FISH OPERATIONS PLAN IMPLEMENTATION REPORT

April 2020

U.S. Army Corps of Engineers
Northwestern Division
Portland, OR.

Introduction

The U.S. Army Corps of Engineers (Corps) developed this report in accordance with the 2020 Fish Operations Plan[1] (2020 FOP). The 2020 FOP describes the Corps' planned operations for juvenile fish passage at its four lower Snake River and four lower Columbia River dams during the 2020 spring and summer fish migration seasons, generally April 3 through August 31. The 2020 FOP is consistent with spill operations for juvenile fish passage and the regional forum process for adaptive management and in-season management provisions outlined in the 2019 NOAA Fisheries Columbia River System Biological Opinion (2019 BiOp)[2], the 2018 Extensions of the 2008 Columbia Basin Fish Accords (Accord Extensions), the 2019-2021 Spill Operation Agreement (Agreement) and subsequent Addendum, the Corps' requirements under the Endangered Species Act (ESA), and is the subject of ongoing consultation and communications with the relevant wildlife agencies to ensure consistency with the ESA. Other project operations and water management actions not specifically addressed in this document will be consistent with the 2019 BiOp and other guiding operative documents, including the 2020 Water Management Plan (WMP), seasonal WMP updates, and the 2020 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2020 FOP during the month of April 2020. In particular, information in this report includes the following:

- total flow: the total hourly river flow rate;
- generation flow: the hourly flow through the powerhouse units;
- target spill: the spill target for that hour (Table 1);
- adjusted spill: the hourly spill level that can be achieved taking into consideration that spill may vary as a function of total river flow, forebay elevation and generator capacity, and is subject to routine operational adjustments that limit the ability to spill to the target spill (see 2020 FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,
- resultant 12-hour average TDG for the tailwater at each project.

[1] The 2020 FOP was posted to the Technical Management Team (TMT) website on March 23, 2020 (http://pweb.crohms.org/tmt/documents/fpp/2020/).
[2] The Corps, in coordination with the other Action Agencies, and National Marine Fisheries Service (NMFS), employs the Regional Implementation Oversight Group (RIOG) and technical teams including the Technical Management Team (TMT) and Fish Passage Operations & Maintenance (FPOM), to coordinate with state, tribal and other federal experts for recommendations for implementing operations consistent with NMFS' Columbia River System Biological Opinions.

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2020 FOP in April 2020.

Data Reporting

I. For each project providing fish passage operations, this report contains a graph displaying the performance of the spring fish passage spill program for the month of April, with hourly spill, target spill, adjusted spill, generation, and total flows. The monthly graphs begin on April 1 and end on April 30 and reflect the following operations for the lower Snake River and the lower Columbia River projects:

- The black line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The orange line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The thin solid blue line represents the actual average hourly spill level through the spillway in kcfs.
- The dashed blue line represents the spill cap portion of the target spill estimated to reach the gas cap or target TDG.
- The thick light blue line represents the performance standard spill level portion of the target spill.
- The thick dark blue line represents the adjusted spill cap spill: the hourly spill cap level that can be achieved taking into consideration that spill may vary as a function of total river flow, forebay elevation, and generator capacity, and is subject to routine operational adjustments that limit the ability to spill to the target spill (2020 FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the April 2020 Average Percent TDG Values Table (Table 4). The numbers in red indicate the project exceeded the %TDG cap - i.e. 125% (tailwater) for each project.

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the adjusted spill due to various conditions as described below. When actual spill varied from adjusted spill levels during periods of voluntary spill, the change in spill level is described below in the April 2020 Spill Variance Table (Table 2).[3] The Spill Variance Table includes average hourly data; but when spill varies from adjusted spill for a portion of an hour, it is characterized as a variance for a full hour. There are instances when the hourly adjusted spill levels are not achievable due to mechanical limitations in setting spill gates to implement the regionally coordinated spill pattern. The project operator sets the spill gate stops to most closely approximate the adjusted spill to the extent practicable. Other routine activities that changed spill levels, which were coordinated with regional partners, are identified in the monthly Pre-Coordinated Operations Table (Table 3).

[3] Involuntary spill conditions shown in the graphs are not considered variances and are not reported in the Spill Variance Table. Involuntary spill conditions may result from lack of load, high river inflows that exceed available powerhouse capacity, scheduled or unscheduled turbine unit outages or transmission outages of various durations, passing debris, etc.

"Low flow" operations at the lower Columbia and lower Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. For this report, the decrease in target spill is represented as adjusted spill. In these situations, the projects operate at minimum generation and pass the remainder of project inflow as spill and through other routes, such as fish ladders, sluiceways, and navigation locks. As flows transition from higher flows to low flows, there may be situations when flows recede at a higher rate than forecasted. In addition, inflows provided by nonfederal projects upstream are variable and uncertain.

The combination of these factors may result in instances when unanticipated changes to inflow result in forebay elevations dropping to the low end of the Minimum Operating Pool (MOP). Since these projects have limited operating flexibility, maintaining minimum generation, MOP elevation, and the target spill may not be possible throughout every hour.

Actual spill levels at Corps projects may vary up to ±2 kcfs within the hour (except as otherwise noted in the 2020 FOP for Bonneville and The Dalles dams,[4] which may range up to ±3 kcfs) as compared to a target spill. A number of factors influence actual spill, including hydraulic efficiency, exact gate opening calibration, spillway gate hoist cable stretch due to temperature changes, and forebay elevation (e.g. a higher forebay results in a greater level of spill since more water can pass under the spill gate). Transition periods between gas cap spill and performance standard spill hours may result in actual hourly spill levels that are slightly higher or lower than target spill levels.

Occurrences requiring an adjustment in operations and/or regional coordination are described in greater detail in the "Operational Adjustments" section below.

April Operations

The month of April was characterized by below average precipitation and below average flows for the lower Snake and lower Columbia Rivers. The April 2020 observed precipitation was 67% of average on the Snake River above Ice Harbor and 62% of average on the Columbia River above The Dalles. The NOAA Northwest River Forecast Center runoff summary for April indicated that the adjusted runoff for the Snake River at Lower Granite was 80% of the 30-year average (1981-2010) with a volume of 3.6 MAF (Million acre-feet)[5]. The April 2020 adjusted runoff for the Columbia River at The Dalles was 76% of the 30-year average (1981-2010) with a volume of 13.8 MAF[6].

Spring spill operations occur April 3–June 20 at the four lower Snake River projects, and April 10–June 15 at the four lower Columbia River projects. Target spill levels for April 2020 at each project are defined in Table 1.

[4] As specified in the 2020 FOP section 3.

[5] Retrieved May 4, 2020: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5

[6] Retrieved May 4, 2020: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php

Table 1: Summary of 2020 spring target spill levels at lower Snake River and lower Columbia River projects.

PROJECT	FLEX SPILL (16 hours per day)[A, B, C, E]	PERFORMANCE STANDARD SPILL (8 hours per day)[B, D, E]
Lower Granite[E]	125% Gas Cap	20 kcfs
Little Goose[F, G]	125% Gas Cap	30%
Lower Monumental	125% Gas Cap (uniform spill pattern)	30 kcfs (bulk spill pattern[H])
Ice Harbor	125% Gas Cap	30%
McNary	125% Gas Cap	48%
John Day	120% TDG target	32%
The Dalles[I]	40%	40%
Bonneville[J]	125% Gas Cap	100 kcfs

A. Attempts should be made to minimize in-season changes to the proposed operations; however, if serious deleterious impacts are observed, existing adaptive management processes may be employed to help address serious issues that may arise in-season as a result of implementing these proposed spill operations.

B. Spill may be temporarily reduced at any project if necessary to ensure navigation safety or transmission reliability. In order to operate consistently with state water quality standards, spill may be also reduced if observed Gas Bubble Trauma (GBT) levels exceed those identified in state water quality standards (see WASH. ADMIN. CODE §173-201A-200(l)(f))).

C. 125% Gas Cap spill is spill to the maximum level that meets, but does not exceed, the TDG criteria allowed under state laws. This includes a criterion for not exceeding 126% TDG for the average of the two greatest hourly values within a day.

D. The 8 hours of performance standard spill may occur with some flexibility (with the exception of Little Goose and Lower Granite operations described in the next key points). Other than at TDA, performance standard spill occurs in either a single 8-hour block or up to two separate blocks per calendar day. No more than 5 hours of performance standard spill may occur between sunset and sunrise, as defined in Fish Passage Plan (FPP) Table BON-5. Performance standard spill is not be implemented between 2200-0300 hours. No ponding above current MOP assumptions except as noted below.

E. Lower Granite Exception One - If adult passage delays are observed at Lower Granite Dam, the Corps may implement performance standard spill at Lower Granite Dam for at least 4 hours in the AM (beginning at 0500 hours). Implementation of this modification may also trigger in-season reevaluation of options to balance power principle.

F. Little Goose Exception One - As soon as practicable (and, in any event, no more than 24 hours) after a cumulative total of 25 adult spring Chinook salmon (not including jacks) pass Lower Monumental Dam, operate Little Goose spill at 30% spill for 8 consecutive am hours (April 3-15 start at 0500 hours; April 16-June 20 start at 0400 hours).

G. Little Goose Exception Two - During periods of involuntary spill, spill at 30% for 8 hours/day during the hours described in footnote F above and store additional inflows that exceed hydraulic capacity in the forebay above MOP if necessary. When it is necessary to pond water to achieve the lower spill levels due to high inflow, water stored above MOP should be drafted out over the remaining hours by increasing spill to pass inflow from 1200-1600 hours (or 1300-1700 hours from April 3-15), then increasing spill as necessary from 1600-0400 (or 1700-0500 hours from April 3-15) to draft the pool back to MOP. If it is forecast that the drafting spill will generate TDG levels in the tailrace in excess of 130% TDG, use all 16 hours to return the pool to MOP.

H. If the specified spill level at bulk pattern exceeds the gas cap, then spill pattern will be changed to uniform.

I. Fish passage spill at The Dalles should be limited to spillbays 1-8 unless river flow exceeds 350 kcfs, then spill outside the spillwall is permitted. TDG levels in The Dalles tailrace may fluctuate up to 125% TDG prior to reducing spill at upstream projects or reducing spill below 40% at The Dalles.

J. Fish passage spill at Bonneville Dam should not exceed 150 kcfs due to erosion concerns.

In its implementation of the 2020 FOP in April, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap or target TDG in the tailrace (see Table 4).[7] This evaluation considered: environmental conditions (e.g., river flow, wind, water temperature, barometric pressure, incoming TDG from upstream, and water travel time) and project operations (e.g., spill level, spill pattern, tailwater elevation, proportion of flow through the turbines, and project configuration).

Starting on April 21 at 0001 hours, Little Goose transitioned to the spring spill operation to maintain spill at 30% of outflow for an 8-hour block each day from 0400 through 1200 hours. This operation was triggered by a cumulative total count of more than 25 adult Chinook at Lower Monumental on April 20, pursuant to criteria in the 2020 FOP (see Table 1 above, footnotes F and G). This operation will continue for the remainder of spring spill.

Operational Adjustments

1. Little Goose

Beginning April 16 at 1800 hours and continuing for the remainder of spring juvenile fish passage spill (through June 20), the operation to manually restrict Little Goose Dam turbine unit 1 to the upper 1% operating range (approximately 16–18 kcfs) was modified to no longer apply during hours of spill to the 125% TDG cap. This modification was requested by regional salmon managers at the FPOM meeting on April 9, then coordinated further via FPOM conference calls on April 14 and April 16 (see FPOM Memo of Coordination 20 LGS 03). The intent of the operation was to allow Unit 1 to operate in the lower 1% range (approximately 11–12 kcfs) during minimum generation in order to pass more flow through the spillway. During hours of 30% spill, the operation of Unit 1 in the upper 1% was maintained in order to prioritize powerhouse flow through the southernmost units to the extent possible and push out the eddy that forms in the tailrace when spilling through the adjustable spillway weir (ASW), per criteria in the 2020 FPP section 4.2.3.

[7] See 2020 FOP section 2.2

Table 2: Spill Variance Table – April 2020 (4/1 to 4/30)

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Lower Granite	Reduced Spill	4/8	0000-0300	4	Program Error	Hourly spill decreased to 29.5 kcfs (less than adjusted spill of 29.6 kcfs) while generation was 13.3 kcfs, greater than the minimum generation range for Unit 1 (11.8-12.9 kcfs[9]).
Little Goose	Reduced Spill	4/3 4/5 4/16 4/17	1900-2300 1400-2300 2200-2400 0100-0500	5 10 3 5	Human Error	Hourly spill decreased to between 9 kcfs and 36 kcfs (less than adjusted spill of between 13 and 37 kcfs), while generation was between 12.1 and 16.0 kcfs, greater than the minimum range for Unit 1 (11.3-11.8 kcfs[10])due to incorrect settings for operations.[11]
Little Goose	Reduced Spill	4/8	1200	1	Human Error	Hourly spill decreased to 27.8% of total flow (less than adjusted spill of 30% ± 1%) due to a miscommunication of the planned spill operation.

[8] Note: Data collected for reporting spill variances is reported using hourly-averaged data. Therefore, while spill may be increased or decreased for only a portion of an hour, it is represented in the Spill Variance Table as an hour.
[9] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Lower Granite turbine Unit 1, the range is 11.6 – 13.2 kcfs. See 2020 FOP section 4.3.1.
[10] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Lower Monumental turbine Unit 1, the range is 11.1 – 12.0 kcfs. See 2020 FOP section 4.3.1.
[11] Minimum generation range changed with hourly flow rate, see 2020 FOP section 4.3.1. Corrective action was taken with project staff.

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Little Goose	Additional Spill	4/8	1400-1800	5	Human Error	Hourly spill increased to between 30 kcfs and 39 kcfs (greater than adjusted spill of 24 -33 kcfs), while generation was 12 kcfs, less than the minimum range for Unit 1 (16 – 18 kcfs), due to incorrect use of minimum generation range.
Little Goose	Additional Spill	4/13	0700-1800	12	Maintenance	Hourly spill increased to between 45 kcfs and 55 kcfs (greater than adjusted spill of between 30 and 35 kcfs). During a planned transmission line outage, the unit relied upon for generation (Unit 6) malfunctioned. No other units were available.
Little Goose	Reduced Spill	4/16	1200-1400	3	Maintenance	Hourly spill held at 36 kcfs (less than adjusted spill between 37 and 39 kcfs) while generation was 21 kcfs, greater than the minimum generation range for Unit 1 (16-18 kcfs) due to unscheduled testing of Unit 6 because of a malfunction..

Project	Parameter	Date	Time[8]	# of Hours	Type	Reason
Ice Harbor	Reduced Spill	4/8	0300	1	Human Error	Hourly spill decreased to 25.1 kcfs (less than adjusted spill of 25.2 kcfs) while generation was 10.4 kcfs, greater than the minimum generation range for Unit 1 (8.4 – 10.1 kcfs[12]).
John Day	Additional Spill	4/30	1100	1	Program Error	Hourly spill was 149 kcfs (greater than adjusted spill of 147 kcfs) while generation was 48 kcfs, less than the minimum generation range of 50 – 60 kcfs[13], due to a change in generation to respond to a malfunctioning forebay gauge.
Bonneville	Reduced Spill	4/15	1900-2200	4	Program Error	Hourly spill decreased to 96 kcfs (less than adjusted spill target of 100 +/- 3 kcfs). The program that sets gate position based on spill patterns was not correctly configured with one gate out of service due to lack of power.

[12] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges for Ice Harbor turbine Unit 1, the range is 8.2-10.3 kcfs. See 2020 FOP section 4.3.1.

[13] Range does not include ±2% due to generating unit governor "dead band." When 2% is applied to the minimum generation flow ranges, the range is 49 – 61 kcfs. See 2020 FOP section 4.3.1.

Table 3: Pre-Coordinated Operations – April 2020 (4/1 to 4/30)

Project	Parameter	Date	Time[14]	# of Hours	Type	Reason
Lower Monumental	Reduced Spill	4/24 4/25 4/26 4/27 4/28 4/29 4/30	1900-2000 1900-2000 1800-1900 1800-1900 1700-1900 1700-1800 1800-1900	2 2 2 2 3 2 2	Navigation	Hourly spill decreased to between 20 kcfs and 27 kcfs (less than the spill target of 30 kcfs) for safe navigation. Regionally coordinated via 2020 FOP, Sections 4.1 and 4.6.
Ice Harbor	Reduced Spill	4/22	1600-1700	2	Maintenance	Hourly spill decreased to 43 kcfs (less than adjusted spill target of 46-48 kcfs) while performing a fish screen inspection. Unit 2 was operating at minimum generation during this time. Regionally coordinated via 2020 FPP, page IHR-10, Section 2.3.2.2.

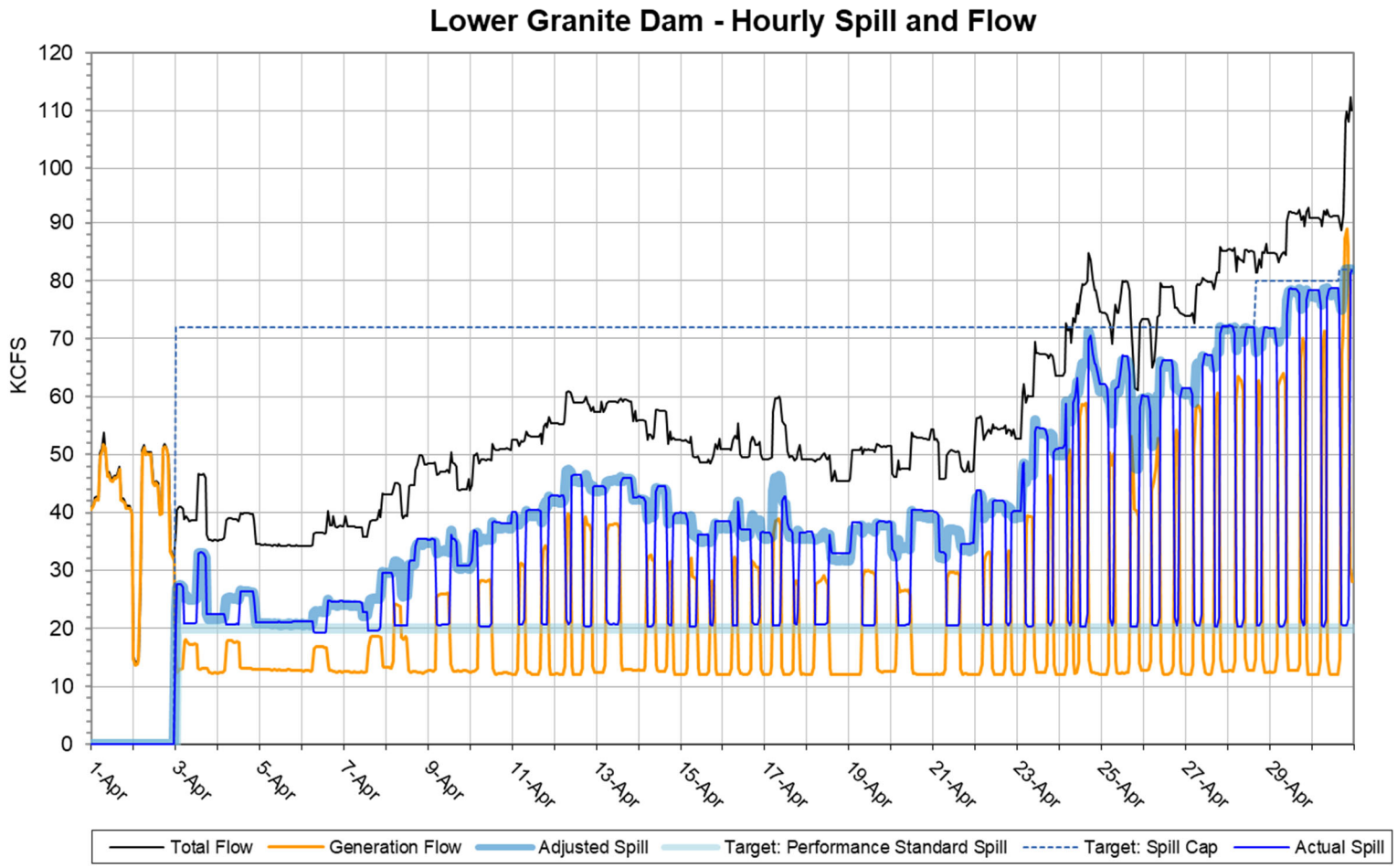
[14] Note: Data collected for reporting spill variances is reported using hourly-averaged data. Therefore, while spill may be increased or decreased for only a portion of an hour, it is represented in the Spill Variance Table as an hour.

Project	Parameter	Date	Time[14]	# of Hours	Type	Reason
John Day	Reduced Spill	4/10	0100-0500, 2400	6	Transmission Reliability	Hourly spill decreased to between 40 and 150 kcfs (less than adjusted spill target of 69 to 156 kcfs) due to an increase in generation in order to provide contingency reserves. Regionally coordinated via 2020 FOP, Section 4.4.1.
		4/11	0100-0700, 1300-1800, 2200-2400	16		
		4/12	0100-0700, 2200-2400	10		
		4/13	0100-0600, 1200-1700, 2100-2400	16		
		4/14	0100-0500, 1000-1800, 2300-2400	16		
		4/15	0100-0500, 2200-2400	8		
		4/16	0100-0500, 0900-1700, 2300-2400	16		
		4/17	0100-0500, 1100-1800, 2200-2400	16		
		4/18	0100-0900, 2200-2400	12		
		4/19	0100-0500, 1000-1800	14		
		4/21	1100-1500	5		
		4/23	0800-1700, 2300-2400	12		
		4/24	0100-0500, 0900-1600	13		
		4/27	2300-2400	2		
		4/28	0100-1000	10		
		4/30	2300-2400	2		
The Dalles	Additional Spill	4/19	2200	1	Transmission Reliability	Hourly spill increased to 42% of total flow (greater than adjusted spill target of 40% ± 1%) due to a generation increase in order to provide reserves. Daily average spill was 40% of the total flow. Regionally coordinated via 2020 FOP, Section 4.4.1.

Table 4: April 2020 Average Percent TDG Values Table (4/1 to 4/30)

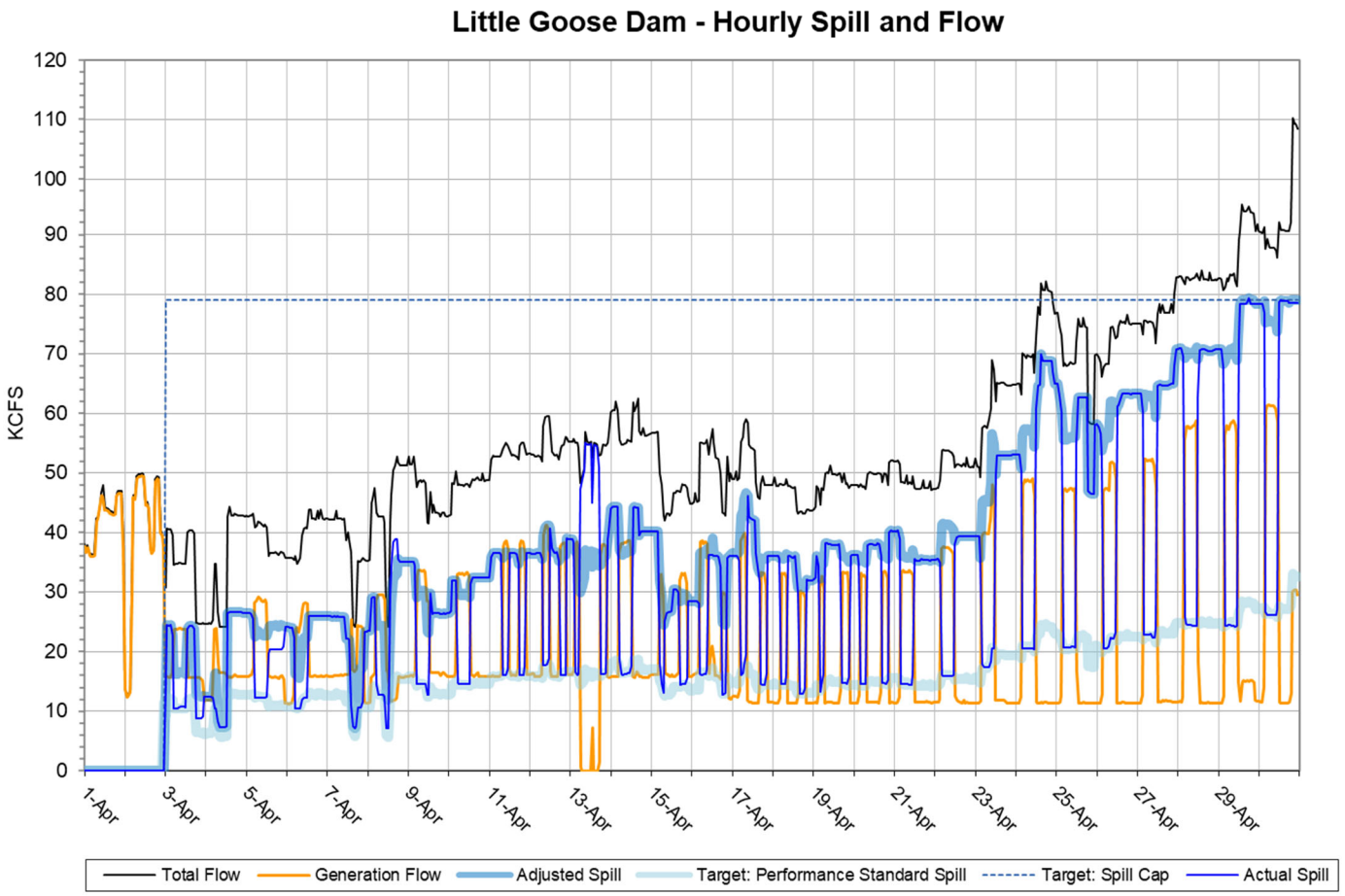
Date	FIXED MONITORING STATIONS															
	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW	JDY	JHAW	TDA	TDDO	BON	CCIW
	Lower Granite FB	Lower Granite TW	Little Goose FB	Little Goose TW	Lower Monumental FB	Lower Monumental TW	Ice Harbor FB	Ice Harbor TW	McNary FB	McNary TW	John Day FB	John Day TW	The Dalles FB	The Dalles TW	Bonneville FB	Bonneville TW
Gas Cap %	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
4/1/2020	100	101	102	101	101	101	101	102	103	104	104	103	104	104	104	112
4/2/2020	100	102	101	100	100	101	101	101	102	105	103	103	103	104	104	112
4/3/2020	100	114	102	116	101	120	102	113	103	102	103	104	104	105	104	112
4/4/2020	101	115	102	117	102	121	102	113	105	106	105	105	104	105	105	115
4/5/2020	101	114	102	115	102	122	103	113	105	107	105	105	105	106	105	116
4/6/2020	101	114	102	115	104	120	106	113	104	105	104	105	104	105	105	116
4/7/2020	101	115	102	114	110	119	112	114	105	106	103	104	104	105	104	115
4/8/2020	101	116	103	116	113	120	115	115	108	107	104	104	104	105	104	116
4/9/2020	102	116	106	115	113	122	117	115	108	109	105	105	105	106	106	116
4/10/2020	102	116	110	117	114	121	118	115	109	117	106	114	105	112	106	116
4/11/2020	102	116	110	118	115	120	118	115	108	116	104	114	108	113	105	116
4/12/2020	101	117	111	118	113	120	117	116	109	116	104	113	110	115	107	116
4/13/2020	100	117	112	121	113	120	116	116	108	115	105	113	112	116	110	117
4/14/2020	100	117	113	119	115	120	116	116	108	116	105	113	112	116	112	117
4/15/2020	100	116	112	116	116	117	116	114	108	116	105	115	110	115	110	117
4/16/2020	101	116	113	117	117	120	116	115	110	115	106	115	113	117	111	117
4/17/2020	103	116	116	118	117	120	117	116	110	116	109	116	115	118	114	119
4/18/2020	103	116	115	117	116	121	116	114	111	115	109	116	113	116	114	118
4/19/2020	102	116	115	118	115	120	116	114	108	115	110	115	110	115	112	117
4/20/2020	103	116	115	118	116	119	116	114	108	116	110	117	113	117	112	117
4/21/2020	103	116	115	118	115	120	116	115	107	116	109	117	112	116	111	118
4/22/2020	103	117	114	118	115	120	116	114	108	115	109	117	112	117	112	118
4/23/2020	103	118	113	121	115	120	116	116	107	116	109	117	113	117	111	120
4/24/2020	103	120	113	123	115	121	115	116	108	117	108	117	114	117	113	120
4/25/2020	103	120	114	122	118	121	117	116	109	116	108	117	116	119	115	120
4/26/2020	103	120	115	124	120	120	118	117	111	116	108	118	117	119	116	119
4/27/2020	103	121	115	123	120	121	118	116	111	116	108	118	116	119	116	120
4/28/2020	103	122	114	124	119	122	116	117	110	118	109	118	117	120	116	120
4/29/2020	104	123	116	125	122	123	119	118	111	119	112	119	117	121	117	121
4/30/2020	104	124	116	125	122	122	120	119	111	119	111	118	115	119	116	120
Exceedances:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 1[15]



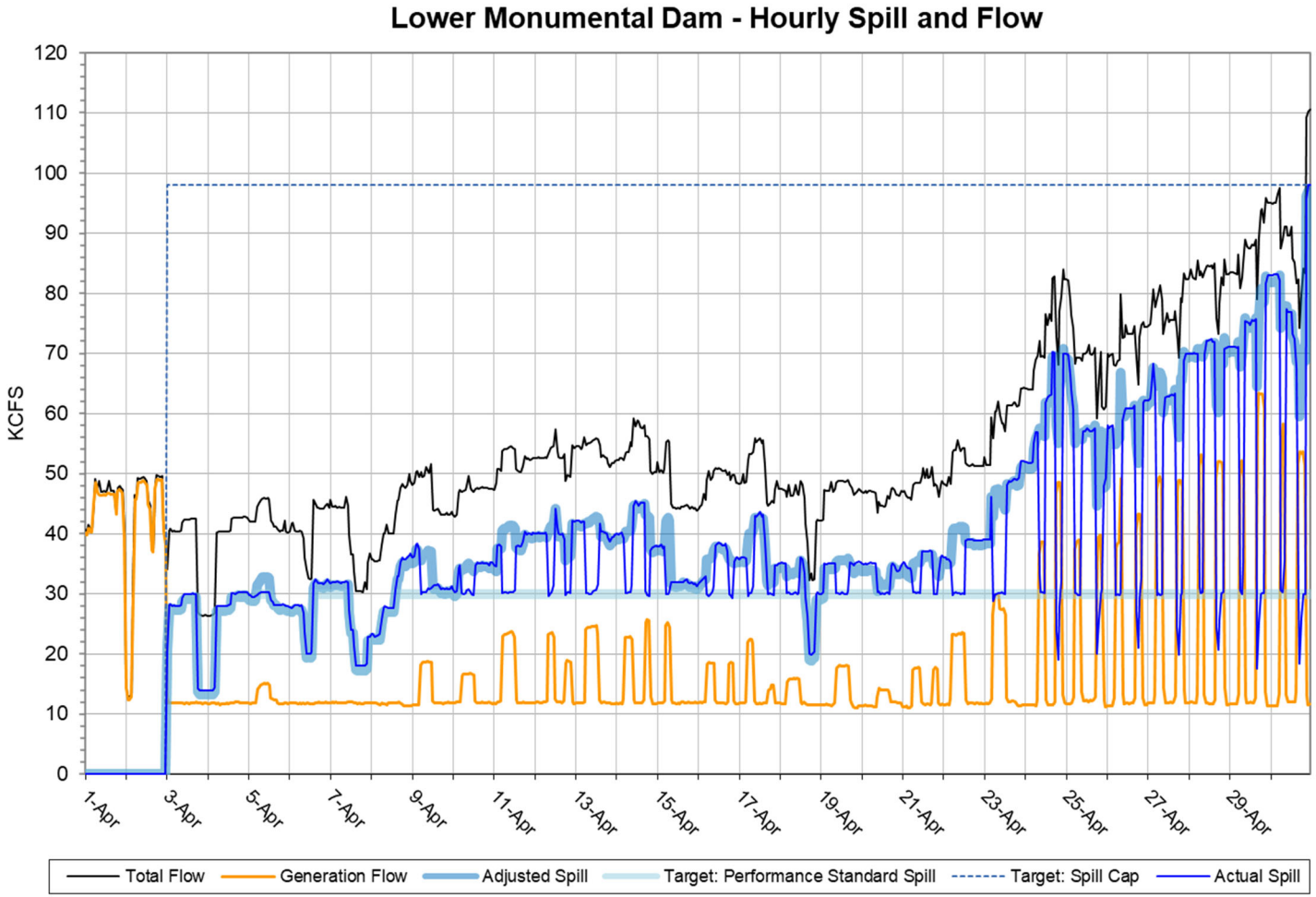
[15] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 2[16]



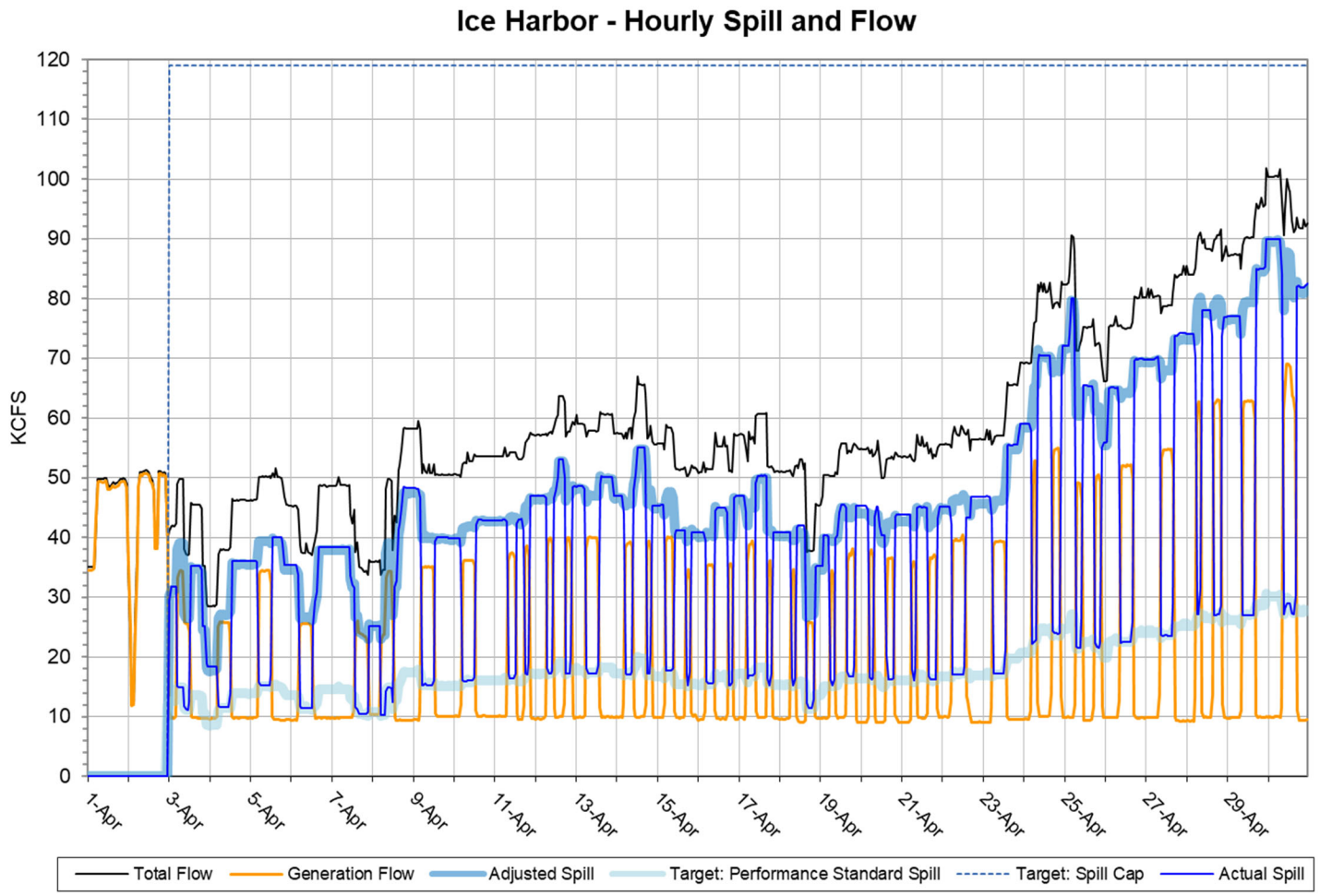
[16] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 3[17]



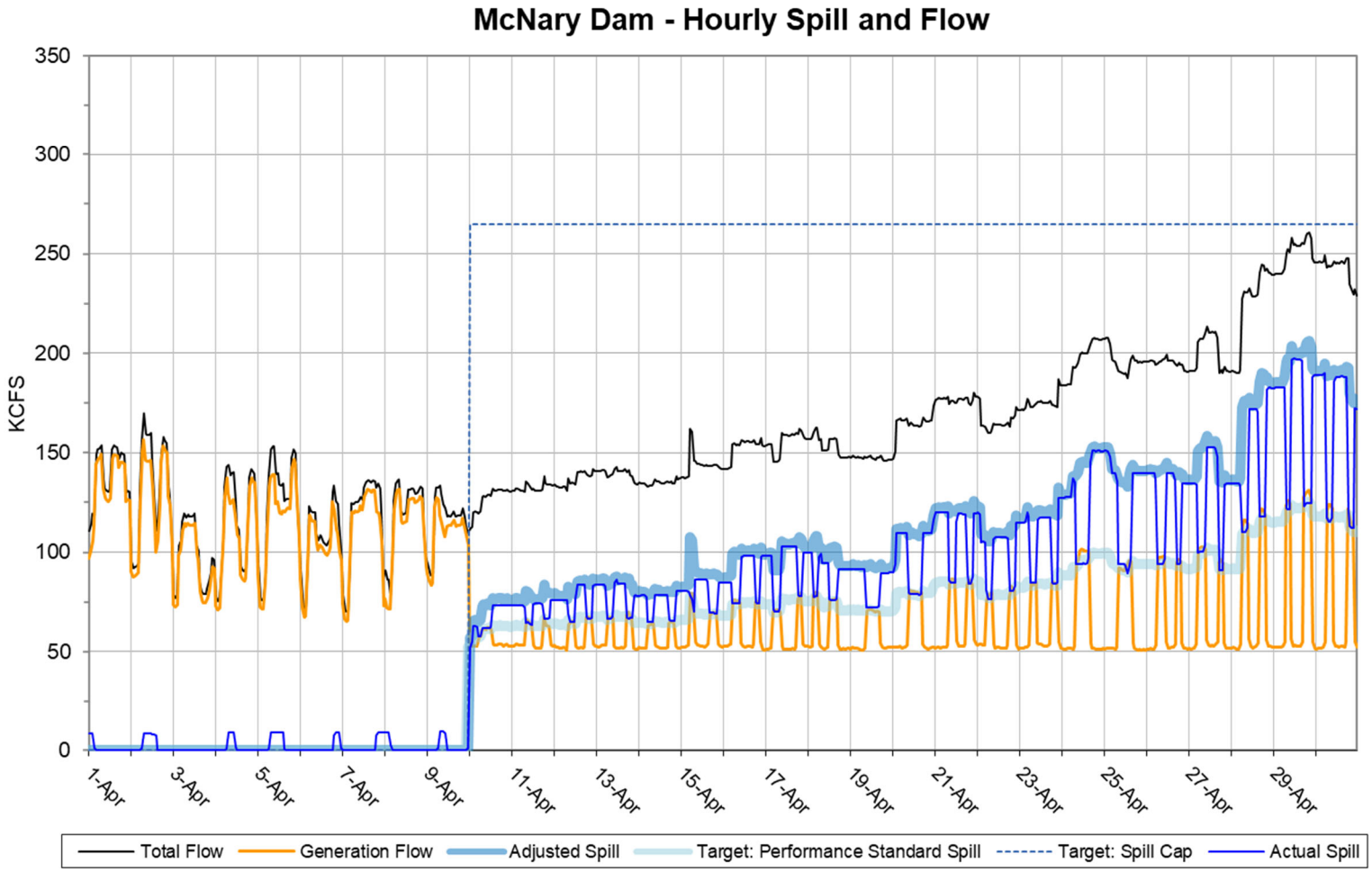
[17] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 4[18]



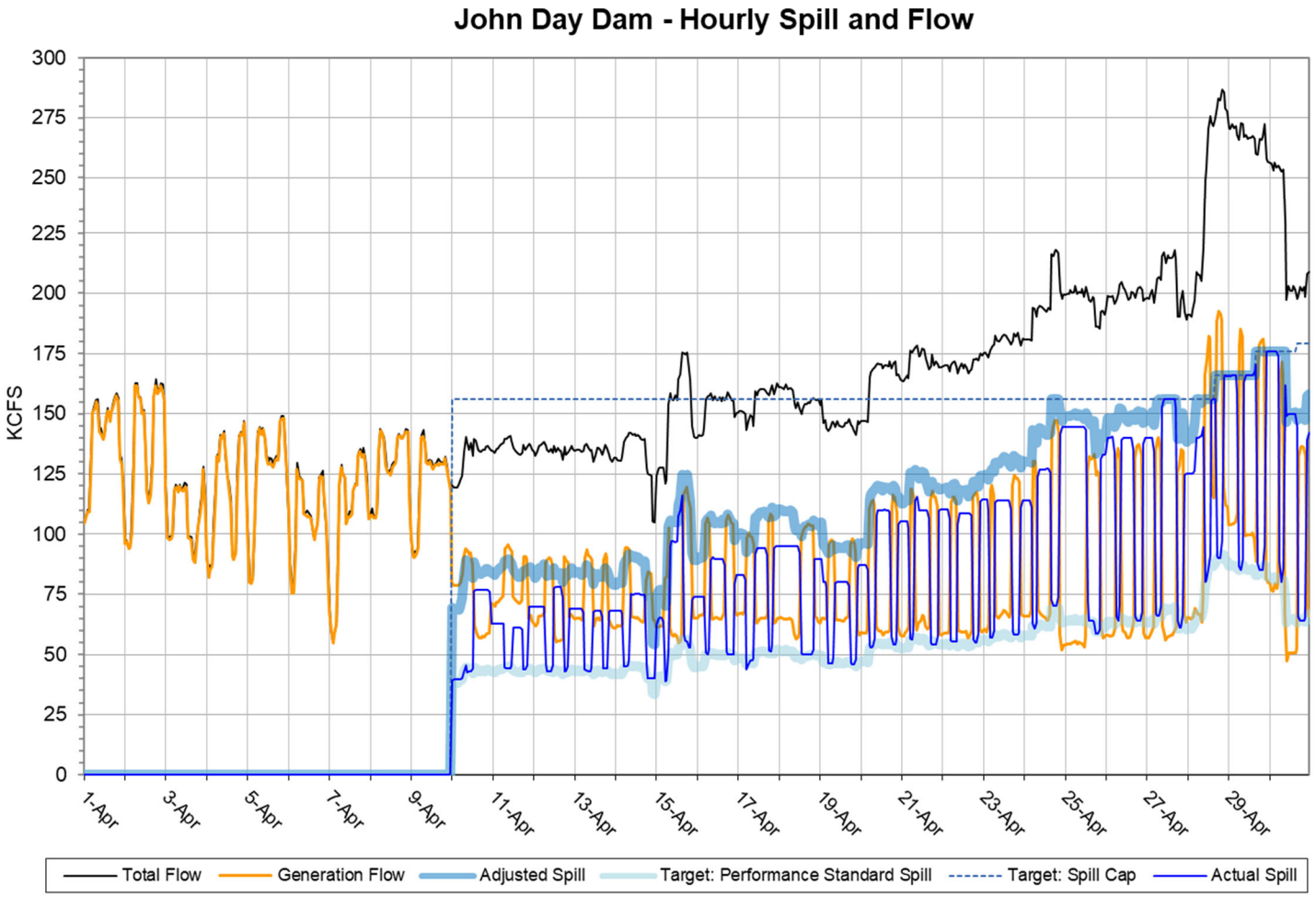
[18] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 5[19]



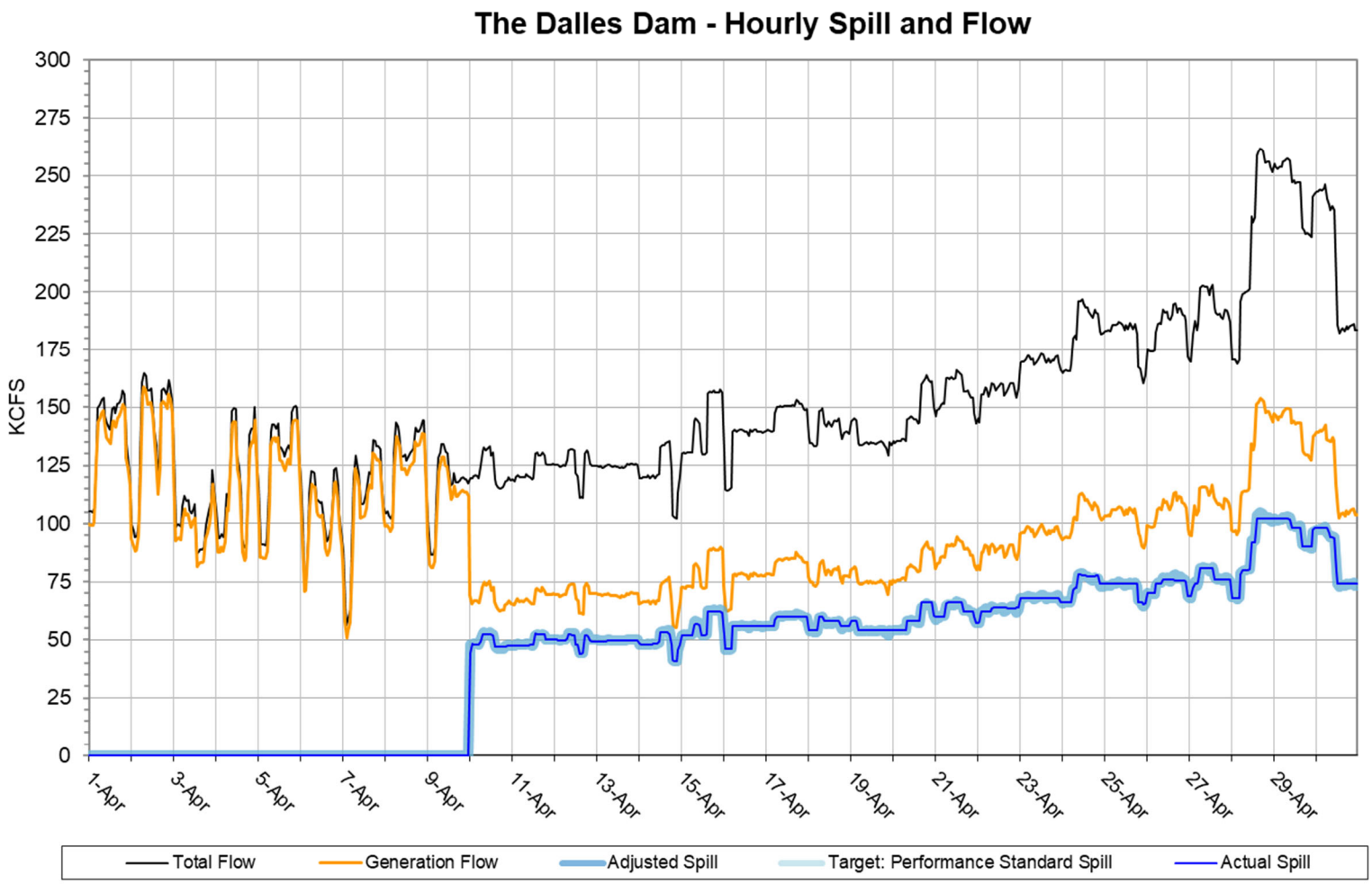
[19] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 6[20]



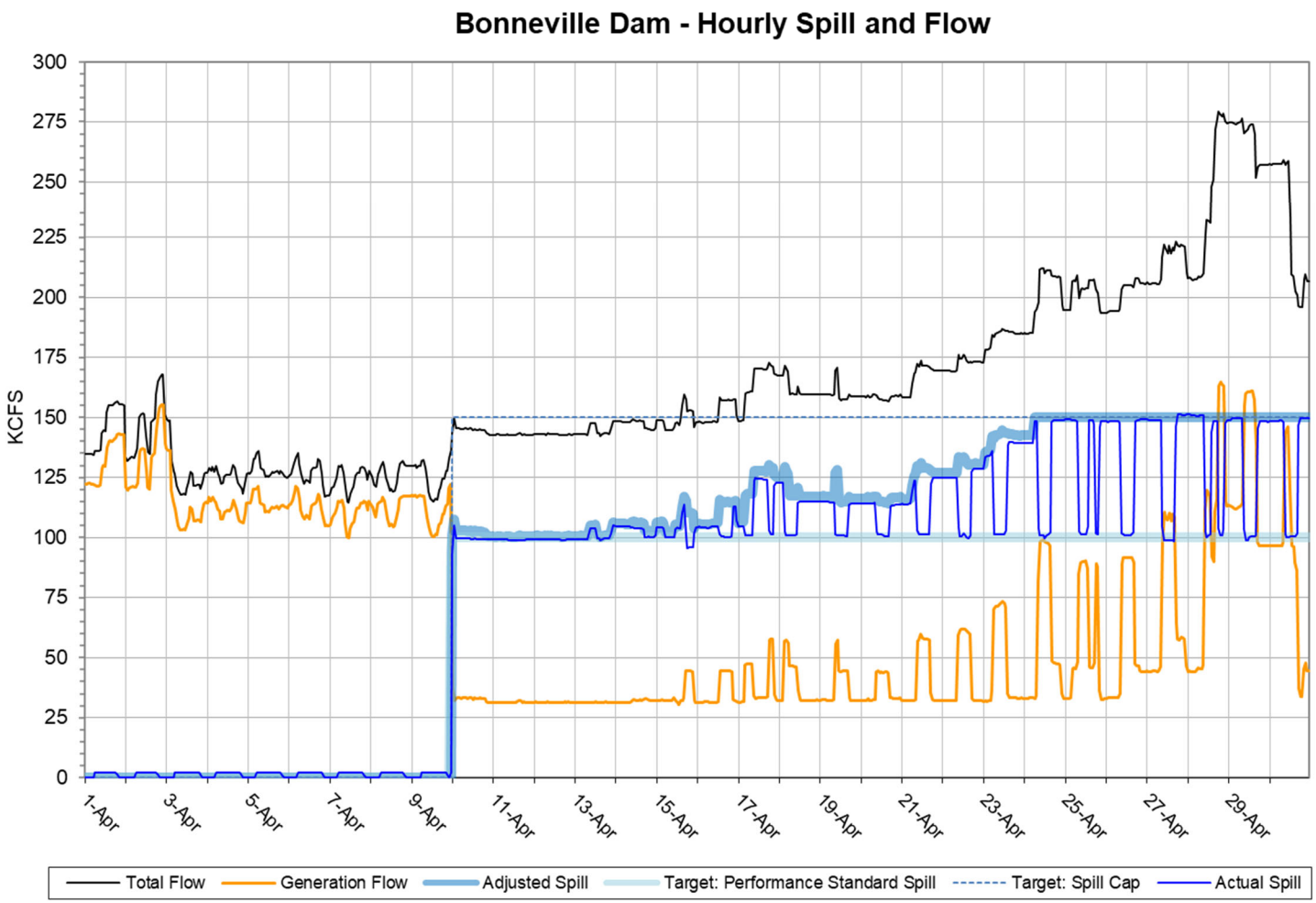
[20] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 7[21]



[21] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.

Figure 8[22]



[22] The adjusted spill line is a simplified representation due to limitations of representing a range of minimum generation values. See Tables 2 and 3 for spill variances and pre-coordinated operations.