

# RECLAMATION

*Managing Water in the West*

## Flaming Gorge Operation Plan - May 2020 through April 2021

### Concurrence by



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CALLISTER  
Date: 2020.04.29 13:22:18 -06'00'

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Kathleen Callister, Resources Management Division Manager

KENT KOFFORD

Digitally signed by KENT  
KOFFORD  
Date: 2020.04.29 15:35:43 -06'00'

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Kent Kofford, Provo Area Office Manager

NICHOLAS WILLIAMS

Digitally signed by NICHOLAS WILLIAMS  
Date: 2020.04.29 16:31:09 -06'00'

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Nicholas Williams, Acting Upper Colorado Power Manager

### Approved by

BRENT ESPLIN

Digitally signed by BRENT ESPLIN  
Date: 2020.04.30 11:01:33 -06'00'

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Brent Esplin, Upper Colorado Regional Director

## **Purpose**

This Flaming Gorge Operation Plan (FG-Ops) fulfills the 2006 Flaming Gorge Record of Decision (ROD) requirement for May 2020 through April 2021. The FG-Ops also completes the 4-step process outlined in the Flaming Gorge Standard Operation Procedures. The Upper Colorado Basin Power Office (UCPO) operators will fulfil the operation plan and may alter from FG-Ops due to day to day conditions, although we will attempt to stay within the boundaries of the operations defined below. Listed below are proposed operation plans for four different scenarios: moderately dry, average (above median), average (below median), and moderately wet. As of the publishing of this document, the most likely scenario is the average (below median), however actual operations will vary with hydrologic conditions. The Upper Colorado River Endangered Fish Recovery Program (Recovery Program), the Flaming Gorge Technical Working Group (FGTWG), Flaming Gorge Working Group (FG WG), United States Fish and Wildlife Service (FWS) and Western Area Power Administration (WAPA) provided input that was considered in the development of this report.

The FG-Ops describes the current hydrologic classification of the Green River Basin and the hydrologic conditions in the Yampa River Basin. The FG-Ops identifies the most likely Reach 2 peak flow magnitude and duration that is to be targeted for the upcoming spring flows. Likely hydrologic conditions are also considered that contain a range of operating strategies that could be implemented under varying hydrologic conditions. Flow and duration targets for these strategies consider moderately dry, average (above / below median), and moderately wet scenarios as the most likely classifications to occur this year.

## **General Operation Criteria for May 2020 through April 2021**

The expected hydrology condition is average (below median) and this scenario is presented below. Note that other scenarios moderately dry, average (above median) and moderately dry are presented later in this document. Per the FGTWG Proposal, the average (below median) 2012 Larval Trigger Study Plan (LTSP) experiment flow will be attempted for spring operation, pending the Yampa River contributing flows. For the summer base flow period, Colorado pikeminnow flows (Bestgen and Hill 2016) will be targeted in Reach 2. Flexibility in the 2000 Flow and Temperature Recommendations will be used to achieve these targets. No flexibility will be used during the autumn base flow period and Reclamation will use the lower flow values that are within the range of the 2000 Flow and Temperature recommendations to achieve Reach 2 flows. The winter +25% base flow adjustment will be used for this season to the maximum extent possible.

## **Current Hydrologic Classification**

To implement the 2006 Flaming Gorge ROD in 2020, an evaluation has been made of the current hydrologic conditions in the Upper Green River (*i.e.* above Flaming Gorge Dam). The evaluation is centered on the historical unregulated inflow statistics for Flaming Gorge Dam during the period from 1963 through 2019. Based on these statistics and the mid-April 2020 unregulated spring inflow forecast of 900,000 acre-feet for Flaming Gorge, the spring 2020 hydrologic classification is average (below median) with a 50% to 70% exceedance.

## Green River Basin Hydrology

The mid-April 2020 unregulated spring inflow forecast (current forecast) for Flaming Gorge Reservoir is 900,000 acre-feet (92% of 30-year average). This forecast falls at 62% exceedance based on the historic unregulated inflow record (1963-2019). Figure 1 shows the current forecast in relation to the historic unregulated inflow volumes.

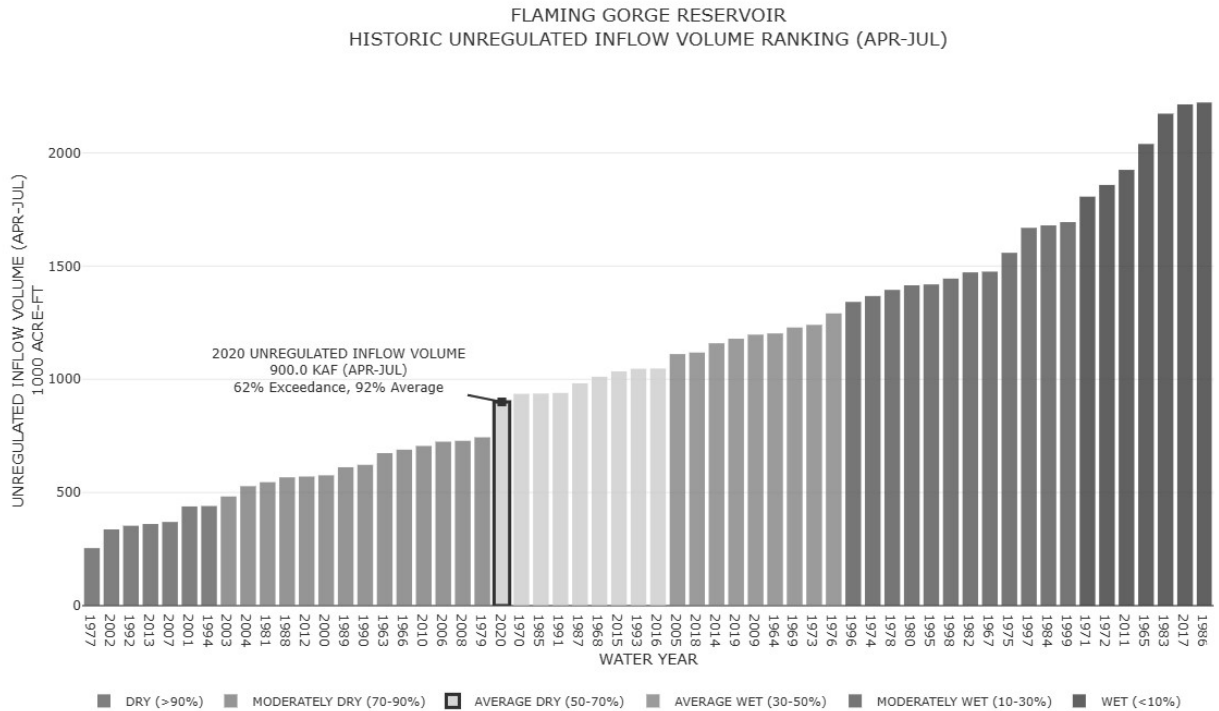


FIGURE 1 - Flaming Gorge Reservoir mid-April 2020 spring forecast and ranked historic unregulated April through July inflow volume for years 1963-2019.

As of April 22, 2020, Flaming Gorge Reservoir's current water surface elevation is 6026.23 feet above sea level. There is 3,205,880 acre-feet of live storage (86% storage capacity) in Flaming Gorge with 543,120 acre-feet of space.

## Yampa River Basin Hydrology

The current April spring forecast for the Little Snake River and Yampa River combined (Little Snake at Lily plus Yampa at Maybell) is 1,300,000 acre-feet (103% of 30-year average). This spring forecast falls above 44% exceedance based on a ranking of the historic record (1922-2019). Figure 2 below shows the current spring forecast in relation to historic flow volumes.

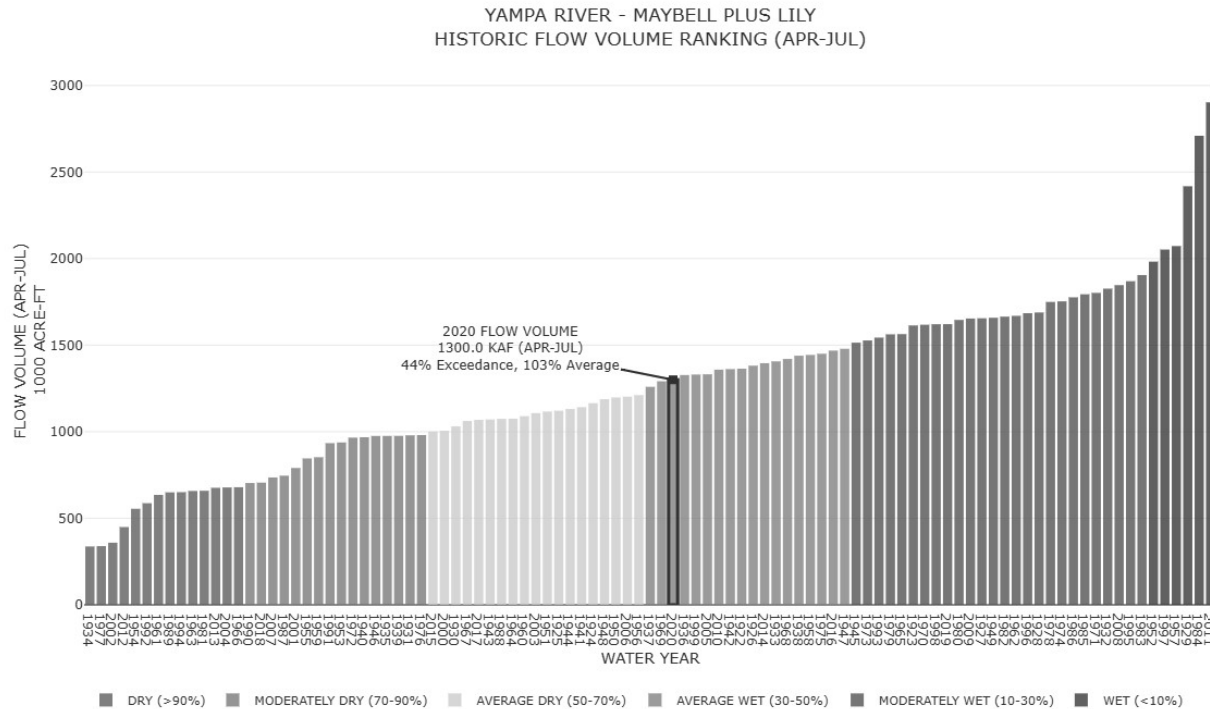


FIGURE 2 - Yampa River Basin (Maybell plus Lily) mid-April 2020 spring forecast and ranked historic unregulated April through July inflow volume for years 1922-2019.

### Probabilities of Flow Events for Spring 2020

According to the hydrologic classifications defined in the 2012 LTSP, Flaming Gorge Reservoir is in the average (below median) hydrologic classification and the Yampa River Basin is in the average hydrologic condition. An analysis was completed on April 17, 2020 to determine appropriate flow objectives for spring and summer 2020. The table below presents the Colorado Basin River Forecast Center (CBRFC) current predictions based on the mid-April spring forecast as to the number of days the Yampa River at Deerlodge Park USGS Gage will exceed various mean daily flow thresholds.

Table 1. The number of days the Yampa River will exceed various mean daily flow thresholds.

Daily Mean Peak	90% Exceedance Probability	75% Exceedance Probability	50% Exceedance Probability	25% Exceedance Probability	10% Exceedance Probability
10,000	4 days	11 days	16 days	30 days	35 days
12,000	0 days	1 days	5 days	15 days	24 days
14,000	0 days	0 days	0 days	7 days	13 days
16,000	0 days	0 days	0 days	0 days	7 days

## **Biological Trigger Procedures**

### **Razorback Sucker Trigger – Spring Peak Flow Period**

#### **Range of Past Spring Peak Triggers**

The mean calendar date of the first capture of razorback sucker larvae (i.e., the "larval trigger") is May 28 (median May 27) and ranges from May 7 to June 24. Historically, 50% of first captures occurred between May 21 and June 2; 75% occurred between May 16 and June 4. In general, first capture of larvae is earliest in years characterized by low flows and/or warmer conditions, and latest in years characterized by high flows and/or cooler conditions.

#### **Spring Peak Pre-trigger Coordination**

The UCPO operator will call in as a participant to any coordination, update, and scheduling activities on the pre-trigger LTSP. During mid-May, a coordination meeting with the Recovery Program, Reclamation, Colorado State University (CSU; Dr. Kevin Bestgen), FWS, National Park Service, WAPA, CBRFC, Utah Division of Wildlife Resources (UDWR) among others will convene to coordinate activities such as monitoring, modeling, and forecasting of Yampa hydrology/temperature.

#### **Spring Peak Trigger**

Timing of LTSP flows is based on the date of first capture and/or significant emergence of the razorback sucker larvae through light trap sampling in the middle Green River which begins in early May of each year. Typically, larval sampling is conducted every morning and evaluation of each morning's sample is completed by mid-morning. As soon as the razorback sucker larvae are positively identified in samples a Recovery Program representative will notify the Resources Management Division (RMD) Manager. The RMD Manager will then send notification via email to the Provo Area Office Manager and UCPO Manager for a concurrence on the initiation of the LTSP. The UCPO will determine the exact timing, magnitude, and duration of the releases. If the timing of release coincides with high recreation use, such as Memorial Day weekend, UCPO may delay releases to minimize risk to the public.

#### **Spring Peak Release Period**

Once river flows in Reach 2 begin to peak, the UCPO operators and the wetland biologists in the field will be in close contact to share information about forecasted flows, floodplain inundation and larvae entrainment efforts. After larvae are detected and dates for initiation of LTSP flows are determined, biologists with the UDWR and FWS will prepare for operations at priority floodplain wetland sites: Stewart Lake (UDWR), Johnson Bottom, Old Charley Wash, Sheppard Bottom (FWS), and others as determined necessary and feasible. Biologists will operate inflow gates at their respective wetlands to maximize entrainment during the LTSP peak flow period. Strategies for maximizing entrainment will vary with hydrology through a series of carefully managed "pulses" of water to induce larvae into the wetlands during average and wetter years, and more singular, shorter-duration attempts to fill wetlands during drier years when peak flows are more likely to recede quickly. Wetland gates will be shut once biologists have determined that flows are unlikely to increase and/or flows begin to leave the wetland for the receding river; however, gates may be re-opened to entrain more larvae if the river exceeds or may exceed wetland water elevations.

## End of Spring Peak Releases

During high releases, the UCPO operator will monitor Yampa River flows in conjunction with Green River flows measured at Jensen. In the event that the average (above median) scenario is targeted, the following scenario provides an example. For moderately dry, average (below/above median), and moderately wet scenarios refer to tables 4 through 7. When it is determined that contributions from Flaming Gorge releases, combined with the Yampa, cannot achieve 18,600 cubic feet per second (cfs) or above, or if desired flows have been achieved for 14 days cumulatively, the releases from Flaming Gorge will be reduced. To limit temperature variations in Reach 2, the release ramp down rate will follow a schedule which reduces flows by 1,000 cfs per day until full power generation flows are reached, and then continue at a rate of 500 cfs per day until base flows are achieved. The dam will be operated to attain Reach 2 peak flow magnitudes and durations which will vary depending on hydrologic conditions (see Table 2 below, and hydrographs in Figures 3 and 6).

Table 2. LTSP design matrix

Peak Flow (x) as Measured at Jensen, Utah	Proposed Study Wetlands (a, b)	Number of Days (x) Flow to Be Exceeded and Corresponding Hydrologic Conditions (c)		
		$1 \leq x < 7$	$7 \leq x < 14$	$x \geq 14$
$8,300 \leq x < 14,000$ cfs	Stewart Lake (f), Above Brennan (f), Old Charley Wash (s) <sup>(d)</sup>	Dry	Moderately dry	Moderately dry and average (below median)
$14,000 \leq x < 18,600$ cfs	Same as previous plus Escalante Ranch (f), Bonanza Bridge (f), Johnson Bottom <sup>e</sup> (s), Stirrup (s), Leota 7 (s)	Average (below median)	Average (below median)	Average (below median)
$18,600 \leq x < 20,300$ cfs	Same as previous	Average (above median)	Average (above median)	Average (above median)
$20,300 \leq x < 26,400$ cfs	Same as previous plus Baeser Bend (s), Wyasket (s), additional Leota units (7a and 4), Sheppard Bottom (s)	Moderately wet	Moderately wet	Moderately wet
$x \geq 26,400$ cfs	Same as previous	Wet	Wet	Wet

The LTSP flow targets in Reach 2 will likely require the use bypass to supplement flows above maximum power plant releases. The use of bypass will be minimized to meet Reach 2 goals.

Pending the hydrologic condition of the Upper Green River and Yampa River, per the EIS, either one or two classifications higher (wetter) or one classification lower (drier) than the actual classification established for the Green River could be recommended for operations.

The duration of spring sustained flows will depend on the type of hydrologic classification and whether hydrology is wetter or drier within that classification range. For example, an average below median hydrologic classification (CBRFC Most Probable April – July '81-2010, May final forecast, 50-70% Exceedance) that has an exceedance value closer to 70% (a dryer condition for that hydrologic classification), 3 days or longer will be the target duration. For an exceedance value near 60%, between 7 and 14 days will be targeted. For an exceedance value near 50% (a wetter condition for that hydrologic classification), a

longer duration will be targeted, 10 days or longer. Pending the Yampa being in a wetter condition, durations could be extended regardless of Green River hydrologic classification.

### **Pikeminnow Trigger – Base flow Period**

Concerning summer (Colorado pikeminnow) base flows (Bestgen and Hill 2016) experiment, within the confines of the 2000 Flow and Temperature Recommendation (+/- 40% base flow), target Reach 2 flows will be attempted several days prior to predicted first presence of Colorado pikeminnow and maintained at that level throughout the summer base flow period. Achieving this targeted base flow depends on the Yampa River flows in Reach 2, which may be in spring runoff prior to the detection of Colorado pikeminnow spawn. When Colorado pikeminnow spawning is confirmed (or expected to occur in the very near future) in the Yampa River, a FWS representative will contact the RMD manager to provide notification. Past investigations indicate the average date of first presence is July 4 (range June 20 to July 24), and is earlier in warmer and lower flow conditions, and later in cooler and higher flow conditions.

Table 3. reproduction of Table 10 from Bestgen Hill 2016a

Hydrologic classification	Reach 2, Middle Green River Flows		Reach 3, Lower Green River Flows	
	2000 (Muth et al.) (cfs)	Proposed (cfs)	2000 (Muth et al.) (cfs)	Proposed (cfs)
Dry (10% of years, 0 to 10% exceedance)	900 – 1,100	1,700 – 1,800	1,300 – 2,600	1,700 – 2,000
Moderately Dry (20% of years)	1,100 – 1,500	1,800 – 2,000	1,500 – 3,400	2,000 – 2,300
Average (40% of years)	1,500 – 2,400	2,000 – 2,600	1,800 – 4,200	2,300 – 2,800
Moderately Wet (20% of years)	2,400 – 2,800	2,200 – 2,800	2,700 – 4,700	2,600 – 3,200
Wet (10% of years, 90 to 100% exceedance)	2,800 -3,000	2,400 – 3,000	3,200 – 4,700	2,800 – 3,800

### **Base Flow Period**

The summer base flow period will be determined through a combination of hydrologic conditions on the Yampa River and Upper Green River, and ends on September 30<sup>th</sup>. The start of the summer base flow will be determined using unregulated inflow and average monthly flows on the Yampa and Green River, supplemented by the 3% change between consecutive mean daily flows due to reservoir releases and 0.1-m stage change at Jensen within a day as recommended in the 2000 Flow and Temperatures Recommendation. The base flow experiment (Bestgen and Hill, 2016) will be attempted within the confines of the baseflow range for the hydrologic classification described in the 2000 Flow and Temperature Recommendations (+/- 40%).

Autumn base flows period will use the lower flow values that are within the range the 2000 Flow and Temperature recommendations to achieve Reach 2 flows. This period is between October 1<sup>st</sup> through November 30<sup>th</sup>.

The Winter +25% base flow will be used for this season to the maximum extent possible.

## **Utah Division of Wildlife Resources Monitoring Program**

UDWR has a long-term fish monitoring program immediately downstream of Flaming Gorge Dam. Each April and September, the agency submits a flow request for two nights of 1,600 cfs, allowing them to electrofish the river at two 1-mile-long study sites, Spillway (Tailrace) and Little Hole. The goal of this request is to ensure that the river is navigable by jet boat and to maintain a consistent flow across sampling events. This request will be considered and approved if conditions are warranted. The UCPO operator will coordinate with WAPA to implement dam releases that meet the flow request.

## **Maintenance**

Regularly scheduled and/or emergency maintenance activities may reduce power plant capacity. Although this will likely not interrupt flow objectives, releases may need to be reduced to accommodate such events. Such interruptions will be remedied, as determined by Reclamation, and operations returned to target flow rates upon work completion.



**Table 4. Proposed Operation Matrix for Moderately Dry Hydrologic Conditions**

Period Name / End of Objective	Date and Description
Pre-Spring Peak / Ends at the Start of LTSP - Biological Trigger	May 1 to LTSP Trigger. ~850 cfs to Full Power Generation (pending operation)
Spring Peak Ends when < 8,300 cfs is predicted or observed at Jensen Gage.	Estimated middle-May, pending Yampa Flows. Increase from full power plant capacity and limit the use of bypass to the extent possible to meet Reach 2 Target, sustained flow $\geq$ 8,300 cfs for greater than 7 days 14 days with a peak near 14,000 cfs.
End of Spring Peak. Ends when summer base flow begins.	Ramp down, end of Spring Peak period – estimated early June. ~1000 cfs/day ramp down from bypass releases to ~350 cfs/day below power plant releases. Releases in the 850 cfs range.
Summer Base Flows / Ends on September 30 <sup>th</sup>	Sustaining Pikeminnow base flow within 2000 Flow and Temperature Recommendations ~1800-2000 cfs in Reach 2 until September 30 <sup>th</sup> . Releases will be no more than ~1800 cfs (+/- 40% period) and estimated to be ~1600 cfs.
Autumn Base Flows / Ends on November 30 <sup>st</sup>	Base flow target in Reach 2 is 1,100-1,500 cfs. Ramp down at 50 cfs/day to approximately ~850 cfs. Late November increase at 50 cfs/day to achieve +25% base flow by December 1 <sup>st</sup> .
Winter Base Flow / Ends on February 28 <sup>th</sup>	Base flows increased to +25% to not exceed 1,875 cfs in Reach 2 from December to the end of February (+/- 25% period). Releases at approximately ~1,000 cfs pending the Yampa.
End of FG Operation Plan and Transition Period / End of May 2020 to April 2021 Flaming Gorge Operation Plan	Flows are reduced to achieve Upper Limit Drawdown (EIS Table 2-3)

**Table 5. Proposed Operation Matrix for Average (below median) Hydrologic Conditions**

Period Name / End of Objective	Date and Description
Pre-Spring Peak / Ends at the Start of LTSP - Biological Trigger	May 1 to LTSP Trigger. ~850 cfs to Full Power Generation (pending operation)
Spring Peak (Average-below median) Ends when < 14,000 cfs is predicted at the Jensen Gage else ends 8,300 – 14,000 cfs is no longer attainable for greater than 14 days.	Estimated middle-late May to early June, pending Yampa Flows. Increase from full power plant capacity in one day and increase 4000 cfs / day during bypass to meet Reach 2 peak Target (near 18,600 cfs). Pending Yampa flows, the target is to have $\geq$ 14,000 cfs in Reach 2 for greater 7 days. To meet the ROD for an average condition if 18,600 cfs is obtainable (pending Yampa) for > than 14 days this will be targeted
End of Spring Peak. Ends when ramp down begins.	Ramp down, end of Spring Peak period – estimated middle to late June. ~1000 cfs/day ramp down from bypass releases to ~500 cfs/day below power plant releases, there after until summer base flow period begins; releases in the 1000 cfs range.
Summer Base Flows / Ends on September 30 <sup>th</sup>	Sustaining Pikeminnow base flow within 2000 Flow and Temperature Recommendations ~2000cfs in Reach 2 until September 30 <sup>th</sup> . Releases will be approximately 1800 cfs release.
Autumn Base Flows / Ends on November 30 <sup>st</sup>	Base flows for October 1 <sup>st</sup> to November 30 <sup>th</sup> ~1,000 cfs (+/- 40% period). Base flow target in Reach 2 is 1,500-2,400 cfs. Late November increase @ 50 cfs/day to achieve +25% base flow by December 1 <sup>st</sup> .
Winter Base Flow / Ends on February 28 <sup>th</sup>	Base flows increased to +25% to not exceed ~3,000 cfs in Reach 2 from December 1 <sup>st</sup> to February 28 <sup>th</sup> (+/- 25% period). Releases at approximately ~2,100 cfs.
End of FG Operation Plan and Transition Period / End of May 2020 to April 2021 Flaming Gorge Operation Plan	Flows are reduced to achieve Upper Limit Drawdown (EIS Table 2-3)

**Table 6. Proposed Operation Matrix for Average (above median) Hydrologic Conditions**

Period Name / End of Objective	Date and Description
Pre-Spring Peak / Ends at the Start of LTSP - Biological Trigger	May 1 to LTSP Trigger. ~850 cfs to Full Power Generation (pending operation)
Spring Peak (Average-above median) Ends when < 18,600 cfs is predicted or observed at Jensen Gage.	Estimated middle-late May to early June, pending Yampa Flows. Increase from full power plant capacity in one day and increase 4000 cfs / day during bypass to meet Reach 2 Target (<20,300 cfs). At least 7 days at ≥ 18,600 cfs, pending Yampa flows.
End of Spring Peak. Ends when ramp down begins.	Ramp down, end of Spring Peak period – estimated middle to late June. ~1000 cfs/day ramp down from bypass releases to ~500 cfs/day below power plant releases, there after until summer base flows begin; releases in the 1,400 cfs range.
Summer Base Flows / Ends on September 30 <sup>th</sup>	Sustaining Pikeminnow base flow within 2000 Flow and Temperature Recommendations ~2000 cfs in Reach 2 until September 30 <sup>th</sup> . Releases will be approximately 1800 cfs release.
Autumn Base Flows / Ends on November 30 <sup>st</sup>	Base flows for October 1 <sup>st</sup> to November 30 <sup>th</sup> ~1,700 cfs (+/- 40% period). Base flow target in Reach 2 is 1,500-2000 cfs. Late November increase @ 50 cfs/day to achieve +25% base flow by December 1 <sup>st</sup> .
Winter Base Flow / Ends on February 28 <sup>th</sup>	Base flows increased to +25% to not exceed ~3,000 cfs in Reach 2 from December 1 <sup>st</sup> to the end of February 28 <sup>th</sup> (+/- 25% period). Releases at approximately ~2,400 cfs.
End of FG Operation Plan and Transition Period / End of May 2020 to April 2021 Flaming Gorge Operation Plan	Flows are reduced to achieve Upper Limit Drawdown (EIS Table 2-3)

**Table 7. Proposed Operation Matrix for Moderately Wet Hydrologic Conditions**

Period Name / End of Objective	Date and Description
Pre-Spring Peak / Ends at the Start of LTSP - Biological Trigger	May 1 to LTSP Trigger. Close to Full Power Generation (4,600 cfs) (pending operation)
Spring Peak Ends when < 20,300 cfs is predicted or observed at Jensen Gage	Estimated late May to early June, pending Yampa River Flows. Increase from full power plant capacity in one day and increase 4000 cfs / day during bypass to meet Reach 2 Target (>20,300 cfs). Bypass could be used for 1-7 weeks. Per Muth et al. > 2 weeks @ 18,600 cfs at Reach 2 will be attempted and this may include the LTSP target of > 20,300 cfs for 1 to ~2 weeks. Reach 2 flows will be attempted to be below flood stage of 24,100 cfs.
End of Spring Peak. Ends when ramp down begins.	Ramp down, end of Spring Peak period – estimated middle to late June. ~1000 cfs/day ramp down from bypass and power plant releases, there after until summer base flows begin; releases in the 1,600 cfs range.
Summer Base Flows / Ends on September 30 <sup>th</sup>	Sustaining Pikeminnow base flow within 2000 Flow and Temperature Recommendations ~2400-2800 cfs in Reach 2 until September 30 <sup>th</sup> . Releases will be in 2,000 cfs range.
Autumn Base Flows / Ends on November 30 <sup>st</sup>	Base flows for October 1 <sup>st</sup> to November 1 <sup>st</sup> ~1,800 cfs (+/- 40% period). Transition from Summer Base Flow to Autumn Base flow @ 50 cfs/day. Base flow target in Reach 2 is 2,400-2,800 cfs. Late November increase @ 50 cfs/day to achieve +25% base flow by December 1 <sup>st</sup> .
Winter Base Flow / Ends on February 28 <sup>th</sup>	Base flows increased to +25% to not exceed ~3,000 cfs in Reach 2 from December 1 <sup>st</sup> to February 28 <sup>th</sup> (+/- 25% period). Releases at approximately ~2,900 cfs.
End of FG Operation Plan and Transition Period / End of May 2020 to April 2021 Flaming Gorge Operation Plan	Flows are reduced to achieve Upper Limit Drawdown (EIS Table 2-3)

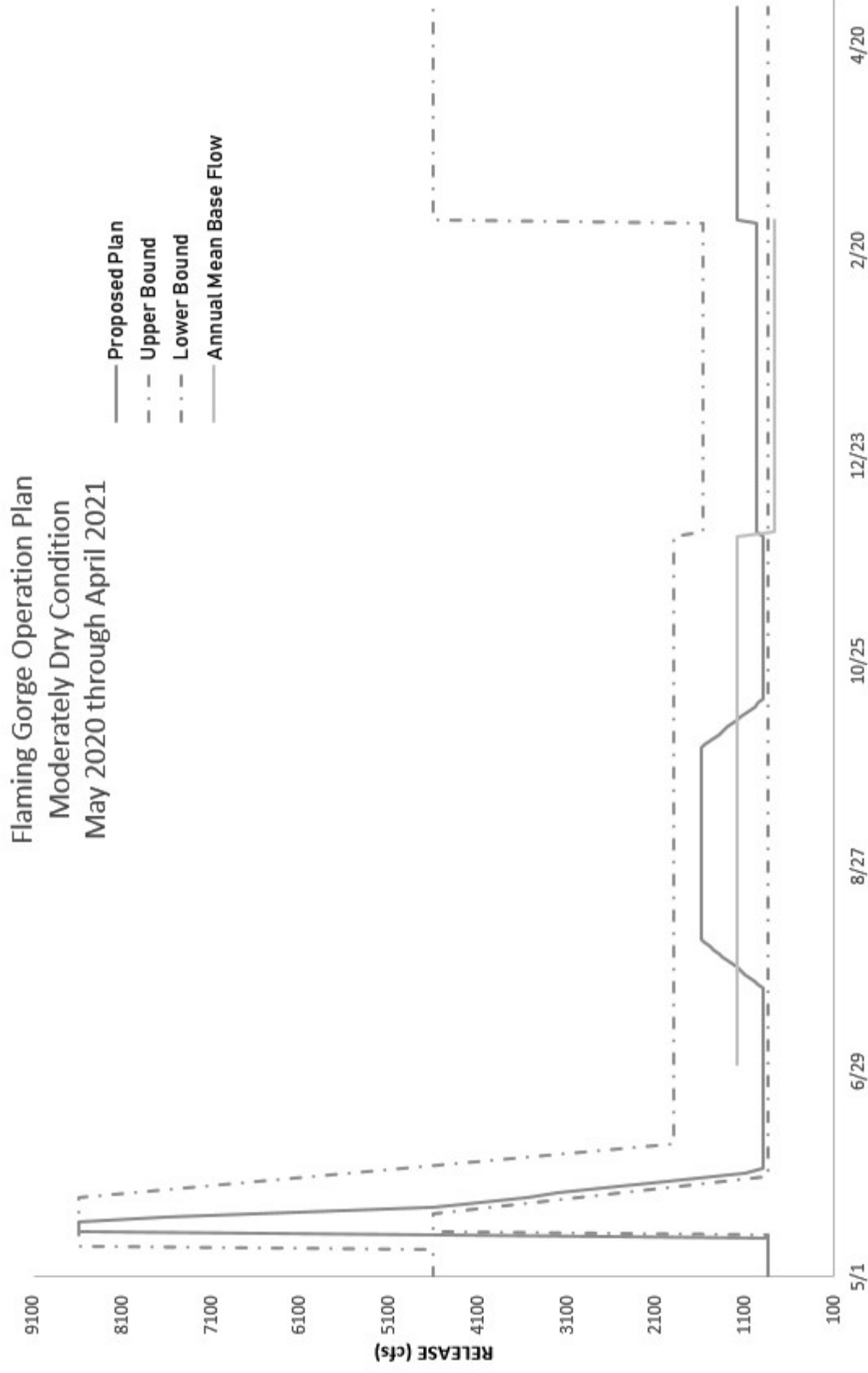


FIGURE 3 – Proposed flow regime for Moderately Dry Hydrology.

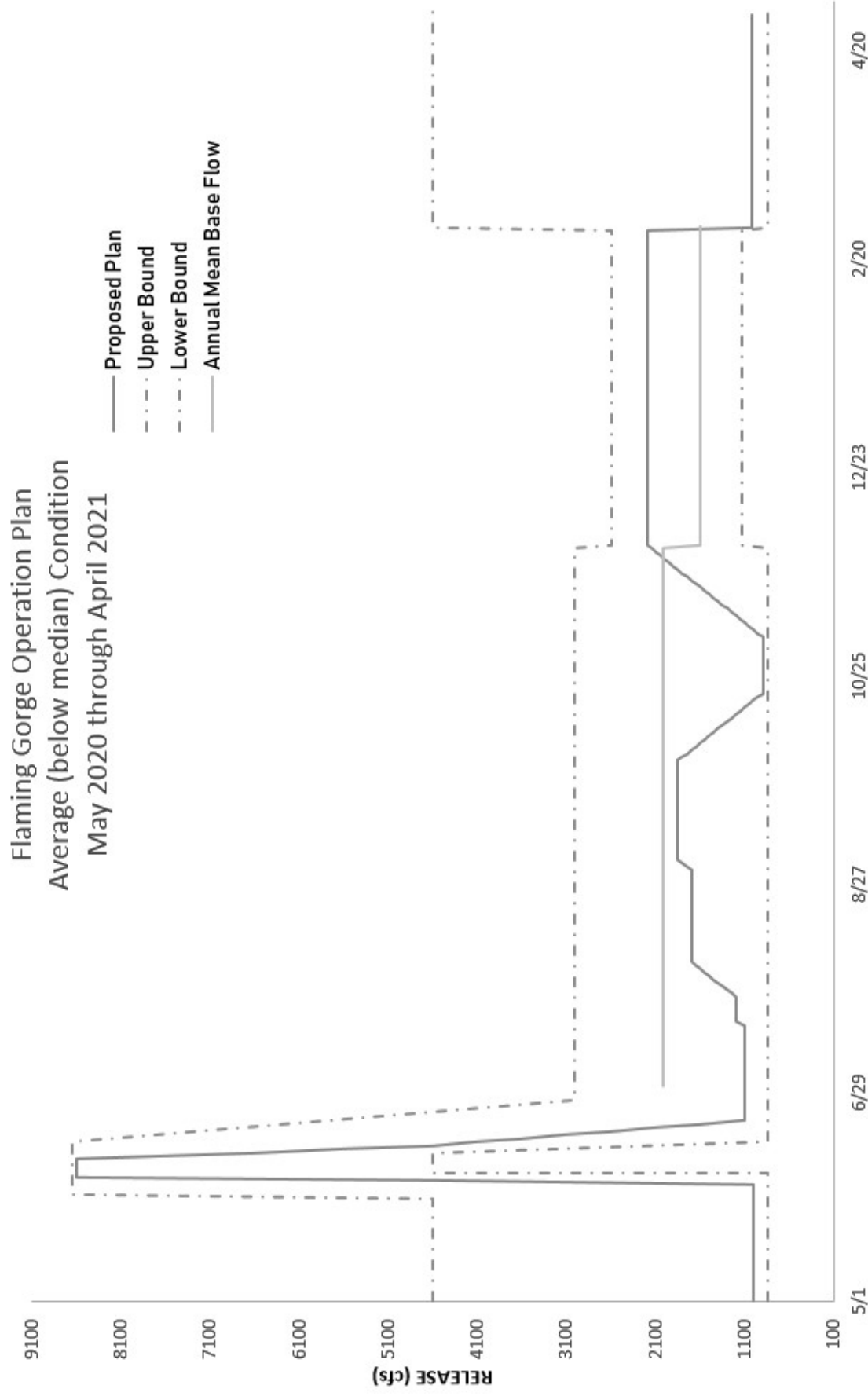


FIGURE 4 – Proposed flow regime for Average (below median) Hydrology.

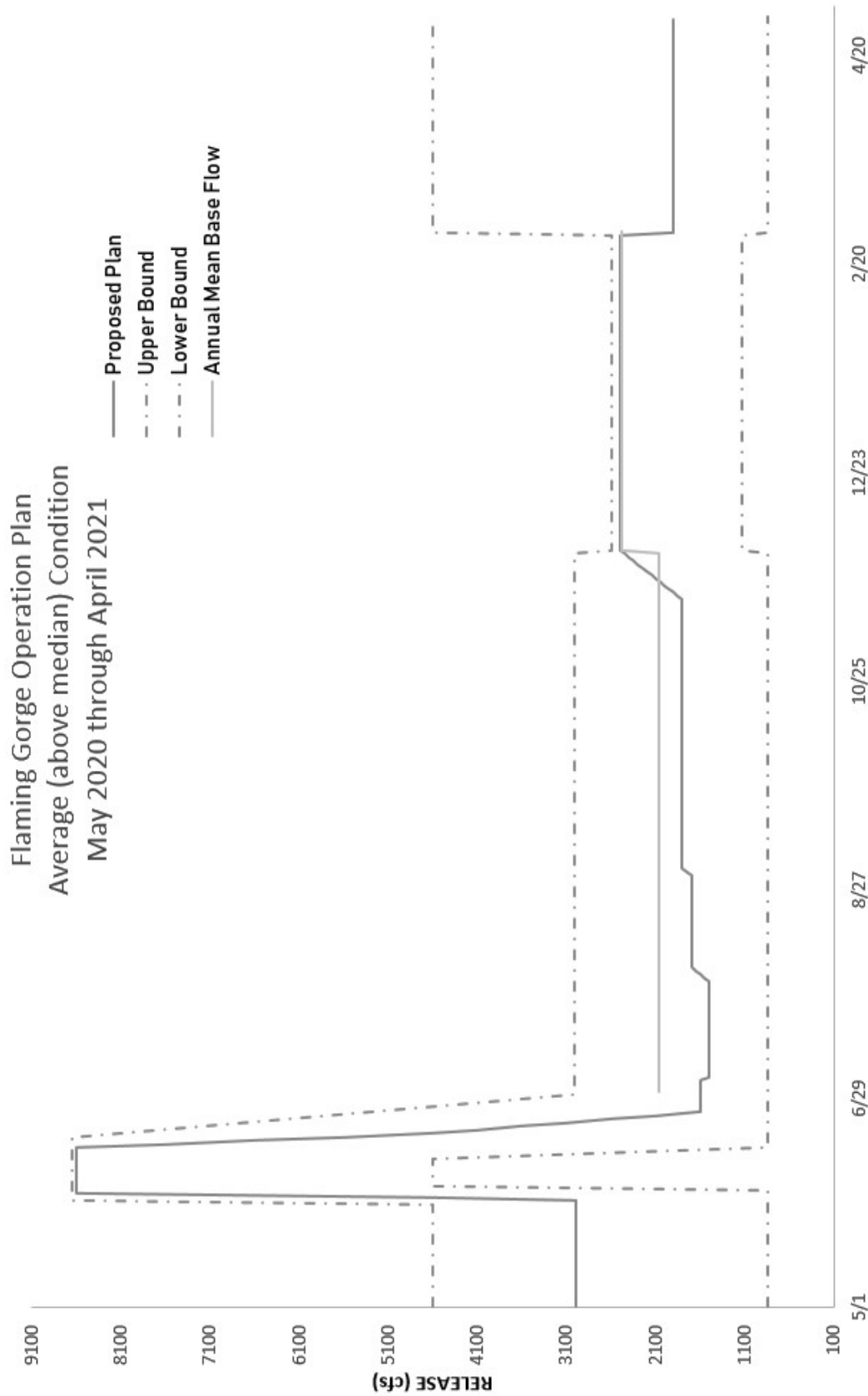


FIGURE 5 – Proposed flow regime for Average (above median) Hydrology.

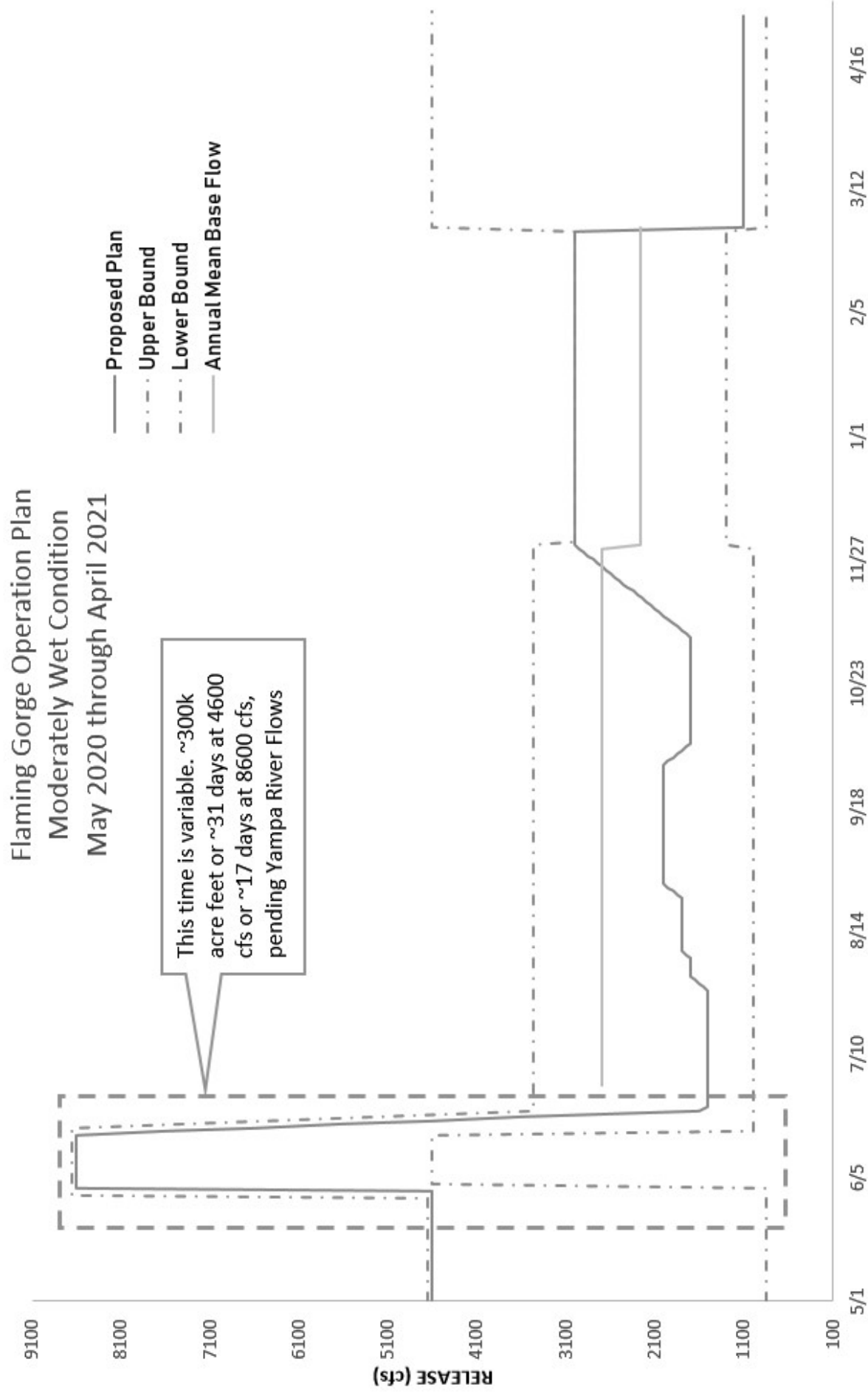


FIGURE 6 – Proposed flow regime for Moderately Wet Hydrology.