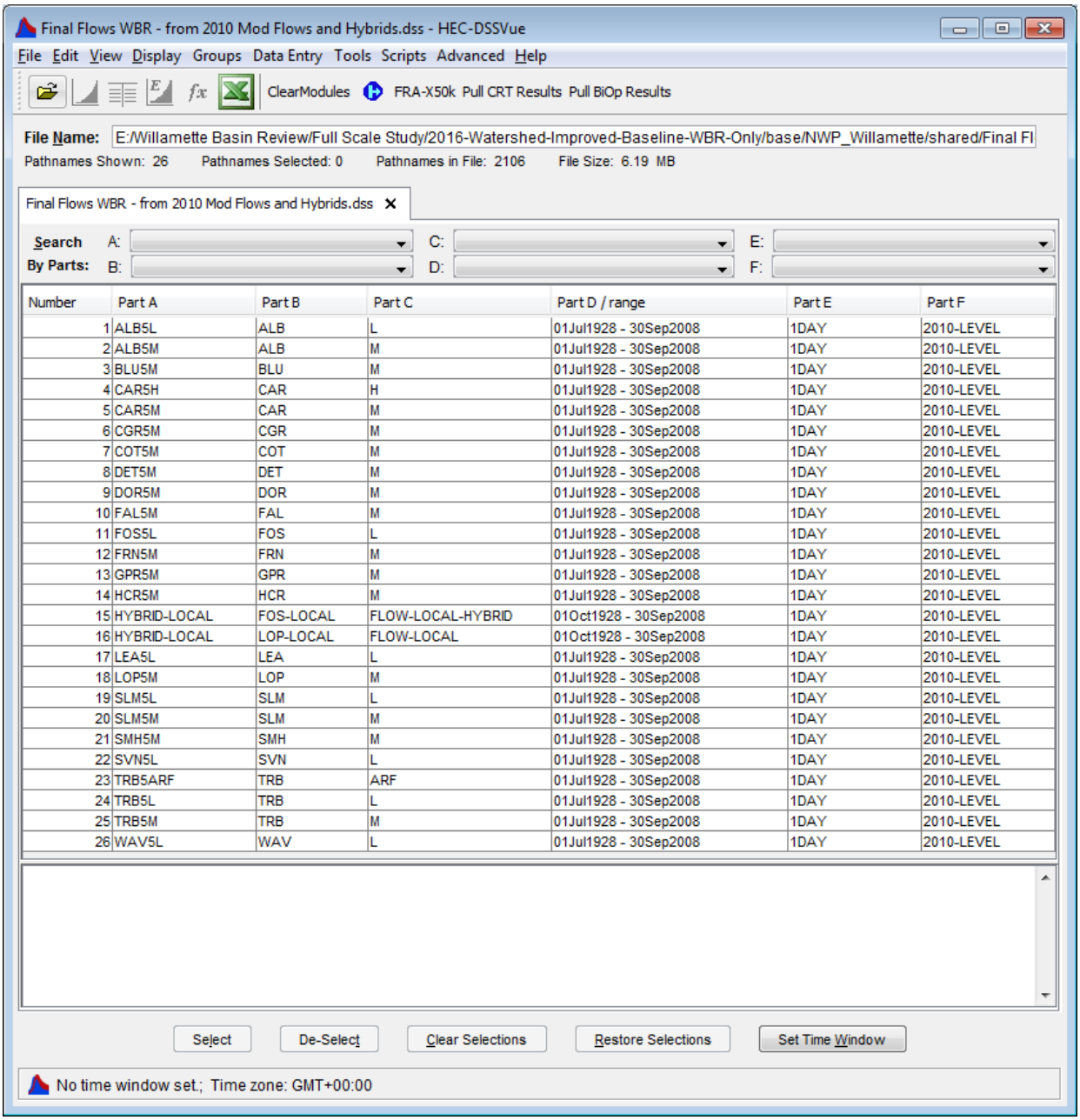
The flows used in the WBR Baseline are from the 2010 Level Modified Streamflows, a complete set of flows for the whole Columbia Basin developed jointly by the Bonneville Power Administration, the US Army Corps of Engineers, and the Bureau of Reclamation. These agencies develop an additional ten years of streamflows every decade, with every year in their complete set adjusted to represent the latest levels of irrigation and evaporation. The modified flows are defined as the historical streamflows that would have been observed without reservoir regulation and will all years adjusted to the same level of irrigation depletions in 2008 so that changes in irrigation practices have accounted for across all years of the dataset. The use of this flow dataset for the WBR is documented in the report "Appendix D Willamette Basin Review – Flow Dataset Used for ResSim Analyses" and the development of the complete dataset for the Columbia Basin is documented in the report "2010 Level Modified Streamflow, 1928-2008".

The relevant flows for the Willamette Basin used for the WBR Baseline were extracted from the complete dataset of the modified flows in the DSS file *2010_modified.dss* and put into a DSS file *Final Flows WBR – from 2010 Mod Flows and Hybrids.dss*. A DSS file is viewed in the program HEC-DSSVue, which displays each time series record in the file with a six-part name. The part names are listed in six columns and labeled Part A through Part F, with Part D always representing the time range of the data and Part E always indicating the time step unit of the data. The time series records displayed are numbered, but the number is not fixed to that specific record – time series records may be sorted in many ways, and the displayed view of the file always starts with record Number 1. An image of the DSS file used for the WBR Baseline is shown in Figure 2.1. Any record with an "M" in the Part C is a total flow record for that location, and any record with an "L" in Part C is a local flow record at that location. So the SLM5M time series record (row number 20 in the image) is the total unregulated flow at Salem, while the SLM5L time series record (row number 19 in the image) is the local flows coming into Salem.

The headwater projects in the Willamette use the "5M" time series records shown in the image. Two reservoirs, Foster and Lookout Point, which are in series with upstream reservoirs, needed some slight adjustments to the "5L" inflows, and those two reservoirs use the hybrid records shown in rows 15 and 16 in the image. The 2010 Modified flow development used a slightly different routing upstream of each of these reservoirs than is used in the ResSim Baseline, so the published FOS5L and LOP5L time series did not quite produce unregulated outflows at Foster and Lookout Point equal to FOS5M and LOP5M when Green Peter and Hills Creek inflows GPR5M and HCR5M were applied.

Table 2.1 below shows the full specification for the time series records used for the Baseline simulation.

Figure 2.1. Image of HEC-DSS file for the flow inputs for the WBR Baseline.



Number	Part A	Part B	Part C	Part D / range	Part E	Part F
1	ALB5L	ALB	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
2	ALB5M	ALB	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
3	BLU5M	BLU	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
4	CAR5H	CAR	H	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
5	CAR5M	CAR	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
6	CGR5M	CGR	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
7	COT5M	COT	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
8	DET5M	DET	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
9	DOR5M	DOR	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
10	FAL5M	FAL	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
11	FOS5L	FOS	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
12	FRN5M	FRN	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
13	GPR5M	GPR	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
14	HCR5M	HCR	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
15	HYBRID-LOCAL	FOS-LOCAL	FLOW-LOCAL-HYBRID	01Oct1928 - 30Sep2008	1DAY	2010-LEVEL
16	HYBRID-LOCAL	LOP-LOCAL	FLOW-LOCAL	01Oct1928 - 30Sep2008	1DAY	2010-LEVEL
17	LEA5L	LEA	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
18	LOP5M	LOP	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
19	SLM5L	SLM	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
20	SLM5M	SLM	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
21	SMH5M	SMH	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
22	SVN5L	SVN	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
23	TRB5ARF	TRB	ARF	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
24	TRB5L	TRB	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
25	TRB5M	TRB	M	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL
26	WAV5L	WAV	L	01Jul1928 - 30Sep2008	1DAY	2010-LEVEL

Table 2.1 Flow Time Series Specification in the WBR Baseline.

Location	Part A	Part B	Comments
Headwater Reservoirs:			
Hills Creek	HCR5M	HCR	All flows into reservoir
Fall Creek	FAL5M	FAL	All flows into reservoir
Dorena	DOR5M	DOR	All flows into reservoir
Cottage Grove	COT5M	COT	All flows into reservoir
Cougar	CGR5M	CGR	All flows into reservoir
Blue River	BLU5M	BLU	All flows into reservoir
Fern Ridge	FRN5M	FRN	All flows into reservoir
Green Peter	GPR5M	GPR	All flows into reservoir
Detroit	DET5M	DET	All flows into reservoir
Downstream Reservoirs:			
Lookout Point	HYBRID-LOCAL	LOP-LOCAL	All flow into LOP between the downstream face of HCR dam and LOP dam. This hybrid flow set makes the total unregulated outflow from LOP equal LOP5M.
Foster	HYBRID-LOCAL	FOS-LOCAL	All flow into FOS between the downstream face of GPR dam and FOS dam, including the unregulated South Santiam River. This hybrid flow set makes the total unregulated outflow from FOS equal FOS5M.
Local Inflows:			
Trail Bridge	TRB5M	M	All inflows to the Trail Bridge reservoir, a small non-USACE project on the upper McKenzie River. This flow includes the outflows from the two small non-USACE reservoirs Carmen and Smith on the Smith River.
Leaburg	LEA5L	L	All flows along the McKenzie that come into Leaburg downstream of BLU, CGR, and Trail Bridge reservoirs.
Walterville	WAV5L	L	All flows along the McKenzie that come into Walterville downstream of Leaburg.
Albany	ALB5L	L	All flows along the Willamette that come into Albany from downstream of Walterville and the reservoirs FRN, COT, DOR, FAL, and DEX.
Salem	SLM5L	L	All flows along the Willamette that come into Salem from downstream of Albany and the reservoirs DET and FOS.
Oregon City	SVN5L		All flows along the Willamette that come into Oregon City above the Falls from downstream of Salem, including the Tualatin River. SVN stands for T.W. Sullivan, a small non-USACE power plant at Willamette Falls.

The baseline model, simulated for the Period of Record (POR) of the 2010 Modified flow time series, does not reproduce the regulated flows that really occurred, but rather produces the regulated flow that *would have* occurred if all reservoirs existed during the whole POR and every year each reservoir was operated the way that USACE operates them right now. There are multiple reasons that observed regulated flows are not reproduced in the Baseline, including that the POR covers pre-dam periods, the dams began their Early Implementation operations (to meet BiOp mainstem and tributary targets, along

with new ramping rates) around 2007 or earlier, and the model does not include various restrictions on flow or pool levels required for any maintenance or construction operations that have occurred over the years. Furthermore, the ResSim program cannot be used for forecasting operations as real time regulators are able to do.

Real-time reservoir regulation in the Willamette Basin requires local flow information at additional locations from those listed in Table 2.1, especially at Jasper (on the MF Willamette), Goshen (on the CF Willamette), Harrisburg (Willamette), Monroe (Long Tom River), Vida (McKenzie River), Waterloo (South Santiam River), Mehama (North Santiam River), and Jefferson (Santiam River). This is because the reservoirs are operated to keep flows at the above listed local control points below bankfull and flood stages when possible for flood risk management. When local flows at any of those locations are high, the upstream reservoir has outflow reduced to its minimum so that flow at a control points is not increased by reservoir operations. Since this flow dataset has merged the local flows components at the above listed locations into just a few downstream points, the winter time (flood season) operations using this dataset will not be well modeled. Therefore, flood season results in the WBR will not be reported – only results for March through October will be presented in the study alternatives.

2.2 Water Year Classification

The POR flows span a period of time just less than 80 years, which encompass a variety of wet and dry water years. The "Willamette Project Supplemental Biological Assessment", Appendix B – Willamette Mainstem Flow Operations Strategy, designates four water year classifications that are used to determine the mainstem Willamette minimum flow targets for April through October. The four classifications are Abundant, Adequate, Insufficient, and Deficit. The Insufficient and Deficit water years have reduced minimum flow targets at Salem and Albany, with the Deficit year targets less than the Insufficient year targets during some, but not all, months. Table 2.2 lists these mainstem targets by water year type.

Table 2.2. Mainstem BiOp Flow Targets for Salem and Albany.

Time Frame	Albany Targets by Year Type (cfs)			Salem Targets by Year Type (cfs)		
	Abundant & Adequate	Insufficient	Deficit	Abundant & Adequate	Insufficient	Deficit
01 - 30 April	--	--	--	17,800	Salem targets are linearly interpolated between Adequate and Deficit targets based on 31 May system storage	15,000
01 -31 May	--	--	--	15,000		15,000
01 - 15 June	4,500	4,500	4,000	13,000		11,000
16 - 30 June	4,500	4,500	4,000	8,700		5,500
01 - 31 July	4,500	4,500	4,000	6,000		5,000
01 - 15 August	5,000	4,500	4,000	6,000		5,000
16 - 31 August	5,000	4,500	4,000	6,500		5,000
01 - 30 September	5,000	4,500	4,000	7,000		5,000
01 - 31 October	5,000	4,500	4,000	7,000		5,000

All years in the POR were classified using this system in order to have a variable minimum flow target in a downstream rule for Salem that was appropriate for the water year type.

The year classification is based on the storage volume targets of the federal projects in the Willamette Basin for each day of May 10 through 20 of any year. The storage volume is determined by summing the conservation pool storage in all the reservoirs (not counting the reregulating dams of Big Cliff and Dexter). The peak composite system conservation storage occurring May 10 - 20 of each year is used to classify the water year type. (The water year type is defined in Table B-3, Section 5, of the previously referenced Supplemental Biological Assessment.) If this volume is less than 0.9 MAF, the year is designated as Deficit. If the storage volume is between 0.9 and 1.19 MAF, the year is designated as Insufficient. Storage volumes from 1.20 to 1.48 MAF are designated as Adequate, and all years with storage volumes greater than 1.48 MAF are designated as Abundant. The maximum useable conservation storage is 1.59 MAF.

Table 2.3 and Figure 2.2 illustrate the water year type definition.

Table 2.3. Definition of Water Year Types in the Willamette Basin.

Water Year Type	Total Willamette Conservation Storage between 10-20 May
Abundant	Greater than 1.48 Maf
Adequate	Between 1.20 and 1.48 Maf
Insufficient	Between 0.90 and 1.20 Maf
Deficit	Less than 0.90 Maf

The year types for the POR were determined from a preliminary (first pass) simulation with all years assumed to be Abundant, and then simulated again using the first pass year classifications to verify system conservation storage during the May window. This process for determining the water year types was iterative:

- A simulation was run with all projects using Salem minimum flow targets for the Abundant/Adequate year, and storage volumes for May 10-20 were calculated for each year.
- Years were then classified by type as a first pass, with Salem minimum flows reduced for Insufficient and Deficit water years.
- Another simulation was run with the first pass estimates of water year type.
- Final conservation storage volumes were calculated for the May window.
- Final water year type classifications were made for every year in the POR.

These water year classifications are shown in Table 2.4. The designation is only of use during the period of April through October, and is not used during the fall and winter. The designation is by calendar year, not water year. October's flow targets are based on the previous May storage volumes.

The water year classifications shown in Table 2.4 were entered into DSS as a time series and used in the model as an external variable for Salem and Albany minimum flow rules.

Figure 2.2. Total conservation storage in Willamette Basin USACE projects, by date, and graphical water year type definition.

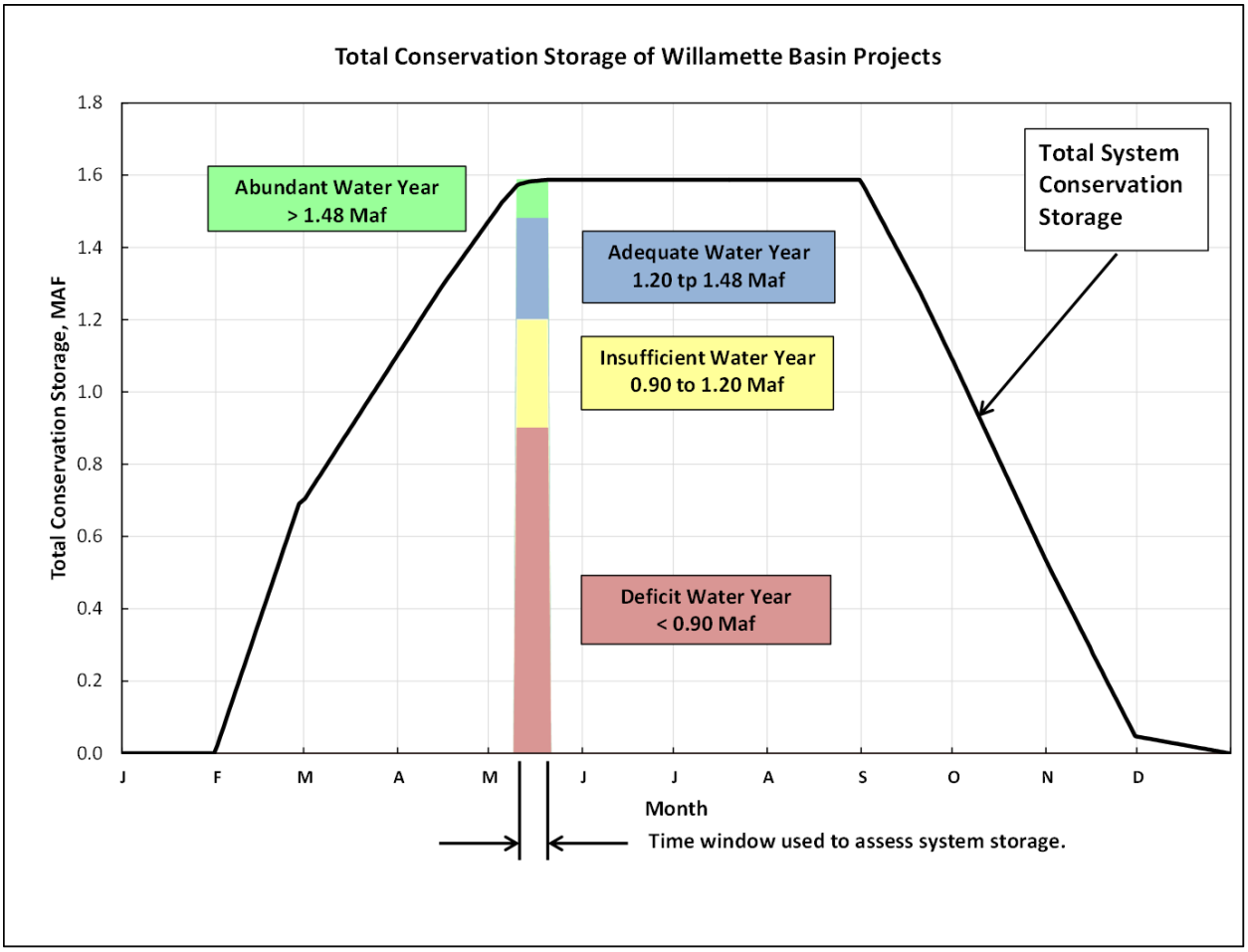


Table 2.4. Water Year Types for 1929 – 2007 and Maximum Conservation Storage Value for May 10-20, in Millions of Acre-Feet.

Year	Water Year Type Category	Storage Maf	Year	Water Year Type Category	Storage Maf	Year	Water Year Type Category	Storage Maf
1929	Adequate	1.45	**1956**	Abundant	1.58	**1983**	Abundant	1.53
1930	Deficit	0.68	**1957**	Abundant	1.50	**1984**	Abundant	1.58
1931	Insufficient	1.10	**1958**	Abundant	1.54	**1985**	Adequate	1.36
1932	Abundant	1.58	**1959**	Adequate	1.39	**1986**	Adequate	1.26
1933	Abundant	1.58	**1960**	Abundant	1.59	**1987**	Insufficient	0.91
1934	Deficit	0.62	**1961**	Abundant	1.58	**1988**	Abundant	1.54
1935	Abundant	1.49	**1962**	Abundant	1.57	**1989**	Abundant	1.51
1936	Abundant	1.53	**1963**	Abundant	1.58	**1990**	Adequate	1.41
1937	Abundant	1.58	**1964**	Adequate	1.38	**1991**	Abundant	1.55
1938	Abundant	1.58	**1965**	Insufficient	1.03	**1992**	Deficit	0.84
1939	Insufficient	1.18	**1966**	Adequate	1.37	**1993**	Abundant	1.58
1940	Insufficient	1.17	**1967**	Insufficient	0.99	**1994**	Deficit	0.87
1941	Deficit	0.34	**1968**	Deficit	0.88	**1995**	Abundant	1.55
1942	Deficit	0.62	**1969**	Abundant	1.56	**1996**	Abundant	1.58
1943	Abundant	1.56	**1970**	Adequate	1.27	**1997**	Abundant	1.56
1944	Insufficient	0.91	**1971**	Abundant	1.58	**1998**	Adequate	1.31
1945	Abundant	1.58	**1972**	Abundant	1.58	**1999**	Abundant	1.58
1946	Abundant	1.50	**1973**	Deficit	0.61	**2000**	Abundant	1.57
1947	Adequate	1.36	**1974**	Abundant	1.58	**2001**	Deficit	0.81
1948	Abundant	1.58	**1975**	Abundant	1.57	**2002**	Adequate	1.43
1949	Abundant	1.58	**1976**	Abundant	1.57	**2003**	Abundant	1.56
1950	Abundant	1.58	**1977**	Deficit	0.76	**2004**	Insufficient	1.112
1951	Abundant	1.50	**1978**	Deficit	0.86	**2005**	Insufficient	1.15
1952	Abundant	1.57	**1979**	Abundant	1.57	**2006**	Adequate	1.30
1953	Abundant	1.58	**1980**	Insufficient	1.10	**2007**	Adequate	1.37
1954	Adequate	1.39	**1981**	Insufficient	1.11	**2008**	Abundant	1.59
1955	Abundant	1.55	**1982**	Abundant	1.54			

3 ResSim Network and Dam Specifics

The reservoir simulation program HEC-ResSim requires input at the network level, which is information about the rivers, streams, and the physical parameters related to the dams that are modeled. This section describes the configuration, routing reaches, and dam physical parameters used in the Baseline simulation for the WBR. Some of the dam physical parameters, discussed in Section 3.3, are shown in tables in Attachment A, due to the amount of data involved. (Note Attachment A is about 75 pages of tables.)

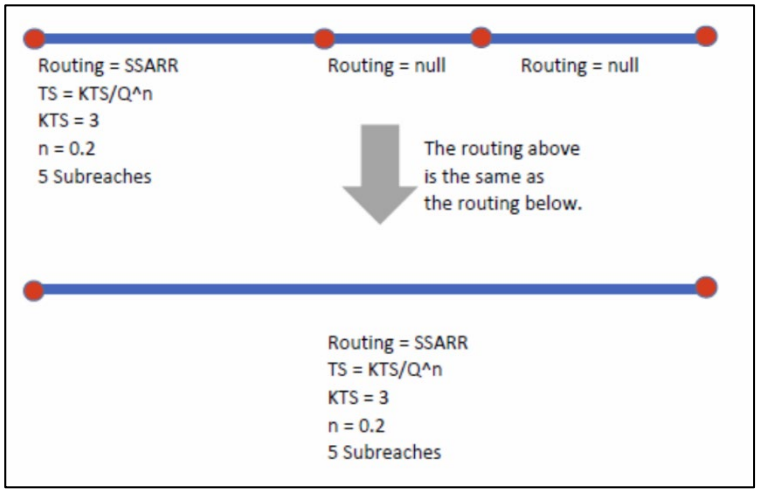
3.1 Configuration in ResSim

The Configuration in ResSim is a specific physical arrangement of projects and computation points modeled in the Watershed. The Configuration used in the Willamette Basin model is called “Existing”, and it is the only configuration in the model.

3.2 Routing Reaches

The river reaches analyzed in the ResSim model (the dark blue lines in Figure 1.1) have a routing associated with them, which the program uses to determine how fast the water will pass through that section of a river. A reach with “null” routing will pass the water through instantaneously, while a reach with routing will have a calculated flow changes. The ResSim model is set to be as close to the routings used for the 2010 Modified Flow development as possible, which largely uses the Streamflow Synthesis and Reservoir Regulation (SSARR) routing method (see USACE, 1991). The SSARR routing was a method developed for the Pacific Northwest in the 1960’s for the HEC-5 model (a precursor to ResSim) for the Willamette Basin. The SSARR routing is based on a timing equation, TS = KTS/Q^n, where the time of storage in the reach is TS, Q is the flow, and KTS and n are parameters determined through hydrologic analyses. Note that the actual length of the reach is not in the equation – the travel time of water down a tributary stream can be applied to any single reach of the tributary, with the remaining reaches in the tributary given null routings. The schematic shown in Figure 3.1 illustrates the above description.

Figure 3.1. Schematic of SSARR routing applied to a portion of a stream.



Most of the reaches in the ResSim network are given null routings, with those reaches not specified as "null" shown in Table 3.1. The lower part of the table shows those reaches designated by interpolation rather than the KTS/Q^n equation.

Table 3.1. SSARR Routing Specifications.

Reach Name	KTS	n	# Sub-reaches
CF Willamette+Row to CF Willamette_nr Goshen	10	0.2	4
Lebanon Div_IN to So Santiam_Mouth	5	0.2	5
Long Tom_nr Alvadore to Long Tom_at Monroe	5	0.2	5
MF Willamette+CF Willamette to Willamette_at Eugene	3	0.2	5
MF Willamette+Fall to MF Willamette_at Jasper	3	0.2	5
MF Willamette_abv Salt Cr nr Oakridge to MF Willamette_Blw NFork	1.5	0.1	2
McKenzie+Blue to McKenzie_at Vida	4	0.1	2
No Santiam_at Niagara to No Santiam_at Mehama	4	0.2	5
So Santiam_nr Foster to So Santiam_at Waterloo	3.5	0.2	5
Stayton Div_IN to Greens Bridge NR Jefferson	7	0.2	5
Willamette+McKenzie to Willamette_at Harrisburg	See Interpolation - A		7
Willamette+Long Tom to Willamette+Marys	See Interpolation - B		6
Willamette+Luckiamute to Willamette+Rickreall	See Interpolation - C		6
Willamette+Marys to Willamette+Calapooia	See Interpolation - D		5
Willamette+Mill to Willamette+Yamhill	See Interpolation - E		2

Interpolation A		Interpolation B		Interpolation C		Interpolation D		Interpolation E	
Outflow, cfs	Storage, hours	Outflow, cfs	Storage, hours	Outflow, cfs	Storage, hours	Outflow, cfs	Storage, hours	Outflow, cfs	Storage, hours
1	2.30	1	4.00	1000	3.33	1	2.94	1	0.40
1000	1.40	1000	3.33	10000	2.67	1000	2.40	50000	0.48
20000	0.57	10000	2.16	20000	2.17	3000	1.96	100000	0.71
30000	0.57	20000	1.83	30000	1.58	10000	1.40	150000	1.12
40000	0.71	30000	1.83	40000	1.42	20000	0.80	200000	1.54
50000	0.89	40000	2.08	50000	1.17	30000	0.60	250000	1.85
60000	1.14	50000	2.67	60000	1.28	40000	0.52	300000	2.10
80000	1.14	60000	3.34	80000	1.42	50000	0.52	350000	2.31
140000	0.83	70000	3.66	100000	2.26	60000	0.60	400000	2.50
180000	0.71	80000	3.58	120000	2.75	80000	0.70	500000	2.65
		100000	3.16	140000	3.00	100000	0.85		
		120000	2.80	170000	3.08	120000	1.00		
		180000	1.83	200000	2.84	150000	1.20		
				250000	2.16	200000	1.40		
				300000	1.83	300000	1.30		
				400000	1.75	400000	1.12		
				500000	1.66	500000	1.00		

3.3 ResSim Inputs for Physical Parameters of Each Dam

All thirteen USACE dams in the Willamette Basin are modeled in ResSim. The thirteen projects are comprised of eleven storage projects and two re-regulation projects. The projects are configured with a variety of outlet types, such as turbines, regulating outlets, and spillways, which can be either gated or uncontrolled. The physical parameters of the dams in ResSim for the Baseline will remain the same for all alternatives evaluated – alternatives will only have operational rule changes from the Baseline.

The following is a list of the USACE projects in the Willamette Basin and their type:

Project	Type of Reservoir	Abbreviation
Big Cliff	Reregulation	BCL
Detroit	Storage	DET
Green Peter	Storage	GPR
Foster	Storage	FOS
Cougar	Storage	CGR
Blue River	Storage	BLU
Hills Creek	Storage	HCR
Lookout Point	Storage	LOP
Dexter	Reregulation	DEX
Fall Creek	Storage	FAL
Dorena	Storage	DOR
Cottage Grove	Storage	COT
Fern Ridge	Storage	FRN

Table 3.2 shows the number of outlets that each dam has of each type. The table also lists the top of dam elevation in feet (in the NGVD29 datum) that is used in ResSim and the length of the dam that is used in ResSim.

Table 3.2. Summary of Outlets by Project

Project	Number of Outlets				Top of Dam Measures, in feet	
	Turbines	Regulating Outlets	Spillway			
			Gated Bays	Uncontrolled	Elevation	Length
Hills Creek	2	2	3	-	1548.0	2235.0
Lookout Point	3	4	5	-	941.0	2840.0
Dexter	1	-	7	-	235.0	2765.0
Fall Creek[1]	-	2	2	-	839.0	5100.0
Cottage Grove	-	3	-	1	808.0	1846.0
Dorena	-	5	-	1	865.7	2800.0
Cougar	2	2	2	-	1705.0	1500.0
Blue River	-	2	2	-	1362.0	1250.0
Fern Ridge[2]	-	5	6	-	379.5	6320.0
Green Peter	2	2	2	-	1020.0	1380.0
Foster	2	-	4	-	646.0	4800.0
Detroit[3]	2	4	6	-	1579.0	1523.2
Big Cliff	1	-	3	-	1210.0	295.0

[1]Fall Creek Dam has a special outflow structure collectively called the fish horns which were not modeled because they are rarely used.

[2]Fern Ridge Dam has four sliding gate regulating outlets and one sluice gate.

[3]Detroit Dam has two Upper Controlled Outlets and two Lower Controlled Outlets. The lower controlled outlets are not modeled because they are not used.

Evaporation is not specified in the physical parameters because the flow dataset used has already adjusted for evaporation in the depletion calculations. (See the 2010 Level Modified Flow report.)

All reservoirs in ResSim have defined flow capacities through the various dam outlets. The flow capacity is defined for each project by the outlet type. The parameters input for the turbine capacities are given in this section, with the flow capacities of the remaining outlet types defined in the Attachment A to this report. The storage elevation tables for each reservoir are also defined in that attachment.

Table 3.3 is a list of the turbine capacity inputs used in ResSim for each of the Willamette USACE projects with a powerhouse. Dorena has a small turbine installed by a private company, but that turbine is not modelled in ResSim since it is using flow from one of the ROs in the project and USACE specifies the amount of flow through the turbine. All projects use a constant hydraulic loss of one foot and no station use is specified at any project.

Table 3.3a. Power Plant Parameters for Projects with USACE Power Generation, continued next page.

	Outlet			Capacity			
Project	**Elev. (ft.)**	**Max Capacity (cfs)**	**Total Capacity (cfs)**	**Elev. (ft.)**	**Capacity (MW)**	**Efficiency**	**Tail-water**
DET	1424.9	0.0	0.0	1,423.00	34.00	Constant	Constant
	1425.0	2025.0	4050.0	1,480.00	57.50	90%	Elev.
	1427.0	2025.0	4050.0	1,578.00	57.50		1198.0 ft.
	1452.0	2450.0	4900.0				
	1485.0	2925.0	5850.0				
	1492.0	2775.0	5550.0				
	1512.0	2525.0	5050.0				
	1542.0	2275.0	4550.0				
	1582.0	2100.0	4200.0				
BCL	1130.0	3200.0	3200.0	1,130.00	0.00	Constant	Constant
	1161.5	3200.0	3200.0	1,181.00	17.00	90%	Elev.
	1210.0	3200.0	3200.0	1,194.00	20.70		1109.0 ft.
				1,210.00	20.70		
FOS	608.9	0.0	0.0	525.00	0.00	Constant	Constant
	609.0	1665.0	3330.0	603.00	7.40	90%	Elev.
	615.8	1730.0	3460.0	633.00	11.50		524.5 ft.
	622.9	1620.0	3240.0	641.00	11.50		
	631.3	1490.0	2980.0				
	642.3	1330.0	2660.0				
	646.6	1290.0	2580.0				
GPR	900.9	0.0	0.0	810.00	0.00	Constant	Constant
	901.0	2240.0	4480.0	902.00	31.00	90%	Elev.
	937.1	2380.0	4760.0	967.00	48.40		700.0 ft.
	962.2	2430.0	4860.0	1,015.00	48.40		
	967.0	2370.0	4740.0				
	981.9	2240.0	4480.0				
	992.7	2170.0	4340.0				
	1021.2	2020.0	4040.0				

Table 3.3b. Power Plant Parameters for Projects with USACE Power Generation, continued.

	Outlet			Capacity			
Project	**Elev. (ft.)**	**Max Capacity (cfs)**	**Total Capacity (cfs)**	**Elev. (ft.)**	**Capacity (MW)**	**Efficiency**	**Tail-water**
CGR	1515.9	0.0	0.0	1,253.00	0.00	Constant	Constant
	1516.0	544.5	1089.0	1,490.00	8.40	90%	Elev.
	1537.3	568.0	1136.0	1,510.00	9.90		1253.6 ft.
	1565.2	613.0	1226.0	1,530.00	11.40		
	1583.3	641.0	1282.0	1,550.00	13.20		
	1604.2	589.0	1178.0	1,570.00	14.90		
	1632.0	535.0	1070.0	1,590.00	15.00		
	1669.9	482.0	964.0	1,610.00	15.00		
	1702.8	452.0	904.0	1,630.00	15.00		
				1,650.00	15.00		
				1,670.00	15.00		
				1,690.00	15.00		
				1,700.00	15.00		
LOP	818.9	0.0	0.0	724.00	0.00	Constant	Constant
	819.0	2331.6	6994.8	821.00	20.00	90%	Elev.
	821.8	2393.3	7179.9	861.00	36.00		690.0 ft.
	849.0	2970.0	8910.0	897.00	46.00		
	853.0	3025.0	9075.0	934.00	46.00		
	860.0	3050.0	9150.0				
	886.0	3100.0	9300.0				
	893.0	2990.0	8970.0				
	913.0	2765.0	8295.0				
	934.0	2765.0	8295.0				
DEX	634.0	4200.0		634.00	0.00	Constant	Constant
	690.0	4200.0		690.00	15.20	90%	Elev.
	697.4	4200.0		694.00	17.20		638.0 ft.
				697.40	17.20		
HCR	1413.9	0.0	0.0	1,384.00	0.00	Constant	Constant
	1414.0	895.0	1790.0	1,403.00	10.70	90%	Elev.
	1446.8	945.0	1890.0	1,443.00	15.00		1226.0 ft.
	1483.7	910.0	1820.0	1,480.00	17.25		
	1504.5	830.0	1660.0	1,543.00	17.25		
	1524.3	780.0	1560.0				
	1546.2	745.0	1490.0				

3.4 Irrigation Diversions

There are no irrigation diversions used in the Baseline simulation. This is because the flow dataset has irrigation included in the depletion calculations, with all years in the flow dataset adjusted to the 2007 level of irrigation.

The alternatives analyzed in the WBR Feasibility study will have diversions added to the network, since those alternatives will represent future demand greater than current levels. The diversions included in those alternatives will be described in the Feasibility report.

4 Reservoir Regulation in the Willamette Basin and General Operations in ResSim

The Willamette Basin contains thirteen Corps owned and operated dams. The primary purpose of all thirteen of the projects is flood risk management. Other project purposes include hydropower generation, water supply, water quality, and recreation.

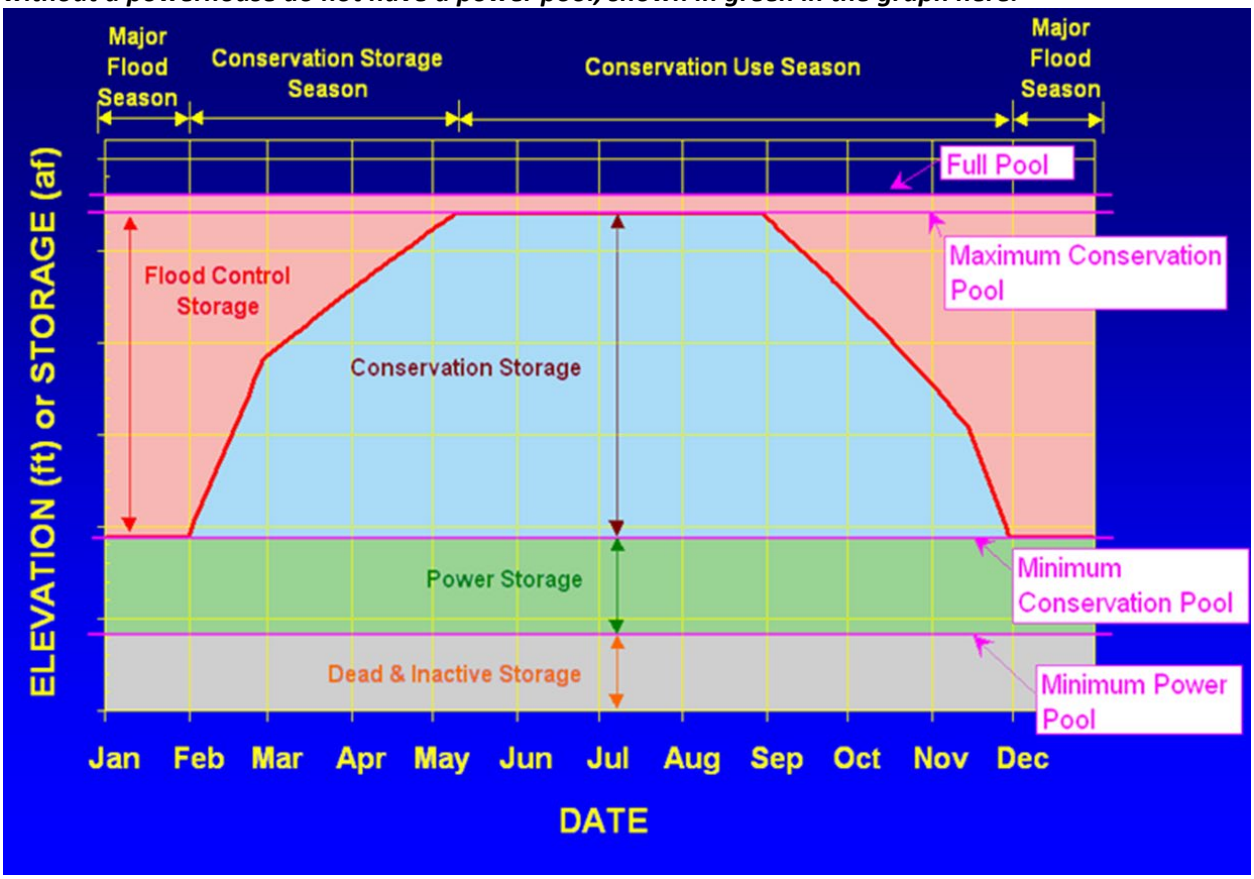
The flood risk management in the basin is accomplished by drafting the reservoirs behind the dams to a low level in the late fall in order to provide storage space to retain inflow during downstream flood events. The release of any retained inflows during the flood season is regulated by the flow levels at downstream control points whenever possible. After the flood season has passed, the reservoirs are filled with the spring inflows to their maximum conservation season level. During the conservation season, which includes late spring, summer, and early fall, project releases are regulated to provide for the secondary purposes of power, water supply, water quality, and recreation. This cycle of drafting and filling is guided by a "Rule Curve" at each storage project that specifies the timing of each of these phases of regulation. The Rule Curve is the pool elevation that the reservoir is managed to stay at or below when possible, with pool levels above the curve when operating for flood risk management, and pool levels below the curve when inflows are low and the stored water is released to meet the various needs of the system.

Eleven of the thirteen projects in the Willamette have Rule Curves – the two that do not are Big Cliff and Dexter Dams, which are re-regulating dams just downstream of Detroit and Lookout Point, respectively. The re-regulation dams function to smooth out the flows downstream of these two power projects which may have varying flows due to power peaking demands. The eleven storage projects each have their own Rule Curve, defined in each project's Water Control Manual, which are the same every year - the Rule Curves do not change by forecasts or by water year type.

The Rule Curves at these eleven projects have a minimum pool elevation called the Minimum Conservation Zone and a maximum elevation called the Maximum Conservation Zone. This curve does not define the whole range of elevations possible at a project, just the range of the conservation season elevations. The generic diagram in Figure 4.1 defines the storage zones and a generic rule curve (the heavy red line).

Note the light blue area of Figure 4.1, labeled as "Conservation Storage". This is the space at each of the eleven storage projects that is the focus of the re-allocation effort of the Willamette Basin Review Feasibility Study. The total conservation storage of the eleven storage projects in the basin (i.e. the sum of the light blue storage values for the eleven rule curves) is 1.59 Maf.

Figure 4.1. Generic storage graph of a Willamette project. Note the rule curve, the heavy red line, is shaped slightly differently for each project and refill and draft schedules also vary by project. Projects without a powerhouse do not have a power pool, shown in green in the graph here.



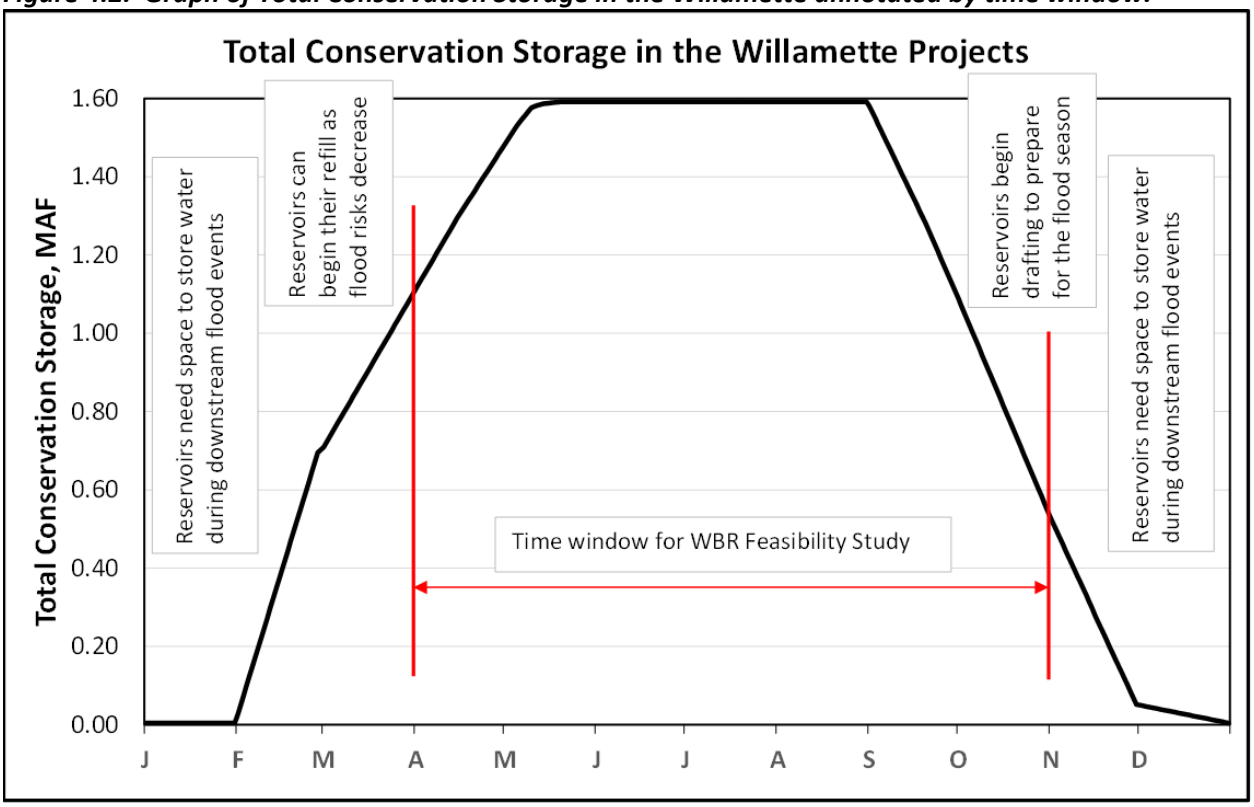
The project storage in the conservation pool at each date of the Rule Curve can be summed for the eleven storage projects into a basin-wide conservation storage curve. This is plotted in Figure 4.2. The graph is annotated by text boxes showing the flood season (when the curve is at or near minimum conservation), the refill season, and the drafting period. The two vertical red lines in the figure span the period 01 April to 31 October, which is the time window covered by the WBR Feasibility study. Note that the total conservation storage in the basin plots just under 1.6 million acre-feet.

The feasibility study (the WBR) has a criteria that the reallocation cannot affect the flood risk management in the basin, so no changes were made in the ResSim modelling of flood events than has been used in other Willamette Basins studies. The WBR also does not include any Rule Curve changes within its scope. Although the reallocation of storage will affect the amount of water in the reservoirs each year because of increased releases to meet demands, the Rule Curves at the projects will not be changed in the study.

The reallocation will affect the conservation storage in the basin beginning in May of each year, since all of the demand values developed for the future municipal, industrial, and agricultural needs in the WBR study are for May through September. However, April through October is the time period covered by the WBR Feasibility report. This is because the minimum flow targets at Salem span this window and are

one of the components of the Biological Opinion that the WBR study must take into account. Therefore, the time window for presenting results from the WBR Feasibility study will be April through October.

Figure 4.2. Graph of Total Conservation Storage in the Willamette annotated by time window.



The Baseline ResSim simulation for the flow dataset period of record contains an operation set of rules for each of the eleven storage projects that is intended to mimic the general way that reservoir regulation occurs in the Willamette Basin. The operation sets were not written to account for any forecasting or agency coordination efforts that actually occur in real time water management decisions, but rather seek to implement a consistent approach to the reservoir operations over all years of the record. This consistent approach means that the reservoirs store water when necessary for flood risk management, release stored water from flood events according to the water control manuals, refill according to the rule curves when inflows are high enough, reservoir releases are reduced to reserve water for later use in the season when pool levels are too far below rule curve, and BiOp rules are included which provide minimum project release targets, minimum mainstem flow targets, and ramping rate rules.

The remainder of this section covers some of the basic operation particulars and rules that are used at multiple projects in the Baseline simulation, while the project specific rules are described individually in Sections 5 through 15 for each specific dam. Most of the particulars described in this section will also be part of the alternatives evaluated for the WBR. Below is a brief outline of the information covered in this section and a note on how the WBR alternatives would use this information:

- Reservoir zones and rule curves: the zones and guide curve to operate a project are defined in the operation set, and all alternatives in the WBR analyses will use the same zones and guide curves as the Baseline simulation.
- Re-regulation dams (Big Cliff and Dexter): these dams are treated the same in all WBR alternatives as they are in the Baseline simulation. They have only zones, no rules.
- Release Allocations: the release allocation, which specifies the preferred order of outlet use for a dam, is part of the operation set, and all WBR alternatives will use the same release order.
- A brief discussion of the RO capacities and minimum gate openings: this applies to only two projects in the basin, and all WBR alternatives will use the same method as described here for the Baseline simulation.
- Induced Surcharge Rules: these rules govern the release of water in special cases to prevent dam overtopping. These rules do not change among any of the operation sets for WBR alternatives.
- Downstream Control Points, Maximum Flow Rules: this section describes the maximum flow rules, which are related to the flood risk management function of the dams. All of these maximum flows rules apply to all WBR alternatives.
- Downstream Control Points, Minimum Flow Rules: this section describes the minimum flow rules on the mainstem of the Willamette River at Albany and Salem. These are BiOp flow target requirements that will only change for an alternative to evaluate the effects of a possible change to these targets.
- Maximum and Minimum rates of flow changes: the rate at which the outflow of a dam can change is also a BiOp requirement, and the rules specifying these rates are the same for all WBR alternatives as they are in the Baseline. These flow changes are also described as ramping rates.

4.1 Reservoir Zones in ResSim and Rule Curves

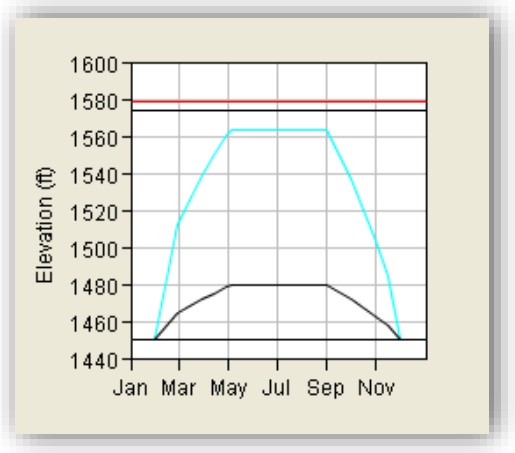
The Willamette reservoirs are divided into zones where specific rules can be applied. The rules for a specific zone are applied when the modeled reservoir elevation is at, or below, that zone. Generally they are applied as described in Table 4.1 below and are shown schematically in Figure 4.3.

Table 4.1. Zone types used in operation sets.

Zone Name	Significance
Top of Dam	The physical top of dam where overtopping would occur.
Flood Control	Max pool available for flood control.
50% FC Pool*	Used to separate the flood control storage into different types of flood control operations at some projects: normal release rules and aggressive release rules which let out additional water when storage space becomes limited.
Primary Flood Control*	
Secondary Flood Control*	
Conservation	The "Guide Curve" which coincides with the project rule curve. (ResSim uses the zone defined as the Guide Curve as the preferential pool elevation for a project to be.)
Buffer	Acts like an interim draft limit to prevent the pool from drafting too rapidly and is used to help mimic real-time reservoir regulation.
Inactive	The lowest zone in the operation set, and is a zone required by the program. No rules can be applied in this zone.

* Not used for all projects

Figure 4.3. Typical Example Graph of Reservoir Zones



Straight Red line – Top of Dam zone.
Straight Gray line – Flood Control zone.
Blue line – Below this line is the Conservation zone, and this line is the Rule Curve. The Rule Curve is always designated as the "Guide Curve" in ResSim, which means the preferred elevation of a pool.
Variable Black line – Below this line is the Buffer zone.
Straight black line – Everything below this line is the Inactive zone.

Inactive Zones. The ResSim program has a special zone required in each reservoir called the Inactive zone, with the program controlling even the name of this zone. This zone was programmed internally to ResSim to represent the pool elevation below which no water can leave the dam, or the elevation just below the lowest outlet, representing the dead storage of the project. The program does not allow any rules to be input to this zone, since it is supposed to be unable to let flow out.

In practice, a modeler can define the Inactive zone at any elevation, although no rules will be able to be applied and no zone can be defined below it. In the Baseline model, the Inactive zone is specified as the elevation of the Minimum Conservation Pool because the Corps is generally not authorized to use the stored water below this level. At projects with power generation, water between this level and the Minimum Power Pool is reserved for use during power emergencies called by BPA. During real time

operations in very dry conditions with pool levels at the minimum conservation pool, the Corps and BPA will often agree to release water from these projects without a power emergency, dropping into the power pool rather than letting a river dry up.

The Inactive zone has another use within the program, which is to be the lower boundary for implicit storage calculations. Implicit storage is used for projects that operate for a downstream minimum flow so that the flow contribution or share of that target flow can be calculated.

When the program calculates that a reservoir pool level has dropped down to the elevation of the inactive zone, it will still release from the reservoir if an outlet has capacity at that elevation. The outlet chosen by the program is based on the release allocation and the physical capacity, but the flow level it calculates to pass is either the last minimum from the zone above or passing inflow, whichever is less. Once the inflow exceeds the last minimum outflow rule long enough to accumulate storage, the pool level raises to the zone above the inactive one, and then the program starts following that zone's rule set.

4.2 Reregulating Dams

There are two dams in the Willamette Basin that are reregulation projects, Big Cliff and Dexter Dams. They are modeled in ResSim only with zones and no rules. Both have a Top of Dam, Flood Control, Conservation, Buffer, and Inactive zone, with the Conservation zone specified as the Guide Curve. All zones are given a constant elevation through the year because these two projects do not have rule curves. No rules are included. These dams have only a small amount of storage, and on a day average, do not accumulate water or pass more than comes in. The Baseline model data is being used to assess statistical data with a daily time step for 80 years, so more detailed modeling at these projects is not necessary for the results needed.

4.3 Release Allocations

Each operation set in ResSim has an associated release allocation which specifies the priority of use of each dam outlet. Table 4.2 below shows the release outlet allocation used for each project, with the flow passing through turbines as first priority at power projects. Some projects have rules that adjust the chosen outlet for certain situations, but unless otherwise specified, the program follows the release order shown here.

Table 4.2. Sequential Release Allocation for all Model Runs.

Project	Allocation Type and Order	Project	Allocation Type and Order
DET	Power Plant	**HCR**	Power Plant
	Upper Controlled Outlet		Regulated Outlet
	Spillway		Spillway
BCL	Power Plant	**LOP**	Power Plant
	Spillway		Regulated Outlet
GPR	Power Plant		Spillway
	Controlled Outlet	**DEX**	Power Plant
	Spillway		Spillway
FOS	Power Plant	**FAL**	Regulated Outlet
	Spillway		Spillway
CGR	Power Plant	**DOR**	Regulated Outlet
	Regulating Outlet		Uncontrolled Outlet
	Spillway	**COT**	Regulated Outlet
BLU	Regulating Outlet		Uncontrolled Outlet
	Spillway	**FRN**	Regulated Outlet
			Spillway
			Sluice Gate

4.4 Capacities and Minimum Gate Openings

Some of the Willamette projects with regulating outlets are operated with minimum gate opening – in other words, if a regulating outlet is going to be used, it has to open a minimum amount. The flow out of an RO with a specific gate opening is a function of the pool elevation, as the amount of head affects the outflow. Many of the dams have controlled outlet physical parameter capacities with zeros for small gate openings in an attempt to model this gate opening restriction; however, in simulations, ResSim will interpolate between a zero outflow at one gate opening and the outflow it computes as necessary with the next higher gate opening, regardless of how small of an increment the gate opening specifications. If the smallest gate opening included in the capacity table is the minimum opening, the simulation can still interpolate to less than that.

The minimum gate opening rules do not apply to Detroit and Lookout Point because there are re-regulation dams just downstream of these projects. For example, in a given day during real project operations, a Detroit dam RO might be opened the minimum amount for a few hours, then closed, and perhaps reopened the minimum amount more times. The average RO flow for the day at Detroit can be less than the minimum required, representing an open gate period for part of the day and a closed gate period for part of the day. The downstream reregulation dam, Big Cliff, will smooth the flows out over the day. Green Peter dam does not need the minimum gate opening rule either, since Foster also acts as a reregulation dam on a day average. Note that Big Cliff, Dexter, and Foster dams do not have regulating outlets.

The dams Blue River, Cottage Grove, Dorena, Fall Creek, and Fern Ridge are not operated with minimum gate openings for the ROs. Two projects that are operated with minimum gate openings for the ROs are Cougar and Hills Creek, and both projects have these minimum RO gate openings modeled in the same way.

Cougar and Hills Creek each have an IF BLOCK to determine if the current time step has calculated RO flow at the project. If not, nothing changes, and no ELSE or ELSE IF is needed. If the current time step does have RO flow at the project, it is required to meet the minimum flow given in the rule within the IF BLOCK. The minimum RO flows listed in the rule are the one RO capacity by reservoir pool level for the minimum gate opening.

4.5 Induced Surcharge

Induced Surcharge Rules. The induced surcharge rule available in ResSim is one that specifies a total flow out of the project based on the pool elevation and the inflow to the reservoir. The purpose of this type of operation is to carefully control the rate of fill as the reservoir gets close to full to still reduce the regulated downstream peak, but also protect the project from overtopping. This type of operation is rare since the storage available at each project is usually sufficient to capture large inflow events in the flood season. The Willamette Valley storage reservoirs each have an induced surcharge operation described in their Water Control Manual (WCM).

The induced surcharge function is difficult to model for a daily time step. The special flood regulation curves shown in the project WCMs are smoothly varying functions of inflow, with the release changing as the inflow changes. With a daily time step, the inflow peak is flattened and widened, and the rule is either applied all day or not at all. Each project's induced surcharge rule is defined in the individual project sections. This rule is used because the flow dataset POR runs continuously from 1928 through 2008 and contains all the flood events in that record.

4.6 Downstream Control Points, Maximum Flow Rules

Flood risk management is the primary authorized purpose of the Willamette dams, and to accomplish this task, each dam in the Willamette regulates its outflow based on at least one control point downstream. This regulation is accomplished by the project storing inflows and reducing outflows either when the downstream control point flows are too high, or to assist in keeping the downstream flows as low as possible. The downstream control points and flow levels for regulation are illustrated in the schematic of Figure 4.4.

The blue triangles in the schematic of Figure 4.4 are the control points for reservoir regulation. Each control point has two key regulation thresholds: *bankfull* and *flood stage*, which are labeled as "BF" and "FS", respectively, in the figure. Each of the control points has a stream gage that is used for reservoir regulation. Other gages in the basin provide additional information to regulators during real time operation, and these gages are shown in the figure as either circles or diamonds. For reservoir operation modeling for Willamette Basin studies, only the control points (the locations marked with the blue triangles) are included in ResSim.

Typically, projects are operated to maintain flows below bankfull level of a downstream control point whenever possible and when there is ample space in the reservoir to store inflows. Bankfull is considered a non-damaging level of flow at that location. In larger flood events, which have high local flow components, projects are operated to maintain control points below flood stage whenever possible. The goal of the reservoir regulation is to not make the flooding worse downstream. In all cases, each project must release its minimum required outflow, but increased releases from those minimums use the flow at the control points to guide the regulation.

These downstream control point flow level operations are modeled in ResSim as maximum downstream rules. A downstream maximum rule is used by ResSim to calculate a project outflow that does not exceed the maximum level specified in the rule.

The Willamette projects are operated as a system for flood control. All key control points on each tributary (Vida, Jasper, Goshen, Monroe, Waterloo, Mehama, and Jefferson) are regulated by the appropriate project upstream in the model. For mainstem control points, the southern projects are operated for a common bottleneck point, Harrisburg, and the northern Santiam projects are used to reduce flows at Salem. By reducing for Harrisburg, the southern projects also reduce Albany and Salem flows. Table 4.3 summarizes which projects are used to reduce stages at each control point.

A project cannot always be operated to meet a bankfull goal at a control point. If the project is getting full, the downstream control point goal may be higher in order to slow the rate of fill. The goal then would be to not exceed flood stage, and these rules would be used at higher reservoir elevations than the bankfull rules. These two types of downstream maximum rules are summarized below by control point below. Note that Hills Creek is modeled as a tandem operation with Lookout Point, rather than a specific downstream rule, so if Lookout Point stores for downstream control points, then Hills Creek adjusts to balance the storage between itself and Lookout Point, effectively reducing flows to help control downstream flows also.

Figure 4.4. Willamette Basin Schematic.

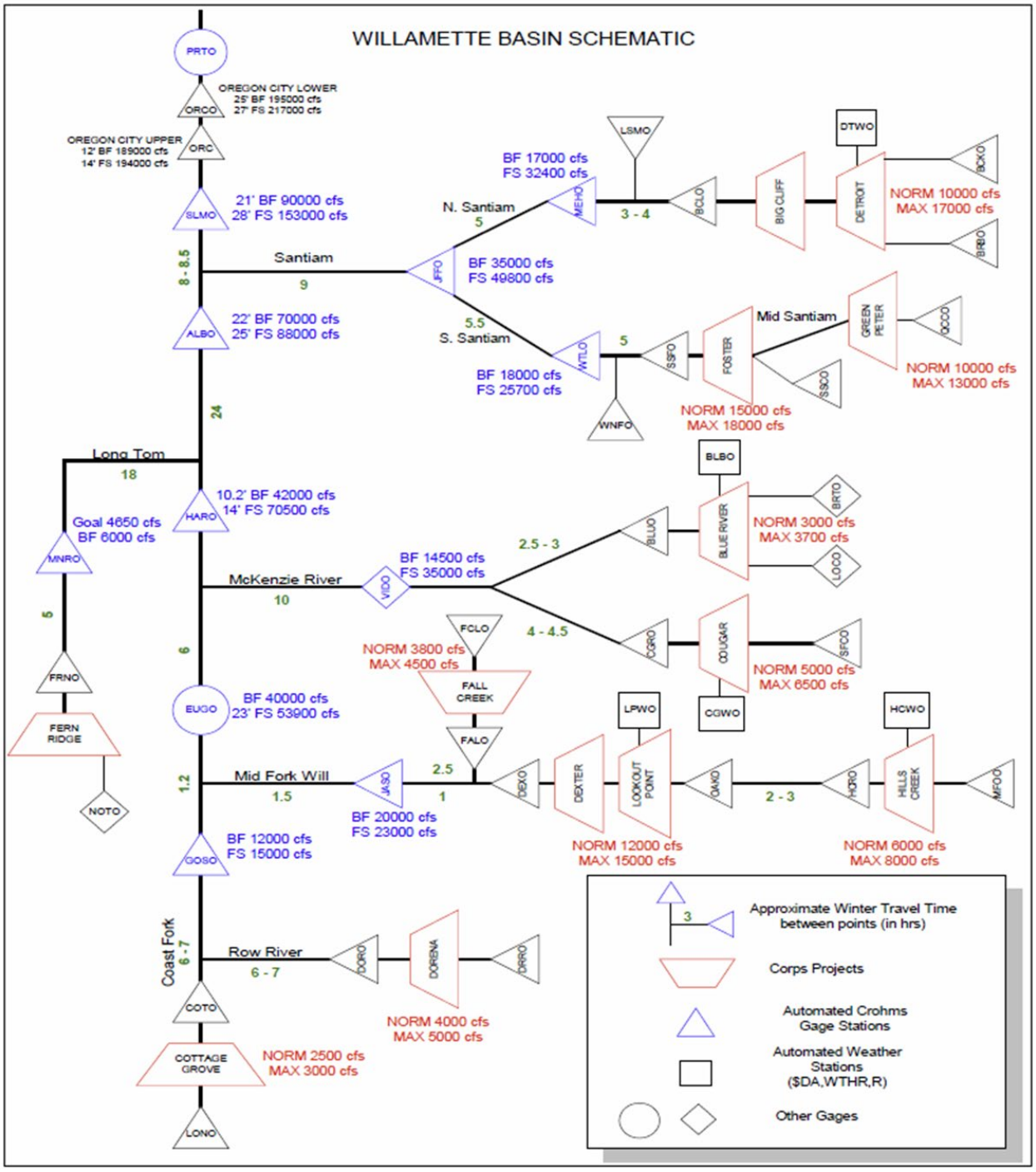


Table 4.3. Project Operation for Control Point Maximum Flows.

Control Point	Hills Creek	Lookout Point	Fall Creek	Cottage Grove	Dorena	Cougar	Blue River	Fern Ridge	Green Peter	Foster	Detroit
Jasper	**√**	**√**	**√**								
Goshen				**√**	**√**						
Vida						**√**	**√**				
Harrisburg	x	**√**	**√**	**√**	**√**	x	x				
Monroe								**√**			
Albany	x	x	x	x	x	x	x	x			
Waterloo									**√**	x	
Mehama											**√**
Jefferson									**√**	x	**√**
Salem	x	x	x	x	x	x	x	x	**√**	x	**√**

√ Project uses ResSim rules to reduce stages at the downstream control point.

x Project does not use a specific ResSim rule to reduce stages at the downstream control point, but reductions upstream do translate to reduced flows at these control points.

Mehama, North Santiam River

- Bankfull (*Max Bankfull Flow – at Mehama*) – Detroit Dam regulates for a bankfull level of 17,000 cfs at Mehama.
- Flood Stage (*Winter Ops max flood flow – at Mehama*) – Detroit Dam regulates for a bankfull level of 17,000 cfs at Mehama for lower reservoir elevation (below 1536 feet) and to 35,000 cfs for higher pool levels.

Waterloo, South Santiam River

- Bankfull (*Max Bankfull Flow – at Waterloo*) – Green Peter and Foster Dams regulate for a bankfull level of 18,000 cfs at Waterloo. Typically this rule does not drive the operation at these projects because flows at Jefferson are usually reaching key threshold levels long before this control point.

Jefferson, Santiam River

- Bankfull (*Max Bankfull Flow – at Jefferson*) – Detroit, Green Peter, and Foster Dams regulate for a bankfull level of 35,000 cfs after a Special Curve operation or during the spring and summer. The WCM specifies that the evacuation of stored water doesn't take place until flows downstream recede below banks.
- Flood Stage (*Winter Ops max flood flow – at Jefferson*) – This rule is applied at Detroit and Green Peter, not Foster. The Jefferson target is a function of the Detroit pool elevation.

Vida, McKenzie River

- Bankfull (*Max Bankfull Flow – at Vida*) – Both Cougar and Blue River dams regulate for a bankfull level of 14,500 cfs at Vida.

Jasper, Middle Fork Willamette River

- Bankfull (*Max Bankfull Flow – at Jasper*) – Both Lookout Point and Fall Creek dams regulate for a bankfull level of 20,000 cfs at Jasper. At Lookout Point this rule is in place when the project is below Secondary Flood Control pool. At Fall Creek this rule is in place when the project is below the 50% flood control pool. Hills Creek has Tandem operations with Lookout Point in the Flood Control and Top of Dam zones, so controls for Jasper through that mechanism.
- Flood Stage (*Max Flood Flow – at Jasper*) – When in the upper ranges of their pools (above Secondary Flood Control pool at Lookout Point and above 50% Flood Control Pool at Fall Creek) the projects operate for a flood regulation goal of 22,000 cfs at Jasper. Hills Creek controls for this through the tandem operation with Lookout Point.

Goshen, Coast Fork Willamette River

- Bankfull (*Max Bankfull Flow – at Goshen*) – Both Cottage Grove and Dorena dams regulate for a bankfull level of 12,000 cfs at Goshen.

Monroe, Long Tom River

- Varying Target (*Max Regulation Goal – at Monroe*) – The Monroe target is a function of the Fern Ridge Elevation. This rule allows Fern Ridge Dam to operate by releasing less water when the pool is low and storage is plentiful and to increase releases during the larger floods when the project is closer to full.

Harrisburg, Willamette River

- Bankfull (*Harrisburg 42,500 cfs Max*) – The bankfull rule (42,500 cfs) is applied in the lowest zones of the smaller storage projects (Conservation Zone only at Cottage Grove, Dorena). Fall Creek and Lookout Point both apply this rule in the Conservation and Secondary Flood Control Zone (50% Flood Control Pool at Fall Creek). Hills Creek controls for this through the tandem operation with Lookout Point.
- Intermediate Regulation Goal (*Harrisburg 51,000 cfs Max*) – Real-time regulation experience has indicated that there are no problems in the Harrisburg area when flows are below 51,000 cfs and this threshold has been used to allow more water to be released when reservoirs are filling. This rule is applied to Fall Creek when above 50% Flood Control Pool (n the Flood Control Zone). Cottage Grove and Dorena apply this rule when below the 50% Flood Control Pool Zone and Lookout Point applies this rule when in the Primary Flood Control Zone. Hills Creek controls for this through the tandem operation with Lookout Point.

- Flood Stage (*Harrisburg 70,500 cfs)* – When the largest southern storage projects are getting full (Lookout Point above Primary Flood Control Zone in Max Pool Zone) the regulation goal downstream increases to flood stage level of 70,500 cfs. Hills Creek controls for this through the tandem operation with Lookout Point.

Salem, Willamette River

- Bankfull (*Max Bankfull Flow – at Salem*) – Detroit Dam regulates for a bankfull level of 90,000 cfs primarily after a Special Curve operation or during spring and summer. Green Peter also has this rule in its Conservation zone. The WCM specifies that the evacuation of stored water doesn't take place until flows downstream recede below banks. Salem is also controlled implicitly by the downstream maximum rules for Harrisburg and Jefferson.
- Varying Target (*Winter Ops max flood flow – at Salem*) – In most cases during the fall and winter flood season, the Salem target is a function of the Detroit Elevation. This rule allows Detroit to release less water when the pool is low and storage is plentiful and to increase releases during the larger floods when pool elevations are higher. Green Peter does not use this rule in ResSim because the flood control operation in conjunction with Foster is relatively constrained and Green Peter is typically reduced to minimum for Foster.

Screen shots of these downstream maximum rules are shown in Figure 4.5a and 4.5b.

The downstream maximum rules are in effect year round, but typically only govern the ResSim program decision making during a winter flood event. Smaller flood events may occur during the spring refill season or late in the drafting season as well that need some regulation to manage.

Figure 4.5a. ResSim Screen Shots of Downstream Maximum Rules.

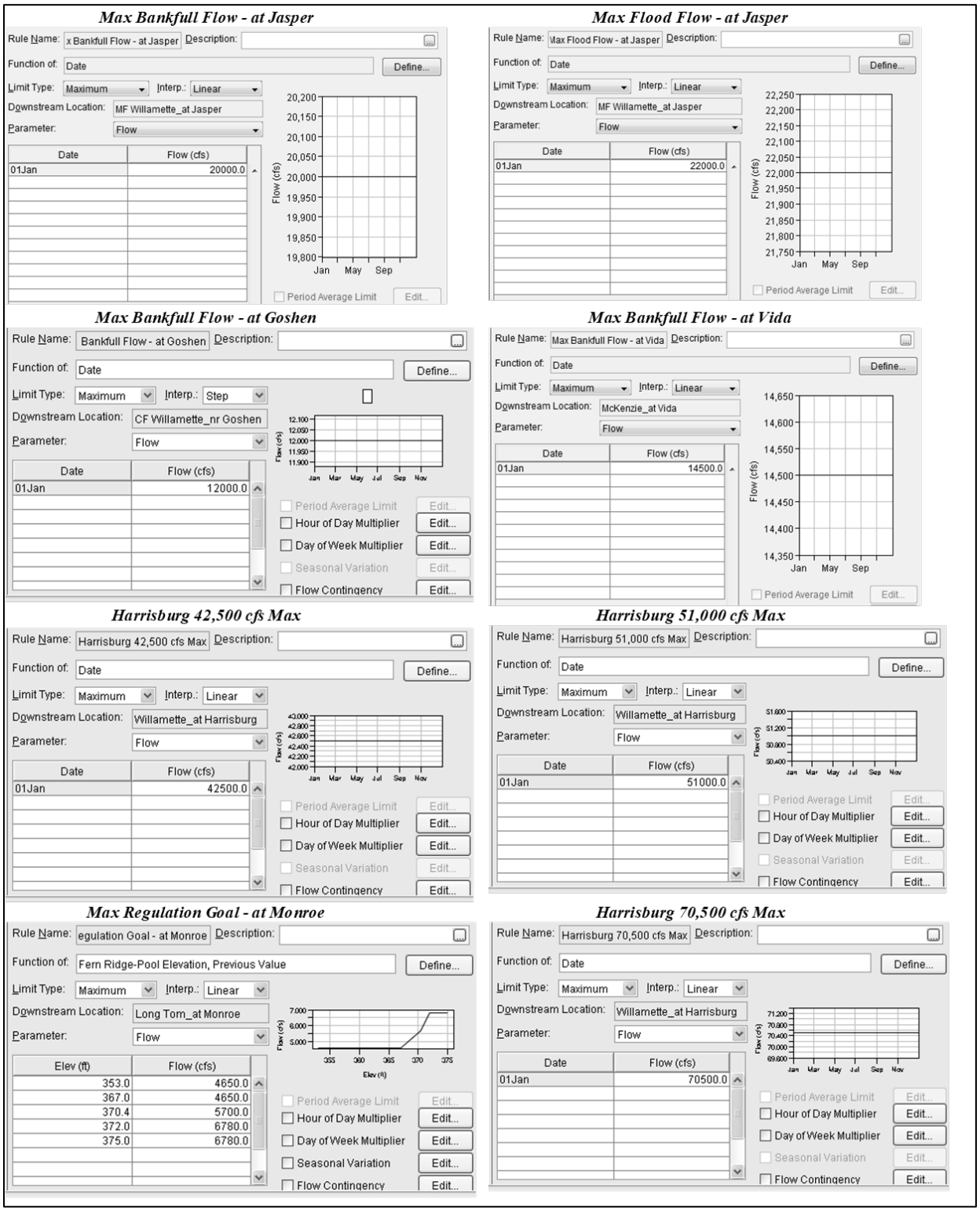
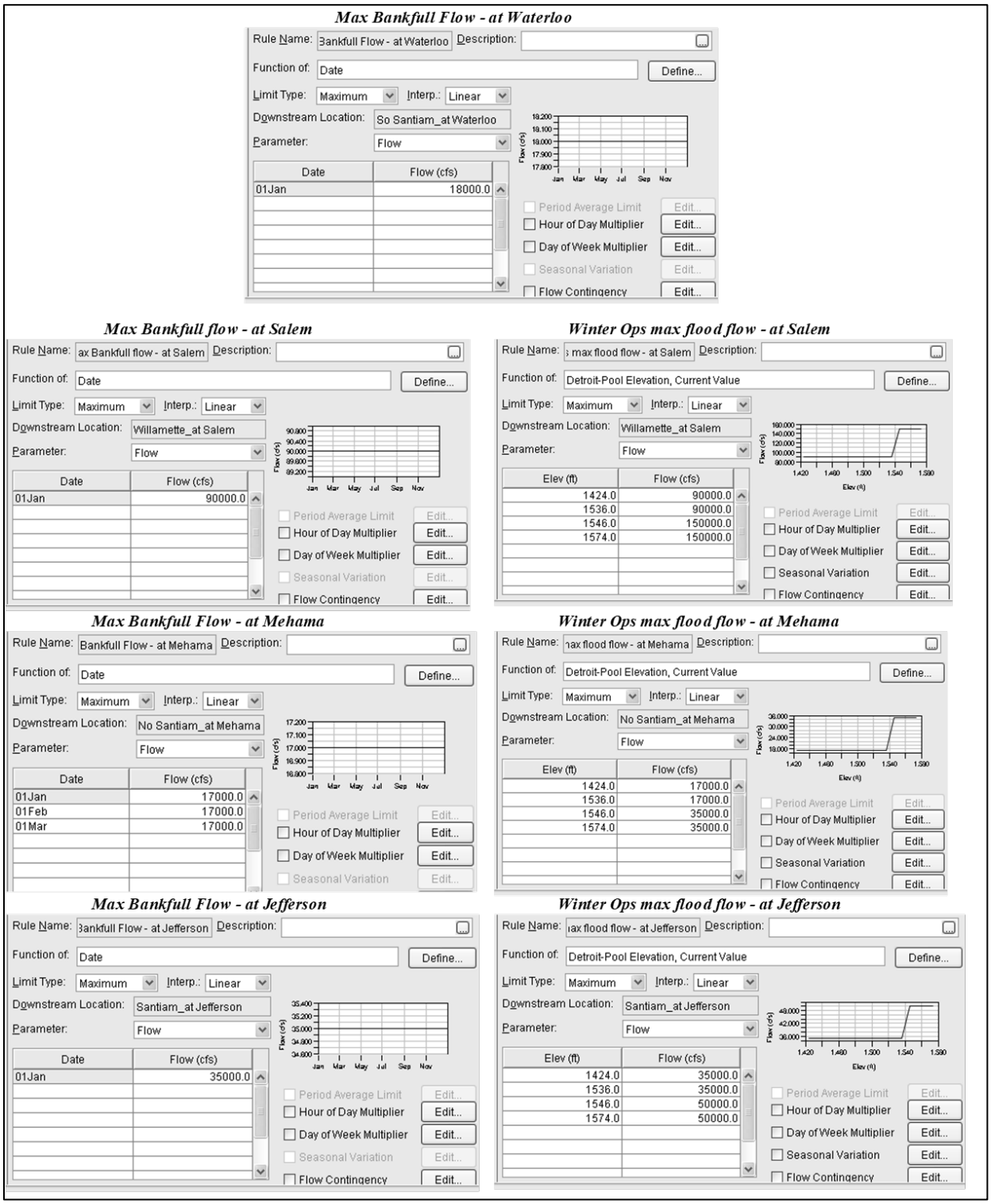


Figure 4.5b. ResSim Screen Shots of Downstream Maximum Rules.



4.7 Downstream Control Points, Minimum Flow Rules

Two control points on the Willamette River mainstem, Albany and Salem, are operated to minimum flows. Multiple projects are used to supplement the local flows in order to meet the target minimum flows, as shown in Table 4.4.

The Salem and Albany minimum flows were set by the Willamette BiOp. These minimum flow targets are set by water year type (Abundant, Adequate, Insufficient, or Deficit) and by time of year. The targets are the same for Abundant and Adequate water years, and they are specific for each time period in the year. Water years defined as Insufficient have a minimum Salem flow that varies between that of Abundant/Adequate and Deficit on a sliding scale based on interpolation between the calculated storage volume and the storage values associated with Adequate and Deficit water years. The Albany minimum flows for Insufficient water years are specified rather than interpolated. These minimum flows were shown previously in Table 2.2.

Both of the minimum flow rules use a two way table, with time periods and a Water Year Type variable that is input as an external time series. The external variable is the computed water in storage, in kaf, described in Table 2.4. The external time series is in a file named "*Water Year Type for 2010 Mod Flows.dss*", and the external variable name is "Water Year Type". Within the .dss file, the Part B of the water year type variable is called "TOTAL STORAGE", which corresponds to the storage volumes in Table 2.2. The downstream Salem minimum rule is called "*Min Flow – at Salem*" and the downstream Albany minimum rule is "*Min Flow – at Albany by Water Year Type*". Screen shots of these two rule are shown in Figures 4.6 and 4.7, respectively.

Table 4.4. Project Operation for Control Point Minimum Flows.

Control Point	Hills Creek	Lookout Point	Fall Creek	Cottage Grove	Dorena	Cougar	Blue River	Fern Ridge	Green Peter	Foster	Detroit
Salem	√	√	√	√	√	√	√	x	x	x	x
Albany	√	√	√	√	√	√	√	x			

√ Project storage is used by ResSim to meet minimum flow targets at downstream control point.

x Project does not use a specific ResSim rule to supplement flow at the downstream control point, but minimum project releases supplement flows at these control points.

Figure 4.6. ResSim Screen Shots of Min Flow – at Salem rule.

Rule Name: Min Flow - at Salem Description:

Function of: Water Year Type, Current Value

Limit Type: Minimum Interp.: Linear

Downstream Location: Willamette_at Salem

Parameter: Flow

Water Year Type	Flow (cfs)											
	01Jan	01Apr	16Apr	01May	01Jun	16Jun	01Jul	01Aug	16Aug	01Sep	01Oct	01Nov
0.0	0.0	15000.0	15000.0	15000.0	11000.0	5500.0	5000.0	5000.0	5000.0	5000.0	5000.0	0.0
0.9	0.0	15000.0	15000.0	15000.0	11000.0	5500.0	5000.0	5000.0	5000.0	5000.0	5000.0	0.0
1.2	0.0	17800.0	17800.0	15000.0	13000.0	8700.0	6000.0	6000.0	6500.0	7000.0	7000.0	0.0
1.48	0.0	17800.0	17800.0	15000.0	13000.0	8700.0	6000.0	6000.0	6500.0	7000.0	7000.0	0.0
2.0	0.0	17800.0	17800.0	15000.0	13000.0	8700.0	6000.0	6000.0	6500.0	7000.0	7000.0	0.0

Figure 4.7. ResSim Screen Shots of Min Flow – at Albany by Water Year Type rule.

Rule Name: Albany by Water Year Type Description: Min flow at Albany for use in any project

Function of: Water Year Type, Current Value

Limit Type: Minimum Interp.: Linear

Downstream Location: Willamette_at Albany

Parameter: Flow

Water Year Type	Flow (cfs)											
	01Jan	01Apr	16Apr	01May	01Jun	16Jun	01Jul	01Aug	16Aug	01Sep	01Oct	01Nov
0.0	0.0	0.0	0.0	0.0	4000.0	4000.0	4000.0	4000.0	4000.0	4000.0	4000.0	0.0
0.9	0.0	0.0	0.0	0.0	4000.0	4000.0	4000.0	4000.0	4000.0	4000.0	4000.0	0.0
1.2	0.0	0.0	0.0	0.0	4500.0	4500.0	4500.0	4500.0	4500.0	4500.0	4500.0	0.0
1.48	0.0	0.0	0.0	0.0	4500.0	4500.0	4500.0	5000.0	5000.0	5000.0	5000.0	0.0
2.0	0.0	0.0	0.0	0.0	4500.0	4500.0	4500.0	5000.0	5000.0	5000.0	5000.0	0.0

4.8 Rate of Flow Changes, Maximum and Minimum Flows

Each project has ramping rate rules for increasing and decreasing flows. The WCM for each project gives maximum rate of change (ramping rate) values for both filling and drafting, but the Willamette BiOp adjusted some of the rates to make for slower changes to flows.

All ramping rate rules at all projects will be the same in WBR alternatives as they are in the Baseline. See each project specific section for the ramping rate applied at each dam.

There are also maximum and minimum flow rules at each project. As with the ramping rates, the WCMs specify max and min outflows at each project, but the Willamette BiOp changed some of the flows. The maximum project outflows at every project will be the same for all WBR alternatives, but the minimum project outflows will vary with each alternative to accommodate stored water releases for future demands. See each project specific section for the max and min flows applied at each dam in the Baseline.

4.9 Minimum Project Outflows

Each project has a defined minimum outflow from its Water Control Manual, which at some projects varies with the time of year. Also, the 2008 BiOp specified a minimum flow for each controlled tributary of the Willamette, which are generally referred to as the tributary minimums. Since the 2008 BiOp, the project minimum outflows were adjusted upward from their WCM values to equal the tributary minimum flows in order to ensure that the BiOp minimums were met. In current real-time water management practice, the use of the BiOp minimum tributary flows as the minimum project outflows are enough to cover the currently existing irrigation contracts for stored water at all projects except Detroit and Fern Ridge Dams, which require some additional releases above BiOp minimums.

The minimum project outflows shown in each of the project specific sections (Sections 5 through 15) are the tributary minimums from the BiOp, with Detroit and Fern Ridge showing additional releases in May through September from the BiOp minimums to cover the irrigation contracts for stored water.

The flow dataset used for analyses in the WBR study already includes the diversion and return flow corrections for all years to the 2007/2008 levels of irrigation in the basin, so no diversions or return flows need to be included in the Baseline ResSim model. However, the rule sets at Detroit and Fern Ridge need to include the additional releases above the BiOp minimum tributary flows associated with meeting 2007 BOR storage contracts specifically on the North Santiam River and the Long Tom River, since that is the current water management practice.

The 2007 BOR contracts on the North Santiam total approximately 9107 ac-ft, with 15,781 ac-ft on the Long Tom River (DMA email dated 4/5/17 with attached spreadsheet). These water volumes are shaped for May through September and then flow equivalents for each day of those months are determined for additional releases at Detroit and Fern Ridge. See the rule descriptions at these two projects in Sections 12 and 15 for the release amounts.

4.10 Environmental Flows

The Sustainable Rivers Program (SRP) began in 2002 as a partnership between The Nature Conservancy (TNC) and the Corps with the objective of developing, implementing, and refining a framework for beneficial flows downstream of dams. SRP efforts in the Willamette River Basin focus on modifying dam releases within existing operational constraints to improve the overall downstream ecosystem health and resiliency by enhancing channel habitat, modifying channel features, and scouring and flushing of channels. The releases that provide these benefits are termed environmental flows (E-flows).

The E-flows are an opportunity driven operation that do not reduce the conservation storage of a reservoir during the summer months. This means that E-flow operations will not affect the availability of stored water in the system for the conservation season, and the use of stored water to meet irrigation or municipal/industrial demands does not affect the ability of the system to provide E-flows as the opportunity arises. The E-flow operations do not need to be modeled in the Baseline Simulation for the WBR Feasibility study.

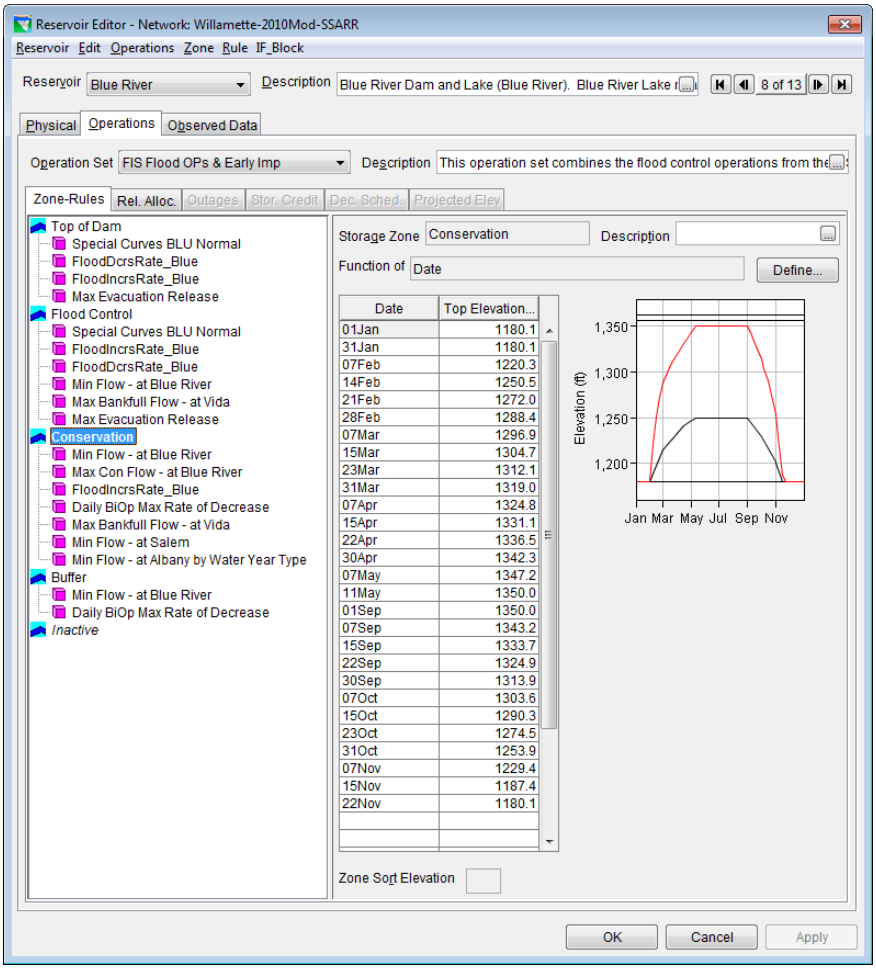
5 Blue River Project Specific Rule Sets

The following eleven chapters document the specific operation sets used in the Baseline simulation. The re-regulation dams, Big Cliff and Dexter, do not have rule sets and operate only by guide curve logic and zone boundaries. A screen shot of the operation set used for each of the eleven storage projects, an alphabetical list of rules and IF blocks used in the operation sets, and screen shots of the rules themselves are presented in the next eleven chapters.

5.1 Operation Set Screen Shot

The ResSim image of the Blue River Baseline operation set is in Figure 5.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots.

Figure 5.1. ResSim Screen Shots of the Blue River operation set used for the Baseline simulation.



5.2 Reservoir Zones

The zone boundaries used for Blue River are listed in Table 5.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Blue River from the WCM.

Table 5.1. Blue River Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	1180.1	01Jan	1180.0025
31Jan	1180.1	31Jan	1180.0025
07Feb	1220.3	28Feb	1214.83
14Feb	1250.5	31Mar	1232.59
21Feb	1272.0	01Apr	1233.15
28Feb	1288.4	15Apr	1240.57
07Mar	1296.9	30Apr	1245.62
15Mar	1304.7	11May	1249.31
23Mar	1312.1	31May	1249.31
31Mar	1319.0	01Jun	1249.31
07Apr	1324.8	30Jun	1249.31
15Apr	1331.1	01Jul	1249.31
22Apr	1336.5	01Aug	1249.31
30Apr	1342.3	31Aug	1249.31
07May	1347.2	30Sep	1229.36
11May	1350.0	31Oct	1201.37
01Sep	1350.0	01Nov	1200.4
07Sep	1343.2	15Nov	1180.0025
15Sep	1333.7	31Dec	1180.0025
22Sep	1324.9		
30Sep	1313.9		
07Oct	1303.6	**Top of Dam Zone**	
15Oct	1290.3	All Year	1362.0
23Oct	1274.5	**Flood Control Zone**	
31Oct	1253.9	All Year	1357.0
07Nov	1229.4	**Inactive Zone**	
15Nov	1187.4	All Year	1180.0
22Nov	1180.1		

5.3 Alphabetical List of Rules in Operation Set

The Blue River Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 5.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: FIS Flood OPs & Early Imp

- *Daily BiOp Max Rate of Decrease* – rate of change flow decrease, linear
- *FloodDcrsRate_Blue* –max rate of change decrease, linear with release
- *FloodIncrsRate_Blue* –max rate of change increase, step function of BLU release value
- *Max Bankfull Flow – at Vida* – Flood flow at Vida is 14,500 cfs
- *Max Con Flow – at Blue River* – normal maximum outflow during the conservation season, a function of date.
- *Max Evacuation Release* – max release function of the previous BLU elevation
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the

Buffer zone to mimic water management practices of conserving some storage when pool levels are low.

- *Min Flow – at Blue River* – min project flow 50 cfs
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *Special Curves BLU Normal* – induced surcharge function, a function of elevation and inflow.

Figure 5.2a. Blue River Baseline Operation Set Rules, continued on next page.

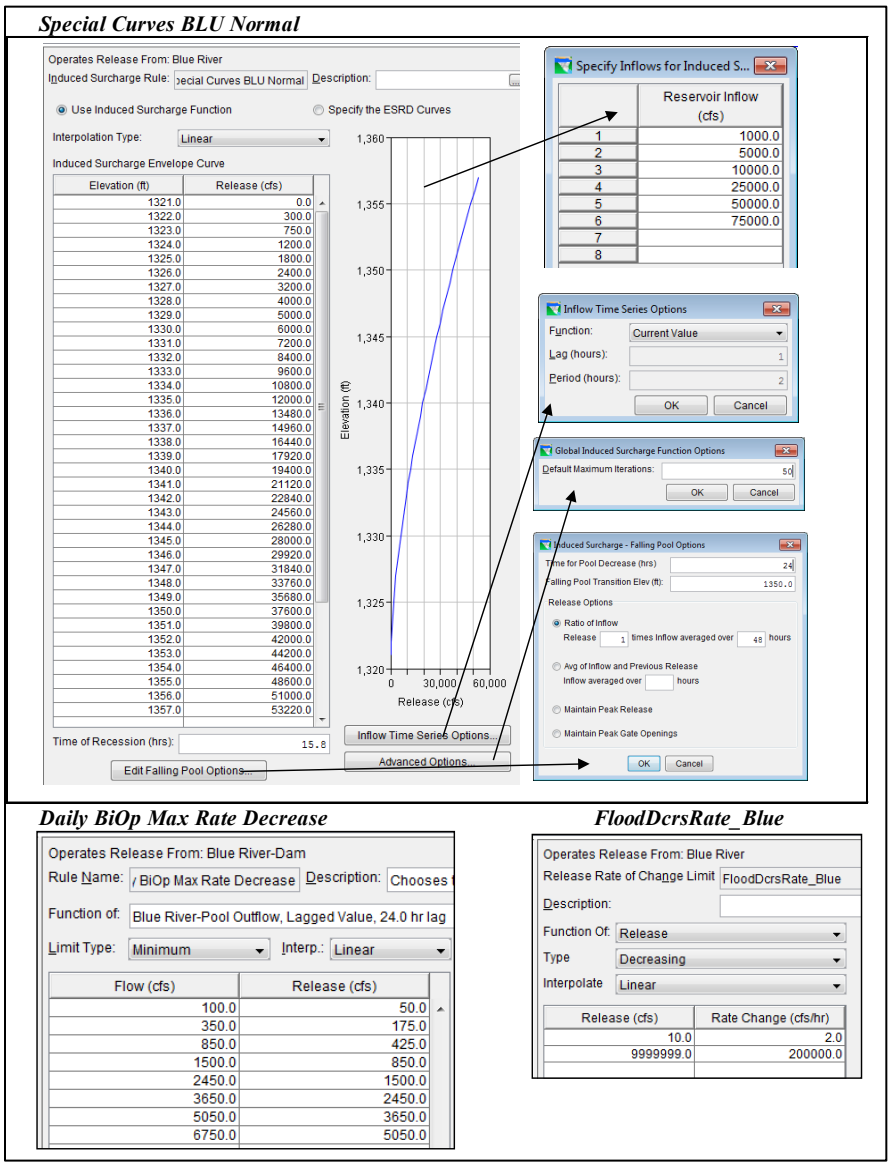


Figure 5.2b. Blue River Baseline Operation Set Rules, continued.

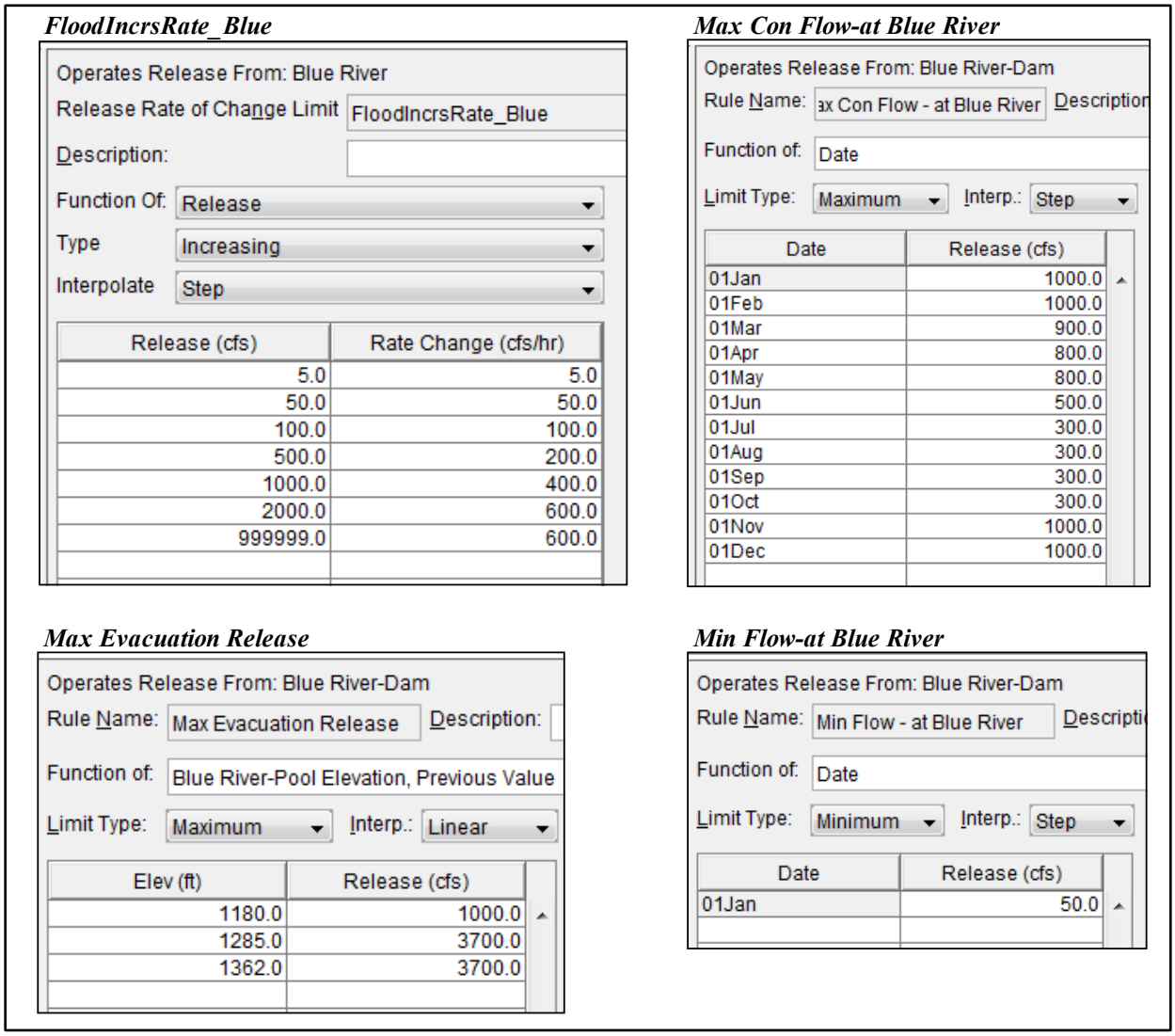
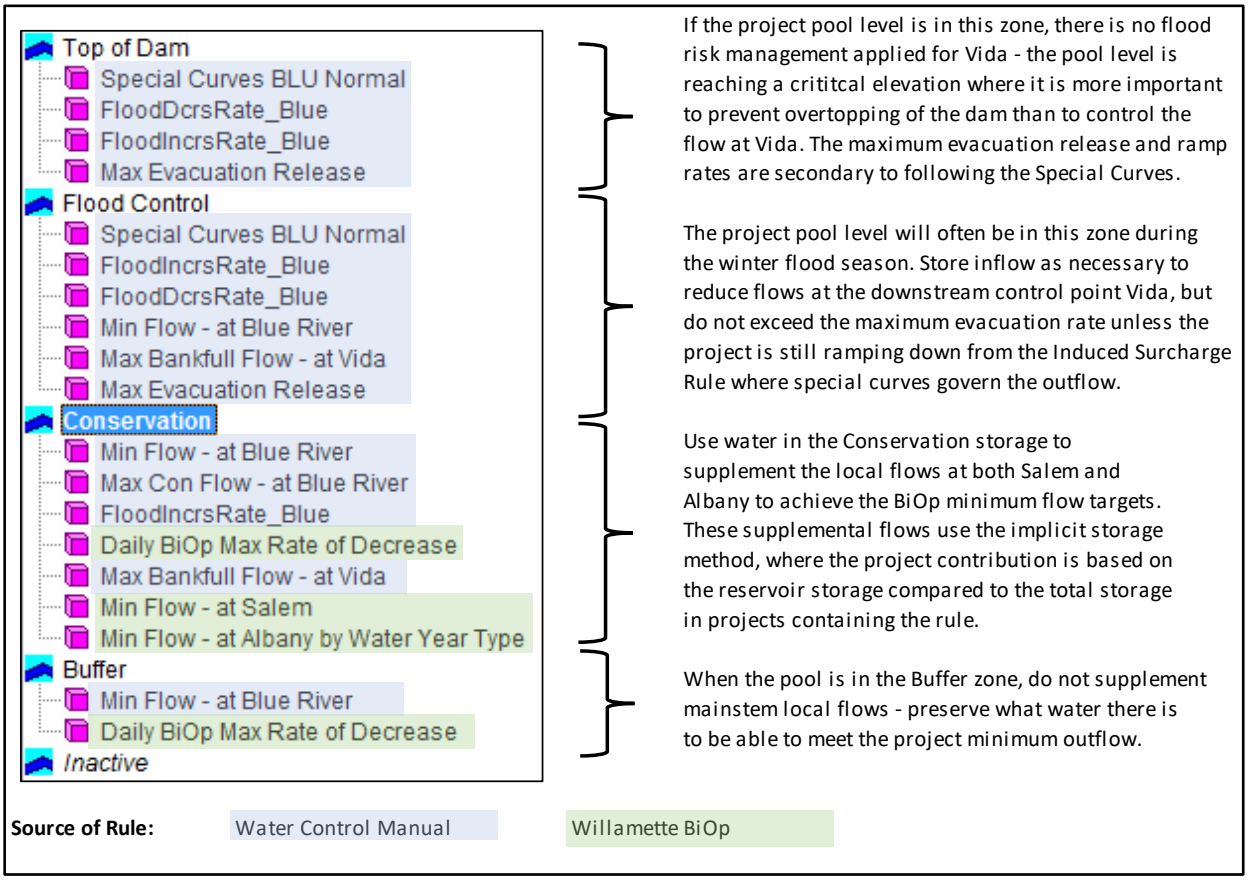


Figure 5.3. Blue River Baseline Operation Set Rule Sources and Regulation Goals.

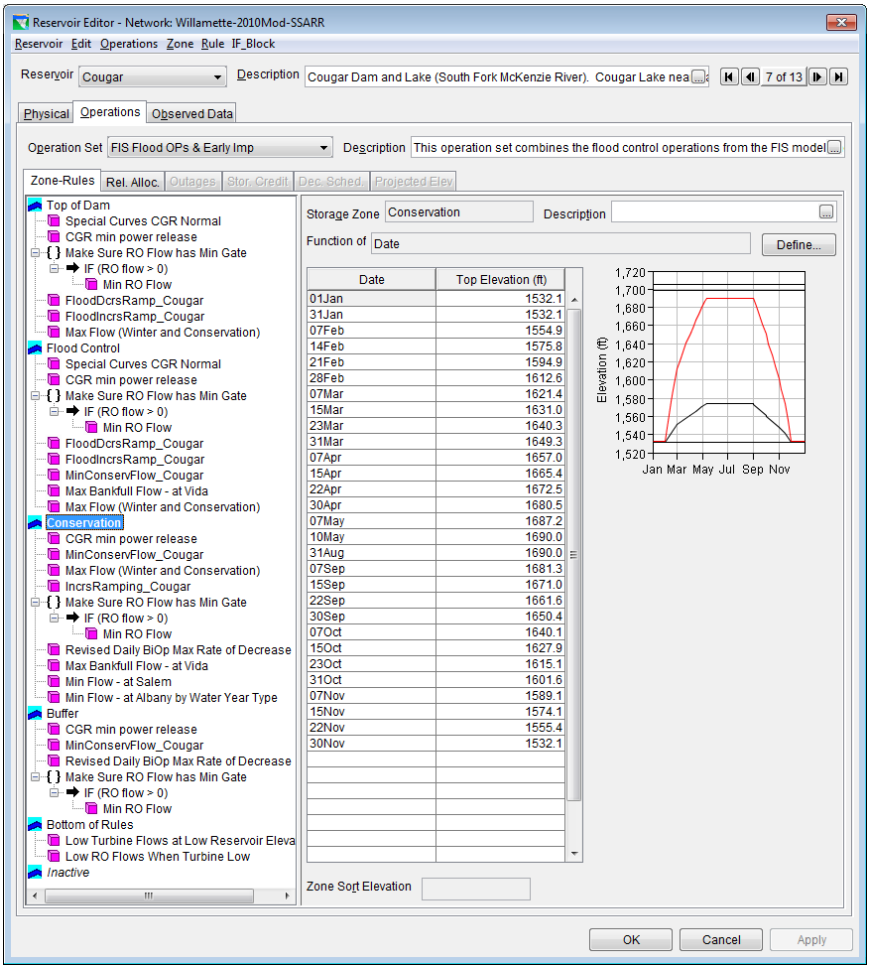


6 Cougar Project Specific Rule Sets

6.1 Operation Set Screen Shot

The ResSim image of the Cougar Baseline operation set is in Figure 6.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots.

Figure 6.1. ResSim Screen Shots of the Cougar operation set used for the Baseline simulation.



6.2 Reservoir Zones

The zone boundaries used for Cougar are listed in Table 6.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Cougar from the WCM.

Table 6.1. Cougar Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	1532.1	01Jan	1532.0025
31Jan	1532.1	31Jan	1532.0025
07Feb	1554.9	28Feb	1551.11
14Feb	1575.8	31Mar	1560.5
21Feb	1594.9	01Apr	1560.83
28Feb	1612.6	15Apr	1565.43
07Mar	1621.4	30Apr	1570.32
15Mar	1631.0	10May	1573.56
23Mar	1640.3	31Jul	1573.56
31Mar	1649.3	01Aug	1573.56
07Apr	1657.0	31Aug	1573.56
15Apr	1665.4	01Sep	1573.13
22Apr	1672.5	30Sep	1560.78
30Apr	1680.5	01Oct	1560.38
07May	1687.2	31Oct	1547.97
10May	1690.0	01Nov	1547.53
31Aug	1690.0	15Nov	1541.32
07Sep	1681.3	30Nov	1532.0025
15Sep	1671.0	31Dec	1532.0025
22Sep	1661.6		
30Sep	1650.4		
07Oct	1640.1	**Top of Dam Zone**	
15Oct	1627.9	All Year	1705.0
23Oct	1615.1	**Flood Control Zone**	
31Oct	1601.6	All Year	1699.0
07Nov	1589.1	**Bottom of Rules Zone**	
15Nov	1574.1	All Year	1532.002
22Nov	1555.4	**Inactive Zone**	
30Nov	1532.1	All Year	1531.0

6.3 Alphabetical List of Rules in Operation Set

The Cougar Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 6.3 indicates the source of each rule (Water Control Manual, Willamette BiOp, or a Hydraulic Design criteria) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: FIS Flood OPs & Early Imp

- *CGR min power release* – min flow through powerhouse with project elevation, but different than speed no load
- *FloodDcrsRamp_Cougar* –max rate of change decrease, 500 cfs/hr.
- *FloodIncrsRamp_Cougar* –max rate of change increase, step function of Cougar release value
- *IncrsRamping_Cougar* –normal max rate of increase, 200 cfs/hr.
- *Low RO Flows When Turbine Low* – Specified flow through the ROs when very near the inactive zone. This rule and the Low Turbine Flow rule make the flow in the zone just above the Inactive

zone to be smaller than normal project minima, and the low RO flows are sometimes for less than min gate openings to achieve this.

- *Low Turbine Flows at Low Reservoir Elevations* – specified low level releases through the turbine when flows out of project are less than the 400 cfs minimum. This low flow is either speed no load (100 cfs) or the approx. 300 cfs min. Is only used in the Bottom of Rules zone, just above the Inactive zone.
- *Max Flow (Winter and Conservation)* – max release function of the previous elevation
- *Max Bankfull Flow – at Vida* – Flood flow at Vida is 14,500 cfs
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low.
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *Min RO Flow* – minimum flow from RO based on min gate opening
- *MinConservFlow_Cougar* – min project flow 400 cfs
- *Revised Daily BiOp Max Rate of Decrease* – flow release 50% change
- *Special Curves CGR Normal* – induced surcharge function, a function of elevation and inflow.

IF BLOCK *Make Sure RO Flow has Min Gate* – use when RO flow is > 0.
IF *(RO flow>0)* – if Cougar-Regulating Outlet Flow, Current Value >0.

Figure 6.2a. Cougar Baseline Operation Set Rules, continued on next pages.

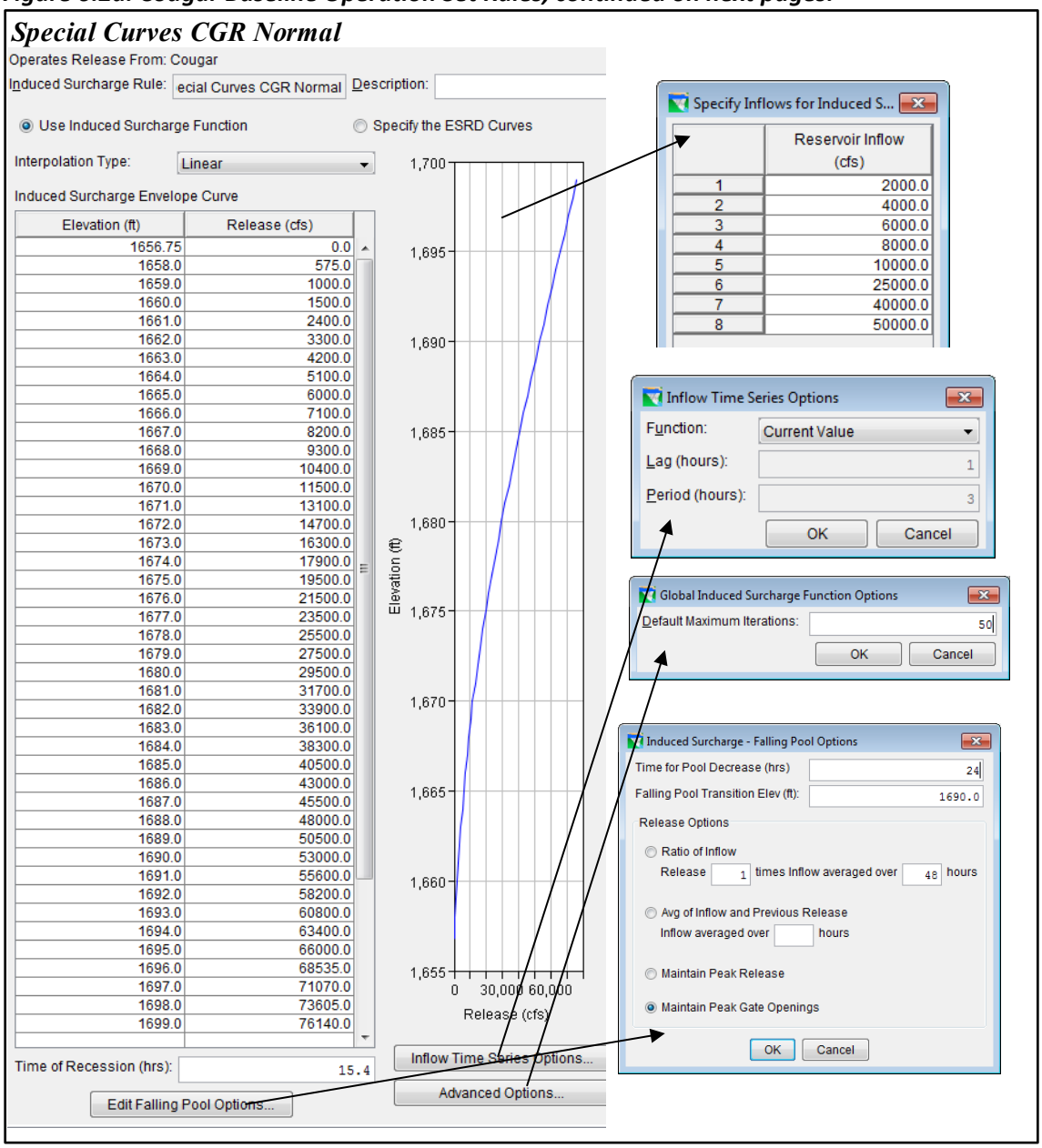
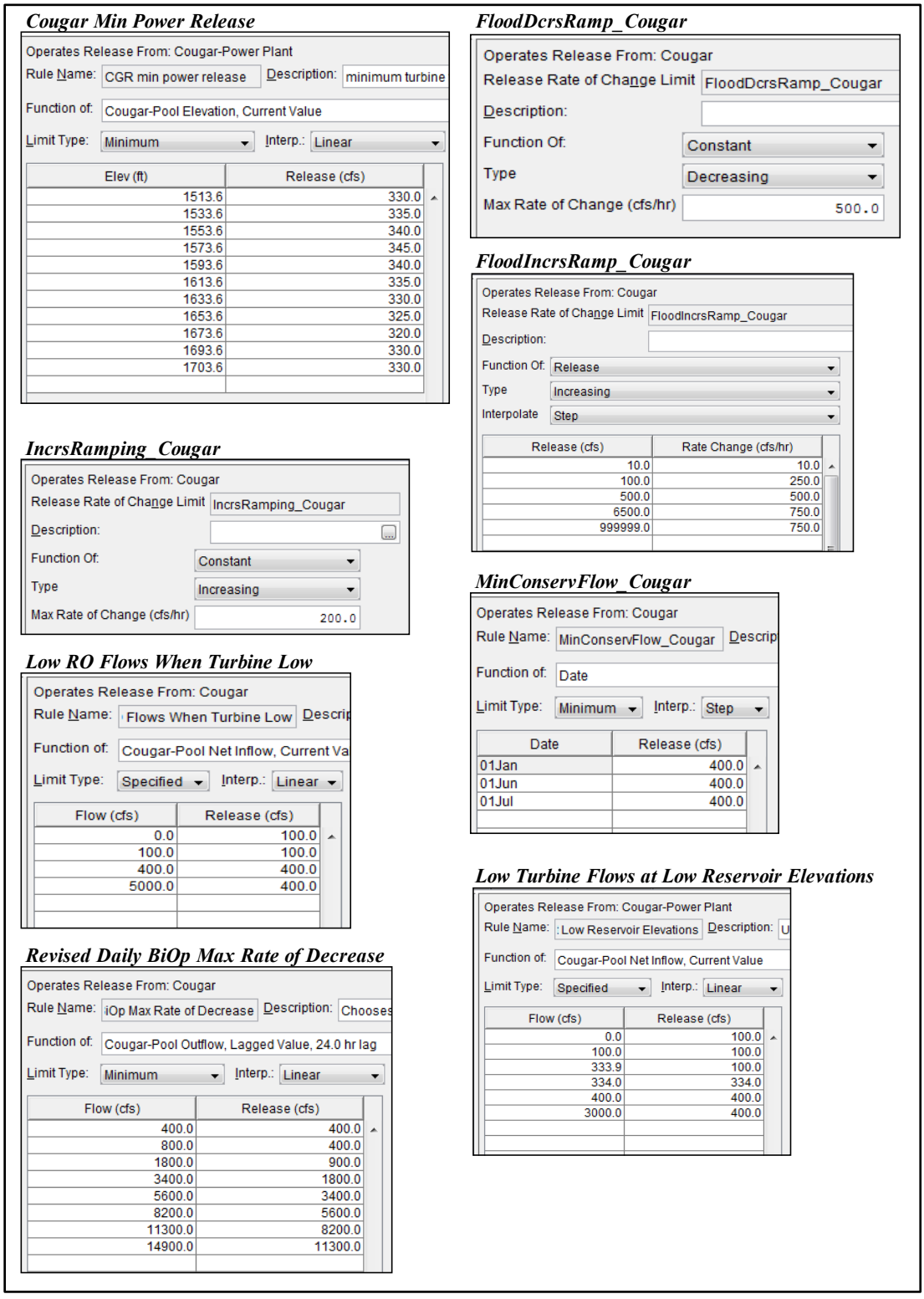


Figure 6.2b. Cougar Baseline Operation Set Rules, continued.



Cougar Min Power Release

Operates Release From: Cougar-Power Plant
Rule Name: CGR min power release Description: minimum turbine
Function of: Cougar-Pool Elevation, Current Value
Limit Type: Minimum Interp.: Linear

Elev (ft)	Release (cfs)
1513.6	330.0
1533.6	335.0
1553.6	340.0
1573.6	345.0
1593.6	340.0
1613.6	335.0
1633.6	330.0
1653.6	325.0
1673.6	320.0
1693.6	330.0
1703.6	330.0

IncrsRamping_Cougar

Operates Release From: Cougar
Release Rate of Change Limit: IncrsRamping_Cougar
Description:
Function Of: Constant
Type: Increasing
Max Rate of Change (cfs/hr): 200.0

Low RO Flows When Turbine Low

Operates Release From: Cougar
Rule Name: Flows When Turbine Low Descrip
Function of: Cougar-Pool Net Inflow, Current Va
Limit Type: Specified Interp.: Linear

Flow (cfs)	Release (cfs)
0.0	100.0
100.0	100.0
400.0	400.0
5000.0	400.0

Revised Daily BiOp Max Rate of Decrease

Operates Release From: Cougar
Rule Name: iOp Max Rate of Decrease Description: Chooses
Function of: Cougar-Pool Outflow, Lagged Value, 24.0 hr lag
Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)
400.0	400.0
800.0	400.0
1800.0	900.0
3400.0	1800.0
5600.0	3400.0
8200.0	5600.0
11300.0	8200.0
14900.0	11300.0

FloodDcrsRamp_Cougar

Operates Release From: Cougar
Release Rate of Change Limit: FloodDcrsRamp_Cougar
Description:
Function Of: Constant
Type: Decreasing
Max Rate of Change (cfs/hr): 500.0

FloodIncrsRamp_Cougar

Operates Release From: Cougar
Release Rate of Change Limit: FloodIncrsRamp_Cougar
Description:
Function Of: Release
Type: Increasing
Interpolate: Step

Release (cfs)	Rate Change (cfs/hr)
10.0	10.0
100.0	250.0
500.0	500.0
6500.0	750.0
999999.0	750.0

MinConservFlow_Cougar

Operates Release From: Cougar
Rule Name: MinConservFlow_Cougar Descrip
Function of: Date
Limit Type: Minimum Interp.: Step

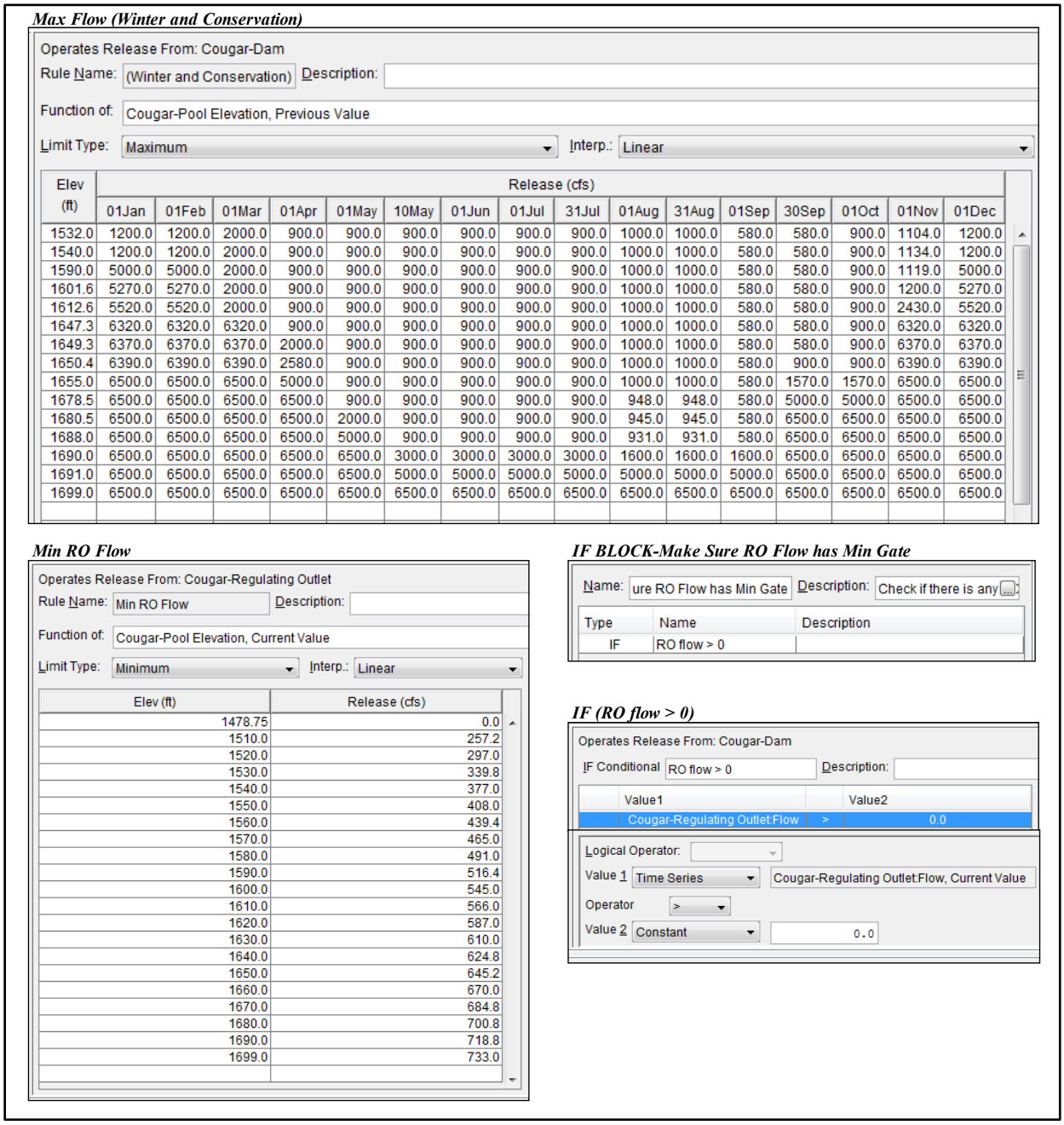
Date	Release (cfs)
01Jan	400.0
01Jun	400.0
01Jul	400.0

Low Turbine Flows at Low Reservoir Elevations

Operates Release From: Cougar-Power Plant
Rule Name: Low Reservoir Elevations Description: U
Function of: Cougar-Pool Net Inflow, Current Value
Limit Type: Specified Interp.: Linear

Flow (cfs)	Release (cfs)
0.0	100.0
100.0	100.0
333.9	100.0
334.0	334.0
400.0	400.0
3000.0	400.0

Figure 6.2c. Cougar Baseline Operation Set Rules, continued.



Max Flow (Winter and Conservation)

Operates Release From: Cougar-Dam

Rule Name: (Winter and Conservation) Description:

Function of: Cougar-Pool Elevation, Previous Value

Limit Type: Maximum Interp.: Linear

Elev (ft)	Release (cfs)															
	01Jan	01Feb	01Mar	01Apr	01May	10May	01Jun	01Jul	31Jul	01Aug	31Aug	01Sep	30Sep	01Oct	01Nov	01Dec
1532.0	1200.0	1200.0	2000.0	900.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	1104.0	1200.0
1540.0	1200.0	1200.0	2000.0	900.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	1134.0	1200.0
1590.0	5000.0	5000.0	2000.0	900.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	1119.0	5000.0
1601.6	5270.0	5270.0	2000.0	900.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	1200.0	5270.0
1612.6	5520.0	5520.0	2000.0	900.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	2430.0	5520.0
1647.3	6320.0	6320.0	6320.0	900.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	6320.0	6320.0
1649.3	6370.0	6370.0	6370.0	2000.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	580.0	900.0	6370.0	6370.0
1650.4	6390.0	6390.0	6390.0	2580.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	900.0	900.0	6390.0	6390.0
1655.0	6500.0	6500.0	6500.0	5000.0	900.0	900.0	900.0	900.0	900.0	1000.0	1000.0	580.0	1570.0	1570.0	6500.0	6500.0
1678.5	6500.0	6500.0	6500.0	6500.0	900.0	900.0	900.0	900.0	900.0	948.0	948.0	580.0	5000.0	5000.0	6500.0	6500.0
1680.5	6500.0	6500.0	6500.0	6500.0	2000.0	900.0	900.0	900.0	900.0	945.0	945.0	580.0	6500.0	6500.0	6500.0	6500.0
1688.0	6500.0	6500.0	6500.0	6500.0	5000.0	900.0	900.0	900.0	900.0	931.0	931.0	580.0	6500.0	6500.0	6500.0	6500.0
1690.0	6500.0	6500.0	6500.0	6500.0	6500.0	3000.0	3000.0	3000.0	3000.0	1600.0	1600.0	1600.0	6500.0	6500.0	6500.0	6500.0
1691.0	6500.0	6500.0	6500.0	6500.0	6500.0	5000.0	5000.0	5000.0	5000.0	5000.0	5000.0	5000.0	6500.0	6500.0	6500.0	6500.0
1699.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0	6500.0

Min RO Flow

Operates Release From: Cougar-Regulating Outlet

Rule Name: Min RO Flow Description:

Function of: Cougar-Pool Elevation, Current Value

Limit Type: Minimum Interp.: Linear

Elev (ft)	Release (cfs)
1478.75	0.0
1510.0	257.2
1520.0	297.0
1530.0	339.8
1540.0	377.0
1550.0	408.0
1560.0	439.4
1570.0	465.0
1580.0	491.0
1590.0	516.4
1600.0	545.0
1610.0	566.0
1620.0	587.0
1630.0	610.0
1640.0	624.8
1650.0	645.2
1660.0	670.0
1670.0	684.8
1680.0	700.8
1690.0	718.8
1699.0	733.0

IF BLOCK-Make Sure RO Flow has Min Gate

Name: ure RO Flow has Min Gate Description: Check if there is any

Type	Name	Description
IF	RO flow > 0	

IF (RO flow > 0)

Operates Release From: Cougar-Dam

IF Conditional RO flow > 0 Description:

	Value1		Value2
	Cougar-Regulating Outlet:Flow	>	0.0

Logical Operator:

Value 1 Time Series Cougar-Regulating Outlet:Flow, Current Value

Operator >

Value 2 Constant 0.0

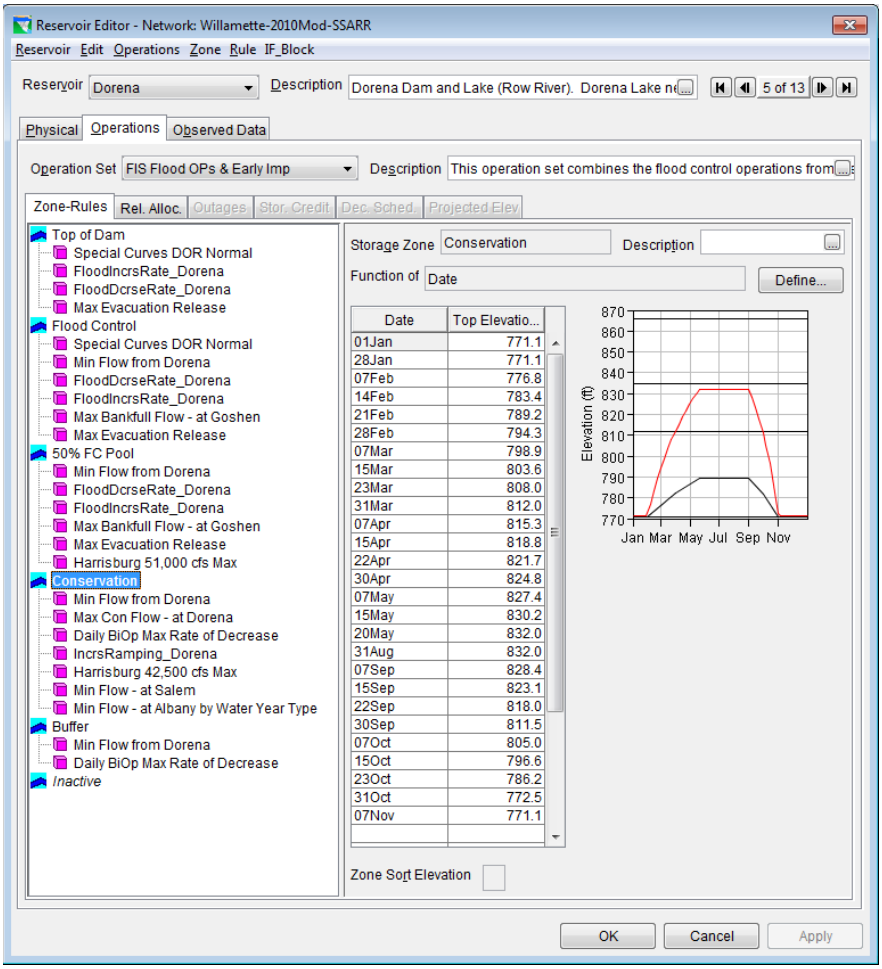
Figure 6.3. Cougar Baseline Operation Set Rule Sources and Regulation Goals.

7 Dorena Project Specific Rule Sets

7.1 Operation Set Screen Shot

The ResSim image of the Dorena Baseline operation set is in Figure 7.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots.

Figure 7.1. ResSim Screen Shots of the Dorena operation set used for the Baseline simulation.



7.2 Reservoir Zones

The zone boundaries used for Dorena are listed in Table 7.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Dorena from the WCM.

Table 7.1. Dorena Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	771.1	01Jan	771.0025
28Jan	771.1	31Jan	771.0025
07Feb	776.8	01Feb	771.0025
14Feb	783.4	28Feb	776.37
21Feb	789.2	31Mar	782.03
28Feb	794.3	01Apr	782.18
07Mar	798.9	20May	789.47
15Mar	803.6	30Jun	789.47
23Mar	808.0	01Jul	789.47
31Mar	812.0	31Aug	789.47
07Apr	815.3	30Sep	781.5
15Apr	818.8	31Oct	771.0025
22Apr	821.7	01Nov	771.0025
30Apr	824.8	31Dec	771.0025
07May	827.4		
15May	830.2		
20May	832.0		
31Aug	832.0		
07Sep	828.4		
15Sep	823.1		
22Sep	818.0		
30Sep	811.5	**Top of Dam Zone**	
07Oct	805.0	All Year	865.7
15Oct	796.6	**Flood Control Zone**	
23Oct	786.2	All Year	835.0
31Oct	772.5	**50% FC Zone**	
07Nov	771.1	All Year	812.0
		Inactive Zone	
		All Year	771.0

7.3 Alphabetical List of Rules in Operation Set

The Dorena Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 7.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: FIS Flood OPs & Early Imp

- *Daily BiOp Max Rate of Decrease* – rate of decrease rule written as a minimum release of previous project outflow, linearly interpolated.
- *FloodDcrseRate_Dorena* –max rate of change decrease, linear function with project release
- *FloodIncrsRate_Dorena* –max rate of change increase, step function of project release value
- *Harrisburg 51,000 cfs Max* – downstream maximum rule for intermediate flow, between bankfull and flood stage, at Harrisburg.
- *Harrisburg 42,500 cfs Max* – downstream maximum rule for bankfull flow at Harrisburg.
- *IncrsRamping_Dorena* – normal increasing rate of change rule at 200 cfs/hr.

- *Max Bankfull Flow – at Goshen* – downstream maximum flow rule to keep Goshen below bankfull.
- *Max Con Flow – at Dorena* – maximum flow rule dependent on time of year.
- *Max Evacuation Release* – Maximum release as a function of the previous pool elevation, linear interpolation.
- *Min Flow from Dorena* – minimum project flow depending on time of year.
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low.
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *Special Curves DOR* Normal– induced surcharge function, a function of elevation and inflow.

Figure 7.2a. Dorena Baseline Operation Set rules, continued on next pages.

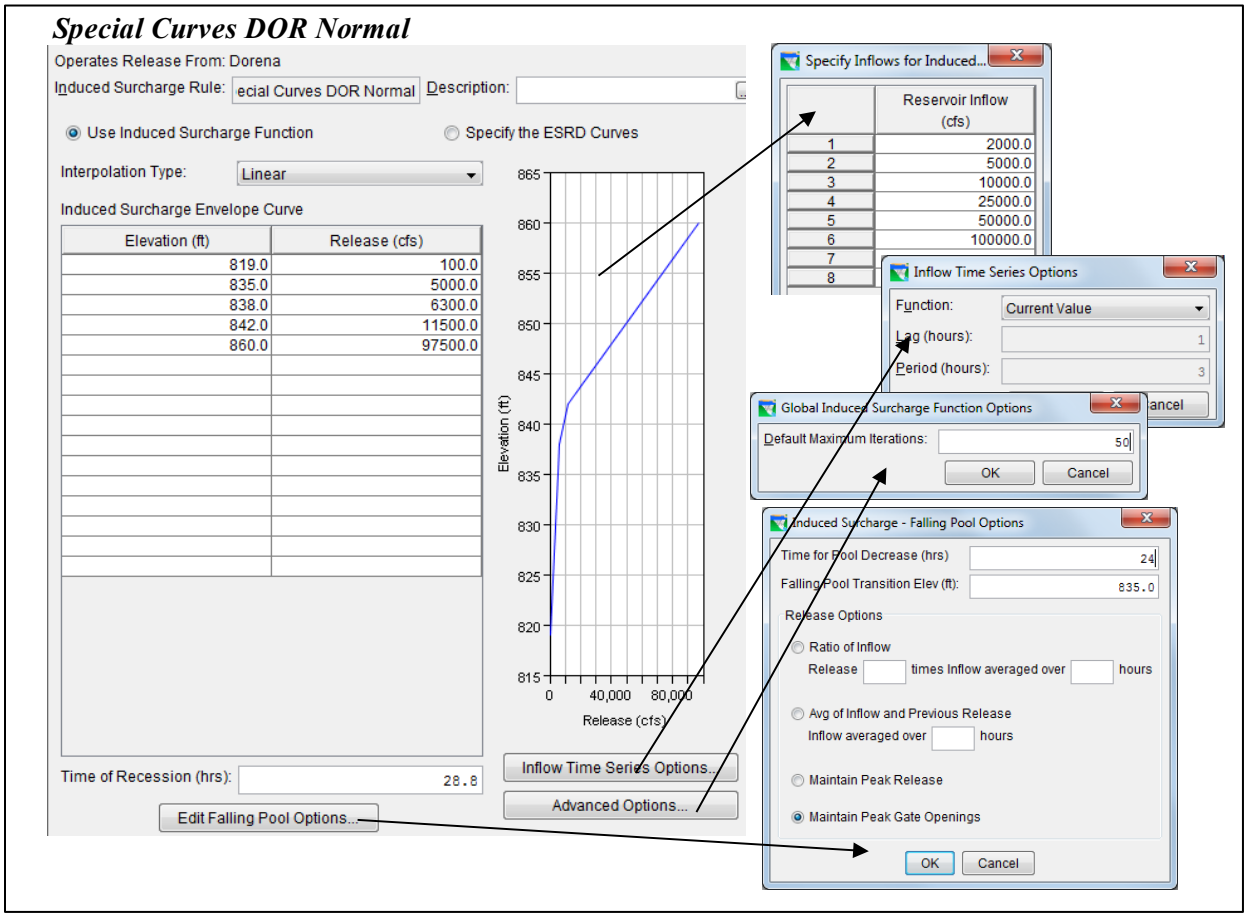


Figure 7.2b. Dorena Baseline Operation Set rules, continued.

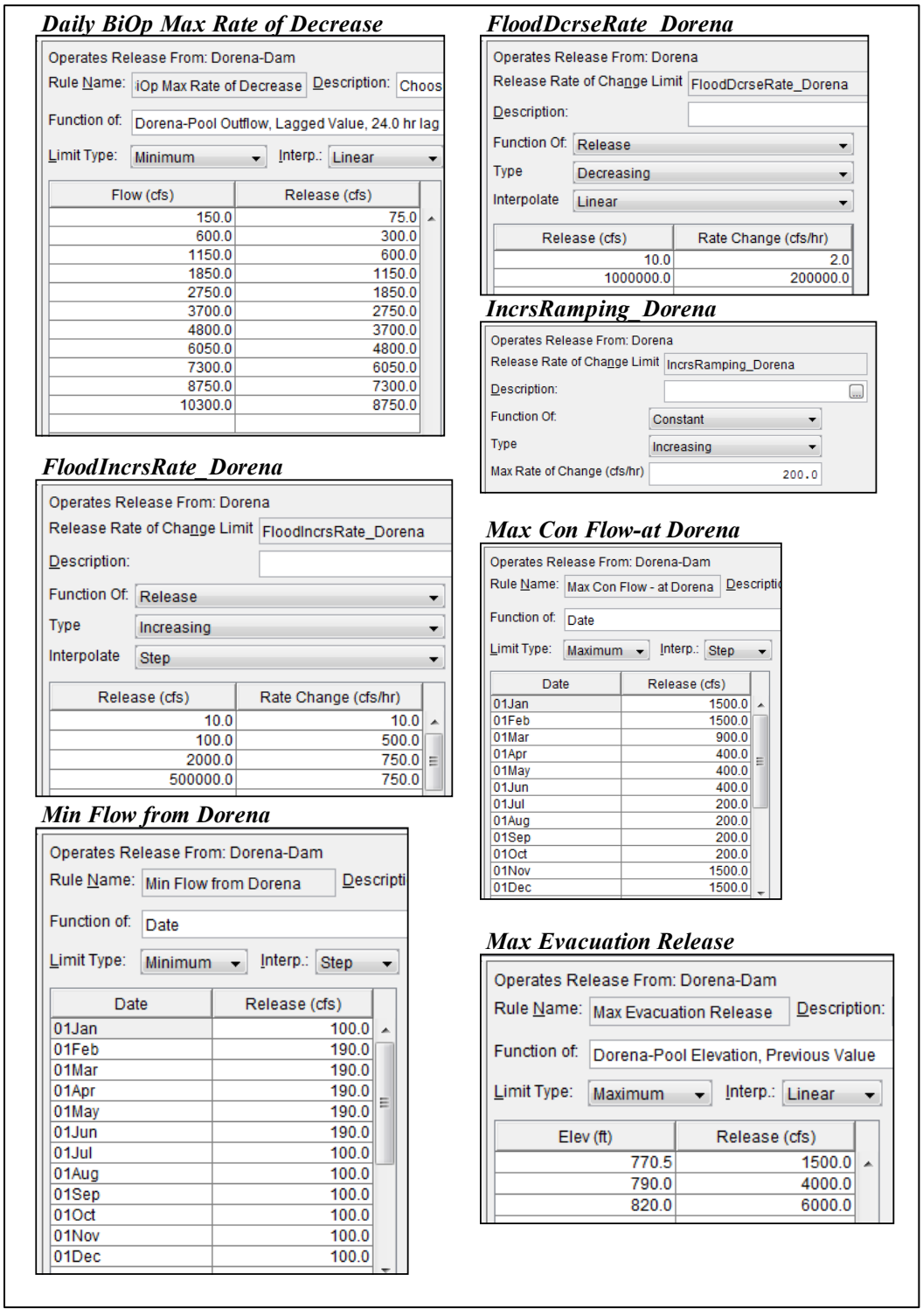
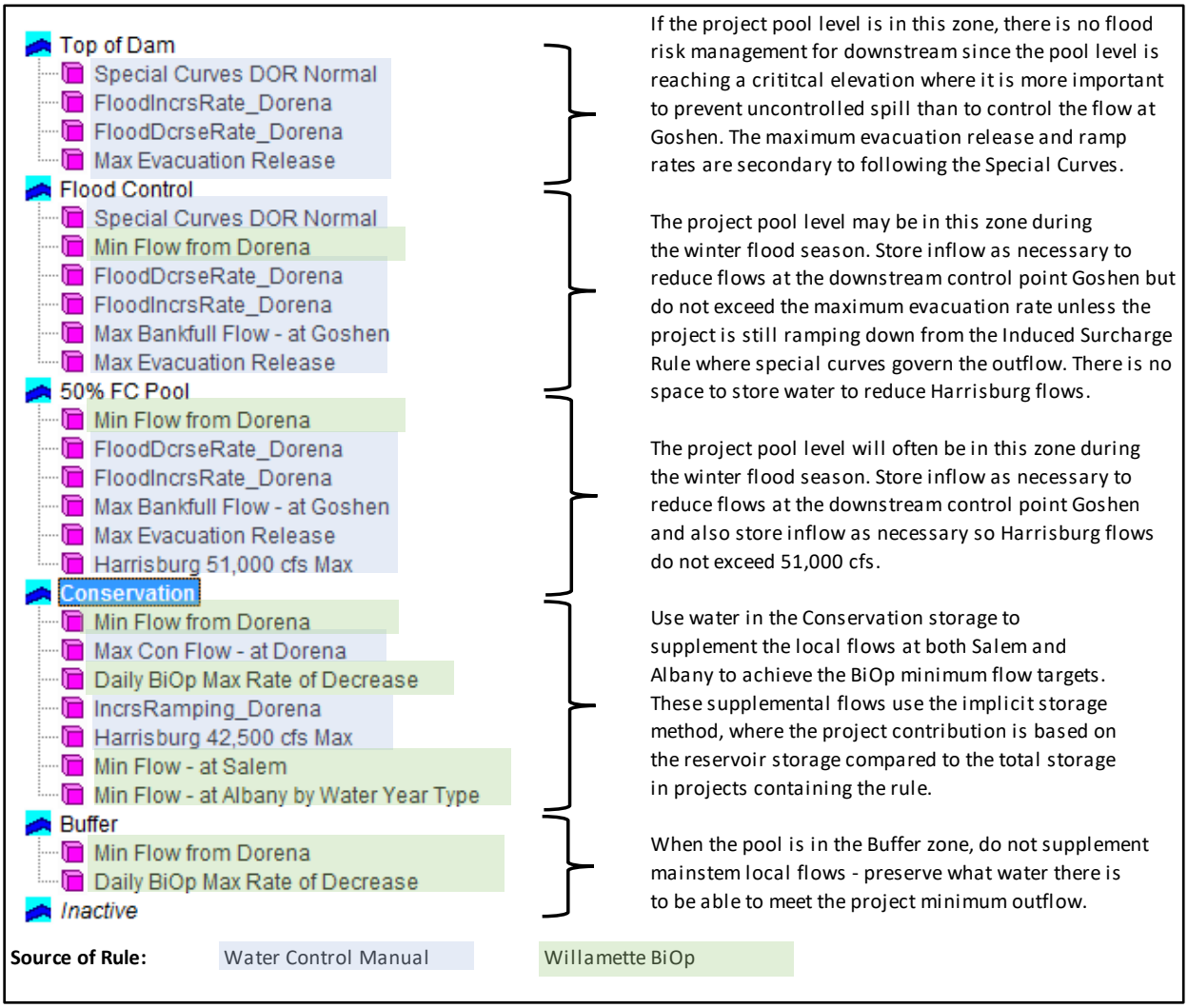


Figure 7.3. Dorena Baseline Operation Set Rule Sources and Regulation Goals.

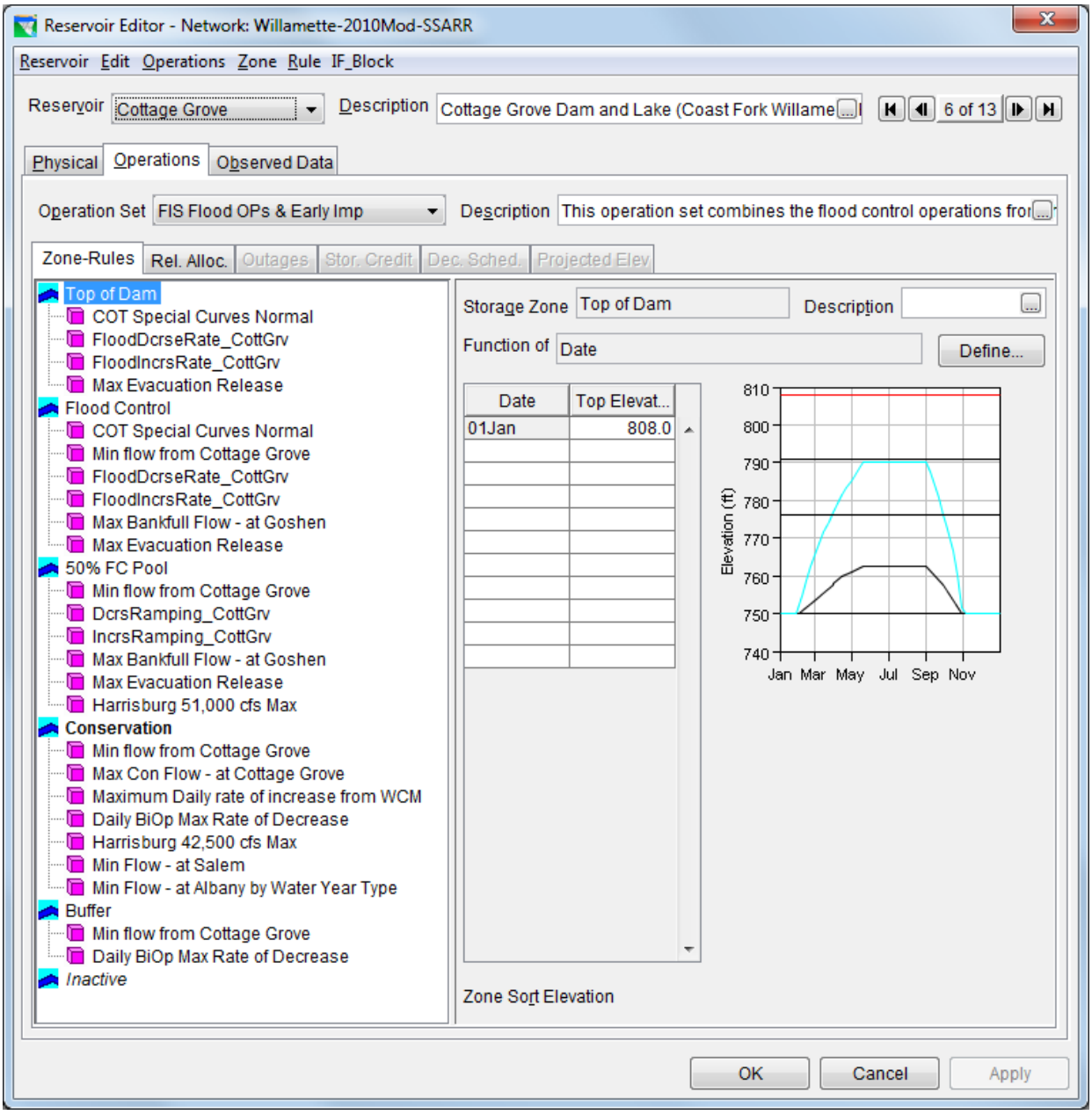


8 Cottage Grove Project Specific Rule Sets

8.1 Operation Set Screen Shot

The ResSim image of the Cottage Grove Baseline operation set is in Figure 8.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots.

Figure 8.1. ResSim Screen Shots of the Cottage Grove operation set used for the Baseline simulation.



8.2 Reservoir Zones

The zone boundaries used for Cottage Grove are listed in Table 8.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Cottage Grove from the WCM.

Table 8.1. Cottage Grove Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	750.1	01Jan	750.0025
28Jan	750.1	31Jan	750.0025
07Feb	754.7	01Feb	750.19
14Feb	758.9	28Feb	753.62
21Feb	762.5	31Mar	757.74
28Feb	765.6	01Apr	757.87
07Mar	768.5	14Apr	759.72
15Mar	771.6	19May	760.96
23Mar	774.3	30Jun	762.38
31Mar	776.9	01Jul	762.38
07Apr	779.0	31Aug	762.38
15Apr	781.3	30Sep	762.38
22Apr	783.2	31Oct	757.48
30Apr	785.3	01Nov	750.0025
07May	787.1	31Dec	750.0025
15May	789.0		
19May	790.0		
01Sep	790.0		
07Sep	787.5		
15Sep	783.9		
22Sep	780.5		
30Sep	776.3	**Top of Dam Zone**	
07Oct	772.2	All Year	808.0
15Oct	766.8	**Flood Control Zone**	
23Oct	760.4	All Year	791.0
31Oct	751.5	**50% FC Zone**	
07Nov	750.1	All Year	776.0
		Inactive Zone	
		All Year	750.0

8.3 Alphabetical List of Rules in Operation Set

The Cottage Grove Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 8.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

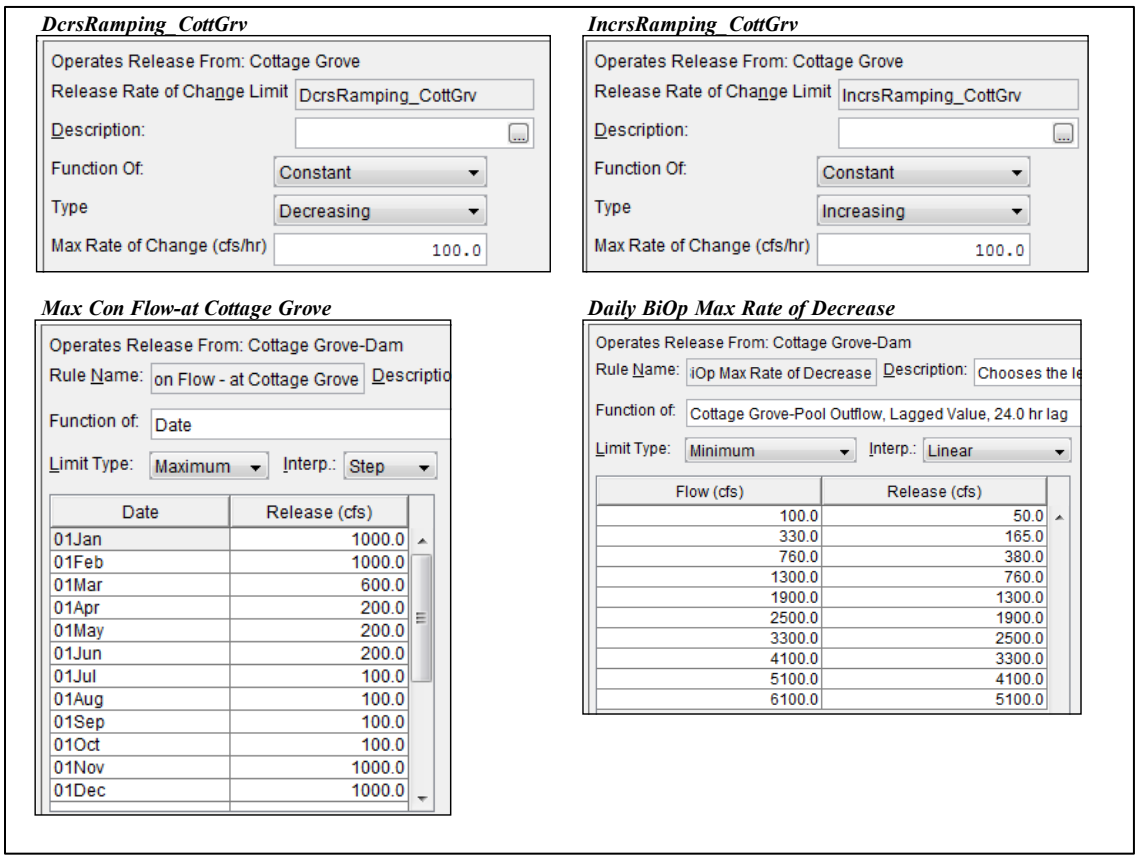
Baseline Operation Set Descriptions

Operation Set Name: FIS Flood OPs & Early Imp

- *COT Special Curves Normal*– induced surcharge function, a function of elevation and inflow.
- *Daily BiOp Max Rate of Decrease* – rate of decrease rule written as a minimum release of previous project outflow, linearly interpolated.
- *DcrsRamping_CottGrv* – decreasing rate of change rule at 100 cfs/hr.
- *FloodDcrseRate_CottGrv* –max rate of change decrease, linear function with project release
- *FloodIncrsRate_CottGrv* –max rate of change increase 350 cfs/hr.

- *Harrisburg 51,000 cfs Max* – downstream maximum rule for intermediate flow, between bankfull and flood stage, at Harrisburg.
- *Harrisburg 42,500 cfs Max* – downstream maximum rule for bankfull flow at Harrisburg.
- *IncrsRamping_CottGrv* – increasing rate of change rule at 100 cfs/hr.
- *Min Flow from Cottage Grove* – minimum project flow depending on time of year.
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low.
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *Max Bankfull Flow – at Goshen* – downstream maximum flow rule to keep Goshen below bankfull.
- *Max Con Flow – at Cottage Grove* – maximum flow rule dependent on time of year.
- *Max Evacuation Release* – Maximum release as a function of the previous pool elevation, linear interpolation.

Figure 8.2a. Cottage Grove Baseline Operation Set Rules, continued on next page.



DcrsRamping_CottGrv

Operates Release From: Cottage Grove
Release Rate of Change Limit: DcrsRamping_CottGrv
Description:
Function Of: Constant
Type: Decreasing
Max Rate of Change (cfs/hr): 100.0

IncrsRamping_CottGrv

Operates Release From: Cottage Grove
Release Rate of Change Limit: IncrsRamping_CottGrv
Description:
Function Of: Constant
Type: Increasing
Max Rate of Change (cfs/hr): 100.0

Max Con Flow-at Cottage Grove

Operates Release From: Cottage Grove-Dam
Rule Name: on Flow - at Cottage Grove Descriptio
Function of: Date
Limit Type: Maximum Interp.: Step

Date	Release (cfs)
01Jan	1000.0
01Feb	1000.0
01Mar	600.0
01Apr	200.0
01May	200.0
01Jun	200.0
01Jul	100.0
01Aug	100.0
01Sep	100.0
01Oct	100.0
01Nov	1000.0
01Dec	1000.0

Daily BiOp Max Rate of Decrease

Operates Release From: Cottage Grove-Dam
Rule Name: iOp Max Rate of Decrease Description: Chooses the le
Function of: Cottage Grove-Pool Outflow, Lagged Value, 24.0 hr lag
Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)
100.0	50.0
330.0	165.0
760.0	380.0
1300.0	760.0
1900.0	1300.0
2500.0	1900.0
3300.0	2500.0
4100.0	3300.0
5100.0	4100.0
6100.0	5100.0

Figure 8.2b. Cottage Grove Baseline Operation Set Rules, continued.

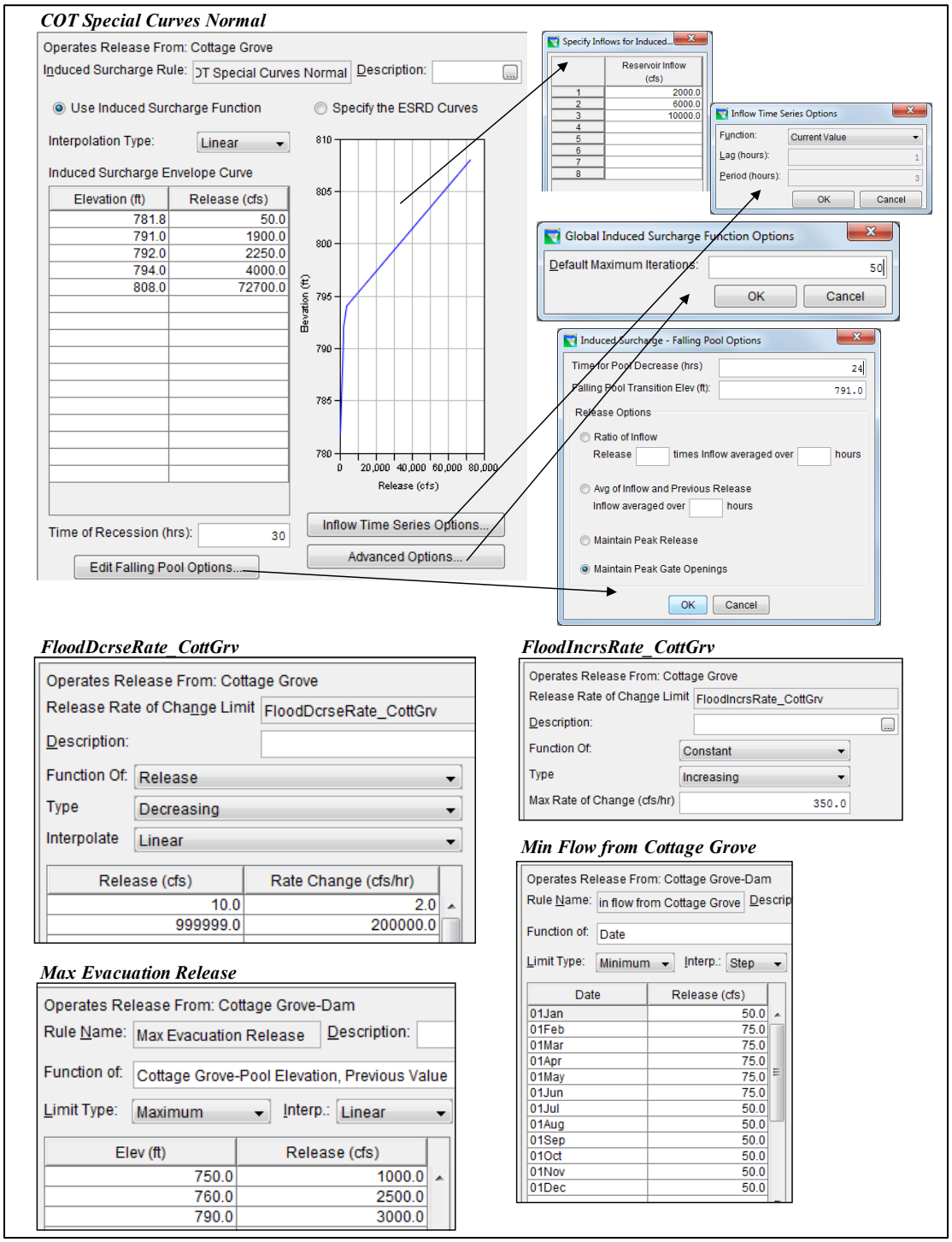
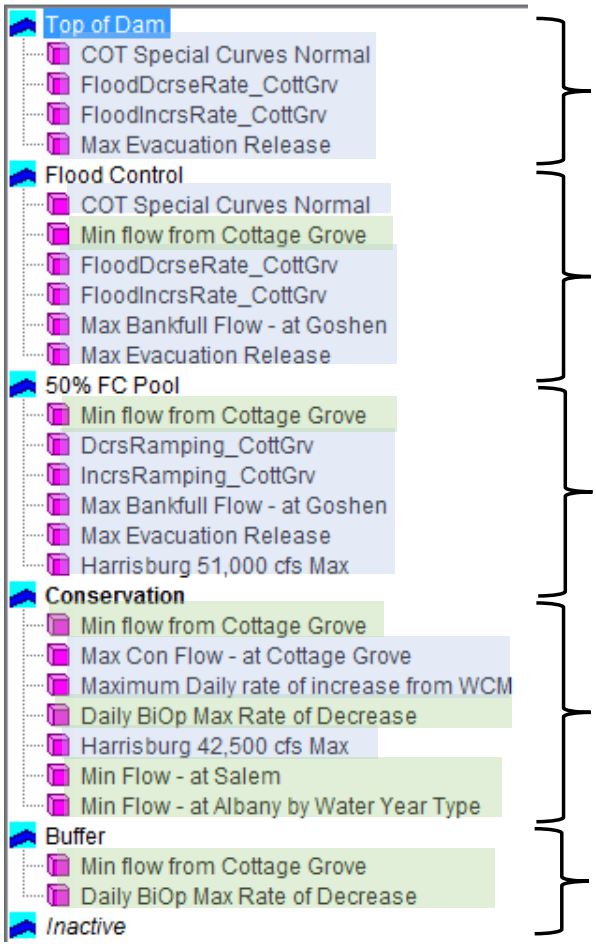


Figure 8.3. Cottage Grove Baseline Operation Set Rule Sources and Regulation Goals.



If the project pool level is in this zone, there is no flood risk management for downstream since the pool level is reaching a crititcal elevation where it is more important to prevent uncontrolled spill than to control the flow at Goshen. The maximum evacuation release and ramp rates are secondary to following the Special Curves.

The project pool level may be in this zone during the winter flood season. Store inflow as necessary to reduce flows at the downstream control point Goshen but do not exceed the maximum evacuation rate unless the project is still ramping down from the Induced Surcharge Rule where special curves govern the outflow. There is no space to store water to reduce Harrisburg flows.

The project pool level will often be in this zone during the winter flood season. Store inflow as necessary to reduce flows at the downstream control point Goshen and also store inflow as necessary so Harrisburg flows do not exceed 51,000 cfs.

Use water in the Conservation storage to supplement the local flows at both Salem and Albany to achieve the BiOp minimum flow targets. These supplemental flows use the implicit storage method, where the project contribution is based on the reservoir storage compared to the total storage in projects containing the rule.

When the pool is in the Buffer zone, do not supplement mainstem local flows - preserve what water there is to be able to meet the project minimum outflow.

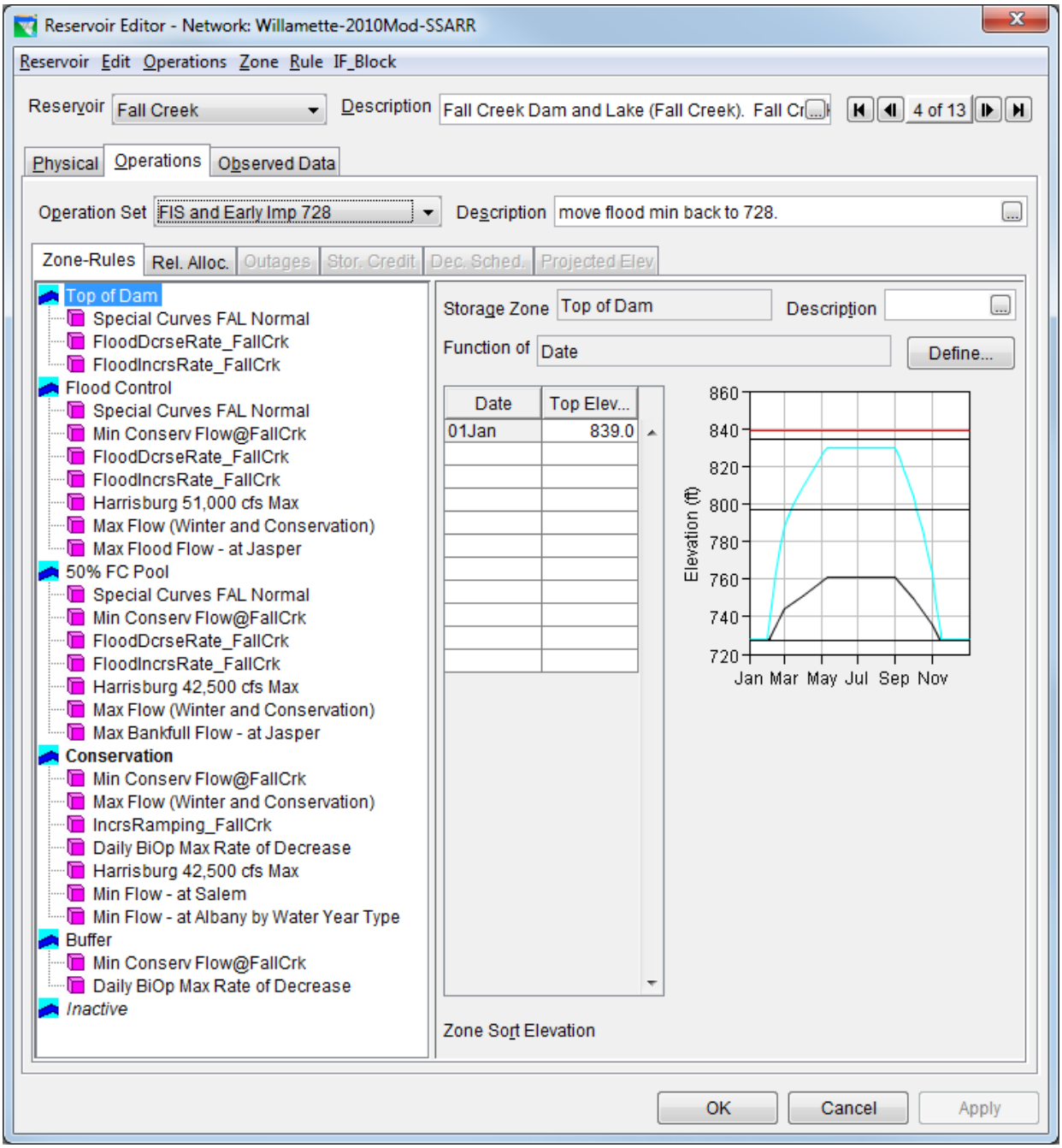
Source of Rule: Water Control Manual | Willamette BiOp

9 Fall Creek Project Specific Rule Sets

9.1 Operation Set Screen Shot

The ResSim image of the Fall Creek Baseline operation set is in Figure 9.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots.

Figure 9.1. ResSim Screen Shots of the Fall Creek operation set used for the Baseline simulation.



9.2 Reservoir Zones

The zone boundaries used for Fall Creek are listed in Table 9.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Fall Creek from the original WCM.

Table 9.1. Fall Creek Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	728.0	01Jan	727.9
28Jan	728.0	04Feb	727.9
01Feb	728.0	05Feb	728.63
07Feb	745.8	28Feb	744.2
14Feb	763.0	31Mar	751.18
21Feb	776.7	01Apr	751.18
28Feb	788.0	11May	760.94
07Mar	793.9	31May	760.94
15Mar	799.2	01Jun	760.94
23Mar	804.1	30Jun	760.94
31Mar	808.8	01Jul	760.94
07Apr	812.7	31Aug	760.94
15Apr	817.0	01Sep	760.56
22Apr	820.6	30Sep	749.31
30Apr	824.7	31Oct	736.01
07May	828.1	01Nov	735.47
11May	830.0	13Nov	728.01
01Sep	830.0	15Nov	727.9
07Sep	825.1	31Dec	727.9
15Sep	818.2		
22Sep	811.9		
30Sep	804.0	**Top of Dam Zone**	
07Oct	796.6	All Year	839.0
15Oct	786.9	**Flood Control Zone**	
23Oct	776.2	All Year	834.0
31Oct	763.3	**50% FC Zone**	
07Nov	749.5	All Year	797.0
15Nov	730.9	**Inactive Zone**	
16Nov	728.0	All Year	727.0
31Dec	728.0		
15Mar	799.2		

The Fall Creek WCM was updated in 2016 to include a deep drawdown in the winter months for fish outmigration (juvenile fish passage). In the new WCM, the Rule Curve shown in Plate 7-2 still defines the pool elevation of 728 ft. as the minimum flood pool, but the reservoir may draft as low as elevation 680 ft. between 30 November and 31 January, but only for a maximum of two weeks in this window. (See page 7-10 of the 2016 Fall Creek WCM for this description.) The timing of the two week deep drawdown is different every year.

The deep drawdown is not included in the Baseline simulation because it is a winter operation that does not affect the spring refill of Fall Creek or the fall drafting of the project, and since the timing of the deep drawdown varies every year, it would not be representative of the operation to fix the timing of the window in the Guide Curve operation of the simulation.

9.3 Alphabetical List of Rules in Operation Set

The Cottage Grove Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 9.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: FIS and Early Imp 728

- *Daily BiOp Max Rate of Decrease* – rate of decrease rule written as a minimum release of the previous project outflow, linearly interpolated.
- *FloodDcrseRate_FallCrk* – max rate of change decrease, linear function with project release
- *FloodIncrsRate_FallCrk* – max rate of change increase, step function of project release value
- *Harrisburg 51,000 cfs Max* – downstream maximum rule for intermediate flow, between bankfull and flood stage, at Harrisburg.
- *Harrisburg 42,500 cfs Max* – downstream maximum rule for bankfull flow at Harrisburg.
- *IncrsRamping_FallCrk* – increasing rate of change rule at 200 cfs/hr.
- *Min Conserv Flow@FallCrk* – minimum project flow depending on time of year.
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low.
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *Max Bankfull Flow – at Jasper* - downstream maximum rule for bankfull flow at Jasper, 20,000 cfs.
- *Max Flood Flow – at Jasper* – downstream maximum rule for bankfull flow at Jasper, 22,000 cfs.
- *Max Flow (Winter and Conservation)* – Maximum release as a function of the previous pool elevation and time of year, linear interpolation.
- *Special Curves FAL Normal* – induced surcharge function, a function of elevation and inflow.

Figure 9.2a. Fall Creek Baseline Operation Set Rules, continued on next page.

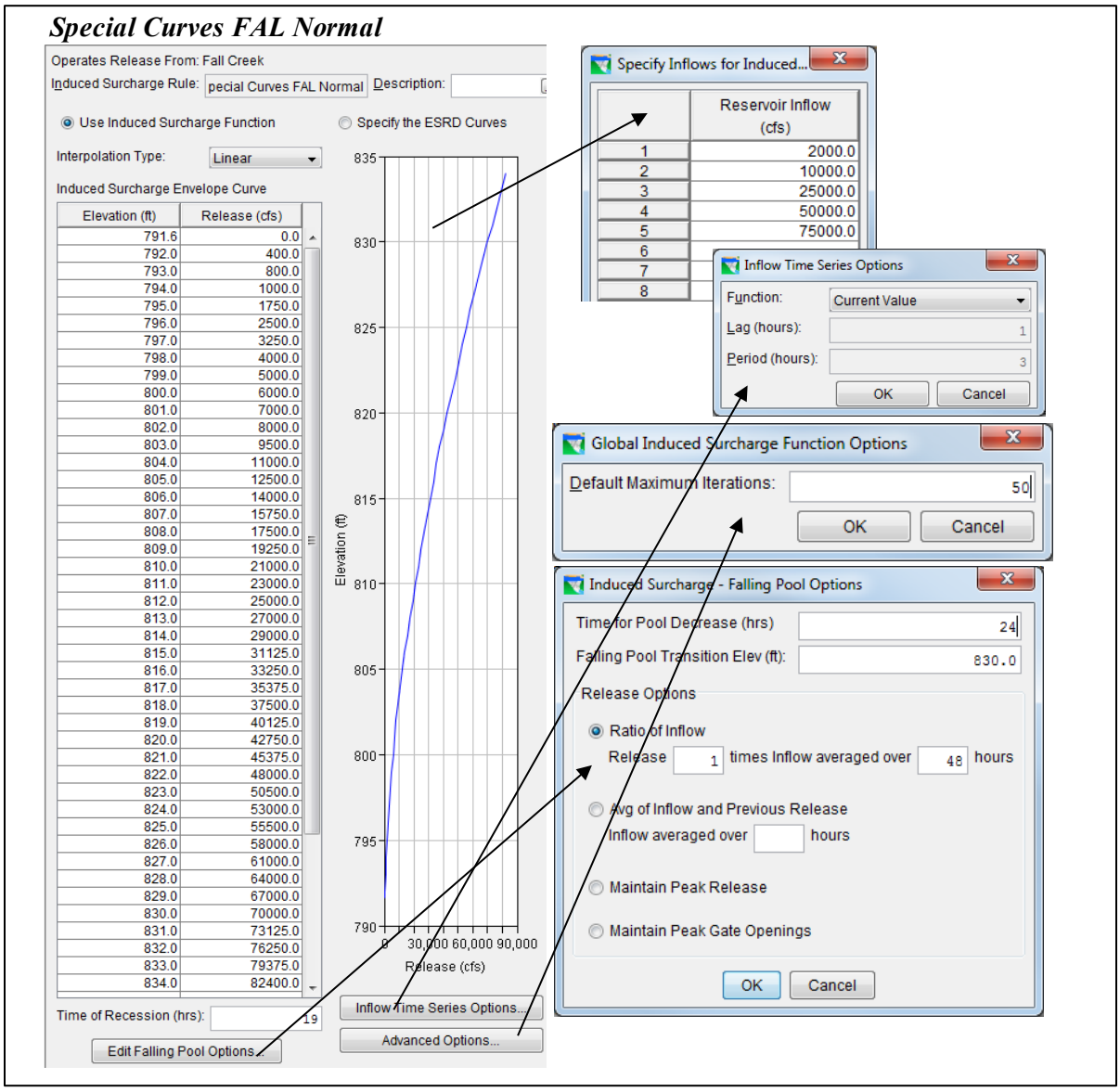
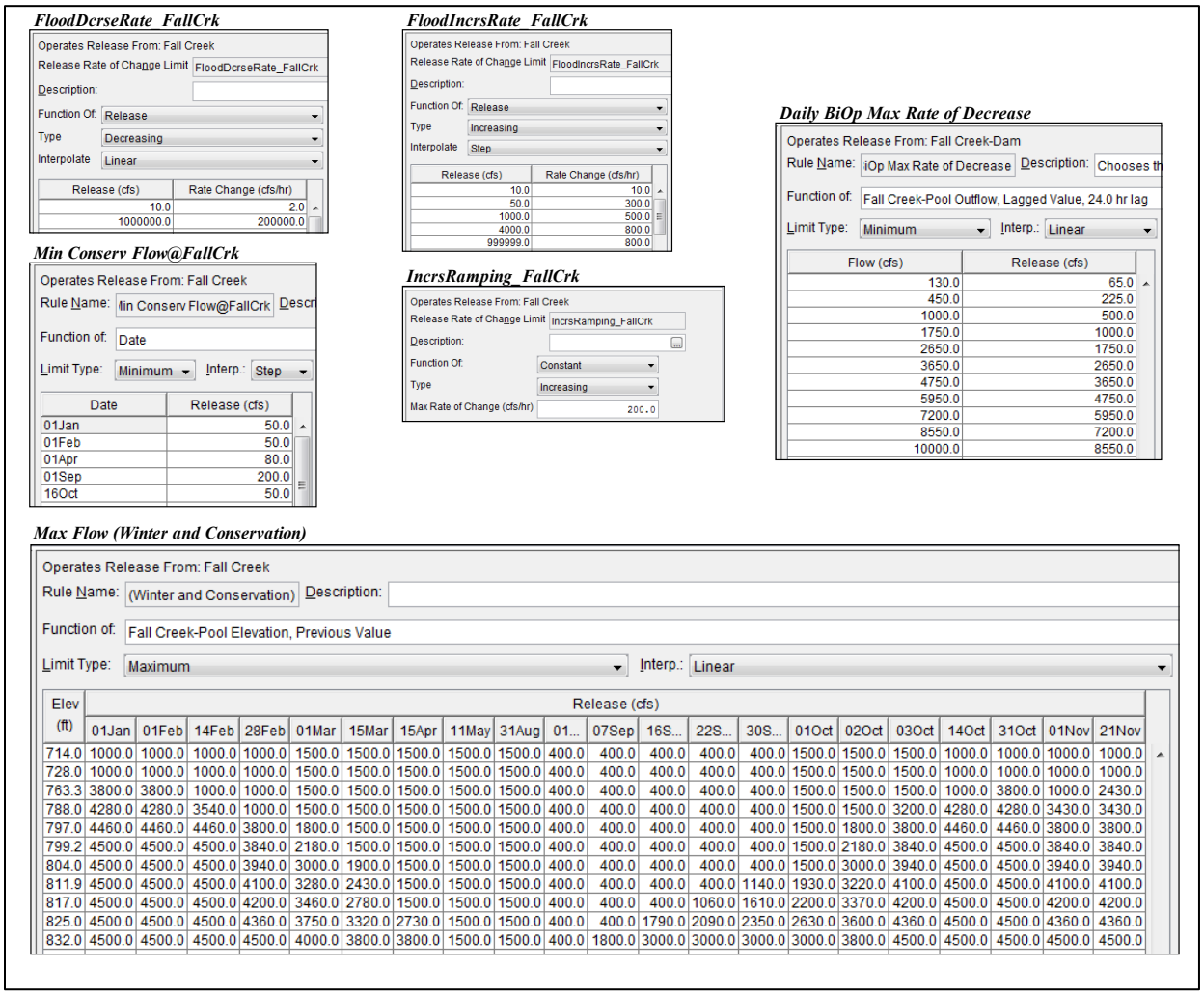


Figure 9.2b. Fall Creek Baseline Operation Set Rules, continued.



FloodDcrseRate_FallCrk

Operates Release From: Fall Creek
Release Rate of Change Limit: FloodDcrseRate_FallCrk
Description:
Function Of: Release
Type: Decreasing
Interpolate: Linear

Release (cfs)	Rate Change (cfs/hr)
10.0	2.0
1000000.0	200000.0

FloodIncrsRate_FallCrk

Operates Release From: Fall Creek
Release Rate of Change Limit: FloodIncrsRate_FallCrk
Description:
Function Of: Release
Type: Increasing
Interpolate: Step

Release (cfs)	Rate Change (cfs/hr)
10.0	10.0
50.0	300.0
1000.0	500.0
4000.0	800.0
999999.0	800.0

Daily BiOp Max Rate of Decrease

Operates Release From: Fall Creek-Dam
Rule Name: iOp Max Rate of Decrease Description: Chooses th
Function of: Fall Creek-Pool Outflow, Lagged Value, 24.0 hr lag
Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)
130.0	65.0
450.0	225.0
1000.0	500.0
1750.0	1000.0
2650.0	1750.0
3650.0	2650.0
4750.0	3650.0
5950.0	4750.0
7200.0	5950.0
8550.0	7200.0
10000.0	8550.0

Min Conserv Flow@FallCrk

Operates Release From: Fall Creek
Rule Name: lin Conserv Flow@FallCrk Descr
Function of: Date
Limit Type: Minimum Interp.: Step

Date	Release (cfs)
01Jan	50.0
01Feb	50.0
01Apr	80.0
01Sep	200.0
16Oct	50.0

IncrsRamping_FallCrk

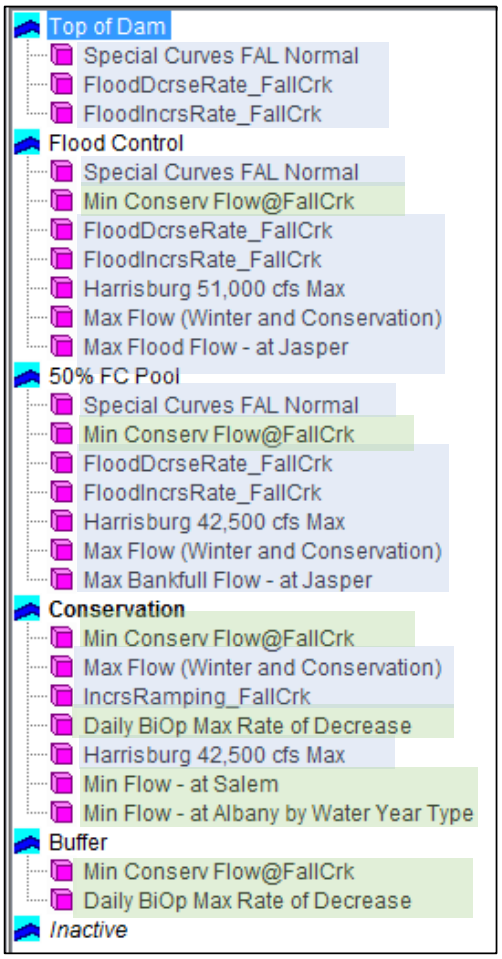
Operates Release From: Fall Creek
Release Rate of Change Limit: IncrsRamping_FallCrk
Description:
Function Of: Constant
Type: Increasing
Max Rate of Change (cfs/hr): 200.0

Max Flow (Winter and Conservation)

Operates Release From: Fall Creek
Rule Name: (Winter and Conservation) Description:
Function of: Fall Creek-Pool Elevation, Previous Value
Limit Type: Maximum Interp.: Linear

Elev (ft)	Release (cfs)																					
	01Jan	01Feb	14Feb	28Feb	01Mar	15Mar	15Apr	11May	31Aug	01...	07Sep	16S...	22S...	30S...	01Oct	02Oct	03Oct	14Oct	31Oct	01Nov	21Nov
714.0	1000.0	1000.0	1000.0	1000.0	1500.0	1500.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	1500.0	1500.0	1000.0	1000.0	1000.0	1000.0
728.0	1000.0	1000.0	1000.0	1000.0	1500.0	1500.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	1500.0	1500.0	1000.0	1000.0	1000.0	1000.0
763.3	3800.0	3800.0	1000.0	1000.0	1500.0	1500.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	1500.0	1500.0	1000.0	3800.0	1000.0	2430.0
788.0	4280.0	4280.0	3540.0	1000.0	1500.0	1500.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	1500.0	3200.0	4280.0	4280.0	3430.0	3430.0
797.0	4460.0	4460.0	4460.0	3800.0	1800.0	1500.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	1800.0	3800.0	4460.0	4460.0	3800.0	3800.0
799.2	4500.0	4500.0	4500.0	3840.0	2180.0	1500.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	2180.0	3840.0	4500.0	4500.0	3840.0	3840.0
804.0	4500.0	4500.0	4500.0	3940.0	3000.0	1900.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	400.0	1500.0	3000.0	3940.0	4500.0	4500.0	3940.0	3940.0
811.9	4500.0	4500.0	4500.0	4100.0	3280.0	2430.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	400.0	1140.0	1930.0	3220.0	4100.0	4500.0	4500.0	4100.0	4100.0
817.0	4500.0	4500.0	4500.0	4200.0	3460.0	2780.0	1500.0	1500.0	1500.0	400.0	400.0	400.0	1060.0	1610.0	2200.0	3370.0	4200.0	4500.0	4500.0	4200.0	4200.0
825.0	4500.0	4500.0	4500.0	4360.0	3750.0	3320.0	2730.0	1500.0	1500.0	400.0	400.0	1790.0	2090.0	2350.0	2630.0	3600.0	4360.0	4500.0	4500.0	4360.0	4360.0
832.0	4500.0	4500.0	4500.0	4500.0	4000.0	3800.0	3800.0	1500.0	1500.0	400.0	1800.0	3000.0	3000.0	3000.0	3000.0	3800.0	4500.0	4500.0	4500.0	4500.0	4500.0

Figure 9.3. Fall Creek Baseline Operation Set Rule Sources and Regulation Goals.



If the project pool level is in this zone, there is no flood risk management for downstream since the pool level is reaching a crititcal elevation where it is more important to prevent overtopping than to control the flow at downstream locations.

The project pool level may be in this zone during the winter flood season. Store inflow as necessary to reduce flows at the downstream at Jasper and Harrisburg but do not exceed the max outflow rates unless the project is still ramping down from the Induced Surcharge Rule where special curves govern the outflow.

The project pool level will often be in this zone during the winter flood season. Store inflow as necessary to reduce flows at the downstream control point Jasper and also store inflow as necessary so Harrisburg flows do not exceed 42,500 cfs.

Use water in the Conservation storage to supplement the local flows at both Salem and Albany to achieve the BiOp minimum flow targets. These supplemental flows use the implicit storage method, where the project contribution is based on the reservoir storage compared to the total storage in projects containing the rule.

When the pool is in the Buffer zone, do not supplement mainstem local flows - preserve what water there is to be able to meet the project minimum outflow.

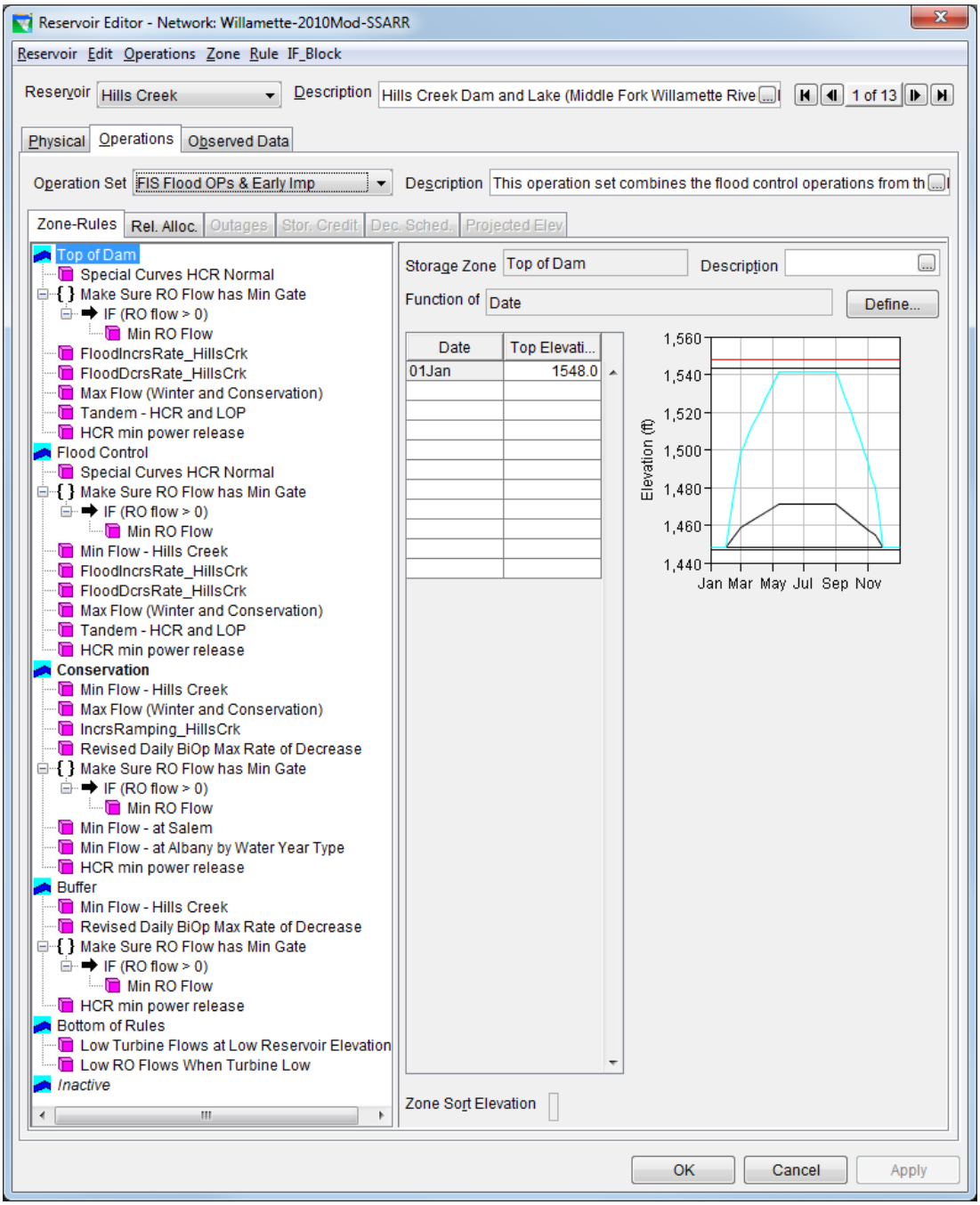
Source of Rule:	Water Control Manual	Willamette BiOp

10 Hills Creek Project Specific Rule Sets

10.1 Operation Set Screen Shot

The ResSim image of the Hills Creek Baseline operation set is in Figure 10.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots.

Figure 10.1. ResSim Screen Shots of the Hills Creek operation set used for the Baseline simulation.



10.2 Reservoir Zones

The zone boundaries used for Hills Creek are listed in Table 10.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Hills Creek from the WCM.

Table 10.1. Hills Creek Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	1448.1	01Jan	1448.0025
31Jan	1448.1	31Jan	1448.0025
07Feb	1462.2	28Feb	1458.91
14Feb	1475.2	31Mar	1463.84
21Feb	1487.2	01Apr	1464.0
28Feb	1498.4	14May	1470.84
07Mar	1502.7	30Jun	1470.84
15Mar	1507.6	31Aug	1470.84
23Mar	1512.4	31Oct	1457.69
31Mar	1517.1	01Nov	1457.48
07Apr	1521.1	15Nov	1454.46
15Apr	1525.6	30Nov	1448.0025
22Apr	1529.4	31Dec	1448.0025
30Apr	1533.7		
07May	1537.4		
14May	1541.0		
31Aug	1541.0		
07Sep	1536.1		
15Sep	1530.3		
22Sep	1525.1		
30Sep	1519.0		
07Oct	1513.5	**Top of Dam Zone**	
15Oct	1507.0	All Year	1548.0
23Oct	1500.4	**Flood Control Zone**	
31Oct	1493.4	All Year	1543.0
07Nov	1487.2	**Bottom of Rules Zone**	
15Nov	1479.7	All Year	1448.002
22Nov	1465.7	**Inactive Zone**	
30Nov	1448.1	All Year	1447.0

10.3 Alphabetical List of Rules in Operation Set

The Hills Creek Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 10.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: FIS Flood OPs & Early Imp

- *FloodDcrsRate_HillsCrk* –max rate of change decrease, linear with release
- *FloodIncrsRate_HillsCrk* –max rate of change increase, step function of HCR release value
- *IncrsRamping_HillsCrk* – increasing rate of change rule of 200 cfs/hour when not in high flows

- *Low RO Flows When Turbine Low* – Needed in combination with the low turbine flow rule. Only in the Bottom of Rules zone. The two rules together make the project meet the minimum 400 cfs outflow when the minimum turbine flows cannot be met, makes speed no load at the turbine while the rest of the minimum flow requirement comes from the RO, which is also meeting its minimum flow rate.
- *Low Turbine Flows at Low Reservoir Elevations*– a specified low turbine flow value based on project elevation to have speed no load (60 cfs) when flows cannot meet the usual minimum. Only in the Bottom of Rules zone.
- *Max Flow (Winter and Conservation)* – max release function two way table, function of HCR elevation at previous time step and time of year, with linear interpolations
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low.
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *Min Flow – Hills Creek* – minimum project flow 400 cfs
- *Min RO Flow* – minimum flow through the RO to model the minimum gate opening requirement. Written as a function of the current pool elevation. This rule is only used when the RO is already going to be used, not as a required minimum flow through RO at all times.
- *Revised Daily BiOp Max Rate of Decrease* – rate of change flow decrease, written as a minimum release function of a lagged HCR outflow of 24 hours, linear interpolation.
- *Special Curves HCR Normal* – induced surcharge function, a function of elevation and inflow.
- *Tandem – HCR and LOP* – rule for tandem operation of Lookout Point and Hills Creek.

- IF BLOCK *Make Sure RO Flow has Min Gate* – use when RO flow is > 0.
- IF *(RO flow>0)* – if Hills Creek-Regulating Outlet Flow, Current Value >0.

Figure 10.2a. Hills Creek Baseline Operation Set Rules, continued on next page.

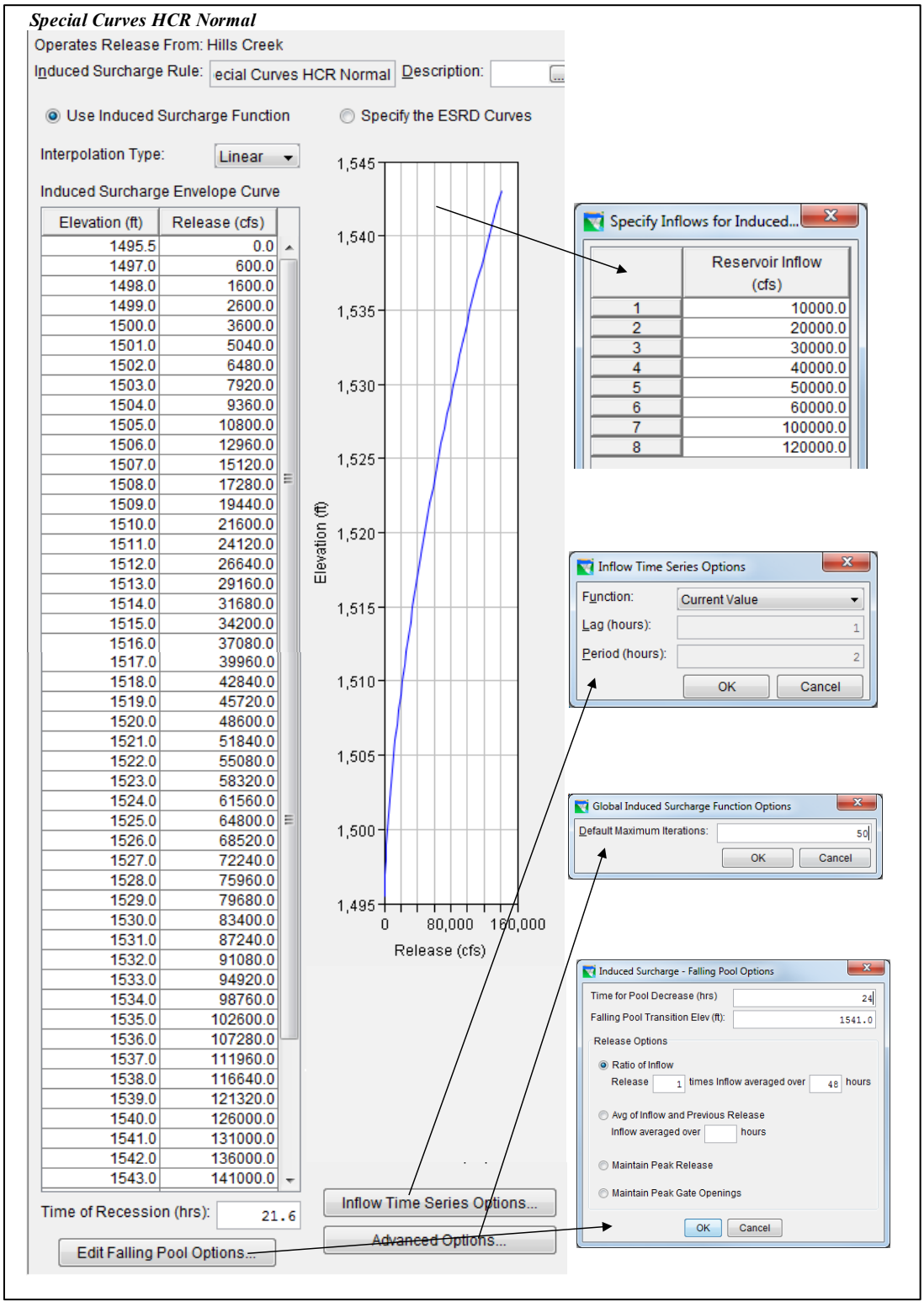
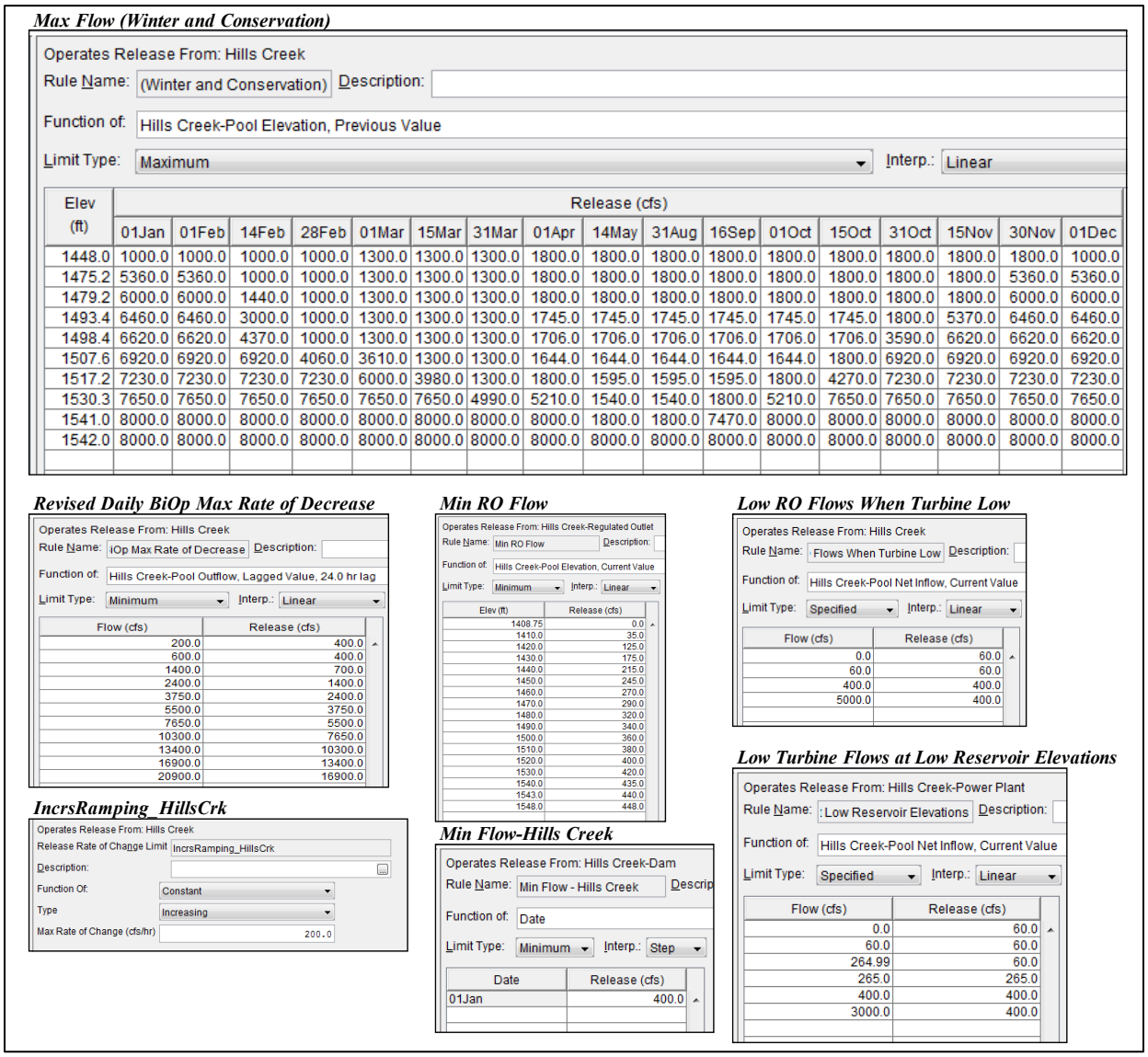


Figure 10.2b. Hills Creek Baseline Operation Set Rules, continued.



Max Flow (Winter and Conservation)

Operates Release From: Hills Creek

Rule Name: (Winter and Conservation) Description:

Function of: Hills Creek-Pool Elevation, Previous Value

Limit Type: Maximum Interp.: Linear

Elev (ft)	Release (cfs)																
	01Jan	01Feb	14Feb	28Feb	01Mar	15Mar	31Mar	01Apr	14May	31Aug	16Sep	01Oct	15Oct	31Oct	15Nov	30Nov	01Dec
1448.0	1000.0	1000.0	1000.0	1000.0	1300.0	1300.0	1300.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1000.0
1475.2	5360.0	5360.0	1000.0	1000.0	1300.0	1300.0	1300.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	5360.0	5360.0
1479.2	6000.0	6000.0	1440.0	1000.0	1300.0	1300.0	1300.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	1800.0	6000.0	6000.0
1493.4	6460.0	6460.0	3000.0	1000.0	1300.0	1300.0	1300.0	1745.0	1745.0	1745.0	1745.0	1745.0	1745.0	1800.0	5370.0	6460.0	6460.0
1498.4	6620.0	6620.0	4370.0	1000.0	1300.0	1300.0	1300.0	1706.0	1706.0	1706.0	1706.0	1706.0	1706.0	3590.0	6620.0	6620.0	6620.0
1507.6	6920.0	6920.0	6920.0	4060.0	3610.0	1300.0	1300.0	1644.0	1644.0	1644.0	1644.0	1644.0	1800.0	6920.0	6920.0	6920.0	6920.0
1517.2	7230.0	7230.0	7230.0	7230.0	6000.0	3980.0	1300.0	1800.0	1595.0	1595.0	1595.0	1800.0	4270.0	7230.0	7230.0	7230.0	7230.0
1530.3	7650.0	7650.0	7650.0	7650.0	7650.0	7650.0	4990.0	5210.0	1540.0	1540.0	1800.0	5210.0	7650.0	7650.0	7650.0	7650.0	7650.0
1541.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	1800.0	1800.0	7470.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0
1542.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0	8000.0

Revised Daily BiOp Max Rate of Decrease

Operates Release From: Hills Creek

Rule Name: iOp Max Rate of Decrease Description:

Function of: Hills Creek-Pool Outflow, Lagged Value, 24.0 hr lag

Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)
200.0	400.0
600.0	400.0
1400.0	700.0
2400.0	1400.0
3750.0	2400.0
5500.0	3750.0
7650.0	5500.0
10300.0	7650.0
13400.0	10300.0
16900.0	13400.0
20900.0	16900.0

IncrsRamping_HillsCrk

Operates Release From: Hills Creek

Release Rate of Change Limit: IncrsRamping_HillsCrk

Description:

Function Of: Constant

Type: Increasing

Max Rate of Change (cfs/hr): 200.0

Min RO Flow

Operates Release From: Hills Creek-Regulated Outlet

Rule Name: Min RO Flow Description:

Function of: Hills Creek-Pool Elevation, Current Value

Limit Type: Minimum Interp.: Linear

Elev (ft)	Release (cfs)
1408.75	0.0
1410.0	35.0
1420.0	125.0
1430.0	175.0
1440.0	215.0
1450.0	245.0
1460.0	270.0
1470.0	290.0
1480.0	320.0
1490.0	340.0
1500.0	360.0
1510.0	380.0
1520.0	400.0
1530.0	420.0
1540.0	435.0
1543.0	440.0
1548.0	448.0

Min Flow-Hills Creek

Operates Release From: Hills Creek-Dam

Rule Name: Min Flow - Hills Creek Descrip

Function of: Date

Limit Type: Minimum Interp.: Step

Date	Release (cfs)
01Jan	400.0

Low RO Flows When Turbine Low

Operates Release From: Hills Creek

Rule Name: Flows When Turbine Low Description:

Function of: Hills Creek-Pool Net Inflow, Current Value

Limit Type: Specified Interp.: Linear

Flow (cfs)	Release (cfs)
0.0	60.0
60.0	60.0
400.0	400.0
5000.0	400.0

Low Turbine Flows at Low Reservoir Elevations

Operates Release From: Hills Creek-Power Plant

Rule Name: Low Reservoir Elevations Description:

Function of: Hills Creek-Pool Net Inflow, Current Value

Limit Type: Specified Interp.: Linear

Flow (cfs)	Release (cfs)
0.0	60.0
60.0	60.0
264.99	60.0
265.0	265.0
400.0	400.0
3000.0	400.0

Figure 10.2c. Hills Creek Baseline Operation Set Rules, continued.

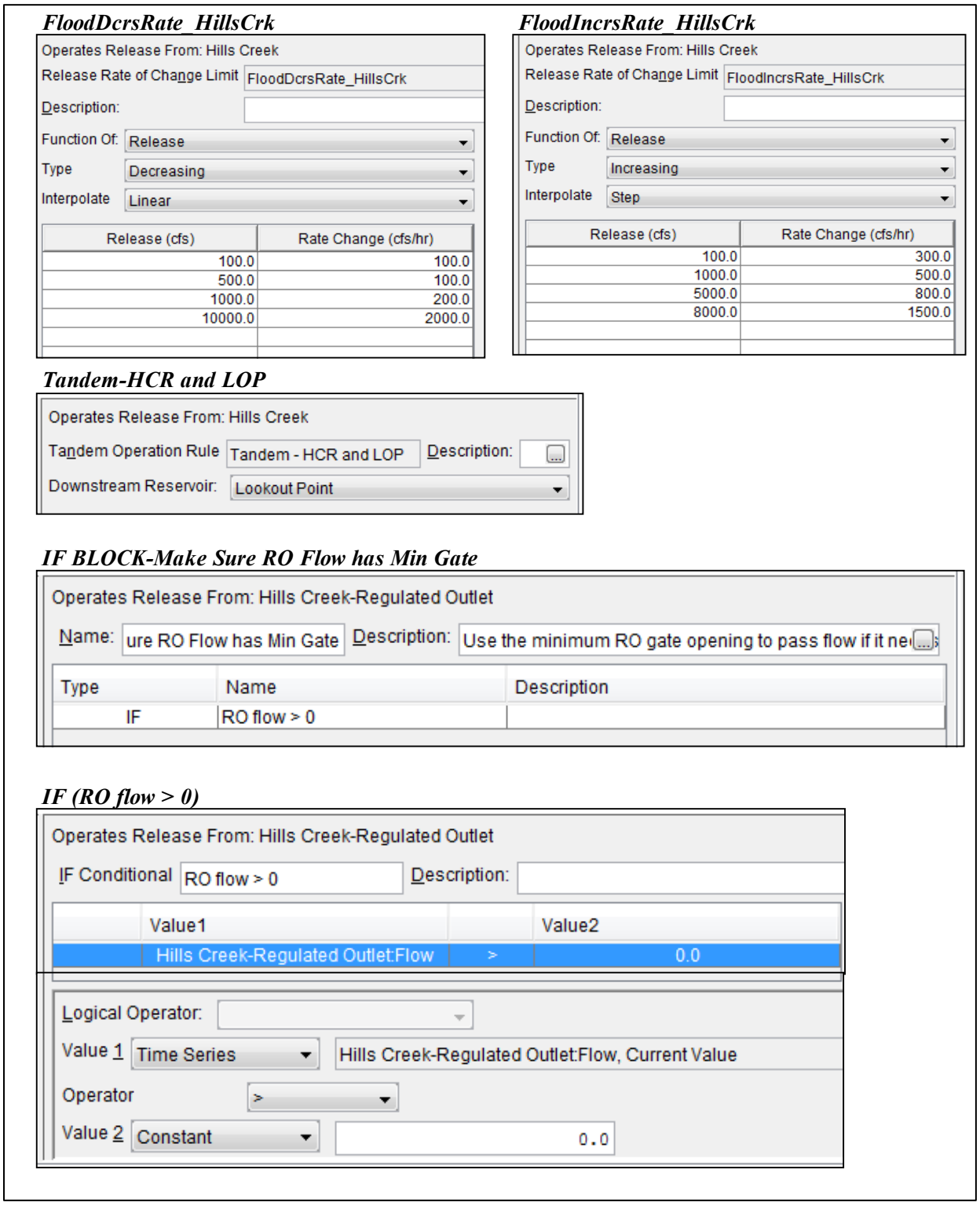
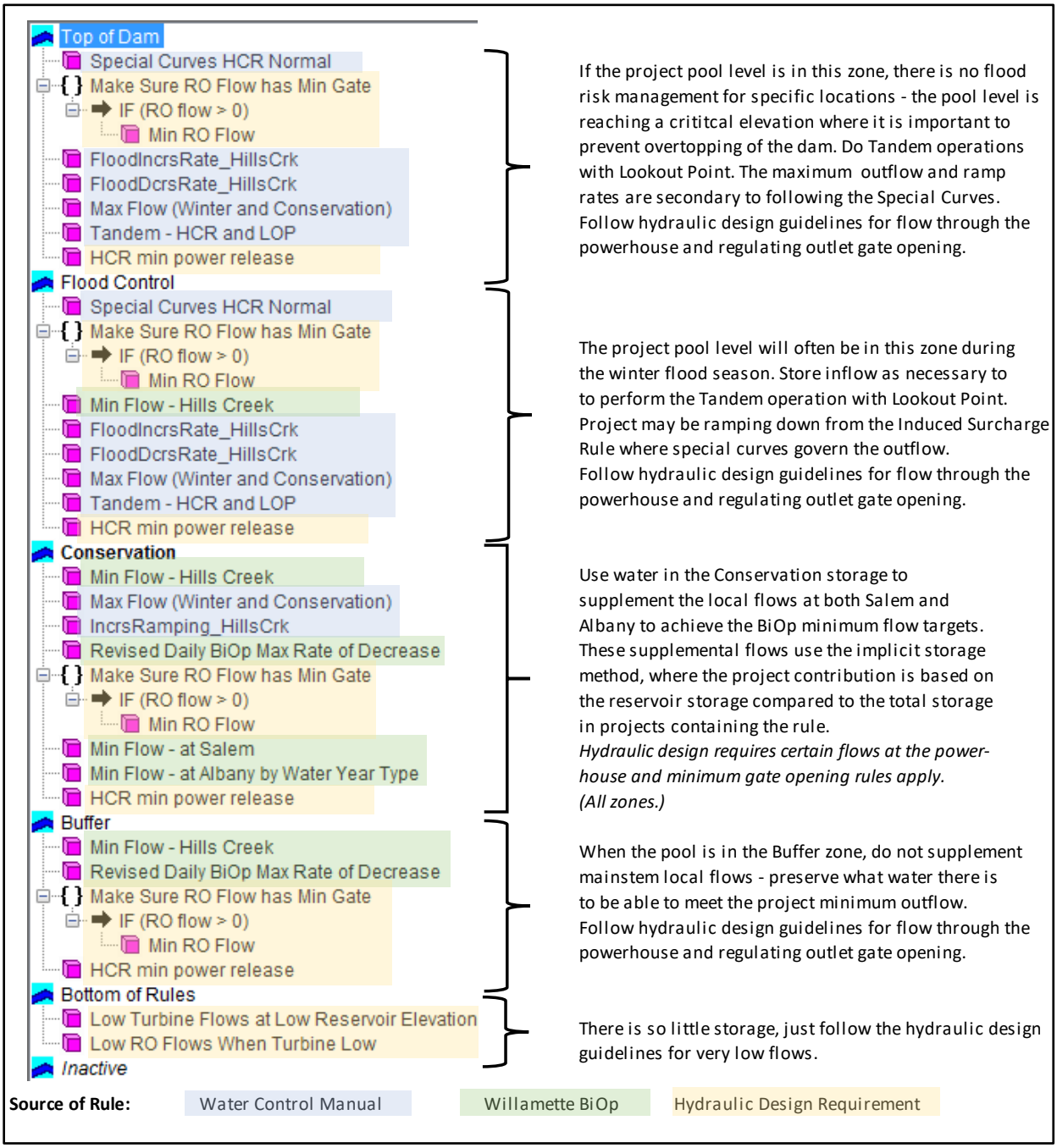


Figure 10.3. Hills Creek Baseline Operation Set Rule Sources and Regulation Goals.

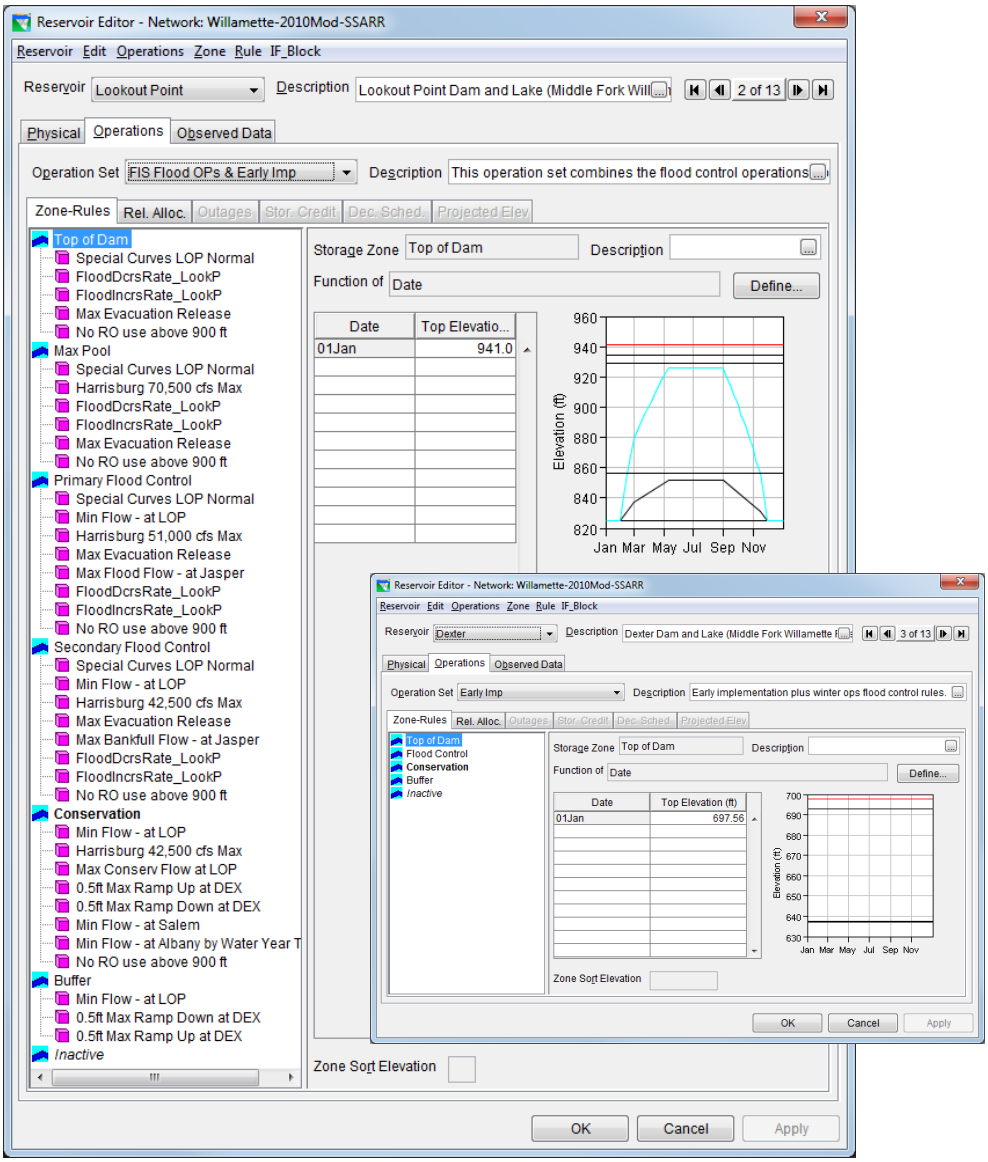


11 Lookout Point Project Specific Rule Sets

11.1 Operation Set Screen Shot

The ResSim image of the Lookout Point Baseline operation set is in Figure 11.1 below, with that of Dexter shown on the inset at the lower right of the image. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots. The Dexter operation set contains only zones, no rules, because it is a small re-regulating dam just downstream of Lookout Point. On average over the day, all water flowing in to Dexter reservoir flows out, and the only flow into the reservoir is the Lookout Point outflow

Figure 11.1. ResSim Screen Shot of Lookout Point and Dexter operation sets used for the Baseline.



11.2 Reservoir Zones

The zone boundaries used for Lookout Point and Dexter are listed in Table 11.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Lookout Point from the WCM. Dexter does not have a Rule Curve, since it does not seasonally fill and draft as Lookout Point does

Table 21. Lookout Point and Dexter Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	825.1	01Jan	825.0025
31Jan	825.1	31Jan	825.0025
07Feb	841.1	28Feb	836.96
14Feb	855.2	10May	851.6
21Feb	867.6	15Jul	851.6
28Feb	879.0	31Aug	851.6
07Mar	884.3	30Sep	843.54
15Mar	890.0	15Nov	831.2
23Mar	895.6	30Nov	825.0025
31Mar	901.0	31Dec	825.0025
07Apr	905.6	**Top of Dam Zone**	
15Apr	910.7	All Year	941.0
22Apr	914.95	**Max Pool Zone**	
30Apr	920.0	All Year	934.0
07May	924.0	**Primary Flood Control Zone**	
10May	926.0	All Year	929.0
31Aug	926.0	**Secondary Flood Control Zone**	
01Sep	925.0	All Year	856.0
15Sep	914.1	**Inactive Zone**	
		All Year	825.0
		Dexter Dam	
22Sep	908.4	**Top of Dam Zone**	
30Sep	901.6	All Year	697.56
07Oct	895.4	**Flood Control Zone**	
15Oct	888.1	All Year	693.05
23Oct	880.5	**Conservation Zone**	
31Oct	872.5	All Year	693.0
07Nov	865.1	**Buffer Zone**	
15Nov	856.1	All Year	637.54
22Nov	842.7	**Inactive Zone**	
30Nov	825.1	All Year	637.27

11.3 Alphabetical List of Rules in Operation Set

The Lookout Point Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6 and downstream minimum rule screen shots in Section 4.7. Figure 11.3 indicates the source of each rule (Water Control Manual, Willamette BiOp, or Hydraulic Design criteria) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: FIS Flood OPs & Early Imp

- *FloodDcrsRate_LookP* –max rate of change decrease, step function with project release
- *FloodIncrsRate_LookP* –max rate of change increase, step function of project release value
- *Harrisburg 70,500 cfs Max* – downstream maximum rule for flood flow at Harrisburg.
- *Harrisburg 51,000 cfs Max* – downstream maximum rule for intermediate flow, between bankfull and flood stage, at Harrisburg.
- *Harrisburg 42,500 cfs Max* – downstream maximum rule for bankfull flow at Harrisburg.
- *Max Bankfull Flow – at Jasper* - downstream maximum rule for bankfull flow at Jasper, 20,000 cfs.
- *Max Conserv Flow at LOP* – maximum flow out of LOP as a function of time of year.
- *Max Evacuation Release* – Maximum release as a function of the previous pool elevation, linear interpolation.
- *Max Flood Flow – at Jasper* – downstream maximum rule for bankfull flow at Jasper, 22,000 cfs.
- *Min Flow – at Albany by Water Year Type* is a downstream min flow rule at Albany dependent on an external variable for the water year type. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low.
- *Min Flow – at LOP* – minimum project flow 1200 cfs
- *Min Flow – at Salem* is downstream min flow rule dependent on an external variable. This rule is not applied in the Buffer zone to mimic water management practices of conserving some storage when pool levels are low
- *No RO use above 900 ft* – the ROs cannot be used above 900 feet.
- *Special Curves LOP Normal* – induced surcharge function, a function of elevation and inflow.
- *0.5ft Max Ramp Down at DEX* – rule implementing the half foot per day max increase at Dexter, with the flow change at LOP adjusted to make Dexter meet the requirement.
- *0.5ft Max Ramp Up at DEX* – rule implementing the half foot per day max decrease at Dexter, with the flow change at LOP adjusted to make Dexter meet the requirement.

Figure 11.2a. Lookout Point Baseline Operation Set Rules, continued on next page.

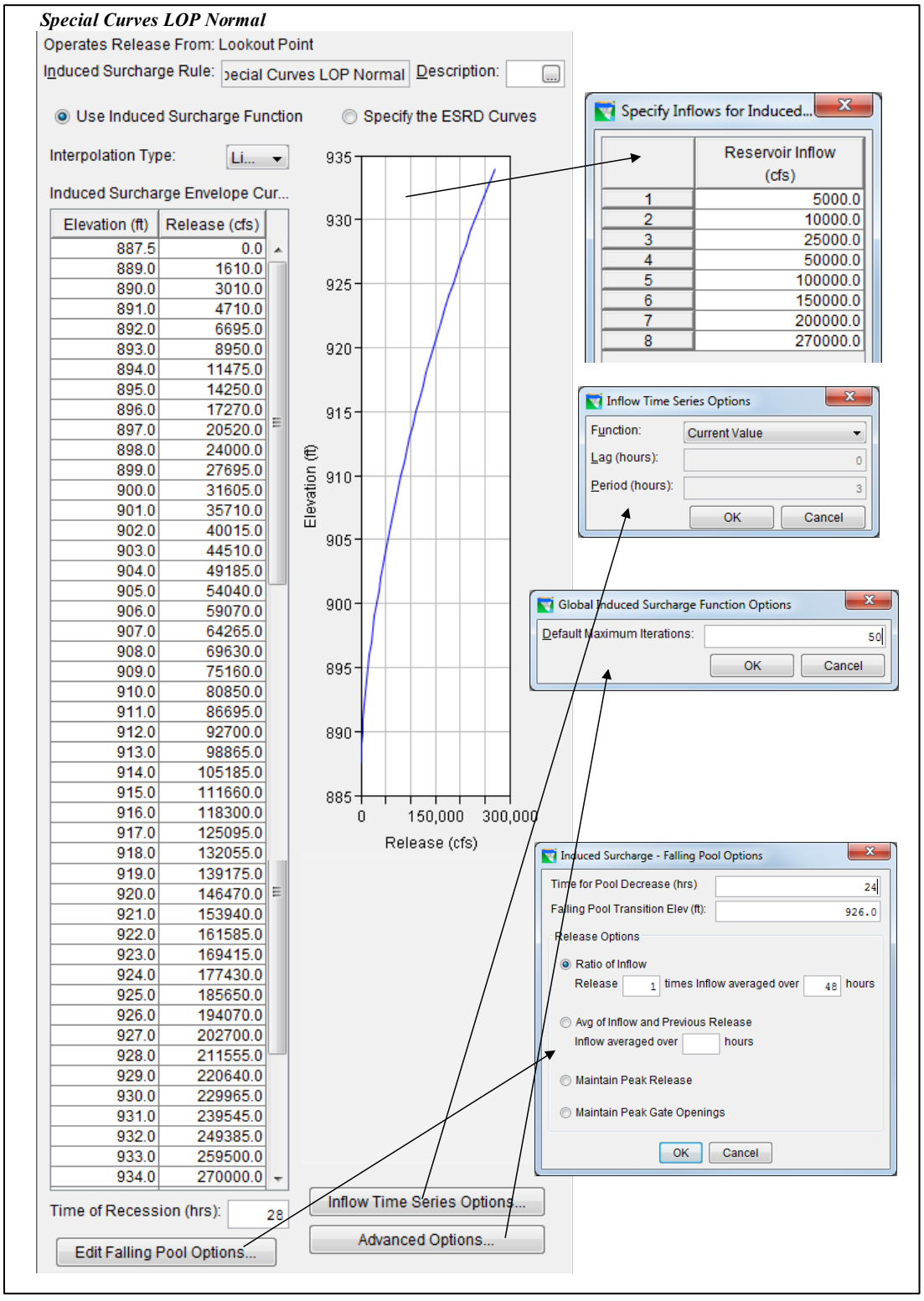
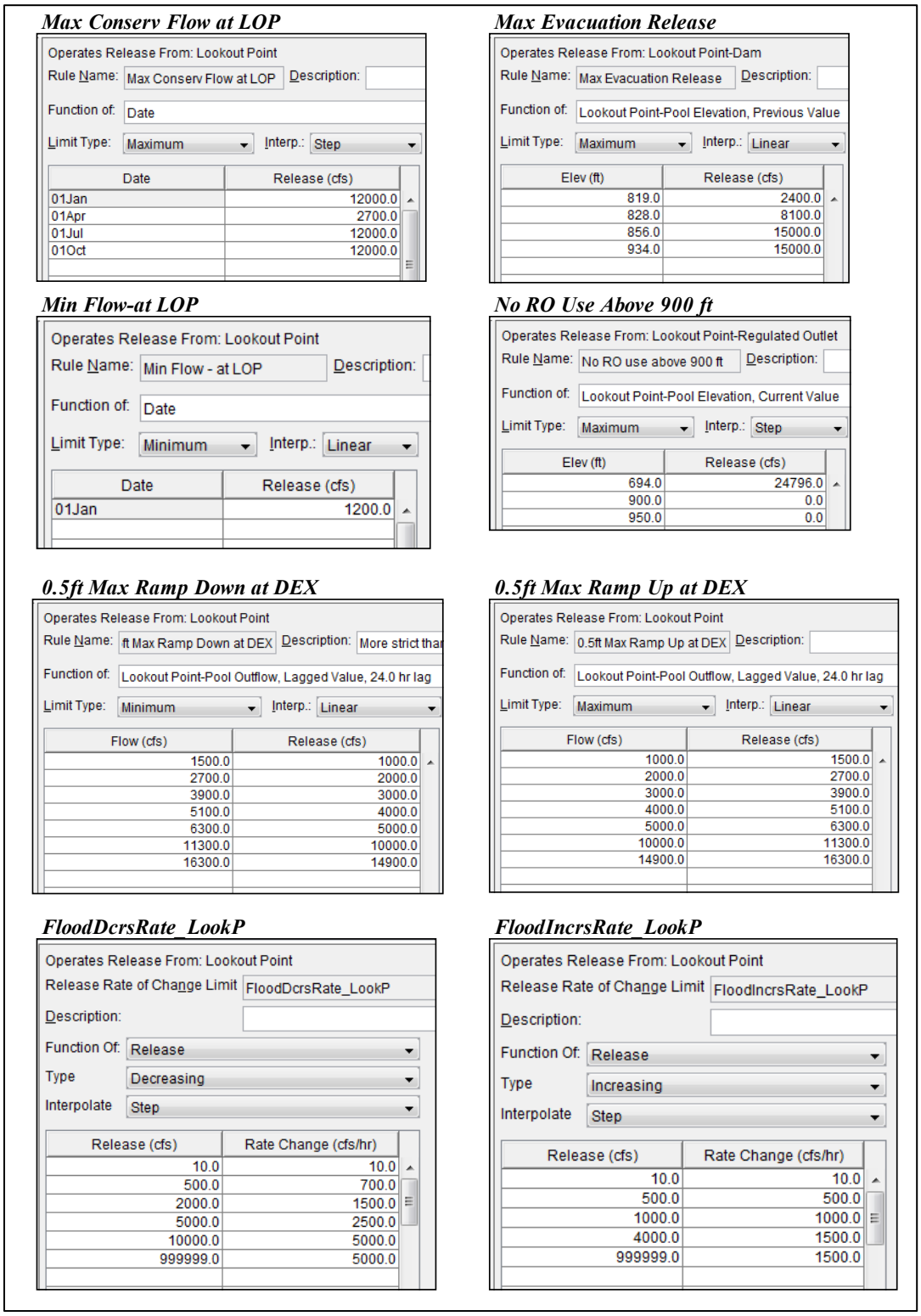


Figure 11.2b. Lookout Point Baseline Operation Set Rules, continued.



Max Conserv Flow at LOP

Operates Release From: Lookout Point
Rule Name: Max Conserv Flow at LOP Description:
Function of: Date
Limit Type: Maximum Interp.: Step

Date	Release (cfs)
01Jan	12000.0
01Apr	2700.0
01Jul	12000.0
01Oct	12000.0

Max Evacuation Release

Operates Release From: Lookout Point-Dam
Rule Name: Max Evacuation Release Description:
Function of: Lookout Point-Pool Elevation, Previous Value
Limit Type: Maximum Interp.: Linear

Elev (ft)	Release (cfs)
819.0	2400.0
828.0	8100.0
856.0	15000.0
934.0	15000.0

Min Flow-at LOP

Operates Release From: Lookout Point
Rule Name: Min Flow - at LOP Description:
Function of: Date
Limit Type: Minimum Interp.: Linear

Date	Release (cfs)
01Jan	1200.0

No RO Use Above 900 ft

Operates Release From: Lookout Point-Regulated Outlet
Rule Name: No RO use above 900 ft Description:
Function of: Lookout Point-Pool Elevation, Current Value
Limit Type: Maximum Interp.: Step

Elev (ft)	Release (cfs)
694.0	24796.0
900.0	0.0
950.0	0.0

0.5ft Max Ramp Down at DEX

Operates Release From: Lookout Point
Rule Name: ft Max Ramp Down at DEX Description: More strict tha
Function of: Lookout Point-Pool Outflow, Lagged Value, 24.0 hr lag
Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)
1500.0	1000.0
2700.0	2000.0
3900.0	3000.0
5100.0	4000.0
6300.0	5000.0
11300.0	10000.0
16300.0	14900.0

0.5ft Max Ramp Up at DEX

Operates Release From: Lookout Point
Rule Name: 0.5ft Max Ramp Up at DEX Description:
Function of: Lookout Point-Pool Outflow, Lagged Value, 24.0 hr lag
Limit Type: Maximum Interp.: Linear

Flow (cfs)	Release (cfs)
1000.0	1500.0
2000.0	2700.0
3000.0	3900.0
4000.0	5100.0
5000.0	6300.0
10000.0	11300.0
14900.0	16300.0

FloodDcrsRate_LookP

Operates Release From: Lookout Point
Release Rate of Change Limit FloodDcrsRate_LookP
Description:
Function Of: Release
Type Decreasing
Interpolate Step

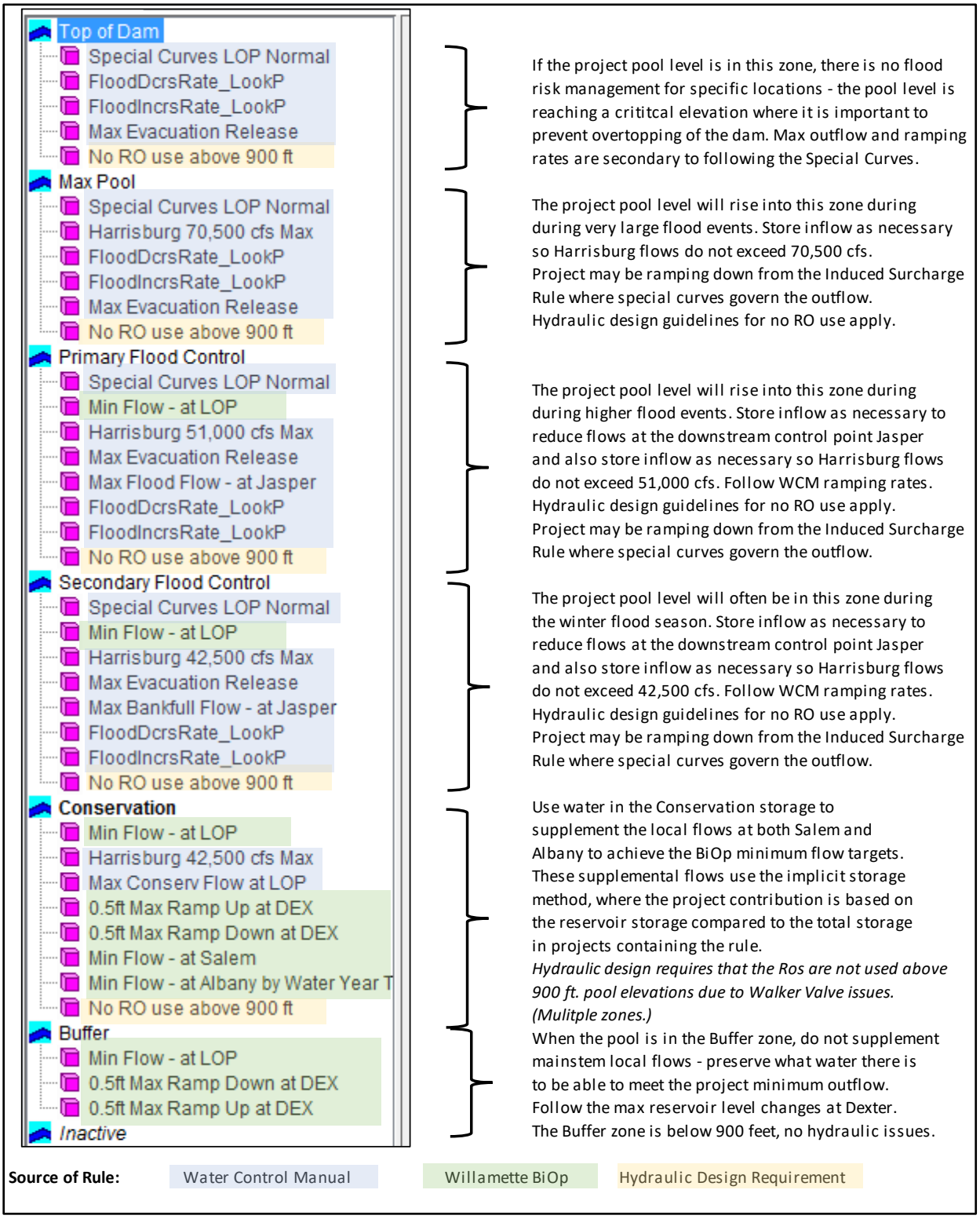
Release (cfs)	Rate Change (cfs/hr)
10.0	10.0
500.0	700.0
2000.0	1500.0
5000.0	2500.0
10000.0	5000.0
999999.0	5000.0

FloodIncrsRate_LookP

Operates Release From: Lookout Point
Release Rate of Change Limit FloodIncrsRate_LookP
Description:
Function Of: Release
Type Increasing
Interpolate Step

Release (cfs)	Rate Change (cfs/hr)
10.0	10.0
500.0	500.0
1000.0	1000.0
4000.0	1500.0
999999.0	1500.0

Figure 11.3. Lookout Point Baseline Operation Set Rule Sources and Regulation Goals.

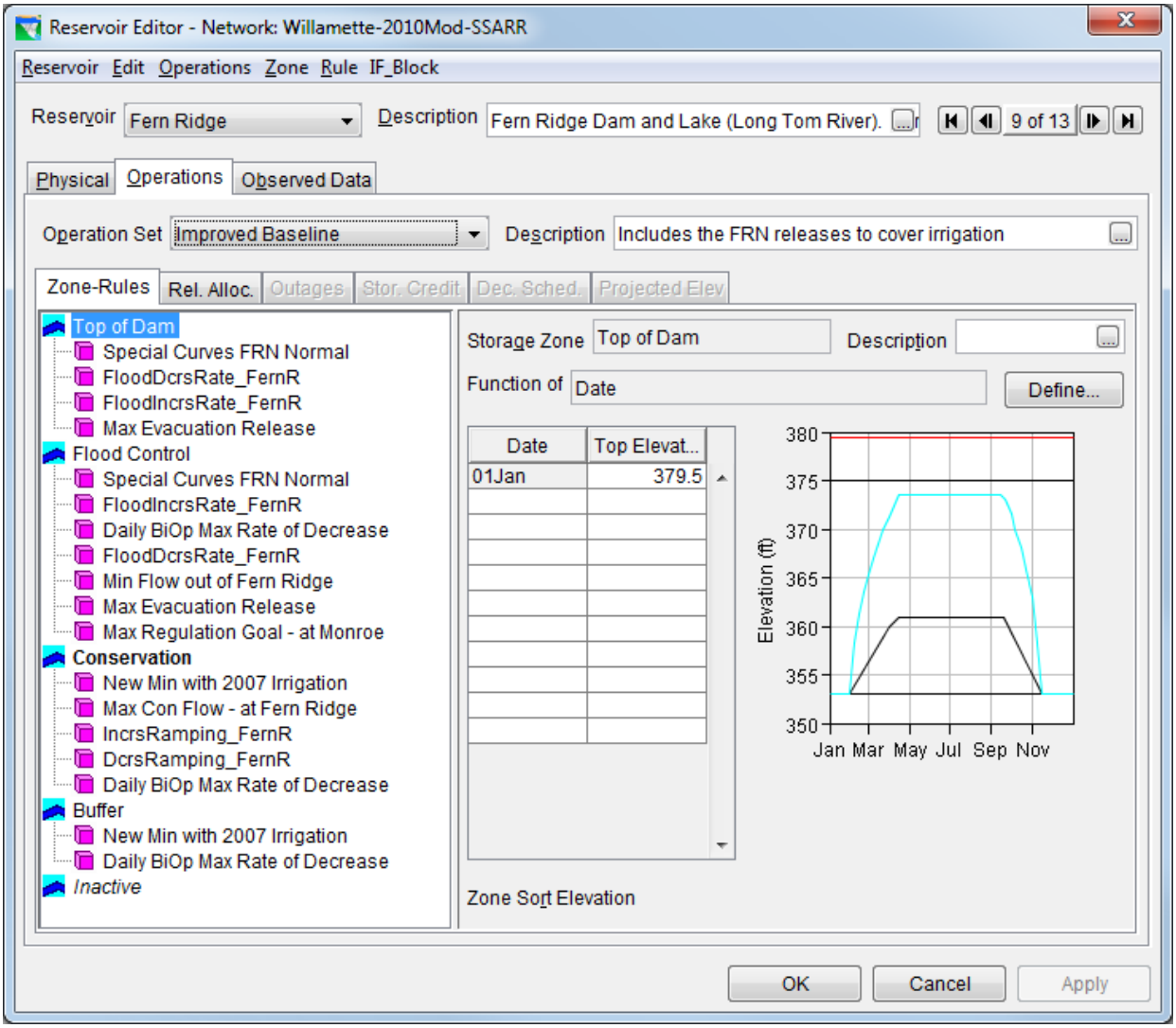


12 Fern Ridge Project Specific Rule Sets

12.1 Operation Set Screen Shot

The ResSim image of the Fern Ridge Baseline operation set is in Figure 12.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots. Note that the Conservation zone of Fern Ridge does not include the minimum flow rules for Albany and Salem as all the previous projects did. Including these rules in Fern Ridge drains this reservoir much earlier in the year than how it is operated in real-time water management. Fern Ridge provides its share of flow meeting Albany and Salem targets by its WCM minimum release value and the additional outflows to cover irrigation along the Long Tom River.

Figure 12.1. ResSim Screen Shot of the Fern Ridge operation set used for the Baseline simulation.



12.2 Reservoir Zones

The zone boundaries used for Fern Ridge are listed in Table 12.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Fern Ridge from the WCM.

Table 12.1. Fern Ridge Zone Specifications.

Conservation Zone Specification		Buffer Zone Specification	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	353.1	01Jan	353.0025
31Jan	353.1	31Jan	353.0025
07Feb	358.3	31Mar	359.86
14Feb	361.2	15Apr	360.87
21Feb	363.5	30Jun	360.87
28Feb	365.3	20Sep	360.87
07Mar	366.9	15Nov	353.0025
15Mar	368.5	31Dec	353.0025
23Mar	369.9		
31Mar	371.2		
07Apr	372.3		
15Apr	373.5		
15Sep	373.5		
22Sep	373.1		
30Sep	371.5		
07Oct	370.0	**Top of Dam Zone**	
15Oct	368.1	All Year	379.5
23Oct	365.9	**Flood Control Zone**	
31Oct	363.1	All Year	375.0
07Nov	359.9	**Inactive Zone**	
15Nov	353.1	All Year	353.0

12.3 Alphabetical List of Rules in Operation Set

The Fern Ridge Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6. Figure 12.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: Improved Baseline

- *Daily BiOp Max Rate of Decrease* – rate of decrease rule written as a minimum release of previous project outflow, linearly interpolated.
- *DcrsRamping_FernR* – decreasing rate of change rule at 200 cfs/hr.
- *FloodDcrsRate_FernR* –max rate of change decrease, linear function with project release
- *FloodIncrsRate_FernR* –max rate of change increase 750 cfs/hr.
- *IncrsRamping_FernR* – increasing rate of change rule at 200 cfs/hr.
- *Max Con Flow – at Fern Ridge* – maximum flow rule dependent on time of year.
- *Max Evacuation Release* – Maximum release as a function of the previous pool elevation, linear interpolation.
- *Max Regulation Goal – at Monroe* – downstream maximum flow rule to limit flows at Monroe, based on Fern Ridge previous pool elevations.
- *Min Flow out of Fern Ridge* – minimum project flow depending on time of year, but only applied in the Flood Control zone. There are no irrigation needs outside of the flood season, so these minimum outflows are from the WCM.

- *New Min with 2007 Irrigation* – minimum project flow depending on time of year, applied in the Conservation and Buffer zones. The minimum outflow in the conservation season is higher than specified in the WCM to cover irrigation needs between the dam and Monroe. The irrigation levels used are those of 2007, which is the irrigation used in the flow dataset for this area. If the flow dataset had local flows at Monroe, a downstream minimum rule would have been applied instead, but without a local flow component at Monroe, the irrigation releases must be specified from the project. The irrigation releases are shaped according to the demand methodology developed by DMA, and these releases are for all water year types. The irrigation releases added to the minimum project outflows are:

  May = 25 cfs, June = 52 cfs, July = 83 cfs, August = 66 cfs, September = 34 cfs.
- *Special Curves FRN Normal*– induced surcharge function, a function of elevation and inflow.

Figure 12.2a. Fern Ridge Baseline Operation Set Rules, continued on next page.

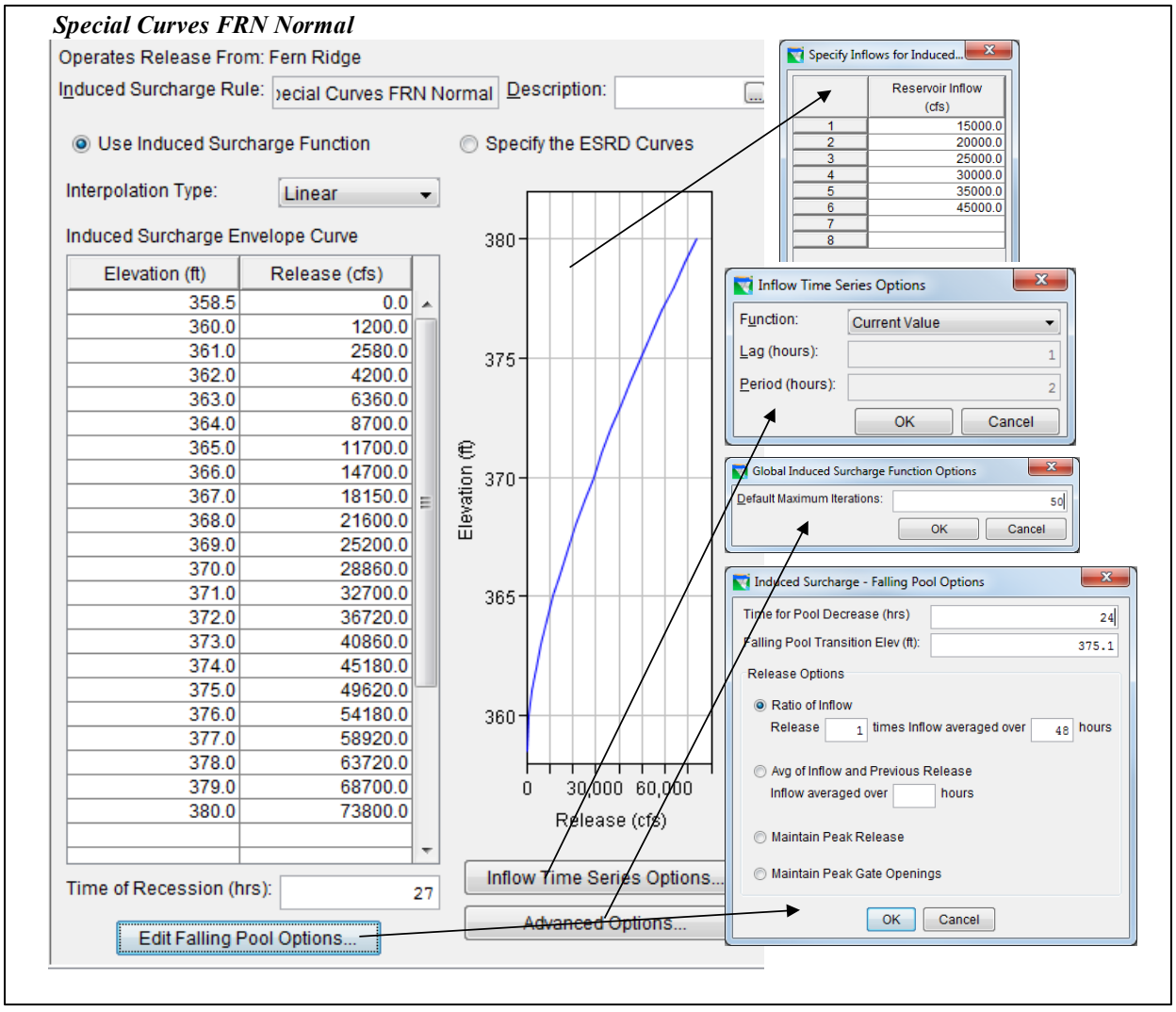


Figure 12.2b. Fern Ridge Baseline Operation Set Rule, continued.

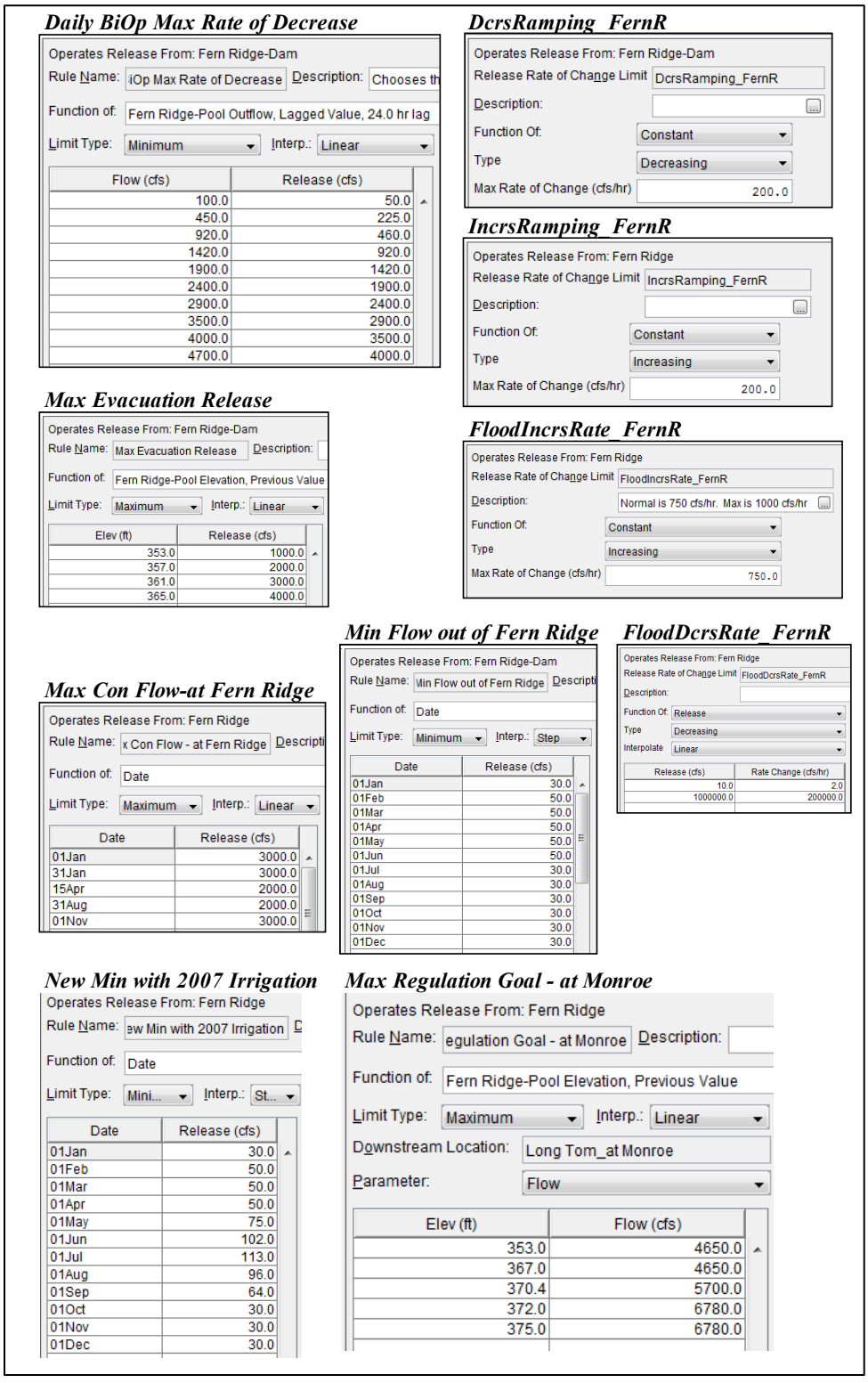
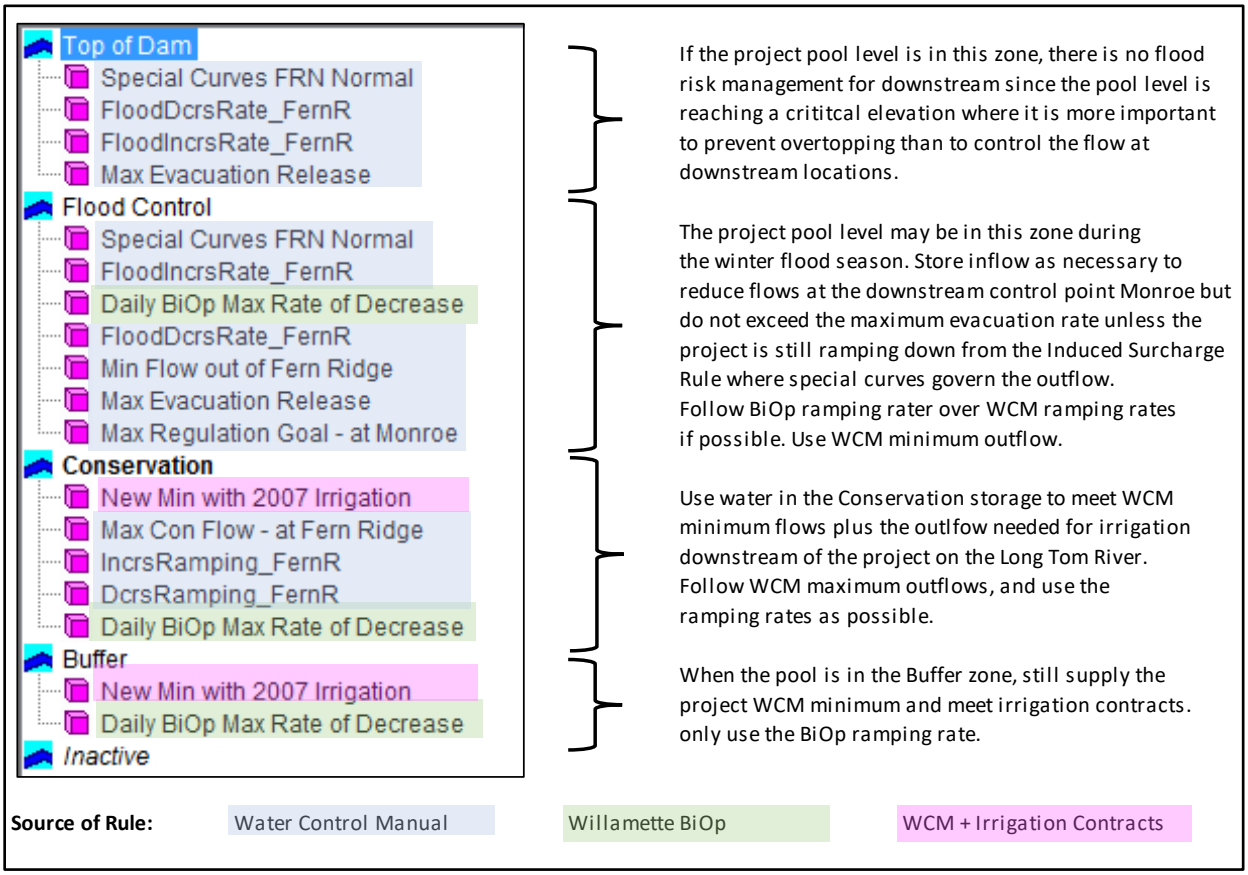


Figure 12.3. Fern Ridge Baseline Operation Set Rule Sources and Regulation Goals.

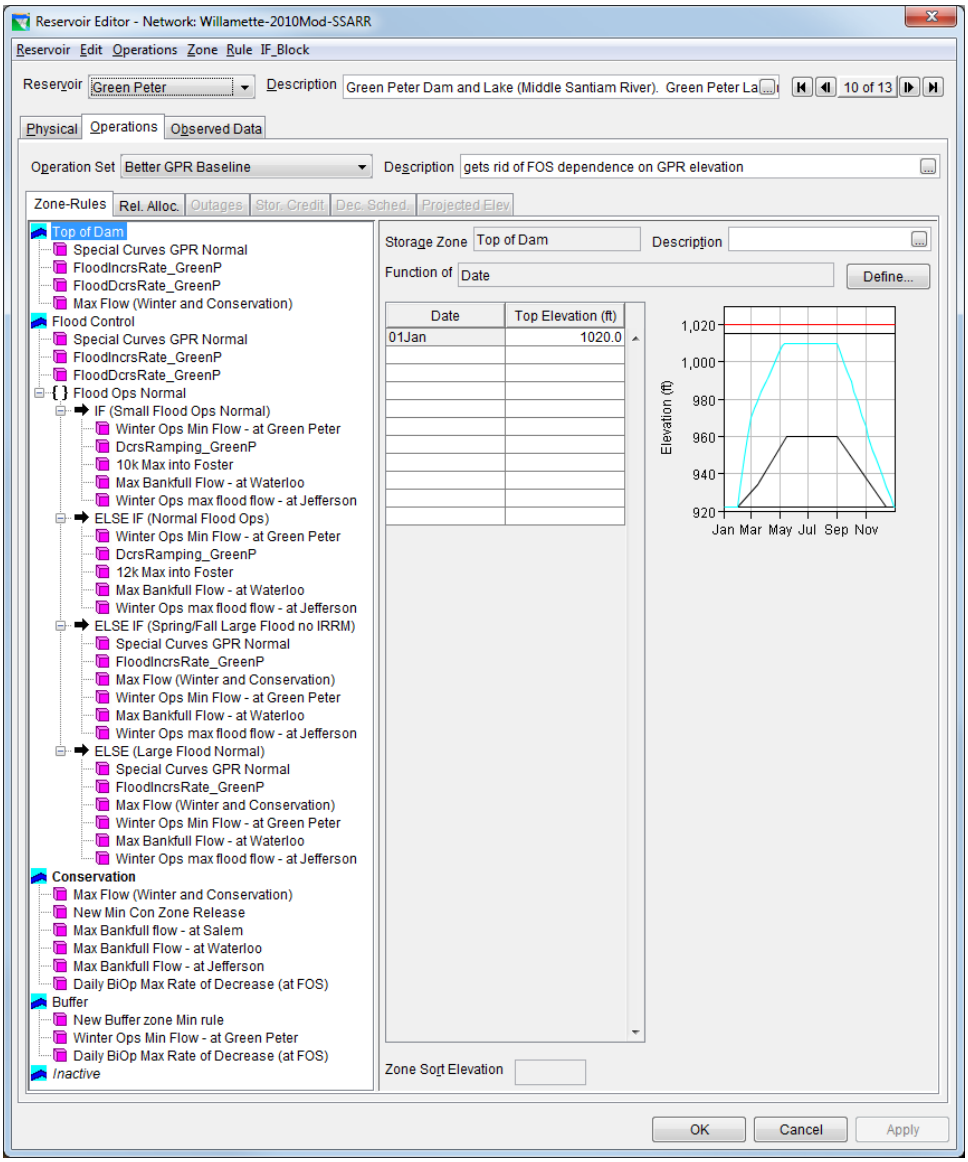


13 Green Peter Project Specific Rule Sets

13.1 Operation Set Screen Shot

The ResSim image of the Green Peter Baseline operation set is in Figure 13.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots. The Conservation zone does not include the minimum flow rule for Salem since Green Peter releases a large amount of stored water to help meet the BiOp minimum flow targets downstream of Foster Dam. If the Salem minimum rule is applied at Green Peter, the reservoir drains rapidly and does not well mimic the water management practices of the project.

Figure 13.1. ResSim Screen Shot of the Green Peter operation set used for the Baseline simulation.



13.2 Reservoir Zones

The zone boundaries used for Green Peter are listed in Table 13.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Green Peter from the WCM.

Table 13.1. Green Peter Zone Specifications.

Conservation Zone Specification		Conservation Zone Specification, continued	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	922.01	30-Nov	943.0
31Jan	922.01	7-Dec	938.5
07Feb	935.8	15-Dec	933.2
14Feb	948.3	23-Dec	927.7
21Feb	959.8	31-Dec	922.01
28Feb	970.4		
07Mar	974.7		
15Mar	979.4		
23Mar	984.1		
31Mar	988.7		
07Apr	992.6	**Buffer Zone Specification**	
15Apr	996.9	**Date**	**Elevation, feet**
22Apr	1000.7	01Jan	922.0025
30Apr	1004.9	31Jan	922.0025
07May	1008.5	15Mar	934.0
10May	1010.0	15May	960.0
31Aug	1010.0	22Jun	960.0
07Sep	1005.3	07Jul	960.0
15Sep	999.9	31Aug	960.0
22Sep	994.9	15Dec	922.0025
30Sep	989.2	31Dec	922.0025
07Oct	984.0		
15Oct	977.9	**Top of Dam Zone**	
23Oct	971.6	All Year	1020.0
31Oct	965.1	**Flood Control Zone**	
07Nov	959.2	All Year	1015.0
15Nov	952.0	**Inactive Zone**	
22Nov	947.9	All Year	922.0

13.3 Alphabetical List of Rules in Operation Set

The Green Peter Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6. Figure 13.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: Better GPR Baseline

- *10k Max into Foster* –controls the amount of flow going into Foster, which includes the flow into Foster from an undammed tributary. Is a max flow based on Foster local inflow, averaged over a four hour period:

- *12k Max into Foster* –controls the amount of flow going into Foster, which includes the flow into Foster from an undammed tributary. Is a max flow based on Foster local inflow, averaged over a four hour period:
- *Daily BiOp Max Rate of Decrease (at FOS)* –min release from GPR based on the Foster outflow, lagged 24 hours (see above)
- *DcrsRamping_GreenP* – max rate of change decrease 1000 cfs/hr.
- *FloodDcrsRate_GreenP* –max rate of change decrease 2500 cfs/hr.
- *FloodIncrsRate_GreenP* –max rate of change increase 2500 cfs/hr.
- *Max Bankfull Flow – at Jefferson* is 35,000 cfs
- *Max Bankfull Flow – at Salem* is 90,000 cfs
- *Max Bankfull Flow – at Waterloo* is 18,000 cfs
- *Max Flow (Winter and Conservation)* – max release function of the previous elevation.
- *New Buffer zone Min rule* – is a minimum release requirement for GPR to help Foster meet its minimum outflow requirements. The minimum outflow from Foster varies by period throughout the year and is a BiOp requirement. This rule assumes that there is very little inflow to Foster from the unregulated South Santiam and that all flow to meet BiOp trib targets downstream of Foster needs to come from Green Peter.
- *New Min Con Zone Release* – is a downstream minimum flow requirement on Foster outflow, so that the GPR release is adjusted to help supplement the unregulated inflow to Foster from the South Santiam. The minimum outflow from Foster varies by period throughout the year and is a BiOp requirement.
- *Special Curves GPR Normal*– induced surcharge function, a function of elevation and inflow.
- *Winter Ops max flood flow – at Jefferson* is a downstream max flow rule, see DET description
- *Winter Ops Min Flow – at Green Peter* – min flow 50 cfs during small floods.

IF BLOCK *Flood Ops Normal*

IF *(Small Flood Ops Normal)* - if pool elevation is less than 950 ft.

ELSE IF *(Normal Flood Ops)* if pool elevation is less than 990 ft but greater than 950 ft.

ELSE IF *(Spring/Fall Large Flood no IRRM)* for current time between 01Mar and 01Nov when pool elevation is more than 990 ft.

ELSE (*Large Flood)* – all other conditions

Figure 13.2a. Green Peter Baseline Operation Set Rule, continued on next page.

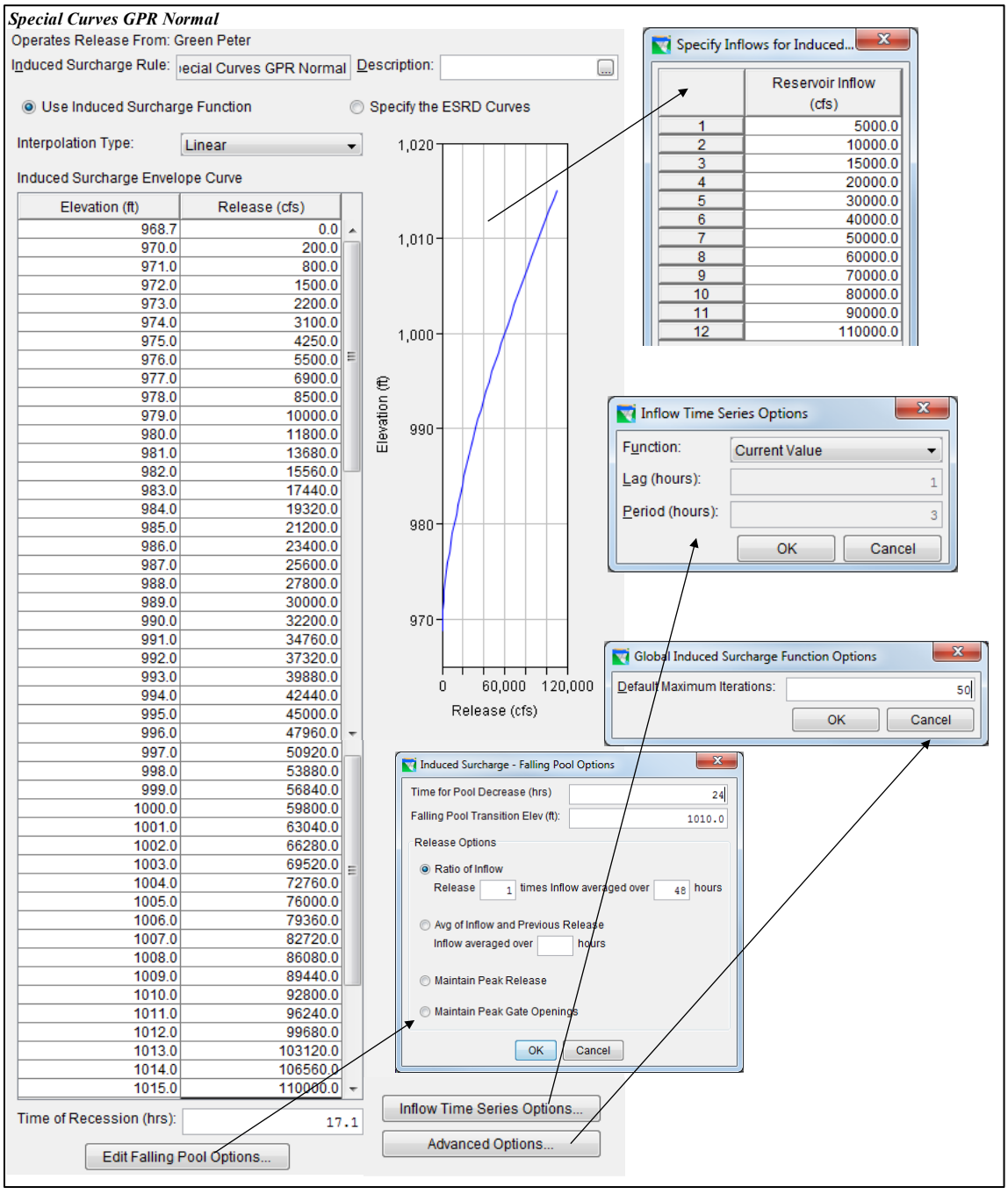


Figure 13.2b. Green Peter Baseline Operation Set Rule, continued on next page.

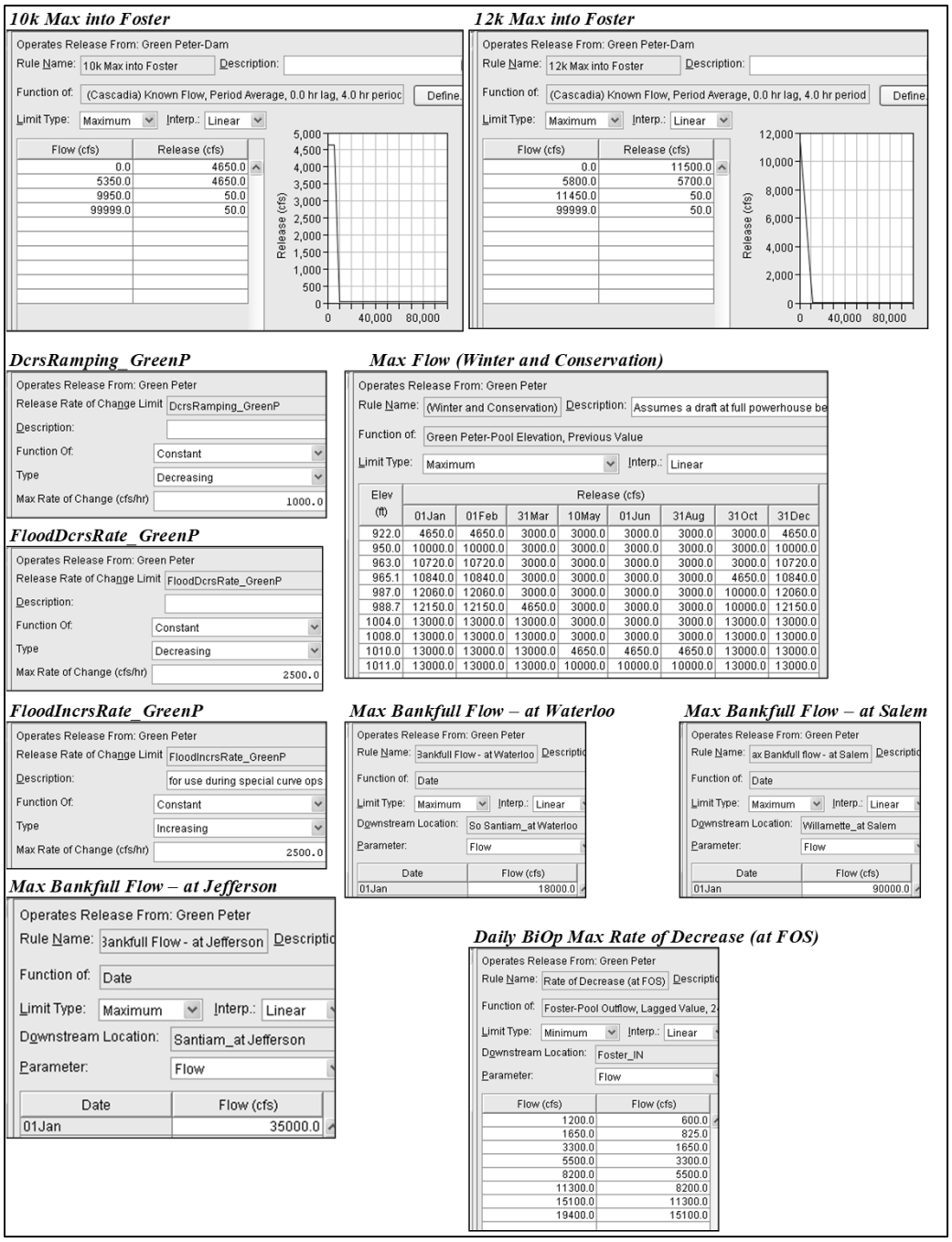


Figure 13.2c. Green Peter Baseline Operation Set Rule, continued.

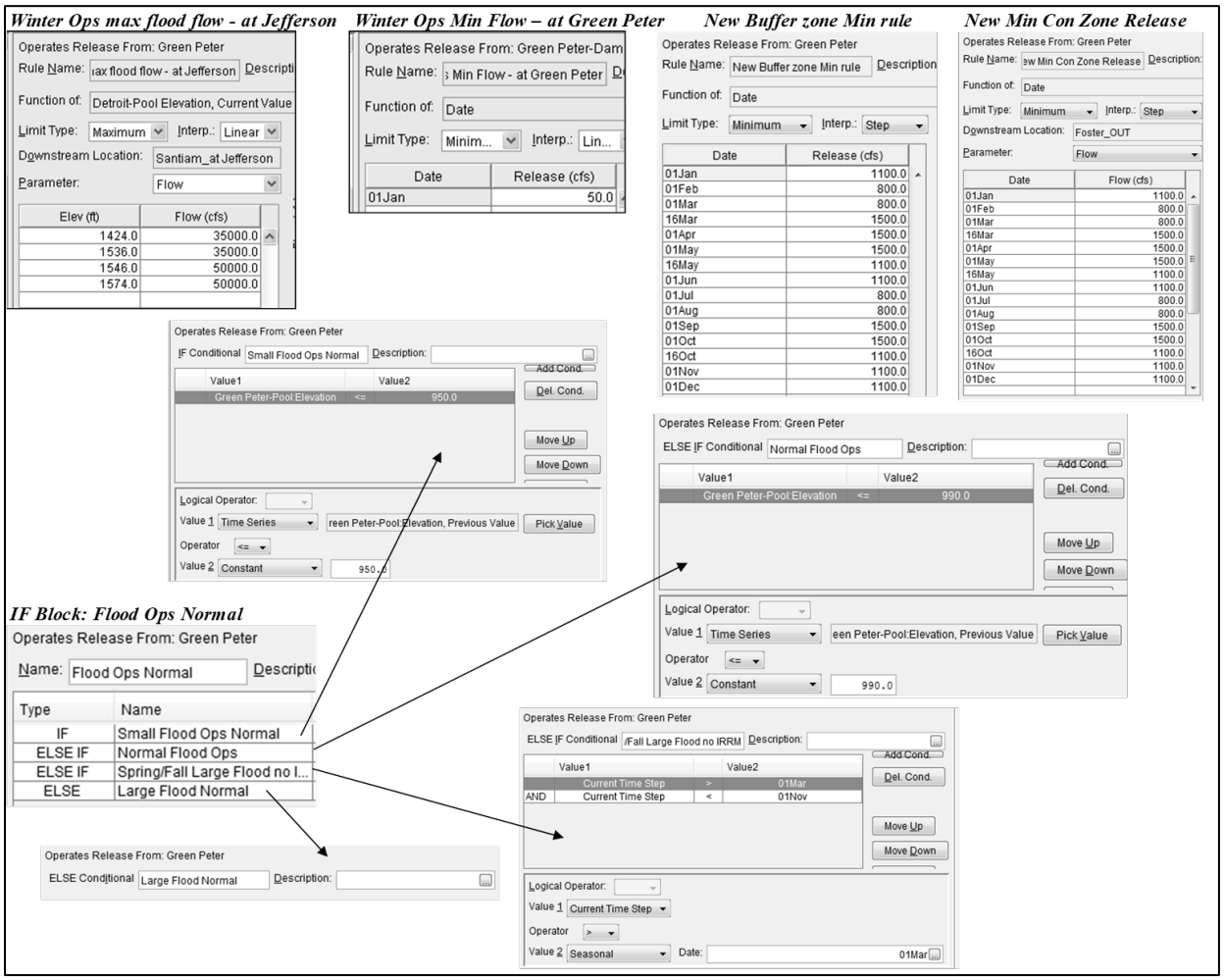
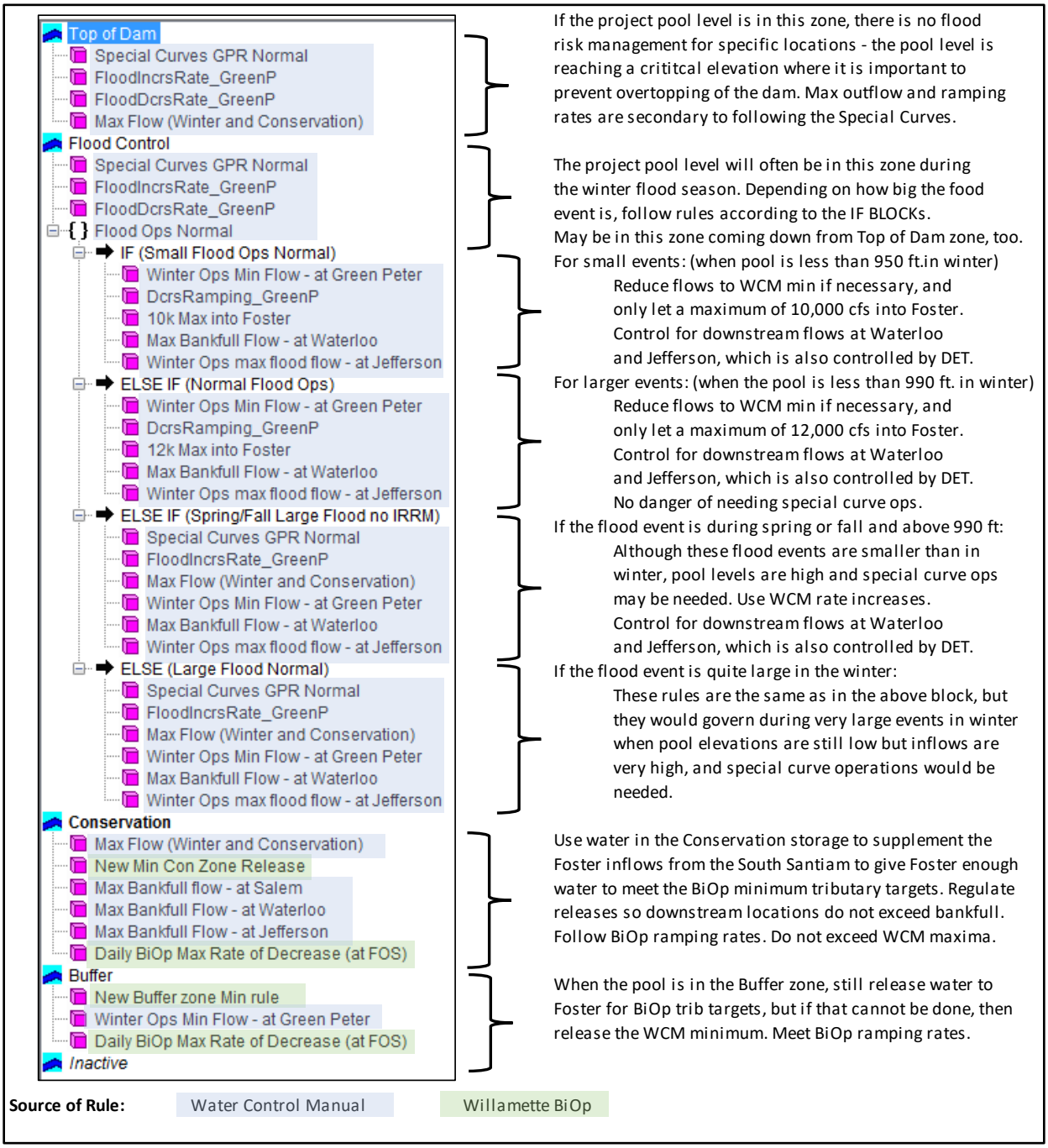


Figure 13.3. Green Peter Baseline Operation Set Rule Sources and Regulation Goals.

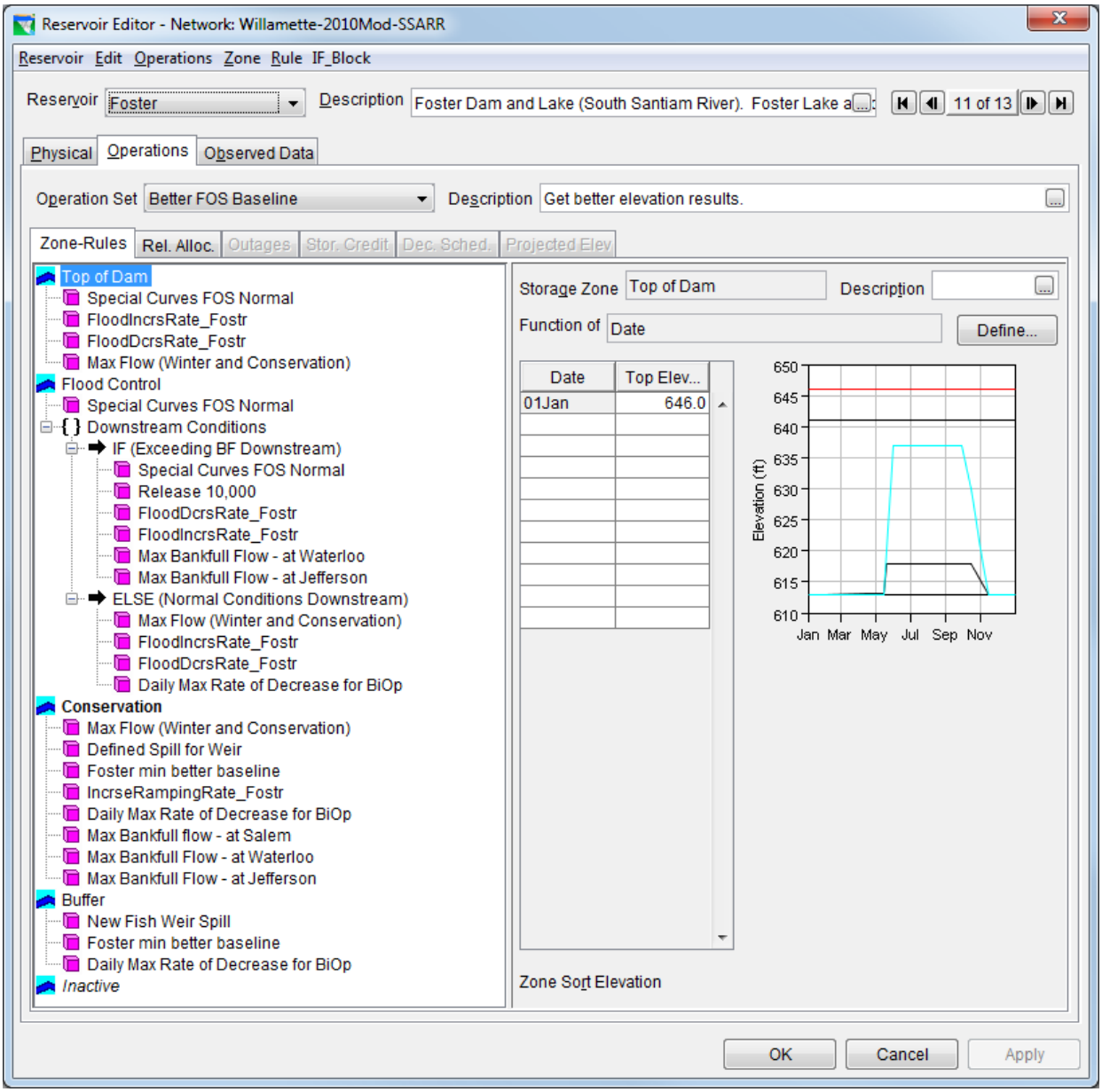


14 Foster Project Specific Rule Sets

14.1 Operation Set Screen Shot

The ResSim image of the Foster Baseline operation set is in Figure 14.1 below. Each of the rules shown in the image are listed alphabetically after the figure, along with some rule screen shots. Note that the Conservation zone does not include the minimum flow rule for Salem. Foster reservoir has very little conservation storage, although the minimum releases required from the BiOp are high. Foster releases the required BiOp flows by passing most of the Green Peter reservoir releases and most of the flows from the unregulated South Santiam River.

Figure 14.1. ResSim Screen Shot of the Foster operation set used for the Baseline simulation.



The specified Guide Curve for the ResSim analysis for Foster is shown in the bright blue line of Figure 14.1. Generally, the Guide Curve in ResSim is the Rule Curve from the project's Water Control Manual, but the Foster Guide Curve has a later refill date than is listed in the Foster WCM. This delay in refill is the current practice for a fish operation. Prior to the Guide Curve shown in the above figure, Foster was often operated to have a partial fill and then a draft back down to minimum conservation zone, with the outflow in that period containing a certain amount of spill over a modified weir inserted in one of the spillway bays. This modified weir is called the Fish Weir, and is still in use, although there is no longer the partial fill of the reservoir.

14.2 Reservoir Zones

The zone boundaries used for Foster are listed in Table 14.1. The Conservation zone is defined as the Guide Curve in the operation set, and this zone is slightly modified from the Rule Curve for Foster from the WCM, as described in Section 14.1.

Table 14.1. Foster Zone Specifications.

Conservation Zone Specification		**Buffer Zone Specification**	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	613.019	01Jan	613.004
31Jan	613.019	31Jan	613.004
01Apr	613.019	15Apr	613.174
15Apr	613.019	16May	613.174
15May	613.019	20May	617.804
31May	637.0	15Oct	617.804
30Sep	637.0	15Nov	613.004
07Oct	633.8	31Dec	613.004
15Oct	629.9		
23Oct	625.9	**Top of Dam Zone**	
31Oct	621.6	All Year	646.0
07Nov	617.7	**Flood Control Zone**	
15Nov	613.019	All Year	641.0
		Inactive Zone	
		All Year	613.0

14.3 Alphabetical List of Rules in Operation Set

The Foster Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6. Figure 14.3 indicates the source of each rule (Water Control Manual or Willamette BiOp) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: Better FOS Baseline

- *Daily Max Rate of Decrease for BiOp* –min release from FOS
- *Defined Spill for Weir* – specifies 200 cfs from Foster spillway for one month, which represents flow over the Fish Weir at the project during that period.

- *FloodDcrsRate_Fostr* –max rate of change decrease, linear function, 20% of release cfs/hr.
- *FloodIncrsRate_Fostr* –max rate of change increase, step function of Foster release value:
- *Foster min better baseline* – min flow equal to GPR outflow
- *IncrseRampingRate_Fostr* – max rate of increase 300 cfs/hr
- *Max Bankfull Flow – at Jefferson* is 35,000 cfs
- *Max Bankfull Flow – at Salem* is 90,000 cfs
- *Max Bankfull Flow – at Waterloo* is 18,000 cfs
- *Max Flow (Winter and Conservation)* – max release function of the previous elevation
- *New Fish Weir Spill* – specifies a varying spillway flow for one month, which represents flow over the Fish Weir at the project during that period, for the buffer zone, when pool elevations are lower.
- *Release 10,000* – specified release value
- *Special Curves FOS Normal* – induced surcharge function, a function of elevation and inflow.

IF BLOCK *Downstream Conditions*

IF *(Exceeding BF Downstream*) – If Waterloo flows are above 18,000 cfs or if Jefferson flows are above 35,000 cfs.

ELSE *(Normal Conditions Downstream)* – for all other conditions.

Figure 14.2a. Foster Baseline Operation Set Rules, continued on next page.

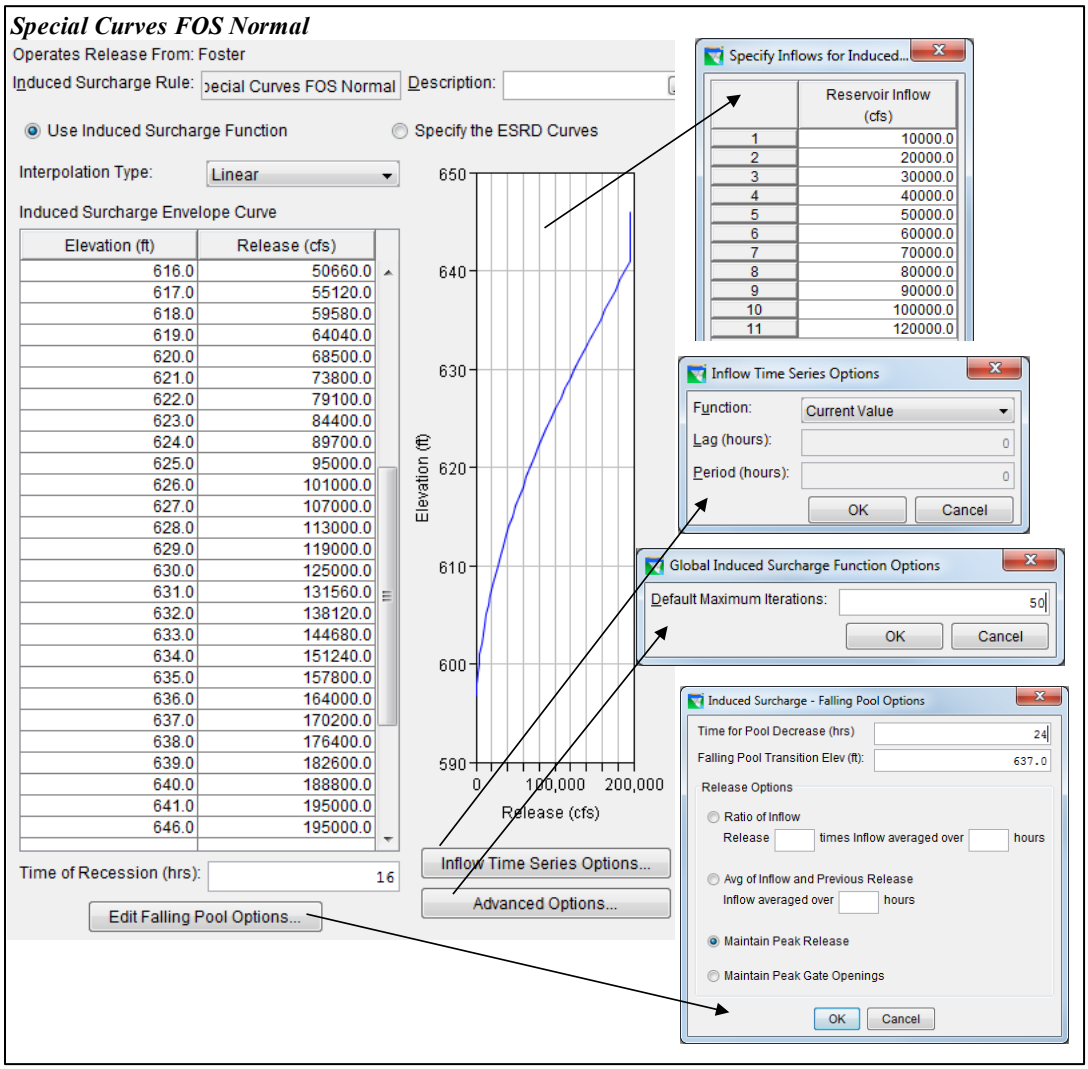


Figure 14.2b. Foster Baseline Operation Set Rules, continued on next page.

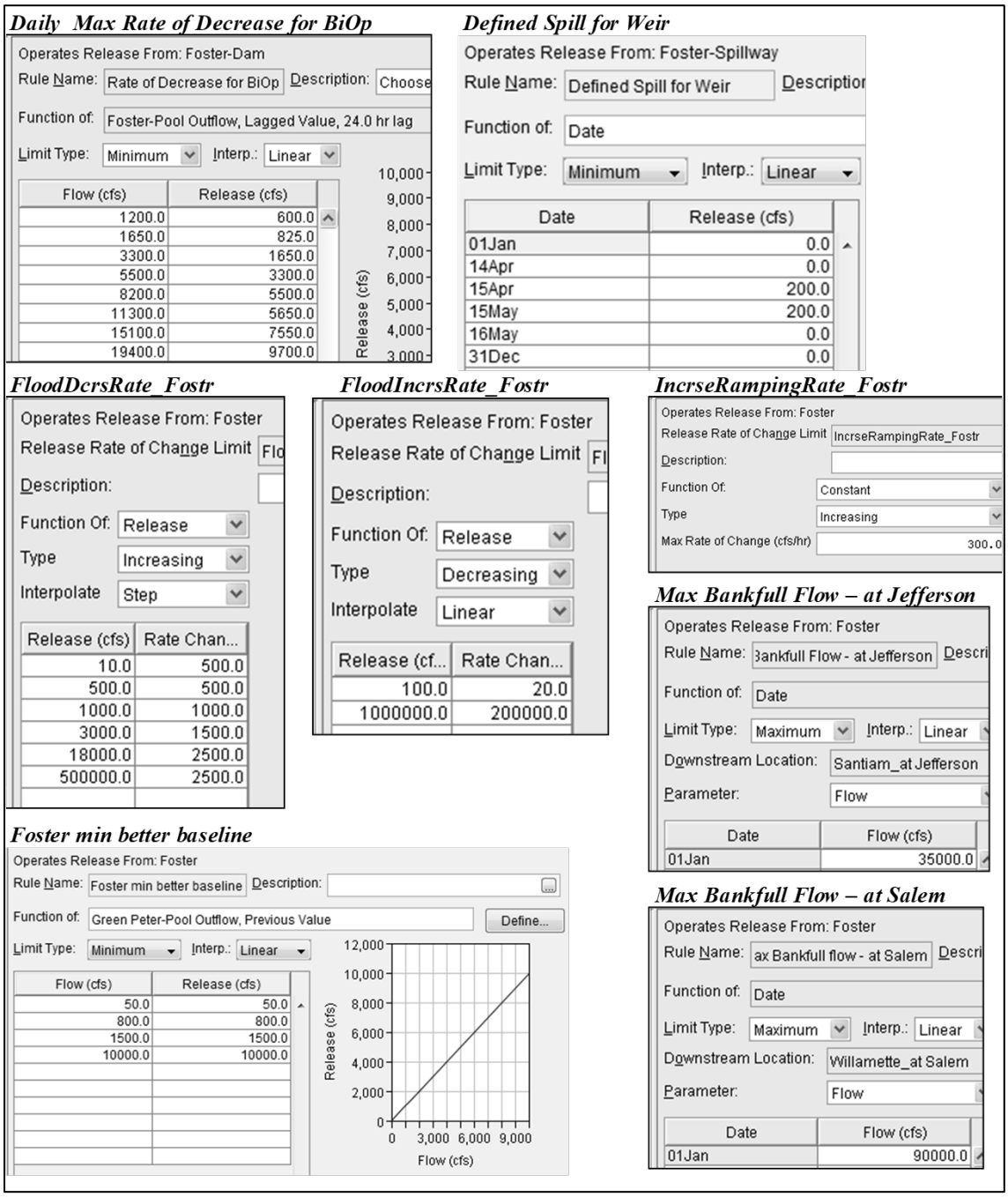


Figure 14.2c. Foster Baseline Operation Set Rules, continued.

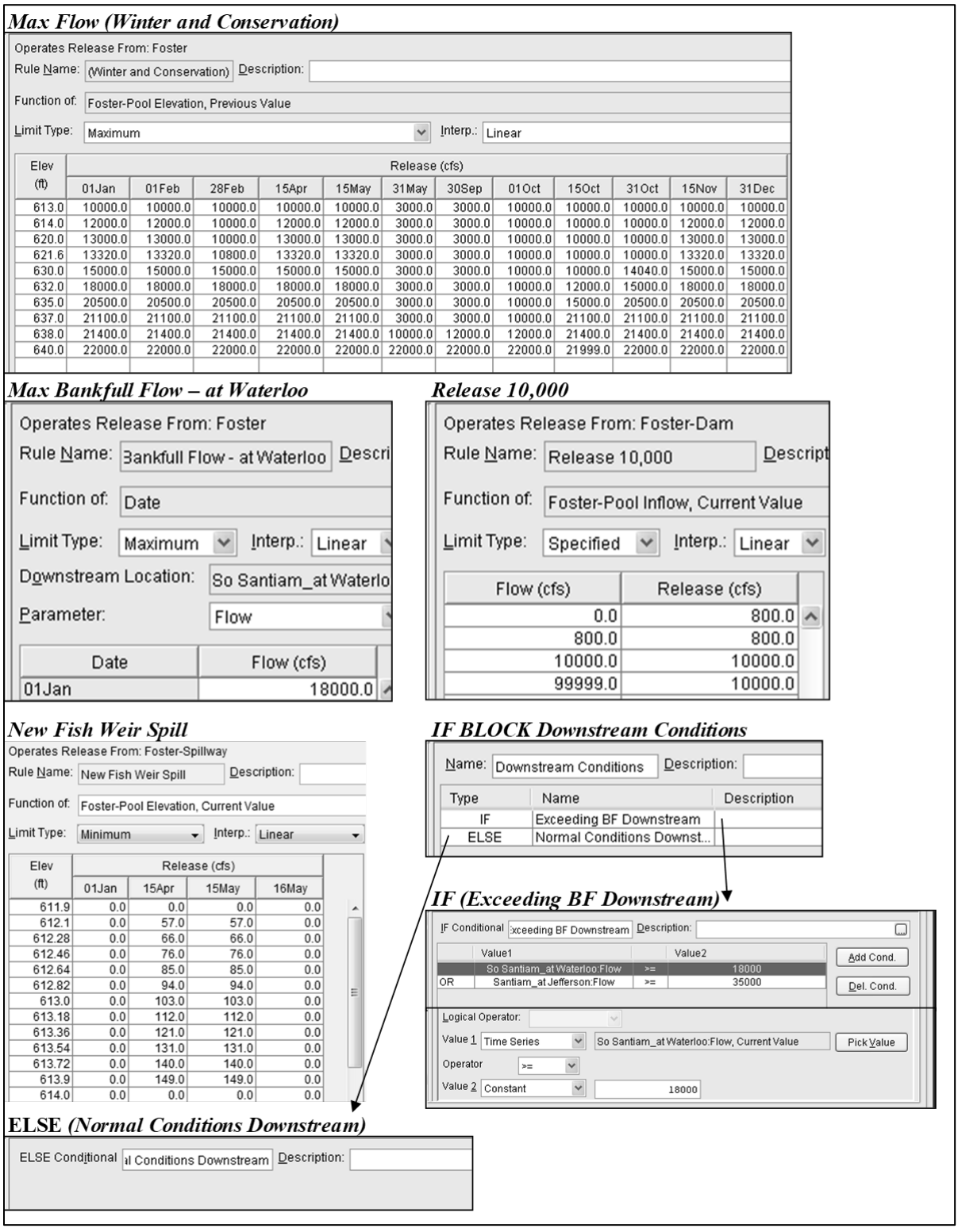
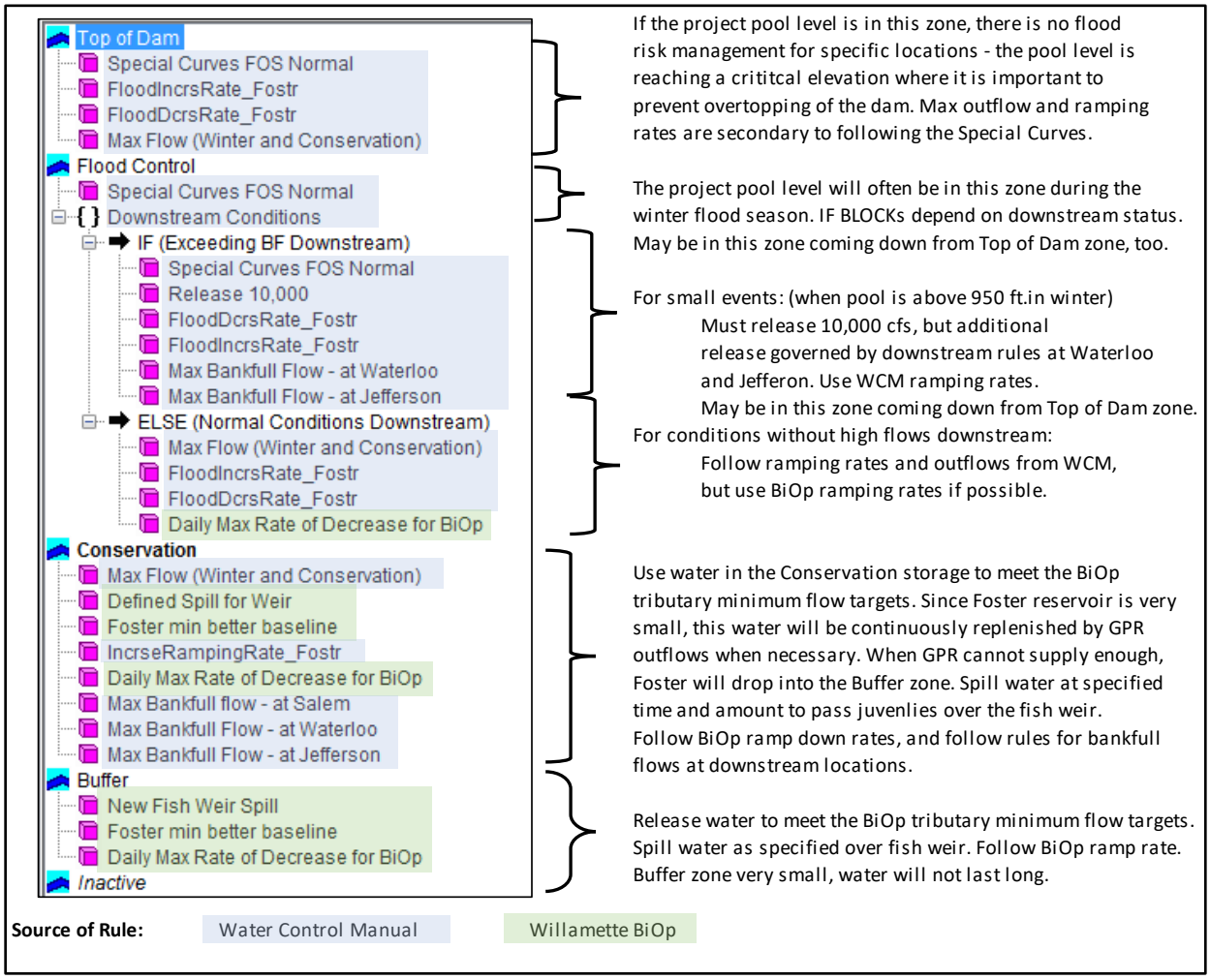


Figure 14.3. Foster Baseline Operation Set Rule Sources and Regulation Goals.

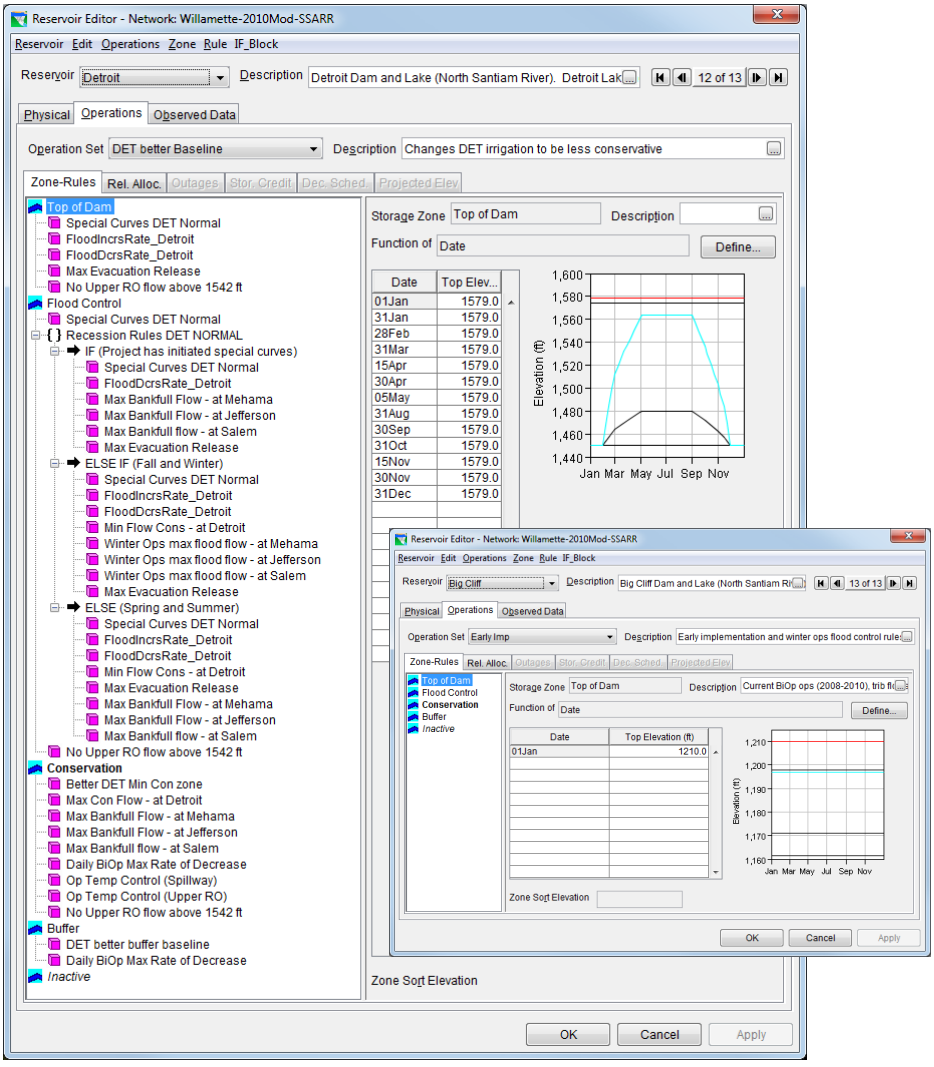


15 Detroit and Big Cliff Project Specific Rule Sets

15.1 Operation Set Screen Shot

The ResSim image of the Detroit Baseline operation set is in Figure 15.1 below, with that of Big Cliff shown on the inset at the lower right of the image. Each of the rules shown in the Detroit image are listed alphabetically after the figure, along with some rule screen shots. Note that the Conservation zone for Detroit does not include the minimum flow rule for Salem. Detroit releases a large amount of stored water to help meet the BiOp minimum flow targets downstream of Big Cliff Dam, which satisfies the project's share of meeting Salem flow targets. The Big Cliff operation set contains only zones, no rules, because it is a small re-regulating dam just downstream of Detroit. On average over the day, all water flowing in to Big Cliff reservoir flows out, and the only flow into the reservoir is the Detroit outflow

Figure 15.1. ResSim Screen Shots of Detroit and Big Cliff operation sets used for the Baseline.



15.2 Reservoir Zones

The zone boundaries used for Detroit and Big Cliff are listed in Table 15.1. The Conservation zone for Detroit is defined as the Guide Curve in the operation set, and this zone is the Rule Curve for Detroit from the WCM. Big Cliff does not have a Rule Curve, since it does not seasonally fill and draft as Detroit does.

Table 15.1. Detroit Zone Specifications.

Conservation Zone Specification		**Buffer Zone Specification**	
Date	**Elevation, feet**	**Date**	**Elevation, feet**
01Jan	1450.01	01Jan	1450.0025
31Jan	1450.01	31Jan	1450.0025
07Feb	1467.7	28Feb	1464.38
14Feb	1484.0	31Mar	1471.99
21Feb	1498.7	15Apr	1475.18
28Feb	1512.1	30Apr	1478.87
07Mar	1518.4	05May	1479.98
15Mar	1525.3	31Aug	1479.98
23Mar	1531.9	30Sep	1471.53
31Mar	1538.3	31Oct	1462.0
07Apr	1543.8	15Nov	1457.17
15Apr	1549.7	30Nov	1450.0025
22Apr	1554.7	31Dec	1450.0025
30Apr	1560.2	**Top of Dam Zone**	
05May	1563.5	All Year	1579.0 ft.
31Aug	1563.5	**Flood Control Zone**	
07Sep	1557.7	All Year	1574.0 ft.
15Sep	1550.7	**Inactive Zone**	
22Sep	1544.4	All Year	1450.0 ft.
30Sep	1536.7		
07Oct	1529.6		
15Oct	1521.3		
23Oct	1512.5	**Big Cliff Zone Definitions, All Year**	
31Oct	1503.2	Top of Dam	1210.0 ft.
07Nov	1494.6	Flood Control	1197.8 ft.
15Nov	1484.1	Conservation Zone	1197.0 ft.
22Nov	1468.9	Buffer Zone	1171.06 ft.
30Nov	1450.01	Inactive Zone	1161.38 ft.

15.3 Alphabetical List of Rules in Operation Set

The Detroit Baseline operation set rules are listed below alphabetically. Rule screen shots are also below, with downstream maximum rule screen shots shown in Section 4.6. Figure 15.3 indicates the source of each rule (Water Control Manual, Willamette BiOp, or Hydraulic Design criteria) and a description of the regulation goal in each zone.

Baseline Operation Set Descriptions

Operation Set Name: DET better Baseline

- *Better DET Min Con zone* –the minimum release from the project, by date and by Water Year Type, to cover both the minimum tributary BiOp flows and the additional irrigation releases for May

through September for current storage contracts. The irrigation releases are shaped according to the demand methodology developed by DMA, and these releases are for all water year types except for Deficit water years. The irrigation releases added to the minimum project outflows are:

May = 14 cfs, June = 30 cfs, July = 48 cfs, August = 38 cfs, September = 20 cfs.

- *Daily BiOp Max Rate of Decrease* –max release function of the 24 hr lagged outflow
- *DET better buffer baseline* –the minimum release from the project, by date and by Water Year Type, to cover both the minimum BiOp outflows and the additional irrigation releases for May through September for current storage contracts. This rule differs from the minimum release rule in the conservation zone by specifying a lower minimum release in September, and it applies only when the pool level is low. (This reduced September minimum outflow when the pool is low is a water management practice, not a reduced BiOp minimum target.) The additional releases to cover irrigation downstream are still applied in all but Deficit water years.
- *FloodDcrsRate_Detroit* –max rate of change decreases up 1/5 of the release per hour
- *FloodIncrsRate_Detroit* –max rate of change increase based on current release.
- *Max Bankfull Flow – at Jefferson* is 35,000 cfs
- *Max Bankfull Flow – at Mehama* is 17,000 cfs
- *Max Bankfull Flow – at Salem* is 90,000 cfs
- *Max Con Flow – at Detroit* – gives maximum flow out of the dam of 5000 cfs except Sep and Oct, which has a max outflow of 3000 cfs.
- *Max Evacuation Release* – max release function of the previous elevation.
- *Min Flow Cons – at Detroit* – min flow as a step function of date. This rule is only used in the flood zones and does not include the releases to cover irrigation contracts.
- *No Upper RO flow above 1542 ft* –max flow upper RO zero above 1542 ft., representing a hydraulic engineering constraint.
- *Op Temp Control (Spillway)* –minimum required spillway flow is a percent of total outflow as a function of date. Spill is 70% from 01Jun to 21Jun, 60% from 21Jun to 09Aug, 45% from 09Aug to 01Sep, and no required spillway flow from 01Oct until next June. The purpose is to blend the warmer surface water with the colder water going through the turbines to attain an appropriate downstream temperature after the flows are mixed in Big Cliff reservoir.
- *Op Temp Control (Upper RO)* – minimum required Upper RO flow is 50% of the current outflow from 01Oct to 13Nov. This is the temperature operation that goes in to effect once the pool level has dropped below the spillway crest.
- *Special Curves DET Normal* – induced surcharge function, a function of elevation and inflow.
- *Winter Ops max flood flow – at Jefferson* is 35,000 cfs below 1536 ft. and 50,000 cfs above that.
- *Winter Ops max flood flow – at Mehama* is 17,000 cfs below 1536 ft. and 35,000 cfs above that.
- *Winter Ops max flood flow – at Salem* is 90,000 cfs below 1536 ft. and 150,000 cfs above that.

IF BLOCK *Recession Rules DET NORMAL*

IF *Project has initiated special curve*s – the condition checks if the special curve rule minimum flow has is non-zero for a specified time window.

ELSE IF *Fall and Winter* – if the current time step is later than 01 Oct or earlier than 01 Mar

ELSE *Spring and Summer*- for all other cases.

Figure 15.2a. Detroit Baseline Operation Set Rules, continued on next page.

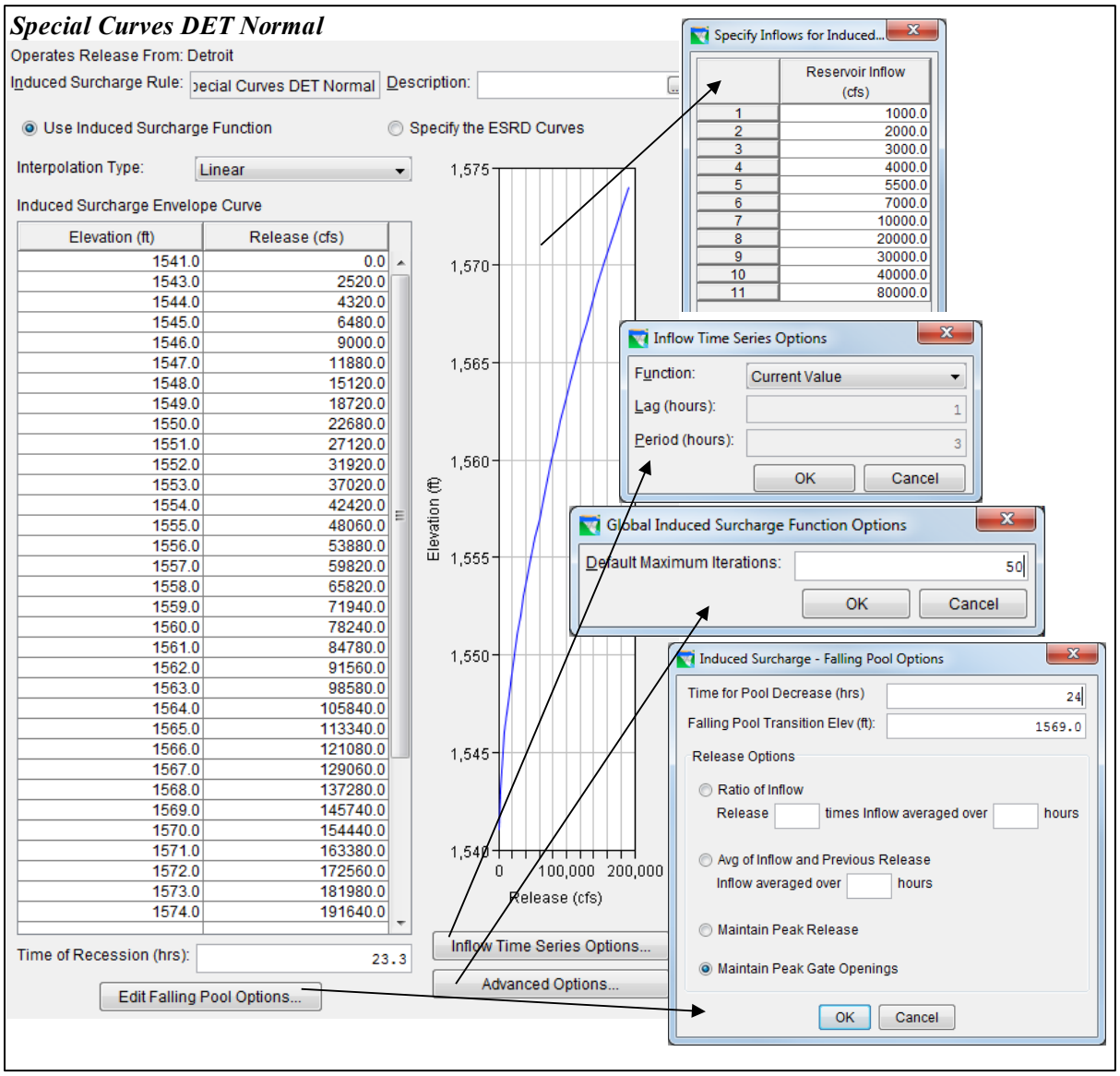
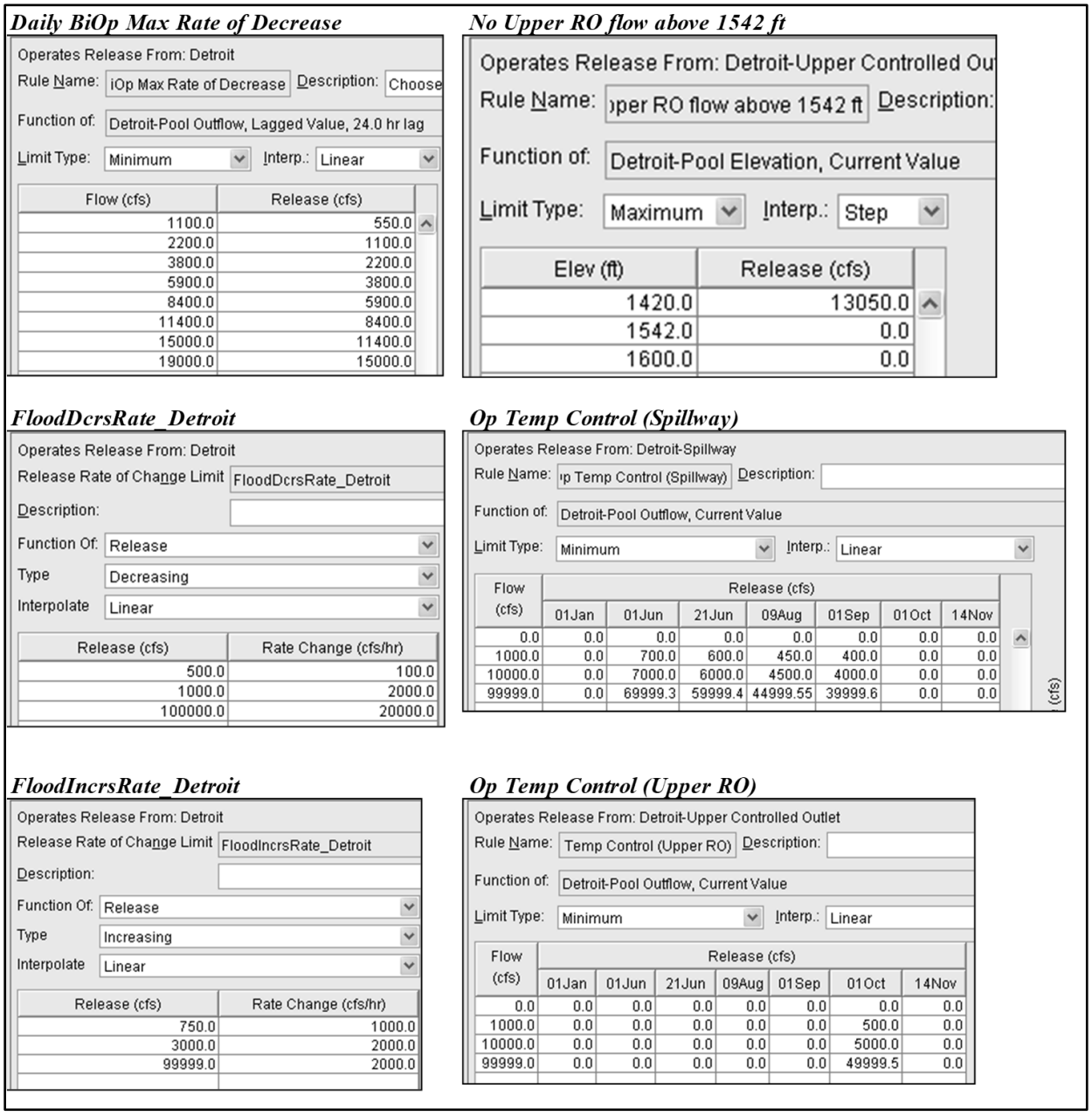


Figure 15.2b. Detroit Baseline Operation Set Rules, continued on next page.



Daily BiOp Max Rate of Decrease

Operates Release From: Detroit

Rule Name: iOp Max Rate of Decrease Description: Choose

Function of: Detroit-Pool Outflow, Lagged Value, 24.0 hr lag

Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)
1100.0	550.0
2200.0	1100.0
3800.0	2200.0
5900.0	3800.0
8400.0	5900.0
11400.0	8400.0
15000.0	11400.0
19000.0	15000.0

No Upper RO flow above 1542 ft

Operates Release From: Detroit-Upper Controlled Ou

Rule Name:)per RO flow above 1542 ft Description:

Function of: Detroit-Pool Elevation, Current Value

Limit Type: Maximum Interp.: Step

Elev (ft)	Release (cfs)
1420.0	13050.0
1542.0	0.0
1600.0	0.0

FloodDcrsRate_Detroit

Operates Release From: Detroit

Release Rate of Change Limit: FloodDcrsRate_Detroit

Description:

Function Of: Release

Type: Decreasing

Interpolate: Linear

Release (cfs)	Rate Change (cfs/hr)
500.0	100.0
1000.0	2000.0
100000.0	20000.0

Op Temp Control (Spillway)

Operates Release From: Detroit-Spillway

Rule Name: ıp Temp Control (Spillway) Description:

Function of: Detroit-Pool Outflow, Current Value

Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)						
	01Jan	01Jun	21Jun	09Aug	01Sep	01Oct	14Nov
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000.0	0.0	700.0	600.0	450.0	400.0	0.0	0.0
10000.0	0.0	7000.0	6000.0	4500.0	4000.0	0.0	0.0
99999.0	0.0	69999.3	59999.4	44999.55	39999.6	0.0	0.0

(cfs)

FloodIncrsRate_Detroit

Operates Release From: Detroit

Release Rate of Change Limit: FloodIncrsRate_Detroit

Description:

Function Of: Release

Type: Increasing

Interpolate: Linear

Release (cfs)	Rate Change (cfs/hr)
750.0	1000.0
3000.0	2000.0
99999.0	2000.0

Op Temp Control (Upper RO)

Operates Release From: Detroit-Upper Controlled Outlet

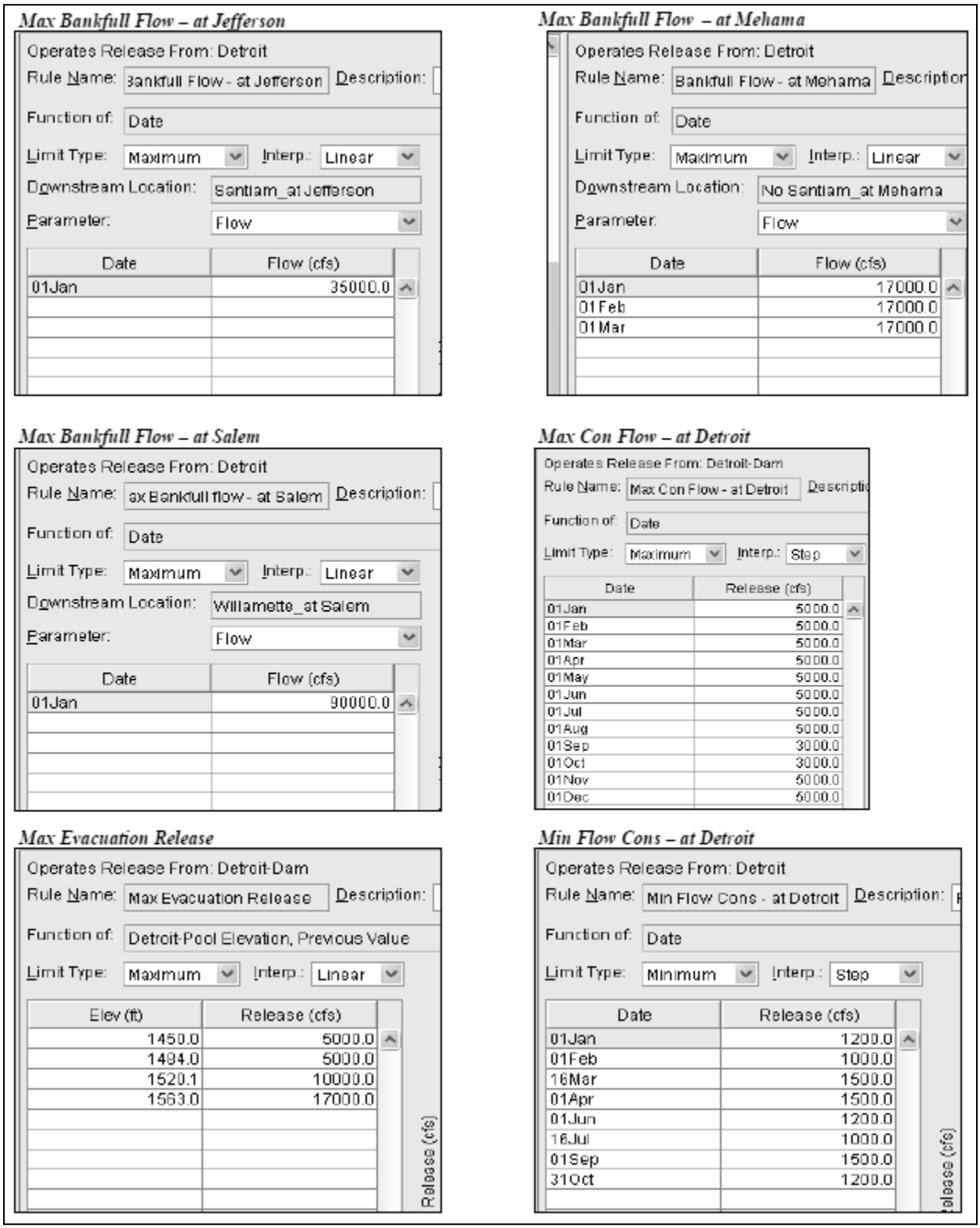
Rule Name: Temp Control (Upper RO) Description:

Function of: Detroit-Pool Outflow, Current Value

Limit Type: Minimum Interp.: Linear

Flow (cfs)	Release (cfs)						
	01Jan	01Jun	21Jun	09Aug	01Sep	01Oct	14Nov
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1000.0	0.0	0.0	0.0	0.0	0.0	500.0	0.0
10000.0	0.0	0.0	0.0	0.0	0.0	5000.0	0.0
99999.0	0.0	0.0	0.0	0.0	0.0	49999.5	0.0

Figure 15.2c. Detroit Baseline Operation Set Rules, continued on next page.



Max Bankfull Flow – at Jefferson

Operates Release From: Detroit
Rule Name: Bankfull Flow - at Jefferson Description:
Function of: Date
Limit Type: Maximum Interp.: Linear
Downstream Location: Santiam_at Jefferson
Parameter: Flow

Date	Flow (cfs)
01Jan	35000.0

Max Bankfull Flow – at Mehama

Operates Release From: Detroit
Rule Name: Bankfull Flow - at Mehama Description
Function of: Date
Limit Type: Maximum Interp.: Linear
Downstream Location: No Santiam_at Mehama
Parameter: Flow

Date	Flow (cfs)
01Jan	17000.0
01Feb	17000.0
01Mar	17000.0

Max Bankfull Flow – at Salem

Operates Release From: Detroit
Rule Name: ax Bankfull flow - at Salem Description:
Function of: Date
Limit Type: Maximum Interp.: Linear
Downstream Location: Willamette_at Salem
Parameter: Flow

Date	Flow (cfs)
01Jan	90000.0

Max Con Flow – at Detroit

Operates Release From: Detroit-Dam
Rule Name: Max Con Flow - at Detroit Descriptio
Function of: Date
Limit Type: Maximum Interp.: Step

Date	Release (cfs)
01Jan	5000.0
01Feb	5000.0
01Mar	5000.0
01Apr	5000.0
01May	5000.0
01Jun	5000.0
01Jul	5000.0
01Aug	5000.0
01Sep	3000.0
01Oct	3000.0
01Nov	5000.0
01Dec	5000.0

Max Evacuation Release

Operates Release From: Detroit-Dam
Rule Name: Max Evacuation Release Description:
Function of: Detroit-Pool Elevation, Previous Value
Limit Type: Maximum Interp.: Linear

Elev (ft)	Release (cfs)
1450.0	5000.0
1494.0	5000.0
1520.1	10000.0
1563.0	17000.0

Release (cfs)

Min Flow Cons – at Detroit

Operates Release From: Detroit
Rule Name: Min Flow Cons - at Detroit Description:
Function of: Date
Limit Type: Minimum Interp.: Step

Date	Release (cfs)
01Jan	1200.0
01Feb	1000.0
16Mar	1500.0
01Apr	1500.0
01Jun	1200.0
16Jul	1000.0
01Sep	1500.0
31Oct	1200.0

Figure 15.2d. Detroit Baseline Operation Set Rules, continued on next page.

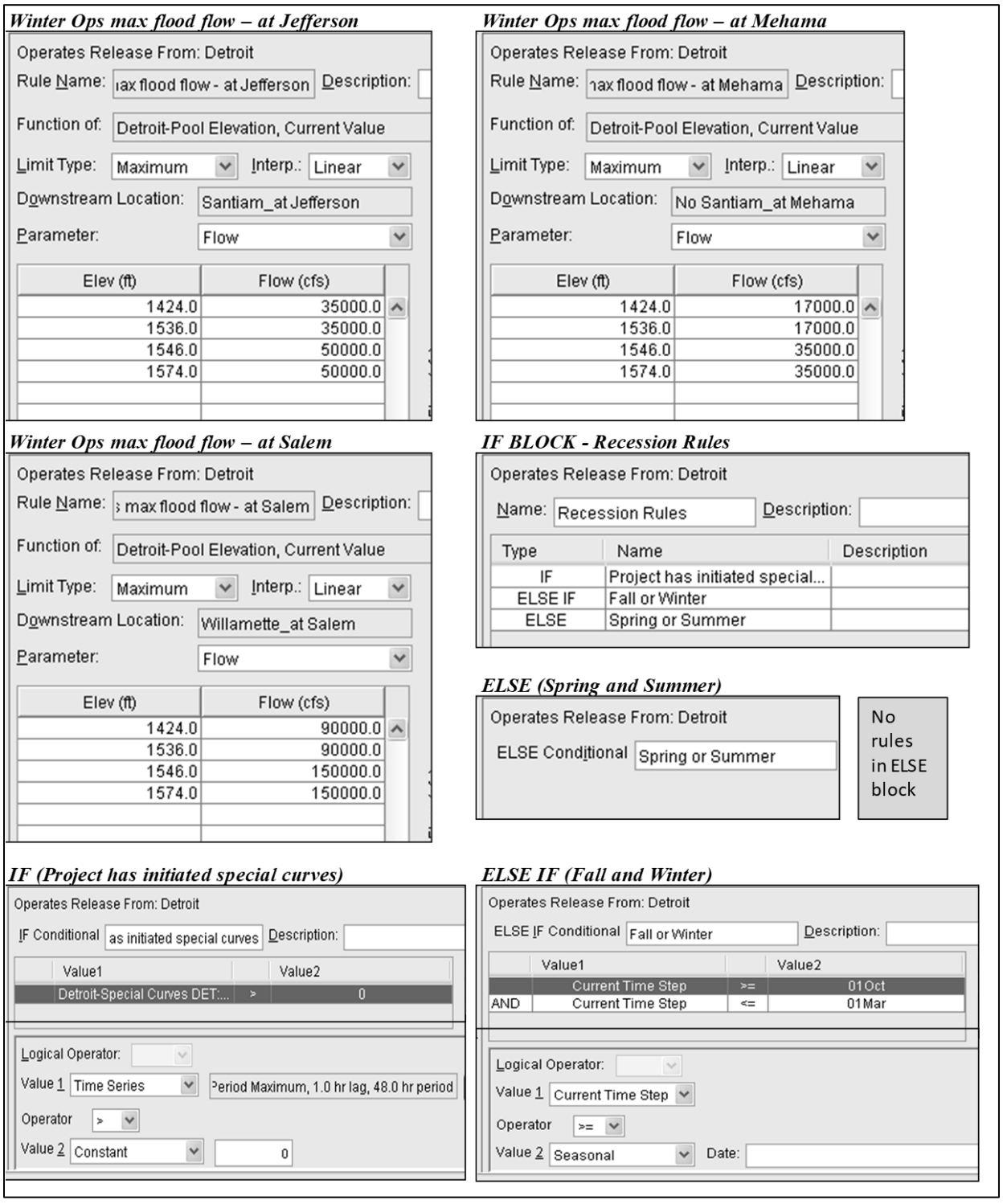


Figure 15.2e. Detroit Baseline Operation Set Rules, continued.

Better DET Min Con zone

Operates Release From: Detroit

Rule Name: Better DET Min Con zone Description:

Function of: Water Year Type, Current Value

Limit Type: Minimum Interp.: Linear

Water Year Type	Release (cfs)												
	01Jan	01Feb	16Mar	01Apr	01May	01Jun	01Jul	15Jul	01Aug	01Sep	16Oct	01Nov	01Dec
0.0	1200.0	1000.0	1500.0	1500.0	1500.0	1200.0	1200.0	1000.0	1000.0	1500.0	1200.0	1200.0	1200.0
0.9	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1520.0	1200.0	1200.0	1200.0
1.2	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1520.0	1200.0	1200.0	1200.0
1.48	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1520.0	1200.0	1200.0	1200.0
2.0	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1520.0	1200.0	1200.0	1200.0

DET better buffer baseline

Operates Release From: Detroit

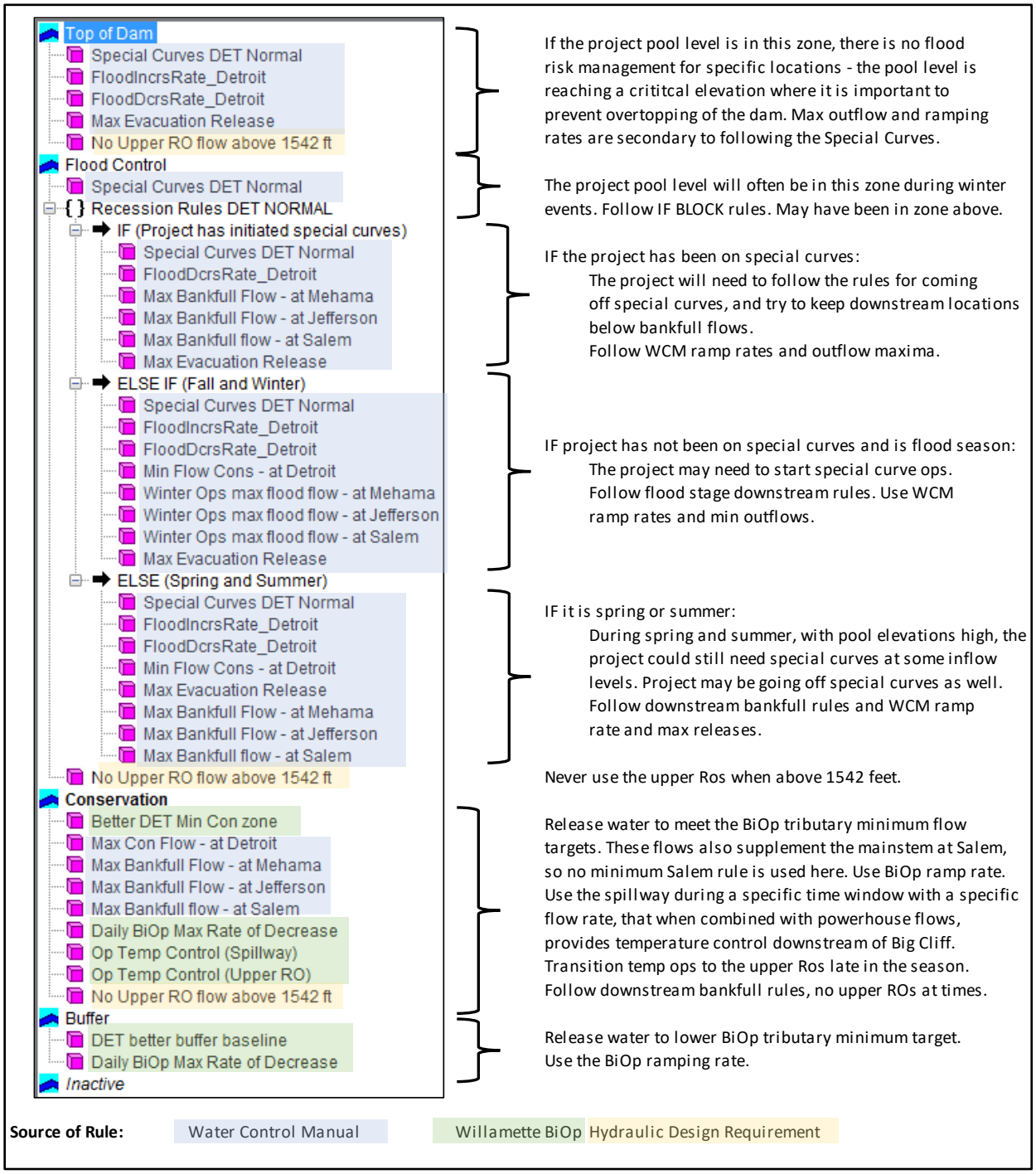
Rule Name: DET better buffer baseline Description:

Function of: Water Year Type, Current Value

Limit Type: Minimum Interp.: Linear

Water Year Type	Release (cfs)												
	01Jan	01Feb	16Mar	01Apr	01May	01Jun	01Jul	15Jul	01Aug	01Sep	16Oct	01Nov	01Dec
0.0	1200.0	1000.0	1500.0	1500.0	1500.0	1200.0	1200.0	1000.0	1000.0	1200.0	1200.0	1200.0	1200.0
0.9	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1220.0	1200.0	1200.0	1200.0
1.2	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1220.0	1200.0	1200.0	1200.0
1.48	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1220.0	1200.0	1200.0	1200.0
2.0	1200.0	1000.0	1500.0	1500.0	1514.0	1230.0	1248.0	1048.0	1038.0	1220.0	1200.0	1200.0	1200.0

Figure 15.3. Detroit Baseline Operation Set Rule Sources and Regulation Goals.



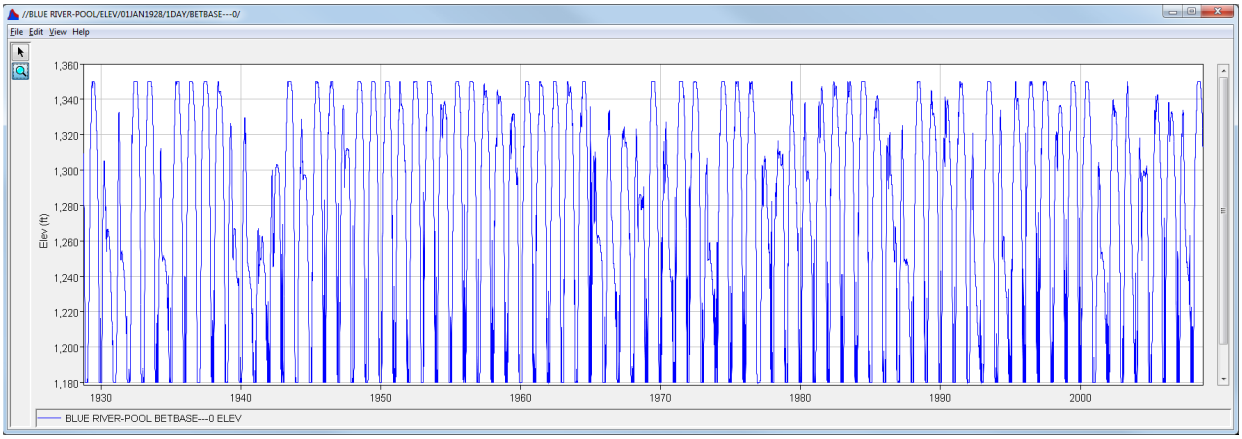
16 HEC-ResSim Baseline Simulation Results

The ResSim results for the Baseline Simulation are in a HEC-DSS file from the program that is labeled by default *"simulation.dss"*. This file contains 2403 individual time series records and is 633 mega-bytes in size. Each time series record contains daily data for the duration of the simulation, which was 01 October 1928 through 30 September 2008. The program evaluates every computation point, river reach, and every dam outlet and parameter for each of the daily time steps in the simulation, which accounts for the number of records and the file size.

Fortunately, not all of the records are needed to summarize the regulated system. The most relevant records are the thirteen project inflows, outflows, pool elevations, pool storage values, and turbine outflows, which can be used for recreation and hydropower assessments and the ability of the projects to meet minimum tributary targets, and the regulated flows at Albany, Salem, and Oregon City above the Falls, which can used to assess the ability of the reservoirs to supplement flows to meet the BiOp mainstem targets.

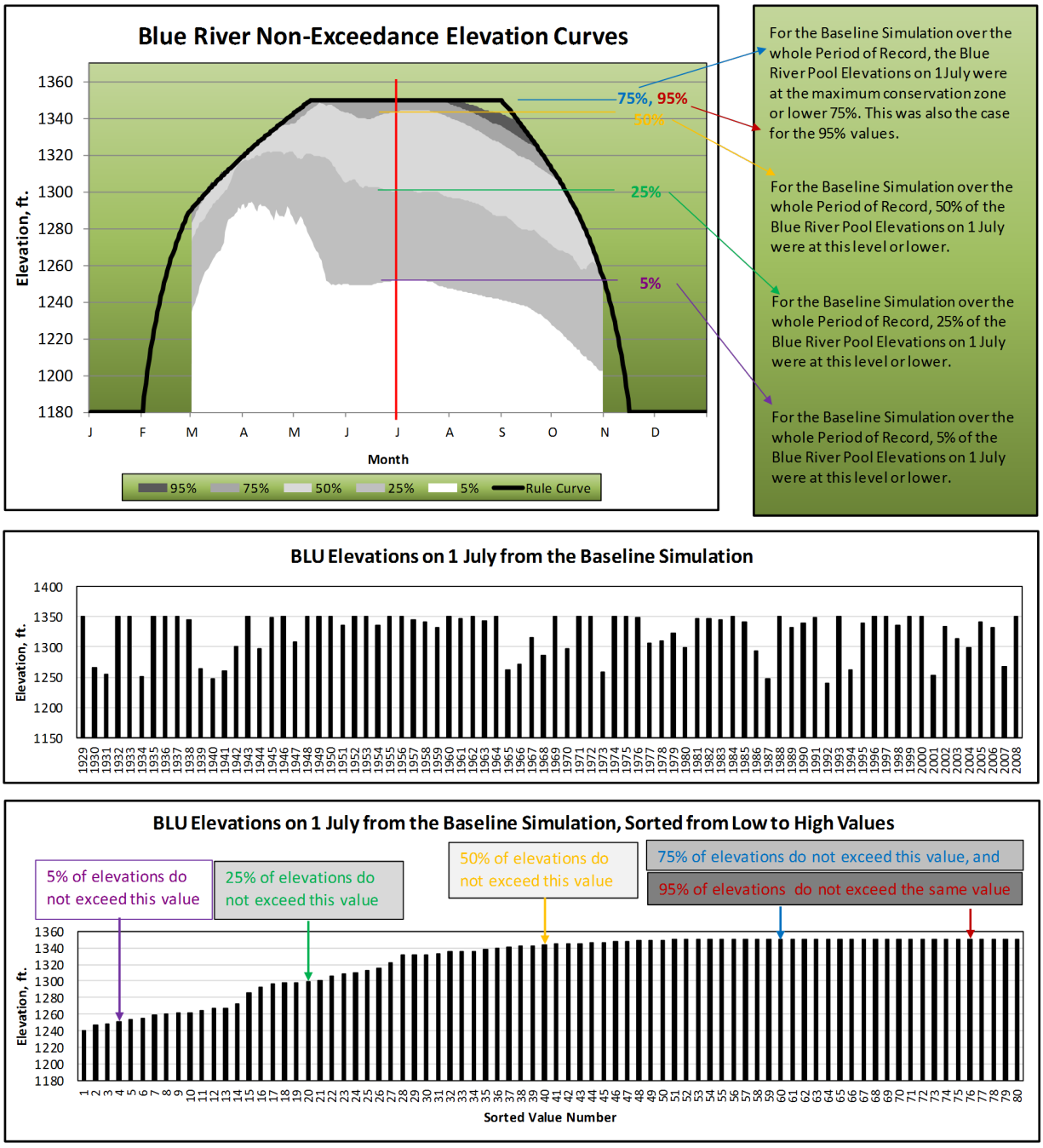
The challenge with so much data in the results file is two-fold – handling that much information and organizing and summarizing the data into something meaningful. One method of dealing with this much information is to re-organize the daily data from a continuous record into daily statistical percentages. Figure 16.1 shows the continuous time series record from the results file for the Blue River pool elevation. This data is then post-processed so that statistics can be calculated for each day of the year. This process is shown graphically in Figure 16.2 and described further below.

Figure 16.1. Example simulation.dss file output graph for the Blue River pool elevation.



The time window of interest in the WBR study is March through the end of October, so all March 1 values for the simulated years are organized together, all March 2 values for all years, and so on through October 31 for all years. The graphical description of the post-processing shown in Figure 16.2 focuses on all 01 July values for the Blue River pool elevation. All 01 July values from Figure 16.1 were pulled from the results and plotted by chronological year, as can be seen in the middle plot (a column graph) of Figure 16.2. Note that many of the bars in the graph are at 1350 feet, which is the maximum conservation zone elevation for Blue River, but many years show lower elevations than that for July 1.

Figure 16.1. Blue River pool elevation non-exceedance percentiles for the Baseline.



The pool elevations shown in the middle graph are then sorted from low to high values, and plotted in the lower graph of Figure 16.2 in another column graph. The lowest value is plotted in position 1 and the highest value in position 80 (there are 80 values for 01 July), although many years have this highest elevation, 1350 feet, for July 1. The sorted elevation values for the first of July are then annotated with some percentiles in order to illustrate the meaning of "Non-Exceedance" values.

Five percent of 80 years is 4 years, so a purple arrow points downward to the pool elevation corresponding to position 4, which is 1253 feet. This elevation is the 5th non-exceedance percentile for

the 01 July elevation values. It means that five percent of the July 1 Blue River pool elevations are this value (1253 feet) or less. In other words, five percent of elevations on this day do not exceed 1253 feet.

The other non-exceedance percentiles annotated in the lower graph of Figure 16.2 are:

- the 25% non-exceedance elevation (1300 ft.) at position 20 (because 20 is 25% of 80 yrs.), shown in green,
- the 50% non-exceedance elevation (1344 ft.) at position 40 (because 40 is 50% of 80 yrs.), shown in gold (this is also the median elevation on 01 July at Blue River),
- the 75% non-exceedance elevation (1350 ft.) at position 60 (because 60 is 75% of 80 yrs.), shown in blue,
- and the 95% non-exceedance elevation (which is also 1350 ft.) at position 76 (because 76 is 95% of 80 yrs.), shown in brick red.

The two lower graphs in Figure 16.2 illustrate the meaning of non-exceedance values, but data does not need to plotted and sorted from low-to-high to calculate these percentages. The percentiles can be readily calculated in Excel or HEC-DSS for any day. The top graph in Figure 16.2 shows the non-exceedance percentiles for 5%, 25%, 50%, 75%, and 95% for the time window of importance to this study (March through October), with these percentiles calculated for each day in this time window and plotted are area graphs. The top of the white area is the 5% values, and it overlaps the 25% values shown in graph, which overlaps the 50% values in light gray, which overlaps the 75% values in a darker gray, and that overlaps the 95% values in the darkest gray, of which only a sliver of the area is different than the 75% values. July 1 is marked with the bright red vertical line, and the horizontal lines show each non-exceedance percentile value on July 1. These horizontal percentile lines and values are color-coded the same as the annotations in the lower figure of the graph.

The top graph in Figure 16.2, with the non-exceedance values, also shows the rule curve in the heavy black line. As indicated in the bullet points above, both the 75% and the 95% non-exceedance values are 1350 ft, which is the elevation of the maximum conservation zone.

It is important to note that none of the percentiles plotted in the top graph of Figure 16.2 correspond to a particular year of data – each day's percentile computations are determined from all years evaluated in the simulation.

Similar non-exceedance percentile graphs are shown for all projects in Figure 16.3a and 16.3b, with each project's rule curve plotted as well. The graphs show the results for the window of interest for WBR, which is March through October. There are no graphs shown for Big Cliff and Dexter, which do not perform any regulation function in the Baseline analysis.

Some general conclusions that can be drawn from these project elevation percentile graphs are that at least 5% of the time most of the storage projects have drafted as low as the minimum conservation zone well ahead of the drafting schedule (the top of the white area is level with the bottom of the heavy rule curve line too early) and that most projects refill at least 50% of the time (the light gray areas most often touch or almost touch the top horizontal part of the heavy black rule curve line).

Figure 16.3a. Pool elevation non-exceedance percentiles for the Baseline for Blue River, Cougar, Dorena, Cottage Grove, Fall Creek, and Hills Creek.

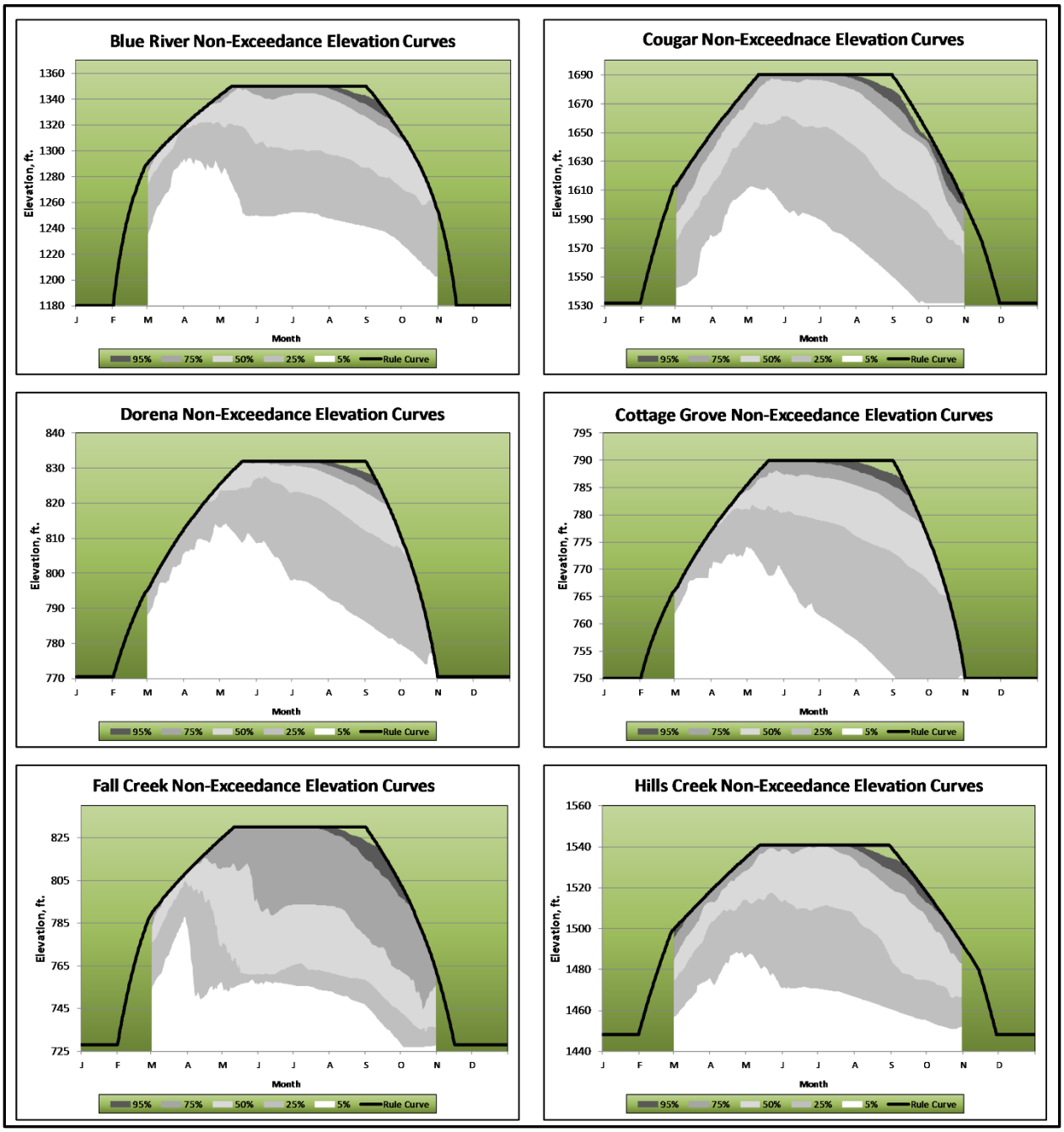
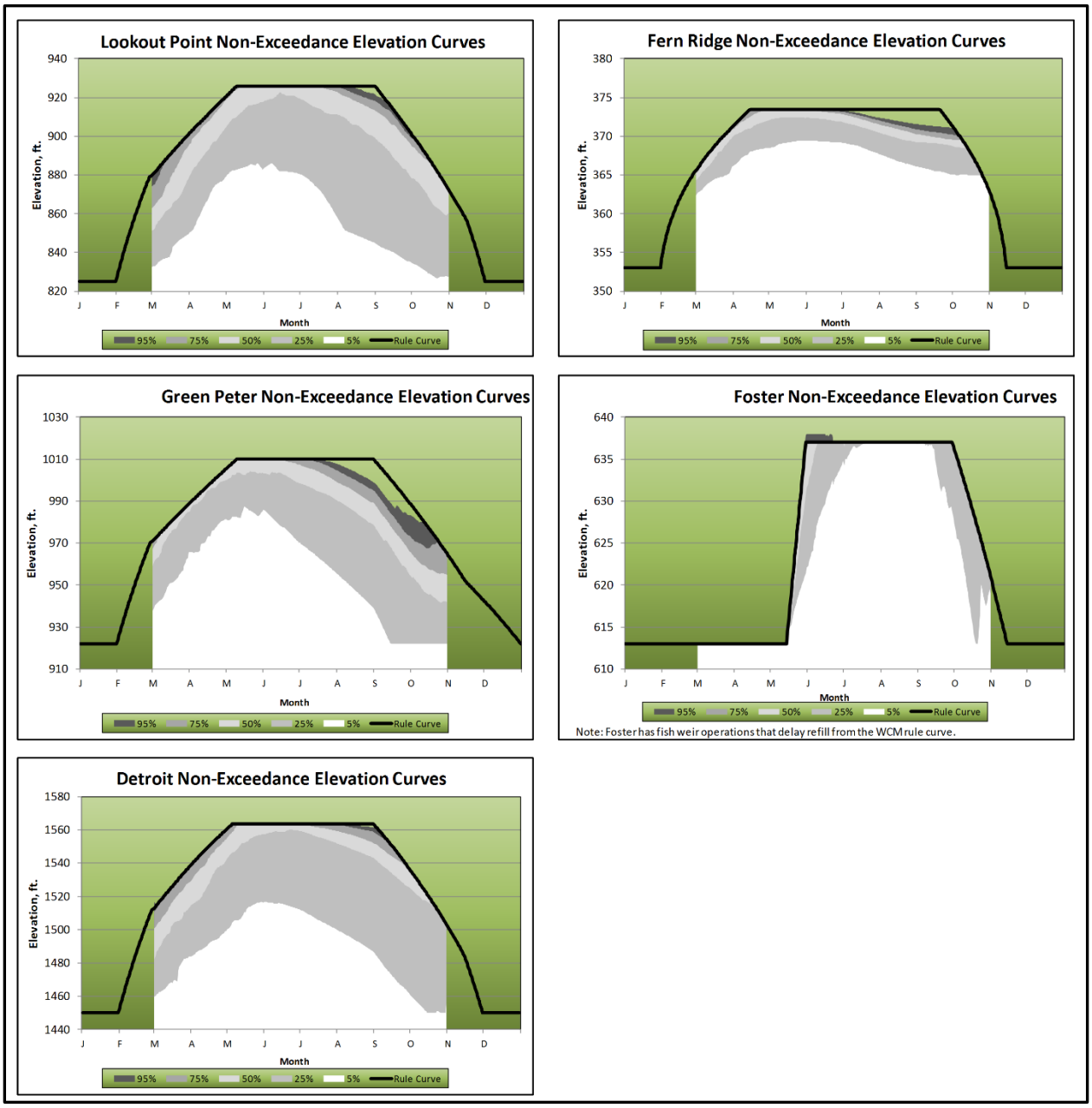


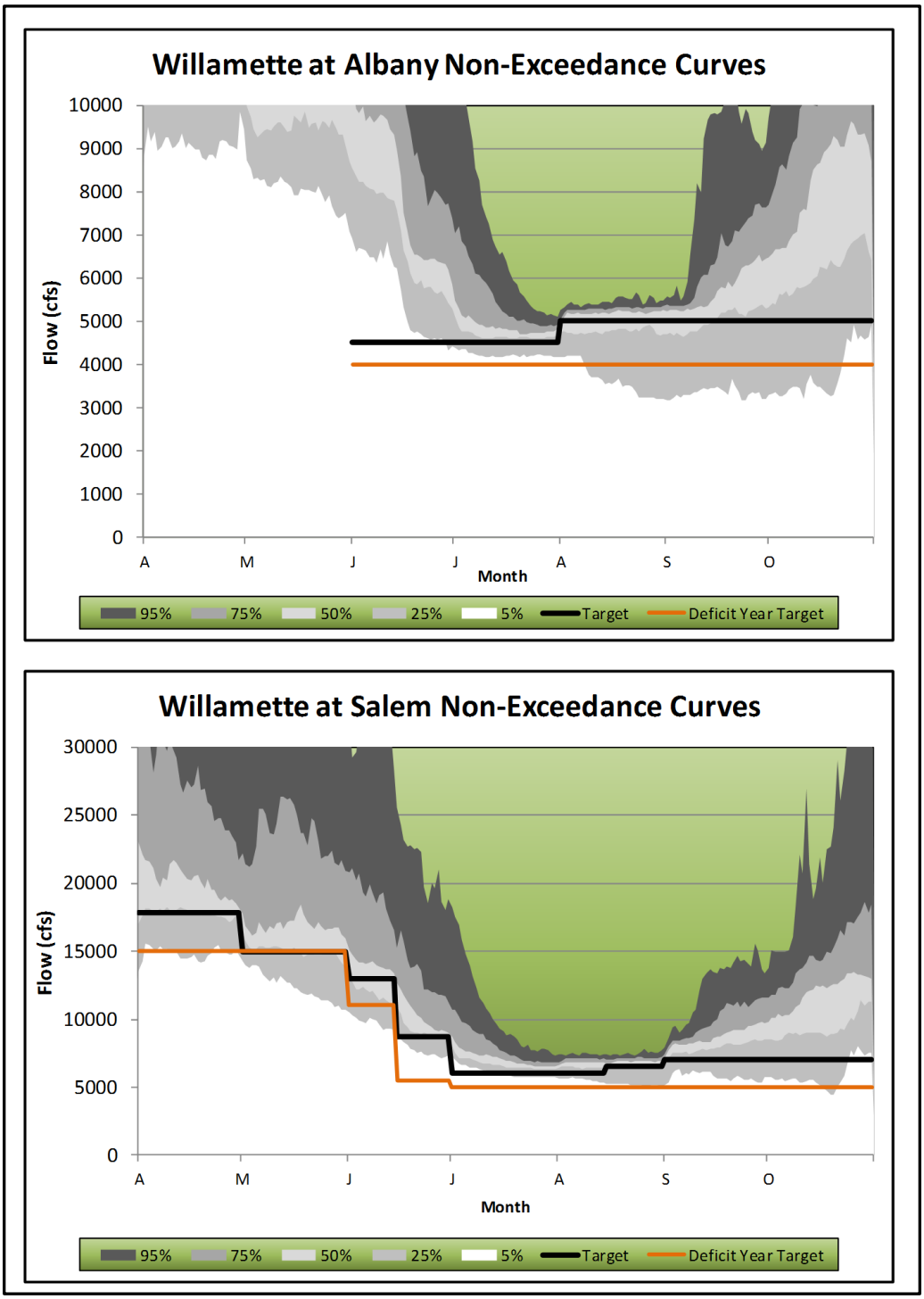
Figure 16.3b. Pool elevation non-exceedance percentiles for the Baseline for Lookout Point, Fern Ridge, Green Peter, Foster, and Detroit.



Non-exceedance percentile graphs are shown for the regulated flow at Albany and Salem in Figure 16.4. These graphs also include the minimum BiOp flow targets that are listed in Table 2.2. Some general conclusions that can be drawn from these two graphs is that the later season targets at Albany are missed more often than the early season targets, and that at least 5% of the time at Salem the spring deficit year target cannot be met, along with difficulty meeting the later season minimum targets about 25% of the time. The difficulty meeting the BiOp targets late in the season at Albany and Salem is because the reservoir levels have dropped too low to add supplemental water to mainstem flows, which

was apparent from the non-exceedance percentile graphs of the project elevations in Figures 16.3a and b.

Figure 16.4. Regulated flow non-exceedance percentiles for the Baseline for Albany and Salem on the Willamette River mainstem. The heavy black lines are the minimum flow targets in the wet years and the heavy orange lines are the deficit year minimum flow targets.



Another general conclusion that can be made from the non-exceedance plot in Figure 16.4 is that the Abundant/Adequate water year minimum flow targets at Salem are met at least half the time (upper line of lighter gray area above the heavy black line), and often by flows well in excess of the minimum target. The late season targets at Salem (for September and October) are well above the minimum target because the reservoirs have generally begun their fall draft. (Look back at the project elevation non-exceedance graphs to see high pool elevations in September are common.) The general statements presented in this paragraph can be summarized simply by saying that when there is lots of water it is easy to meet BiOp targets and still have stored water remaining, and when there is little water, there isn't enough stored water to supplement flows to meet minimum Deficit year targets.

The regulated flow at Salem can be used as a measure to quantify shortages in water volume availability. Figure 16.5 illustrates how this calculate is made. This graph is an area plot of the regulated flow at Salem (the bright blue area) for one specific water year that is a Deficit year (it happens to be the modeled 1973 year), the heavy orange line is the Deficit year Salem minimum flow target (same as in Figure 16.4), and the area in red represents the volume of water missing at Salem to meet the minimum target. The dotted black line is the component of the flow at Salem that did not pass through any USACE dams – it is the water that is not under USACE regulation that flows through Salem.

Figure 16.5 has several annotations included for a day in late May. The vertical arrow from zero flow to the peak near the end of May is the water not under control by USACE dams, and the peak at this time indicates a small rain event. The vertical line directly above it shows the water that passed through Salem that had come from releases at all the USACE dams – this water was released to meet minimum tributary targets and mainstem minimum targets. However, there wasn't enough water in the reservoirs to release to meet the full mainstem need, so there was a shortage on this day. The top vertical line shows the shortage in flow at Salem from its target.

The total shortage in meeting mainstem targets for the year shown in Figure 16.5 is made by determining the flow shortage on any day where the blue area is below the heavy orange line, converting the flow to a volume of water for that day, and summing all computed volume shortages.

The flows above the target value are not involved in the calculation, as this is strictly a measure of the volume shortage for each day that the target is not met. While real-time reservoir regulation might smooth flows out more than the Baseline simulation did, this type of volume computation from simulation analyses provides a quantitative result. The same computations can then be made for any WBR alternative analyzed to obtain a quantitative result of the impact that alternative has on the regulated flows meeting the minimum targets.

The computation is made for every year in the simulation, with the target for each specific year used to calculate the shortage. The Abundant, Adequate, and Deficit year target minimums are listed in Table 2.2, while the minimum targets for Insufficient years are variable. For each year, the days where the flow at Salem is below the target for that year are summed to obtain a volume, with the shortages for a year determined by half month intervals for April through October. This provides half month water volume shortage calculations for each simulated year. The 14 half month period shortages are then

grouped by their respective water year types, as listed in Table 2.4. The average shortage by period for each water year type are then plotted as shown in Figure 16.6, where the red bars are the average water volume shortage in meeting Deficit year targets, the yellow bars are the average water volume shortage in meeting Insufficient year targets, the blue bars are for Adequate water years, and the bright green bars are for Abundant water years. Note the Abundant year average shortage by period is nearly always zero – only the first half of June has a small bump visible for the bright green bars.

Figure 16.5. Illustration of water volume shortage at Salem for one specific Deficit water year.

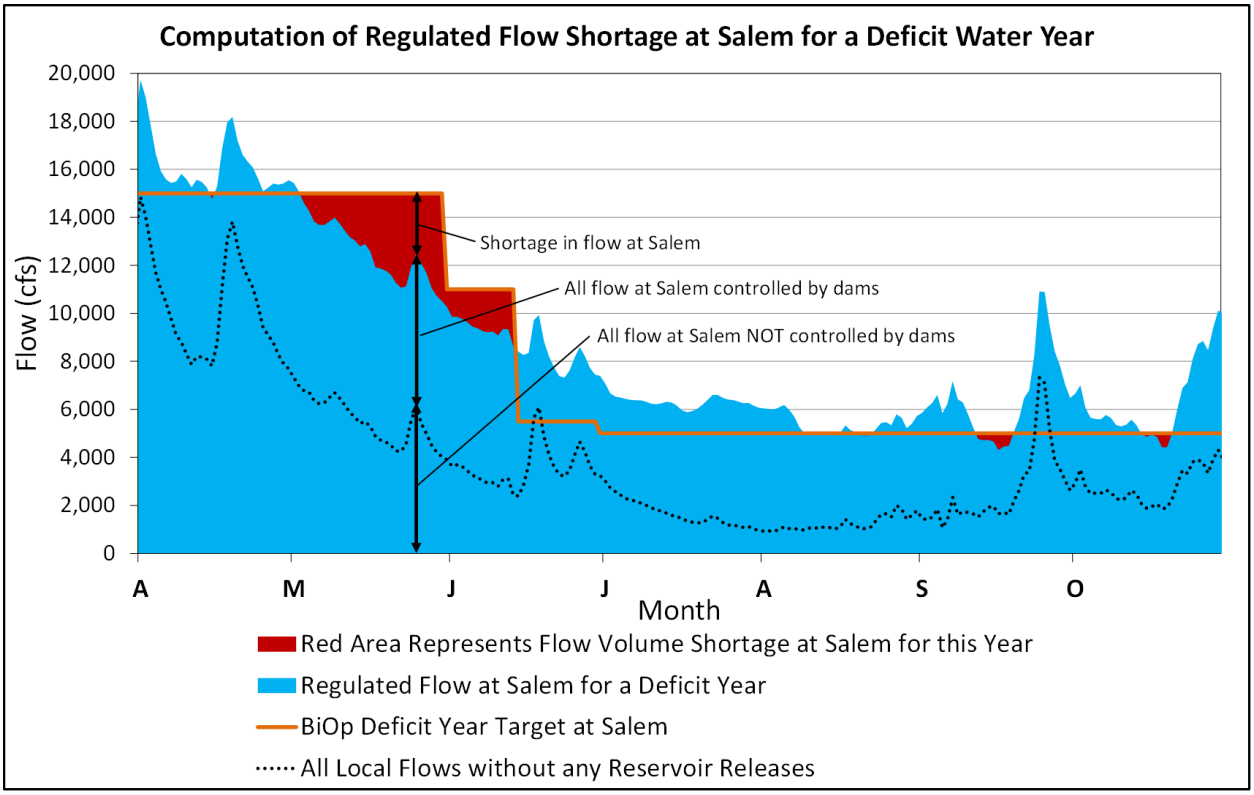
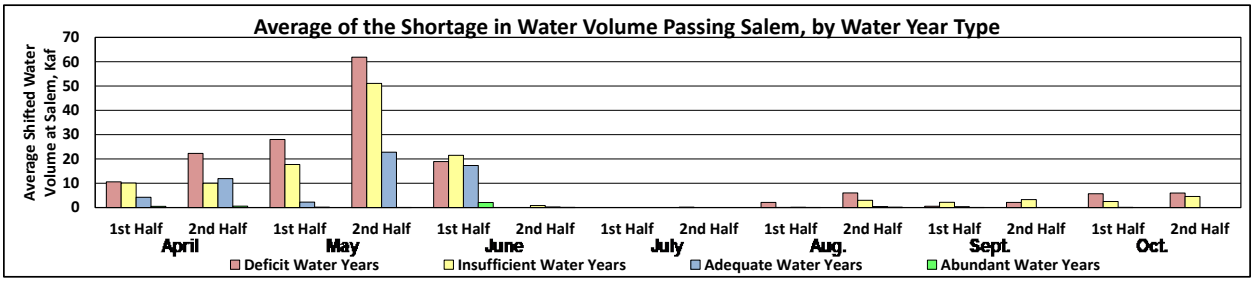


Figure 16.6. Graph of the average shortage in water volume at Salem by water year type.



17 Baseline Simulation Verification

The Baseline simulation was verified to be a realistic representation of current operations based on comparisons to actual observed data. The comparison data presented here was obtained from After Action Reports written by the water management section in the Portland District (CENWP-EC-HR) and also from their Annual Graphs of operations, which are reservoir plots of actual data that the section maintains. All comparisons for verification used the reservoir elevations from the simulation to compared to the reservoir elevations from the actual data.

The flow dataset used in the Baseline simulation spans 1928 to 2008, and Figure 17.1 designates four time periods within that span. These four periods highlight the difficulties associated with using observed or actual data in each window for Baseline verification. **Recall that the Baseline simulation applies the same operating rules to all years, and is not meant to reproduce actual data, but rather to see *what would have happened every year in 1928-2008 if all thirteen reservoirs existed and operated according to current practices for each of those years*.**

The first time period in the figure is 1928 to 1942, where no USACE dams existed in the basin. This window cannot be used for any verifications because the full time span of the flow dataset is modeled with the current reservoir operations and all thirteen dams.

The second time period is 1942 through 1968, over which the thirteen USACE dams were completed. This window cannot be used for any verifications because the full time span of the flow dataset is modeled with the current reservoir operations and all thirteen dams.

The third time period is 1968 through about 2000. During this period, all thirteen dams were operating, but all dams were operated according to their Water Control Manuals and not to the BiOp. Each project WCM specifies a different minimum outflow than is specified by the BiOp, the mainstem targets were much lower than the BiOp, and the ramping rates (changes in flow over time) are different in the BiOp than in the WCMs. This time window does not represent dam operations as modeled in the Baseline simulation and cannot be used for verification.

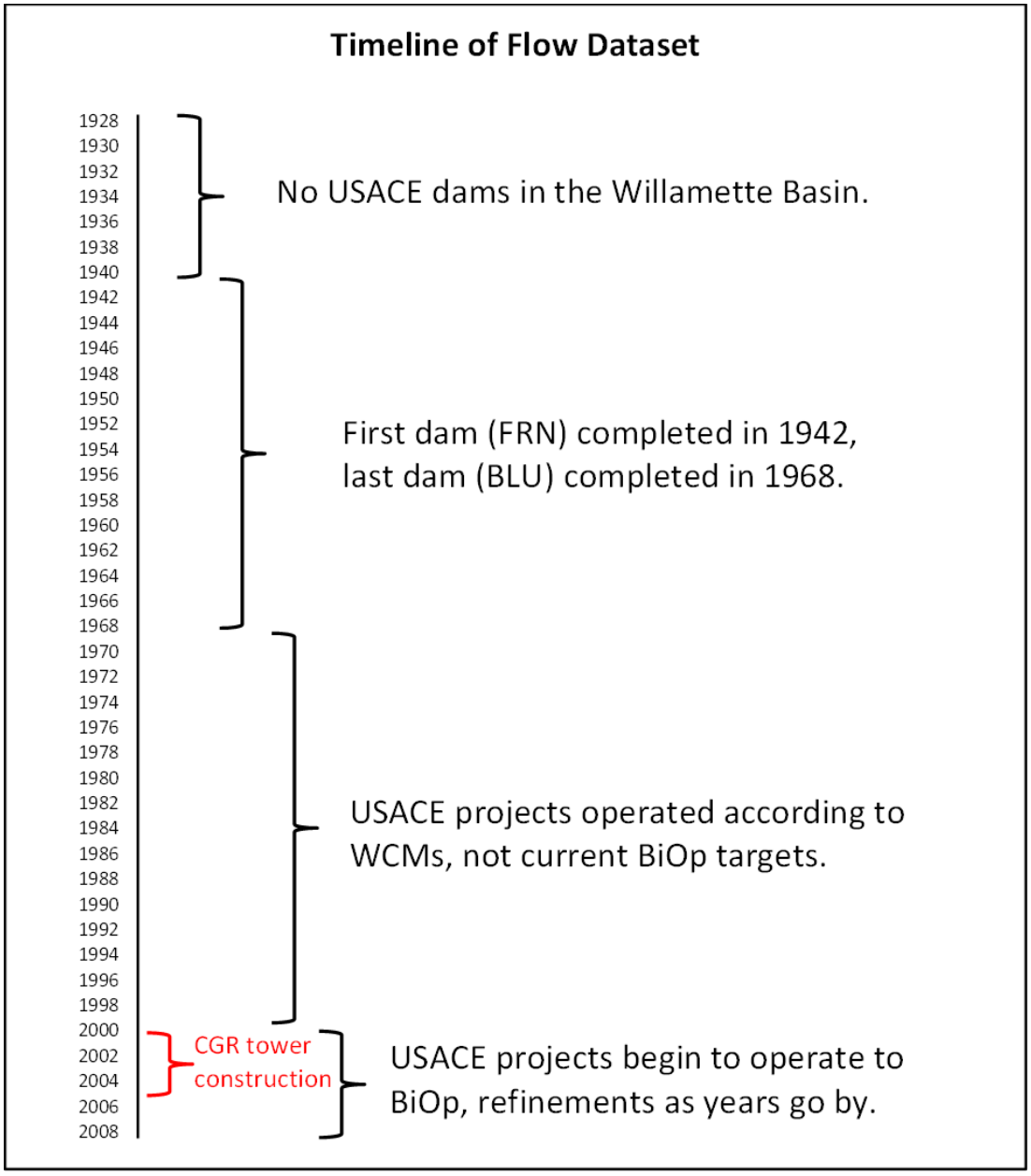
The fourth time period spans 2000 through 2008. This is the only window in which any meaningful comparisons can be made with the Baseline simulation, since during this time the BiOp flows, mainstem targets, and ramping rates were being implemented. In this eight year window, the operation of the reservoir system for the BiOp was a learning process – the later years in the window operated more closely to current regulation practices than the early years did. For example, there are current regulation practices not represented in the full 2000-2008 window, such as the temperature operations at Detroit (included in the Baseline simulation) that began after 2007.

Another difficulty in using the actual data from 2000 to 2008 for calibration is that the dams had various repairs or construction occurring at different times. One of the most significant construction projects began in 2000, the temperature control tower at Cougar, which was completed and the reservoir refilled in 2005. The construction of the tower represents a very large difference from the operating rules used

in the Baseline simulation. Therefore, years 2006, 2007, and 2008 will be used for the verification of the Baseline simulation.

All project actuals were obtained from the CENWP-EC-HR water management reservoir regulation internal data files. The three files used were: *daily project graphs 2006.xls*, *daily project graphs 2007.xls*, and *daily project graphs 2008.xls*. Each of these files has a graph for each dam's actual pool elevation, inflow, and outflow, along with the project's rule curve. The pool elevation actuals will be used as the comparison with the Baseline simulation results, as this provides an easy visual comparison. The actuals for each project are in the left side graphs for Figures 17.2-17.12.

Figure 17.1. General timeline of activity in the Willamette Basin for the span of the flow dataset.



The Baseline data is from the *simulation.dss* file produced when ResSim was run with all the specifications shown in Table 1.1. The time series records used from this file were:

//BLUE RIVER-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//COUGAR-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//DORENA-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//COTTAGE GROVE-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//FALL CREEK-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//HILLS CREEK-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//LOOKOUT POINT-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//FERN RIDGE-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//GREEN PETER-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//FOSTER-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/
//DETROIT-POOL/ELEV/01JAN1928 - 01JAN2008/1DAY/BETBASE---0/

The simulation pool elevations for each project are in the right side graphs of Figures 17.2-17.12, plotted as the heavy red lines. The project rule curves used for the Baseline simulation are the heavy black lines in the right hand graphs. Foster is the only project modeled with a rule curve different than that shown in the actuals.

The left side graphs in Figures 17.2-17.12 also show the project inflows and outflows. That data is included in the actual graphs because the graph images were copied directly from the Excel files referenced above, although the simulated inflows and outflows are not plotted in the right side graphs of these figures.

The three years used for the verification are wetter water years. The years 2006 and 2007 were Adequate water years, and 2008 was an Abundant water year. (See Table 2.4 for a listing of all water year types for years in the flow dataset.) No drier water years (Insufficient and Deficit) with reservoir operations similar to those modeled in the Baseline are available to compare actuals to simulation results.

Each project comparison is described below, then Table 17.1 provides a summary of the comparisons, and Figure 17.2 through 17.12 follow the table.

Blue River

The Baseline simulation pool elevation for 2008 compares very well with the 2008 actual. The elevation comparisons for 2006 and 2007 are reasonable. The Baseline elevation for 2006 is slightly lower than the actual, indicating this project was not used quite as heavily for mainstem supplemental flows as was modeled for this year.

Cougar

The Baseline simulation pool elevations for all three years compare very well with the actual elevations.

Dorena

The Baseline simulation pool elevations for all three years compare very well with the actual elevations, although the modeled year 2006 shows a slight dip in elevation that the actual does not have. This indicates a use of the reservoir in the model for flow supplements that did not occur at that time in the actuals.

Cottage Grove

The Baseline simulation pool elevation for 2008 compares very well with the 2008 actual. The elevation comparisons for 2007 are reasonable. The Baseline elevation for 2006 is slightly lower than the actual, indicating this project was not used quite as heavily for mainstem supplemental flows as was modeled for this year.

Fall Creek

The Baseline simulation pool elevation for 2008 compares very well with the 2008 actual. The elevation comparisons for 2006 and 2007 show the model drawing more heavily on the project for mainstem flow supplements than is indicated in the actuals.

Hills Creek

The Baseline simulation pool elevations for all three years compare well with the actual elevations.

Lookout Point

The Baseline simulation pool elevation for 2008 compares very well with the 2008 actual. The elevation comparisons for 2007 show the actuals releasing more water than the model did. The Baseline elevation for 2006 is slightly lower than the actual for the spring refill period.

Fern Ridge

The Baseline simulation pool elevations for all three years compare very well with the actual elevations.

Green Peter

The Baseline simulation pool elevations for all three years are slightly higher than the actuals, with this most apparent in 2006. This means that in the actual regulation, Green Peter was used more heavily to supplement flows at Salem than is modeled in the Baseline. Since Green Peter actuals released more in 2006 and 2007 than the Baseline simulation, this means that other projects (such as Blue River, Dorena, Cottage Grove, and particularly Fall Creek) did not release quite as much water in the actuals as was modeled in the Baseline.

The heavier use of Green Peter stored water in the actuals for 2006-2008 corresponds with real-time reservoir regulation a decade ago. Prior to around 2014 or so, reservoir regulation used Green Peter for supplemental flows at Salem, but NWP often found the reservoir level dropped too low late in the conservation season. Current practice in reservoir regulation of the Willamette system is to reserve

more water in Green Peter to help Foster meet the BiOp tributary target minimum outflows in the late conservation season rather than to release the water early to supplement Salem flows.

Foster

The actual Foster operations in Figure 17.11 reflect an older practice of a partial fill of the reservoir in the spring, then a draft to spill over the fish weir at a lower pool elevation, and then full refill. This partial fill is no longer used in water management, so the two rule curves in the graphs on the left and right sides are different. Note that both rule curve types plotted are different than in the project Water Control Manual, which did not specify the fish weir operation. Also note that the 2008 actual indicates a fish operation occurring with the pool level held to different elevations in steps. This stair-step fish operation was not part of the Baseline modeling.

Detroit

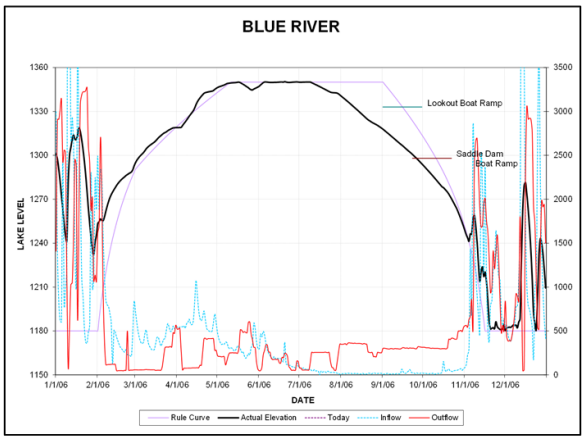
The Baseline simulation pool elevations for all three years compare very well with the actual elevations.

Table 17.1 summarizes the verification comparisons for each project for 2006 through 2008.

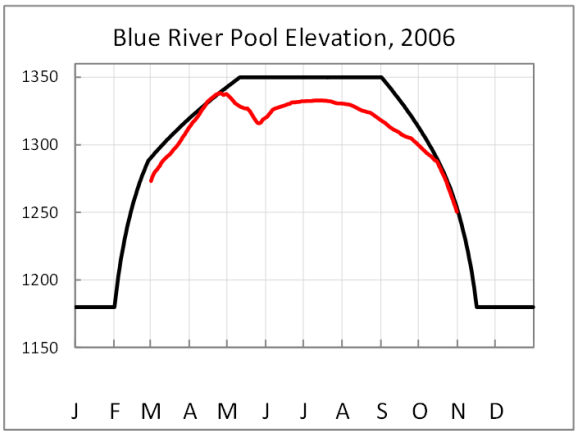
Table 17.1. Comments on pool elevation verifications for 2006, 2007, and 2008.

Project Code	Comments on Comparisons of Baseline Simulation to Actuals for this year:		
	2006	2007	2008
BLU	Simulation slightly lower elevations	General trend of elevation drawdown is similar	Excellent match
CGR	Early spring simulation elevations a little lower	General trend of elevation drawdown is similar	Very close match
DOR	Very close except early May simulation lower	General trend of elevation drawdown is similar	Excellent match
COT	Simulation elevations a little lower, especially in May	Very close match	Excellent match
FAL	Simulation heavy releases in May not like actual	Simulation elevation drawdown more rapid	Very close match
HCR	Early spring simulation elevations a lower	General trend of elevation drawdown is similar	Excellent match
LOP	Early spring simulation elevations a lower	General trend is lower actual elevations	Early spring actual elevations a little lower
FRN	Excellent match	Excellent match	Excellent match
GPR	Actuals show higher releases, opposite of FAL	Actuals show higher releases but shape is similar	Similar except early season
FOS	May to end Oct excellent match	Reasonable match	Stair-step fish operation not modeled
DET	Excellent match	Excellent match	Excellent match

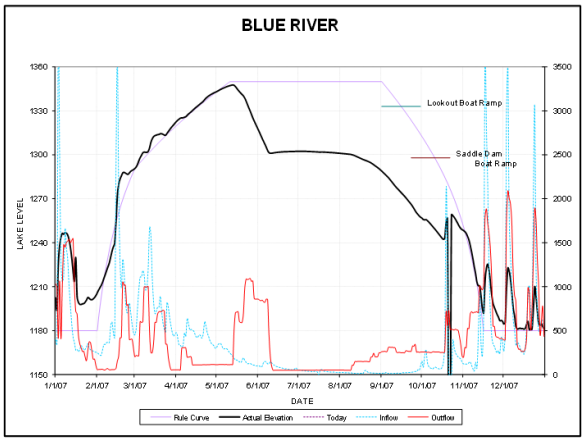
Figure 17.2. Comparison of Blue River actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



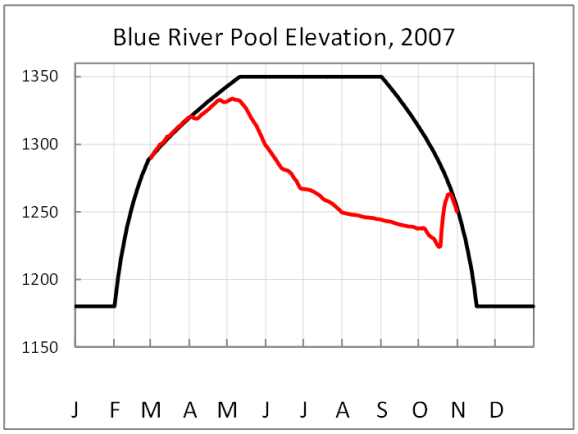
From: daily project graphs-2006.xls



From: simulation.dss file from Baseline-14April2017



From: daily project graphs-2007.xls



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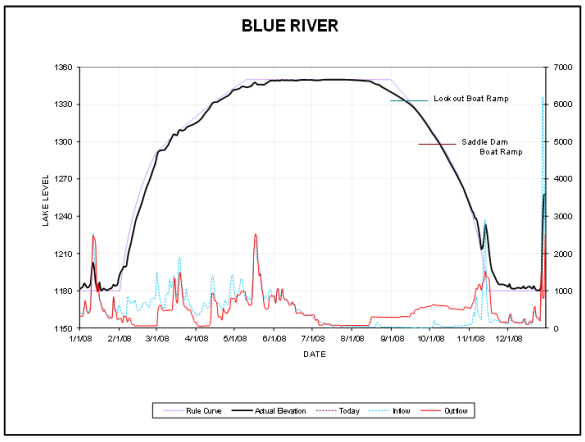
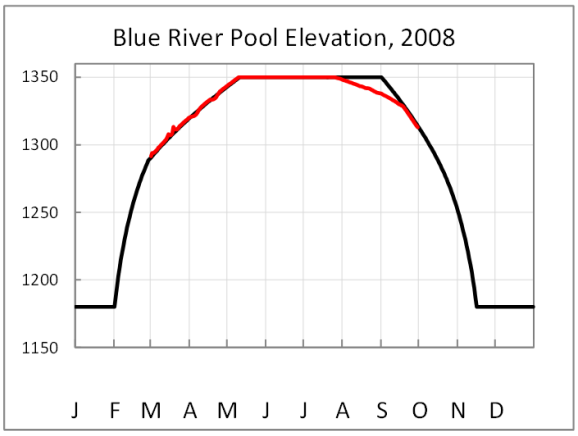
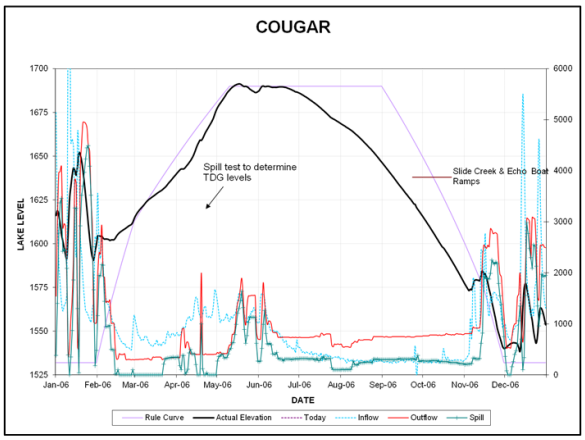


From: daily project graphs-2008.xls

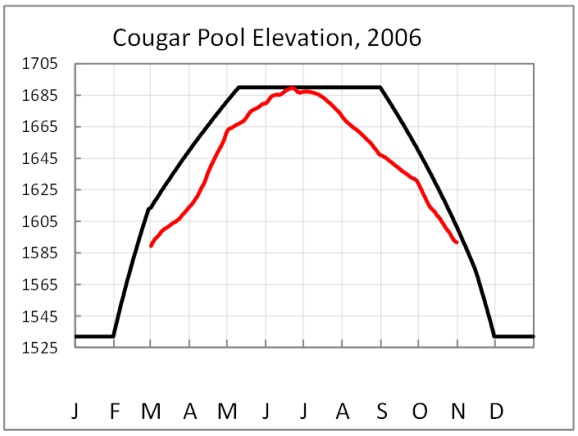


From: simulation.dss file from Baseline-14April2017

Figure 17.3. Comparison of Cougar actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



From: daily project graphs-2006.xls



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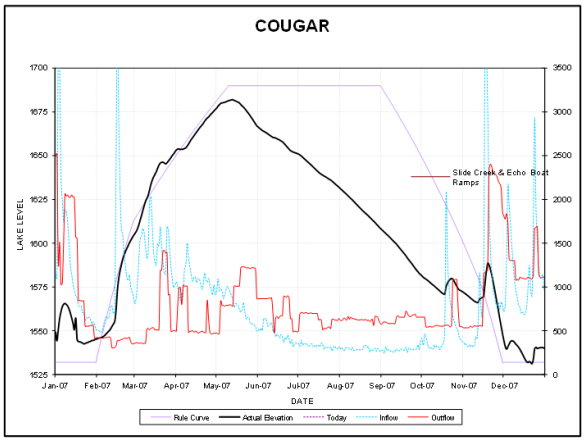

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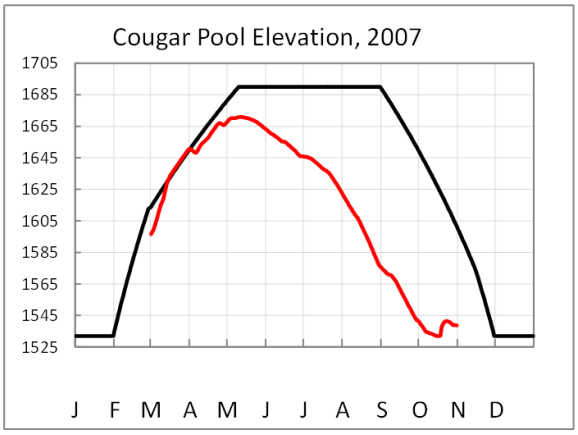

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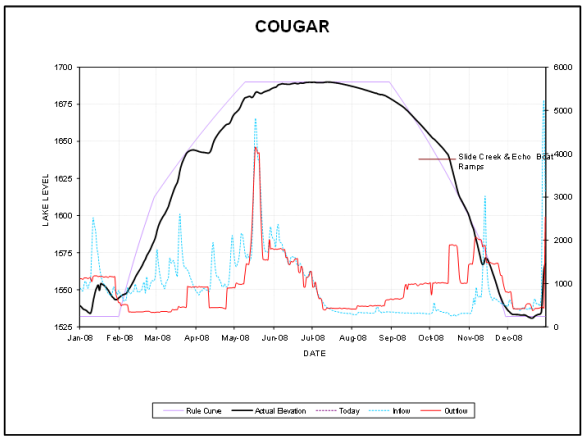
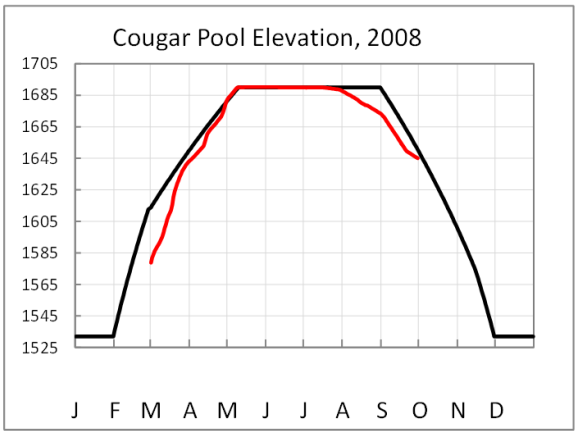
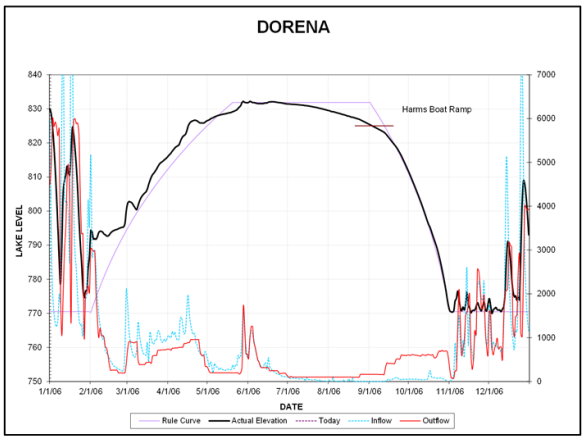


From: daily project graphs-2008.xls



From: simulation.dss file from Baseline-14April2017

Figure 17.4. Comparison of Dorena actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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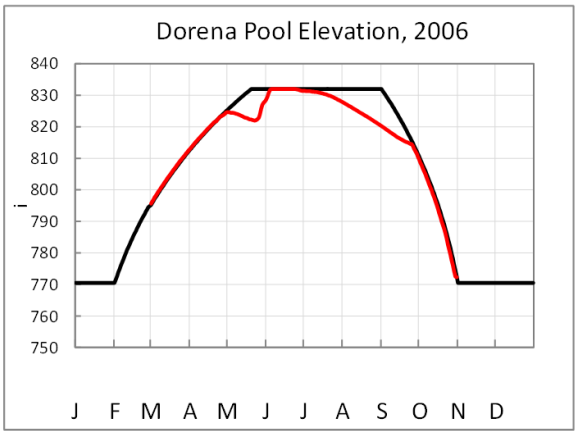

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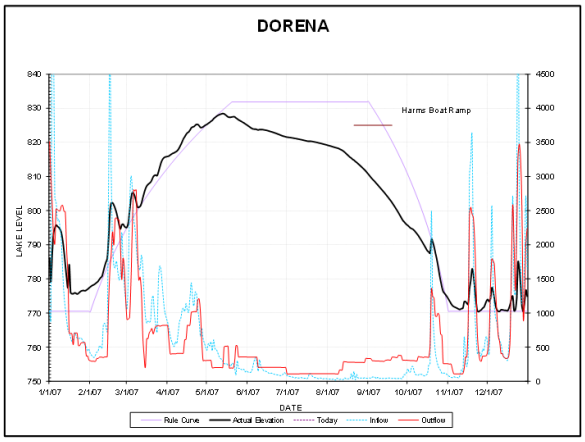

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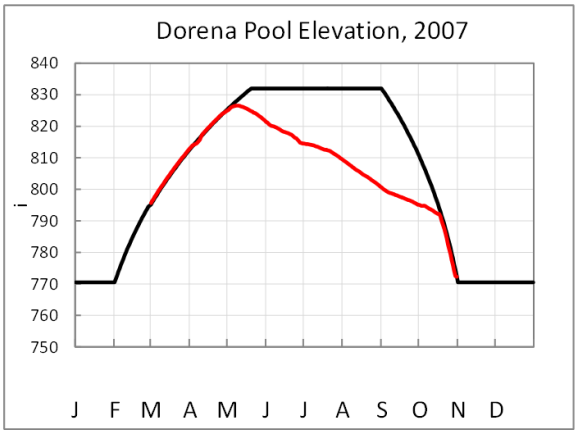

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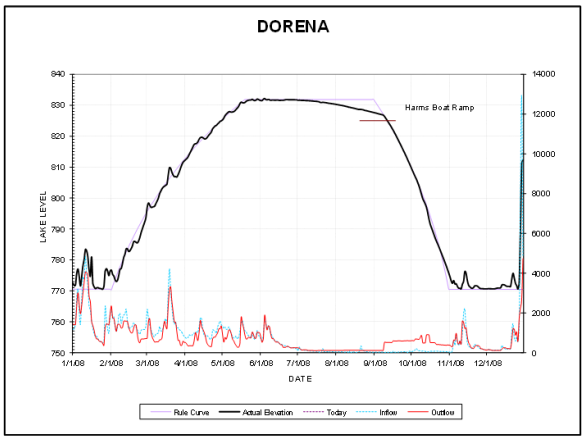
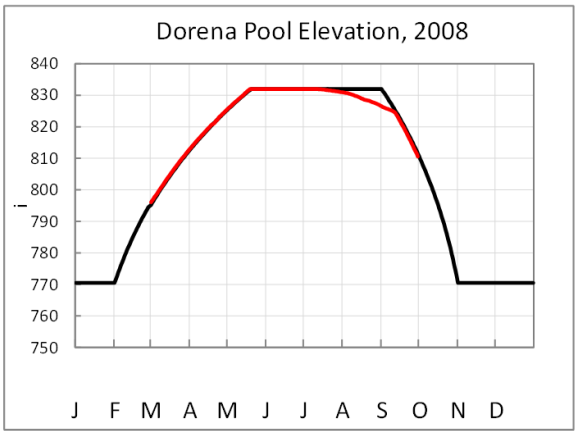
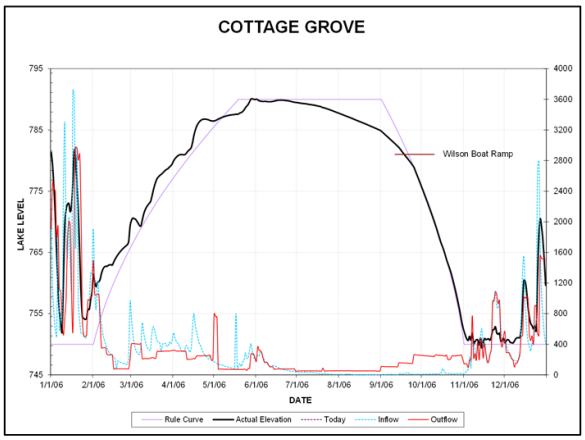


From: daily project graphs-2008.xls

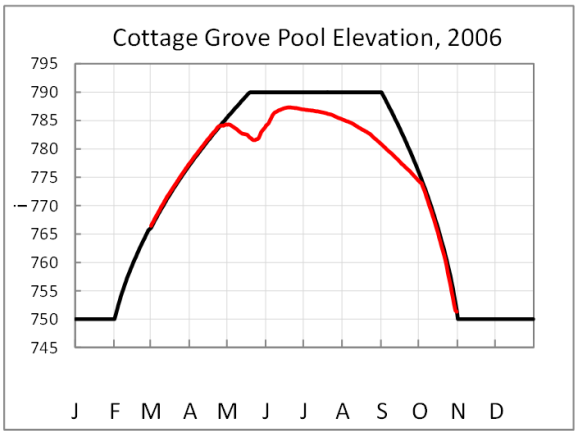


From: simulation.dss file from Baseline-14April2017

Figure 17.5. Comparison of Cottage Grove actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



From: daily project graphs-2006.xls



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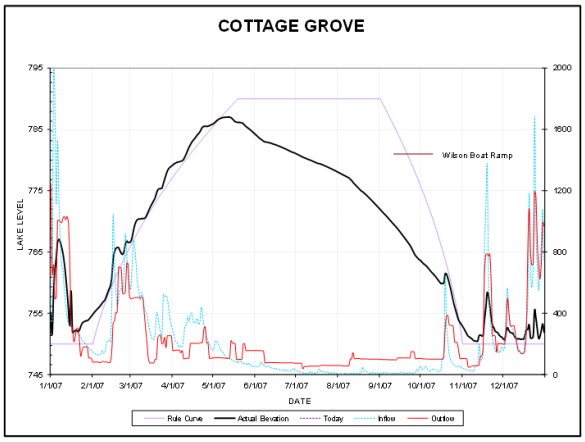

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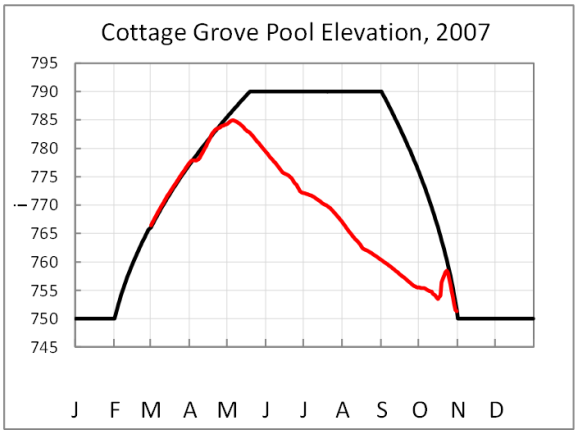

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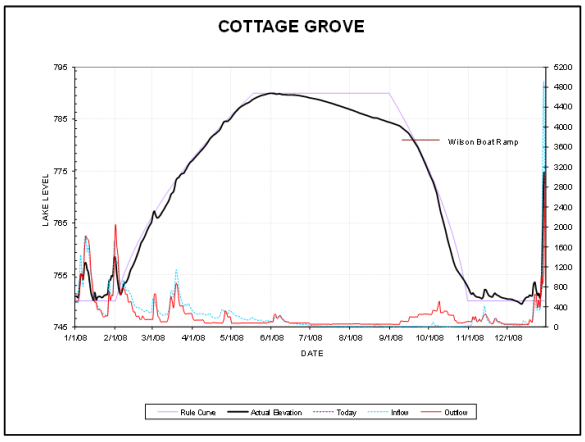

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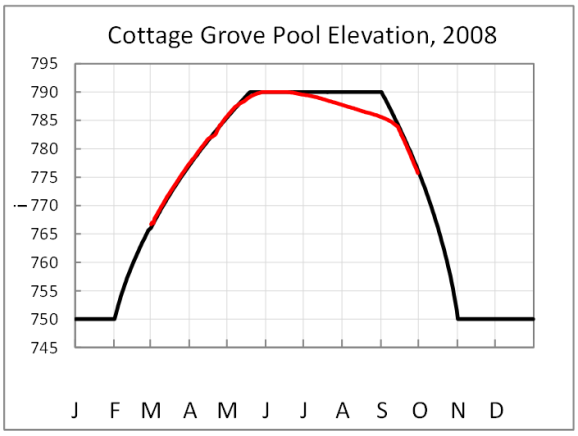
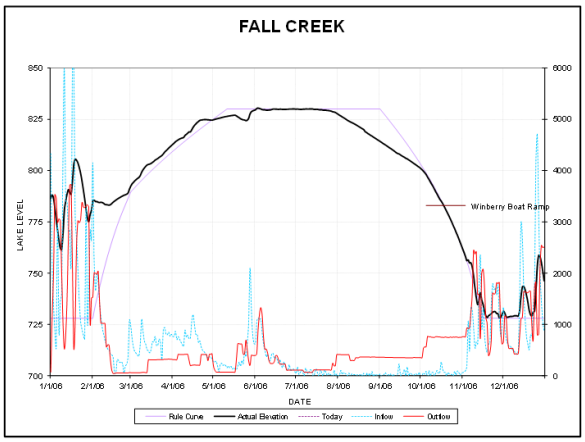
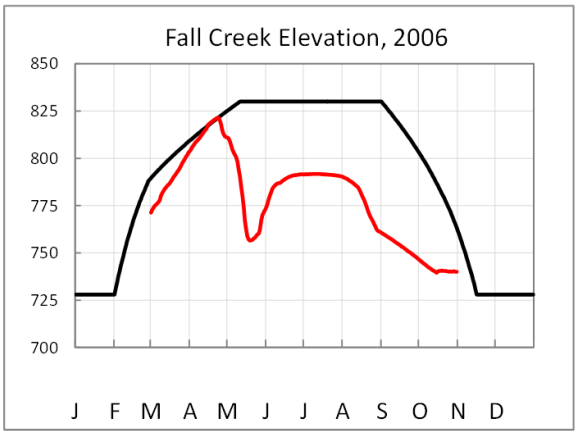


From: simulation.dss file from Baseline-14April2017

Figure 17.6. Comparison of Fall Creek actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



From: daily project graphs-2006.xls



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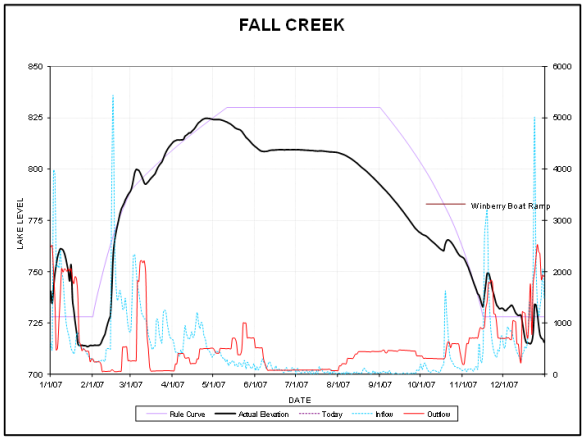

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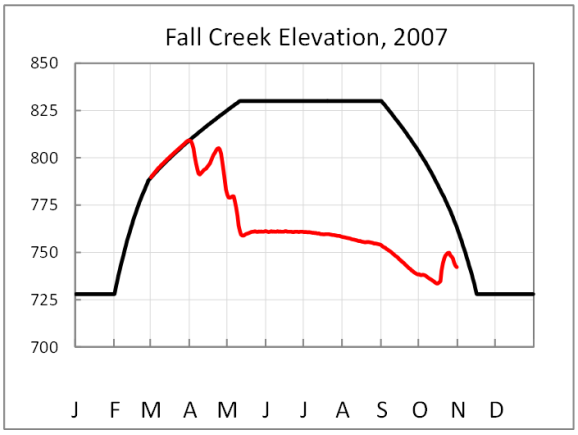

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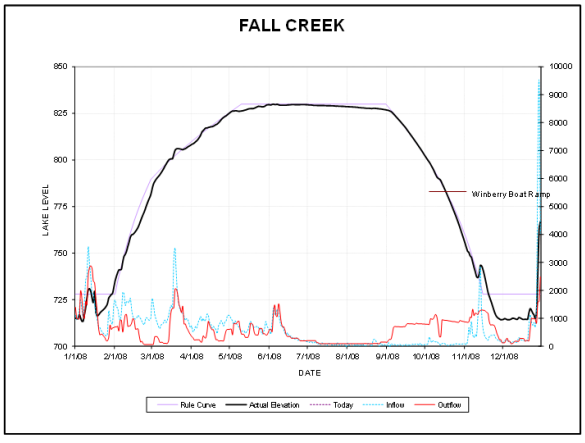

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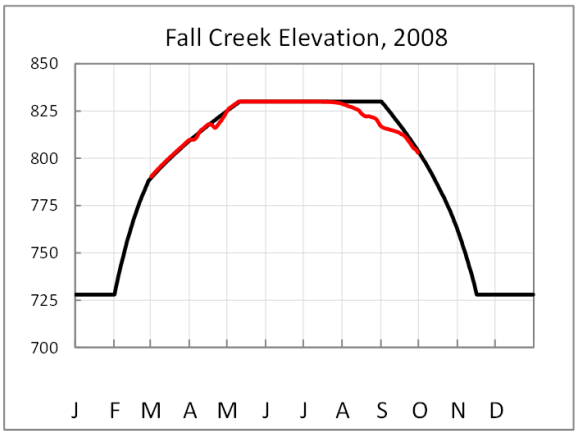

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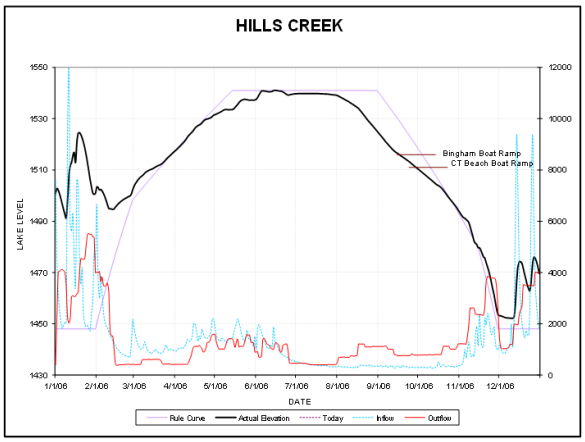
Figure 17.7. Comparison of Hills Creek actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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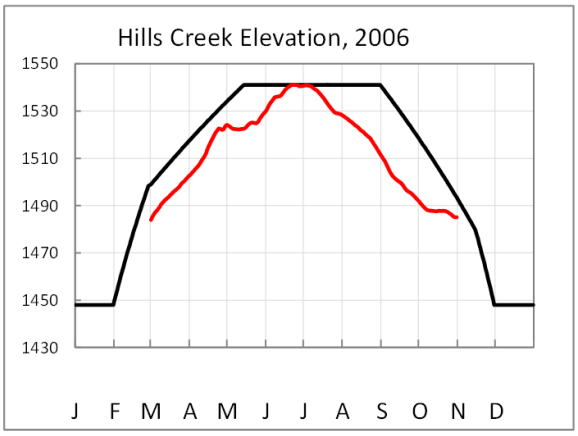

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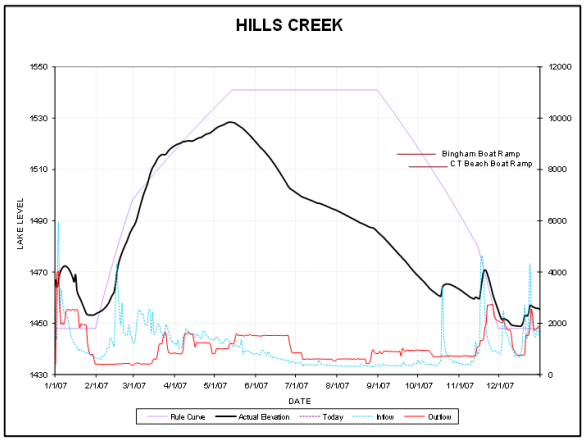

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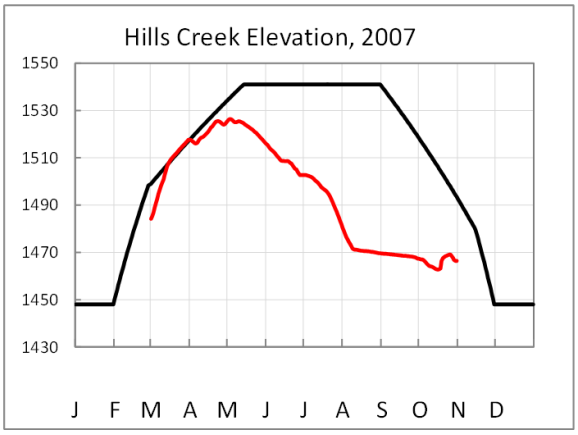

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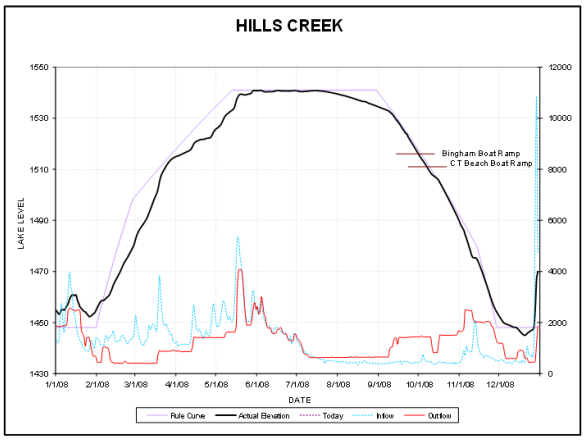

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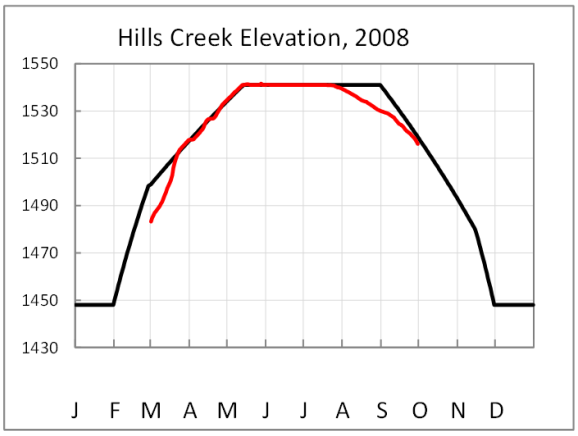

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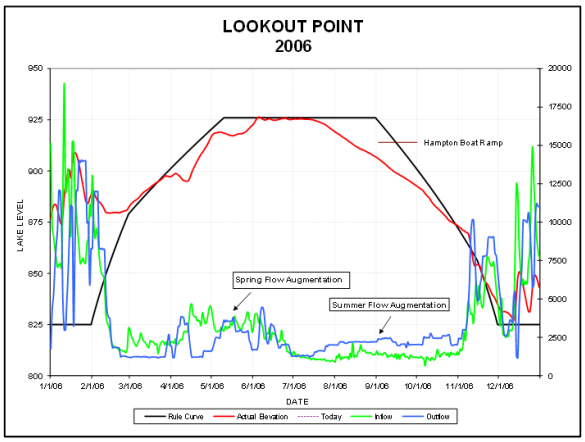
Figure 17.8. Comparison of Lookout Point actual pool elevations (left side graphs, red lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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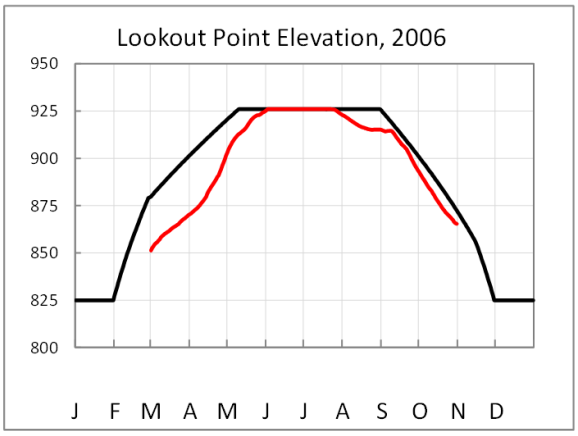

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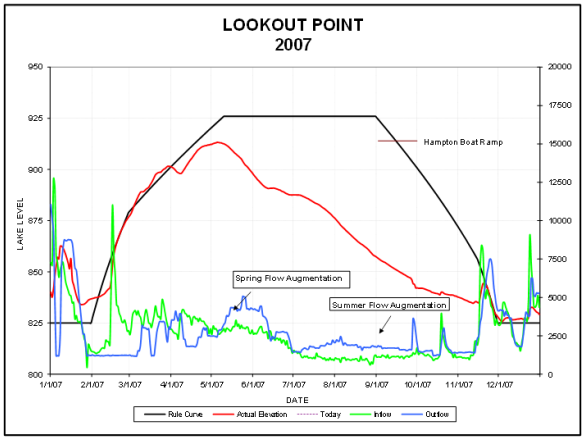

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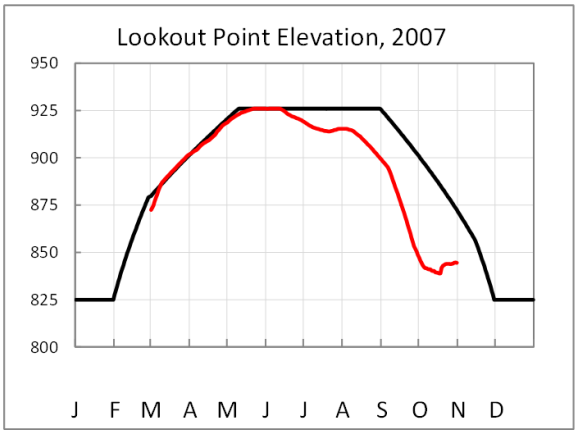

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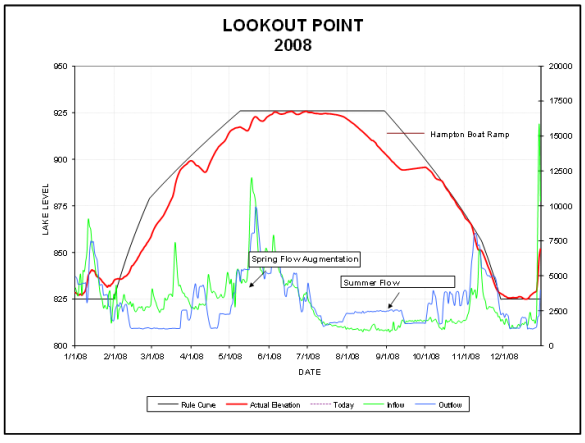

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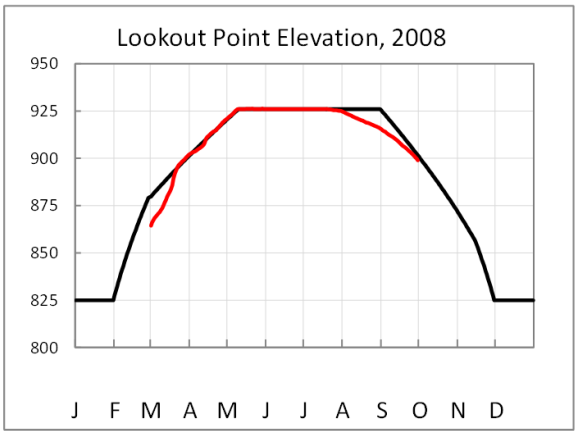

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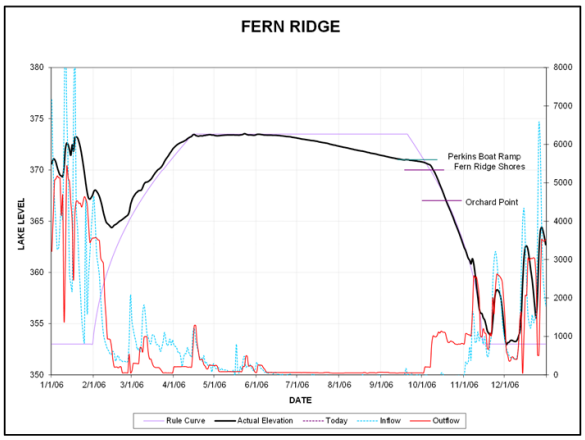
Figure 17.9. Comparison of Fern Ridge actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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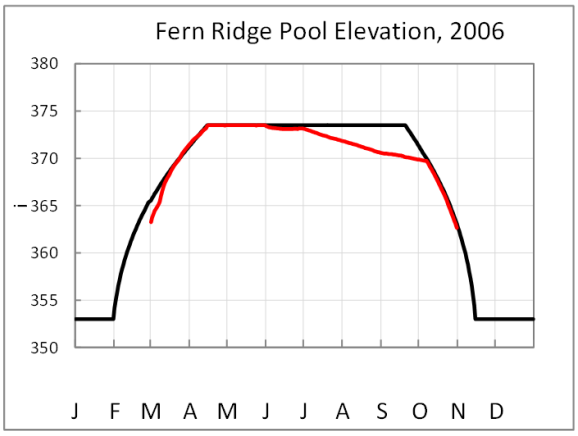

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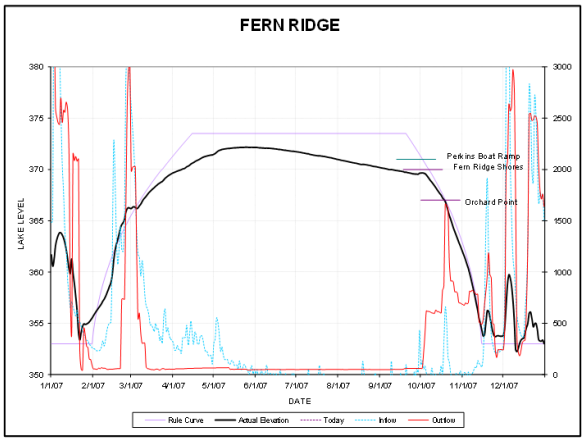

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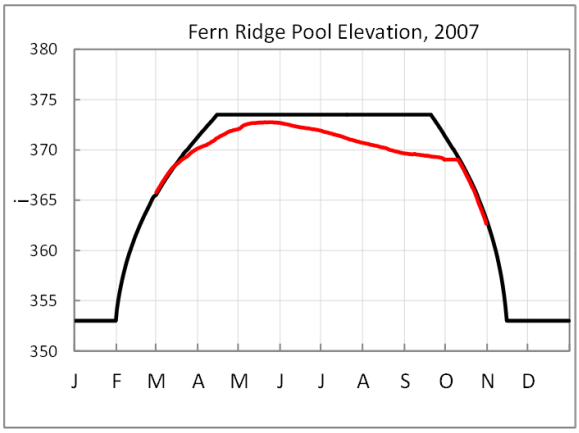

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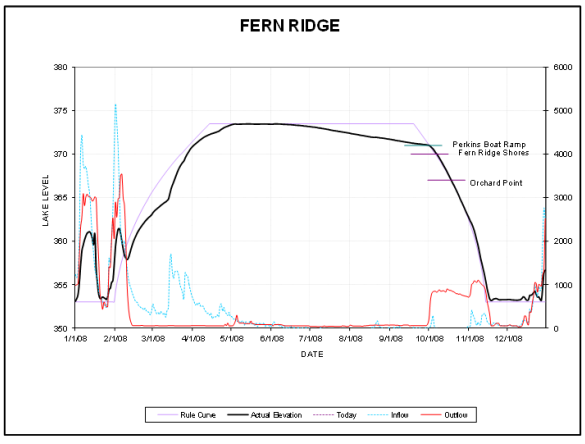

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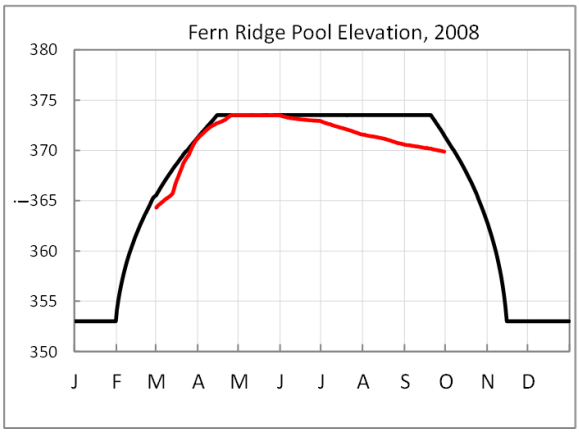

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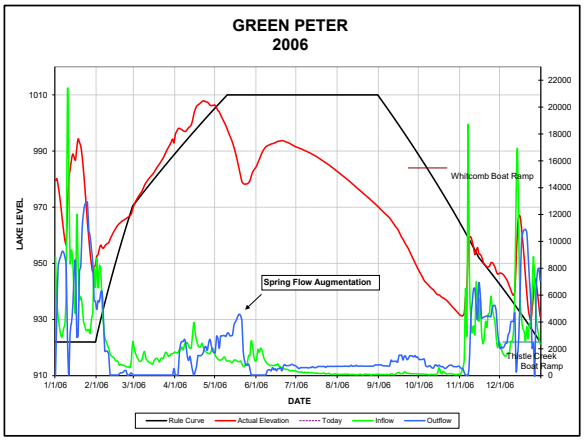
Figure 17.10. Comparison of Green Peter actual pool elevations (left side graphs, red lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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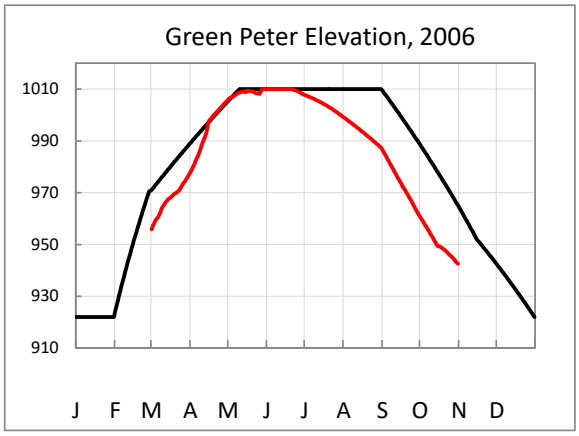

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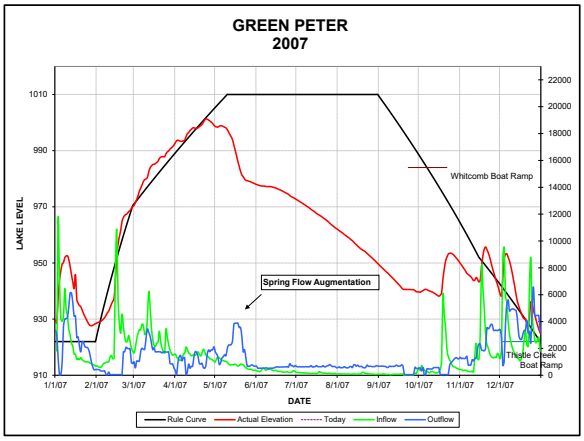

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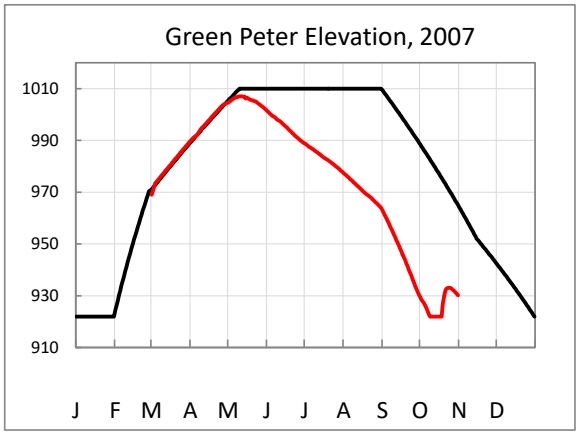

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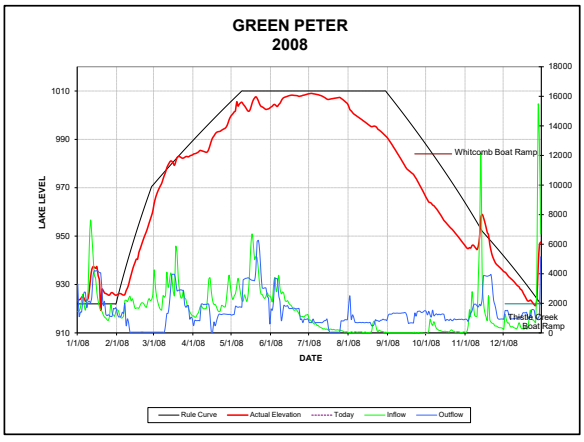

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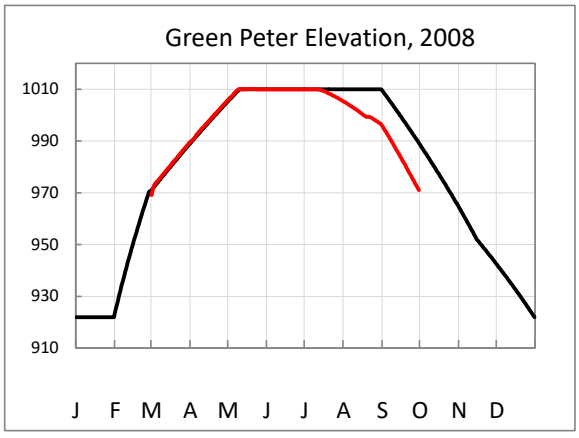
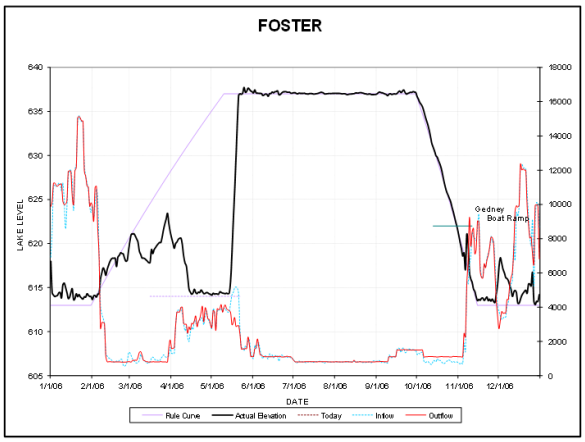


From: simulation.dss file from Baseline-14April2017

Figure 17.11. Comparison of Foster actual pool elevations (left side graphs, black lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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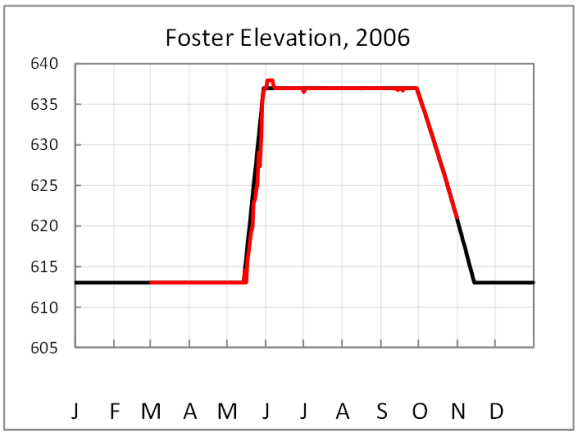

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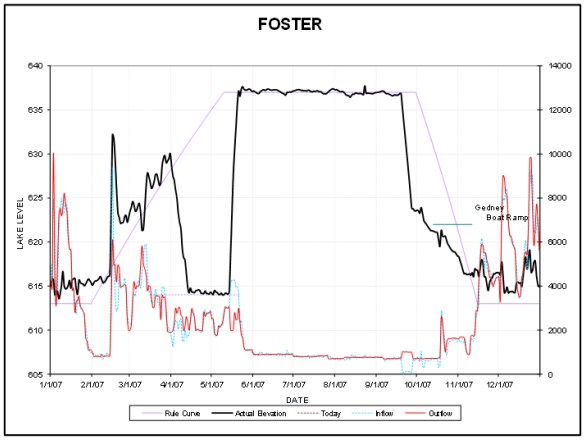

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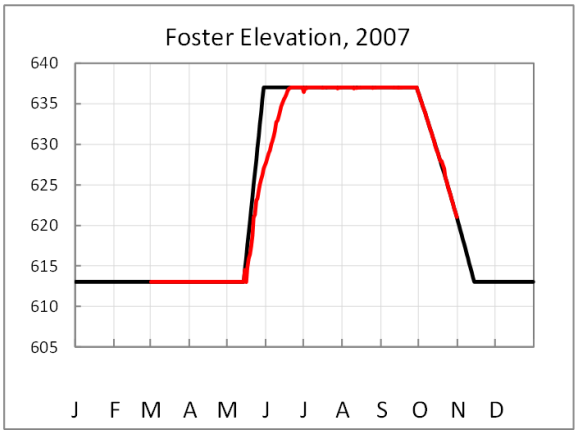

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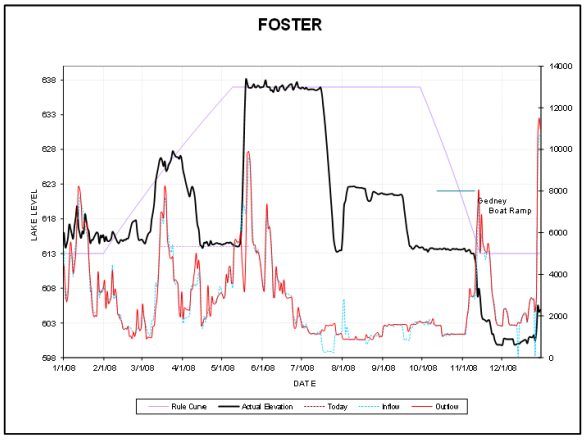

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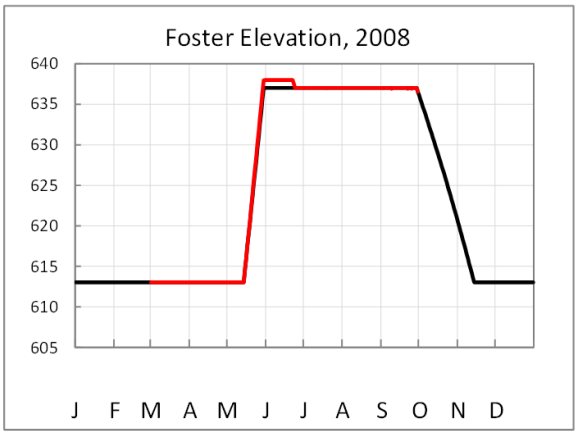
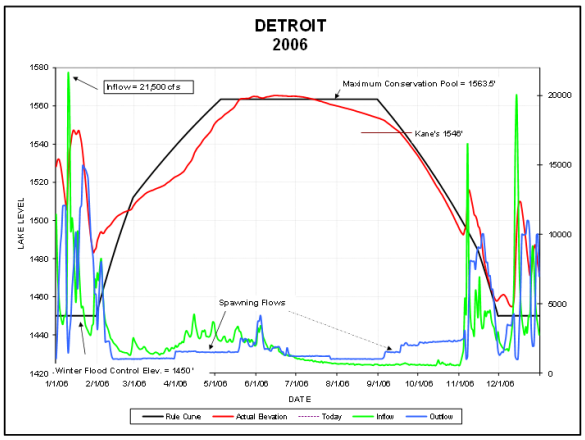


From: simulation.dss file from Baseline-14April2017

Figure 17.12. Comparison of Detroit actual pool elevations (left side graphs, red lines) to the Baseline simulation pool elevations (right side graphs, red lines) for 2006, 2007, and 2008.



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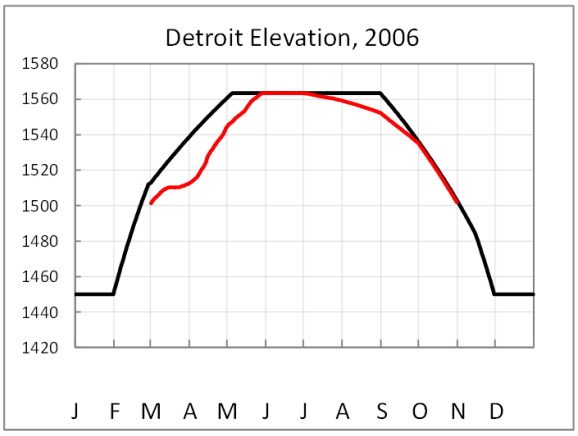

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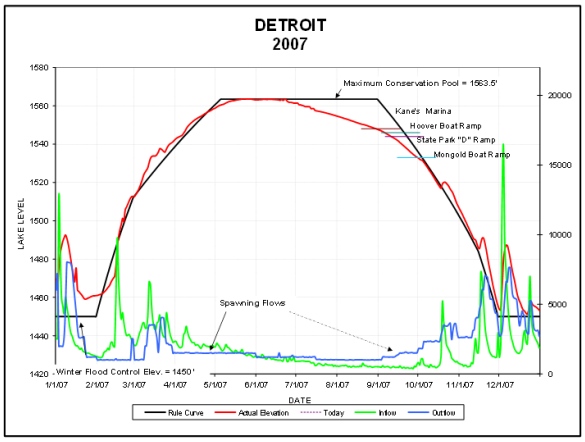

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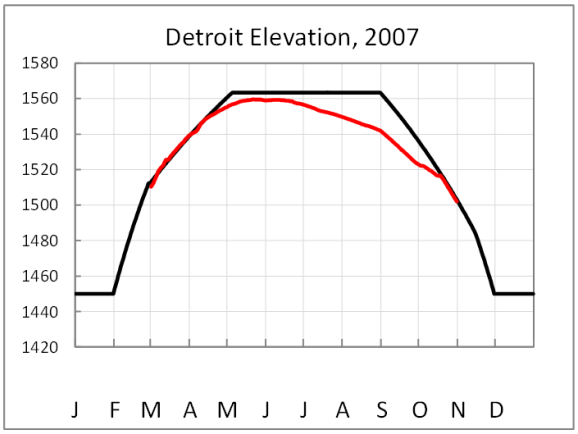

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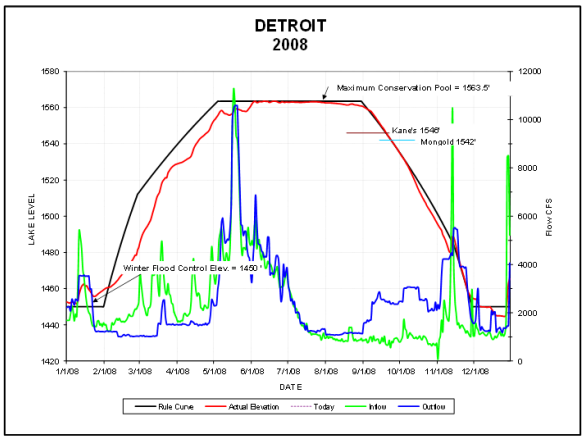

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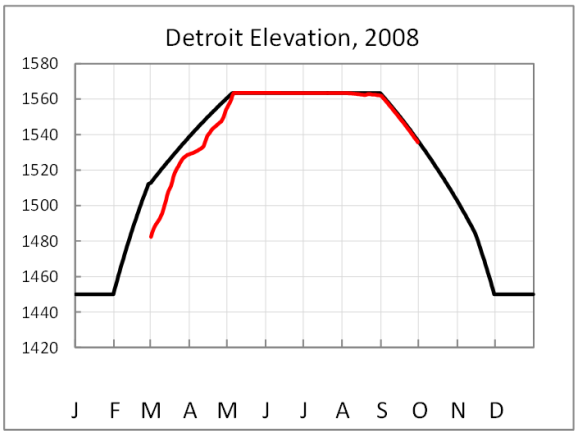

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Data files used for reference:

daily project graphs 2006.xls
daily project graphs 2007.xls
daily project graphs 2008.xls
simulation.dss from the ResSim model

Attachment A

For the Willamette Basin Review – ResSim Baseline Model Documentation Report

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1.1 Storage Elevation Tables

Table A1. Detroit Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1201.0	11.0	0.0	1259.0	1904.0	76.0	1317.0	17100.0	410.0	1375.0	56700.0	932.0
1202.0	17.0	0.5	1260.0	1997.0	78.0	1318.0	17500.0	420.0	1376.0	57700.0	940.0
1203.0	23.0	1.0	1261.0	2094.0	80.0	1319.0	18000.0	430.0	1377.0	58600.0	948.0
1204.0	29.0	1.5	1262.0	2196.0	85.0	1320.0	18500.0	440.0	1378.0	59600.0	956.0
1205.0	36.0	2.0	1263.0	2303.0	90.0	1321.0	19000.0	450.0	1379.0	60600.0	964.0
1206.0	43.0	2.5	1264.0	2414.0	95.0	1322.0	19400.0	460.0	1380.0	61500.0	972.0
1207.0	51.0	3.0	1265.0	2530.0	100.0	1323.0	19900.0	470.0	1381.0	62500.0	980.0
1208.0	59.0	3.5	1266.0	2652.0	105.0	1324.0	20400.0	480.0	1382.0	63500.0	989.0
1209.0	67.0	4.0	1267.0	2778.0	110.0	1325.0	20900.0	490.0	1383.0	64500.0	998.0
1210.0	77.0	4.5	1268.0	2910.0	115.0	1326.0	21400.0	500.0	1384.0	65500.0	1007.0
1211.0	86.0	5.0	1269.0	3047.0	120.0	1327.0	22000.0	510.0	1385.0	66600.0	1016.0
1212.0	96.0	5.5	1270.0	3189.0	125.0	1328.0	22500.0	520.0	1386.0	67600.0	1025.0
1213.0	107.0	6.0	1271.0	3337.0	130.0	1329.0	23000.0	530.0	1387.0	68600.0	1034.0
1214.0	118.0	6.5	1272.0	3491.0	135.0	1330.0	23500.0	540.0	1388.0	69700.0	1043.0
1215.0	130.0	7.0	1273.0	3650.0	140.0	1331.0	24100.0	550.0	1389.0	70700.0	1052.0
1216.0	142.0	7.5	1274.0	3815.0	145.0	1332.0	24600.0	560.0	1390.0	71800.0	1061.0
1217.0	155.0	8.0	1275.0	3987.0	150.0	1333.0	25200.0	570.0	1391.0	72900.0	1070.0
1218.0	168.0	8.5	1276.0	4164.0	155.0	1334.0	25700.0	580.0	1392.0	74000.0	1080.0
1219.0	182.0	9.0	1277.0	4347.0	160.0	1335.0	26300.0	590.0	1393.0	75000.0	1090.0
1220.0	197.0	9.5	1278.0	4537.0	165.0	1336.0	26900.0	600.0	1394.0	76100.0	1100.0
1221.0	212.0	10.0	1279.0	4733.0	170.0	1337.0	27500.0	610.0	1395.0	77300.0	1110.0
1222.0	229.0	12.0	1280.0	4936.0	175.0	1338.0	28000.0	620.0	1396.0	78400.0	1120.0
1223.0	246.0	14.0	1281.0	5145.0	180.0	1339.0	28600.0	630.0	1397.0	79500.0	1130.0
1224.0	264.0	16.0	1282.0	5360.0	186.0	1340.0	29200.0	640.0	1398.0	80600.0	1140.0
1225.0	284.0	18.0	1283.0	5581.0	192.0	1341.0	29800.0	650.0	1399.0	81800.0	1150.0
1226.0	304.0	20.0	1284.0	5808.0	198.0	1342.0	30500.0	659.0	1400.0	82900.0	1160.0
1227.0	325.0	22.0	1285.0	6041.0	204.0	1343.0	31100.0	668.0	1401.0	84100.0	1170.0
1228.0	348.0	24.0	1286.0	6281.0	210.0	1344.0	31700.0	677.0	1402.0	85300.0	1181.0
1229.0	371.0	26.0	1287.0	6527.0	216.0	1345.0	32400.0	686.0	1403.0	86400.0	1192.0
1230.0	396.0	28.0	1288.0	6779.0	222.0	1346.0	33000.0	695.0	1404.0	87600.0	1203.0
1231.0	422.0	30.0	1289.0	7038.0	228.0	1347.0	33700.0	704.0	1405.0	88800.0	1214.0
1232.0	449.0	31.0	1290.0	7303.0	234.0	1348.0	34400.0	713.0	1406.0	90100.0	1225.0
1233.0	477.0	32.0	1291.0	7576.0	240.0	1349.0	35100.0	722.0	1407.0	91300.0	1236.0
1234.0	506.0	33.0	1292.0	7855.0	245.0	1350.0	35800.0	731.0	1408.0	92500.0	1247.0
1235.0	537.0	34.0	1293.0	8141.0	250.0	1351.0	36500.0	740.0	1409.0	93700.0	1258.0
1236.0	569.0	35.0	1294.0	8433.0	255.0	1352.0	37200.0	748.0	1410.0	95000.0	1269.0
1237.0	602.0	36.0	1295.0	8733.0	260.0	1353.0	38000.0	756.0	1411.0	96200.0	1280.0
1238.0	637.0	37.0	1296.0	9040.0	265.0	1354.0	38700.0	764.0	1412.0	97500.0	1293.0
1239.0	673.0	38.0	1297.0	9354.0	270.0	1355.0	39500.0	772.0	1413.0	98800.0	1306.0
1240.0	710.0	39.0	1298.0	9676.0	275.0	1356.0	40300.0	780.0	1414.0	100100.0	1319.0
1241.0	749.0	40.0	1299.0	10000.0	280.0	1357.0	41000.0	788.0	1415.0	101400.0	1332.0
1242.0	790.0	42.0	1300.0	10300.0	285.0	1358.0	41800.0	796.0	1416.0	102700.0	1345.0
1243.0	834.0	44.0	1301.0	10700.0	290.0	1359.0	42600.0	804.0	1417.0	104000.0	1358.0
1244.0	880.0	46.0	1302.0	11000.0	296.0	1360.0	43500.0	812.0	1418.0	105300.0	1371.0
1245.0	929.0	48.0	1303.0	11400.0	302.0	1361.0	44300.0	820.0	1419.0	106700.0	1384.0
1246.0	980.0	50.0	1304.0	11800.0	308.0	1362.0	45100.0	828.0	1420.0	108000.0	1397.0
1247.0	1034.0	52.0	1305.0	12100.0	314.0	1363.0	46000.0	836.0	1421.0	109400.0	1410.0
1248.0	1090.0	54.0	1306.0	12500.0	320.0	1364.0	46800.0	844.0	1422.0	110800.0	1419.0
1249.0	1149.0	56.0	1307.0	12900.0	326.0	1365.0	47700.0	852.0	1423.0	112100.0	1428.0
1250.0	1211.0	58.0	1308.0	13300.0	332.0	1366.0	48600.0	860.0	1424.0	113500.0	1437.0
1251.0	1276.0	60.0	1309.0	13700.0	338.0	1367.0	49400.0	868.0	1425.0	115000.0	1446.0
1252.0	1343.0	62.0	1310.0	14100.0	344.0	1368.0	50300.0	876.0	1426.0	116400.0	1455.0
1253.0	1414.0	64.0	1311.0	14500.0	350.0	1369.0	51200.0	884.0	1427.0	117800.0	1464.0
1254.0	1488.0	66.0	1312.0	14900.0	360.0	1370.0	52100.0	892.0	1428.0	119300.0	1473.0
1255.0	1564.0	68.0	1313.0	15300.0	370.0	1371.0	53000.0	900.0	1429.0	120700.0	1482.0
1256.0	1644.0	70.0	1314.0	15700.0	380.0	1372.0	53900.0	908.0	1430.0	122200.0	1491.0
1257.0	1727.0	72.0	1315.0	16200.0	390.0	1373.0	54900.0	916.0	1431.0	123700.0	1500.0
1258.0	1814.0	74.0	1316.0	16600.0	400.0	1374.0	55800.0	924.0	1432.0	125200.0	1508.0

(Continued on next page.)

Table A1. Detroit Storage Elevation Table, continued.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1433.0	126700.0	1516.0	1491.0	234200.0	2150.0	1549.0	387700.0	3136.0			
1434.0	128200.0	1524.0	1492.0	236400.0	2167.0	1550.0	390900.0	3158.0			
1435.0	129800.0	1532.0	1493.0	238600.0	2184.0	1551.0	394100.0	3180.0			
1436.0	131300.0	1540.0	1494.0	240800.0	2201.0	1552.0	397300.0	3200.0			
1437.0	132900.0	1548.0	1495.0	243100.0	2218.0	1553.0	400600.0	3220.0			
1438.0	134500.0	1556.0	1496.0	245400.0	2235.0	1554.0	403800.0	3240.0			
1439.0	136100.0	1564.0	1497.0	247700.0	2252.0	1555.0	407100.0	3260.0			
1440.0	137700.0	1572.0	1498.0	249900.0	2269.0	1556.0	410400.0	3280.0			
1441.0	139300.0	1580.0	1499.0	252300.0	2286.0	1557.0	413800.0	3300.0			
1442.0	140900.0	1588.0	1500.0	254600.0	2303.0	1558.0	417200.0	3320.0			
1443.0	142600.0	1596.0	1501.0	256900.0	2320.0	1559.0	420500.0	3340.0			
1444.0	144200.0	1604.0	1502.0	259300.0	2334.0	1560.0	424000.0	3360.0			
1445.0	145900.0	1612.0	1503.0	261700.0	2348.0	1561.0	427400.0	3380.0			
1446.0	147600.0	1620.0	1504.0	264100.0	2362.0	1562.0	430800.0	3400.0			
1447.0	149300.0	1628.0	1505.0	266500.0	2376.0	1563.0	434300.0	3420.0			
1448.0	151000.0	1636.0	1506.0	268900.0	2390.0	1564.0	437700.0	3440.0			
1449.0	152700.0	1644.0	1507.0	271300.0	2404.0	1565.0	441200.0	3460.0			
1450.0	154400.0	1652.0	1508.0	273800.0	2418.0	1566.0	444700.0	3480.0			
1451.0	156100.0	1660.0	1509.0	276200.0	2432.0	1567.0	448100.0	3500.0			
1452.0	157900.0	1672.0	1510.0	278700.0	2446.0	1568.0	451600.0	3520.0			
1453.0	159600.0	1684.0	1511.0	281200.0	2460.0	1569.0	455100.0	3540.0			
1454.0	161400.0	1696.0	1512.0	283700.0	2476.0	1570.0	458600.0	3560.0			
1455.0	163200.0	1708.0	1513.0	286300.0	2492.0	1571.0	462100.0	3580.0			
1456.0	164900.0	1720.0	1514.0	288800.0	2508.0	1572.0	465600.0	3605.0			
1457.0	166800.0	1732.0	1515.0	291300.0	2524.0	1573.0	469100.0	3630.0			
1458.0	168600.0	1744.0	1516.0	293900.0	2540.0	1574.0	472600.0	3655.0			
1459.0	170400.0	1756.0	1517.0	296500.0	2556.0	1575.0	476200.0	3680.0			
1460.0	172200.0	1768.0	1518.0	299100.0	2572.0						
1461.0	174100.0	1780.0	1519.0	301700.0	2588.0						
1462.0	175900.0	1794.0	1520.0	304400.0	2604.0						
1463.0	177800.0	1808.0	1521.0	307000.0	2620.0						
1464.0	179700.0	1822.0	1522.0	309700.0	2634.0						
1465.0	181600.0	1836.0	1523.0	312400.0	2648.0						
1466.0	183400.0	1850.0	1524.0	315100.0	2662.0						
1467.0	185300.0	1864.0	1525.0	317800.0	2676.0						
1468.0	187300.0	1878.0	1526.0	320500.0	2690.0						
1469.0	189200.0	1892.0	1527.0	323200.0	2704.0						
1470.0	191100.0	1906.0	1528.0	326000.0	2718.0						
1471.0	193000.0	1920.0	1529.0	328800.0	2732.0						
1472.0	195000.0	1933.0	1530.0	331500.0	2746.0						
1473.0	197000.0	1946.0	1531.0	334300.0	2760.0						
1474.0	198900.0	1959.0	1532.0	337200.0	2780.0						
1475.0	200900.0	1972.0	1533.0	340000.0	2800.0						
1476.0	202900.0	1985.0	1534.0	342800.0	2820.0						
1477.0	204900.0	1998.0	1535.0	345700.0	2840.0						
1478.0	206900.0	2011.0	1536.0	348600.0	2860.0						
1479.0	208900.0	2024.0	1537.0	351500.0	2880.0						
1480.0	210900.0	2037.0	1538.0	354400.0	2900.0						
1481.0	213000.0	2050.0	1539.0	357300.0	2920.0						
1482.0	215000.0	2060.0	1540.0	360200.0	2940.0						
1483.0	217100.0	2070.0	1541.0	363200.0	2960.0						
1484.0	219200.0	2080.0	1542.0	366200.0	2982.0						
1485.0	221300.0	2090.0	1543.0	369200.0	3004.0						
1486.0	223400.0	2100.0	1544.0	372200.0	3026.0						
1487.0	225500.0	2110.0	1545.0	375300.0	3048.0						
1488.0	227700.0	2120.0	1546.0	378400.0	3070.0						
1489.0	229800.0	2130.0	1547.0	381500.0	3092.0						
1490.0	232000.0	2140.0	1548.0	384600.0	3114.0						

Table A2. Big Cliff Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1106.0	1000000.0	0.0	1166.0	1001380.0	49.0						
1108.0	1000002.0	1.0	1167.0	1001429.0	50.0						
1110.0	1000004.0	1.0	1168.0	1001479.0	51.0						
1111.0	1000007.0	4.0	1169.0	1001530.0	52.0						
1112.0	1000011.0	5.0	1170.0	1001582.0	53.0						
1113.0	1000016.0	6.0	1171.0	1001635.0	54.0						
1114.0	1000021.0	6.0	1172.0	1001689.0	55.0						
1115.0	1000027.0	7.0	1173.0	1001745.0	57.0						
1116.0	1000034.0	8.0	1174.0	1001803.0	59.0						
1117.0	1000042.0	9.0	1175.0	1001861.0	59.0						
1118.0	1000051.0	10.0	1176.0	1001922.0	62.0						
1119.0	1000060.0	10.0	1177.0	1001984.0	63.0						
1120.0	1000071.0	12.0	1178.0	1002047.0	64.0						
1121.0	1000082.0	12.0	1179.0	1002112.0	66.0						
1122.0	1000093.0	12.0	1180.0	1002179.0	68.0						
1123.0	1000105.0	13.0	1181.0	1002247.0	69.0						
1124.0	1000118.0	14.0	1182.0	1002318.0	72.0						
1125.0	1000132.0	15.0	1183.0	1002390.0	73.0						
1126.0	1000146.0	15.0	1184.0	1002465.0	76.0						
1127.0	1000162.0	17.0	1185.0	1002543.0	79.0						
1128.0	1000178.0	17.0	1186.0	1002622.0	80.0						
1129.0	1000196.0	19.0	1187.0	1002704.0	83.0						
1130.0	1000214.0	19.0	1188.0	1002788.0	85.0						
1131.0	1000233.0	20.0	1189.0	1002875.0	88.0						
1132.0	1000252.0	20.0	1190.0	1002964.0	90.0						
1133.0	1000272.0	21.0	1191.0	1003056.0	93.0						
1134.0	1000293.0	22.0	1192.0	1003150.0	95.0						
1135.0	1000314.0	22.0	1193.0	1003246.0	97.0						
1136.0	1000337.0	24.0	1194.0	1003345.0	100.0						
1137.0	1000359.0	24.0	1195.0	1003447.0	103.0						
1138.0	1000383.0	25.0	1196.0	1003552.0	106.0						
1139.0	1000408.0	26.0	1197.0	1003659.0	108.0						
1140.0	1000433.0	26.0	1198.0	1003768.0	110.0						
1141.0	1000459.0	27.0	1199.0	1003881.0	114.0						
1142.0	1000486.0	28.0	1200.0	1003996.0	116.0						
1143.0	1000513.0	28.0	1201.0	1004114.0	119.0						
1144.0	1000541.0	29.0	1202.0	1004234.0	121.0						
1145.0	1000570.0	30.0	1203.0	1004356.0	123.0						
1146.0	1000600.0	31.0	1204.0	1004481.0	126.0						
1147.0	1000631.0	32.0	1205.0	1004608.0	128.0						
1148.0	1000663.0	33.0	1206.0	1004738.0	131.0						
1149.0	1000696.0	34.0	1207.0	1004870.0	133.0						
1150.0	1000729.0	34.0	1208.0	1005004.0	135.0						
1151.0	1000763.0	35.0	1209.0	1005141.0	138.0						
1152.0	1000797.0	35.0	1210.0	1005280.0	141.0						
1153.0	1000833.0	37.0									
1154.0	1000870.0	38.0									
1155.0	1000907.0	38.0									
1156.0	1000945.0	39.0									
1157.0	1000984.0	40.0									
1158.0	1001025.0	42.0									
1159.0	1001066.0	42.0									
1160.0	1001108.0	43.0									
1161.0	1001151.0	44.0									
1162.0	1001195.0	45.0									
1163.0	1001240.0	46.0									
1164.0	1001285.0	46.0									
1165.0	1001332.0	48.0									

Table A3. Green Peter Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
700.0	0.0	0.0	758.0	1450.0	25.0	816.0	20400.0	650.0	874.0	78600.0	1300.0
701.0	25.0	25.0	759.0	1475.0	25.0	817.0	21050.0	650.0	875.0	79900.0	1300.0
702.0	50.0	25.0	760.0	1500.0	25.0	818.0	21700.0	650.0	876.0	81300.0	1400.0
703.0	75.0	25.0	761.0	1600.0	100.0	819.0	22350.0	650.0	877.0	82700.0	1400.0
704.0	100.0	25.0	762.0	1700.0	100.0	820.0	23000.0	650.0	878.0	84100.0	1400.0
705.0	125.0	25.0	763.0	1800.0	100.0	821.0	23800.0	800.0	879.0	85500.0	1400.0
706.0	150.0	25.0	764.0	1900.0	100.0	822.0	24600.0	800.0	880.0	86900.0	1400.0
707.0	175.0	25.0	765.0	2000.0	100.0	823.0	25400.0	800.0	881.0	88400.0	1500.0
708.0	200.0	25.0	766.0	2100.0	100.0	824.0	26200.0	800.0	882.0	89800.0	1500.0
709.0	225.0	25.0	767.0	2200.0	100.0	825.0	27000.0	800.0	883.0	91300.0	1500.0
710.0	250.0	25.0	768.0	2300.0	100.0	826.0	27800.0	800.0	884.0	92700.0	1500.0
711.0	275.0	25.0	769.0	2400.0	100.0	827.0	28600.0	800.0	885.0	94200.0	1500.0
712.0	300.0	25.0	770.0	2500.0	100.0	828.0	29400.0	800.0	886.0	95700.0	1500.0
713.0	325.0	25.0	771.0	2700.0	200.0	829.0	30200.0	800.0	887.0	97300.0	1500.0
714.0	350.0	25.0	772.0	2900.0	200.0	830.0	31000.0	800.0	888.0	98800.0	1600.0
715.0	375.0	25.0	773.0	3100.0	200.0	831.0	31600.0	900.0	889.0	100300.0	1600.0
716.0	400.0	25.0	774.0	3300.0	200.0	832.0	32500.0	900.0	890.0	101900.0	1600.0
717.0	425.0	25.0	775.0	3500.0	200.0	833.0	33300.0	900.0	891.0	103500.0	1600.0
718.0	450.0	25.0	776.0	3700.0	200.0	834.0	34200.0	900.0	892.0	105000.0	1600.0
719.0	475.0	25.0	777.0	3900.0	200.0	835.0	35100.0	900.0	893.0	106600.0	1600.0
720.0	500.0	25.0	778.0	4100.0	200.0	836.0	35900.0	900.0	894.0	108300.0	1600.0
721.0	525.0	25.0	779.0	4300.0	200.0	837.0	36800.0	900.0	895.0	109900.0	1700.0
722.0	550.0	25.0	780.0	4500.0	200.0	838.0	37800.0	900.0	896.0	111500.0	1700.0
723.0	575.0	25.0	781.0	4800.0	300.0	839.0	38700.0	900.0	897.0	113200.0	1700.0
724.0	600.0	25.0	782.0	5100.0	300.0	840.0	39600.0	900.0	898.0	114900.0	1700.0
725.0	625.0	25.0	783.0	5400.0	300.0	841.0	40600.0	1000.0	899.0	116600.0	1700.0
726.0	650.0	25.0	784.0	5700.0	300.0	842.0	41600.0	1000.0	900.0	118300.0	1700.0
727.0	675.0	25.0	785.0	6000.0	300.0	843.0	42500.0	1000.0	901.0	120000.0	1800.0
728.0	700.0	25.0	786.0	6300.0	300.0	844.0	43500.0	1000.0	902.0	121700.0	1800.0
729.0	725.0	25.0	787.0	6600.0	300.0	845.0	44500.0	1000.0	903.0	123500.0	1800.0
730.0	750.0	25.0	788.0	6900.0	300.0	846.0	45500.0	1000.0	904.0	125300.0	1800.0
731.0	775.0	25.0	789.0	7200.0	300.0	847.0	46600.0	1000.0	905.0	127000.0	1800.0
732.0	800.0	25.0	790.0	7500.0	300.0	848.0	47600.0	1000.0	906.0	128800.0	1800.0
733.0	825.0	25.0	791.0	7900.0	400.0	849.0	48600.0	1000.0	907.0	130700.0	1800.0
734.0	850.0	25.0	792.0	8300.0	400.0	850.0	49700.0	1000.0	908.0	132500.0	1800.0
735.0	875.0	25.0	793.0	8700.0	400.0	851.0	50700.0	1100.0	909.0	134300.0	1900.0
736.0	900.0	25.0	794.0	9100.0	400.0	852.0	51800.0	1100.0	910.0	136200.0	1900.0
737.0	925.0	25.0	795.0	9500.0	400.0	853.0	52900.0	1100.0	911.0	138100.0	1900.0
738.0	950.0	25.0	796.0	9900.0	400.0	854.0	54000.0	1100.0	912.0	140000.0	1900.0
739.0	975.0	25.0	797.0	10300.0	400.0	855.0	55100.0	1100.0	913.0	141900.0	1900.0
740.0	1000.0	25.0	798.0	10700.0	400.0	856.0	56300.0	1100.0	914.0	143800.0	1900.0
741.0	1025.0	25.0	799.0	11100.0	400.0	857.0	57400.0	1100.0	915.0	145800.0	1900.0
742.0	1050.0	25.0	800.0	11500.0	400.0	858.0	58500.0	1100.0	916.0	147700.0	1900.0
743.0	1075.0	25.0	801.0	12000.0	500.0	859.0	59700.0	1100.0	917.0	149700.0	2000.0
744.0	1100.0	25.0	802.0	12500.0	500.0	860.0	60900.0	1100.0	918.0	151700.0	2000.0
745.0	1125.0	25.0	803.0	13000.0	500.0	861.0	62100.0	1200.0	919.0	153700.0	2000.0
746.0	1150.0	25.0	804.0	13500.0	500.0	862.0	63300.0	1200.0	920.0	155700.0	2000.0
747.0	1175.0	25.0	805.0	14000.0	500.0	863.0	64500.0	1200.0	921.0	157800.0	2000.0
748.0	1200.0	25.0	806.0	14500.0	500.0	864.0	65700.0	1200.0	922.0	159900.0	2000.0
749.0	1225.0	25.0	807.0	15000.0	500.0	865.0	66900.0	1200.0	923.0	161900.0	2000.0
750.0	1250.0	25.0	808.0	15500.0	500.0	866.0	68200.0	1200.0	924.0	164000.0	2200.0
751.0	1275.0	25.0	809.0	16000.0	500.0	867.0	69400.0	1200.0	925.0	166100.0	2200.0
752.0	1300.0	25.0	810.0	16500.0	500.0	868.0	70700.0	1200.0	926.0	168300.0	2200.0
753.0	1325.0	25.0	811.0	17150.0	650.0	869.0	72000.0	1200.0	927.0	170400.0	2200.0
754.0	1350.0	25.0	812.0	17800.0	650.0	870.0	73300.0	1200.0	928.0	172600.0	2200.0
755.0	1375.0	25.0	813.0	18450.0	650.0	871.0	74600.0	1300.0	929.0	174800.0	2200.0
756.0	1400.0	25.0	814.0	19100.0	650.0	872.0	75900.0	1300.0	930.0	177000.0	2200.0
757.0	1425.0	25.0	815.0	19750.0	650.0	873.0	77200.0	1300.0	931.0	179200.0	2200.0

(Continued on next page.)

Table A3. Green Peter Storage Elevation Table, continued.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
932.0	181400.0	2300.0	990.0	341500.0	3200.0						
933.0	183700.0	2300.0	991.0	344700.0	3200.0						
934.0	185900.0	2300.0	992.0	348000.0	3200.0						
935.0	188200.0	2300.0	993.0	351300.0	3200.0						
936.0	190500.0	2400.0	994.0	354600.0	3300.0						
937.0	192800.0	2400.0	995.0	357900.0	3300.0						
938.0	195200.0	2400.0	996.0	361300.0	3300.0						
939.0	197500.0	2400.0	997.0	364600.0	3300.0						
940.0	199900.0	2400.0	998.0	368000.0	3300.0						
941.0	202300.0	2400.0	999.0	371400.0	3400.0						
942.0	204700.0	2500.0	1000.0	374800.0	3400.0						
943.0	207100.0	2500.0	1001.0	378200.0	3400.0						
944.0	209500.0	2500.0	1002.0	381600.0	3400.0						
945.0	212000.0	2500.0	1003.0	385100.0	3400.0						
946.0	214500.0	2500.0	1004.0	388600.0	3600.0						
947.0	217000.0	2600.0	1005.0	392100.0	3600.0						
948.0	219500.0	2600.0	1006.0	395600.0	3600.0						
949.0	222000.0	2600.0	1007.0	399100.0	3800.0						
950.0	224600.0	2600.0	1008.0	402700.0	3800.0						
951.0	227100.0	2600.0	1009.0	406200.0	3800.0						
952.0	229700.0	2600.0	1010.0	409800.0	4000.0						
953.0	232300.0	2600.0	1011.0	413400.0	4000.0						
954.0	235000.0	2600.0	1012.0	417100.0	4000.0						
955.0	237600.0	2700.0	1013.0	420700.0	4000.0						
956.0	240300.0	2700.0	1014.0	424400.0	4000.0						
957.0	243000.0	2700.0	1015.0	428100.0	4000.0						
958.0	245700.0	2700.0	1016.0	431800.0	4000.0						
959.0	248400.0	2700.0	1017.0	435600.0	4000.0						
960.0	251100.0	2700.0	1018.0	439300.0	4000.0						
961.0	253900.0	2700.0	1019.0	443100.0	4000.0						
962.0	256700.0	2700.0	1020.0	446900.0	4000.0						
963.0	259500.0	2800.0									
964.0	262300.0	2800.0									
965.0	265100.0	2800.0									
966.0	268000.0	2800.0									
967.0	270800.0	2800.0									
968.0	273700.0	2800.0									
969.0	276600.0	2800.0									
970.0	279600.0	2900.0									
971.0	282500.0	2900.0									
972.0	285500.0	2900.0									
973.0	288500.0	2900.0									
974.0	291500.0	2900.0									
975.0	294500.0	2900.0									
976.0	297500.0	2900.0									
977.0	300500.0	2900.0									
978.0	303600.0	3000.0									
979.0	306700.0	3000.0									
980.0	309700.0	3000.0									
981.0	312800.0	3000.0									
982.0	316000.0	3000.0									
983.0	319100.0	3000.0									
984.0	322200.0	3100.0									
985.0	325400.0	3100.0									
986.0	328600.0	3100.0									
987.0	331800.0	3100.0									
988.0	335000.0	3100.0									
989.0	338200.0	3200.0									

Table A4. Foster Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
526.5	0.0	0.0	587.0	11600.0	566.7	645.0	66000.0	1380.0			
530.0	16.0	8.0	588.0	12200.0	600.0	646.0	67400.0	1400.0			
531.0	27.0	11.0	589.0	12800.0	616.7	647.0	68800.0	1425.0			
532.0	41.0	14.0	590.0	13400.0	633.3	648.0	70200.0	1450.0			
533.0	59.0	18.0	591.0	14000.0	650.0	649.0	71600.0	1475.0			
534.0	80.0	21.0	592.0	14700.0	666.7	650.0	73100.0	1500.0			
535.0	104.0	24.0	593.0	15300.0	683.3						
536.0	133.0	29.0	594.0	16000.0	700.0						
537.0	166.0	33.0	595.0	16700.0	714.3						
538.0	204.0	38.0	596.0	17400.0	728.6						
539.0	247.0	43.0	597.0	18100.0	742.9						
540.0	295.0	48.0	598.0	18800.0	757.1						
541.0	348.0	53.0	599.0	19600.0	771.4						
542.0	406.0	58.0	600.0	20300.0	785.7						
543.0	470.0	64.0	601.0	21100.0	800.0						
544.0	538.0	68.0	602.0	21800.0	812.5						
545.0	611.0	73.0	603.0	22600.0	825.0						
546.0	691.0	80.0	604.0	23400.0	837.5						
547.0	776.0	85.0	605.0	24200.0	850.0						
548.0	867.0	91.0	606.0	25100.0	862.5						
549.0	964.0	97.0	607.0	25900.0	875.0						
550.0	1068.0	104.0	608.0	26700.0	887.5						
551.0	1178.0	110.0	609.0	27600.0	900.0						
552.0	1293.0	115.0	610.0	28400.0	909.1						
553.0	1415.0	122.0	611.0	29300.0	918.2						
554.0	1542.0	127.0	612.0	30200.0	927.3						
555.0	1676.0	134.0	613.0	31100.0	936.4						
556.0	1816.0	140.0	614.0	32000.0	945.5						
557.0	1962.0	146.0	615.0	32900.0	954.6						
558.0	2115.0	153.0	616.0	33800.0	963.6						
559.0	2274.0	159.0	617.0	34700.0	972.7						
560.0	2441.0	167.0	618.0	35700.0	981.8						
561.0	2616.0	175.0	619.0	36600.0	990.9						
562.0	2800.0	184.0	620.0	37600.0	1000.0						
563.0	2995.0	195.0	621.0	38500.0	1012.5						
564.0	3200.0	205.0	622.0	39500.0	1025.0						
565.0	3416.0	216.0	623.0	40500.0	1037.5						
566.0	3642.0	226.0	624.0	41500.0	1050.0						
567.0	3880.0	238.0	625.0	42600.0	1062.5						
568.0	4129.0	249.0	626.0	43600.0	1075.0						
569.0	4390.0	261.0	627.0	44600.0	1087.5						
570.0	4663.0	273.0	628.0	45700.0	1100.0						
571.0	4949.0	286.0	629.0	46800.0	1116.7						
572.0	5248.0	299.0	630.0	47900.0	1133.3						
573.0	5561.0	313.0	631.0	49000.0	1150.0						
574.0	5889.0	328.0	632.0	50100.0	1166.7						
575.0	6231.0	342.0	633.0	51200.0	1183.3						
576.0	6588.0	357.0	634.0	52400.0	1200.0						
577.0	6961.0	373.0	635.0	53500.0	1214.3						
578.0	7348.0	387.0	636.0	54700.0	1228.6						
579.0	7752.0	404.0	637.0	55900.0	1242.9						
580.0	8172.0	420.0	638.0	57100.0	1257.1						
581.0	8609.0	437.0	639.0	58300.0	1271.4						
582.0	9064.0	455.0	640.0	59500.0	1285.7						
583.0	9537.0	473.0	641.0	60800.0	1300.0						
584.0	10000.0	475.0	642.0	62100.0	1320.0						
585.0	10500.0	500.0	643.0	63400.0	1340.0						
586.0	11100.0	533.3	644.0	64700.0	1360.0						

Table A5. Cougar Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1301.0	2.0	0.0	1359.0	1415.0	62.0	1417.0	8916.0	192.0	1475.0	25300.0	369.0
1302.0	3.0	1.0	1360.0	1480.0	64.0	1418.0	9114.0	195.0	1476.0	25700.0	372.0
1303.0	5.0	2.0	1361.0	1552.0	65.0	1419.0	9315.0	198.0	1477.0	26100.0	375.0
1304.0	7.0	2.0	1362.0	1627.0	72.0	1420.0	9520.0	198.0	1478.0	26400.0	378.0
1305.0	9.0	2.0	1363.0	1705.0	75.0	1421.0	9728.0	198.0	1479.0	26800.0	381.0
1306.0	10.0	2.0	1364.0	1785.0	78.0	1422.0	9940.0	199.0	1480.0	27200.0	384.0
1307.0	12.0	2.0	1365.0	1867.0	80.0	1423.0	10200.0	199.0	1481.0	27600.0	388.0
1308.0	14.0	2.0	1366.0	1953.0	82.0	1424.0	10400.0	199.0	1482.0	28000.0	391.0
1309.0	15.0	2.0	1367.0	2041.0	86.0	1425.0	10600.0	199.0	1483.0	28400.0	394.0
1310.0	17.0	2.0	1368.0	2131.0	88.0	1426.0	10800.0	200.0	1484.0	28800.0	397.0
1311.0	23.0	2.0	1369.0	2224.0	90.0	1427.0	11000.0	200.0	1485.0	29200.0	400.0
1312.0	30.0	6.0	1370.0	2320.0	93.0	1428.0	11300.0	200.0	1486.0	29600.0	403.0
1313.0	36.0	6.0	1371.0	2418.0	96.0	1429.0	11500.0	204.0	1487.0	30000.0	406.0
1314.0	43.0	6.0	1372.0	2519.0	98.0	1430.0	11800.0	208.0	1488.0	30500.0	410.0
1315.0	49.0	6.0	1373.0	2623.0	101.0	1431.0	12000.0	212.0	1489.0	30900.0	413.0
1316.0	55.0	6.0	1374.0	2729.0	104.0	1432.0	12200.0	216.0	1490.0	31300.0	416.0
1317.0	62.0	6.0	1375.0	2837.0	106.0	1433.0	12500.0	220.0	1491.0	31700.0	419.0
1318.0	68.0	7.0	1376.0	2949.0	108.0	1434.0	12700.0	224.0	1492.0	32200.0	423.0
1319.0	75.0	7.0	1377.0	3063.0	112.0	1435.0	13000.0	228.0	1493.0	32600.0	426.0
1320.0	81.0	7.0	1378.0	3179.0	114.0	1436.0	13300.0	232.0	1494.0	33000.0	429.0
1321.0	91.0	7.0	1379.0	3298.0	116.0	1437.0	13500.0	236.0	1495.0	33500.0	432.0
1322.0	103.0	10.0	1380.0	3420.0	119.0	1438.0	13800.0	240.0	1496.0	33900.0	435.0
1323.0	115.0	12.0	1381.0	3552.0	122.0	1439.0	14000.0	244.0	1497.0	34400.0	439.0
1324.0	129.0	12.0	1382.0	3684.0	132.0	1440.0	14300.0	248.0	1498.0	34800.0	442.0
1325.0	143.0	14.0	1383.0	3816.0	132.0	1441.0	14600.0	252.0	1499.0	35300.0	445.0
1326.0	159.0	14.0	1384.0	3948.0	132.0	1442.0	14800.0	256.0	1500.0	35700.0	448.0
1327.0	176.0	16.0	1385.0	4080.0	132.0	1443.0	15100.0	260.0	1501.0	36200.0	452.0
1328.0	194.0	17.0	1386.0	4212.0	132.0	1444.0	15400.0	264.0	1502.0	36700.0	455.0
1329.0	214.0	18.0	1387.0	4344.0	132.0	1445.0	15600.0	268.0	1503.0	37100.0	458.0
1330.0	234.0	20.0	1388.0	4476.0	132.0	1446.0	15900.0	272.0	1504.0	37600.0	461.0
1331.0	256.0	20.0	1389.0	4608.0	132.0	1447.0	16200.0	276.0	1505.0	38100.0	465.0
1332.0	278.0	22.0	1390.0	4740.0	132.0	1448.0	16500.0	280.0	1506.0	38600.0	468.0
1333.0	302.0	22.0	1391.0	4872.0	132.0	1449.0	16700.0	284.0	1507.0	39000.0	471.0
1334.0	327.0	24.0	1392.0	5004.0	132.0	1450.0	17000.0	288.0	1508.0	39500.0	474.0
1335.0	353.0	25.0	1393.0	5136.0	132.0	1451.0	17300.0	292.0	1509.0	40000.0	477.0
1336.0	380.0	26.0	1394.0	5268.0	132.0	1452.0	17600.0	296.0	1510.0	40500.0	481.0
1337.0	408.0	27.0	1395.0	5400.0	132.0	1453.0	17900.0	300.0	1511.0	41000.0	484.0
1338.0	438.0	28.0	1396.0	5532.0	132.0	1454.0	18200.0	303.0	1512.0	41500.0	487.0
1339.0	468.0	30.0	1397.0	5664.0	132.0	1455.0	18500.0	306.0	1513.0	42000.0	490.0
1340.0	500.0	30.0	1398.0	5796.0	132.0	1456.0	18800.0	309.0	1514.0	42500.0	494.0
1341.0	533.0	32.0	1399.0	5928.0	132.0	1457.0	19100.0	313.0	1515.0	43000.0	497.0
1342.0	567.0	33.0	1400.0	6100.0	132.0	1458.0	19400.0	316.0	1516.0	43500.0	500.0
1343.0	603.0	34.0	1401.0	6201.0	135.0	1459.0	19800.0	319.0	1517.0	44100.0	503.0
1344.0	641.0	36.0	1402.0	6346.0	140.0	1460.0	20100.0	322.0	1518.0	44600.0	506.0
1345.0	680.0	38.0	1403.0	6494.0	145.0	1461.0	20400.0	325.0	1519.0	45100.0	509.0
1346.0	722.0	39.0	1404.0	6645.0	148.0	1462.0	20700.0	328.0	1520.0	45600.0	513.0
1347.0	765.0	42.0	1405.0	6799.0	151.0	1463.0	21100.0	331.0	1521.0	46200.0	516.0
1348.0	809.0	43.0	1406.0	6957.0	154.0	1464.0	21400.0	334.0	1522.0	46700.0	519.0
1349.0	856.0	44.0	1407.0	7119.0	158.0	1465.0	21700.0	338.0	1523.0	47200.0	522.0
1350.0	904.0	47.0	1408.0	7283.0	162.0	1466.0	22100.0	341.0	1524.0	47800.0	525.0
1351.0	954.0	48.0	1409.0	7451.0	164.0	1467.0	22400.0	344.0	1525.0	48300.0	528.0
1352.0	1005.0	50.0	1410.0	7622.0	168.0	1468.0	22800.0	347.0	1526.0	48900.0	531.0
1353.0	1059.0	51.0	1411.0	7797.0	171.0	1469.0	23100.0	350.0	1527.0	49400.0	534.0
1354.0	1114.0	54.0	1412.0	7975.0	175.0	1470.0	23500.0	353.0	1528.0	50000.0	538.0
1355.0	1170.0	55.0	1413.0	8157.0	178.0	1471.0	23800.0	356.0	1529.0	50500.0	541.0
1356.0	1229.0	56.0	1414.0	8341.0	182.0	1472.0	24200.0	359.0	1530.0	51100.0	544.0
1357.0	1289.0	59.0	1415.0	8529.0	184.0	1473.0	24600.0	363.0	1531.0	51700.0	547.0
1358.0	1351.0	60.0	1416.0	8721.0	188.0	1474.0	24900.0	366.0	1532.0	52200.0	550.0

(Continued on next page.)

Table A5. Cougar Storage Elevation Table, continued.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1533.0	52700.0	553.0	1591.0	90600.0	778.0	1649.0	143100.0	1033.0			
1534.0	53300.0	556.0	1592.0	91400.0	783.0	1650.0	144100.0	1038.0			
1535.0	53800.0	559.0	1593.0	92200.0	787.0	1651.0	145200.0	1042.0			
1536.0	54300.0	563.0	1594.0	93000.0	791.0	1652.0	146200.0	1046.0			
1537.0	54900.0	566.0	1595.0	93800.0	796.0	1653.0	147300.0	1050.0			
1538.0	55400.0	569.0	1596.0	94600.0	800.0	1654.0	148300.0	1054.0			
1539.0	56000.0	572.0	1597.0	95400.0	805.0	1655.0	149400.0	1058.0			
1540.0	56500.0	575.0	1598.0	96200.0	809.0	1656.0	150400.0	1063.0			
1541.0	57100.0	578.0	1599.0	97000.0	814.0	1657.0	151500.0	1067.0			
1542.0	57700.0	581.0	1600.0	97800.0	818.0	1658.0	152600.0	1071.0			
1543.0	58200.0	584.0	1601.0	98700.0	823.0	1659.0	153600.0	1075.0			
1544.0	58800.0	588.0	1602.0	99500.0	827.0	1660.0	154700.0	1079.0			
1545.0	59400.0	591.0	1603.0	100300.0	832.0	1661.0	155800.0	1083.0			
1546.0	60000.0	594.0	1604.0	101100.0	836.0	1662.0	156900.0	1088.0			
1547.0	60600.0	597.0	1605.0	102000.0	841.0	1663.0	158000.0	1092.0			
1548.0	61200.0	600.0	1606.0	102800.0	845.0	1664.0	159100.0	1096.0			
1549.0	61700.0	604.0	1607.0	103700.0	850.0	1665.0	160200.0	1100.0			
1550.0	62300.0	608.0	1608.0	104500.0	855.0	1666.0	161300.0	1104.0			
1551.0	63000.0	612.0	1609.0	105400.0	859.0	1667.0	162400.0	1108.0			
1552.0	63600.0	616.0	1610.0	106200.0	864.0	1668.0	163500.0	1113.0			
1553.0	64200.0	620.0	1611.0	107100.0	868.0	1669.0	164600.0	1117.0			
1554.0	64800.0	624.0	1612.0	108000.0	873.0	1670.0	165700.0	1121.0			
1555.0	65400.0	628.0	1613.0	108800.0	877.0	1671.0	166800.0	1125.0			
1556.0	66000.0	632.0	1614.0	109700.0	882.0	1672.0	168000.0	1129.0			
1557.0	66700.0	636.0	1615.0	110600.0	886.0	1673.0	169100.0	1133.0			
1558.0	67300.0	640.0	1616.0	111500.0	891.0	1674.0	170200.0	1138.0			
1559.0	67900.0	644.0	1617.0	112400.0	895.0	1675.0	171400.0	1142.0			
1560.0	68600.0	648.0	1618.0	113300.0	900.0	1676.0	172500.0	1146.0			
1561.0	69200.0	652.0	1619.0	114200.0	904.0	1677.0	173700.0	1150.0			
1562.0	69900.0	656.0	1620.0	115100.0	909.0	1678.0	174800.0	1154.0			
1563.0	70500.0	660.0	1621.0	116000.0	913.0	1679.0	176000.0	1158.0			
1564.0	71200.0	664.0	1622.0	116900.0	917.0	1680.0	177100.0	1163.0			
1565.0	71900.0	668.0	1623.0	117800.0	922.0	1681.0	178300.0	1167.0			
1566.0	72500.0	672.0	1624.0	118700.0	926.0	1682.0	179500.0	1171.0			
1567.0	73200.0	676.0	1625.0	119600.0	930.0	1683.0	180600.0	1175.0			
1568.0	73900.0	680.0	1626.0	120600.0	935.0	1684.0	181800.0	1179.0			
1569.0	74600.0	684.0	1627.0	121500.0	939.0	1685.0	183000.0	1183.0			
1570.0	75200.0	688.0	1628.0	122400.0	943.0	1686.0	184200.0	1188.0			
1571.0	75900.0	692.0	1629.0	123400.0	948.0	1687.0	185400.0	1192.0			
1572.0	76600.0	696.0	1630.0	124300.0	952.0	1688.0	186600.0	1196.0			
1573.0	77300.0	700.0	1631.0	125300.0	957.0	1689.0	187800.0	1200.0			
1574.0	78000.0	704.0	1632.0	126200.0	961.0	1690.0	189000.0	1209.0			
1575.0	78700.0	709.0	1633.0	127200.0	965.0	1691.0	190200.0	1218.0			
1576.0	79400.0	713.0	1634.0	128200.0	970.0	1692.0	191400.0	1227.0			
1577.0	80200.0	717.0	1635.0	129100.0	974.0	1693.0	192600.0	1236.0			
1578.0	80900.0	722.0	1636.0	130100.0	978.0	1694.0	193900.0	1245.0			
1579.0	81600.0	726.0	1637.0	131100.0	983.0	1695.0	195100.0	1255.0			
1580.0	82300.0	730.0	1638.0	132000.0	987.0	1696.0	196300.0	1264.0			
1581.0	83100.0	735.0	1639.0	133000.0	991.0	1697.0	197600.0	1273.0			
1582.0	83800.0	739.0	1640.0	134000.0	996.0	1698.0	198800.0	1282.0			
1583.0	84600.0	743.0	1641.0	135000.0	1000.0	1699.0	200000.0	1291.0			
1584.0	85300.0	748.0	1642.0	136000.0	1004.0						
1585.0	86100.0	752.0	1643.0	137000.0	1008.0						
1586.0	86800.0	757.0	1644.0	138000.0	1013.0						
1587.0	87600.0	761.0	1645.0	139000.0	1017.0						
1588.0	88300.0	765.0	1646.0	140000.0	1021.0						
1589.0	89100.0	770.0	1647.0	141100.0	1025.0						
1590.0	89900.0	774.0	1648.0	142100.0	1029.0						

Table A6. Blue River Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1120.0	156.0	0.0	1178.0	3711.0	83.0	1236.0	15100.0	200.0	1294.0	39300.0	493.3
1121.0	182.0	1.0	1179.0	3839.0	85.0	1237.0	15300.0	205.0	1295.0	39900.0	500.0
1122.0	209.0	1.0	1180.0	3971.0	87.0	1238.0	15600.0	210.0	1296.0	40600.0	507.1
1123.0	236.0	1.0	1181.0	4105.0	90.0	1239.0	15900.0	215.0	1297.0	41200.0	514.3
1124.0	263.0	3.0	1182.0	4241.0	93.0	1240.0	16200.0	220.0	1298.0	41800.0	521.4
1125.0	291.0	3.0	1183.0	4379.0	95.0	1241.0	16500.0	225.0	1299.0	42400.0	528.6
1126.0	319.0	5.0	1184.0	4518.0	97.0	1242.0	16800.0	230.0	1300.0	43100.0	535.7
1127.0	348.0	5.0	1185.0	4660.0	101.0	1243.0	17100.0	235.0	1301.0	43700.0	542.9
1128.0	377.0	8.0	1186.0	4804.0	102.0	1244.0	17400.0	240.0	1302.0	44400.0	550.0
1129.0	407.0	9.0	1187.0	4949.0	106.0	1245.0	17700.0	245.0	1303.0	45100.0	557.1
1130.0	437.0	10.0	1188.0	5097.0	108.0	1246.0	18000.0	250.0	1304.0	45700.0	564.3
1131.0	468.0	13.0	1189.0	5247.0	112.0	1247.0	18300.0	255.0	1305.0	46400.0	571.4
1132.0	499.0	14.0	1190.0	5399.0	114.0	1248.0	18600.0	260.0	1306.0	47100.0	578.6
1133.0	530.0	17.0	1191.0	5552.0	116.0	1249.0	18900.0	265.0	1307.0	47800.0	585.7
1134.0	562.0	20.0	1192.0	5708.0	120.0	1250.0	19300.0	270.0	1308.0	48500.0	592.9
1135.0	594.0	21.0	1193.0	5866.0	122.0	1251.0	19600.0	275.0	1309.0	49200.0	600.0
1136.0	627.0	25.0	1194.0	6026.0	126.0	1252.0	19900.0	280.0	1310.0	49900.0	606.7
1137.0	660.0	26.0	1195.0	6188.0	128.0	1253.0	20300.0	285.0	1311.0	50600.0	613.3
1138.0	694.0	27.0	1196.0	6353.0	132.0	1254.0	20600.0	290.0	1312.0	51300.0	620.0
1139.0	728.0	27.0	1197.0	6519.0	134.0	1255.0	21000.0	295.0	1313.0	52000.0	626.7
1140.0	763.0	27.0	1198.0	6687.0	136.0	1256.0	21300.0	300.0	1314.0	52800.0	633.3
1141.0	799.0	28.0	1199.0	6858.0	138.0	1257.0	21700.0	304.2	1315.0	53500.0	640.0
1142.0	837.0	28.0	1200.0	7031.0	139.0	1258.0	22000.0	308.3	1316.0	54200.0	646.7
1143.0	876.0	29.0	1201.0	7206.0	142.0	1259.0	22400.0	312.5	1317.0	55000.0	653.3
1144.0	918.0	29.0	1202.0	7384.0	144.0	1260.0	22800.0	316.7	1318.0	55700.0	660.0
1145.0	961.0	30.0	1203.0	7564.0	145.0	1261.0	23100.0	320.8	1319.0	56500.0	666.7
1146.0	1006.0	30.0	1204.0	7747.0	148.0	1262.0	23500.0	325.0	1320.0	57200.0	673.3
1147.0	1054.0	31.0	1205.0	7933.0	150.0	1263.0	23900.0	329.2	1321.0	58000.0	680.0
1148.0	1103.0	31.0	1206.0	8121.0	152.0	1264.0	24300.0	333.3	1322.0	58800.0	686.7
1149.0	1155.0	31.0	1207.0	8312.0	153.0	1265.0	24700.0	337.5	1323.0	59600.0	693.3
1150.0	1208.0	32.0	1208.0	8505.0	156.0	1266.0	25100.0	341.7	1324.0	60300.0	700.0
1151.0	1264.0	32.0	1209.0	8701.0	158.0	1267.0	25500.0	345.8	1325.0	61100.0	705.6
1152.0	1323.0	33.0	1210.0	8900.0	160.0	1268.0	26000.0	350.0	1326.0	61900.0	711.1
1153.0	1383.0	33.0	1211.0	9101.0	162.0	1269.0	26400.0	354.2	1327.0	62700.0	716.7
1154.0	1446.0	34.0	1212.0	9306.0	165.0	1270.0	26800.0	358.3	1328.0	63500.0	722.2
1155.0	1511.0	34.0	1213.0	9513.0	166.0	1271.0	27300.0	362.5	1329.0	64400.0	727.8
1156.0	1579.0	35.0	1214.0	9722.0	168.0	1272.0	27700.0	366.7	1330.0	65200.0	733.3
1157.0	1649.0	36.0	1215.0	9935.0	171.0	1273.0	28200.0	370.8	1331.0	66000.0	738.9
1158.0	1721.0	38.0	1216.0	10200.0	173.0	1274.0	28600.0	375.0	1332.0	66800.0	744.4
1159.0	1796.0	39.0	1217.0	10400.0	175.0	1275.0	29100.0	379.2	1333.0	67700.0	750.0
1160.0	1874.0	42.0	1218.0	10600.0	178.0	1276.0	29600.0	383.3	1334.0	68500.0	755.6
1161.0	1954.0	43.0	1219.0	10800.0	180.0	1277.0	30100.0	387.5	1335.0	69400.0	761.1
1162.0	2037.0	45.0	1220.0	11000.0	183.0	1278.0	30500.0	391.7	1336.0	70200.0	766.7
1163.0	2122.0	48.0	1221.0	11300.0	186.0	1279.0	31000.0	395.8	1337.0	71100.0	772.2
1164.0	2209.0	49.0	1222.0	11500.0	188.0	1280.0	31500.0	400.0	1338.0	72000.0	777.8
1165.0	2299.0	52.0	1223.0	11700.0	191.0	1281.0	32100.0	406.7	1339.0	72800.0	783.3
1166.0	2392.0	53.0	1224.0	12000.0	193.0	1282.0	32600.0	413.3	1340.0	73700.0	788.9
1167.0	2487.0	56.0	1225.0	12200.0	196.0	1283.0	33100.0	420.0	1341.0	74600.0	794.4
1168.0	2584.0	59.0	1226.0	12500.0	199.0	1284.0	33600.0	426.7	1342.0	75500.0	800.0
1169.0	2685.0	60.0	1227.0	12700.0	199.0	1285.0	34200.0	433.3	1343.0	76400.0	805.6
1170.0	2787.0	63.0	1228.0	13000.0	199.0	1286.0	34700.0	440.0	1344.0	77300.0	811.1
1171.0	2893.0	65.0	1229.0	13200.0	199.0	1287.0	35300.0	446.7	1345.0	78200.0	816.7
1172.0	3001.0	68.0	1230.0	13500.0	199.0	1288.0	35800.0	453.3	1346.0	79100.0	822.2
1173.0	3113.0	70.0	1231.0	13700.0	199.0	1289.0	36400.0	460.0	1347.0	80000.0	827.8
1174.0	3227.0	72.0	1232.0	14000.0	200.0	1290.0	37000.0	466.7	1348.0	81000.0	833.3
1175.0	3343.0	75.0	1233.0	14200.0	200.0	1291.0	37500.0	473.3	1349.0	81900.0	838.9
1176.0	3463.0	78.0	1234.0	14500.0	200.0	1292.0	38100.0	480.0	1350.0	82800.0	844.4
1177.0	3585.0	80.0	1235.0	14800.0	200.0	1293.0	38700.0	486.7	1351.0	83800.0	850.0

(Continued on next page.)

Table A6. Blue River Storage Elevation Table, continued.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1352.0	84700.0	855.6									
1353.0	85700.0	861.1									
1354.0	86600.0	866.7									
1355.0	87600.0	872.2									
1356.0	88600.0	877.8									
1357.0	89500.0	883.3									
1358.0	90500.0	888.9									
1359.0	91500.0	894.4									
1360.0	92500.0	900.0									
1361.0	93500.0	905.9									
1362.0	94400.0	911.8									
1363.0	95500.0	917.7									
1364.0	96500.0	923.5									
1365.0	97500.0	929.4									
1366.0	98500.0	935.3									
1367.0	99500.0	941.2									
1368.0	100500.0	947.1									
1369.0	101600.0	952.9									
1370.0	102600.0	958.8									
1371.0	103700.0	964.7									
1372.0	104700.0	970.6									
1373.0	105800.0	976.5									
1374.0	106800.0	982.4									
1375.0	107900.0	988.2									
1376.0	109000.0	994.1									
1377.0	110000.0	1000.0									
1378.0	111100.0	1005.0									
1379.0	112200.0	1010.0									
1380.0	113300.0	1015.0									
1381.0	114400.0	1020.0									
1382.0	115500.0	1025.0									
1383.0	116600.0	1030.0									
1384.0	117700.0	1035.0									
1385.0	118900.0	1040.0									
1386.0	120000.0	1045.0									
1387.0	121100.0	1050.0									
1388.0	122300.0	1055.0									
1389.0	123400.0	1060.0									
1390.0	124500.0	1065.0									
1391.0	125700.0	1070.0									
1392.0	126900.0	1075.0									
1393.0	128000.0	1080.0									
1394.0	129200.0	1085.0									
1395.0	130400.0	1090.0									
1396.0	131500.0	1095.0									
1397.0	132700.0	1100.0									
1398.0	133900.0	1105.3									
1399.0	135100.0	1110.5									
1400.0	136300.0	1115.8									

Table A7. Hills Creek Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
1366.0	52600.0	0.0	1424.0	120000.0	1292.0	1482.0	214800.0	1813.0	1540.0	347300.0	2475.0
1367.0	53500.0	100.0	1425.0	121400.0	1300.0	1483.0	216800.0	1825.0	1541.0	350000.0	2488.0
1368.0	54500.0	200.0	1426.0	122800.0	1307.0	1484.0	218800.0	1838.0	1542.0	352800.0	2500.0
1369.0	55500.0	300.0	1427.0	124200.0	1314.0	1485.0	220700.0	1850.0	1543.0	355600.0	2517.0
1370.0	56400.0	400.0	1428.0	125600.0	1321.0	1486.0	222700.0	1863.0	1544.0	358400.0	2533.0
1371.0	57400.0	450.0	1429.0	127000.0	1329.0	1487.0	224700.0	1875.0	1545.0	361400.0	2550.0
1372.0	58400.0	850.0	1430.0	128400.0	1336.0	1488.0	226800.0	1888.0	1546.0	364400.0	2567.0
1373.0	59400.0	850.0	1431.0	129800.0	1343.0	1489.0	228800.0	1900.0	1547.0	367500.0	2583.0
1374.0	60400.0	850.0	1432.0	131300.0	1350.0	1490.0	230800.0	1911.0	1548.0	370600.0	2600.0
1375.0	61400.0	850.0	1433.0	132700.0	1357.0	1491.0	232900.0	1922.0	1549.0	373800.0	2625.0
1376.0	62400.0	850.0	1434.0	134200.0	1364.0	1492.0	234900.0	1933.0	1550.0	377100.0	2650.0
1377.0	63400.0	850.0	1435.0	135600.0	1371.0	1493.0	237000.0	1944.0	1551.0	380500.0	2675.0
1378.0	64500.0	900.0	1436.0	137100.0	1379.0	1494.0	239100.0	1956.0	1552.0	383900.0	2700.0
1379.0	65500.0	900.0	1437.0	138600.0	1386.0	1495.0	241200.0	1967.0	1553.0	387400.0	2800.0
1380.0	66600.0	900.0	1438.0	140000.0	1393.0	1496.0	243300.0	1978.0	1554.0	391000.0	2800.0
1381.0	67600.0	900.0	1439.0	141500.0	1400.0	1497.0	245400.0	1989.0	1555.0	394600.0	2800.0
1382.0	68700.0	920.0	1440.0	143000.0	1408.0	1498.0	247600.0	2000.0	1556.0	398400.0	3000.0
1383.0	69800.0	940.0	1441.0	144600.0	1415.0	1499.0	249700.0	2013.0	1557.0	402200.0	3000.0
1384.0	70800.0	960.0	1442.0	146100.0	1423.0	1500.0	251900.0	2025.0	1558.0	406100.0	3100.0
1385.0	71900.0	980.0	1443.0	147600.0	1431.0	1501.0	254000.0	2038.0	1559.0	410000.0	3100.0
1386.0	73000.0	1000.0	1444.0	149100.0	1438.0	1502.0	256200.0	2050.0	1560.0	414100.0	3200.0
1387.0	74100.0	1008.0	1445.0	150700.0	1446.0	1503.0	258400.0	2063.0			
1388.0	75200.0	1015.0	1446.0	152200.0	1454.0	1504.0	260600.0	2075.0			
1389.0	76300.0	1023.0	1447.0	153800.0	1462.0	1505.0	262800.0	2088.0			
1390.0	77500.0	1031.0	1448.0	155400.0	1469.0	1506.0	265000.0	2100.0			
1391.0	78600.0	1038.0	1449.0	157000.0	1477.0	1507.0	267300.0	2111.0			
1392.0	79700.0	1046.0	1450.0	158500.0	1485.0	1508.0	269500.0	2122.0			
1393.0	80900.0	1054.0	1451.0	160100.0	1492.0	1509.0	271800.0	2133.0			
1394.0	82000.0	1062.0	1452.0	161700.0	1500.0	1510.0	274000.0	2144.0			
1395.0	83200.0	1069.0	1453.0	163400.0	1509.0	1511.0	276300.0	2156.0			
1396.0	84400.0	1077.0	1454.0	165000.0	1518.0	1512.0	278600.0	2167.0			
1397.0	85600.0	1085.0	1455.0	166600.0	1527.0	1513.0	280900.0	2178.0			
1398.0	86700.0	1092.0	1456.0	168300.0	1536.0	1514.0	283200.0	2189.0			
1399.0	87900.0	1100.0	1457.0	169900.0	1545.0	1515.0	285500.0	2200.0			
1400.0	89100.0	1108.0	1458.0	171600.0	1555.0	1516.0	287800.0	2210.0			
1401.0	90400.0	1115.0	1459.0	173200.0	1564.0	1517.0	290200.0	2220.0			
1402.0	91600.0	1123.0	1460.0	174900.0	1573.0	1518.0	292500.0	2230.0			
1403.0	92800.0	1131.0	1461.0	176600.0	1582.0	1519.0	294900.0	2240.0			
1404.0	94000.0	1138.0	1462.0	178300.0	1591.0	1520.0	297200.0	2250.0			
1405.0	95300.0	1146.0	1463.0	180000.0	1600.0	1521.0	299600.0	2260.0			
1406.0	96500.0	1154.0	1464.0	181700.0	1610.0	1522.0	302000.0	2270.0			
1407.0	97700.0	1162.0	1465.0	183500.0	1620.0	1523.0	304400.0	2280.0			
1408.0	99000.0	1169.0	1466.0	185200.0	1630.0	1524.0	306800.0	2290.0			
1409.0	100300.0	1177.0	1467.0	187000.0	1640.0	1525.0	309200.0	2300.0			
1410.0	101500.0	1185.0	1468.0	188800.0	1650.0	1526.0	311700.0	2311.0			
1411.0	102800.0	1192.0	1469.0	190500.0	1660.0	1527.0	314100.0	2322.0			
1412.0	104100.0	1200.0	1470.0	192300.0	1670.0	1528.0	316600.0	2333.0			
1413.0	105400.0	1208.0	1471.0	194100.0	1680.0	1529.0	319100.0	2344.0			
1414.0	106700.0	1215.0	1472.0	196000.0	1690.0	1530.0	321600.0	2356.0			
1415.0	108000.0	1223.0	1473.0	197800.0	1700.0	1531.0	324100.0	2367.0			
1416.0	109300.0	1231.0	1474.0	199600.0	1713.0	1532.0	326600.0	2378.0			
1417.0	110600.0	1238.0	1475.0	201500.0	1725.0	1533.0	329200.0	2389.0			
1418.0	111900.0	1246.0	1476.0	203400.0	1738.0	1534.0	331700.0	2400.0			
1419.0	113300.0	1254.0	1477.0	205200.0	1750.0	1535.0	334300.0	2413.0			
1420.0	114600.0	1262.0	1478.0	207100.0	1763.0	1536.0	336900.0	2425.0			
1421.0	115900.0	1269.0	1479.0	209100.0	1775.0	1537.0	339500.0	2438.0			
1422.0	117300.0	1277.0	1480.0	211000.0	1788.0	1538.0	342100.0	2450.0			
1423.0	118600.0	1285.0	1481.0	212900.0	1800.0	1539.0	344700.0	2463.0			

Table A8. Lookout Point Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
689.0	0.0	0.0	747.0	14094.0	584.8	805.0	78144.0	1685.7	863.0	208614.0	2922.2
690.0	0.5	15.4	748.0	14655.0	600.1	806.0	79782.0	1706.7	864.0	211569.0	2944.0
691.0	1.0	24.1	749.0	15236.0	615.6	807.0	81436.0	1727.6	865.0	214545.0	2965.8
692.0	2.0	32.5	750.0	15837.0	631.2	808.0	83104.0	1748.6	866.0	217546.0	2987.5
693.0	4.0	40.6	751.0	16458.0	647.1	809.0	84787.0	1769.7	867.0	220572.0	3009.3
694.0	8.0	48.6	752.0	17099.0	663.1	810.0	86480.0	1790.7	868.0	223620.0	3031.2
695.0	13.0	56.4	753.0	17760.0	679.4	811.0	88186.0	1811.7	869.0	226687.0	3053.0
696.0	21.0	64.1	754.0	18442.0	695.8	812.0	89903.0	1832.8	870.0	229775.0	3074.9
697.0	31.0	71.7	755.0	19143.0	712.3	813.0	91632.0	1853.9	871.0	232884.0	3096.7
698.0	44.0	79.1	756.0	19863.0	729.1	814.0	93371.0	1875.0	872.0	236018.0	3118.6
699.0	61.0	86.5	757.0	20601.0	746.0	815.0	95120.0	1896.1	873.0	239176.0	3122.1
700.0	85.0	93.8	758.0	21357.0	763.1	816.0	96880.0	1917.2	874.0	242358.0	3134.1
701.0	123.0	101.1	759.0	22136.0	780.4	817.0	98653.0	1938.3	875.0	245562.0	3140.5
702.0	181.0	108.4	760.0	22939.0	797.8	818.0	100439.0	1959.4	876.0	248790.0	3162.4
703.0	260.0	115.7	761.0	23764.0	815.3	819.0	102242.0	1980.6	877.0	252043.0	3184.3
704.0	359.0	123.0	762.0	24612.0	833.1	820.0	104063.0	2001.7	878.0	255322.0	3206.3
705.0	475.0	130.4	763.0	25483.0	850.9	821.0	105906.0	2022.9	879.0	258630.0	3228.2
706.0	610.0	137.8	764.0	26377.0	868.9	822.0	107773.0	2044.0	880.0	261966.0	3250.2
707.0	757.0	145.2	765.0	27298.0	887.1	823.0	109673.0	2065.2	881.0	265332.0	3316.0
708.0	916.0	152.8	766.0	28246.0	905.3	824.0	111618.0	2086.4	882.0	268727.0	3338.0
709.0	1086.0	160.4	767.0	29215.0	923.8	825.0	113619.0	2107.6	883.0	272150.0	3360.0
710.0	1266.0	168.1	768.0	30201.0	942.3	826.0	115673.0	2128.8	884.0	275603.0	3381.9
711.0	1455.0	176.0	769.0	31200.0	960.9	827.0	117771.0	2150.0	885.0	279083.0	3403.9
712.0	1654.0	184.0	770.0	32213.0	979.7	828.0	119901.0	2171.3	886.0	282588.0	3425.8
713.0	1861.0	192.1	771.0	33241.0	998.6	829.0	122059.0	2192.5	887.0	286111.0	3447.8
714.0	2074.0	200.3	772.0	34286.0	1017.6	830.0	124242.0	2213.7	888.0	289651.0	3469.7
715.0	2293.0	208.8	773.0	35346.0	1036.7	831.0	126449.0	2235.0	889.0	293207.0	3491.6
716.0	2519.0	217.3	774.0	36422.0	1055.9	832.0	128676.0	2256.2	890.0	296780.0	3513.6
717.0	2750.0	226.1	775.0	37516.0	1075.3	833.0	130922.0	2277.5	891.0	300372.0	3535.5
718.0	2988.0	235.0	776.0	38625.0	1094.7	834.0	133189.0	2298.8	892.0	303982.0	3557.3
719.0	3233.0	244.1	777.0	39754.0	1114.2	835.0	135477.0	2320.1	893.0	307612.0	3579.2
720.0	3487.0	253.4	778.0	40902.0	1133.8	836.0	137786.0	2341.4	894.0	311263.0	3601.0
721.0	3751.0	262.9	779.0	42065.0	1153.5	837.0	140115.0	2362.7	895.0	314931.0	3622.8
722.0	4025.0	272.5	780.0	43238.0	1173.2	838.0	142464.0	2384.1	896.0	318617.0	3644.6
723.0	4308.0	282.4	781.0	44422.0	1193.1	839.0	144835.0	2405.4	897.0	322320.0	3666.3
724.0	4598.0	292.5	782.0	45617.0	1213.0	840.0	147229.0	2426.7	898.0	326044.0	3688.0
725.0	4895.0	302.8	783.0	46823.0	1233.0	841.0	149645.0	2448.1	899.0	329788.0	3709.7
726.0	5201.0	313.3	784.0	48041.0	1253.0	842.0	152088.0	2469.5	900.0	333554.0	3731.3
727.0	5516.0	324.1	785.0	49272.0	1273.2	843.0	154556.0	2490.9	901.0	337340.0	3752.9
728.0	5841.0	335.0	786.0	50517.0	1293.4	844.0	157044.0	2512.3	902.0	341148.0	3774.4
729.0	6177.0	346.2	787.0	51776.0	1313.6	845.0	159553.0	2533.7	903.0	344976.0	3795.8
730.0	6526.0	357.6	788.0	53052.0	1333.9	846.0	162082.0	2555.2	904.0	348824.0	3817.2
731.0	6886.0	369.2	789.0	54354.0	1354.3	847.0	164632.0	2576.6	905.0	352694.0	3838.6
732.0	7256.0	381.0	790.0	55680.0	1374.7	848.0	167200.0	2598.1	906.0	356584.0	3859.9
733.0	7634.0	393.0	791.0	57030.0	1395.2	849.0	169790.0	2619.6	907.0	360495.0	3881.1
734.0	8019.0	405.3	792.0	58403.0	1415.7	850.0	172405.0	2641.1	908.0	364424.0	3902.2
735.0	8411.0	417.8	793.0	59800.0	1436.3	851.0	175042.0	2662.6	909.0	368370.0	3923.3
736.0	8814.0	430.5	794.0	61220.0	1456.9	852.0	177702.0	2684.1	910.0	372333.0	3944.3
737.0	9231.0	443.5	795.0	62664.0	1477.5	853.0	180387.0	2705.7	911.0	376314.0	3965.1
738.0	9661.0	456.7	796.0	64130.0	1498.2	854.0	183097.0	2727.3	912.0	380314.0	3985.9
739.0	10104.0	470.0	797.0	65617.0	1518.9	855.0	185829.0	2748.8	913.0	384332.0	4006.6
740.0	10559.0	483.6	798.0	67121.0	1539.7	856.0	188583.0	2770.5	914.0	388366.0	4027.2
741.0	11028.0	497.5	799.0	68645.0	1560.4	857.0	191365.0	2792.1	915.0	392418.0	4047.7
742.0	11511.0	511.5	800.0	70186.0	1581.3	858.0	194175.0	2813.7	916.0	396487.0	4068.1
743.0	12005.0	525.8	801.0	71745.0	1602.1	859.0	197011.0	2835.4	917.0	400573.0	4088.4
744.0	12510.0	540.2	802.0	73321.0	1623.0	860.0	199872.0	2857.1	918.0	404676.0	4108.6
745.0	13026.0	554.9	803.0	74913.0	1643.9	861.0	202761.0	2878.8	919.0	408796.0	4128.6
746.0	13553.0	569.7	804.0	76522.0	1664.8	862.0	205677.0	2900.5	920.0	412936.0	4148.5

Table A8. Lookout Point Storage Elevation Table, continued.

Elevation	Storage	Area
feet	Ac-ft	acre
Lookout Point continued…		
921.0	417096.0	4168.3
922.0	421274.0	4187.9
923.0	425471.0	4207.4
924.0	429688.0	4226.7
925.0	433924.0	4245.9
926.0	438179.0	4264.9
927.0	442452.0	4283.8
928.0	446742.0	4302.5
929.0	451049.0	4321.0
930.0	455374.0	4339.3
931.0	459718.0	4357.5
932.0	464083.0	4375.4
933.0	468470.0	4393.2
934.0	472877.0	4410.7
935.0	477204.0	4428.1
936.0	481590.0	4445.2
937.0	485978.0	4462.2
938.0	490364.0	4478.9
939.0	494752.0	4495.4
940.0	499138.0	4511.6
941.0	503625.0	4527.6
942.0	508112.0	4600.0
943.0	512600.0	4700.0
944.0	517086.0	4800.0
945.0	521574.0	4900.0

Table A9. Dexter Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre
Dexter			**Dexter**		
634.0	0.0	0.0	691.0	23400.0	952.0
635.0	6.0	2.0	692.0	24400.0	963.0
636.0	12.0	4.0	693.0	25400.0	972.0
637.0	18.0	8.0	694.0	26300.0	981.0
638.0	24.0	13.0	695.0	27300.0	990.0
639.0	30.0	26.0	696.0	28300.0	999.0
640.0	36.0	36.0	697.0	29300.0	1007.0
641.0	75.0	42.0	698.0	30300.0	1015.0
642.0	120.0	46.0	699.0	31400.0	1023.0
643.0	171.0	51.0	700.0	32400.0	1031.0
644.0	229.0	58.0			
645.0	294.0	69.0			
646.0	372.0	88.0			
647.0	470.0	112.0			
648.0	589.0	139.0			
649.0	733.0	165.0			
650.0	903.0	184.0			
651.0	1091.0	197.0			
652.0	1288.0	204.0			
653.0	1493.0	210.0			
654.0	1708.0	217.0			
655.0	1931.0	228.0			
656.0	2168.0	244.0			
657.0	2424.0	262.0			
658.0	2699.0	282.0			
659.0	2993.0	304.0			
660.0	3309.0	326.0			
661.0	3647.0	350.0			
662.0	4008.0	375.0			
663.0	4394.0	400.0			
664.0	4805.0	426.0			
665.0	5243.0	451.0			
666.0	5705.0	475.0			
667.0	6188.0	501.0			
668.0	6694.0	524.0			
669.0	7223.0	546.0			
670.0	7775.0	564.0			
671.0	8343.0	575.0			
672.0	8917.0	579.0			
673.0	9499.0	582.0			
674.0	10100.0	588.0			
675.0	10700.0	600.0			
676.0	11300.0	621.0			
677.0	11900.0	644.0			
678.0	12600.0	678.0			
679.0	13300.0	710.0			
680.0	14000.0	738.0			
681.0	14800.0	763.0			
682.0	15500.0	789.0			
683.0	16300.0	813.0			
684.0	17200.0	837.0			
685.0	18000.0	858.0			
686.0	18900.0	872.0			
687.0	19800.0	895.0			
688.0	20700.0	911.0			
689.0	21600.0	926.0			
690.0	22500.0	940.0			

Table A10. Fall Creek Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
680.0	0.0	0.0	738.0	14553.0	500.0	796.0	64344.0	1144.0			
681.0	1.0	13.0	739.0	15116.0	511.0	797.0	65597.0	1156.0			
682.0	5.0	13.0	740.0	15687.0	522.0	798.0	66866.0	1167.0			
683.0	12.0	13.0	741.0	16267.0	533.0	799.0	68150.0	1178.0			
684.0	21.0	13.0	742.0	16855.0	544.0	800.0	69449.0	1189.0			
685.0	33.0	13.0	743.0	17450.0	556.0	801.0	70763.0	1200.0			
686.0	48.0	13.0	744.0	18052.0	567.0	802.0	72094.0	1225.0			
687.0	66.0	13.0	745.0	18661.0	578.0	803.0	73441.0	1250.0			
688.0	88.0	43.0	746.0	19279.0	589.0	804.0	74803.0	1275.0			
689.0	116.0	48.0	747.0	19906.0	600.0	805.0	76180.0	1300.0			
690.0	153.0	54.0	748.0	20542.0	608.0	806.0	77573.0	1317.0			
691.0	201.0	61.0	749.0	21189.0	617.0	807.0	78984.0	1333.0			
692.0	264.0	67.0	750.0	21846.0	625.0	808.0	80411.0	1350.0			
693.0	343.0	74.0	751.0	22512.0	633.0	809.0	81855.0	1367.0			
694.0	434.0	82.0	752.0	23187.0	642.0	810.0	83319.0	1383.0			
695.0	532.0	89.0	753.0	23870.0	650.0	811.0	84803.0	1400.0			
696.0	639.0	97.0	754.0	24563.0	658.0	812.0	86304.0	1414.0			
697.0	753.0	106.0	755.0	25264.0	667.0	813.0	87822.0	1429.0			
698.0	877.0	111.0	756.0	25977.0	675.0	814.0	89357.0	1443.0			
699.0	1012.0	114.0	757.0	26700.0	683.0	815.0	90908.0	1457.0			
700.0	1157.0	116.0	758.0	27433.0	692.0	816.0	92476.0	1471.0			
701.0	1312.0	120.0	759.0	28175.0	700.0	817.0	94060.0	1486.0			
702.0	1478.0	121.0	760.0	28929.0	709.0	818.0	95658.0	1500.0			
703.0	1655.0	125.0	761.0	29695.0	718.0	819.0	97270.0	1514.0			
704.0	1840.0	127.0	762.0	30472.0	727.0	820.0	98899.0	1529.0			
705.0	2032.0	130.0	763.0	31260.0	736.0	821.0	100542.0	1543.0			
706.0	2233.0	132.0	764.0	32057.0	745.0	822.0	102199.0	1557.0			
707.0	2445.0	136.0	765.0	32867.0	755.0	823.0	103870.0	1571.0			
708.0	2668.0	142.0	766.0	33689.0	764.0	824.0	105555.0	1586.0			
709.0	2902.0	151.0	767.0	34521.0	773.0	825.0	107254.0	1600.0			
710.0	3146.0	160.0	768.0	35364.0	782.0	826.0	108967.0	1614.0			
711.0	3403.0	171.0	769.0	36218.0	791.0	827.0	110696.0	1629.0			
712.0	3674.0	181.0	770.0	37082.0	800.0	828.0	112437.0	1643.0			
713.0	3956.0	192.0	771.0	37957.0	813.0	829.0	114192.0	1657.0			
714.0	4250.0	202.0	772.0	38843.0	825.0	830.0	115960.0	1671.0			
715.0	4552.0	214.0	773.0	39742.0	838.0	831.0	117742.0	1686.0			
716.0	4866.0	225.0	774.0	40652.0	850.0	832.0	119536.0	1700.0			
717.0	5191.0	237.0	775.0	41575.0	863.0	833.0	121342.0	1717.0			
718.0	5526.0	246.0	776.0	42510.0	875.0	834.0	123162.0	1733.0			
719.0	5874.0	250.0	777.0	43459.0	888.0	835.0	124995.0	1750.0			
720.0	6234.0	256.0	778.0	44423.0	900.0	836.0	126842.0	1767.0			
721.0	6606.0	262.0	779.0	45401.0	917.0	837.0	128704.0	1783.0			
722.0	6991.0	266.0	780.0	46393.0	933.0	838.0	130581.0	1800.0			
723.0	7386.0	273.0	781.0	47398.0	950.0	839.0	132474.0	1825.0			
724.0	7791.0	277.0	782.0	48418.0	967.0	840.0	134383.0	1850.0			
725.0	8204.0	283.0	783.0	49453.0	983.0						
726.0	8626.0	289.0	784.0	50504.0	1000.0						
727.0	9059.0	294.0	785.0	51569.0	1013.0						
728.0	9505.0	306.0	786.0	52649.0	1025.0						
729.0	9962.0	325.0	787.0	53747.0	1038.0						
730.0	10429.0	344.0	788.0	54865.0	1050.0						
731.0	10909.0	364.0	789.0	55998.0	1063.0						
732.0	11400.0	384.0	790.0	57147.0	1075.0						
733.0	11900.0	405.0	791.0	58310.0	1088.0						
734.0	12409.0	427.0	792.0	59487.0	1100.0						
735.0	12928.0	449.0	793.0	60679.0	1111.0						
736.0	13458.0	479.0	794.0	61885.0	1122.0						
737.0	13999.0	490.0	795.0	63106.0	1133.0						

Table A11. Dorena Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre	feet	Ac-ft	acre
740.0	35.0	0.0	798.0	26500.0	800.0	856.0	121800.0	2200.0			
741.0	59.0	3.0	799.0	27500.0	900.0	857.0	124100.0	2200.0			
742.0	91.0	5.0	800.0	28500.0	900.0	858.0	126400.0	2200.0			
743.0	130.0	6.0	801.0	29500.0	900.0	859.0	128700.0	2300.0			
744.0	179.0	11.0	802.0	30500.0	900.0	860.0	131100.0	2300.0			
745.0	237.0	15.0	803.0	31600.0	900.0						
746.0	307.0	24.0	804.0	32600.0	1000.0						
747.0	388.0	32.0	805.0	33700.0	1000.0						
748.0	482.0	39.0	806.0	34800.0	1000.0						
749.0	590.0	49.0	807.0	35900.0	1000.0						
750.0	712.0	58.0	808.0	37000.0	1100.0						
751.0	849.0	70.0	809.0	38200.0	1100.0						
752.0	1000.0	81.0	810.0	39400.0	1100.0						
753.0	1166.0	94.0	811.0	40600.0	1100.0						
754.0	1348.0	108.0	812.0	41800.0	1100.0						
755.0	1547.0	122.0	813.0	43000.0	1100.0						
756.0	1762.0	137.0	814.0	44300.0	1200.0						
757.0	1995.0	151.0	815.0	45600.0	1200.0						
758.0	2247.0	166.0	816.0	46900.0	1200.0						
759.0	2518.0	182.0	817.0	48300.0	1200.0						
760.0	2809.0	199.0	818.0	49700.0	1200.0						
761.0	3119.0	215.0	819.0	51100.0	1300.0						
762.0	3448.0	233.0	820.0	52500.0	1300.0						
763.0	3797.0	252.0	821.0	53900.0	1300.0						
764.0	4166.0	271.0	822.0	55400.0	1400.0						
765.0	4555.0	291.0	823.0	56900.0	1400.0						
766.0	4966.0	310.0	824.0	58500.0	1400.0						
767.0	5399.0	329.0	825.0	60100.0	1400.0						
768.0	5855.0	349.0	826.0	61700.0	1400.0						
769.0	6333.0	369.0	827.0	63300.0	1500.0						
770.0	6835.0	389.0	828.0	65000.0	1500.0						
771.0	7355.0	411.0	829.0	66700.0	1600.0						
772.0	7886.0	433.0	830.0	68500.0	1600.0						
773.0	8428.0	456.0	831.0	70300.0	1600.0						
774.0	8980.0	478.0	832.0	72100.0	1600.0						
775.0	9543.0	502.0	833.0	73900.0	1700.0						
776.0	10100.0	520.0	834.0	75700.0	1700.0						
777.0	10700.0	531.0	835.0	77600.0	1800.0						
778.0	11300.0	542.0	836.0	79500.0	1800.0						
779.0	11900.0	552.0	837.0	81400.0	1800.0						
780.0	12500.0	563.0	838.0	83400.0	1800.0						
781.0	13200.0	557.0	839.0	85300.0	1800.0						
782.0	13800.0	600.0	840.0	87300.0	1900.0						
783.0	14500.0	600.0	841.0	89300.0	1900.0						
784.0	15200.0	600.0	842.0	91400.0	1900.0						
785.0	15800.0	600.0	843.0	93400.0	2000.0						
786.0	16600.0	600.0	844.0	95500.0	2000.0						
787.0	17300.0	600.0	845.0	97600.0	2000.0						
788.0	18000.0	700.0	846.0	99700.0	2000.0						
789.0	18800.0	700.0	847.0	101800.0	2100.0						
790.0	19600.0	700.0	848.0	104000.0	2100.0						
791.0	20400.0	700.0	849.0	106100.0	2100.0						
792.0	21200.0	700.0	850.0	108300.0	2100.0						
793.0	22000.0	700.0	851.0	110600.0	2100.0						
794.0	22900.0	800.0	852.0	112800.0	2100.0						
795.0	23800.0	800.0	853.0	115000.0	2100.0						
796.0	24700.0	800.0	854.0	117300.0	2100.0						
797.0	25600.0	800.0	855.0	119500.0	2200.0						

Table A12. Cottage Grove Storage Elevation Table.

Elevation	Storage	Area	Elevation	Storage	Area
feet	Ac-ft	acre	feet	Ac-ft	acre
Cottage Grove			**Cottage Grove**		
720.0	3.0	0.0	777.0	18800.0	820.0
721.0	9.0	1.0	778.0	19600.0	840.0
722.0	15.0	2.0	779.0	20500.0	860.0
723.0	23.0	6.0	780.0	21500.0	880.0
724.0	33.0	6.0	781.0	22400.0	900.0
725.0	44.0	8.0	782.0	23400.0	920.0
726.0	58.0	10.0	783.0	24300.0	940.0
727.0	75.0	11.0	784.0	25400.0	960.0
728.0	95.0	14.0	785.0	26400.0	980.0
729.0	120.0	17.0	786.0	27400.0	1000.0
730.0	150.0	20.0	787.0	28500.0	1020.0
731.0	185.0	25.0	788.0	29600.0	1040.0
732.0	227.0	30.0	789.0	30700.0	1060.0
733.0	276.0	35.0	790.0	31800.0	1080.0
734.0	333.0	42.0	791.0	32900.0	1100.0
735.0	399.0	49.0	792.0	34100.0	1120.0
736.0	475.0	57.0	793.0	35300.0	1140.0
737.0	565.0	66.0	794.0	36500.0	1160.0
738.0	669.0	76.0	795.0	37700.0	1180.0
739.0	789.0	90.0	796.0	38900.0	1200.0
740.0	925.0	104.0	797.0	40200.0	1214.0
741.0	1077.0	120.0	798.0	41400.0	1229.0
742.0	1245.0	136.0	799.0	42700.0	1243.0
743.0	1427.0	152.0	800.0	44000.0	1257.0
744.0	1627.0	168.0	801.0	45400.0	1271.0
745.0	1843.0	182.0	802.0	46700.0	1286.0
746.0	2075.0	200.0	803.0	48000.0	1300.0
747.0	2320.0	216.0	804.0	49400.0	1325.0
748.0	2578.0	232.0	805.0	50800.0	1350.0
749.0	2851.0	245.0			
750.0	3139.0	258.0			
751.0	3444.0	273.0			
752.0	3768.0	288.0			
753.0	4112.0	305.0			
754.0	4478.0	324.0			
755.0	4865.0	344.0			
756.0	5274.0	366.0			
757.0	5707.0	387.0			
758.0	6164.0	409.0			
759.0	6646.0	433.0			
760.0	7153.0	457.0			
761.0	7682.0	482.0			
762.0	8228.0	507.0			
763.0	8791.0	529.0			
764.0	9373.0	546.0			
765.0	9973.0	563.0			
766.0	10600.0	582.0			
767.0	11200.0	591.0			
768.0	11900.0	600.0			
769.0	12600.0	625.0			
770.0	13300.0	650.0			
771.0	14000.0	675.0			
772.0	14700.0	700.0			
773.0	15500.0	725.0			
774.0	16300.0	750.0			
775.0	17100.0	775.0			
776.0	17900.0	800.0			

Table A13. Fern Ridge Storage Elevation Table.

Elevation	Storage	Area
feet	Ac-ft	acre
Fern Ridge		
347.0	0.0	0.0
348.0	13.0	40.0
349.0	182.0	350.0
350.0	605.0	500.0
351.0	1179.0	650.0
352.0	1901.0	800.0
353.0	2802.0	1000.0
354.0	3897.0	1200.0
355.0	5247.0	1500.0
356.0	6896.0	1800.0
357.0	8844.0	2100.0
358.0	11100.0	2400.0
359.0	13700.0	2750.0
360.0	16600.0	3100.0
361.0	19900.0	3450.0
362.0	23500.0	3800.0
363.0	27500.0	4200.0
364.0	31900.0	4700.0
365.0	36900.0	5200.0
366.0	42300.0	5700.0
367.0	48300.0	6200.0
368.0	54700.0	6700.0
369.0	61700.0	7200.0
370.0	69100.0	7550.0
371.0	76800.0	7850.0
372.0	84800.0	8150.0
373.0	93000.0	8450.0
374.0	101600.0	8750.0
375.0	110500.0	9000.0

1.2 Spillway Capacity Tables

Table A14. Cottage Grove and Dorena Uncontrolled Outlet Flow.

Cottage Grove		Dorena	
Elev. (feet)	Outflow (cfs)	Elev. (feet)	Outflow (cfs)
791.0	0.0	835.0	0.0
792.0	810.0	836.0	800.0
793.0	2380.0	837.0	1700.0
794.0	4530.0	838.0	3200.0
795.0	7200.0	839.0	5025.0
796.0	10400.0	840.0	7125.0
797.0	14000.0	841.0	9800.0
798.0	18000.0	842.0	12150.0
799.0	22500.0	843.0	15075.0
800.0	27300.0	844.0	18250.0
801.0	32400.0	845.0	21675.0
802.0	37600.0	846.0	25325.0
802.6	40800.0	847.0	29300.0
803.0	43100.0	848.0	33300.0
804.0	48600.0	849.0	37825.0
805.0	54300.0	850.0	42175.0
806.0	60300.0	851.0	46925.0
807.0	66400.0	852.0	51875.0
808.0	72700.0	853.0	57000.0
		854.0	62300.0
		855.0	67775.0
		856.0	73425.0
		857.0	79225.0
		858.0	85175.0
		859.0	91275.0
		860.0	97500.0

Table A15. Big Cliff Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
1161.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1163.0	90	180	260	280	280	280	280	280	280	280	280	280	280	280	280	280
1164.0	110	210	310	400	490	580	600	600	600	600	600	600	600	600	600	600
1165.0	120	240	350	460	570	670	770	860	960	960	960	960	960	960	960	960
1166.0	0	260	390	510	630	750	860	970	1080	1190	1290	1290	1290	1290	1290	1290
1167.0	0	280	420	560	690	820	950	1070	1190	1310	1430	1540	1650	1650	1650	1650
1168.0	0	310	450	600	750	890	1030	1160	1300	1430	1560	1680	1810	1930	2040	2040
1169.0	0	320	480	640	800	950	1100	1250	1390	1540	1680	1820	1950	2080	2220	2340
1170.0	0	340	510	680	840	1010	1170	1330	1480	1640	1790	1940	2090	2230	2370	2510
1171.0	0	360	540	710	890	1060	1230	1400	1570	1730	1890	2050	2210	2370	2520	2670
1172.0	0	0	560	750	930	1110	1290	1470	1650	1820	1990	2160	2330	2500	2660	2830
1173.0	0	0	590	780	970	1160	1350	1540	1720	1910	2090	2270	2450	2620	2800	2970
1174.0	0	0	610	810	1010	1210	1410	1600	1800	1990	2180	2370	2550	2740	2920	3110
1175.0	0	0	630	840	1050	1260	1460	1660	1870	2070	2260	2460	2660	2850	3050	3240
1176.0	0	0	660	870	1090	1300	1510	1720	1930	2140	2350	2550	2760	2960	3160	3360
1177.0	0	0	0	900	1120	1340	1560	1780	2000	2210	2430	2640	2860	3070	3280	3480
1178.0	0	0	0	930	1160	1380	1610	1840	2060	2290	2510	2730	2950	3170	3380	3600
1179.0	0	0	0	950	1190	1420	1660	1890	2120	2350	2580	2810	3040	3270	3490	3710
1180.0	0	0	0	980	1220	1460	1700	1940	2180	2420	2660	2890	3130	3360	3590	3820
1181.0	0	0	0	1000	1250	1500	1750	1990	2240	2490	2730	2970	3210	3450	3690	3930
1182.0	0	0	0	1030	1280	1540	1790	2040	2300	2550	2800	3050	3300	3540	3790	4040
1183.0	0	0	0	0	1310	1570	1830	2090	2350	2610	2870	3120	3380	3630	3880	4140
1184.0	0	0	0	0	1340	1610	1880	2140	2410	2670	2930	3200	3460	3720	3980	4240
1185.0	0	0	0	0	1370	1640	1920	2190	2460	2730	3000	3270	3530	3800	4070	4330
1186.0	0	0	0	0	1400	1680	1960	2230	2510	2790	3060	3340	3610	3880	4160	4430
1187.0	0	0	0	0	1430	1710	2000	2280	2560	2840	3120	3400	3690	3960	4240	4520
1188.0	0	0	0	0	0	1740	2030	2320	2610	2900	3190	3470	3760	4040	4330	4610
1189.0	0	0	0	0	0	1780	2070	2370	2660	2950	3250	3540	3830	4120	4410	4700
1190.0	0	0	0	0	0	1810	2110	2410	2710	3010	3300	3600	3900	4200	4490	4790
1191.0	0	0	0	0	0	1840	2140	2450	2750	3060	3360	3670	3970	4270	4570	4870
1192.0	0	0	0	0	0	1870	2180	2490	2800	3110	3420	3730	4040	4340	4650	4960
1193.0	0	0	0	0	0	1900	2220	2530	2850	3160	3480	3790	4100	4420	4730	5040
1194.0	0	0	0	0	0	0	2250	2570	2890	3210	3530	3850	4170	4490	4810	5120
1195.0	0	0	0	0	0	0	2280	2610	2930	3260	3580	3910	4230	4560	4880	5200
1196.0	0	0	0	0	0	0	2320	2650	2980	3310	3640	3970	4300	4630	4950	5280
1197.0	0	0	0	0	0	0	2350	2690	3020	3360	3690	4030	4360	4690	5030	5360
1198.0	0	0	0	0	0	0	2380	2720	3060	3400	3740	4080	4420	4760	5100	5440
1199.0	0	0	0	0	0	0	0	2760	3100	3450	3790	4140	4480	4830	5170	5510
1200.0	0	0	0	0	0	0	0	2800	3150	3500	3840	4190	4540	4890	5240	5590
1201.0	0	0	0	0	0	0	0	2830	3190	3540	3890	4250	4600	4960	5310	5660
1202.0	0	0	0	0	0	0	0	2870	3230	3580	3940	4300	4660	5020	5380	5740
1203.0	0	0	0	0	0	0	0	2900	3270	3630	3990	4360	4720	5080	5440	5810
1204.0	0	0	0	0	0	0	0	2940	3300	3670	4040	4410	4780	5140	5510	5880
1205.0	0	0	0	0	0	0	0	0	3340	3720	4090	4460	4830	5200	5580	5950
1206.0	0	0	0	0	0	0	0	0	3380	3760	4130	4510	4890	5260	5640	6020
1207.0	0	0	0	0	0	0	0	0	3420	3800	4180	4560	4940	5320	5710	6090
1208.0	0	0	0	0	0	0	0	0	0	3800	4230	4610	5000	5380	5770	6150
1209.0	0	0	0	0	0	0	0	0	0	3800	4230	4610	5000	5380	5770	6150
1210.0	0	0	0	0	0	0	0	0	0	3800	4230	4610	5000	5380	5770	6150

(Table continued on next page.)

Table A15. Big Cliff Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
1161.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1163.0	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280
1164.0	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
1165.0	960	960	960	960	960	960	960	960	960	960	960	960	960	960	960
1166.0	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290
1167.0	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
1168.0	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040
1169.0	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470
1170.0	2650	2790	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920
1171.0	2820	2970	3120	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260
1172.0	2990	3150	3300	3460	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760
1173.0	3140	3310	3480	3640	3970	4280	4280	4280	4280	4280	4280	4280	4280	4280	4280
1174.0	3290	3470	3640	3820	4160	4500	4830	4830	4830	4830	4830	4830	4830	4830	4830
1175.0	3430	3620	3800	3990	4350	4710	5060	5400	5400	5400	5400	5400	5400	5400	5400
1176.0	3560	3760	3950	4150	4530	4910	5280	5640	6000	6000	6000	6000	6000	6000	6000
1177.0	3690	3900	4100	4310	4710	5100	5490	5870	6250	6620	6620	6620	6620	6620	6620
1178.0	3820	4030	4240	4460	4870	5290	5690	6100	6490	6880	7260	7260	7260	7260	7260
1179.0	3940	4160	4380	4600	5040	5470	5890	6310	6720	7130	7530	7920	7920	7920	7920
1180.0	4060	4290	4510	4740	5190	5640	6080	6520	6950	7370	7790	8200	8600	8600	8600
1181.0	4170	4410	4640	4880	5350	5810	6260	6720	7160	7600	8040	8470	8890	9310	9310
1182.0	4280	4530	4770	5010	5490	5970	6440	6910	7370	7830	8280	8730	9170	9610	10030
1183.0	4390	4640	4890	5140	5640	6130	6620	7100	7580	8050	8520	8980	9440	9890	10340
1184.0	4500	4750	5010	5270	5780	6280	6790	7280	7780	8270	8750	9230	9700	10170	10640
1185.0	4600	4860	5130	5390	5920	6440	6950	7460	7970	8480	8980	9470	9960	10450	10920
1186.0	4700	4970	5240	5510	6050	6580	7110	7640	8160	8680	9200	9710	10210	10710	11210
1187.0	4800	5080	5350	5630	6180	6730	7270	7810	8350	8880	9410	9930	10450	10970	11480
1188.0	4900	5180	5460	5750	6310	6870	7430	7980	8530	9080	9620	10160	10690	11220	11750
1189.0	4990	5280	5570	5860	6440	7010	7580	8140	8710	9270	9820	10380	10930	11470	12010
1190.0	5090	5380	5680	5970	6560	7140	7730	8310	8880	9460	10020	10590	11150	11710	12270
1191.0	5180	5480	5780	6080	6680	7280	7870	8460	9050	9640	10220	10800	11380	11950	12520
1192.0	5270	5570	5880	6190	6800	7410	8010	8620	9220	9820	10410	11010	11600	12180	12760
1193.0	5360	5670	5980	6290	6920	7540	8160	8770	9390	10000	10600	11210	11810	12410	13000
1194.0	5440	5760	6080	6400	7030	7660	8290	8920	9550	10170	10790	11410	12020	12630	13240
1195.0	5530	5850	6180	6500	7140	7790	8430	9070	9710	10340	10970	11600	12230	12850	13470
1196.0	5610	5940	6270	6600	7260	7910	8560	9210	9860	10510	11150	11800	12430	13070	13700
1197.0	5700	6030	6360	6700	7370	8030	8690	9360	10020	10670	11330	11980	12630	13280	13930
1198.0	5780	6120	6460	6800	7470	8150	8820	9500	10170	10840	11510	12170	12830	13490	14150
1199.0	5860	6200	6550	6890	7580	8270	8950	9640	10320	11000	11680	12350	13030	13700	14370
1200.0	5940	6290	6640	6990	7690	8380	9080	9770	10470	11160	11850	12530	13220	13900	14580
1201.0	6020	6370	6730	7080	7790	8500	9200	9910	10610	11310	12010	12710	13410	14100	14790
1202.0	6100	6450	6810	7170	7890	8610	9320	10040	10750	11470	12180	12890	13590	14300	15000
1203.0	6170	6540	6900	7260	7990	8720	9450	10170	10900	11620	12340	13060	13780	14500	15210
1204.0	6250	6620	6990	7350	8090	8830	9570	10300	11040	11770	12500	13230	13960	14690	15410
1205.0	6320	6700	7070	7440	8190	8940	9680	10430	11170	11920	12660	13400	14140	14880	15610
1206.0	6400	6770	7150	7530	8290	9040	9800	10560	11310	12060	12820	13570	14320	15060	15810
1207.0	6470	6850	7240	7620	8380	9150	9920	10680	11440	12210	12970	13730	14490	15250	16010
1208.0	6540	6930	7320	7700	8480	9250	10030	10800	11580	12350	13120	13890	14660	15430	16200
1209.0	6610	7010	7400	7790	8570	9360	10140	10930	11710	12490	13270	14050	14830	15610	16390
1210.0	6610	7010	7400	7790	8670	9460	10250	11050	11840	12630	13420	14210	15000	15790	16580

(Table continued on next page.)

Table A15. Big Cliff Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
1161.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1163.0	280	280	280	280	280	280	280	280	280	280	280	280	280	280
1164.0	600	600	600	600	600	600	600	600	600	600	600	600	600	600
1165.0	960	960	960	960	960	960	960	960	960	960	960	960	960	960
1166.0	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290	1290
1167.0	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
1168.0	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040	2040
1169.0	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470	2470
1170.0	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920	2920
1171.0	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260	3260
1172.0	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760	3760
1173.0	4280	4280	4280	4280	4280	4280	4280	4280	4280	4280	4280	4280	4280	4280
1174.0	4830	4830	4830	4830	4830	4830	4830	4830	4830	4830	4830	4830	4830	4830
1175.0	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400	5400
1176.0	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
1177.0	6620	6620	6620	6620	6620	6620	6620	6620	6620	6620	6620	6620	6620	6620
1178.0	7260	7260	7260	7260	7260	7260	7260	7260	7260	7260	7260	7260	7260	7260
1179.0	7920	7920	7920	7920	7920	7920	7920	7920	7920	7920	7920	7920	7920	7920
1180.0	8600	8600	8600	8600	8600	8600	8600	8600	8600	8600	8600	8600	8600	8600
1181.0	9310	9310	9310	9310	9310	9310	9310	9310	9310	9310	9310	9310	9310	9310
1182.0	10030	10030	10030	10030	10030	10030	10030	10030	10030	10030	10030	10030	10030	10030
1183.0	10780	10780	10780	10780	10780	10780	10780	10780	10780	10780	10780	10780	10780	10780
1184.0	11090	11540	11540	11540	11540	11540	11540	11540	11540	11540	11540	11540	11540	11540
1185.0	11400	11870	12330	12330	12330	12330	12330	12330	12330	12330	12330	12330	12330	12330
1186.0	11700	12180	12660	13130	13130	13130	13130	13130	13130	13130	13130	13130	13130	13130
1187.0	11990	12490	12980	13470	13960	13960	13960	13960	13960	13960	13960	13960	13960	13960
1188.0	12270	12790	13300	13800	14300	14800	14800	14800	14800	14800	14800	14800	14800	14800
1189.0	12550	13080	13600	14120	14640	15150	15660	15660	15660	15660	15660	15660	15660	15660
1190.0	12820	13360	13900	14440	14970	15500	16020	16540	16540	16540	16540	16540	16540	16540
1191.0	13080	13640	14200	14750	15300	15840	16370	16910	17430	17430	17430	17430	17430	17430
1192.0	13340	13920	14490	15050	15610	16170	16720	17270	17810	17810	17810	17810	17810	17810
1193.0	13600	14180	14770	15350	15920	16490	17060	17620	18180	18180	18180	18180	18180	18180
1194.0	13850	14450	15040	15640	16230	16810	17390	17970	18540	19670	19670	19670	19670	19670
1195.0	14090	14710	15320	15920	16530	17120	17720	18310	18900	20060	20060	20060	20060	20060
1196.0	14330	14960	15580	16200	16820	17430	18040	18640	19240	20430	21600	21600	21600	21600
1197.0	14570	15210	15850	16480	17110	17730	18350	18970	19590	20800	22000	22000	22000	22000
1198.0	14800	15460	16100	16750	17390	18030	18660	19300	19920	21170	22390	23630	23630	23630
1199.0	15030	15700	16360	17020	17670	18320	18970	19610	20250	21520	22780	24040	24040	24040
1200.0	15260	15940	16610	17280	17950	18610	19270	19930	20580	21870	23150	24450	25740	25740
1201.0	15480	16170	16860	17540	18220	18890	19560	20230	20900	22220	23530	24850	26170	26170
1202.0	15700	16400	17100	17790	18480	19170	19850	20540	21210	22560	23890	25240	26590	27930
1203.0	15920	16630	17340	18040	18750	19450	20140	20830	21530	22900	24250	25630	27000	28370
1204.0	16140	16860	17580	18290	19010	19720	20420	21130	21830	23230	24610	26010	27410	28810
1205.0	16350	17080	17810	18540	19260	19980	20700	21420	22130	23550	24960	26380	27810	29240
1206.0	16560	17300	18040	18780	19510	20250	20980	21710	22430	23870	25310	26750	28210	29660
1207.0	16760	17520	18270	19020	19760	20510	21250	21990	22730	24190	25650	27120	28600	30080
1208.0	16970	17730	18490	19250	20010	20760	21520	22270	23020	24510	25980	27480	28990	30490
1209.0	17170	17940	18710	19480	20250	21020	21780	22540	23300	24810	26310	27830	29370	30890
1210.0	17370	18150	18930	19710	20490	21270	22040	22820	23590	25120	26640	28190	29740	31290

(Table continued on next page.)

Table A15. Big Cliff Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.				Total Max Capacity
(feet)	21.0	22.0	22.01	44.50	
1161.5	0	0	0	0	0
1163.0	280	280	200	200	600
1164.0	600	600	420	420	1260
1165.0	960	960	700	700	2100
1166.0	1290	1290	1140	1140	3420
1167.0	1650	1650	1580	1580	4740
1168.0	2040	2040	2060	2060	6180
1169.0	2470	2470	2580	2580	7740
1170.0	2920	2920	3100	3100	9300
1171.0	3260	3260	3840	3840	11520
1172.0	3760	3760	4580	4580	13740
1173.0	4280	4280	5400	5400	16200
1174.0	4830	4830	6220	6220	18660
1175.0	5400	5400	7110	7110	21330
1176.0	6000	6000	8000	8000	24000
1177.0	6620	6620	8960	8960	26880
1178.0	7260	7260	9920	9920	29760
1179.0	7920	7920	10950	10950	32850
1180.0	8600	8600	11980	11980	35940
1181.0	9310	9310	13080	13080	39240
1182.0	10030	10030	14180	14180	42540
1183.0	10780	10780	15350	15350	46050
1184.0	11540	11540	16520	16520	49560
1185.0	12330	12330	17760	17760	53280
1186.0	13130	13130	19000	19000	57000
1187.0	13960	13960	20310	20310	60930
1188.0	14800	14800	21620	21620	64860
1189.0	15660	15660	23000	23000	69000
1190.0	16540	16540	24380	24380	73140
1191.0	17430	17430	25830	25830	77490
1192.0	17810	17810	27280	27280	81840
1193.0	18180	18180	28800	28800	86400
1194.0	19670	19670	30320	30320	90960
1195.0	20060	20060	31910	31910	95730
1196.0	21600	21600	33500	33500	100500
1197.0	22000	22000	35160	35160	105480
1198.0	23630	23630	36820	36820	110460
1199.0	24040	24040	38540	38540	115620
1200.0	25740	25740	40260	40260	120780
1201.0	26170	26170	42070	42070	126210
1202.0	27930	27930	43880	43880	131640
1203.0	28370	28370	45750	45750	137250
1204.0	30190	30190	47620	47620	142860
1205.0	30650	30650	49560	49560	148680
1206.0	31100	32380	51500	51500	154500
1207.0	31540	32850	53510	53510	160530
1208.0	31980	33310	55520	55520	166560
1209.0	32410	33770	57595	57595	172785
1210.0	32830	34220	59667	59667	179001

Table A16. Detroit Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
1541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1543	90	170	250	330	390	390	390	390	390	390	390	390	390	390	390	390
1544	100	200	290	380	470	560	640	720	720	720	720	720	720	720	720	720
1545	110	220	320	430	530	630	720	810	900	990	1080	1080	1080	1080	1080	1080
1546	120	240	350	470	580	690	800	900	1000	1100	1200	1300	1390	1390	1390	1390
1547	130	260	380	500	630	750	860	980	1090	1210	1320	1420	1530	1630	1730	1730
1548	140	270	410	540	670	800	930	1050	1180	1300	1420	1540	1660	1770	1880	2000
1549	150	290	430	570	710	850	990	1120	1260	1390	1520	1650	1780	1900	2030	2150
1550	150	300	450	600	750	900	1040	1190	1330	1470	1610	1750	1890	2020	2160	2290
1551	160	320	480	630	790	940	1100	1250	1400	1550	1700	1850	1990	2140	2280	2420
1552	170	330	500	660	820	990	1150	1310	1470	1630	1780	1940	2090	2250	2400	2550
1553	170	350	520	690	860	1030	1200	1360	1530	1700	1860	2030	2190	2350	2510	2670
1554	180	360	540	710	890	1070	1240	1420	1590	1760	1940	2110	2280	2450	2620	2790
1555	190	370	550	740	920	1100	1290	1470	1650	1830	2010	2190	2370	2550	2720	2900
1556	190	380	570	760	950	1140	1330	1520	1710	1890	2080	2270	2450	2640	2820	3000
1557	200	390	590	790	980	1180	1370	1570	1760	1960	2150	2340	2530	2730	2920	3110
1558	200	410	610	810	1010	1210	1410	1610	1820	2020	2220	2410	2610	2810	3010	3210
1559	210	420	620	830	1040	1250	1450	1660	1870	2070	2280	2490	2690	2900	3100	3310
1560	210	430	640	850	1070	1280	1490	1700	1920	2130	2340	2550	2770	2980	3190	3400
1561	220	440	660	870	1090	1310	1530	1750	1970	2180	2400	2620	2840	3060	3270	3490
1562	220	450	670	890	1120	1340	1570	1790	2010	2240	2460	2690	2910	3130	3360	3580
1563	230	460	690	910	1140	1370	1600	1830	2060	2290	2520	2750	2980	3210	3440	3670
1564	230	470	700	930	1170	1400	1640	1870	2110	2340	2580	2810	3050	3280	3520	3750
1565	240	480	710	950	1190	1430	1670	1910	2150	2390	2630	2870	3110	3350	3590	3840
1566	240	490	730	970	1220	1460	1700	1950	2200	2440	2690	2930	3180	3420	3670	3920
1567	250	490	740	990	1240	1490	1740	1990	2240	2490	2740	2990	3240	3490	3740	4000
1568	250	500	760	1010	1260	1520	1770	2030	2280	2540	2790	3050	3300	3560	3820	4070
1569	260	510	770	1030	1280	1540	1800	2060	2320	2580	2840	3100	3370	3630	3890	4150
1570	260	520	780	1040	1310	1570	1830	2100	2360	2630	2890	3160	3430	3690	3960	4230
1571	260	530	800	1060	1330	1600	1860	2130	2400	2670	2940	3210	3480	3760	4030	4300
1572	270	540	810	1080	1350	1620	1890	2170	2440	2720	2990	3270	3540	3820	4100	4370
1573	270	540	810	1080	1350	1620	1920	2200	2480	2760	3040	3320	3600	3880	4160	4450
1574	270	540	810	1080	1350	1620	1920	2200	2480	2760	3040	3320	3600	3940	4230	4520

(Table continued on next page.)

Table A16. Detroit Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
1541	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1543	390	390	390	390	390	390	390	390	390	390	390	390	390	390	390
1544	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720
1545	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080
1546	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390
1547	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730
1548	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100
1549	2270	2380	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
1550	2420	2550	2680	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800
1551	2560	2700	2840	2980	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240
1552	2700	2850	3000	3140	3430	3710	3710	3710	3710	3710	3710	3710	3710	3710	3710
1553	2830	2990	3140	3300	3610	3910	4200	4200	4200	4200	4200	4200	4200	4200	4200
1554	2950	3120	3280	3450	3770	4090	4410	4720	4720	4720	4720	4720	4720	4720	4720
1555	3070	3250	3420	3590	3940	4270	4610	4930	5260	5260	5260	5260	5260	5260	5260
1556	3190	3370	3550	3730	4090	4450	4800	5140	5480	5820	5820	5820	5820	5820	5820
1557	3300	3490	3680	3860	4240	4610	4980	5340	5700	6050	6400	6400	6400	6400	6400
1558	3400	3600	3800	3990	4380	4770	5150	5530	5910	6280	6640	7010	7010	7010	7010
1559	3510	3710	3910	4120	4520	4920	5320	5720	6110	6500	6880	7260	7630	7630	7630
1560	3610	3820	4030	4240	4660	5070	5490	5900	6300	6710	7110	7500	7890	8280	8280
1561	3710	3920	4140	4360	4790	5220	5650	6070	6490	6910	7330	7740	8150	8550	8950
1562	3800	4030	4250	4470	4920	5360	5800	6240	6680	7110	7540	7970	8390	8810	9220
1563	3900	4120	4350	4580	5040	5500	5950	6410	6860	7300	7750	8190	8630	9060	9490
1564	3990	4220	4460	4690	5160	5630	6100	6570	7030	7490	7950	8410	8860	9310	9760
1565	4080	4320	4560	4800	5280	5760	6240	6720	7200	7680	8150	8620	9090	9550	10010
1566	4160	4410	4650	4900	5400	5890	6380	6880	7370	7850	8340	8820	9310	9780	10260
1567	4250	4500	4750	5000	5510	6020	6520	7030	7530	8030	8530	9030	9520	10010	10500
1568	4330	4590	4850	5100	5620	6140	6660	7170	7690	8200	8710	9220	9730	10240	10740
1569	4410	4680	4940	5200	5730	6260	6790	7320	7840	8370	8890	9420	9940	10460	10970
1570	4490	4760	5030	5300	5840	6380	6920	7460	8000	8530	9070	9610	10140	10670	11200
1571	4570	4850	5120	5390	5940	6490	7050	7600	8150	8700	9240	9790	10340	10880	11420
1572	4650	4930	5210	5490	6050	6610	7170	7730	8290	8850	9410	9970	10530	11090	11640
1573	4730	5010	5290	5580	6150	6720	7290	7870	8440	9010	9580	10150	10720	11290	11860
1574	4800	5090	5380	5670	6250	6830	7410	8000	8580	9160	9750	10330	10910	11490	12070

(Table continued on next page.)

Table A16. Detroit Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.												Total Max
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	16.0	31.0	Capacity
1541	0	0	0	0	0	0	0	0	0	0	0	0	0
1543	390	390	390	390	390	390	390	390	390	390	420	420	2520
1544	720	720	720	720	720	720	720	720	720	720	720	720	4320
1545	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	1080	6480
1546	1390	1390	1390	1390	1390	1390	1390	1390	1390	1390	1500	1500	9000
1547	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1980	1980	11880
1548	2100	2100	2100	2100	2100	2100	2100	2100	2100	2100	2520	2520	15120
1549	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	3120	3120	18720
1550	2800	2800	2800	2800	2800	2800	2800	2800	2800	2800	3780	3780	22680
1551	3240	3240	3240	3240	3240	3240	3240	3240	3240	3240	4520	4520	27120
1552	3710	3710	3710	3710	3710	3710	3710	3710	3710	3710	5320	5320	31920
1553	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200	6170	6170	37020
1554	4720	4720	4720	4720	4720	4720	4720	4720	4720	4720	7070	7070	42420
1555	5260	5260	5260	5260	5260	5260	5260	5260	5260	5260	8010	8010	48060
1556	5820	5820	5820	5820	5820	5820	5820	5820	5820	5820	8980	8980	53880
1557	6400	6400	6400	6400	6400	6400	6400	6400	6400	6400	9970	9970	59820
1558	7010	7010	7010	7010	7010	7010	7010	7010	7010	7010	10970	10970	65820
1559	7630	7630	7630	7630	7630	7630	7630	7630	7630	7630	11990	11990	71940
1560	8280	8280	8280	8280	8280	8280	8280	8280	8280	8280	13040	13040	78240
1561	8950	8950	8950	8950	8950	8950	8950	8950	8950	8950	14130	14130	84780
1562	9630	9630	9630	9630	9630	9630	9630	9630	9630	9630	15260	15260	91560
1563	9920	10340	10340	10340	10340	10340	10340	10340	10340	10340	16430	16430	98580
1564	10200	10640	11070	11070	11070	11070	11070	11070	11070	11070	17640	17640	105840
1565	10470	10920	11370	11820	11820	11820	11820	11820	11820	11820	18890	18890	113340
1566	10730	11200	11670	12130	12590	12590	12590	12590	12590	12590	20180	20180	121080
1567	10990	11470	11950	12430	12900	13380	13380	13380	13380	13380	21510	21510	129060
1568	11240	11740	12230	12720	13210	13710	14210	14210	14210	14210	22880	22880	137280
1569	11490	12000	12510	13010	13520	14030	14550	14550	14550	14550	24290	24290	145740
1570	11730	12250	12780	13300	13810	14340	14870	15400	15400	15400	25740	25740	154440
1571	11960	12500	13040	13570	14100	14640	15190	15740	16280	16280	27230	27230	163380
1572	12200	12750	13300	13840	14390	14940	15500	16060	16620	16620	28760	28760	172560
1573	12420	12990	13550	14110	14660	15230	15810	16380	16960	18030	30330	30330	181980
1574	12650	13220	13800	14370	14940	15520	16110	16700	17290	18380	31940	31940	191640

Table A17. Green Peter Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
968.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
970	20	100	170	220	220	220	220	220	220	220	220	220	220	220	220	220
971	30	120	210	300	380	460	520	520	520	520	520	520	520	520	520	520
972	30	140	250	350	450	540	630	720	800	800	800	800	800	800	800	800
973	30	160	270	390	500	610	720	820	920	1020	1110	1110	1110	1110	1110	1110
974	40	170	300	430	550	680	790	910	1030	1140	1240	1350	1450	1450	1450	1450
975	40	180	320	460	600	730	860	990	1120	1240	1370	1480	1600	1710	1820	1820
976	40	200	350	500	640	790	930	1070	1210	1340	1480	1610	1740	1860	1990	2110
977	50	210	370	530	680	840	990	1140	1290	1440	1580	1720	1860	2000	2140	2270
978	50	220	390	560	720	880	1050	1210	1370	1520	1680	1830	1980	2130	2280	2420
979	50	230	410	580	760	930	1100	1270	1440	1610	1770	1930	2090	2250	2410	2570
980	50	240	420	610	790	970	1150	1330	1510	1680	1860	2030	2200	2370	2540	2700
981	50	250	440	630	820	1010	1200	1390	1570	1760	1940	2120	2300	2480	2660	2830
982	60	260	460	660	860	1050	1250	1440	1640	1830	2020	2210	2400	2590	2770	2950
983	60	270	470	680	890	1090	1300	1500	1700	1900	2100	2300	2490	2690	2880	3070
984	60	280	490	700	920	1130	1340	1550	1760	1970	2170	2380	2580	2780	2990	3190
985	60	280	510	730	950	1160	1380	1600	1810	2030	2240	2460	2670	2880	3090	3300
986	60	290	520	750	970	1200	1420	1650	1870	2090	2310	2530	2750	2970	3190	3400
987	70	300	530	770	1000	1230	1460	1690	1920	2150	2380	2610	2830	3060	3280	3510
988	70	310	550	790	1030	1270	1500	1740	1980	2210	2450	2680	2910	3150	3380	3610
989	70	320	560	810	1050	1300	1540	1780	2030	2270	2510	2750	2990	3230	3470	3710
990	70	320	570	830	1080	1330	1580	1830	2080	2330	2570	2820	3070	3310	3560	3800
991	70	330	590	850	1100	1360	1610	1870	2130	2380	2630	2890	3140	3390	3640	3890
992	70	340	600	860	1130	1390	1650	1910	2170	2430	2690	2950	3210	3470	3730	3980
993	80	340	610	880	1150	1420	1680	1950	2220	2490	2750	3020	3280	3550	3810	4070
994	80	350	630	900	1170	1450	1720	1990	2260	2540	2810	3080	3350	3620	3890	4160
995	80	360	640	920	1200	1470	1750	2030	2310	2590	2860	3140	3420	3690	3970	4250
996	80	360	650	930	1220	1500	1790	2070	2350	2640	2920	3200	3480	3770	4050	4330
997	80	370	660	950	1240	1530	1820	2110	2400	2680	2970	3260	3550	3840	4120	4410
998	80	380	670	970	1260	1560	1850	2140	2440	2730	3030	3320	3610	3910	4200	4490
999	80	380	680	980	1280	1580	1880	2180	2480	2780	3080	3380	3680	3970	4270	4570
1000	80	390	690	1000	1300	1610	1910	2220	2520	2820	3130	3430	3740	4040	4340	4650
1001	90	400	700	1010	1320	1630	1940	2250	2560	2870	3180	3490	3800	4110	4420	4720
1002	90	400	710	1030	1340	1660	1970	2290	2600	2910	3230	3540	3860	4170	4490	4800
1003	90	410	730	1040	1360	1680	2000	2320	2640	2960	3280	3600	3920	4230	4550	4870
1004	90	410	740	1060	1380	1710	2030	2350	2680	3000	3330	3650	3970	4300	4620	4950
1005	90	420	750	1070	1400	1730	2060	2390	2710	3040	3370	3700	4030	4360	4690	5020
1006	90	420	760	1090	1420	1750	2090	2420	2750	3090	3420	3750	4090	4420	4750	5090
1007	90	430	770	1100	1440	1780	2110	2450	2790	3130	3470	3800	4140	4480	4820	5160
1008	90	430	780	1120	1460	1800	2140	2480	2830	3170	3510	3850	4200	4540	4880	5230
1009	100	440	780	1130	1480	1820	2170	2510	2860	3210	3560	3900	4250	4600	4950	5290
1010	100	450	790	1140	1490	1840	2190	2550	2900	3250	3600	3950	4300	4660	5010	5360
1011	100	450	800	1160	1510	1870	2220	2580	2930	3290	3640	4000	4360	4710	5070	5430
1012	100	460	810	1170	1530	1890	2250	2610	2970	3330	3690	4050	4410	4770	5130	5490
1013	100	460	820	1180	1550	1910	2270	2640	3000	3360	3730	4090	4460	4830	5190	5560
1014	100	470	830	1200	1560	1930	2300	2670	3030	3400	3770	4140	4510	4880	5250	5620
1015	100	470	840	1210	1580	1950	2320	2690	3070	3440	3810	4190	4560	4940	5310	5690

(Table continued on next page.)

Table A17. Green Peter Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.5	4.75	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5
968.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
970	220	220	220	220	220	220	220	220	220	220	220	220	220	220	220
971	520	520	520	520	520	520	520	520	520	520	520	520	520	520	520
972	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
973	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110
974	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
975	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820
976	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220
977	2400	2530	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650
978	2560	2700	2840	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980
979	2720	2870	3020	3170	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460
980	2860	3030	3190	3350	3660	3960	3960	3960	3960	3960	3960	3960	3960	3960	3960
981	3000	3180	3350	3510	3850	4170	4490	4490	4490	4490	4490	4490	4490	4490	4490
982	3140	3320	3500	3680	4030	4370	4710	5040	5040	5040	5040	5040	5040	5040	5040
983	3260	3450	3640	3830	4200	4560	4920	5270	5610	5610	5610	5610	5610	5610	5610
984	3390	3580	3780	3980	4370	4750	5120	5490	5850	6210	6210	6210	6210	6210	6210
985	3500	3710	3920	4120	4530	4920	5320	5710	6090	6460	6830	6830	6830	6830	6830
986	3620	3830	4050	4260	4680	5100	5510	5910	6310	6700	7090	7470	7470	7470	7470
987	3730	3950	4170	4390	4830	5260	5690	6110	6530	6940	7340	7740	8130	8130	8130
988	3840	4070	4290	4520	4970	5420	5870	6300	6740	7160	7590	8000	8410	8820	8820
989	3940	4180	4410	4650	5120	5580	6040	6490	6940	7380	7820	8260	8680	9110	9520
990	4040	4290	4530	4770	5250	5730	6200	6670	7140	7600	8050	8500	8950	9390	9820
991	4140	4390	4640	4890	5390	5880	6370	6850	7330	7800	8280	8740	9200	9660	10110
992	4240	4500	4750	5010	5520	6020	6520	7020	7520	8010	8490	8970	9450	9920	10390
993	4340	4600	4860	5120	5640	6160	6680	7190	7700	8200	8700	9200	9690	10180	10660
994	4430	4700	4970	5230	5770	6300	6830	7350	7880	8400	8910	9420	9930	10430	10930
995	4520	4790	5070	5340	5890	6440	6980	7520	8050	8580	9110	9640	10160	10670	11190
996	4610	4890	5170	5450	6010	6570	7120	7670	8220	8770	9310	9850	10380	10910	11440
997	4700	4980	5270	5560	6130	6700	7260	7830	8390	8950	9500	10050	10600	11150	11690
998	4780	5080	5370	5660	6240	6820	7400	7980	8550	9120	9690	10260	10820	11380	11930
999	4870	5170	5460	5760	6360	6950	7540	8130	8710	9300	9880	10460	11030	11600	12170
1000	4950	5250	5560	5860	6470	7070	7670	8270	8870	9470	10060	10650	11240	11820	12400
1001	5030	5340	5650	5960	6580	7190	7800	8420	9030	9630	10240	10840	11440	12040	12630
1002	5110	5430	5740	6050	6680	7310	7930	8560	9180	9800	10420	11030	11640	12250	12860
1003	5190	5510	5830	6150	6790	7430	8060	8700	9330	9960	10590	11220	11840	12460	13080
1004	5270	5590	5920	6240	6890	7540	8190	8830	9480	10120	10760	11400	12030	12670	13300
1005	5350	5680	6010	6340	6990	7650	8310	8970	9620	10280	10930	11580	12220	12870	13510
1006	5420	5760	6090	6430	7100	7760	8430	9100	9770	10430	11090	11750	12410	13070	13720
1007	5500	5840	6180	6520	7200	7870	8550	9230	9910	10580	11260	11930	12600	13260	13930
1008	5570	5910	6260	6600	7290	7980	8670	9360	10050	10730	11420	12100	12780	13460	14130
1009	5640	5990	6340	6690	7390	8090	8790	9490	10180	10880	11570	12270	12960	13650	14340
1010	5710	6070	6420	6780	7490	8190	8900	9610	10320	11030	11730	12430	13140	13840	14530
1011	5790	6140	6500	6860	7580	8300	9020	9740	10450	11170	11880	12600	13310	14020	14730
1012	5860	6220	6580	6950	7670	8400	9130	9860	10580	11310	12040	12760	13480	14200	14920
1013	5920	6290	6660	7030	7770	8500	9240	9980	10710	11450	12190	12920	13650	14390	15120
1014	5990	6360	6740	7110	7860	8600	9350	10100	10840	11590	12330	13080	13820	14560	15300
1015	6060	6440	6810	7190	7950	8700	9460	10210	10970	11730	12480	13240	13990	14740	15490

(Table continued on next page.)

Table A17. Green Peter Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
968.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
970	220	220	220	220	220	220	220	220	220	220	220	220	220	220
971	520	520	520	520	520	520	520	520	520	520	520	520	520	520
972	800	800	800	800	800	800	800	800	800	800	800	800	800	800
973	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110	1110
974	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450	1450
975	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820
976	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220	2220
977	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650	2650
978	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980	2980
979	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460	3460
980	3960	3960	3960	3960	3960	3960	3960	3960	3960	3960	3960	3960	3960	3960
981	4490	4490	4490	4490	4490	4490	4490	4490	4490	4490	4490	4490	4490	4490
982	5040	5040	5040	5040	5040	5040	5040	5040	5040	5040	5040	5040	5040	5040
983	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610	5610
984	6210	6210	6210	6210	6210	6210	6210	6210	6210	6210	6210	6210	6210	6210
985	6830	6830	6830	6830	6830	6830	6830	6830	6830	6830	6830	6830	6830	6830
986	7470	7470	7470	7470	7470	7470	7470	7470	7470	7470	7470	7470	7470	7470
987	8130	8130	8130	8130	8130	8130	8130	8130	8130	8130	8130	8130	8130	8130
988	8820	8820	8820	8820	8820	8820	8820	8820	8820	8820	8820	8820	8820	8820
989	9520	9520	9520	9520	9520	9520	9520	9520	9520	9520	9520	9520	9520	9520
990	10250	10250	10250	10250	10250	10250	10250	10250	10250	10250	10250	10250	10250	10250
991	10550	10990	10990	10990	10990	10990	10990	10990	10990	10990	10990	10990	10990	10990
992	10850	11300	11750	11750	11750	11750	11750	11750	11750	11750	11750	11750	11750	11750
993	11140	11610	12070	12540	12540	12540	12540	12540	12540	12540	12540	12540	12540	12540
994	11420	11910	12390	12860	13340	13340	13340	13340	13340	13340	13340	13340	13340	13340
995	11690	12200	12690	13190	13670	14150	14150	14150	14150	14150	14150	14150	14150	14150
996	11960	12480	12990	13500	14000	14500	14990	14990	14990	14990	14990	14990	14990	14990
997	12220	12760	13280	13810	14320	14840	15340	15340	15340	15340	15340	15340	15340	15340
998	12480	13030	13570	14110	14640	15170	15690	16210	16210	16210	16210	16210	16210	16210
999	12730	13290	13850	14400	14950	15490	16030	16560	17090	17090	17090	17090	17090	17090
1000	12980	13550	14120	14690	15250	15800	16360	16900	17450	17450	17450	17450	17450	17450
1001	13220	13810	14390	14970	15540	16110	16680	17240	17800	18900	18900	18900	18900	18900
1002	13460	14060	14660	15250	15830	16420	17000	17570	18140	19270	19270	19270	19270	19270
1003	13690	14310	14910	15520	16120	16720	17310	17900	18480	19640	20780	20780	20780	20780
1004	13920	14550	15170	15790	16400	17010	17620	18220	18820	20000	21170	21170	21170	21170
1005	14150	14790	15420	16050	16680	17300	17920	18530	19140	20350	21550	22760	22760	22760
1006	14370	15020	15670	16310	16950	17580	18210	18840	19470	20700	21920	23160	23160	23160
1007	14590	15250	15910	16560	17210	17860	18510	19150	19780	21040	22290	23560	24820	24820
1008	14810	15480	16150	16810	17480	18140	18790	19440	20090	21380	22650	23950	25240	25240
1009	15020	15700	16380	17060	17740	18410	19070	19740	20400	21710	23010	24330	25650	26950
1010	15230	15920	16620	17300	17990	18670	19350	20030	20700	22040	23360	24710	26050	27380
1011	15440	16140	16840	17540	18240	18940	19630	20320	21000	22360	23710	25080	26450	27800
1012	15640	16360	17070	17780	18490	19200	19900	20600	21290	22680	24050	25450	26840	28220
1013	15840	16570	17290	18020	18730	19450	20170	20880	21580	22990	24390	25810	27230	28630
1014	16040	16780	17510	18250	18980	19700	20430	21150	21870	23300	24720	26160	27610	29040
1015	16240	16990	17730	18470	19210	19950	20690	21420	22150	23610	25050	26520	27980	29440

(Table continued on next page.)

Table A17. Green Peter Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.				Total Max Capacity
(feet)	21.0	22.0	22.01	48.0	
968.7	0	0	0	0	0
970	220	220	220	100	200
971	520	520	520	400	800
972	800	800	890	750	1500
973	1110	1110	1320	1100	2200
974	1450	1450	1810	1550	3100
975	1820	1820	2350	2125	4250
976	2220	2220	2930	2750	5500
977	2650	2650	3550	3450	6900
978	2980	2980	4210	4250	8500
979	3460	3460	4910	5000	10000
980	3960	3960	5640	5900	11800
981	4490	4490	6410	6840	13680
982	5040	5040	7200	7780	15560
983	5610	5610	8030	8720	17440
984	6210	6210	8890	9660	19320
985	6830	6830	9770	10600	21200
986	7470	7470	10690	11700	23400
987	8130	8130	11630	12800	25600
988	8820	8820	12590	13900	27800
989	9520	9520	13580	15000	30000
990	10250	10250	14600	16100	32200
991	10990	10990	15640	17380	34760
992	11750	11750	16700	18660	37320
993	12540	12540	17790	19940	39880
994	13340	13340	18900	21220	42440
995	14150	14150	20030	22500	45000
996	14990	14990	21180	23980	47960
997	15340	15340	22360	25460	50920
998	16210	16210	23550	26940	53880
999	17090	17090	24770	28420	56840
1000	17450	17450	26000	29900	59800
1001	18900	18900	27260	31520	63040
1002	19270	19270	28540	33140	66280
1003	20780	20780	29830	34760	69520
1004	21170	21170	31150	36380	72760
1005	22760	22760	32480	38000	76000
1006	23160	23160	33830	39680	79360
1007	24820	24820	35200	41360	82720
1008	25240	25240	36590	43040	86080
1009	26950	26950	37990	44720	89440
1010	27380	27380	39410	46400	92800
1011	29140	29140	40850	48120	96240
1012	29590	29590	42310	49840	99680
1013	30030	31220	43790	51560	103120
1014	30460	31670	45280	53280	106560
1015	30890	32120	46780	55000	110000

Table A18. Foster Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
596.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
598	90	170	200	200	200	200	200	200	200	200	200	200	200	200	200	200
599	100	200	290	380	460	490	490	490	490	490	490	490	490	490	490	490
600	110	220	330	430	530	630	720	810	850	850	850	850	850	850	850	850
601	0	250	360	480	590	700	810	910	1010	1110	1200	1280	1280	1280	1280	1280
602	0	270	390	520	640	760	880	1000	1110	1220	1330	1440	1540	1640	1640	1640
603	0	290	420	560	690	830	950	1080	1210	1330	1450	1570	1680	1800	1910	2010
604	0	300	450	600	740	880	1020	1160	1290	1430	1560	1690	1820	1940	2060	2180
605	0	320	480	630	780	930	1080	1230	1380	1520	1660	1800	1940	2080	2210	2340
606	0	340	500	660	820	980	1140	1300	1450	1610	1760	1910	2060	2200	2350	2490
607	0	0	520	690	860	1030	1200	1360	1530	1690	1850	2010	2170	2320	2480	2630
608	0	0	550	720	900	1080	1250	1420	1600	1770	1940	2110	2270	2440	2600	2760
609	0	0	570	750	940	1120	1300	1480	1660	1840	2020	2200	2370	2550	2720	2890
610	0	0	590	780	970	1160	1350	1540	1730	1920	2100	2280	2470	2650	2830	3010
611	0	0	610	810	1000	1200	1400	1600	1790	1980	2180	2370	2560	2750	2940	3130
612	0	0	0	830	1040	1240	1450	1650	1850	2050	2250	2450	2650	2850	3040	3240
613	0	0	0	860	1070	1280	1490	1700	1910	2120	2320	2530	2740	2940	3140	3350
614	0	0	0	880	1100	1320	1530	1750	1970	2180	2390	2610	2820	3030	3240	3450
615	0	0	0	910	1130	1350	1580	1800	2020	2240	2460	2680	2900	3120	3340	3550
616	0	0	0	930	1160	1390	1620	1850	2070	2300	2530	2750	2980	3200	3430	3650
617	0	0	0	950	1190	1420	1660	1890	2130	2360	2590	2820	3060	3290	3520	3750
618	0	0	0	0	1210	1450	1700	1940	2180	2420	2660	2890	3130	3370	3610	3840
619	0	0	0	0	1240	1490	1730	1980	2230	2470	2720	2960	3210	3450	3690	3940
620	0	0	0	0	1270	1520	1770	2020	2270	2530	2780	3030	3280	3530	3780	4030
621	0	0	0	0	1290	1550	1810	2060	2320	2580	2840	3090	3350	3600	3860	4110
622	0	0	0	0	1320	1580	1840	2110	2370	2630	2890	3150	3420	3680	3940	4200
623	0	0	0	0	0	1610	1880	2150	2410	2680	2950	3220	3480	3750	4020	4280
624	0	0	0	0	0	1640	1910	2190	2460	2730	3000	3280	3550	3820	4090	4370
625	0	0	0	0	0	1670	1950	2230	2500	2780	3060	3340	3610	3890	4170	4450
626	0	0	0	0	0	1700	1980	2260	2550	2830	3110	3400	3680	3960	4240	4530
627	0	0	0	0	0	1730	2010	2300	2590	2880	3160	3450	3740	4030	4320	4610
628	0	0	0	0	0	1750	2050	2340	2630	2920	3220	3510	3800	4100	4390	4680
629	0	0	0	0	0	0	2080	2370	2670	2970	3270	3570	3860	4160	4460	4760
630	0	0	0	0	0	0	2110	2410	2710	3010	3320	3620	3920	4230	4530	4830
631	0	0	0	0	0	0	2140	2450	2750	3060	3370	3670	3980	4290	4600	4910
632	0	0	0	0	0	0	2170	2480	2790	3100	3420	3730	4040	4350	4660	4980
633	0	0	0	0	0	0	2200	2520	2830	3150	3460	3780	4100	4410	4730	5050
634	0	0	0	0	0	0	2230	2550	2870	3190	3510	3830	4150	4470	4800	5120
635	0	0	0	0	0	0	0	2580	2910	3230	3560	3880	4210	4530	4860	5190
636	0	0	0	0	0	0	0	2620	2940	3270	3600	3930	4260	4590	4930	5260
637	0	0	0	0	0	0	0	2650	2980	3310	3650	3980	4320	4650	4990	5320
638	0	0	0	0	0	0	0	2680	3020	3360	3690	4030	4370	4710	5050	5390
639	0	0	0	0	0	0	0	2710	3050	3400	3740	4080	4420	4770	5110	5460
640	0	0	0	0	0	0	0	0	3090	3440	3780	4130	4480	4820	5170	5520
641	0	0	0	0	0	0	0	0	3120	3470	3830	4180	4530	4880	5230	5590

(Table continued on next page.)

Table A18. Foster Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5
596.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
598	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
599	490	490	490	490	490	490	490	490	490	490	490	490	490	490	490
600	850	850	850	850	850	850	850	850	850	850	850	850	850	850	850
601	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280
602	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
603	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
604	2300	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420
605	2470	2600	2720	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850
606	2630	2770	2910	3040	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
607	2780	2930	3080	3220	3510	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780
608	2920	3080	3240	3390	3700	4000	4290	4290	4290	4290	4290	4290	4290	4290	4290
609	3060	3230	3390	3560	3880	4200	4510	4820	4820	4820	4820	4820	4820	4820	4820
610	3190	3370	3540	3710	4060	4390	4730	5050	5370	5370	5370	5370	5370	5370	5370
611	3310	3500	3680	3860	4230	4580	4930	5280	5620	5950	5950	5950	5950	5950	5950
612	3430	3630	3820	4010	4390	4760	5130	5490	5850	6200	6550	6550	6550	6550	6550
613	3550	3750	3950	4150	4540	4930	5320	5700	6080	6450	6810	6810	6810	6810	6810
614	3660	3870	4080	4280	4690	5100	5500	5900	6290	6680	7060	7440	7440	7440	7440
615	3770	3990	4200	4410	4840	5260	5680	6090	6500	6910	7310	7700	8090	8090	8090
616	3880	4100	4320	4540	4980	5420	5850	6280	6710	7130	7540	7960	8360	8760	8760
617	3980	4210	4440	4670	5120	5570	6020	6460	6900	7340	7770	8200	8620	9040	9460
618	4080	4320	4550	4790	5250	5720	6180	6640	7090	7550	8000	8440	8880	9310	9740
619	4180	4420	4660	4900	5380	5860	6340	6810	7280	7750	8210	8670	9130	9580	10020
620	4270	4520	4770	5020	5510	6000	6490	6980	7460	7940	8420	8900	9370	9830	10300
621	4370	4620	4880	5130	5640	6140	6640	7140	7640	8140	8630	9120	9600	10080	10560
622	4460	4720	4980	5240	5760	6270	6790	7300	7810	8320	8830	9330	9830	10330	10820
623	4550	4820	5080	5350	5880	6400	6930	7460	7980	8510	9030	9540	10060	10570	11070
624	4640	4910	5180	5450	5990	6530	7070	7610	8150	8690	9220	9750	10280	10800	11320
625	4720	5000	5280	5560	6110	6660	7210	7760	8310	8860	9410	9950	10490	11030	11560
626	4810	5090	5380	5660	6220	6780	7350	7910	8470	9030	9590	10150	10700	11250	11800
627	4890	5180	5470	5760	6330	6910	7480	8060	8630	9200	9770	10340	10910	11470	12030
628	4980	5270	5560	5860	6440	7030	7610	8200	8780	9370	9950	10530	11110	11680	12260
629	5060	5350	5650	5950	6550	7140	7740	8340	8940	9530	10120	10720	11310	11900	12480
630	5140	5440	5740	6050	6650	7260	7870	8480	9080	9690	10300	10900	11500	12100	12700
631	5210	5520	5830	6140	6760	7370	7990	8610	9230	9850	10470	11080	11690	12310	12920
632	5290	5600	5920	6230	6860	7490	8110	8750	9370	10000	10630	11260	11880	12510	13130
633	5370	5690	6000	6320	6960	7600	8240	8880	9520	10160	10800	11430	12070	12700	13340
634	5440	5770	6090	6410	7060	7710	8350	9010	9660	10310	10960	11610	12250	12900	13540
635	5520	5840	6170	6500	7160	7810	8470	9130	9790	10460	11120	11770	12430	13090	13750
636	5590	5920	6250	6590	7250	7920	8590	9260	9930	10600	11270	11940	12610	13280	13950
637	5660	6000	6340	6670	7350	8020	8700	9380	10060	10750	11430	12110	12790	13470	14140
638	5730	6070	6420	6760	7440	8130	8820	9510	10200	10890	11580	12270	12960	13650	14340
639	5800	6150	6500	6840	7540	8230	8930	9630	10330	11030	11730	12430	13130	13830	14530
640	5870	6220	6570	6920	7630	8330	9040	9750	10460	11170	11880	12590	13300	14010	14720
641	5940	6300	6650	7010	7720	8430	9150	9860	10580	11300	12020	12750	13470	14190	14900

(Table continued on next page.)

Table A18. Foster Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
596.79	0	0	0	0	0	0	0	0	0	0	0	0	0	0
598	200	200	200	200	200	200	200	200	200	200	200	200	200	200
599	490	490	490	490	490	490	490	490	490	490	490	490	490	490
600	850	850	850	850	850	850	850	850	850	850	850	850	850	850
601	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280
602	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
603	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010	2010
604	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420
605	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850
606	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300	3300
607	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780
608	4290	4290	4290	4290	4290	4290	4290	4290	4290	4290	4290	4290	4290	4290
609	4820	4820	4820	4820	4820	4820	4820	4820	4820	4820	4820	4820	4820	4820
610	5370	5370	5370	5370	5370	5370	5370	5370	5370	5370	5370	5370	5370	5370
611	5950	5950	5950	5950	5950	5950	5950	5950	5950	5950	5950	5950	5950	5950
612	6550	6550	6550	6550	6550	6550	6550	6550	6550	6550	6550	6550	6550	6550
613	6810	6810	6810	6810	6810	6810	6810	6810	6810	6810	6810	6810	6810	6810
614	7440	7440	7440	7440	7440	7440	7440	7440	7440	7440	7440	7440	7440	7440
615	8090	8090	8090	8090	8090	8090	8090	8090	8090	8090	8090	8090	8090	8090
616	8760	8760	8760	8760	8760	8760	8760	8760	8760	8760	8760	8760	8760	8760
617	9460	9460	9460	9460	9460	9460	9460	9460	9460	9460	9460	9460	9460	9460
618	10170	10170	10170	10170	10170	10170	10170	10170	10170	10170	10170	10170	10170	10170
619	10470	10900	10900	10900	10900	10900	10900	10900	10900	10900	10900	10900	10900	10900
620	10750	11210	11650	11650	11650	11650	11650	11650	11650	11650	11650	11650	11650	11650
621	11030	11500	11970	12430	12430	12430	12430	12430	12430	12430	12430	12430	12430	12430
622	11310	11790	12270	12750	13220	13220	13220	13220	13220	13220	13220	13220	13220	13220
623	11580	12070	12570	13060	13540	14030	14030	14030	14030	14030	14030	14030	14030	14030
624	11840	12350	12860	13360	13870	14360	14850	14850	14850	14850	14850	14850	14850	14850
625	12090	12620	13140	13660	14180	14690	15200	15700	15700	15700	15700	15700	15700	15700
626	12340	12880	13420	13960	14490	15010	15530	16050	16560	16560	16560	16560	16560	16560
627	12590	13140	13690	14240	14790	15330	15860	16400	16920	16920	16920	16920	16920	16920
628	12830	13400	13960	14520	15080	15630	16190	16730	17270	18350	18350	18350	18350	18350
629	13060	13650	14220	14800	15370	15940	16500	17060	17620	18720	18720	18720	18720	18720
630	13300	13890	14480	15070	15650	16230	16810	17390	17960	19090	20200	20200	20200	20200
631	13520	14130	14730	15330	15930	16520	17120	17700	18290	19440	20590	20590	20590	20590
632	13750	14370	14980	15590	16200	16810	17410	18020	18610	19800	20970	22120	22120	22120
633	13970	14600	15230	15850	16470	17090	17710	18320	18930	20140	21340	22520	22520	22520
634	14190	14830	15470	16100	16740	17370	18000	18620	19250	20480	21710	22920	24130	24130
635	14400	15050	15700	16350	17000	17640	18280	18920	19560	20820	22070	23300	24540	24540
636	14610	15280	15940	16600	17250	17910	18560	19210	19860	21150	22420	23680	24950	26240
637	14820	15490	16170	16840	17510	18170	18840	19500	20160	21470	22770	24060	25350	26670
638	15020	15710	16390	17080	17760	18440	19110	19790	20460	21790	23120	24430	25750	27090
639	15230	15920	16620	17310	18000	18690	19380	20070	20750	22110	23460	24790	26140	27500
640	15430	16130	16840	17540	18250	18950	19650	20340	21040	22420	23790	25150	26520	27910
641	15620	16340	17060	17770	18480	19200	19910	20610	21320	22730	24120	25510	26900	28320

(Table continued on next page.)

Table A18. Foster Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.				Total Max Capacity
(feet)	21.0	22.0	22.01	45.0	
596.79	0	0	0	0	0
598	200	200	200	200	800
599	490	490	490	490	1960
600	850	850	850	850	3400
601	1280	1280	1280	1280	5120
602	1640	1640	1770	1770	7080
603	2010	2010	2300	2300	9200
604	2420	2420	2870	2870	11480
605	2850	2850	3490	3490	13960
606	3300	3300	4150	4150	16600
607	3780	3780	4840	4840	19360
608	4290	4290	5570	5570	22280
609	4820	4820	6340	6340	25360
610	5370	5370	7130	7130	28520
611	5950	5950	7950	7950	31800
612	6550	6550	8810	8810	35240
613	6810	6810	9690	9690	38760
614	7440	7440	10600	10600	42400
615	8090	8090	11540	11540	46160
616	8760	8760	12500	12500	50000
617	9460	9460	13490	13490	53960
618	10170	10170	14510	14510	58040
619	10900	10900	15540	15540	62160
620	11650	11650	16610	16610	66440
621	12430	12430	17690	17690	70760
622	13220	13220	18800	18800	75200
623	14030	14030	19930	19930	79720
624	14850	14850	21080	21080	84320
625	15700	15700	22250	22250	89000
626	16560	16560	23440	23440	93760
627	16920	16920	24660	24660	98640
628	18350	18350	25890	25890	103560
629	18720	18720	27150	27150	108600
630	20200	20200	28420	28420	113680
631	20590	20590	29710	29710	118840
632	22120	22120	31030	31030	124120
633	22520	22520	32360	32360	129440
634	24130	24130	33710	33710	134840
635	24540	24540	35070	35070	140280
636	26240	26240	36460	36460	145840
637	26670	26670	37860	37860	151440
638	27090	27090	39290	39290	157160
639	28860	28860	40720	40720	162880
640	29300	29300	42180	42180	168720
641	29730	31130	43650	43650	174600

Table A19. Fern Ridge Spillway Capacity Table in ResSim.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
358.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
360	60	110	150	200	200	200	200	200	200	200	200	200	200	200	200	200
361	70	130	190	250	300	350	350	350	350	350	350	350	350	350	350	350
362	80	150	220	290	360	420	480	540	540	540	540	540	540	540	540	540
363	90	170	250	330	410	480	550	630	690	760	760	760	760	760	760	760
364	0	190	270	360	450	530	620	700	780	860	930	1010	1010	1010	1010	1010
365	0	200	300	390	490	580	670	760	850	940	1030	1110	1200	1280	1280	1280
366	0	220	320	420	520	620	720	820	920	1020	1120	1210	1310	1400	1490	1580
367	0	230	340	450	560	670	770	880	990	1090	1200	1300	1400	1510	1610	1710
368	0	240	360	470	590	700	820	930	1050	1160	1270	1380	1500	1610	1720	1820
369	0	0	370	500	620	740	860	980	1100	1220	1340	1460	1580	1700	1820	1930
370	0	0	390	520	650	780	900	1030	1160	1290	1410	1540	1660	1790	1920	2040
371	0	0	410	540	680	810	940	1080	1210	1340	1480	1610	1740	1880	2010	2140
372	0	0	420	560	700	840	980	1120	1260	1400	1540	1680	1820	1960	2100	2230
373	0	0	440	580	730	870	1020	1160	1310	1450	1600	1740	1890	2040	2180	2330
374	0	0	450	600	750	900	1050	1200	1350	1500	1660	1810	1960	2110	2260	2410
375	0	0	0	620	780	930	1090	1240	1400	1550	1710	1870	2030	2180	2340	2500
376	0	0	0	640	800	960	1120	1280	1440	1600	1770	1930	2090	2250	2420	2580
377	0	0	0	660	820	990	1150	1320	1480	1650	1820	1990	2150	2320	2490	2660
378	0	0	0	680	840	1010	1180	1350	1520	1700	1870	2040	2210	2390	2560	2740
379	0	0	0	690	860	1040	1210	1390	1560	1740	1920	2100	2270	2450	2630	2810
380	0	0	0	710	890	1060	1240	1420	1600	1780	1970	2150	2330	2520	2700	2890

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.												Total Max Capacity
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.01	17.70	
358.5	0	0	0	0	0	0	0	0	0	0	0	0	0
360	200	200	200	200	200	200	200	200	200	200	210	200	1200
361	350	350	350	350	350	350	350	350	350	350	440	430	2580
362	540	540	540	540	540	540	540	540	540	540	730	700	4200
363	760	760	760	760	760	760	760	760	760	760	1070	1060	6360
364	1010	1010	1010	1010	1010	1010	1010	1010	1010	1010	1450	1450	8700
365	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1860	1950	11700
366	1580	1580	1580	1580	1580	1580	1580	1580	1580	1580	2300	2450	14700
367	1800	1900	1900	1900	1900	1900	1900	1900	1900	1900	2780	3025	18150
368	1930	2040	2140	2250	2250	2250	2250	2250	2250	2250	3290	3600	21600
369	2050	2160	2280	2390	2620	2620	2620	2620	2620	2620	3820	4200	25200
370	2160	2290	2410	2530	2770	3010	3010	3010	3010	3010	4380	4810	28860
371	2270	2400	2530	2660	2920	3170	3420	3420	3420	3420	4960	5450	32700
372	2370	2510	2650	2780	3060	3330	3590	3850	3850	3850	5570	6120	36720
373	2470	2610	2760	2900	3190	3470	3750	4030	4300	4300	6200	6810	40860
374	2560	2720	2870	3020	3320	3620	3910	4200	4490	4770	6850	7530	45180
375	2660	2810	2970	3130	3440	3750	4060	4370	4670	4970	7520	8270	49620
376	2740	2910	3070	3230	3560	3890	4210	4530	4840	5160	8210	9030	54180
377	2830	3000	3170	3340	3680	4010	4350	4680	5010	5340	8930	9820	58920
378	2910	3090	3260	3440	3790	4140	4490	4830	5170	5510	9660	10620	63720
379	2990	3170	3350	3530	3900	4260	4620	4980	5330	5680	10410	11450	68700
380	3070	3260	3440	3630	4000	4380	4750	5120	5480	5850	11190	12300	73800

Table A20. Cougar Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
1656.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1658	70	140	180	180	180	180	180	180	180	180	180	180	180	180	180	180
1659	90	170	250	320	390	450	450	450	450	450	450	450	450	450	450	450
1660	100	190	290	380	460	550	630	700	700	700	700	700	700	700	700	700
1661	110	220	320	420	520	620	710	800	890	970	970	970	970	970	970	970
1662	0	240	350	470	580	680	790	890	990	1090	1190	1280	1280	1280	1280	1280
1663	0	260	380	500	630	740	860	980	1090	1200	1300	1410	1510	1610	1610	1610
1664	0	270	410	540	670	800	930	1050	1170	1290	1410	1530	1640	1750	1860	1970
1665	0	290	430	570	710	850	990	1120	1250	1380	1510	1640	1760	1880	2000	2120
1666	0	310	460	610	750	900	1050	1190	1330	1470	1610	1740	1880	2010	2140	2270
1667	0	0	480	640	790	950	1100	1250	1400	1550	1700	1840	1980	2120	2260	2400
1668	0	0	500	670	830	990	1150	1310	1470	1620	1780	1930	2080	2230	2380	2530
1669	0	0	520	690	860	1030	1200	1370	1530	1700	1860	2020	2180	2340	2500	2650
1670	0	0	540	720	900	1070	1250	1420	1600	1770	1940	2110	2270	2440	2610	2770
1671	0	0	560	750	930	1110	1290	1480	1660	1830	2010	2190	2360	2540	2710	2880
1672	0	0	580	770	960	1150	1340	1530	1710	1900	2080	2270	2450	2630	2810	2990
1673	0	0	0	790	990	1190	1380	1580	1770	1960	2150	2340	2530	2720	2910	3090
1674	0	0	0	820	1020	1220	1420	1620	1820	2020	2220	2420	2610	2810	3000	3190
1675	0	0	0	840	1050	1260	1460	1670	1880	2080	2280	2490	2690	2890	3090	3290
1676	0	0	0	860	1080	1290	1500	1720	1930	2140	2350	2560	2770	2970	3180	3390
1677	0	0	0	880	1100	1320	1540	1760	1980	2190	2410	2620	2840	3050	3270	3480
1678	0	0	0	0	1130	1360	1580	1800	2030	2250	2470	2690	2910	3130	3350	3570
1679	0	0	0	0	1160	1390	1620	1840	2070	2300	2530	2750	2980	3210	3430	3660
1680	0	0	0	0	1180	1420	1650	1890	2120	2350	2590	2820	3050	3280	3510	3740
1681	0	0	0	0	1210	1450	1690	1930	2170	2400	2640	2880	3120	3350	3590	3820
1682	0	0	0	0	1230	1480	1720	1970	2210	2450	2700	2940	3180	3420	3660	3910
1683	0	0	0	0	1250	1500	1750	2000	2250	2500	2750	3000	3250	3490	3740	3990
1684	0	0	0	0	0	1530	1790	2040	2300	2550	2800	3060	3310	3560	3810	4070
1685	0	0	0	0	0	1560	1820	2080	2340	2600	2850	3110	3370	3630	3880	4140
1686	0	0	0	0	0	1590	1850	2120	2380	2640	2910	3170	3430	3690	3960	4220
1687	0	0	0	0	0	1610	1880	2150	2420	2690	2960	3220	3490	3760	4020	4290
1688	0	0	0	0	0	1640	1910	2190	2460	2730	3000	3280	3550	3820	4090	4370
1689	0	0	0	0	0	0	1940	2220	2500	2780	3050	3330	3610	3880	4160	4440
1690	0	0	0	0	0	0	1970	2260	2540	2820	3100	3380	3660	3940	4230	4510
1691	0	0	0	0	0	0	2000	2290	2580	2860	3150	3430	3720	4000	4290	4580
1692	0	0	0	0	0	0	2030	2320	2610	2900	3190	3480	3770	4060	4360	4650
1693	0	0	0	0	0	0	2060	2360	2650	2940	3240	3530	3830	4120	4420	4710
1694	0	0	0	0	0	0	2090	2390	2690	2990	3280	3580	3880	4180	4480	4780
1695	0	0	0	0	0	0	0	2420	2720	3030	3330	3630	3940	4240	4540	4850
1696	0	0	0	0	0	0	0	2450	2760	3070	3370	3680	3990	4290	4600	4910
1697	0	0	0	0	0	0	0	2480	2790	3100	3420	3730	4040	4350	4660	4970
1698	0	0	0	0	0	0	0	2510	2830	3140	3460	3770	4090	4400	4720	5040
1699	0	0	0	0	0	0	0	2540	2860	3180	3500	3820	4140	4460	4780	5100

(Table continued on next page.)

Table A20. Cougar Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
1656.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1658	180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
1659	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450
1660	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700
1661	970	970	970	970	970	970	970	970	970	970	970	970	970	970	970
1662	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280
1663	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610
1664	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970
1665	2240	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
1666	2390	2520	2640	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760
1667	2540	2670	2810	2940	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190
1668	2680	2820	2960	3100	3380	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650
1669	2810	2960	3110	3260	3560	3840	4120	4120	4120	4120	4120	4120	4120	4120	4120
1670	2930	3090	3250	3410	3720	4030	4330	4620	4620	4620	4620	4620	4620	4620	4620
1671	3050	3220	3390	3560	3890	4210	4530	4840	5140	5140	5140	5140	5140	5140	5140
1672	3170	3340	3520	3690	4040	4380	4710	5040	5360	5680	5680	5680	5680	5680	5680
1673	3280	3460	3650	3830	4190	4540	4890	5240	5580	5910	6240	6240	6240	6240	6240
1674	3390	3580	3770	3960	4330	4700	5070	5430	5780	6130	6480	6480	6480	6480	6480
1675	3490	3690	3890	4080	4470	4860	5240	5610	5980	6350	6710	7060	7060	7060	7060
1676	3590	3800	4000	4200	4610	5000	5400	5790	6170	6550	6930	7300	7660	7660	7660
1677	3690	3900	4110	4320	4740	5150	5560	5960	6360	6760	7150	7530	7910	8290	8290
1678	3790	4000	4220	4440	4860	5290	5710	6130	6540	6950	7360	7760	8150	8540	8930
1679	3880	4100	4330	4550	4990	5430	5860	6290	6720	7140	7560	7980	8390	8790	9190
1680	3970	4200	4430	4660	5110	5560	6010	6450	6890	7330	7760	8190	8610	9030	9450
1681	4060	4300	4530	4760	5230	5690	6150	6610	7060	7510	7950	8400	8830	9270	9690
1682	4150	4390	4630	4870	5340	5820	6290	6760	7220	7690	8140	8600	9050	9500	9940
1683	4230	4480	4720	4970	5460	5940	6430	6910	7380	7860	8330	8800	9260	9720	10170
1684	4320	4570	4820	5070	5570	6070	6560	7050	7540	8030	8510	8990	9470	9940	10410
1685	4400	4660	4910	5170	5680	6190	6690	7190	7690	8190	8690	9180	9670	10150	10630
1686	4480	4740	5000	5260	5780	6300	6820	7330	7850	8350	8860	9360	9860	10360	10850
1687	4560	4830	5090	5360	5890	6420	6950	7470	7990	8510	9030	9550	10060	10570	11070
1688	4640	4910	5180	5450	5990	6530	7070	7600	8140	8670	9200	9720	10250	10770	11280
1689	4710	4990	5270	5540	6090	6640	7190	7740	8280	8820	9360	9900	10430	10970	11490
1690	4790	5070	5350	5630	6190	6750	7310	7870	8420	8970	9520	10070	10620	11160	11700
1691	4860	5150	5440	5720	6290	6860	7430	7990	8560	9120	9680	10240	10800	11350	11900
1692	4940	5230	5520	5810	6390	6970	7540	8120	8690	9270	9840	10410	10970	11540	12100
1693	5010	5300	5600	5890	6480	7070	7660	8240	8830	9410	9990	10570	11150	11720	12290
1694	5080	5380	5680	5980	6580	7170	7770	8370	8960	9550	10140	10730	11320	11900	12490
1695	5150	5450	5760	6060	6670	7280	7880	8490	9090	9690	10290	10890	11490	12080	12680
1696	5220	5530	5840	6140	6760	7380	7990	8610	9220	9830	10440	11050	11660	12260	12860
1697	5290	5600	5910	6230	6850	7470	8100	8720	9340	9970	10580	11200	11820	12430	13050
1698	5350	5670	5990	6310	6940	7570	8210	8840	9470	10100	10730	11360	11980	12610	13230
1699	5420	5740	6060	6380	7030	7670	8310	8950	9590	10230	10870	11510	12140	12780	13410

(Table continued on next page.)

Table A20. Cougar Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
1656.75	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1658	180	180	180	180	180	180	180	180	180	180	180	180	180	180
1659	450	450	450	450	450	450	450	450	450	450	450	450	450	450
1660	700	700	700	700	700	700	700	700	700	700	700	700	700	700
1661	970	970	970	970	970	970	970	970	970	970	970	970	970	970
1662	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280	1280
1663	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610	1610
1664	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970	1970
1665	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
1666	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760	2760
1667	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190	3190
1668	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650
1669	4120	4120	4120	4120	4120	4120	4120	4120	4120	4120	4120	4120	4120	4120
1670	4620	4620	4620	4620	4620	4620	4620	4620	4620	4620	4620	4620	4620	4620
1671	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140
1672	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680	5680
1673	6240	6240	6240	6240	6240	6240	6240	6240	6240	6240	6240	6240	6240	6240
1674	6480	6480	6480	6480	6480	6480	6480	6480	6480	6480	6480	6480	6480	6480
1675	7060	7060	7060	7060	7060	7060	7060	7060	7060	7060	7060	7060	7060	7060
1676	7660	7660	7660	7660	7660	7660	7660	7660	7660	7660	7660	7660	7660	7660
1677	8290	8290	8290	8290	8290	8290	8290	8290	8290	8290	8290	8290	8290	8290
1678	8930	8930	8930	8930	8930	8930	8930	8930	8930	8930	8930	8930	8930	8930
1679	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580
1680	9860	10260	10260	10260	10260	10260	10260	10260	10260	10260	10260	10260	10260	10260
1681	10120	10540	10950	10950	10950	10950	10950	10950	10950	10950	10950	10950	10950	10950
1682	10380	10810	11240	11660	11660	11660	11660	11660	11660	11660	11660	11660	11660	11660
1683	10630	11070	11520	11950	12390	12390	12390	12390	12390	12390	12390	12390	12390	12390
1684	10870	11330	11790	12240	12690	13130	13130	13130	13130	13130	13130	13130	13130	13130
1685	11110	11580	12050	12520	12980	13440	13890	13890	13890	13890	13890	13890	13890	13890
1686	11340	11830	12310	12790	13260	13730	14200	14660	14660	14660	14660	14660	14660	14660
1687	11570	12070	12570	13060	13540	14030	14510	14980	15450	15450	15450	15450	15450	15450
1688	11800	12310	12820	13320	13820	14310	14810	15290	15780	15780	15780	15780	15780	15780
1689	12020	12540	13060	13580	14090	14600	15100	15600	16100	17080	17080	17080	17080	17080
1690	12240	12770	13300	13830	14350	14870	15390	15900	16410	17420	17420	17420	17420	17420
1691	12450	12990	13540	14080	14610	15140	15670	16200	16720	17750	18800	18800	18800	18800
1692	12660	13210	13770	14320	14870	15410	15950	16490	17020	18080	19160	19160	19160	19160
1693	12860	13430	14000	14560	15120	15670	16220	16770	17320	18400	19500	20590	20590	20590
1694	13070	13650	14220	14790	15360	15930	16490	17050	17610	18710	19840	20960	20960	20960
1695	13270	13860	14440	15020	15600	16180	16760	17330	17900	19020	20180	21320	22450	22450
1696	13460	14060	14660	15250	15840	16430	17020	17600	18180	19330	20500	21670	22830	22830
1697	13660	14270	14870	15480	16080	16680	17270	17870	18460	19630	20830	22020	23200	23200
1698	13850	14470	15080	15700	16310	16920	17530	18130	18730	19920	21150	22360	23570	24700
1699	14040	14670	15290	15920	16540	17160	17770	18390	19000	20210	21460	22700	23930	25090

(Table continued on next page.)

Table A20. Cougar Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.			Total Max Capacity
(feet)	21.0	21.01	40.0	
1656.75	0	0	0	0
1658	180	288	288	576
1659	450	500	500	1000
1660	700	750	750	1500
1661	970	1200	1200	2400
1662	1280	1650	1650	3300
1663	1610	2100	2100	4200
1664	1970	2550	2550	5100
1665	2350	3000	3000	6000
1666	2760	3550	3550	7100
1667	3190	4100	4100	8200
1668	3650	4650	4650	9300
1669	4120	5200	5200	10400
1670	4620	5750	5750	11500
1671	5140	6550	6550	13100
1672	5680	7350	7350	14700
1673	6240	8150	8150	16300
1674	6480	8950	8950	17900
1675	7060	9750	9750	19500
1676	7660	10750	10750	21500
1677	8290	11750	11750	23500
1678	8930	12750	12750	25500
1679	9580	13750	13750	27500
1680	10260	14750	14750	29500
1681	10950	15850	15850	31700
1682	11660	16950	16950	33900
1683	12390	18050	18050	36100
1684	13130	19150	19150	38300
1685	13890	20250	20250	40500
1686	14660	21500	21500	43000
1687	15450	22750	22750	45500
1688	15780	24000	24000	48000
1689	17080	25250	25250	50500
1690	17420	26500	26500	53000
1691	18800	27800	27800	55600
1692	19160	29100	29100	58200
1693	20590	30400	30400	60800
1694	20960	31700	31700	63400
1695	22450	33000	33000	66000
1696	22830	34268	34268	68536
1697	23200	35535	35535	71070
1698	24700	36803	36803	73606
1699	25090	38070	38070	76140

Table A21. Blue River Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
1321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1322	50	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1323	70	130	190	250	250	250	250	250	250	250	250	250	250	250	250	250
1324	80	160	230	300	370	430	430	430	430	430	430	430	430	430	430	430
1325	90	180	270	350	430	510	580	650	650	650	650	650	650	650	650	650
1326	100	200	300	390	480	570	660	740	830	910	910	910	910	910	910	910
1327	0	220	320	430	530	630	730	820	920	1010	1100	1180	1180	1180	1180	1180
1328	0	230	350	460	570	680	790	900	1000	1100	1200	1300	1390	1490	1490	1490
1329	0	250	370	490	610	730	850	960	1080	1190	1300	1400	1510	1610	1720	1820
1330	0	260	390	520	650	780	900	1030	1150	1270	1390	1500	1620	1730	1840	1950
1331	0	280	420	550	690	820	950	1080	1210	1340	1470	1600	1720	1840	1960	2080
1332	0	0	440	580	720	860	1000	1140	1280	1410	1550	1680	1810	1950	2070	2200
1333	0	0	460	610	750	900	1050	1190	1340	1480	1620	1770	1910	2040	2180	2320
1334	0	0	470	630	790	940	1090	1240	1400	1550	1700	1840	1990	2140	2280	2430
1335	0	0	490	650	820	980	1140	1290	1450	1610	1770	1920	2070	2230	2380	2530
1336	0	0	510	680	840	1010	1180	1340	1510	1670	1830	1990	2150	2310	2470	2630
1337	0	0	530	700	870	1040	1220	1390	1560	1730	1900	2060	2230	2400	2560	2730
1338	0	0	0	720	900	1080	1250	1430	1610	1780	1960	2130	2310	2480	2650	2820
1339	0	0	0	740	930	1110	1290	1470	1660	1840	2020	2200	2380	2560	2730	2910
1340	0	0	0	760	950	1140	1330	1520	1700	1890	2080	2260	2450	2630	2820	3000
1341	0	0	0	780	980	1170	1360	1560	1750	1940	2130	2320	2520	2710	2890	3080
1342	0	0	0	800	1000	1200	1400	1600	1790	1990	2190	2390	2580	2780	2970	3170
1343	0	0	0	0	1020	1230	1430	1630	1840	2040	2240	2440	2650	2850	3050	3250
1344	0	0	0	0	1050	1260	1460	1670	1880	2090	2300	2500	2710	2910	3120	3320
1345	0	0	0	0	1070	1280	1500	1710	1920	2130	2350	2560	2770	2980	3190	3400
1346	0	0	0	0	1090	1310	1530	1750	1960	2180	2400	2610	2830	3050	3260	3480
1347	0	0	0	0	1110	1340	1560	1780	2000	2220	2450	2670	2890	3110	3330	3550
1348	0	0	0	0	1140	1360	1590	1820	2040	2270	2490	2720	2950	3170	3400	3620
1349	0	0	0	0	0	1390	1620	1850	2080	2310	2540	2770	3000	3230	3460	3690
1350	0	0	0	0	0	1410	1650	1880	2120	2350	2590	2820	3060	3290	3530	3760
1351	0	0	0	0	0	1440	1680	1920	2160	2400	2630	2870	3110	3350	3590	3830
1352	0	0	0	0	0	1460	1700	1950	2190	2440	2680	2920	3170	3410	3650	3900
1353	0	0	0	0	0	1480	1730	1980	2230	2480	2720	2970	3220	3470	3720	3960
1354	0	0	0	0	0	0	1760	2010	2260	2520	2770	3020	3270	3520	3780	4030
1355	0	0	0	0	0	0	1790	2040	2300	2550	2810	3070	3320	3580	3840	4090
1356	0	0	0	0	0	0	1810	2070	2330	2590	2850	3110	3370	3630	3890	4150
1357	0	0	0	0	0	0	1840	2100	2370	2630	2890	3160	3420	3690	3950	4220

(Table continued on next page.)

Table A21. Blue River Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
1321	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1322	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
1323	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
1324	430	430	430	430	430	430	430	430	430	430	430	430	430	430	430
1325	650	650	650	650	650	650	650	650	650	650	650	650	650	650	650
1326	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910
1327	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180
1328	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490
1329	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820
1330	2060	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170
1331	2200	2310	2430	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540
1332	2330	2450	2580	2700	2930	2930	2930	2930	2930	2930	2930	2930	2930	2930	2930
1333	2450	2580	2720	2850	3100	3350	3350	3350	3350	3350	3350	3350	3350	3350	3350
1334	2570	2710	2850	2990	3260	3520	3780	3780	3780	3780	3780	3780	3780	3780	3780
1335	2680	2830	2980	3120	3410	3690	3970	4240	4240	4240	4240	4240	4240	4240	4240
1336	2790	2940	3100	3250	3550	3850	4140	4430	4710	4710	4710	4710	4710	4710	4710
1337	2890	3050	3210	3370	3690	4000	4310	4610	4910	5200	5200	5200	5200	5200	5200
1338	2990	3160	3330	3490	3820	4150	4470	4790	5100	5400	5700	5700	5700	5700	5700
1339	3090	3260	3440	3610	3950	4290	4630	4960	5280	5600	5920	5920	5920	5920	5920
1340	3180	3360	3540	3720	4080	4430	4780	5120	5460	5790	6120	6450	6450	6450	6450
1341	3270	3460	3640	3830	4200	4560	4920	5280	5630	5980	6320	6660	7000	7000	7000
1342	3360	3550	3740	3940	4320	4690	5070	5430	5800	6160	6520	6870	7220	7560	7560
1343	3450	3640	3840	4040	4430	4820	5200	5580	5960	6340	6710	7070	7430	7790	8140
1344	3530	3730	3940	4140	4540	4940	5340	5730	6120	6510	6890	7270	7640	8010	8370
1345	3610	3820	4030	4240	4650	5060	5470	5870	6280	6670	7070	7460	7840	8230	8600
1346	3690	3910	4120	4330	4760	5180	5600	6010	6430	6840	7240	7640	8040	8440	8830
1347	3770	3990	4210	4430	4860	5290	5720	6150	6570	6990	7410	7820	8230	8640	9040
1348	3850	4070	4290	4520	4960	5410	5850	6280	6720	7150	7580	8000	8420	8840	9260
1349	3920	4150	4380	4610	5060	5520	5970	6410	6860	7300	7740	8180	8610	9040	9460
1350	4000	4230	4460	4700	5160	5620	6080	6540	7000	7450	7900	8350	8790	9230	9670
1351	4070	4310	4550	4780	5260	5730	6200	6670	7130	7590	8050	8510	8970	9420	9860
1352	4140	4380	4630	4870	5350	5830	6310	6790	7260	7740	8210	8680	9140	9600	10060
1353	4210	4460	4700	4950	5440	5930	6420	6910	7390	7880	8360	8840	9310	9780	10250
1354	4280	4530	4780	5030	5530	6030	6530	7030	7520	8020	8510	8990	9480	9960	10440
1355	4350	4600	4860	5110	5620	6130	6640	7150	7650	8150	8650	9150	9640	10130	10620
1356	4410	4670	4930	5190	5710	6230	6750	7260	7770	8280	8790	9300	9800	10310	10800
1357	4480	4740	5010	5270	5800	6330	6850	7370	7900	8420	8930	9450	9960	10470	10980

(Table continued on next page.)

Table A21. Blue River Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	17.0	38.0	Max Capacity
1321	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1322	100	100	100	100	100	100	100	100	100	100	100	120	120	240
1323	250	250	250	250	250	250	250	250	250	250	250	330	330	660
1324	430	430	430	430	430	430	430	430	430	430	430	600	600	1200
1325	650	650	650	650	650	650	650	650	650	650	650	920	920	1840
1326	910	910	910	910	910	910	910	910	910	910	910	1290	1290	2580
1327	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1180	1700	1700	3400
1328	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	1490	2140	2140	4280
1329	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	1820	2610	2610	5220
1330	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	2170	3120	3120	6240
1331	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540	2540	3650	3650	7300
1332	2930	2930	2930	2930	2930	2930	2930	2930	2930	2930	2930	4210	4210	8420
1333	3350	3350	3350	3350	3350	3350	3350	3350	3350	3350	3350	4800	4800	9600
1334	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780	3780	5410	5410	10820
1335	4240	4240	4240	4240	4240	4240	4240	4240	4240	4240	4240	6050	6050	12100
1336	4710	4710	4710	4710	4710	4710	4710	4710	4710	4710	4710	6710	6710	13420
1337	5200	5200	5200	5200	5200	5200	5200	5200	5200	5200	5200	7390	7390	14780
1338	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	8100	8100	16200
1339	5920	5920	5920	5920	5920	5920	5920	5920	5920	5920	5920	8820	8820	17640
1340	6450	6450	6450	6450	6450	6450	6450	6450	6450	6450	6450	9570	9570	19140
1341	7000	7000	7000	7000	7000	7000	7000	7000	7000	7000	7000	10330	10330	20660
1342	7560	7560	7560	7560	7560	7560	7560	7560	7560	7560	7560	11120	11120	22240
1343	8140	8140	8140	8140	8140	8140	8140	8140	8140	8140	8140	11920	11920	23840
1344	8730	8730	8730	8730	8730	8730	8730	8730	8730	8730	8730	12740	12740	25480
1345	8980	9350	9350	9350	9350	9350	9350	9350	9350	9350	9350	13580	13580	27160
1346	9210	9590	9970	9970	9970	9970	9970	9970	9970	9970	9970	14440	14440	28880
1347	9440	9840	10230	10630	10630	10630	10630	10630	10630	10630	10630	15310	15310	30620
1348	9670	10070	10480	10890	11300	11300	11300	11300	11300	11300	11300	16200	16200	32400
1349	9890	10300	10720	11140	11570	11980	11980	11980	11980	11980	11980	17110	17110	34220
1350	10100	10530	10960	11390	11830	12260	12680	12680	12680	12680	12680	18040	18040	36080
1351	10310	10750	11190	11640	12080	12530	12960	13400	13400	13400	13400	18980	18980	37960
1352	10520	10970	11420	11880	12340	12790	13240	13690	14120	14120	14120	19940	19940	39880
1353	10720	11180	11640	12110	12580	13050	13510	13970	14410	14410	14410	20910	20910	41820
1354	10910	11390	11860	12340	12820	13300	13770	14240	14700	15490	15490	21900	21900	43800
1355	11110	11590	12080	12570	13060	13550	14030	14520	14980	15790	15790	22900	22900	45800
1356	11300	11790	12290	12790	13290	13790	14290	14780	15260	16090	16890	23920	23920	47840
1357	11490	11990	12500	13010	13520	14030	14540	15040	15530	16380	17200	24950	24950	49900

Table A22. Hills Creek Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
1495.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1497	53	100	140	167	167	167	167	167	167	167	167	167	167	167	167	167
1498	60	120	173	227	280	327	327	327	327	327	327	327	327	327	327	327
1499	73	140	207	267	327	387	447	500	500	500	500	500	500	500	500	500
1500	80	153	227	300	373	440	507	573	633	693	693	693	693	693	693	693
1501	0	167	253	333	413	487	567	640	707	780	847	913	913	913	913	913
1502	0	187	273	360	447	533	613	700	780	853	933	1007	1080	1147	1147	1147
1503	0	193	293	387	480	573	660	753	840	927	1007	1093	1173	1253	1333	1407
1504	0	207	313	413	513	607	707	800	900	987	1080	1173	1260	1347	1433	1520
1505	0	220	327	433	540	647	747	853	953	1053	1147	1247	1340	1433	1527	1620
1506	0	0	347	453	567	680	787	893	1000	1107	1213	1313	1420	1520	1620	1720
1507	0	0	360	480	593	713	827	940	1053	1160	1273	1380	1493	1600	1707	1813
1508	0	0	373	500	620	740	860	980	1100	1213	1333	1447	1560	1673	1787	1900
1509	0	0	387	513	647	767	893	1020	1140	1267	1387	1507	1627	1747	1867	1980
1510	0	0	400	533	667	800	927	1060	1187	1313	1440	1567	1693	1813	1940	2060
1511	0	0	413	553	687	827	960	1093	1227	1360	1493	1620	1753	1880	2013	2140
1512	0	0	0	573	713	853	993	1127	1267	1407	1540	1680	1813	1947	2080	2213
1513	0	0	0	587	733	880	1020	1167	1307	1447	1587	1733	1873	2007	2147	2287
1514	0	0	0	607	753	900	1047	1200	1347	1493	1633	1780	1927	2073	2213	2353
1515	0	0	0	620	773	927	1080	1233	1380	1533	1680	1833	1980	2127	2280	2427
1516	0	0	0	633	793	947	1107	1260	1420	1573	1727	1880	2033	2187	2340	2493
1517	0	0	0	0	813	973	1133	1293	1453	1613	1767	1927	2087	2240	2400	2553
1518	0	0	0	0	833	993	1160	1320	1487	1647	1813	1973	2133	2300	2460	2620
1519	0	0	0	0	847	1020	1187	1353	1520	1687	1853	2020	2187	2347	2513	2680
1520	0	0	0	0	867	1040	1213	1380	1553	1720	1893	2060	2233	2400	2573	2740
1521	0	0	0	0	887	1060	1233	1407	1587	1760	1933	2107	2280	2453	2627	2800
1522	0	0	0	0	900	1080	1260	1440	1613	1793	1973	2147	2327	2500	2680	2853
1523	0	0	0	0	0	1100	1280	1467	1647	1827	2007	2193	2373	2553	2733	2913
1524	0	0	0	0	0	1120	1307	1493	1673	1860	2047	2233	2413	2600	2780	2967
1525	0	0	0	0	0	1140	1327	1520	1707	1893	2080	2273	2460	2647	2833	3020
1526	0	0	0	0	0	1160	1353	1547	1733	1927	2120	2313	2500	2693	2887	3073
1527	0	0	0	0	0	1180	1373	1567	1767	1960	2153	2347	2547	2740	2933	3127
1528	0	0	0	0	0	0	1393	1593	1793	1993	2187	2387	2587	2780	2980	3180
1529	0	0	0	0	0	0	1420	1620	1820	2020	2220	2427	2627	2827	3027	3227
1530	0	0	0	0	0	0	1440	1640	1847	2053	2260	2460	2667	2873	3073	3280
1531	0	0	0	0	0	0	1460	1667	1873	2080	2287	2500	2707	2913	3120	3327
1532	0	0	0	0	0	0	1480	1693	1900	2113	2320	2533	2747	2953	3167	3373
1533	0	0	0	0	0	0	1500	1713	1927	2140	2353	2567	2780	3000	3213	3427
1534	0	0	0	0	0	0	0	1733	1953	2167	2387	2607	2820	3040	3253	3473
1535	0	0	0	0	0	0	0	1760	1980	2200	2420	2640	2860	3080	3300	3520
1536	0	0	0	0	0	0	0	1780	2007	2227	2447	2673	2893	3120	3340	3567
1537	0	0	0	0	0	0	0	1800	2027	2253	2480	2707	2933	3160	3380	3607
1538	0	0	0	0	0	0	0	1827	2053	2280	2513	2740	2967	3193	3427	3653
1539	0	0	0	0	0	0	0	0	2080	2307	2540	2773	3000	3233	3467	3700
1540	0	0	0	0	0	0	0	0	2100	2333	2567	2807	3040	3273	3507	3740
1541	0	0	0	0	0	0	0	0	2127	2360	2600	2833	3073	3313	3547	3787
1542	0	0	0	0	0	0	0	0	2147	2387	2627	2867	3107	3347	3587	3827
1543	0	0	0	0	0	0	0	0	2173	2413	2653	2900	3140	3387	3627	3867

(Table continued on next page.)

Table A22. Hills Creek Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
1495.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1497	167	167	167	167	167	167	167	167	167	167	167	167	167	167	167
1498	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327
1499	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
1500	693	693	693	693	693	693	693	693	693	693	693	693	693	693	693
1501	913	913	913	913	913	913	913	913	913	913	913	913	913	913	913
1502	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
1503	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407
1504	1600	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680
1505	1713	1800	1887	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973
1506	1813	1913	2007	2100	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280
1507	1913	2013	2120	2220	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413
1508	2007	2113	2227	2333	2540	2747	2747	2747	2747	2747	2747	2747	2747	2747	2747
1509	2100	2213	2327	2440	2660	2880	3087	3087	3087	3087	3087	3087	3087	3087	3087
1510	2187	2307	2427	2540	2773	3007	3227	3447	3447	3447	3447	3447	3447	3447	3447
1511	2267	2393	2520	2640	2887	3127	3367	3593	3820	3820	3820	3820	3820	3820	3820
1512	2347	2480	2607	2740	2993	3247	3493	3733	3973	4213	4213	4213	4213	4213	4213
1513	2420	2560	2693	2827	3093	3360	3620	3873	4120	4367	4613	4613	4613	4613	4613
1514	2500	2640	2780	2920	3193	3467	3740	4000	4267	4520	4780	5027	5027	5027	5027
1515	2573	2713	2860	3007	3293	3573	3853	4133	4400	4673	4933	5200	5453	5453	5453
1516	2640	2793	2940	3087	3387	3680	3967	4253	4533	4813	5093	5360	5633	5893	5893
1517	2707	2867	3020	3173	3473	3780	4080	4373	4667	4953	5240	5520	5800	6073	6347
1518	2780	2933	3093	3253	3567	3873	4187	4487	4793	5093	5387	5680	5967	6253	6533
1519	2840	3007	3167	3333	3653	3973	4287	4600	4913	5220	5527	5827	6127	6427	6713
1520	2907	3073	3240	3407	3740	4067	4393	4713	5033	5353	5667	5980	6287	6593	6893
1521	2967	3140	3313	3480	3820	4153	4493	4820	5153	5480	5800	6120	6440	6753	7067
1522	3033	3207	3380	3553	3900	4247	4587	4927	5267	5600	5933	6260	6587	6913	7233
1523	3093	3267	3447	3627	3980	4333	4687	5033	5380	5720	6060	6400	6733	7067	7400
1524	3147	3333	3513	3693	4060	4420	4780	5133	5487	5840	6187	6533	6880	7220	7560
1525	3207	3393	3580	3767	4133	4500	4867	5233	5593	5953	6313	6667	7020	7367	7713
1526	3267	3453	3647	3833	4207	4587	4960	5333	5700	6067	6433	6793	7160	7513	7873
1527	3320	3513	3707	3900	4287	4667	5047	5427	5807	6180	6553	6927	7293	7660	8020
1528	3373	3573	3767	3967	4353	4747	5133	5520	5907	6287	6667	7047	7427	7800	8173
1529	3427	3627	3827	4027	4427	4827	5220	5613	6007	6393	6787	7173	7553	7940	8320
1530	3480	3687	3887	4093	4500	4900	5307	5707	6107	6500	6900	7293	7687	8073	8460
1531	3533	3740	3947	4153	4567	4980	5387	5793	6200	6607	7007	7413	7807	8207	8600
1532	3587	3800	4007	4213	4633	5053	5467	5880	6293	6707	7120	7527	7933	8340	8740
1533	3640	3853	4067	4280	4700	5127	5547	5973	6393	6807	7227	7640	8053	8467	8880
1534	3687	3907	4120	4333	4767	5200	5627	6053	6480	6907	7333	7753	8173	8593	9013
1535	3740	3960	4173	4393	4833	5273	5707	6140	6573	7007	7440	7867	8293	8720	9147
1536	3787	4007	4233	4453	4900	5340	5780	6227	6667	7100	7540	7980	8413	8847	9273
1537	3833	4060	4287	4513	4960	5413	5860	6307	6753	7200	7640	8087	8527	8967	9407
1538	3880	4113	4340	4567	5027	5480	5933	6387	6840	7293	7740	8193	8640	9087	9533
1539	3927	4160	4393	4627	5087	5547	6007	6467	6927	7387	7840	8300	8753	9207	9660
1540	3973	4213	4447	4680	5147	5613	6080	6547	7013	7480	7940	8400	8867	9320	9780
1541	4020	4260	4493	4733	5207	5680	6153	6627	7100	7567	8040	8507	8973	9440	9900
1542	4067	4307	4547	4787	5267	5747	6227	6707	7180	7660	8133	8607	9080	9553	10027
1543	4113	4353	4600	4840	5327	5813	6293	6780	7267	7747	8227	8707	9187	9667	10147

(Table continued on next page.)

Table A22. Hills Creek Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
1495.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1497	167	167	167	167	167	167	167	167	167	167	167	167	167	167
1498	327	327	327	327	327	327	327	327	327	327	327	327	327	327
1499	500	500	500	500	500	500	500	500	500	500	500	500	500	500
1500	693	693	693	693	693	693	693	693	693	693	693	693	693	693
1501	913	913	913	913	913	913	913	913	913	913	913	913	913	913
1502	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147	1147
1503	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407	1407
1504	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680
1505	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973
1506	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280	2280
1507	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413	2413
1508	2747	2747	2747	2747	2747	2747	2747	2747	2747	2747	2747	2747	2747	2747
1509	3087	3087	3087	3087	3087	3087	3087	3087	3087	3087	3087	3087	3087	3087
1510	3447	3447	3447	3447	3447	3447	3447	3447	3447	3447	3447	3447	3447	3447
1511	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820	3820
1512	4213	4213	4213	4213	4213	4213	4213	4213	4213	4213	4213	4213	4213	4213
1513	4613	4613	4613	4613	4613	4613	4613	4613	4613	4613	4613	4613	4613	4613
1514	5027	5027	5027	5027	5027	5027	5027	5027	5027	5027	5027	5027	5027	5027
1515	5453	5453	5453	5453	5453	5453	5453	5453	5453	5453	5453	5453	5453	5453
1516	5893	5893	5893	5893	5893	5893	5893	5893	5893	5893	5893	5893	5893	5893
1517	6347	6347	6347	6347	6347	6347	6347	6347	6347	6347	6347	6347	6347	6347
1518	6813	6813	6813	6813	6813	6813	6813	6813	6813	6813	6813	6813	6813	6813
1519	7000	7287	7287	7287	7287	7287	7287	7287	7287	7287	7287	7287	7287	7287
1520	7193	7487	7773	7773	7773	7773	7773	7773	7773	7773	7773	7773	7773	7773
1521	7373	7680	7980	8273	8273	8273	8273	8273	8273	8273	8273	8273	8273	8273
1522	7553	7867	8173	8480	8787	8787	8787	8787	8787	8787	8787	8787	8787	8787
1523	7727	8047	8367	8687	9000	9307	9307	9307	9307	9307	9307	9307	9307	9307
1524	7893	8227	8553	8880	9207	9527	9840	9840	9840	9840	9840	9840	9840	9840
1525	8060	8400	8740	9073	9407	9740	10060	10387	10387	10387	10387	10387	10387	10387
1526	8227	8573	8920	9267	9607	9947	10280	10613	10940	10940	10940	10940	10940	10940
1527	8387	8740	9100	9453	9800	10147	10493	10833	11173	11173	11173	11173	11173	11173
1528	8540	8907	9273	9633	9993	10347	10700	11053	11400	12087	12087	12087	12087	12087
1529	8693	9067	9440	9813	10180	10547	10907	11267	11620	12327	12327	12327	12327	12327
1530	8847	9227	9607	9987	10360	10733	11107	11473	11840	12560	13293	13293	13293	13293
1531	8993	9387	9773	10160	10540	10927	11300	11680	12053	12793	13540	13540	13540	13540
1532	9140	9540	9933	10327	10720	11107	11493	11880	12260	13020	13787	13787	13787	13787
1533	9287	9693	10093	10493	10893	11293	11687	12080	12467	13240	14027	14800	14800	14800
1534	9427	9840	10253	10660	11067	11473	11873	12273	12673	13460	14260	15053	15053	15053
1535	9567	9987	10407	10820	11233	11647	12060	12467	12873	13673	14493	15307	16107	16107
1536	9707	10133	10560	10980	11400	11820	12240	12653	13067	13887	14720	15547	16367	16367
1537	9840	10273	10707	11140	11567	11993	12420	12840	13260	14100	14947	15793	16627	17447
1538	9973	10413	10853	11293	11727	12160	12593	13027	13453	14307	15173	16027	16880	17713
1539	10107	10553	11000	11447	11887	12327	12767	13207	13640	14507	15387	16267	17133	17980
1540	10240	10693	11147	11600	12047	12493	12940	13387	13827	14707	15607	16493	17380	18247
1541	10367	10827	11287	11747	12200	12660	13107	13560	14007	14907	15820	16720	17620	18507
1542	10493	10960	11427	11893	12353	12820	13280	13733	14193	15100	16027	16947	17860	18760
1543	10620	11093	11567	12040	12507	12973	13440	13907	14367	15293	16233	17167	18100	19013

(Table continued on next page.)

Table A22. Hills Creek Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.				Total Max Capacity
(feet)	21.00	22.00	22.01	48.23	
1495.5	0	0	0	0	0
1497	167	167	167	200	600
1498	327	327	367	533	1599
1499	500	500	607	867	2601
1500	693	693	880	1200	3600
1501	913	913	1193	1680	5040
1502	1147	1147	1533	2160	6480
1503	1407	1407	1900	2640	7920
1504	1680	1680	2287	3120	9360
1505	1973	1973	2707	3600	10800
1506	2280	2280	3147	4320	12960
1507	2413	2413	3607	5040	15120
1508	2747	2747	4087	5760	17280
1509	3087	3087	4580	6480	19440
1510	3447	3447	5100	7200	21600
1511	3820	3820	5640	8040	24120
1512	4213	4213	6193	8880	26640
1513	4613	4613	6767	9720	29160
1514	5027	5027	7353	10560	31680
1515	5453	5453	7953	11400	34200
1516	5893	5893	8573	12360	37080
1517	6347	6347	9213	13320	39960
1518	6813	6813	9860	14280	42840
1519	7287	7287	10527	15240	45720
1520	7773	7773	11207	16200	48600
1521	8273	8273	11900	17280	51840
1522	8787	8787	12607	18360	55080
1523	9307	9307	13327	19440	58320
1524	9840	9840	14060	20520	61560
1525	10387	10387	14807	21600	64800
1526	10940	10940	15567	22840	68520
1527	11173	11173	16333	24080	72240
1528	12087	12087	17120	25320	75960
1529	12327	12327	17913	26560	79680
1530	13293	13293	18727	27800	83400
1531	13540	13540	19547	29080	87240
1532	13787	13787	20373	30360	91080
1533	14800	14800	21220	31640	94920
1534	15053	15053	22073	32920	98760
1535	16107	16107	22940	34200	102600
1536	16367	16367	23813	35760	107280
1537	17447	17447	24700	37320	111960
1538	17713	17713	25600	38880	116640
1539	18700	18700	26507	40440	121320
1540	18980	18980	27427	42000	126000
1541	19253	19987	28360	43667	131001
1542	19520	20273	29300	45333	135999
1543	19787	20553	30247	47000	141000

Table A23. Lookout Point Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
887.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
889	70	140	210	260	260	260	260	260	260	260	260	260	260	260	260	260
890	90	180	260	340	420	490	490	490	490	490	490	490	490	490	490	490
891	110	210	310	400	490	580	660	740	740	740	740	740	740	740	740	740
892	120	230	340	450	560	660	760	860	950	1040	1040	1040	1040	1040	1040	1040
893	130	250	380	500	620	730	850	960	1060	1170	1270	1370	1370	1370	1370	1370
894	140	280	410	540	670	800	920	1050	1170	1280	1400	1510	1620	1730	1730	1730
895	150	290	440	580	720	860	1000	1130	1260	1390	1520	1640	1760	1880	2000	2120
896	160	310	470	620	770	920	1060	1210	1350	1490	1630	1760	1900	2030	2160	2290
897	170	330	490	650	810	970	1130	1280	1430	1580	1730	1880	2020	2160	2300	2440
898	170	350	520	690	850	1020	1180	1350	1510	1670	1830	1980	2140	2290	2440	2590
899	180	360	540	720	890	1070	1240	1410	1580	1750	1920	2080	2250	2410	2570	2730
900	190	380	560	750	930	1110	1300	1480	1650	1830	2010	2180	2350	2530	2700	2860
901	200	390	580	780	970	1160	1350	1530	1720	1910	2090	2270	2450	2630	2810	2990
902	200	400	610	800	1000	1200	1400	1590	1790	1980	2170	2360	2550	2740	2930	3110
903	210	420	630	830	1040	1240	1450	1650	1850	2050	2250	2450	2650	2840	3040	3230
904	220	430	640	860	1070	1280	1490	1700	1910	2120	2320	2530	2740	2940	3140	3340
905	220	440	660	880	1100	1320	1540	1750	1970	2180	2400	2610	2820	3030	3240	3450
906	230	460	680	910	1130	1360	1580	1800	2030	2250	2470	2690	2910	3130	3340	3560
907	230	470	700	930	1160	1390	1620	1850	2080	2310	2540	2760	2990	3210	3440	3660
908	240	480	720	960	1190	1430	1670	1900	2140	2370	2600	2840	3070	3300	3530	3760
909	250	490	730	980	1220	1460	1710	1950	2190	2430	2670	2910	3150	3390	3620	3860
910	250	500	750	1000	1250	1500	1750	1990	2240	2490	2730	2980	3220	3470	3710	3960
911	260	510	770	1020	1280	1530	1790	2040	2290	2540	2800	3050	3300	3550	3800	4050
912	260	520	780	1040	1300	1560	1820	2080	2340	2600	2860	3110	3370	3630	3880	4140
913	270	530	800	1070	1330	1600	1860	2130	2390	2650	2920	3180	3440	3710	3970	4230
914	270	540	810	1090	1360	1630	1900	2170	2440	2710	2970	3240	3510	3780	4050	4320
915	280	550	830	1110	1380	1660	1930	2210	2480	2760	3030	3310	3580	3850	4130	4400
916	280	560	840	1130	1410	1690	1970	2250	2530	2810	3090	3370	3650	3930	4210	4480
917	290	570	860	1150	1430	1720	2000	2290	2570	2860	3140	3430	3710	4000	4280	4570
918	290	580	870	1160	1460	1750	2040	2330	2620	2910	3200	3490	3780	4070	4360	4650
919	300	590	890	1180	1480	1770	2070	2370	2660	2960	3250	3550	3840	4140	4430	4730
920	300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600	3910	4210	4510	4810
921	310	610	920	1220	1530	1830	2140	2440	2750	3050	3360	3660	3970	4270	4580	4880
922	310	620	930	1240	1550	1860	2170	2480	2790	3100	3410	3720	4030	4340	4650	4960
923	310	630	940	1260	1570	1880	2200	2510	2830	3140	3460	3770	4090	4400	4720	5030
924	320	640	960	1270	1590	1910	2230	2550	2870	3190	3510	3830	4150	4470	4790	5110
925	320	650	970	1290	1610	1940	2260	2580	2910	3230	3560	3880	4200	4530	4850	5180
926	330	650	980	1310	1640	1960	2290	2620	2950	3270	3600	3930	4260	4590	4920	5250
927	330	660	990	1320	1660	1990	2320	2650	2990	3320	3650	3980	4320	4650	4990	5320
928	340	670	1010	1340	1680	2010	2350	2690	3020	3360	3700	4040	4370	4710	5050	5390
929	340	680	1020	1360	1700	2040	2380	2720	3060	3400	3740	4090	4430	4770	5120	5460
930	340	680	1020	1360	1700	2060	2410	2750	3100	3440	3790	4140	4480	4830	5180	5530
931	340	680	1020	1360	1700	2060	2410	2750	3100	3440	3840	4190	4540	4890	5240	5590
932	340	680	1020	1360	1700	2060	2410	2750	3100	3440	3840	4190	4540	4890	5240	5660
933	340	680	1020	1360	1700	2060	2410	2750	3100	3440	3840	4190	4540	4890	5240	5660
934	340	680	1020	1360	1700	2060	2410	2750	3100	3440	3840	4190	4540	4890	5240	5660

(Table continued on next page.)

Table A23. Lookout Point Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
887.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
889	260	260	260	260	260	260	260	260	260	260	260	260	260	260	260
890	490	490	490	490	490	490	490	490	490	490	490	490	490	490	490
891	740	740	740	740	740	740	740	740	740	740	740	740	740	740	740
892	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040
893	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370
894	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730
895	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120
896	2410	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530
897	2580	2710	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850
898	2740	2880	3030	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170
899	2890	3040	3200	3350	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650
900	3030	3200	3360	3520	3840	4150	4150	4150	4150	4150	4150	4150	4150	4150	4150
901	3170	3340	3510	3680	4020	4350	4670	4670	4670	4670	4670	4670	4670	4670	4670
902	3300	3480	3660	3840	4200	4540	4890	5220	5220	5220	5220	5220	5220	5220	5220
903	3420	3610	3800	3990	4360	4730	5090	5440	5790	5790	5790	5790	5790	5790	5790
904	3540	3740	3940	4140	4530	4910	5290	5660	6020	6380	6380	6380	6380	6380	6380
905	3660	3870	4070	4280	4680	5080	5480	5860	6250	6620	6990	6990	6990	6990	6990
906	3770	3990	4200	4410	4830	5250	5660	6060	6460	6860	7240	7620	7620	7620	7620
907	3880	4110	4330	4550	4980	5410	5840	6260	6670	7080	7490	7880	8280	8280	8280
908	3990	4220	4450	4670	5120	5570	6010	6440	6880	7300	7720	8140	8550	8950	8950
909	4100	4330	4560	4800	5260	5720	6180	6630	7070	7510	7950	8380	8810	9220	9640
910	4200	4440	4680	4920	5400	5870	6340	6800	7260	7720	8170	8620	9060	9490	9920
911	4300	4540	4790	5040	5530	6010	6500	6980	7450	7920	8390	8850	9300	9750	10200
912	4390	4650	4900	5150	5660	6160	6650	7140	7630	8120	8600	9070	9540	10010	10470
913	4490	4750	5010	5270	5780	6300	6800	7310	7810	8310	8800	9290	9780	10260	10730
914	4580	4850	5110	5380	5910	6430	6950	7470	7990	8500	9000	9510	10010	10500	10990
915	4670	4940	5220	5490	6030	6560	7100	7630	8160	8680	9200	9720	10230	10740	11240
916	4760	5040	5320	5590	6140	6690	7240	7780	8320	8860	9390	9920	10450	10970	11490
917	4850	5130	5420	5700	6260	6820	7380	7930	8490	9030	9580	10120	10660	11200	11730
918	4940	5230	5510	5800	6370	6950	7520	8080	8650	9210	9770	10320	10870	11420	11960
919	5020	5320	5610	5900	6490	7070	7650	8230	8800	9380	9950	10510	11080	11640	12190
920	5100	5400	5700	6000	6600	7190	7780	8370	8960	9540	10120	10700	11280	11850	12420
921	5190	5490	5790	6100	6700	7310	7910	8510	9110	9710	10300	10890	11480	12060	12640
922	5270	5580	5890	6190	6810	7430	8040	8650	9260	9870	10470	11070	11670	12270	12860
923	5350	5660	5980	6290	6920	7540	8170	8790	9410	10030	10640	11250	11860	12470	13070
924	5430	5740	6060	6380	7020	7660	8290	8920	9550	10180	10810	11430	12050	12670	13290
925	5500	5830	6150	6470	7120	7770	8410	9050	9700	10330	10970	11610	12240	12870	13490
926	5580	5910	6240	6560	7220	7880	8530	9180	9840	10490	11130	11780	12420	13060	13700
927	5650	5990	6320	6650	7320	7990	8650	9310	9970	10630	11290	11950	12600	13250	13900
928	5730	6070	6400	6740	7420	8090	8770	9440	10110	10780	11450	12120	12780	13440	14100
929	5800	6140	6490	6830	7510	8200	8880	9570	10250	10930	11600	12280	12950	13630	14300
930	5870	6220	6570	6920	7610	8300	9000	9690	10380	11070	11760	12440	13130	13810	14490
931	5940	6300	6650	7000	7700	8410	9110	9810	10510	11210	11910	12600	13300	13990	14680
932	6020	6370	6730	7080	7800	8510	9220	9930	10640	11350	12060	12760	13470	14170	14870
933	6020	6370	6730	7080	7890	8610	9330	10050	10770	11490	12200	12920	13630	14350	15060
934	6020	6370	6730	7080	7890	8610	9330	10170	10900	11620	12350	13080	13800	14520	15240

(Table continued on next page.)

Table A23. Lookout Point Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
887.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
889	260	260	260	260	260	260	260	260	260	260	260	260	260	260
890	490	490	490	490	490	490	490	490	490	490	490	490	490	490
891	740	740	740	740	740	740	740	740	740	740	740	740	740	740
892	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040	1040
893	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370
894	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730	1730
895	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120	2120
896	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530	2530
897	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850	2850
898	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170	3170
899	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650	3650
900	4150	4150	4150	4150	4150	4150	4150	4150	4150	4150	4150	4150	4150	4150
901	4670	4670	4670	4670	4670	4670	4670	4670	4670	4670	4670	4670	4670	4670
902	5220	5220	5220	5220	5220	5220	5220	5220	5220	5220	5220	5220	5220	5220
903	5790	5790	5790	5790	5790	5790	5790	5790	5790	5790	5790	5790	5790	5790
904	6380	6380	6380	6380	6380	6380	6380	6380	6380	6380	6380	6380	6380	6380
905	6990	6990	6990	6990	6990	6990	6990	6990	6990	6990	6990	6990	6990	6990
906	7620	7620	7620	7620	7620	7620	7620	7620	7620	7620	7620	7620	7620	7620
907	8280	8280	8280	8280	8280	8280	8280	8280	8280	8280	8280	8280	8280	8280
908	8950	8950	8950	8950	8950	8950	8950	8950	8950	8950	8950	8950	8950	8950
909	9640	9640	9640	9640	9640	9640	9640	9640	9640	9640	9640	9640	9640	9640
910	10350	10350	10350	10350	10350	10350	10350	10350	10350	10350	10350	10350	10350	10350
911	10640	11070	11070	11070	11070	11070	11070	11070	11070	11070	11070	11070	11070	11070
912	10930	11380	11820	11820	11820	11820	11820	11820	11820	11820	11820	11820	11820	11820
913	11200	11670	12130	12580	12580	12580	12580	12580	12580	12580	12580	12580	12580	12580
914	11470	11950	12430	12900	13360	13360	13360	13360	13360	13360	13360	13360	13360	13360
915	11740	12230	12720	13210	13690	14160	14160	14160	14160	14160	14160	14160	14160	14160
916	12000	12510	13010	13510	14000	14490	14970	14970	14970	14970	14970	14970	14970	14970
917	12250	12770	13290	13800	14310	14810	15310	15810	15810	15810	15810	15810	15810	15810
918	12500	13040	13570	14090	14610	15130	15640	16160	16680	16680	16680	16680	16680	16680
919	12740	13290	13840	14380	14910	15440	15970	16490	17030	17030	17030	17030	17030	17030
920	12980	13540	14100	14650	15200	15750	16290	16820	17370	18460	18460	18460	18460	18460
921	13220	13790	14360	14930	15490	16040	16600	17150	17710	18830	18830	18830	18830	18830
922	13450	14030	14610	15190	15770	16340	16900	17470	18050	19190	19190	19190	19190	19190
923	13670	14270	14870	15460	16040	16620	17200	17780	18370	19540	20690	20690	20690	20690
924	13900	14510	15110	15710	16310	16910	17500	18090	18690	19890	21070	21070	21070	21070
925	14120	14740	15350	15970	16580	17190	17790	18390	19010	20230	21430	22630	22630	22630
926	14330	14960	15590	16220	16840	17460	18070	18690	19320	20560	21800	23020	23020	23020
927	14550	15190	15830	16470	17100	17730	18350	18980	19620	20890	22150	23400	24450	24450
928	14760	15410	16060	16710	17350	17990	18630	19270	19920	21220	22500	23770	24850	24850
929	14960	15630	16290	16950	17600	18260	18900	19560	20220	21540	22850	24140	25240	26310
930	15170	15840	16510	17180	17850	18510	19170	19840	20510	21850	23190	24510	25630	26720
931	15370	16050	16740	17420	18090	18770	19440	20110	20800	22170	23520	24870	26010	27130
932	15570	16260	16960	17650	18330	19020	19700	20380	21080	22470	23850	25220	26390	27520
933	15760	16470	17170	17870	18570	19270	19960	20650	21360	22770	24180	25570	26760	27920
934	15960	16670	17390	18100	18800	19510	20210	20920	21640	23070	24500	25910	27120	28300

(Table continued on next page.)

Table A23. Lookout Point Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.		Total Max Capacity
(feet)	20.01	41.5	
887.5	0	0	0
889	260	322	1610
890	550	602	3010
891	920	942	4710
892	1340	1339	6695
893	1810	1790	8950
894	2320	2295	11475
895	2880	2850	14250
896	3480	3454	17270
897	4110	4104	20520
898	4770	4800	24000
899	5470	5539	27695
900	6200	6321	31605
901	6960	7142	35710
902	7740	8003	40015
903	8560	8902	44510
904	9400	9837	49185
905	10270	10808	54040
906	11160	11814	59070
907	12080	12853	64265
908	13020	13926	69630
909	13980	15032	75160
910	14970	16170	80850
911	15980	17339	86695
912	17010	18540	92700
913	18060	19773	98865
914	19130	21037	105185
915	20230	22332	111660
916	21340	23660	118300
917	22470	25019	125095
918	23620	26411	132055
919	24800	27835	139175
920	25990	29294	146470
921	27190	30788	153940
922	28420	32317	161585
923	29670	33883	169415
924	30930	35486	177430
925	32210	37130	185650
926	33500	38814	194070
927	34820	40540	202700
928	36150	42311	211555
929	37500	44128	220640
930	38860	45993	229965
931	40240	47909	239545
932	41630	49877	249385
933	43040	51900	259500
934	44470	54000	270000

Table A24. Dexter Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
660	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
662	90	170	250	330	400	410	410	410	410	410	410	410	410	410	410	410
663	100	200	290	390	470	560	640	710	710	710	710	710	710	710	710	710
664	120	230	330	440	540	640	730	830	910	1000	1000	1000	1000	1000	1000	1000
665	0	250	370	480	600	710	820	920	1030	1130	1230	1320	1320	1320	1320	1320
666	0	270	400	530	650	770	890	1010	1130	1240	1350	1460	1570	1670	1670	1670
667	0	290	430	560	700	830	970	1090	1220	1350	1470	1590	1710	1830	1940	2050
668	0	300	450	600	750	890	1030	1170	1310	1450	1580	1710	1840	1970	2100	2220
669	0	320	480	630	790	940	1090	1240	1390	1540	1680	1820	1960	2100	2240	2380
670	0	340	500	670	830	990	1150	1310	1470	1620	1780	1930	2080	2230	2380	2520
671	0	0	530	700	870	1040	1210	1370	1540	1700	1870	2030	2190	2350	2510	2660
672	0	0	550	730	910	1080	1260	1440	1610	1780	1950	2120	2290	2460	2630	2790
673	0	0	570	760	940	1130	1310	1490	1680	1860	2040	2220	2390	2570	2740	2920
674	0	0	590	780	980	1170	1360	1550	1740	1930	2120	2300	2490	2670	2860	3040
675	0	0	610	810	1010	1210	1410	1610	1800	2000	2190	2390	2580	2770	2960	3160
676	0	0	0	840	1040	1250	1450	1660	1860	2070	2270	2470	2670	2870	3070	3270
677	0	0	0	860	1070	1290	1500	1710	1920	2130	2340	2550	2760	2960	3170	3380
678	0	0	0	880	1100	1320	1540	1760	1980	2190	2410	2620	2840	3050	3270	3480
679	0	0	0	910	1130	1360	1580	1810	2030	2250	2480	2700	2920	3140	3360	3580
680	0	0	0	930	1160	1390	1620	1850	2080	2310	2540	2770	3000	3230	3450	3680
681	0	0	0	950	1190	1430	1660	1900	2140	2370	2610	2840	3080	3310	3540	3780
682	0	0	0	0	1220	1460	1700	1950	2190	2430	2670	2910	3150	3390	3630	3870
683	0	0	0	0	1250	1490	1740	1990	2240	2480	2730	2980	3230	3470	3720	3960
684	0	0	0	0	1270	1530	1780	2030	2290	2540	2790	3040	3300	3550	3800	4050
685	0	0	0	0	1300	1560	1820	2070	2330	2590	2850	3110	3370	3630	3880	4140
686	0	0	0	0	1320	1590	1850	2120	2380	2640	2910	3170	3440	3700	3960	4230
687	0	0	0	0	0	1620	1890	2160	2430	2690	2960	3230	3500	3770	4040	4310
688	0	0	0	0	0	1650	1920	2200	2470	2740	3020	3290	3570	3840	4120	4390
689	0	0	0	0	0	1680	1950	2230	2510	2790	3070	3350	3630	3910	4190	4470
690	0	0	0	0	0	1700	1990	2270	2560	2840	3130	3410	3700	3980	4270	4550
691	0	0	0	0	0	1730	2020	2310	2600	2890	3180	3470	3760	4050	4340	4630
692	0	0	0	0	0	1760	2050	2350	2640	2940	3230	3530	3820	4120	4410	4710
693	0	0	0	0	0	0	2080	2380	2680	2980	3280	3580	3880	4180	4480	4790
694	0	0	0	0	0	0	2120	2420	2720	3030	3330	3640	3940	4250	4550	4860
695	0	0	0	0	0	0	2150	2460	2760	3070	3380	3690	4000	4310	4620	4930
696	0	0	0	0	0	0	2180	2490	2800	3120	3430	3740	4060	4370	4690	5010
697	0	0	0	0	0	0	2210	2520	2840	3160	3480	3800	4120	4440	4760	5080
698	0	0	0	0	0	0	0	2560	2880	3200	3530	3850	4170	4500	4820	5150
699	0	0	0	0	0	0	0	2560	2880	3200	3570	3900	4230	4560	4890	5220
700	0	0	0	0	0	0	0	2560	2880	3200	3570	3900	4230	4560	4890	5290
701	0	0	0	0	0	0	0	2560	2880	3200	3570	3900	4230	4560	4890	5290
702	0	0	0	0	0	0	0	2560	2880	3200	3570	3900	4230	4560	4890	5290

(Table continued on next page.)

Table A24. Dexter Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
660	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
662	410	410	410	410	410	410	410	410	410	410	410	410	410	410	410
663	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710
664	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
665	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320
666	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670
667	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050
668	2340	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460
669	2510	2640	2770	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890
670	2670	2810	2950	3080	3360	3360	3360	3360	3360	3360	3360	3360	3360	3360	3360
671	2810	2970	3120	3270	3560	3840	3840	3840	3840	3840	3840	3840	3840	3840	3840
672	2960	3120	3280	3440	3750	4060	4360	4360	4360	4360	4360	4360	4360	4360	4360
673	3090	3260	3430	3600	3930	4260	4580	4890	4890	4890	4890	4890	4890	4890	4890
674	3220	3400	3580	3750	4110	4450	4790	5130	5450	5450	5450	5450	5450	5450	5450
675	3340	3530	3720	3900	4270	4640	5000	5350	5700	5700	5700	5700	5700	5700	5700
676	3460	3660	3850	4050	4430	4820	5190	5560	5930	6290	6290	6290	6290	6290	6290
677	3580	3780	3990	4190	4590	4990	5380	5770	6150	6530	6910	6910	6910	6910	6910
678	3690	3900	4110	4320	4740	5150	5560	5970	6370	6770	7160	7540	7540	7540	7540
679	3800	4020	4240	4450	4890	5320	5740	6160	6580	6990	7400	7800	8200	8200	8200
680	3910	4130	4360	4580	5030	5470	5910	6350	6780	7210	7640	8060	8470	8880	8880
681	4010	4240	4470	4700	5160	5620	6080	6530	6980	7420	7860	8300	8730	9160	9580
682	4110	4350	4590	4820	5300	5770	6240	6710	7170	7630	8090	8540	8990	9430	9860
683	4210	4450	4700	4940	5430	5920	6400	6880	7360	7830	8300	8770	9230	9690	10140
684	4300	4560	4810	5060	5560	6060	6550	7050	7540	8030	8510	9000	9470	9950	10420
685	4400	4660	4910	5170	5680	6190	6700	7210	7720	8220	8720	9220	9710	10200	10680
686	4490	4750	5020	5280	5800	6330	6850	7370	7890	8410	8920	9430	9940	10440	10940
687	4580	4850	5120	5380	5920	6460	7000	7530	8060	8590	9120	9640	10160	10680	11190
688	4670	4940	5220	5490	6040	6590	7140	7680	8230	8770	9310	9850	10380	10910	11440
689	4750	5030	5310	5590	6150	6720	7280	7830	8390	8950	9500	10050	10590	11140	11680
690	4840	5120	5410	5690	6270	6840	7410	7980	8550	9120	9680	10240	10800	11360	11920
691	4920	5210	5500	5790	6380	6960	7540	8130	8710	9290	9860	10440	11010	11580	12150
692	5010	5300	5600	5890	6490	7080	7680	8270	8860	9450	10040	10630	11210	11800	12380
693	5090	5390	5690	5990	6590	7200	7810	8410	9010	9620	10220	10820	11410	12010	12600
694	5170	5470	5780	6080	6700	7320	7930	8550	9160	9780	10390	11000	11610	12210	12820
695	5240	5560	5870	6180	6800	7430	8060	8680	9310	9930	10560	11180	11800	12420	13030
696	5320	5640	5950	6270	6910	7540	8180	8820	9450	10090	10720	11360	11990	12620	13250
697	5400	5720	6040	6360	7010	7650	8300	8950	9600	10240	10890	11530	12180	12820	13460
698	5470	5800	6120	6450	7110	7760	8420	9080	9740	10390	11050	11700	12360	13010	13660
699	5550	5880	6210	6540	7200	7870	8540	9210	9870	10540	11210	11870	12540	13200	13860
700	5620	5950	6290	6630	7300	7980	8650	9330	10010	10690	11370	12040	12720	13390	14060
701	5620	5950	6290	6630	7400	8080	8770	9460	10140	10830	11520	12210	12890	13580	14260
702	5620	5950	6290	6630	7400	8080	8770	9580	10280	10980	11670	12370	13070	13760	14460

(Table continued on next page.)

Table A24. Dexter Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	18.0	35.0	Max
660	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
662	410	410	410	410	410	410	410	410	410	410	410	410	410	429	3003
663	710	710	710	710	710	710	710	710	710	710	710	710	750	743	5201
664	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1160	1143	8001
665	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1320	1620	1571	10997
666	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	1670	2130	2057	14399
667	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2050	2690	2629	18403
668	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	2460	3290	3257	22799
669	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890	2890	3920	3971	27797
670	3360	3360	3360	3360	3360	3360	3360	3360	3360	3360	3360	3360	4590	4700	32900
671	3840	3840	3840	3840	3840	3840	3840	3840	3840	3840	3840	3840	5300	5429	38003
672	4360	4360	4360	4360	4360	4360	4360	4360	4360	4360	4360	4360	6040	6286	44002
673	4890	4890	4890	4890	4890	4890	4890	4890	4890	4890	4890	4890	6810	7171	50197
674	5450	5450	5450	5450	5450	5450	5450	5450	5450	5450	5450	5450	7610	8057	56399
675	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	5700	8440	9043	63301
676	6290	6290	6290	6290	6290	6290	6290	6290	6290	6290	6290	6290	9290	9986	69902
677	6910	6910	6910	6910	6910	6910	6910	6910	6910	6910	6910	6910	10180	10971	76797
678	7540	7540	7540	7540	7540	7540	7540	7540	7540	7540	7540	7540	11090	12029	84203
679	8200	8200	8200	8200	8200	8200	8200	8200	8200	8200	8200	8200	12030	13100	91700
680	8880	8880	8880	8880	8880	8880	8880	8880	8880	8880	8880	8880	12990	14214	99498
681	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	9580	13970	15371	107597
682	10300	10300	10300	10300	10300	10300	10300	10300	10300	10300	10300	10300	14980	16543	115801
683	10590	11030	11030	11030	11030	11030	11030	11030	11030	11030	11030	11030	16020	17757	124299
684	10880	11340	11790	11790	11790	11790	11790	11790	11790	11790	11790	11790	17070	19000	133000
685	11160	11630	12110	12570	12570	12570	12570	12570	12570	12570	12570	12570	18150	20286	142002
686	11430	11920	12410	12890	13370	13370	13370	13370	13370	13370	13370	13370	19250	21657	151599
687	11700	12200	12710	13200	13690	14180	14180	14180	14180	14180	14180	14180	20370	22929	160503
688	11960	12480	13000	13510	14010	14520	15010	15010	15010	15010	15010	15010	21510	24314	170198
689	12220	12750	13280	13810	14330	14840	15360	15860	15860	15860	15860	15860	22680	25729	180103
690	12470	13010	13560	14100	14630	15160	15690	16220	16730	16730	16730	16730	23860	27214	190498
691	12710	13270	13830	14380	14930	15480	16020	16560	17090	17090	17090	17090	25060	28700	200900
692	12950	13530	14100	14660	15230	15790	16340	16890	17440	18550	18550	18550	26280	30157	211099
693	13190	13770	14360	14940	15520	16090	16660	17220	17790	18920	18920	18920	27530	31714	221998
694	13420	14020	14620	15210	15800	16390	16970	17550	18120	19290	20460	20460	28790	33214	232498
695	13650	14260	14870	15470	16080	16680	17270	17860	18450	19650	20850	20850	30070	34829	243803
696	13870	14500	15120	15740	16350	16960	17570	18180	18780	20000	21230	22450	31360	36357	254499
697	14090	14730	15360	15990	16620	17240	17860	18480	19100	20350	21600	22850	32680	37857	264999
698	14310	14960	15600	16240	16880	17520	18150	18780	19410	20690	21970	23240	34010	39429	276003
699	14530	15180	15840	16490	17140	17790	18440	19080	19720	21020	22330	23630	35360	40990	286930
700	14740	15410	16070	16740	17400	18060	18720	19370	20030	21350	22690	24020	36730	42570	297990
701	14940	15620	16300	16980	17650	18330	19000	19660	20330	21680	23040	24390	38120	44180	309260
702	15150	15840	16530	17220	17900	18590	19270	19950	20620	22000	23380	24760	39520	45810	320670

Table A25. Fall Creek Spillway Capacity Table in ResSim, continued on next page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.															
(feet)	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	3.75	4.00
791.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
792	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
793	80	140	200	200	200	200	200	200	200	200	200	200	200	200	200	200
794	100	180	260	330	400	400	400	400	400	400	400	400	400	400	400	400
795	110	210	300	390	470	560	630	630	630	630	630	630	630	630	630	630
796	130	240	340	440	540	640	730	820	910	910	910	910	910	910	910	910
797	0	260	380	490	600	710	810	920	1020	1120	1210	1210	1210	1210	1210	1210
798	0	280	410	530	650	770	890	1010	1120	1230	1340	1440	1540	1540	1540	1540
799	0	300	440	570	700	830	960	1090	1210	1330	1450	1570	1680	1800	1910	1910
800	0	320	470	610	750	890	1030	1160	1300	1430	1560	1690	1810	1940	2060	2180
801	0	340	490	640	790	940	1090	1240	1380	1520	1660	1800	1930	2070	2200	2330
802	0	360	520	680	840	990	1150	1300	1460	1610	1760	1900	2050	2190	2330	2470
803	0	0	540	710	880	1040	1200	1370	1530	1690	1850	2000	2160	2310	2460	2610
804	0	0	560	740	910	1090	1260	1430	1600	1760	1930	2100	2260	2420	2580	2740
805	0	0	590	770	950	1130	1310	1490	1660	1840	2010	2190	2360	2530	2700	2860
806	0	0	610	800	980	1170	1360	1540	1730	1910	2090	2270	2450	2630	2810	2980
807	0	0	630	820	1020	1210	1410	1600	1790	1980	2170	2360	2540	2730	2910	3090
808	0	0	0	850	1050	1250	1450	1650	1850	2050	2240	2440	2630	2820	3010	3200
809	0	0	0	880	1080	1290	1500	1700	1910	2110	2310	2510	2710	2910	3110	3310
810	0	0	0	900	1110	1330	1540	1750	1960	2170	2380	2590	2800	3000	3210	3410
811	0	0	0	920	1140	1360	1580	1800	2020	2230	2450	2660	2880	3090	3300	3510
812	0	0	0	950	1170	1400	1620	1850	2070	2290	2510	2730	2950	3170	3390	3610
813	0	0	0	970	1200	1430	1660	1890	2120	2350	2580	2800	3030	3260	3480	3700
814	0	0	0	0	1230	1470	1700	1940	2170	2410	2640	2870	3100	3340	3570	3800
815	0	0	0	0	1260	1500	1740	1980	2220	2460	2700	2940	3180	3410	3650	3890
816	0	0	0	0	1280	1530	1780	2020	2270	2510	2760	3000	3250	3490	3730	3970
817	0	0	0	0	1310	1560	1810	2060	2320	2570	2820	3070	3320	3560	3810	4060
818	0	0	0	0	1330	1590	1850	2110	2360	2620	2870	3130	3380	3640	3890	4140
819	0	0	0	0	0	1620	1880	2150	2410	2670	2930	3190	3450	3710	3970	4230
820	0	0	0	0	0	1650	1920	2190	2450	2720	2980	3250	3510	3780	4040	4310
821	0	0	0	0	0	1680	1950	2220	2500	2770	3040	3310	3580	3850	4120	4390
822	0	0	0	0	0	1710	1990	2260	2540	2810	3090	3370	3640	3920	4190	4460
823	0	0	0	0	0	1740	2020	2300	2580	2860	3140	3420	3700	3980	4260	4540
824	0	0	0	0	0	0	2050	2340	2620	2910	3190	3480	3760	4050	4330	4620
825	0	0	0	0	0	0	2080	2370	2660	2950	3240	3530	3820	4110	4400	4690
826	0	0	0	0	0	0	2110	2410	2700	3000	3290	3590	3880	4180	4470	4760
827	0	0	0	0	0	0	2140	2440	2740	3040	3340	3640	3940	4240	4540	4840
828	0	0	0	0	0	0	2170	2480	2780	3090	3390	3690	4000	4300	4600	4910
829	0	0	0	0	0	0	2200	2510	2820	3130	3440	3750	4050	4360	4670	4980
830	0	0	0	0	0	0	0	2550	2860	3170	3480	3800	4110	4420	4730	5050
831	0	0	0	0	0	0	0	2580	2900	3210	3530	3850	4160	4480	4800	5110
832	0	0	0	0	0	0	0	2610	2930	3250	3580	3900	4220	4540	4860	5180
833	0	0	0	0	0	0	0	2650	2970	3300	3620	3950	4270	4600	4920	5250
834	0	0	0	0	0	0	0	2680	3010	3340	3670	3990	4320	4650	4980	5310

(Table continued on next page.)

Table A25. Fall Creek Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.														
(feet)	4.25	4.50	4.75	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50
791.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
792	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
793	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
794	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
795	630	630	630	630	630	630	630	630	630	630	630	630	630	630	630
796	910	910	910	910	910	910	910	910	910	910	910	910	910	910	910
797	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210
798	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540
799	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910
800	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290
801	2460	2580	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710
802	2610	2750	2880	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010
803	2760	2900	3050	3190	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470
804	2900	3050	3200	3360	3650	3950	3950	3950	3950	3950	3950	3950	3950	3950	3950
805	3030	3190	3350	3520	3830	4140	4440	4440	4440	4440	4440	4440	4440	4440	4440
806	3150	3330	3500	3670	4000	4330	4650	4960	4960	4960	4960	4960	4960	4960	4960
807	3280	3460	3640	3810	4160	4510	4850	5180	5500	5500	5500	5500	5500	5500	5500
808	3390	3580	3770	3950	4320	4680	5030	5380	5730	6060	6060	6060	6060	6060	6060
809	3510	3700	3900	4090	4470	4850	5220	5580	5940	6300	6640	6640	6640	6640	6640
810	3620	3820	4020	4220	4620	5010	5390	5770	6150	6520	6880	7240	7240	7240	7240
811	3720	3930	4140	4350	4760	5160	5560	5960	6350	6740	7120	7490	7860	7860	7860
812	3830	4040	4260	4470	4890	5310	5730	6140	6550	6950	7340	7730	8110	8490	8490
813	3930	4150	4370	4590	5030	5460	5890	6310	6730	7150	7560	7960	8360	8760	9150
814	4030	4250	4480	4710	5160	5600	6050	6480	6920	7350	7770	8190	8610	9010	9420
815	4120	4360	4590	4820	5280	5740	6200	6650	7100	7540	7980	8410	8840	9260	9680
816	4210	4460	4690	4930	5410	5880	6350	6810	7270	7730	8180	8630	9070	9510	9940
817	4310	4550	4800	5040	5530	6010	6490	6970	7440	7910	8380	8840	9290	9750	10190
818	4400	4650	4900	5150	5650	6140	6640	7120	7610	8090	8570	9040	9510	9980	10440
819	4480	4740	5000	5250	5760	6270	6780	7280	7770	8270	8760	9240	9730	10200	10680
820	4570	4830	5100	5360	5880	6400	6910	7420	7930	8440	8940	9440	9930	10420	10910
821	4660	4920	5190	5460	5990	6520	7050	7570	8090	8610	9120	9630	10140	10640	11140
822	4740	5010	5280	5560	6100	6640	7180	7710	8240	8770	9300	9820	10340	10850	11370
823	4820	5100	5380	5650	6210	6760	7310	7850	8390	8930	9470	10010	10540	11060	11590
824	4900	5180	5470	5750	6310	6870	7430	7990	8540	9090	9640	10190	10730	11270	11800
825	4980	5270	5560	5840	6420	6990	7560	8120	8690	9250	9810	10370	10920	11470	12010
826	5060	5350	5640	5940	6520	7100	7680	8260	8830	9400	9970	10540	11110	11670	12220
827	5130	5430	5730	6030	6620	7210	7800	8390	8970	9560	10140	10710	11290	11860	12430
828	5210	5510	5810	6120	6720	7320	7920	8520	9110	9700	10300	10880	11470	12050	12630
829	5280	5590	5900	6200	6820	7430	8040	8640	9250	9850	10450	11050	11650	12240	12830
830	5360	5670	5980	6290	6910	7530	8150	8770	9380	10000	10610	11220	11820	12420	13030
831	5430	5750	6060	6380	7010	7640	8270	8890	9520	10140	10760	11380	11990	12610	13220
832	5500	5820	6140	6460	7100	7740	8380	9010	9650	10280	10910	11540	12160	12790	13410
833	5570	5900	6220	6550	7190	7840	8490	9130	9780	10420	11060	11700	12330	12960	13600
834	5640	5970	6300	6630	7290	7940	8600	9250	9900	10560	11200	11850	12500	13140	13780

(Table continued on next page.)

Table A25. Fall Creek Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.													
(feet)	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	16.0	17.0	18.0	19.0	20.0
791.6	0	0	0	0	0	0	0	0	0	0	0	0	0	0
792	40	40	40	40	40	40	40	40	40	40	40	40	40	40
793	200	200	200	200	200	200	200	200	200	200	200	200	200	200
794	400	400	400	400	400	400	400	400	400	400	400	400	400	400
795	630	630	630	630	630	630	630	630	630	630	630	630	630	630
796	910	910	910	910	910	910	910	910	910	910	910	910	910	910
797	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210	1210
798	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540	1540
799	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910	1910
800	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290	2290
801	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710	2710
802	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010	3010
803	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470	3470
804	3950	3950	3950	3950	3950	3950	3950	3950	3950	3950	3950	3950	3950	3950
805	4440	4440	4440	4440	4440	4440	4440	4440	4440	4440	4440	4440	4440	4440
806	4960	4960	4960	4960	4960	4960	4960	4960	4960	4960	4960	4960	4960	4960
807	5500	5500	5500	5500	5500	5500	5500	5500	5500	5500	5500	5500	5500	5500
808	6060	6060	6060	6060	6060	6060	6060	6060	6060	6060	6060	6060	6060	6060
809	6640	6640	6640	6640	6640	6640	6640	6640	6640	6640	6640	6640	6640	6640
810	7240	7240	7240	7240	7240	7240	7240	7240	7240	7240	7240	7240	7240	7240
811	7860	7860	7860	7860	7860	7860	7860	7860	7860	7860	7860	7860	7860	7860
812	8490	8490	8490	8490	8490	8490	8490	8490	8490	8490	8490	8490	8490	8490
813	9150	9150	9150	9150	9150	9150	9150	9150	9150	9150	9150	9150	9150	9150
814	9820	9820	9820	9820	9820	9820	9820	9820	9820	9820	9820	9820	9820	9820
815	10100	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500	10500
816	10370	10790	11210	11210	11210	11210	11210	11210	11210	11210	11210	11210	11210	11210
817	10630	11070	11500	11930	11930	11930	11930	11930	11930	11930	11930	11930	11930	11930
818	10890	11340	11790	12230	12670	12670	12670	12670	12670	12670	12670	12670	12670	12670
819	11150	11610	12070	12530	12980	13420	13420	13420	13420	13420	13420	13420	13420	13420
820	11390	11870	12340	12810	13280	13740	13740	13740	13740	13740	13740	13740	13740	13740
821	11640	12130	12610	13090	13570	14040	14520	14520	14520	14520	14520	14520	14520	14520
822	11870	12380	12880	13370	13860	14350	14840	15330	15330	15330	15330	15330	15330	15330
823	12110	12620	13130	13640	14140	14640	15140	15650	16150	16150	16150	16150	16150	16150
824	12330	12860	13390	13900	14420	14930	15450	15970	16480	16480	16480	16480	16480	16480
825	12560	13100	13630	14160	14690	15220	15740	16280	16810	17850	17850	17850	17850	17850
826	12780	13330	13880	14420	14960	15500	16040	16580	17120	18200	18200	18200	18200	18200
827	12990	13560	14120	14670	15220	15770	16320	16880	17430	18530	19620	19620	19620	19620
828	13210	13780	14350	14920	15480	16040	16600	17170	17740	18860	19970	19970	19970	19970
829	13420	14000	14580	15160	15730	16300	16880	17460	18040	19190	20320	21340	21340	21340
830	13620	14220	14810	15400	15980	16560	17150	17740	18340	19510	20670	21710	21710	21710
831	13830	14430	15030	15630	16230	16820	17420	18020	18630	19820	21010	22070	23060	23060
832	14030	14640	15250	15860	16470	17070	17680	18300	18910	20130	21340	22430	23430	23430
833	14220	14850	15470	16090	16710	17320	17940	18570	19190	20440	21670	22780	23810	24810
834	14420	15050	15690	16320	16940	17570	18200	18840	19470	20740	21990	23130	24170	25190

(Table continued on next page.)

Table A25. Fall Creek Spillway Capacity Table in ResSim, continued from previous page.

Elev.	Spillway Capacity in cfs for a given Single Spillway Gate Opening, in feet.		Total Max Capacity
(feet)	20.01	40.00	
791.6	0	0	0
792	40	200	400
793	230	400	800
794	500	500	1000
795	840	875	1750
796	1230	1250	2500
797	1670	1625	3250
798	2160	2000	4000
799	2680	2500	5000
800	3240	3000	6000
801	3830	3500	7000
802	4450	4000	8000
803	5110	4750	9500
804	5790	5500	11000
805	6500	6250	12500
806	7240	7000	14000
807	8010	7875	15750
808	8800	8750	17500
809	9610	9625	19250
810	10450	10500	21000
811	11310	11500	23000
812	12200	12500	25000
813	13100	13500	27000
814	14030	14500	29000
815	14980	15563	31126
816	15950	16625	33250
817	16940	17688	35376
818	17950	18750	37500
819	18970	20063	40126
820	20020	21375	42750
821	21090	22688	45376
822	22170	24000	48000
823	23270	25250	50500
824	24390	26500	53000
825	25530	27750	55500
826	26680	29000	58000
827	27850	30500	61000
828	29040	32000	64000
829	30240	33500	67000
830	31460	35000	70000
831	32690	36563	73126
832	33950	38125	76250
833	35210	39688	79376
834	36500	41200	82400

1.3 Controlled Outlet Capacity Inputs in ResSim

Table A26a. Detroit Upper Controlled Outlet Capacity Table in ResSim, continued on next page.

Elev.	Upper Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.															
(feet)	0.20	0.99	1.00	1.40	1.80	2.00	2.40	2.80	3.00	3.40	3.80	4.00	4.40	4.80	5.00	5.40
1335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1420	0	0	430	572	681	740	852	964	1020	1132	1248	1310	1438	1566	1630	1758
1422	0	0	433	577	689	748	861	974	1030	1142	1262	1323	1453	1582	1647	1778
1424	0	0	436	582	697	756	870	984	1040	1156	1276	1336	1467	1598	1664	1798
1426	0	0	439	587	704	764	879	994	1050	1170	1289	1349	1482	1615	1681	1819
1428	0	0	442	592	712	772	888	1004	1060	1181	1301	1362	1496	1631	1698	1839
1430	0	0	445	598	720	780	897	1014	1070	1192	1314	1375	1511	1647	1715	1859
1432	0	0	448	603	726	788	905	1024	1080	1203	1326	1388	1526	1663	1732	1879
1434	0	0	451	608	735	796	914	1032	1090	1214	1339	1401	1540	1679	1749	1899
1436	0	0	454	613	743	804	923	1041	1100	1226	1350	1414	1555	1696	1766	1920
1438	0	0	457	618	751	812	932	1051	1110	1236	1363	1427	1569	1712	1783	1940
1440	0	0	460	624	759	820	940	1060	1120	1246	1376	1440	1584	1728	1800	1960
1442	0	0	463	630	766	827	948	1070	1129	1256	1386	1452	1598	1743	1816	1977
1444	0	0	466	635	773	834	956	1078	1138	1266	1397	1464	1611	1758	1832	1994
1446	0	0	469	640	780	841	964	1085	1147	1276	1410	1476	1625	1774	1848	2010
1448	0	0	472	645	787	848	972	1094	1156	1286	1422	1488	1638	1789	1864	2027
1450	0	0	475	650	794	855	980	1104	1165	1297	1433	1500	1652	1804	1880	2044
1452	0	0	478	655	800	862	988	1113	1174	1306	1444	1512	1666	1819	1896	2061
1454	0	0	481	660	806	869	996	1121	1183	1316	1455	1524	1679	1834	1912	2078
1456	0	0	484	665	812	876	1004	1129	1192	1326	1465	1536	1693	1850	1928	2094
1458	0	0	487	670	818	883	1012	1137	1201	1336	1477	1548	1706	1865	1944	2111
1460	0	0	490	675	824	890	1020	1143	1210	1346	1488	1560	1720	1880	1960	2128
1462	0	0	493	679	830	897	1028	1152	1219	1356	1498	1572	1734	1895	1976	2146
1464	0	0	496	683	836	904	1036	1161	1228	1365	1510	1584	1747	1910	1992	2163
1466	0	0	499	687	842	911	1044	1170	1237	1375	1521	1596	1761	1926	2008	2181
1468	0	0	502	691	848	918	1052	1178	1246	1385	1532	1608	1774	1941	2024	2198
1470	0	0	505	695	854	925	1060	1187	1255	1395	1544	1620	1788	1956	2040	2216
1472	0	0	508	699	860	932	1068	1196	1264	1405	1554	1632	1802	1971	2056	2234
1474	0	0	511	703	866	939	1076	1205	1273	1414	1566	1644	1815	1986	2072	2251
1476	0	0	514	707	872	946	1084	1213	1282	1424	1577	1656	1829	2002	2088	2269
1478	0	0	517	711	878	953	1091	1221	1291	1434	1588	1668	1842	2017	2104	2286
1480	0	0	520	715	884	960	1098	1229	1300	1444	1600	1680	1856	2032	2120	2304
1482	0	0	523	719	890	966	1105	1237	1308	1453	1610	1692	1870	2047	2136	2321
1484	0	0	526	723	896	972	1112	1245	1316	1463	1622	1704	1883	2062	2152	2338
1486	0	0	529	727	902	978	1119	1253	1324	1473	1632	1716	1897	2078	2168	2354
1488	0	0	532	731	908	984	1126	1261	1332	1482	1642	1728	1910	2093	2184	2371
1490	0	0	535	735	913	990	1133	1269	1340	1492	1653	1740	1924	2108	2200	2388
1492	0	0	538	738	918	996	1140	1276	1348	1501	1664	1752	1938	2123	2216	2405
1494	0	0	541	741	923	1002	1147	1284	1356	1510	1675	1764	1951	2138	2232	2422
1496	0	0	544	744	928	1008	1154	1291	1364	1520	1685	1776	1965	2154	2248	2438
1498	0	0	547	747	933	1014	1161	1298	1372	1531	1695	1788	1978	2169	2264	2455
1500	0	0	550	750	938	1020	1167	1305	1380	1540	1706	1800	1992	2184	2280	2472
1502	0	0	553	754	943	1026	1174	1312	1388	1550	1717	1812	2006	2199	2295	2489
1504	0	0	555	758	949	1033	1180	1320	1396	1559	1728	1824	2018	2213	2311	2508
1506	0	0	558	762	954	1039	1187	1328	1404	1569	1740	1836	2031	2228	2326	2525
1508	0	0	561	766	960	1046	1193	1335	1412	1578	1751	1848	2045	2243	2342	2544
1510	0	0	564	769	965	1052	1200	1343	1420	1588	1762	1859	2058	2257	2357	2561
1512	0	0	566	773	970	1059	1207	1350	1428	1598	1774	1871	2071	2272	2372	2578
1514	0	0	569	777	976	1065	1213	1358	1436	1607	1785	1883	2084	2286	2388	2597
1516	0	0	572	781	981	1072	1220	1366	1444	1617	1796	1895	2097	2301	2403	2614
1518	0	0	574	785	987	1078	1227	1373	1452	1626	1808	1907	2111	2316	2419	2632
1520	0	0	577	789	992	1085	1233	1381	1460	1636	1819	1919	2124	2330	2434	2650
1522	0	0	580	793	998	1091	1240	1388	1468	1646	1830	1931	2137	2345	2449	2667
1524	0	0	582	797	1003	1098	1246	1396	1476	1655	1842	1943	2150	2360	2465	2685
1526	0	0	585	801	1008	1104	1253	1403	1484	1665	1853	1954	2164	2374	2480	2703
1528	0	0	588	804	1014	1111	1260	1411	1492	1674	1864	1966	2176	2389	2496	2721
1530	0	0	591	808	1019	1117	1266	1418	1500	1684	1875	1978	2190	2404	2511	2739
1532	0	0	593	812	1025	1124	1273	1426	1508	1694	1887	1990	2203	2418	2526	2756
1534	0	0	596	816	1030	1130	1280	1434	1516	1703	1898	2002	2216	2433	2542	2774
1536	0	0	599	820	1035	1137	1286	1441	1524	1713	1909	2014	2229	2447	2557	2792
1538	0	0	601	824	1041	1143	1293	1449	1531	1722	1921	2026	2243	2463	2573	2810
1540	0	0	604	828	1046	1150	1299	1456	1539	1732	1932	2038	2256	2477	2588	2828

Table A26b. Detroit Upper Controlled Outlet Capacity Table in ResSim, continued from previous page.

Elev.	Upper Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.														
(feet)	5.80	6.00	6.40	6.80	7.00	7.40	7.80	8.00	8.40	8.80	9.00	9.40	9.80	10.00	Max
1335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1420	0	0	430	572	681	740	852	964	1020	1132	1248	1310	1438	1566	1630
1422	0	0	433	577	689	748	861	974	1030	1142	1262	1323	1453	1582	1647
1424	0	0	436	582	697	756	870	984	1040	1156	1276	1336	1467	1598	1664
1426	0	0	439	587	704	764	879	994	1050	1170	1289	1349	1482	1615	1681
1428	0	0	442	592	712	772	888	1004	1060	1181	1301	1362	1496	1631	1698
1430	0	0	445	598	720	780	897	1014	1070	1192	1314	1375	1511	1647	1715
1432	0	0	448	603	726	788	905	1024	1080	1203	1326	1388	1526	1663	1732
1434	0	0	451	608	735	796	914	1032	1090	1214	1339	1401	1540	1679	1749
1436	0	0	454	613	743	804	923	1041	1100	1226	1350	1414	1555	1696	1766
1438	0	0	457	618	751	812	932	1051	1110	1236	1363	1427	1569	1712	1783
1440	0	0	460	624	759	820	940	1060	1120	1246	1376	1440	1584	1728	1800
1442	0	0	463	630	766	827	948	1070	1129	1256	1386	1452	1598	1743	1816
1444	0	0	466	635	773	834	956	1078	1138	1266	1397	1464	1611	1758	1832
1446	0	0	469	640	780	841	964	1085	1147	1276	1410	1476	1625	1774	1848
1448	0	0	472	645	787	848	972	1094	1156	1286	1422	1488	1638	1789	1864
1450	0	0	475	650	794	855	980	1104	1165	1297	1433	1500	1652	1804	1880
1452	0	0	478	655	800	862	988	1113	1174	1306	1444	1512	1666	1819	1896
1454	0	0	481	660	806	869	996	1121	1183	1316	1455	1524	1679	1834	1912
1456	0	0	484	665	812	876	1004	1129	1192	1326	1465	1536	1693	1850	1928
1458	0	0	487	670	818	883	1012	1137	1201	1336	1477	1548	1706	1865	1944
1460	0	0	490	675	824	890	1020	1143	1210	1346	1488	1560	1720	1880	1960
1462	0	0	493	679	830	897	1028	1152	1219	1356	1498	1572	1734	1895	1976
1464	0	0	496	683	836	904	1036	1161	1228	1365	1510	1584	1747	1910	1992
1466	0	0	499	687	842	911	1044	1170	1237	1375	1521	1596	1761	1926	2008
1468	0	0	502	691	848	918	1052	1178	1246	1385	1532	1608	1774	1941	2024
1470	0	0	505	695	854	925	1060	1187	1255	1395	1544	1620	1788	1956	2040
1472	0	0	508	699	860	932	1068	1196	1264	1405	1554	1632	1802	1971	2056
1474	0	0	511	703	866	939	1076	1205	1273	1414	1566	1644	1815	1986	2072
1476	0	0	514	707	872	946	1084	1213	1282	1424	1577	1656	1829	2002	2088
1478	0	0	517	711	878	953	1091	1221	1291	1434	1588	1668	1842	2017	2104
1480	0	0	520	715	884	960	1098	1229	1300	1444	1600	1680	1856	2032	2120
1482	0	0	523	719	890	966	1105	1237	1308	1453	1610	1692	1870	2047	2136
1484	0	0	526	723	896	972	1112	1245	1316	1463	1622	1704	1883	2062	2152
1486	0	0	529	727	902	978	1119	1253	1324	1473	1632	1716	1897	2078	2168
1488	0	0	532	731	908	984	1126	1261	1332	1482	1642	1728	1910	2093	2184
1490	0	0	535	735	913	990	1133	1269	1340	1492	1653	1740	1924	2108	2200
1492	0	0	538	738	918	996	1140	1276	1348	1501	1664	1752	1938	2123	2216
1494	0	0	541	741	923	1002	1147	1284	1356	1510	1675	1764	1951	2138	2232
1496	0	0	544	744	928	1008	1154	1291	1364	1520	1685	1776	1965	2154	2248
1498	0	0	547	747	933	1014	1161	1298	1372	1531	1695	1788	1978	2169	2264
1500	0	0	550	750	938	1020	1167	1305	1380	1540	1706	1800	1992	2184	2280
1502	0	0	553	754	943	1026	1174	1312	1388	1550	1717	1812	2006	2199	2295
1504	0	0	555	758	949	1033	1180	1320	1396	1559	1728	1824	2018	2213	2311
1506	0	0	558	762	954	1039	1187	1328	1404	1569	1740	1836	2031	2228	2326
1508	0	0	561	766	960	1046	1193	1335	1412	1578	1751	1848	2045	2243	2342
1510	0	0	564	769	965	1052	1200	1343	1420	1588	1762	1859	2058	2257	2357
1512	0	0	566	773	970	1059	1207	1350	1428	1598	1774	1871	2071	2272	2372
1514	0	0	569	777	976	1065	1213	1358	1436	1607	1785	1883	2084	2286	2388
1516	0	0	572	781	981	1072	1220	1366	1444	1617	1796	1895	2097	2301	2403
1518	0	0	574	785	987	1078	1227	1373	1452	1626	1808	1907	2111	2316	2419
1520	0	0	577	789	992	1085	1233	1381	1460	1636	1819	1919	2124	2330	2434
1522	0	0	580	793	998	1091	1240	1388	1468	1646	1830	1931	2137	2345	2449
1524	0	0	582	797	1003	1098	1246	1396	1476	1655	1842	1943	2150	2360	2465
1526	0	0	585	801	1008	1104	1253	1403	1484	1665	1853	1954	2164	2374	2480
1528	0	0	588	804	1014	1111	1260	1411	1492	1674	1864	1966	2176	2389	2496
1530	0	0	591	808	1019	1117	1266	1418	1500	1684	1875	1978	2190	2404	2511
1532	0	0	593	812	1025	1124	1273	1426	1508	1694	1887	1990	2203	2418	2526
1534	0	0	596	816	1030	1130	1280	1434	1516	1703	1898	2002	2216	2433	2542
1536	0	0	599	820	1035	1137	1286	1441	1524	1713	1909	2014	2229	2447	2557
1538	0	0	601	824	1041	1143	1293	1449	1531	1722	1921	2026	2243	2463	2573
1540	0	0	604	828	1046	1150	1299	1456	1539	1732	1932	2038	2256	2477	2588

Table A27. Green Peter Controlled Outlet Capacity Table in ResSim.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.												
(feet)	0.10	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40
745	0	0	0	0	0	0	0	0	0	0	0	0	0
910	41	83	166	248	331	414	496	579	661	744	826	910	994
920	43	85	170	256	341	426	511	596	680	765	850	937	1024
930	44	88	175	263	350	438	525	612	700	787	874	963	1052
940	45	90	180	270	360	450	540	629	719	808	898	990	1081
950	46	92	184	277	369	461	553	645	737	829	921	1015	1109
960	47	95	189	284	378	473	567	661	755	849	943	1039	1136
970	48	97	194	290	387	484	580	676	773	869	955	1064	1162
980	49	99	198	296	395	494	592	691	789	888	986	1087	1188
990	51	101	202	303	404	505	605	706	806	907	1007	1110	1213
1000	52	103	206	309	412	515	618	720	823	925	1028	1133	1238
1010	53	105	210	315	420	525	630	734	839	943	1048	1155	1262
1015	53	106	212	318	424	530	636	741	847	952	1058	1166	1274
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**												
(feet)	**2.60**	**2.80**	**3.00**	**3.20**	**3.40**	**3.60**	**3.80**	**4.00**	**4.20**	**4.40**	**4.60**	**4.80**	**5.00**
745	0	0	0	0	0	0	0	0	0	0	0	0	0
910	1079	1163	1247	1329	1411	1494	1576	1658	1744	1831	1917	2004	2090
920	1110	1197	1284	1369	1453	1538	1622	1707	1796	1885	1975	2064	2153
930	1142	1231	1320	1407	1494	1581	1668	1755	1847	1939	2030	2122	2214
940	1173	1264	1356	1445	1535	1624	1714	1803	1897	1992	2086	2181	2275
950	1203	1297	1391	1483	1574	1666	1757	1849	1946	2042	2139	2235	2332
960	1232	1329	1425	1519	1613	1707	1801	1895	1994	2093	2192	2291	2390
970	1261	1359	1458	1554	1650	1747	1843	1939	2040	2142	2243	2345	2446
980	1288	1389	1490	1588	1687	1785	1884	1982	2086	2189	2293	2396	2500
990	1316	1419	1522	1622	1722	1823	1923	2023	2129	2235	2341	2447	2553
1000	1343	1448	1553	1655	1758	1860	1963	2065	2173	2281	2389	2497	2605
1010	1370	1477	1584	1689	1794	1898	2003	2108	2218	2328	2439	2549	2659
1015	1383	1491	1599	1705	1811	1916	2022	2128	2239	2350	2462	2573	2684
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**												
(feet)	**5.50**	**6.00**	**6.50**	**7.00**	**7.50**	**8.00**	**8.50**	**9.00**	**9.50**	**10.00**	**Max**		
745	0	0	0	0	0	0	0	0	0	0	0		
910	2324	2558	2783	3008	3250	3491	3763	4035	4580	5124	10248		
920	2395	2636	2869	3101	3350	3599	3879	4158	4720	5282	10564		
930	2464	2713	2954	3194	3451	3707	3990	4283	4864	5445	10890		
940	2532	2788	3035	3282	3547	3812	4110	4408	4998	5587	11174		
950	2596	2859	3113	3366	3638	3910	4216	4521	5127	5733	11466		
960	2660	2929	3189	3449	3728	4007	4320	4633	5254	5875	11750		
970	2722	2998	3264	3530	3816	4101	4422	4743	5378	6013	12026		
980	2783	3065	3337	3609	3901	4193	4521	4849	5499	6148	12296		
990	2841	3129	3407	3685	3983	4281	4617	4952	5617	6282	12564		
1000	2900	3194	3478	3762	4066	4370	4713	5053	5734	6412	12824		
1010	2960	3261	3551	3840	4151	4462	4812	5161	5850	6538	13076		
1015	2987	3290	3563	3880	4190	4503	4856	5209	5906	6603	13206		

Table A28. Fern Ridge Controlled Outlet Capacity Table in ResSim.

Elev.	Upper Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.															
(feet)	0.99	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00
340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
341	0	20	25	35	45	45	45	45	45	45	45	45	45	45	45	45
342	0	35	40	65	80	95	105	105	105	105	105	105	105	105	105	105
343	0	50	70	95	115	140	150	175	175	175	175	175	175	175	175	175
344	0	60	85	115	145	175	200	225	245	265	265	265	265	265	265	265
345	0	75	105	140	175	210	240	270	295	325	340	360	360	360	360	360
346	0	85	120	160	195	235	270	310	340	375	400	425	445	470	470	470
347	0	90	130	175	220	265	305	345	380	420	450	485	515	545	565	590
348	0	100	140	195	240	285	330	375	415	460	495	535	570	605	630	660
349	0	110	160	210	260	310	355	405	450	500	540	580	620	665	695	725
350	0	115	165	220	275	330	380	435	485	535	575	620	665	715	750	785
351	0	120	175	230	285	345	400	460	515	575	615	660	710	765	805	845
352	0	125	180	240	300	365	425	485	540	595	645	700	755	810	855	900
353	0	130	190	250	315	380	445	510	565	625	680	740	795	855	905	955
354	0	135	195	260	325	395	460	530	590	655	715	775	835	895	950	1005
355	0	140	205	270	340	410	480	550	615	685	745	810	870	935	995	1060
356	0	140	210	280	350	420	495	570	640	715	780	845	910	980	1045	1115
357	0	145	215	285	360	435	510	590	665	745	810	880	950	1020	1095	1175
358	0	145	220	295	370	450	530	615	690	770	840	915	985	1060	1135	1215
359	0	150	225	305	385	465	545	630	710	790	865	945	1020	1100	1175	1255
360	0	155	230	310	395	475	560	650	735	820	895	975	1055	1140	1220	1300
361	0	160	235	315	400	485	575	665	755	845	925	1005	1090	1175	1260	1345
362	0	160	240	325	410	495	590	685	775	865	950	1035	1120	1210	1295	1385
363	0	160	245	330	420	510	605	700	795	885	975	1065	1155	1245	1335	1425
364	0	165	250	335	425	520	615	715	810	905	995	1090	1185	1280	1370	1460
365	0	170	255	345	435	530	630	730	825	925	1020	1115	1210	1310	1400	1495
366	0	170	260	350	445	540	645	750	845	945	1040	1140	1240	1340	1435	1530
367	0	175	265	355	455	550	660	765	865	965	1065	1165	1265	1370	1465	1565
368	0	175	270	360	460	560	670	780	880	980	1080	1185	1290	1395	1495	1595
369	0	180	275	370	470	570	680	795	895	1000	1100	1205	1310	1420	1520	1620
370	0	185	280	375	475	580	695	810	910	1015	1120	1225	1330	1440	1545	1645
371	0	185	280	380	485	590	705	825	925	1030	1135	1245	1350	1460	1565	1665
372	0	190	285	385	495	605	720	835	940	1045	1150	1260	1370	1480	1585	1685
373	0	190	290	390	500	615	730	850	955	1060	1170	1280	1385	1495	1600	1705
373.5	0	190	290	395	505	620	735	855	960	1070	1180	1285	1395	1505	1610	1715
382	0	209	318	442	571	714	839	968	1083	1202	1331	1436	1556	1666	1780	1894

Elev.	Gate Opening, in feet.				Elev.	Gate Opening, in feet.				Elev.	Gate Opening, in feet.					
(feet)	8.50	9.00	9.67	Max	(feet)	8.50	9.00	9.67	Max	(feet)	8.50	9.00	9.67	Max		
340	0	0	0	0	352	950	1005	1075	4300	364	1550	1640	1755	7020		
341	45	45	45	180	353	1010	1070	1140	4560	365	1585	1680	1800	7200		
342	105	105	105	420	354	1065	1130	1205	4820	366	1625	1720	1840	7360		
343	175	175	175	700	355	1120	1185	1270	5080	367	1660	1760	1880	7520		
344	265	265	265	1060	356	1180	1245	1330	5320	368	1690	1790	1915	7660		
345	360	360	360	1440	357	1235	1300	1390	5560	369	1720	1820	1945	7780		
346	470	470	470	1880	358	1280	1355	1450	5800	370	1745	1845	1975	7900		
347	605	620	620	2480	359	1330	1405	1505	6020	371	1765	1870	2005	8020		
348	690	720	750	3000	360	1380	1460	1560	6240	372	1790	1895	2030	8120		
349	765	805	845	3380	361	1425	1510	1615	6460	373	1810	1915	2055	8220		
350	830	880	930	3720	362	1470	1555	1665	6660	373.5	1820	1925	2065	8260		
351	895	945	1000	4000	363	1510	1600	1715	6860	382	2009	2123	2292	9168		

Table A29a. Blue River Controlled Outlet Capacity Table in ResSim, continued on next page.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.												
(feet)	0.20	0.50	0.79	0.80	1.00	1.30	1.50	1.70	2.00	2.30	2.50	2.70	3.00
1132	0	0	0	0	0	0	0	0	0	0	0	0	0
1150	0	0	0	92	115	148	170	192	225	258	280	302	335
1160	0	0	0	116	145	187	215	243	285	328	356	385	427
1170	0	0	0	135	169	219	252	285	335	386	420	454	504
1180	0	0	0	151	188	245	283	321	378	436	474	513	570
1190	0	0	0	168	210	272	314	355	417	481	523	566	629
1200	0	0	0	182	227	295	340	385	452	522	568	615	684
1210	0	0	0	195	244	317	365	413	485	560	610	660	734
1220	0	0	0	207	259	336	387	438	515	595	648	701	781
1230	0	0	0	219	274	355	409	463	544	629	685	741	825
1240	0	0	0	230	287	373	430	487	572	661	720	779	867
1250	0	0	0	240	300	390	449	509	598	691	753	815	907
1260	0	0	0	251	313	407	469	531	624	721	785	849	945
1270	0	0	0	262	327	423	487	551	647	748	815	882	983
1280	0	0	0	270	337	437	504	571	671	775	845	914	1018
1290	0	0	0	279	348	452	521	590	694	802	874	946	1053
1300	0	0	0	287	359	466	537	608	715	826	900	974	1085
1310	0	0	0	295	369	479	553	626	736	851	927	1003	1118
1320	0	0	0	304	380	493	569	644	757	875	954	1032	1150
1330	0	0	0	312	390	506	584	661	777	898	979	1059	1180
1340	0	0	0	319	399	519	598	678	797	921	1004	1086	1210
1350	0	0	0	327	409	534	613	694	816	943	1028	1112	1239
1357	0	0	0	333	416	540	623	705	829	958	1044	1130	1258
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**												
(feet)	**3.30**	**3.50**	**3.70**	**4.00**	**4.30**	**4.50**	**4.70**	**5.00**	**5.30**	**5.50**	**5.70**	**6.00**	**6.30**
1132	0	0	0	0	0	0	0	0	0	0	0	0	0
1150	366	389	407	438	470	491	512	543	573	592	612	641	670
1160	469	497	525	566	609	638	666	709	751	779	807	849	893
1170	554	587	620	669	721	756	791	843	895	929	964	1015	1070
1180	627	665	703	759	819	859	899	958	1018	1058	1098	1158	1222
1190	692	734	776	838	905	950	994	1061	1128	1173	1218	1285	1357
1200	753	795	844	912	988	1039	1090	1166	1237	1284	1331	1401	1480
1210	808	857	906	980	1059	1112	1164	1243	1323	1376	1429	1508	1594
1220	860	912	965	1043	1128	1184	1240	1324	1409	1466	1522	1607	1699
1230	908	964	1019	1102	1192	1251	1311	1400	1491	1551	1611	1701	1799
1240	955	1013	1072	1159	1253	1316	1379	1473	1568	1632	1695	1790	1893
1250	998	1060	1121	1213	1312	1378	1444	1542	1642	1709	1775	1875	1983
1260	1041	1105	1169	1265	1368	1437	1505	1608	1713	1782	1852	1956	2069
1270	1083	1149	1216	1315	1422	1494	1565	1672	1781	1853	1926	2034	2152
1280	1122	1191	1260	1363	1474	1548	1622	1733	1846	1922	1997	2110	2232
1290	1160	1231	1302	1409	1524	1601	1677	1792	1909	1987	2065	2182	2309
1300	1196	1269	1343	1453	1572	1652	1731	1850	1970	2050	2130	2250	2381
1310	1232	1308	1384	1498	1620	1701	1782	1904	2029	2112	2195	2319	2454
1320	1267	1345	1423	1539	1666	1750	1834	1960	2087	2172	2257	2384	2524
1330	1300	1380	1460	1580	1710	1796	1882	2011	2143	2231	2319	2450	2593
1340	1333	1415	1497	1620	1753	1841	1930	2062	2197	2286	2377	2511	2658
1350	1365	1449	1533	1659	1795	1886	1976	2112	2251	2343	2435	2573	2723
1357	1387	1472	1558	1686	1823	1914	2005	2142	2284	2379	2473	2615	2771

Table A29b. Blue River Controlled Outlet Capacity Table in ResSim, continued from previous page.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.							
(feet)	6.50	6.70	7.00	7.30	7.50	7.70	8.00	Max
1132	0	0	0	0	0	0	0	0
1150	690	709	738	802	844	887	950	1900
1160	922	951	994	1101	1172	1243	1350	2700
1170	1106	1142	1196	1323	1408	1493	1620	3240
1180	1265	1307	1371	1516	1613	1710	1855	3710
1190	1405	1453	1525	1686	1793	1900	2060	4120
1200	1533	1586	1665	1838	1953	2068	2240	4480
1210	1651	1708	1794	1981	2105	2229	2415	4830
1220	1761	1822	1914	2114	2247	2380	2580	5160
1230	1864	1929	2026	2237	2378	2519	2730	5460
1240	1962	2030	2133	2356	2504	2653	2875	5750
1250	2055	2127	2235	2468	2623	2778	3010	6020
1260	2144	2219	2332	2575	2736	2898	3140	6280
1270	2231	2309	2427	2677	2844	3010	3260	6520
1280	2313	2394	2515	2775	2948	3121	3380	6760
1290	2394	2478	2604	2873	3052	3231	3500	7000
1300	2468	2555	2686	2963	3148	3333	3610	7220
1310	2544	2634	2769	3055	3245	3435	3720	7440
1320	2617	2710	2849	3142	3337	3532	3825	7650
1330	2688	2783	2925	3227	3428	3629	3930	7860
1340	2756	2854	3001	3310	3516	3722	4030	8060
1350	2823	2923	3073	3392	3604	3817	4135	8270
1357	2874	2978	3133	3453	3667	3880	4200	8400

Table A30. Cougar Controlled Outlet Capacity Table in ResSim.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.												
(feet)	1.29	1.30	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	6.00	6.50
1478.75	0	0	0	0	0	0	0	0	0	0	0	0	0
1510	0	190	302	413	513	613	713	813	925	1038	1109	1180	1290
1520	0	225	345	465	585	705	828	950	1070	1190	1293	1395	1510
1530	0	260	393	525	663	800	938	1075	1203	1330	1453	1575	1715
1540	0	290	435	580	728	875	1025	1175	1320	1465	1596	1750	1895
1550	0	315	470	625	785	945	1110	1275	1428	1580	1740	1900	2058
1560	0	338	507	675	843	1010	1185	1360	1524	1688	1859	2030	2205
1570	0	360	535	710	890	1070	1258	1445	1618	1790	1975	2160	2345
1580	0	380	565	750	938	1125	1319	1523	1700	1888	2084	2280	2483
1590	0	400	594	788	987	1185	1393	1600	1793	1985	2190	2395	2608
1600	0	425	625	825	1030	1235	1450	1665	1870	2075	2288	2500	2725
1610	0	440	650	860	1074	1288	1509	1730	1945	2160	2383	2605	2838
1620	0	455	675	895	1118	1340	1570	1800	2023	2245	2475	2705	2948
1630	0	475	700	925	1155	1385	1623	1860	2093	2325	2563	2800	3053
1640	0	485	718	950	1190	1430	1678	1925	2165	2405	2648	2890	3153
1650	0	500	742	983	1229	1478	1732	1988	2234	2480	2730	2980	3250
1660	0	520	770	1020	1273	1525	1788	2050	2305	2551	2815	3070	3348
1670	0	530	788	1045	1305	1565	1837	2108	2365	2623	2891	3160	3445
1680	0	540	808	1075	1343	1608	1887	2163	2427	2690	2967	3243	3537
1690	0	555	828	1100	1375	1650	1935	2220	2492	2763	3047	3330	3628
1699	0	565	845	1125	1405	1685	1980	2275	2550	2825	3118	3411	3715
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**												
(feet)	**7.00**	**7.50**	**8.00**	**8.50**	**9.00**	**9.50**	**10.00**	**10.50**	**11.00**	**11.50**	**12.00**	**12.50**	**Max**
1478.75	0	0	0	0	0	0	0	0	0	0	0	0	0
1510	1400	1494	1588	1700	1813	1919	2025	2083	2140	2140	2140	2140	4280
1520	1625	1738	1850	1983	2110	2230	2350	2425	2500	2525	2550	2575	5150
1530	1855	1983	2110	2265	2415	2528	2640	2713	2785	2827	2862	2900	5800
1540	2040	2190	2340	2508	2675	2790	2905	2972	3038	3084	3130	3175	6350
1550	2215	2383	2550	2733	2915	3025	3135	3203	3270	3325	3380	3435	6870
1560	2380	2558	2735	2935	3135	3243	3343	3419	3488	3550	3613	3675	7350
1570	2530	2723	2915	3120	3325	3438	3550	3623	3695	3760	3825	3890	7780
1580	2685	2883	3080	3290	3500	3619	3738	3814	3890	3960	4030	4100	8200
1590	2820	3030	3240	3453	3665	3793	3920	4000	4080	4152	4223	4295	8590
1600	2950	3178	3405	3613	3820	3953	4085	4174	4263	4337	4411	4485	8970
1610	3070	3308	3545	3755	3965	4103	4240	4338	4435	4514	4592	4670	9340
1620	3190	3438	3685	3898	4110	4255	4400	4503	4605	4682	4758	4835	9670
1630	3305	3563	3820	4035	4250	4395	4540	4653	4765	4844	4922	5000	10000
1640	3415	3683	3950	4170	4390	4538	4685	4800	4915	4997	5078	5160	10320
1650	3520	3798	4075	4300	4525	4673	4820	4938	5055	5141	5222	5305	10610
1660	3625	3908	4190	4425	4660	4808	4955	5078	5200	5285	5375	5455	10910
1670	3730	4023	4315	4550	4785	4935	5085	5213	5340	5429	5517	5605	11210
1680	3830	4130	4430	4675	4920	5068	5215	5345	5475	5567	5658	5750	11500
1690	3925	4233	4540	4793	5045	5190	5335	5473	5610	5705	5800	5895	11790
1699	4020	4335	4650	4913	5175	5313	5450	5590	5730	5829	5927	6025	12050

Table A31a. Dorena Controlled Outlet Capacity Table in ResSim, continued on next page.

Elev.	Singe RO Capacity, cfs, Gate Opening, ft.							Elev.	Singe RO Capacity, cfs, Gate Opening, ft.						
(feet)	0.59	0.60	0.80	1.00	1.20	1.40	1.60	(feet)	0.59	0.60	0.80	1.00	1.20	1.40	1.60
739	0	0	0	0	0	0	0	801	0	147	194	243	287	336	384
760	0	84	110	138	165	193	220	802	0	148	196	245	289	338	387
761	0	86	113	141	169	197	225	803	0	149	197	247	292	341	390
762	0	88	116	145	173	202	230	804	0	150	199	248	294	343	393
763	0	90	118	148	176	206	235	805	0	151	200	250	296	346	396
764	0	92	121	151	180	210	240	806	0	152	202	252	298	349	399
765	0	94	124	154	183	214	245	807	0	153	205	255	300	352	402
766	0	96	126	157	186	218	249	808	0	154	205	257	305	355	405
767	0	97	128	160	190	222	254	809	0	155	207	258	306	358	408
768	0	99	130	163	193	226	259	810	0	156	208	260	308	360	411
769	0	101	133	166	196	230	264	811	0	157	209	261	310	363	414
770	0	103	135	169	200	234	268	812	0	158	210	263	312	365	417
771	0	105	137	172	203	238	273	813	0	159	212	265	314	368	420
772	0	106	140	175	206	242	277	814	0	160	213	267	316	370	423
773	0	107	143	177	209	245	281	815	0	161	214	268	318	373	425
774	0	109	145	180	213	249	286	816	0	162	215	270	320	375	428
775	0	111	147	183	216	253	290	817	0	163	217	271	323	378	431
776	0	113	148	189	219	257	294	818	0	164	218	273	324	380	434
777	0	115	150	188	222	260	298	819	0	165	219	275	327	383	437
778	0	117	153	190	225	263	302	820	0	165	220	276	329	385	439
779	0	118	156	193	230	267	306	821	0	166	222	277	331	387	442
780	0	119	157	196	231	270	310	822	0	167	223	279	333	390	445
781	0	120	158	198	234	274	314	823	0	168	224	280	335	392	447
782	0	122	160	200	237	277	318	824	0	169	225	282	337	394	450
783	0	124	163	203	239	281	321	825	0	170	227	284	339	396	453
784	0	125	165	206	242	284	325	826	0	171	228	285	341	398	455
785	0	126	167	208	245	287	328	827	0	172	229	287	343	401	458
786	0	127	168	210	247	290	332	828	0	173	230	288	345	403	460
787	0	128	170	213	250	293	336	829	0	173	231	289	347	405	463
788	0	129	172	215	253	296	340	830	0	174	232	290	349	408	466
789	0	131	174	217	256	300	344	831	0	175	233	292	351	410	468
790	0	133	176	219	258	303	347	832	0	176	234	294	353	412	470
791	0	134	178	222	261	306	350	833	0	177	236	295	355	414	473
792	0	135	180	224	264	309	354	834	0	177	237	296	357	416	476
793	0	137	182	226	267	312	357	835	0	178	238	297	358	418	478
794	0	138	183	228	269	315	360	836	0	179	239	299	360	421	480
795	0	139	185	230	272	318	364	837	0	180	240	300	362	423	483
796	0	141	187	232	275	321	367	838	0	180	241	302	364	425	485
797	0	142	188	235	277	324	370	839	0	181	242	303	366	427	487
798	0	143	190	237	279	327	374	840	0	182	243	305	368	429	490
799	0	144	191	239	282	330	377	866	0	203	269	347	420	486	552
800	0	145	193	241	286	333	380								

Table A31b. Dorena Controlled Outlet Capacity Table in ResSim, continued on next page.

Elev.	Singe RO Capacity, cfs, Gate Opening, ft.							Elev.	Singe RO Capacity, cfs, Gate Opening, ft.						
(feet)	1.80	2.00	2.20	2.40	2.60	2.80	3.00	(feet)	1.80	2.00	2.20	2.40	2.60	2.80	3.00
739	0	0	0	0	0	0	0	801	428	474	515	564	609	655	700
760	247	273	300	330	358	384	415	802	432	478	519	568	615	661	706
761	253	279	306	337	366	392	423	803	436	482	523	573	620	667	712
762	258	285	313	343	373	399	430	804	439	486	528	578	625	673	719
763	264	291	319	349	380	407	435	805	443	490	532	583	630	679	725
764	269	297	325	355	387	415	446	806	446	494	536	588	635	685	731
765	274	303	331	362	394	422	454	807	450	498	540	593	640	690	738
766	279	309	337	368	401	429	461	808	455	502	545	596	645	696	744
767	284	315	343	375	407	437	469	809	456	506	549	603	651	702	750
768	290	320	349	381	414	444	476	810	460	510	554	608	656	708	756
769	295	326	354	387	420	451	484	811	464	513	558	613	661	713	762
770	299	330	359	393	427	458	491	812	467	517	562	618	666	718	768
771	304	336	365	399	434	465	498	813	471	520	566	622	671	724	774
772	308	341	370	405	440	472	506	814	474	524	570	627	676	730	780
773	313	346	376	411	446	479	513	815	477	528	575	631	681	735	786
774	318	351	381	417	453	486	520	816	480	532	579	636	686	741	792
775	323	357	386	423	459	493	527	817	484	535	583	640	691	746	798
776	328	362	392	428	466	499	535	818	487	539	587	645	695	752	804
777	332	366	397	434	472	506	542	819	490	543	591	650	700	758	810
778	336	371	403	440	478	513	549	820	493	546	596	655	705	764	815
779	340	376	408	446	484	519	556	821	497	550	600	659	710	769	821
780	345	381	413	452	490	525	563	822	500	554	603	664	715	774	827
781	349	386	418	458	498	532	570	823	504	557	607	669	720	779	833
782	354	390	423	463	502	538	577	824	507	560	611	673	725	784	839
783	358	395	428	466	508	545	584	825	510	563	615	678	729	790	845
784	362	400	433	474	514	552	590	826	513	567	620	682	734	795	850
785	366	406	438	479	520	558	597	827	516	571	624	686	739	801	855
786	370	409	443	485	526	565	604	828	519	575	628	690	743	806	861
787	374	414	448	490	532	571	610	829	522	578	632	695	748	811	867
788	378	418	453	496	538	577	617	830	525	581	636	700	753	816	873
789	382	423	458	501	544	584	624	831	528	585	640	704	758	822	879
790	386	428	463	506	549	590	630	832	530	588	644	708	762	828	885
791	390	432	468	512	555	595	637	833	533	591	647	713	767	833	890
792	394	436	473	517	560	602	644	834	536	595	651	717	771	838	896
793	398	440	478	523	565	608	650	835	540	598	655	721	776	843	901
794	402	445	482	528	571	614	657	836	543	601	659	726	780	849	907
795	406	449	486	534	577	620	663	837	546	604	663	730	785	854	913
796	410	454	491	538	583	626	669	838	549	607	666	735	790	859	918
797	414	458	496	543	588	632	676	839	552	610	670	739	794	864	924
798	418	462	500	549	594	638	682	840	555	614	674	744	799	869	930
799	421	466	505	554	599	644	688	866	633	697	773	864	919	1004	1081
800	425	470	510	559	604	650	694								

Table A31c. Dorena Controlled Outlet Capacity Table in ResSim, continued from previous page.

Elev.	Singe RO Capacity, cfs, Gate Opening, ft.							Elev.	Singe RO Capacity, cfs, Gate Opening, ft.						
(feet)	3.60	4.00	4.50	5.00	5.50	6.00	Max	(feet)	3.60	4.00	4.50	5.00	5.50	6.00	Max
739	0	0	0	0	0	0	0	801	828	948	1073	1210	1350	1522	7610
760	480	555	620	690	750	830	4150	802	835	956	1082	1220	1361	1533	7665
761	491	566	635	708	773	860	4300	803	842	964	1091	1230	1372	1544	7720
762	501	578	650	726	796	890	4450	804	849	972	1100	1239	1383	1555	7775
763	512	589	664	743	818	917	4585	805	856	980	1109	1249	1393	1566	7830
764	522	600	676	759	837	943	4715	806	863	989	1118	1258	1401	1577	7885
765	532	611	690	775	857	969	4845	807	870	997	1128	1268	1414	1587	7935
766	542	622	704	791	876	992	4960	808	877	1005	1137	1277	1424	1598	7990
767	551	633	717	807	895	1015	5075	809	883	1013	1145	1288	1434	1608	8040
768	561	644	730	823	912	1037	5185	810	890	1021	1153	1295	1444	1618	8090
769	570	654	742	838	928	1057	5285	811	897	1029	1162	1304	1454	1628	8140
770	580	664	754	853	946	1077	5385	812	903	1037	1170	1313	1464	1638	8190
771	589	675	766	866	965	1097	5483	813	910	1044	1179	1322	1474	1648	8240
772	598	685	778	880	980	1116	5580	814	917	1052	1188	1331	1484	1658	8290
773	607	693	790	894	996	1135	5675	815	924	1060	1197	1340	1494	1668	8340
774	616	705	802	908	1012	1153	5763	816	930	1068	1206	1349	1504	1678	8390
775	625	715	813	921	1028	1170	5850	817	937	1075	1213	1358	1513	1688	8440
776	634	724	825	934	1043	1187	5935	818	943	1083	1222	1367	1523	1698	8490
777	643	734	836	947	1057	1203	6015	819	950	1091	1230	1375	1533	1707	8535
778	651	744	847	960	1071	1219	6095	820	955	1099	1239	1384	1543	1716	8580
779	659	753	858	973	1086	1236	6180	821	963	1107	1248	1393	1552	1728	8640
780	668	762	868	985	1099	1250	6250	822	969	1114	1256	1401	1562	1736	8680
781	676	771	878	998	1113	1266	6330	823	975	1122	1263	1410	1571	1745	8725
782	684	780	889	1010	1127	1280	6400	824	982	1129	1271	1418	1581	1754	8770
783	692	790	900	1021	1140	1296	6480	825	988	1137	1280	1427	1590	1764	8820
784	700	800	910	1032	1153	1310	6550	826	994	1144	1288	1438	1599	1773	8865
785	708	809	920	1044	1166	1324	6620	827	1000	1152	1296	1444	1608	1783	8913
786	716	818	930	1055	1179	1337	6685	828	1006	1159	1304	1452	1618	1792	8960
787	724	827	940	1066	1191	1350	6750	829	1013	1169	1312	1460	1627	1801	9005
788	732	835	950	1077	1203	1363	6815	830	1019	1174	1320	1469	1636	1810	9050
789	739	845	960	1087	1215	1377	6885	831	1025	1182	1328	1477	1645	1819	9095
790	746	854	969	1098	1227	1390	6950	832	1031	1190	1336	1485	1655	1828	9140
791	754	863	979	1109	1239	1403	7015	833	1038	1197	1344	1493	1663	1837	9185
792	763	871	989	1119	1251	1416	7080	834	1044	1204	1352	1501	1672	1846	9230
793	769	879	998	1130	1263	1428	7140	835	1050	1212	1360	1510	1681	1855	9275
794	777	888	1008	1140	1274	1440	7200	836	1056	1219	1368	1518	1690	1864	9320
795	784	897	1018	1150	1285	1452	7260	837	1062	1226	1376	1526	1699	1873	9365
796	791	906	1027	1160	1296	1465	7325	838	1068	1233	1384	1534	1708	1882	9410
797	799	915	1037	1171	1307	1476	7380	839	1074	1241	1391	1542	1717	1891	9455
798	806	923	1046	1181	1318	1487	7435	840	1080	1248	1399	1550	1725	1900	9500
799	813	931	1055	1191	1329	1499	7495	866	1236	1435	1602	1758	1954	2134	10670
800	820	940	1065	1200	1340	1510	7550								

Table A32. Cottage Grove Controlled Outlet Capacity Table in ResSim.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.								
(feet)	0.99	1.00	2.00	3.00	4.00	5.00	6.00	6.5	Max
719	0	0	0	0	0	0	0	0	0
740	0	103	203	298	389	478	566	642	1926
741	0	106	209	306	400	493	584	662	1986
742	0	109	213	314	412	507	602	680	2040
743	0	111	219	321	422	521	619	697	2091
744	0	114	224	329	432	535	635	714	2142
745	0	116	228	337	443	549	651	731	2193
746	0	118	233	344	453	562	667	747	2241
747	0	120	237	351	462	574	682	764	2292
748	0	122	242	357	472	587	697	780	2340
749	0	125	245	364	481	599	713	795	2385
750	0	127	249	371	491	611	728	810	2430
751	0	129	253	378	499	622	743	825	2475
752	0	131	258	384	508	634	757	840	2520
753	0	133	261	391	516	644	771	855	2565
754	0	134	266	397	525	654	785	870	2610
755	0	136	270	403	533	665	798	883	2649
756	0	138	274	410	541	675	811	896	2688
757	0	140	278	415	550	685	824	909	2727
758	0	142	282	421	558	696	838	922	2766
759	0	144	286	427	566	706	850	935	2805
760	0	146	290	432	575	716	862	948	2844
761	0	148	293	437	581	727	874	961	2883
762	0	149	297	443	588	736	886	974	2922
763	0	151	301	447	596	745	899	987	2961
764	0	153	305	453	603	756	910	999	2997
765	0	155	308	459	611	765	921	1011	3033
766	0	157	312	464	619	775	932	1023	3069
767	0	159	315	470	626	784	944	1034	3102
768	0	160	319	475	634	793	955	1046	3138
769	0	162	321	479	640	803	966	1058	3174
770	0	164	325	485	648	811	977	1070	3210
771	0	165	329	491	654	820	987	1081	3243
772	0	166	332	495	661	828	997	1092	3276
773	0	168	335	500	667	837	1008	1103	3309
774	0	170	338	506	674	845	1018	1114	3342
775	0	171	341	510	681	854	1028	1125	3375
776	0	173	344	515	687	862	1039	1136	3408
777	0	175	348	520	694	870	1049	1146	3438
778	0	176	351	525	700	879	1059	1156	3468
779	0	178	353	529	706	887	1070	1167	3501
780	0	180	356	533	713	895	1080	1177	3531
781	0	181	359	539	718	902	1090	1187	3561
782	0	182	362	543	724	910	1100	1198	3594
783	0	183	365	547	730	917	1109	1209	3627
784	0	185	368	552	736	925	1119	1219	3657
785	0	186	371	556	743	932	1128	1229	3687
786	0	188	374	561	748	940	1137	1239	3717
787	0	189	377	566	754	948	1147	1248	3744
788	0	191	380	570	760	955	1156	1258	3774
789	0	192	383	574	766	963	1165	1267	3801
790	0	194	385	578	772	970	1173	1277	3831
791	0	195	388	582	777	978	1182	1287	3861
792	0	196	391	586	784	985	1190	1296	3888
793	0	197	394	590	790	992	1198	1307	3921
794	0	198	397	594	795	998	1207	1316	3948
795	0	200	400	598	801	1006	1215	1325	3975
808	0	216	439	650	876	1100	1324	1450	4349

Table A33a. Fall Creek Controlled Outlet Capacity Table in ResSim, continued on next page.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.														
(feet)	0.10	0.20	0.40	0.50	0.60	0.80	0.99	1.00	1.10	1.20	1.40	1.50	1.60	1.80	1.90
670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
671	0	0	0	0	0	0	0	20	20	20	20	20	20	20	20
672	0	0	0	0	0	0	0	36	37	39	42	43	44	47	49
673	0	0	0	0	0	0	0	42	47	52	61	66	71	80	85
674	0	0	0	0	0	0	0	48	56	64	81	89	97	114	122
675	0	0	0	0	0	0	0	54	64	75	96	106	116	137	148
676	0	0	0	0	0	0	0	60	71	82	103	114	125	146	157
677	0	0	0	0	0	0	0	66	77	88	111	122	133	156	167
678	0	0	0	0	0	0	0	72	84	95	118	130	142	165	176
679	0	0	0	0	0	0	0	77	89	101	125	137	149	173	185
680	0	0	0	0	0	0	0	82	94	107	132	144	156	181	194
681	0	0	0	0	0	0	0	87	100	113	138	151	164	189	202
682	0	0	0	0	0	0	0	92	105	118	144	158	171	197	210
683	0	0	0	0	0	0	0	97	110	124	151	164	177	204	218
684	0	0	0	0	0	0	0	102	116	129	157	171	184	212	225
685	0	0	0	0	0	0	0	107	121	135	163	177	191	219	233
686	0	0	0	0	0	0	0	112	126	141	169	184	198	226	241
687	0	0	0	0	0	0	0	117	132	146	175	190	205	234	248
688	0	0	0	0	0	0	0	122	137	152	181	196	211	240	255
689	0	0	0	0	0	0	0	127	142	157	187	202	217	247	262
690	0	0	0	0	0	0	0	132	147	162	193	208	223	254	269
691	0	0	0	0	0	0	0	137	152	168	199	214	229	260	276
692	0	0	0	0	0	0	0	141	157	172	204	220	235	267	282
693	0	0	0	0	0	0	0	145	161	177	209	225	241	273	289
694	0	0	0	0	0	0	0	149	165	182	214	231	247	279	296
695	0	0	0	0	0	0	0	153	170	186	219	236	252	285	302
696	0	0	0	0	0	0	0	157	174	190	224	241	257	291	307
697	0	0	0	0	0	0	0	161	178	195	229	246	262	296	313
698	0	0	0	0	0	0	0	165	182	199	233	251	268	302	319
699	0	0	0	0	0	0	0	169	186	204	238	256	273	307	325
700	0	0	0	0	0	0	0	172	190	207	242	260	278	313	330
701	0	0	0	0	0	0	0	175	193	211	247	265	282	318	336
702	0	0	0	0	0	0	0	178	196	214	251	269	287	324	342
703	0	0	0	0	0	0	0	181	199	218	255	273	291	328	347
704	0	0	0	0	0	0	0	184	203	221	258	277	296	333	351
705	0	0	0	0	0	0	0	187	206	225	262	281	300	337	356
706	0	0	0	0	0	0	0	190	209	228	266	285	304	342	361
707	0	0	0	0	0	0	0	193	213	232	272	292	311	351	370
708	0	0	0	0	0	0	0	196	216	235	274	294	314	353	372
709	0	0	0	0	0	0	0	198	218	237	277	297	316	356	375
710	0	0	0	0	0	0	0	200	220	240	280	303	320	360	380
720	0	0	0	0	0	0	0	230	252	274	318	340	362	406	428
730	0	0	0	0	0	0	0	250	275	300	350	375	400	450	475
740	0	0	0	0	0	0	0	270	297	324	378	405	432	486	513
750	0	0	0	0	0	0	0	290	318	346	402	430	458	514	542
760	0	0	0	0	0	0	0	310	339	368	426	455	484	542	571
770	0	0	0	0	0	0	0	330	360	390	450	480	501	570	600
780	0	0	0	0	0	0	0	340	372	404	468	500	532	596	628
790	0	0	0	0	0	0	0	350	384	418	486	520	550	622	656
800	0	0	0	0	0	0	0	360	396	432	504	540	576	648	684
810	0	0	0	0	0	0	0	380	416	452	524	560	596	668	704
820	0	0	0	0	0	0	0	390	428	466	542	580	618	694	732
830	0	0	0	0	0	0	0	400	439	478	556	595	634	712	751
834	0	0	0	0	0	0	0	405	445	484	563	603	642	721	761

Table A33b. Fall Creek Controlled Outlet Capacity Table in ResSim, continued on next page.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.														
(feet)	2.00	2.10	2.20	2.40	2.50	2.60	2.80	2.90	3.00	3.10	3.20	3.40	3.50	3.60	3.80
670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
671	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
672	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
673	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90
674	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
675	158	160	161	165	167	168	172	173	175	175	175	175	175	175	175
676	168	174	179	191	197	202	214	219	225	225	225	225	225	225	225
677	178	188	198	219	229	239	260	270	280	280	280	280	280	280	280
678	188	199	209	230	241	252	273	283	294	298	302	310	315	319	327
679	197	208	219	241	252	263	285	296	307	316	325	342	351	360	377
680	206	217	229	251	263	274	296	308	319	331	342	366	378	389	413
681	215	227	238	261	273	285	308	319	331	343	355	379	391	402	426
682	223	235	247	271	283	294	318	330	342	354	366	391	403	415	440
683	231	243	255	280	292	304	329	341	353	366	378	403	416	428	453
684	239	252	264	289	302	314	339	352	364	377	390	415	428	441	466
685	247	260	273	298	311	324	349	362	375	388	401	427	441	454	480
686	255	268	281	307	321	334	360	373	386	399	413	439	453	466	492
687	263	276	290	316	330	343	369	383	396	410	423	450	464	478	505
688	270	284	297	324	338	352	379	392	406	420	434	462	476	489	517
689	277	291	305	333	347	360	388	402	416	430	444	473	487	501	530
690	284	298	312	341	355	369	398	412	426	441	455	484	499	513	542
691	291	306	320	349	364	378	407	422	436	451	465	495	510	524	554
692	298	313	328	357	372	387	416	431	446	461	476	506	521	535	565
693	305	320	335	365	381	396	426	441	456	471	486	516	532	547	577
694	312	327	343	373	389	404	434	450	465	480	496	527	542	557	588
695	318	334	349	380	396	412	443	458	474	490	505	537	553	568	600
696	324	340	356	388	404	419	451	467	483	499	515	547	563	579	611
697	330	346	362	395	411	427	460	476	492	508	524	557	573	589	622
698	336	353	369	402	419	435	468	485	501	517	534	567	583	599	632
699	342	359	376	409	426	443	476	493	510	527	543	576	593	610	643
700	348	365	382	416	434	451	485	502	519	536	553	586	603	620	653
701	354	371	389	424	441	458	493	511	528	545	562	596	613	630	664
702	360	378	395	430	448	466	501	518	536	553	571	605	623	640	674
703	365	383	401	437	455	472	508	526	544	562	579	614	632	650	685
704	370	388	406	443	461	479	516	534	552	570	588	623	641	659	694
705	375	394	412	449	468	486	523	542	560	578	596	632	650	668	704
706	380	399	418	455	474	493	530	549	568	586	604	641	659	677	714
707	390	409	427	464	483	502	539	557	576	594	613	650	668	686	723
708	392	411	430	469	488	507	546	565	584	603	621	658	677	696	733
709	395	415	434	474	494	513	553	572	592	611	630	667	686	705	742
710	400	420	440	480	500	520	560	580	600	619	638	676	695	714	752
720	450	472	494	538	560	582	626	648	670	691	712	754	775	796	838
730	500	522	544	588	610	632	676	698	720	745	770	820	845	870	920
740	540	565	590	640	665	690	740	765	790	821	842	894	920	946	998
750	570	597	624	678	705	732	786	813	840	867	894	948	975	1002	1056
760	600	629	658	716	745	774	832	861	890	919	948	1006	1035	1064	1122
770	630	661	692	754	785	816	878	909	940	970	1000	1060	1090	1120	1180
780	660	692	724	788	820	852	916	948	980	1012	1044	1108	1140	1172	1236
790	690	724	758	826	860	894	962	996	1030	1063	1096	1162	1195	1228	1294
800	720	755	790	860	895	930	1000	1035	1070	1105	1140	1210	1245	1280	1350
810	740	777	814	888	925	962	1036	1073	1110	1147	1184	1258	1295	1332	1406
820	770	808	846	922	960	998	1074	1112	1150	1188	1226	1302	1340	1378	1454
830	790	830	870	950	990	1030	1110	1150	1190	1229	1268	1346	1385	1424	1502
834	800	840	880	960	1000	1040	1120	1160	1200	1240	1280	1360	1400	1440	1520

Table A33c. Fall Creek Controlled Outlet Capacity Table in ResSim, continued from previous page.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.														
(feet)	3.90	4.00	4.50	5.00	5.50	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	Max
670	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
671	20	20	20	20	20	20	20	20	20	20	20	20	20	20	40
672	50	50	50	50	50	50	50	50	50	50	50	50	50	50	100
673	90	90	90	90	90	90	90	90	90	90	90	90	90	90	180
674	130	130	130	130	130	130	130	130	130	130	130	130	130	130	260
675	175	175	175	175	175	175	175	175	175	175	175	175	175	175	350
676	225	225	225	225	225	225	225	225	225	225	225	225	225	225	450
677	280	280	280	280	280	280	280	280	280	280	280	280	280	280	560
678	331	335	335	335	335	335	335	335	335	335	335	335	335	335	670
679	386	395	395	395	395	395	395	395	395	395	395	395	395	395	790
680	424	436	451	465	465	465	465	465	465	465	465	465	465	465	930
681	438	450	498	545	545	545	545	545	545	545	545	545	545	545	1090
682	452	464	527	589	612	635	635	635	635	635	635	635	635	635	1270
683	466	478	542	606	666	725	725	725	725	725	725	725	725	725	1450
684	479	492	558	623	687	751	783	815	815	815	815	815	815	815	1630
685	493	506	573	640	707	774	819	864	885	905	905	905	905	905	1810
686	506	519	588	656	726	796	847	897	946	995	995	995	995	995	1990
687	518	532	602	672	745	817	867	917	973	1029	1060	1090	1090	1090	2180
688	531	545	617	688	763	837	896	955	1009	1062	1116	1170	1173	1175	2350
689	544	558	631	704	780	856	919	981	1038	1094	1150	1206	1225	1244	2488
690	557	571	646	720	798	875	940	1005	1065	1124	1182	1240	1272	1304	2608
691	568	583	659	735	814	893	961	1028	1091	1153	1214	1274	1316	1358	2716
692	580	595	673	750	831	911	981	1050	1116	1181	1244	1307	1358	1408	2816
693	592	607	686	765	847	929	1001	1072	1140	1208	1274	1340	1398	1455	2910
694	604	619	700	780	863	946	1020	1093	1164	1234	1303	1372	1436	1500	3000
695	615	631	713	795	879	963	1039	1114	1187	1260	1332	1404	1474	1543	3086
696	627	643	726	809	895	980	1058	1135	1210	1285	1360	1435	1510	1584	3168
697	638	654	739	823	910	997	1076	1155	1233	1310	1388	1466	1545	1623	3246
698	649	665	751	837	926	1014	1095	1175	1255	1334	1415	1496	1578	1660	3320
699	659	676	764	851	941	1030	1113	1195	1277	1358	1442	1526	1611	1695	3390
700	670	687	776	865	956	1046	1131	1215	1298	1381	1468	1555	1642	1729	3458
701	681	698	788	878	970	1062	1148	1234	1319	1404	1494	1583	1673	1762	3524
702	692	709	800	891	985	1078	1166	1253	1340	1426	1518	1610	1702	1794	3588
703	702	720	812	904	999	1094	1183	1272	1360	1448	1542	1636	1731	1825	3650
704	712	730	824	917	1014	1110	1201	1291	1380	1469	1565	1661	1758	1855	3710
705	722	740	835	930	1028	1125	1218	1310	1400	1490	1588	1685	1785	1884	3768
706	732	750	846	942	1041	1140	1234	1328	1419	1510	1609	1708	1810	1912	3824
707	742	760	857	954	1055	1155	1251	1346	1438	1530	1630	1730	1835	1940	3880
708	751	770	868	966	1068	1170	1267	1364	1457	1550	1651	1751	1859	1967	3934
709	761	780	879	978	1082	1185	1284	1382	1476	1570	1671	1771	1883	1994	3988
710	771	790	890	990	1095	1200	1300	1400	1495	1590	1690	1790	1905	2020	4040
720	859	880	990	1104	1217	1331	1445	1558	1672	1785	1899	2013	2126	2240	4480
730	945	970	1085	1208	1331	1455	1578	1701	1824	1947	2070	2194	2317	2440	4880
740	1024	1050	1175	1306	1438	1569	1700	1832	1963	2095	2226	2357	2489	2620	5240
750	1083	1110	1245	1385	1524	1664	1803	1943	2082	2222	2361	2501	2640	2780	5560
760	1151	1180	1320	1467	1614	1760	1907	2054	2201	2348	2495	2641	2788	2935	5870
770	1210	1240	1395	1549	1703	1857	2011	2165	2320	2474	2628	2782	2936	3090	6180
780	1268	1300	1460	1621	1782	1943	2104	2265	2425	2586	2747	2908	3069	3230	6460
790	1327	1360	1530	1696	1863	2029	2195	2362	2528	2695	2861	3027	3194	3360	6720
800	1385	1420	1595	1767	1940	2112	2284	2456	2629	2801	2973	3145	3318	3490	6980
810	1443	1480	1660	1838	2016	2195	2373	2551	2729	2907	3085	3264	3442	3620	7240
820	1492	1530	1720	1904	2087	2271	2455	2638	2822	3005	3189	3373	3556	3740	7480
830	1541	1580	1775	1965	2154	2344	2533	2723	2912	3102	3291	3481	3670	3860	7720
834	1560	1600	1800	1992	2184	2375	2567	2759	2951	3143	3335	3526	3718	3910	7820

Table A34. Lookout Point Controlled Outlet Capacity Table in ResSim.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.														
(feet)	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	2.50	3.00	3.50	4.00	4.50
723	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
740	31	62	92	122	150	178	205	228	257	282	342	400	454	504	520
750	41	82	122	161	199	236	272	308	343	378	462	543	621	694	764
760	49	98	145	182	238	282	328	370	412	454	547	656	751	843	930
770	58	111	165	219	271	322	373	422	471	518	637	752	852	969	1071
780	62	123	184	243	301	358	414	469	532	577	709	837	961	1080	1195
790	65	134	200	265	328	390	451	511	571	630	774	914	1050	1181	1307
800	73	145	215	285	353	420	483	551	613	678	834	985	1132	1274	1410
810	77	154	229	303	378	448	516	587	650	723	890	1052	1209	1361	1507
820	82	163	243	321	398	474	546	622	694	766	942	1114	1281	1442	1597
830	85	171	255	338	419	499	577	654	731	808	982	1173	1346	1519	1681
840	90	180	267	354	439	522	604	685	765	845	1039	1229	1414	1593	1764
850	94	187	279	369	458	545	631	715	790	881	1085	1283	1478	1663	1842
860	98	195	290	384	476	568	658	744	831	917	1128	1335	1538	1730	1917
870	101	202	301	398	493	587	680	771	861	951	1170	1384	1593	1795	1989
880	105	209	311	412	510	608	703	797	891	984	1210	1432	1646	1857	2058
890	108	215	321	425	527	627	728	823	920	1016	1250	1479	1702	1918	2126
900	112	222	331	436	543	646	746	848	946	1046	1288	1524	1754	1976	2191
910	115	228	340	450	556	664	769	873	975	1075	1324	1567	1804	2033	2254
920	118	234	349	462	573	682	790	896	1001	1104	1360	1610	1853	2089	2315
930	121	240	359	474	588	700	810	919	1027	1133	1395	1652	1901	2138	2375
934	122	243	362	479	594	707	818	928	1037	1144	1409	1667	1920	2160	2399
940	124	248	367	487	603	718	830	942	1052	1161	1430	1690	1949	2192	2435
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**														
(feet)	**0.20**	**0.40**	**0.60**	**0.80**	**1.00**	**1.20**	**1.40**	**1.60**	**1.80**	**2.00**	**2.50**	**3.00**	**3.50**	**4.00**	**4.50**
723	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
740	594	634	671	706	739	769	796	819	838	854	864	867	858	867	867
750	830	894	954	1013	1071	1126	1182	1234	1284	1332	1378	1426	1474	1519	1548
760	1013	1093	1171	1247	1323	1397	1470	1542	1611	1678	1747	1820	1900	1987	2070
770	1168	1262	1353	1444	1534	1623	1711	1787	1881	1965	2051	2143	2247	2364	2466
780	1304	1410	1514	1617	1719	1820	1921	2020	2118	2215	2315	2424	2547	2699	2842
790	1428	1548	1659	1773	1888	1999	2111	2221	2330	2439	2552	2675	2816	2979	3158
800	1541	1670	1793	1918	2038	2162	2285	2405	2525	2644	2769	2904	3061	3242	3446
810	1647	1782	1917	2049	2182	2314	2446	2577	2708	2835	2970	3117	3287	3486	3711
820	1746	1888	2031	2175	2316	2457	2598	2737	2875	3014	3150	3316	3499	3714	3958
830	1840	1994	2144	2291	2442	2592	2741	2889	3031	3182	3335	3489	3694	3928	4191
840	1940	2091	2249	2408	2563	2720	2877	3033	3187	3342	3504	3662	3889	4133	4411
850	2016	2184	2349	2513	2677	2842	3007	3170	3332	3495	3665	3852	4070	4327	4617
860	2096	2273	2445	2610	2788	2960	3131	3302	3471	3641	3819	4015	4243	4512	4822
870	2176	2356	2537	2710	2894	3073	3251	3429	3604	3782	3957	4171	4409	4691	5015
880	2252	2441	2625	2800	2996	3181	3367	3551	3731	3917	4110	4322	4569	4862	5200
890	2326	2520	2713	2904	3095	3287	3476	3669	3858	4048	4248	4468	4724	5028	5380
900	2407	2599	2796	2993	3191	3389	3586	3783	3978	4175	4381	4608	4874	5189	5553
910	2467	2674	2876	3080	3284	3486	3692	3894	4094	4299	4511	4748	5010	5345	5721
920	2534	2747	2957	3164	3374	3584	3794	4002	4209	4418	4631	4879	5151	5495	5883
930	2600	2817	3033	3247	3462	3675	3893	4107	4320	4535	4750	5008	5298	5644	6044
934	2626	2844	3062	3280	3497	3714	3932	4149	4365	4581	4808	5059	5352	5702	6106
940	2665	2885	3106	3330	3550	3773	3991	4212	4431	4650	4895	5136	5433	5789	6199

Elev.	Capacity, cfs	Elev.	Capacity, cfs	Elev.	Capacity, cfs
(feet)	Max	(feet)	Max	(feet)	Max
723	0	830	16764	930	24176
740	3468	840	17644	934	24424
750	6192	850	18466	940	24796
760	8280	860	19288		
770	9864	870	20060		
780	11368	880	20800		
790	12632	890	21520		
800	13784	900	22212		
810	14844	910	22884		
820	15832	920	23530		

Table A35. Hills Creek Controlled Outlet Capacity Table in ResSim.

Elev.	Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.														
(feet)	0.20	0.40	0.60	0.99	1.00	1.20	1.40	1.60	1.80	2.00	2.20	2.40	2.60	2.80	3.00
1409	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1410	0	0	0	0	35	35	35	35	35	35	35	35	35	35	35
1420	0	0	0	0	125	148	171	194	217	240	259	278	297	316	335
1430	0	0	0	0	175	208	241	274	307	340	372	404	436	468	500
1440	0	0	0	0	215	255	295	335	375	415	455	495	535	575	615
1450	0	0	0	0	245	292	339	386	433	480	527	569	621	668	715
1460	0	0	0	0	270	323	376	429	482	535	588	641	694	747	800
1470	0	0	0	0	290	349	408	467	526	585	644	703	762	821	880
1480	0	0	0	0	320	383	446	509	572	635	698	765	824	887	950
1490	0	0	0	0	340	408	476	544	612	680	747	814	881	948	1015
1500	0	0	0	0	360	432	504	576	648	720	791	862	933	1004	1075
1510	0	0	0	0	380	456	532	608	684	760	835	910	985	1060	1135
1520	0	0	0	0	400	480	560	640	720	800	878	956	1034	1112	1190
1530	0	0	0	0	420	504	588	672	756	840	920	1000	1080	1170	1240
1540	0	0	0	0	435	523	611	699	787	875	958	1041	1124	1207	1290
1543	0	0	0	0	440	529	618	707	796	885	970	1055	1140	1225	1310
1548	0	0	0	0	448	539	630	720	811	902	990	1078	1167	1255	1343
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**														
(feet)	**3.20**	**3.40**	**3.60**	**3.80**	**4.00**	**4.50**	**5.00**	**5.50**	**6.00**	**6.50**	**7.00**	**7.50**	**8.00**	**8.50**	**9.00**
1409	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1410	35	35	35	35	35	35	33	35	35	35	35	35	35	35	35
1420	353	371	389	407	425	470	515	550	550	550	550	550	550	550	550
1430	530	560	590	620	650	730	810	885	960	1023	1085	1138	1190	1240	1290
1440	655	695	735	775	815	913	1015	1123	1230	1328	1425	1523	1620	1718	1815
1450	762	809	856	903	950	1065	1175	1300	1415	1540	1665	1785	1915	2040	2180
1460	854	908	962	1016	1070	1198	1320	1460	1600	1738	1875	2018	2160	2305	2450
1470	939	998	1057	1116	1175	1315	1448	1600	1753	1903	2055	2210	2368	2528	2688
1480	1015	1080	1145	1210	1275	1425	1575	1740	1905	2070	2235	2405	2575	2750	2925
1490	1085	1155	1225	1295	1365	1528	1688	1863	2038	2213	2388	2570	2755	2943	3133
1500	1150	1225	1300	1375	1450	1625	1800	1985	2170	2355	2540	2738	2935	3138	3340
1510	1214	1293	1372	1451	1530	1715	1898	2093	2288	2485	2683	2890	3098	3305	3515
1520	1273	1356	1439	1522	1605	1800	1995	2200	2405	2615	2825	3043	3260	3475	3690
1530	1327	1414	1501	1588	1675	1880	2085	2300	2515	2735	2955	3183	3413	3638	3865
1540	1380	1470	1560	1650	1740	1958	2175	2400	2625	2855	3085	3325	3565	3803	4040
1543	1402	1494	1586	1678	1770	1985	2200	2428	2655	2890	3125	3368	3610	3850	4090
1548	1439	1534	1629	1725	1820	2031	2242	2473	2705	2948	3192	3438	3685	3929	4173
Elev.	**Controlled Capacity in cfs for a given Single RO, Gate Opening, in feet.**														
(feet)	**9.50**	**10.00**	**10.50**	**11.00**	**11.50**	**12.00**	**12.50**	**Max**							
1409	0	0	0	0	0	0	0	0							
1410	35	35	35	35	35	35	35	70							
1420	550	550	550	550	550	550	550	1100							
1430	1350	1410	1468	1525	1550	1550	1550	3100							
1440	1903	1990	2075	2160	2238	2315	2380	4760							
1450	2285	2415	2535	2640	2740	2820	2885	5770							
1460	2595	2740	2868	2995	3088	3180	3245	6490							
1470	2848	3008	3148	3288	3388	3488	3560	7120							
1480	3100	3275	3428	3580	3688	3795	3875	7750							
1490	3318	3505	3673	3840	3955	4073	4145	8290							
1500	3538	3735	3918	4100	4225	4350	4415	8830							
1510	3725	3940	4123	4310	4443	4578	4658	9316							
1520	3915	4140	4330	4520	4663	4805	4900	9800							
1530	4100	4314	4528	4718	4868	5018	5115	10230							
1540	4288	4506	4725	4915	5073	5230	5330	10660							
1543	4340	4559	4778	4965	5123	5280	5380	10760							
1548	4428	4646	4865	5048	5206	5363	5463	10926							