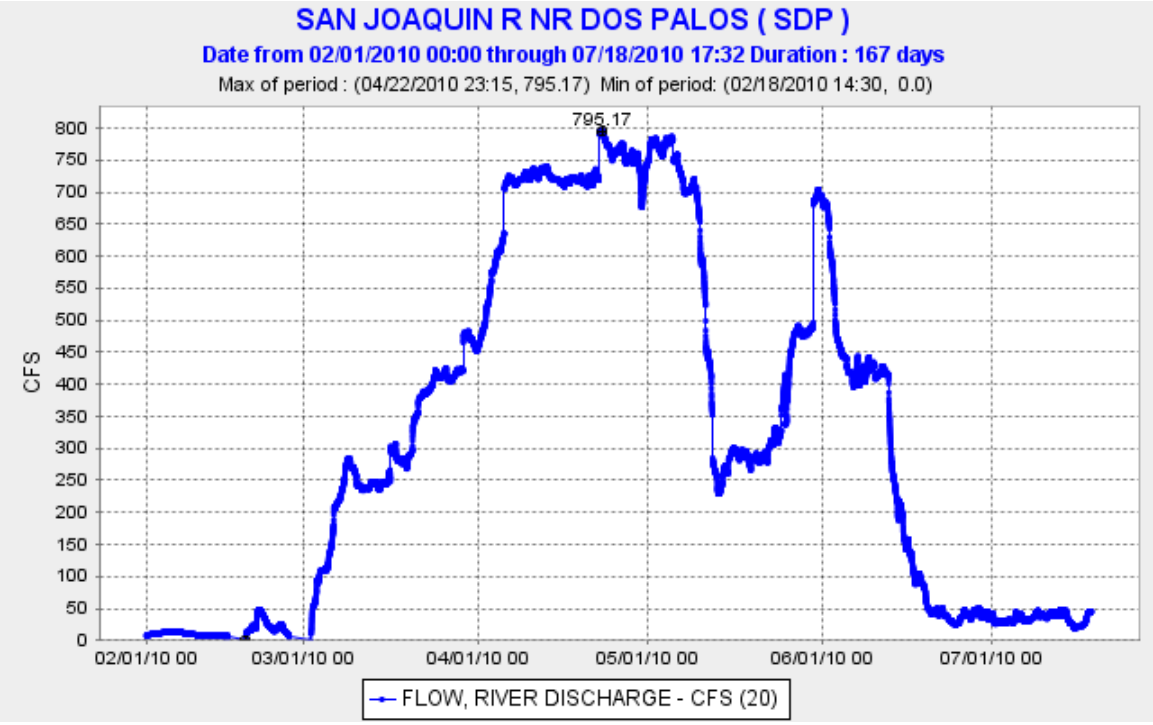
Attachment 3

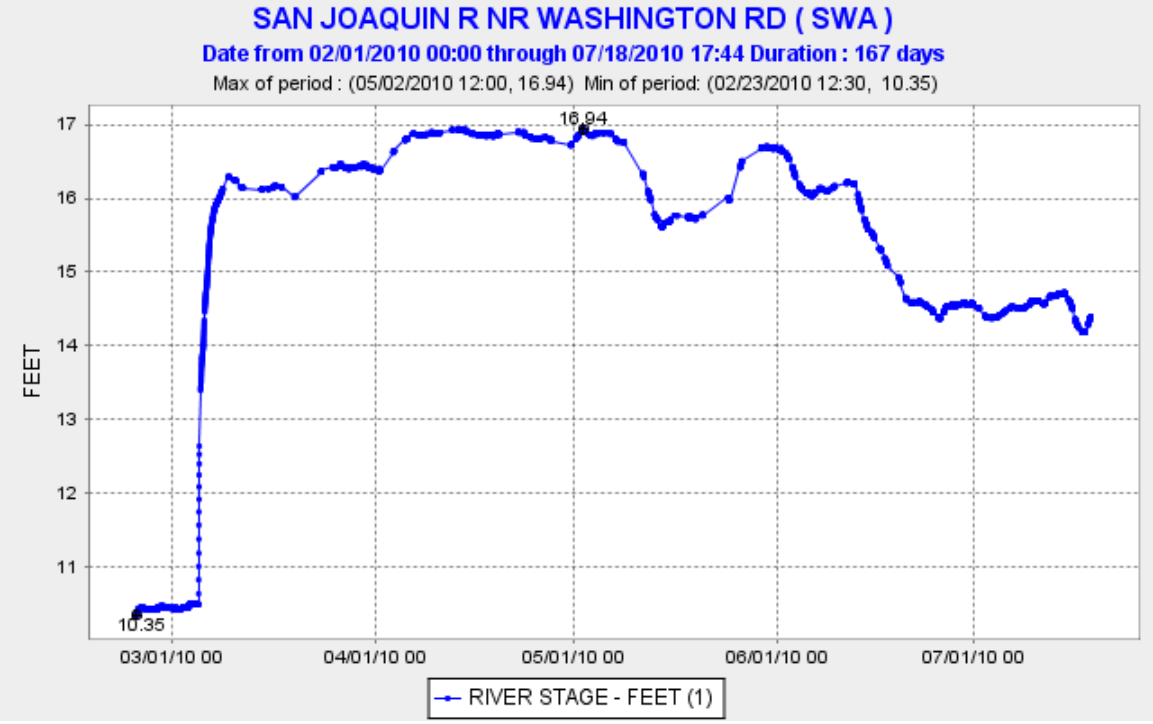
Report on the Effects of San Joaquin River Interim Restoration Flows on Shallow Groundwater Within CCID

Releases of San Joaquin River Interim Restoration Flows from Friant Dam began on October 1, 2009, and were temporarily terminated on November 20th 2009, which was the duration for flows in 2009. Largely due to channel losses, only a small volume of Interim Flows made it passed Sack Dam for a few days in November before releases were terminated.

Interim Flows were commenced again on February 1, 2010, and are scheduled to run through September 30, 2010. The flows passed Sack Dam on approximately February 20th, and have been flowing through Reaches 3 and 4A continuously since that time. The following chart is taken from the State of California, Department of Water Resources, California Data Exchange Center (CDEC) Website, showing the flows in the San Joaquin River, just downstream of the Sack Dam. The site is the San Joaquin River near Dos Palos, (SDP).



The measured flow at SDP, which is located at the head of reach 4A, represents the level of Interim Flows that were present in Reaches 3 and 4A in 2010. DWR also re-established a gauging station near Washington Avenue (SWA), at the end of Reach 4A in 2010, but the stage versus CFS flow rate has not yet been established. The following is the measured stage at SWA taken from CDEC. The flow at Washington Avenue should have about the same magnitude as at SDP.



To determine the actual depth of water in the San Joaquin River at SWA, one must subtract 10.35 feet from the measured gauge heights, for example, if the gauge height is 14', the depth of water in the SJR is approximately 3.7'. Looking at the graph, it can be seen that the depth of water was approximately 6.5' at the end of Reach 4A when the Interim Flows were at about 750 cfs. Even though the flows in reach 4A have dropped to a base level of around 40 cfs to 50 cfs near the end of June, the depth of flow in the lower Reach 4A has remained abnormally high, at a depth of 4.0' to 4.5 feet, due to the elevation of the Sand Slough Control Structure and the East Side Bypass channel.

As built drawings of the construction of the Sand Slough Control Structure and the East Side Bypass show that the Structure was built to only deliver low flow San Joaquin River flows to the head of the old Sand Slough near Washington Avenue. The structure is basically a 15' long partial flume fitted with weir board guides on the upstream side, and a concrete low flow containment levee. The center bays are not efficient due to impacts from silt buildup and aquatic plants. Only the outer most bays are partially open. In addition, water is backing down from the East Side bypass even under the very low flows.

Sand Slough Control Structure

Interim Flow Water 4+' deep, under very low flows., in Reach 4A.

(Photo looking westerly)

As a result of these flow obstructions the interim flows in the river remain over 4' deep even under flows of around 40 cfs to 50 cfs. The water surface in the above photo, taken

on July 14, 2010, was at elevation of 103.5. At an elevation of 103.5, water in the river is only 4.0 feet below the surrounding ground surface to the west. Therefore, interim flows are contributing to very high groundwater levels in adjoining ground this flow condition.

Sand Slough Control Structure

Center bays completely plugged with silts and aquatics.

(Photo looking west)

High water mark adjacent to the Sand Slough Control Structure

Existing water line shown is at 40 cfs to 50 cfs Interim Flows, the visual High Water mark is from 750 cfs Interim Flow (Photo looking east)

As a direct result of the obstructions related to the East Side Bypass connection, the Interim Flow created a water surface within the river of about 6.5 feet deep or an elevations in the lower Reach 4A that was only 1.84 feet below the surrounding ground surface for most of March April and the first 10 day of March. In May, at least partially due to the information submitted CCID to the SJRRP, the Program reduced Interim Flows to about 350 cfs below Sack Dam into Reach 4A.

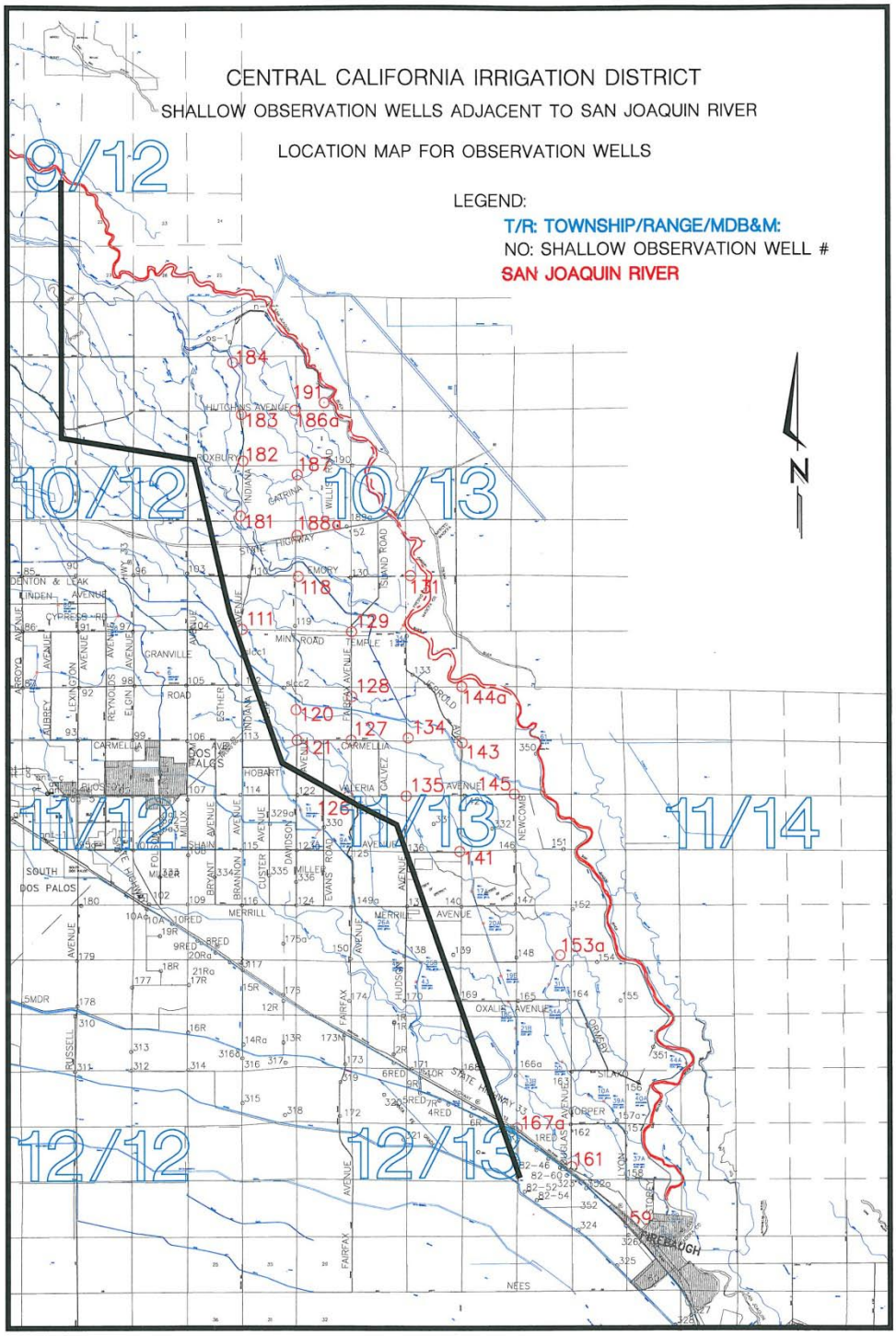
Table 1

	Interim Flow Rate (cfs)	River Stage (SWA) (Feet)	Depth of Water in River (Feet)	River WS versus Adjacent Land (Feet)
No Flow	0	10.35	0	-8.4
Low Flow	50	14.72	4.4	-4
Reduce Flow in April	350	15.7	5.35	-3.05
High 2010 Flow	750	16.95	6.6	-1.8

Table 1 shows the relationship between the Interim flow rates in Reach 4A and the resulting river water surface relative to the adjoining land. At the higher flows, during most of March, April and portions of May and June, the water surface in the river was between 2.4 and 1.8 feet below the surrounding ground surface. This has had a significant impact on the groundwater levels in Reach 4A.

Groundwater Levels:

CCID has maintained and monitored shallow groundwater observation wells within its service area since 1983. The District has typically measure depth to groundwater, and taken water samples to measure both Electroconductivity (EC) and Boron. The following is a base map showing the location of the CCID shallow observation wells within the CCID boundaries and within 3 miles of the San Joaquin River northwest of the City of Firebaugh.



Map of Shallow Observation Wells within 3 miles of the San Joaquin River

Red Highlighted Wells indicated locations impacted by Interim Flows

During the 2010 interim flow period CCID has monitored the depth to groundwater more frequently and has reported the information to the SJRRP. CCID has about 56 shallow observation wells within the area which we have been monitoring. Of these, groundwater levels within 25 wells are being impacted by interim flows.

OB. WELL NO.	Depth to Groundwater Measurement	Depth to Groundwater Measurement
Date of Measurement	6/28/2010	4/7/2010
110	-4.1	
111	-2.8	-3.2
118	-4.1	-4.5
119	-3.6	-5.0
120	-3.7	-4.5
121	-4.6	
126	-3.5	-4.2
127	-3.3	-3.8
128	-3.3	-4.3
129	-2.5	-1.6
130	-3.1	-7.4
131	-10.4	-12.5
132	-9.6	-9.1
133	-5.0	-7.8
134	-1.4	-1.8
135	-4.5	-5.3
136	-4.5	-5.9
139	-16.2	-15.8
140	-9.3	-9.0
141	-3.1	
142	-3.2	-3.4
143	-3.4	-3.8
145	-3.6	-3.9
146	-6.3	-5.6
147	-5.6	-7.9
148	-13.8	-13.7

OB. WELL NO.	Depth to Groundwater Measurement	Depth to Groundwater Measurement
Date Of Measurement	6/28/2010	4/7/2010
151	-5.3	-8.4
152	-6.3	-7.0
154	-5.7	-7.9
155	-9.3	-10.7
156	-5.8	-8.3
157	-5.1	-7.8
158	-11.0	-12.6
159	-13.1	-6.8
161	-1.6	-4.4
163	-10.9	-12.2
164	-7.1	-9.9
169	-12.9	-12.5
181	-9.7	-7.9
182	-3.0	-2.7
183	-2.5	-3.3
184	-4.3	-5.3
187	-2.4	-3.3
190	-10.3	-11.1
191	-6.2	-7.4
350	-8.5	-8.5
351	-9.5	-11.8
144A	-7.0	-6.2
153A	-3.3	-4.5
162A	-10.3	-11.7
165A	-11.3	-12.4
166A	-13.0	-12.7
167A	-2.3	-3.4
186A	-2.3	-4.5
188A	-4.1	-4.2
189A		
331A		

= Depths impacted by interim flows.

The Interim Flows have caused shallow groundwater in these areas to rise to the levels of March of 2006 when the river was in extreme flood stage (4500 cfs from Pine Flat Reservoir).

The following Chart 1 shows the impact of Interim Flows on shallow groundwater and shows all the depth measurements taken from the wells from the Spring of 2006 until today.

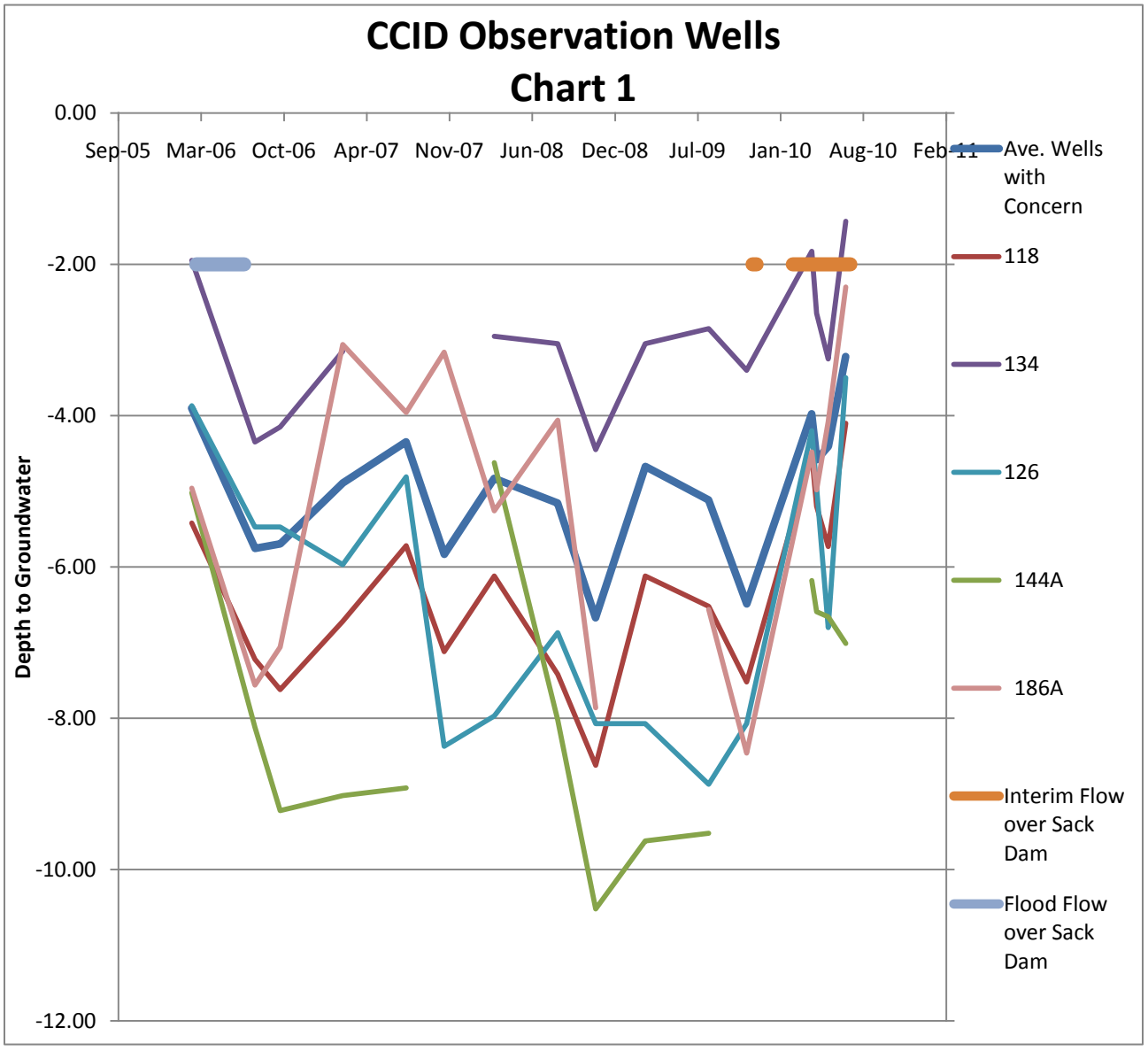
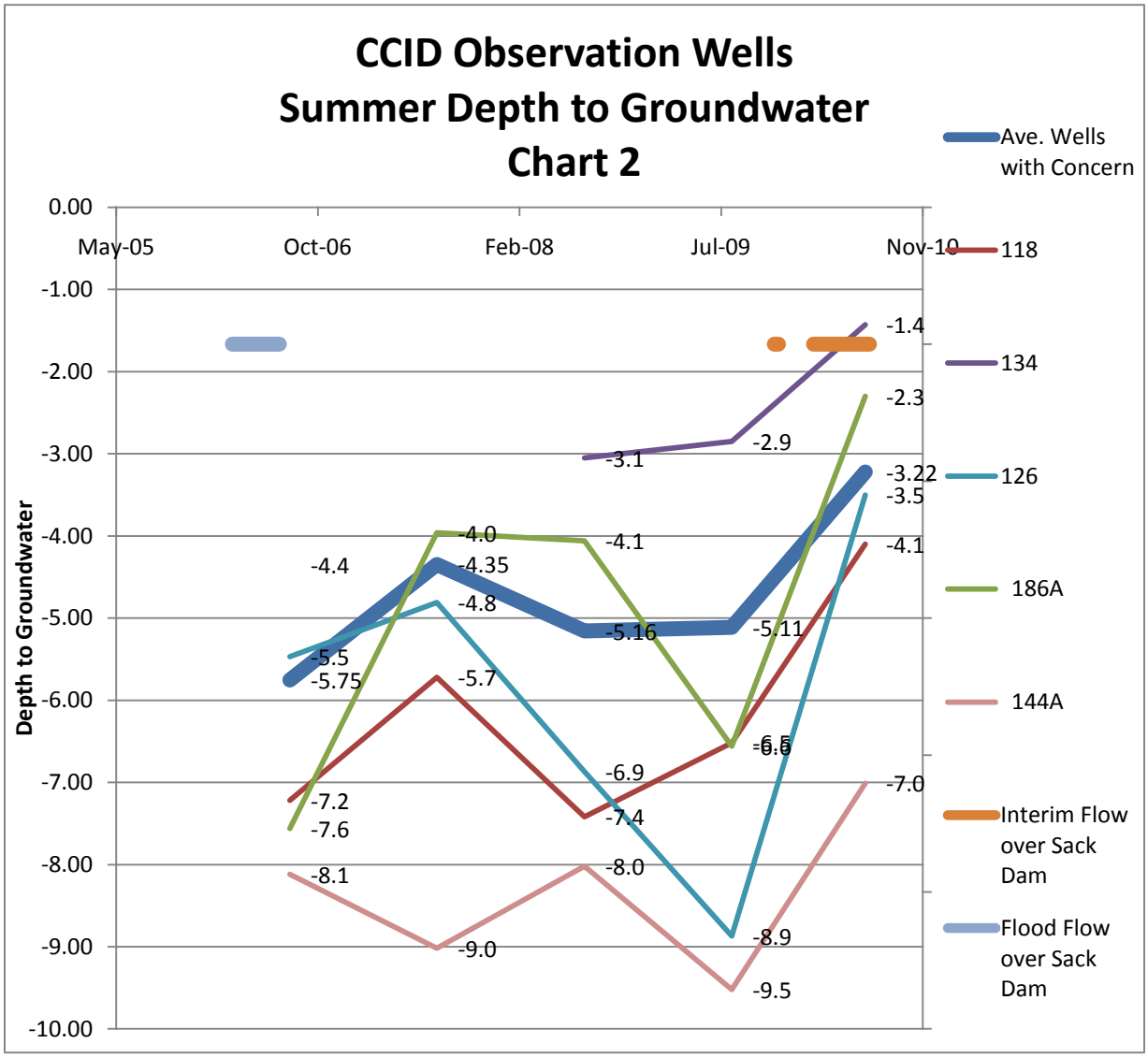


Chart 2 is a plot of the summer depths to groundwater in the same wells. The data shows that the summer of 2010 is on average 1.9 feet more shallow than summer 2009 and well within the buffer zone provided under the SJRRP seepage management program.



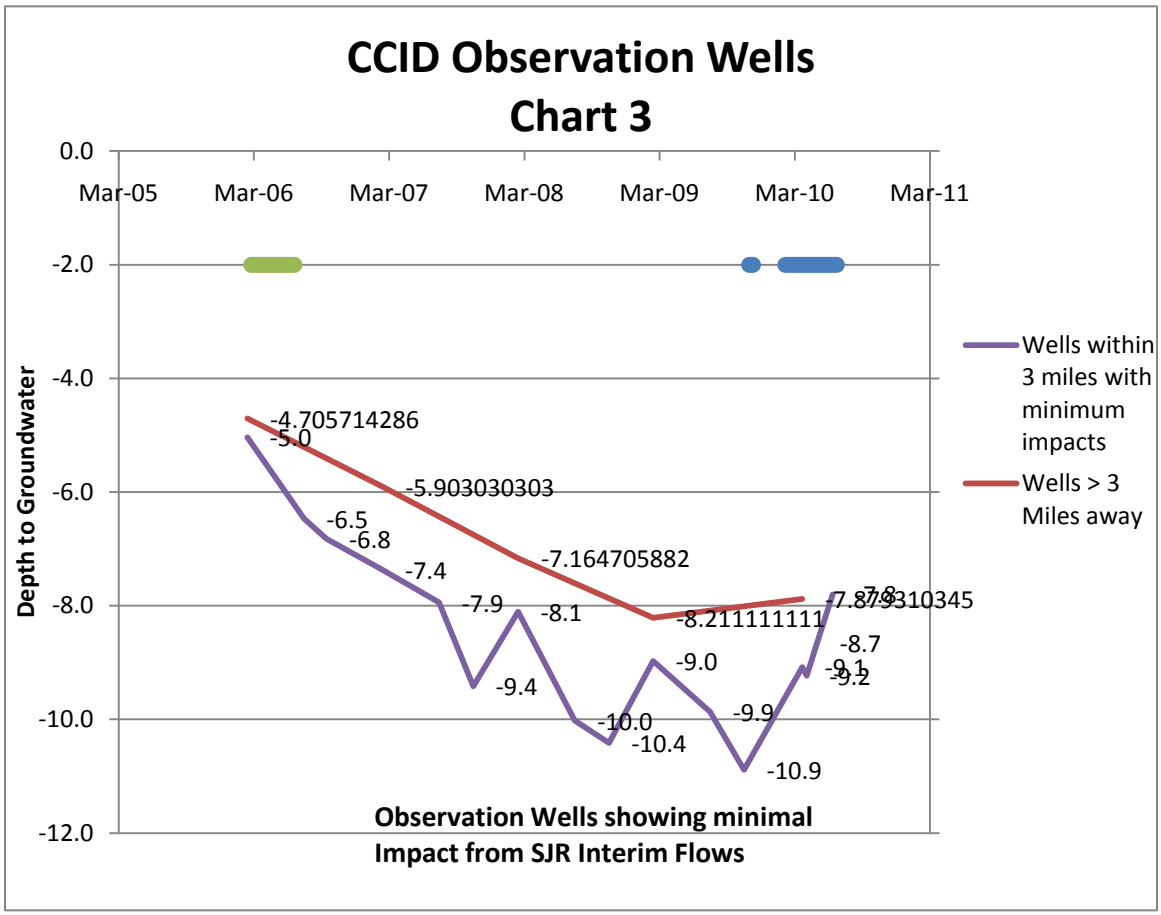
Question – How do we know that the increased levels are not simply from the rainfall this spring?

Answer – The groundwater impacts are primarily from Interim Flows.

1. The rainfall this spring is not significantly higher in this area than in 2009. The rainfall depths measured at Los Banos were as follows:
    1. 2009-2010 11.24”
    2. 2008-2009 7.02”
    3. 2007-2008 3.68”
    4. 2006-2007 10.93”

5. 2005-2006 14.86”

2. Only the groundwater in specific areas within 3 miles of the river is impacted. If these were rainfall related we would expect regional, across the board, impacts.
3. Almost none of the wells located 3 to 6 miles away from the river show any such impacts.
4. The hydrographs from continuous recorders within 2 CCID wells show direct correlation to the measured river stage within the SJR.



Question – What site conditions are present in areas where these impacts are occurring? What’s causing these impacts?

Answer –

1) The San Joaquin River in reaches 3 and 4A is situated on a ridge. On the west side, both surface and sub-surface drainage flows away from the river from east to

west. When flows are present in the river it immediately provides seepage into the adjacent groundwater.

2) The local landowners have long maintained that while the old sloughs are no longer directly connected to the river, they act as underground conduits (sand stringers). The location of many of the wells where impacts are encountered are near the old Poso and Santa Rita Sloughs. These sloughs are presently used to convey irrigation tailwater from the area. Gauge measurements of slough flow show equal or less in 2010 than 2009 eliminating tailwater or rainfall runoff as a factor.
3) The lower Reach 4A has been significantly impacted due to the artificially high water elevation needed to push even low flows out of reach 4A and into the East Side Bypass. The water surface is artificially high from the San Slough Control Structure all the way south to about Highway 152.

Question: What are the impacts to the adjacent land from groundwater being raised by Interim Flows?

Answer: There are several potential impacts which would affect the plant growth and production.

1) Lack of oxygen. If soil saturation is sufficient, and waters become depleted of oxygen, roots can die quickly, within hours depending upon several factors.
2) Root Pruning. The fine roots which are very important for nutrient uptake, growth and yield are damaged or killed. This may lead to nutrient deficiencies.
3) N2 fixation. N-fixing bacteria live in nodules which can slough off during saturated conditions, reducing N fixation.
4) Since the roots are damaged, re-growth is compromised, and some plants may be killed.
5) These effects are exacerbated under some conditions, such as with elevated temperatures and high BOD, tight soils or high EC.
6) Stage of growth, variety and other factors may affect the extent of damage. Depth of water table is likely a major variable.

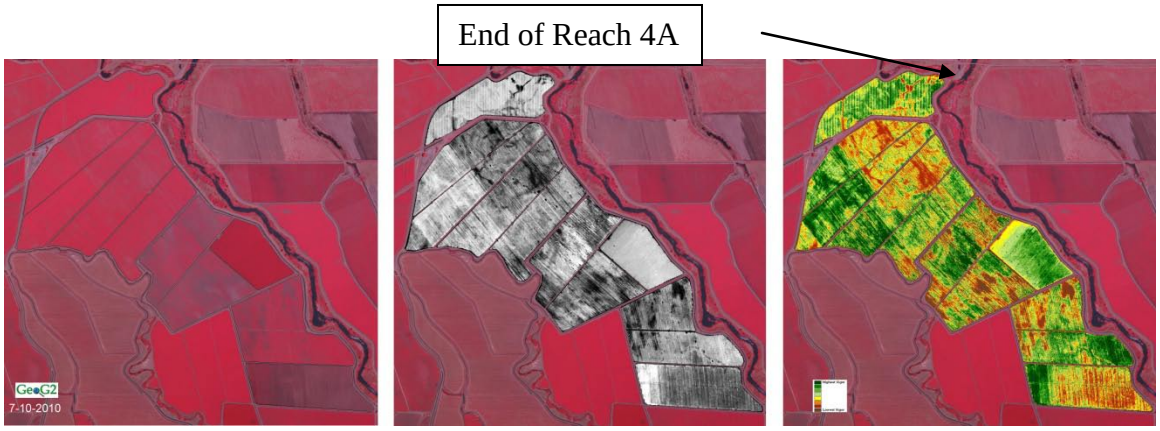
7) Length of time of saturation, the layering, the structure as well as the texture of the soil will determine the extent of the damage.
8) Disease issues such as phytopthora can be major issue under saturated soil conditions.
9) High humidity near the soil surface, due to saturated soils, creates conditions for diseases, such as sclerotinia, and leaf diseases, and slow the drying of the soil (leading to compaction during harvest), and delays drying of the crop, causing windrow damage.

The background groundwater quality within the affected wells is as follows:

Ob Well No.	EC- Nov. 2009	Ob Well No.	EC- Nov. 2009
110	2150	154	1377
118	1303	156	989
119	4510	157	680
120	4090	159	910
121	3010	161	1818
126	1846	164	1899
127	1193	165	1588
128	1411	167	2020
129	1078	182	1566
133	1628	183	1084
134	2670	184	902
135	2100	186	1748
136	1708	188	782
141	1882	189	1360
142	3380	331	1148
143	1308		
145	2530		
146	1468		
147	937		
152	750		
153	943		

CCID looked at selected fields near the end of Reach 4A to see if crop damages are occurring where the river water surface has been within 1.8 feet of the farmed land

surface for a significant period this spring, and is still within 4 feet. Visually, large portions of the tomato fields irrigated by drip and owned by Nickel are damaged. In addition, the landowner's consultant provided the imagery of the SJR River area with the false color IR, gray scale NDVI, and the 8 class colorized NDVI, areas in Red representing poor vegetation and the green is dense vegetation.



The areas showing poor vegetation are also within the areas near where shallow observation wells measure shallow groundwater due to Interim Flows. We believe these impacts are present throughout Reach 4A and portions of Reach 3.

Question: How could this have happened, how did the existing seepage management plan fail to protect these lands?
Answer: The seepage management plan did not operate as intended.

The program has been notified several times this spring of potential seepage impacts to surrounding groundwater from interim flows. Attached is such a communication to the program from CCID on April 29, 2010, in which the program was advised to reduce interim flows and perform the site visits to lands adjacent to the wells to assess impacts as prescribed by the seepage management plan. In response the program actually did reduce interim flows in Reaches 3 and 4A from about 750 cfs to about 350 cfs for two weeks in mid-May, after which the Interim Flows were raised again to 750 cfs for a short duration. To the best of CCID's knowledge, the program never performed assessments at the sites.

In addition, the program never has referenced the river stage elevations at key points to the adjacent ground and groundwater levels which would be necessary to detect potential for river seepage damages as are seen within Reach 4A.

Attachment

April 29, 2010 Communications with SJRRP about Seepage Impacts

From: Phillips, Jason R [mailto:JPhillips@usbr.gov]
Sent: Thursday, April 29, 2010 5:03 PM
To: Christopher White; Mooney, David M
Cc: Jackson, Michael P.; Buelna, Antonio M.; Deflitch, Douglas A; Salazar, Edward; Steve Chedester; Chris White; Chase Hurley; Reggie Hill; Harrison, Katrina E; Randy Houk; Faulkenberry, Kevin; Gasdick, Alicia E; Larry Freeman; Joann White; Tracey Rosin; TMBerliner@duanemorris.com; Paul Minasian; John Relvas; James L. Nickel; James O'Banion; Morris, Scott A.; Monty Schmitt; Rod Meade; Ron Jacobsma
Subject: RE: Interim Flow Seepage Impact Analysis

Thank you Chris for this additional analysis and highlighting the potential issue in reach 3. We will review your information for consideration in our seepage management analysis. Reclamation has recently performed multiple site visits in reach 3 downstream of Mendota Dam in response to landowner calls to the seepage hotline.

Also, I've included representatives of the Settling Parties on this e-mail to keep them up to speed on this issue as it is having an effect on the Settlement flows.

Thanks,
Jason

Jason Phillips
U.S. Bureau of Reclamation
SJRRP Program Manager
(916) 978-5456
jphillips@usbr.gov

From: Christopher White [cwhite@ccidwater.org]
Sent: Thursday, April 29, 2010 2:26 PM
To: Christopher White; Mooney, David M
Cc: Jackson, Michael P.; Buelna, Antonio M.; Deflitch, Douglas A; Salazar, Edward; Steve Chedester; Chris White; Chase Hurley; Reggie Hill; Harrison, Katrina E; Randy Houk; Phillips, Jason R; Faulkenberry, Kevin; Gasdick, Alicia E; Larry Freeman; Joann White; Tracey Rosin; TMBerliner@duanemorris.com; Paul Minasian; John Relvas; James L. Nickel; James O'Banion; Morris, Scott A.
Subject: Interim Flow Seepage Impact Analysis

David,

We have re-measured the depth to groundwater in the CCID observation wells and continue to identify areas of high potential for crop damage due to interim flows.

Area North of Firebaugh:
For background, the section the CCID is situated within 3 miles of the river and north of the City of Firebaugh is comprised of approximately 15,000 acres. There are a wide variety of annual crops grown within the area. Alfalfa is a year round crop which has a

high potential for damage from rising groundwater. This specific area presently has about 5700 acres of alfalfa being grown. The other crops such as cotton (3500 acres), tomatoes (2000 acres), corn (1800 acres), melons, etc. will be planted soon of have just been planted. The other crops would be potentially damaged by rising groundwater caused by interim flows since most of the shallow groundwater is relatively highly saline. There are about 400 acres of permanent crops (orchard) within the area and about 400 acres of wheat which is soon to be harvested.

Water Quality:
The following is the latest water quality measurements taken from the groundwater within the CCID shallow observation wells in this area.

SHALLOW
OBSERVATION
WELLS
Water Quality

Ob Well No.	EC- Nov. 2009	Ob Well No.	EC- Nov. 2009
110	2150	154	1377
118	1303	156	989
119	4510	157	680
120	4090	159	910
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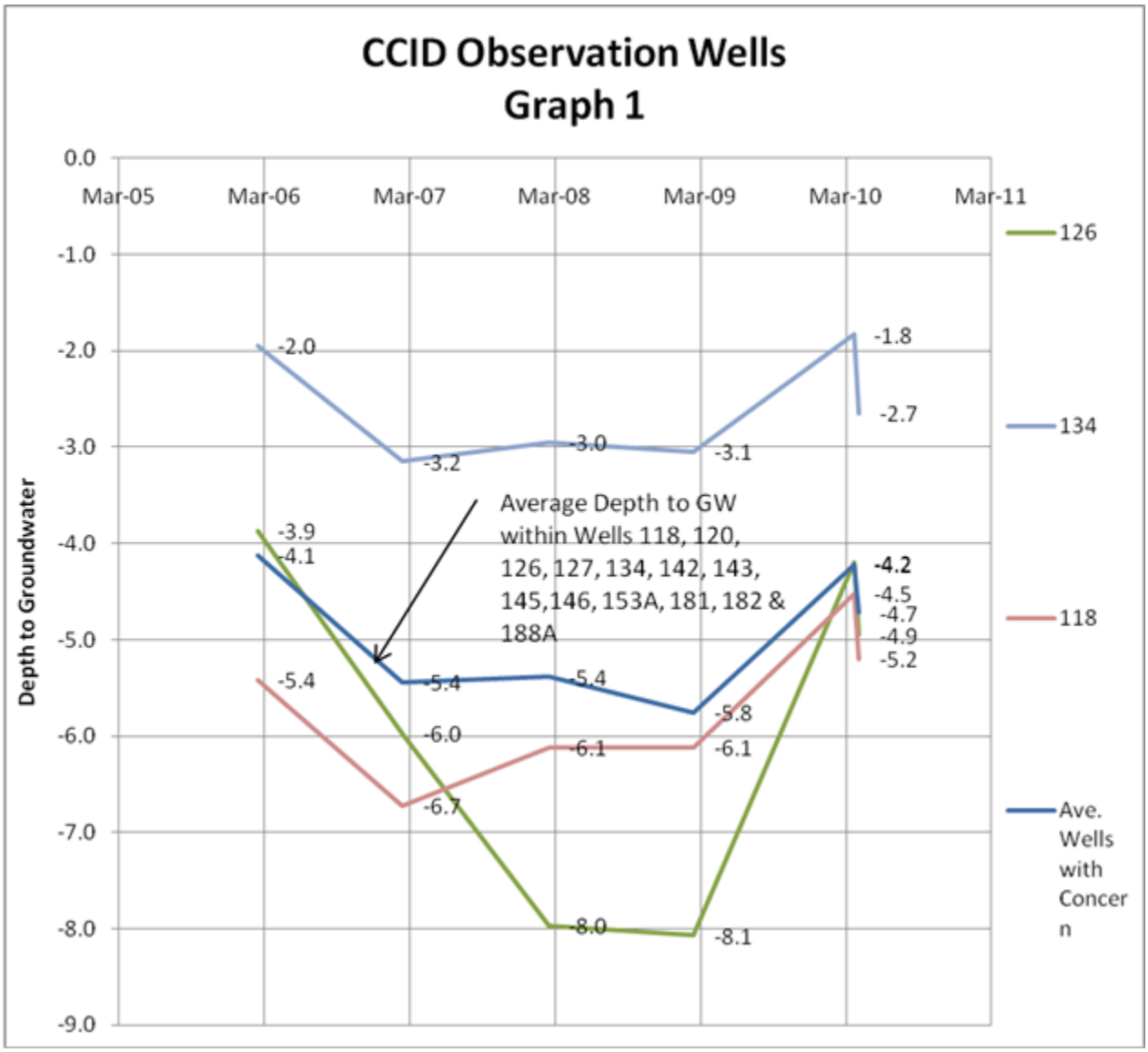
141	1882	189	1360
142	3380	331	1148
143	1308		
145	2530		
146	1468		
147	937		
152	750		
153	943		

Depth to Groundwater:

CCID has about 56 shallow observation wells within the area which we have been monitoring. Of these it appears that groundwater with 21 wells are being impacted by interim flows. The groundwater at 13 of the sites has risen to the level that could damage the crops grown.

Graph 1 shows hydrographs for Wells 126, 134, and 118 and the hydrograph of the average depth to groundwater of the wells of present concern.

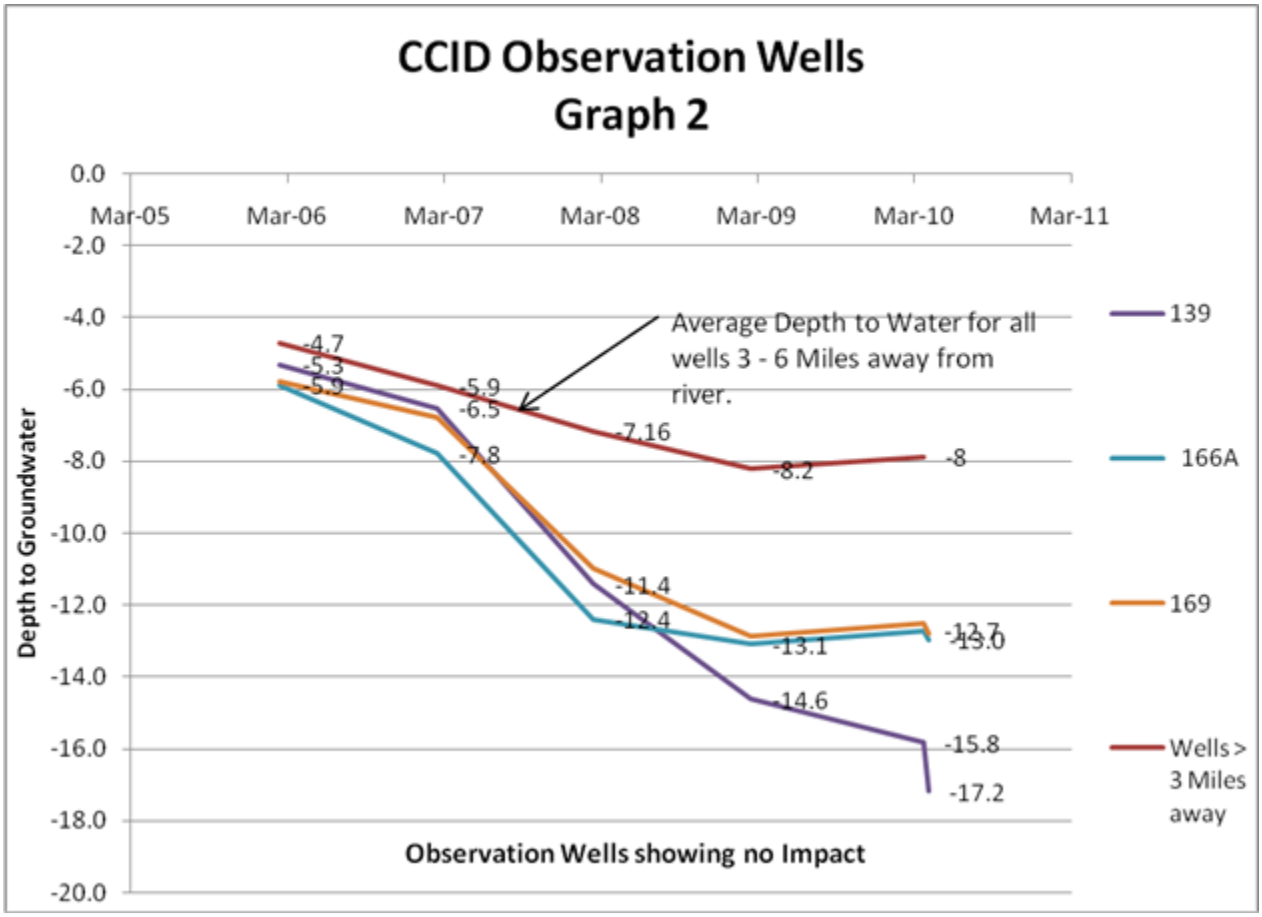


The chart shows that the interim flows have caused shallow groundwater in these areas to the levels from of March of 2006 when the river was in extreme flood stage (4500 cfs from Pine Flat Reservoir).

Question – How do we know that the levels are not simply from the rainfall this spring?

Answer – The groundwater impacts are primarily from Interim Flows.

1. The rainfall this spring is not significantly higher in this area than the March 2009.
2. Only the groundwater in specific areas within 3 miles of the river is impacted. If these were rainfall related we would expect regional, across the board, impacts.
3. Almost none of the wells located 3 to 6 miles away from the river show any such impacts.
4. The hydrographs from continuous recorders within 3 CCID wells show direct correlation to the measured river stage within the SJR.

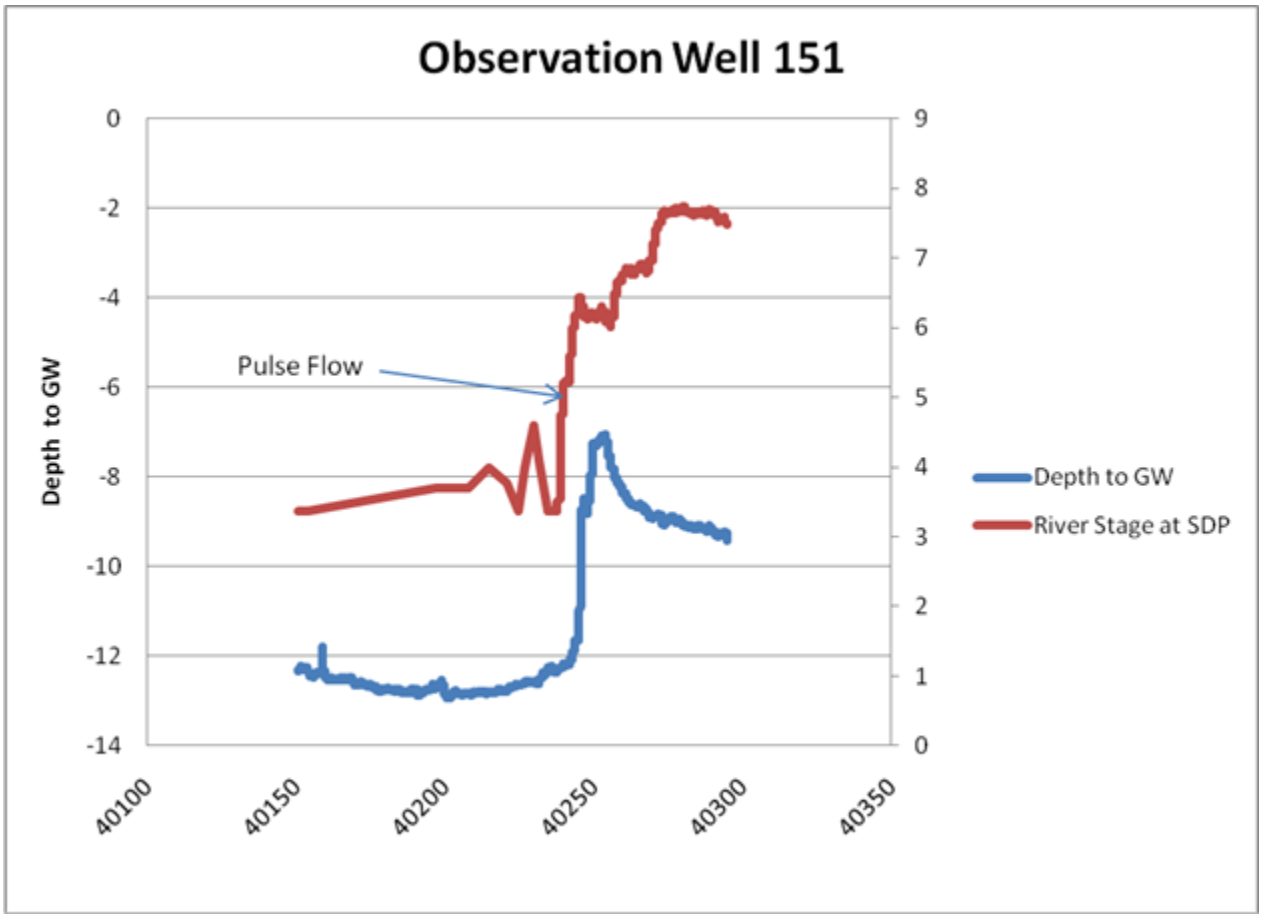


Question – What site conditions are present in areas where these impacts are occurring? What's causing these impacts?

Answer – The San Joaquin River in reaches 3 and 4A is situated on a ridge. On the west side, drainage flows away from the river from east to west. The local landowners have long maintained that while the old Sloughs are no longer directed connected to the river

act as underground conduits (sand stringers). The location of many of the wells where impacts are encountered are near the old Poso and Santa Rita Sloughs. These sloughs are presently used to convey irrigation tailwater from the area. The irrigation season has not really started yet due to the weather. Gauge measurements of slough flow show equal or less in 2010 then 2009 eliminating tailwater or rainfall runoff as a factor. In other areas such as Nickel, the lands are adjacent to the river and lower in elevation.

The following graph shows how the groundwater surface in observation Well 151 reacted to new interim flows in the river. The graph is similar for all three wells where CCID maintains continuous recorders in the area.



One site just Downstream of Mendota Dam. In addition, groundwater within our monitoring well #364, located adjacent to Almond orchards downstream of the Mendota Dam has risen from 8.6' deep in March to 5.5'. This is a high potential to damage the almond crop.

Conclusion: The Interim Flows are already having significant impacts on the groundwater within Reaches 3 and 4. CCID is advising that interim flow levels below Mendota Dam should not be increased and probably reduced because of seepage impacts.

The seepage site assessments called for in the Seepage Monitoring and Management Plan needs to be accomplished at each of the sites to assess crop impacts and to help in determining if a flow reduction to the last safe flow level is needed. We will assist the program to complete these as soon as possible.

1. Careful attention to increases in Reach 3. As San Luis Canal Company increases irrigation deliveries the total flow in reach 3 will escalate if Interim flows are not reduced by a like amount.
2. Another indicator that flows should be reduced. The groundwater situation in the area is likely to get much worse since interim flows have already filled up the soil profile, and now irrigation of alfalfa (and most crops in general) is about to begin. There is no space for deep percolation from the irrigation. In the past when flood flows were present the rainfall precluded irrigation. Now with the artificial hydrographs for interim flows, river pulse flows will be present for the next month which is forecast to be warm and requiring irrigation.

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