UPDATE: SJRRP Flow Bench Memo

December 28, 2021

Introduction

The following memo is an update attachment to the Flow Bench Evaluation (FBE) dated December 23, 2021. To accelerate evacuation of remaining 2021 Restoration Flows as well as manage storage capacity in Millerton Lake, an Ad Hoc Flow Recommendation from the Restoration Administrator to target 430 cfs at Gravelly Ford and therefore 285 cfs from Sack Dam was made on December 23, 2021. Due to lower losses than anticipated, flows at the Bifurcation (SJB) have been stabilizing at approximately 15 - 20 cfs more than initially estimated, allowing for releases of 295 cfs below Sack Dam. Given preceding groundwater conditions and well measurements documented in the December 23 FBE, the 295 cfs order below Sack Dam is deemed acceptable, but not recommended to exceed 300 cfs until additional flow bench evaluations can be conducted under stabilizing groundwater conditions.

Data and Analysis

The December 23 FBE evaluated a 430 cfs target at GRF and 285 cfs at Sack Dam by conservatively applying an additional 60 cfs at each monitoring location based on monitoring data collected on December 21. The largest anticipated water level increase was estimated to be 0.9 ft with a buffer of at least 1.2 ft from the nearest field threshold.

With lower losses than estimated below GRF, if the initial FBE had been evaluated assuming 320 cfs at SJB (rather than 304 cfs) and 300 cfs below Sack Dam (rather than 285 cfs), the results would have been as projected in Table 1. The largest anticipated water level increase would have been estimated at 1.0 ft (0.1 ft more than previously estimated) with a buffer of at least 1.2 ft from the nearest field threshold (same as previously estimated). That is, this FBE update does not produce considerably different results whether evaluating 285 cfs below Sack Dam or 300 cfs.

Summary

Groundwater depths as of December 21 indicate conditions below thresholds. Groundwater levels are continuing to rise from previously dry conditions and will continue to be monitored; however, no new manual measurements are available as of the date of this memo. Regardless, updated FBE results suggest significant buffer from any groundwater thresholds. An updated manual measurement is expected at MW-09-49B on December 29 or 30. Real-time equipment at MW-10-89 indicates groundwater continues to respond to increasing surface water conditions in Reach 4A and are not yet stable. For this reason, and in consideration of historic FBE reports and forecasted storms, Sack Dam flows are recommended to not exceed 300 cfs until additional flow bench evaluations can be conducted under stabilizing groundwater conditions.

Table 1. Predicted Groundwater Levels for Priority Wells with Projected Flows - UPDATE

Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	Date Measured	2-Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	6 - Predicted WSEL Change (feet)	7 - Predicted Shallowest GW Depth (ft bgs_field)	5 - Field Threshold (feet bgs)	Comment
MA-4	2A	12.6	12/21/2021	6.1	4.6	11.1	0.2	10.9	7.0	Acceptable
MW-09-47	2A	9.2	12/21/2021	2.5	3.3	10.0	0.2	9.7	7.7	Acceptable
MW-09-49B	2A	6.7	12/21/2021	1.7	2.4	7.4	0.2	7.2	6.0	Acceptable
PZ-09-R3-5	3	11.0	12/21/2021	1.2		9.8	0.4	9.5	5.7	Acceptable
PZ-09-R3-7	3	8.6	12/21/2021	0.7	1.1	9.0	0.4	8.6	6.5	Acceptable
MW-17-225	4A	14.2	12/21/2021	2.9	1.1	12.4	0.5	11.8	6.5	Acceptable
MW-10-89	4A	16.9	12/21/2021	1.0		15.9	1.0	14.9	6.5	Acceptable

bgs = below ground surface; GW = groundwater; WSEL = water surface elevation

SJRRP Flow Bench Evaluation

December 23, 2021

Introduction

The following Flow Bench Evaluation (FBE) documents groundwater conditions following resumption of Restoration Flows and evaluates potential Restoration Flow increases to manage storage capacity in Millerton Lake and accelerate the evacuation of remaining 2021 Restoration Flows. Note that use of "FBE" throughout the report refers specifically to the FBE model-based analysis described in Appendix J of the Seepage Management Plan (SMP).

Restoration Flows were halted from June 4 to October 8 to conserve water during the Critical High water year type and to preserve the Millerton Reservoir cold water pool. This resulted in a disconnection of the San Joaquin River, with Reach 2A, Reach 4A, and downstream into the Eastside Bypass having no Restoration Flows. Since early October, an Ad Hoc Flow Recommendation from the Restoration Administrator (RA) placed a minimum release "floor" of 230 cfs for Friant Dam in the event that holding contract demand dropped below 230 cfs (needed to keep at least 5 cfs at Gravelly Ford (GRF)). On October 8, holding contract demand dropped below 230 cfs, and small amounts of Restoration Flows exceeding 5 cfs at GRF began to occur. Beginning on November 24, 2021 the RA Recommendation called for 100 cfs of Restoration Flows at GRF, this was increased to 200 cfs on November 29 and a 300 cfs target on December 4. Beginning December 9, the RA Recommendation has called for 600 cfs releases from Friant Dam.

With recent and forecasted storms, capacity in Millerton Lake is diminishing and the likelihood for flood control releases is increasing. This FBE evaluates an additional 60 cfs of Restoration Flows from the current target of 600 cfs releases from Friant Dam in order to meet an Ad Hoc Flow Recommendation from the RA to target 430 cfs at Gravelly Ford and therefore a target of 285 cfs from Sack Dam.

As of December 23, 2021:

1. Channel conveyance: Flow rates are below known conveyance thresholds.

2. Operations Conference Call: An operations call was held on December 15, 2021. No known operational constraints were identified on the call.

3. Seepage Hotline Calls: The seepage hotline has received no calls regarding Restoration Flows in Water Year 2022.

4. Real-time wells: A number of real-time equipment locations are currently going through equipment upgrades. All functioning telemetered groundwater monitoring well levels are below Seepage Management Plan (SMP) thresholds.

5. Priority wells: Weekly groundwater measurements in priority wells, both real-time and manually measured, indicate that all wells are below well thresholds. Note that manual monitoring efforts have been impacted by storm conditions, but data is collected using dataloggers at most locations and will be downloaded at the next opportunity.

6. Flow Stabilization: At 1300 on December 9, releases from Friant Dam were increased from 590 cfs to 600 cfs to meet the Gravelly Ford target. Restoration Flows arrived at Sack Dam on December 11 and began releases into Reach 4A on December 12. Flows at the Bifurcation (SJB) had stabilized at 240-244 cfs from December 17 through 21, allowing for Sack Dam flow orders of 220 cfs during that period. Dos Palos Gauge below Sack Dam (SDP) has been showing approximately 160 cfs on the California Data Exchange Center (CDEC); however, the Mendota Pool Watermaster estimates flows below Sack Dam at 225 cfs based on gate readings. The rating curve for the SDP gage has not been appropriately updated due to limited access resulting from vegetation. On December 22, flows at SJB increased to 246 cfs, yielding a Sack Dam flow order of 225 cfs. On December 23, flows at SJB increased to 265 cfs, likely due to stormwater runoff from the Fresno area, yielding a Sack Dam flow order of 245 cfs. The Mendota Pool Watermaster reported a flow of 245-250 cfs at Sack Dam at 0800 on December 23.

7. Projected Groundwater Level Changes: Groundwater levels are projected to increase with the proposed 430 cfs target at GRF and 285 cfs at Sack Dam. Therefore, the flow rates for this FBE used a conservative approach of assuming an additional 60 cfs at each monitoring location to provide confidence that wells would remain below threshold based on the empirical data evaluated. This analysis required comparing depth to water measurements for the monitoring well network to well thresholds identified in the SMP. Accessible manual and real-time monitoring locations for critical well locations are listed in Table 1. This FBE evaluates projected groundwater level increases at those locations.

8. Levees: LSJLD has not expressed concerns about current flows.

9. Water Districts: The SJRECWA has not identified any operational concerns.

Data

The following Data section considers monitoring measurements collected during the stable flow period below Sack Dam beginning December 17. These values are referred to as “pre-condition” to inform current groundwater levels before any changes to Restoration Flows. The “projected” values indicate the results from this FBE model-based analysis with the proposed flow increase.

Table 1 shows groundwater depths in one real-time well and six manual measurements from field staff. Measurements were reported from the field on December 21, 2021 and will be reported in the Weekly Groundwater Report with a publish date for the week ending December 25, 2021. Reclamation publishes the Weekly Groundwater Report with manual measurements via electronic well sounder on the SJRRP website HERE. To calculate field depths, Reclamation adds ground surface buffers and lateral gradient buffers to measured groundwater depths in the well (Equation 1, Figure 1).

$$Field\ Depth_{Current} = D_{well} - GS_{Buffer} + LG_{Buffer} \quad (1)$$

Where:

$Field\ Depth_{Current}$	Current groundwater level depth in the field
D_{Well}	Current groundwater level depth as measured in the monitoring well
GS_{Buffer}	Ground surface buffer, or the difference in elevation between the well and the field
LG_{Buffer}	Lateral gradient buffer, to account for losing reaches where the groundwater table slopes away from the river (if any)

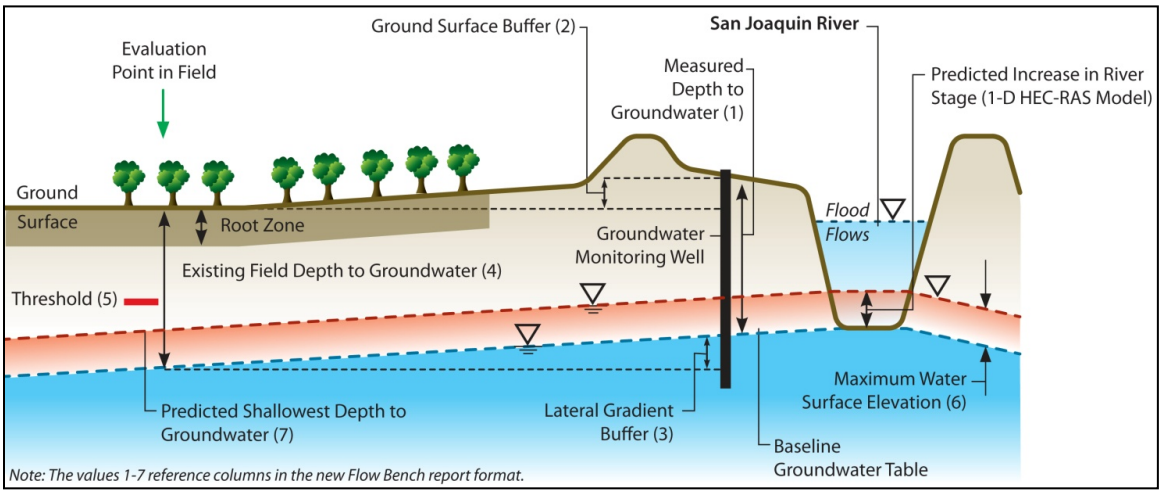

Figure 1. Conceptual Model for Observed Groundwater Level Method

The pre-condition well data in Table 1 show acceptable conditions throughout the critical monitoring locations. Again, the pre-condition data represents the levels observed during the period of stabilizing flows below Sack Dam. Groundwater depths in all wells indicate conditions below thresholds. Groundwater levels are continuing to rise from previously dry conditions and will continue to be monitored. Measurements at other monitoring locations are not available at this time due to recent storm conditions and ongoing equipment replacement, but additional monitoring locations will be included in subsequent FBEs.

Table 1. Pre-Condition Well Data

Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	Date Measured	2 - Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	5 - Field Threshold (feet bgs)	Comment
MA-4	2A	12.6	12/21/21	6.1	4.6	11.1	7.0	Acceptable
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bgs = below ground surface; GW = groundwater

Analysis

With many well locations starting from dry conditions due to lack of Restoration Flows since June (documented in Weekly Groundwater Monitoring Reports located HERE), groundwater levels are still well below threshold throughout the Restoration Area. After consideration of 430 cfs target at GRF and 285 cfs at Sack Dam by conservatively applying an additional 60 cfs at each monitoring location, the largest anticipated water level increase was estimated based on the concept illustrated in Figure 2. This is expected to be 0.9 ft with a buffer of at least 1.2 ft from the nearest field threshold. Although groundwater levels are continuing to rise from previously dry conditions, critical well locations will continue to be monitored, and no well thresholds are projected to be exceeded. After any changes to Restoration Flows, subsequent FBEs may be completed to assess stabilizing conditions.

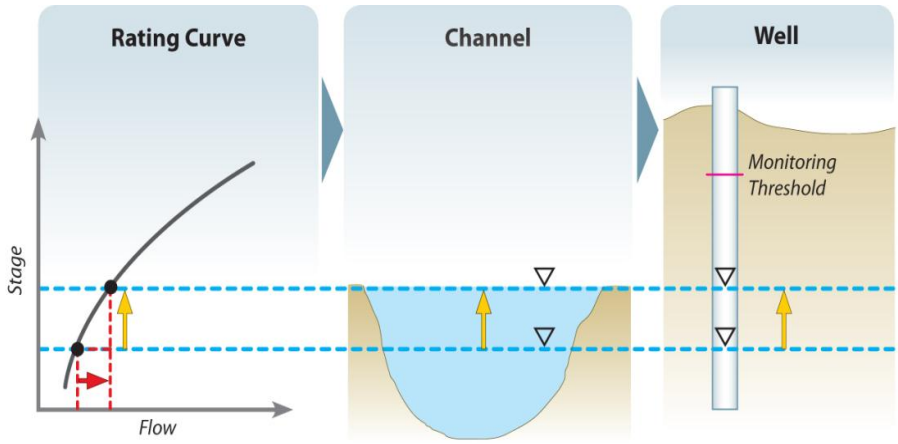

Figure 2. Conceptual Relationship between River Stage and Groundwater Levels

Table 2 shows the flow rates used to evaluate projected groundwater depths. No losses were applied to conservatively estimate potential increases in the groundwater table. Pre-condition flows are based on the Sack Dam order of 220 cfs and the Mendota Pool Watermaster's observations of 225 cfs at the Sack Dam gates. San Luis Canal Company (SLCC) demands were also accounted for in Reach 3 using the operations spreadsheet sent December 15. SLCC demands have been fluctuating, as low as 60 cfs in the last week, but were reported to be 90 cfs on December 21. SLCC demands were assumed to not change from 90 cfs between the pre-condition and projected flow scenarios. The comparison of pre-condition and projected flows informs the estimated result of increasing flows by 60 cfs.

Table 2. Anticipated Change in Flows with Addition of 60 cfs

	Pre-condition Flows (cfs)	Projected Flows from Evaluation (cfs)
Friant Dam	603[1]	663
Reach 2A	371[1]	431
Reach 3	366[2]	426[2]
Reach 4A	225[3]	285

[1] Source: CDEC, 12/21/2021 @ approx. 12pm
[2] Assumes 90 cfs SLCC demand, reported by Mendota Pool Watermaster on 12/21/2021
[3] Source: Mendota Pool Watermaster, Sack Dam gates

Table 3 shows the change in groundwater based on estimated changes in river stage and the conceptual models shown in Figures 1 and Figure 2. Field depths are calculated by taking the most recent measurements from Table 1, adding the ground surface and the lateral gradient buffers, and subtracting the maximum predicted stage increase (Equation 2).

$$Field\ Depth_{Predicted} = Field\ Depth_{Current} - WSEL_{Max\ Increase} \quad (2)$$

Summary

This analysis, in combination with recent field measurements, indicates acceptable conditions for 285 cfs past Sack Dam. Groundwater levels will continue to be monitored so as not to surpass thresholds. SLCC demands will also be monitored to assess the capacity for Restoration Flows in Reach 3. Reclamation retains the right to recapture Restoration Flows in Mendota Pool to adjust for any Restoration Flow constraints. Subsequent FBEs will be performed to evaluate stabilizing conditions and to inform any other potential flow changes.

Table 3. Predicted Groundwater Levels for Priority Wells with Projected Flows

Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	Date Measured	2-Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	6 - Predicted WSEL Change (feet)	7 - Predicted Shallowest GW Depth (ft bgs_field)	5 - Field Threshold (feet bgs)	Comment
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