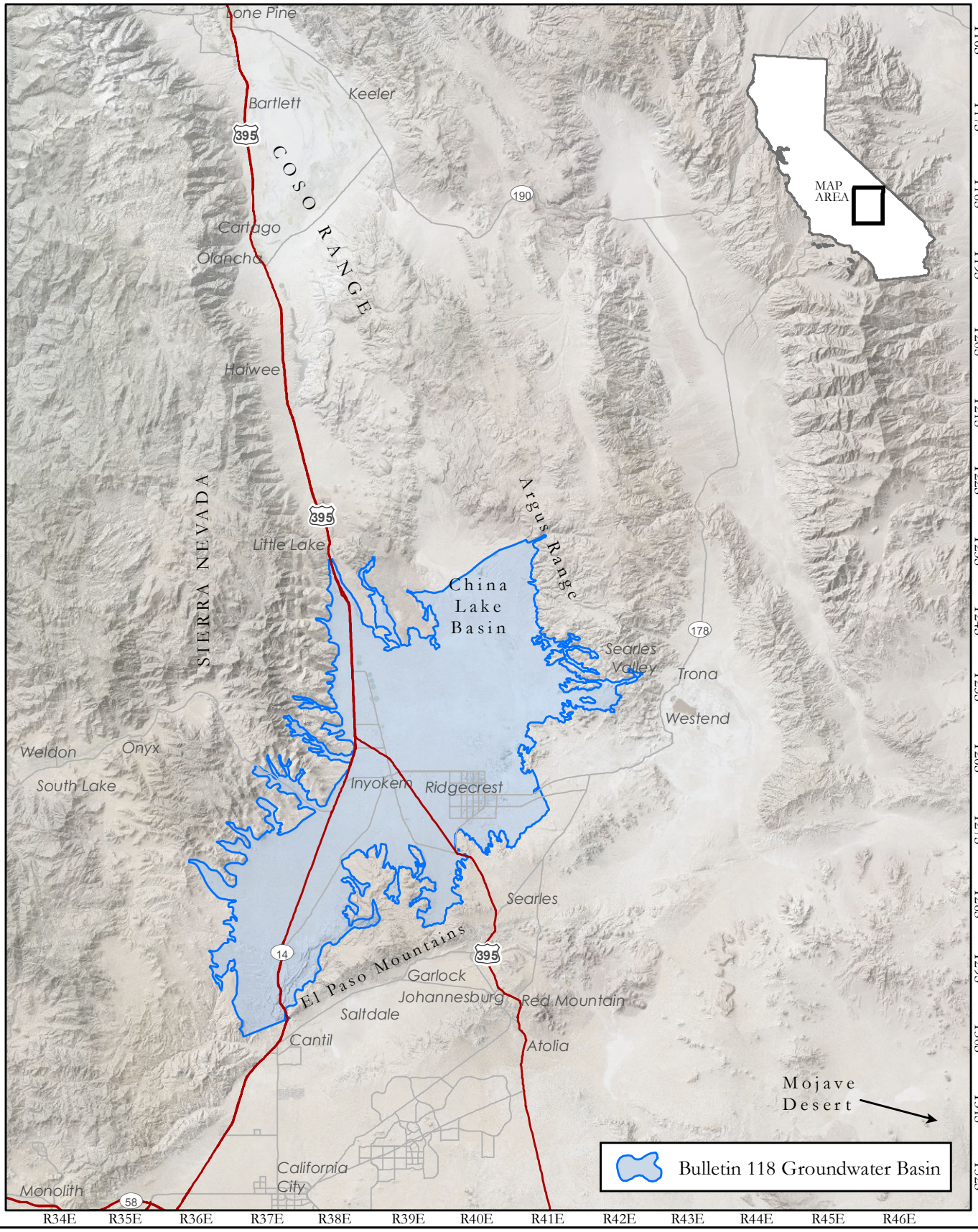
FIGURES

(Page Intentionally Left Blank)

FIGURE 2-1



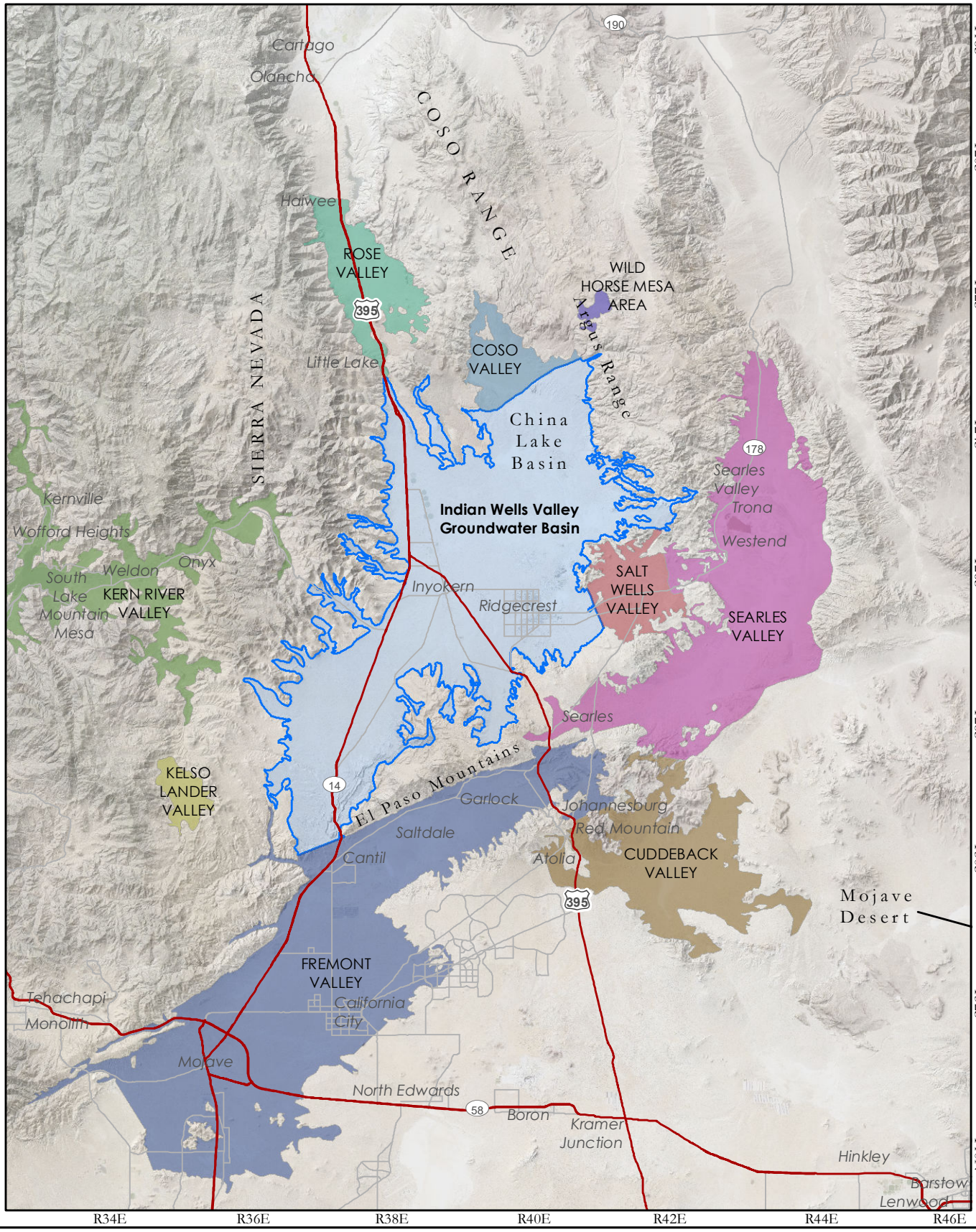
STETSON ENGINEERS INC.

GENERAL BASIN SETTING
INDIAN WELLS VALLEY GROUNDWATER BASIN
(DWR BULLETIN 118 BASIN NO. 6-054)

N

0 5 10 Miles

Document Path: J:\jn2652\IWV_Sec2_General_Basin_Setting.mxd



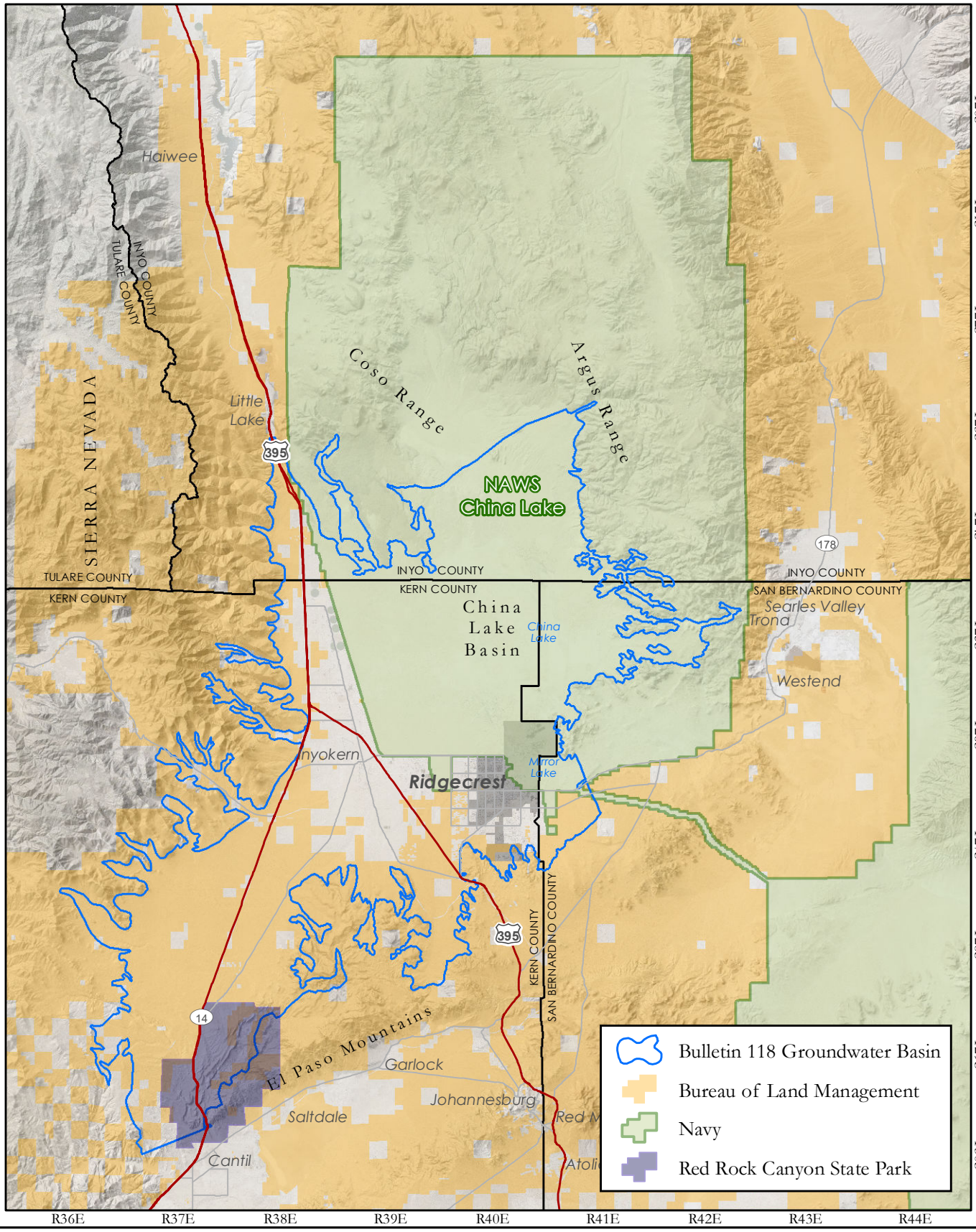
STETSON ENGINEERS INC.

ADJACENT AND NEIGHBORING GROUNDWATER BASINS
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 5 10 Miles

Document Path: J:\jn2652\IWV_Sec2_Adjacent_GW_Basins.mxd



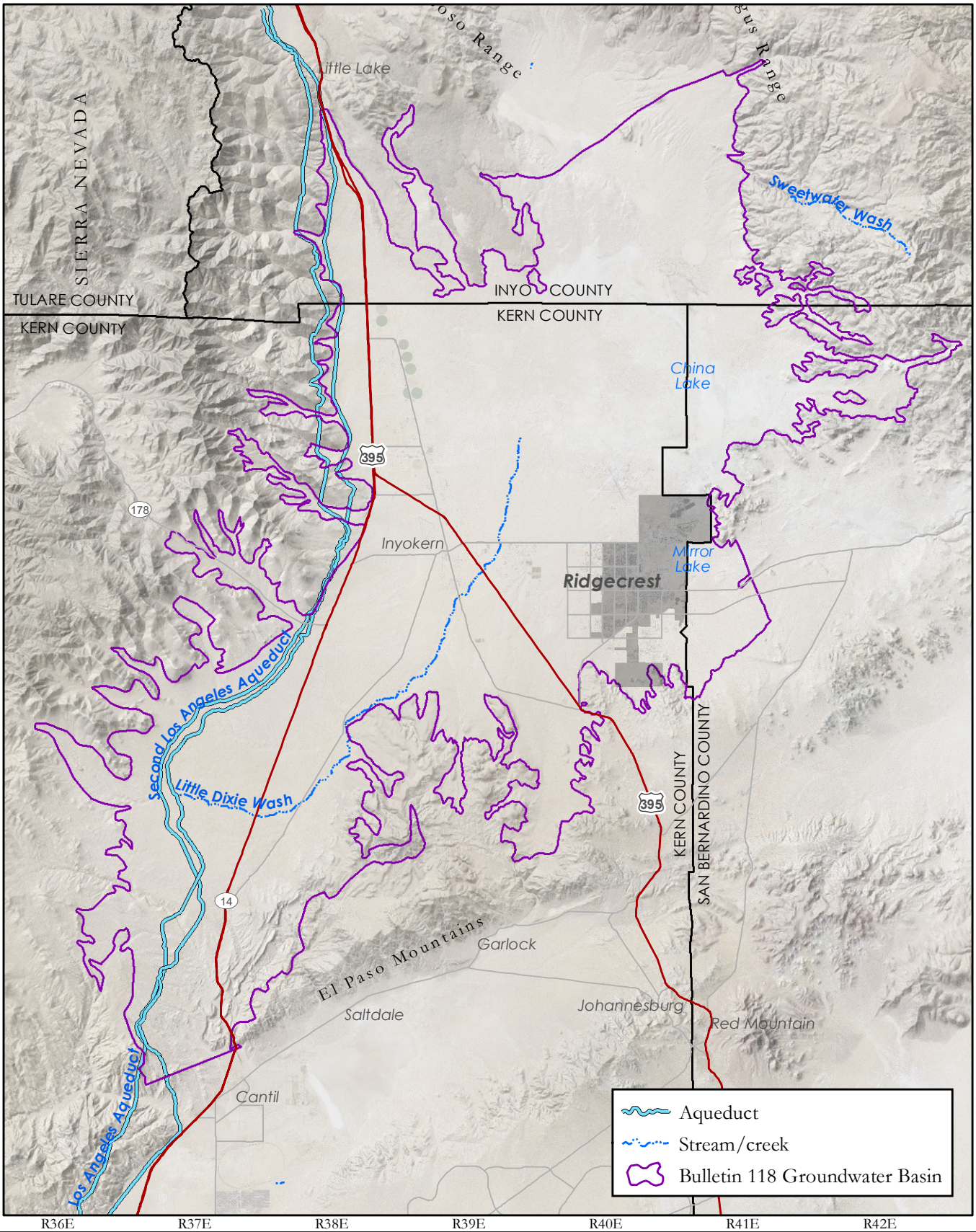
JURISDICTIONS AND BOUNDARIES OF FEDERAL AND STATE LANDS INDIAN WELLS VALLEY GROUNDWATER BASIN

STETSON ENGINEERS INC.

N

0 2.5 5 Miles

Document Path: J:\jn2652\IWV_Sec2_Jurisdictions_and_Boundaries.mxd



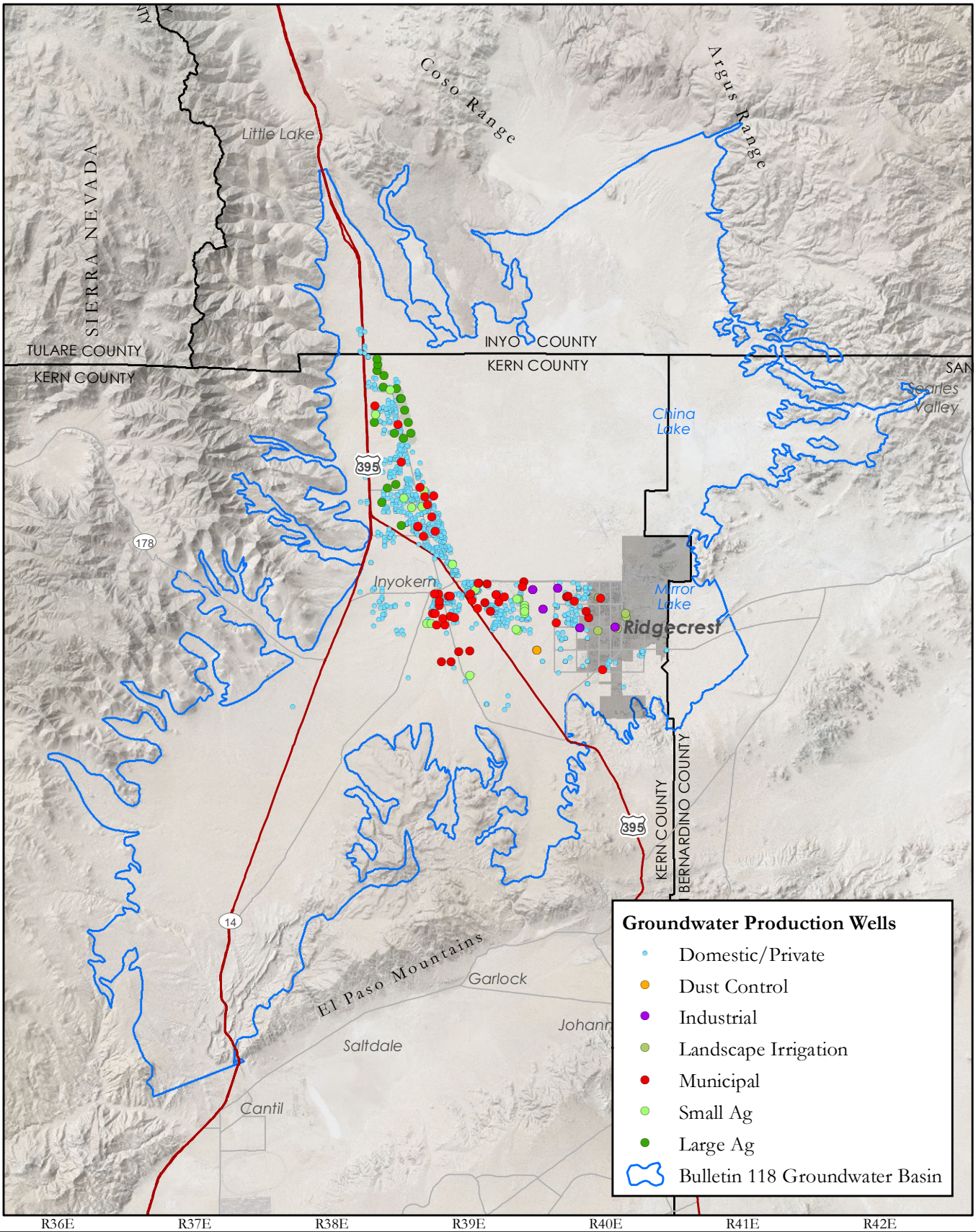
Document Path: J:\jn2652\IWV_Sec2_Surface_water.mxd

STETSON ENGINEERS INC.

STREAMS, RIVERS, AND OTHER SURFACE WATERS
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2 4 Miles



Document Path: J:\jn2652\IWV_Sec2_Groundwater_Production_Wells.mxd

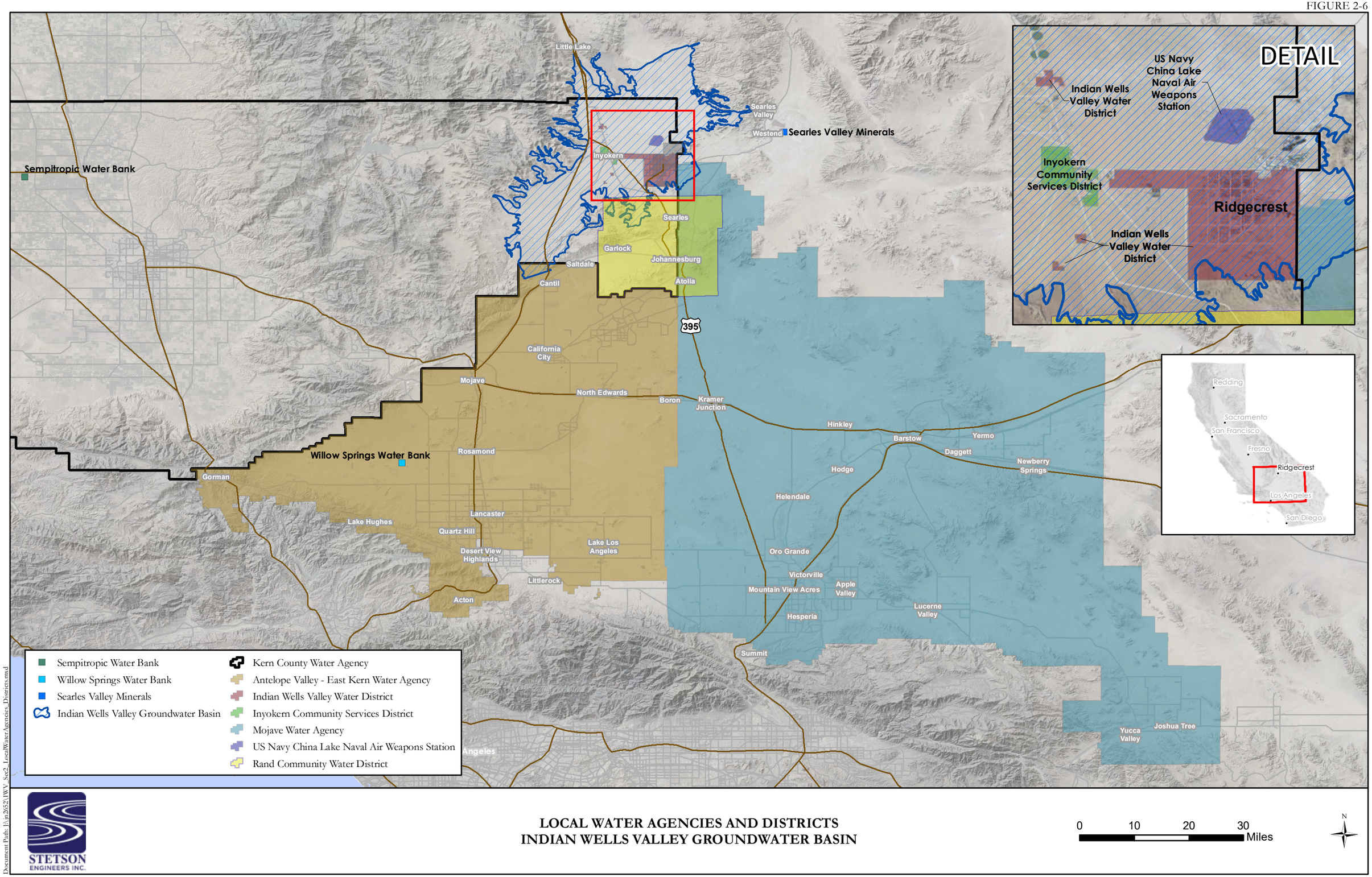
STETSON ENGINEERS INC.

LOCATIONS OF KNOWN GROUNDWATER PRODUCTION WELLS INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2 4 Miles

FIGURE 2-6



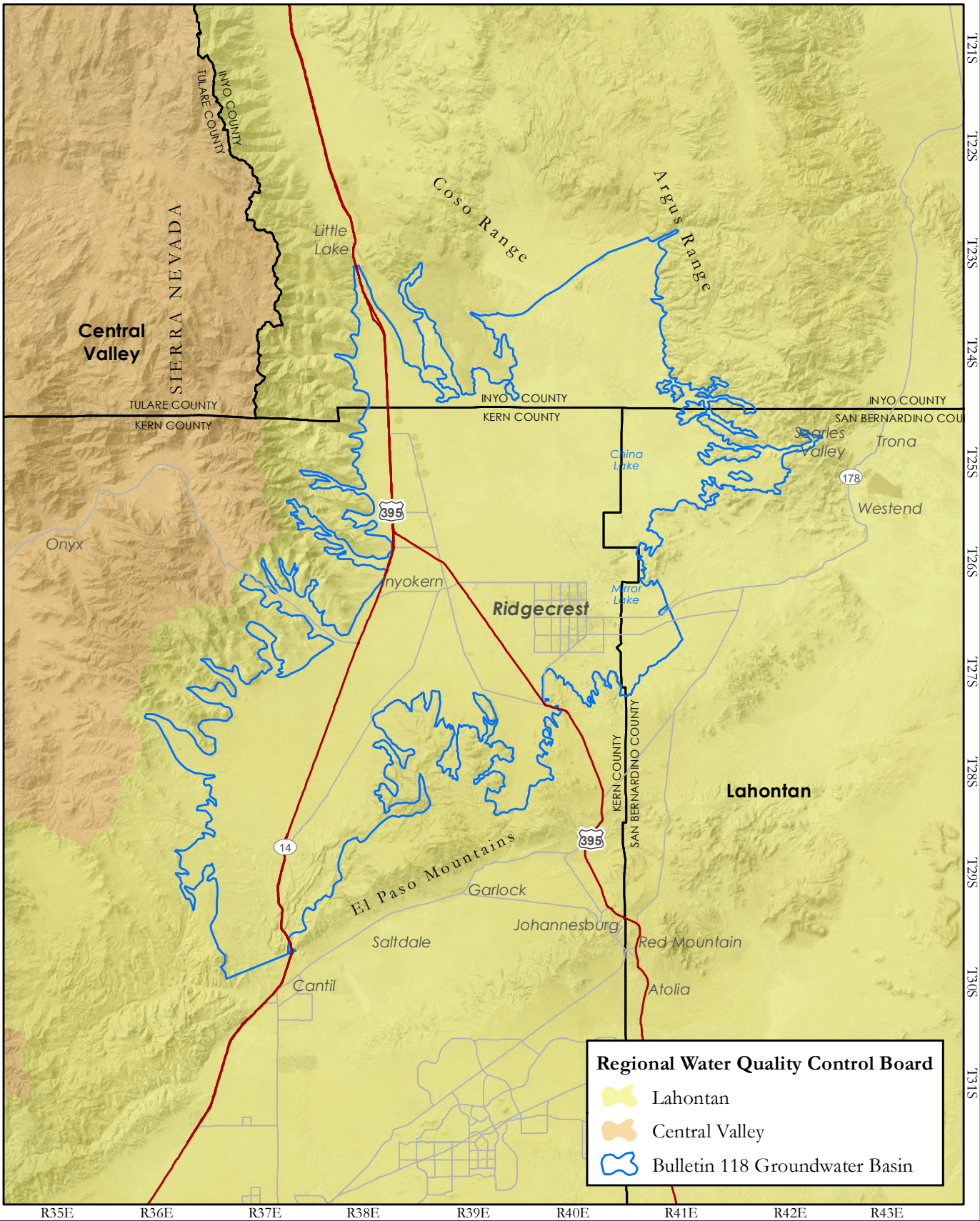
Document Path: J:\jn\2652\IWV_Sec2_LocalWaterAgencies_Districts.mxd

STETSON ENGINEERS INC.

LOCAL WATER AGENCIES AND DISTRICTS
INDIAN WELLS VALLEY GROUNDWATER BASIN

0 10 20 30 Miles

N



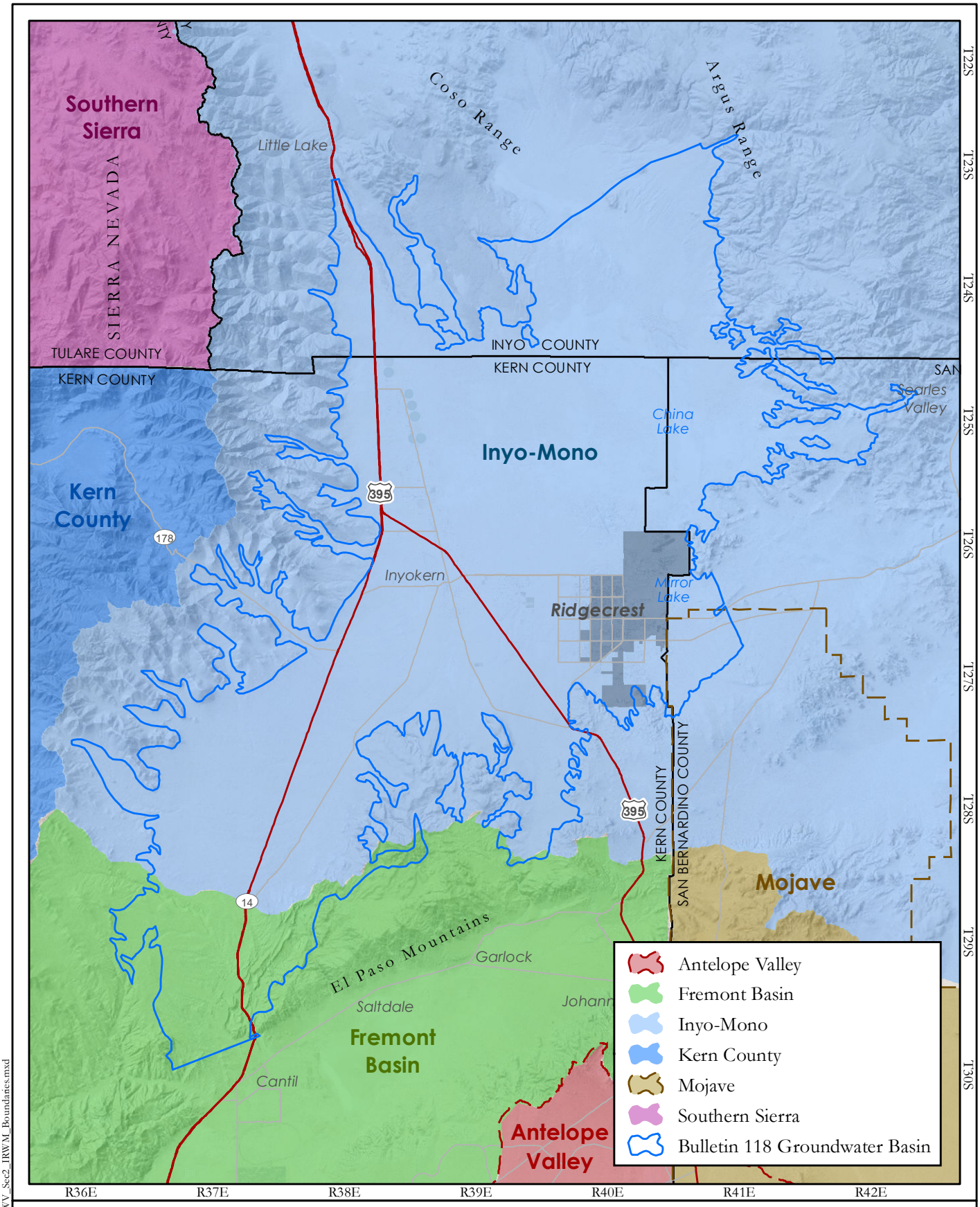
STETSON ENGINEERS INC.

REGIONAL BOARD BOUNDARIES
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2.5 5 Miles

Document Path: J:\jn2652\IWV_Sec2_Regional_Board_Boundaries.mxd



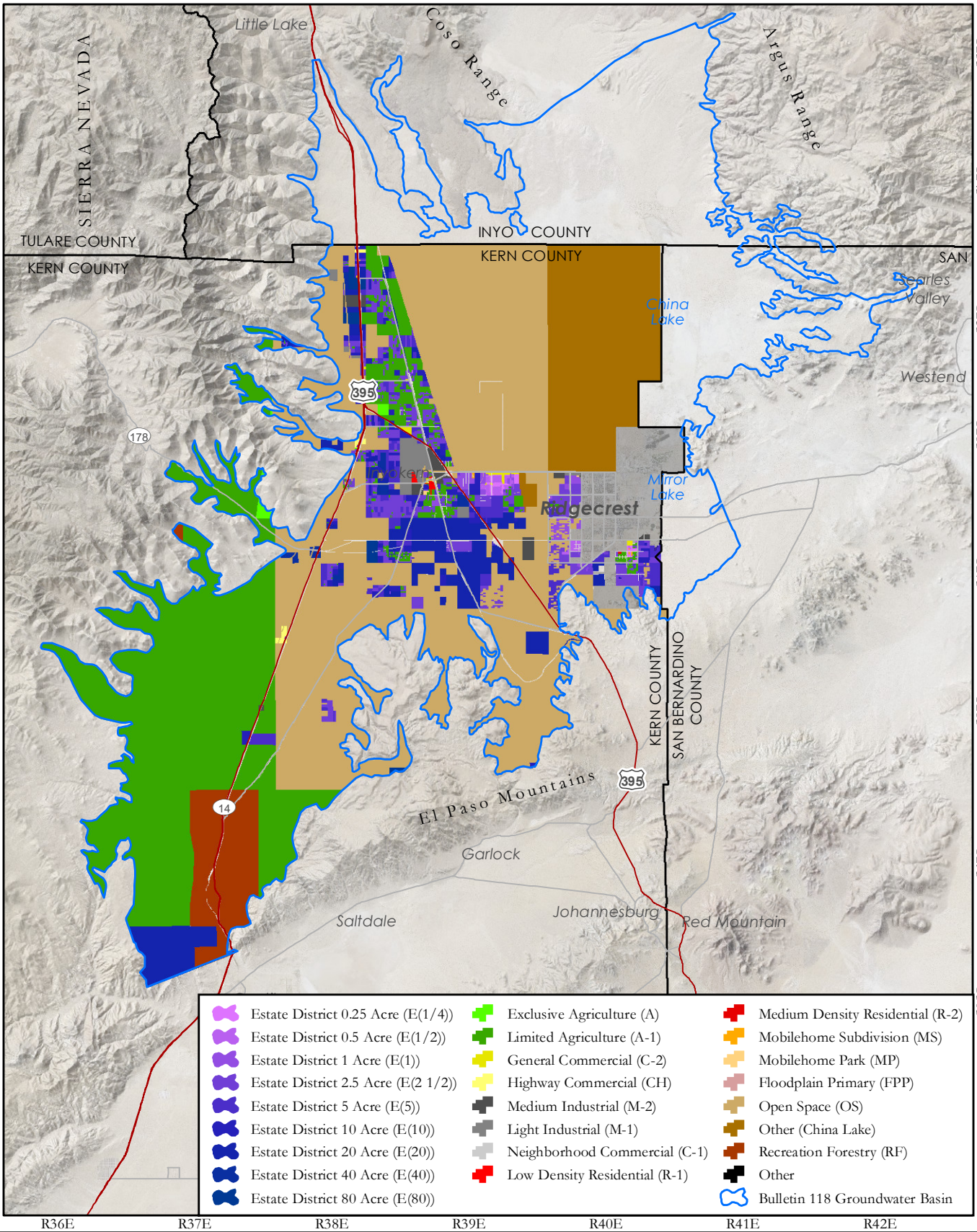
STETSON ENGINEERS INC.

INTEGRATED REGIONAL WATER MANAGEMENT (IRWM) BOUNDARIES
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2 4 Miles

Document Path: J:\jn2652\IWV_Sec2_IRWM_Boundaries.mxd



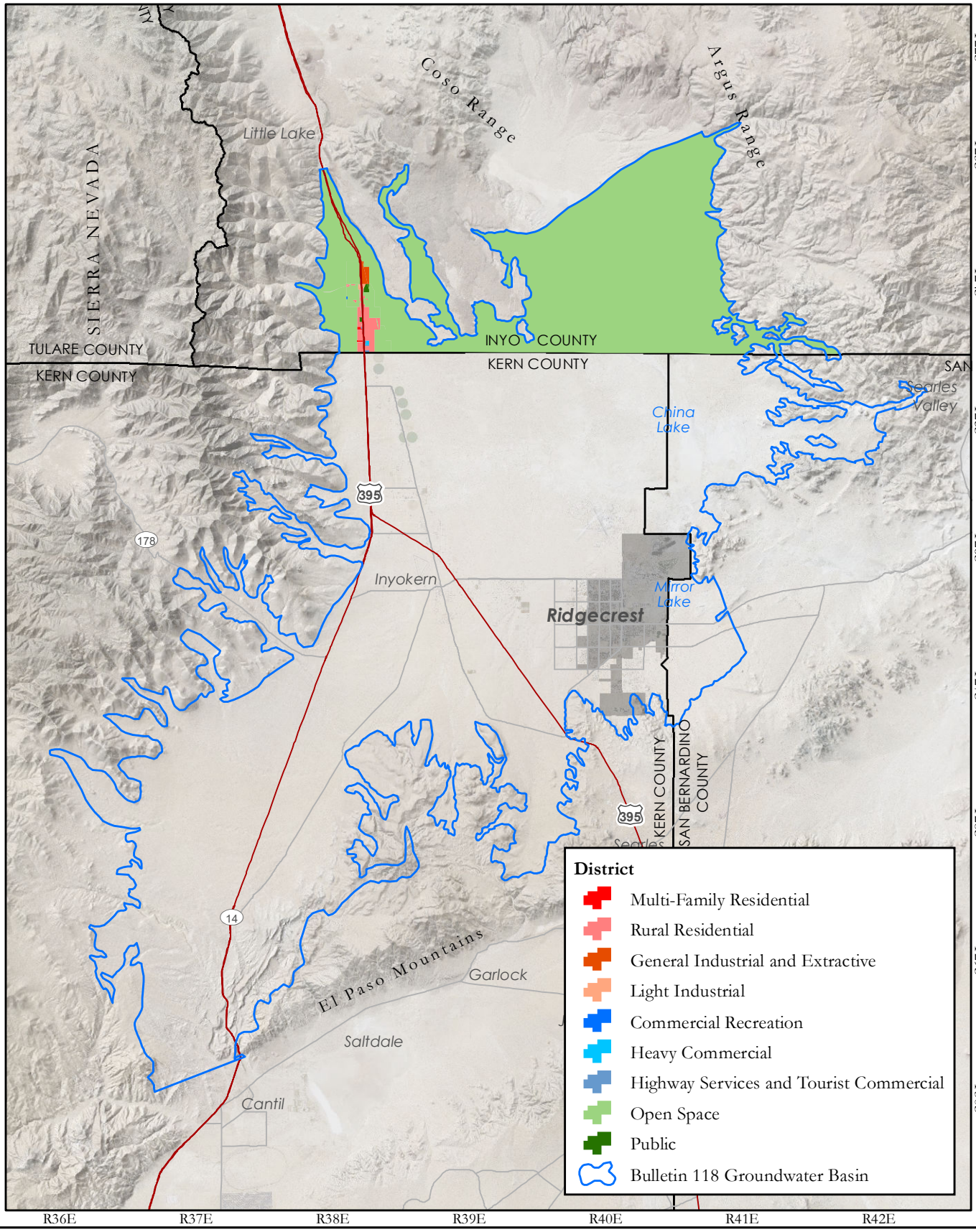
Document Path: J:\jn2652\IWV_Sec2_Kern_Zoning.mxd

STETSON ENGINEERS INC.

ZONING DISTRICTS (KERN COUNTY)
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2 4 Miles



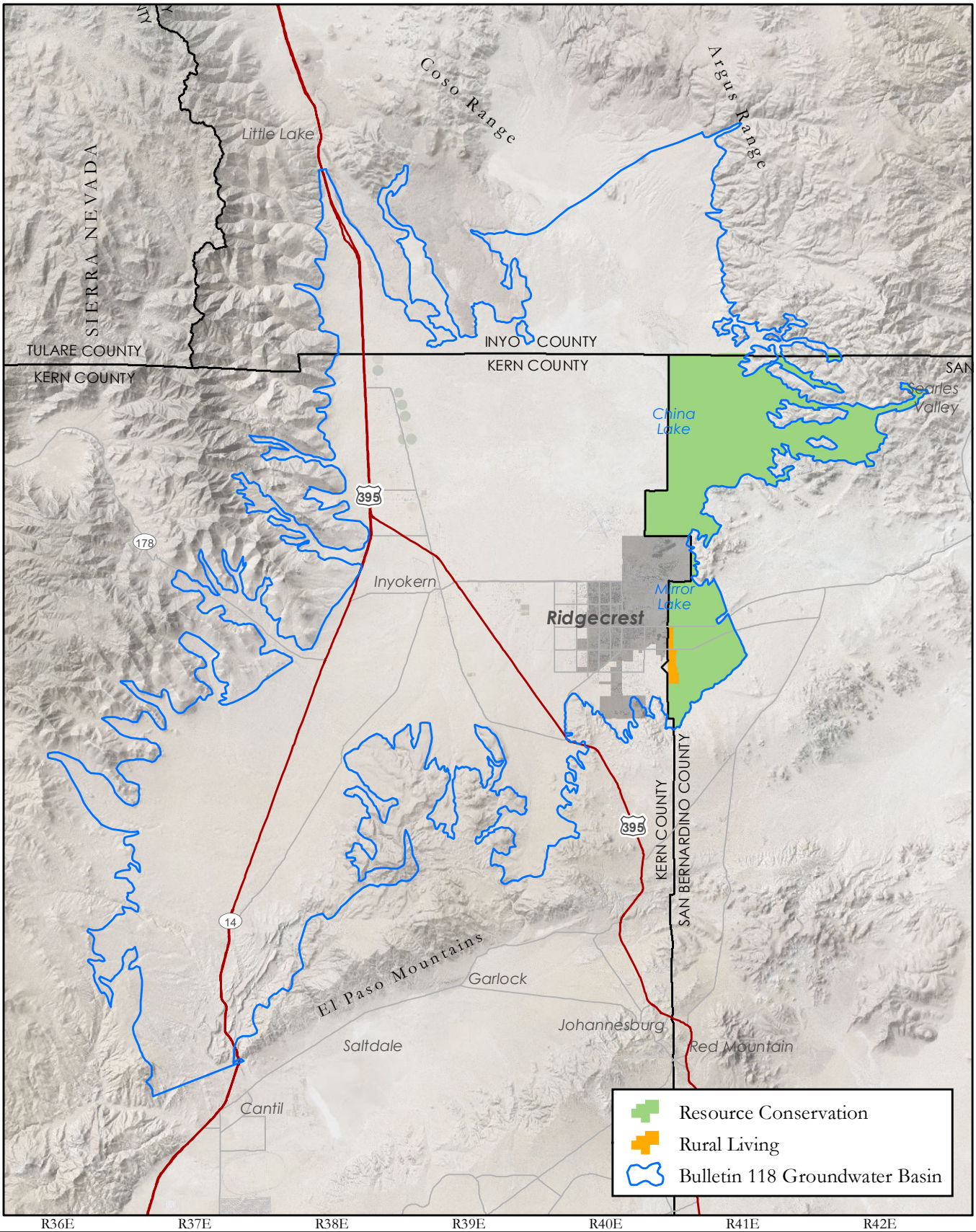
STETSON ENGINEERS INC.

ZONING DISTRICTS (INYO COUNTY)
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2 4 Miles

Document Path: J:\jn2652\IWV_Sec2_Inyo_Zoning.mxd



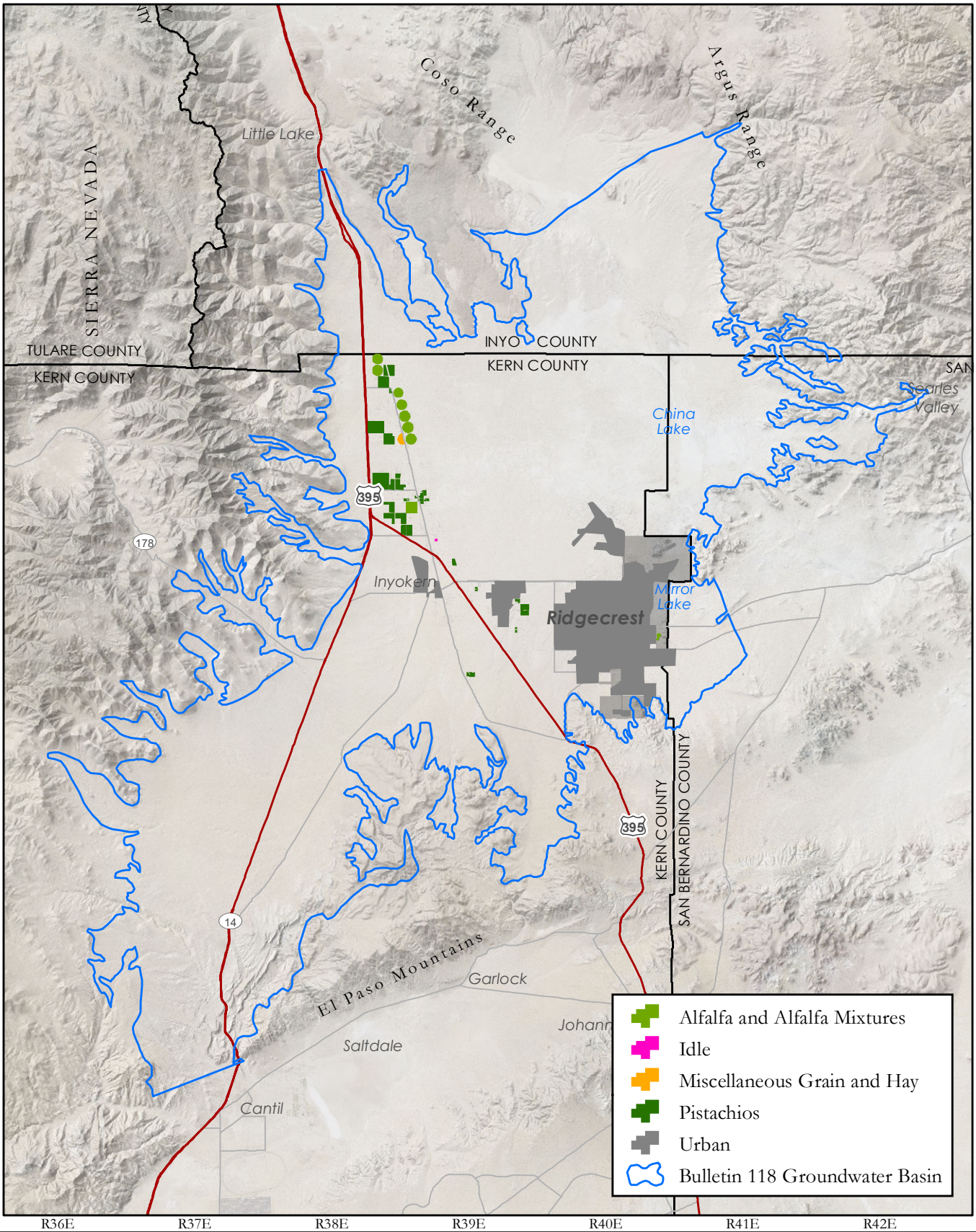
Document Path: J:\jn2652\IWV_Sec2_San_Bernardino_Zoning.mxd

STETSON ENGINEERS INC.

ZONING DISTRICTS (SAN BERNARDINO COUNTY)
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

0 2 4 Miles



STETSON ENGINEERS INC.

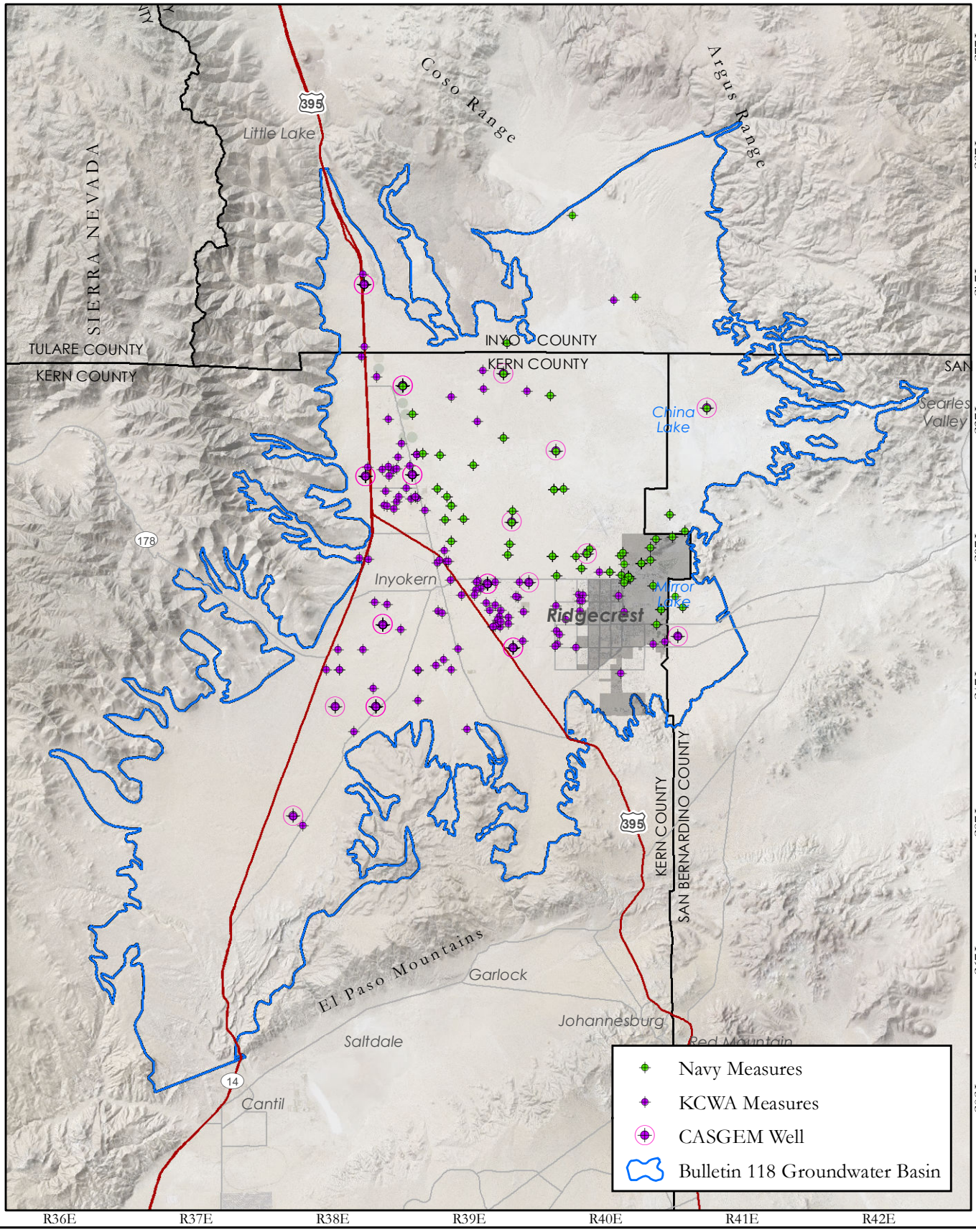
ACTIVE AGRICULTURAL LANDS
INDIAN WELLS VALLEY GROUNDWATER BASIN

Source: DWR State Crop Mapping 2014; https://data.cnra.ca.gov/dataset/crop-mapping-2014

N

0 2 4 Miles

Document Path: J:\jn2652\IWV_Sec2_Active_Ag.mxd



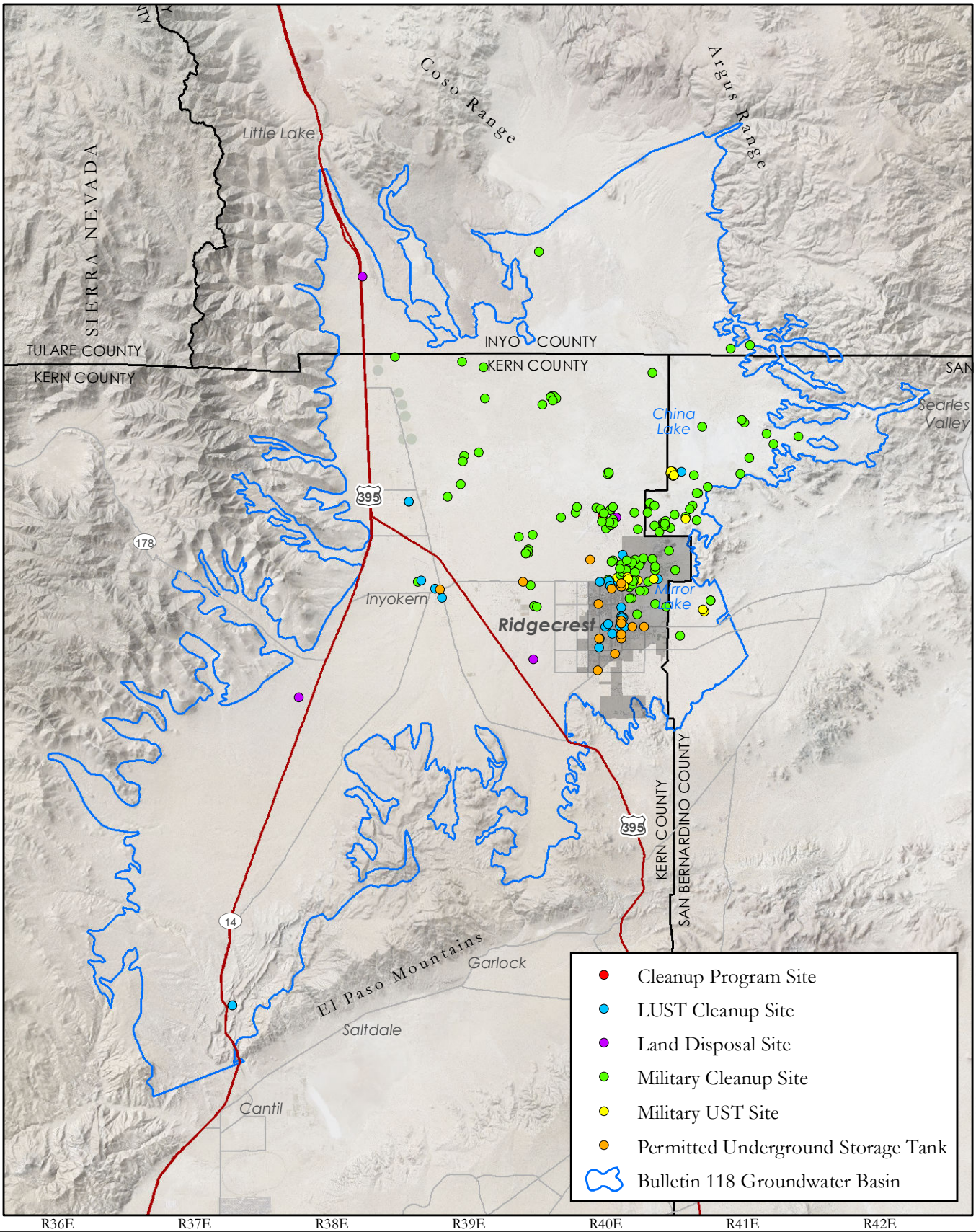
LOCATIONS OF MONITORING WELLS
INDIAN WELLS VALLEY GROUNDWATER BASIN

STETSON ENGINEERS INC.

N

0 2 4 Miles

Document Path: J:\jn2652\IWV_Sec2_Monitoring_Wells.mxd



STETSON ENGINEERS INC.

LOCATIONS OF
GROUNDWATER CONTAMINATION CLEANUP SITES
INDIAN WELLS VALLEY GROUNDWATER BASIN

N

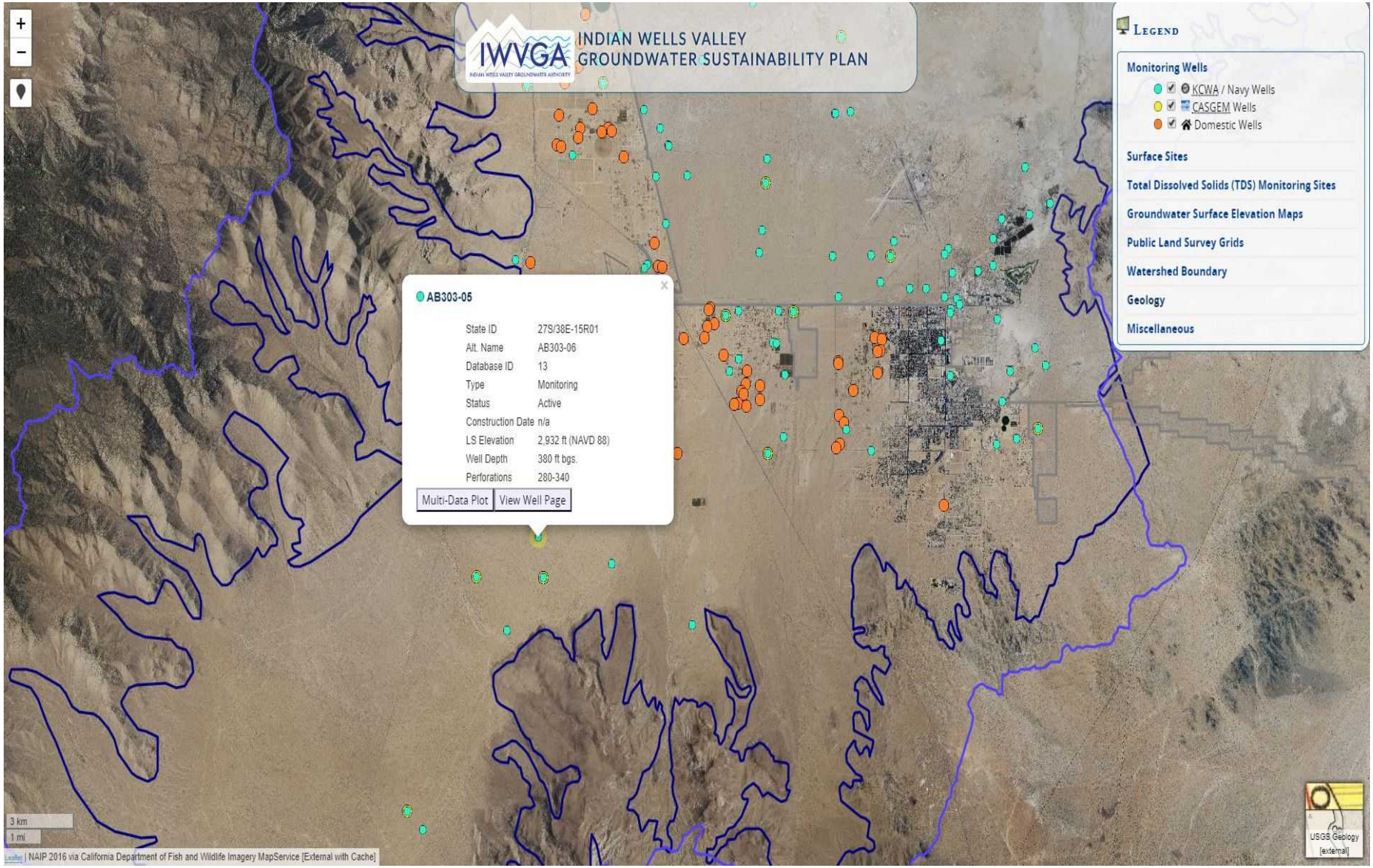
0 2 4 Miles

Document Path: J:\jn2652\IWV_Sec2_Cleanup_Sites.mxd

STETSON ENGINEERS INC.

Screenshot of the Data Management System Login Page

FIGURE 2-15

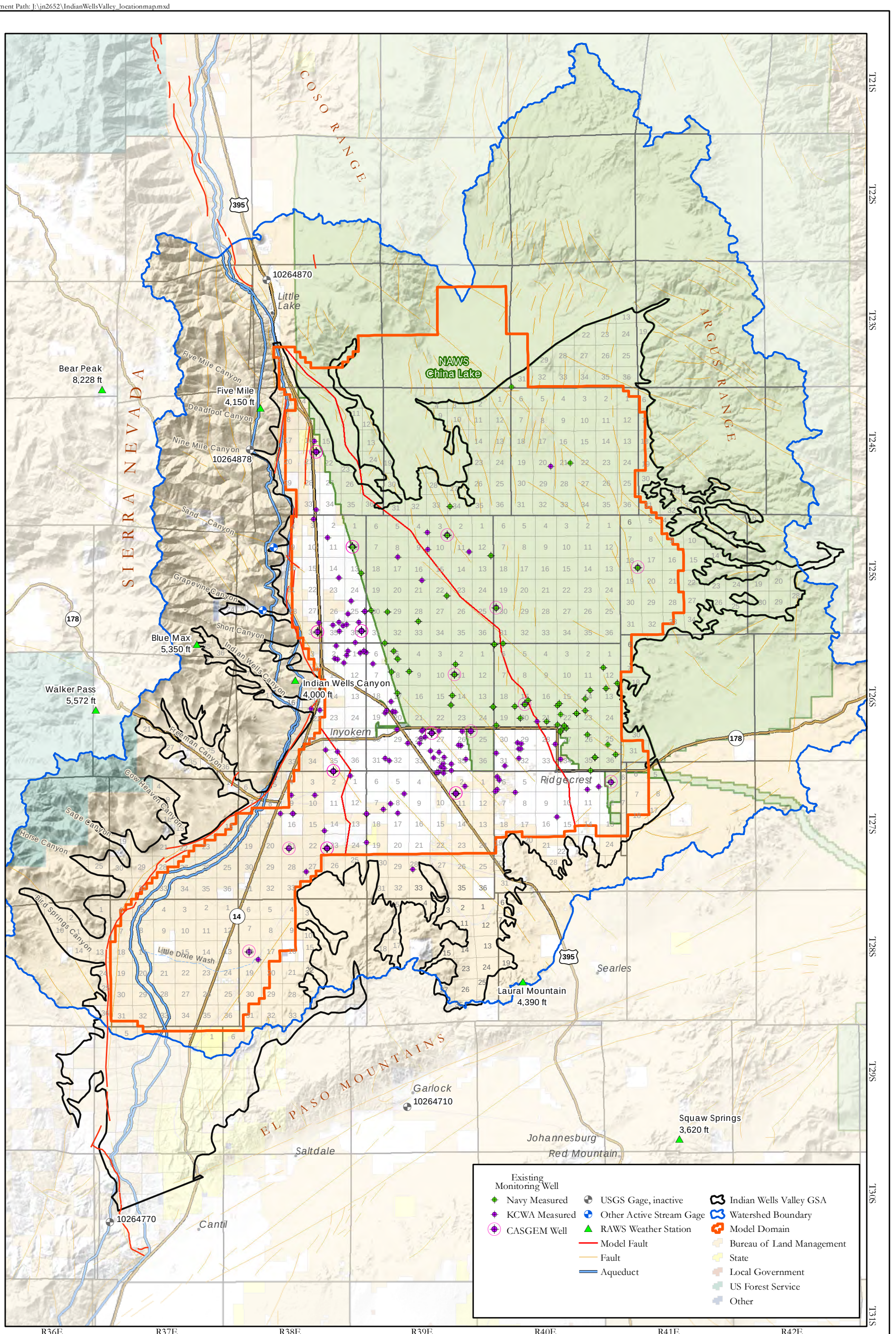


STETSON ENGINEERS INC.

Screenshot of the Data Management System Map Page

FIGURE 2-16

Document Path: J:\jn2652\IndianWellsValley_locationmap.mxd



STETSON ENGINEERS INC.

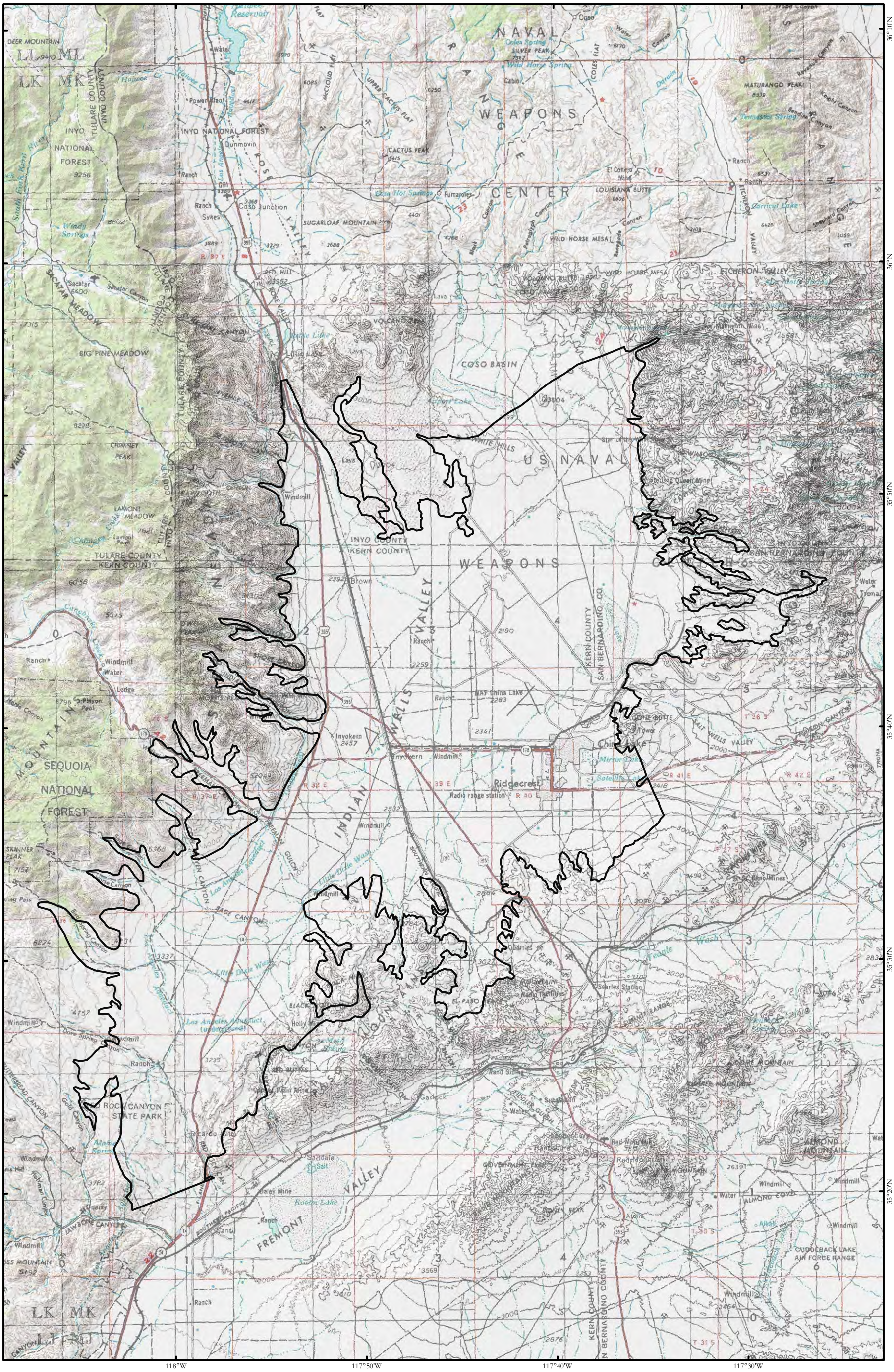
LOCATION MAP
INDIAN WELLS VALLEY
DRAFT 12/10/2019

0 2 4 Miles

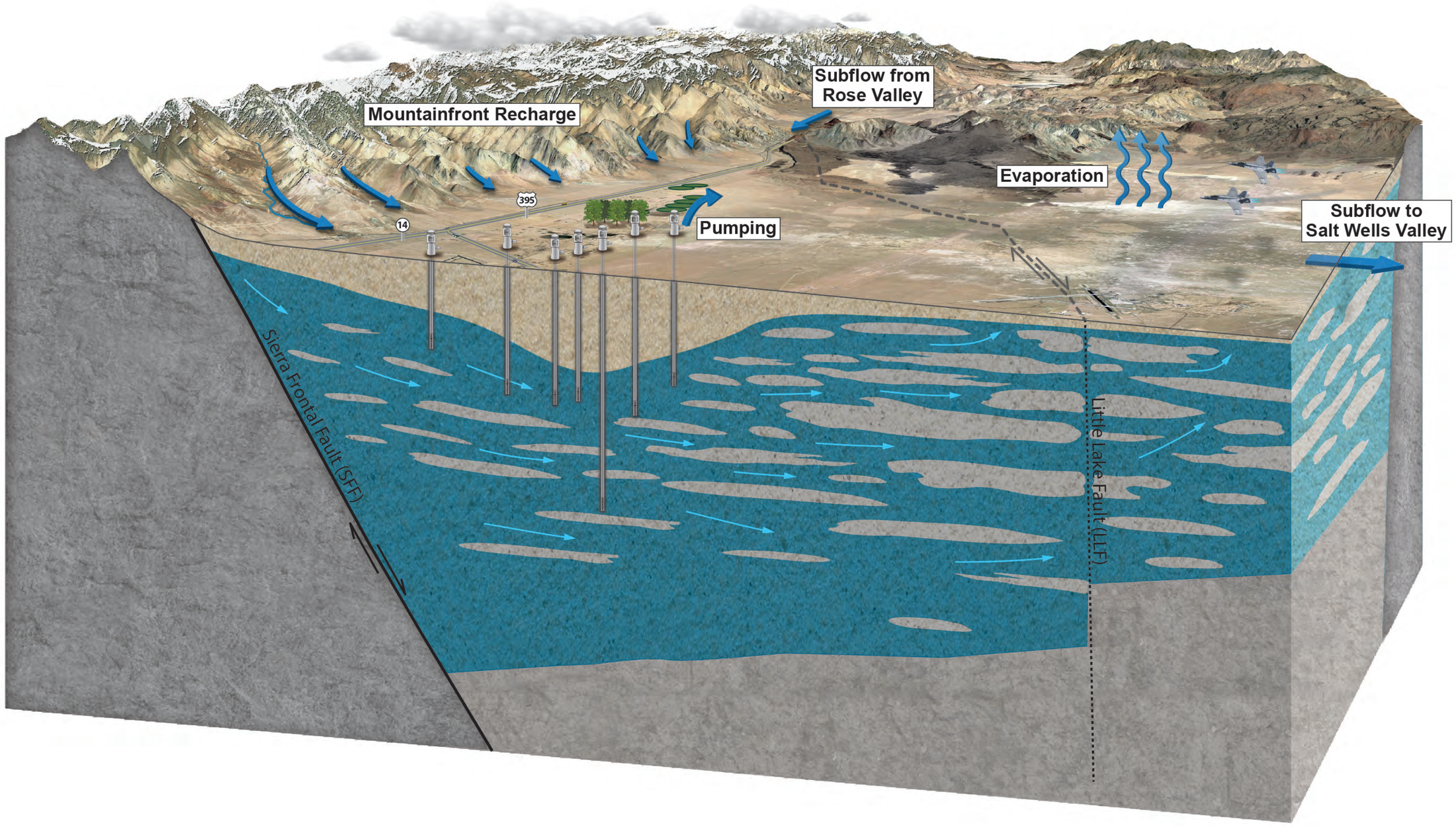
N

FIGURE 3-1

Document Path: J:\jn2652\IndianWellsValley_topomap.mxd



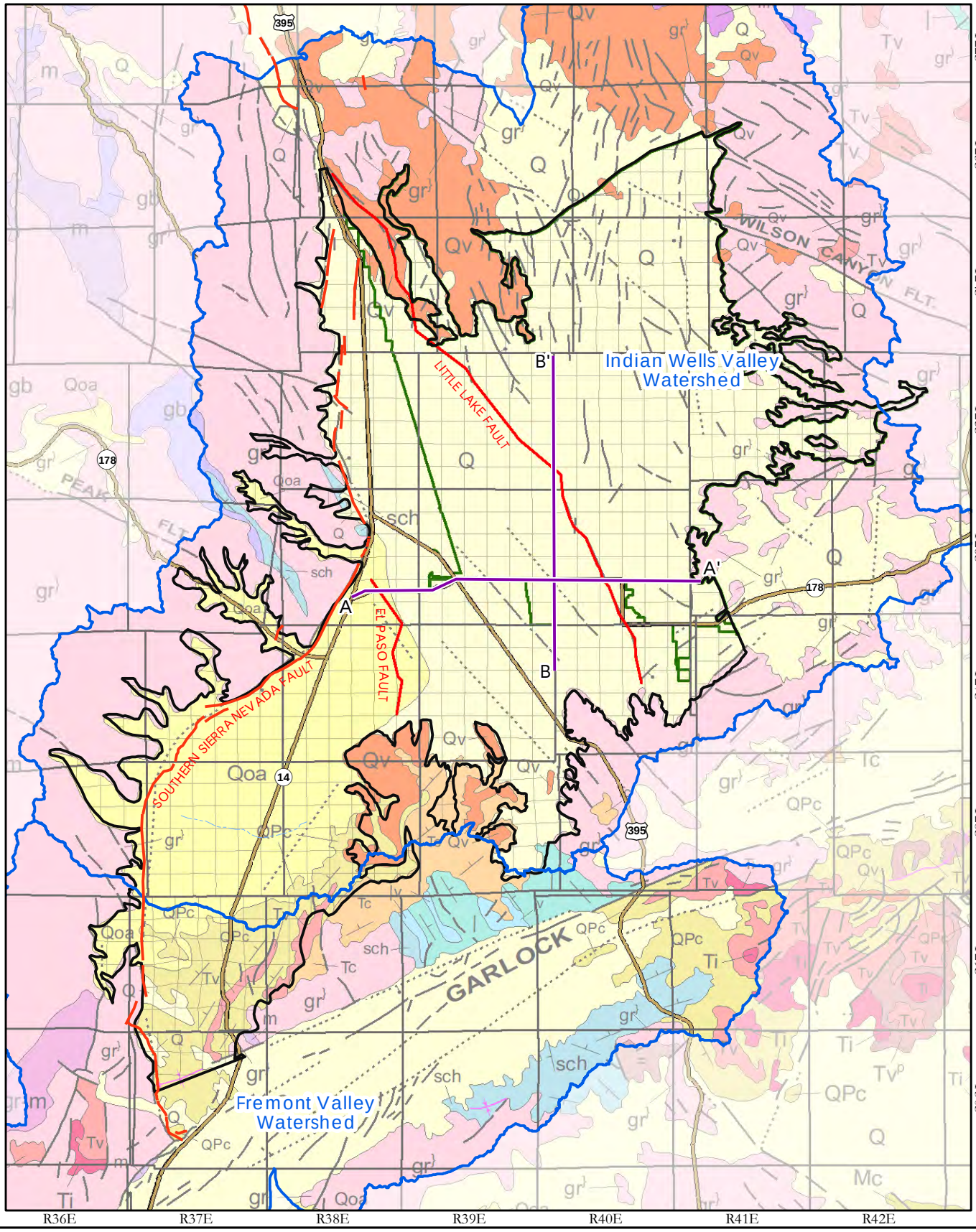
Document Path- C:/Job Folder/2652/Hydrologic Conceptual Model_8x11_1b.ai



STETSON ENGINEERS INC.

HYDROGEOLOGIC CONCEPTUAL MODEL
INDIAN WELLS VALLEY GROUNDWATER BASIN

FIGURE 3-3



GEOLOGY MAP
INDIAN WELLS VALLEY
DRAFT 12/10/2019

STETSON ENGINEERS INC.

Geology
California Geological Survey, Geologic Data Map No. 2 (2010)

N

0 3 6 Miles

Document Path: J:\jn2652\IndianWellsValley_geology_v3.mxd

Legend

- Cross Section (Berenbrock & Martin, 1991)
- Road
- Watershed Boundary
- Indian Wells Valley GSA
- Military Installation
- Township/Range
- Section

Faults

- contact, certain
- Regional Faults (Garner, 2017)
- fault, approx. located
- fault, certain
- fault, concealed
- fault, concealed, queried
- thrust fault, certain
- normal fault, certain
- normal fault, concealed

Quaternary

- Q — Alluvium, lake, playa and terrace deposits
- Qoa — Older alluvium, lake, playa and terrace deposits
- QPc — Sandstone, shale and gravel deposits
- Qv — Volcanic deposits

Tertiary

- Tc — Undivided sandstone (nonmarine), shale, conglomerate & breccia deposits
- Mc — Sandstone (nonmarine), shale, conglomerate & fanglomerate deposits
- Tv — Volcanic flow deposits
- Tvp — Pyroclastic & volcanic mudflow deposits
- Ti — Intrusive rocks

Mesozoic

- sch — Schists
- gr-m — Granitic & metamorphic rocks
- mv — Undivided metavolcanic rocks
- gr^{Mz} — Granite & qtz-rich igneous rocks
- gb — Gabbro & dark dioritic rocks

Paleozoic

- Pz — Undivided metasedimentary rocks
- m — Undivided metasedimentary and metavolcanic rocks
- pzv — Undivided metavolcanic rocks

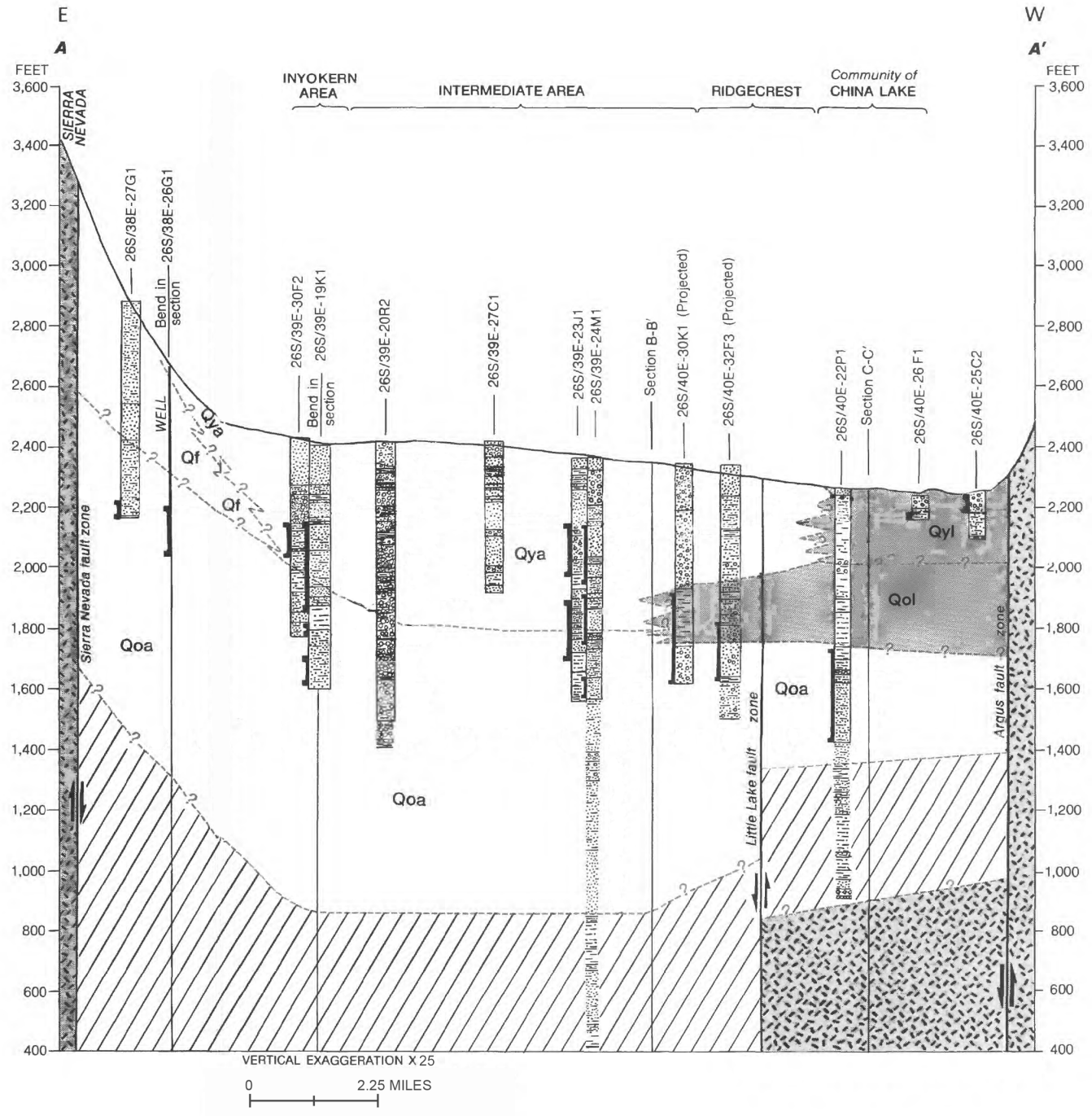
Pre-Cambrian

- pC — Sedimentary and metamorphic basement

STETSON ENGINEERS INC.

GEOLOGY MAP LEGEND
INDIAN WELLS VALLEY

C:\\WorkFolder/2652-001\08\03/GEOLOGY MAP LEGEND_1a.ai

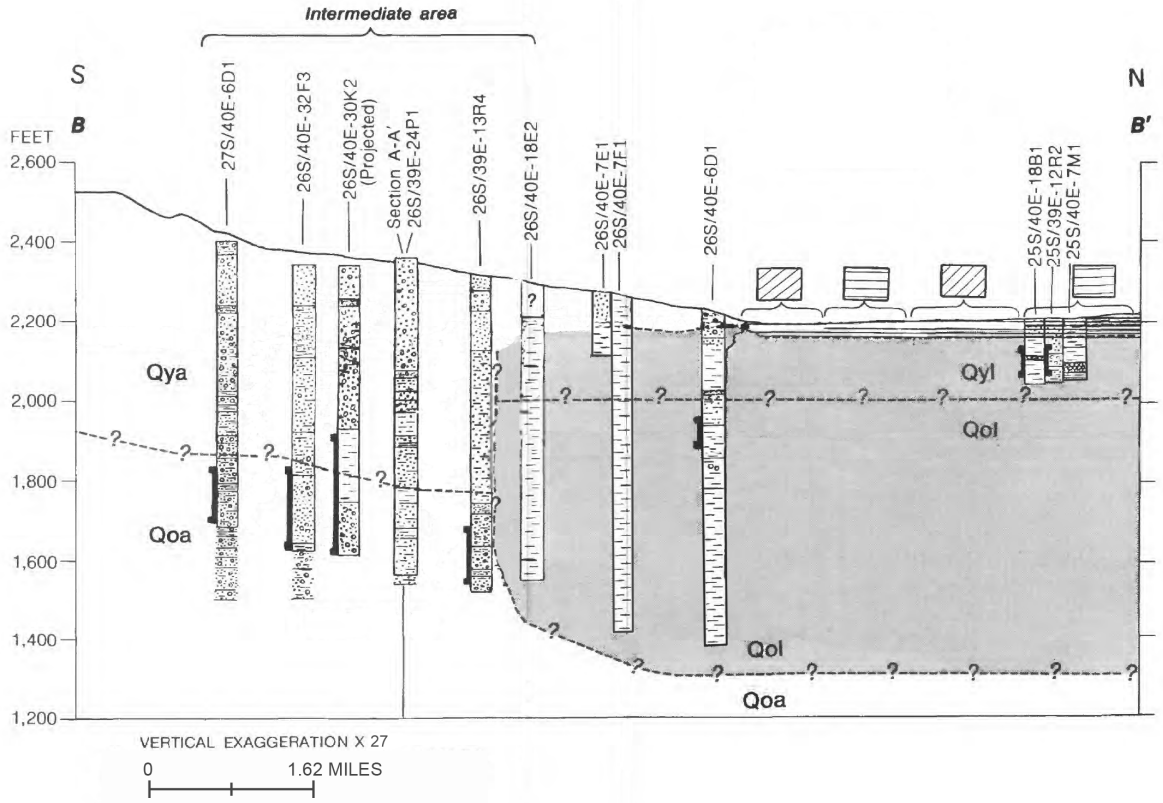


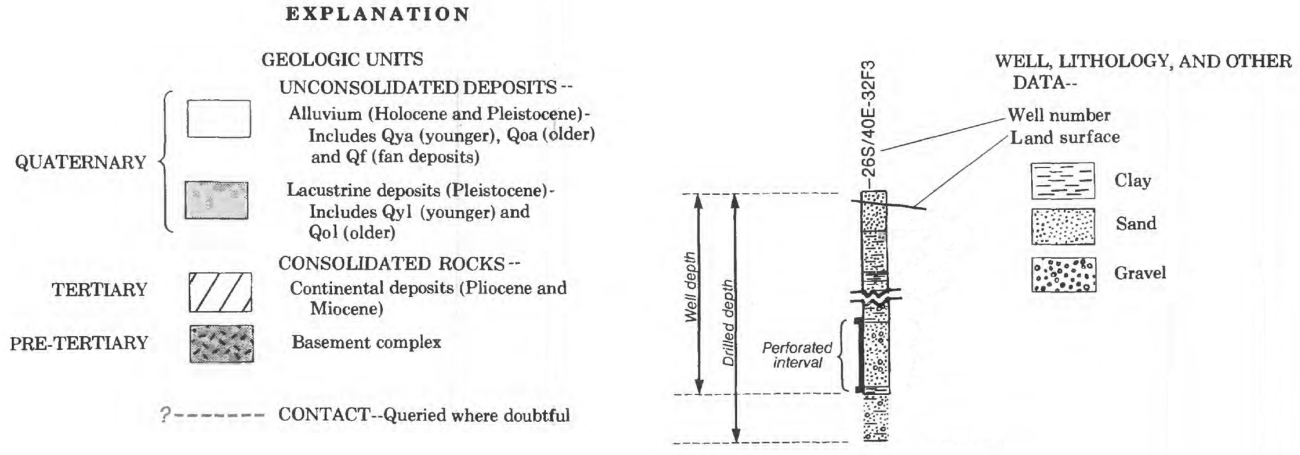
Modified from Berenbrock and Martin (1991, Figure 3); Kunkel and Chase (1969, Figure 3)

CROSS-SECTION A TO A'
INDIAN WELLS VALLEY

STETSON ENGINEERS INC.

C:\WorkFolder\2652-001\08\03\CrossSectA-A_PAGE_Portrait_1a.ai





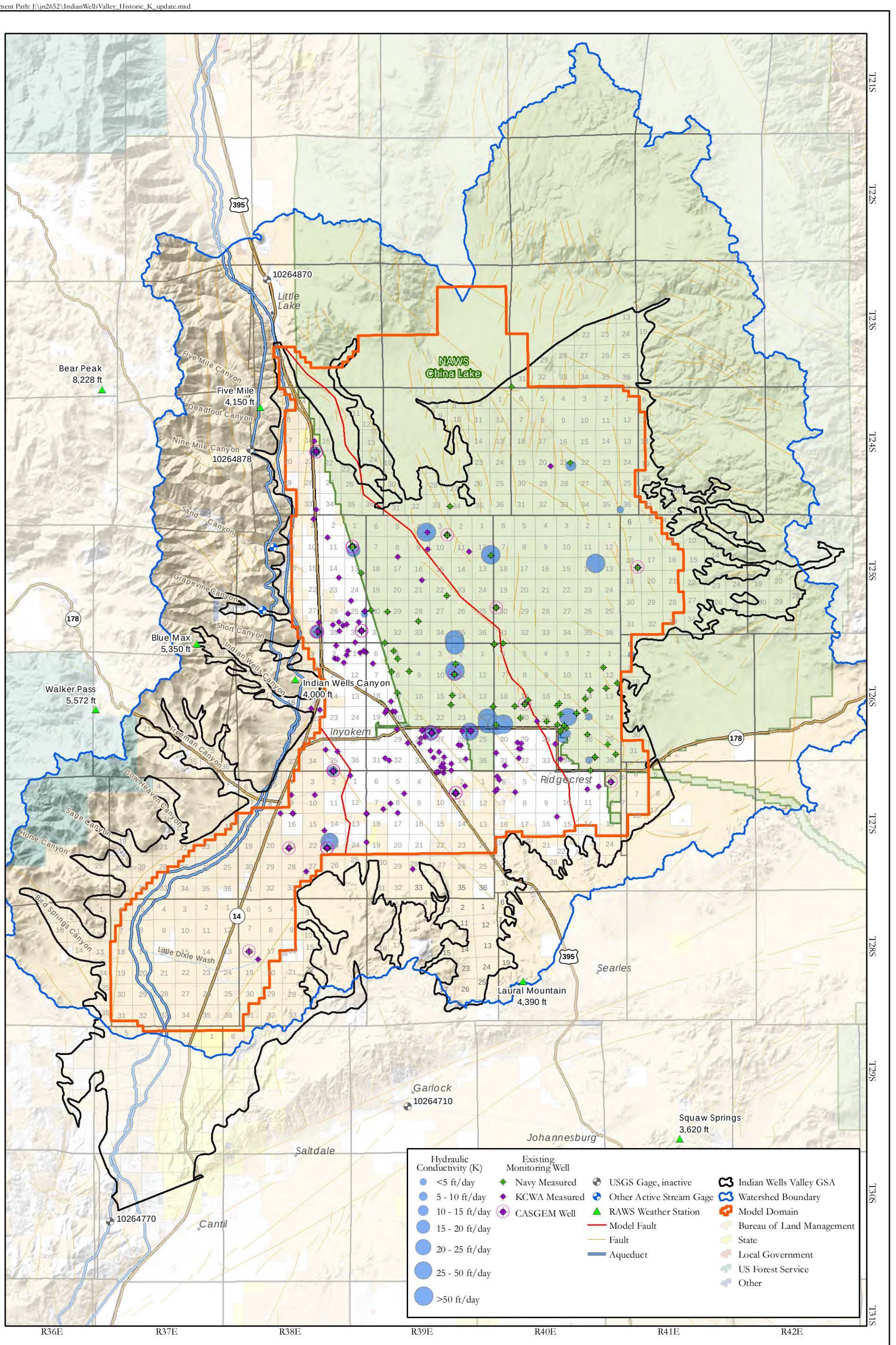
Modified from Berenbrock and Martin (1991, Figure 3); Kunkel and Chase (1969, Figure 3)

CROSS-SECTION B TO B'
INDIAN WELLS VALLEY

STETSON ENGINEERS INC.

C:\WorkFolder\2652-001\98\03\CrossSectB-B_PAGE_Portrait_1aai

Document Path: J:\jn2652\IndianWellsValley_Historic_K_update.mxd



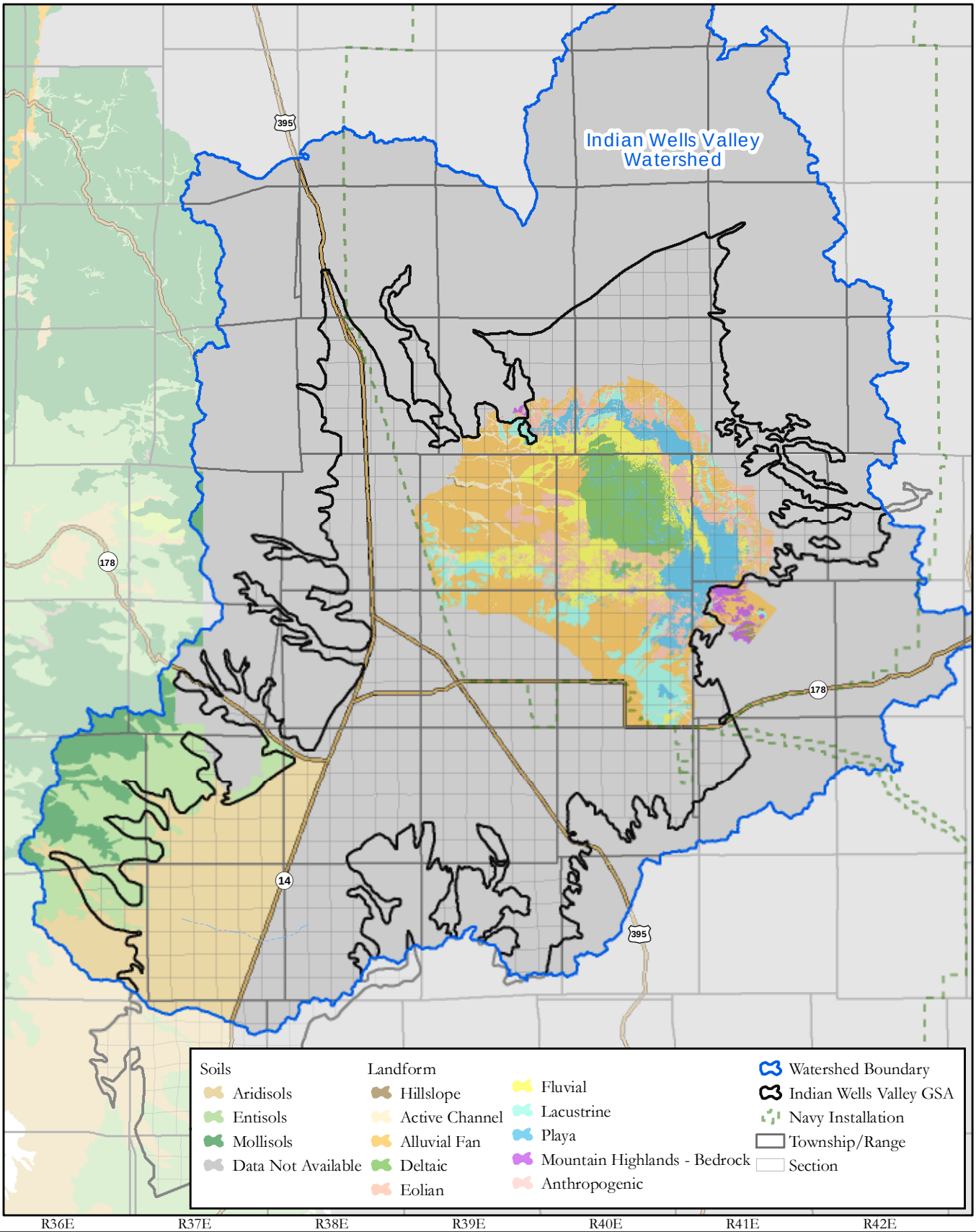
STETSON ENGINEERS INC.

HISTORICAL AQUIFER TEST LOCATIONS
INDIAN WELLS VALLEY
DRAFT 12/10/2019

0 2 4 Miles

N

FIGURE 3-6



STETSON ENGINEERS INC.

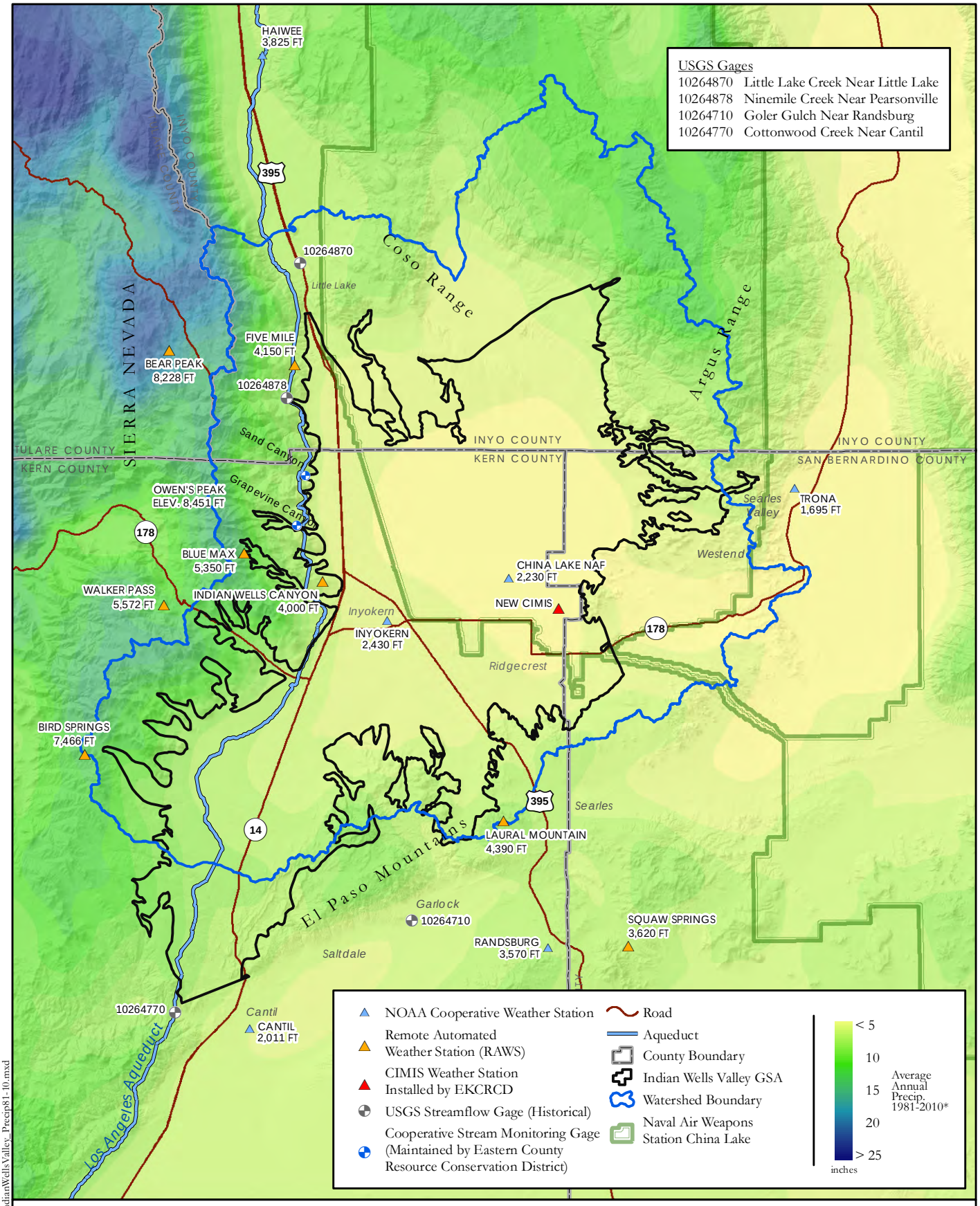
Soils
NRCS SSURGO (2018)
Landforms
Bullard, Bacon, Adams, and Decker, May 2019.
Prepared by DRI for Navy, China Lake.

SOILS AND LANDFORMS
INDIAN WELLS VALLEY
DRAFT 12/10/2019

N

0 3 6
Miles

Document Path: J:\jn2652\IndianWellsValley_soils.mxd



WEATHER STATIONS, STREAM GAGES, AND AVERAGE ANNUAL PRECIPITATION

INDIAN WELLS VALLEY

DRAFT 12/10/2019

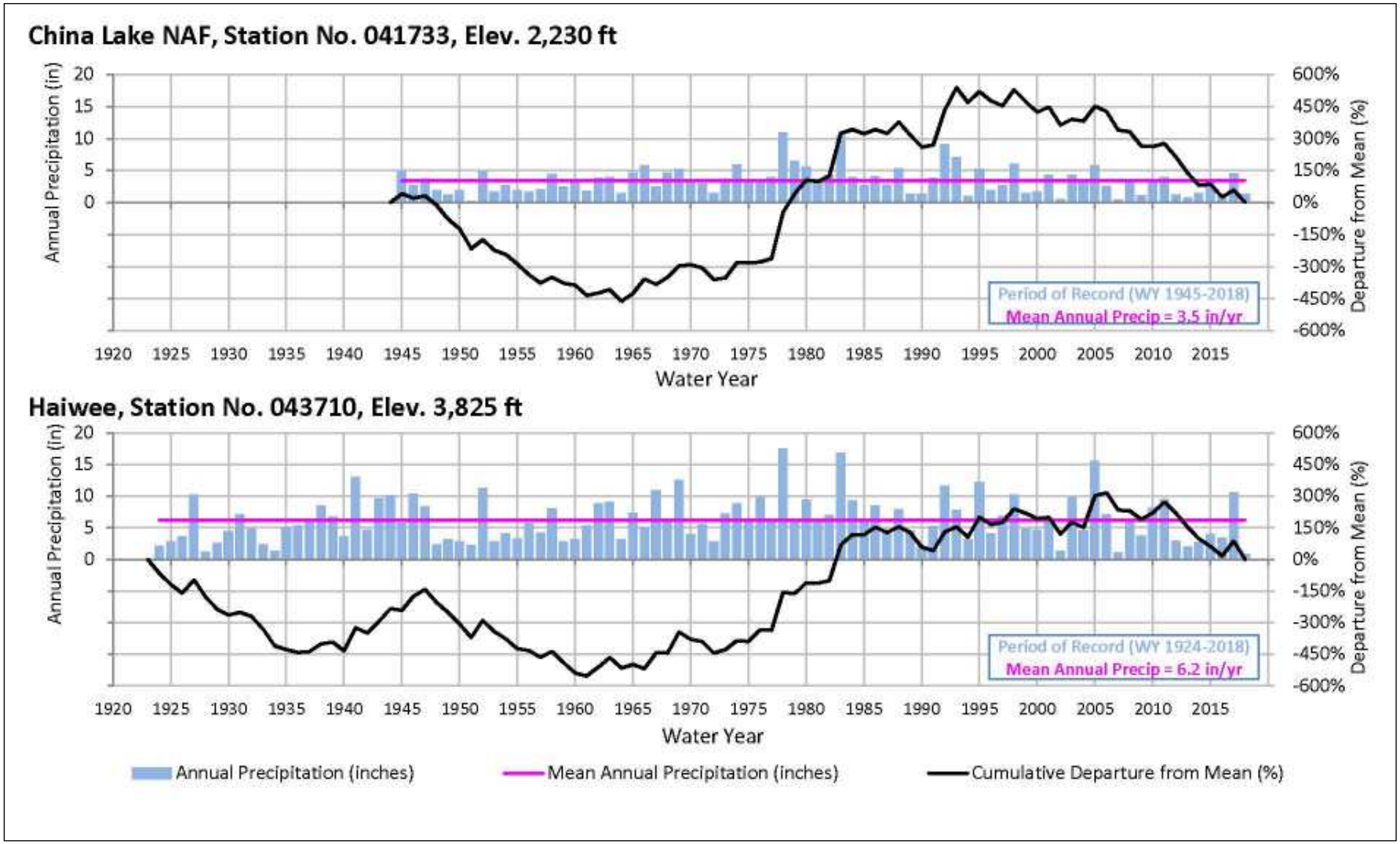
STETSON ENGINEERS INC.

N

0 4 8 Miles

* OREGON STATE PRISM CLIMATE GROUP, CLIMATE NORMALS FOR 1981-2010

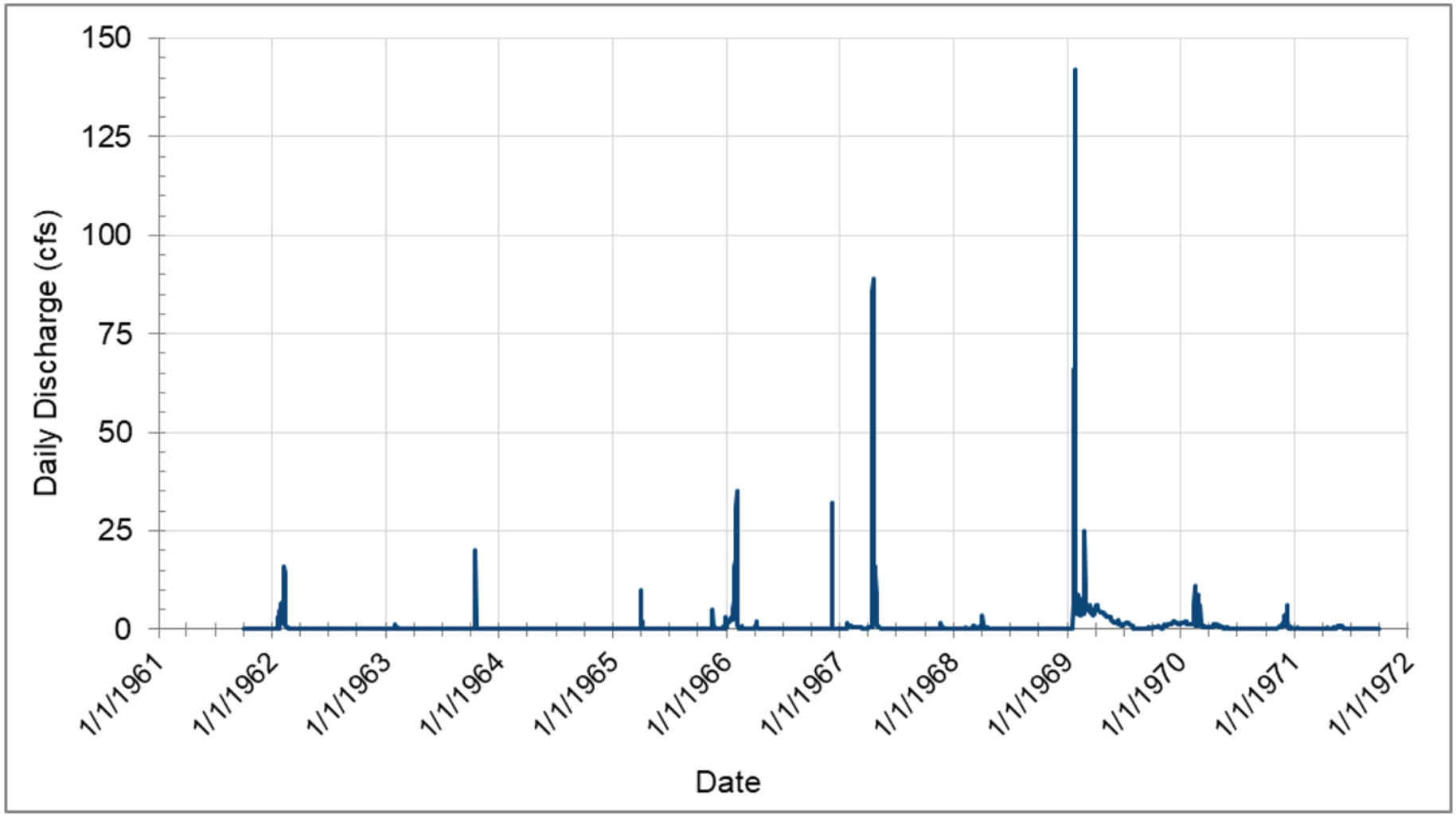
Document Path: J:\jn2652\IndianWellsValley_Precip81-10.mxd



STETSON ENGINEERS INC.

ANNUAL PRECIPITATION AND CUMULATIVE DEPARTURE FROM MEAN AT STATIONS WITHIN/NEAR INDIAN WELLS VALLEY GROUNDWATER BASIN

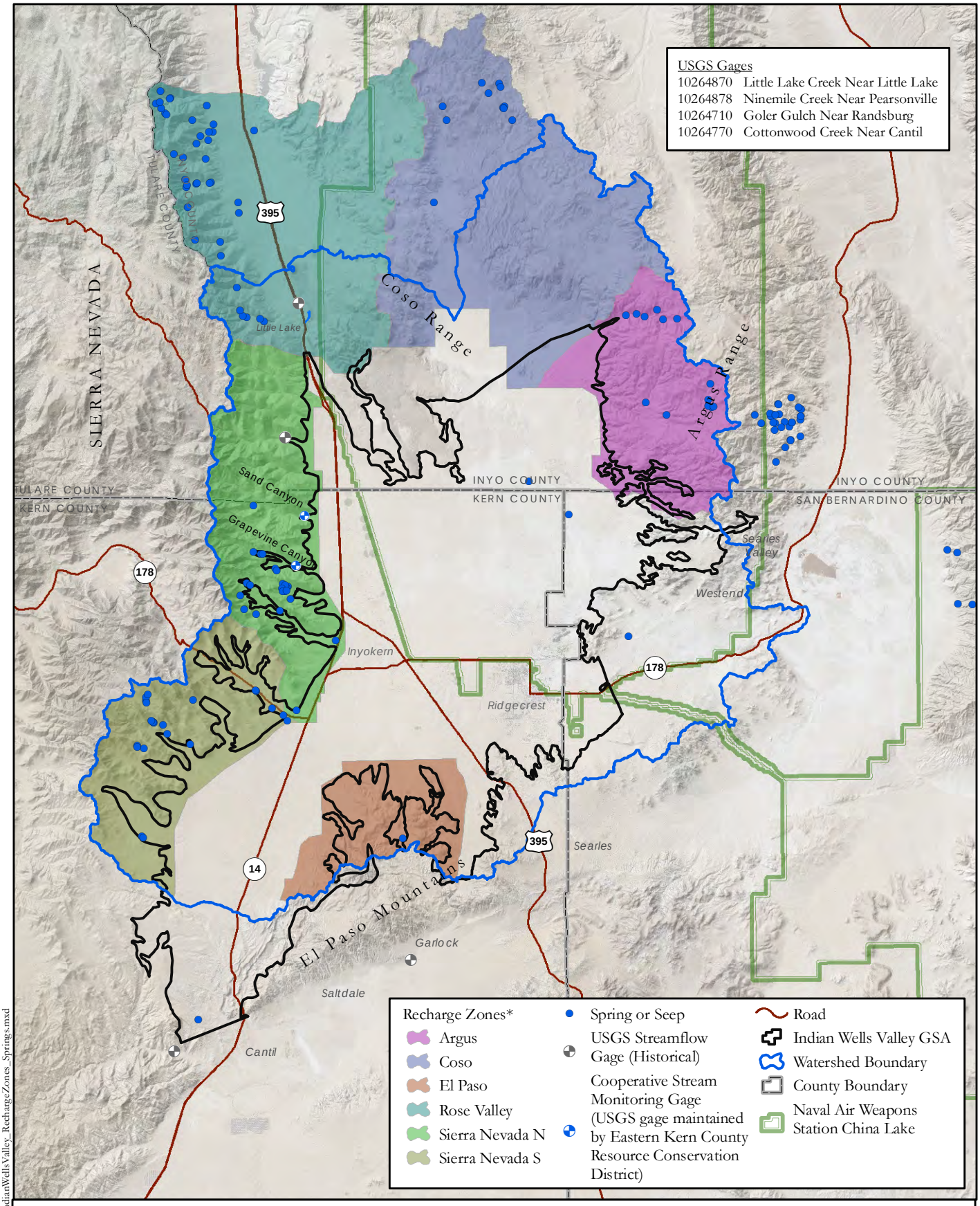
FIGURE 3-9



STETSON ENGINEERS INC.

HYDROGRAPH OF DAILY DISCHARGE AT NINEMILE CREEK NEAR PEARSONVILLE, USGS GAGE 10264878, 1961-1971

FIGURE 3-10



STETSON ENGINEERS INC.

RECHARGE ZONES AND SPRINGS
INDIAN WELLS VALLEY
DRAFT 12/10/2019

*Recharge zones as developed by Desert Research Institute (McGraw et al, 2016)

Document Path: J:\jn2652\IndianWellsValley_RechargeZones_Springs.mxd

Document Path: J:\jn2652\IndianWellsValley_CASGEM_Monitoring_Prog_graphs.mxd

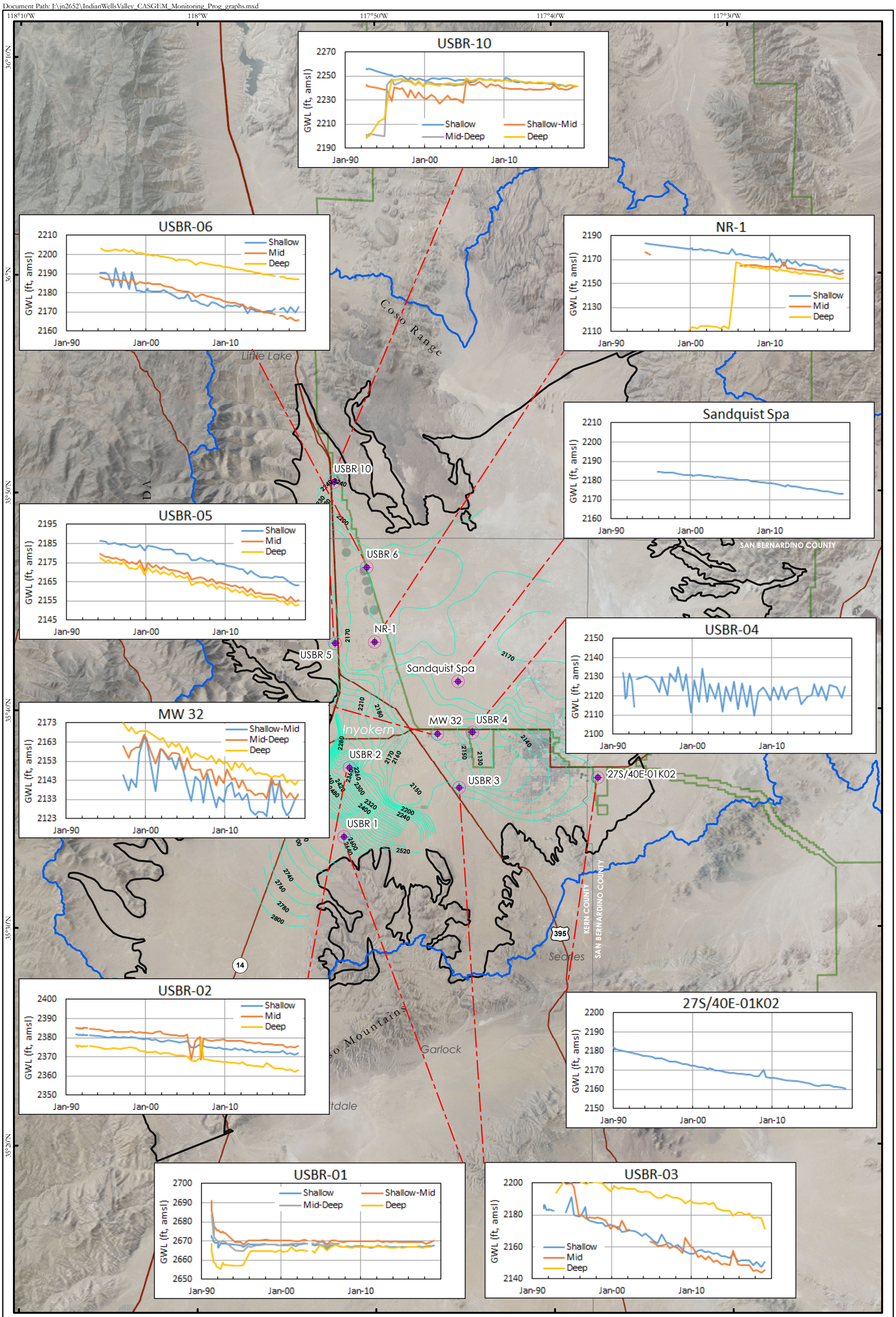
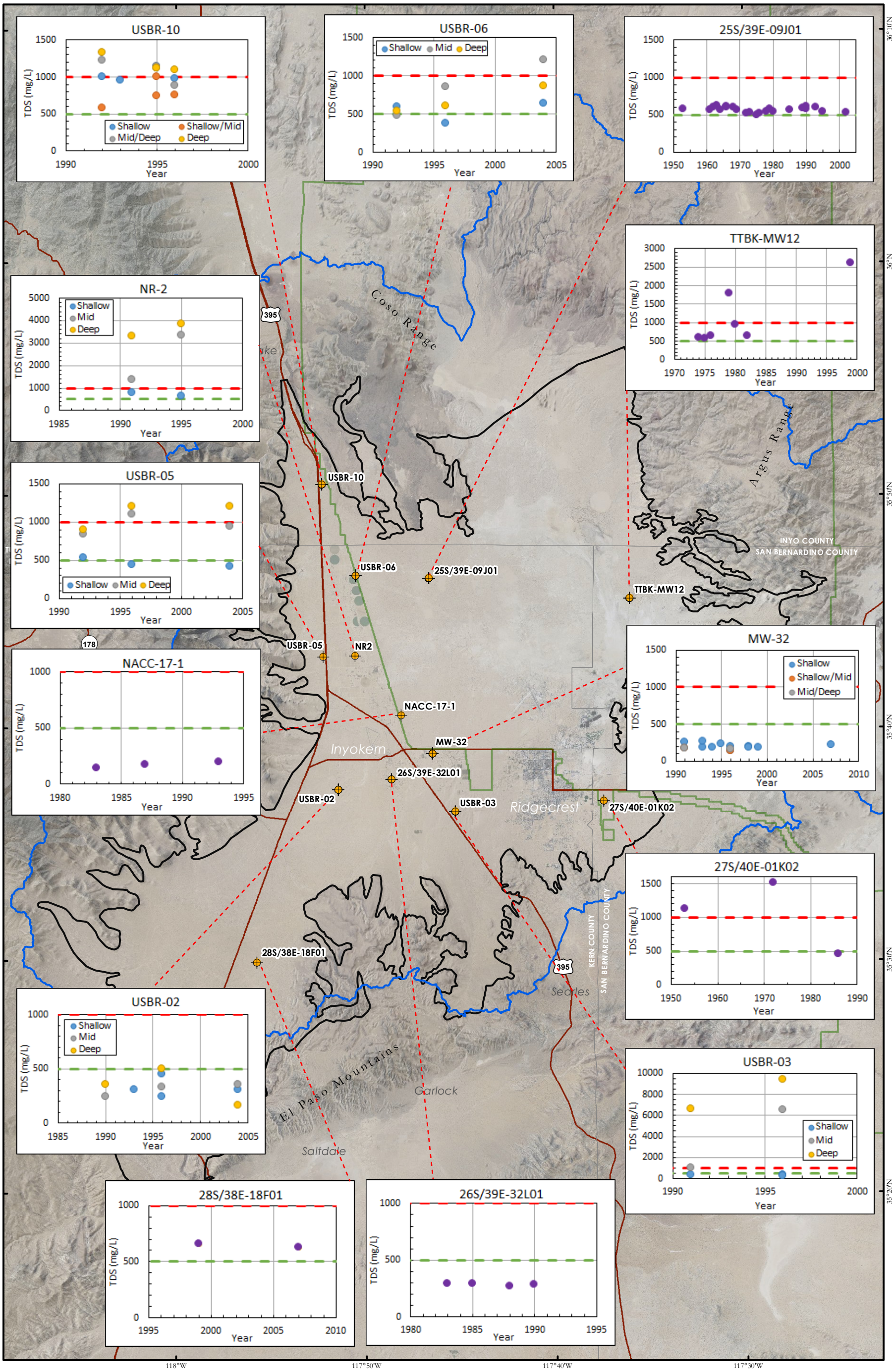


FIGURE 3-12

Document Path: J:\jn2652\IndianWellsValley_TDSTrends.mxd



Well
Indian Wells Valley GSA
Watershed Boundary
Navy
County Boundary

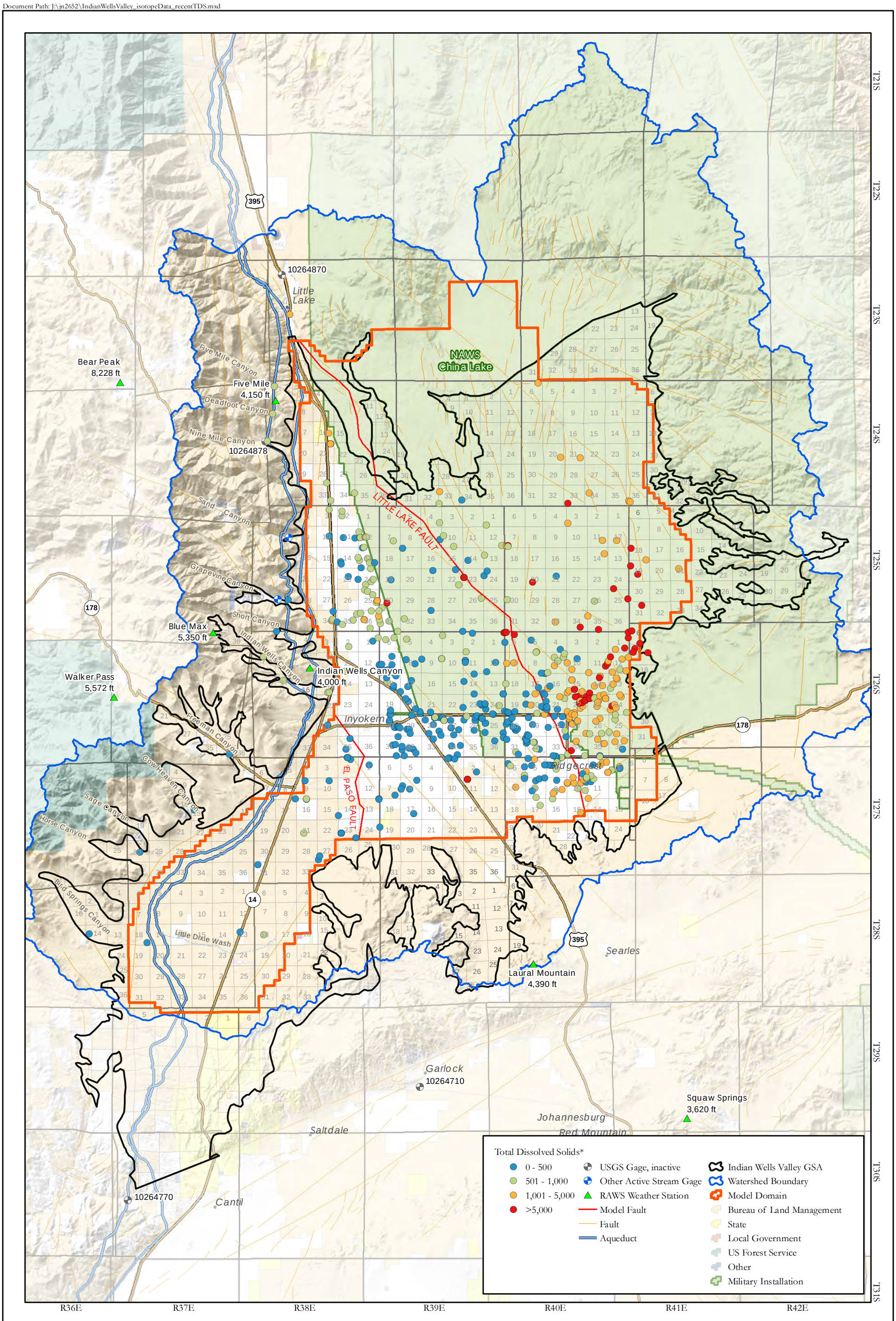
STETSON ENGINEERS INC.

TDS (MG/L) TRENDS
INDIAN WELLS VALLEY
DRAFT 10/18/2019

N
0 2.5 5
Miles

FIGURE 3-13

Document Path: J:\jn2652\IndianWellsValley_isotopeData_recentTDS.mxd



STETSON ENGINEERS INC.

MOST RECENT TDS (MG/L)
INDIAN WELLS VALLEY
DRAFT 12/10/2019

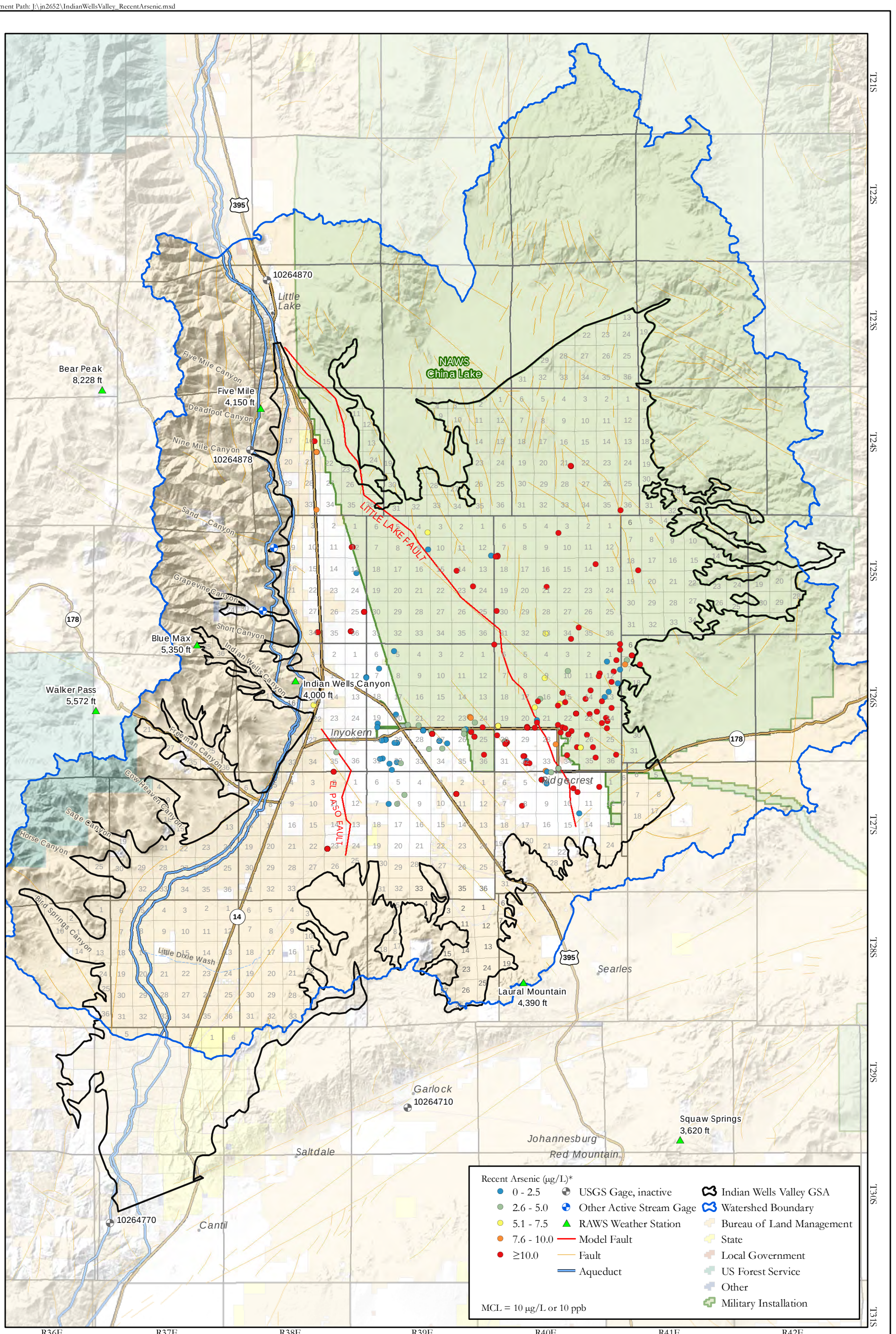
0 2 4 Miles

N

* Where multiple data points exist, the most recent data point was used.

FIGURE 3-14

Document Path: J:\jn2652\IndianWellsValley_RecentArsenic.mxd



STETSON ENGINEERS INC.

MOST RECENT ARSENIC (µg/L)

INDIAN WELLS VALLEY

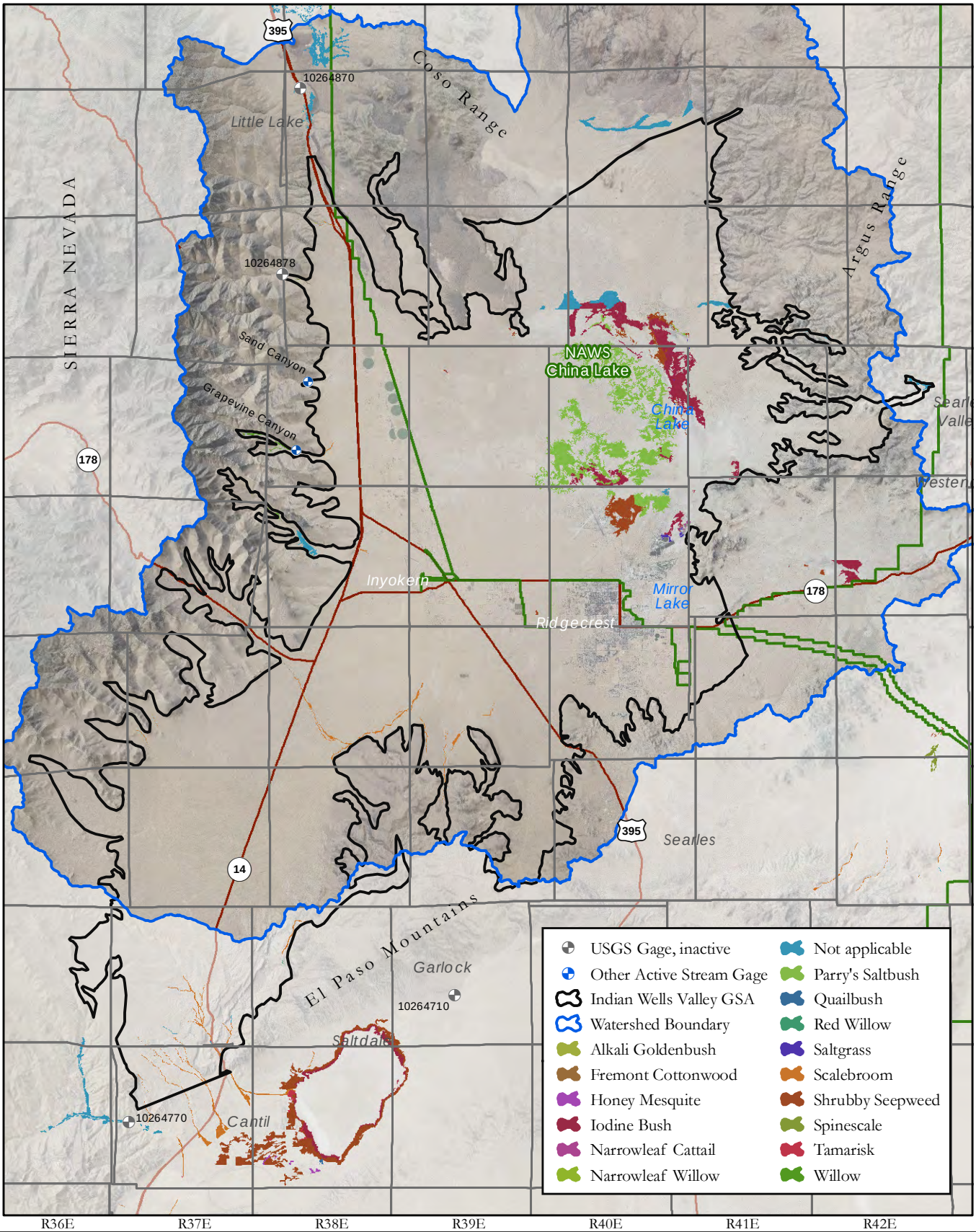
DRAFT 12/10/2019

0 2 4 Miles

N

* Where multiple arsenic data exist, the most recent data is posted.

FIGUR 3-15



GROUNDWATER DEPENDENT ECOSYSTEMS (GDE)

INDIAN WELLS VALLEY

DRAFT 10/15/2019

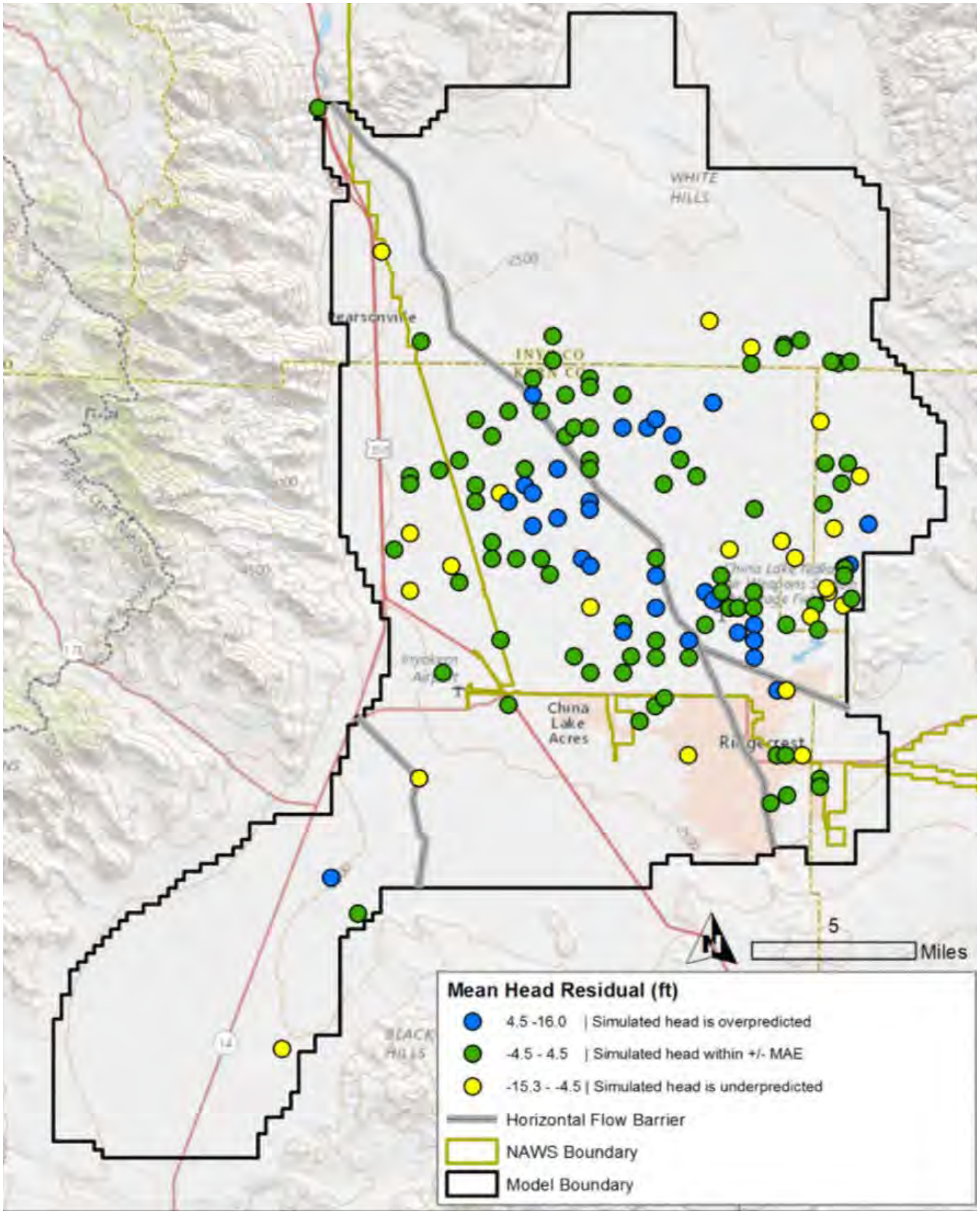
STETSON ENGINEERS INC.

Source: DWR Natural Communities Commonly Associated with Groundwater

N

0 3 6 Miles

Document Path: J:\jn2652\IWV_NCDataset_vegetation.mxd

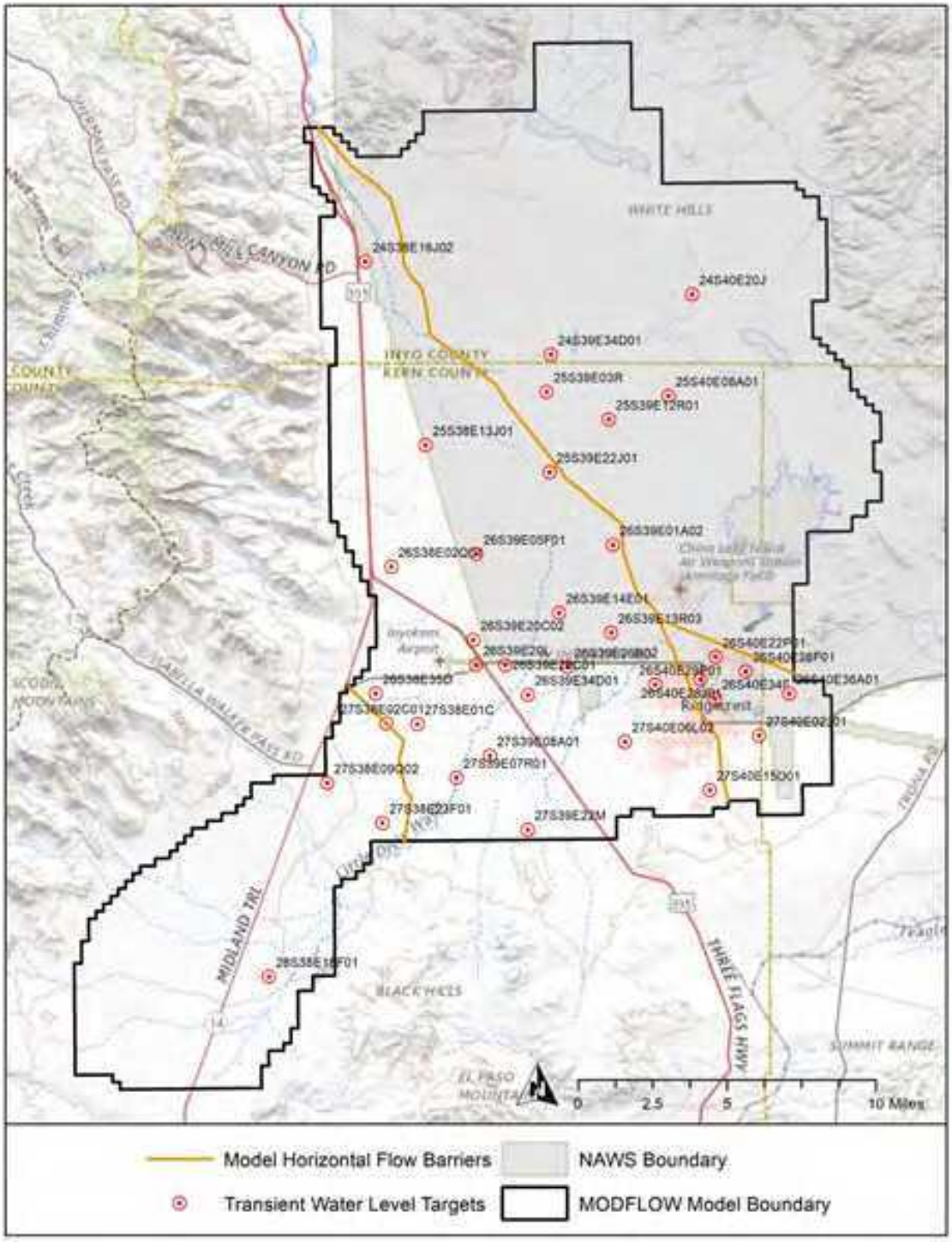


Source: Desert Research Institute

STETSON ENGINEERS INC.

CALIBRATION
SIMULATED - MEASURED RESIDUAL GROUNDWATER LEVELS
STEADY-STATE FLOW MODEL

Document Path: C:/Job Folder/2652/STEADY-STATE FLOW MODEL.ai



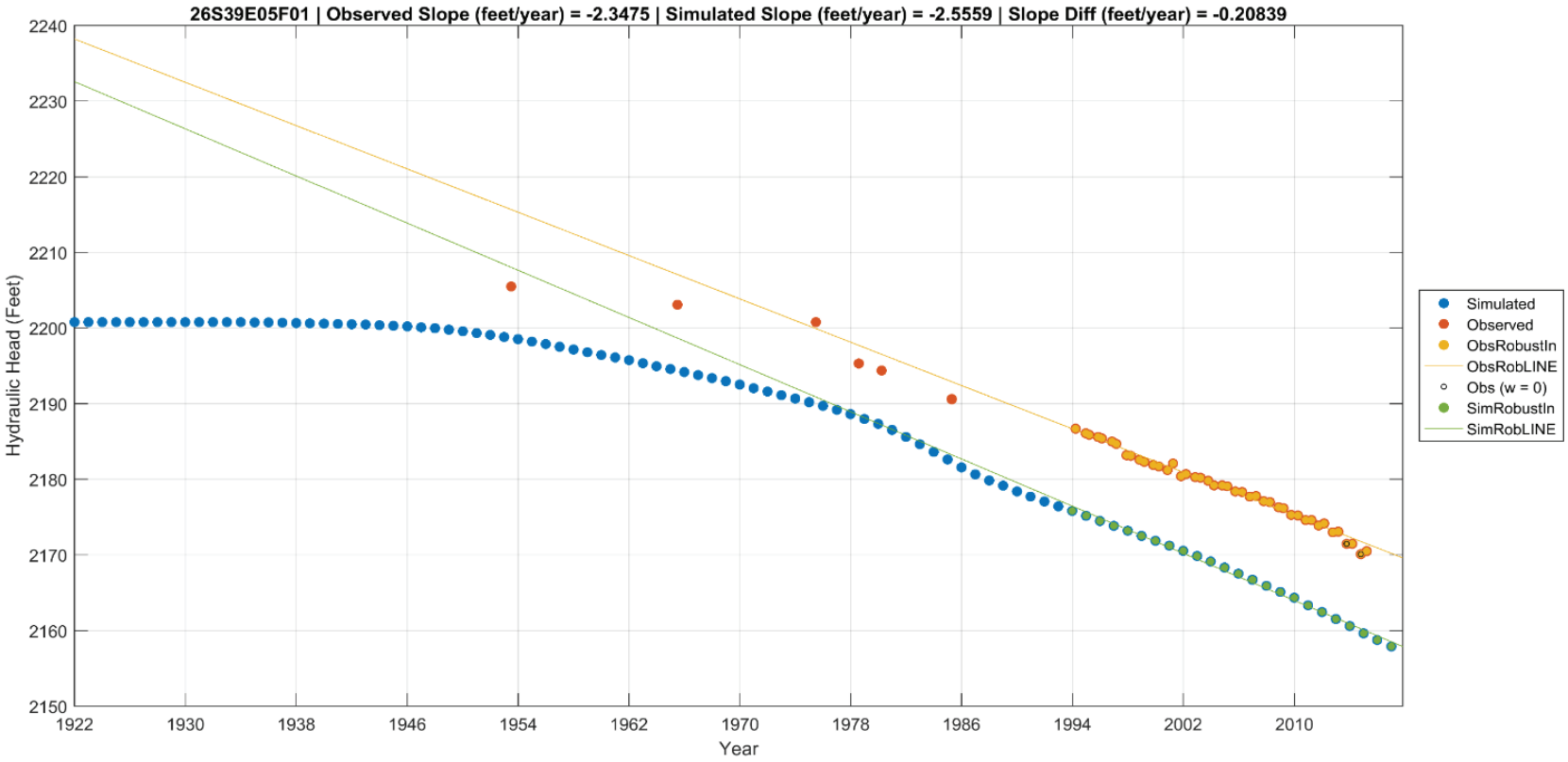
Source: Desert Research Institute

CALIBRATION
GROUNDWATER LEVEL TARGETS
TRANSIENT FLOW MODEL

STETSON ENGINEERS INC.

GARNER ET AL (2017)

Document Path: C:/Job Folder/2652/GROUNDWATER LEVEL TARGETS.ai

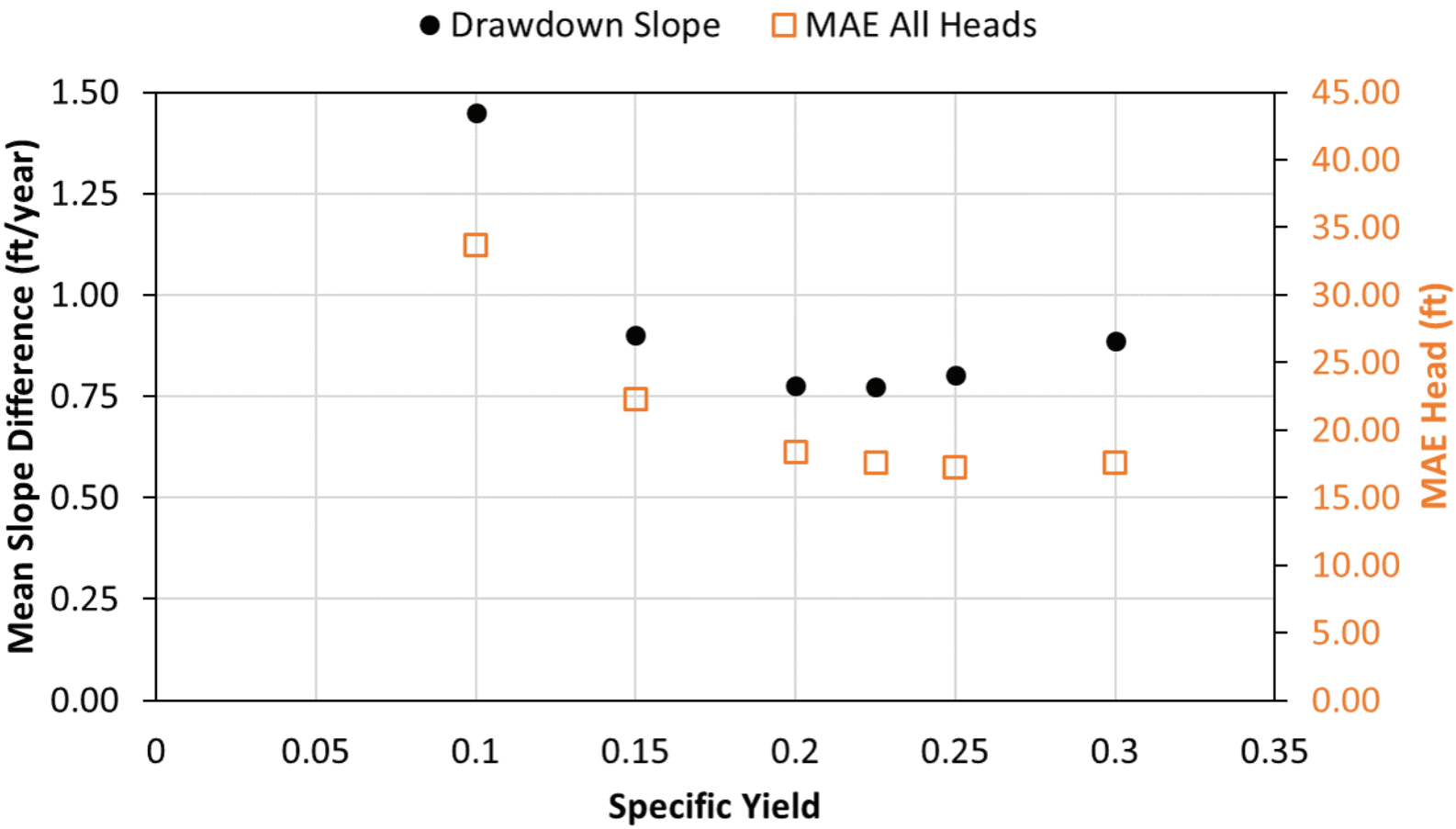


Source: Desert Research Institute

STETSON ENGINEERS INC.

EXAMPLE
HYDROGRAPH AND SLOPE-FITTING METHOD USED FOR CALIBRATION TRANSIENT FLOW MODEL

FIGURE 3-19

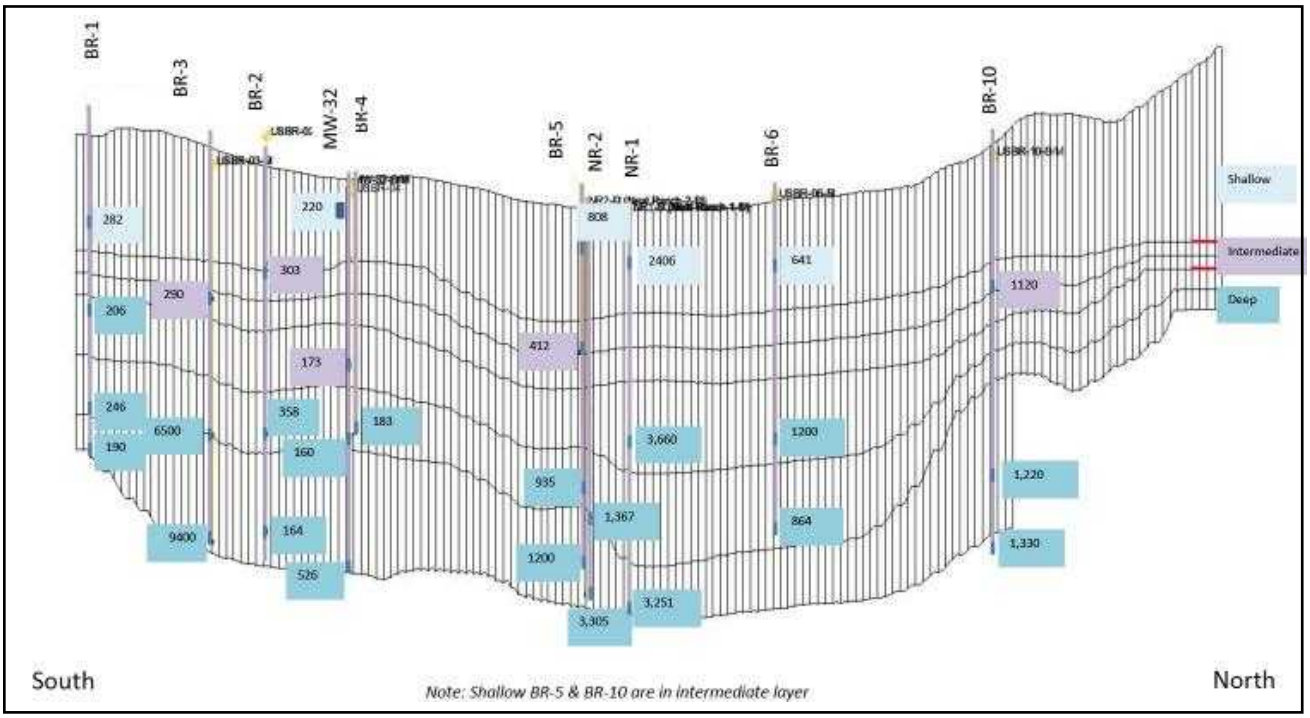


Source: Desert Research Institute

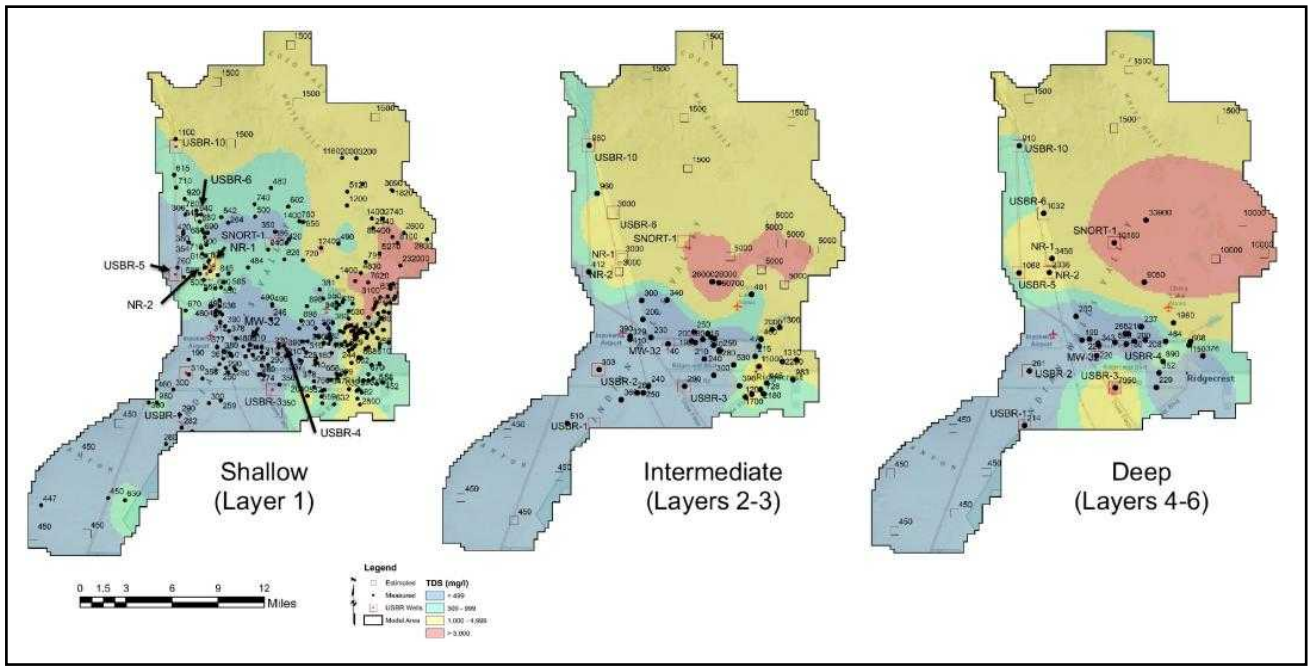
STETSON ENGINEERS INC.

CALIBRATION
DRAWDOWN SLOPE AND MEAN ABSOLUTE ERROR (MAE) RESULTS
TRANSIENT FLOW MODEL

FIGURE 3-20



An example North-South cross section through the transport model illustrating the relationship between of the Shallow, Intermediate, and Deep TDS zones to the six computational layers in the flow model. TDS measurements at selected well locations are also shown to illustrate the averaging of multiple values within a TDS zone. Measured TDS concentrations were interpolated to the transport model grid cells based on the TDS zone in which they fall.



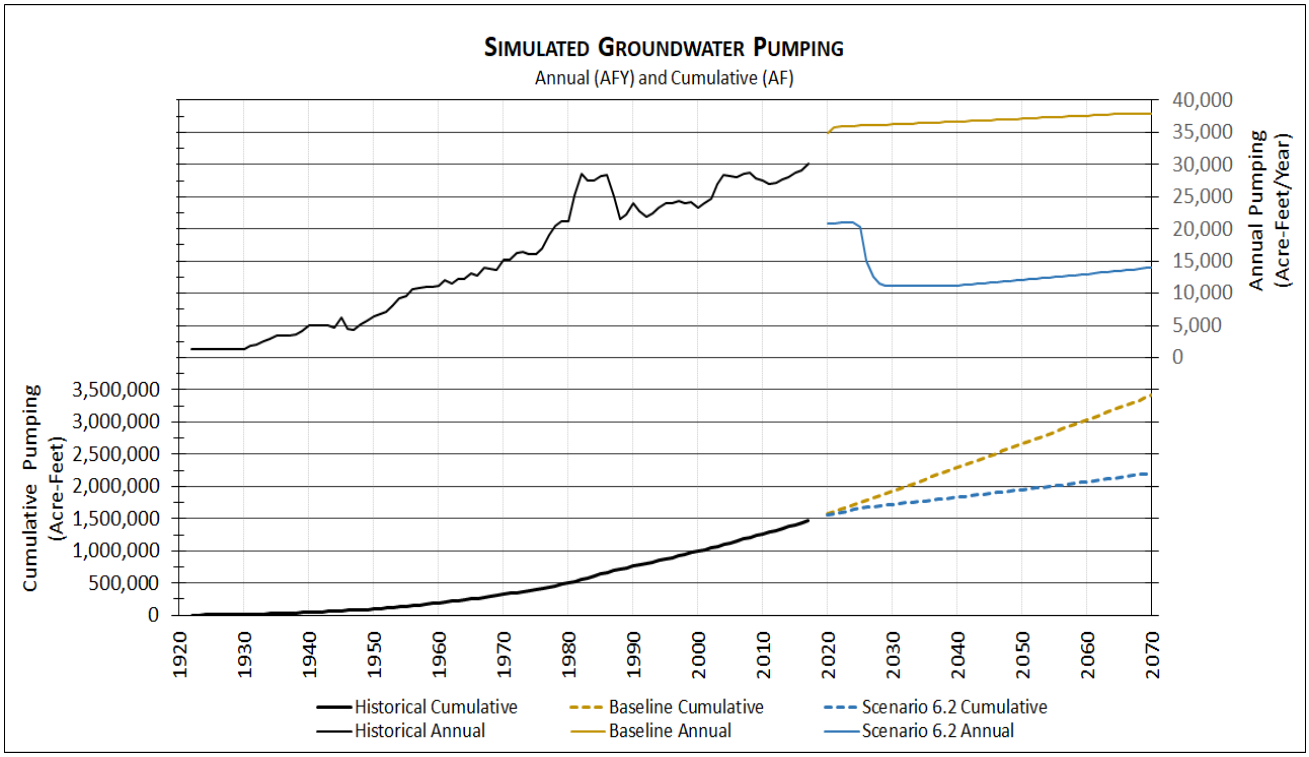
Spatial distributions of TDS concentration in the three TDS zones that are used for initial conditions in the transport model.

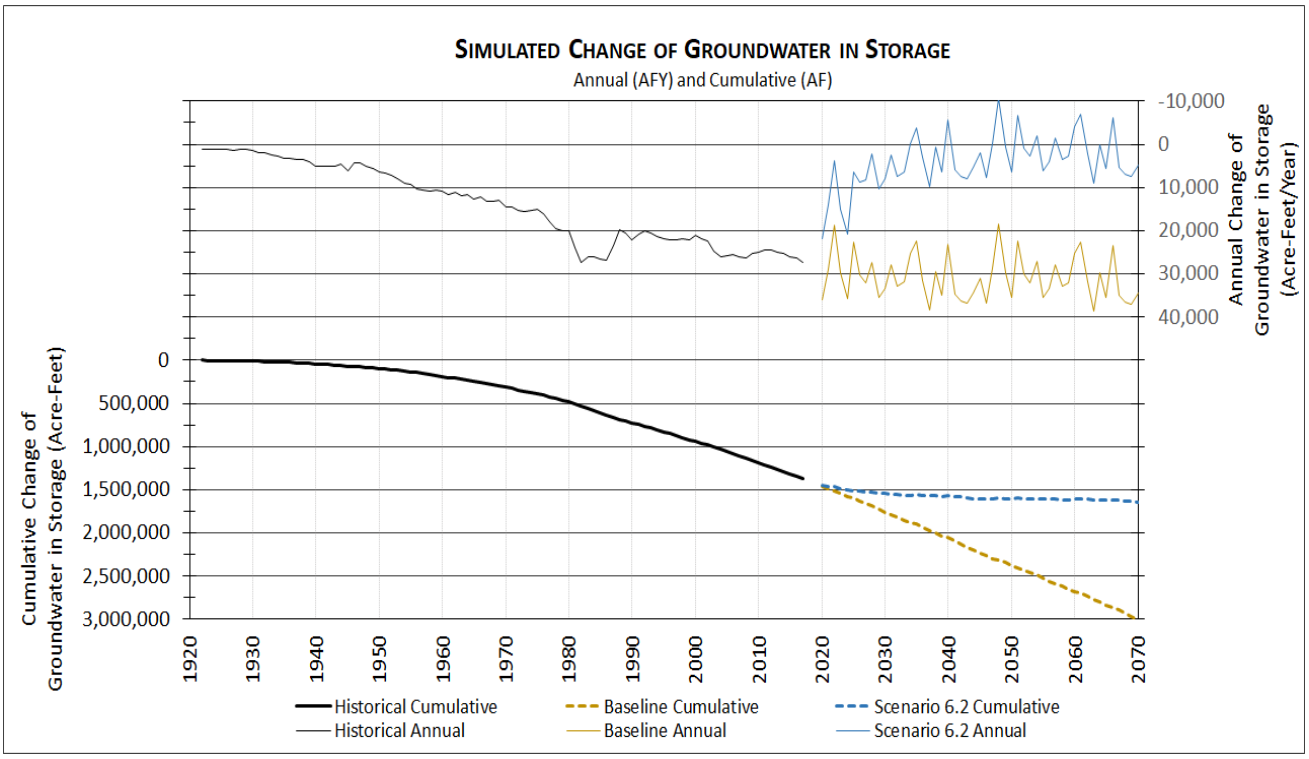
Source: Desert Research Institute

TRANSPORT MODEL
Indian Wells Valley

STETSON ENGINEERS INC.

Document Path: C:/Job Folder/2652/GROUNDWATER LEVEL TARGETS.ai





STETSON ENGINEERS INC.

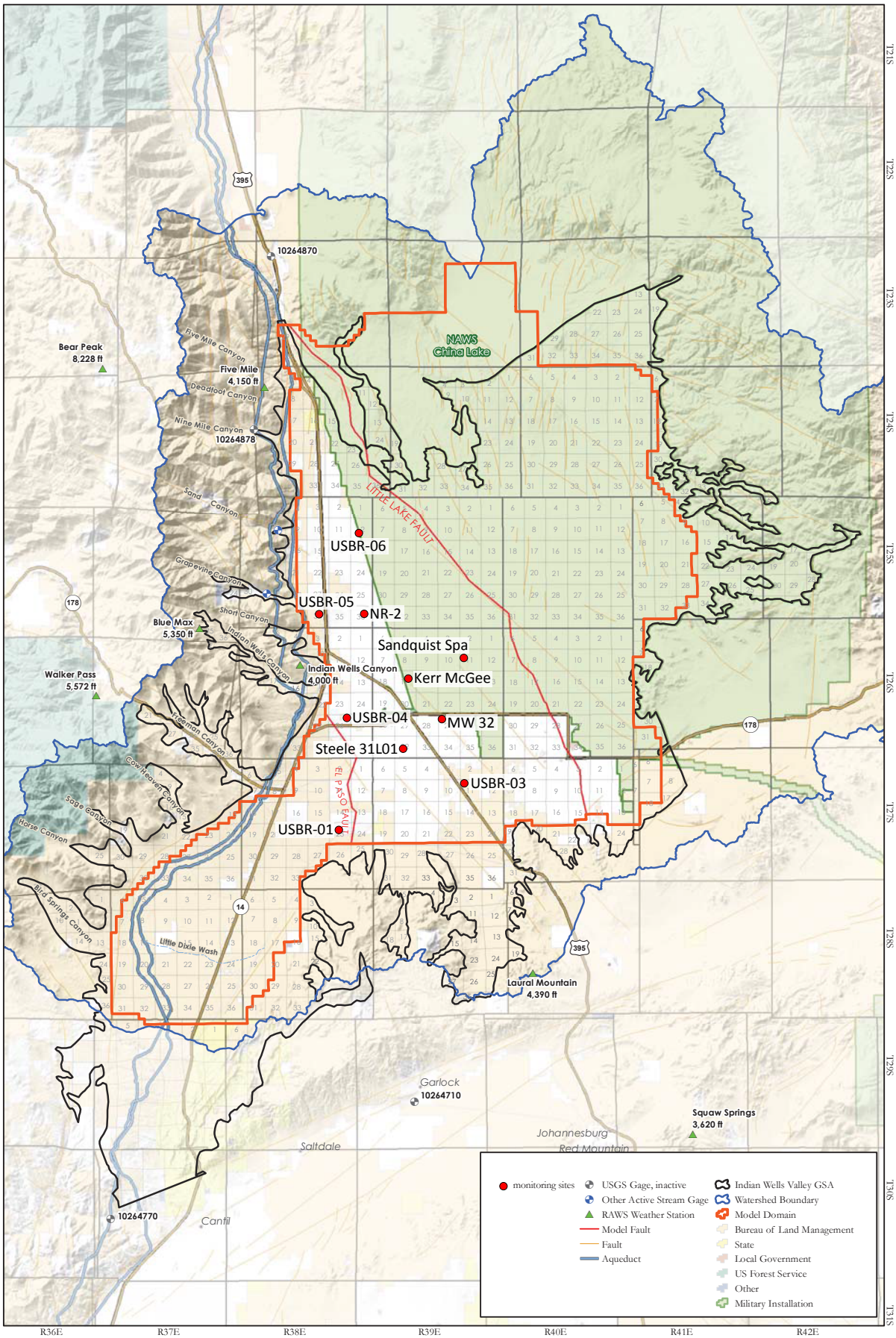
SIMULATED PUMPING AND STORAGE
Historical, Baseline, and Scenario 6.2
Indian Wells Valley

STETSON ENGINEERS INC.

NAWS CHINA LAKE AREA DE-DESIGNATED FOR MUNICIPAL/DOMESTIC USE

FIGURE 4-1

Document Path: J:\jn2652\IndianWellsValley_isotopeData_recentTDS.mxd



STETSON ENGINEERS INC.

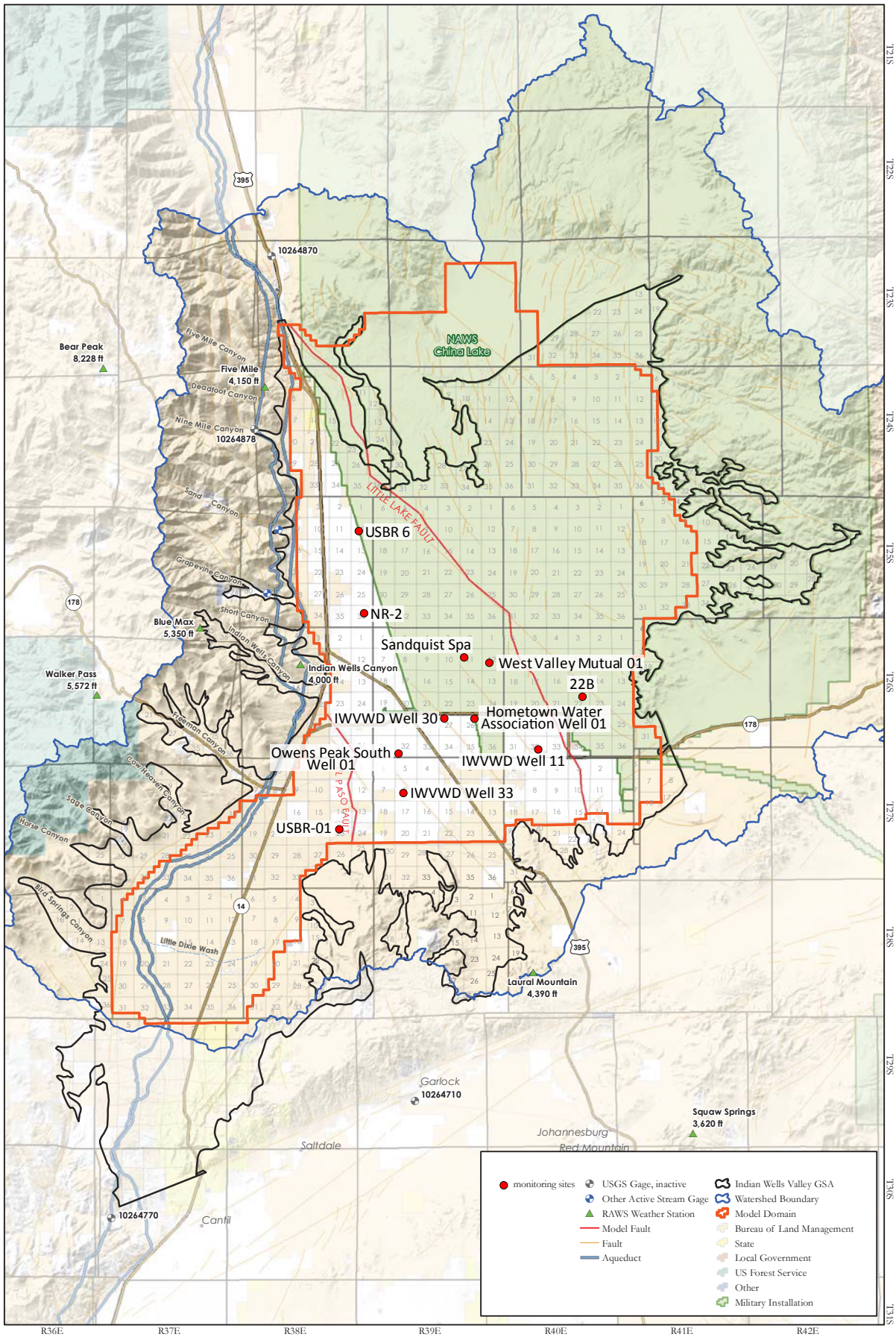
REPRESENTATIVE MONITORING SITES FOR CHRONIC LOWERING OF GROUNDWATER LEVELS

0 2 4 Miles

N

FIGURE 4-2

Document Path: J:\jn2652\IndianWellsValley_isotopeData_recentTDS.mxd



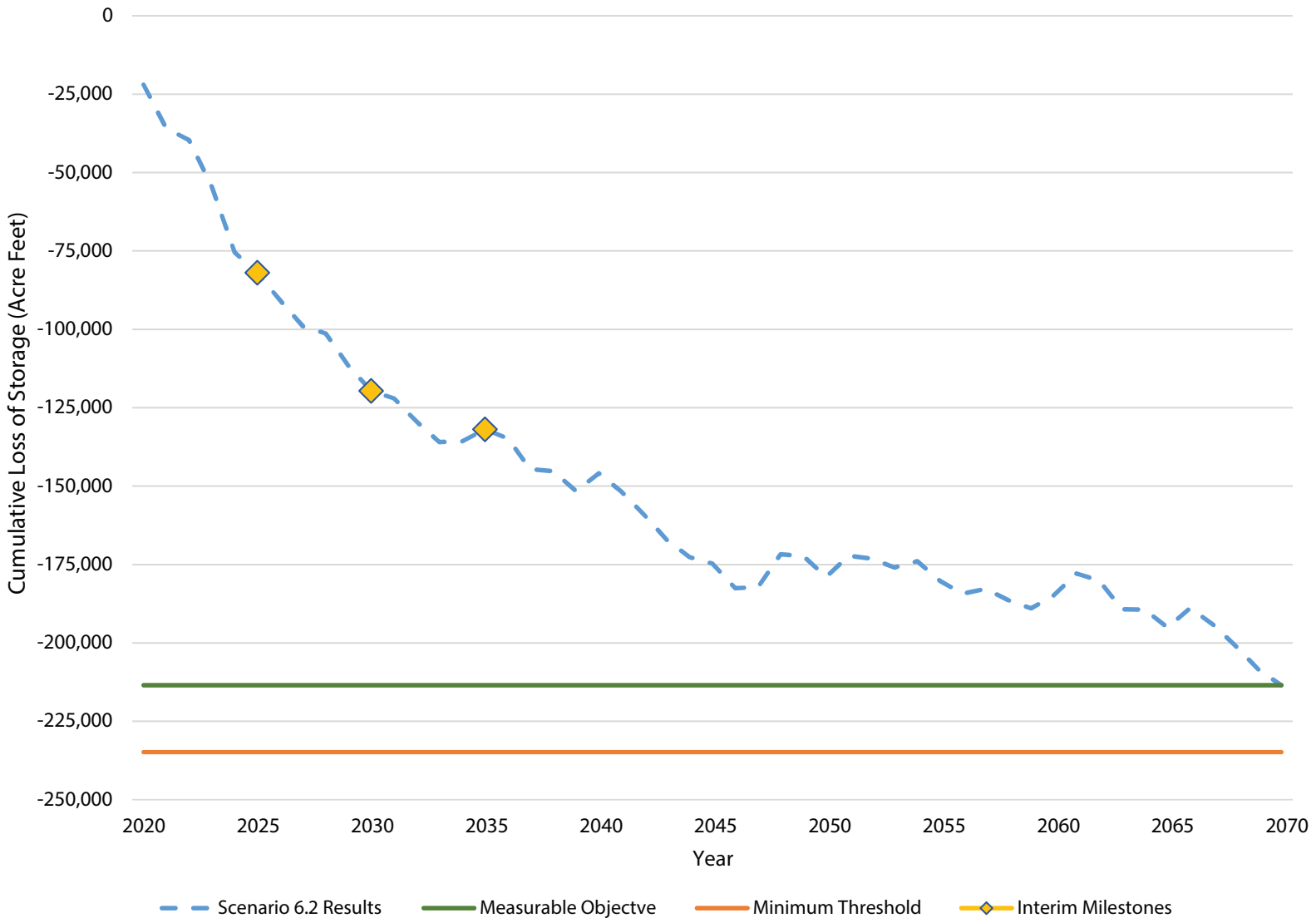
STETSON ENGINEERS INC.

REPRESENTATIVE MONITORING SITES FOR DEGRADED WATER QUALITY

0 2 4 Miles

N

FIGURE 4-3

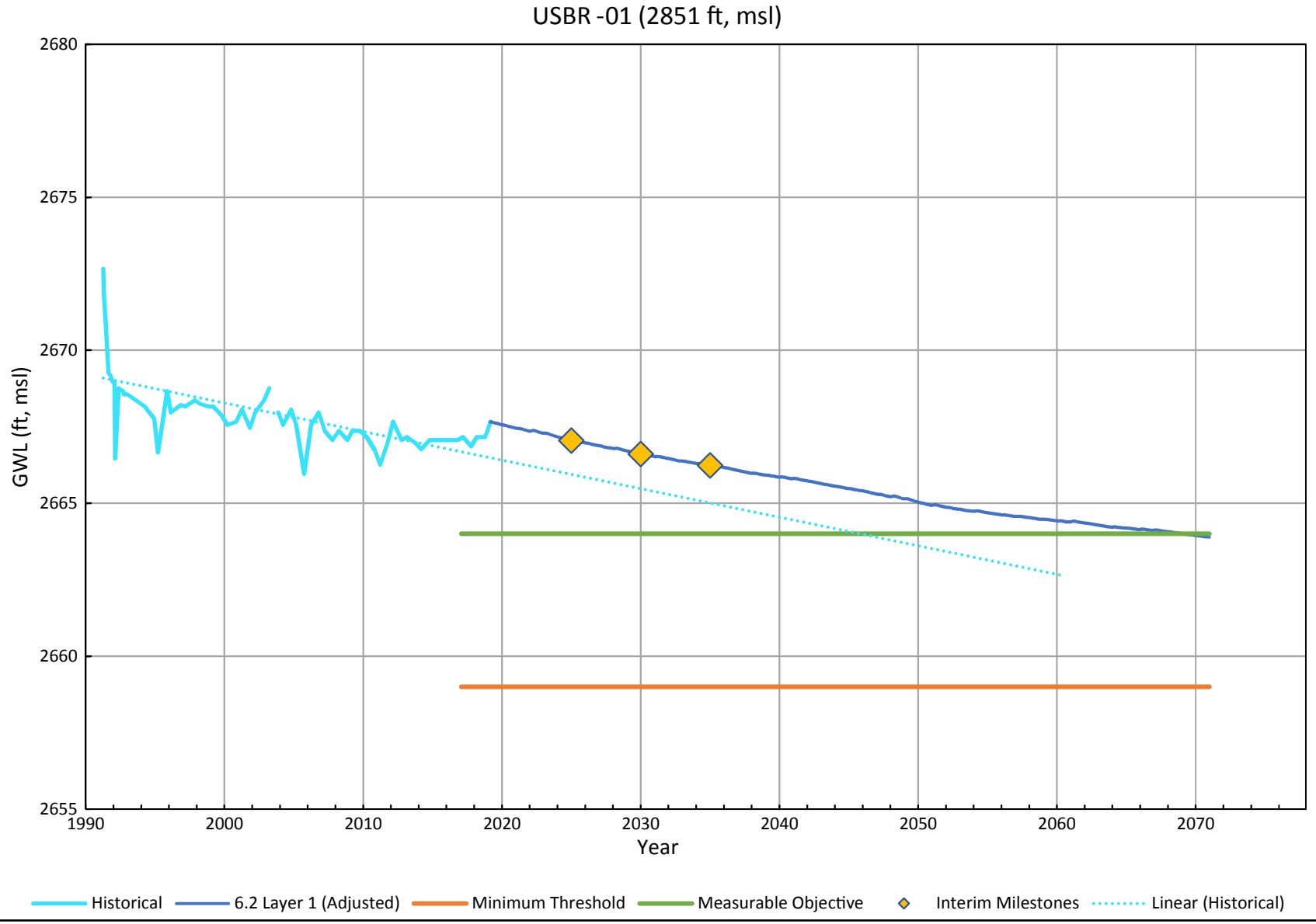


STETSON ENGINEERS INC.

SUSTAINABLE MANAGEMENT CRITERIA: GROUNDWATER REMOVED FROM STORAGE

FIGURE 4-4

C/JobFolder/2652-001:08.08

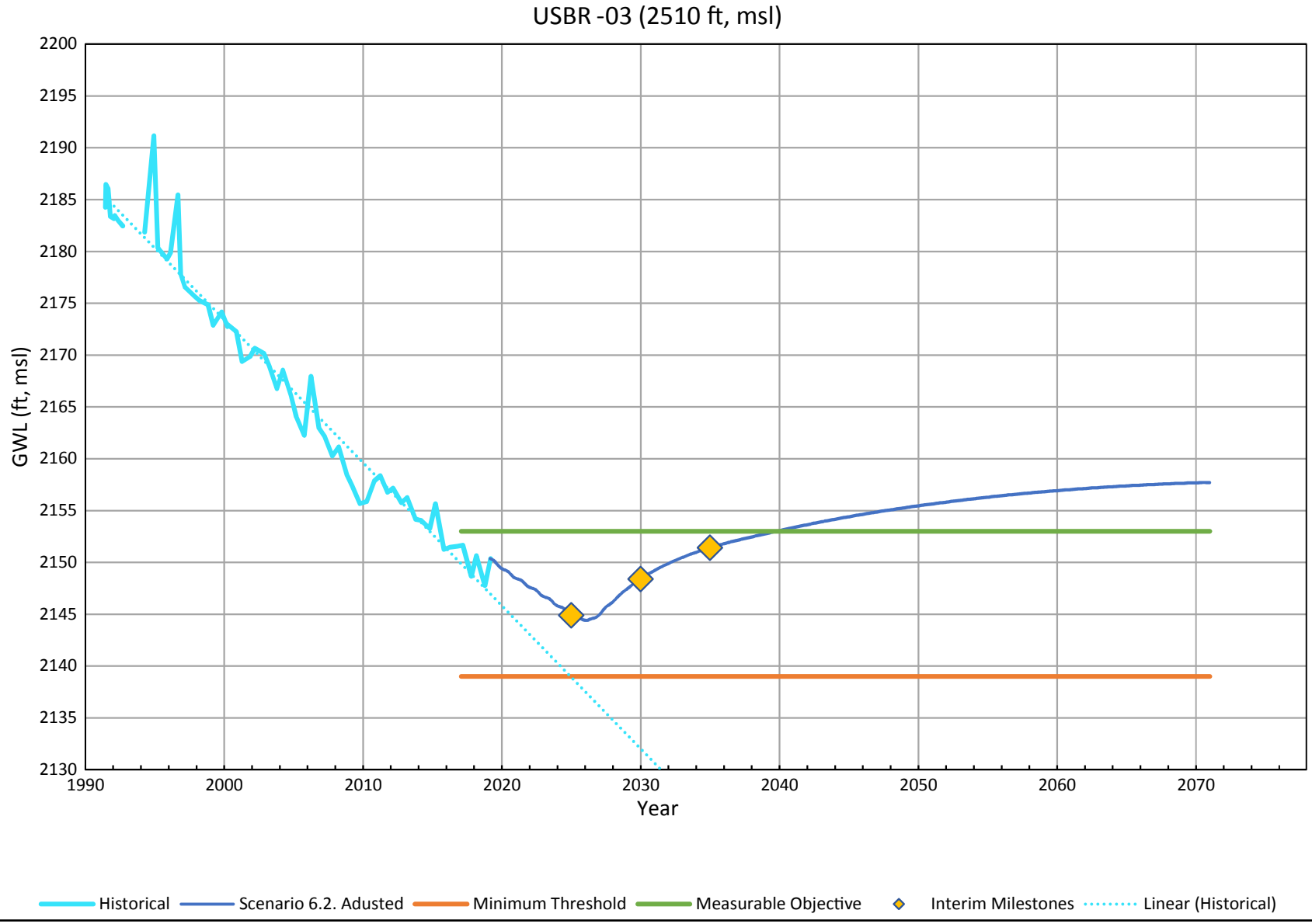


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5a

C/JobFolder/2652-001:08.08

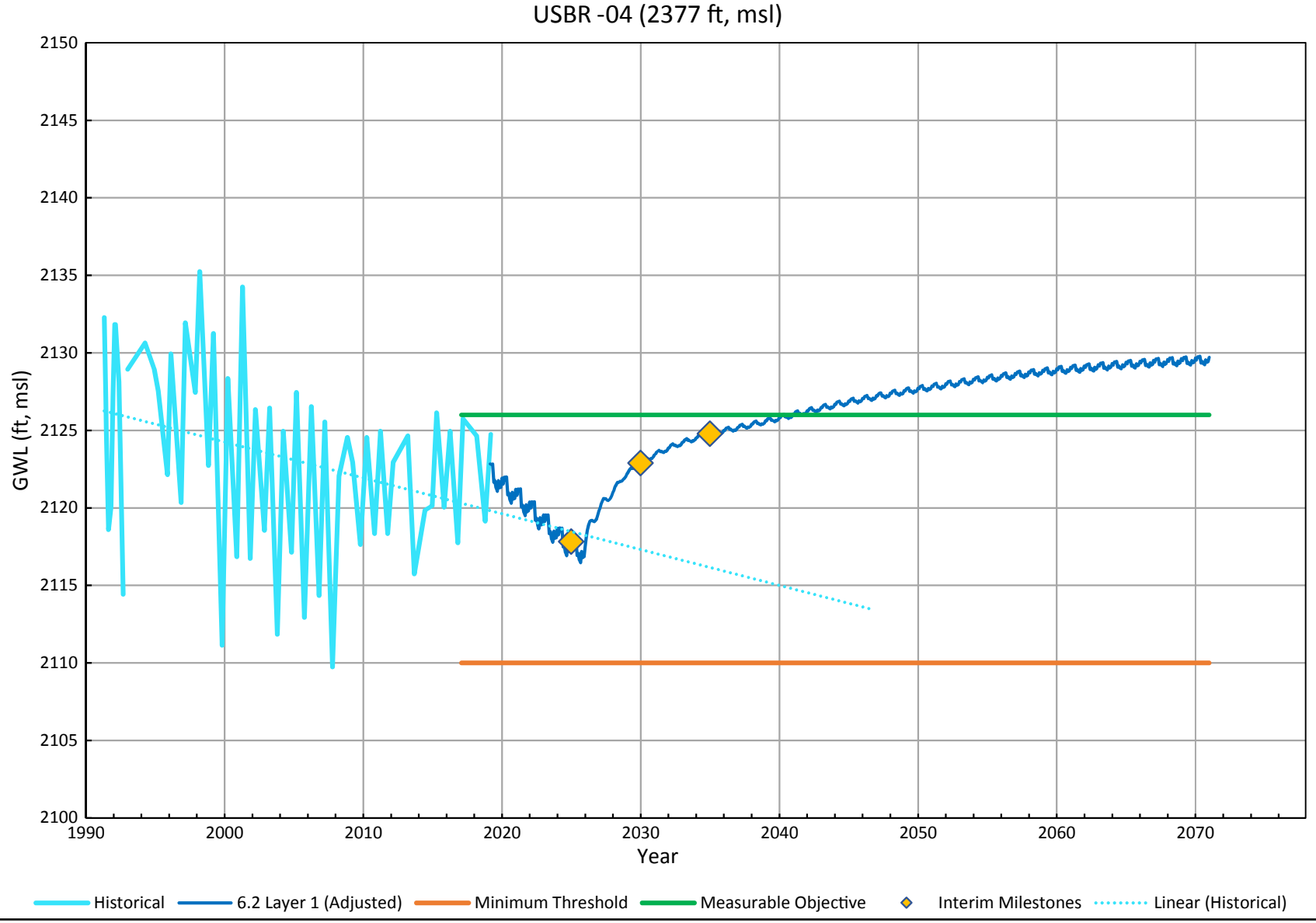


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5b

C/JobFolder/2652-001:08.08

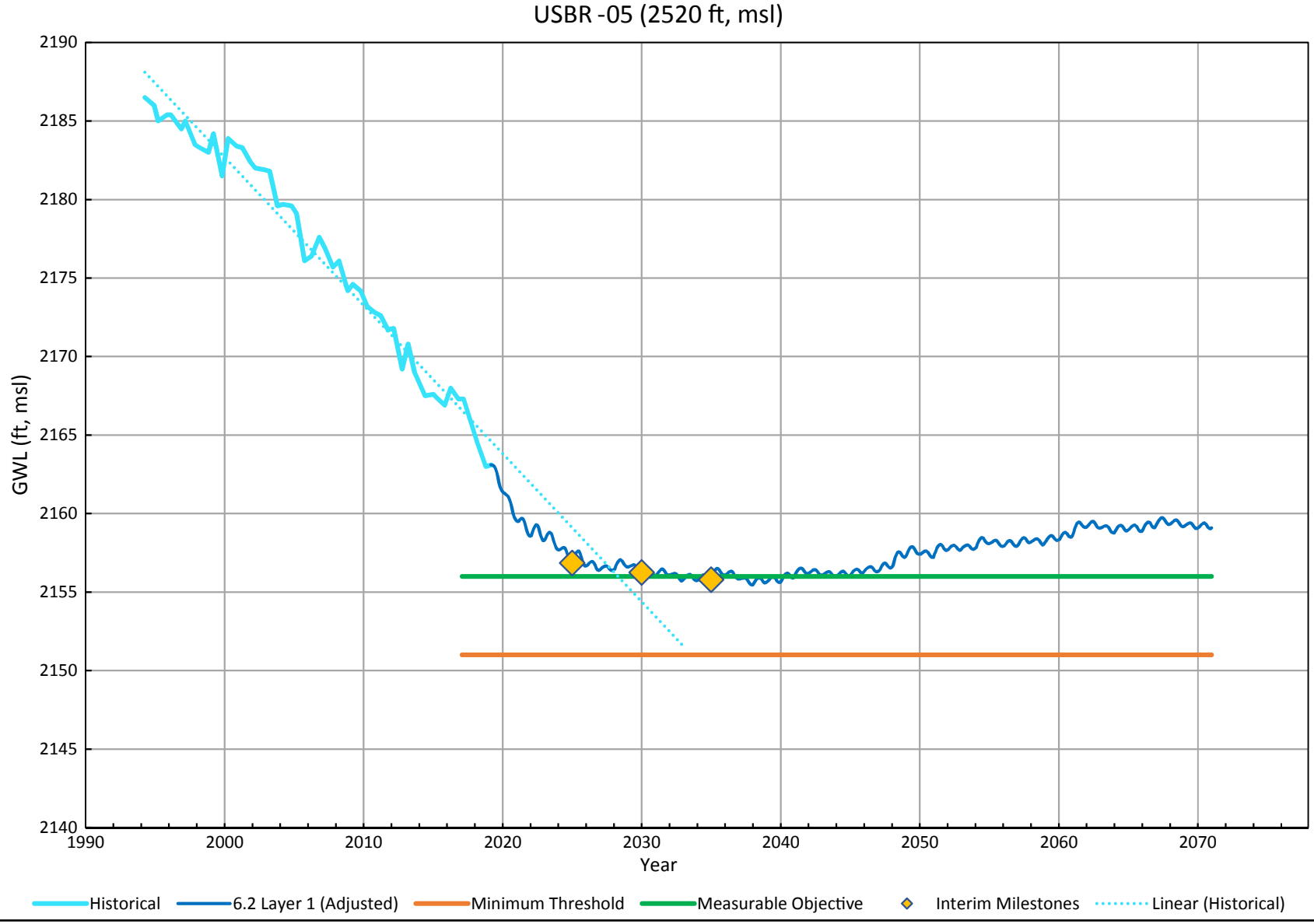


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5c

C/JobFolder/2652-001:08.08

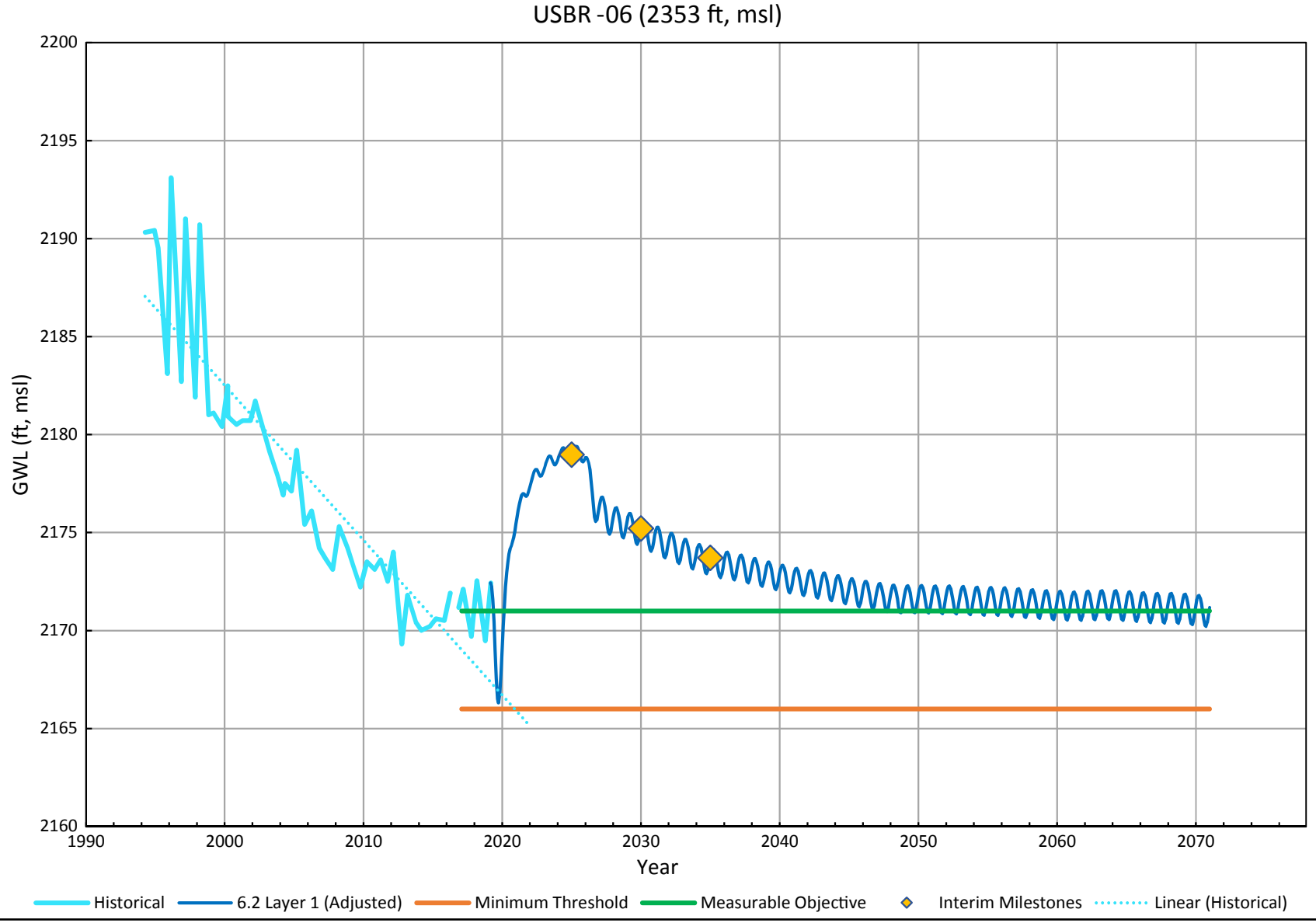


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5d

C/JobFolder/2652-001:08.08

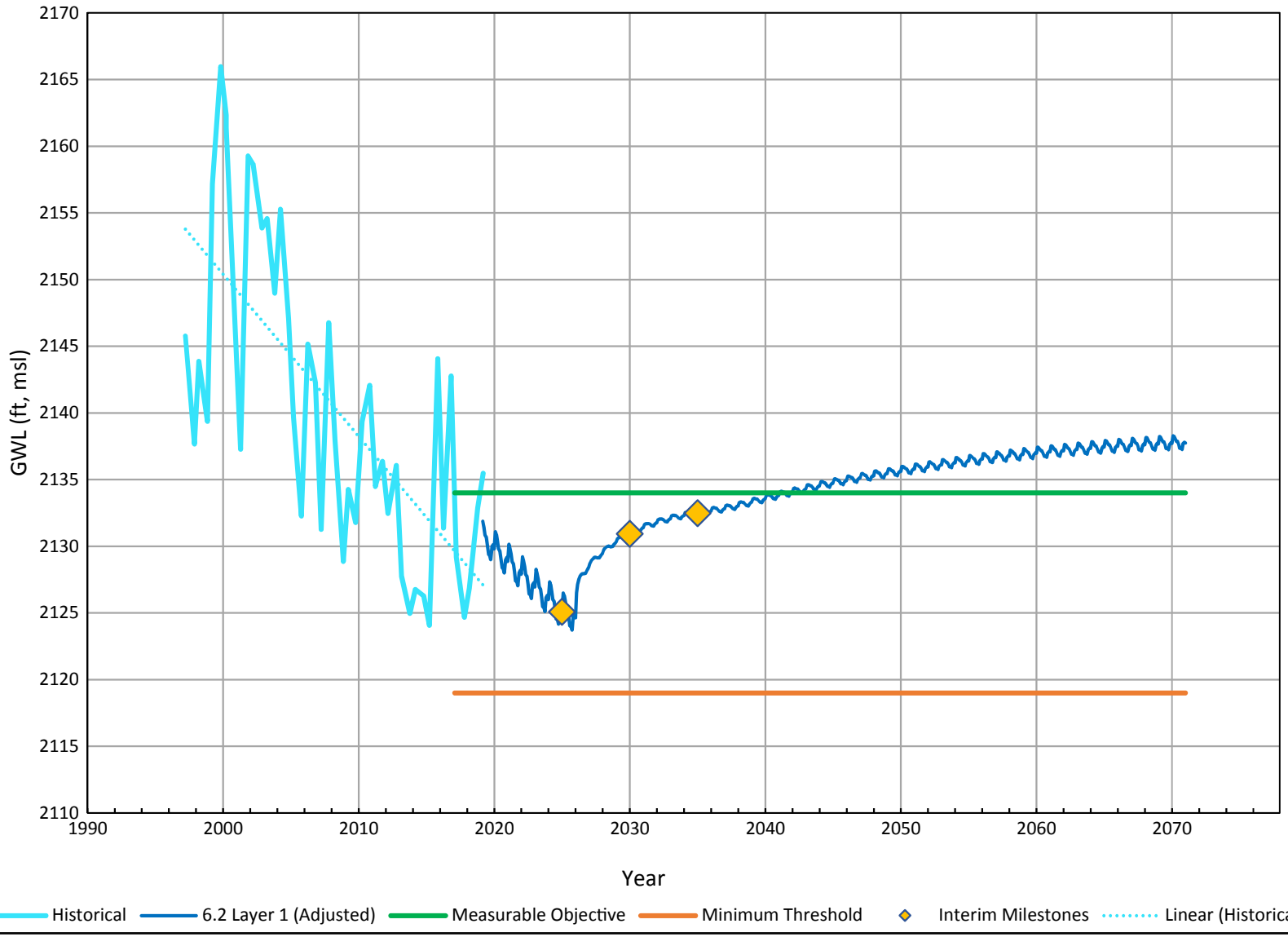


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5e

C/JobFolder/2652-001:08.08

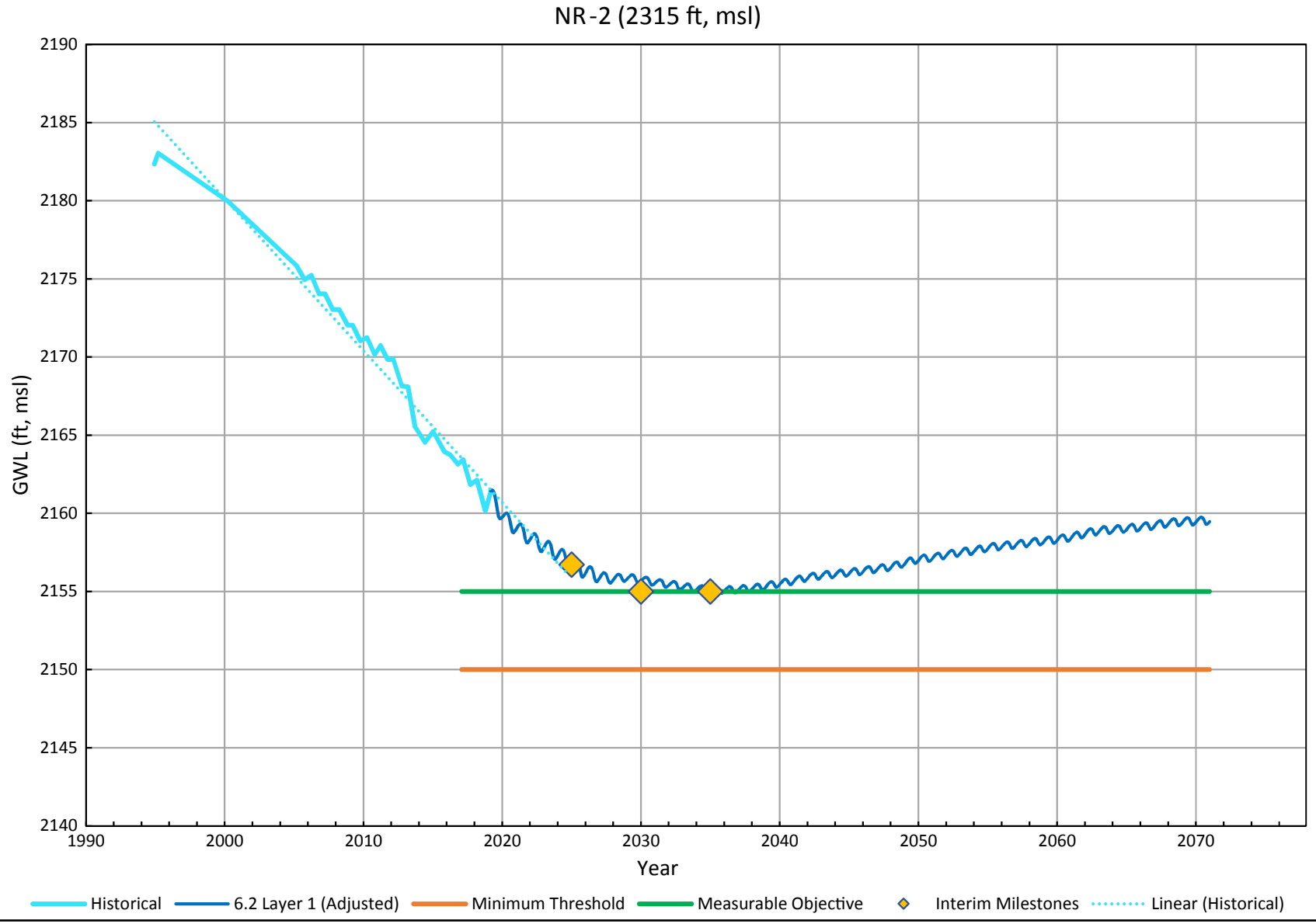


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5f

C/JobFolder/2652-001:08.08

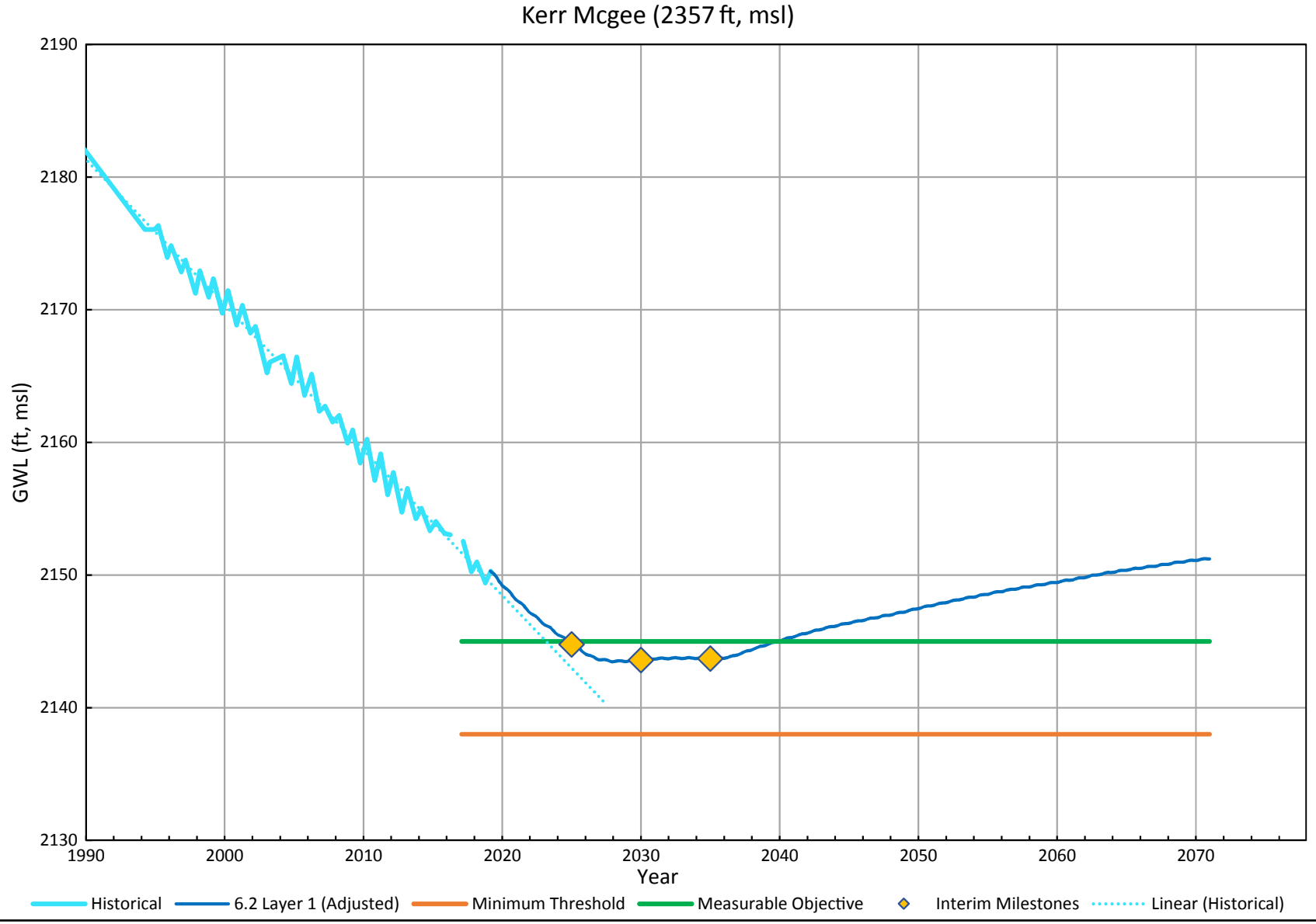


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5g

C/JobFolder/2652-001:08.08

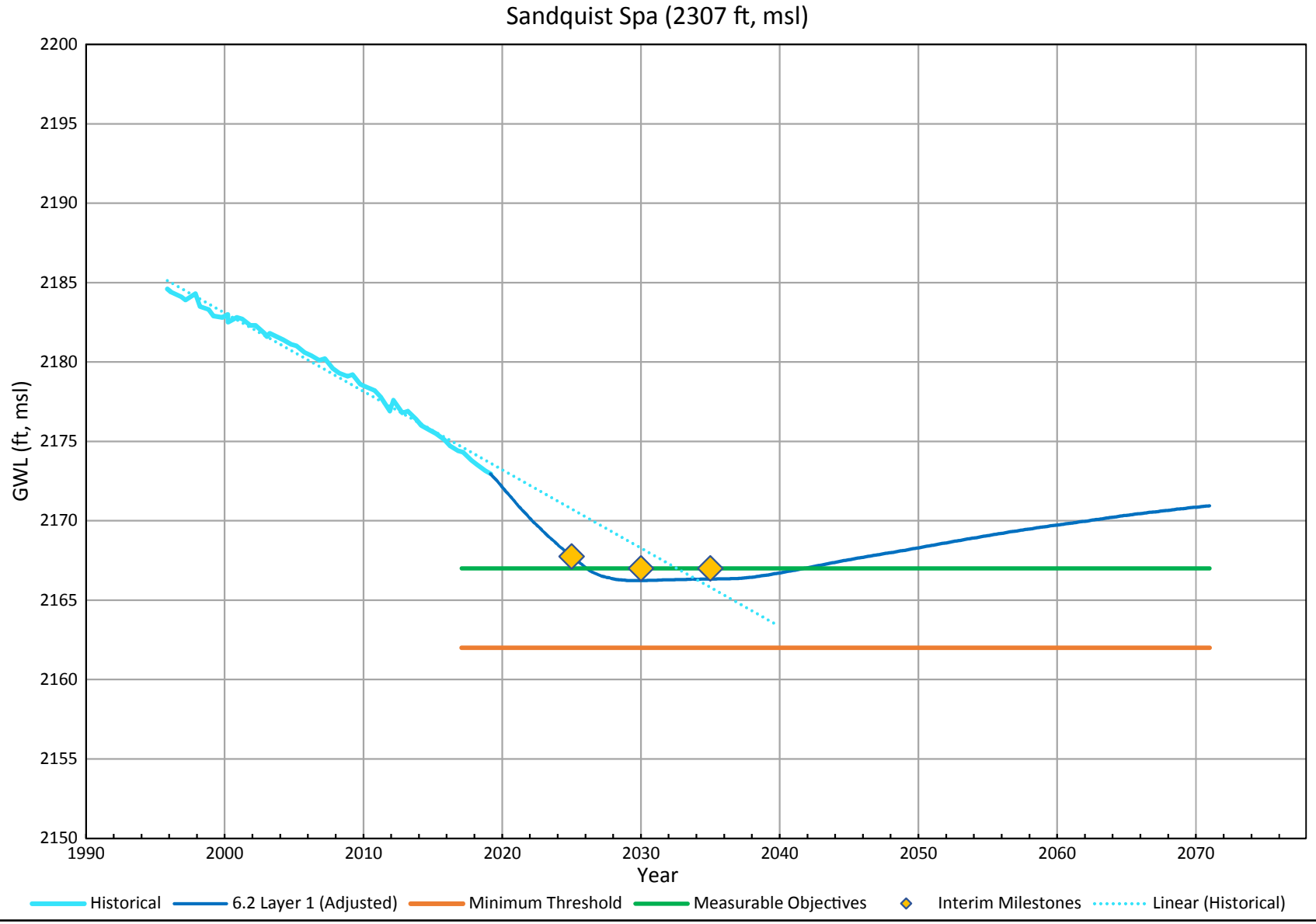


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5h

C/JobFolder/2652-001:08.08

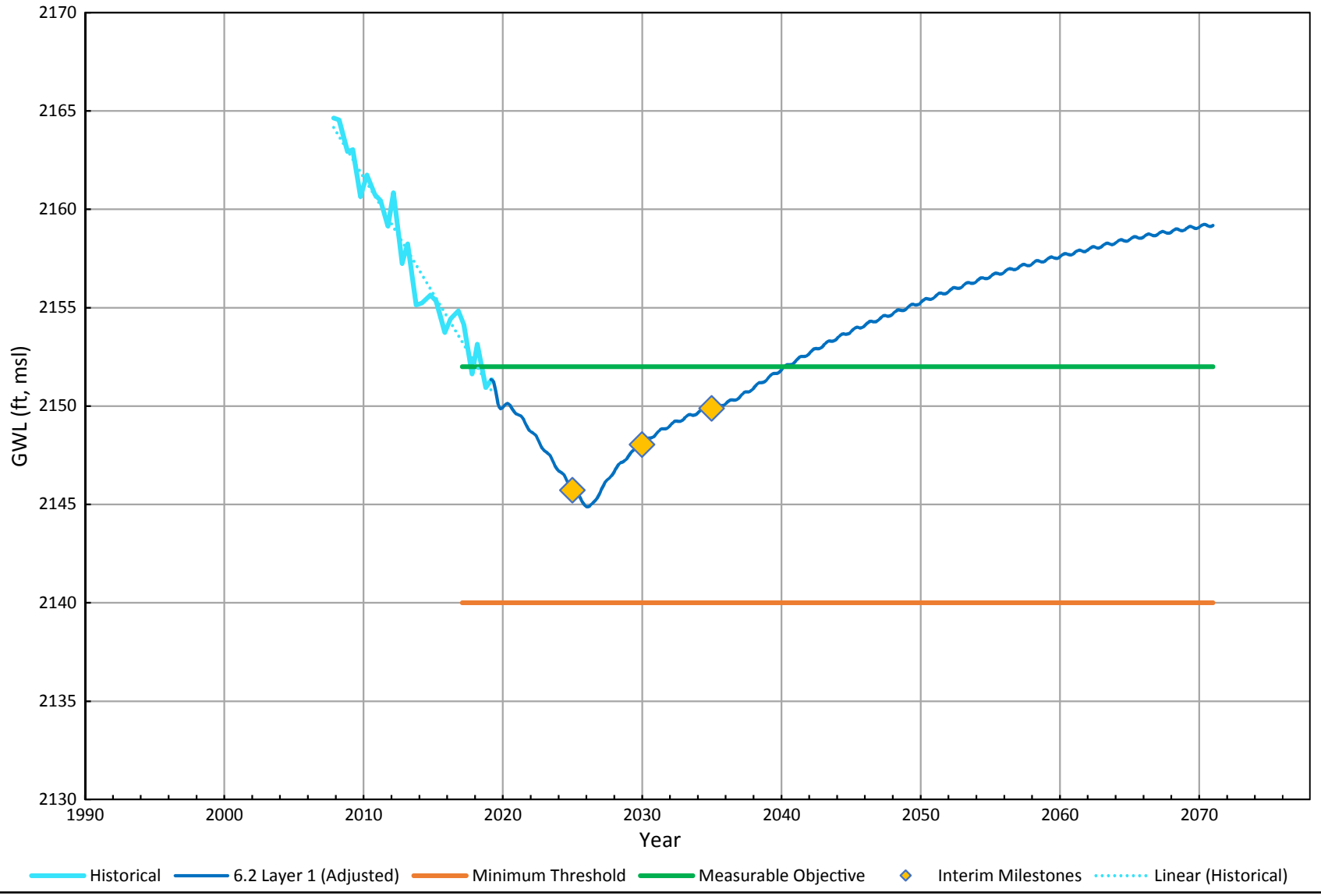


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5i

C/JobFolder/2652-001:08.08

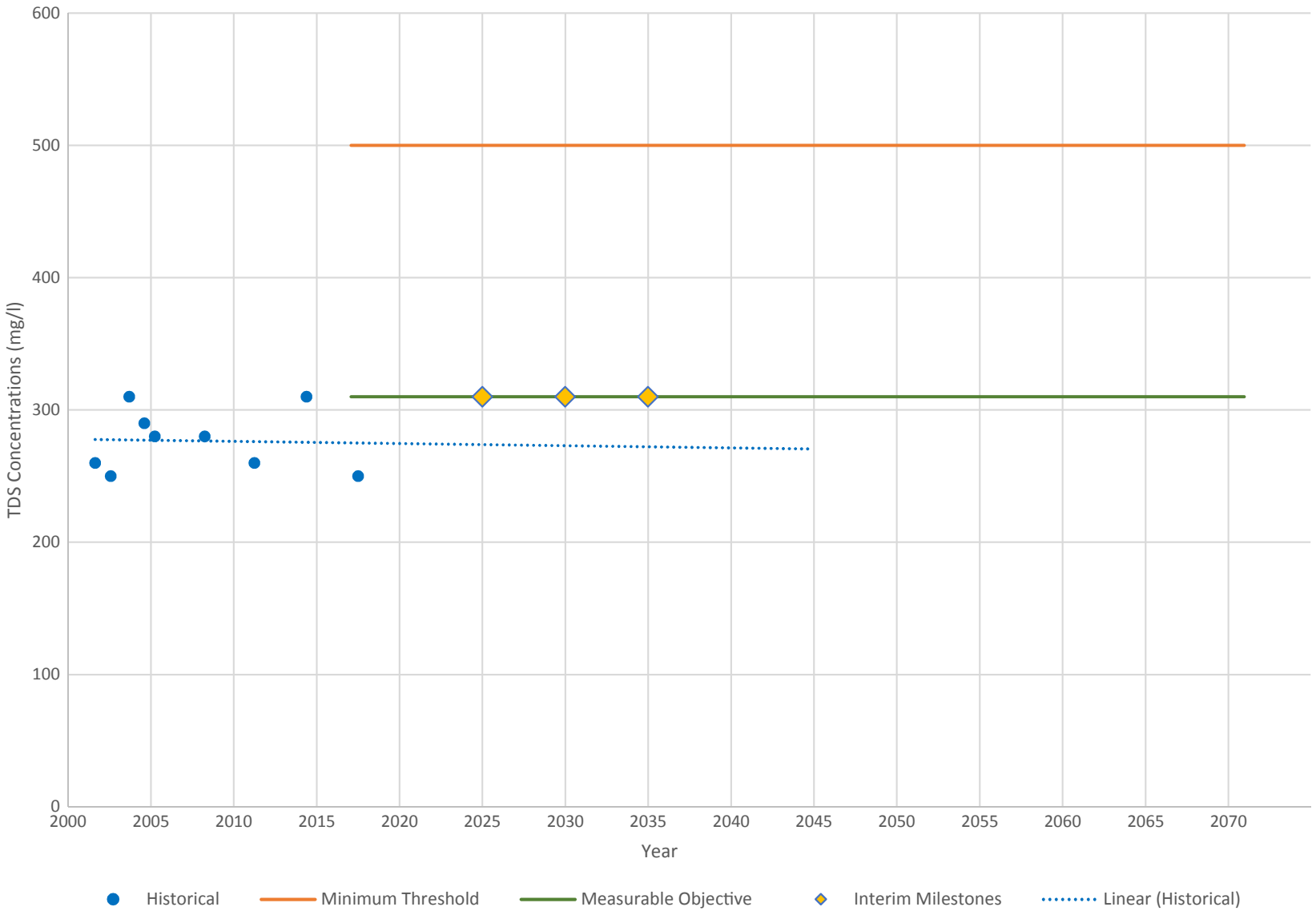


STETSON ENGINEERS INC.

Sustainable Management Criteria: Chronic Lowering of Groundwater Levels

FIGURE 4-5j

C/JobFolder/2652-001:08.08

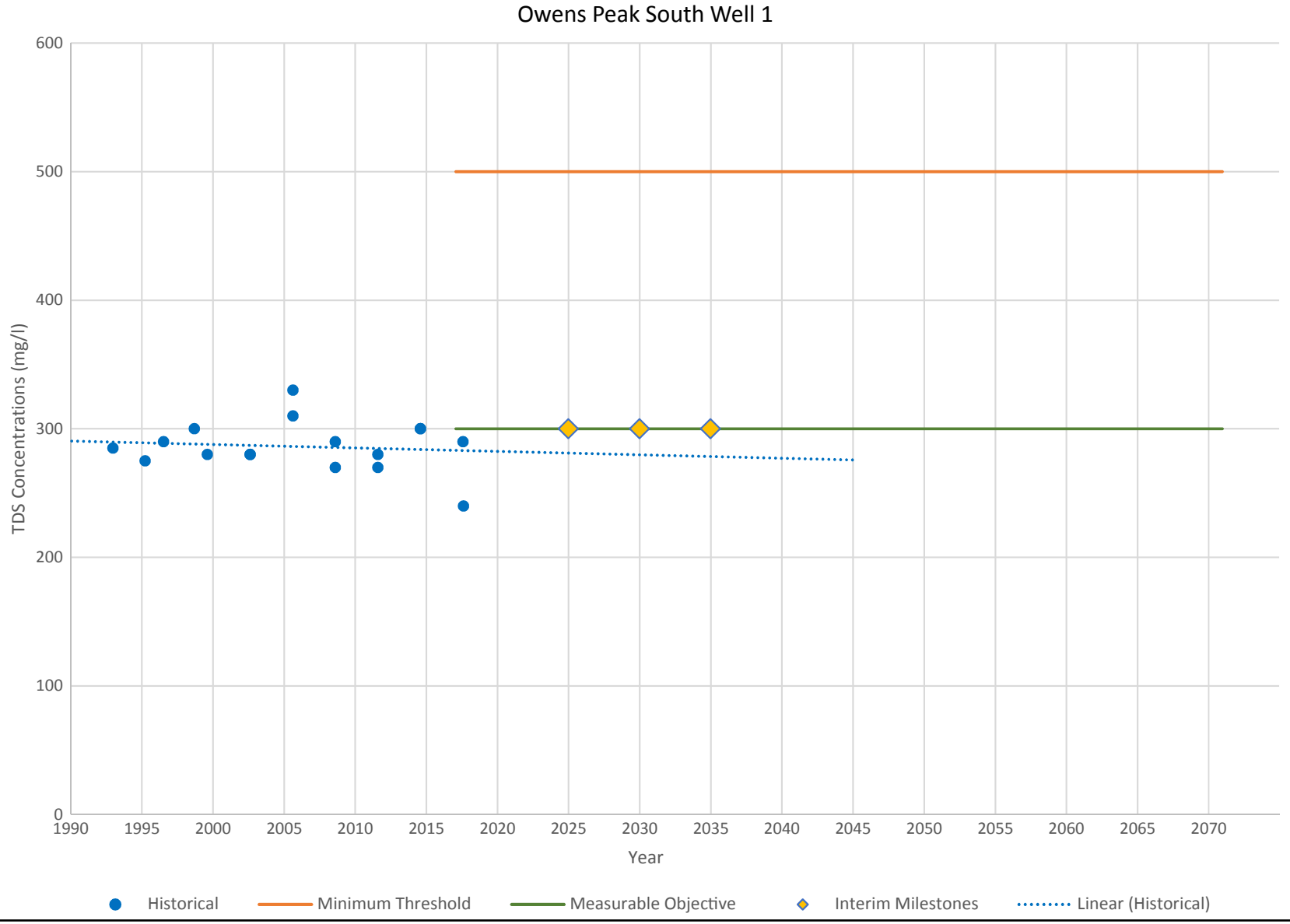


STETSON ENGINEERS INC.

Sustainable Management Criteria: Degraded Water Quality

FIGURE 4-6a

C/JobFolder/2652-001:08.08

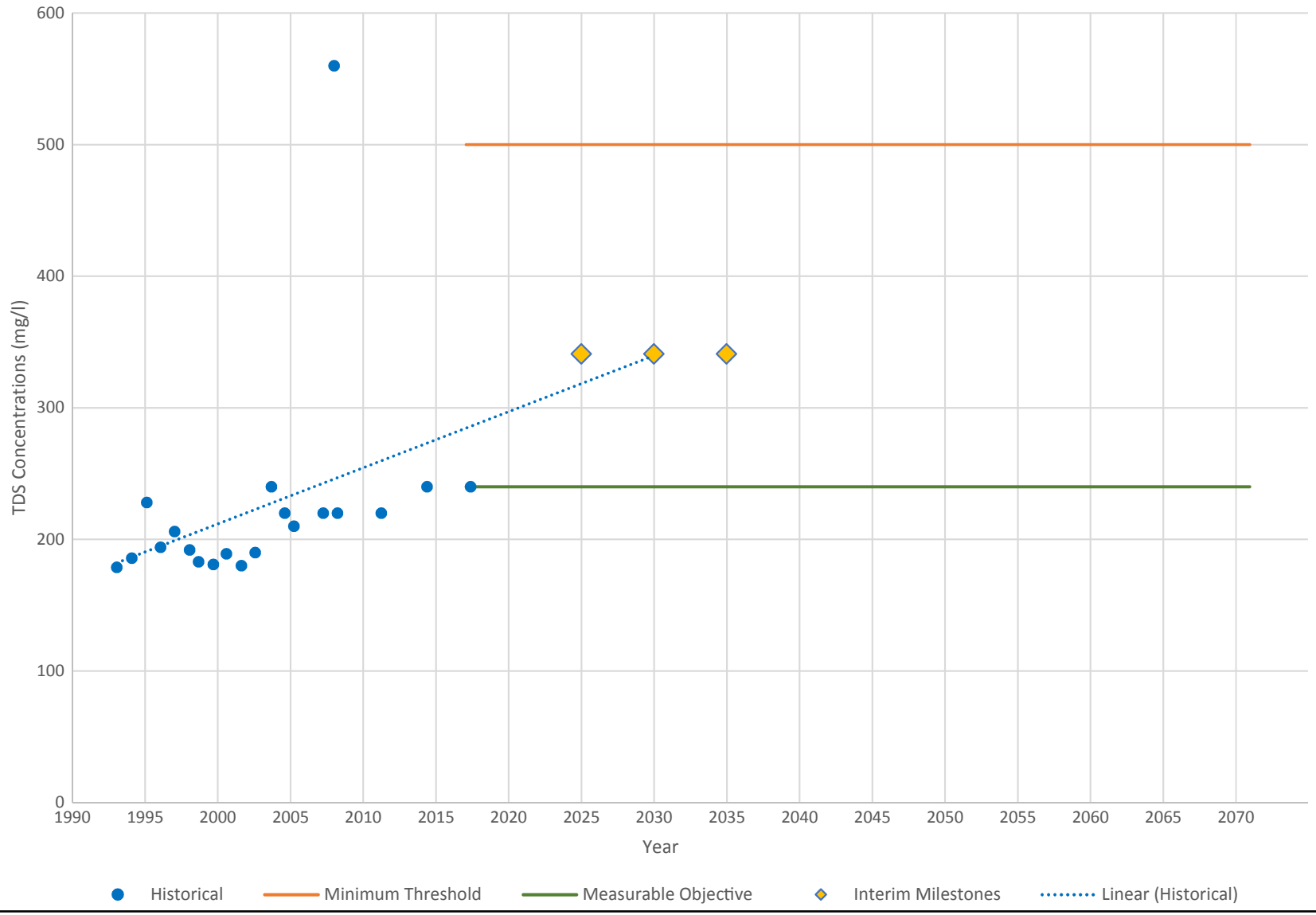


STETSON ENGINEERS INC.

Sustainable Management Criteria: Degraded Water Quality

FIGURE 4-6b

C/JobFolder/2652-001:08.08

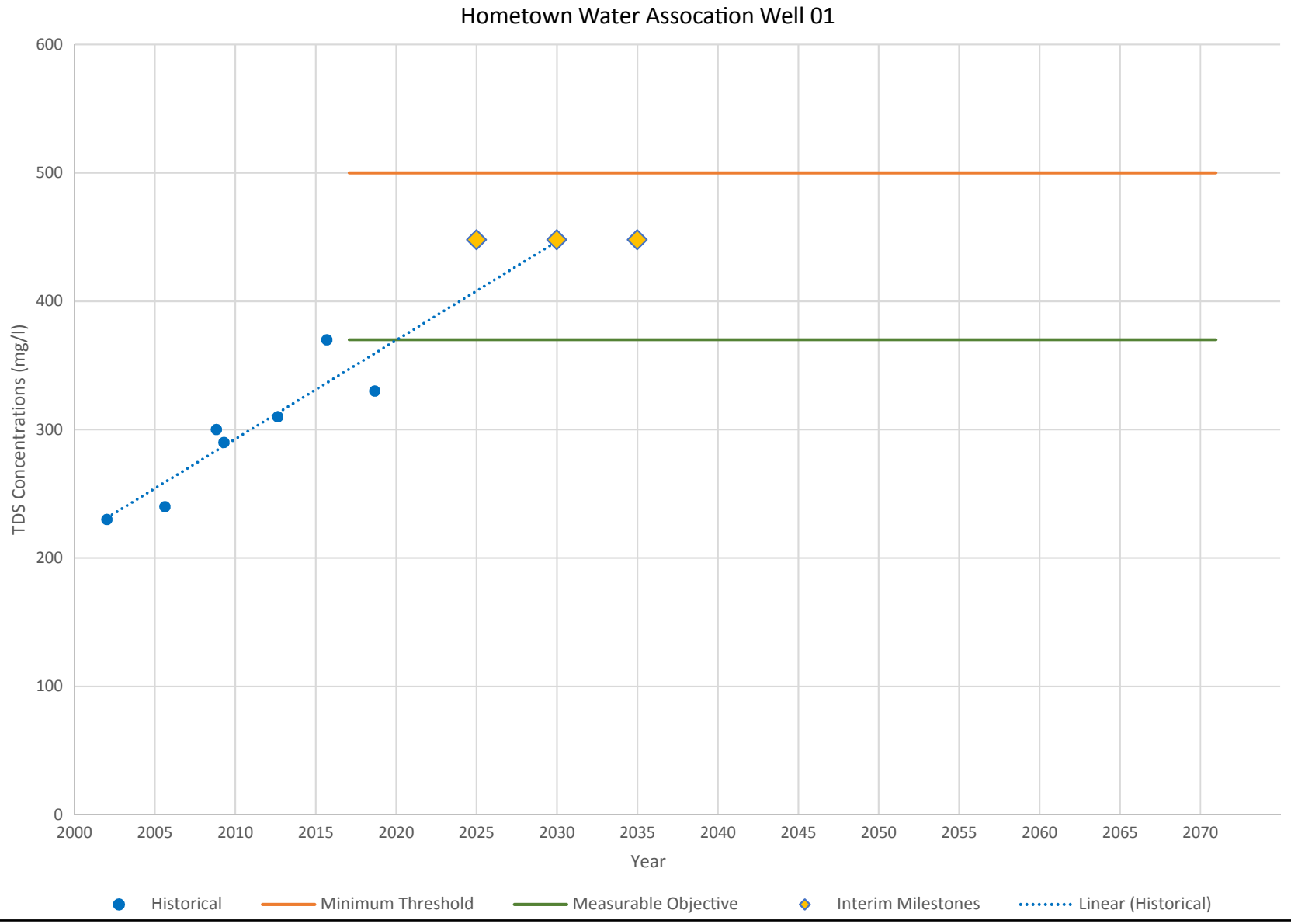


STETSON ENGINEERS INC.

Sustainable Management Criteria: Degraded Water Quality

FIGURE 4-6c

C/JobFolder/2652-001:08.08

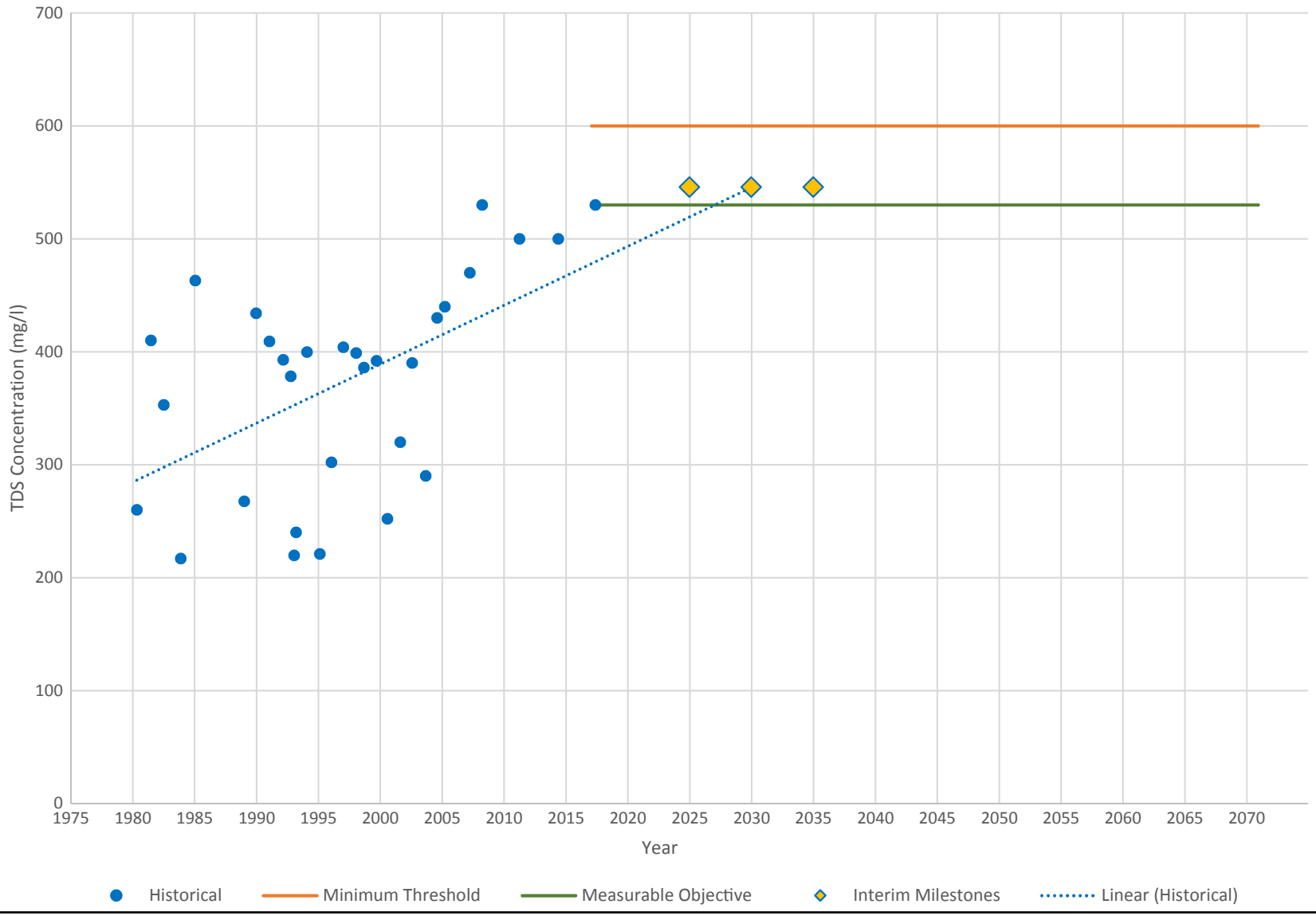


STETSON ENGINEERS INC.

Sustainable Management Criteria: Degraded Water Quality

FIGURE 4-6d

C/JobFolder/2652-001:08.08

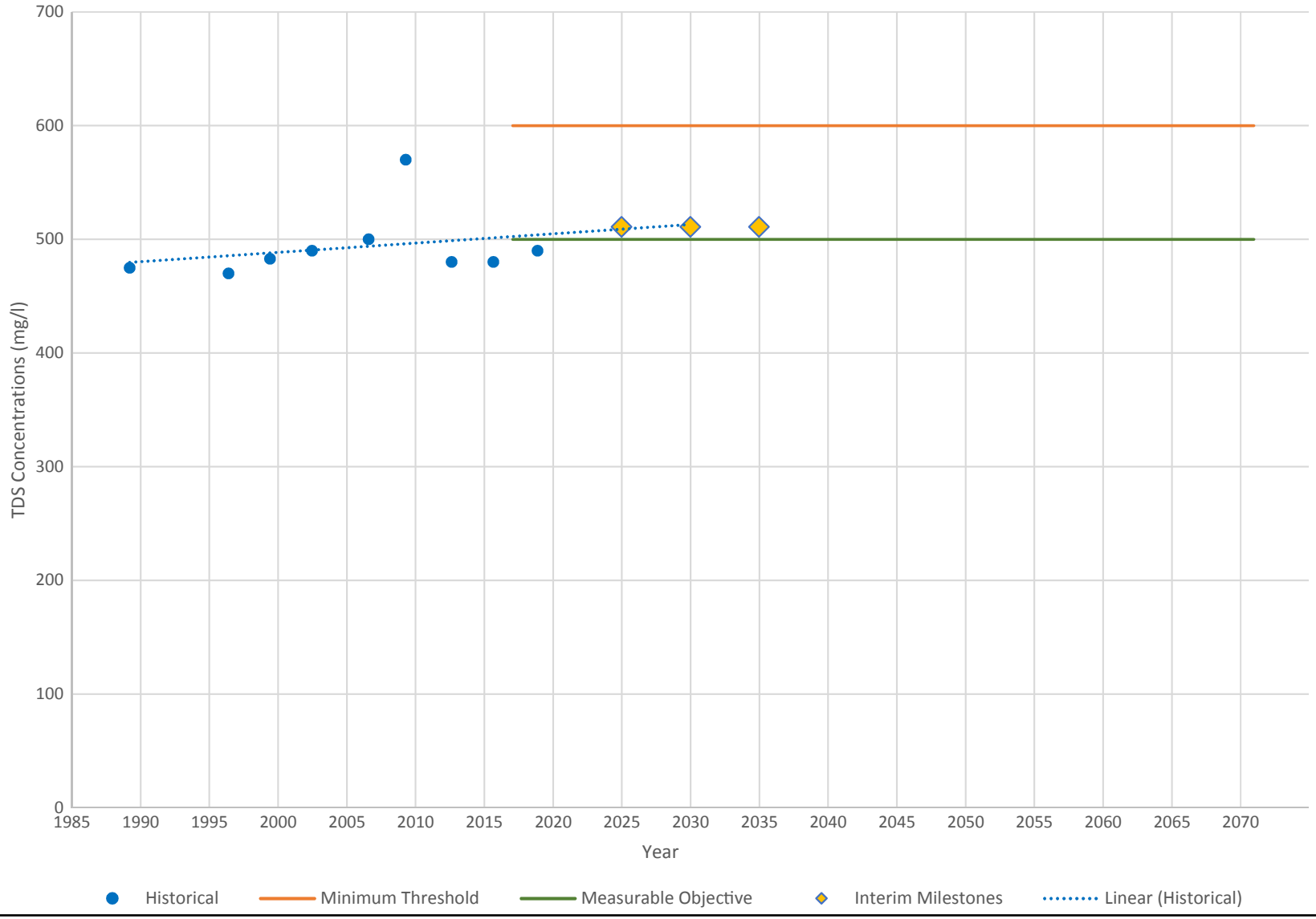


STETSON ENGINEERS INC.

Sustainable Management Criteria: Degraded Water Quality

FIGURE 4-6e

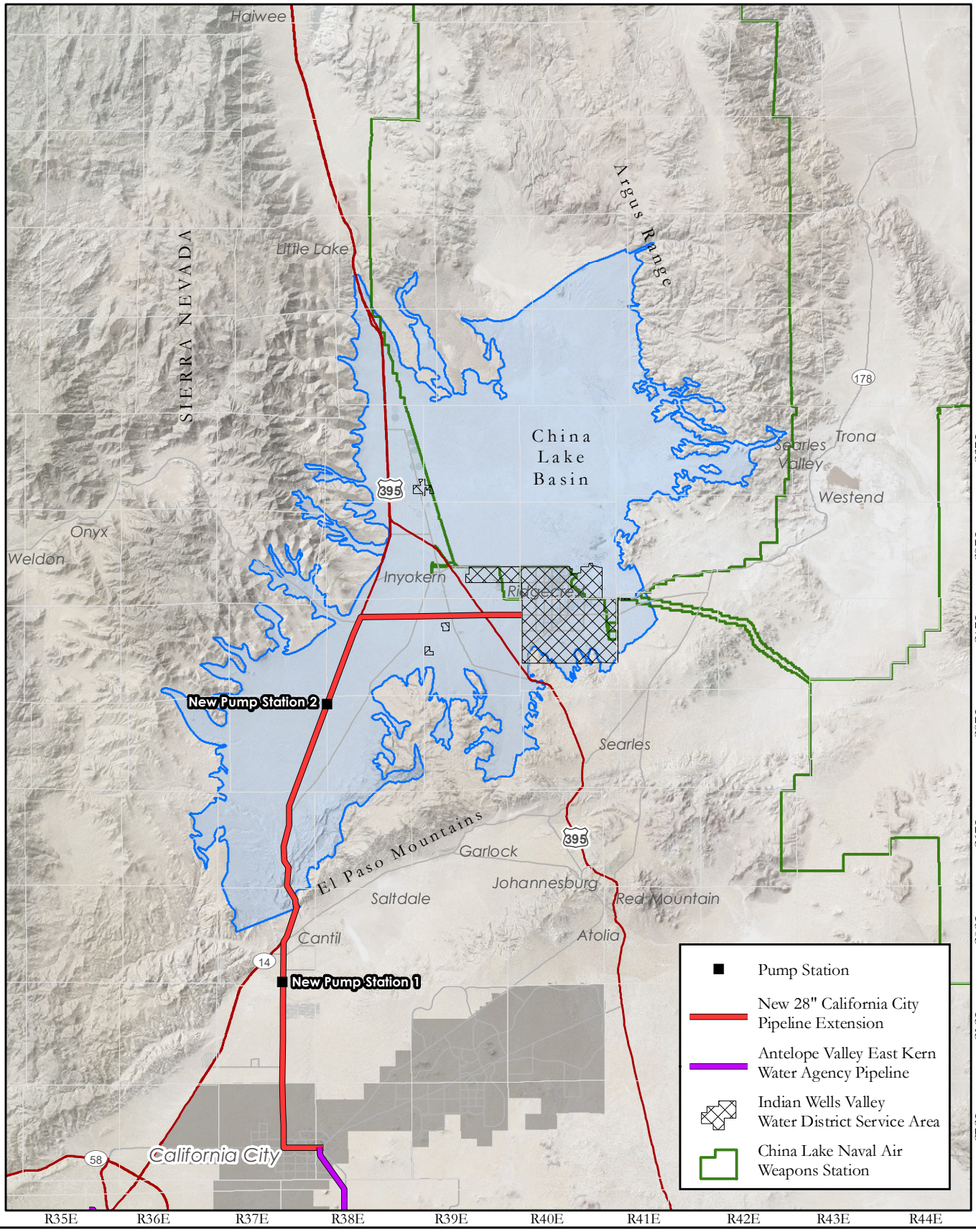
C/JobFolder/2652-001:08.08



STETSON ENGINEERS INC.

Sustainable Management Criteria: Degraded Water Quality

FIGURE 4-6f



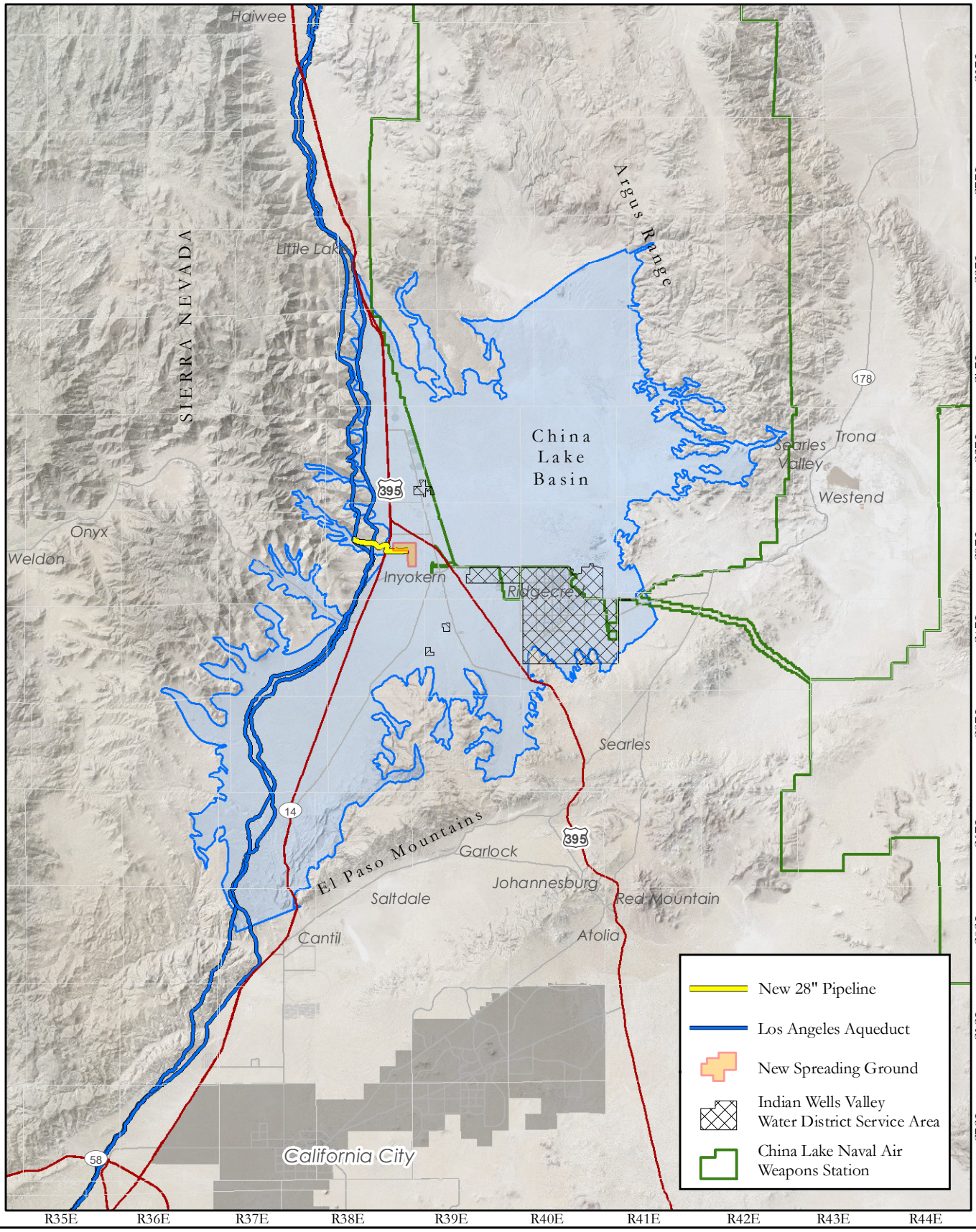
Document Path: J:\jn2652\IWV_Sec5_ImportedWaterProject1.mxd

STETSON ENGINEERS INC.

IMPORTED WATER PROJECT 1 CONCEPTUAL MAP
DIRECT USE PROJECT WITH ANTELOPE VALLEY EAST KERN WATER AGENCY

N

0 3.5 7 Miles



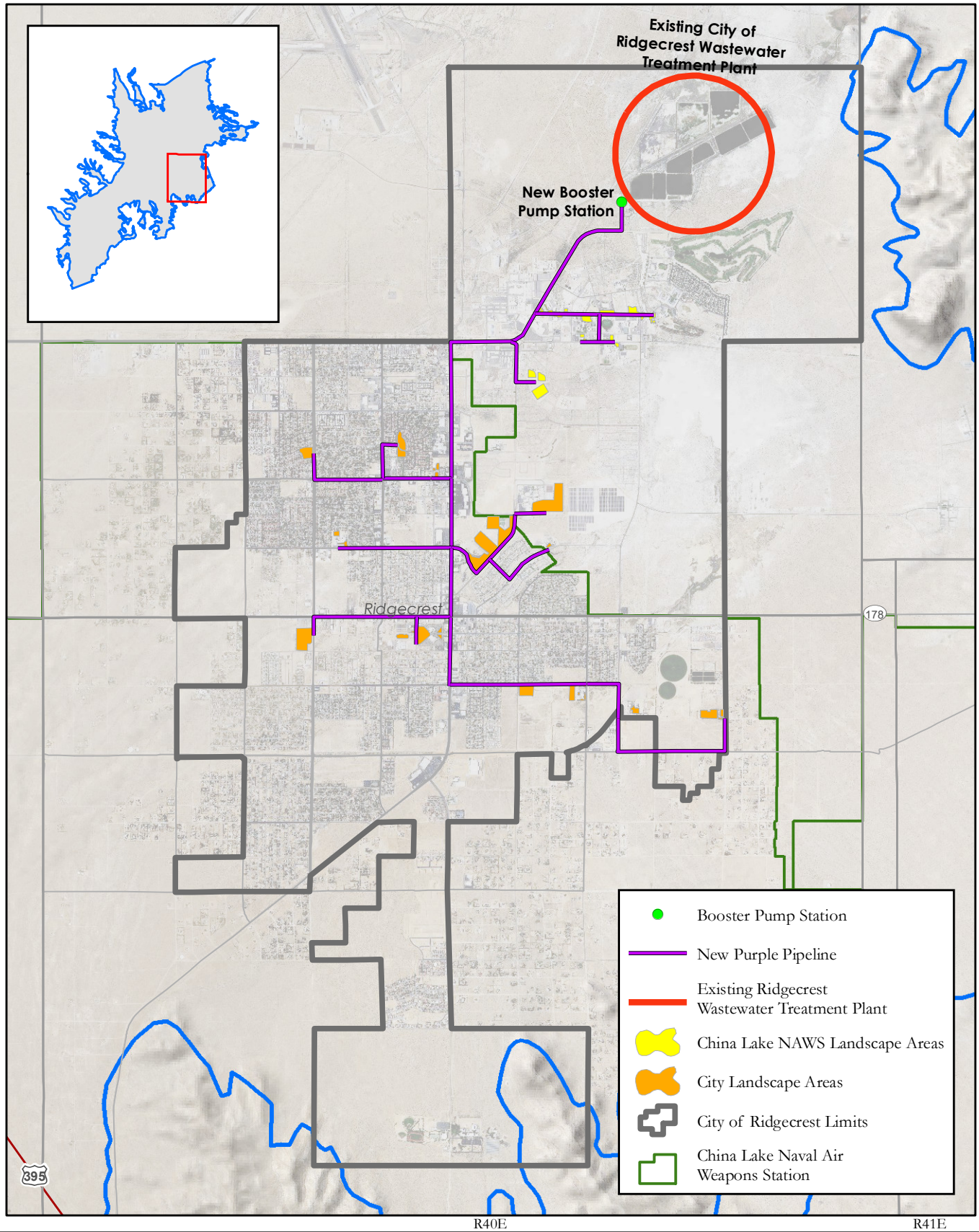
IMPORTED WATER PROJECT 2 CONCEPTUAL MAP
GROUNDWATER RECHARGE PROJECT WITH
LOS ANGELES DEPARTMENT OF WATER AND POWER

STETSON ENGINEERS INC.

N

0 3.5 7 Miles

Document Path: J:\jn2652\IWV_Sec5_ImportedWaterProject2.mxd



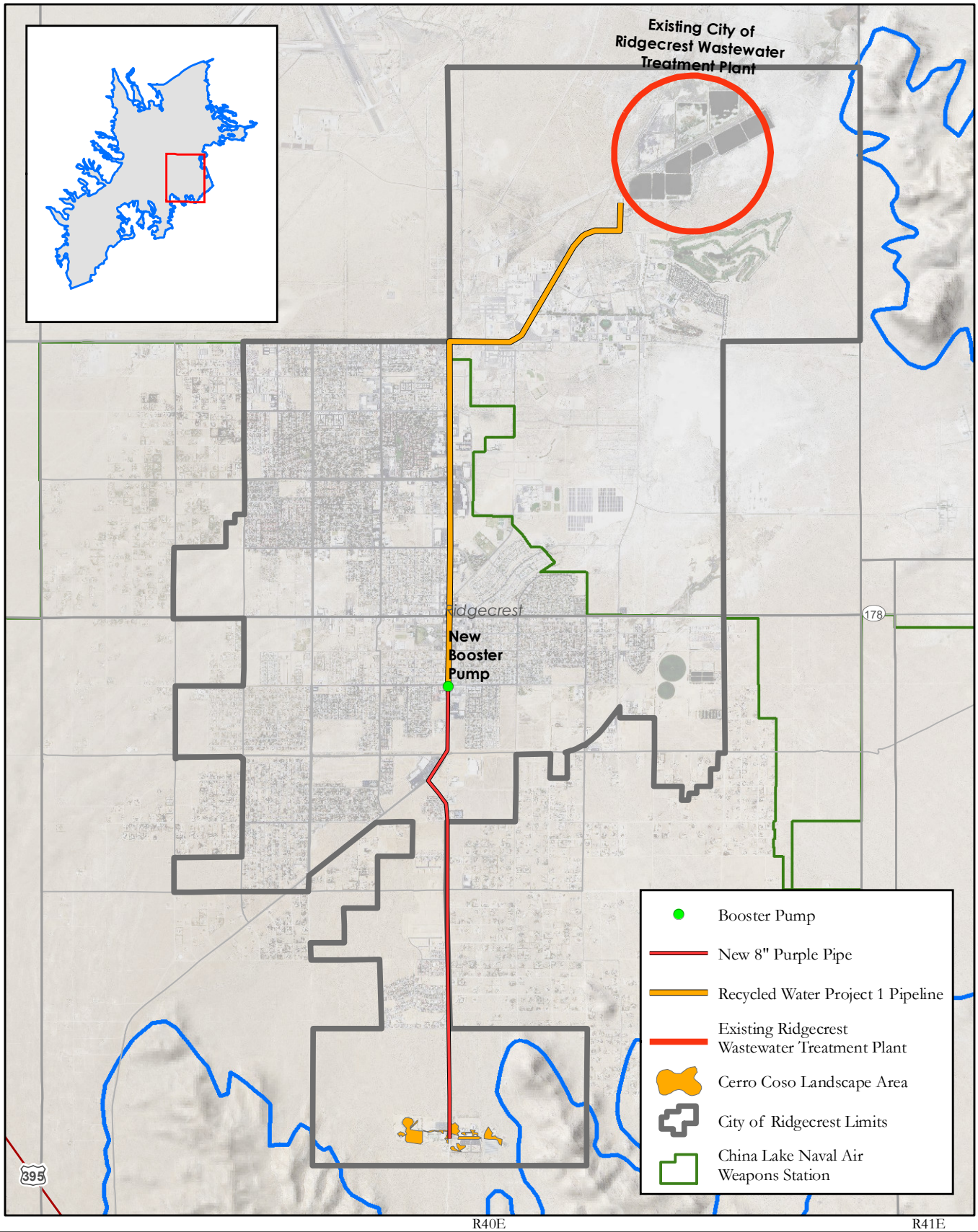
RECYCLED WATER PROJECT 1 CONCEPTUAL MAP
LANDSCAPE IRRIGATION IN THE CITY OF RIDGECREST AND CHINA LAKE NAWS

STETSON ENGINEERS INC.

N

0 0.4 0.8 Miles

Document Path: J:\jn2652\IWV_Sec5_RecycledWaterProject1.mxd



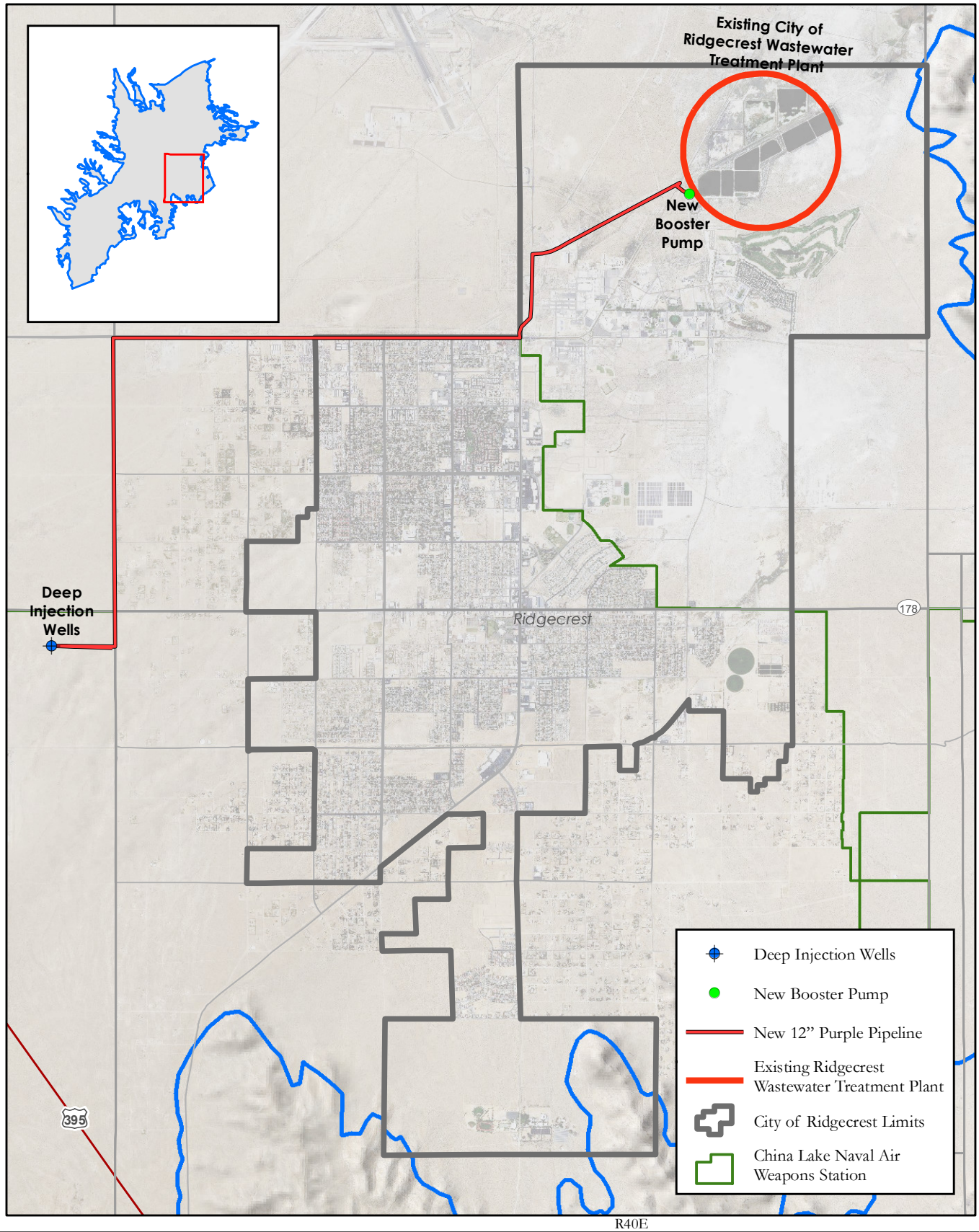
RECYCLED WATER PROJECT 1A CONCEPTUAL MAP
LANDSCAPE IRRIGATION
AT CERRO COSO COMMUNITY COLLEGE

STETSON ENGINEERS INC.

N

0 0.4 0.8 Miles

Document Path: J:\jn2652\IWV_Sec5_RecycledWaterProject1a.mxd



RECYCLED WATER PROJECT 2 CONCEPTUAL MAP
GROUNDWATER RECHARGE WITH RECYCLED WATER

STETSON ENGINEERS INC.

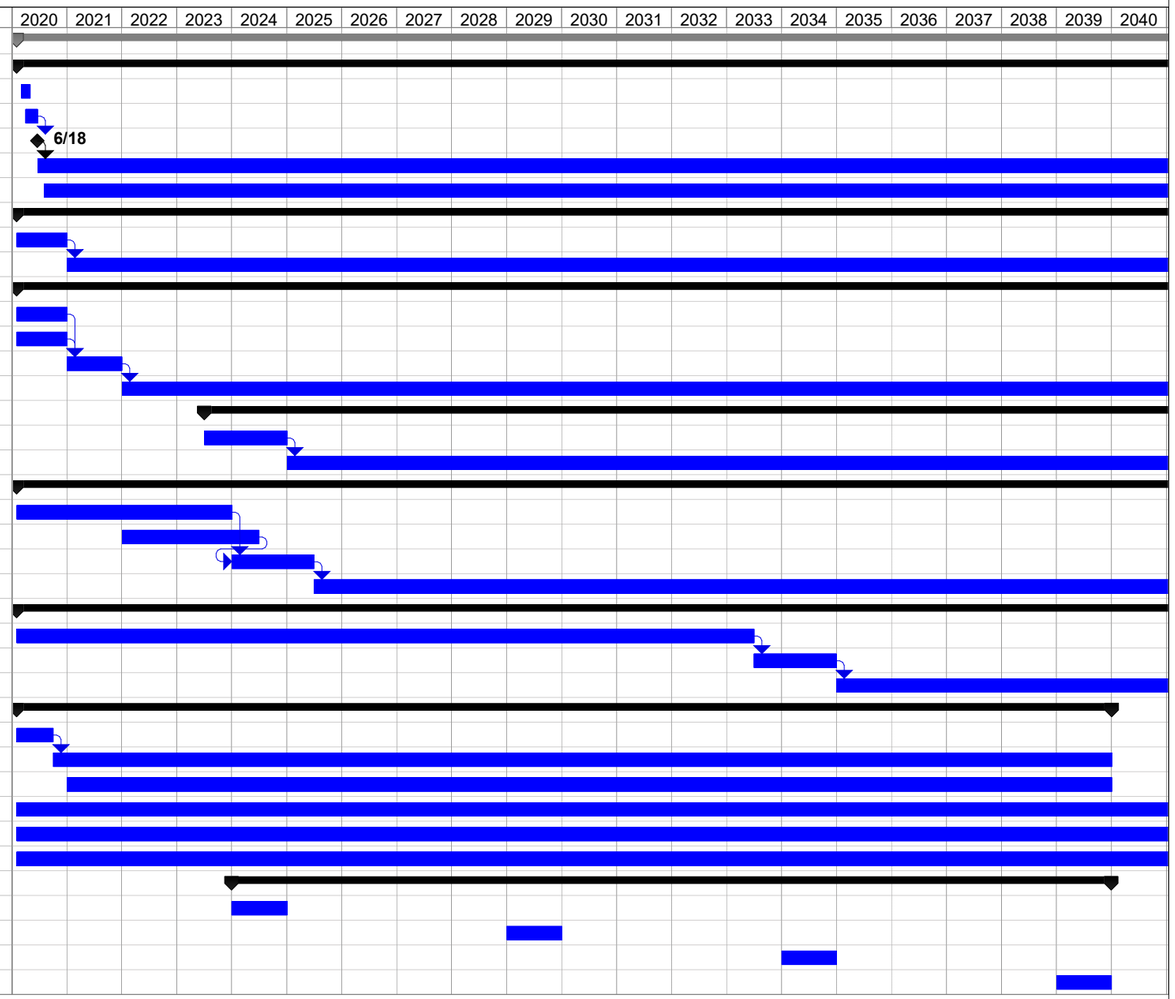
N

0 0.45 0.9 Miles

Document Path: J:\jn2652\IWV_Sec5_RecycledWaterProject2.mxd

INDIAN WELLS VALLEY GROUNDWATER AUTHORITY
Preliminary GSP Implementation Schedule
December 10, 2019

ID	Task Name	Start	Finish
0	**Preliminary GSP Program Development and Implementation Schedule**	**Mon 2/3/20**	**Wed 1/1/70**
1	**Management Action No. 1: Pumping Allocation Plan, Transient Pool, and Fallowing Program**	**Mon 2/3/20**	**Wed 1/1/70**
2	Pumping Verification Process	Wed 3/4/20	Thu 4/30/20
3	Pumping Allocations and Transient Pool Plan Development	Wed 4/1/20	Thu 6/18/20
4	Board Adoption of Pumping Allocations and Transient Pool Plan	Thu 6/18/20	Thu 6/18/20
5	Pumping Allocations and Transient Pool Plan Implementation	Fri 6/19/20	Wed 1/1/70
6	Fallowing Program Implementation	Mon 8/3/20	Wed 1/1/70
7	**Project No. 5: Dust Control Mitigation Plan**	**Mon 2/3/20**	**Wed 1/1/70**
8	Dust Control Feasibility/Planning/Permitting	Mon 2/3/20	Thu 12/31/20
9	Dust Control Mitigation Plan Implementation	Fri 1/1/21	Wed 1/1/70
10	**Project No. 3: Conservation Efforts**	**Mon 2/3/20**	**Wed 1/1/70**
11	SDAC Pilot Project: Water Audit, Leak Detection, and Leak Repair Program	Mon 2/3/20	Thu 12/31/20
12	SDAC Pilot Project: Rebate Program	Mon 2/3/20	Thu 12/31/20
13	Conservation Program Development	Fri 1/1/21	Fri 12/31/21
14	Conservation Program Implementation	Mon 1/3/22	Wed 1/1/70
15	**Project No. 6: Pumping Optimization**	**Mon 7/3/23**	**Wed 1/1/70**
16	Pumping Optimization Plan Development	Mon 7/3/23	Tue 12/31/24
17	Pumping Optimization Implementation	Wed 1/1/25	Wed 1/1/70
18	**Project No. 3: Recycled Water Project**	**Mon 2/3/20**	**Wed 1/1/70**
19	Ridgecrest WWTP Upgrades (Non-IWVGA) *	Mon 2/3/20	Mon 1/1/24
20	Recycled Water Project Feasibility/Planning/Design	Mon 1/3/22	Fri 6/28/24
21	Recycled Water Project Construction	Tue 1/2/24	Mon 6/30/25
22	Recycled Water Project Implementation	Tue 7/1/25	Wed 1/1/70
23	**Project No. 1: Imported Water Project**	**Mon 2/3/20**	**Wed 1/1/70**
24	Imported Water Supply Feasibility/Planning/Design	Mon 2/3/20	Thu 6/30/33
25	Imported Water Supply Project Construction	Fri 7/1/33	Fri 12/29/34
26	Imported Water Supply Project Implementation	Mon 1/1/35	Wed 1/1/70
27	**Project No. 4: Shallow Well Mitigation Program**	**Mon 2/3/20**	**Mon 1/2/40**
28	Shallow Well Evaluation Criteria Development	Mon 2/3/20	Wed 9/30/20
29	Impacted Shallow Well Identification and Characteriztaion	Thu 10/1/20	Mon 1/2/40
30	Shallow Well Mitigation Program Implementation	Fri 1/1/21	Mon 1/2/40
31	**GSP Monitoring Program**	Mon 2/3/20	Wed 1/1/70
32	**Data Gap Analysis and Project Implementation**	Mon 2/3/20	Wed 1/1/70
33	**GSP Annual Reports**	Mon 2/3/20	Wed 1/1/70
34	**GSP DWR Updates**	**Mon 1/1/24**	**Fri 12/30/39**
35	2025 Update	Mon 1/1/24	Tue 12/31/24
36	2030 Update	Mon 1/1/29	Mon 12/31/29
37	2035 Update	Mon 1/2/34	Fri 12/29/34
38	2040 Update	Mon 1/3/39	Fri 12/30/39



Notes:
* Schedule subject to Navy and Ridgecrest negotiations.

Task	Rolled Up Milestone	Inactive Milestone	Start-only	Baseline
Critical Task	Rolled Up Progress	Inactive Summary	Finish-only	Baseline Milestone
Milestone	Split	Manual Task	External Tasks	Baseline Summary
Summary	External Tasks	Duration-only	External Milestone	Progress
Rolled Up Task	Project Summary	Manual Summary Rollup	Critical	Deadline
Rolled Up Critical Task	Group By Summary	Manual Summary	Critical Split	