Appendix H. Groundwater Level Thresholds

This appendix documents the ongoing development of thresholds associated with water levels measured in wells. This process has included input from stakeholders, and will continue to do so as part of the update and revision process.

H.1 Conceptual Development of Thresholds

Thresholds represent surface or groundwater elevations that may risk adverse impacts due to groundwater seepage. The SJRRP will operate to maintain groundwater levels below thresholds. Estimates of flow increases that would exceed a threshold will trigger a site visit and a response action. Crop type and associated rooting depths, soil type, and other factors vary spatially; therefore, the thresholds are customized to represent site conditions at each monitoring well location.

Events unrelated to river flows may also cause groundwater levels to exceed thresholds. For example, an irrigation event or local precipitation may cause a rapid rise in the water table. Such events would likely cause short-term saturation of the root zone resulting in little effect on crop health. Field notes during groundwater measurements and site visits would attempt to address this complication. Temporal aspects to groundwater levels, for example during the dormant season or fallow periods, may allow increased flows, in coordination with landowners, above threshold levels.

H.1.1 Purpose

The purpose of this appendix is to describe the development of groundwater level thresholds for SJRRP wells.

H.1.2 Objectives

The objectives of groundwater level thresholds development include:

- Determine the components to include in threshold development,
- Solicit stakeholder input and comments on each threshold component, and
- Determine the threshold values to use for each of the components.

H.1.3 Approach

Reclamation has developed two different methods to determine monitoring well thresholds. These include approaches based on: (1) idealized agricultural practices and (2) historical groundwater levels. The shallower threshold from these two methods is

used as the project threshold. Ideal agricultural root zones may be constrained by pre-existing groundwater tables.

H.1.3.1 Agricultural Practices Method

A conceptual model, shown in Figure H-1, has been developed for determining thresholds based on idealized agricultural practices. This model is based on input from landowners and water district managers. The model considers several different components including site characteristics, farming practices, and physical processes.

The components of the threshold model include:

- Effective Root Zone: provides an unsaturated zone to avoid waterlogging;
- Capillary Fringe: allows for the saturated (anoxic) portion of the capillary rise and maintain an aerated root zone; and
- Ground Surface Adjustment: adjusts for differences in elevation between the ground surface of the field and the ground surface at the monitoring well. Wells located in locations most convenient for landowners may not be in the most critical seepage location.

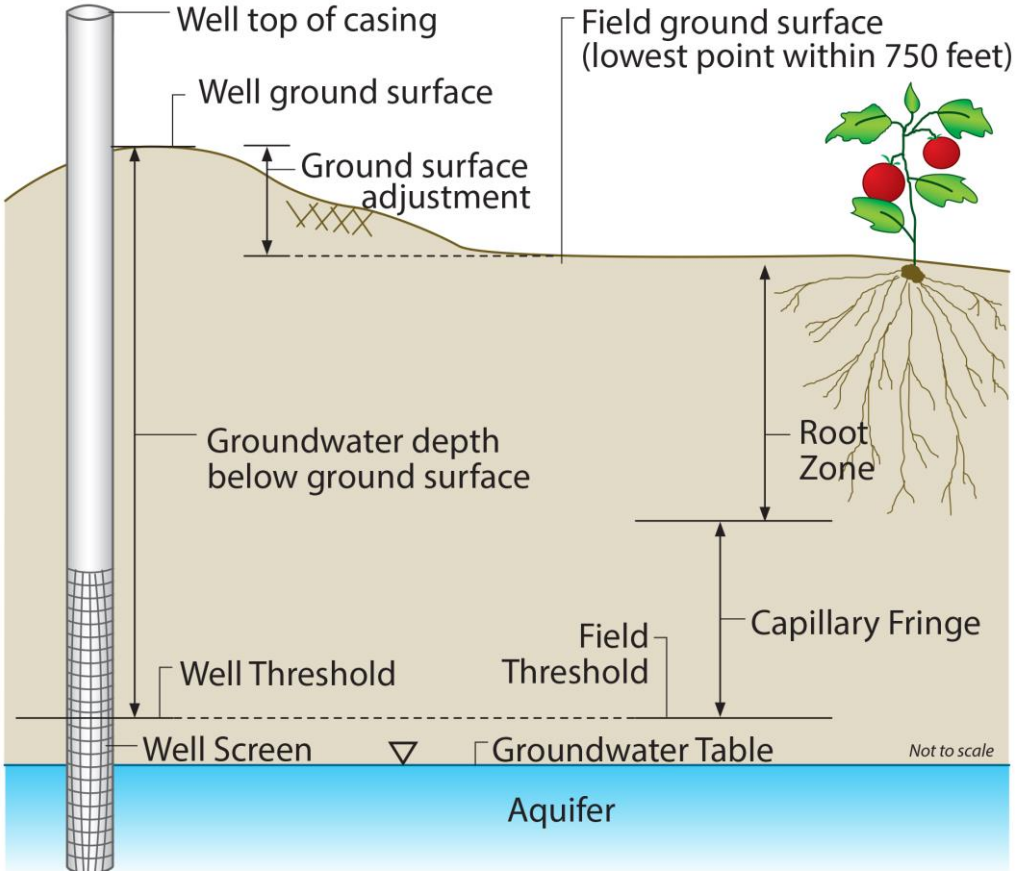

Figure H-1.
Schematic Diagram of Idealized Agricultural Practices Threshold Model

Field Threshold ($Threshold_{Field}$) is calculated according to the following:

$$Threshold_{Field} = h_{Root\ Zone} + h_{Capillary\ Fringe}$$

Where: $h_{Root\ Zone}$ = depth of the effective root zone; and
$h_{Capillary\ Fringe}$ = height of capillary fringe.

To monitor for groundwater levels at the field threshold in a monitoring well, which may not be located at the same elevation as the most critical location, a ground surface adjustment and lateral gradient buffer are applied. The Well Threshold ($Threshold_{Well}$) is defined as:

$$Threshold_{Well} = h_{RootZone} + h_{Capillary\ Fringe} + (Elevation_{WellGS} - Elevation_{FieldGS}) - LG_{Buffer}$$

Where: $Elevation_{WellGS}$ = elevation of the ground surface at a monitoring well; and
$Elevation_{FieldGS}$ = elevation of the ground surface within 750 feet of the well in the adjacent field.
LG_{Buffer} = lateral gradient buffer, as described in section H.1.3.3.

Thresholds may also include a time component, resulting in potentially different thresholds in spring than during other times throughout the year.

H.1.3.2 Historical Groundwater Method

In some locations along the San Joaquin River, historical groundwater measurements show elevations above the computed agricultural threshold. In locations where thresholds estimated using the agricultural practices approach are deeper than historical groundwater levels, the shallower historical groundwater level will be used. The historical threshold method results in more localized thresholds rather than generalizations.

Thresholds based on historical groundwater levels were developed using four methods:

- For wells with long-term groundwater level records, thresholds were calculated based on spring measurements of groundwater levels in those wells.
- For wells without long-term records, nearby wells with long-term records were used to calculate the threshold.
- For wells without long-term records and with no nearby wells, depth to water (DTW) maps were created; groundwater levels were interpolated between wells for a number of years and seasons. This analysis allows for using available groundwater level data in the region to inform the choice at each threshold location.
- For wells with groundwater level measurements available during the December 1, 2011 to January 31, 2016 period without Restoration or flood flows in Reach 3 and downstream, the shallowest groundwater level of a 3-point moving average was used within that period.

Additional methods could be used if identified later during the analysis process.

H.1.3.3 Lateral Gradient Buffer

Appendix J (Operations) describes the concept of the "lateral gradient buffer" and how this affects operations along the river. This buffer accounts for the fact that, in some areas (losing reaches), the groundwater table slopes away from the river. Without accounting for this slope, threshold calculations assume that the water table is horizontal. This horizontal water table assumption may result in thresholds in the field (away from the river) that are artificially too high, given the slope of the groundwater table. This buffer term adjusts the threshold to a more realistic estimate of depth, based on groundwater conditions in that area. The lateral gradient buffer relates the threshold in the well to the threshold in the field:

$$Threshold_{field} = Threshold_{well} - GS_{Buffer} + LG_{Buffer}$$

Where:

$Threshold_{field}$	Threshold in the field
$Threshold_{well}$	Threshold in the monitoring well
GS_{Buffer}	Ground surface buffer, or the difference in elevation between the well and the field within 750 feet of the well. This adjusts groundwater levels for wells located up on a levee or down in a channel to match the groundwater level under the field.
LG_{Buffer}	Lateral gradient buffer, to account for losing reaches where the groundwater table slopes away from the river

The Flow Bench Evaluation process (Appendix J) utilizes the thresholds in 14 wells to determine changes in Restoration Flow releases. At these 14 locations, Reclamation reviewed existing field data (groundwater level and river stage) to estimate the slope of the groundwater table, as the groundwater table drops away from the river. The slope is calculated based on the difference between either (1) the river stage adjacent to the monitoring well and the groundwater level in the wells in the well transect (if there is flow in the river) or (2) the assumed water table under the river and the groundwater levels in the well transect (no flow in the river). The slope of the groundwater table away from the river is multiplied by the distance between the groundwater well and the field to determine the lateral gradient buffer.

Table H-1 shows, for each of the 14 wells, the difference in elevation between the groundwater level in the well and the groundwater level in the adjacent field as the groundwater level decreases away from the river. This table also shows the range of differences seen at each well.

Table H-1. Difference Between Well and Field Groundwater Elevations[1]

Well	Reach	Bank	Minimum Difference (feet)	Maximum Difference (feet)	Average Difference (feet)	Lateral Gradient Buffer (feet)
FA-9	2A	Left	-1.6	3.6	-0.9	0.0
MA-4	2A	Right	-1.1	6.6	1.5	0.0
MW-09-47	2A	Right	-15.0	18.3	-7.7	0.0
MW-09-49B	2A	Left	-6.9	-0.1	-1.6	0.0
MW-09-54B	2B	Right	2.0	3.6	2.8	2.0
MW-09-55B	2B	Left	6.5	9.6	7.2	6.5
MW-10-75	3	Left	0.0	0.0	0.0	0.0
MW-10-89	4A	Right	0.0	0.0	0.0	0.0
MW-10-92	4A	Left	0.0	0.0	0.0	0.0
MW-11-130	4A	Left	0.0	0.0	0.0	0.0
MW-12-191	3	Right	-0.5	0.6	0.0	0.0
MW-14-208	4A	Right	0.0	0.0	0.0	0.0
PZ-09-R3-5	3	Right	-0.6	0.2	-0.1	0.0
PZ-09-R3-7	3	Right	-0.7	0.5	-0.2	0.0

Notes:
[1] Difference is calculated as the slope of (1) the river stage adjacent to the monitoring well to the groundwater level in the well (if there is flow in the river) or (2) the assumed water table under the river and the groundwater level in the well (no flow in the river), times the distance between the monitoring well and the adjacent field.

H.1.4 Next Steps

Thresholds, as a component of the SMP, may undergo revisions as additional information and historical groundwater analysis becomes available.

H.2 Method 1 - Agricultural Practices

This section describes the components of threshold development including the effective crop root zone, ground surface buffer, and capillary rise.

H.2.1 Effective Crop Root Zone

The establishment of an effective crop root zone includes the following:

- Identification of different effective root zones based on crop type.
- Inclusion of multiple effective root zones for each crop based on young and mature plants, if information is available.

H.2.1.1 Approach

The effective root zone refers to the soil depth within which a majority of a crop's root metabolic activity takes place. The effective root zone differs from the maximum root depth which describes the depth to which a particular crop's roots may penetrate given unrestricted growth conditions and no physical impediments. The effective root zone

generally occurs in the top few feet of soil (Erie et al., 1982) or in some cases in the top six inches (Hanaway and Larson, 2004), and can account for 60 to 70 percent of root mass, even for deep-rooted crops. The type of crop, soil texture, irrigation practices, and depth to the groundwater table affect crop rooting depth. Poorly drained soils generally restrict crop root growth (Sands, 2001). Fine-grained soils can restrict root growth of some crops, although grape root depth does not appear to be affected by soil texture (Smart et al., 2006). Irrigation practices can have important and variable impacts on root depth. For many crops, including alfalfa, proper irrigation results in more roots near the top of the soil column and fewer roots at depth (Speigel Roy, 1996; Abdul-Jabbar et al., 1982); however, this effect is not seen in cotton crops (McMichael et al., 2011). Because of the multitude of conditions that can affect root depth for different crops in diverse ways, only unrestricted root growth in soils with adequate drainage is considered here.

A literature review was conducted to identify sources of crop root depths. References include:

- Allen et al., Crop Evapotranspiration, Guidelines for Computing Crop Water Requirements, FAO Irrigation and Drainage Paper No. 56.
- Almond Board of California. Undated. Irrigation Management, California Almond Sustainability Program. Ed. Sonke, D., A. Arnold, G. Ludwig, and J Dlott.
- Carlson, L. and J. Bauder. 2005. Sugarbeet Agronomy 101. Montana State University. http://waterquality.montana.edu/docs/irrigation/sugarbeet101.shtml. Accessed September 25, 2012.
- Food and Agriculture Organization (FAO) of the United Nations, 2009 Crop Water Information.
- Scherer, T. 1997. Understanding Crop Water Availability. Water Spouts No. 228.
- South Jersey RC&D Council, Inc. Undated. http://www.sjrcd.org/ag/effective_root_zone.htm. Accessed September 24, 2012.
- University of California Division of Agriculture and Natural Resources Almond Production Manual Publication 3364
- University of California Division of Agriculture and Natural Resources Cotton Production Manual Publication 3352
- University of California Division of Agriculture and Natural Resources Small Grains Production Manual Publication 8167
- U.S. Department of the Interior, Bureau of Reclamation, Drainage Manual
- Weaver, J.E. 1926. Root Development of Field Crops. McGraw-Hill, New York.

- Westlands Irrigation District

The Reclamation Drainage Manual (page 48) does not make recommendations by crop type but generalizes two feet for shallow-rooted crops such as potatoes and vegetables and six feet for peach, walnut, and avocado trees. For most irrigated crops, a three to four-foot root zone can be used. The Reclamation Drainage Manual assumes adequate drainage and leaching for salinity control are provided.

Local information is available on tomato root zones from the Irrigation Training and Research Center (ITRC) report (Burt, 2010). This local information was used over other sources. In general, an integer value towards the high end of the FAO identified effective root zone was used as a threshold for all crop types.

H.2.1.2 Results

Table H-2 below shows effective crop root depths by crop type. The ranges in Table H-2 are due to variations in soil type and time in the growing season.

Table H-2. Maximum Effective Crop Root Depths

Crop	Effective Root Depth (feet)[1]
Alfalfa (Hay)	3.3-6.6 5 [2]
Almonds	3.3-6.6 2.5 [3]
Barley	3.3-4.9 3.5 [2]
Lima Beans	2.6-3.9
Cotton	3.3-5.6
Grape	3.3-6.6 2 [4]
Corn	3.3-5.6 (sweet) 2.6-3.9 (field) 4 [2]
Melon	2.6-4.9 2 [4]
Pistachio	3.3-4.9
Safflower	3.3-6.6
Spring Wheat Winter [7]	3.3-4.9 3.5 [2] 2 [4, 5]
Sugar Beet	2.3-3.9 4 [2] 3.3 [6]
Tomato	2.3-4.9 2 [4]
Wheat (Fall Planted)	3.3-4.9 2 [4, 5]

Notes:
[1] Unless otherwise noted, root depths from Food and Agriculture Organization of the United Nations, 2009
[2] Scherer, 2007
[3] Almond Board of California, Undated
[4] South Jersey RC&D Council, Undated
[5] Weaver, 1926
[6] Carlson and Bauder, 2005
[7] Hard red spring wheat planted during the winter growing season

For the purposes of the SMP, buffer zones, and action level thresholds, the root zone values are summarized in Table H-3.

Table H-3. Root Zone Values

Crop	Root Zone Depth
Sugar beet, lima beans	4 feet
Assumed annual crop, cotton, tomatoes, melon, pistachio, corn, palms, grain (wheat, barley)	5 feet
Alfalfa, grapes, pomegranates, safflower	6 feet
Almonds	6 feet

H.2.1.3 Limitations

Limitations of this analysis include:

- This approach does not address soil type or irrigation methods which could affect root zones and may restrict root growth to shallower depths.
- These values do not take into consideration the effects of a historically shallow water table on crop root depths or seasonal or long term trends in the water table. However, by selecting the shallowest of the agricultural or historical thresholds, this is addressed.
- The root zone buffer is chosen based on root zone depth of mature crops. This depth is not modified to accommodate the age of the crop.
- Field crops are generally rotated each year, which may require changing thresholds on an annual basis as cropping patterns change. Landowners should review the SMP and notify the SJRRP when crop changes may require adjustments to the root zone assumptions.

H.2.2 Ground Surface Adjustment

Adjustments due to differences in ground surface elevation intend to:

- Represent groundwater levels below agricultural fields near monitoring wells where groundwater levels are measured, and
- Adjust the groundwater well threshold based on the difference between the elevation of the ground surface in the adjacent field and the ground surface elevation at the monitoring well.

H.2.2.1 Approach

The ground surface adjustment (or buffer) is determined from groundwater well metadata and updated field observations. For wells without a measured ground surface adjustment, the value is calculated as the difference in the ground surface elevation between the monitoring well and the point in the field with lowest elevation within 750 feet of the well. Roads, ditches, and canals are excluded as they do not represent field elevations.

Ground surface adjustments were calculated using ground surface elevations from two sources: (1) 2008 Light Detection and Ranging[1] (LiDAR) survey and; (2) USGS's National Elevation Dataset (NED). The LiDAR survey was flown within approximately one-quarter to one mile on either side of the San Joaquin River and flood control bypasses. The LiDAR data has a resolution of approximately 5 feet while the NED data has a resolution of approximately 30 feet. Wells located within the LiDAR survey zone have two sets of ground surface adjustments (one from LiDAR and one from NED data set). For these wells the ground surface adjustment from the LiDAR data is used as the LiDAR data has better resolution. Some wells are at boundary of the LiDAR survey zone

[1] An optical remote sensing technology that measures properties of scattered light to find topographic information.

and the 750 feet buffer zone does not completely fall under the LiDAR survey zone. For these wells, if more than 60 percent of the buffer zone falls within the LiDAR survey zone, then the LiDAR ground surface adjustment is used. Wells with less than 60 percent of the buffer zone within the LiDAR survey zone or outside the LiDAR survey zone use NED based ground surface adjustments.

Figure H-2 shows an example of the 750-foot buffer zone that is partially missing due to the lack of available LiDAR data. For this well more than 60 percent of the buffer zone had LiDAR data, so LiDAR data was used for the ground surface adjustment calculation.

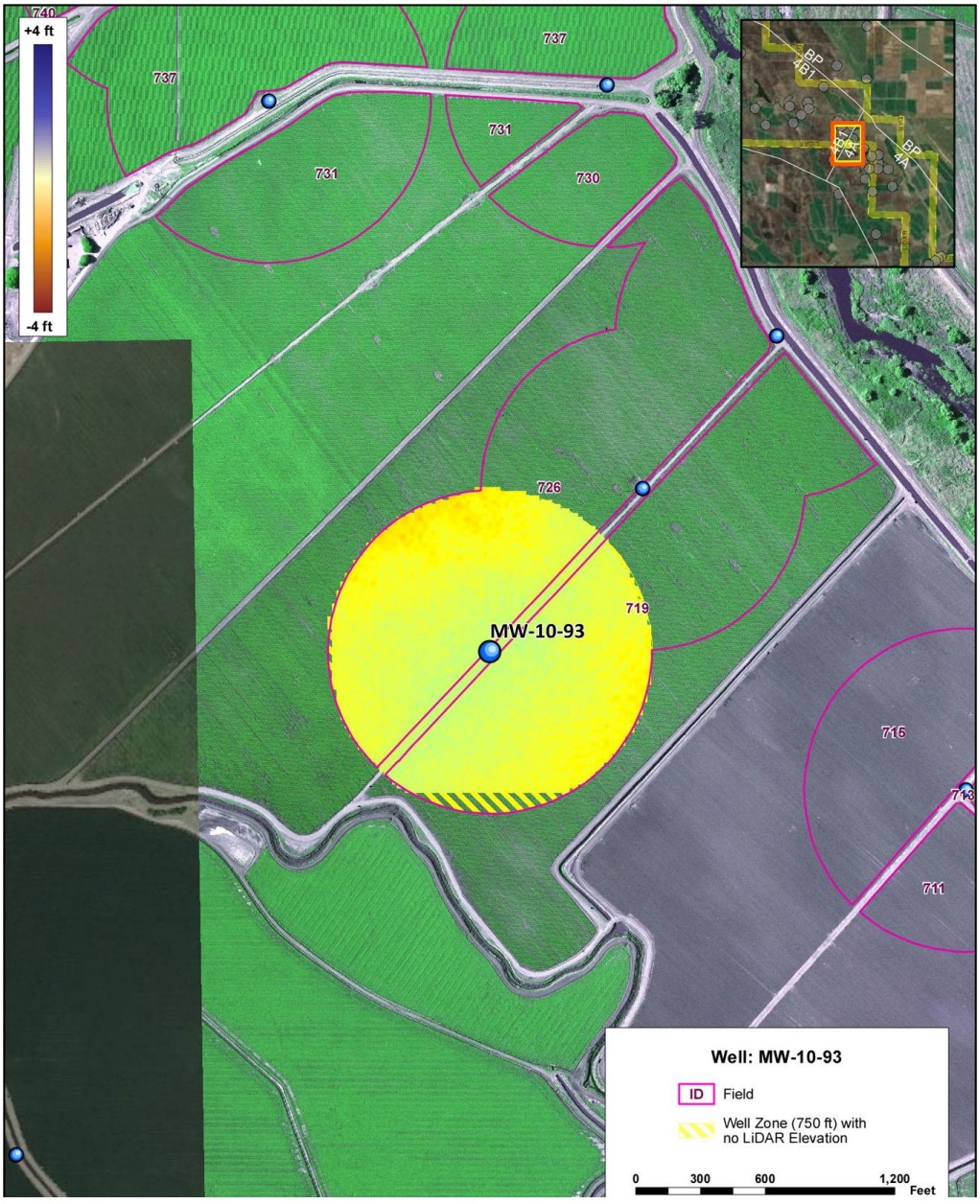

Figure H-2.
Monitoring Well MW-10-93

The difference between the ground surface elevation at the well and the minimum field elevation within 750 feet of the well was used as the ground surface buffer. A negative ground surface buffer indicates that the well is located lower than the adjacent field, such as in the river channel. An example of this is shown in Figure H-3.

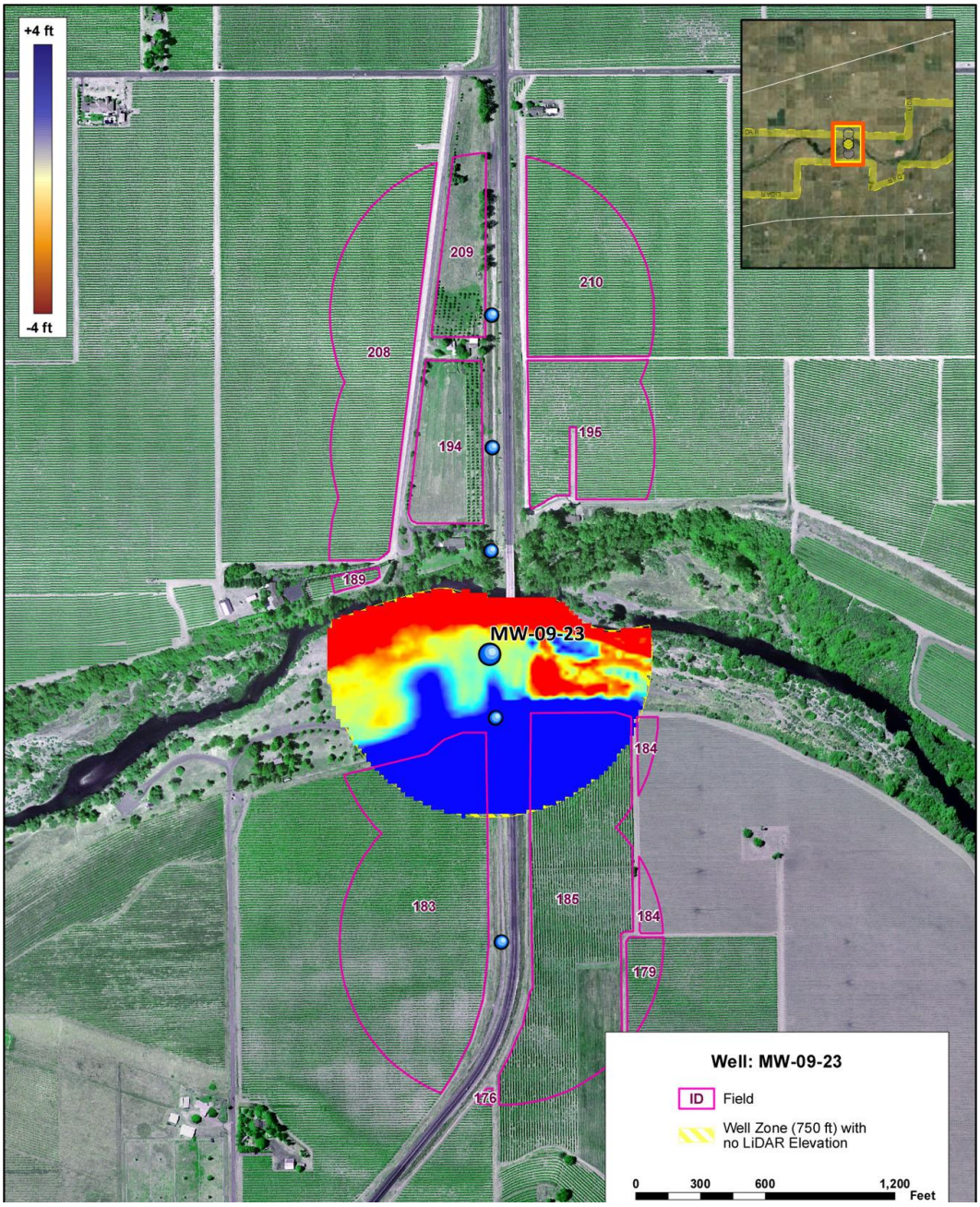

Figure H-3.
Monitoring Well MW-09-23

H.2.2.2 Results

Ground surface adjustments are shown per well in Table H-4 below. Wells within the groundwater monitoring well network that are not included in Table H-4 are assumed to have a ground surface adjustment of zero feet.

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
110		0.3	0.3
111		0.0	0.0
118		1.7	1.7
119		2.1	2.1
120		0.3	0.3
121		0.3	0.3
126		0.7	0.7
127		2.3	2.3
128		4.6	4.6
129		1.5	1.5
130		0.7	0.7
131	2.8	3.2	2.8
132	2.2	0.8	2.2
133		2.3	2.3
134		2.1	2.1
135		0.3	0.3
136		2.6	2.6
139		0.7	0.7
140		0.7	0.7
141		1.0	1.0
142	0.4		0.4
143	2.1		2.1
145	3.1		3.1
146	5.2		5.2
147		1.0	1.0
148		2.3	2.3
151	5.4		5.4
152	2.9		2.9
153		3.6	3.6
154	2.3		2.3
155	3.3		3.3
156	6.0		6.0

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
157	1.3		1.3
158	4.0		4.0
159	2.3		2.3
161		5.8	5.8
162		0.7	0.7
163		4.6	4.6
164	5.0		5.0
167		4.5	4.5
169		0.7	0.7
181		0.5	0.5
182		0.7	0.7
183		2.0	2.0
184	2.9		2.9
187	0.3		0.3
189	4.6	1.4	4.6
190	1.8	1.0	1.8
191	2.9		2.9
350	3.9	1.0	3.9
355	1.1	2.3	1.1
356	0.7	1.0	0.7
357	3.7	1.3	3.7
358	7.0	2.0	7.0
359	6.8	0.3	6.8
360	5.6	0.3	5.6
361	6.2	1.6	6.2
362	2.3	0.0	2.3
363		2.9	2.9
364	8.6	9.0	8.6
365		0.3	0.3
366		0.7	0.7
367	5.2	5.0	5.2
368	4.4	-0.3	4.4
370	3.3	2.2	3.3
371	0.6	0.4	0.6
372		0.1	0.1
373		0.0	0.0

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
374	0.4	1.3	0.4
375	1.2	1.0	1.2
376	2.3	2.3	2.3
377	2.6	4.8	2.6
378	2.8	0.0	2.8
379	4.0	1.9	4.0
385	1.7	1.4	1.7
386	1.9	0.2	1.9
387	1.2	0.0	1.2
388	2.0	0.3	2.0
389	2.8	0.7	2.8
390	3.4	2.0	3.4
132A	1.4	3.3	1.4
144A	2.1		2.1
165A		0.1	0.1
166A		0.8	0.8
186A	2.0		2.0
188A		1.7	1.7
CNOW-13-50	1.0	0.0	1.0
CNOW-14-52	0.7	0.0	0.7
CWOW-14-15	1.8	0.0	1.8
CWSPT-15	0.9	0.0	0.9
FA-1	1.8		1.8
FA-2	2.2		2.2
FA-3	1.5		1.5
FA-4	-4.6		-4.6
FA-5	-4.7		-4.7
FA-6	4.8		4.8
FA-7	5.6		5.6
FA-8	1.7		1.7
FA-9	3.7		2.0
MA-1	1.7		1.7
MA-2	2.9		2.9
MA-3	0.9		0.9
MA-4	6.1		6.1
MW-09-21	5.8		5.8

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
MW-09-22	3.4		3.4
MW-09-23	-8.8		-8.8
MW-09-23B	-8.8		-8.8
MW-09-25	-9.6		-9.6
MW-09-26	-5.9		-5.9
MW-09-27	-6.7		-6.7
MW-09-36	4.5		4.5
MW-09-37	4.2		4.2
MW-09-37B	3.0		3.0
MW-09-39	1.6		1.6
MW-09-39B	0.5		0.5
MW-09-41	-3.4		-3.4
MW-09-44	4.4		4.4
MW-09-46	4.3		4.3
MW-09-47	3.5		2.5
MW-09-49	1.8		1.8
MW-09-49B	1.7		1.7
MW-09-52	0.9		0.9
MW-09-53	1.4		1.4
MW-09-54	7.7		7.7
MW-09-54B	7.9		7.9
MW-09-55	5.4		5.4
MW-09-55B	3.7		3.7
MW-09-56	1.7		1.7
MW-09-57	1.6		1.6
MW-09-84	3.4		3.4
MW-09-85	7.1		7.1
MW-09-85B	6.9		6.9
MW-09-86	8.0		8.0
MW-09-86B	7.9		7.9
MW-09-87	2.0		2.0
MW-09-87B	1.9		1.9
MW-09-88	2.2		2.2
MW-10-74	4.2		4.2
MW-10-75	0.5		0.5
MW-10-76	2.7		2.7

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
MW-10-78	3.0		3.0
MW-10-89	3.4		1.0
MW-10-91	3.7		3.7
MW-10-92	2.6		1.0
MW-10-93	2.2		2.2
MW-10-95	1.2		1.2
MW-10-96	2.0		2.0
MW-10-97	3.4		3.4
MW-10-98	4.0		4.0
MW-10-99	4.7		4.7
MW-10-100	4.5		4.5
MW-10-102	2.4		2.4
MW-10-103	4.6		4.6
MW-10-105	1.4		1.4
MW-10-106	2.0		2.0
MW-10-107	2.7		2.7
MW-10-108	1.7		1.7
MW-10-109	1.5		1.5
MW-10-110	1.8		1.8
MW-10-111	1.8		1.8
MW-10-113	4.4		4.4
MW-10-114	1.9		1.9
MW-10-118	2.4		2.4
MW-10-119	2.4		2.4
MW-10-129	0.6		0.6
MW-10-188	2.1		2.1
MW-12-165	2.2		2.2
MW-12-166	1.6		1.6
MW-12-167	1.0		1.0
MW-12-168	2.8		2.8
MW-12-169	3.5		3.5
MW-12-170	1.7	0.0	1.7
MW-12-171		1.0	1.0
MW-12-172	1.8	0.4	1.8
MW-12-173		0.7	0.7
MW-12-174		1.3	1.3

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
MW-12-175		1.0	1.0
MW-12-176	3.2	1.7	3.2
MW-12-177	1.3		1.3
MW-12-178	3.7	0.0	3.7
MW-12-179	1.3	0.0	1.3
MW-12-180		0.0	0.0
MW-12-181	1.4	0.2	1.4
MW-12-182		1.3	1.3
MW-12-183	4.6	0.3	4.6
MW-12-184	7.0	0.7	7.0
MW-12-185	4.2	4.2	4.2
MW-12-186	8.7	2.6	8.7
MW-12-187	3.6	0.0	3.6
MW-12-189	4.0	2.5	4.0
MW-12-190	2.4	-0.2	2.4
MW-12-191	2.7	2.1	1.0
MW-12-192	3.0	1.7	3.0
MW-13-193	1.6	0.0	1.6
MW-13-194	1.1	0.0	1.1
MW-13-195	6.5	4.3	6.5
MW-13-196	3.0	-1.7	3.0
MW-13-197	4.9	0.0	4.9
MW-13-198	2.5	0.0	2.5
MW-13-199	6.0	3.4	6.0
MW-13-200	8.1	3.2	8.1
MW-13-201	2.9	6.4	2.9
MW-13-202		0.0	0.0
MW-13-210	5.2	-0.9	5.2
MW-13-211		0.0	0.0
MW-13-212	3.0	0.0	3.0
MW-13-213	3.1	0.7	3.1
MW-13-214	1.5	1.7	1.5
MW-13-215	0.9	-0.5	0.9
MW-13-216	0.4	0.3	0.4
MW-14-203	2.3	4.2	2.3
MW-14-204	1.7	0.0	1.7

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
MW-14-205	1.7	0.4	1.7
MW-14-206	6.2	0.1	6.2
MW-14-207	5.6	1.7	5.6
MW-14-208	2.1	0.0	1.0
MW-14-209	1.2	0.7	1.2
PZ-09-R2B-2	3.9		3.9
PZ-09-R3-3	4.3		4.3
PZ-09-R3-5	1.2		1.2
PZ-09-R3-7	0.7		0.7
PZ-12-R4B-10	1.0	1.1	1.0
PZ-12-R4B-10D	1.0	1.1	1.0
PZ-13-R2B-7	-6.1	0.0	-6.1
PZ-13-R2B-8	1.2	0.0	1.2
PZ-13-R4A-2	-8.0	-1.1	-8.0
SJR W-1	1.8		1.8
SJR W-2	4.2		4.2
SJR W-3	3.8		3.8
SJR W-4	1.1		1.1
SJR W-5	1.9		1.9
SJR W-6	4.4		4.4
SJR W-7	4.0		4.0
SJR W-8	3.3		3.3
SJR W-9	1.1		1.1
SJR W-10	1.8		1.8
SJR W-11	1.8		1.8
SJR W-12	2.1		2.1
SLCC-011	2.3	5.6	2.3
SLCC-012	1.5	0.0	1.5
SLCC-019	1.5	0.6	1.5
SLCC-027	2.8	0.0	2.8
SPT-11-1	5.1	-2.2	5.1
SPT-11-2	11.3	-1.6	11.3
T10-1 (1m)	-6.6	-0.6	-6.6
T10-1 (3m)	-6.6	-0.6	-6.6
T12-1	-6.6	0.0	-6.6
T12-2	-3.8	0.0	-3.8

Table H-4. Ground Surface Adjustment

Well	Ground Surface Adjustment using LiDAR data[1] (feet)	Ground Surface Adjustment using NED data[1] (feet)	Ground Surface Adjustment (feet)
T13-2	-5.3	0.0	-5.3
T13-3	0.1	0.0	0.1

[1] Calculated as [Ground surface elevation at monitoring well] minus [Minimum ground surface elevation within 750 feet of the well in the adjacent field]

H.2.2.3 Limitations

Limitations of this analysis include:

- This approach assumes the groundwater level measured at a monitoring well represents the groundwater level under the lowest point within 750 feet of the well in the adjacent field. It does not address ground slope away from the river and assumes there is no groundwater table gradient within 750 feet of each well.

- The lowest adjacent field elevation within 750 feet may not represent a large acreage of the actively growing adjacent crop. The adjacent field could have a small depression that would result in a large ground surface adjustment and a conservative threshold in the well. Reclamation has confirmed the ground surface adjustments for priority wells with in-field observations.

H.2.3 Capillary Fringe Objectives

This section addresses the inclusion of a capillary fringe buffer with the intentions of accounting for the tension saturated (anoxic) capillary fringe.

H.2.3.1 Approach

The height of the capillary fringe depends on soil texture, depth to the water table, evaporative demand of the atmosphere, and land use (Belitz, 1993). Fine-grained soil texture with broad distribution of grain sizes contains small pores, which increases the capillary rise (Hackett, 1927; Carman, 1941). A deeper water table will often have a larger capillary fringe. In addition, crop roots transpire water, affecting capillary rise and concentrating salts.

Shallow groundwater impacts include potential saturation of the crop root zone and the movement of dissolved salts and potential to increase the salinity of the soil root zone. Saturation of the crop root zone is addressed in this section by including a capillary fringe buffer for the anaerobic (tension saturated) portion of the capillary fringe.

A water table and associated capillary rise under actively growing crops can increase soil moisture and supply some of the crop water demand, reducing irrigation (Ramirez, 1996). If the water table is too deep, then groundwater is not able to move up far enough, or at a rate fast enough, to supply much of the crop demand. If the water table is too shallow and encroaches on the root zone then crop production will suffer due to lack of air in the

root zone. Also, if the water table is too saline, the crop cannot use much of the groundwater.

For this approach, capillary rise refers to the full range of capillary moisture above the water table and capillary fringe refers to the tension saturated, anoxic portion of the capillary rise.

The illustrations presented in Figures H-4 and H-5 (adapted from Sands, 2001) show the relationship of soil capillary rise potential vs. the amount of saturation and air in the soil pore space. Capillary forces can conduct water several feet above a water table in medium and fine textured soils. A large portion of the capillary rise above the water table contains air and water and is not detrimental to plant root growth from a water logging standpoint. The capillary rise is a zone above a water table that is nearly saturated near the base and just above field capacity at the top. Field capacity is representative of the condition when a fully saturated soil profile is allowed to drain for 12 to 24 hours, where the water is held under slight tension often defined as 1/3 bar or 1/3 atmospheric pressure (Brady, 1974). Only the part of the capillary rise that is immediately above the water table is the area of concern for water-logging and could be included in the monitoring threshold. For the purposes of the SMP, only this anoxic portion will be included in the capillary fringe buffer.

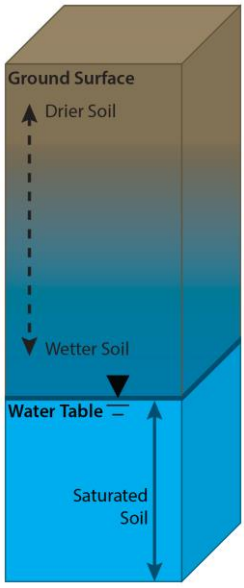

Figure H-4.
Soil Moisture Variation above the Water Table
(adapted from Sands, 2001)

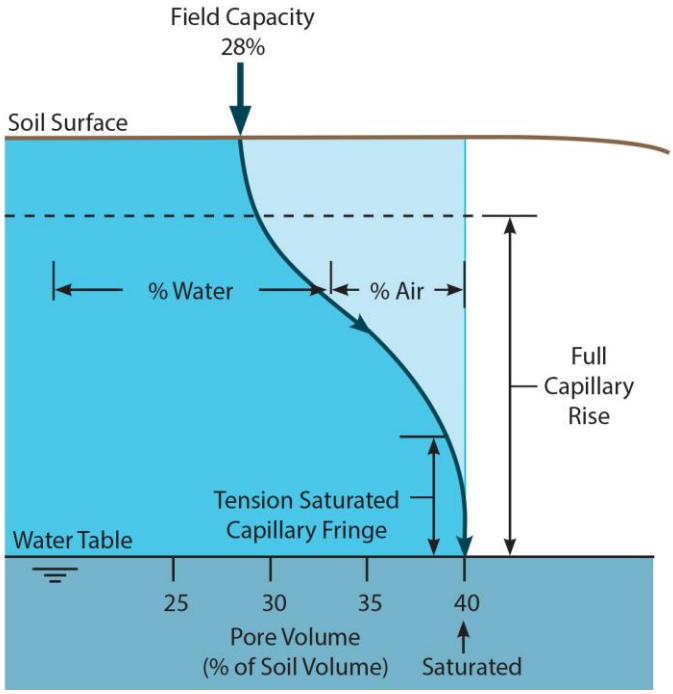

Figure H-5.
Proportion of Air- and Water-Filled Pores between the Water Table and the Soil Surface after the Downward Flow of Water Ceases
(adapted from Sands, 2001)

The lower, tension saturated portion of the capillary rise is considered too wet for crop health and few roots penetrate this zone. However, crops do use water from the top portion of this capillary rise zone which has more entrapped air. Capillary fringes may be thicker in the non-growing season, under roads and other barren areas, and when water tables are deeper in the substrata.

Usually entrapped air, soil stratification, and the discontinuity of soil pores and structural channels limit the thickness of a capillary fringe.

Capillary fringe values used in this analysis include values from literature, input from university experts, and local observations. References include:

- Aghajani, H. F., A. S., Piltan, and T. Shourijeh. 2011. An improved solution to capillary rise of water in soils. International Journal of Civil Engineering, Vol. 9, No. 4.

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- University of Colorado Boulder. Undated. Water in soils: infiltration and redistribution. http://www.colorado.edu/geography/class_homepages/geog_3511_s11/notes/Notes_8.pdf Accessed November 30, 2015.

- Webster, D.H. and G.C. Topp. 1983. Measurement of capillary rise under field conditions and related soil properties. Kentville Research Station Technical Bulletin No. 3. Research Branch Agriculture Canada.

Literature review on capillary fringe values and consultations with University experts verify that capillary rise determination is complex and variable with soil conditions. As a result, experts agree that published values of capillary fringe represent good approximations of capillary fringe thickness in various soil types and additional field investigation may only improve these estimates incrementally.

The most widely cited literature values are summarized in the Handbook of Soil Science (Sumner 1999) and consider capillary fringe studies in over 1,320 soils across 32 states. These are presented in Table H-5 below.

Table H-5. Soil-Water Parameters of Saturated Soils

Soil Type	Saturated Hydraulic Conductivity (cm/hr)	Total Porosity (cm^3/cm^3)	Estimated Capillary Rise (inches)
Sand	21.00	0.437	6.4
Loamy sand	6.11	0.437	8.24
Sandy loam	2.59	0.453	12.08
Loam	1.32	0.463	16.04
Silt loam	0.68	0.501	20.36
Clay loam	0.23	0.464	22.56
Sandy clay loam	0.43	0.398	23.76
Silty clay loam	0.15	0.471	28.12
Silty clay	0.09	0.479	30.6
Sandy clay	0.12	0.43	31.8
Clay	0.06	0.475	34.24

Source: Handbook of Soil Science. Ed. Sumner. 2000. CRC Press LLC, Boca Raton, FL. Adapted from Rawls et al. (1982) and Brakensiek and Rawls (1992).

Soil boring logs from 85 local SJRRP soil sampling sites collected in March and April of 2010 were also reviewed to determine the potential thickness of capillary fringe zones in soils of various textures on lands near the San Joaquin River. These are presented in Table H-6.

Drill logs or soil boring logs (when available) were examined to determine soil textures in the monitoring wells from four to six feet deep. Many soil sampling sites were offset from stakes that were planned for future monitoring well sites when wells had not yet been drilled. In some cases, the drill logs had fill. Under these circumstances the texture evaluation was four to six feet below the fill or the native soil boundary as noted on the logs for the subsurface profile. Each well was assigned a capillary fringe thickness based on this analysis. Capillary fringe thicknesses for each well are presented in Table H-6.

H.2.3.2 Results

A summary of the findings from the review of soil logs is presented below in Table H-6. These observations reflect shallower soil profile conditions within field crops in the growing season.

Table H-6. Capillary Fringe Thickness

Category	Soil Texture	Number of Observations	Average Rise (Inches)	95% Confidence Range (Inches)
1	Sand, loamy sand	15	6.9	4.1 – 9.1
2	Sandy loam, loamy fine sand	4	13.75	9.5 – 18.1
3	Fine sandy loam, loam, silt loam, very fine sandy loam	21	18.3	14.3 – 22.3
4	Clay loam, silty clay loam, clay	6	10.3	5.1 – 15.5
2 and 3	Loamy fine sand, silt loam	25	17.6	14.1 – 20.9

Based on the data provided in the literature, input from subject matter experts, and observations of local field conditions presented above from soil sampling sites (mostly in Reaches 4A and 4B) Table H-7 provides the capillary rise thicknesses for use in the SMP.

Values from Table H-7 will be the default capillary fringe values applied for well thresholds. Any capillary fringe site specific field studies conducted in the future will also be considered in establishing agricultural method thresholds. The greater capillary fringe value (more protective) between Table H-7 and site specific results will be used in assigning the threshold. The corresponding threshold tables will be updated accordingly and posted on the website.

Table H-7. Capillary Fringe Values for Agricultural Method

Soil Type	Capillary Fringe (inches)	Capillary Fringe (feet)
Sand	6	0.5
Loamy sand; very fine sand; fine sand	8	0.7
Sandy loam; loamy very fine sand; loamy fine sand	12	1.0
Very fine or fine sandy loam; silt loam; loam	20	1.7
Sandy clay loam; clay loam	24	2.0
Silty clay loam	28	2.3
Sandy clay; silty clay	32	2.7
Clay	36	3.0

Values adapted from Handbook of Soil Science. Ed. Sumner. 2000. CRC Press LLC, Boca Raton, FL. Adapted from Rawls et al. (1982) and Brakensiek and Rawls (1992).

The following assumptions were used for the capillary fringe estimates:

- Values were adapted from literature summarized in the Handbook of Soil Science (Sumner 1999), which considers a broad range of soil characteristics.
- The soil physical characteristics of fine and very fine sands result in greater capillary rise. As a result, these textural classes were added to Table H-7 and grouped with finer texture classes observed to have similar capillary fringe characteristics.
- These estimates focus on the tension saturated capillary fringe. The upper, unsaturated portion of capillary rise contains enough air to permit root establishment.
- When an actively growing crop is present and is consuming water from the upper portion of the capillary fringe the thickness of the capillary fringe would likely be less than the thickness used in this method.

H.2.3.3 Limitations

Limitations of the analysis include:

- Timing of the capillary fringe vs. growing season or root development is not addressed in this approach.
- Water quality of the groundwater is not included as part of this evaluation.
- This approach does not address the degree of soil salinity existing at each site, or the potential for salts to rise through the entire capillary fringe rather than just the anaerobic portion addressed here.

H.2.3.4 Agricultural Practices Threshold Results

Table H-8 below shows the results of the agricultural practices method.

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
130	4A	Left	Alfalfa	6.0	0.5	6.5	0.7	7.2
131	4A	Left	Almond, Cotton	6.0	0.5	6.5	2.8	9.3
132	4A	Left	Cotton	5.0	0.5	5.5	2.2	7.7
133	4A	Left	Alfalfa, Almond, Cotton	6.0	0.5	6.5	2.3	8.8
134	4A	Left	Assumed Annual Crop	5.0	0.5	5.5	2.1	7.6
135	3	Left	Alfalfa, Cotton	6.0	0.5	6.5	0.3	6.8
139	3	Left	Alfalfa	6.0	0.5	6.5	0.7	7.2
142	3	Left	Corn, Cotton	5.0	0.5	5.5	0.4	5.9
143	4A	Left	Cotton, Melon	5.0	0.5	5.5	2.1	7.6
145	3	Left	Alfalfa, Corn, Cotton	6.0	0.5	6.5	3.1	9.6
146	3	Left	Alfalfa, Cotton	6.0	0.5	6.5	5.2	11.7
147	3	Left	Alfalfa, Cotton	6.0	0.5	6.5	1.0	7.5
148	3	Left	Cotton	5.0	0.5	5.5	2.3	7.8
151	3	Left	Alfalfa, Cotton	6.0	0.5	6.5	5.4	11.9
152	3	Left	Assumed Annual Crop	5.0	0.5	5.5	2.9	8.4
153	3	Left	Almond	6.0	0.5	6.5	3.6	10.1
154	3	Left	Alfalfa, Cotton	6.0	0.5	6.5	2.3	8.8
155	3	Left	Almond	6.0	1.0	7.0	3.3	10.3
156	3	Left	Assumed Annual Crop	5.0	0.5	5.5	6.0	11.5
157	3	Left	Almond, Tomato	6.0	0.5	6.5	1.3	7.8
159	3	Left	Cotton	5.0	0.5	5.5	2.3	7.8
164	3	Left	Almond, Cotton	6.0	0.5	6.5	5.0	11.5
169	3	Left	Cotton, Pistachios	5.0	0.5	5.5	0.7	6.2
182	4A	Left	Corn	5.0	0.5	5.5	0.7	6.2
183	4A	Left	Melon	5.0	0.5	5.5	2.0	7.5

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
184	4A	Left	Cotton	5.0	0.5	5.5	2.9	8.4
189	4A	Left	Almond	6.0	0.5	6.5	4.6	11.1
190	4A	Left	Cotton	5.0	0.5	5.5	1.8	7.3
191	4A	Left	Tomato	5.0	1.0	6.0	2.9	8.9
355	3	Left	Almond	6.0	0.5	6.5	1.1	7.6
356	3	Left	Almond	6.0	0.5	6.5	0.7	7.2
358	3	Left	Alfalfa	6.0	0.5	6.5	7.0	13.5
359	3	Left	Almond	6.0	0.5	6.5	6.8	13.3
361	3	Left	Assumed Annual Crop, Fallow	5.0	0.5	5.5	6.2	11.7
363	3	Left	Cotton	5.0	0.5	5.5	2.9	8.4
364	3	Left	Almond, Cotton	6.0	0.5	6.5	8.6	15.1
365	3	Left	Alfalfa	6.0	0.5	6.5	0.3	6.8
366	3	Left	Alfalfa	6.0	0.5	6.5	0.7	7.2
368	3	Left	Almond	6.0	0.5	6.5	4.4	10.9
370	3	Left	Almond	6.0	0.5	6.5	3.3	9.8
371	3	Left	Almond	6.0	0.5	6.5	0.6	7.1
374	3	Left	Alfalfa, Almond	6.0	0.5	6.5	0.4	6.9
375	3	Left	Alfalfa, Almond	6.0	0.5	6.5	1.2	7.7
376	3	Left	Almond	6.0	0.5	6.5	2.3	8.8
379	3	Left	Assumed Annual Crop	5.0	0.5	5.5	4.0	9.5
385	4A	Left	Cotton	5.0	0.5	5.5	1.7	7.2
386	4A	Left	Cotton	5.0	0.5	5.5	1.9	7.4
387	4A	Left	Cotton	5.0	0.5	5.5	1.2	6.7
388	4A	Left	Cotton	5.0	0.5	5.5	2.0	7.5

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
389	4A	Left	Cotton	5.0	0.5	5.5	2.8	8.3
390	4A	Left	Cotton	5.0	0.5	5.5	3.4	8.9
132A	4A	Left	Cotton	5.0	0.5	5.5	1.4	6.9
165A	3	Left	Alfalfa, Almond	6.0	0.5	6.5	0.1	6.6
186A	4A	Left	Corn	5.0	1.0	6.0	2.0	8.0
188A	4A	Left	Annual Crop	5.0	0.5	5.5	1.7	7.2
369B	3	Left	Almond	6.0	0.5	6.5	0.7	7.2
CNOW-13-50	2B	Left	Assumed Annual Crop, Fallow	5.0	0.5	5.5	1.0	6.5
CNOW-14-52	2B	Left	Pistachio	5.0	0.5	5.5	0.7	6.2
CNSPT-52	2B	Left	Almond	6.0	0.5	6.5		6.5
CWOW-14-15	2B	Left	Almond	6.0	0.5	6.5	1.8	8.3
CWSPT-15	2B	Left	Almond	6.0	0.5	6.5	0.9	7.4
FA-1	1B	Left	Vineyard	6.0	1.0	7.0	1.8	8.8
FA-2	1B	Left	Vineyard	6.0	1.0	7.0	2.2	9.2
FA-3	1B	Left	Vineyard	6.0	1.0	7.0	1.5	8.5
FA-7	2A	Left	Almond	6.0	1.0	7.0	5.6	12.6
FA-9	2A	Left	Corn	5.0	1.0	6.0	2.0	8.0
MA-1	1B	Left	Assumed Almond	6.0	1.0	7.0	1.7	8.7
MA-2	2A	Right	Vineyard	6.0	1.0	7.0	2.9	9.9
MA-3	2A	Right	Alfalfa	6.0	1.0	7.0	0.9	7.9
MA-4	2A	Right	Vineyard	6.0	1.0	7.0	6.1	13.1
MW-09-36	2A	Right	Assumed Annual Crop, Fallow	5.0	0.5	5.5	4.5	10.0
MW-09-37B	2A	Left	Vineyard	6.0	1.7	7.7	3.0	10.8
MW-09-39	2A	Left	Pistachio	5.0	1.0	6.0	1.6	7.6

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
MW-09-39B	2A	Left	Pistachio	5.0	1.0	6.0	0.5	6.5
MW-09-47	2A	Right	Vineyard	6.0	0.5	6.5	2.5	9.0
MW-09-49	2A	Left	Alfalfa	6.0	0.5	6.5	1.8	8.3
MW-09-49B	2A	Left	Corn	5.0	0.5	5.5	1.7	7.2
MW-09-52	2B	Right	Almond	6.0	1.7	7.7	0.9	8.6
MW-09-53	2B	Right	Almond	6.0	1.7	7.7	1.4	9.1
MW-09-54	2B	Right	Almond	6.0	1.0	7.0	7.7	14.7
MW-09-54B	2B	Right	Almond	6.0	1.0	7.0	7.9	12.9 *
MW-09-55	2B	Left	Palms	5.0	0.5	5.5	5.4	10.9
MW-09-55B	2B	Left	Palms	5.0	0.5	5.5	3.7	2.7 *
MW-09-56	2B	Left	Pistachio	5.0	1.0	6.0	1.7	7.7
MW-09-57	2B	Left	Vineyard	6.0	0.5	6.5	1.6	8.1
MW-09-86	4A	Left	Almond	6.0	2.7	8.7	8.0	16.7
MW-09-86B	4A	Left	Almond	6.0	2.7	8.7	7.9	16.6
MW-09-87	4A	Left	Almond, Cotton	6.0	0.5	6.5	2.0	8.5
MW-09-87B	4A	Left	Almond, Cotton	6.0	0.5	6.5	1.9	8.4
MW-09-125	5	Right	Grain, Fallow	5.0	0.5	5.5		5.5
MW-10-74	3	Left	Almond	6.0	3.0	9.0	4.2	13.2
MW-10-75	3	Left	Almond	6.0	2.0	8.0	0.5	8.5
MW-10-76	3	Left	Cotton	5.0	1.7	6.7	2.7	9.4
MW-10-78	3	Right	Cotton	5.0	0.5	5.5	3.0	8.5
MW-10-89	4A	Right	Almond	6.0	0.5	6.5	1.0	7.5
MW-10-90	4B1	Right	Pistachio	5.0	2.0	7.0		7.0
MW-10-91	4A	Left	Tomato	5.0	3.0	8.0	3.7	11.7
MW-10-92	4A	Left	Tomato	5.0	2.0	7.0	1.0	8.0

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
MW-10-93	4A	Left	Tomato	5.0	2.0	7.0	2.2	9.2
MW-10-94	4B1	Right	Pistachio	5.0	1.0	6.0		6.0
MW-10-95	4B1	Right	Alfalfa	6.0	2.0	8.0	1.2	9.2
MW-10-96	4B1	Right	Alfalfa	6.0	2.0	8.0	2.0	10.0
MW-10-97	4B1	Right	Alfalfa, Corn	6.0	0.5	6.5	3.4	9.9
MW-10-98	4B1	Left	Assumed Annual Crop	5.0	2.0	7.0	4.0	11.0
MW-10-99	4B1	Left	Alfalfa, Tomato	6.0	1.7	7.7	4.7	12.4
MW-10-100	4B1	Left	Cotton, Tomato	5.0	2.7	7.7	4.5	12.2
MW-10-102	4B1	Right	Cotton, Tomato	5.0	2.0	7.0	2.4	9.4
MW-10-103	4B1	Right	Cotton, Tomato	5.0	2.0	7.0	4.6	11.6
MW-10-105	4B1	Left	Cotton	5.0	2.0	7.0	1.4	8.4
MW-10-106	4B1	Left	Tomato	5.0	0.5	5.5	2.0	7.5
MW-10-107	4B1	Left	Cotton, Tomato	5.0	1.7	6.7	2.7	9.4
MW-10-108	4B1	Left	Melon	5.0	3.0	8.0	1.7	9.7
MW-10-109	4B1	Left	Melon	5.0	1.7	6.7	1.5	8.2
MW-10-110	4B1	Left	Cotton	5.0	0.5	5.5	1.8	7.3
MW-10-111	4B1	Left	Alfalfa, Corn	6.0	1.7	7.7	1.8	9.5
MW-10-112	4B1	Right	Tomato	5.0	2.0	7.0		7.0
MW-10-113	4B1	Left	Melon	5.0	1.7	6.7	4.4	11.1
MW-10-114	4B1	Left	Alfalfa, Melon, Tomato	6.0	2.0	8.0	1.9	9.9
MW-10-115	4A	Left	Alfalfa, Cotton	6.0	1.7	7.7		7.7
MW-10-116	4A	Right	Alfalfa	6.0	2.0	8.0		8.0
MW-10-117	3	Right	Almond	6.0	1.7	7.7		7.7
MW-10-118	3	Right	Almond	6.0	0.5	6.5	2.4	8.9
MW-10-119	3	Right	Almond	6.0	0.5	6.5	2.4	8.9

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
MW-10-120	3	Left	Almond, Tomato	6.0	3.0	9.0		9.0
MW-10-126	3	Left	Cotton	5.0	1.0	6.0		6.0
MW-10-127	3	Right	Almond	6.0	1.0	7.0		7.0
MW-10-128	3	Left	Cotton, Tomato	5.0	1.0	6.0		6.0
MW-10-129	3	Right	Almond	6.0	1.0	7.0	0.6	7.6
MW-10-188	4A	Left	Alfalfa, Almond, Cotton	6.0	0.5	6.5	2.1	8.6
MW-11-130	4A	Left	Alfalfa, Almond	6.0	1.0	7.0		7.0
MW-11-131	4A	Left	Alfalfa, Almond	6.0	1.7	7.7		7.7
MW-11-132	4A	Left	Alfalfa, Almond	6.0	3.0	9.0		9.0
MW-11-133	4A	Left	Alfalfa, Cotton	6.0	3.0	9.0		9.0
MW-11-134	4A	Left	Almond, Cotton	6.0	1.0	7.0		7.0
MW-11-135	4A	Left	Cotton	5.0	3.0	8.0		8.0
MW-11-136	4A	Left	Alfalfa, Almond, Cotton	6.0	3.0	9.0		9.0
MW-11-137	4B1	Right	Assumed Annual Crop	5.0	2.0	7.0		7.0
MW-11-138	4B1	Right	Assumed Annual Crop	5.0	1.7	6.7		6.7
MW-11-139	4B1	Right	Assumed Annual Crop	5.0	2.0	7.0		7.0
MW-11-140	4B1	Left	Assumed Annual Crop	5.0	3.0	8.0		8.0
MW-11-141	4B1	Right	Assumed Annual Crop	5.0	1.0	6.0		6.0
MW-11-143	4B1	Right	Assumed Annual Crop	5.0	2.0	7.0		7.0
MW-11-144	4B1	Right	Assumed Annual Crop	5.0	2.0	7.0		7.0
MW-11-145	4B1	Left	Corn, Cotton	5.0	2.0	7.0		7.0
MW-11-146	4B1	Right	Assumed Annual Crop	5.0	3.0	8.0		8.0
MW-11-147	4B1	Right	Assumed Annual Crop	5.0	1.7	6.7		6.7
MW-11-148	4A	Left	Cotton	5.0	2.0	7.0		7.0
MW-11-149	4A	Left	Cotton	5.0	2.0	7.0		7.0

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
MW-11-150	3	Left	Cotton	5.0	2.0	7.0		7.0
MW-11-151	2A	Right	Vineyard	6.0	1.7	7.7		7.7
MW-11-152	4B1	Right	Alfalfa	6.0	1.7	7.7		7.7
MW-11-153	4B1	Right	Alfalfa, Corn	6.0	1.7	7.7		7.7
MW-11-154	4B2	Right	Alfalfa, Corn	6.0	1.7	7.7		7.7
MW-11-155	3	Right	Almond	6.0	1.7	7.7		7.7
MW-11-156	3	Right	Almond	6.0	1.7	7.7		7.7
MW-11-157	3	Right	Pistachio	5.0	2.7	7.7		7.7
MW-11-158	2A	Right	Vineyard	6.0	0.5	6.5		6.5
MW-11-159	2A	Right	Vineyard	6.0	0.5	6.5		6.5
MW-11-160	3	Left	Almond	6.0	3.0	9.0		9.0
MW-11-161	3	Right	Almond	6.0	2.0	8.0		8.0
MW-11-162	4A	Right	Almond	6.0	2.7	8.7		8.7
MW-11-163	3	Right	Almond	6.0	1.7	7.7		7.7
MW-11-164	2B	Left	Almond	6.0	1.0	7.0		7.0
MW-12-165	4A	Right	Alfalfa	6.0	1.0	7.0	2.2	9.2
MW-12-166	4A	Right	Alfalfa	6.0	0.5	6.5	1.6	8.1
MW-12-167	4A	Right	Alfalfa	6.0	2.0	8.0	1.0	9.0
MW-12-168	4A	Right	Alfalfa	6.0	1.0	7.0	2.8	9.8
MW-12-169	4A	Right	Alfalfa	6.0	1.7	7.7	3.5	11.2
MW-12-170	4B1	Right	Alfalfa	6.0	0.5	6.5	1.7	8.2
MW-12-171	4B1	Right	Alfalfa	6.0	0.5	6.5	1.0	7.5
MW-12-172	4B1	Right	Alfalfa	6.0	1.7	7.7	1.8	9.5
MW-12-173	4B1	Right	Pistachio	5.0	0.5	5.5	0.7	6.2
MW-12-174	4B1	Right	Pistachio	5.0	0.5	5.5	1.3	6.8

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
MW-12-175	4B1	Right	Almond, Pistachio	6.0	1.7	7.7	1.0	8.7
MW-12-176	4B1	Right	Pistachio	5.0	0.5	5.5	3.2	8.7
MW-12-177	4A	Right	Alfalfa	6.0	2.0	8.0	1.3	9.3
MW-12-178	4A	Left	Cotton	5.0	0.5	5.5	3.7	9.2
MW-12-179	4A	Left	Cotton	5.0	2.0	7.0	1.3	8.3
MW-12-180	3	Left	Almond, Cotton	6.0	3.0	9.0	0.0	9.0
MW-12-181	3	Left	Almond, Cotton	6.0	3.0	9.0	1.4	10.4
MW-12-182	3	Left	Cotton	5.0	0.5	5.5	1.3	6.8
MW-12-183	3	Left	Almond	6.0	0.5	6.5	4.6	11.1
MW-12-184	3	Right	Assumed Annual Crop, Fallow	5.0	0.5	5.5	7.0	12.5
MW-12-185	3	Right	Assumed Annual Crop, Fallow	5.0	0.5	5.5	4.2	9.7
MW-12-186	3	Right	Assumed Annual Crop, Fallow	5.0	2.0	7.0	8.7	15.7
MW-12-187	3	Right	Assumed Annual Crop, Fallow	5.0	1.0	6.0	3.6	9.6
MW-12-189	3	Right	Grain, Fallow	5.0	0.5	5.5	4.0	9.5
MW-12-190	3	Right	Grain, Fallow	5.0	0.5	5.5	2.4	7.9
MW-12-191	3	Right	Almond	6.0	0.5	6.5	1.0	7.5
MW-12-192	3	Right	Almond	6.0	0.5	6.5	3.0	9.5
MW-13-193	3	Right	Cotton	5.0	2.0	7.0	1.6	8.6
MW-13-194	3	Right	Cotton	5.0	1.7	6.7	1.1	7.8
MW-13-195	3	Right	Cotton	5.0	3.0	8.0	6.5	14.5
MW-13-196	3	Right	Cotton	5.0	0.5	5.5	3.0	8.5
MW-13-197	3	Right	Cotton	5.0	1.7	6.7	4.9	11.6
MW-13-198	3	Right	Almond	6.0	3.0	9.0	2.5	11.5

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
MW-13-199	3	Right	Almond	6.0	3.0	9.0	6.0	15.0
MW-13-200	3	Right	Almond	6.0	3.0	9.0	8.1	17.1
MW-13-201	3	Right	Almond	6.0	2.0	8.0	2.9	10.9
MW-13-202	2B	Left	Almond	6.0	1.7	7.7		7.7
MW-13-210	3	Right	Almond	6.0	2.0	8.0	5.2	13.2
MW-13-211	3	Right	Almond	6.0	1.7	7.7	0.0	7.7
MW-13-212	3	Right	Almond	6.0	2.0	8.0	3.0	11.0
MW-13-213	3	Right	Pistachio	5.0	3.0	8.0	3.1	11.1
MW-13-214	3	Right	Almond	6.0	2.0	8.0	1.5	9.5
MW-13-215	3	Right	Pistachio	5.0	3.0	8.0	0.9	8.9
MW-13-216	3	Right	Pistachio	5.0	1.7	6.7	0.4	7.1
MW-14-203	4A	Right	Grain, Fallow	5.0	1.7	6.7	2.3	9.0
MW-14-204	4A	Right	Cotton	5.0	1.0	6.0	1.7	7.7
MW-14-205	4A	Right	Tomato	5.0	0.5	5.5	1.7	7.2
MW-14-206	4A	Right	Assumed Annual Crop, Fallow	5.0	1.0	6.0	6.2	12.2
MW-14-207	4A	Right	Assumed Annual Crop, Fallow	5.0	1.0	6.0	5.6	11.6
MW-14-208	4A	Right	Assumed Annual Crop, Fallow	5.0	0.5	5.5	1.0	6.5
MW-14-209	4A	Right	Grain, Fallow	5.0	1.7	6.7	1.2	7.9
MW-16-219	4A	Left	Cotton	5.0	0.7	5.7		5.7
MW-16-220	4A	Left	Cotton	5.0	1.7	6.7		6.7
MW-16-222	4A	Left	Cotton	5.0	0.5	5.5		5.5
MW-16-224	4A	Left	Cotton	5.0	0.5	5.5		5.5
PZ-09-R2B-2	2B	Right	Alfalfa	6.0	0.5	6.5	3.9	10.4

Table H-8. Agricultural Practices Method Thresholds

Well	Reach	Bank	Crop Type(s)	Root Zone (feet)	Capillary Fringe (feet)	Agricultural Practices Threshold (feet bgs in field)	Ground Surface Adjustment (feet)	Agricultural Practices Threshold (feet bgs in well)
PZ-09-R3-3	3	Right	Almond	6.0	1.7	7.7	4.3	12.0
PZ-09-R3-5	3	Right	Grain, Fallow	5.0	0.7	5.7	1.2	6.9
PZ-09-R3-7	3	Right	Almond	6.0	0.5	6.5	0.7	7.2
PZ-12-R2B-3	2B	Left	Vineyard	6.0	0.5	6.5		6.5
PZ-12-R2B-4	2B	Left	Vineyard	6.0	0.5	6.5		6.5
PZ-12-R2B-5	2B	Left	Vineyard	6.0	1.7	7.7		7.7
PZ-12-R2B-6	2B	Left	Vineyard	6.0	1.7	7.7		7.7
SJR W-1	4B1	Left	Tomato	5.0	1.0	6.0	1.8	7.8
SJR W-2	4B1	Left	Tomato	5.0	1.0	6.0	4.2	10.2
SJR W-3	4B1	Left	Melon	5.0	1.0	6.0	3.8	9.8
SJR W-4	4A	Left	Alfalfa, Melon	6.0	1.0	7.0	1.1	8.1
SJR W-5	4A	Left	Tomato	5.0	1.0	6.0	1.9	7.9
SJR W-6	4A	Left	Tomato	5.0	1.0	6.0	4.4	10.4
SJR W-7	4A	Left	Tomato	5.0	1.0	6.0	4.0	10.0
SJR W-8	4A	Left	Corn	5.0	1.0	6.0	3.3	9.3
SJR W-9	4A	Left	Alfalfa	6.0	1.0	7.0	1.1	8.1
SJR W-10	4A	Left	Alfalfa	6.0	1.0	7.0	1.8	8.8
SJR W-11	4A	Left	Alfalfa	6.0	1.0	7.0	1.8	8.8
SJR W-12	4A	Left	Alfalfa, Melon	6.0	1.0	7.0	2.1	9.1
SLCC-027	4B1	Left	Alfalfa	6.0	0.5	6.5	2.8	9.3

* Threshold calculation includes lateral gradient buffer as described in section H.1.3.3.

H.3 Method 2 - Historical Groundwater Levels

The second method to set thresholds makes use of long-term historical groundwater level measurements to derive thresholds in the context of historical field conditions and agricultural practices. Groundwater level data along the San Joaquin River does not exist in all areas and times of interest. Sources of historical groundwater data include CCID (which maintains a network of shallow monitoring wells), the USGS, and the DWR. Ninety percent of the available records represent the period from 1960 to the present, with some wells covering a longer time period. Although some wells have monthly or weekly measurements for short periods of time, the majority of wells have biannual spring and fall measurements.

H.3.1 Objectives

The objective of the historical groundwater level method is to use long-term groundwater level data, and December 2011 through January 2016 data which did not include the effects of Restoration or flood flow in the San Joaquin River, to indicate hydrologic conditions under which agriculture has historically operated, and to derive thresholds on the basis of this information.

H.3.2 Approach

Threshold development using historical groundwater levels is approached in four ways, depending on availability of long-term data:

1. If the threshold well has been monitored long term, the groundwater levels are used directly to derive a threshold;
2. If the threshold well has not been monitored long term, but a nearby well has, the groundwater levels from the nearby well is used indirectly to derive a threshold; or
3. If the threshold well has not been monitored long term, and no nearby wells have been monitored long term, mapped estimates of the depth to water at the well location are used to derive a threshold.
4. If the threshold well has not been monitored long term, but groundwater level measurements are available during the December 1, 2011 to January 31, 2016 period, then an additional historical level was developed – the shallowest groundwater level of a 3-point moving average within that period. The identified time period did not have any Restoration or flood flows, and therefore, approximates pre-SJRRP conditions for areas without historical groundwater level data.

H.3.2.1 Method A: Thresholds for Long-Term Wells

Long-term groundwater level data for a shallow well provides a good indication of historical variability and position of the water table. This data reflects a combination of climatic influences and agricultural practices. Climatic influences include local precipitation and flows in canals and the river. Agricultural practices include irrigation, groundwater pumping, and various forms of drainage. Long-term groundwater levels

represent the combined effect of these processes, making the data very useful for developing monitoring thresholds.

Hydrographs were made for threshold wells having available data during the period from 1983 through September 2009, just prior to the first Interim Restoration Flows in October 2009. This time period is relatively data rich, and represents the post-recovery period following importation of surface water to various areas surrounding the exchange contractors and the associated decline in groundwater pumping (Belitz and others, 1993).

From these hydrographs, spring (March through May) measurements were identified and grouped. For each group of spring measurements for a threshold well, the greatest 31 percent of the groundwater level elevations were assumed to be representative of relatively wet climatic conditions, and therefore not representative of typical agricultural conditions. The 31 percent cutoff was based on the number of wet years (nine) that occurred during the period of record for groundwater level measurements in CCID monitoring wells (29 years). The threshold was then defined as the greatest remaining groundwater level elevation after removal of the top 31 percent of values.

As an example, Figure H-6 shows the location of well CCID 191. Figure H-7 shows the historical groundwater threshold developed for CCID 191 using this method. Groundwater levels (points) shown in blue were measured during the spring; those in grey were measured during other times of the year, or were among the greatest 31 percent of spring measurements. The green dashed line is the threshold; note that the high groundwater levels associated with 1983 and other relatively wet or flood years are above the threshold, as designed.

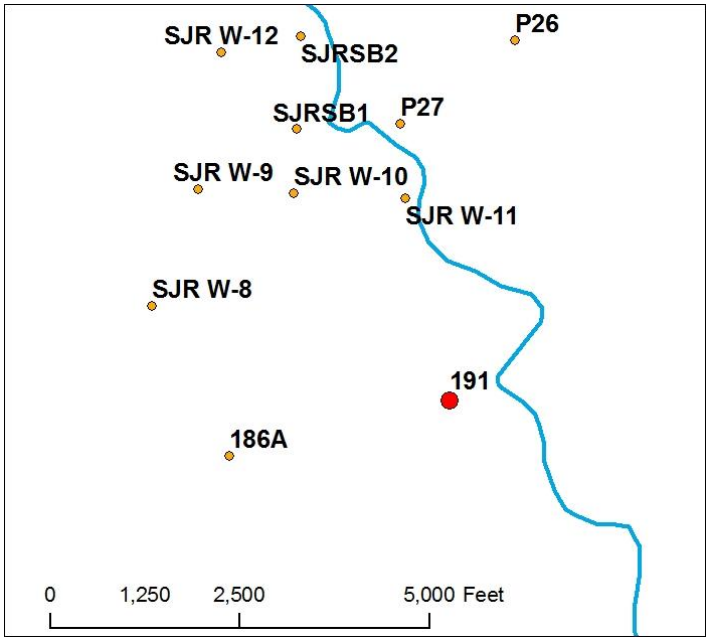


Figure H-6.
General location of CCID shallow monitoring well 191

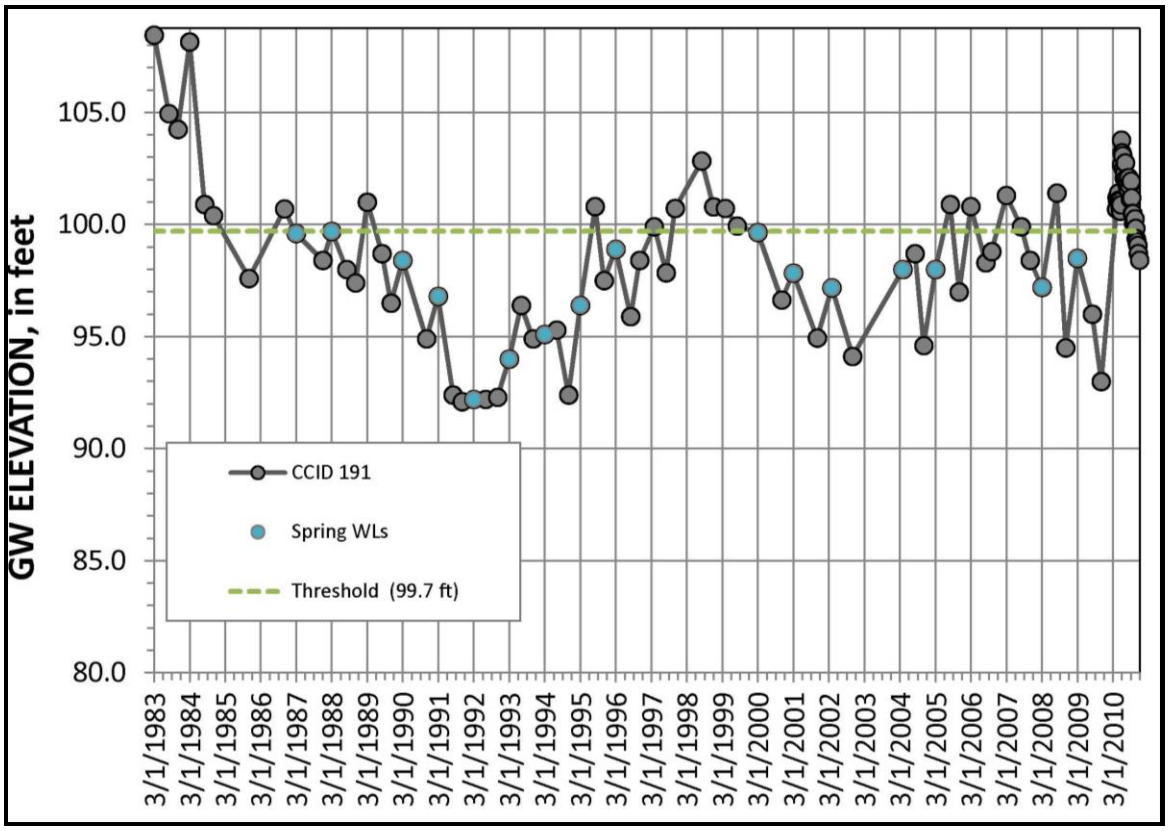


Figure H-7.
Thresholds Developed Using Historical Groundwater-Level Measurements in CCID Well 191 (Ground Surface Elevation: 108.8 ft)

H.3.2.2 Method B: Thresholds for Wells Near Long-Term Wells

To assign thresholds for wells having only short-term groundwater level data (beginning in 2009 or later), long-term groundwater level data associated with a nearby well (within one mile) was used. Thresholds were calculated as described above using long-term groundwater levels from the nearby well, with one exception: groundwater level elevations for the nearby well were adjusted by the difference in ground surface elevation between the nearby and threshold wells.

A key assumption in this approach is that hydrologic conditions local to the well having long-term data, such as depth to water, are similar to those at the threshold well. This assumption was tested graphically by comparing historical data from the nearby well to short-term data from the threshold well. This comparison may not be precise, but it is reasonable as a first-cut test of the assumption.

MW-09-88 will be used as an example. Figure H-8 shows the location of well MW-09-88 and nearby well CCID 188a, which has long-term groundwater level data that was used to develop the threshold. The ground surface elevation at the CCID well is the same as the ground surface elevation at the threshold well; therefore, no adjustment for the difference in elevation was necessary in this case. Groundwater levels (points) shown as

blue circles in Figure H-9 were measured in CCID 188a during the spring, and those in grey were measured during other times of the year, or were among the greatest 31 percent of spring measurements; dark blue diamonds represent measurements in MW-09-88. The green dashed line is the threshold; note that the high groundwater levels associated with 1983 and other relatively wet years are above the threshold, as designed. Also note that the cluster of measurements in MW-09-88 during 2010 reasonably match measurements made in CCID 188a; thus, the assumption of similar hydrologic conditions at the two wells appears reasonable.

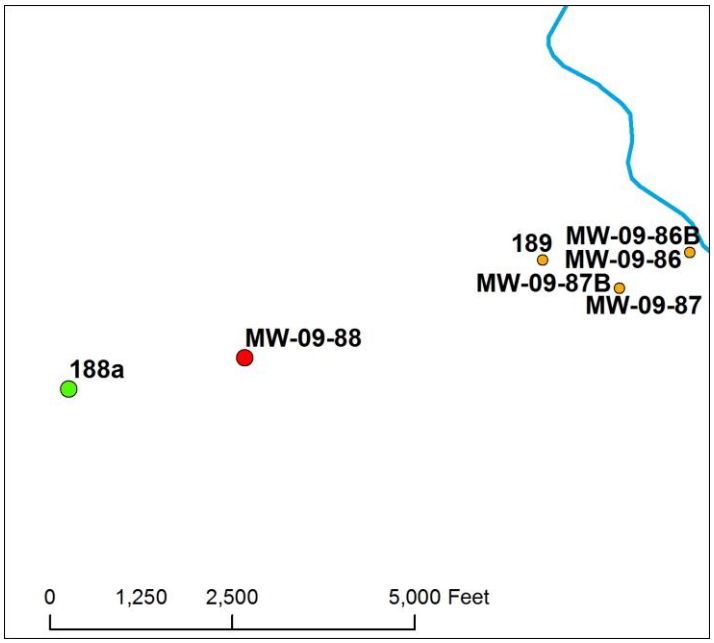


Figure H-8.
General Location of Well MW-09-88 and Nearby CCID Shallow Monitoring Well 188a

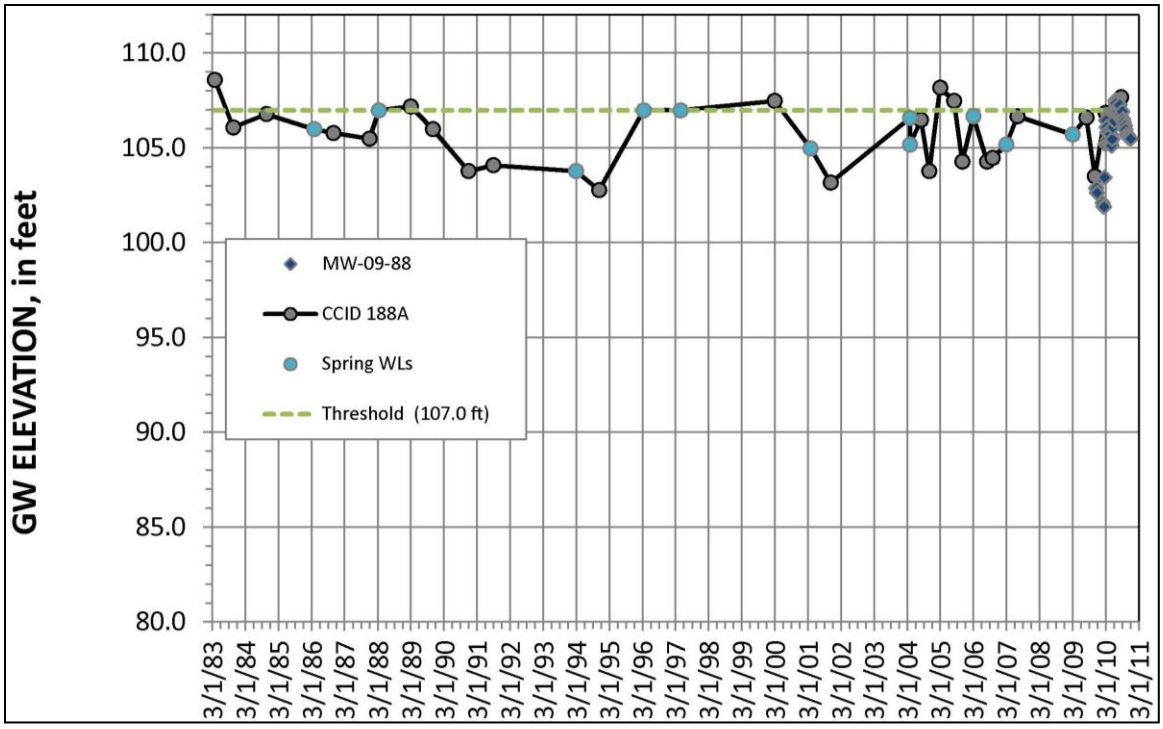


Figure H-9.
Threshold Developed for MW-09-88 Using Historical Groundwater-Level Measurements from Nearby CCID Well 188a (Ground Surface Elevation: 112.0 ft)

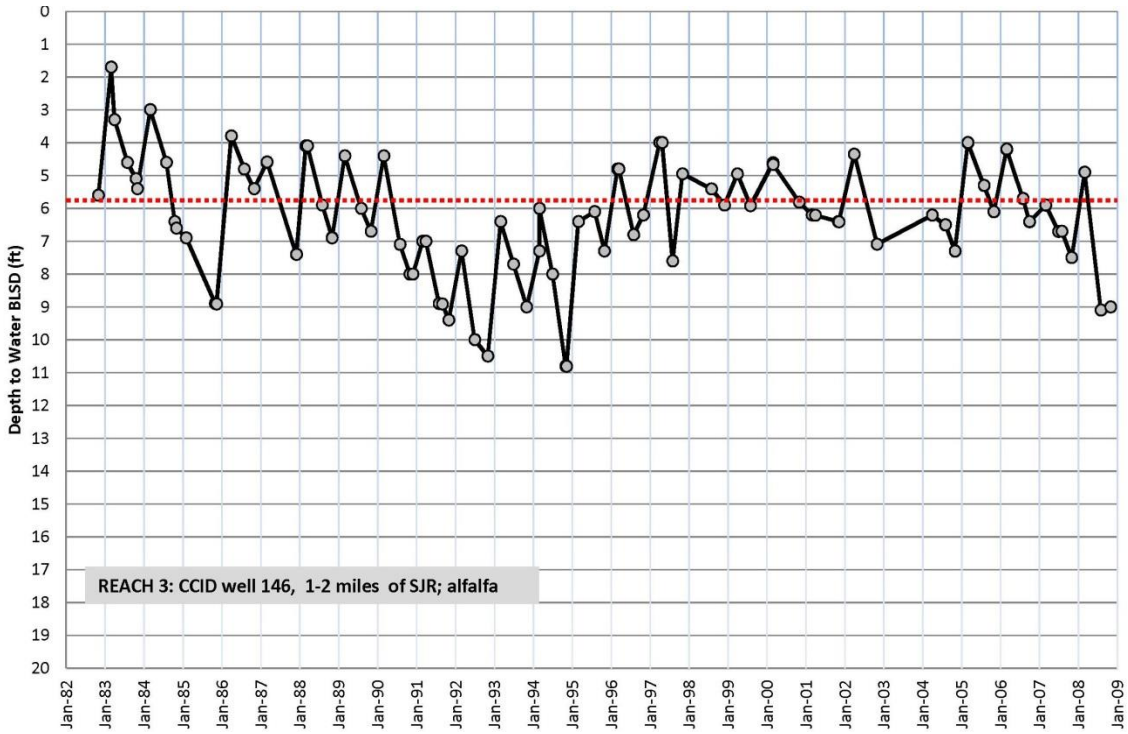
H.3.2.3 Method C: Thresholds for Wells with No Long-Term Data

There is a third set of threshold wells for which little or no short-term groundwater level data are available, and no nearby wells provide long-term data. Thresholds for these wells based on historic groundwater levels, regardless of methodology, will have a relatively high degree of uncertainty. However, threshold estimates were developed using existing maps of depth to water, and maps developed based on average long-term data from CCID.

H.3.2.4 Thresholds Based on Map of Long-Term Average CCID Data (Method C1)

The above approach uses a database of mainly bi-annual measurements. However, CCID maintains an extensive monitoring well network along the west side of Reaches 3 and 4A of the San Joaquin River, representing a long historical record. Ground surface elevation is available for all CCID wells, thus ensuring vertical control and a large set of groundwater levels that represent the water table. Groundwater levels were averaged for each well; these measurements were made over an extensive period of time and at a set interval, which raises confidence that an average of these measurements best represents average groundwater conditions in this area.

Figure H-10 shows a typical hydrograph for well CCID 146. The dotted line represents the average groundwater level during the period shown. Average groundwater levels for wells similar to this were used in the analysis; wells indicating strong influence from groundwater pumping were not used.



Note: BLSD = below land surface datum (equivalent to below ground surface)

Figure H-10.
Hydrograph of CCID Well 146 Showing Long-term Average

As a first step, average DTW below ground surface at each CCID well was converted to water table elevation using the known ground surface elevation near each CCID well. CCID corrects their depth to water measurements to be below field ground surface, so no ground surface adjustment for the difference between the well and the field is necessary. Then these water table elevations were interpolated using inverse distance weighted (IDW) across Reaches 3 and 4A.

Figure H-11 below shows the interpolated water table elevation map. Green stars represent the subset of CCID wells with consistent data and hydrographs created by USGS. These green stars also represent the data points used for interpolating the groundwater level contour shown in Figure H-11. Thresholds at the threshold wells (represented by black squares in Figure H-11) were extracted from the groundwater level map. These extracted groundwater elevations were then converted to DTW at each well using the surveyed ground surface elevations.

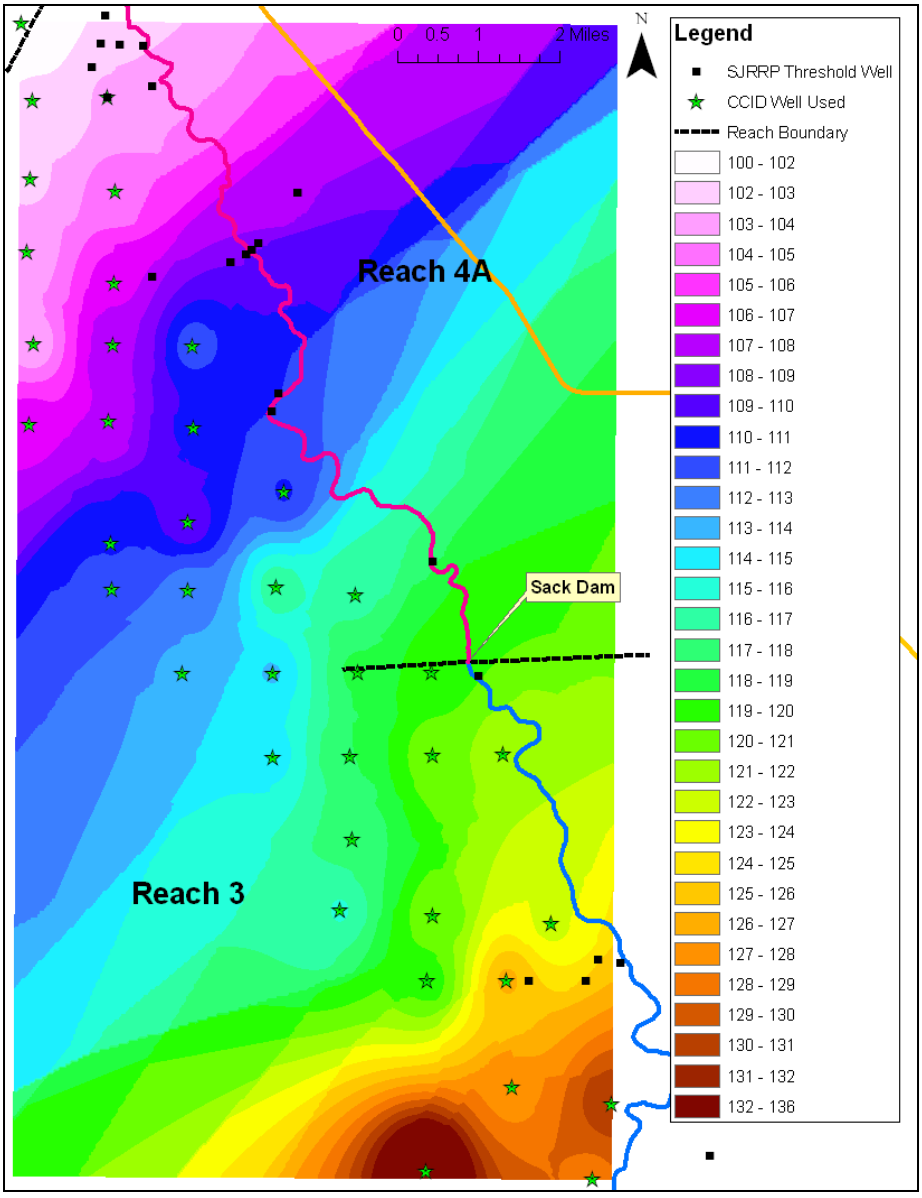


Figure H-11.
Map of Average Historical Water-Table Elevation in CCID Wells

H.3.2.5 Thresholds Based on Maps of Depth to Water (Methods C2 and C3)

The USGS developed maps of DTW for various years from 1981 to present having the greatest number of measurements and/or the greatest interest with respect to climatic conditions. Because the water level database contains few spring groundwater level measurements, DTW maps were created for the fall measurement period (September 15 through November 15). Dry, normal-dry, wet, and normal-wet water year designations were based on the total annual unimpaired runoff at Friant Dam for the water year (October through September) as defined by the SJRRP year type. Because the applied kriging interpolation method required good spatial density of wells, an effort was made to keep as many wells as possible with the following constraints; (1) deep wells were

removed, (2) wells screened throughout (pumping wells) were removed and: (3) wells with unknown well construction data were evaluated using a nearest neighbor approach in ArcGIS®. The nearest neighbor approach process evaluated DTW values of wells with unknown well construction data to nearby wells with known construction data. A well with unknown well construction data was included if the DTW values were similar to and seemed acceptable given changes in topography. The DTW maps presented in Figures H-12 through H-15 were developed by the USGS using data from CCID, DWR, Mendota Pool Group, and USGS; these data were interpolated using an ordinary kriging, as described in Appendix B. Interpolations in areas having no wells within a two mile radius (identified as stippled zones with less transparency on the DTW maps) can only be considered an approximation of actual conditions. Interpolated depths to water at SJRRP monitoring well locations were assigned as threshold values. Historical threshold Method C2 uses data from 1999. Historical threshold Method C3 uses data from 2009.

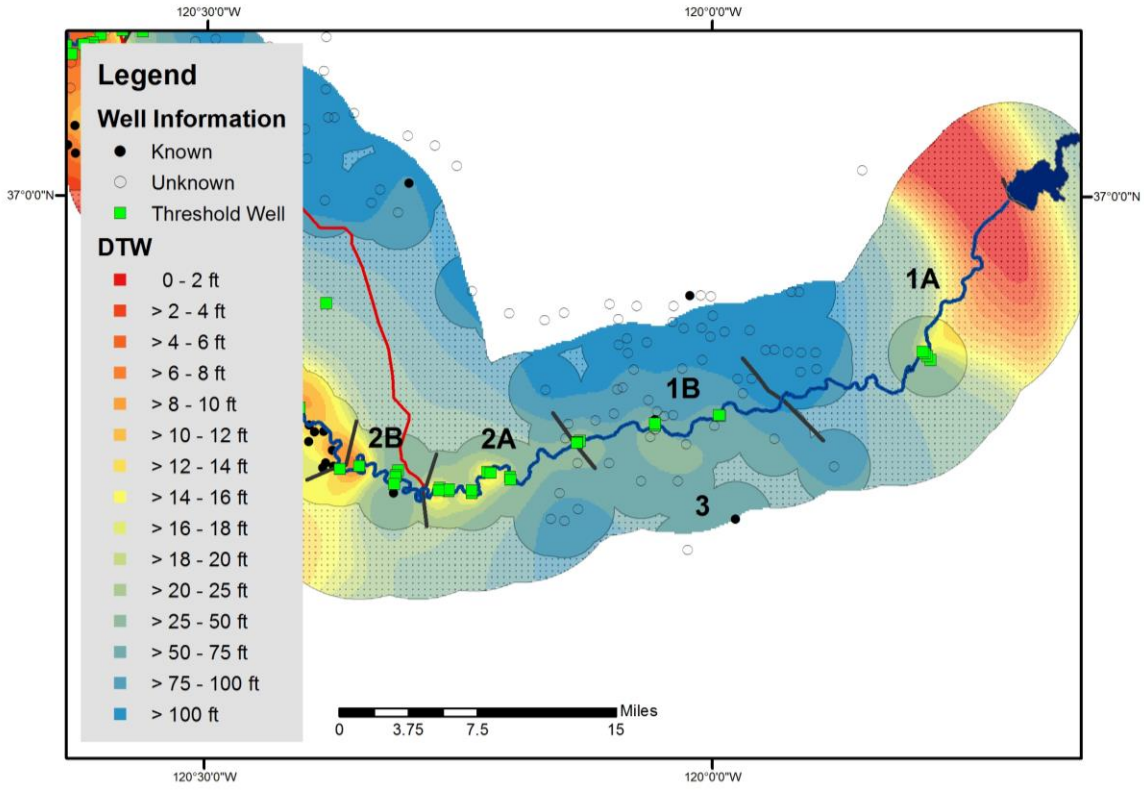


Figure H-12.
Fall 2009 Depth to Water in Reaches 1A through 2B for a Normal-Dry Year

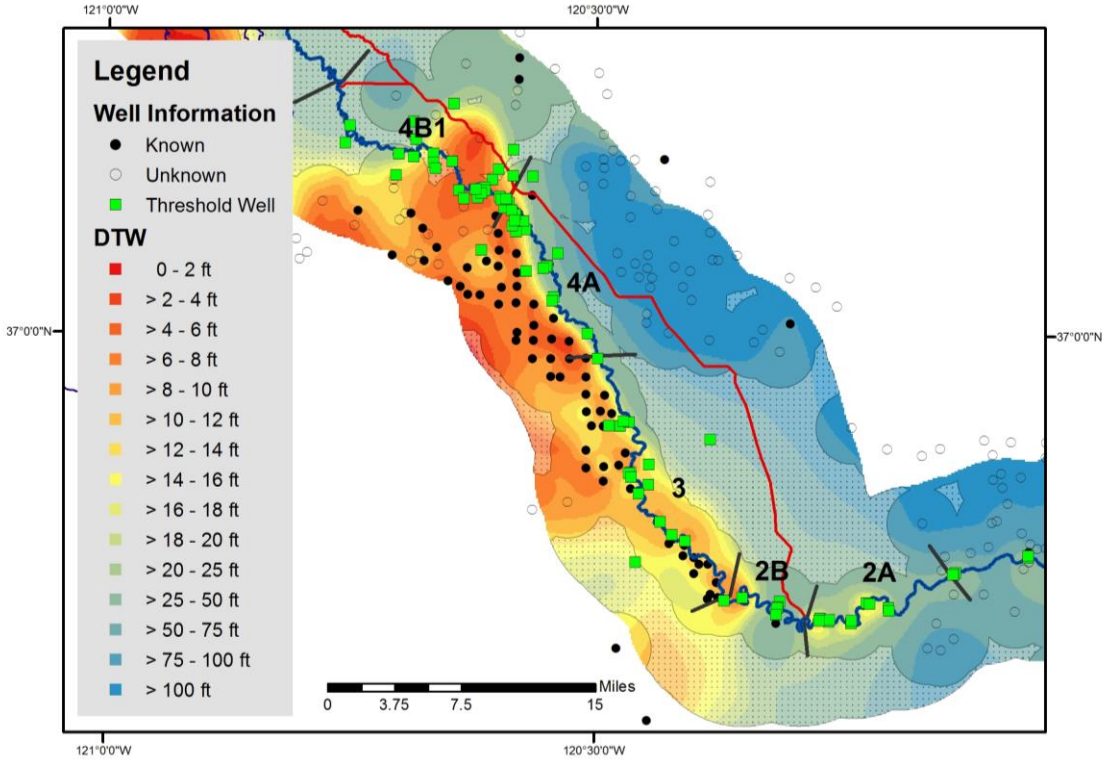


Figure H-13.
Fall 2009 Depth to Water in Reaches 2A through 4B1 for a Normal-Dry Year

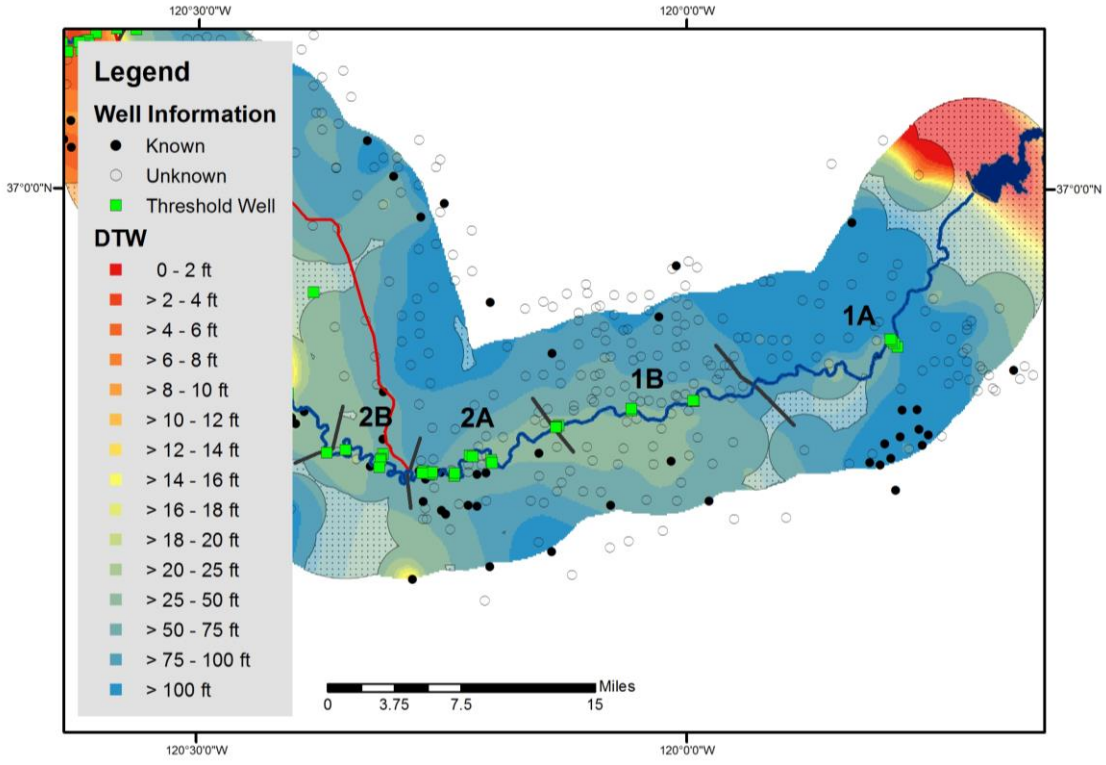


Figure H-14.
Fall 1999 Depth to Water in Reaches 1A through 2B for a Normal-Wet Year

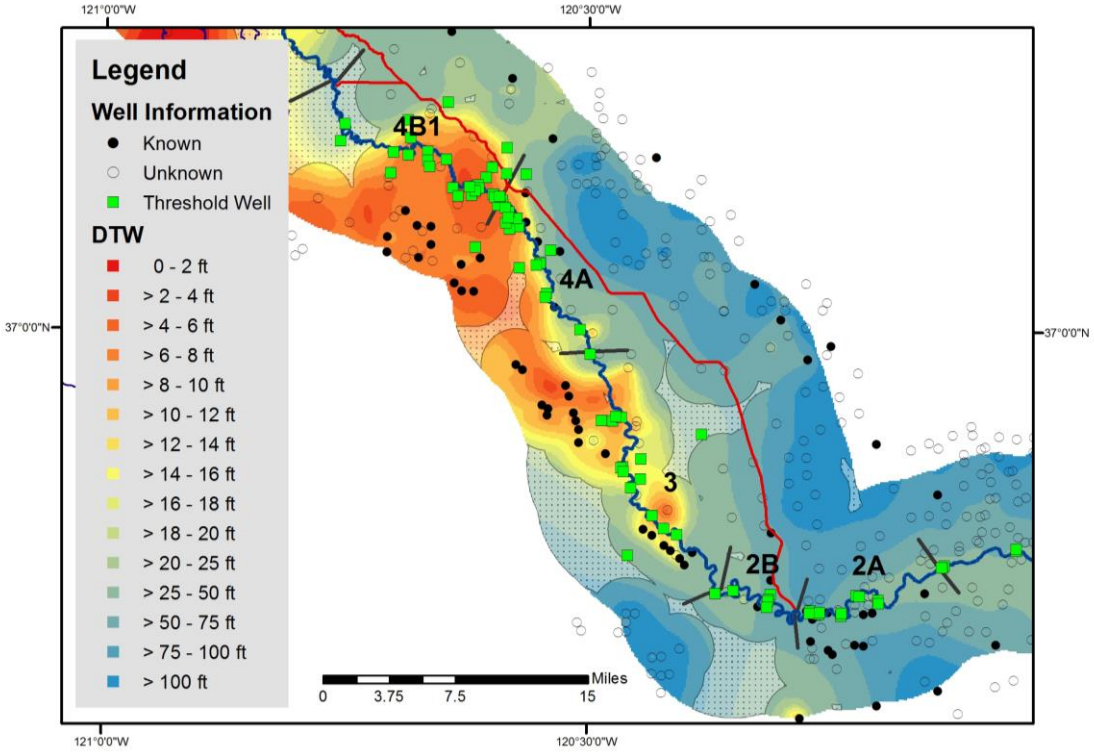


Figure H-15.
Fall 1999 Depth to Water in Reaches 2A through 4B1 for a Normal-Wet

H.3.2.6 Using a Range of Recent Groundwater Level Data (Method C4)

Given the lack of Restoration Flows in the San Joaquin River since 2011, Reclamation also utilized a method to determine the shallowest groundwater level along the river from December 2011 through January 2016. Reclamation did not release Restoration Flows beyond Reach 2B during this period, and thus it represents conditions agriculture historically operated to prior to the San Joaquin River Restoration Program in Reach 3 and downstream, as there were no flood flows during this period. Note that Method C4 was not applied to wells in Reaches 1 and 2 as there were some Restoration Flows in these sections of the river in the identified time period. The shallowest groundwater level of a three-point centered moving average was selected and potentially used in developing thresholds via the Historical Groundwater method depending on other available historic data as explained in section H.3.3.

Groundwater elevations at many wells can be variable between readings, even if only a week has elapsed between readings. To remove some of the "erratic" variability of the water levels, Reclamation applied a three-point centered moving average of manual groundwater level measurements. The shallowest groundwater level in the moving average was selected. The shallowest three-point centered moving average indicates the well threshold, and Reclamation converted the well thresholds to in-field thresholds using the ground surface adjustment and lateral gradient buffer where applicable. Figure H-16 shows an example of this method. For this example well, the shallowest manual measurement observation indicates a peak in the data at 2.05 ft bgs, while the calculated

three-point average reduces variability in the data and peaks at a deeper 2.78 ft bgs. The three-point average marks a more conservative (i.e., deeper) threshold than the individual manual measurements for all wells analyzed.

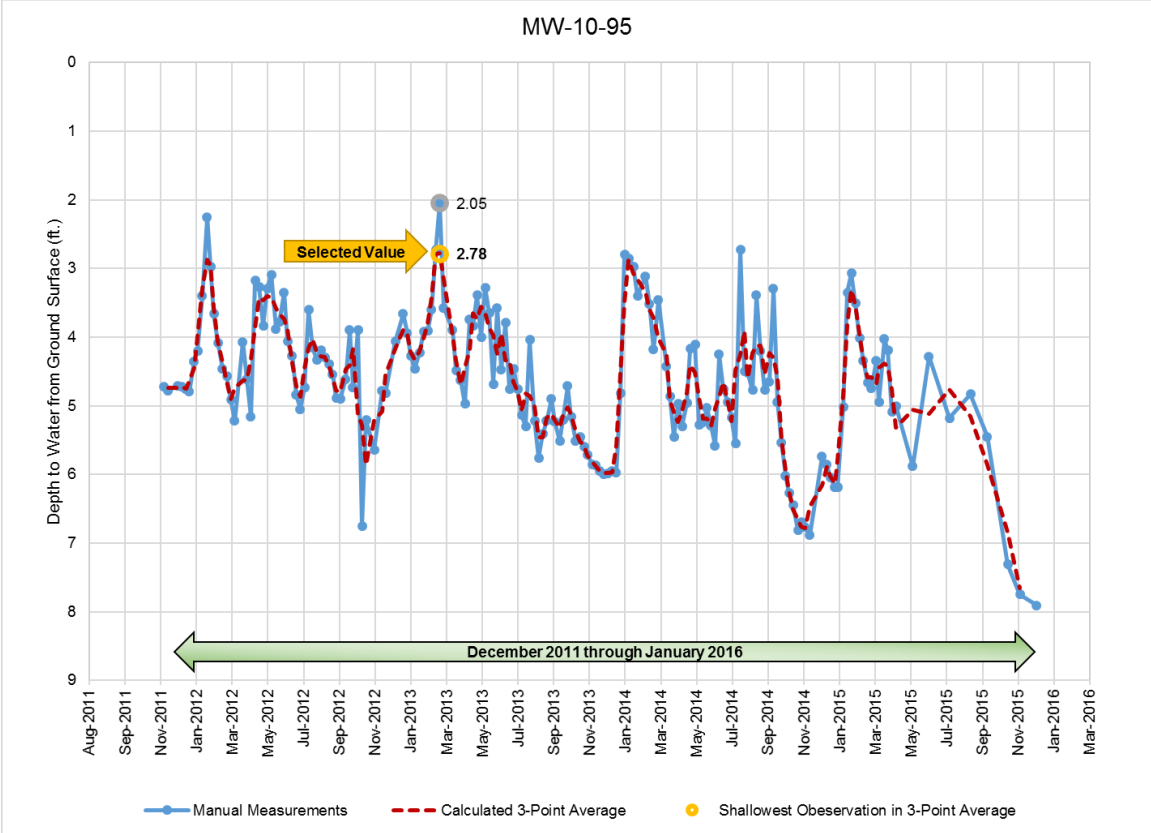


Figure H-16.
Groundwater Level data at MW-10-95 during Estimation of Threshold via Method C4

H.3.3 Results

Table H-9 below shows thresholds derived from historical groundwater levels. Method A (based on long period historic groundwater levels in the well) was used if it was available. If Method A was not available, Method B (based on long period historic groundwater levels in an adjacent well) was used. If neither Method A nor Method B was available, Method C1 (based on long-term average CCID data) was used. Finally, if neither Methods A, B, or C1 were available for a threshold well, the shallowest groundwater level calculated from the 3 remaining sub methods of Method C was used.

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
110			7.7	5.5	7.8	4.3	7.7	C1
111			0.2	4.4	6.6	4.1	0.2	C1
118			3.0	6.9	7.5	3.7	3.0	C1
119				5.5	8.1	4.0	0.0	C1
120				6.6	8.3	4.9	0.0	C1
121				7.2	7.0	3.9	0.0	C1
126			5.3	7.1	7.9	4.5	5.3	C1
127				7.2	5.4	3.2	0.0	C1
128				7.5	5.5	0.1	0.0	C1
129			2.6	7.2	5.6	1.4	2.6	C1
130			4.4	9.2	12.9	4.2	4.4	C1
131			8.1	17.8	29.9	7.4	8.1	C1
132			7.7	13.1	16.8	11.1	7.7	C1
133			5.1	13.4	10.8	2.5	5.1	C1
134			1.3	11.5	3.4	0.2	1.3	C1
135			6.1	9.5	8.4	3.7	6.1	C1
136			4.1	5.4	8.6	3.8	4.1	C1
139			9.2	7.6	12.4	8.4	9.2	C1
140			6.1	4.7	10.2	7.5	6.1	C1
141			4.7	7.6	7.2	2.6	4.7	C1
142			2.9	16.2	5.0	3.8	2.9	C1
143			3.1	17.4	3.0	0.8	3.1	C1

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
145			1.6	21.5	6.7	0.4	1.6	C1
146			1.2	16.4	8.3	0.0	1.2	C1
147			10.2	8.5	10.6	5.5	10.2	C1
148			6.9	7.8	15.8	6.5	6.9	C1
151			2.8	18.7	15.9	1.1	2.8	C1
152			3.6	7.8	10.3	3.1	3.6	C1
153			3.3	6.4	7.2	2.0	3.3	C1
154			4.5	8.0	11.1	5.3	4.5	C1
155	6.7		6.2	9.9	13.7	6.6	6.7	A
156			1.0	11.7	8.5	0.0	1.0	C1
157			6.2	10.9	8.3	6.1	6.2	C1
158			5.9	14.8	12.8	5.3	5.9	C1
159			10.8	15.9	14.9	10.6	10.8	C1
161			4.5	15.1	7.1	0.0	4.5	C1
162			8.3	12.5	15.9	14.2	8.3	C1
163			3.4	15.4	11.4	2.9	3.4	C1
164			2.0	10.4	11.5	0.0	2.0	C1
167				14.3	5.9	0.0	0.0	C1
169			8.4	10.0	11.7	9.9	8.4	C1
181			9.5	6.8	10.1	8.0	9.5	C1
182			4.9	6.8	5.8	4.6	4.9	C1
183			2.5	5.5	6.1	1.5	2.5	C1

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
184			2.4	4.6	6.2	1.3	2.4	C1
187			3.2	8.0	6.7	1.7	3.2	C1
189			2.3	15.0	24.8	10.2	2.3	C1
190			6.9	13.6	24.0	10.5	6.9	C1
191	9.1		7.8	8.2	15.3	4.1	9.1	A
350			3.7	19.1	21.4		3.7	C1
355				13.5	10.9	8.7	8.7	C4
356				30.8	12.9	9.7	9.7	C4
357				35.9	13.2	9.6	9.6	C4
358				12.8	12.0	4.3	4.3	C4
359				12.8	12.0	5.7	5.7	C4
360				16.7	13.0	6.7	6.7	C4
361				14.7	15.0	4.2	4.2	C4
362				25.7	10.2	7.6	7.6	C4
363				20.4	14.7	10.3	10.3	C4
364				36.9	7.6	0.0	0.0	C4
365				40.7	14.8	10.8	10.8	C4
366				44.5	16.8	12.7	12.7	C4
367				41.1	13.0	6.6	6.6	C4
368				35.6	11.4	8.3	8.3	C4
370				34.0	11.4	9.7	9.7	C4
371				36.7	9.5	9.6	9.5	C3

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
372			6.3	5.9	8.6	4.9	6.3	C1
373			6.4	7.2	9.7	5.0	6.4	C1
374			5.4	6.4	13.2	5.6	5.4	C1
375			5.6	7.6	13.0	7.1	5.6	C1
376			6.0	8.8	14.2	6.7	6.0	C1
377			3.5	7.0	15.0	6.4	3.5	C1
378			4.7	8.0	15.0	2.6	4.7	C1
379			6.0	9.8	18.2	4.8	6.0	C1
385			7.9	16.7	29.3		7.9	C1
386			11.4	15.4	29.1	10.0	11.4	C1
387			10.9	11.0	22.1	9.8	10.9	C1
388			6.8	11.8	21.1	8.3	6.8	C1
389			5.6	9.5	16.7	4.3	5.6	C1
390			6.2	8.4	15.4	3.5	6.2	C1
132A			8.2	12.2	15.6	8.5	8.2	C1
144A			7.9	19.7	16.3	7.5	7.9	C1
165A			8.2	9.7	13.0	4.8	8.2	C1
166A			8.2	12.5	13.1	9.1	8.2	C1
186A	3.5		2.9	6.9	9.5	0.5	3.5	A
188A			3.6	7.8	7.5	1.7	3.6	C1
369B				28.1	13.4	10.0	0.0	C1
CNOW-13-50				36.1	8.7		8.7	C3

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
CNOW-14-52				57.0	24.3		24.3	C3
CNSPT-52				61.9	24.1		24.1	C3
CWOW-14-15				36.1	8.7		8.7	C3
CWSPT-15				61.9	24.1		24.1	C3
FA-1				42.1	16.6		16.6	C3
FA-2				40.3	19.3		19.3	C3
FA-3				40.3	19.3		19.3	C3
FA-4				49.9	13.2		13.2	C3
FA-5				52.5	10.8		10.8	C3
FA-6				57.1	9.3		9.3	C3
FA-7				57.1	9.3		9.3	C3
FA-8				68.0	19.9		19.9	C3
FA-9				67.7	21.0		21.0	C3
JR-1				98.9	25.5		25.5	C3
JR-2				95.4	17.8		17.8	C3
MA-1				40.3	19.3		19.3	C3
MA-2				54.7	13.0		13.0	C3
MA-3				53.8	21.1		21.1	C3
MA-4				70.6	15.9		15.9	C3
MW-09-1				98.6	12.2		12.2	C3
MW-09-2				99.6	14.0		14.0	C3
MW-09-21				39.3	30.0		30.0	C3

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-09-22				42.5	24.0		24.0	C3
MW-09-23				44.3	11.0		11.0	C3
MW-09-23B				44.3	11.0		11.0	C3
MW-09-25				46.2	24.0		24.0	C3
MW-09-26				48.1	33.0		33.0	C3
MW-09-27				49.9	46.0		46.0	C3
MW-09-36				37.7	17.0		17.0	C3
MW-09-37				41.3	20.0		20.0	C3
MW-09-37B				41.3	20.0		20.0	C3
MW-09-39				49.9	13.0		13.0	C3
MW-09-39B				49.9	13.0		13.0	C3
MW-09-41				52.5	11.0		11.0	C3
MW-09-44				57.1	9.0		9.0	C3
MW-09-46				68.0	20.0		20.0	C3
MW-09-47				69.7	20.0		20.0	C3
MW-09-49				67.2	7.0		7.0	C3
MW-09-49B				67.2	7.0		7.0	C3
MW-09-52				58.8	40.0		40.0	C3
MW-09-53				59.2	38.0		38.0	C3
MW-09-54				58.2	29.0		29.0	C3
MW-09-54B				58.2	29.0		29.0	C3
MW-09-55				58.5	13.0		13.0	C3

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-09-55B				58.5	13.0		13.0	C3
MW-09-56				58.7	25.0		25.0	C3
MW-09-57				57.0	39.0		39.0	C3
MW-09-83				39.0	52.0	29.1	29.1	C4
MW-09-83B				39.0	52.0	29.4	29.4	C4
MW-09-84				23.6	38.0	15.1	15.1	C4
MW-09-85				21.4	39.0	14.5	14.5	C4
MW-09-85B				21.4	39.0	10.4	10.4	C4
MW-09-86			0.6	19.4	38.0	12.5	0.6	C1
MW-09-86B			0.7	19.4	38.0	11.5	0.7	C1
MW-09-87			5.7	16.5	28.0	10.8	5.7	C1
MW-09-87B			5.8	16.5	28.0	9.9	5.8	C1
MW-09-88		5.0	2.7	9.2	9.0	1.5	5.0	B
MW-09-121				5.7	10.2	3.4	3.4	C4
MW-09-123				5.8	10.0	8.5	5.8	C2
MW-09-124				6.0	9.9	8.5	6.0	C2
MW-09-125				6.1	10.1	11.9	6.1	C2
MW-10-74		9.6	6.3	10.3	18.0	7.9	9.6	B
MW-10-75			9.4	9.7	16.0	9.2	9.4	C1
MW-10-76			4.7	10.2	12.0	3.3	4.7	C1
MW-10-78				27.3	20.0	3.9	3.9	C4
MW-10-89				13.6	19.0	10.7	10.7	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-10-90				14.3	18.0	3.8	3.8	C4
MW-10-91				6.6	8.0	4.2	4.2	C4
MW-10-92				6.2	7.0	4.8	4.8	C4
MW-10-93				5.6	6.0	1.4	1.4	C4
MW-10-94				17.4	23.1	4.7	4.7	C4
MW-10-95				7.1	11.0	1.6	1.6	C4
MW-10-96				4.8	7.6	1.7	1.7	C4
MW-10-97				4.0	6.0	2.1	2.1	C4
MW-10-98				3.9	6.0	2.4	2.4	C4
MW-10-99				4.0	5.0	1.2	1.2	C4
MW-10-100				4.2	5.0	0.7	0.7	C4
MW-10-102				18.4	32.0	1.9	1.9	C4
MW-10-103				10.7	23.0	0.8	0.8	C4
MW-10-105				6.4	16.0	1.8	1.8	C4
MW-10-106				10.4	21.0	3.8	3.8	C4
MW-10-107				7.2	13.0	2.4	2.4	C4
MW-10-108				7.3	11.1	3.2	3.2	C4
MW-10-109				7.3	9.4	4.0	4.0	C4
MW-10-110				24.9	32.0	4.7	4.7	C4
MW-10-111				21.1	24.0	2.4	2.4	C4
MW-10-112				22.2	21.0	5.4	5.4	C4
MW-10-113				7.1	5.8	2.1	2.1	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-10-114				7.5	8.3	3.4	3.4	C4
MW-10-115				6.9	10.0	4.4	4.4	C4
MW-10-116				30.4	36.0	7.2	7.2	C4
MW-10-117				35.1	46.4		35.1	C2
MW-10-118				15.7	15.0	11.5	11.5	C4
MW-10-119				15.1	13.0	8.7	8.7	C4
MW-10-120				39.7	15.8	13.6	13.6	C4
MW-10-126				14.8	11.0	16.7	11.0	C3
MW-10-127				21.7	12.0	24.4	12.0	C3
MW-10-128				60.7	16.0	7.2	7.2	C4
MW-10-129				37.8	11.0	26.1	11.0	C3
MW-10-188		9.5	9.2	15.5	23.0	7.9	9.5	B
MW-11-130			8.1	18.6	16.0	7.7	8.1	C1
MW-11-131			8.8	18.1	19.0	8.5	8.8	C1
MW-11-132			9.5	18.3	20.0	10.9	9.5	C1
MW-11-133			5.2	16.6	4.0	4.9	5.2	C1
MW-11-134			9.2	16.0	15.0	7.7	9.2	C1
MW-11-135			8.5	15.1	13.0	8.6	8.5	C1
MW-11-136			7.1	12.5	11.0	5.7	7.1	C1
MW-11-137				25.2	35.1	5.5	5.5	C4
MW-11-138				32.6	49.0	8.7	8.7	C4
MW-11-139				32.4	48.0	5.0	5.0	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-11-140				18.0	27.3	6.2	6.2	C4
MW-11-141				31.2	45.7	5.3	5.3	C4
MW-11-143				22.7	36.0	3.2	3.2	C4
MW-11-144				34.2	53.0	5.3	5.3	C4
MW-11-145				20.2	21.6	5.8	5.8	C4
MW-11-146				27.1	38.0	9.1	9.1	C4
MW-11-147				27.8	39.0	8.5	8.5	C4
MW-11-148			7.3	11.2	19.0	7.9	7.3	C1
MW-11-149			9.6	16.7	29.0	14.9	9.6	C1
MW-11-150			8.2	21.2	23.0	10.8	8.2	C1
MW-11-151				86.4	21.0		21.0	C3
MW-11-152				7.4	6.2	10.1	6.2	C3
MW-11-153				7.5	3.0	3.1	3.0	C3
MW-11-154				6.9	4.0	4.1	4.0	C3
MW-11-155				10.7	20.0	13.3	10.7	C2
MW-11-156				10.9	22.0	15.9	10.9	C2
MW-11-157				16.8	20.0	8.1	8.1	C4
MW-11-158				40.2	45.0		40.2	C2
MW-11-159				44.3	49.0		44.3	C2
MW-11-160				35.4	10.0	12.2	10.0	C3
MW-11-161				31.3	25.0	6.3	6.3	C4
MW-11-162				19.1	27.0	14.1	14.1	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-11-163				32.5	33.0	5.5	5.5	C4
MW-11-164				20.4	16.0		16.0	C3
MW-12-165				8.5	11.0	4.0	4.0	C4
MW-12-166				19.8	29.0	18.0	18.0	C4
MW-12-167				19.6	30.0	21.7	19.6	C2
MW-12-168				10.0	17.0	3.5	3.5	C4
MW-12-169				7.4	9.0	3.4	3.4	C4
MW-12-170				13.9	14.0	2.3	2.3	C4
MW-12-171				10.5	13.0	3.8	3.8	C4
MW-12-172				7.7	11.0	2.7	2.7	C4
MW-12-173				24.2		6.2	6.2	C4
MW-12-174				15.6	21.0	4.1	4.1	C4
MW-12-175				27.1	34.0	2.5	2.5	C4
MW-12-176				15.9	20.0	0.8	0.8	C4
MW-12-177				10.8	16.0	3.4	3.4	C4
MW-12-178			7.8	12.2	24.0	14.3	7.8	C1
MW-12-179			11.4	18.0	32.0	18.7	11.4	C1
MW-12-180			6.5	22.7	12.0	6.1	6.5	C1
MW-12-181			6.5	25.3	19.0	7.1	6.5	C1
MW-12-182			6.7	19.8	14.0	5.2	6.7	C1
MW-12-183			2.0	25.3	16.0	6.3	2.0	C1
MW-12-184				17.7	9.0	6.1	6.1	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-12-185				20.0	12.0	8.0	8.0	C4
MW-12-186				25.3	11.0	3.9	3.9	C4
MW-12-187				35.3	11.0	8.8	8.8	C4
MW-12-189				12.8	11.0	6.8	6.8	C4
MW-12-190				13.2	12.0	5.7	5.7	C4
MW-12-191				11.1	10.0	10.2	10.0	C3
MW-12-192				10.2	10.0	6.2	6.2	C4
MW-13-193				18.1	10.4	11.9	10.4	C3
MW-13-194				18.9	10.4	9.6	9.6	C4
MW-13-195				20.3	10.7	5.5	5.5	C4
MW-13-196				18.5	10.5	8.8	8.8	C4
MW-13-197				17.3	10.9	8.5	8.5	C4
MW-13-198				15.2	12.9	10.8	10.8	C4
MW-13-199				13.5	12.4	7.8	7.8	C4
MW-13-200				37.5	15.5	5.5	5.5	C4
MW-13-201				18.7	32.5	8.5	8.5	C4
MW-13-202				19.4	34.7		19.4	C2
MW-13-210				9.0	19.6	14.4	9.0	C2
MW-13-211				14.9	21.6	17.7	14.9	C2
MW-13-212				17.0	26.5	14.7	14.7	C4
MW-13-213				23.7	27.6	11.8	11.8	C4
MW-13-214				28.7	23.5	18.0	18.0	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
MW-13-215				59.6	31.2	13.4	13.4	C4
MW-13-216				57.0	24.3	13.4	13.4	C4
MW-14-203				13.2	25.4	29.8	13.2	C2
MW-14-204				9.9	20.4	40.2	9.9	C2
MW-14-205				9.7	20.5	30.9	9.7	C2
MW-14-206				8.1	9.4	19.5	8.1	C2
MW-14-207				20.6	36.9	9.7	9.7	C4
MW-14-208				7.1	16.5	7.6	7.1	C2
MW-14-209				8.9	25.7	35.8	8.9	C2
MW-16-219			10.3				10.3	C1
MW-16-220			9.5				9.5	C1
MW-16-222			11.7				11.7	C1
MW-16-224			11.8				11.8	C1
PZ-09-R2B-2				40.3	10.0		10.0	C3
PZ-09-R3-3				13.4	14.0	7.4	7.4	C4
PZ-09-R3-5				12.2	11.0	8.6	8.6	C4
PZ-09-R3-7				16.3	9.0	6.6	6.6	C4
PZ-12-R2B-3				59.7	26.0		26.0	C3
PZ-12-R2B-4				62.7	26.0		26.0	C3
PZ-12-R2B-5				60.0	29.0		29.0	C3
PZ-12-R2B-6				58.8	29.0		29.0	C3
PZ-12-R4B-10				8.4	12.3		8.4	C2

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
PZ-12-R4B-10D				7.3	11.4	3.3	3.3	C4
PZ-13-R2B-7				14.4	19.1		14.4	C2
PZ-13-R2B-8				12.7	16.2		12.7	C2
PZ-13-R4A-2			18.6	11.2	14.8		18.6	C1
SJR W-1				4.0	5.0	2.3	2.3	C4
SJR W-2				4.8	5.0	1.8	1.8	C4
SJR W-3				4.4	5.0	1.8	1.8	C4
SJR W-4				6.6	7.0	4.2	4.2	C4
SJR W-5				5.6	7.0	2.2	2.2	C4
SJR W-6				5.5	7.0	0.7	0.7	C4
SJR W-7				6.9	9.0	2.1	2.1	C4
SJR W-8			1.8	6.3	7.0	1.6	1.8	C1
SJR W-9			6.0	6.6	8.0	1.6	6.0	C1
SJR W-10			7.2	7.1	9.0	1.1	7.2	C1
SJR W-11		11.2	10.0	8.1	13.0	6.1	11.2	B
SJR W-12				7.0	7.0	2.2	2.2	C4
SLCC-011				9.6	19.0		9.6	C2
SLCC-012				7.1	17.0		7.1	C2
SLCC-019				7.2			7.2	C2
SLCC-027				4.0	5.0		4.0	C2
SPT-11-1						11.3	11.3	C4
SPT-11-2						4.4	4.4	C4

Table H-9. Historical Groundwater Method Thresholds

Well	Method A Historical Threshold: Based on Water Levels in Well (feet bgs in field)	Method B Historical Threshold: Based on Water Levels in Nearby Well (feet bgs in field)	Method C1 Historical Threshold: CCID Well Average Groundwater Depth (feet bgs in field)	Method C2 Historical Threshold: Groundwater Depth Fall 1999 (feet bgs in field)	Method C3 Historical Threshold: Groundwater Depth Fall 2009 (feet bgs in field)	Method C4 Historical Threshold: Groundwater Depth Dec/2011 – Jan/2016 (feet bgs in field)	Historical Groundwater Threshold (feet bgs in field) [1]	Method Used [1]
T10-1 (1m)				57.1	9.0		9.0	C3
T10-1 (3m)				57.1	9.0		9.0	C3
T10-2				55.5	15.0		15.0	C2
T12-1				69.7	20.0		20.0	C3
T12-2				69.7	20.0		20.0	C3
T12-3				69.7	20.0		20.0	C2
T13-2				67.2	7.0		7.0	C3
T13-3				67.2	7.0		7.0	C3

[1]Method A was used if it was available. If Method A was not available, Method B was used. If neither Methods A or B were available, Method C1 was used. If none of the preceding methods was available, the shallowest groundwater level calculated from the remaining C methods was used (i.e. C2, C3, or C4).

H.3.4 Limitations

All thresholds based on measured groundwater levels are subject to inaccuracies associated with the DTW measurements themselves and with the local datum used to calculate groundwater level elevations. Given the low-precision nature of threshold estimation and good measurement protocols in place, the potential error in measurement of DTW can be neglected. However, some measurements may have been taken during, or soon after, irrigation and may not represent static groundwater conditions. These measurements may be filtered from the data set if field notes suggest recent irrigation events.

Thresholds calculated on the basis of long-term spring water levels measured in the threshold well are strongly tied to known field conditions, and therefore are relatively well posed. The elimination of the greatest 31 percent of groundwater level elevations, based on the percentage of wet years during the CCID well network period of record, is subject to change as analysis continues.

Thresholds calculated using long-term data from a nearby well are subject to error from the assumption that hydrologic conditions at the two wells are similar. This error is minimized by graphically comparing groundwater level elevations for each well (having offset values for the nearby well by the difference in ground surface elevations); however, historic conditions differ from those that include Interim and Restoration Flows, so a graphical comparison is an imprecise indication of error.

Threshold elevation estimates derived from the interpolated DTW maps were chosen for years that had good well coverage and represent average (normal conditions) based on the SJRRP year type classification. Threshold elevations based on these maps may be biased high or low depending on potential irrigation methods and amounts because the maps were produced for the fall season (September 15 through November 15) as there was a lack of spring DTW long-term data for many wells. In addition, threshold wells located in areas having no wells within a two-mile radius (identified as stippled zones with less transparency on the DTW maps) can only be considered an approximation of actual conditions. In addition, the maps generated using only CCID well data has clear advantages, including a data set of only shallow wells relatively unaffected by groundwater pumping and compensation for varying ground surface elevations, but also has disadvantages, including:

- The average of all measured groundwater elevations was used for each CCID well. With regard to a threshold, this translates to having historically been at or above the threshold about 50 percent of the time. Consideration will be given to using an alternative to the average, e.g., the 69th percentile.

- There are no CCID wells east of the San Joaquin River and most of the SJRRP threshold wells are east of the CCID wells; therefore, extrapolated, not interpolated values are assigned as thresholds.

Groundwater level thresholds generated based on 2011 - 2016 groundwater levels are also subject to limitations. These include the lack of a long-term dataset, the drought conditions underway which may result in overly conservative (i.e. deep) groundwater levels, and the possibility of measurement error as manual measurements were used.

H.4 Validation of Thresholds

The Reclamation Drainage Manual was first printed in 1978 and revised in 1993. The Drainage Manual states: "All the methods and techniques covered in the manual have proven to be very satisfactory through observed field conditions on irrigated lands throughout the world. Some methods have a more elegant development and basis in science than others, but all have been designed to solve practical problems in the field. The manual contains techniques developed over the last 50 years by personnel in the Bureau of Reclamation."

According to the Drainage manual, a maintaining of DTW of at least three to five feet is generally satisfactory, depending on local conditions including type of crops grown (Reclamation, 1993; pg. 132). Many thresholds established in the previous sections are deeper than three to five feet, indicating that those thresholds may be conservative, depending on crop type and other factors.

H.5 Threshold Results

A summary of the threshold analysis is presented in Tables H-10 and H-11. Table H-10 presents thresholds in "field"; Table H-11 presents "well" thresholds. The difference between "field" and "well" thresholds is presented in Section H.1.3.1. Some considerations regarding the thresholds follow:

- Several SJRRP monitoring wells are deeper wells, intended to monitor groundwater flow across a transect rather than water-table effects. Thresholds were developed for these wells, but will not be used for operations as they do not monitor the shallow groundwater table.

- A negative threshold indicates the well is in the river channel, and screened at an interval deeper below ground surface than the threshold in the adjacent field. These wells cannot be used to monitor groundwater levels in the adjacent field and will not be used for operations.

- Wells without a threshold elevation have not yet been surveyed and were outside of the LiDAR survey range. Thus, the ground surface elevation for these wells is unknown.

- Thresholds will continue to be revised as additional monitoring and data collection efforts result in modification to assumptions.

Table H-12 presents a summary of the number of wells that utilize the different threshold methods.

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
130	4A	Left	Alfalfa	6.5	4.4	4.4	109.7	2
131	4A	Left	Almond, Cotton	6.5	8.1	6.5	106.0	1
132	4A	Left	Cotton	5.5	7.7	5.5	110.3	1
133	4A	Left	Alfalfa, Almond, Cotton	6.5	5.1	5.1	109.6	2
134	4A	Left	Assumed Annual Crop	5.5	1.3	1.3	114.2	2
135	3	Left	Alfalfa, Cotton	6.5	6.1	6.1	113.7	2
139	3	Left	Alfalfa	6.5	9.2	6.5	118.4	1
142	3	Left	Corn, Cotton	5.5	2.9	2.9	118.4	2
143	4A	Left	Cotton, Melon	5.5	3.1	3.1	114.3	2
145	3	Left	Alfalfa, Corn, Cotton	6.5	1.6	1.6	118.6	2
146	3	Left	Alfalfa, Cotton	6.5	1.2	1.2	118.2	2
147	3	Left	Alfalfa, Cotton	6.5	10.2	6.5	119.2	1
148	3	Left	Cotton	5.5	6.9	5.5	121.3	1
151	3	Left	Alfalfa, Cotton	6.5	2.8	2.8	119.6	2
152	3	Left	Assumed Annual Crop	5.5	3.6	3.6	124.3	2
153	3	Left	Almond	6.5	3.3	3.3	124.5	2
154	3	Left	Alfalfa, Cotton	6.5	4.5	4.5	123.6	2
155	3	Left	Almond	7.0	6.7	6.7	122.9	2
156	3	Left	Assumed Annual Crop	5.5	1.0	1.0	128.8	2
157	3	Left	Almond, Tomato	6.5	6.2	6.2	130.3	2
159	3	Left	Cotton	5.5	10.8	5.5	132.7	1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
164	3	Left	Almond, Cotton	6.5	2.0	2.0	122.9	2
169	3	Left	Cotton, Pistachios	5.5	8.4	5.5	121.5	1
182	4A	Left	Corn	5.5	4.9	4.9	105.0	2
183	4A	Left	Melon	5.5	2.5	2.5	103.3	2
184	4A	Left	Cotton	5.5	2.4	2.4	98.9	2
189	4A	Left	Almond	6.5	2.3	2.3	108.4	2
190	4A	Left	Cotton	5.5	6.9	5.5	106.0	1
191	4A	Left	Tomato	6.0	9.1	6.0	102.0	1
355	3	Left	Almond	6.5	8.7	6.5	137.7	1
356	3	Left	Almond	6.5	9.7	6.5	139.7	1
358	3	Left	Alfalfa	6.5	4.3	4.3	137.0	2
359	3	Left	Almond	6.5	5.7	5.7	135.6	2
361	3	Left	Assumed Annual Crop, Fallow	5.5	4.2	4.2	137.0	2
363	3	Left	Cotton	5.5	10.3	5.5	142.9	1
364	3	Left	Almond, Cotton	6.5	0.0	0.0	145.9	
365	3	Left	Alfalfa	6.5	10.8	6.5	145.3	1
366	3	Left	Alfalfa	6.5	12.7	6.5	145.3	1
368	3	Left	Almond	6.5	8.3	6.5	143.0	1
370	3	Left	Almond	6.5	9.7	6.5	140.7	1
371	3	Left	Almond	6.5	9.5	6.5	143.4	1
374	3	Left	Alfalfa, Almond	6.5	5.4	5.4	122.7	2

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
375	3	Left	Alfalfa, Almond	6.5	5.6	5.6	123.7	2
376	3	Left	Almond	6.5	6.0	6.0	122.9	2
379	3	Left	Assumed Annual Crop	5.5	6.0	5.5	126.0	1
385	4A	Left	Cotton	5.5	7.9	5.5	106.1	1
386	4A	Left	Cotton	5.5	11.4	5.5	103.5	1
387	4A	Left	Cotton	5.5	10.9	5.5	102.7	1
388	4A	Left	Cotton	5.5	6.8	5.5	105.4	1
389	4A	Left	Cotton	5.5	5.6	5.5	103.4	1
390	4A	Left	Cotton	5.5	6.2	5.5	101.4	1
132A	4A	Left	Cotton	5.5	8.2	5.5	110.0	1
165A	3	Left	Alfalfa, Almond	6.5	8.2	6.5	120.8	1
186A	4A	Left	Corn	6.0	3.5	3.5	102.5	2
188A	4A	Left	Annual Crop	5.5	3.6	3.6	107.1	2
369B	3	Left	Almond	6.5	0.0	0.0	144.2	
CNOW-13-50	2B	Left	Assumed Annual Crop, Fallow	5.5	8.7	5.5	156.3	1
CNOW-14-52	2B	Left	Pistachio	5.5	24.3	5.5	154.2	1
CNSPT-52	2B	Left	Almond	6.5	24.1	6.5		1
CWOW-14-15	2B	Left	Almond	6.5	8.7	6.5		1
CWSPT-15	2B	Left	Almond	6.5	24.1	6.5		1
FA-1	1B	Left	Vineyard	7.0	16.6	7.0		1
FA-2	1B	Left	Vineyard	7.0	19.3	7.0		1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
FA-3	1B	Left	Vineyard	7.0	19.3	7.0		1
FA-7	2A	Left	Almond	7.0	9.3	7.0	166.4	1
FA-9	2A	Left	Corn	6.0	21.0	6.0	166.0	1
MA-1	1B	Left	Assumed Almond	7.0	19.3	7.0		1
MA-2	2A	Right	Vineyard	7.0	13.0	7.0	172.8	1
MA-3	2A	Right	Alfalfa	7.0	21.1	7.0	171.1	1
MA-4	2A	Right	Vineyard	7.0	15.9	7.0	161.4	1
MW-09-36	2A	Right	Assumed Annual Crop, Fallow	5.5	17.0	5.5	181.0	1
MW-09-37B	2A	Left	Vineyard	7.7	20.0	7.7	181.4	1
MW-09-39	2A	Left	Pistachio	6.0	13.0	6.0	177.3	1
MW-09-39B	2A	Left	Pistachio	6.0	13.0	6.0	178.4	1
MW-09-47	2A	Right	Vineyard	6.5	20.0	6.5	165.7	1
MW-09-49	2A	Left	Alfalfa	6.5	7.0	6.5	162.7	1
MW-09-49B	2A	Left	Corn	5.5	7.0	5.5	163.7	1
MW-09-52	2B	Right	Almond	7.7	40.0	7.7	153.5	1
MW-09-53	2B	Right	Almond	7.7	38.0	7.7	153.7	1
MW-09-54	2B	Right	Almond	7.0	29.0	7.0	153.3	1
MW-09-54B	2B	Right	Almond	7.0	29.0	7.0	153.3 *	1
MW-09-55	2B	Left	Palms	5.5	13.0	5.5	155.2	1
MW-09-55B	2B	Left	Palms	5.5	13.0	5.5	156.5 *	1
MW-09-56	2B	Left	Pistachio	6.0	25.0	6.0	153.5	1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-09-57	2B	Left	Vineyard	6.5	39.0	6.5	155.0	1
MW-09-86	4A	Left	Almond	8.7	0.6	0.6	112.4	2
MW-09-86B	4A	Left	Almond	8.7	0.7	0.7	112.3	2
MW-09-87	4A	Left	Almond, Cotton	6.5	5.7	5.7	107.4	2
MW-09-87B	4A	Left	Almond, Cotton	6.5	5.8	5.8	107.4	2
MW-09-125	5	Right	Grain, Fallow	5.5	6.1	5.5	68.9	1
MW-10-74	3	Left	Almond	9.0	9.6	9.0	122.8	1
MW-10-75	3	Left	Almond	8.0	9.4	8.0	123.3	1
MW-10-76	3	Left	Cotton	6.7	4.7	4.7	123.3	2
MW-10-78	3	Right	Cotton	5.5	3.9	3.9	118.3	2
MW-10-89	4A	Right	Almond	6.5	10.7	6.5	111.3	1
MW-10-90	4B1	Right	Pistachio	7.0	3.8	3.8	97.5	2
MW-10-91	4A	Left	Tomato	8.0	4.2	4.2	99.3	2
MW-10-92	4A	Left	Tomato	7.0	4.8	4.8	100.2	2
MW-10-93	4A	Left	Tomato	7.0	1.4	1.4	101.8	2
MW-10-94	4B1	Right	Pistachio	6.0	4.7	4.7	96.9	2
MW-10-95	4B1	Right	Alfalfa	8.0	1.6	1.6	96.2	2
MW-10-96	4B1	Right	Alfalfa	8.0	1.7	1.7	96.7	2
MW-10-97	4B1	Right	Alfalfa, Corn	6.5	2.1	2.1	95.7	2
MW-10-98	4B1	Left	Assumed Annual Crop	7.0	2.4	2.4	95.7	2
MW-10-99	4B1	Left	Alfalfa, Tomato	7.7	1.2	1.2	98.4	2

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-10-100	4B1	Left	Cotton, Tomato	7.7	0.7	0.7	97.5	2
MW-10-102	4B1	Right	Cotton, Tomato	7.0	1.9	1.9	91.5	2
MW-10-103	4B1	Right	Cotton, Tomato	7.0	0.8	0.8	93.7	2
MW-10-105	4B1	Left	Cotton	7.0	1.8	1.8	93.4	2
MW-10-106	4B1	Left	Tomato	5.5	3.8	3.8	86.3	2
MW-10-107	4B1	Left	Cotton, Tomato	6.7	2.4	2.4	91.0	2
MW-10-108	4B1	Left	Melon	8.0	3.2	3.2	92.1	2
MW-10-109	4B1	Left	Melon	6.7	4.0	4.0	93.0	2
MW-10-110	4B1	Left	Cotton	5.5	4.7	4.7	85.9	2
MW-10-111	4B1	Left	Alfalfa, Corn	7.7	2.4	2.4	86.4	2
MW-10-112	4B1	Right	Tomato	7.0	5.4	5.4	98.2	2
MW-10-113	4B1	Left	Melon	6.7	2.1	2.1	94.5	2
MW-10-114	4B1	Left	Alfalfa, Melon, Tomato	8.0	3.4	3.4	94.2	2
MW-10-115	4A	Left	Alfalfa, Cotton	7.7	4.4	4.4	103.4	2
MW-10-116	4A	Right	Alfalfa	8.0	7.2	7.2	97.5	2
MW-10-117	3	Right	Almond	7.7	35.1	7.7	139.8	1
MW-10-118	3	Right	Almond	6.5	11.5	6.5	129.4	1
MW-10-119	3	Right	Almond	6.5	8.7	6.5	131.6	1
MW-10-120	3	Left	Almond, Tomato	9.0	13.6	9.0	157.9	1
MW-10-126	3	Left	Cotton	6.0	11.0	6.0	144.4	1
MW-10-127	3	Right	Almond	7.0	12.0	7.0	140.8	1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-10-128	3	Left	Cotton, Tomato	6.0	7.2	6.0	162.0	1
MW-10-129	3	Right	Almond	7.0	11.0	7.0	146.2	1
MW-10-188	4A	Left	Alfalfa, Almond, Cotton	6.5	9.5	6.5	108.3	1
MW-11-130	4A	Left	Alfalfa, Almond	7.0	8.1	7.0	115.0	1
MW-11-131	4A	Left	Alfalfa, Almond	7.7	8.8	7.7	114.3	1
MW-11-132	4A	Left	Alfalfa, Almond	9.0	9.5	9.0	114.8	1
MW-11-133	4A	Left	Alfalfa, Cotton	9.0	5.2	5.2	113.9	2
MW-11-134	4A	Left	Almond, Cotton	7.0	9.2	7.0	110.2	1
MW-11-135	4A	Left	Cotton	8.0	8.5	8.0	111.1	1
MW-11-136	4A	Left	Alfalfa, Almond, Cotton	9.0	7.1	7.1	109.6	2
MW-11-137	4B1	Right	Assumed Annual Crop	7.0	5.5	5.5	85.4	2
MW-11-138	4B1	Right	Assumed Annual Crop	6.7	8.7	6.7	86.6	1
MW-11-139	4B1	Right	Assumed Annual Crop	7.0	5.0	5.0	84.6	2
MW-11-140	4B1	Left	Assumed Annual Crop	8.0	6.2	6.2	88.4	2
MW-11-141	4B1	Right	Assumed Annual Crop	6.0	5.3	5.3	84.0	2
MW-11-143	4B1	Right	Assumed Annual Crop	7.0	3.2	3.2	89.9	2
MW-11-144	4B1	Right	Assumed Annual Crop	7.0	5.3	5.3	83.8	2
MW-11-145	4B1	Left	Corn, Cotton	7.0	5.8	5.8	83.4	2
MW-11-146	4B1	Right	Assumed Annual Crop	8.0	9.1	8.0	88.8	1
MW-11-147	4B1	Right	Assumed Annual Crop	6.7	8.5	6.7	91.2	1
MW-11-148	4A	Left	Cotton	7.0	7.3	7.0	104.2	1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-11-149	4A	Left	Cotton	7.0	9.6	7.0	106.6	1
MW-11-150	3	Left	Cotton	7.0	8.2	7.0	121.9	1
MW-11-151	2A	Right	Vineyard	7.7	21.0	7.7	163.9	1
MW-11-152	4B1	Right	Alfalfa	7.7	6.2	6.2	97.0	2
MW-11-153	4B1	Right	Alfalfa, Corn	7.7	3.0	3.0	96.8	2
MW-11-154	4B2	Right	Alfalfa, Corn	7.7	4.0	4.0	94.6	2
MW-11-155	3	Right	Almond	7.7	10.7	7.7	126.3	1
MW-11-156	3	Right	Almond	7.7	10.9	7.7	127.0	1
MW-11-157	3	Right	Pistachio	7.7	8.1	7.7	118.4	1
MW-11-158	2A	Right	Vineyard	6.5	40.2	6.5	193.4	1
MW-11-159	2A	Right	Vineyard	6.5	44.3	6.5	193.6	1
MW-11-160	3	Left	Almond	9.0	10.0	9.0	140.2	1
MW-11-161	3	Right	Almond	8.0	6.3	6.3	116.8	2
MW-11-162	4A	Right	Almond	8.7	14.1	8.7	107.0	1
MW-11-163	3	Right	Almond	7.7	5.5	5.5	115.0	2
MW-11-164	2B	Left	Almond	7.0	16.0	7.0	152.0	1
MW-12-165	4A	Right	Alfalfa	7.0	4.0	4.0	97.4	2
MW-12-166	4A	Right	Alfalfa	6.5	18.0	6.5	98.3	1
MW-12-167	4A	Right	Alfalfa	8.0	19.6	8.0	97.7	1
MW-12-168	4A	Right	Alfalfa	7.0	3.5	3.5	100.3	2
MW-12-169	4A	Right	Alfalfa	7.7	3.4	3.4	100.5	2

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-12-170	4B1	Right	Alfalfa	6.5	2.3	2.3	95.1	2
MW-12-171	4B1	Right	Alfalfa	6.5	3.8	3.8	94.4	2
MW-12-172	4B1	Right	Alfalfa	7.7	2.7	2.7	93.6	2
MW-12-173	4B1	Right	Pistachio	5.5	6.2	5.5	96.8	1
MW-12-174	4B1	Right	Pistachio	5.5	4.1	4.1	97.2	2
MW-12-175	4B1	Right	Almond, Pistachio	7.7	2.5	2.5	97.1	2
MW-12-176	4B1	Right	Pistachio	5.5	0.8	0.8	96.8	2
MW-12-177	4A	Right	Alfalfa	8.0	3.4	3.4	98.9	2
MW-12-178	4A	Left	Cotton	5.5	7.8	5.5	104.1	1
MW-12-179	4A	Left	Cotton	7.0	11.4	7.0	104.3	1
MW-12-180	3	Left	Almond, Cotton	9.0	6.5	6.5	115.7	2
MW-12-181	3	Left	Almond, Cotton	9.0	6.5	6.5	118.2	2
MW-12-182	3	Left	Cotton	5.5	6.7	5.5	119.6	1
MW-12-183	3	Left	Almond	6.5	2.0	2.0	120.3	2
MW-12-184	3	Right	Assumed Annual Crop, Fallow	5.5	6.1	5.5	134.7	1
MW-12-185	3	Right	Assumed Annual Crop, Fallow	5.5	8.0	5.5	140.0	1
MW-12-186	3	Right	Assumed Annual Crop, Fallow	7.0	3.9	3.9	137.1	2
MW-12-187	3	Right	Assumed Annual Crop, Fallow	6.0	8.8	6.0	141.6	1
MW-12-189	3	Right	Grain, Fallow	5.5	6.8	5.5	136.3	1
MW-12-190	3	Right	Grain, Fallow	5.5	5.7	5.5	136.1	1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-12-191	3	Right	Almond	6.5	10.0	6.5	138.3	1
MW-12-192	3	Right	Almond	6.5	6.2	6.2	134.1	2
MW-13-193	3	Right	Cotton	7.0	10.4	7.0		1
MW-13-194	3	Right	Cotton	6.7	9.6	6.7		1
MW-13-195	3	Right	Cotton	8.0	5.5	5.5		2
MW-13-196	3	Right	Cotton	5.5	8.8	5.5	134.4	1
MW-13-197	3	Right	Cotton	6.7	8.5	6.7	132.2	1
MW-13-198	3	Right	Almond	9.0	10.8	9.0		1
MW-13-199	3	Right	Almond	9.0	7.8	7.8	128.9	2
MW-13-200	3	Right	Almond	9.0	5.5	5.5	128.4	2
MW-13-201	3	Right	Almond	8.0	8.5	8.0	127.7	1
MW-13-202	2B	Left	Almond	7.7	19.4	7.7	146.9	1
MW-13-210	3	Right	Almond	8.0	9.0	8.0	120.8	1
MW-13-211	3	Right	Almond	7.7	14.9	7.7	119.0	1
MW-13-212	3	Right	Almond	8.0	14.7	8.0	119.9	1
MW-13-213	3	Right	Pistachio	8.0	11.8	8.0	118.1	1
MW-13-214	3	Right	Almond	8.0	18.0	8.0	119.6	1
MW-13-215	3	Right	Pistachio	8.0	13.4	8.0	116.8	1
MW-13-216	3	Right	Pistachio	6.7	13.4	6.7	114.0	1
MW-14-203	4A	Right	Grain, Fallow	6.7	13.2	6.7	103.4	1
MW-14-204	4A	Right	Cotton	6.0	9.9	6.0	102.6	1

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
MW-14-205	4A	Right	Tomato	5.5	9.7	5.5	102.9	1
MW-14-206	4A	Right	Assumed Annual Crop, Fallow	6.0	8.1	6.0	101.3	1
MW-14-207	4A	Right	Assumed Annual Crop, Fallow	6.0	9.7	6.0	100.2	1
MW-14-208	4A	Right	Assumed Annual Crop, Fallow	5.5	7.1	5.5	98.6	1
MW-14-209	4A	Right	Grain, Fallow	6.7	8.9	6.7	100.9	1
MW-16-219	4A	Left	Cotton	5.7	10.3	5.7		1
MW-16-220	4A	Left	Cotton	6.7	9.5	6.7		1
MW-16-222	4A	Left	Cotton	5.5	11.7	5.5		1
MW-16-224	4A	Left	Cotton	5.5	11.8	5.5		1
PZ-09-R2B-2	2B	Right	Alfalfa	6.5	10.0	6.5	142.0	1
PZ-09-R3-3	3	Right	Almond	7.7	7.4	7.4	128.8	2
PZ-09-R3-5	3	Right	Grain, Fallow	5.7	8.6	5.7	138.5	1
PZ-09-R3-7	3	Right	Almond	6.5	6.6	6.5	137.4	1
PZ-12-R2B-3	2B	Left	Vineyard	6.5	26.0	6.5	160.2	1
PZ-12-R2B-4	2B	Left	Vineyard	6.5	26.0	6.5	160.4	1
PZ-12-R2B-5	2B	Left	Vineyard	7.7	29.0	7.7	157.6	1
PZ-12-R2B-6	2B	Left	Vineyard	7.7	29.0	7.7	157.6	1
SJR W-1	4B1	Left	Tomato	6.0	2.3	2.3	96.1	2
SJR W-2	4B1	Left	Tomato	6.0	1.8	1.8	97.2	2
SJR W-3	4B1	Left	Melon	6.0	1.8	1.8	97.0	2

Table H-10. Threshold Summary Table (Field Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in field)	Method 2 Threshold - Historical Groundwater (feet bgs in field)	Threshold (feet bgs in field) [1]	Threshold Elevation [1]	Method Used [1]
SJR W-4	4A	Left	Alfalfa, Melon	7.0	4.2	4.2	101.0	2
SJR W-5	4A	Left	Tomato	6.0	2.2	2.2	99.4	2
SJR W-6	4A	Left	Tomato	6.0	0.7	0.7	100.6	2
SJR W-7	4A	Left	Tomato	6.0	2.1	2.1	100.9	2
SJR W-8	4A	Left	Corn	6.0	1.8	1.8	103.7	2
SJR W-9	4A	Left	Alfalfa	7.0	6.0	6.0	98.0	2
SJR W-10	4A	Left	Alfalfa	7.0	7.2	7.0	97.9	1
SJR W-11	4A	Left	Alfalfa	7.0	11.2	7.0	99.4	1
SJR W-12	4A	Left	Alfalfa, Melon	7.0	2.2	2.2	101.8	2
SLCC-027	4B1	Left	Alfalfa	6.5	4.0	4.0	95.2	2

[1] The method with the shallower water level establishes the threshold. Method 1 and 2 correspond to agricultural and historical, respectively.

* Threshold calculation includes lateral gradient buffer as described in section H.1.3.3.

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
130	4A	Left	Alfalfa	7.2	5.1	5.1	109.7	2
131	4A	Left	Almond, Cotton	9.3	10.9	9.3	106.0	1
132	4A	Left	Cotton	7.7	9.9	7.7	110.3	1
133	4A	Left	Alfalfa, Almond, Cotton	8.8	7.4	7.4	109.6	2
134	4A	Left	Assumed Annual Crop	7.6	3.4	3.4	114.2	2
135	3	Left	Alfalfa, Cotton	6.8	6.4	6.4	113.7	2
139	3	Left	Alfalfa	7.2	9.8	7.2	118.4	1
142	3	Left	Corn, Cotton	5.9	3.4	3.4	118.4	2
143	4A	Left	Cotton, Melon	7.6	5.2	5.2	114.3	2
145	3	Left	Alfalfa, Corn, Cotton	9.6	4.7	4.7	118.6	2
146	3	Left	Alfalfa, Cotton	11.7	6.3	6.3	118.2	2
147	3	Left	Alfalfa, Cotton	7.5	11.1	7.5	119.2	1
148	3	Left	Cotton	7.8	9.2	7.8	121.3	1
151	3	Left	Alfalfa, Cotton	11.9	8.3	8.3	119.6	2
152	3	Left	Assumed Annual Crop	8.4	6.5	6.5	124.3	2
153	3	Left	Almond	10.1	6.9	6.9	124.5	2
154	3	Left	Alfalfa, Cotton	8.8	6.8	6.8	123.6	2
155	3	Left	Almond	10.3	10.0	10.0	122.9	2
156	3	Left	Assumed Annual Crop	11.5	6.9	6.9	128.8	2
157	3	Left	Almond, Tomato	7.8	7.5	7.5	130.3	2
159	3	Left	Cotton	7.8	13.1	7.8	132.7	1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
164	3	Left	Almond, Cotton	11.5	7.0	7.0	122.9	2
169	3	Left	Cotton, Pistachios	6.2	9.1	6.2	121.5	1
182	4A	Left	Corn	6.2	5.6	5.6	105.0	2
183	4A	Left	Melon	7.5	4.5	4.5	103.3	2
184	4A	Left	Cotton	8.4	5.3	5.3	98.9	2
189	4A	Left	Almond	11.1	6.9	6.9	108.4	2
190	4A	Left	Cotton	7.3	8.7	7.3	106.0	1
191	4A	Left	Tomato	8.9	12.0	8.9	102.0	1
355	3	Left	Almond	7.6	9.7	7.6	137.7	1
356	3	Left	Almond	7.2	10.4	7.2	139.7	1
358	3	Left	Alfalfa	13.5	11.3	11.3	137.0	2
359	3	Left	Almond	13.3	12.4	12.4	135.6	2
361	3	Left	Assumed Annual Crop, Fallow	11.7	10.4	10.4	137.0	2
363	3	Left	Cotton	8.4	13.2	8.4	142.9	1
364	3	Left	Almond, Cotton	15.1	8.5	8.6	145.9	2
365	3	Left	Alfalfa	6.8	11.2	6.8	145.3	1
366	3	Left	Alfalfa	7.2	13.4	7.2	145.3	1
368	3	Left	Almond	10.9	12.7	10.9	143.0	1
370	3	Left	Almond	9.8	12.9	9.8	140.7	1
371	3	Left	Almond	7.1	10.1	7.1	143.4	1
374	3	Left	Alfalfa, Almond	6.9	5.8	5.8	122.7	2

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
375	3	Left	Alfalfa, Almond	7.7	6.7	6.7	123.7	2
376	3	Left	Almond	8.8	8.3	8.3	122.9	2
379	3	Left	Assumed Annual Crop	9.5	10.0	9.5	126.0	1
385	4A	Left	Cotton	7.2	9.6	7.2	106.1	1
386	4A	Left	Cotton	7.4	13.4	7.4	103.5	1
387	4A	Left	Cotton	6.7	12.1	6.7	102.7	1
388	4A	Left	Cotton	7.5	8.8	7.5	105.4	1
389	4A	Left	Cotton	8.3	8.4	8.3	103.4	1
390	4A	Left	Cotton	8.9	9.6	8.9	101.4	1
132A	4A	Left	Cotton	6.9	9.6	6.9	110.0	1
165A	3	Left	Alfalfa, Almond	6.6	8.3	6.6	120.8	1
186A	4A	Left	Corn	8.0	5.5	5.5	102.5	2
188A	4A	Left	Annual Crop	7.2	5.3	5.3	107.1	2
369B	3	Left	Almond	7.2	0.0	0.7	144.2	2
CNOW-13-50	2B	Left	Assumed Annual Crop, Fallow	6.5	9.7	6.5	156.3	1
CNOW-14-52	2B	Left	Pistachio	6.2	25.0	6.2	154.2	1
CNSPT-52	2B	Left	Almond	6.5	24.1	6.5		1
CWOW-14-15	2B	Left	Almond	8.3	10.5	8.3		1
CWSPT-15	2B	Left	Almond	7.4	25.0	7.4		1
FA-1	1B	Left	Vineyard	8.8	18.4	8.8		1
FA-2	1B	Left	Vineyard	9.2	21.5	9.2		1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
FA-3	1B	Left	Vineyard	8.5	20.8	8.5		1
FA-7	2A	Left	Almond	12.6	14.9	12.6	166.4	1
FA-9	2A	Left	Corn	8.0	23.0	8.0	166.0	1
MA-1	1B	Left	Assumed Almond	8.7	21.0	8.7		1
MA-2	2A	Right	Vineyard	9.9	15.9	9.9	172.8	1
MA-3	2A	Right	Alfalfa	7.9	22.0	7.9	171.1	1
MA-4	2A	Right	Vineyard	13.1	22.0	13.1	161.4	1
MW-09-36	2A	Right	Assumed Annual Crop, Fallow	10.0	21.5	10.0	181.0	1
MW-09-37B	2A	Left	Vineyard	10.8	23.1	10.8	181.4	1
MW-09-39	2A	Left	Pistachio	7.6	14.6	7.6	177.3	1
MW-09-39B	2A	Left	Pistachio	6.5	13.5	6.5	178.4	1
MW-09-47	2A	Right	Vineyard	9.0	22.5	9.0	165.7	1
MW-09-49	2A	Left	Alfalfa	8.3	8.8	8.3	162.7	1
MW-09-49B	2A	Left	Corn	7.2	8.7	7.2	163.7	1
MW-09-52	2B	Right	Almond	8.6	40.9	8.6	153.5	1
MW-09-53	2B	Right	Almond	9.1	39.4	9.1	153.7	1
MW-09-54	2B	Right	Almond	14.7	36.7	14.7	153.3	1
MW-09-54B	2B	Right	Almond	12.9	34.9	12.9	155.3 *	1
MW-09-55	2B	Left	Palms	10.9	18.4	10.9	155.2	1
MW-09-55B	2B	Left	Palms	2.7	10.2	2.7	163.0 *	1
MW-09-56	2B	Left	Pistachio	7.7	26.7	7.7	153.5	1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-09-57	2B	Left	Vineyard	8.1	40.6	8.1	155.0	1
MW-09-86	4A	Left	Almond	16.7	8.6	8.6	112.4	2
MW-09-86B	4A	Left	Almond	16.6	8.6	8.6	112.3	2
MW-09-87	4A	Left	Almond, Cotton	8.5	7.6	7.6	107.4	2
MW-09-87B	4A	Left	Almond, Cotton	8.4	7.6	7.6	107.4	2
MW-09-125	5	Right	Grain, Fallow	5.5	6.1	5.5	68.9	1
MW-10-74	3	Left	Almond	13.2	13.8	13.2	122.8	1
MW-10-75	3	Left	Almond	8.5	9.9	8.5	123.3	1
MW-10-76	3	Left	Cotton	9.4	7.4	7.4	123.3	2
MW-10-78	3	Right	Cotton	8.5	7.0	7.0	118.3	2
MW-10-89	4A	Right	Almond	7.5	11.7	7.5	111.3	1
MW-10-90	4B1	Right	Pistachio	7.0	3.8	3.8	97.5	2
MW-10-91	4A	Left	Tomato	11.7	7.9	7.9	99.3	2
MW-10-92	4A	Left	Tomato	8.0	5.8	5.8	100.2	2
MW-10-93	4A	Left	Tomato	9.2	3.6	3.6	101.8	2
MW-10-94	4B1	Right	Pistachio	6.0	4.7	4.7	96.9	2
MW-10-95	4B1	Right	Alfalfa	9.2	2.8	2.8	96.2	2
MW-10-96	4B1	Right	Alfalfa	10.0	3.7	3.7	96.7	2
MW-10-97	4B1	Right	Alfalfa, Corn	9.9	5.5	5.5	95.7	2
MW-10-98	4B1	Left	Assumed Annual Crop	11.0	6.5	6.5	95.7	2
MW-10-99	4B1	Left	Alfalfa, Tomato	12.4	5.9	5.9	98.4	2

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-10-100	4B1	Left	Cotton, Tomato	12.2	5.2	5.2	97.5	2
MW-10-102	4B1	Right	Cotton, Tomato	9.4	4.2	4.2	91.5	2
MW-10-103	4B1	Right	Cotton, Tomato	11.6	5.4	5.4	93.7	2
MW-10-105	4B1	Left	Cotton	8.4	3.3	3.3	93.4	2
MW-10-106	4B1	Left	Tomato	7.5	5.7	5.7	86.3	2
MW-10-107	4B1	Left	Cotton, Tomato	9.4	5.0	5.0	91.0	2
MW-10-108	4B1	Left	Melon	9.7	4.9	4.9	92.1	2
MW-10-109	4B1	Left	Melon	8.2	5.5	5.5	93.0	2
MW-10-110	4B1	Left	Cotton	7.3	6.5	6.5	85.9	2
MW-10-111	4B1	Left	Alfalfa, Corn	9.5	4.1	4.1	86.4	2
MW-10-112	4B1	Right	Tomato	7.0	5.4	5.4	98.2	2
MW-10-113	4B1	Left	Melon	11.1	6.5	6.5	94.5	2
MW-10-114	4B1	Left	Alfalfa, Melon, Tomato	9.9	5.3	5.3	94.2	2
MW-10-115	4A	Left	Alfalfa, Cotton	7.7	4.4	4.4	103.4	2
MW-10-116	4A	Right	Alfalfa	8.0	7.2	7.2	97.5	2
MW-10-117	3	Right	Almond	7.7	35.1	7.7	139.8	1
MW-10-118	3	Right	Almond	8.9	13.9	8.9	129.4	1
MW-10-119	3	Right	Almond	8.9	11.1	8.9	131.6	1
MW-10-120	3	Left	Almond, Tomato	9.0	13.6	9.0	157.9	1
MW-10-126	3	Left	Cotton	6.0	11.0	6.0	144.4	1
MW-10-127	3	Right	Almond	7.0	12.0	7.0	140.8	1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-10-128	3	Left	Cotton, Tomato	6.0	7.2	6.0	162.0	1
MW-10-129	3	Right	Almond	7.6	11.6	7.6	146.2	1
MW-10-188	4A	Left	Alfalfa, Almond, Cotton	8.6	11.6	8.6	108.3	1
MW-11-130	4A	Left	Alfalfa, Almond	7.0	8.1	7.0	115.0	1
MW-11-131	4A	Left	Alfalfa, Almond	7.7	8.8	7.7	114.3	1
MW-11-132	4A	Left	Alfalfa, Almond	9.0	9.5	9.0	114.8	1
MW-11-133	4A	Left	Alfalfa, Cotton	9.0	5.2	5.2	113.9	2
MW-11-134	4A	Left	Almond, Cotton	7.0	9.2	7.0	110.2	1
MW-11-135	4A	Left	Cotton	8.0	8.5	8.0	111.1	1
MW-11-136	4A	Left	Alfalfa, Almond, Cotton	9.0	7.1	7.1	109.6	2
MW-11-137	4B1	Right	Assumed Annual Crop	7.0	5.5	5.5	85.4	2
MW-11-138	4B1	Right	Assumed Annual Crop	6.7	8.7	6.7	86.6	1
MW-11-139	4B1	Right	Assumed Annual Crop	7.0	5.0	5.0	84.6	2
MW-11-140	4B1	Left	Assumed Annual Crop	8.0	6.2	6.2	88.4	2
MW-11-141	4B1	Right	Assumed Annual Crop	6.0	5.3	5.3	84.0	2
MW-11-143	4B1	Right	Assumed Annual Crop	7.0	3.2	3.2	89.9	2
MW-11-144	4B1	Right	Assumed Annual Crop	7.0	5.3	5.3	83.8	2
MW-11-145	4B1	Left	Corn, Cotton	7.0	5.8	5.8	83.4	2
MW-11-146	4B1	Right	Assumed Annual Crop	8.0	9.1	8.0	88.8	1
MW-11-147	4B1	Right	Assumed Annual Crop	6.7	8.5	6.7	91.2	1
MW-11-148	4A	Left	Cotton	7.0	7.3	7.0	104.2	1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-11-149	4A	Left	Cotton	7.0	9.6	7.0	106.6	1
MW-11-150	3	Left	Cotton	7.0	8.2	7.0	121.9	1
MW-11-151	2A	Right	Vineyard	7.7	21.0	7.7	163.9	1
MW-11-152	4B1	Right	Alfalfa	7.7	6.2	6.2	97.0	2
MW-11-153	4B1	Right	Alfalfa, Corn	7.7	3.0	3.0	96.8	2
MW-11-154	4B2	Right	Alfalfa, Corn	7.7	4.0	4.0	94.6	2
MW-11-155	3	Right	Almond	7.7	10.7	7.7	126.3	1
MW-11-156	3	Right	Almond	7.7	10.9	7.7	127.0	1
MW-11-157	3	Right	Pistachio	7.7	8.1	7.7	118.4	1
MW-11-158	2A	Right	Vineyard	6.5	40.2	6.5	193.4	1
MW-11-159	2A	Right	Vineyard	6.5	44.3	6.5	193.6	1
MW-11-160	3	Left	Almond	9.0	10.0	9.0	140.2	1
MW-11-161	3	Right	Almond	8.0	6.3	6.3	116.8	2
MW-11-162	4A	Right	Almond	8.7	14.1	8.7	107.0	1
MW-11-163	3	Right	Almond	7.7	5.5	5.5	115.0	2
MW-11-164	2B	Left	Almond	7.0	16.0	7.0	152.0	1
MW-12-165	4A	Right	Alfalfa	9.2	6.2	6.2	97.4	2
MW-12-166	4A	Right	Alfalfa	8.1	19.6	8.1	98.3	1
MW-12-167	4A	Right	Alfalfa	9.0	20.6	9.0	97.7	1
MW-12-168	4A	Right	Alfalfa	9.8	6.3	6.3	100.3	2
MW-12-169	4A	Right	Alfalfa	11.2	6.9	6.9	100.5	2

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-12-170	4B1	Right	Alfalfa	8.2	4.0	4.0	95.1	2
MW-12-171	4B1	Right	Alfalfa	7.5	4.8	4.8	94.4	2
MW-12-172	4B1	Right	Alfalfa	9.5	4.5	4.5	93.6	2
MW-12-173	4B1	Right	Pistachio	6.2	6.9	6.2	96.8	1
MW-12-174	4B1	Right	Pistachio	6.8	5.5	5.5	97.2	2
MW-12-175	4B1	Right	Almond, Pistachio	8.7	3.5	3.5	97.1	2
MW-12-176	4B1	Right	Pistachio	8.7	4.0	4.0	96.8	2
MW-12-177	4A	Right	Alfalfa	9.3	4.7	4.7	98.9	2
MW-12-178	4A	Left	Cotton	9.2	11.5	9.2	104.1	1
MW-12-179	4A	Left	Cotton	8.3	12.8	8.3	104.3	1
MW-12-180	3	Left	Almond, Cotton	9.0	6.6	6.6	115.7	2
MW-12-181	3	Left	Almond, Cotton	10.4	8.0	8.0	118.2	2
MW-12-182	3	Left	Cotton	6.8	8.0	6.8	119.6	1
MW-12-183	3	Left	Almond	11.1	6.6	6.6	120.3	2
MW-12-184	3	Right	Assumed Annual Crop, Fallow	12.5	13.1	12.5	134.7	1
MW-12-185	3	Right	Assumed Annual Crop, Fallow	9.7	12.2	9.7	140.0	1
MW-12-186	3	Right	Assumed Annual Crop, Fallow	15.7	12.6	12.6	137.1	2
MW-12-187	3	Right	Assumed Annual Crop, Fallow	9.6	12.4	9.6	141.6	1
MW-12-189	3	Right	Grain, Fallow	9.5	10.8	9.5	136.3	1
MW-12-190	3	Right	Grain, Fallow	7.9	8.1	7.9	136.1	1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-12-191	3	Right	Almond	7.5	11.0	7.5	138.3	1
MW-12-192	3	Right	Almond	9.5	9.2	9.2	134.1	2
MW-13-193	3	Right	Cotton	8.6	11.9	8.6		1
MW-13-194	3	Right	Cotton	7.8	10.7	7.8		1
MW-13-195	3	Right	Cotton	14.5	12.0	12.0		2
MW-13-196	3	Right	Cotton	8.5	11.8	8.5	134.4	1
MW-13-197	3	Right	Cotton	11.6	13.4	11.6	132.2	1
MW-13-198	3	Right	Almond	11.5	13.3	11.5		1
MW-13-199	3	Right	Almond	15.0	13.8	13.8	128.9	2
MW-13-200	3	Right	Almond	17.1	13.6	13.6	128.4	2
MW-13-201	3	Right	Almond	10.9	11.4	10.9	127.7	1
MW-13-202	2B	Left	Almond	7.7	19.4	7.7	146.9	1
MW-13-210	3	Right	Almond	13.2	14.2	13.2	120.8	1
MW-13-211	3	Right	Almond	7.7	14.9	7.7	119.0	1
MW-13-212	3	Right	Almond	11.0	17.7	11.0	119.9	1
MW-13-213	3	Right	Pistachio	11.1	14.8	11.1	118.1	1
MW-13-214	3	Right	Almond	9.5	19.5	9.5	119.6	1
MW-13-215	3	Right	Pistachio	8.9	14.3	8.9	116.8	1
MW-13-216	3	Right	Pistachio	7.1	13.8	7.1	114.0	1
MW-14-203	4A	Right	Grain, Fallow	9.0	15.5	9.0	103.4	1
MW-14-204	4A	Right	Cotton	7.7	11.6	7.7	102.6	1

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
MW-14-205	4A	Right	Tomato	7.2	11.4	7.2	102.9	1
MW-14-206	4A	Right	Assumed Annual Crop, Fallow	12.2	14.3	12.2	101.3	1
MW-14-207	4A	Right	Assumed Annual Crop, Fallow	11.6	15.3	11.6	100.2	1
MW-14-208	4A	Right	Assumed Annual Crop, Fallow	6.5	8.1	6.5	98.6	1
MW-14-209	4A	Right	Grain, Fallow	7.9	10.1	7.9	100.9	1
MW-16-219	4A	Left	Cotton	5.7	10.3	5.7		1
MW-16-220	4A	Left	Cotton	6.7	9.5	6.7		1
MW-16-222	4A	Left	Cotton	5.5	11.7	5.5		1
MW-16-224	4A	Left	Cotton	5.5	11.8	5.5		1
PZ-09-R2B-2	2B	Right	Alfalfa	10.4	13.9	10.4	142.0	1
PZ-09-R3-3	3	Right	Almond	12.0	11.7	11.7	128.8	2
PZ-09-R3-5	3	Right	Grain, Fallow	6.9	9.7	6.9	138.5	1
PZ-09-R3-7	3	Right	Almond	7.2	7.4	7.2	137.4	1
PZ-12-R2B-3	2B	Left	Vineyard	6.5	26.0	6.5	160.2	1
PZ-12-R2B-4	2B	Left	Vineyard	6.5	26.0	6.5	160.4	1
PZ-12-R2B-5	2B	Left	Vineyard	7.7	29.0	7.7	157.6	1
PZ-12-R2B-6	2B	Left	Vineyard	7.7	29.0	7.7	157.6	1
SJR W-1	4B1	Left	Tomato	7.8	4.0	4.0	96.1	2
SJR W-2	4B1	Left	Tomato	10.2	6.0	6.0	97.2	2
SJR W-3	4B1	Left	Melon	9.8	5.6	5.6	97.0	2

Table H-11. Threshold Summary Table (Well Threshold)

Well	Reach	Bank	Crop Type	Method 1 Threshold - Agricultural Practices (feet bgs in well)	Method 2 Threshold - Historical Groundwater (feet bgs in well)	Threshold (feet bgs in well) [1]	Threshold Elevation [1]	Method Used [1]
SJR W-4	4A	Left	Alfalfa, Melon	8.1	5.3	5.3	101.0	2
SJR W-5	4A	Left	Tomato	7.9	4.0	4.0	99.4	2
SJR W-6	4A	Left	Tomato	10.4	5.1	5.1	100.6	2
SJR W-7	4A	Left	Tomato	10.0	6.1	6.1	100.9	2
SJR W-8	4A	Left	Corn	9.3	5.1	5.1	103.7	2
SJR W-9	4A	Left	Alfalfa	8.1	7.1	7.1	98.0	2
SJR W-10	4A	Left	Alfalfa	8.8	9.0	8.8	97.9	1
SJR W-11	4A	Left	Alfalfa	8.8	13.0	8.8	99.4	1
SJR W-12	4A	Left	Alfalfa, Melon	9.1	4.3	4.3	101.8	2
SLCC-027	4B1	Left	Alfalfa	9.3	6.8	6.8	95.2	2

[1] The method with the shallower water level establishes the threshold. Method 1 and 2 correspond to agricultural and historical, respectively.

* Threshold calculation includes lateral gradient buffer as described in section H.1.3.3.

Table H-12. Count of Thresholds Calculated Via Each Method

Threshold Method	Number of Wells
Agricultural Practices	134
Historical Groundwater Method A	2
Historical Groundwater Method B	0
Historical Groundwater Method C	103
Historical Groundwater Method C1, CCID Well	36
Historical Groundwater Method C2, 1999	1
Historical Groundwater Method C3, 2009	3
Historical Groundwater Method C4 (Dec/2011-Jan/2016)	63