SJRRP Flow Bench Evaluation

August 14, 2016

The Restoration Administrator, as of July 13, 2016, recommends continued Restoration Flow releases of 180 cfs past Gravelly Ford through August 30. The recommendation also includes a release of 50 cfs past Sack Dam following the conclusion of the Eastside Bypass Sand Removal project, which finished on August 12. The combined release from Friant Dam, including Restoration Flows and holding contract releases, will remain at least 460 cfs upon release of flows below Sack Dam. Due to projected groundwater levels in MW-10-92, Restoration Flows of 40 cfs will be released from Mendota Dam on Tuesday, August 16, 2016, and 40 cfs will be released below Sack Dam when flows arrive (anticipated Wednesday, August 17, 2016).

As of August 14, 2016:

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

2. Operations Conference Call: An operations call was held August 10, 2016. No issues were raised. A notification email is being sent to notify Mendota Dam and Sack Dam operators as well, with specific release instructions to follow.

3. Seepage Hotline Calls: The seepage hotline has received no calls in Water Year 2016.

4. Real-time wells: Groundwater monitoring well levels are below thresholds. These wells do not restrict releases.

5. Priority wells: Weekly groundwater measurements in priority wells, Table 3, indicate that all wells are below thresholds. These wells do not restrict releases.

6. Flow Stabilization: For the last three weeks, elevated flows of up to 950 cfs past Gravelly Ford have been released down the San Joaquin River to satisfy demand at Mendota Pool. Over the past week, these flows have been reduced to an 800 cfs release from Friant Dam, which has stabilized to approximately 500 cfs past Gravelly Ford. On Friday, these additional flows were stopped, and now only Restoration Flows, with a 450 cfs Friant Release, are being conveyed down the river. Groundwater levels are anticipated to fall over the next several days due to this decrease in flow. As all key groundwater monitoring wells are currently below thresholds,

7. Projected Groundwater Level Increases: Projected groundwater levels indicate that all monitoring wells except MW-10-92 will remain below thresholds with the recommended Restoration Flow releases. MW-10-92 is predicted to reach a depth of 5.6 feet, equal to the field threshold of 5.6 feet, at a 50 cfs release from Sack Dam. This well restricts releases to 40 cfs below Sack Dam at this time. Reclamation will closely monitor the groundwater level in MW-10-92 and re-evaluate an increase in flows below Sack Dam as the groundwater well responds to the flows in Reach 4A.

8. Levees: LSJLD has not expressed concerns about levees. LSJLD has expressed concerns about ongoing maintenance at the Eastside Bypass Control Structure and Mariposa

Bypass Control Structure. Restoration Flows into the Eastside Bypass will pass through one of these structures and continue on through Reach 5.

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

Analysis

All sixteen groundwater monitoring wells are currently below seepage thresholds. Modeled groundwater levels resulting from the proposed Restoration Flows predict that all wells will remain below thresholds with this flow increase. The SJRRP will continue weekly monitoring of groundwater wells to track the impact of Restoration Flows, and will update this analysis if any increases to Restoration Flows are recommended.

Data

$$\textbf{\textit{Field}}\ Depth_{Current} = D_{Well} + GS_{Buffer} + LG_{Buffer} \qquad (1)$$

where:

D_{Well} = Depth in the groundwater well (feet below ground surface)

GS_{Buffer} = Difference between the ground surface at the well and the ground surface in the field

LG_{Buffer} = Lateral Gradient Buffer, to account for slope of groundwater table away from the river in losing reaches (if any)

Table shows the groundwater depth in six real-time wells as of August 14, 2016 and ten manual measurements from field staff as reported in the weekly groundwater report with a publish date of August 13, 2016. Reclamation publishes the weekly groundwater report with manual measurements via electronic well sounder and recent flow data on the SJRRP website at: http://www.restoresjr.net/flows/Groundwater/Groundwater.html. To calculate field depths, Reclamation adds ground surface buffers and lateral gradient buffers to measured groundwater depths in the well (Figure 1, Equation 1). A negative ground surface buffer indicates the ground surface at the well is above the field ground surface elevation.

$$Field\ Depth_{Current} = D_{Well} + GS_{Buffer} + LG_{Buffer} \qquad (1)$$

where:

D_{Well} = Depth in the groundwater well (feet below ground surface)

GS_{Buffer} = Difference between the ground surface at the well and the ground surface in the field

LG_{Buffer} = Lateral Gradient Buffer, to account for slope of groundwater table away from the river in losing reaches (if any)

Table 1: Well Data

Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	2 - Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	5 - Field Threshold (feet bgs)	Comment
FA-9	2A	8.8	-3.7	2.5	7.6	7.0	Acceptable
MW-09-47	2A	7.8	-3.5	3.3	7.6	7.0	Acceptable
MA-4	2A	11.5	-6.1	4.6	10.1	7.0	Acceptable
MW-09-49B	2A	5.1	-1.7	2.4	5.8	5.5	Acceptable
MW-09-54B	2B	15.1	-7.9	5.5	12.7	10.0	Acceptable
MW-09-55B	2B	8.1	-3.7	3.0	7.4	6.0	Acceptable
PZ-09-R3-5	3	10.2	-1.2	0.0	9.0	6.0	Acceptable
PZ-09-R3-6	3	9.0	-1.5	0.0	7.6	6.0	Acceptable
PZ-09-R3-7	3	7.7	-0.7	0.0	7.0	5.5	Acceptable
MW-10-75	3	21.6	-0.5	0.2	21.3	6.3	Acceptable
MW-11-130	4A	12.2	0.0	0.0	12.2	6.0	Acceptable
MW-14-208	4A	14.7	-2.1	0.0	12.5	5.0	Acceptable
MW-10-89	4A	DRY	-3.4	0.0	DRY	4.0	Acceptable
MW-10-92	4A	9.6	-2.6	0.0	7.1	5.6	Acceptable
MW-10-90	4B1	7.8	0.8	0.0	8.6	4.9	Acceptable
MW-10-94	4B1	24.8	0.0	1.0	25.7	6.0	Acceptable

bgs = below ground surface; GW = groundwater;

Table shows the anticipated flow rates used to evaluate future groundwater depths. Reclamation calculated losses from Friant Dam to the Mendota Pool based on the long-term pattern established by Exhibit B. Note that flows are currently not at steady state, Friant Dam reduced releases at 0800 (8:00 am) on August 12, and this change has not yet equilibrated throughout the system. Actuals were used at gage locations in Reach 1, 2A, 2B, and 3 as of 0900 (9:00 am) August 14. Reaches 2A and 2B may represent higher flows than anticipated in steady-state conditions for a 450 cfs Friant release.

Table 2: Anticipated Change in Flows

	Recent Flows (cfs)	Projected Flows for Evaluation (cfs)

Reach 1	450	450
Reach 2A	350	350
Reach 2B	350	350
Reach 3	504	554
Reach 4A	0	50
Reach 4B1 (ESB)	0	50

Table 3 shows the current and maximum rise in groundwater based on estimated changes in river stage and the conceptual model shown in Figure 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 buffer, and subtracting the maximum predicted stage increase (Equation 2).

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

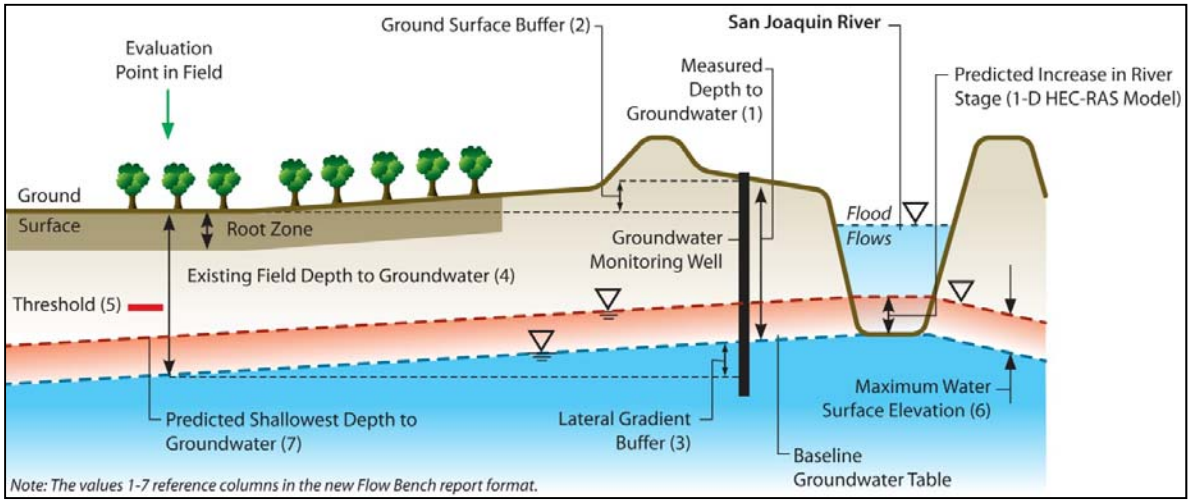


Figure 1: Conceptual Model for Increase in Stage Method

Table 3: Predicted Groundwater Levels for Key Wells – Increase in Stage Method

Well	Reach	1 - Measured Groundwater Depth in Well (feet bgs)	2 - Ground Surface Buffer (feet)	3 - Lateral Gradient Buffer (feet)	4 - Field GW Depth (feet bgs)	6 - Maximum Predicted WSEL Increase (feet)	7 - Predicted Shallowest GW Depth (feet bgs)	5 - Field Threshold (feet bgs)	Comment
FA-9	2A	8.8	-3.7	2.5	7.6	0.0	7.6	7.0	Acceptable
MW-09-47	2A	7.8	-3.5	3.3	7.6	0.0	7.6	7.0	Acceptable
MA-4	2A	11.5	-6.1	4.6	10.1	0.0	10.1	7.0	Acceptable
MW-09-49B	2A	5.1	-1.7	2.4	5.8	0.0	5.8	5.5	Acceptable
MW-09-54B	2B	15.1	-7.9	5.5	12.7	0.0	12.7	10.0	Acceptable
MW-09-55B	2B	8.1	-3.7	3.0	7.4	0.0	7.4	6.0	Acceptable
PZ-09-R3-5	3	10.2	-1.2	0.0	9.0	0.0	9.0	6.0	Acceptable
PZ-09-R3-6	3	9.0	-1.5	0.0	7.6	0.0	7.6	6.0	Acceptable
PZ-09-R3-7	3	7.7	-0.7	0.0	7.0	0.2	6.8	5.5	Acceptable
MW-10-75	3	21.6	-0.5	0.2	21.3	0.2	21.1	6.3	Acceptable
MW-11-130	4A	12.2	0.0	0.0	12.2	0.2	12.0	6.0	Acceptable
MW-14-208	4A	14.7	-2.1	0.0	12.5	1.2	11.4	5.0	Acceptable
MW-10-89	4A	DRY	-3.4	0.0	DRY	DRY	DRY	4.0	Acceptable
MW-10-92	**4A**	**9.6**	**-2.6**	**0.0**	**7.1**	**1.5**	**5.6**	**5.6**	**Not acceptable. At 40 cfs, shallowest predicted groundwater depth is 5.9 feet. This is acceptable.**
MW-10-90	4B1	7.8	0.8	0.0	8.6	0.9	7.7	4.9	Acceptable
MW-10-94	4B1	24.8	0.0	1.0	25.7	1.6	24.1	6.0	Acceptable

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

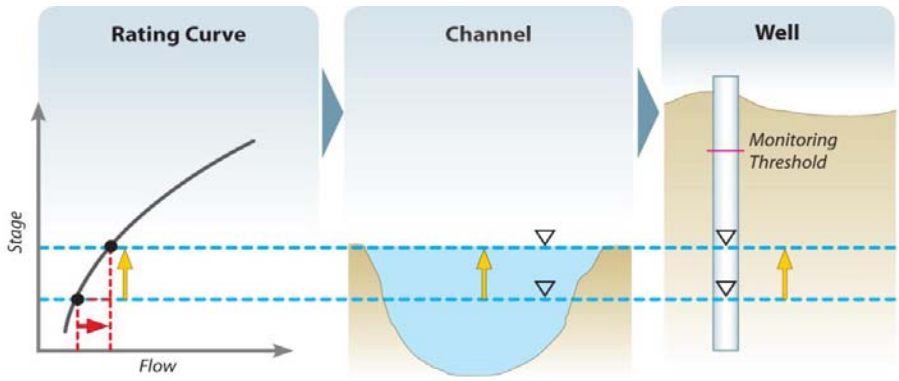


Figure 2: One to one surface to groundwater relationship for Increase in Stage Method

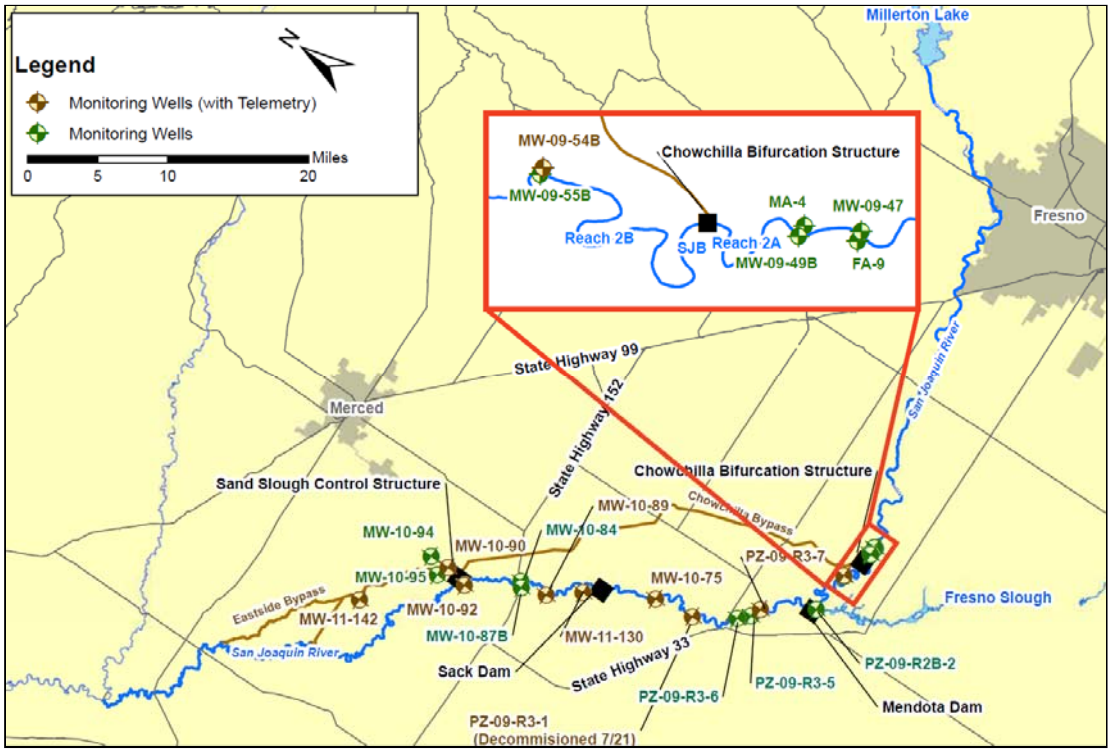
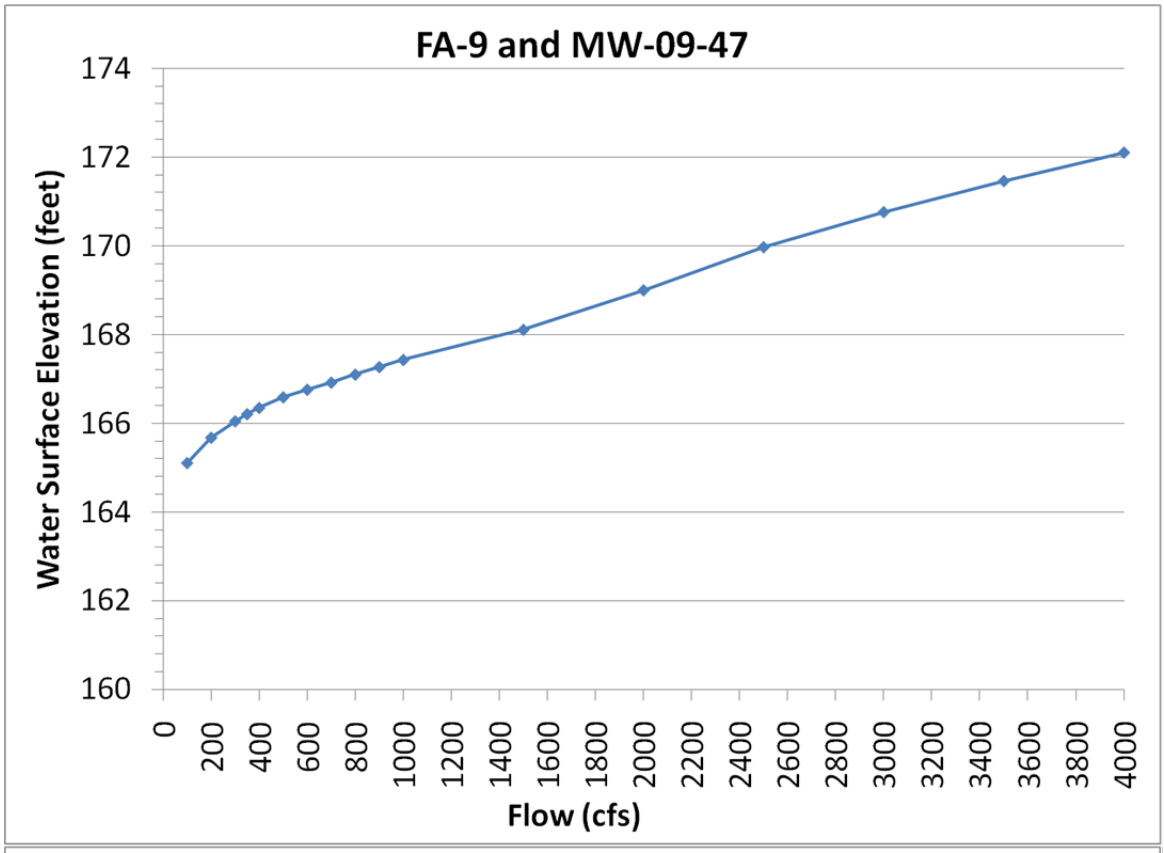
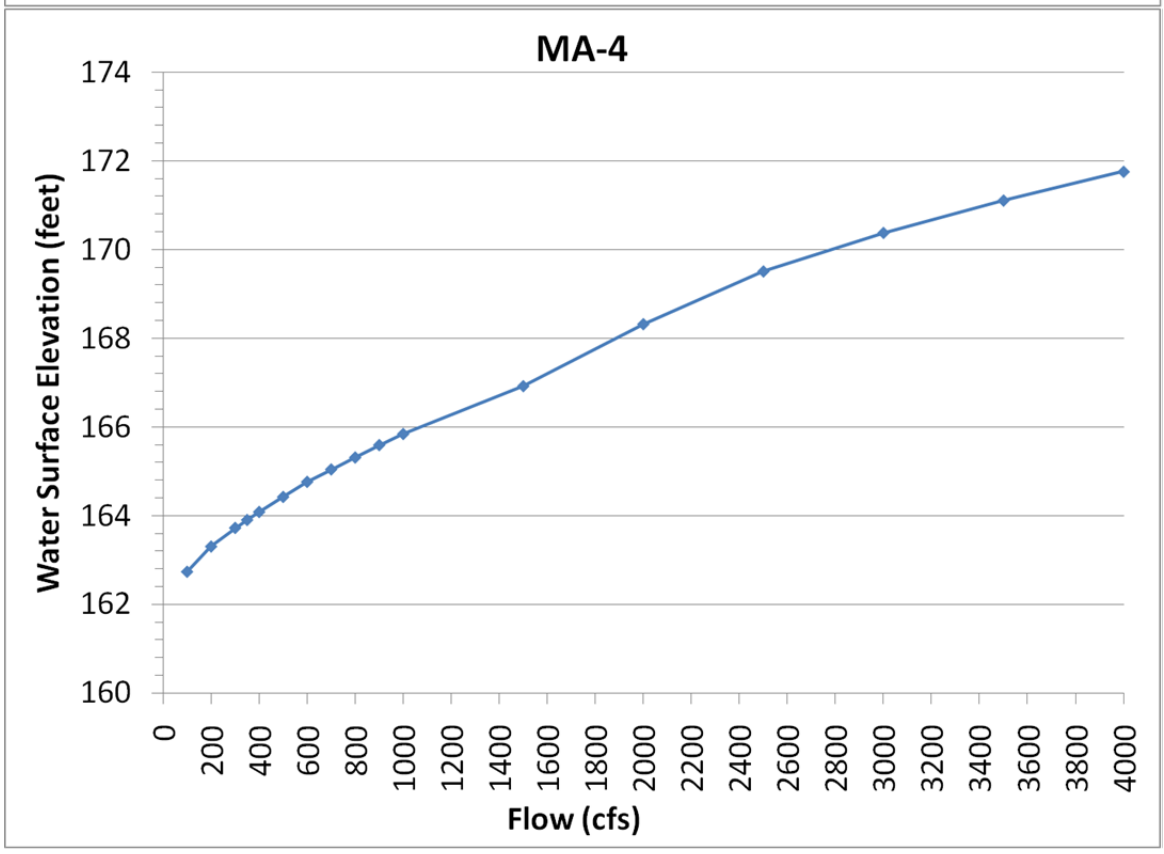
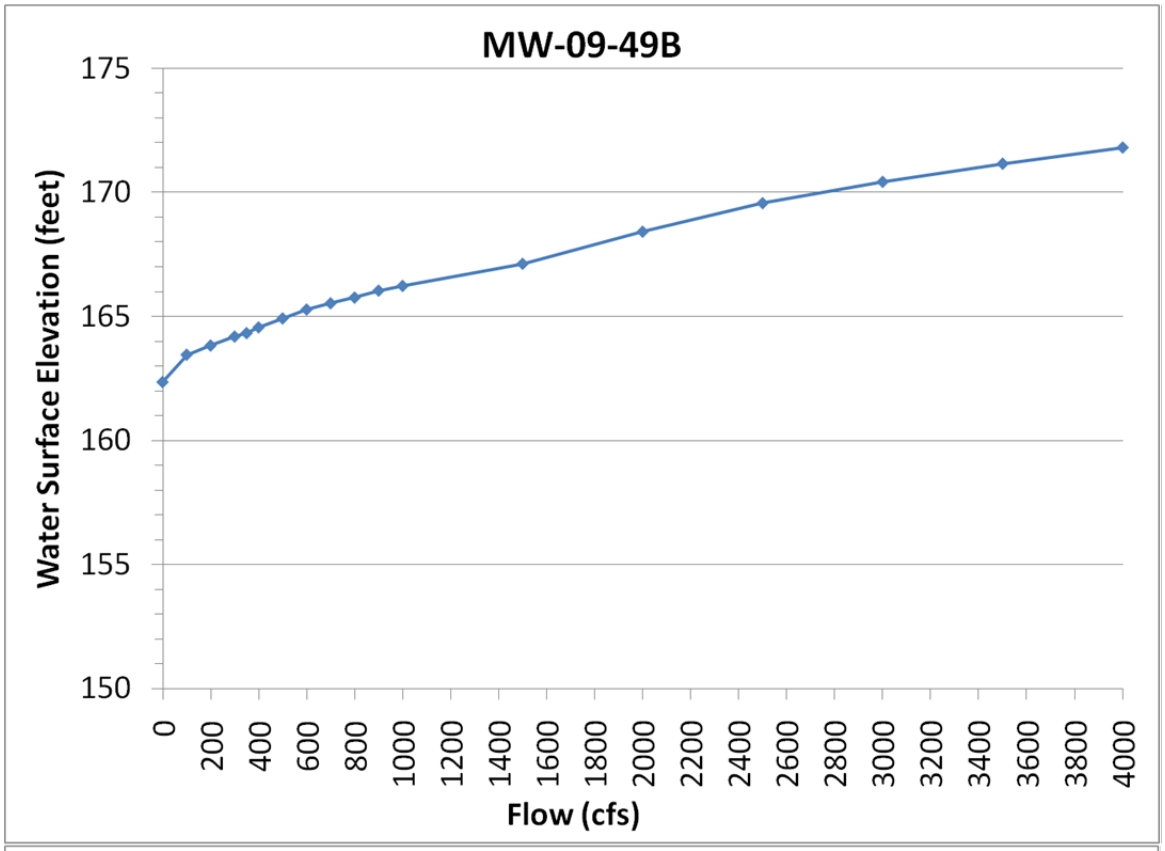
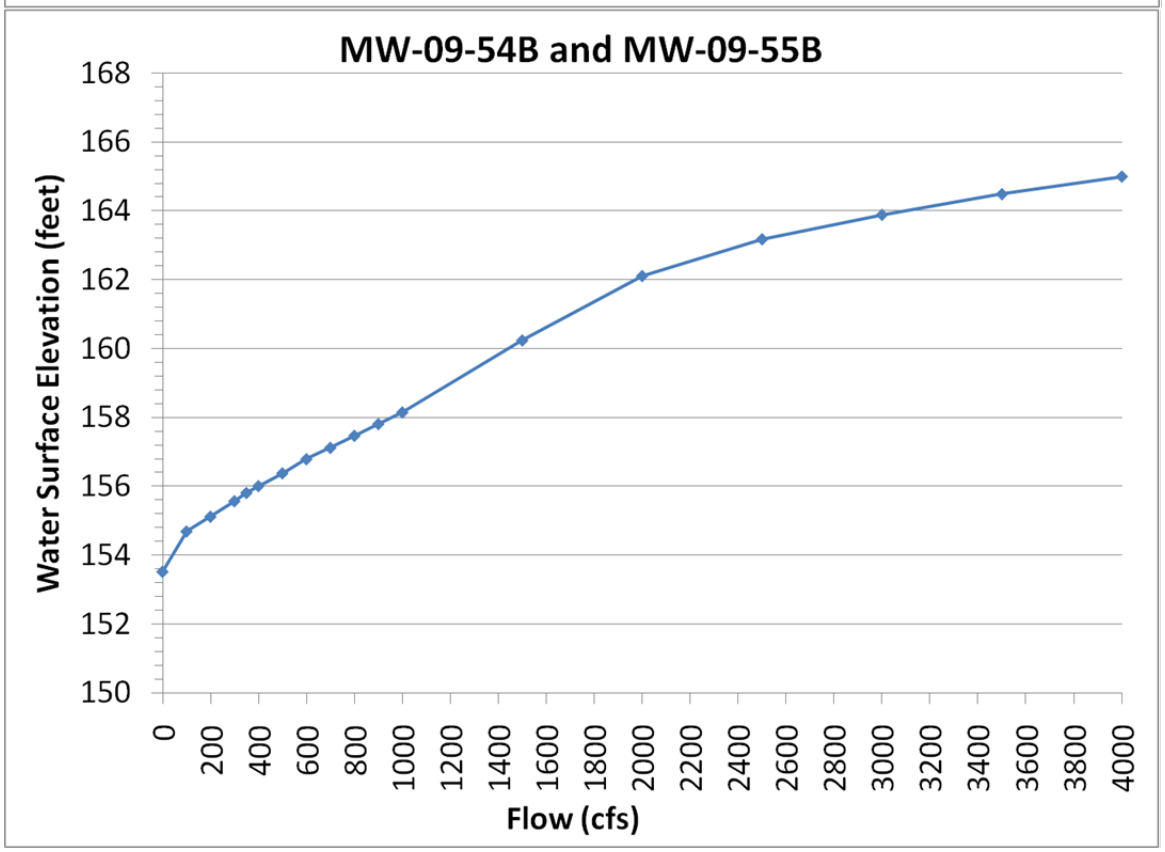


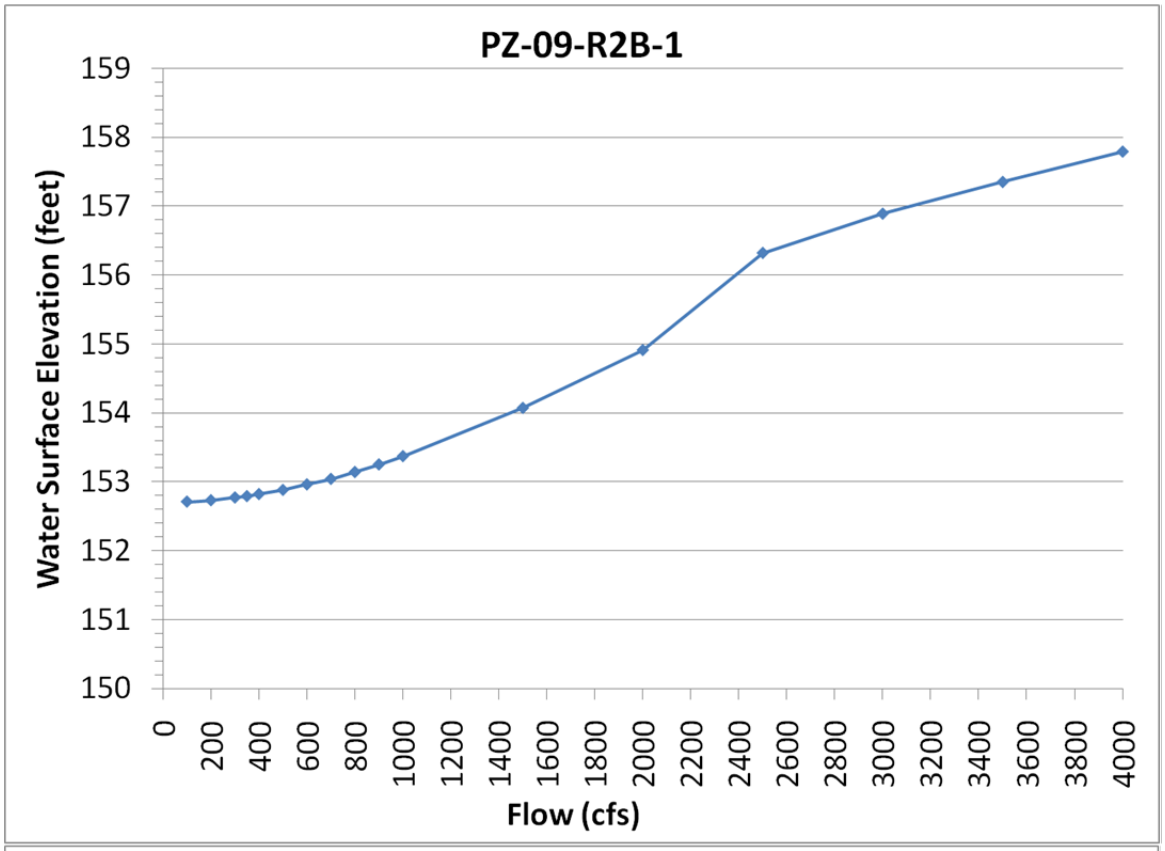
Figure 3: Key Monitoring Well Locations

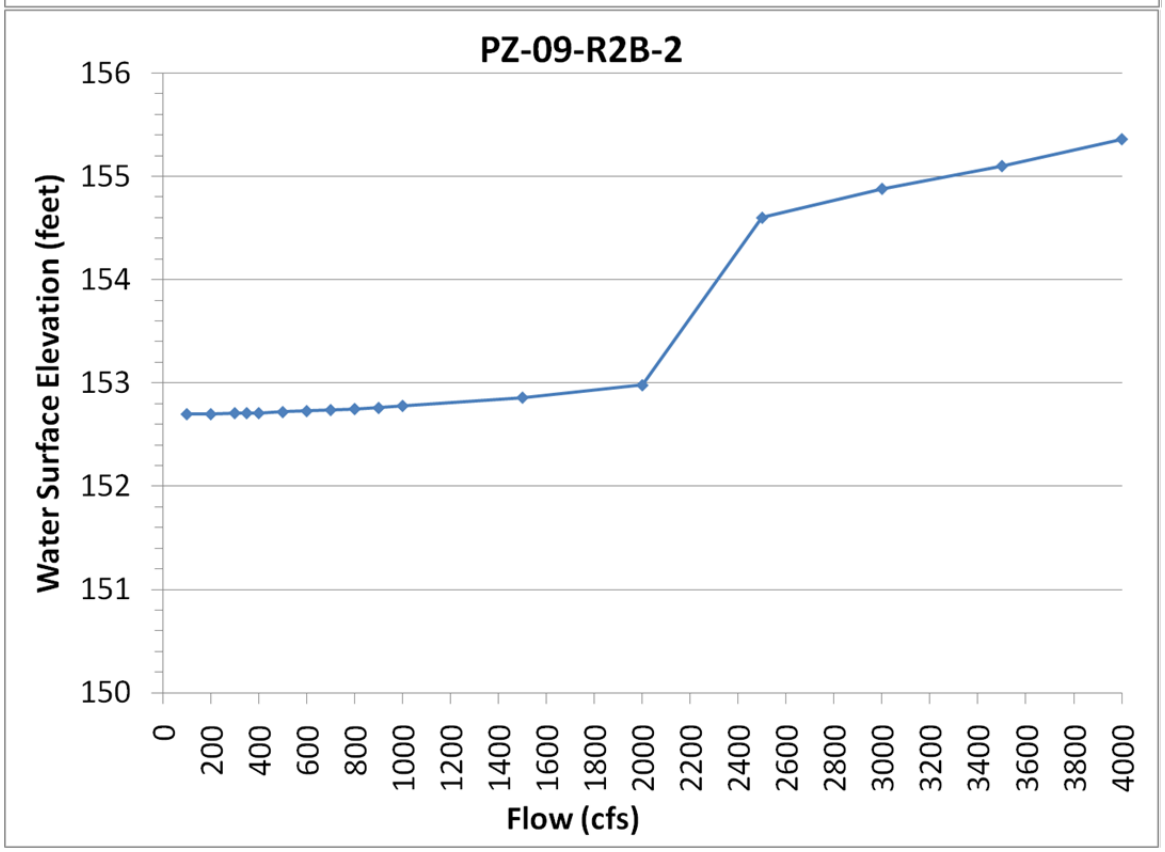

FA-9 and MW-09-47
Water Surface Elevation (feet)
174
172
170
168
166
164
162
160
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

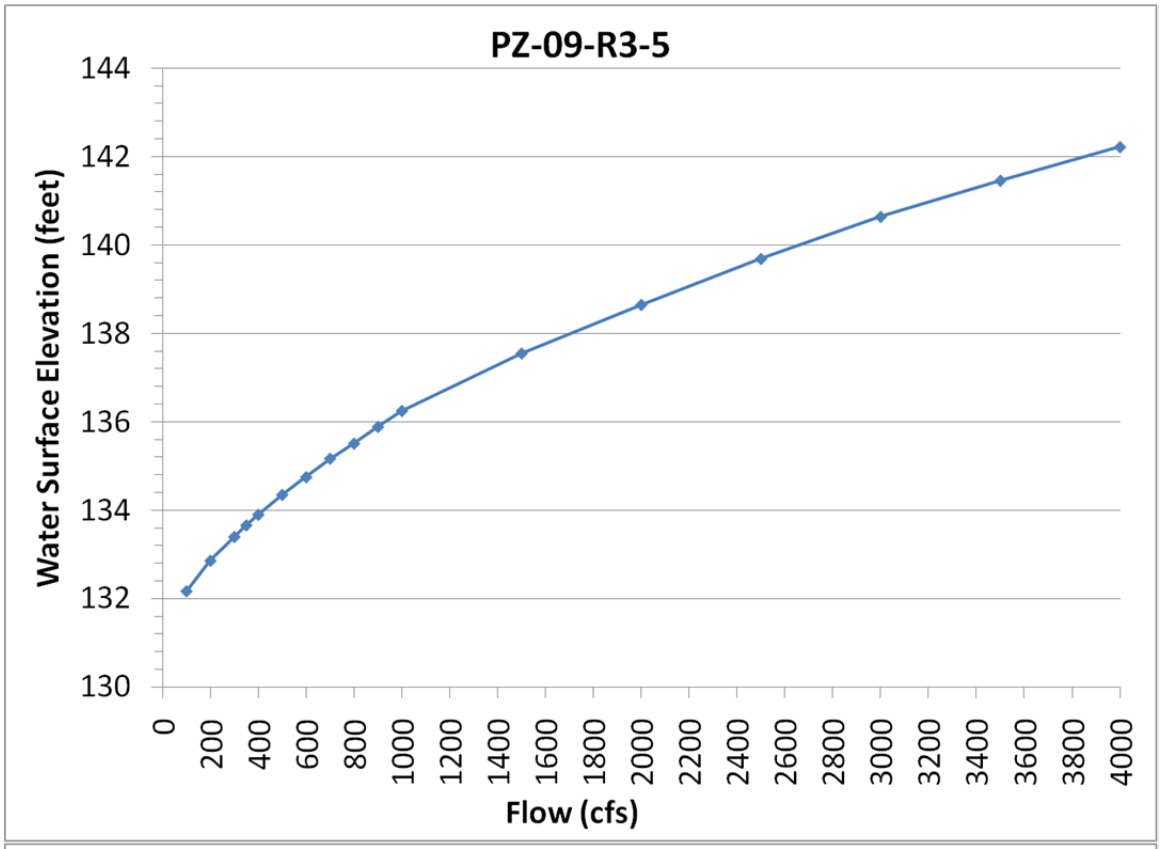

MA-4
Water Surface Elevation (feet)
174
172
170
168
166
164
162
160
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

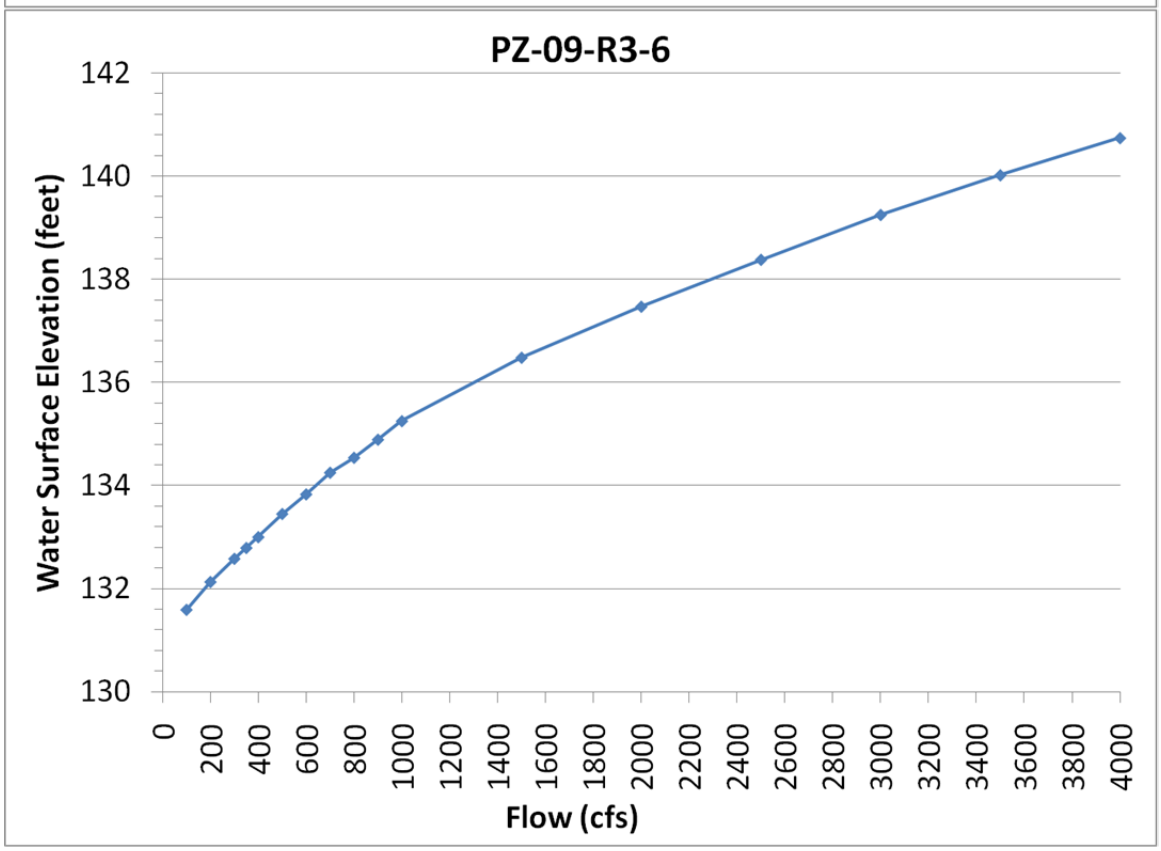

MW-09-49B
Water Surface Elevation (feet)
175
170
165
160
155
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

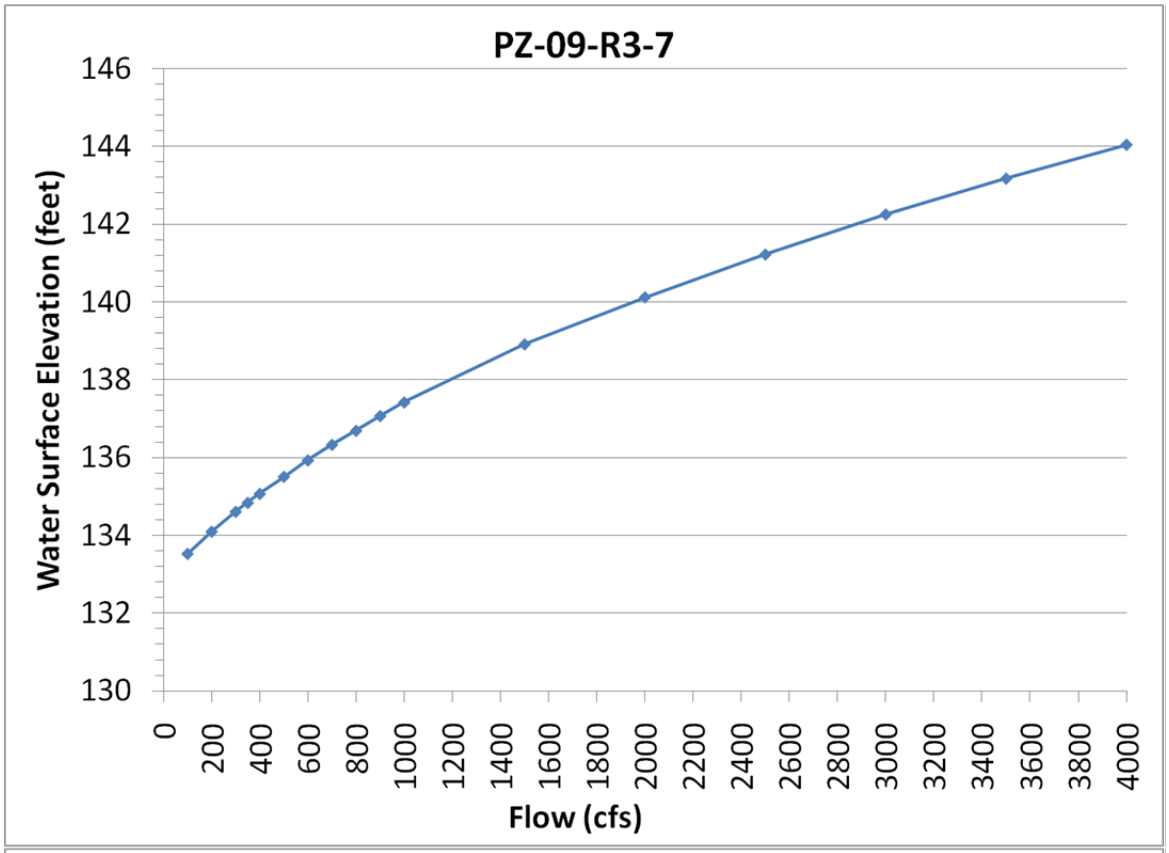

MW-09-54B and MW-09-55B
Water Surface Elevation (feet)
168
166
164
162
160
158
156
154
152
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

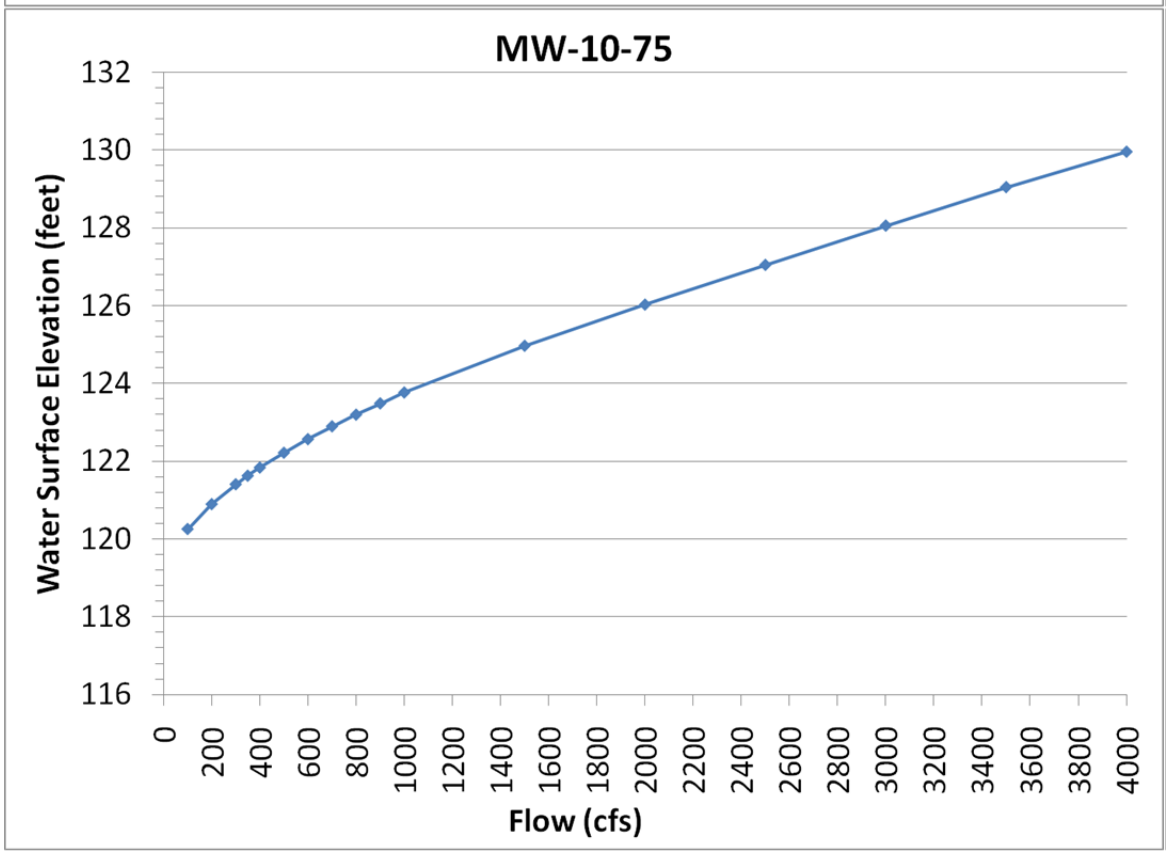

PZ-09-R2B-1
Water Surface Elevation (feet)
159
158
157
156
155
154
153
152
151
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

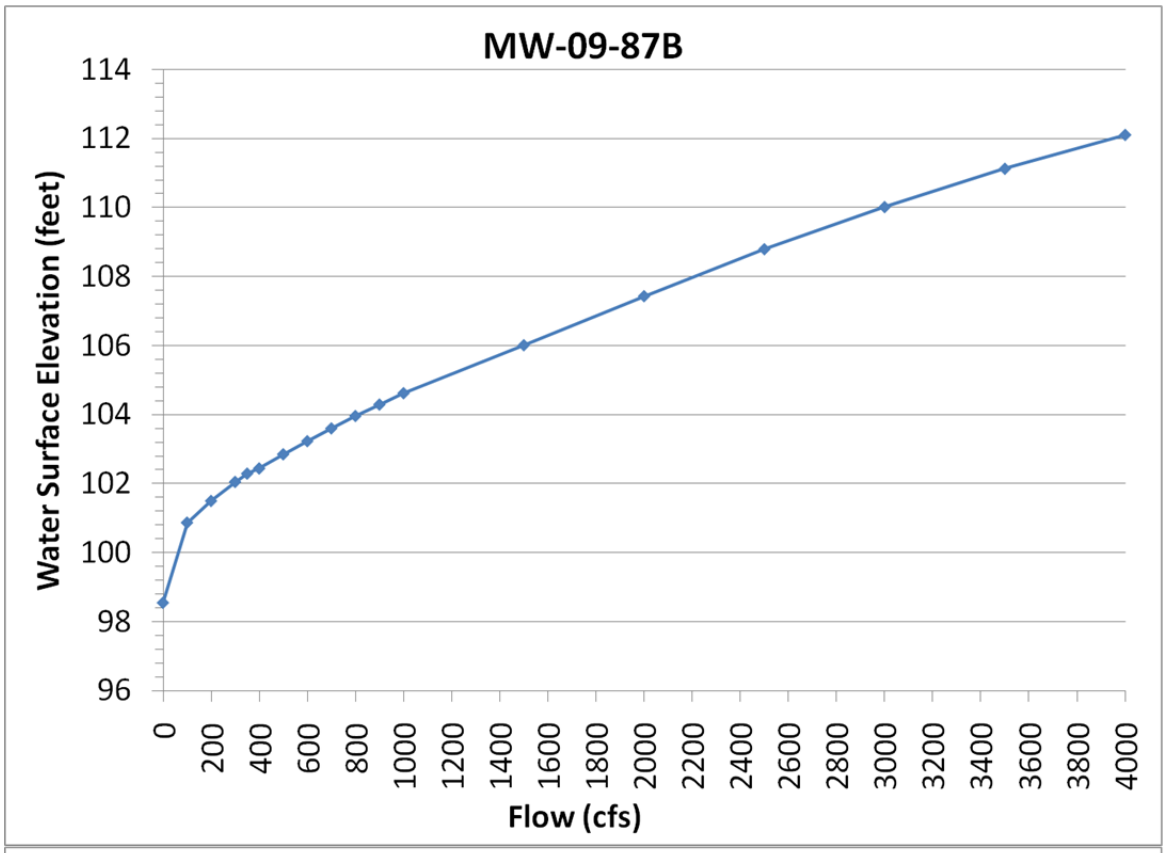

PZ-09-R2B-2
Water Surface Elevation (feet)
156
155
154
153
152
151
150
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

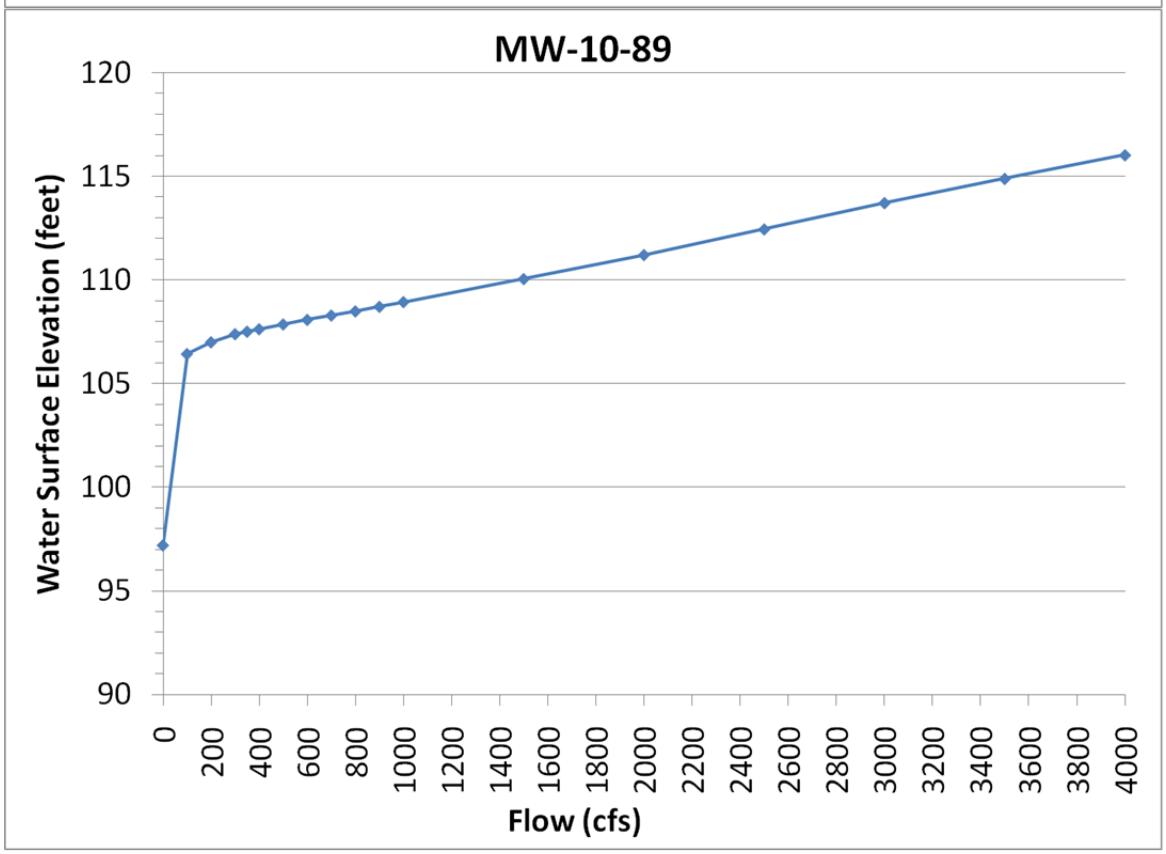

PZ-09-R3-5
Water Surface Elevation (feet)
144
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

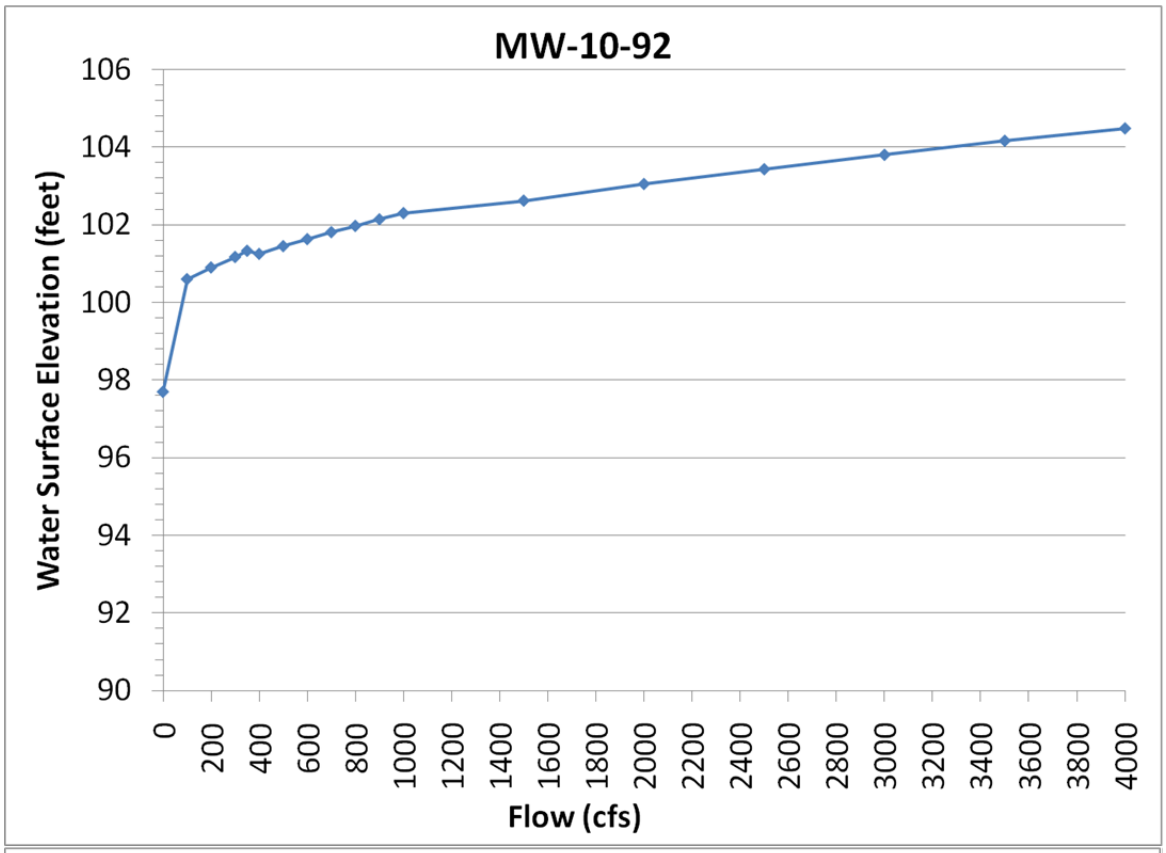

PZ-09-R3-6
Water Surface Elevation (feet)
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

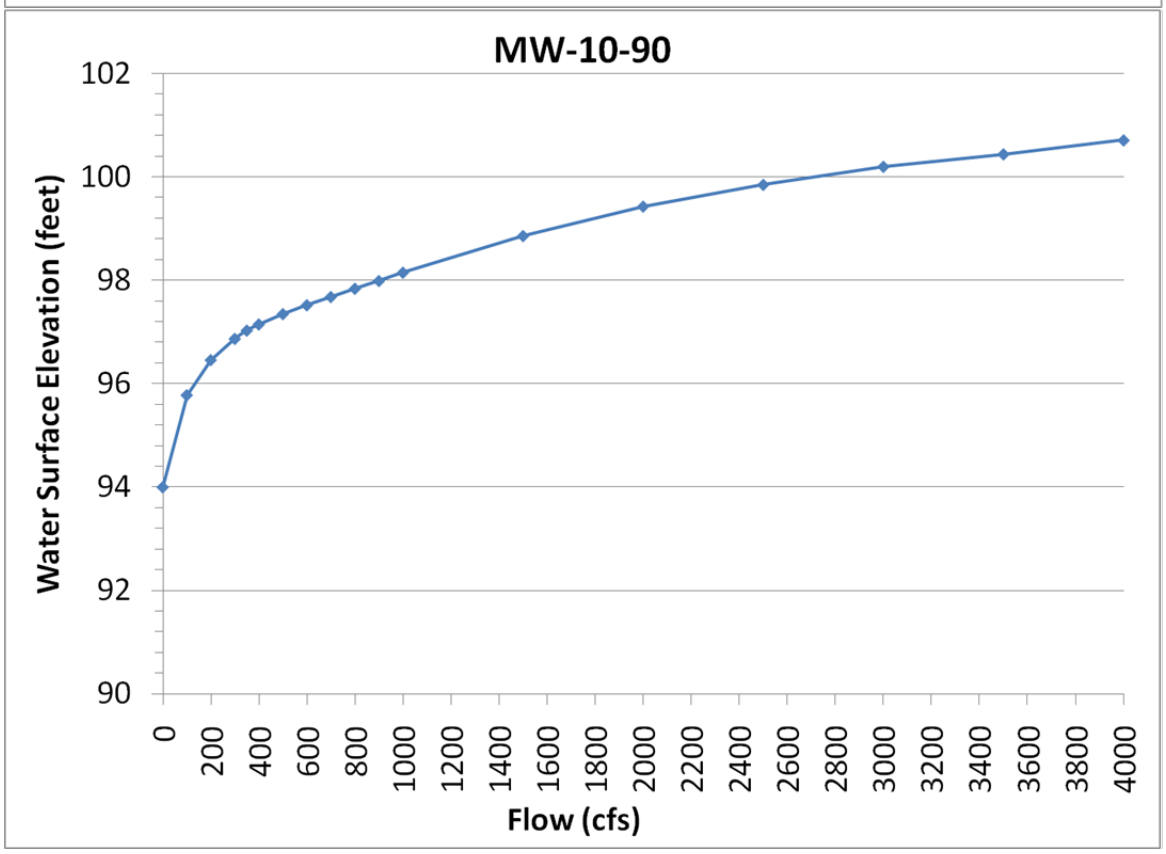

PZ-09-R3-7
Water Surface Elevation (feet)
146
144
142
140
138
136
134
132
130
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)

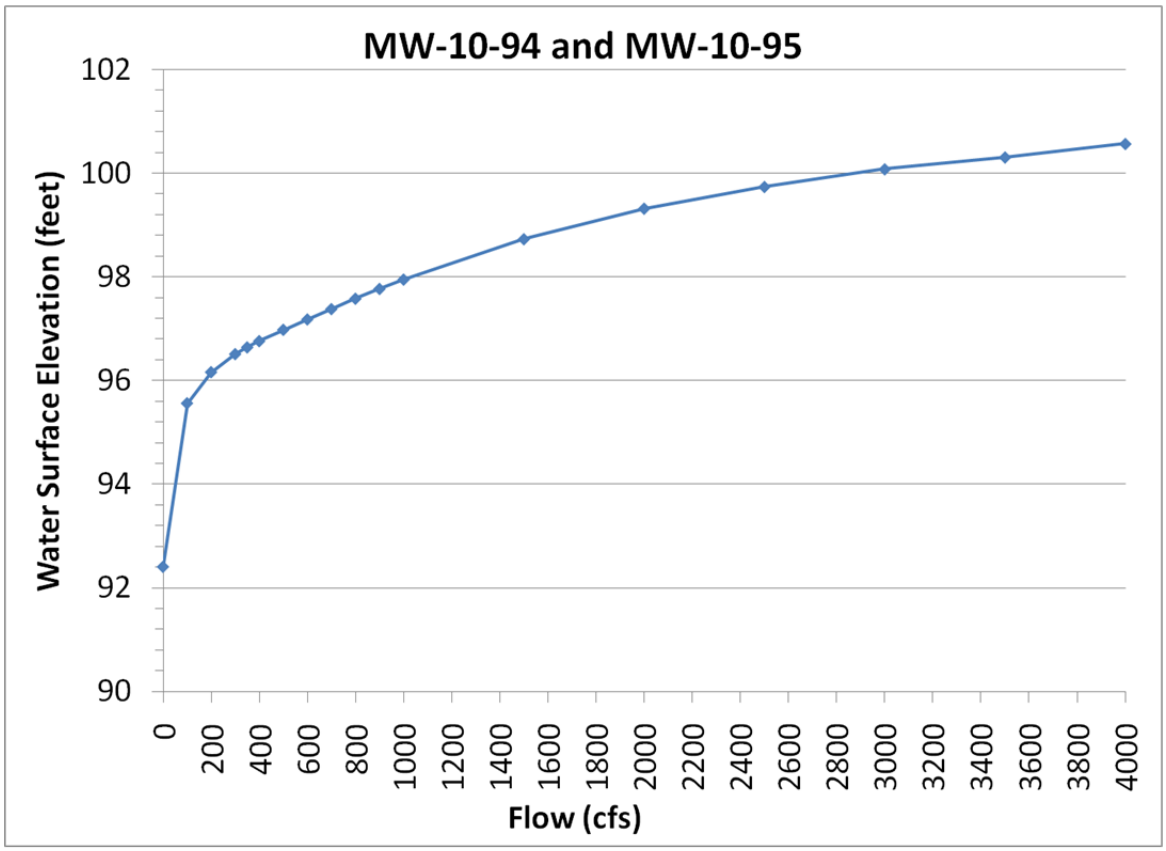

MW-10-75
Water Surface Elevation (feet)
132
130
128
126
124
122
120
118
116
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-09-87B
Water Surface Elevation (feet)
114
112
110
108
106
104
102
100
98
96
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-89
Water Surface Elevation (feet)
120
115
110
105
100
95
90
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-92
Water Surface Elevation (feet)
106
104
102
100
98
96
94
92
90
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-90
Water Surface Elevation (feet)
102
100
98
96
94
92
90
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)


MW-10-94 and MW-10-95
Water Surface Elevation (feet)
102
100
98
96
94
92
90
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
3400
3600
3800
4000
Flow (cfs)