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Supplement to the Spring Rise Alternatives Report
Detailed Discussion of Alternatives and Flood Control Targets
Hydrology and Water Quality Technical Working Group

During the June 28-29 Technical Group Meetings in Bismarck, ND, several members of the Hydrology and Water Quality Technical Working Group requested a more detailed outline of the various alternatives that have been modeled and were presented in the Spring Rise Alternatives Report. Also, there were several questions about the varying flood control criteria used in several of the runs. This report will provide the necessary information on the flood control targets and a more detailed narrative on each alternative.

System Service Levels and Flow Targets

First of all, it would be helpful to briefly explain the concept of the "service level." To facilitate appropriate application of System multipurpose regulation criteria, a numeric "service level" has been adopted. For the "full-service" level, the numeric service level value is 35,000 cubic feet per second (cfs). For the "minimum-service" level, the numeric service level value is 29,000 cfs. This service level is used for selection of appropriate flow target values at previously established downstream control locations on the Missouri River. There are four flow target locations selected below Gavins Point to assure that the Missouri River has adequate water available for the entire downstream reach to achieve regulation objectives. The specific technical criteria for the relationship between service level and control point target discharge are as shown in Table VII-1 of the Missouri River Mainstem Reservoir System Master Water Control Manual (Master Manual).

Master Manual Table VII-1
Relation of Target Discharges to Service Level

Control Point Location	Flow Target Discharge Deviation from Service Level
Sioux City	-4,000 cfs
Omaha	-4,000 cfs
Nebraska City	+2,000 cfs
Kansas City	+6,000 cfs

A "full-service level" of 35,000 cfs results in target discharges of 31,000 cfs at Sioux City and Omaha, 37,000 cfs at Nebraska City and 41,000 cfs at Kansas City. Similarly, a "minimum service" level of 29,000 cfs results in target values of 6,000 cfs less than the full service levels at the four System control points identified above.

The service level determination has a range much greater than the minimum and full-service discussed so far. The application of the service level concept is used in the evacuation of flood runoff accumulated in the System. It has also been used in the modeling of the spring rise periods. For example, a service level of 35,000 cfs plus a spring rise of 16,000 cfs, would result in a new numeric service level of 51,000 cfs. The new service level would result in target discharges of 47,000 cfs at Sioux City and Omaha, 53,000 cfs at Nebraska City and 57,000 cfs at Kansas City. More information on service levels can be found in section 7-03.2 of the Master Manual.

Missouri River Flood Target Flows

As a flood control measure, the normal relationship between service levels and target flow levels may be modified when large amounts of tributary inflow are forecasted between Gavins Point Dam and the downstream flow target control points. One level of flood target flows reduces flows to that consistent with full-service and the second level of flood target flows reduces flows to that consistent with minimum-service. Criteria for these modifications are presented in Master Manual Tables VII-7 and VII-8.

Master Manual Table VII-7
Criteria for Modifying Target Flows – Full Service

Target flows will be reduced to those consistent with the full-service level of 35,000 cfs when one or more of the anticipated downstream flows exceed the current service level flow values by more than:	
6,000 cfs at Omaha	(target flow plus 10,000 cfs)
12,000 cfs at Nebraska City	(target flow plus 10,000 cfs)
36,000 cfs at Kansas City	(target flow plus 30,000 cfs)

Master Manual Table VII-8
Criteria for Modifying Target Flows – Minimum Service

Target flows will be reduced to those consistent with the minimum-service level of 29,000 cfs in order that one or more of the anticipated resultant downstream flows exceed the current service level flow value by more than:	
11,000 cfs at Omaha	(target flow plus 15,000 cfs)
22,000 cfs at Nebraska City	(target flow plus 20,000 cfs)
66,000 cfs at Kansas City	(target flow plus 60,000 cfs)

Using the previous example, with the service level set at 51,000 cfs, System releases would be reduced consistent with the full-service level if it were deemed necessary to maintain flows at or below 57,000 cfs at Omaha, 63,000 cfs at Nebraska City, or 87,000 cfs at Kansas City. These values compare to 41,000 cfs at Omaha, 47,000 cfs at Nebraska City, and 71,000 cfs at Kansas City with a service level of 35,000 cfs. These target flows may be modified by up to 5,000 cfs after consideration is given to antecedent, current, and projected hydrometeorological conditions.

Table 1 summarizes the examples, and adds the target flows for the other locations.

Table 1
Flow Targets and Flood Control Targets in kcfs

	Flow Target for Service Level of 35 (Full Service)	Flood Control Target (Reduce to Full Service)	Flood Control Target (Reduce to Min. Service)
Sioux City	31		
Omaha	31	41	46
Nebraska City	37	47	57
Kansas City	41	71	101

	Full Service + 16		
	Flow Target for Service Level of 51 (FS+16)	Flood Control Target (Reduce to Full Service)	Flood Control Target (Reduce to Min. Service)
Sioux City	47		
Omaha	47	57	62
Nebraska City	53	63	73
Kansas City	57	87	117

Note that this example set includes only starting from full-service. Values for minimum service plus 16 would be reduced by the necessary amount.

Modified Spring Rise Flood Target Flows

The spring rise alternatives that have been modeled to this point have used a range of flood targets. In some cases, the flood targets were raised the full 16 kcfs. To cover an additional range of options, certain alternatives were to be analyzed with a raise in service level for flood targets of 12, 8, and 4 kcfs. In real-time regulation this would be possible, but the current model only allowed for a close approximation to this service level raise.

The differing flood target levels were labeled as F1, F2, and F3 in the original set of alternatives. The targets flows used for modeling are shown in Table 2. The additional number in parentheses is the number that would be used if the flow was actually set by raising the service level +12, +8, and +4 respectively.

Table 2
Modified Flood Target Flows in kcfs

F1 (+12)		F2 (+8)		F3 (+4)	
Reduced FC Target (Reduce to Full Service)	Reduced FC Target (Reduce to Min. Service)	Reduced FC Target (Reduce to Full Service)	Reduced FC Target (Reduce to Min. Service)	Reduced FC Target (Reduce to Full Service)	Reduced FC Target (Reduce to Min. Service)
53 (53)	56 (58)	51 (49)	53 (54)	49 (45)	50 (50)
59 (59)	65 (69)	57 (55)	61 (65)	55 (51)	57 (61)
81 (83)	105 (113)	78 (79)	99 (109)	75 (75)	93 (105)

Service Level System Water-in-Storage Checks

Alternatives discussed in the later sections refer to the system water-in-storage checks in the Master Manual that occur on constant key dates (March 15 and July 1) of each year. The specific technical criteria for System service level are as shown in Table VII-2 of the Master Manual and is repeated below.

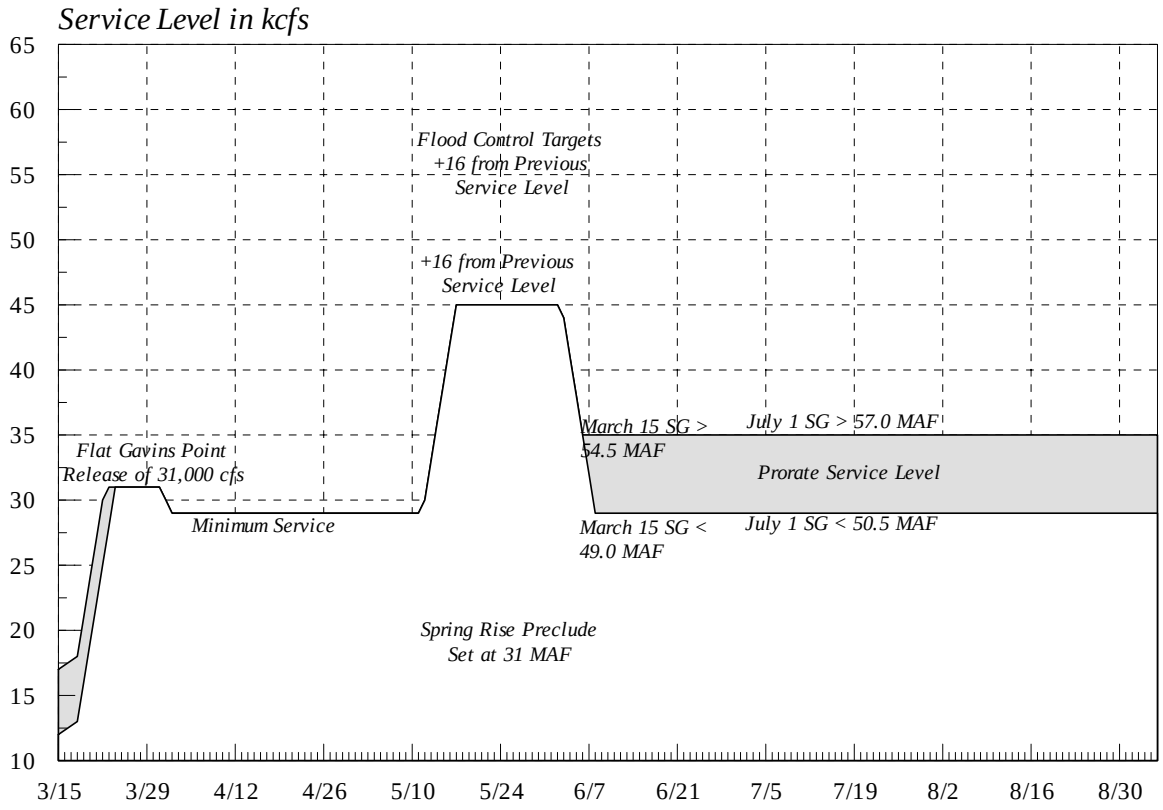
Master Manual Table VII-2
Relation of Service Level to the Volume of Water in System Storage

Date	**Service Level (cfs)**	**Water in System Storage (MAF)**
March 15	35,000 cfs (full-service)	54.5 or more
March 15	29,000 cfs (minimum-service)	49.0 to 31.0
March 15	(no service)	31.0 or less
July 1	35,000 cfs (full-service)	57.0 or more
July 1	29,000 cfs (minimum-service)	50.5 or less

The spring rise alternatives use some variation on this water-in-storage check and will be explained in a later section.

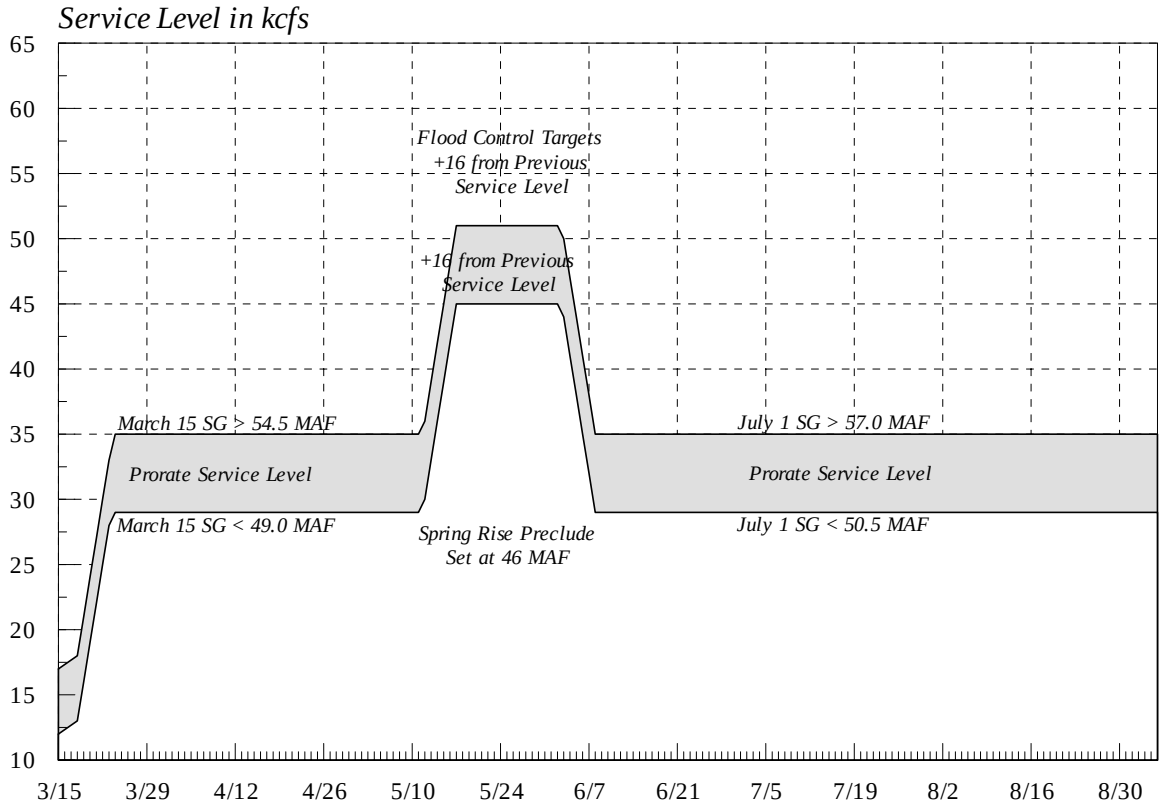
Modeled Spring Rise Alternatives

MRBIO3



First Pulse: Flat Gavins Point release of 31,000.
Spring Service Level (April after first pulse and May before second rise): Minimum service.
Second Rise: Service level is minimum service plus 16,000 cfs, for a service level of 45,000 cfs.
After rise, but before July 1: Sets the service level based on the current Master Manual March 15 water-in-storage check as shown in Master Manual Table VII-2. Selects flat Gavins Point release during tern/plover nesting season.
After July 1: Sets service level based on Master Manual Table VII-2.

MR16FS

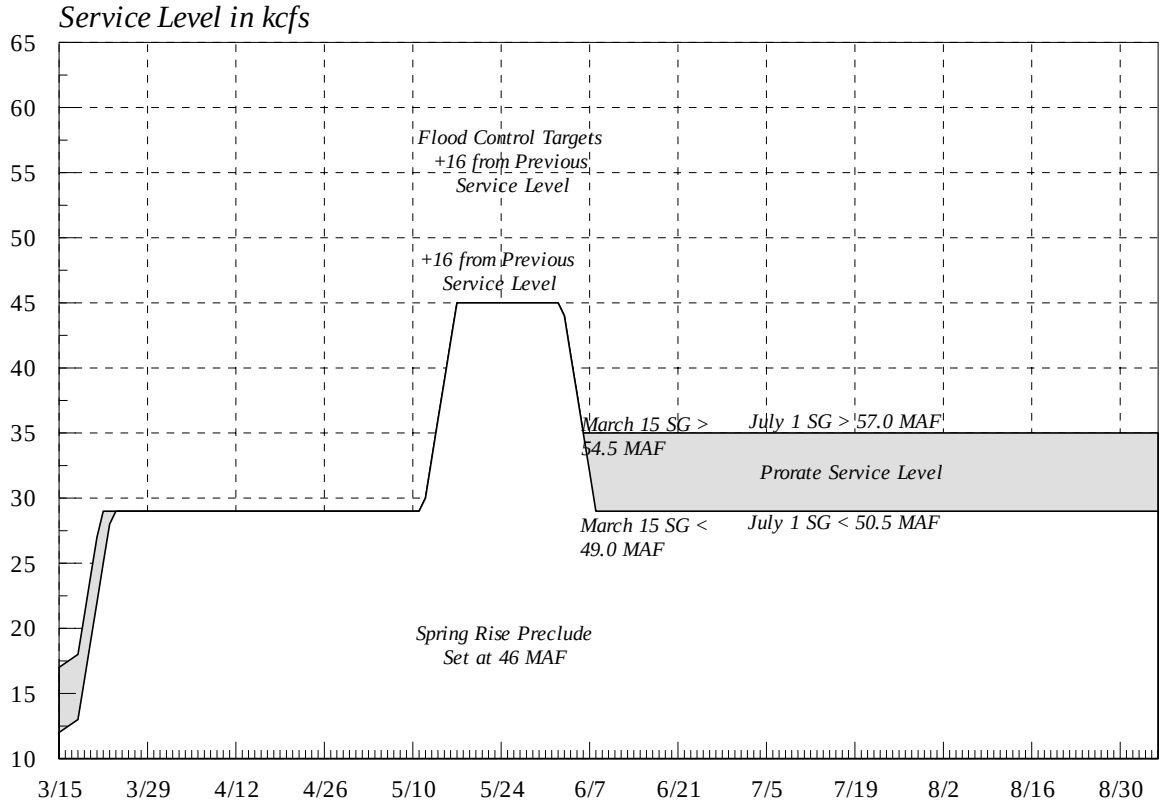


First Pulse: None.
Spring Service Level: The April service level is set based on the current Master Manual March 15 water-in-storage check.
Spring Rise: The spring rise service level is the April service level plus 16,000 cfs. Flood control targets are also raised 16,000 cfs. Spring rise preclude is 46 MAF.
After Rise, but before July 1: Returns to April service level but sets a steady release from Gavins Point during the tern/plover nesting season.
After July 1: Sets service level based on Master Manual Table VII-2.

MR16F1, MR16F2, and MR16F3: Alternatives are based on MR16FS. The only change was to the flood control targets during the spring rise period. MR16F1, MR16F2, and MR16F3 use F1, F2, and F3 flood control targets as explained previously and shown in Table 2.

M16F50, M16F40, and M16F31: Alternatives are based on MR16FS. The only change was to the spring rise preclude. Alternatives shut spring rises off at system storage of 50, 40, and 41 MAF respectively.

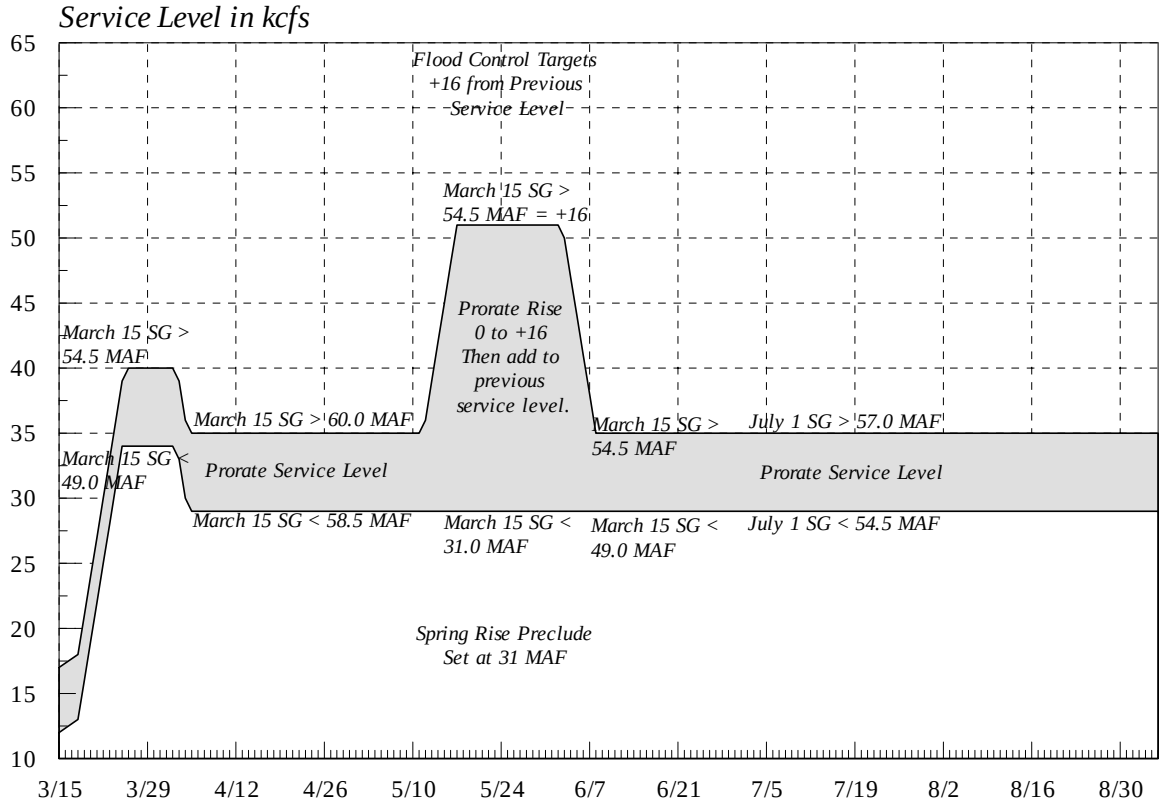
MR16MN: Alternative is the same as MRBIO3 except no first pulse.



First Pulse: None.
Spring Service Level (April after first pulse and May before second rise): Minimum service.
Second Rise: Service level is minimum service plus 16,000 cfs, for a service level of 45,000 cfs.
After rise, but before July 1: Sets the service level based on the March 15 system storage as specified in the Master Manual. Selects flat Gavins Point release during tern/plover nesting season.
After July 1: Sets service level based on Master Manual Table VII-2.

MR16M1, MR16M2, and MR16M3: Alternatives are based on MR16MN. The only change was to the flood control targets during the spring rise period. MR16M1, MR16M2, and MR16M3 use F1, F2, and F3 flood control targets as explained previously and shown in Table 2.

MRBIO5



First Pulse: The first pulse is +5 on top of the service level set based on Master Manual Table VII-2.

Spring Service Level (April after first pulse and May before second rise): The April service level is set based on the March 15 water-in-storage check. Below 58.5 MAF releases are set at minimum service levels. From 58.5 MAF to 60.0 MAF the service level is prorated from minimum service to full service. Above 60 MAF the service level would be set at full service or adjusted as necessary for flood evacuation based on the Master Manual.

Second Rise: Rise is prorated from 0 to 16 kcfs based on the March 15 system storage. Below 31 MAF there is no spring rise, above 54.5 MAF, 16 is added to the April service level. Between 54.5 and 60 MAF the rise is prorated from 0 to 16 kcfs, and then added to the April service level.

MRBIO4

This alternative is the same as MRBIO5 except that it has a flat release of 31,000 cfs from Gavins Point for the first pulse instead of setting a service level based on system storage.

MRBI5N

This alternative is the same as MRBIO5 except that it has no first pulse.

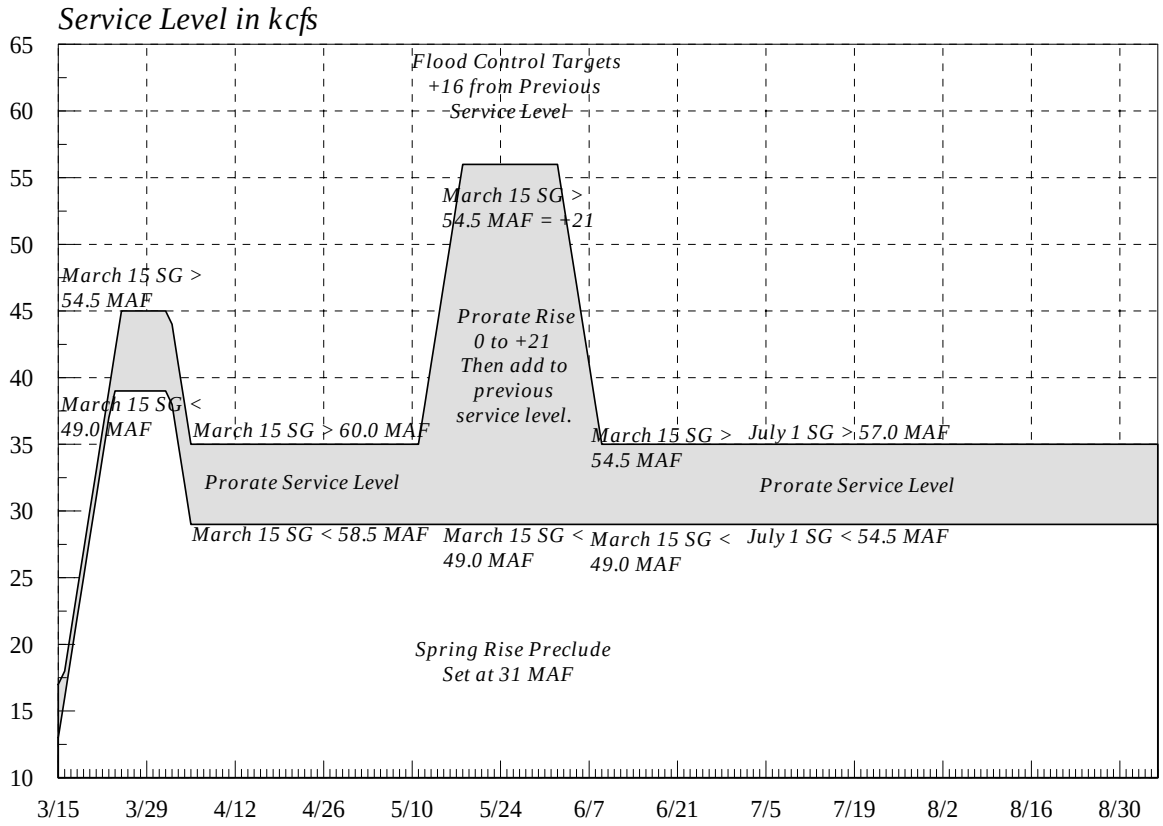
MBIO53
This alternative is the same as MRBIO5 except it uses the flood control criteria F3 as shown in Table 2.

MBI53N
This alternative is the same as MRBI5N except it uses the flood control criteria F3 as shown in Table 2. (This alternative could also be compared to MRBIO5, with no first pulse and F3 flood control criteria.)

MRBP52
This alternative is MRBIO5 criteria with a shorter second spring rise. This shorter duration rise was intended to be one week-long but is really about 9 days due to a limitation in the model.

MRBP32
This alternative is MRBIO3 criteria with a shorter second spring rise. This shorter duration rise was intended to be one week-long but is really about 9 days due to a limitation in the model.

BIO521

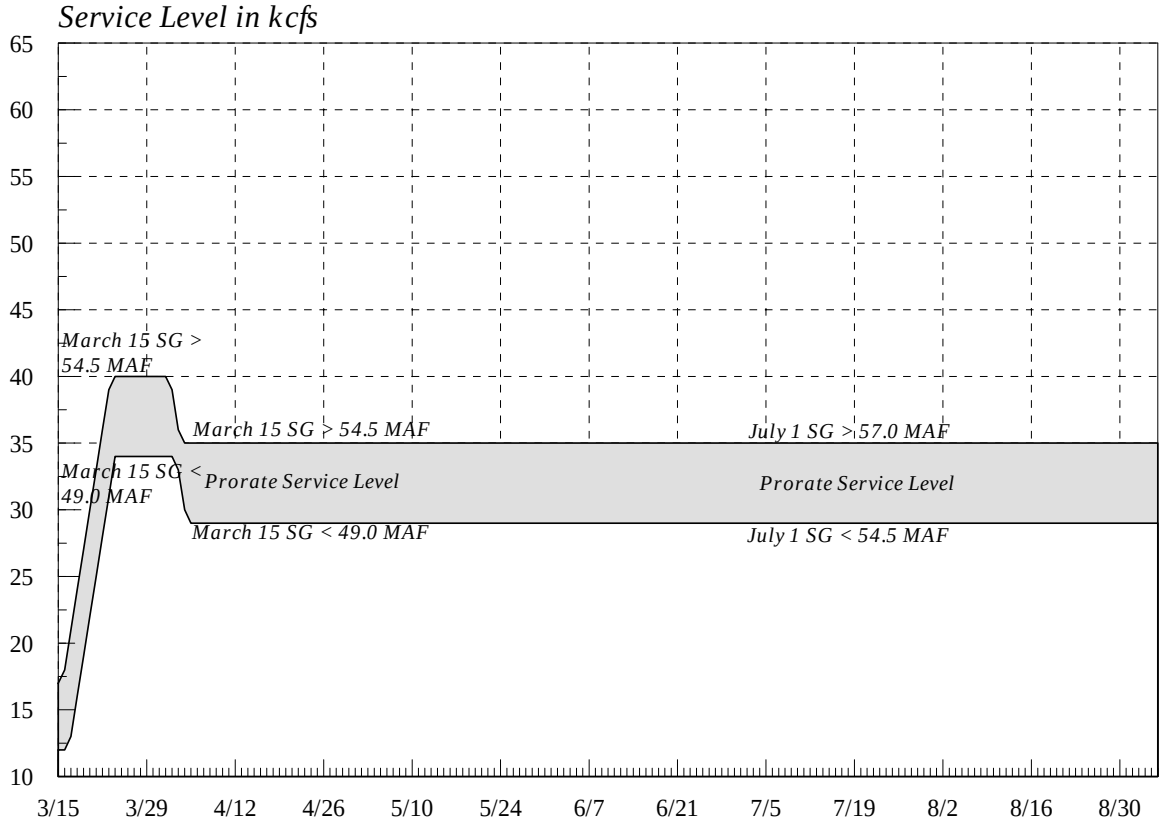


This alternative is based on MRBP52. Both rises have an additional +5 kcfs on top of what was in MRBP52. So, the first rise is actually +10, and the second rise is actually

+21. In each case the rise was intended to be shorter duration of a week, but it is really about 9 days due to a limitation in the model.

BIO500

This alternative has only the first pulse in it and no second rise.



First Pulse: The first pulse is +5 on top of the service level set by the Master Manual water-in-storage check based on March 15 storage.

Spring Service Level (After Pulse): Service level is set according to March 15 system storage based on Master Manual Table VII-2.

After July 1: Sets service level based on Master Manual Table VII-2.

B16JUN

Based on MRBIO5, but the spring rise is shifted to the middle of June. The request for this run asked for the rise on July 1. The June rise was the closest that could be modeled at this time.

BIO518

This alternative has a non-navigation period in April during droughts, and is based on MRBIO5. When March 15 system storage is less than 36.5 MAF it runs a service level of 18 kcfs between the first pulse and second rise. This alternative keeps both rises whereas B5DANN eliminates the first rise when it has the lower spring release. It also shifts the navigation season to later in the year, since the 18 kcfs is less than minimum service.

B5DANN
This alternative was described as the “navigation shift” alternative. It is based on MRBIO5. When March 15 system storage is less than 41 MAF, releases are not increased to support navigation until May, the normal time for the second spring rise. This part of the navigation season is then shifted to the end of the navigation season. One difference between this run and the described alternative was the prorating of the second spring rise. The second rise was prorated and then added to minimum service instead of adding sixteen to the winter release, which could result in less than minimum service.

Jorgenson
This alternative has a spring rise with gradual flow reductions throughout the summer. This alternative has not been completed.