FISH OPERATIONS PLAN IMPLEMENTATION REPORT

May 2018

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

Introduction

The U.S. Army Corps of Engineers (Corps) is submitting this report in accordance with the January 8, 2018 Order (Court Order) from the U.S. District Court for the District of Oregon and 2018 Spring Fish Operations Plan[1] (2018 Spring FOP). The 2018 Spring FOP describes the Corps' project operations for fish passage at its Federal Columbia River Power System (FCRPS) dams during the spring fish migration season, generally April 3 through June 20, 2018. To the extent Corps project operations are not specified in the Court Order or the 2018 Spring FOP, the FCRPS operations will be consistent with the 2014 NOAA Fisheries Supplemental Biological Opinion (2014 Supplemental BiOp), the U.S. Fish and Wildlife Service's 2000 and 2006 Biological Opinions, and/or other operative documents, including the 2018 Water Management Plan (WMP), WMP seasonal updates, and the 2018 Fish Passage Plan (FPP).

This report describes the Corps' implementation of the 2018 Spring FOP during the month of May 2018 in accordance with the Court Order. 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, i.e. the spill cap[2];
- 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 2018 Spring FOP, section 4.1);
- actual spill: the hourly flow over the spillway; and,

[1] The 2018 Spring FOP was posted to the Technical Management Team (TMT) website on March 1, 2018 (http://pweb.crohms.org/tmt/documents/fpp/2018/).

[2] The terms "spill caps" and "target spill" are typically synonymous and both mean the maximum spill level at each project that is estimated to meet, but not exceed, the gas cap (the applicable state TDG water quality standard) in the tailrace and the downstream forebay; however, in the event the spill cap is constrained (e.g. 150 kcfs maximum spill for Bonneville Dam or containing fish passage spill within the spillwall (bays 1-8) at The Dalles), the monthly FOP Implementation Reports plots will display this level of spill rather than the gas cap spill level. In these specified instances in which the target spill differs from the spill cap, the Corps will provide the spill cap information at the regularly scheduled TMT meetings and reflected in the monthly FOP Implementation Reports.

- the resultant 12-hour average TDG for the tailwater at each project and for the next project's forebay downstream.[3]

This report also provides information on issues and unanticipated or emergency situations that arose during implementation of the 2018 Spring FOP in May 2018.

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 May, with hourly spill, target spill, generation, and total flows. The monthly graphs begin on May 1 and end on May 31 and reflect the following operations for the lower Snake River and the lower Columbia River projects:

- The dark tan line represents the average hourly total river flow through the project in thousand cubic feet per second (kcfs).
- The dotted blue line represents the average hourly generation flow through the powerhouse each hour in kcfs.
- The dotted pink line represents the actual average hourly spill level through the spillway in kcfs.
- The thin green line represents the hourly target spill, i.e., the spill cap.
- The thick green line represents the 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 (2018 Spring FOP section 4.1).

II. The average daily %TDG for the 12 highest hours for all projects is shown in the May 2018 Average Percent TDG Values Table (Table 3) . The numbers in red indicate the project exceeded the %TDG cap - i.e. 115% (forebay of the next downstream dam) or 120% (tailwater) for each project. For the lower Columbia projects, tailwater TDG values are presented by displaying the highest value %TDG (i.e., controlling limit, labelled "comb" for combined).

General Implementation Remarks

For all projects that spill for fish passage, the actual spill may vary from the target spill due to various conditions as described below. When actual spill levels are below or above the level specified in the 2018 Spring FOP, the dotted pink line will be below or above the thick green line in the figures.[4] When actual spill varied from target spill levels during periods of voluntary

[3] Averages reported are consistent with the current and applicable Oregon TDG standard modification (120% tailwater) and Washington TDG criteria adjustments (120% tailwater/115% forebay). The Oregon TDG standard modification and the Washington TDG criteria adjustments have different methodologies for calculating TDG. When the standards vary or conflict, the Corps applies the more stringent standard. See 2018 Spring FOP section 2.1.

[4] The actual thickness of the adjusted spill level (thick green line) is not representative of the spill cap range; if the actual spill level is slightly outside the adjusted spill level, it should not be construed to indicate a spill variance or involuntary spill.

spill, the change in spill level is described below in the May 2018 Spill Variance Table (Table 1).[5] The Spill Variance Table includes average hourly data. When spill varies from target spill for a portion of an hour, resulting in the average hourly data varying from target spill, it is characterized as a variance for a full hour. There are instances when the hourly target 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 target spill to the extent practicable. Other routine activities that changed spill levels and had been coordinated with regional partners are identified in the monthly Pre-Coordinated Operations Table (Table 2).

"Low flow" operations at the lower Columbia and Snake projects are triggered when inflow is insufficient to provide both minimum generation and the target spill levels. 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 2018 Spring FOP for Bonneville and The Dalles dams,[6] 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).

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

May Operations

The month of May was characterized by well above average flows for the lower Snake and lower Columbia rivers along with above average air temperatures and widely varying precipitation across the Columbia Basin. The May 2018 observed precipitation was 96% of average on the Snake River above Ice Harbor and 78% of average on the Columbia River above The Dalles.[7] The NOAA Northwest River Forecast Center runoff summary for May indicated that the

[5] 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.
[6] As specified in the 2018 Spring FOP section 3.
[7] Retrieved June 4, 2018: https://www.nwrfc.noaa.gov/water_supply/wy_summary/wy_summary.php?tab=5

adjusted runoff for the Snake River at Lower Granite was 149% of the 30-year average (1981-2010) with a volume of 10.3 MAF (Million acre-feet).[8] The May 2018 adjusted runoff for the Columbia River at The Dalles was 176% of the 30-year average (1981-2010) with a volume of 44.6 MAF.

During the May 2018 reporting period, the planned 2018 Spring FOP spill operations were carried out as follows:

- Lower Granite Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- Little Goose Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- Lower Monumental Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- Ice Harbor Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- McNary – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- John Day Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- The Dalles Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.
- Bonneville Dam – May 1 – May 31: spill cap[2] to achieve the 120%/115% Gas Cap.

The 2018 spring fish passage spill operation at the Corps' eight lower Snake and lower Columbia River projects is a more complex operation to implement than the past years' operations. In its implementation of the 2018 Spring FOP in May, the Corps evaluated conditions every day to establish spill caps at a level that was estimated to meet, but not exceed, the gas cap in the tailrace and the next downstream forebay (see Table 3).[9] 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). For the month of May 2018, conditions constraining the spill cap at Bonneville and The Dalles dams did not occur.[2]

Operational Adjustments

1. Lower Granite

On Wednesday, May 2, from 0930-1430 hours, all six units at Lower Granite Dam were out of service due to a transmission line outage for emergency equipment repairs. During the outage, the Corps operated to prevent excessive TDG in the Lower Granite tailrace by maintaining spill in the range of 50–58 kcfs (approximately 120% TDG) and storing the remainder of inflow in the forebay above the Lower Granite variable MOP range of 734–735 feet[10] up to a maximum of 736.5 feet at 1600 hours (below the maximum elevation of 737.7 feet at the Lewiston gauge for flood risk management). After the powerhouse returned to service at 1430 hours, the Corps resumed spilling at the daily spill cap level to meet but not exceed the gas cap (34 kcfs through 1600, then changed to 35 kcfs) and drafted the pool back to the MOP+1 range by 0500 hours the next morning. The emergency equipment repair was in response to a failed disconnect at a

[8] Retrieved June 4, 2018: https://www.nwrfc.noaa.gov/runoff/runoff_summary.php?date=06/04/2018
[9] See 2018 Spring FOP section 2.2 and attachment "Procedure for Setting 2018 Spring Spill Caps."
[10] The Lower Granite variable MOP operation began on April 3, 2018, as coordinated with TMT on March 7, 2018. Under the observed inflows in May, the variable MOP operation was MOP+1 or 734-735 feet.

transmission line switchyard. There will be a second outage of similar duration in June to complete the repairs. The Corps and BPA coordinated this operation with the TMT sovereign representatives on Monday, April 30, and all TMT representatives either supported or did not object.

2. Little Goose

From May 30 through June 2,[11] the Corps reduced the level of involuntary spill at Little Goose Dam to 30% of total outflow from 0400–1200 hours each day to reduce upstream passage delay of adult spring Chinook salmon. To accomplish this, inflow above approximately 128 kcfs (powerhouse capacity and 30% spill) during those hours was stored in the Little Goose forebay above the MOP 1-foot range of 633–634 feet. After the daily operation ended at 1200 hours, spill was increased to pass inflow from 1200–1600 hours, then increased further between the hours of 1600 and 0400 as necessary to draft back to MOP. Over the four days of this operation, spill ranged from 38–80 kcfs, which was above the daily spill cap level of 26 kcfs set by the Corps to meet but not exceed the gas cap, and the forebay reached a maximum elevation of 634.8 feet (average 633.9 feet).

Prior to implementing this operation, and in accordance with the 2018 Spring FOP Section II., paragraph 4, the Action Agencies coordinated with TMT sovereign representatives at meetings on May 23, 25, and 29, to review adult PIT-tag monitoring tools that indicated a delay in adult fish migration below Little Goose. From May 24–29, daily counts of adult spring Chinook at Little Goose were in the range of 368–677 per day, and the total count differential between Lower Monumental and Little Goose had increased to 8,752. At the meeting on May 29, all TMT representatives either supported or did not object to implementing the operation from May 30 through June 1. Daily counts of adult spring Chinook passing Little Goose Dam increased to 2,689 on May 30, 2,892 on May 31, and 2,309 on June 1, and the count differential between Lower Monumental and Little Goose decreased to 5,015. The TMT reconvened on June 1 and all TMT members either supported or did not object to extending the operation through June 2. The count of adult fish passing Little Goose Dam on June 2 was 1,531 and the count differential decreased to 4,237. Starting on June 3, flows in the Snake River decreased and the Action Agencies resumed fish passage spill to the gas cap per the 2018 Spring FOP.

3. The Dalles

On May 31 at 1545 hours, all spillbays at The Dalles Dam were closed for approximately 25 minutes due to an emergency rescue of a boat with two passengers that was caught in the spillway forebay near spillbays 3 and 4. During the emergency spillway closure, all flow was diverted through the powerhouse and the forebay filled approximately 1.4 feet to an elevation of 160.1 feet, which is 0.1 feet above the operating range maximum. To prevent the forebay from filling higher, most turbines were operated above the 1% range for approximately 10 minutes. The Dalles resumed spill operations at 1610 hours except that spillbays 3 and 4 remained closed

[11] Operations in June are outside the scope of the May FOP Implementation Report and are not shown in the tables or figures. However, since the operation did not result in a spill variance, the operation in its entirety is included here to provide a comprehensive discussion. This operation will also be in the June FOP Implementation Report in the Operational Adjustments section and in the tables and figures for operations on June 1 and June 2.

through 1635 hours for inspection. After spillbays 3 and 4 were returned to service, spill was increased to lower the forebay elevation back into the normal operating range. The project resumed normal operations about 1 hour after taking emergency action for the rescue. Due to involuntary spill conditions, hourly average spill remained above the daily spill cap of 90 kcfs (176.8 kcfs from 1500-1600 hours and 187.4 kcfs from 1600-1700 hours) during this emergency operation.

The Corps notified regional salmon managers of this incident via a Memorandum for the Record (MFR) emailed to FPOM on June 1 and at the TMT meeting on June 1.

Table 1: Spill Variance Table – May 2018 (5/1 to 5/31)

Project	Parameter	Date	Time[12]	Hours	Type	Reason
Lower Monumental	Reduced Spill	5/2/18	1400-1500	2	Operational Limitation	Hourly average spill was 0.2 kcfs below target spill due to operating Unit 2 for minimum generation at 12.7 kcfs, which is above the minimum generation upper limit of 12.3 kcfs defined in the 2018 Spring FOP Table 1 and above the allowable precision of ±2% (12.5 kcfs). However, the range in the 2018 Spring FOP was estimated prior to index testing of Unit 2 with fixed blades. Based on test results, the updated Unit 2 minimum generation range is 11.8–13.9 kcfs; therefore, this operation falls within the bounds of the updated range and would not be considered a variance. The updated range was communicated to FPOM on May 16, 2018, and is included in the 2018 Summer FOP.
Lower Granite	Additional Spill	5/2/18	1000-1500	6	Maintenance	Hourly average spill was 20-24 kcfs above target spill due to a powerhouse outage for emergency transmission line repairs. A second outage will be required in June. Regionally coordinated via TMT on April 30, 2018.

Table 2: Pre-Coordinated Operations – May 2018 (5/1 to 5/31)

Project	Parameter	Date	Time[12]	Hours	Type	Reason
Lower Monumental	Reduced Spill	5/1/18 5/2/18 5/3/18 5/4/18 5/5/18 5/13/18	1900, 2100 1900 1700 1800-1900 1800-1900 1700-1800	2 1 1 2 2 2	Navigation	Hourly spill reduced below target spill for safe navigation. Regionally coordinated via 2018 Spring FOP, Sections 4.1 and 4.6.

[12] Spill variances and pre-coordinated operations are reported using hourly average data. If hourly average spill varies from the target, it is reported as one hour even if it occurred for less than one hour.

Table 3: May 2018 Average Percent TDG Values (5/1 to 5/31)

Date	FIXED MONITORING STATIONS															
	LWG	LGNW	LGSA	LGSW	LMNA	LMNW	IHRA	IDSW	MCNA	MCPW[a]	JDY	JHAW	TDA	TDDO[b]	BON	CCIW[c]
	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 %:	115	120	115	120	115	120	115	120	115	120	115	120	115	120	115	120
Method:	WA	WA	WA	WA	WA	WA	WA	WA	WA	Comb	WA	Comb	WA	Comb	WA	Comb
5/1/2018	104	115	111	117	117	119	116	119	114	119	109	120	112	118	116	123
5/2/2018	105	117	111	115	116	117	116	118	115	119	111	120	115	123	118	123
5/3/2018	105	117	112	115	117	117	117	118	115	119	113	119	115	123	122	124
5/4/2018	105	116	114	116	115	116	117	118	116	119	114	118	115	118	121	124
5/5/2018	105	116	115	116	116	115	117	118	117	120	117	121	118	120	119	123
5/6/2018	105	116	116	116	117	119	116	118	117	121	117	121	118	122	120	123
5/7/2018	104	117	116	121	117	124	116	121	117	122	116	124	119	123	120	123
5/8/2018	105	116	114	120	121	123	121	121	118	124	119	127	121	124	124	124
5/9/2018	106	117	113	121	121	124	121	121	118	124	119	127	122	124	124	124
5/10/2018	106	121	111	124	119	126	119	124	117	124	119	126	120	122	122	124
5/11/2018	105	121	111	124	123	127	120	125	117	127	117	128	121	122	121	126
5/12/2018	106	119	116	122	124	121	122	122	119	130	118	132	126	126	124	128
5/13/2018	107	117	116	118	124	118	122	120	122	131	125	132	128	127	128	128
5/14/2018	107	115	116	117	122	119	121	119	124	132	129	132	128	127	128	•
5/15/2018	106	115	115	118	120	119	121	120	126	134	131	132	130	127	128	•
5/16/2018	106	115	114	118	118	120	119	121	126	134	130	133	129	127	124	•
5/17/2018	105	117	113	119	117	121	117	122	123	133	128	133	125	124	121	•
5/18/2018	104	118	111	120	121	121	118	122	123	130	122	133	128	125	123	•
5/19/2018	105	118	113	126	122	121	120	123	124	130	125	133	129	126	127	•
5/20/2018	106	118	114	122	127	121	120	122	124	130	127	134	129	126	126	•
5/21/2018	106	118	114	121	125	121	121	122	123	130	126	134	129	125	124	•
5/22/2018	106	118	114	121	122	122	121	122	123	131	127	133	131	126	128	•
5/23/2018	107	120	115	123	123	•	121	124	125	133	129	132	131	127	129	•
5/24/2018	107	119	114	123	123	121	120	124	125	132	129	132	129	126	126	•
5/25/2018	106	124	116	124	123	122	120	125	124	131	127	132	127	126	125	•
5/26/2018	107	126	116	126	124	122	120	126	123	131	123	129	123	123	123	•
5/27/2018	106	126	118	127	128	121	122	130	119	132	119	129	122	122	120	•
5/28/2018	107	123	120	124	129	121	123	125	121	132	119	127	122	122	120	•
5/29/2018	107	122	120	126	126	122	123	124	120	129	119	127	117	120	119	•
5/30/2018	107	121	117	125	127	122	122	124	120	129	119	128	123	123	120	•
5/31/2018	107	119	116	125	126	122	121	126	120	129	119	126	123	123	121	•

• Red shaded cells indicate no data due to malfunctioning gauge.

[a] The McNary tailwater gauge (MCPW) began reporting data with an 11-hour offset between the USGS and Corps databases on May 23. All data appear to be reporting correctly. The Corps and USGS are investigating options to resolve the issue.

[b] The Dalles tailwater gauge (TDDO) became stuck in the deployment pipe at 5 feet below the water surface during routine maintenance on May 15. All data appear to be reporting correctly. The Corps and USGS are investigating options to resolve the issue.

[c] The Bonneville tailwater gauge at Cascades Island (CCIW) was damaged by debris on May 13. Until the gauge is repaired, the Corps is setting Bonneville spill caps using SYSTDG and/or an analog using the gauge at Warrendale. The Corps and USGS are investigating options to resolve the issue.

Figure 1

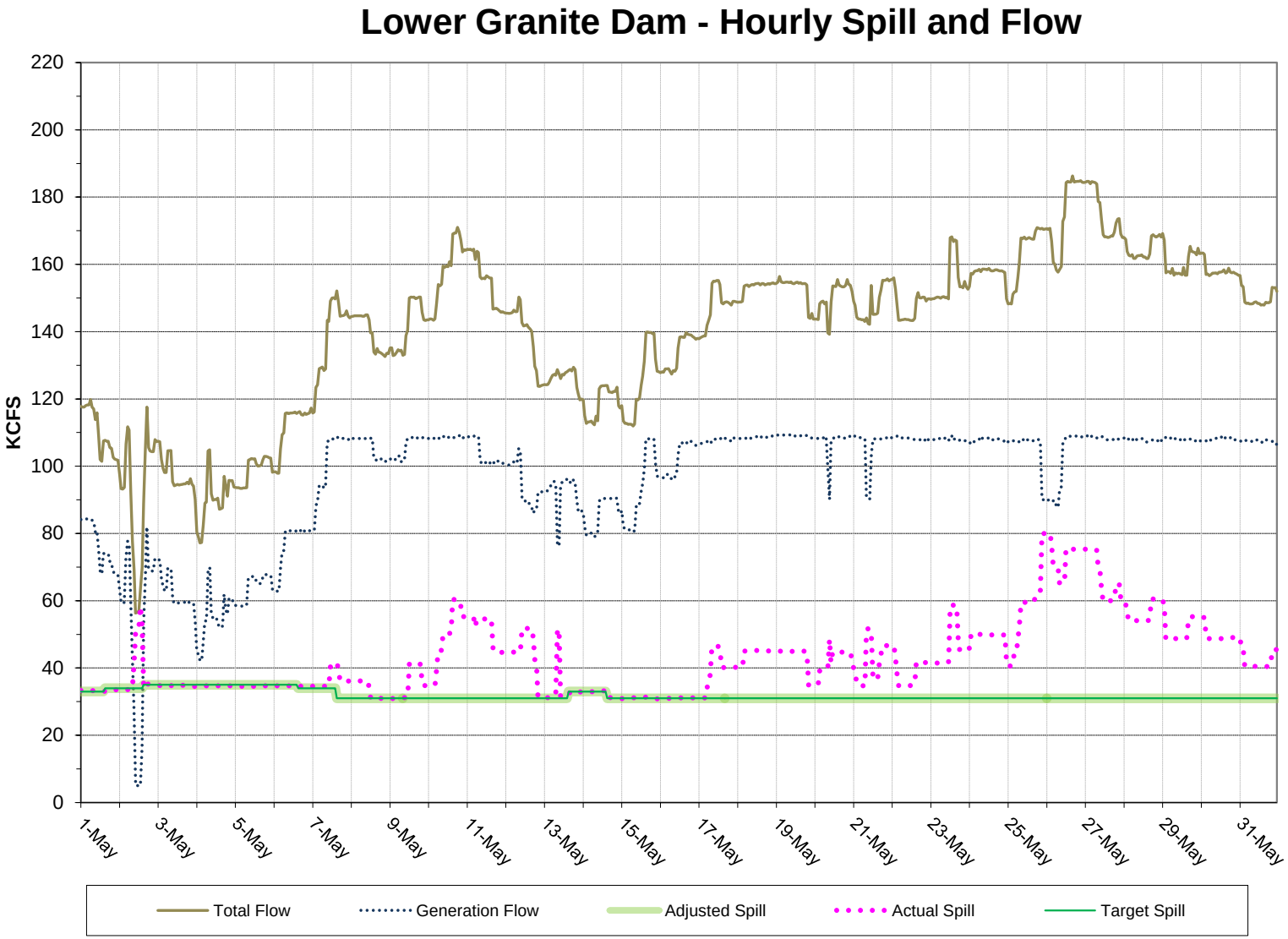

Lower Granite Dam - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill

Figure 2

Little Goose Dam - Hourly Spill and Flow

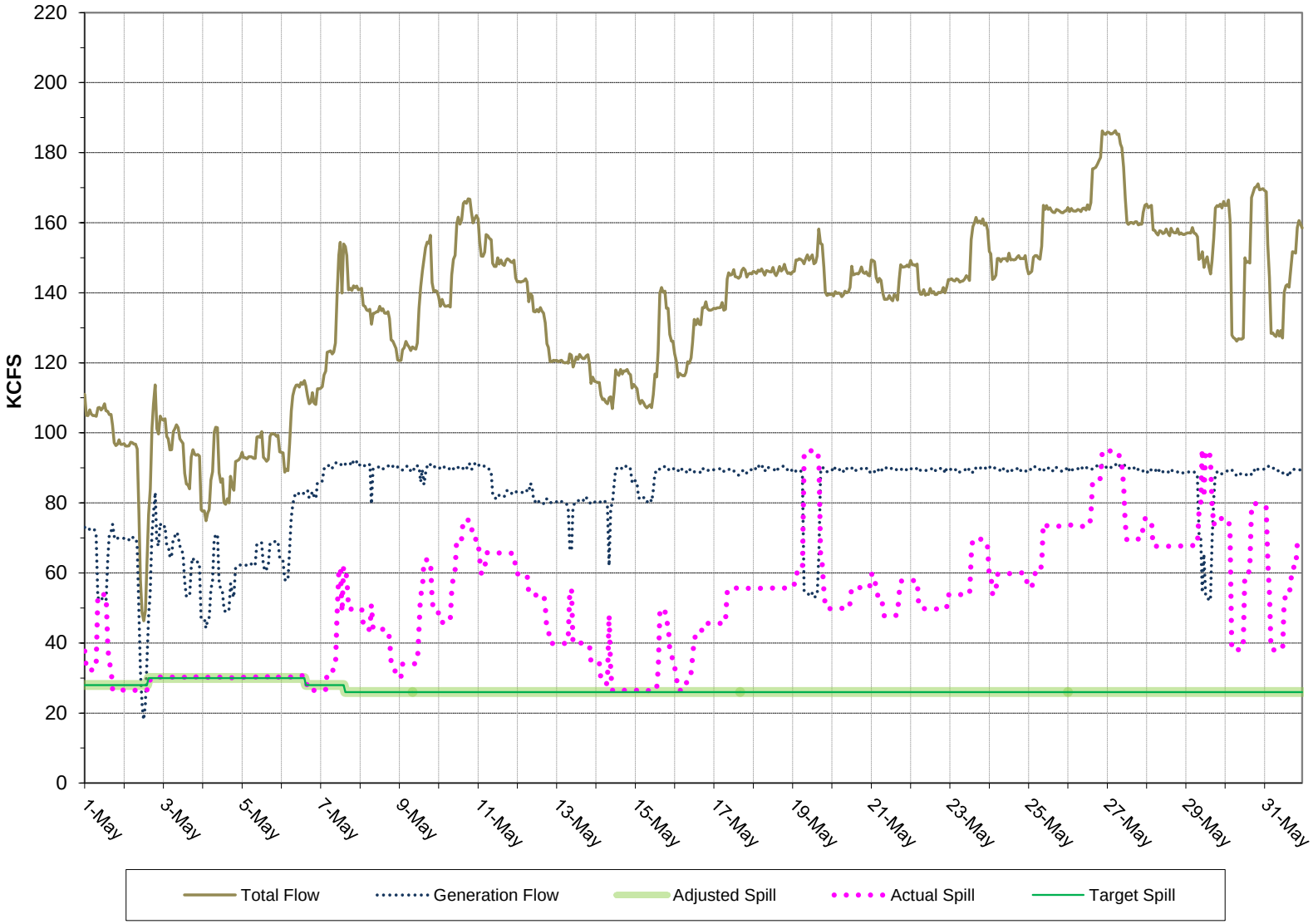


Figure 3

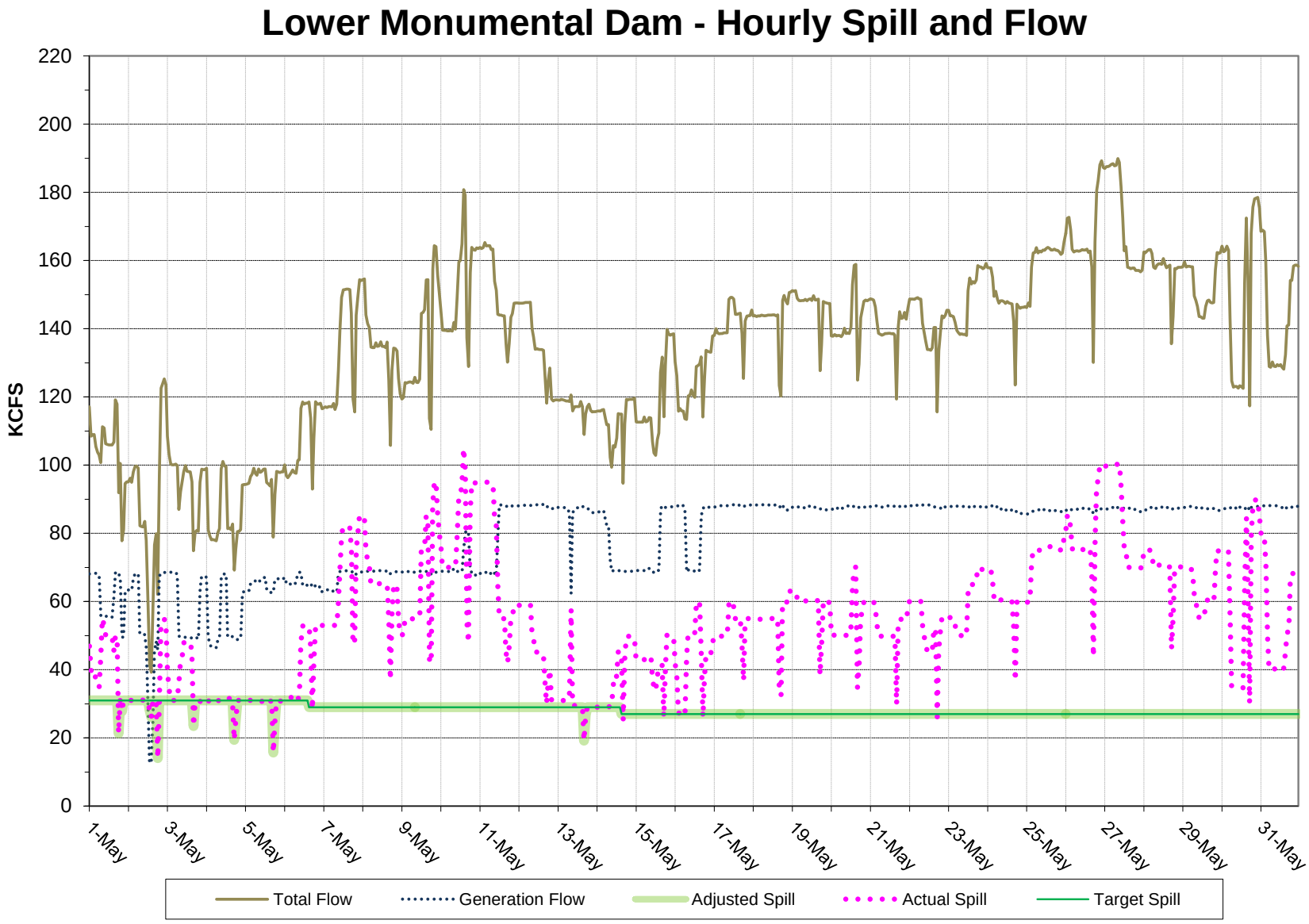

Lower Monumental Dam - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill

Figure 4

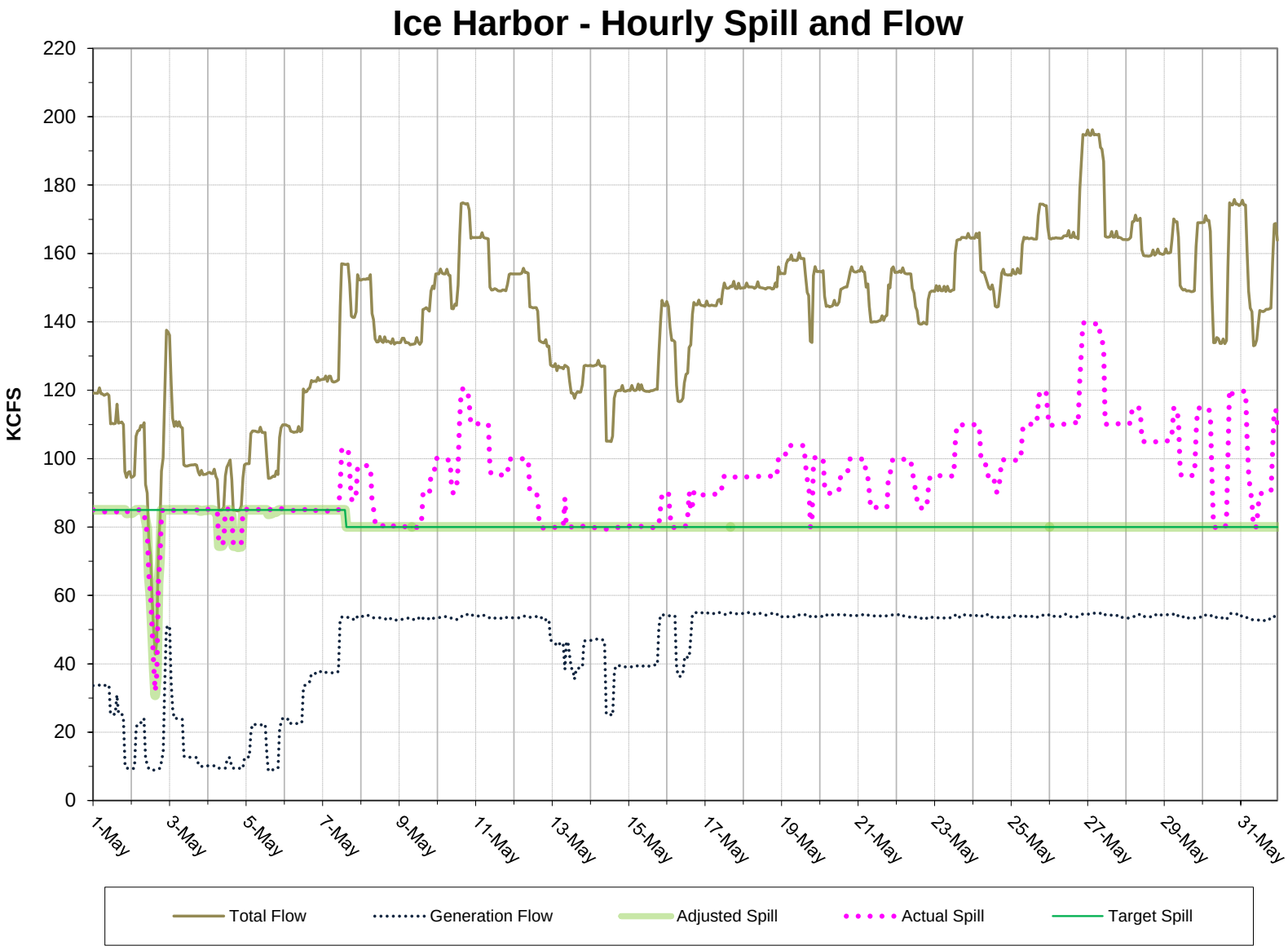

Ice Harbor - Hourly Spill and Flow
KCFS
220
200
180
160
140
120
100
80
60
40
20
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill

Figure 5

McNary Dam - Hourly Spill and Flow

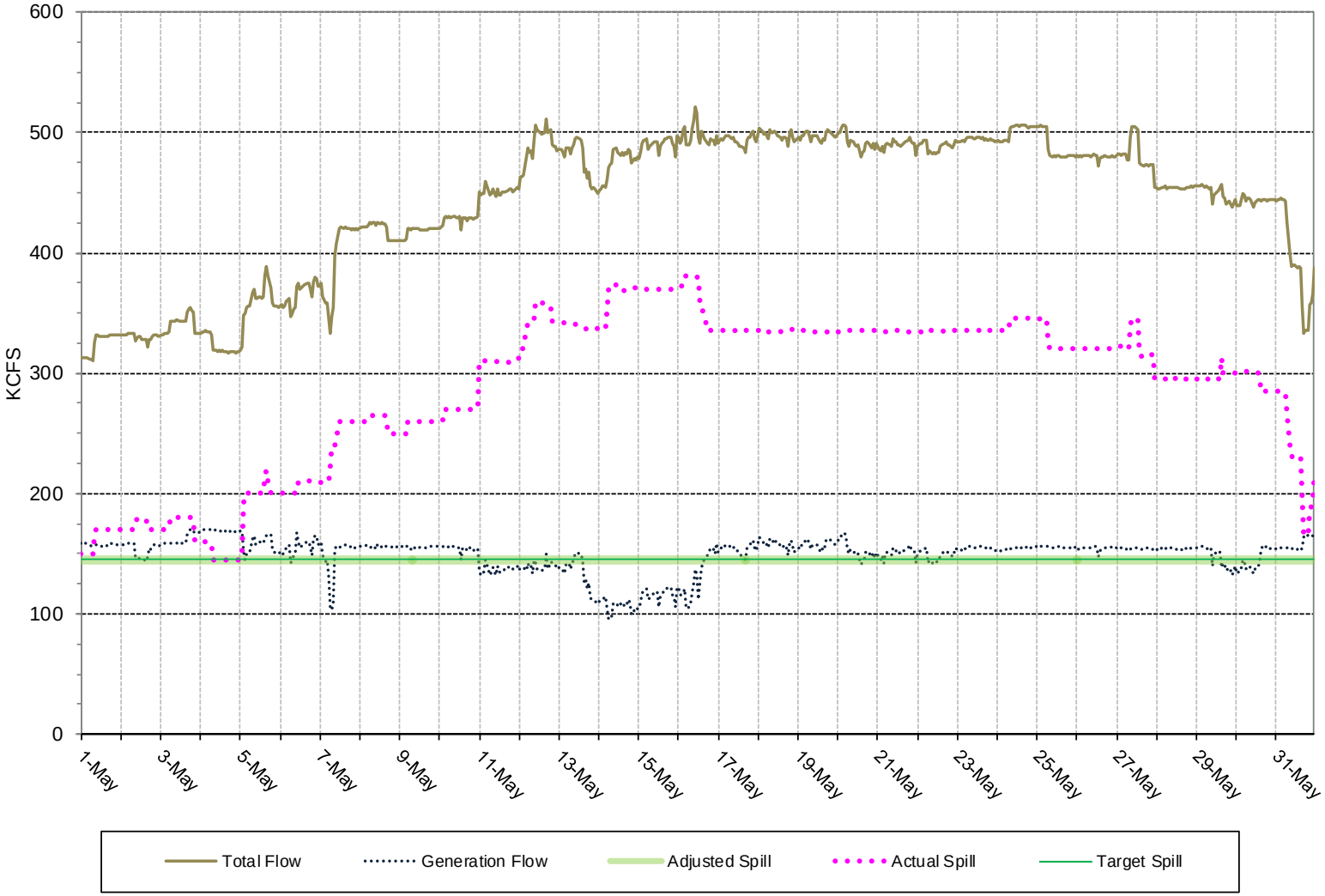


Figure 6

John Day Dam - Hourly Spill and Flow

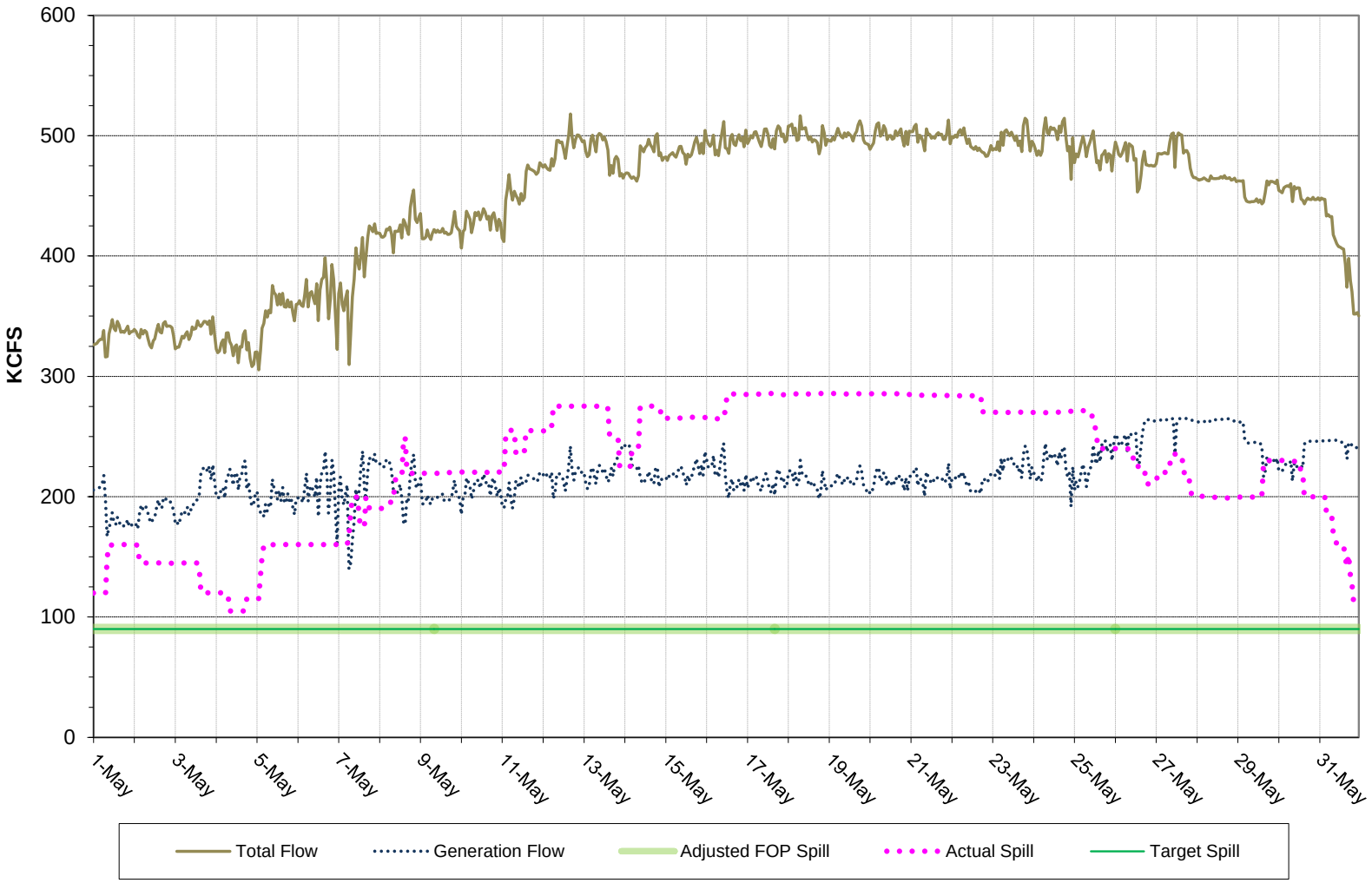


Figure 7

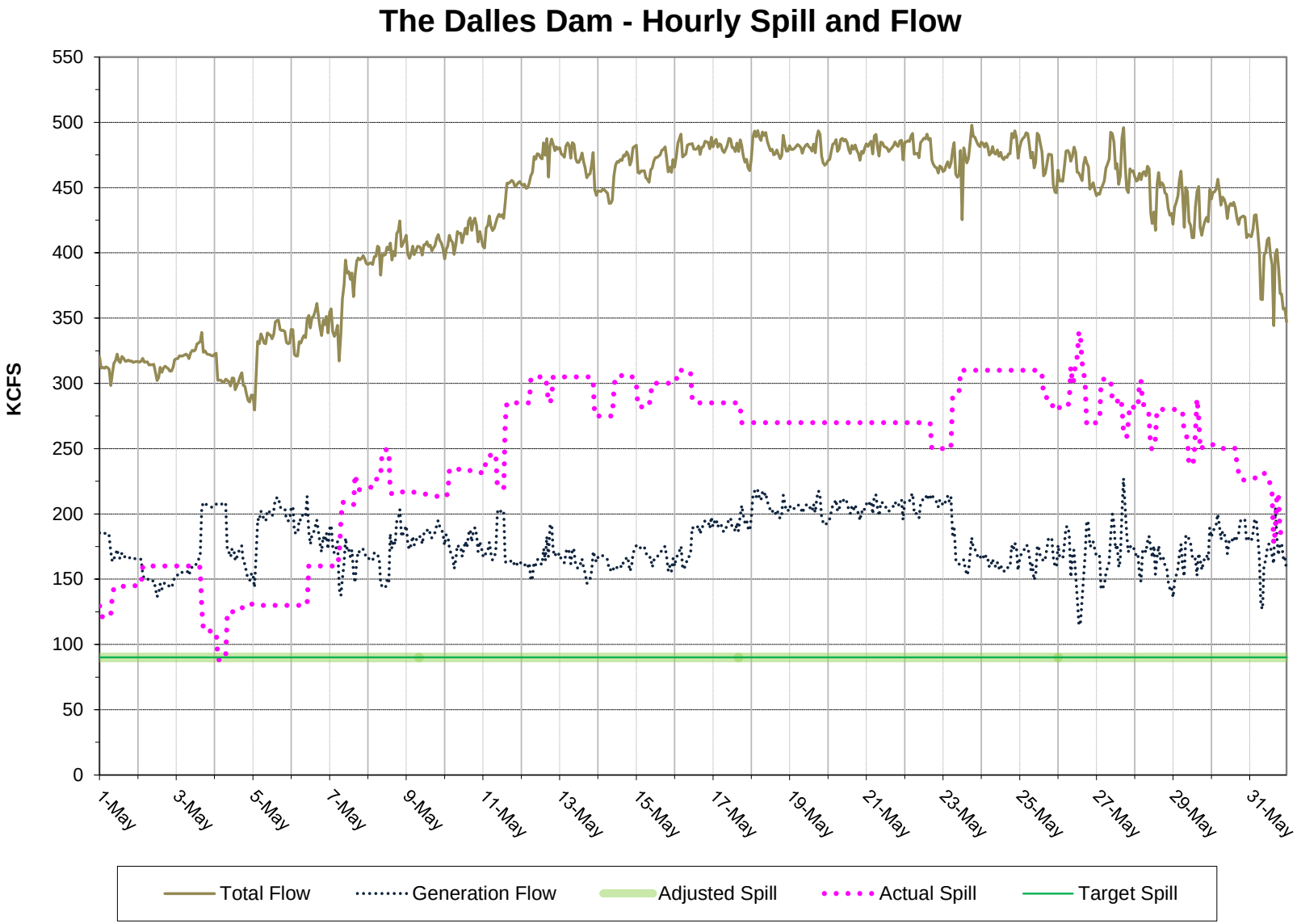
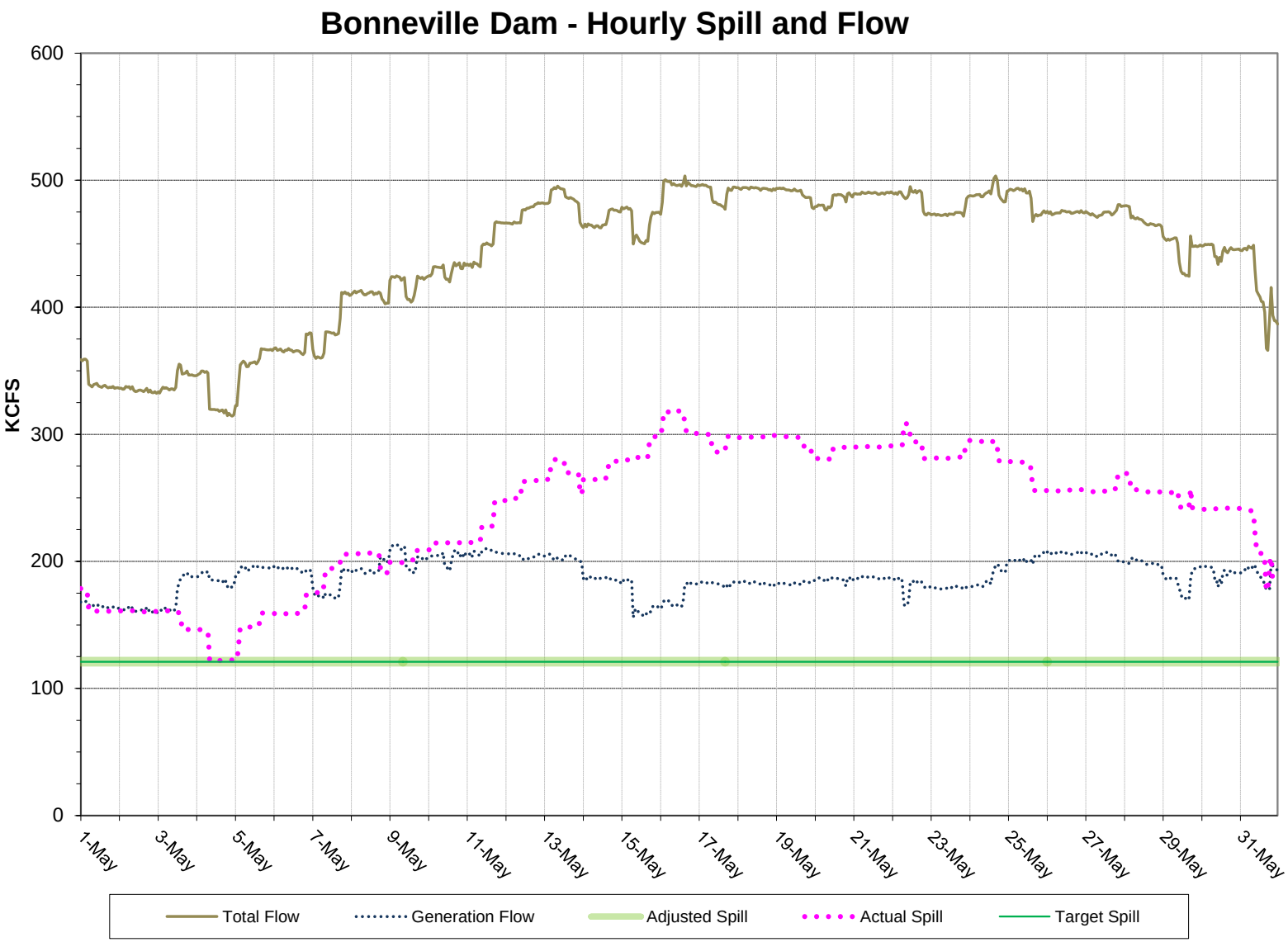

The Dalles Dam - Hourly Spill and Flow
KCFS
550
500
450
400
350
300
250
200
150
100
50
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill

Figure 8


Bonneville Dam - Hourly Spill and Flow
KCFS
600
500
400
300
200
100
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted Spill
Actual Spill
Target Spill