FISH OPERATIONS PLAN IMPLEMENTATION REPORT

May 2016

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 2016 Fish Operations Plan (2016 FOP) posted to the TMT website on February 29, 2016. The 2016 FOP describes the Corps' project operations for fish passage at its Federal Columbia River Power System (FCRPS) dams during the spring and summer fish migration season, generally April through August. To the extent Corps project operations are not specified in the 2016 FOP, the FCRPS operations will be consistent with the 2014 NOAA Fisheries Supplemental Biological Opinion (2014 Supplemental BiOp), the USFWS 2000 and 2006 BiOps, and/or other operative documents, including the 2016 Water Management Plan (WMP), WMP seasonal updates, and the 2016 Fish Passage Plan (FPP).

The Corps' May 2016 lower Snake and Columbia River project and fish passage operations are contained in this report. In particular, information in this report includes the following:

- Hourly flow through the powerhouse at each dam;
- Hourly flow over the spillway compared to the spill target for that hour; and
- Daily average Total Dissolved Gas (TDG) levels (percent of saturation) in the tailwater at each project, and in the subsequent downstream project's forebay.[1]

This report also provides information on presented issues and unanticipated or emergency situations that arose during implementation of the 2016 FOP in May 2016.

Data Reporting

I. For each project providing fish passage operations, this report contains one graph per operational month (May) displaying the performance of the fish passage spill program, with hourly spill, FOP spill, generation, and total flows. The monthly graphs begin on May 1 and end on May 31 for the following lower Snake River and lower Columbia River projects: Lower Granite, Little Goose, Lower Monumental, Ice Harbor, McNary, John Day, The Dalles, and Bonneville.

[1] 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.

Operations represented on the monthly graphs start at 0100 hours on May 1 for the lower Snake River and the lower Columbia River projects as follows:

- 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 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 FOP spill level as defined in the 2016 FOP.
- The thick green line represents the adjusted FOP spill. This is the hourly maximum 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 the following conditions:

    - spill percentage or flow rate specified in the 2016 FOP;
    - spill caps as set daily for TDG management;
    - test spill levels for fish passage research;
    - minimum generation for power system needs;
    - minimum spill at Bonneville (50 kcfs) dam; and
    - minimum spill at John Day is 25 percent of project outflow.

II. The average daily %TDG for the 12 highest hours for all projects is found at the end of the report (see 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 (controlling limit), and the lower value is displayed with a strikethrough.

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 spill levels briefly deviate below or above the level specified in the 2016 FOP, the dotted pink line will be below or above the heavy green line in the figures.[2] Actual deviations from the target operation during voluntary spill hours are described below in the May 2016 Spill Variance Table (Table 1).[3] The Spill Variance Table includes average hourly data; therefore, while spill may vary from target FOP spill for only a portion of an hour, the Spill Variance Table characterizes the variance as a full hour. There are instances when the hourly FOP spill levels are not achievable due to mechanical limitations in setting spill gates

[2] The actual thickness of the heavy green line (Adjusted FOP Spill) is not intended to represent the full allowable tolerance; and if the dotted pink line is slightly outside it should not be construed to indicate a spill variance or involuntary spill.

[3] Involuntary spill conditions appearing in the graphs, but 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, and passing debris.

to implement the regionally coordinated spill pattern. The project operator sets the spill gate stops to most closely approximate the 2016 FOP level of spill while also avoiding exceeding the %TDG spill cap to the extent practicable.

"Low flow" operations at the lower Columbia and Snake projects are triggered when inflow is insufficient to provide both minimum generation and the specified 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. During low flow periods at Little Goose Dam, the overall project spill percentage appears to be reduced because the calculations do not account for the volume of water released during navigational lockages; however, the actual spill volume remains constant. When this occurs, it is recorded in the monthly Pre-Coordinated Operations Table (Table 2)[4] denoted as "Navigation" type.

Actual spill levels at Corps projects with set flow targets may vary up to ±2 kcfs within the hour (except as otherwise noted in the 2016 FOP for Bonneville and The Dalles dams[5], which may range up to ±3 kcfs) as compared to those specified in the 2016 FOP and the RCC spill priority list (defining the project %TDG spill caps). 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).

The 2016 FOP describes project "Operations during Rapid Load Changes" (p. 6). For reporting purposes, when hourly spill levels were not met as a result of load swing hours and other related within-hour load variability issues, the notation "Transmission Stability" will be used in the Spill Variance Table. "Transmission Stability" occurs because projects must be available to respond to within-hour load variability to satisfy North American Electric Reliability Corporation (NERC) reserve requirements ("on response") or other NERC mandatory reliability regulatory requirements. In addition to within-hour load variability, projects on response must be responsive to within hour changes resulting from intermittent generation (such as wind generation). During periods of rapidly changing loads and intermittent generation, projects on response may have significant changes in turbine discharge within the hour while spill quantity remains the same within the hour. Under normal conditions, within-hour load changes primarily occur immediately preceding and following the peak load hours; however, within-hour changes

[4] Other routine activities that change spill levels and have been coordinated with regional partners will be identified in Table 2.

[5] As specified in the 2016 FOP (p. 14), this applies when the spill level is below 40% of total flow at The Dalles Dam.

in intermittent generation can occur at any hour of the day. Occasionally, several hours after peak load hours, the project may be decreasing total outflow and generation faster than the corresponding spill decreases causing the percent spill to be slightly higher. Due to the high variability of within-hour load, reporting actual spill percentages that vary by more than the ±1 percent within hour requirement (or other ranges specified in the 2016 FOP) may occur with greater frequency with "Transmission Stability" hours than other hours.

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 slightly below average flows for the lower Snake River and average flows for the lower Columbia River. The NOAA Northwest River Forecast Center's Runoff Processor indicated that the May 2016 adjusted volume runoff on the lower Snake River was below the 30 year average (1981-2010): 6.2 MAF (Million Acre Feet) or 90% of average as measured at Lower Granite Dam. For the lower Columbia, the Runoff Processor indicated the May 2016 adjusted volume runoff was near the 30 year average (1981-2010): 24.8 MAF or 98% of average as measured at The Dalles. The monthly precipitation summary for May was below average at 84% on the Snake River above Ice Harbor Dam and below average on the Columbia River above The Dalles Dam at 93%.

During the May 2016 reporting period, the planned 2016 FOP spill operations were carried out as follows:

- Lower Granite Dam - The hourly target spill level was 20 kcfs, 24 hours/day.
- Little Goose Dam - The hourly target spill level was 30% of total project outflow, 24 hours/day.
- Lower Monumental Dam - The hourly target spill level was the %TDG cap, 24 hours/day.
- Ice Harbor Dam - The hourly target spill level was alternated between two day treatments of 30% of total project outflow, 24 hours/day vs. 45 kcfs during the daytime and the %TDG cap during the nighttime. Nighttime spill hours are 1800–0500.
- McNary Dam - The hourly target spill level was 40% of total project outflow, 24 hours/day.
- John Day Dam - The hourly target spill level was alternated between two day treatments of 30% and 40% of total project outflow, 24 hours/day. Spill level changes occur at 2000 hours.
- The Dalles Dam - The hourly target spill level was 40% of total project outflow, 24 hours/day.
- Bonneville Dam - The hourly target spill level was 100 kcfs, 24 hours/day.

Operational Adjustments

1. Lower Monumental Dam

On May 13 at 1900 hours, the Corps changed the spill pattern at Lower Monumental Dam from bulk to uniform as requested by regional salmon managers in the System Operations Request (SOR) 2016-1A "Lower Monumental Dam Operations" received on May 13. The objective of the operational change was to increase spill in order to reduce the number of juvenile sockeye collected in the juvenile bypass system for transport. Preliminary study results indicate that under conditions observed in 2015 transported juvenile sockeye do not return as adults as well as juveniles that were left in-river to migrate. As a result of this change, the TDG spill cap increased from 27 kcfs under the bulk spill pattern to 37 kcfs under the uniform spill pattern. This operation was requested to continue until June 3 unless modified in coordination with TMT based on the observed run timing of juvenile Snake River sockeye.

The Corps coordinated this operation with TMT at meetings on May 11, 18, and June 1, and via email on May 15. TMT members either supported or did not object to this operation.

Table 1: May 2016 (5/1 – 5/31) – Spill Variance Table

Project	Parameter	Date	Time [6]	Hours	Type	Reason
Ice Harbor	Additional Spill	5/2/16	0600	1	Program Error	Hourly spill increased to 58 kcfs (above FOP 45 kcfs ±2 kcfs). Delay in changing spill due to spill program malfunction.
Ice Harbor	Reduced Spill	5/27/16	1900	1	Operational Limitations	Hourly spill decreased to 28% (below 30 ±1% range). The forebay elevation dropped below MOP (437 ft), while spill was reduced at Lower Monumental to provide safe transit of fish barge. 24-hr avg. spill 30%.
Ice Harbor	Additional Spill	5/28/16	0600	1	Maintenance	Hourly spill decreased to 40 kcfs (below FOP 45 kcfs ±2 kcfs) due to the malfunctioning of spillbay gate 9.
John Day	Reduced Spill	5/3/16	0800	1	Program Error	Hourly spill decreased to 28% (below 30 ±1% range) due to a malfunction of the program that manages generation.
The Dalles	Additional Spill	5/2/16	0100	1	Human Error	Hourly spill increased to 42% (above 40 ±1% range) due to a miscalculation of spill. 24-hr avg. spill 40%.

Table 2: May 2016 (5/1 – 5/31) – Pre-Coordinated Operations

Project	Date [5]	Type	Description of Event	Regional Coordination
Lower Monumental	Daily, from 5/2 through 5/25 and every other day from 5/27 through 5/31	Navigation	Spill was reduced for safe passage of fish barges crossing project tailwater.	2016 FOP, pages 2, 4 and 7
Ice Harbor	May 17 from 0800-1600 hrs	Maintenance	Spill was increased during the Submersible Traveling Screens (STS) inspections.	2016 FPP, Ice Harbor Dam section 2.3.3.2.

[6] 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.

Figure 1

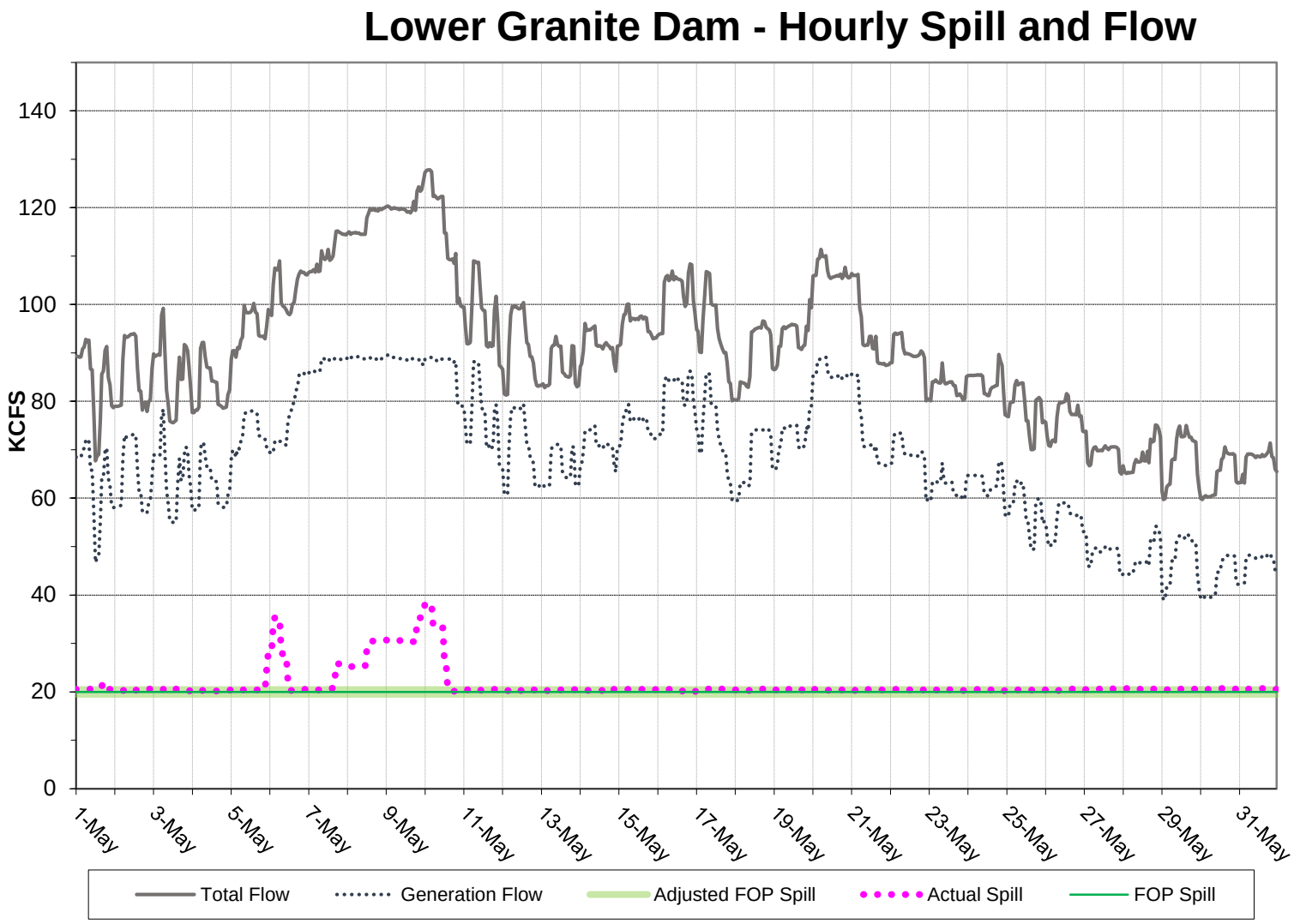
Lower Granite Dam - Hourly Spill and Flow
KCFS
140
120
100
80
60
40
20
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 2

Little Goose Dam - Hourly Spill and Flow

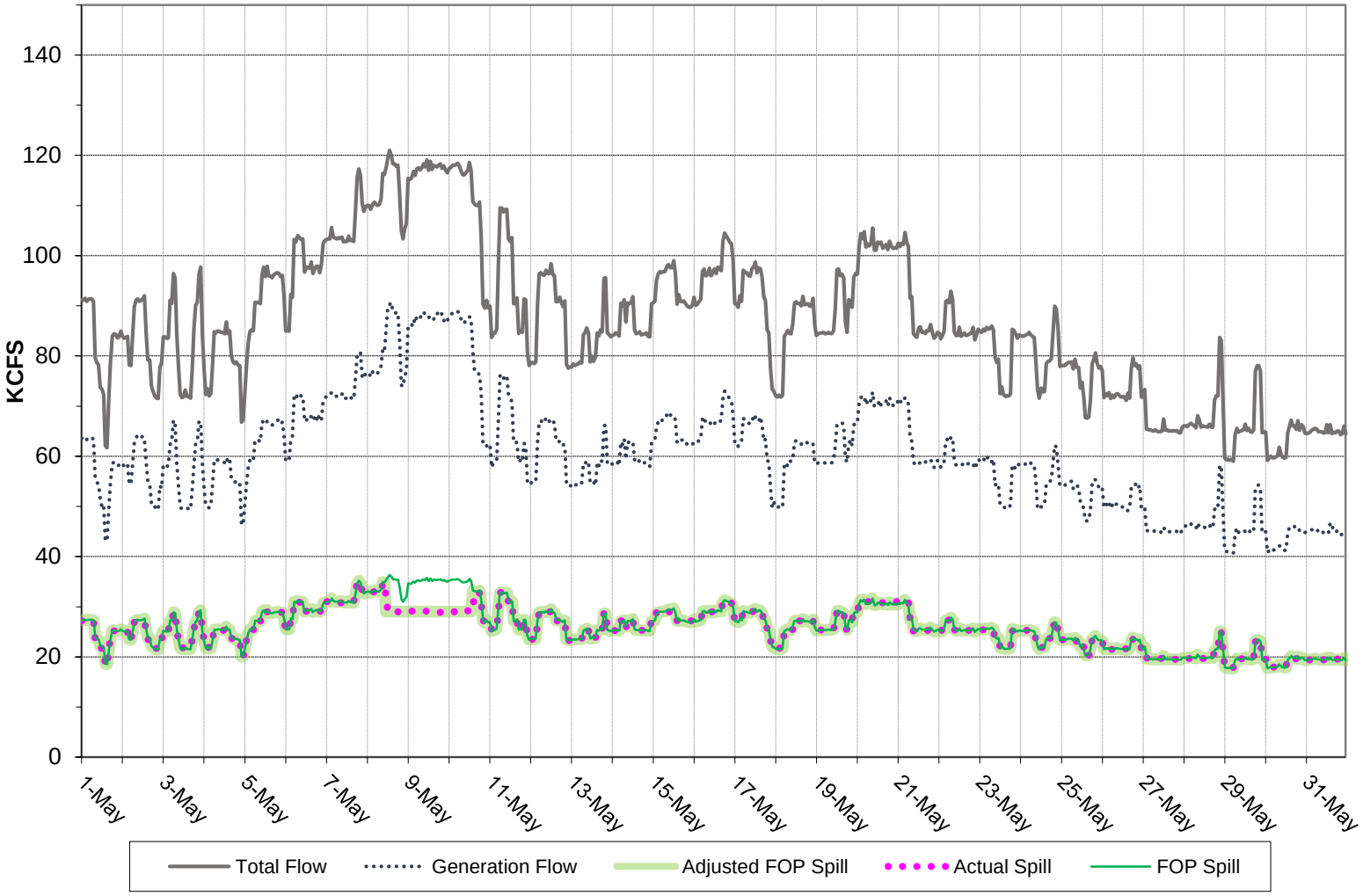

Figure 3

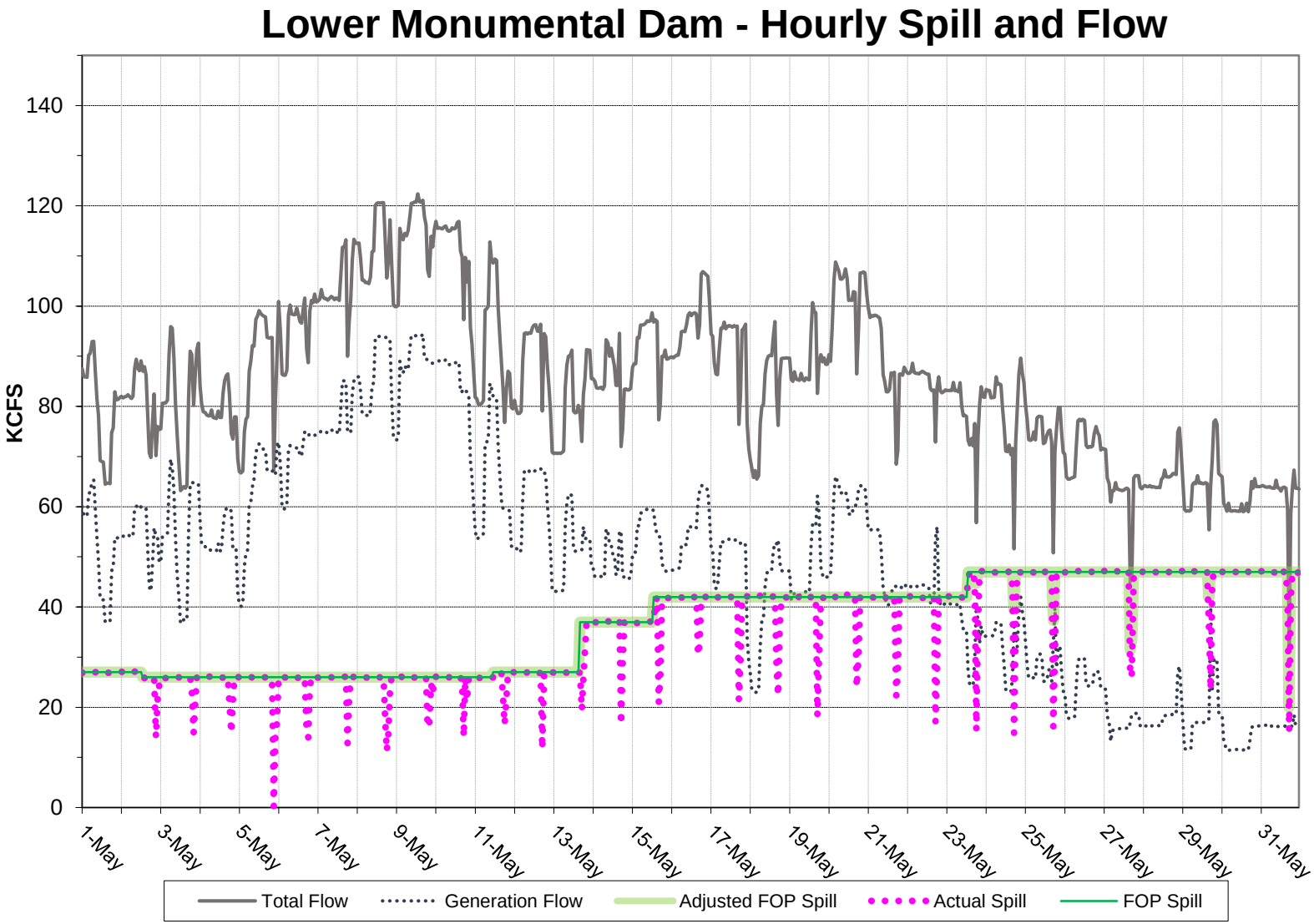
Lower Monumental Dam - Hourly Spill and Flow
KCFS
140
120
100
80
60
40
20
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 4

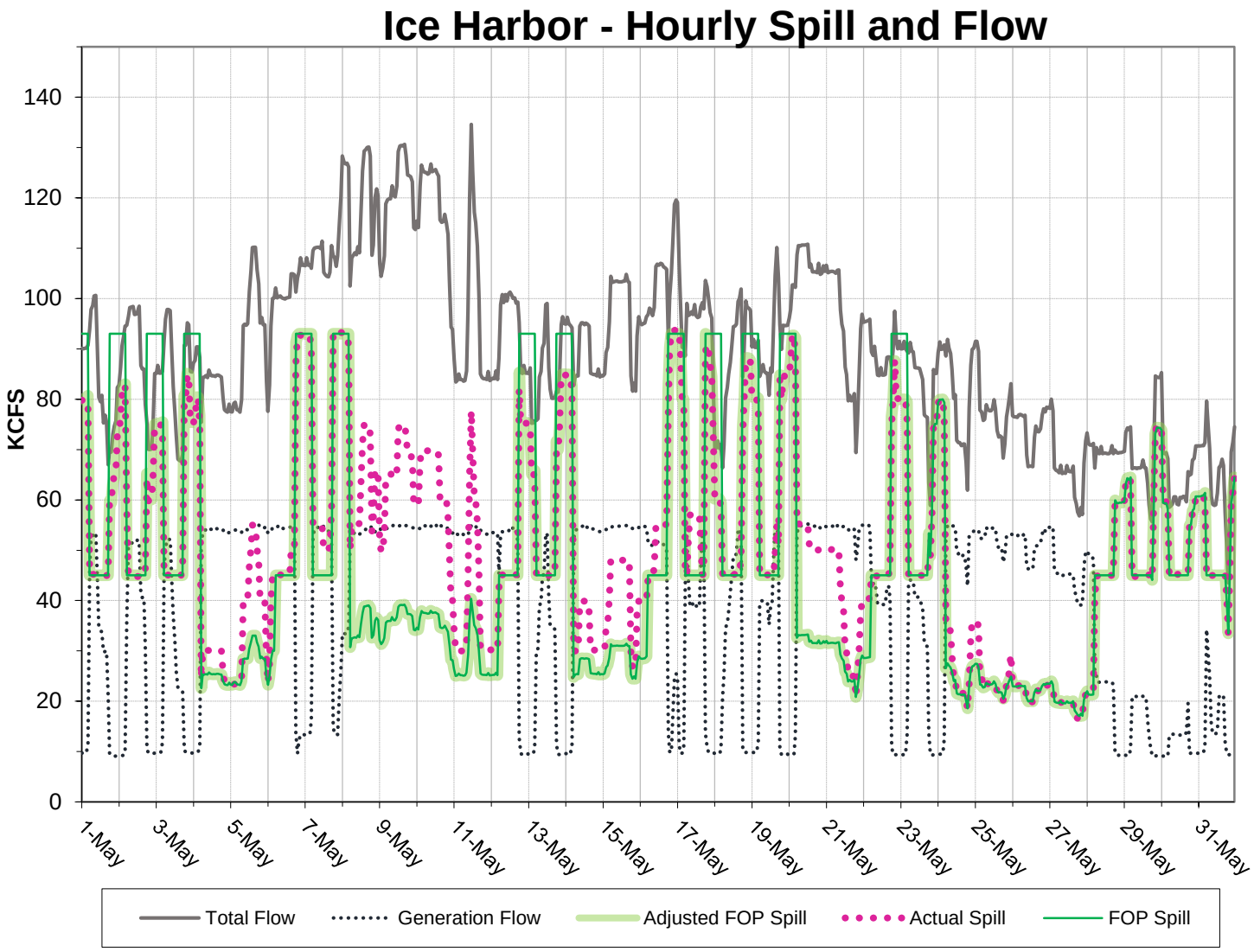
Ice Harbor - Hourly Spill and Flow
KCFS
0
20
40
60
80
100
120
140
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 5

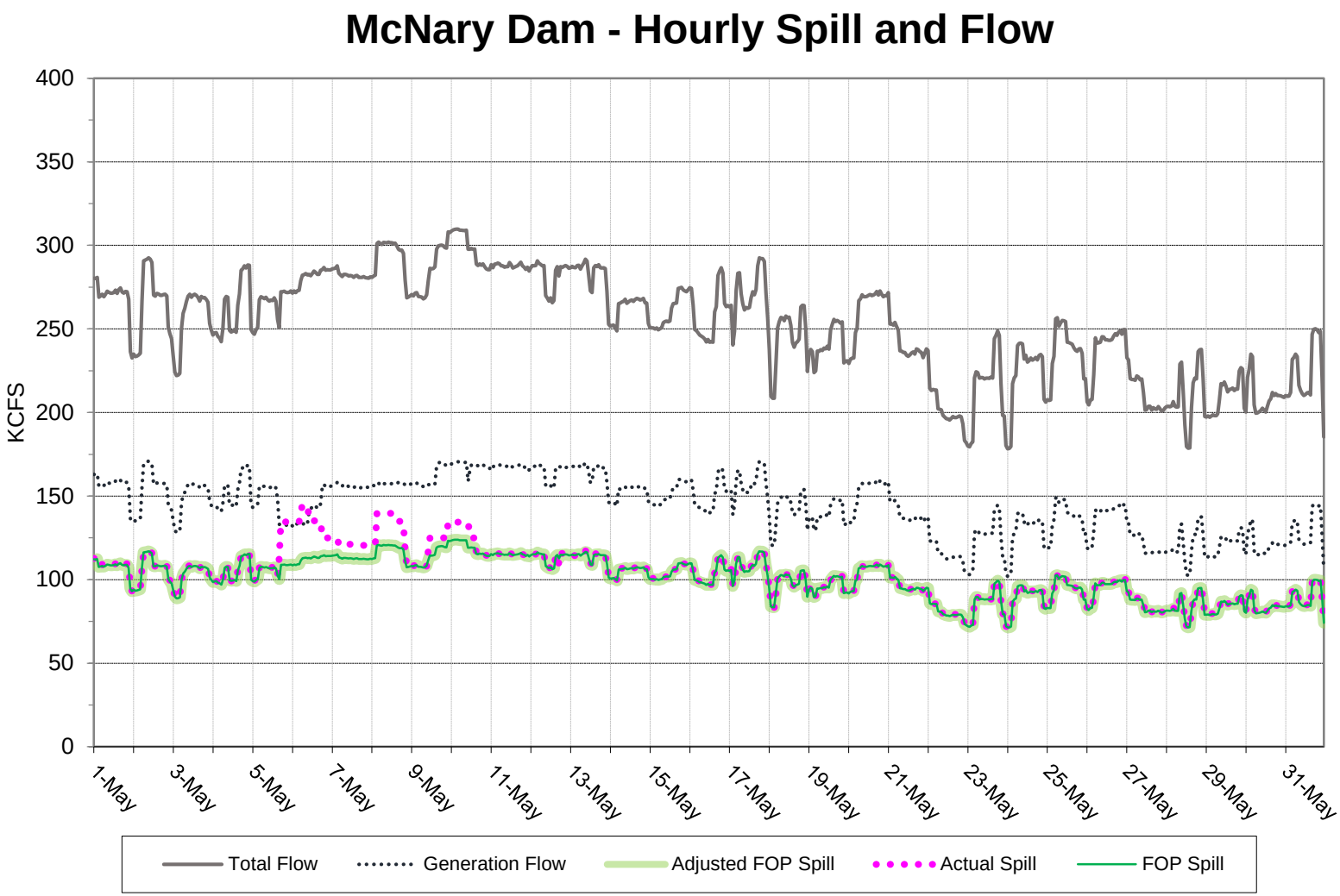
McNary Dam - Hourly Spill and Flow
KCFS
400
350
300
250
200
150
100
50
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 6

John Day Dam - Hourly Spill and Flow

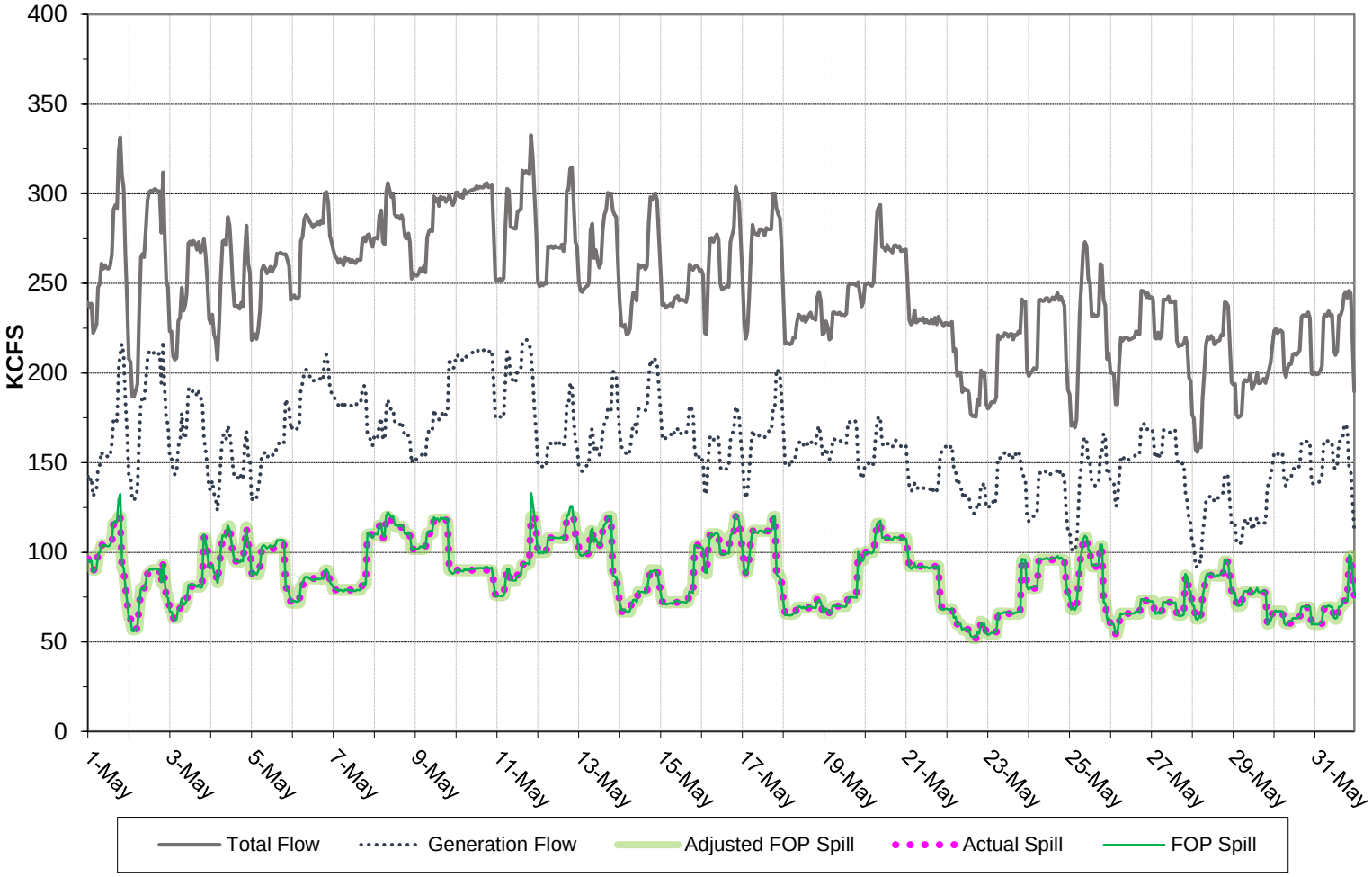

Figure 7

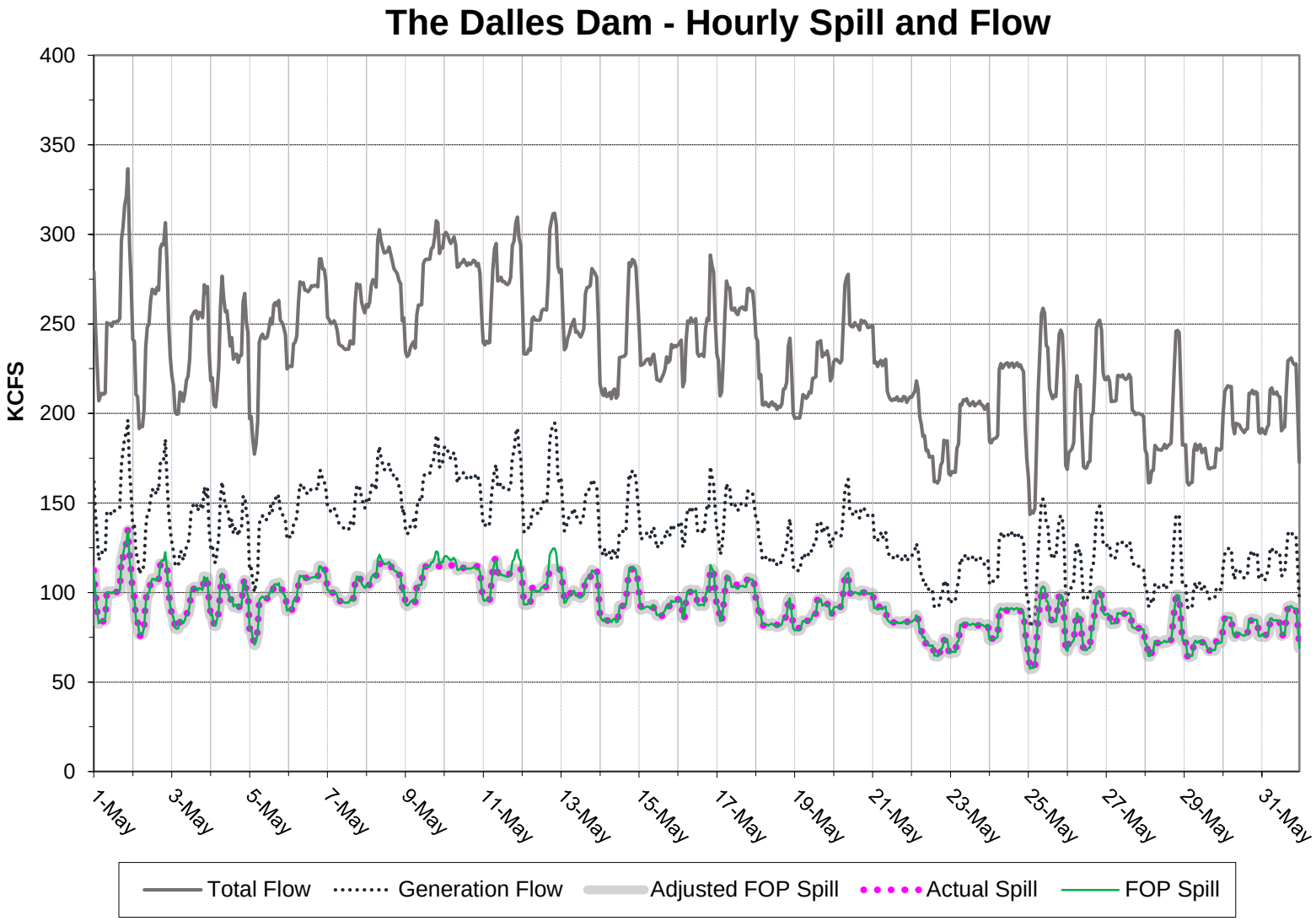
The Dalles Dam - Hourly Spill and Flow
KCFS
400
350
300
250
200
150
100
50
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Figure 8

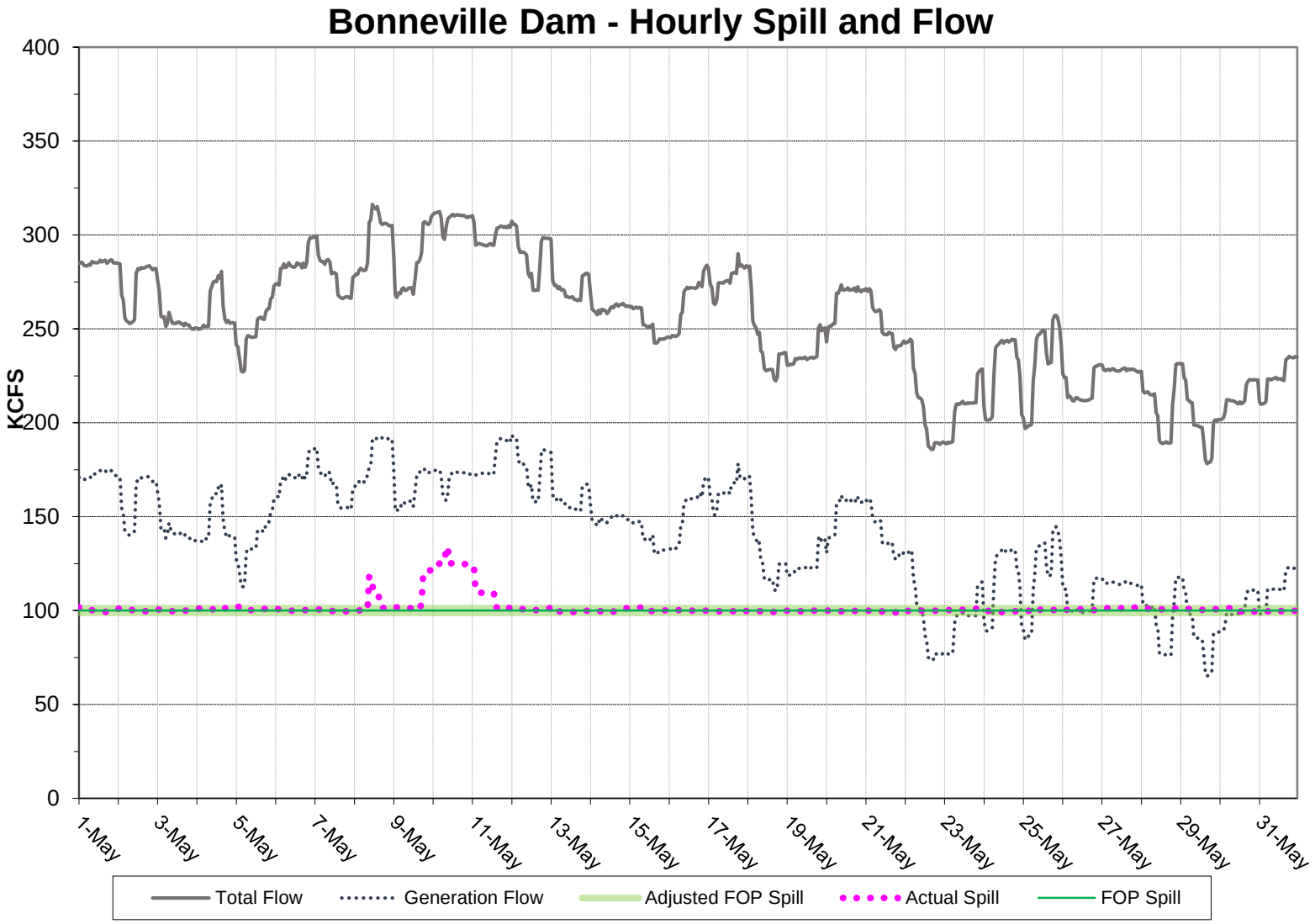
Bonneville Dam - Hourly Spill and Flow
KCFS
400
350
300
250
200
150
100
50
0
1-May
3-May
5-May
7-May
9-May
11-May
13-May
15-May
17-May
19-May
21-May
23-May
25-May
27-May
29-May
31-May
Total Flow
Generation Flow
Adjusted FOP Spill
Actual Spill
FOP Spill

Table 3

Average Percent TDG Values for May 1 – May 31

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 %:	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	OR	WA	WA	OR	WA	WA	OR	WA	WA	OR	WA
5/1/2016	103	110	107	113	113	120	**116**	116	113	116	~~116~~	112	~~119~~	119	114	118	~~118~~	**116**	119	~~119~~
5/2/2016	104	110	108	113	114	**121**	**117**	117	114	116	~~116~~	112	~~117~~	119	114	~~118~~	118	**118**	119	~~119~~
5/3/2016	105	110	109	114	114	120	**118**	116	114	116	~~116~~	112	117	~~117~~	113	~~117~~	117	**119**	~~118~~	119
5/5/2016	105	110	110	114	114	120	**118**	117	114	116	~~116~~	113	119	~~118~~	114	117	~~117~~	**117**	118	~~118~~
5/5/2016	105	110	111	115	114	120	**118**	117	113	117	~~117~~	114	118	~~118~~	114	117	~~117~~	114	~~118~~	118
5/6/2016	104	115	111	115	114	120	**117**	119	112	~~117~~	117	114	~~117~~	117	114	118	~~118~~	**117**	119	~~119~~
5/7/2016	105	112	111	116	**116**	120	**118**	120	113	~~117~~	117	114	~~117~~	117	114	118	~~118~~	**118**	~~119~~	119
5/8/2016	105	115	111	116	**116**	**121**	**118**	120	114	118	~~118~~	114	120	~~120~~	114	~~116~~	118	**118**	120	~~120~~
5/9/2016	105	115	110	115	**116**	120	**117**	119	113	~~117~~	117	110	~~120~~	120	110	115	~~115~~	111	~~119~~	119
5/10/2016	103	116	106	114	112	119	114	119	110	~~117~~	117	108	~~117~~	119	111	116	~~116~~	114	120	~~120~~
5/11/2016	104	110	109	115	112	119	114	117	111	116	~~116~~	108	118	~~118~~	111	116	~~116~~	**117**	~~120~~	120
5/12/2016	106	110	112	115	114	120	115	117	112	~~116~~	116	109	119	~~119~~	112	117	~~117~~	**117**	~~119~~	120
5/13/2016	106	110	112	114	115	120	**116**	116	114	116	~~116~~	112	~~118~~	119	114	118	~~118~~	**116**	119	~~119~~
5/14/2016	106	110	109	114	115	118	**116**	117	114	~~115~~	116	113	~~115~~	117	114	~~117~~	118	**116**	~~119~~	119
5/15/2016	105	110	108	114	113	118	115	116	111	115	~~115~~	113	~~115~~	115	112	~~116~~	117	114	~~118~~	119
5/16/2016	104	110	108	115	113	118	113	119	111	115	~~115~~	111	118	~~117~~	110	115	~~115~~	112	118	~~118~~
5/17/2016	102	109	107	114	114	118	**116**	119	110	116	~~116~~	109	118	~~118~~	112	116	~~116~~	111	118	~~118~~
5/18/2016	105	110	109	114	**116**	118	**118**	118	112	~~116~~	116	109	~~114~~	117	112	~~116~~	116	113	~~118~~	118
5/19/2016	105	110	109	114	**116**	118	**118**	117	112	~~115~~	115	109	115	~~115~~	109	~~114~~	115	112	117	~~117~~
5/20/2016	106	110	108	115	114	118	**117**	119	111	116	~~116~~	108	118	~~118~~	111	115	~~115~~	111	118	~~118~~
5/21/2016	105	110	108	115	114	118	**116**	119	111	~~115~~	115	108	~~116~~	118	112	~~116~~	116	111	~~118~~	118
5/22/2016	103	110	107	113	114	118	115	116	108	~~115~~	115	107	~~115~~	115	109	~~114~~	114	110	~~117~~	117
5/23/2016	103	110	106	113	112	118	113	117	108	115	~~115~~	106	115	~~115~~	108	114	~~114~~	111	117	~~117~~
5/24/2016	103	110	104	112	111	117	113	116	107	~~114~~	115	106	117	~~117~~	109	114	~~114~~	111	117	~~117~~
5/25/2016	103	110	106	112	111	117	115	116	108	114	~~114~~	106	117	~~117~~	109	114	~~114~~	110	~~117~~	117
5/26/2016	103	110	107	111	112	117	115	116	108	~~114~~	114	105	~~114~~	115	108	~~113~~	113	109	~~117~~	117
5/27/2016	104	110	107	111	111	117	115	115	108	114	~~114~~	104	114	~~114~~	105	~~112~~	112	108	117	~~117~~
5/28/2016	104	110	107	111	110	117	114	115	107	114	~~114~~	104	116	~~116~~	107	113	~~113~~	109	~~117~~	117
5/29/2016	103	110	108	111	110	117	115	115	108	114	~~114~~	104	~~114~~	115	109	114	~~114~~	110	~~117~~	117
5/30/2016	103	110	108	111	110	116	**116**	115	109	114	~~114~~	104	114	~~114~~	108	114	~~114~~	111	117	~~117~~
5/31/2016	104	110	110	111	111	117	**117**	115	110	114	~~114~~	106	114	~~114~~	109	~~115~~	115	114	117	~~117~~