DRAFT Technical Memorandum

Locations of Potential Seepage Risks

March 23, 2011

Study: Locations of Potential Seepage Risk

San Joaquin River Restoration Program

Version History

2011.03.20 – Initial outline and draft components for discussion at Seepage and Conveyance Technical Feedback Meeting on March 23, 2011.

1. Introduction

This study will screen for potential locations of seepage risk based on land elevation and predicted water surface up to 4500 cubic feet per second (cfs), to allow full Restoration Flows. Seepage management includes real-time management of flows to reduce or avoid material adverse seepage impacts, as well as implementation of projects to increase capacity outside of site-specific projects, as part of Paragraph 12 in the Stipulation of Settlement (Settlement) in *NRDC et al., v. Rodger,s et al.* Locations will require a more detailed analysis to determine if seepage concerns exist and an evaluation to identify the type, advantages, and limitations of a potential project.

2. Purpose / Statement of Need

This TM will screen out locations that do not require more detailed site evaluations and potential plan formulation for installation of seepage projects.

This TM and the future Seepage Project Handbook will inform management decisions by identifying areas more or less at risk for groundwater seepage, at what flows they become at risk, and begin identifying locations for projects.

3. Background

The San Joaquin River Restoration Program (SJRRP) increases releases from Friant Dam in a program of Interim Flows to collect data on relevant physical and biological parameters. High groundwater tables restrict the amount of water the channel can convey without causing adverse impacts to agriculture in adjacent fields. Reclamation will limit releases from Friant Dam and Mendota Dam to non-damaging flow rates. Installation of projects will increase conveyance capacity in support of the Restoration Goal.

The Seepage Management Plan (SMP) includes maps of historical shallow groundwater and locations of identified seepage risks from landowner anecdotes. This TM expands upon the data in the SMP, by mapping water surface in the San Joaquin River onto the surrounding lands without consideration of levees or topography.

The United States Geological Survey (USGS) is developing a refined version of the Central Valley Hydrologic Model (CVHM) for the SJRRP. Planned tasks include refinement of the existing 1 mile grid to a ¼ mile grid within 5 miles of the San Joaquin River, and further refinement to a few hundred feet grid size within approximately 1 mile of the San Joaquin River. Current schedules estimate these tasks to be complete in 2012. Upon completion of the CVHM refinement, the groundwater model may provide useful information for locations of potential seepage projects.

The San Joaquin River Restoration Settlement Act, Public Law 111-11 Title X, authorizes Reclamation to design and construct channel and structural improvements.

4. Anticipated Outcomes

At the end of the study, the conclusions should result in the following:

- Maps of locations of seepage risk
- Flows at which locations become at risk

5. Methodology

Landowner- and San Joaquin River Resource Management Coalition-identified seepage risks have been updated based on comments and are included in Appendix A.

San Joaquin River water surface elevations taken from the HEC-RAS hydraulic model as well as surveys were compared with terrain. The analysis extended water surface elevations beneath the adjacent fields to obtain predicted depths below ground surface, as shown in Figure 1.

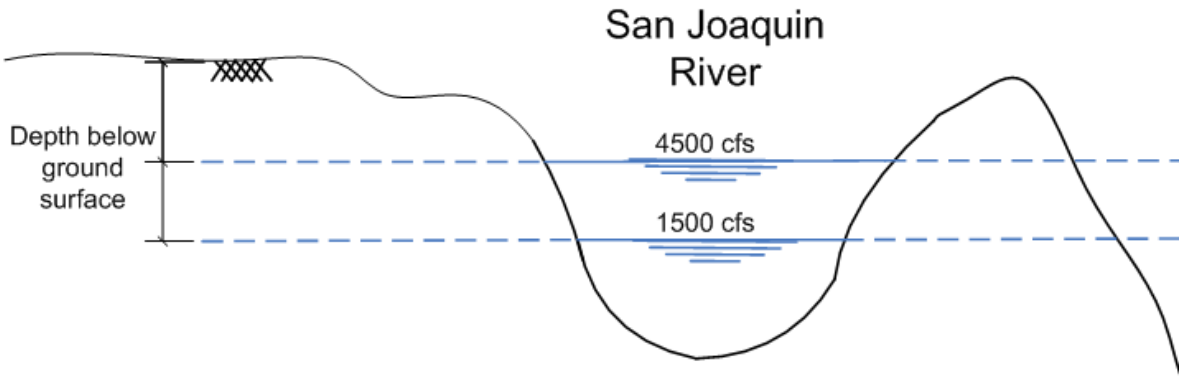


Figure 1: Seepage Project Elevation Analysis Conceptual Model

The one-dimensional hydraulic model predicts water surface elevations at cross-sections. Analysis included local flows of 1500 and 4500 cfs. Reclamation subtracted the water surface elevations from the 2008 LiDAR. Subtracted values give the shallowest depth below ground surface, and do not consider groundwater gradient.

A second analysis used surveyed water surface elevations from surveys. See

Table 1 below for a description of the surveys and hydraulic modeling runs used to conduct this elevation analysis.

Table 1: Results by Reach

Reach	Type	Date	Local Flow (cfs)
1B	HEC-RAS Results		1500
1B	HEC-RAS Results		4500
2A	HEC-RAS Results		1500
2A	HEC-RAS Results		4500
3	HEC-RAS Results		1500
3	DWR Survey	January 5 – 11, 2011	1880
3	HEC-RAS Results		4500
4A	HEC-RAS Results		1500
4A	HEC-RAS Results		4500

6. Results

Appendix B shows a series of maps for the different water surface elevations and reaches. Maps shown in Appendix B include colored areas based on the groundwater depth below ground surface assuming no gradient to the groundwater table. The results assume the water surface elevation in the river matches the groundwater elevation. Areas colored blue indicate that the water surface elevation in the river is above the ground surface. If there was a flat groundwater gradient, there would be surface ponding at that flow. Areas in red indicate that the water surface elevation in the river and assumed groundwater level is between 0 and 3 feet below the ground surface. Both blue and red areas indicate a high potential for seepage risks.

7. Discussion

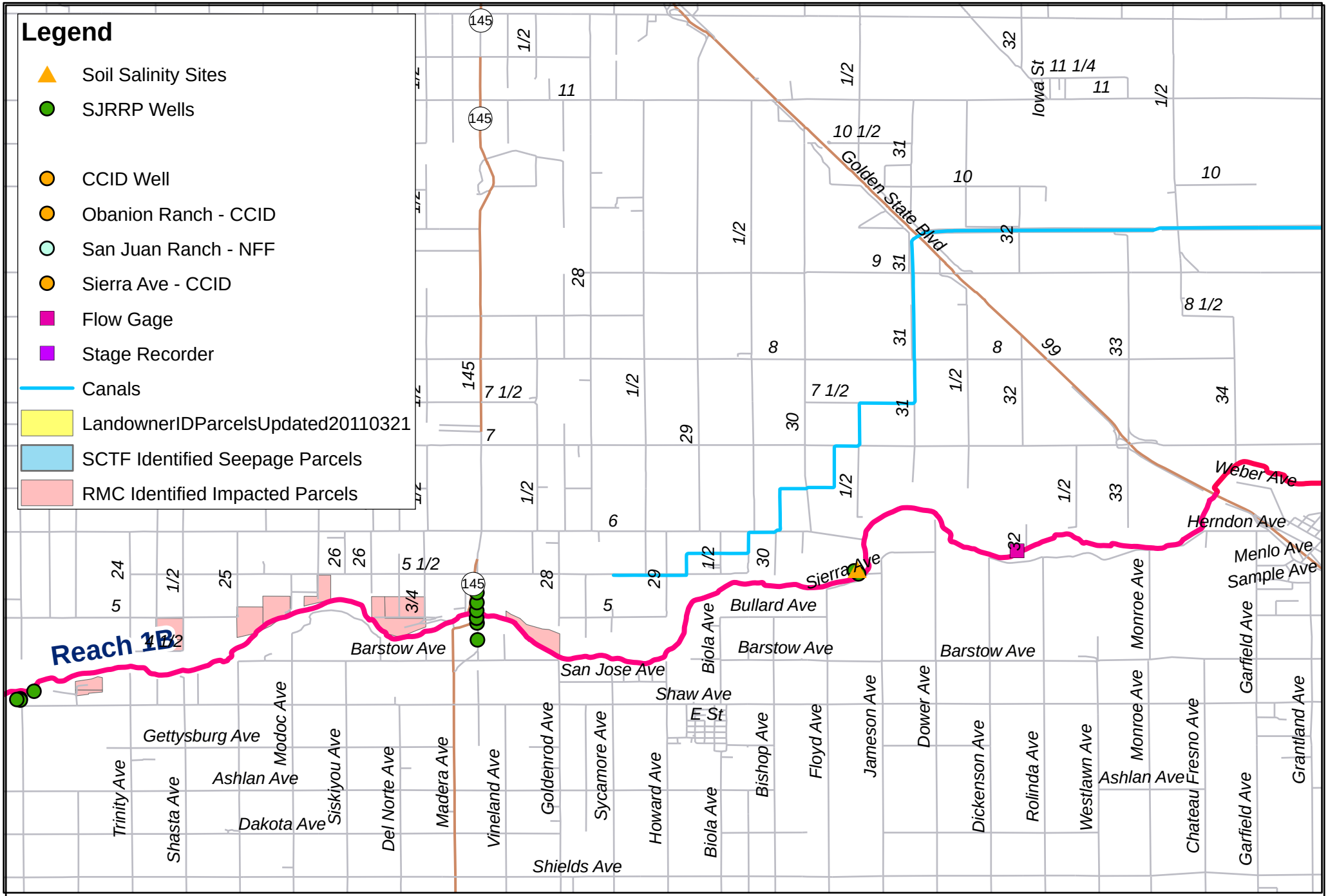
This analysis assumes a flat groundwater table with no gradient. Monitoring data collected by the SJRRP during the last 2 years indicates gradients exist in most locations. This TM does not extrapolate between groundwater transects to make assumptions about gradient. The USGS will conduct a gradient analysis over the entire SJRRP area as part of the refined CVHM model. The lack of gradient analysis in this TM thus overestimates the effects of river stage on seepage. This approach results in more locations and larger areas identified. The approach taken overestimates potential seepage risks, making it conservative with respect to protection of agricultural lands.

8. Conclusions

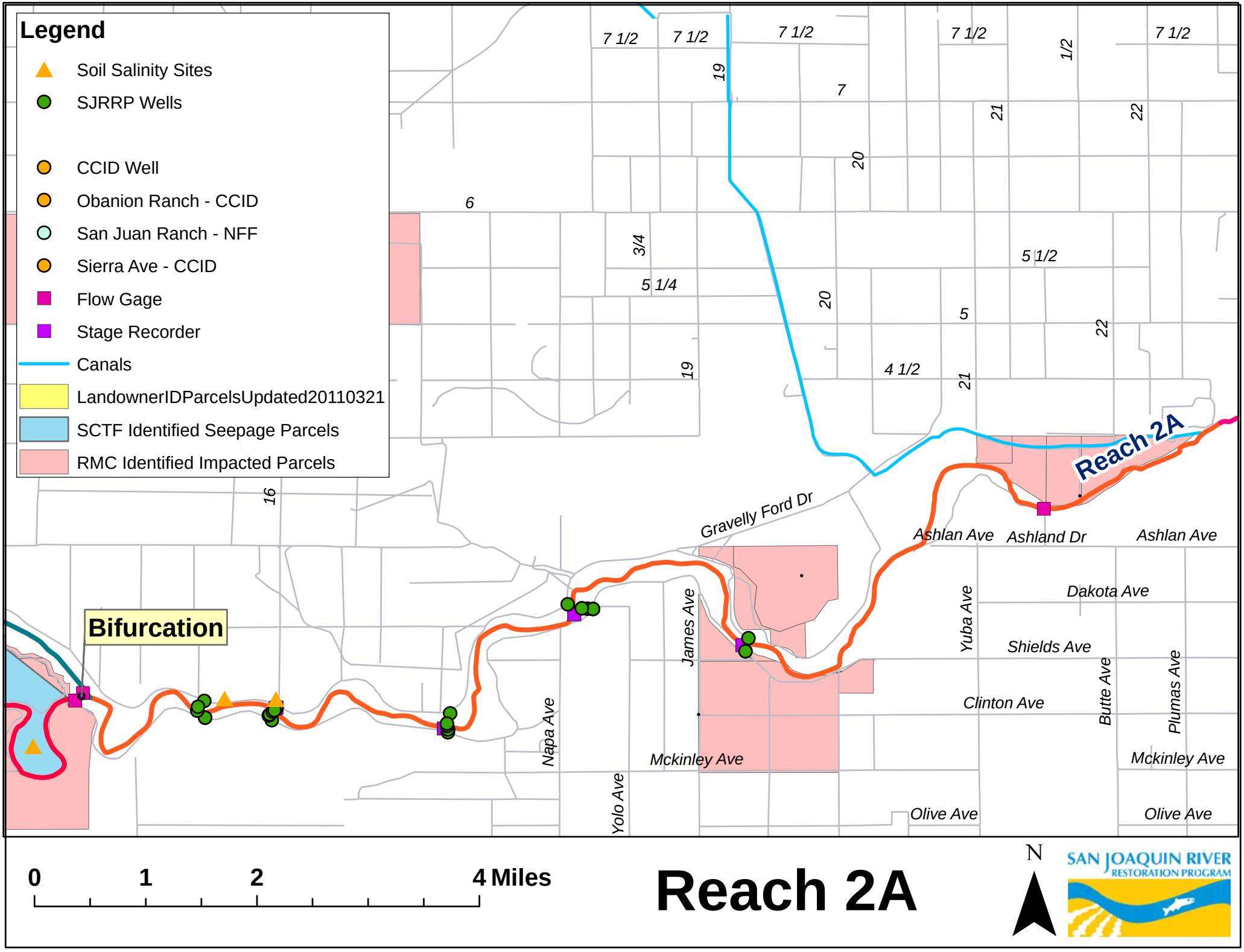
The Paragraph 11(a) projects for Reach 2B and the Mendota Pool Bypass and Reach 4B will increase channel capacity to 4500 cfs in those reaches.

The key areas of concern for seepage projects include the downstream end of Reach 2A, portions of Reach 3, and the downstream end of Reach 4A.

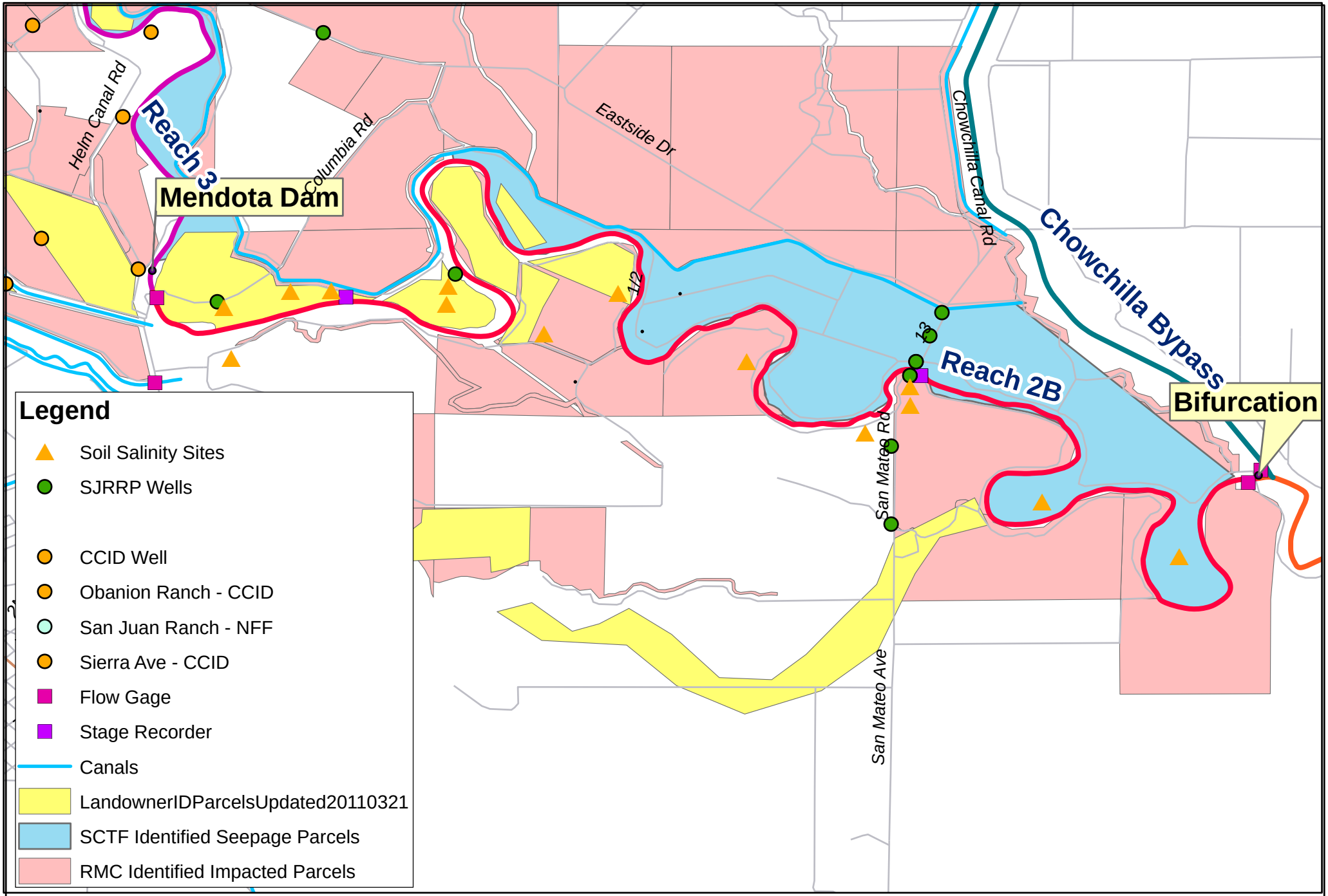
Appendix A


Legend
Soil Salinity Sites
SJRRP Wells
CCID Well
Obanion Ranch - CCID
San Juan Ranch - NFF
Sierra Ave - CCID
Flow Gage
Stage Recorder
Canals
LandownerIDParcelsUpdated20110321
SCTF Identified Seepage Parcels
RMC Identified Impacted Parcels
Reach 1B
Golden State Blvd
Iowa St
Weber Ave
Herndon Ave
Menlo Ave
Sample Ave
Sierra Ave
Bullard Ave
Barstow Ave
San Jose Ave
Shaw Ave
E St
Ashlan Ave
Dakota Ave
Gettysburg Ave
Shields Ave
Trinity Ave
Shasta Ave
Modoc Ave
Siskiyou Ave
Del Norte Ave
Madera Ave
Vineland Ave
Goldenrod Ave
Sycamore Ave
Howard Ave
Biola Ave
Bishop Ave
Floyd Ave
Jameson Ave
Dower Ave
Dickenson Ave
Rolinda Ave
Westlawn Ave
Monroe Ave
Chateau Fresno Ave
Garfield Ave
Grantland Ave
145
0 1 2 4 Miles
N
SAN JOAQUIN RIVER RESTORATION PROGRAM

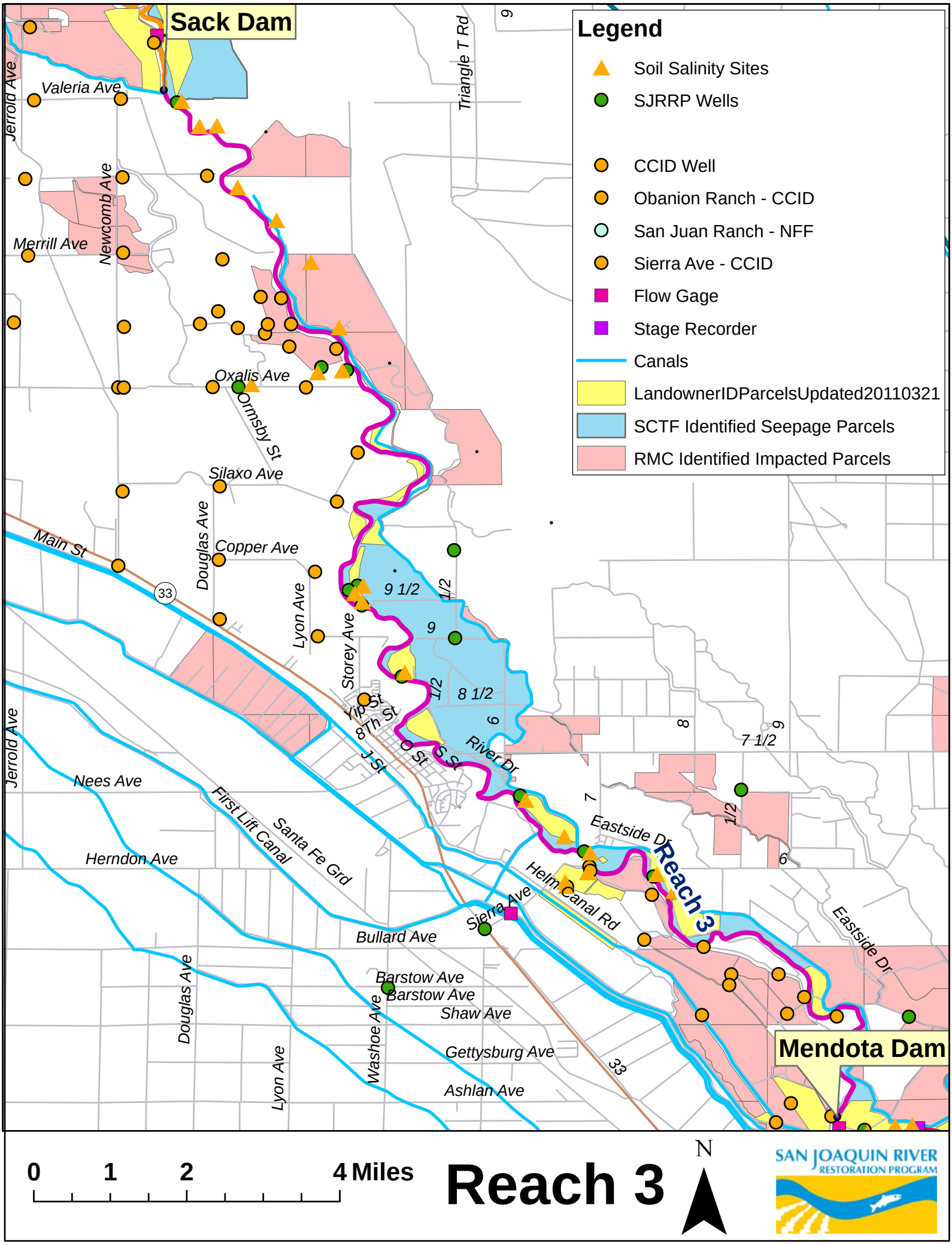
Reach 1B

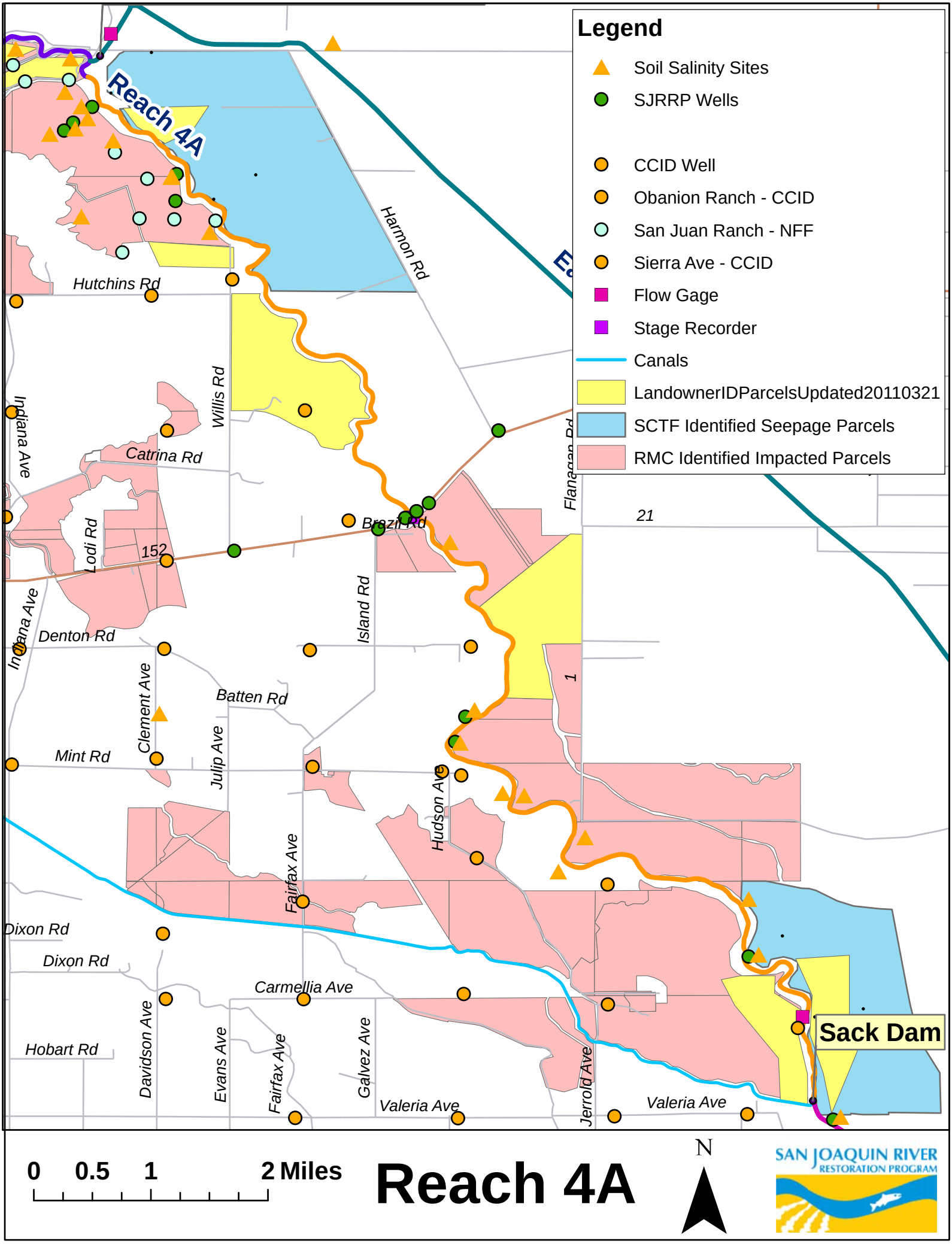

Legend
Soil Salinity Sites
SJRRP Wells
CCID Well
Obanion Ranch - CCID
San Juan Ranch - NFF
Sierra Ave - CCID
Flow Gage
Stage Recorder
Canals
LandownerIDParcelsUpdated20110321
SCTF Identified Seepage Parcels
RMC Identified Impacted Parcels
Reach 2A
Bifurcation
Gravelly Ford Dr
Ashlan Ave
Ashland Dr
Ashlan Ave
Dakota Ave
Shields Ave
Clinton Ave
Mckinley Ave
Olive Ave
James Ave
Yuba Ave
Butte Ave
Plumas Ave
Napa Ave
Yolo Ave
7 1/2
5 1/2
5 1/4
4 1/2
3/4
1/2
0
1
2
4 Miles
N
SAN JOAQUIN RIVER RESTORATION PROGRAM

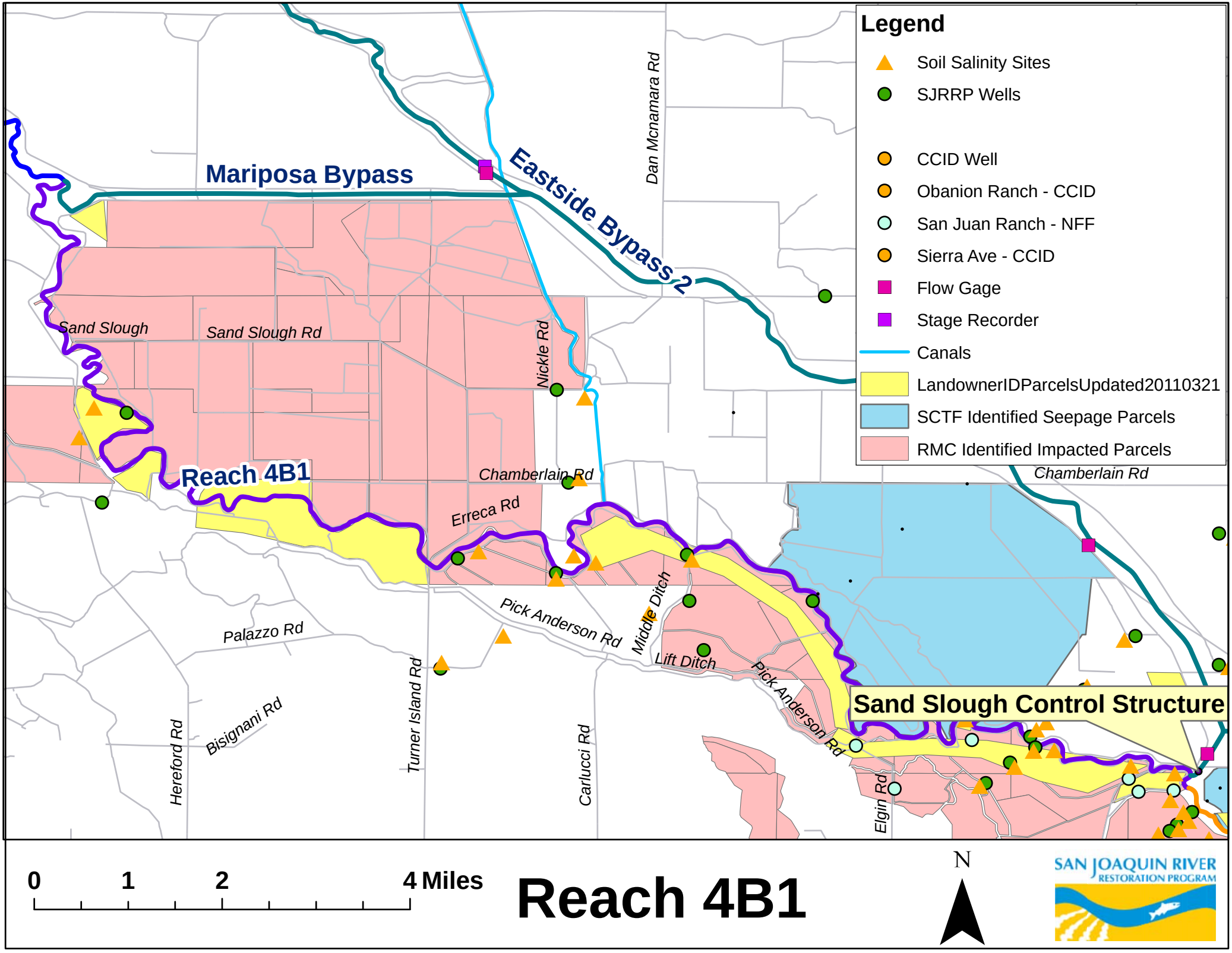
Reach 2A


Helm Canal Rd
Reach 3
Columbia Rd
Mendota Dam
Eastside Dr
Chowchilla Canal Rd
Chowchilla Bypass
1/2
Reach 2B
Bifurcation
San Mateo Rd
San Mateo Ave
Legend
Soil Salinity Sites
SJRRP Wells
CCID Well
Obanion Ranch - CCID
San Juan Ranch - NFF
Sierra Ave - CCID
Flow Gage
Stage Recorder
Canals
LandownerIDParcelsUpdated20110321
SCTF Identified Seepage Parcels
RMC Identified Impacted Parcels
0
0.5
1
2 Miles
N
SAN JOAQUIN RIVER
RESTORATION PROGRAM

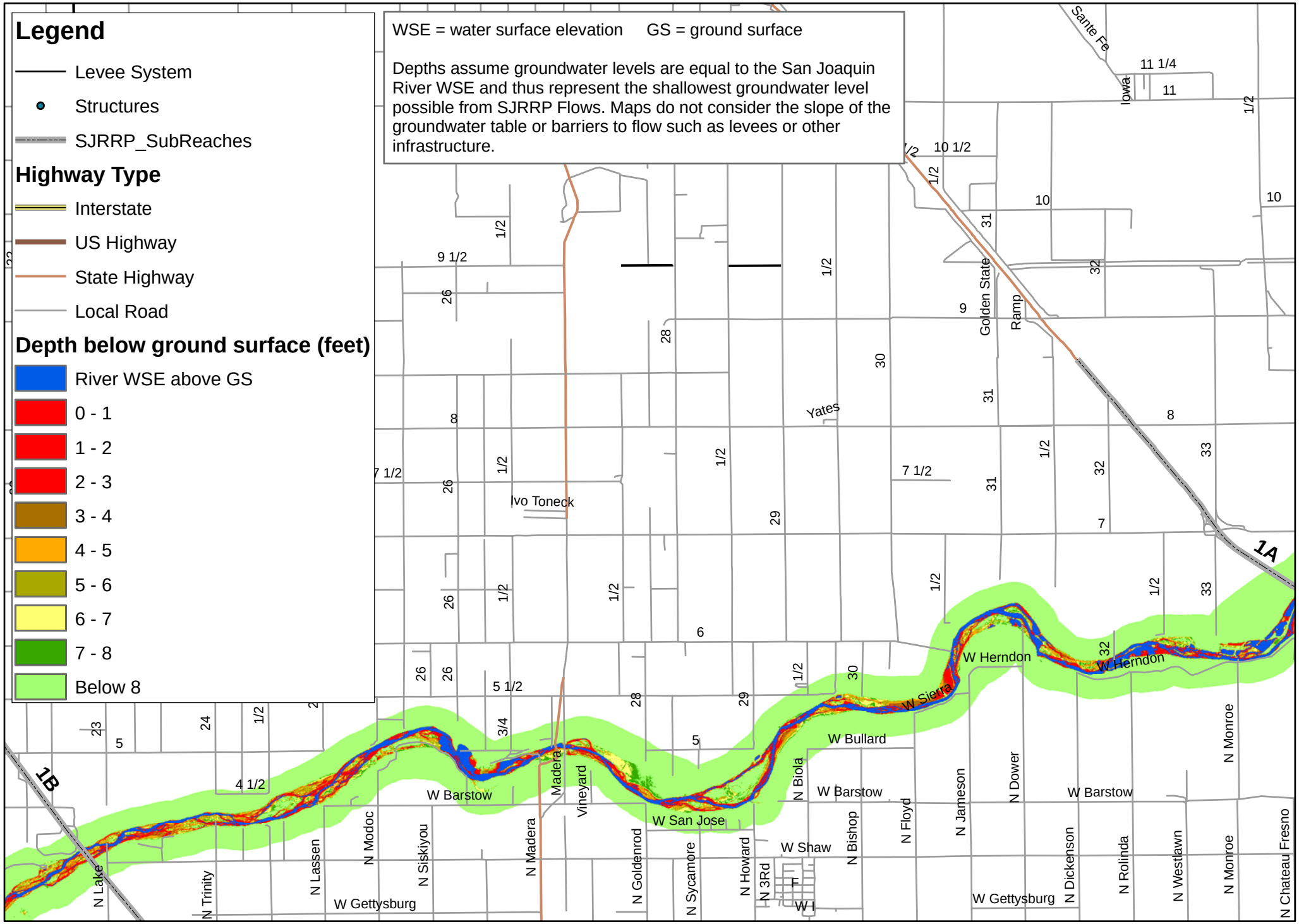
Reach 2B

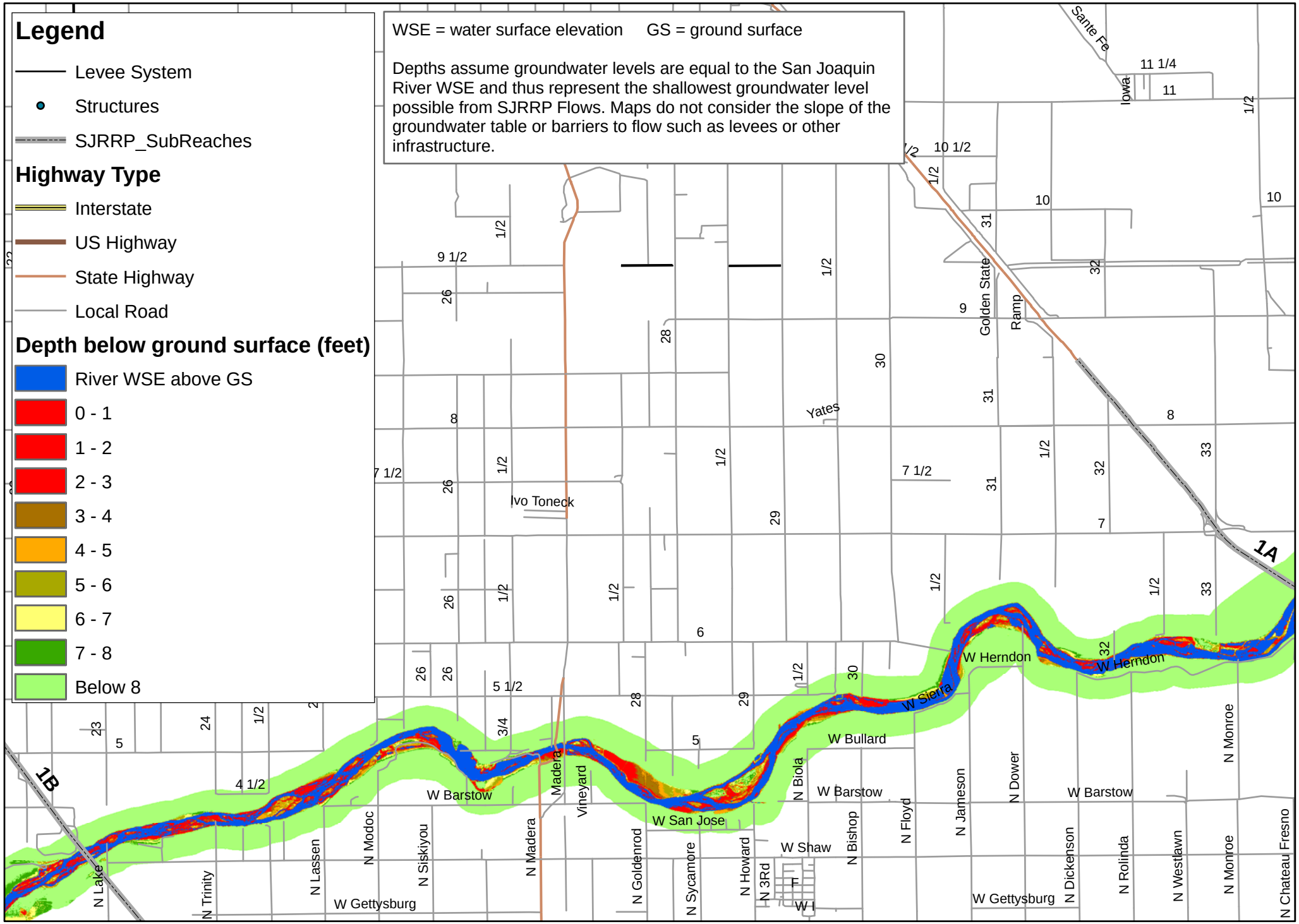

Sack Dam
Mendota Dam
Reach 3
Legend
Soil Salinity Sites
SJRRP Wells
CCID Well
Obanion Ranch - CCID
San Juan Ranch - NFF
Sierra Ave - CCID
Flow Gage
Stage Recorder
Canals
LandownerIDParcelsUpdated20110321
SCTF Identified Seepage Parcels
RMC Identified Impacted Parcels
Valeria Ave
Merrill Ave
Oxalis Ave
Silaxo Ave
Copper Ave
Main St
Nees Ave
Herndon Ave
Bullard Ave
Barstow Ave
Shaw Ave
Gettysburg Ave
Ashlan Ave
Jerrold Ave
Newcomb Ave
Ormsby St
Douglas Ave
Lyon Ave
Storey Ave
Washoe Ave
Triangle T Rd
First Lift Canal
Santa Fe Grd
River Dr
Eastside Dr
Helm Canal Rd
Sierra Ave
J St
O St
S St
8Th St
Yip St
33
0 1 2 4 Miles
N


Legend
Soil Salinity Sites
SJRRP Wells
CCID Well
Obanion Ranch - CCID
San Juan Ranch - NFF
Sierra Ave - CCID
Flow Gage
Stage Recorder
Canals
LandownerIDParcelsUpdated20110321
SCTF Identified Seepage Parcels
RMC Identified Impacted Parcels
Reach 4A
Harmon Rd
Hutchins Rd
Willis Rd
Indiana Ave
Catrina Rd
Lodi Rd
152
Brazil Rd
Island Rd
Flanagan Rd
21
1
Denton Rd
Clement Ave
Batten Rd
Julip Ave
Mint Rd
Hudson Ave
Fairfax Ave
Dixon Rd
Dixon Rd
Carmellia Ave
Davidson Ave
Evans Ave
Fairfax Ave
Galvez Ave
Valeria Ave
Jerrold Ave
Valeria Ave
Hobart Rd
Sack Dam
0 0.5 1 2 Miles
Reach 4A
N
SAN JOAQUIN RIVER RESTORATION PROGRAM


Legend
Soil Salinity Sites
SJRRP Wells
CCID Well
Obanion Ranch - CCID
San Juan Ranch - NFF
Sierra Ave - CCID
Flow Gage
Stage Recorder
Canals
LandownerIDParcelsUpdated20110321
SCTF Identified Seepage Parcels
RMC Identified Impacted Parcels
Mariposa Bypass
Eastside Bypass 2
Dan Mcnamara Rd
Sand Slough
Sand Slough Rd
Nickle Rd
Reach 4B1
Chamberlain Rd
Erreca Rd
Pick Anderson Rd
Middle Ditch
Lift Ditch
Palazzo Rd
Turner Island Rd
Hereford Rd
Bisignani Rd
Carlucci Rd
Elgin Rd
Sand Slough Control Structure
0 1 2 4 Miles
Reach 4B1
N
SAN JOAQUIN RIVER RESTORATION PROGRAM

Appendix B


Legend
Levee System
Structures
SJRRP_SubReaches
Highway Type
Interstate
US Highway
State Highway
Local Road
Depth below ground surface (feet)
River WSE above GS
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Below 8
WSE = water surface elevation GS = ground surface
Depths assume groundwater levels are equal to the San Joaquin River WSE and thus represent the shallowest groundwater level possible from SJRRP Flows. Maps do not consider the slope of the groundwater table or barriers to flow such as levees or other infrastructure.
Santa Fe
Iowa
Golden State
Ramp
Yates
Ivo Toneck
1A
1B
W Herndon
W Sierra
W Bullard
W Barstow
W San Jose
W Shaw
W Gettysburg
N Lake
N Trinity
N Lassen
N Modoc
N Siskiyou
N Madera
Madera
Vineyard
N Goldenrod
N Sycamore
N Howard
N 3Rd
N Biola
N Bishop
N Floyd
N Jameson
N Dower
N Dickenson
N Rolinda
N Westlawn
N Monroe
N Chateau Fresno
0 0.5 1 2 Miles
N
Reach 1B - 1500 cfs local flow
3/22/2011 Preliminary Draft
Subject to Revision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Levee System
Structures
SJRRP_SubReaches
Highway Type
Interstate
US Highway
State Highway
Local Road
Depth below ground surface (feet)
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6 - 7
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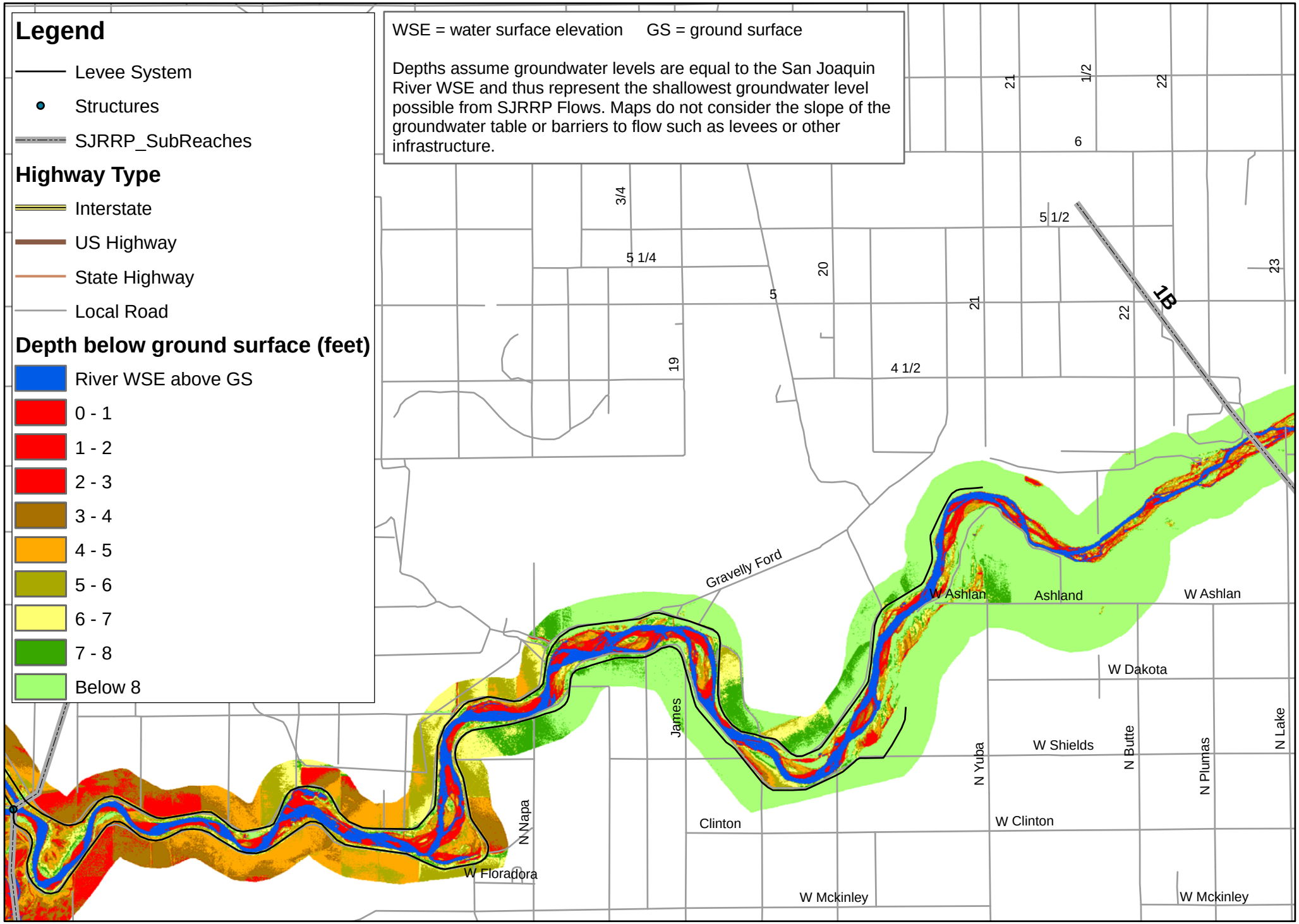
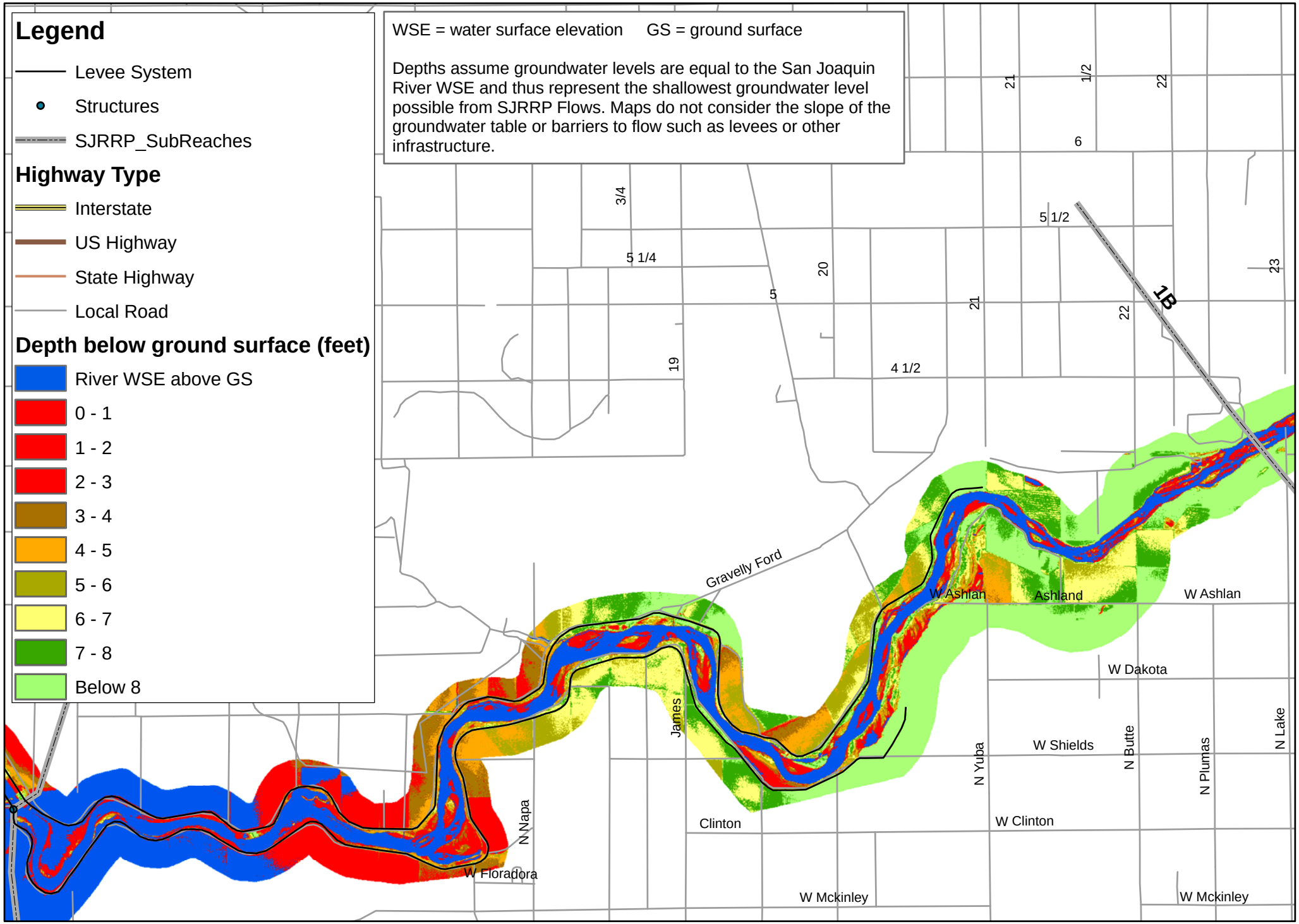
Santa Fe
Iowa
Golden State
Ramp
Yates
Ivo Toneck
1A
1B
W Herndon
W Sierra
W Bullard
W Barstow
W San Jose
W Shaw
W Gettysburg
N Lake
N Trinity
N Lassen
N Modoc
N Siskiyou
N Madera
Madera
Vineyard
N Goldenrod
N Sycamore
N Howard
N 3Rd
N Biola
N Bishop
N Floyd
N Jameson
N Dower
N Dickenson
N Rolinda
N Westlawn
N Monroe
N Chateau Fresno
0 0.5 1 2 Miles
N
Reach 1B - 4500 cfs local flow
3/22/2011 Preliminary Draft
Subject to Revision



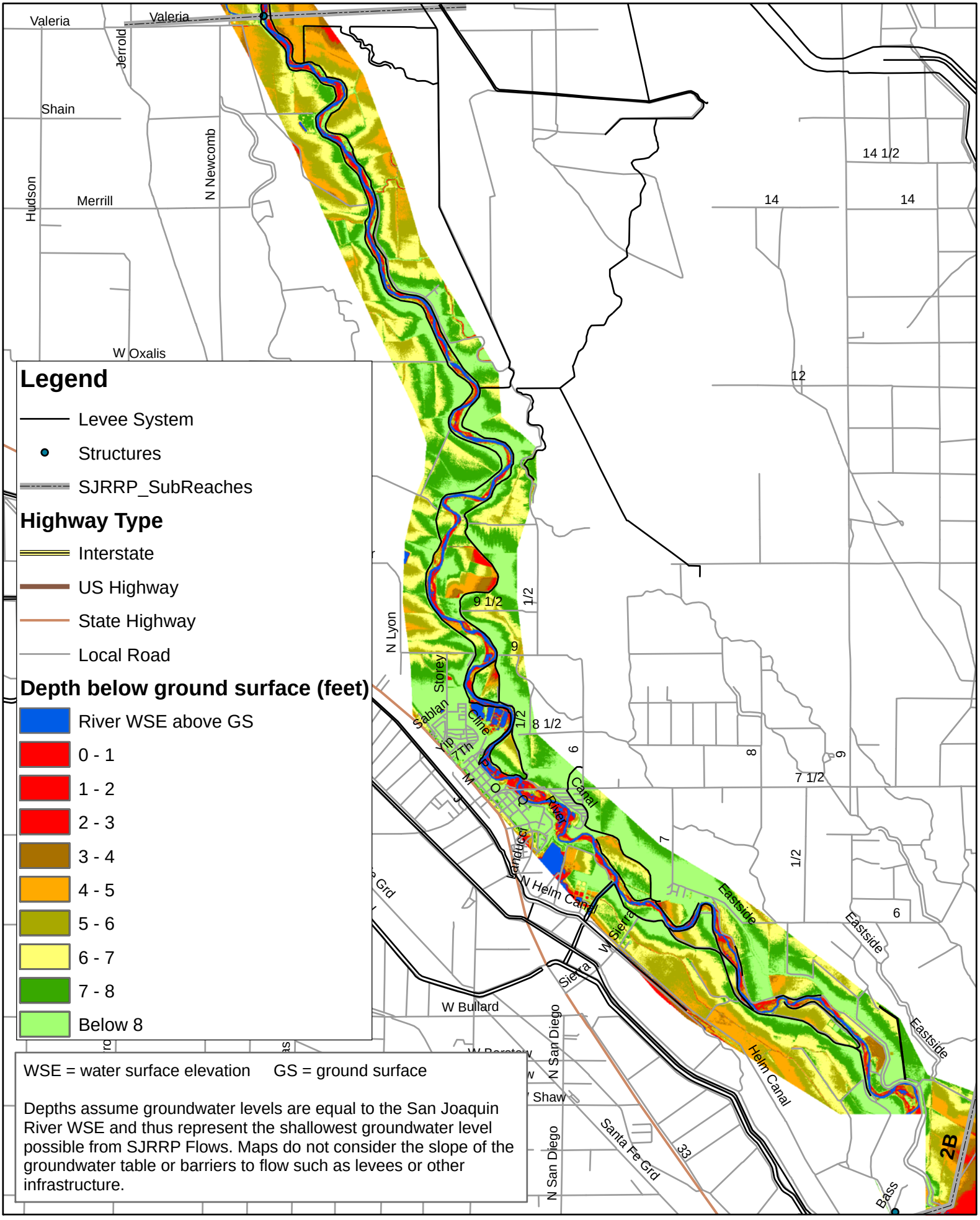
Reach 2A - 1500 cfs local flow

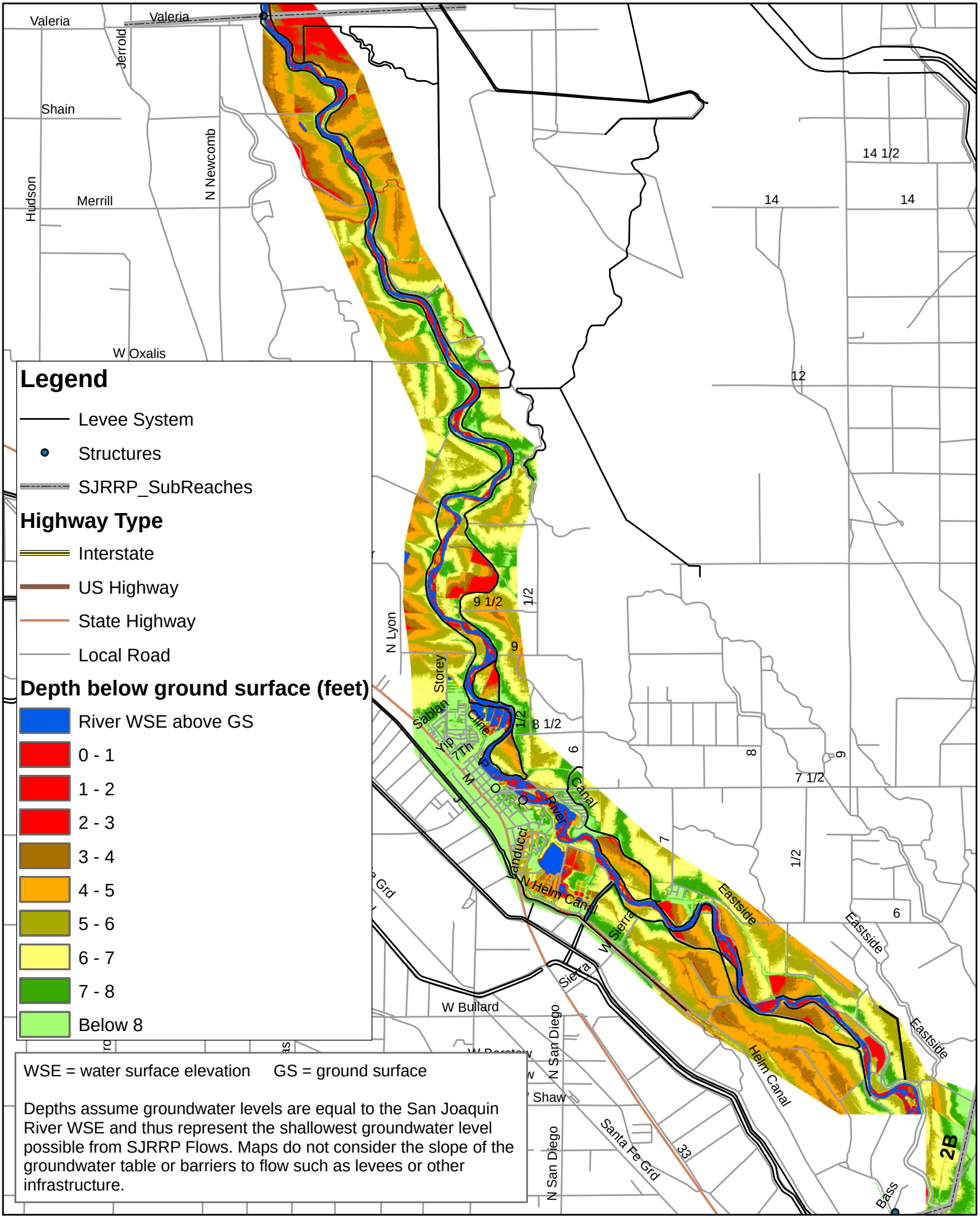
3/22/2011 Preliminary Draft
Subject to Revision



Reach 2A - 4500 cfs local flow

3/22/2011 Preliminary Draft
Subject to Revision


Valeria
Valeria
Jerrold
Shain
N Newcomb
Hudson
Merrill
W Oxalis
14 1/2
14
14
12
9 1/2
1/2
9
N Lyon
Storey
Sablan
Clinton
1/2
8 1/2
6
8
9
7 1/2
Canal
River
7
1/2
6
Eastside
Eastside
Eastside
Helm Canal
Helm Canal
W Bullard
N San Diego
Shaw
N San Diego
Santa Fe Grd
33
2B
Bass
Legend
Levee System
Structures
SJRRP_SubReaches
Highway Type
Interstate
US Highway
State Highway
Local Road
Depth below ground surface (feet)
River WSE above GS
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Below 8
WSE = water surface elevation GS = ground surface
Depths assume groundwater levels are equal to the San Joaquin River WSE and thus represent the shallowest groundwater level possible from SJRRP Flows. Maps do not consider the slope of the groundwater table or barriers to flow such as levees or other infrastructure.
0 0.5 1 2 Miles
N
Reach 3 - 1500 cfs local flow
3/22/2011
Preliminary Draft
Subject to Revision



Legend

- Levee System
- Structures
- SJRRP_SubReaches

Highway Type

- Interstate
- US Highway
- State Highway
- Local Road

Depth below ground surface (feet)

- River WSE above GS
- 0 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- Below 8

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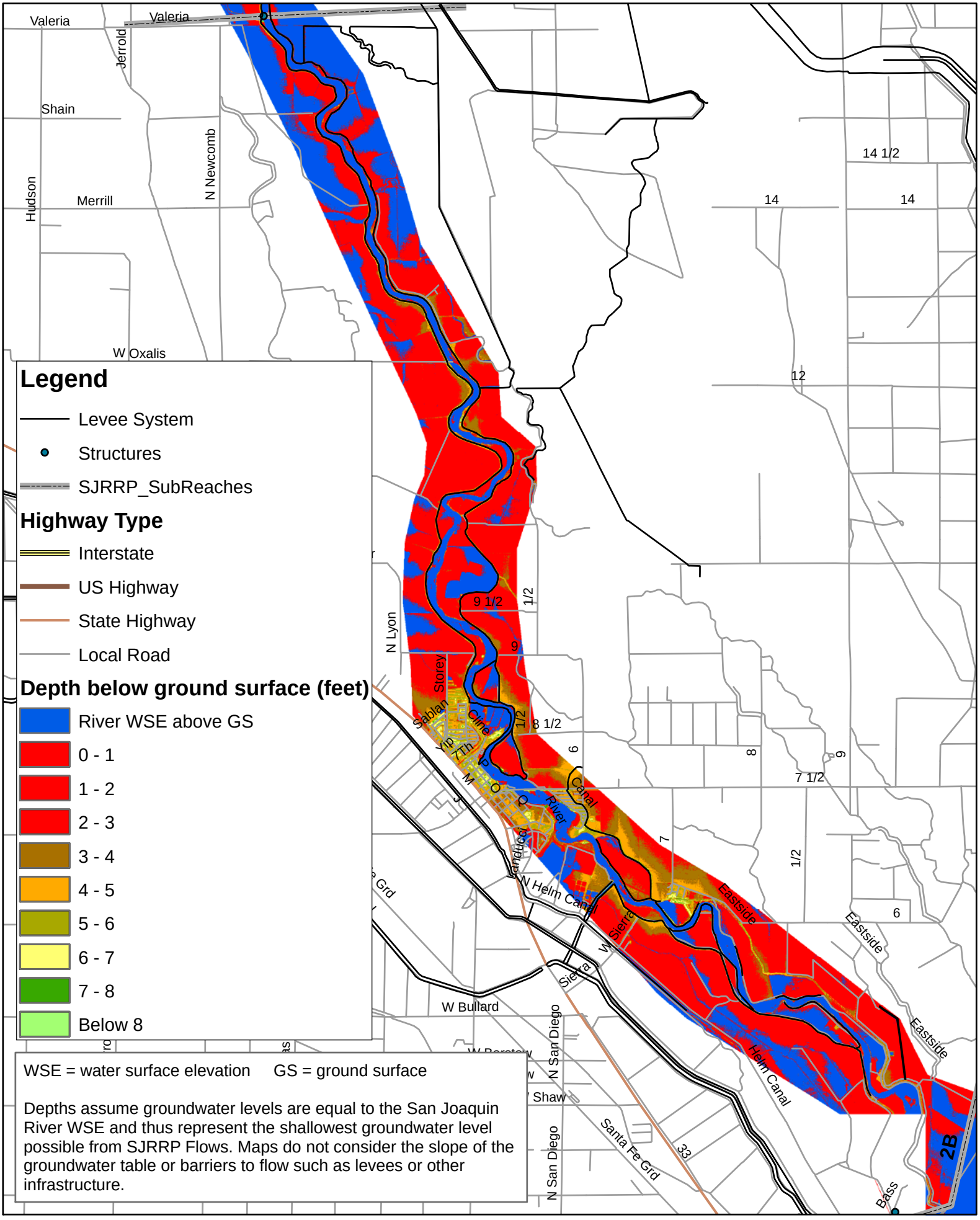
0 0.5 1 2 Miles

N

Reach 3 - 1880 cfs local flow

3/22/2011
Preliminary Draft
Subject to Revision



Legend

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- Structures
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- Interstate
- US Highway
- State Highway
- Local Road

Depth below ground surface (feet)

- River WSE above GS
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- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8
- Below 8

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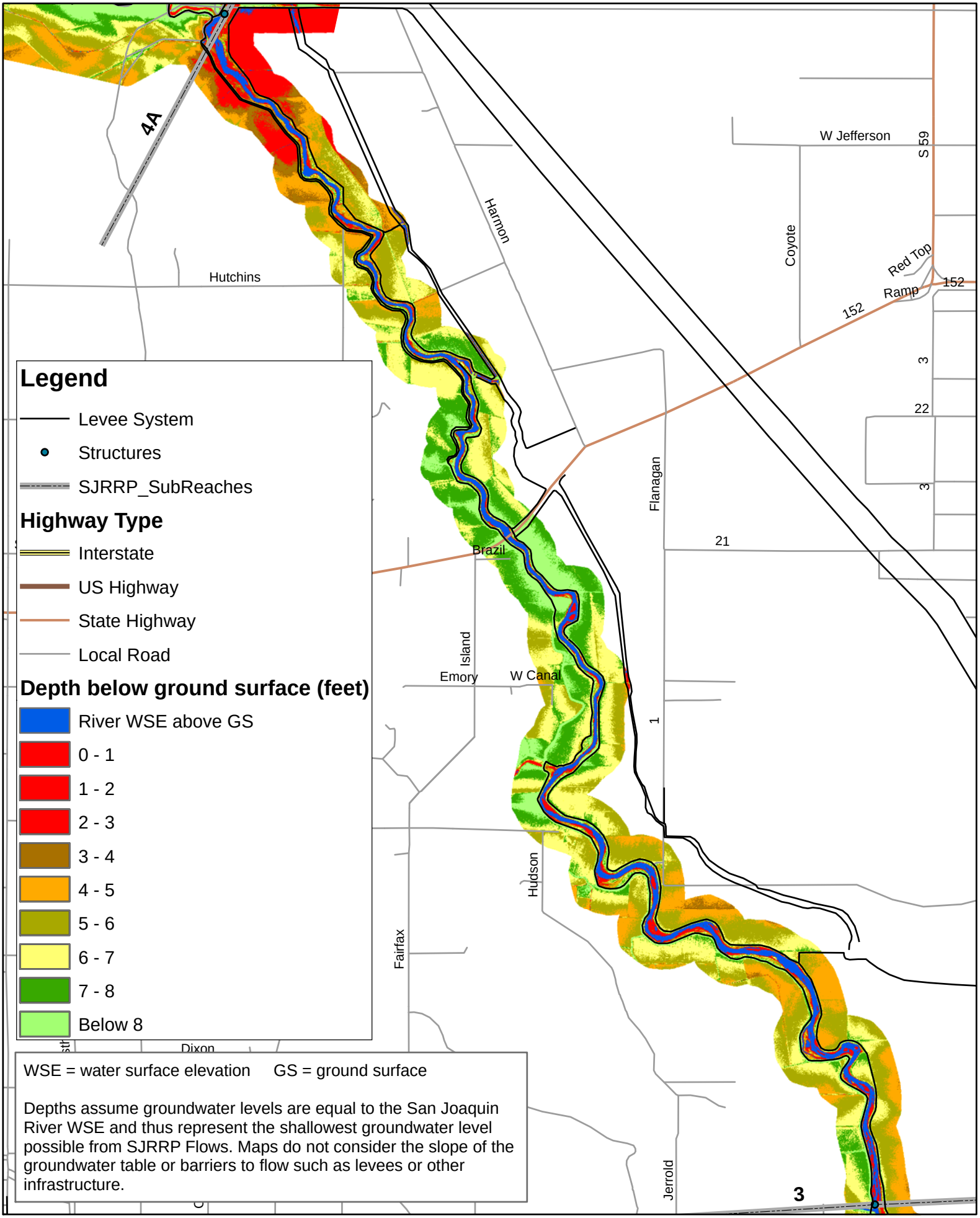
0 0.5 1 2 Miles

N

Reach 3 - 4500 cfs local flow

3/22/2011
Preliminary Draft
Subject to Revision


4A
Hutchins
Harmon
W Jefferson
S 59
Coyote
Red Top
Ramp
152
152
3
22
3
Flanagan
21
Brazil
Island
Emory
W Canal
1
Hudson
Fairfax
Jerrold
3
Dixon
Legend
Levee System
Structures
SJRRP_SubReaches
Highway Type
Interstate
US Highway
State Highway
Local Road
Depth below ground surface (feet)
River WSE above GS
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2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
Below 8
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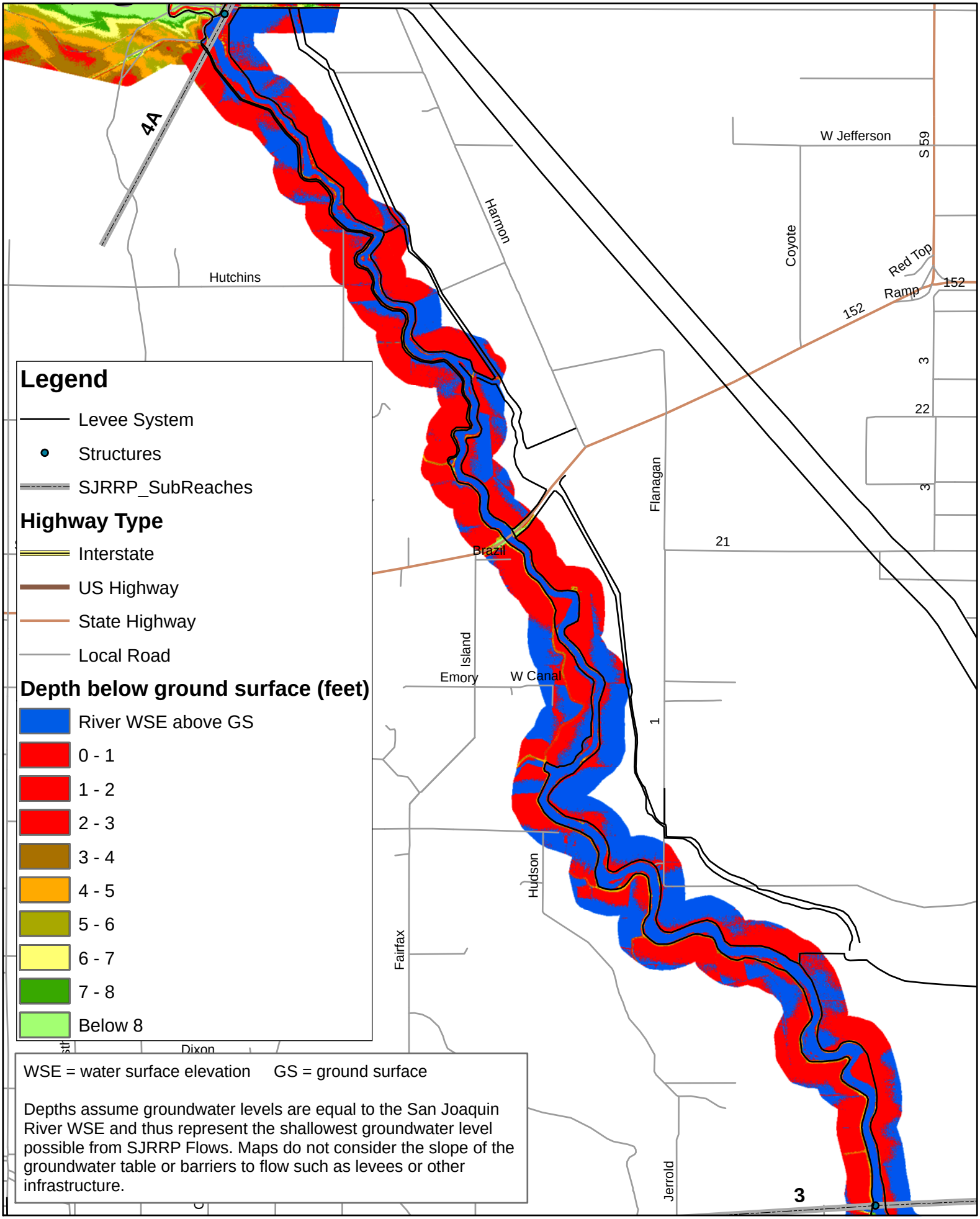
0 0.25 0.5 1 Miles
N
Reach 4A - 1500 cfs local flow
3/22/2011
Preliminary Draft
Subject to Revision


4A
Hutchins
Harmon
W Jefferson
S 59
Coyote
Red Top
Ramp
152
152
3
22
3
Flanagan
21
Brazil
Island
Emory
W Canal
1
Hudson
Fairfax
Jerrold
3
Dixon
Legend
Levee System
Structures
SJRRP_SubReaches
Highway Type
Interstate
US Highway
State Highway
Local Road
Depth below ground surface (feet)
River WSE above GS
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
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6 - 7
7 - 8
Below 8
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0 0.25 0.5 1 Miles
N
Reach 4A - 4500 cfs local flow
3/22/2011
Preliminary Draft
Subject to Revision