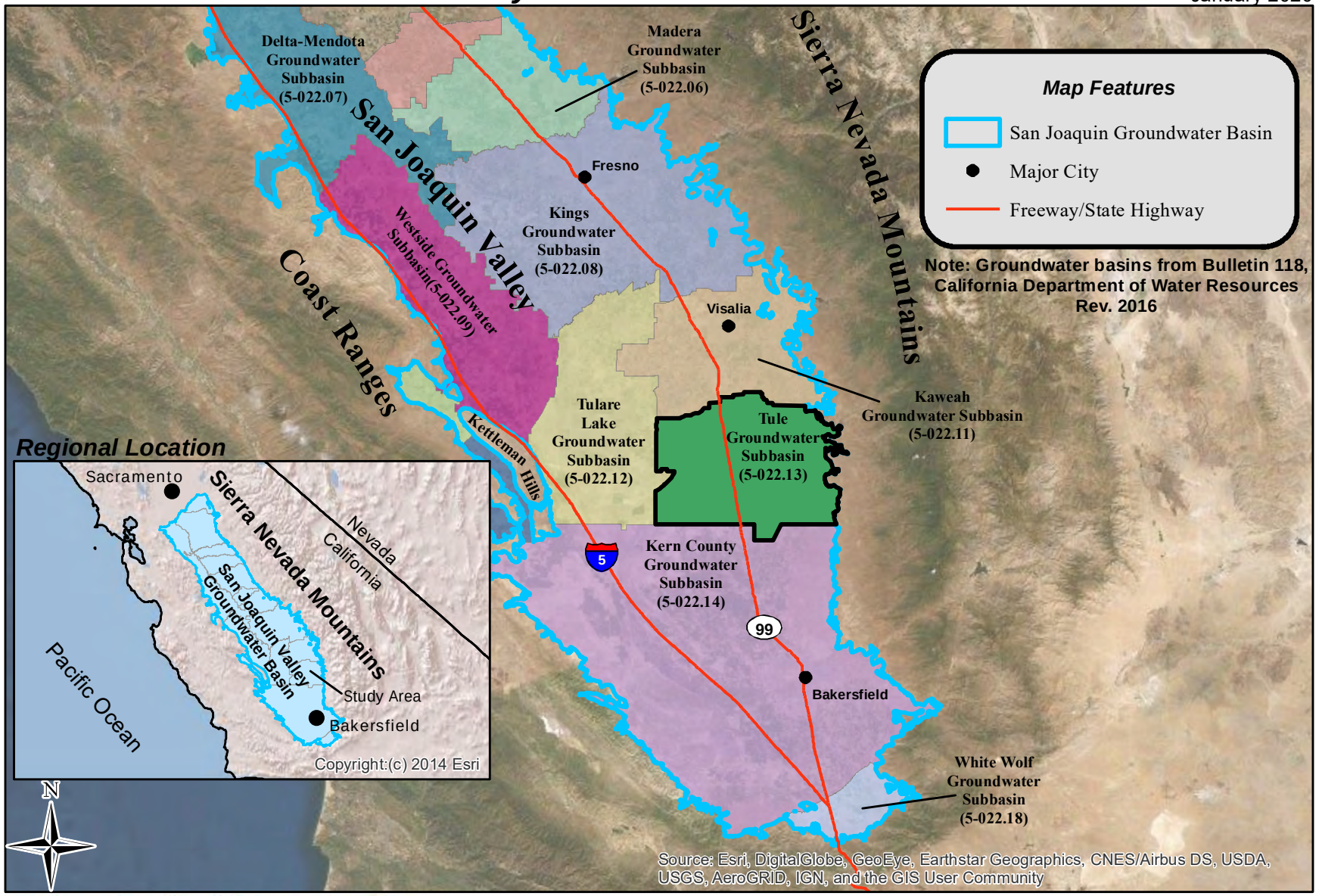
Groundwater Flow Model of the Tule Subbasin

Tule Subbasin Technical Advisory Committee

January 2020



Thomas Harder & Co.
Groundwater Consulting

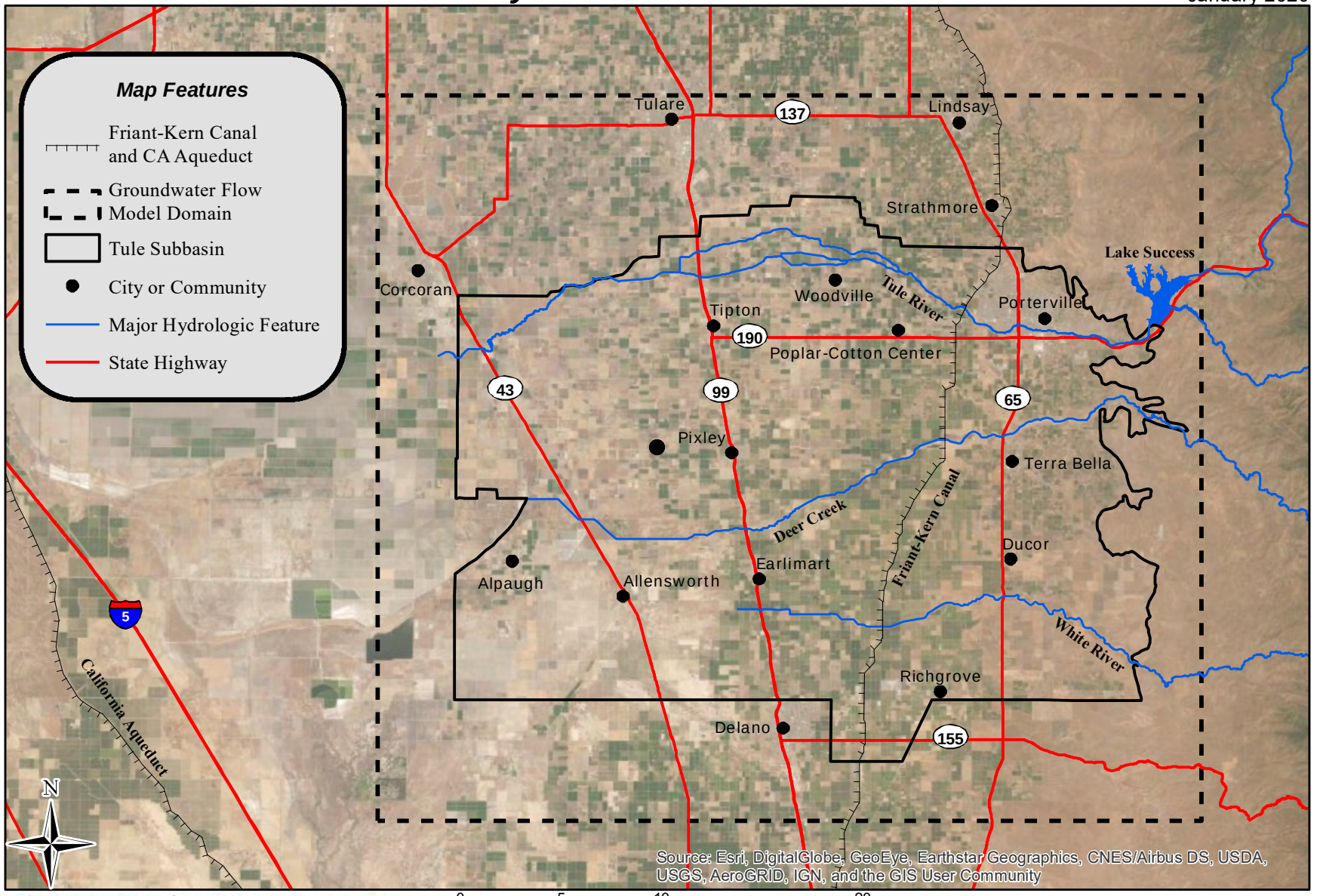
0 10 20 40
Miles

Regional Map
Figure 1

Groundwater Flow Model of the Tule Subbasin

Tule Subbasin Technical Advisory Committee

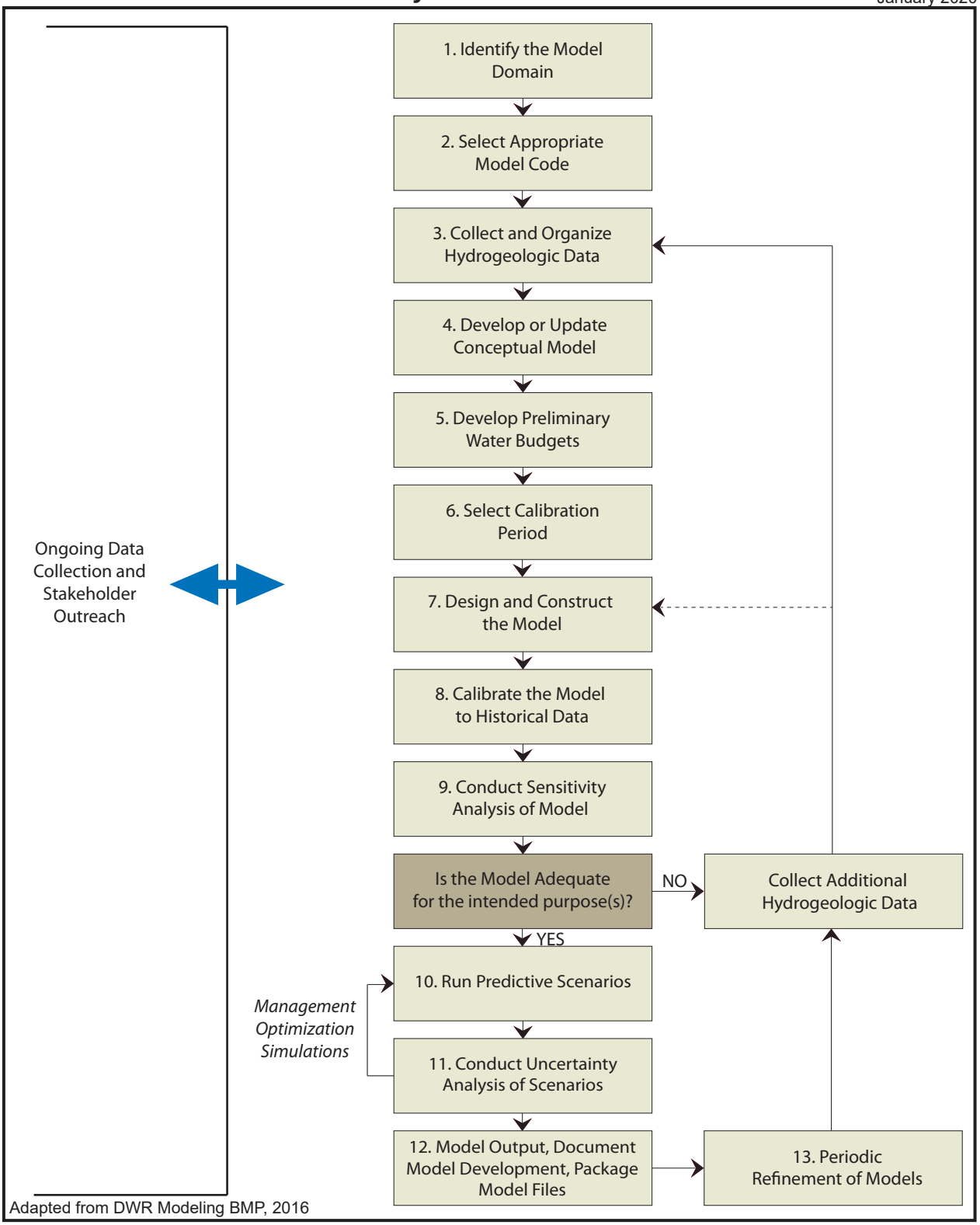
January 2020

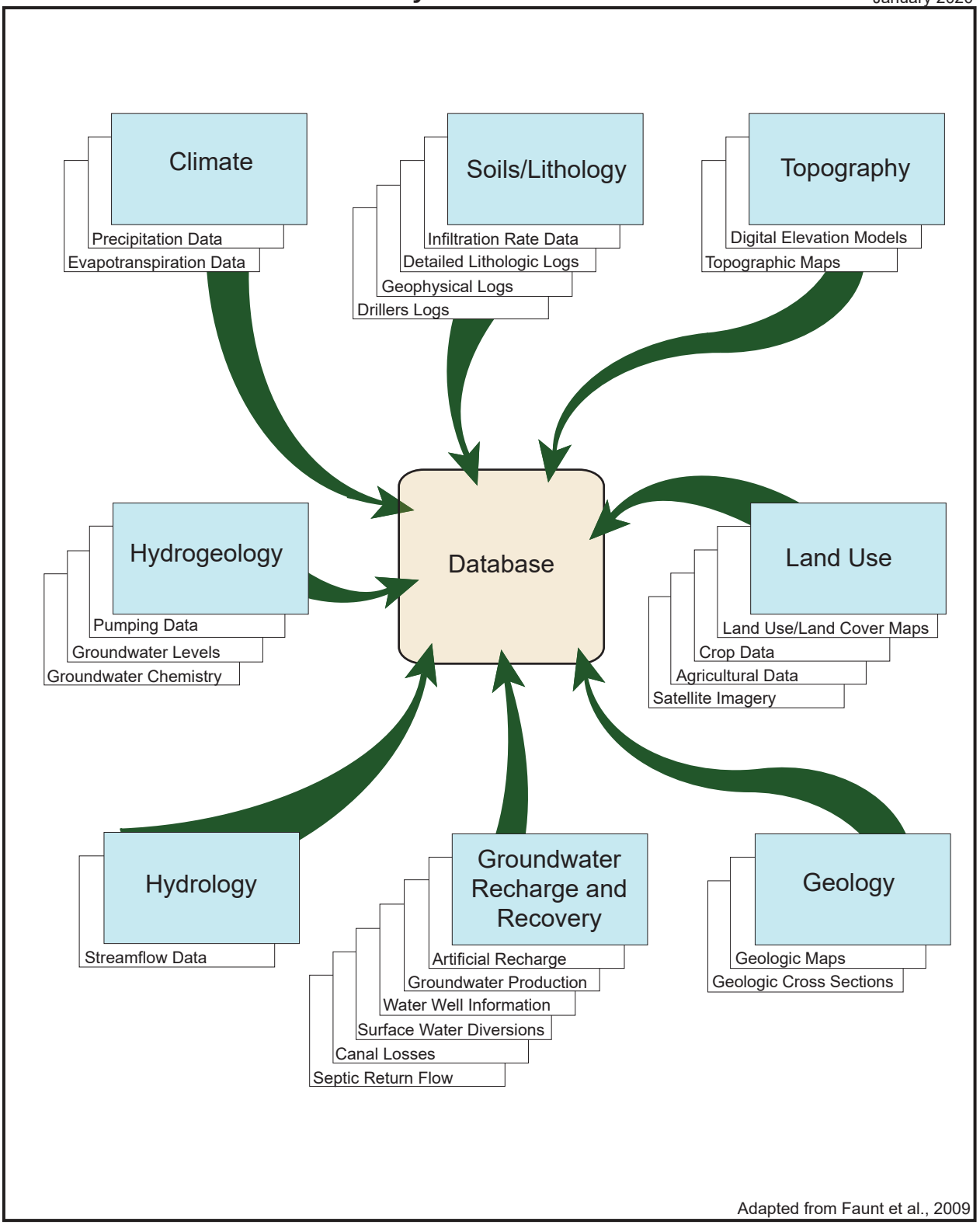


Thomas Harder & Co.
Groundwater Consulting

Study Area

Figure 2


1. Identify the Model Domain
2. Select Appropriate Model Code
3. Collect and Organize Hydrogeologic Data
4. Develop or Update Conceptual Model
5. Develop Preliminary Water Budgets
6. Select Calibration Period
7. Design and Construct the Model
8. Calibrate the Model to Historical Data
9. Conduct Sensitivity Analysis of Model
Is the Model Adequate for the intended purpose(s)?
NO
Collect Additional Hydrogeologic Data
YES
10. Run Predictive Scenarios
Management Optimization Simulations
11. Conduct Uncertainty Analysis of Scenarios
12. Model Output, Document Model Development, Package Model Files
13. Periodic Refinement of Models
Ongoing Data Collection and Stakeholder Outreach
Adapted from DWR Modeling BMP, 2016



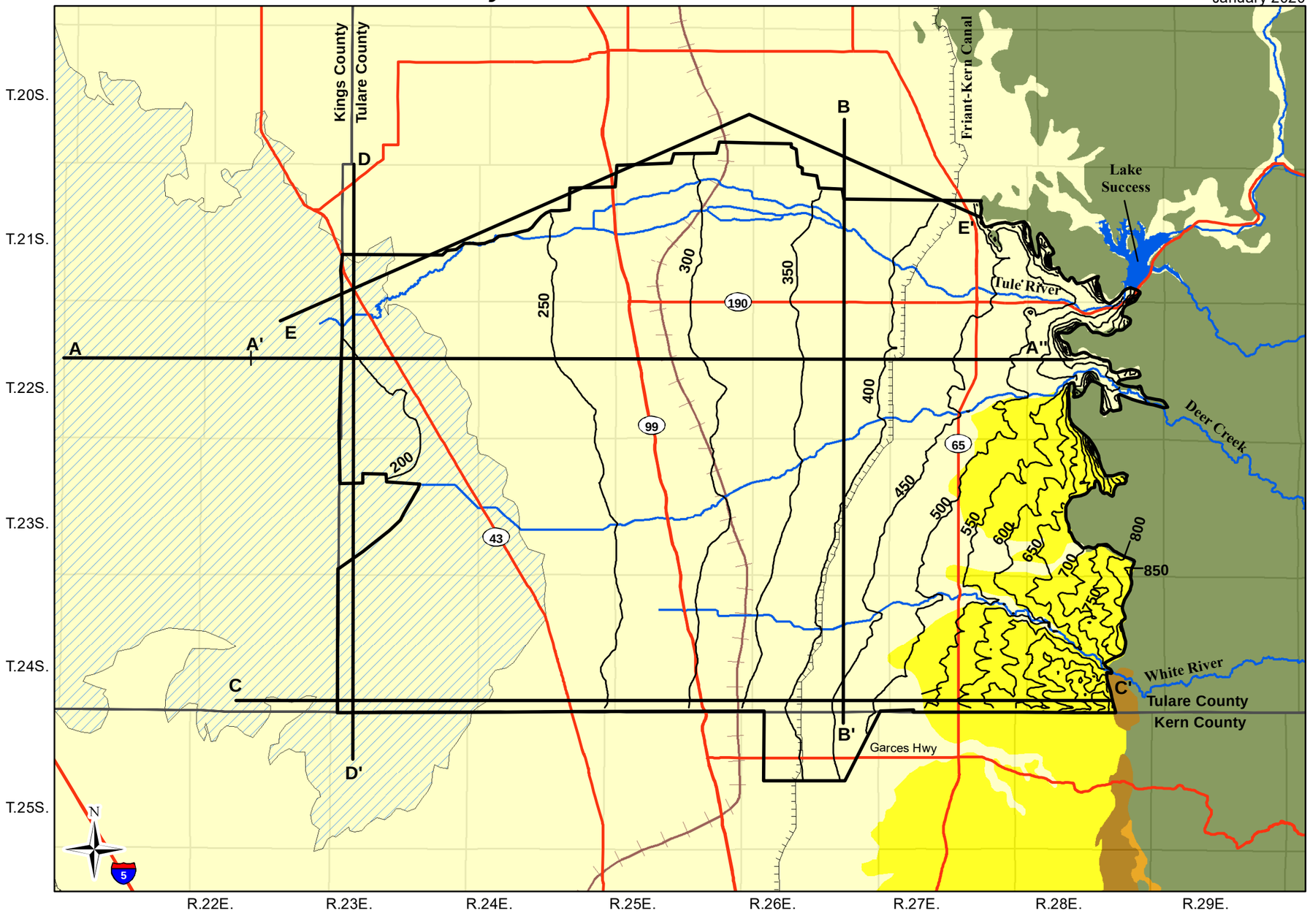
Adapted from Faunt et al., 2009

Thomas Harder & Co.
Groundwater Consulting

Data Type Diversity Flow Chart
Figure 4

Tule Subbasin Technical Advisory Committee

January 2020



Thomas Harder & Co.
Groundwater Consulting

Groundwater Flow Model of the Tule Subbasin

Map Features

- 300 — Land Surface Elevation Contour (ft amsl)
- Cross Section
- County Boundary
- Surficial Deposits
- Tertiary Loosely Consolidated Deposits
- Non-Marine Sedimentary Rocks
- Marine Sedimentary Rocks
- Crystalline Basement
- Approximate Eastern Extent of the Corcoran Clay
- Tulare Lake Surface Deposits
- Friant-Kern Canal
- Tule Subbasin
- Major Hydrologic Feature
- State Highway/Major Road

Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Geologic units modified from USGS Open-File Report 2005-1305

Lake Deposits from California Geological Survey
Geologic Atlas of California Map No. 002
1:250,000 scale, Compiled by A.R. Smith, 1964
and Geologic Atlas of California Map No. 005,
1:250,000 scale, Compiled by: R.A. Matthews and J.L. Burnett

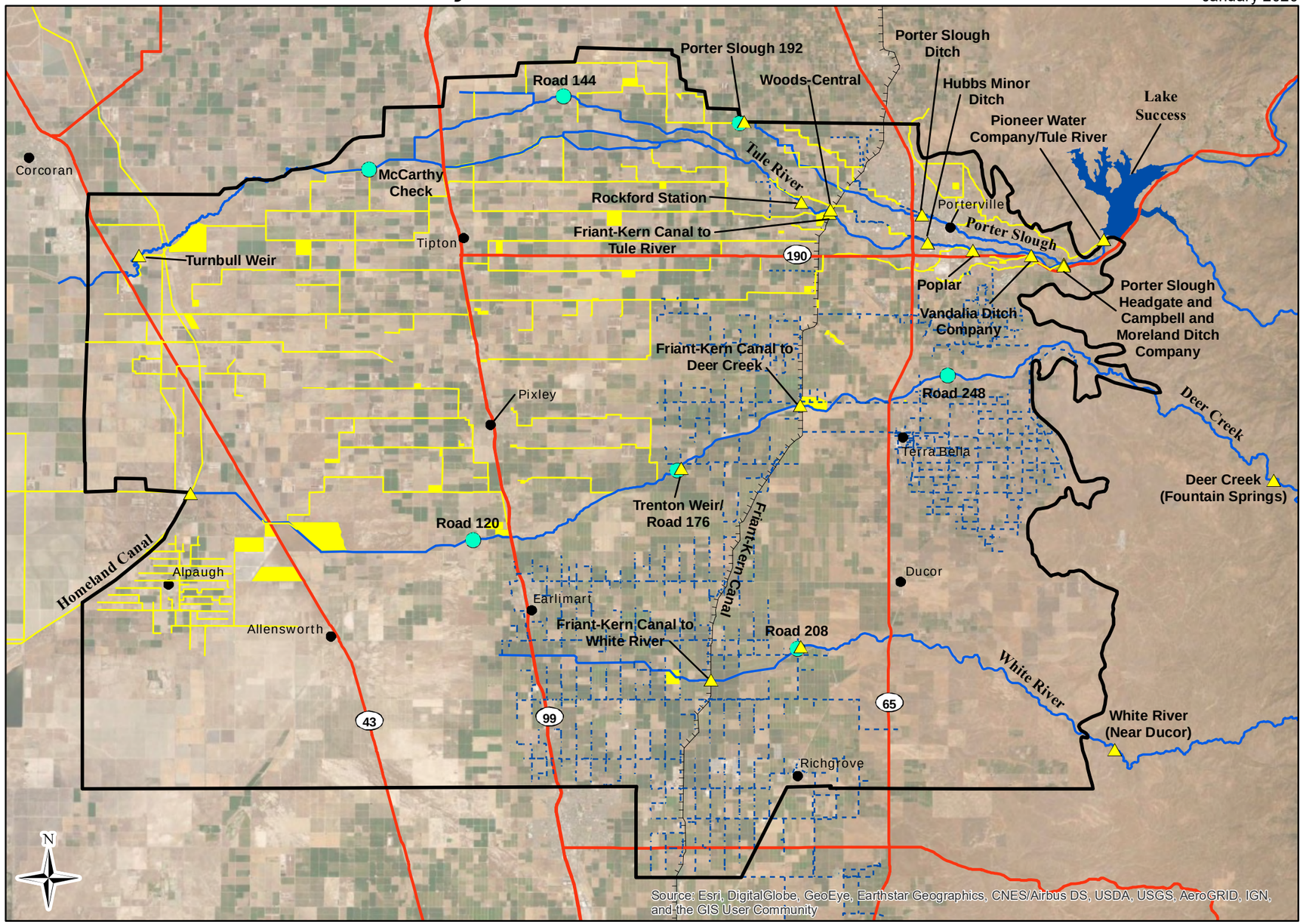
Geology and Cross Section Locations

Figure 5

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



Map Features

- Artificial Recharge Basin
- Surface Water Quality Monitoring Location
- Gaging Location/Surface Water Diversion
- Major Hydrologic Feature
- Friant-Kern Canal and California Aqueduct
- Canal
- Pipe
- Tule Subbasin
- City or Community
- Freeway/State Highway

Thomas Harder & Co.
Groundwater Consulting

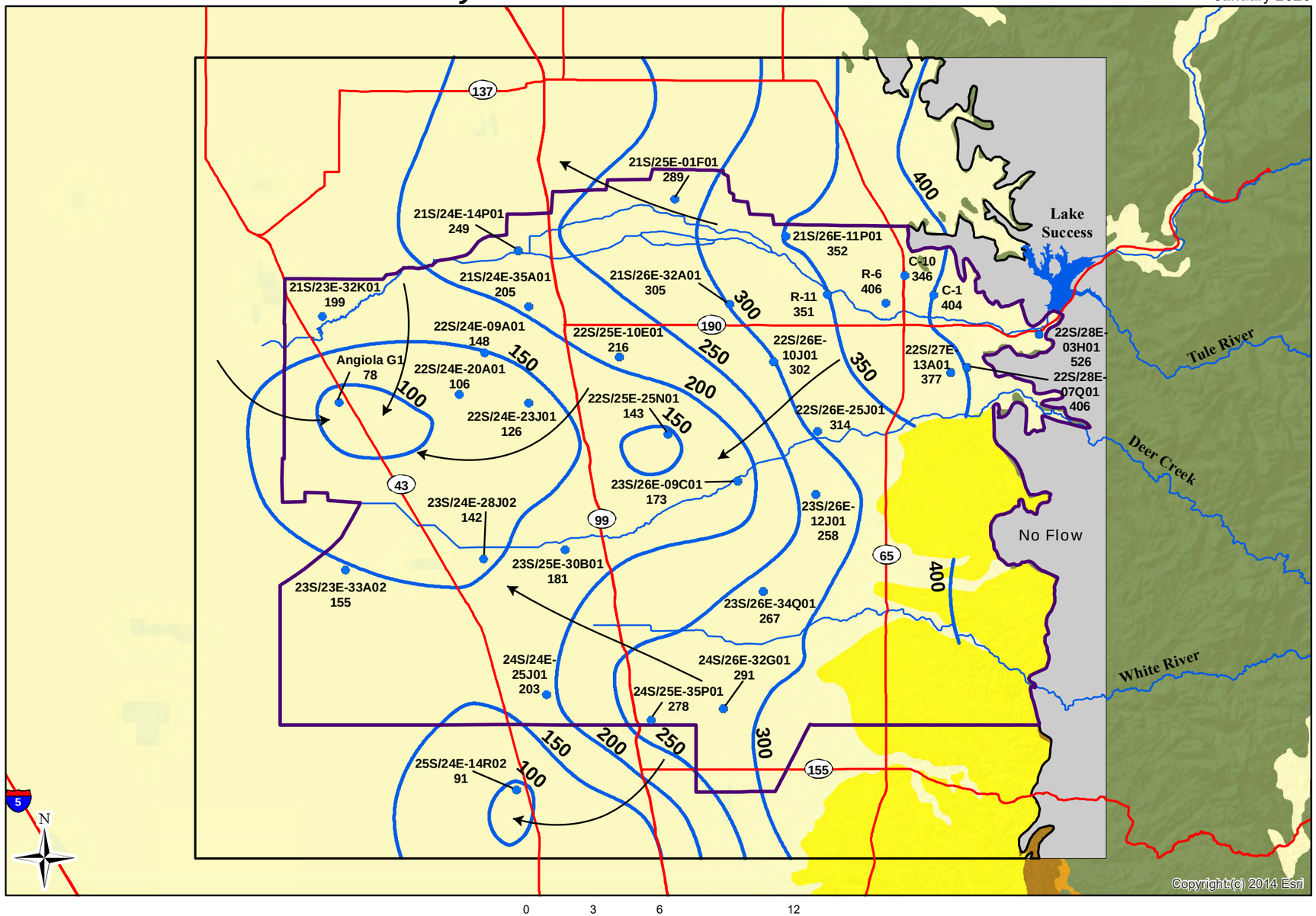
Surface Water Features in the Tule Subbasin and Vicinity

Figure 6

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



NAD 83 State Plane Zone 4

Map Features

22S/25E-25N01
143

- Well with Groundwater Elevation (ft amsl)
- 150 Groundwater Elevation Contour (ft amsl)
- Groundwater Flow Direction
- Surficial Deposits
- Tertiary Loosely Consolidated Deposits
- Non-Marine Sedimentary Rocks
- Marine Sedimentary Rocks
- Crystalline Basement
- State Highway/Major Road
- Tule Subbasin
- No Flow
- Model Domain

Note: All groundwater elevations in feet above mean sea level. Groundwater elevations measured from October 1986 to March 1990.

Thomas Harder & Co.
Groundwater Consulting

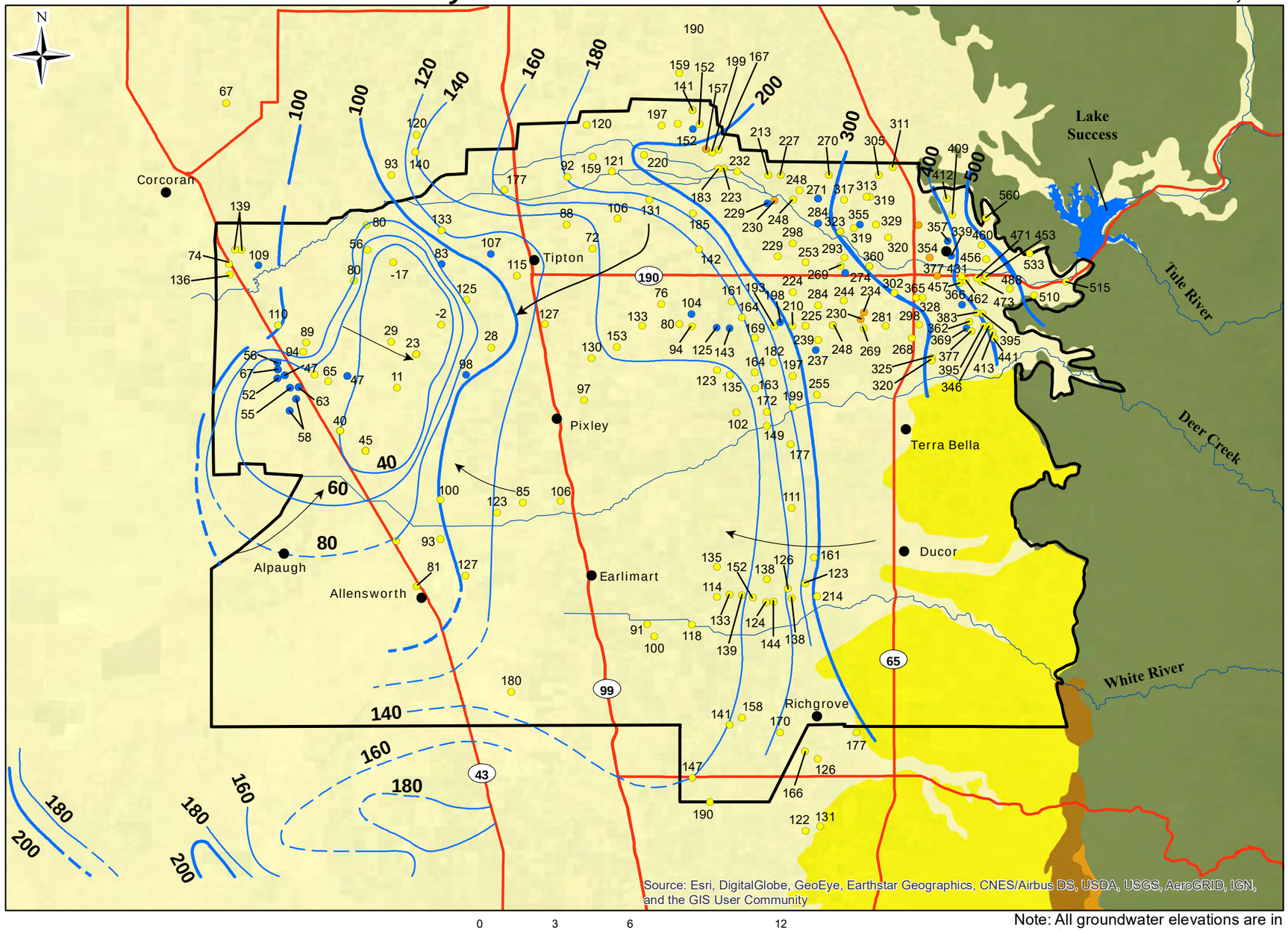
Initial Groundwater Elevations Upper Aquifer - Model Layer 1

Figure 7

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



Map Features

- 140 — Groundwater Elevation Contour, dashed where approximate (ft amsl)
- Groundwater Flow Direction
- Groundwater Elevations from Well with Unknown Perforation Interval
- Groundwater Elevations from Well with Perforations in the Upper and Lower Aquifer
- Groundwater Elevations from Well with Perforations in the Upper Aquifer
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road
- Surficial Deposits
- Tertiary Loosely Consolidated Deposits
- Non-Marine Sedimentary Rocks
- Marine Sedimentary Rocks
- Crystalline Basement

Groundwater contours shown south of the Tule Subbasin and west of Highway 43 are depicted based on Water-Level Elevations And Direction of Groundwater Flow For the Upper Zone (Spring 2017)

Note: All groundwater elevations are in feet above mean sea level.

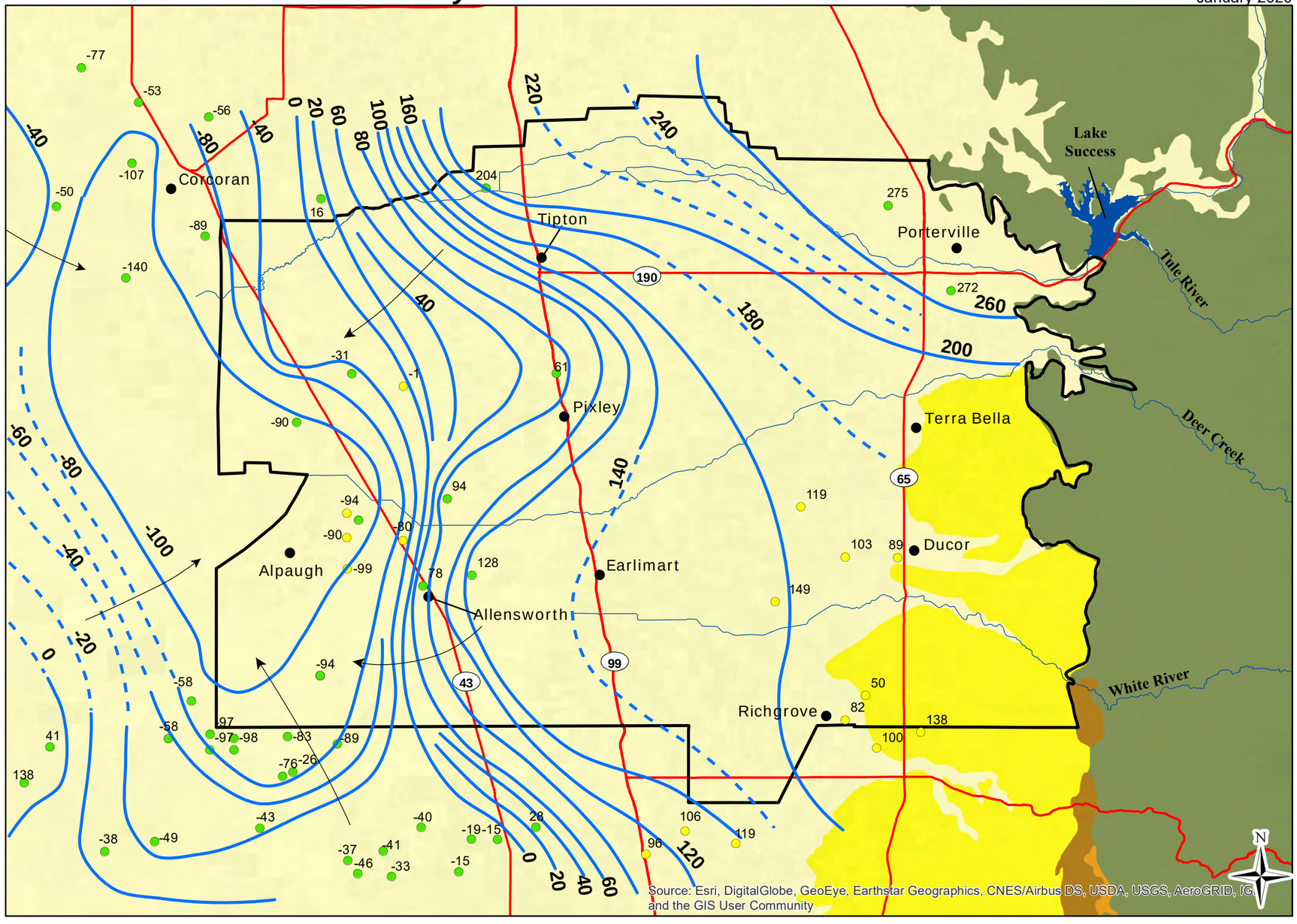
Groundwater Elevations are measured from January to May.

Spring 2017 Upper Aquifer Groundwater Elevation Contours

Figure 8

Tule Subbasin Technical Advisory Committee

January 2020



Thomas Harder & Co.
Groundwater Consulting

Groundwater Flow Model of the Tule Subbasin

Map Features

- 140 — Groundwater Elevation Contour, dashed where approximate (ft amsl)
- Groundwater Flow Direction
- Groundwater Elevations from Well with Perforations in the Deep Aquifer
- Groundwater Elevations from Well with Unknown Perforation Interval
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road
- Surficial Deposits
- Tertiary loosely consolidated deposits
- Non-Marine Sedimentary Rocks
- Marine Sedimentary Rocks
- Crystalline Basement

Note: All groundwater elevations are in feet above mean sea level.

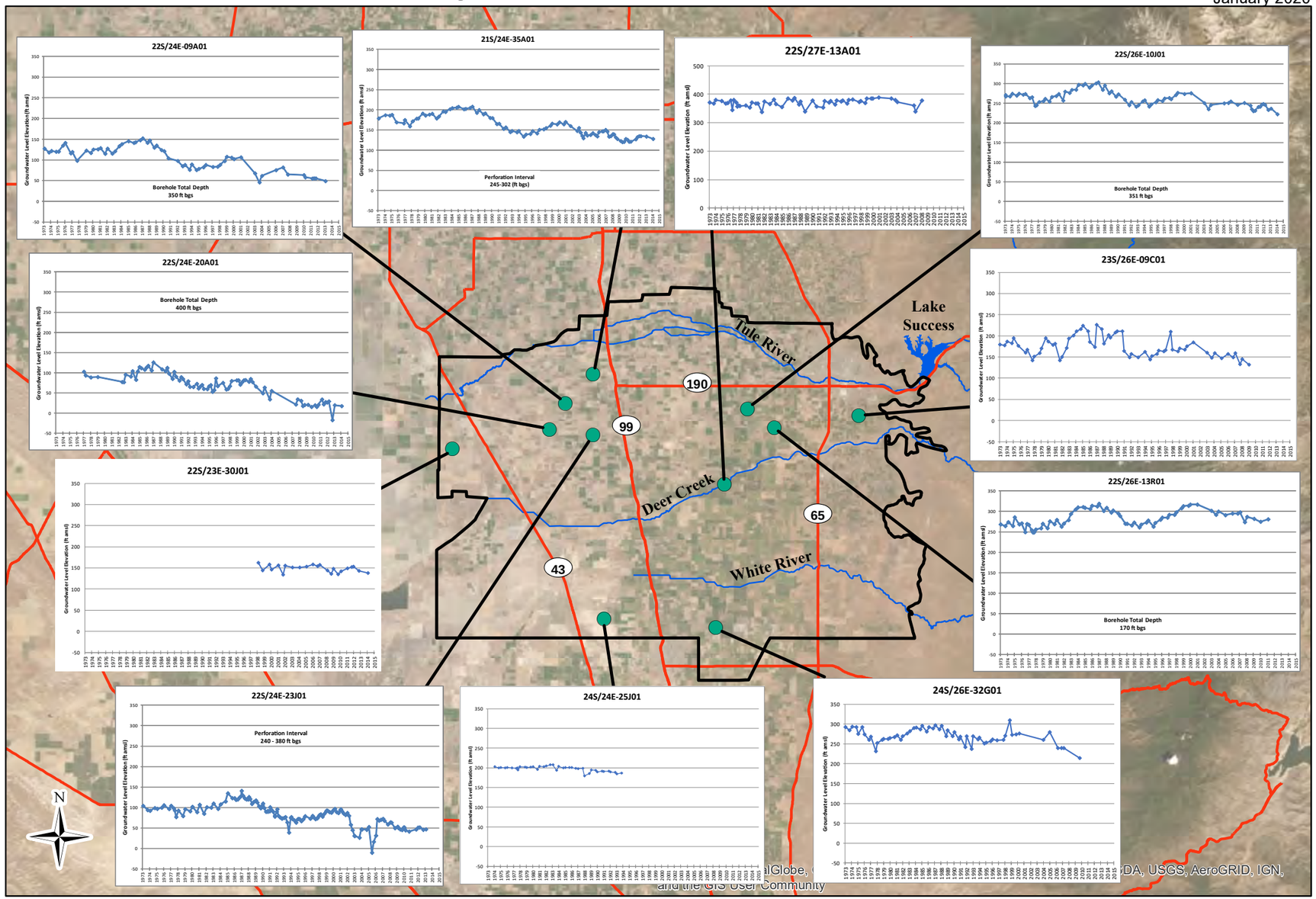
Groundwater Elevations are measured from October to December.

Fall 2010 Lower Aquifer Groundwater Elevation Contours

Figure 9

Tule Subbasin Technical Advisory Committee

January 2020



Groundwater Flow Model of the Tule Subbasin

Map Features

- Hydrograph Well
- Tule Subbasin
- Major Hydrologic Feature
- State Highway/Major Road

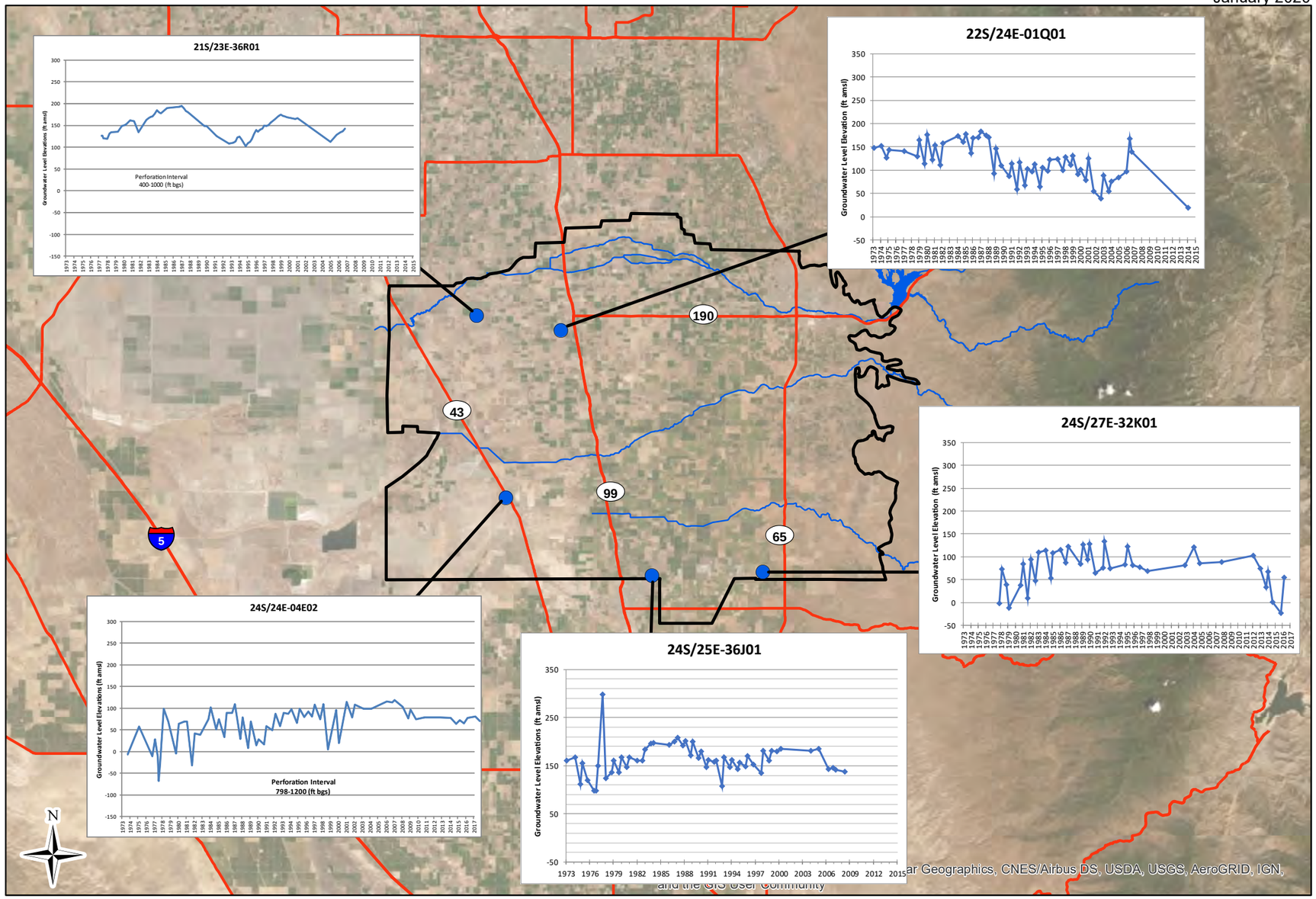
Thomas Harder & Co.
Groundwater Consulting

Upper Aquifer Groundwater Level Hydrographs

Figure 10

Tule Subbasin Technical Advisory Committee

January 2020



NAD 83 State Plane Zone 4

Groundwater Flow Model of the Tule Subbasin

Map Features

- Hydrograph Well
- Tule Subbasin
- Major Hydrologic Feature
- State Highway/Major Road

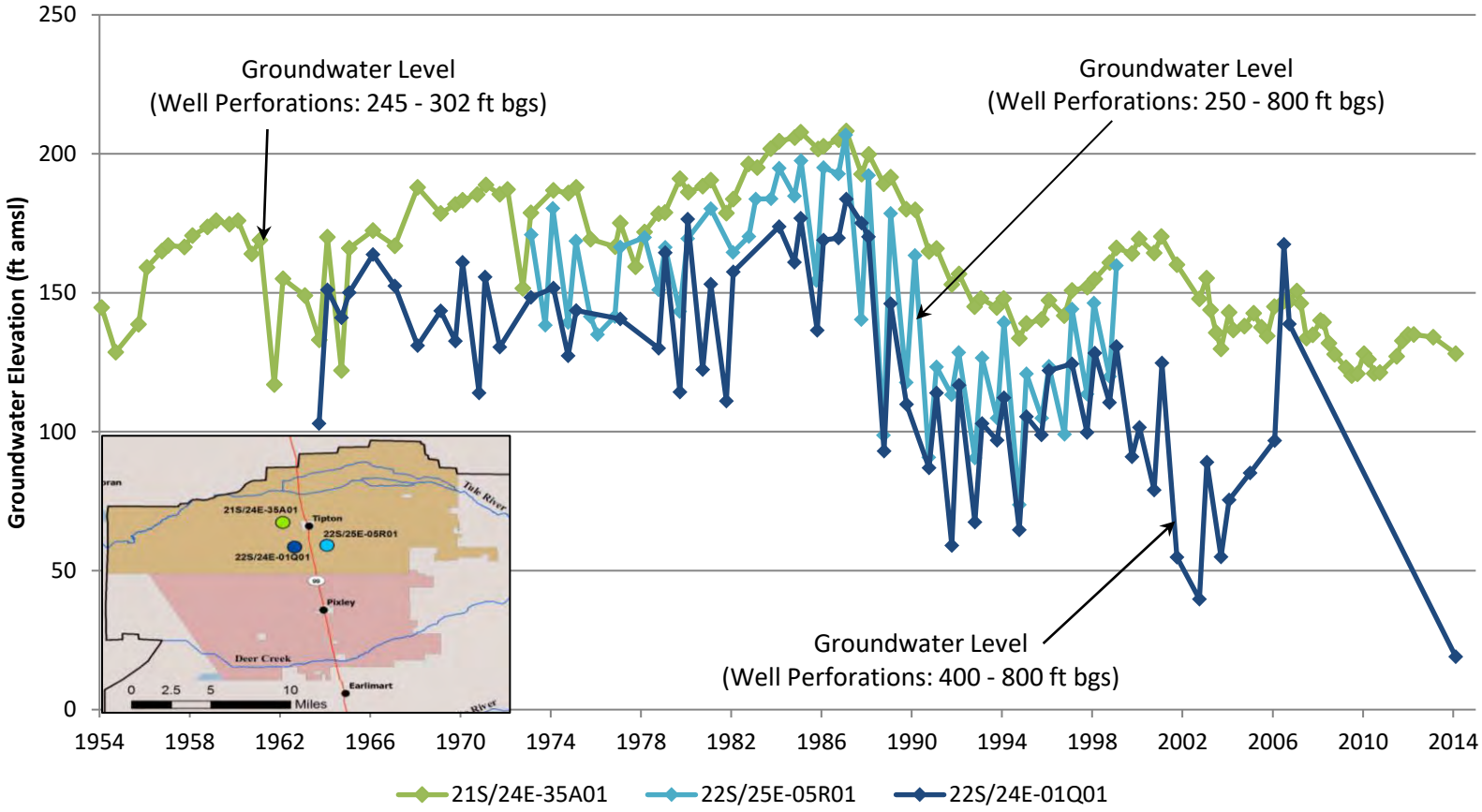
Thomas Harder & Co.
Groundwater Consulting

Lower Aquifer Groundwater Level Hydrographs

Figure 11

Figure 12

Comparison of Upper Aquifer and Lower Aquifer Groundwater Levels

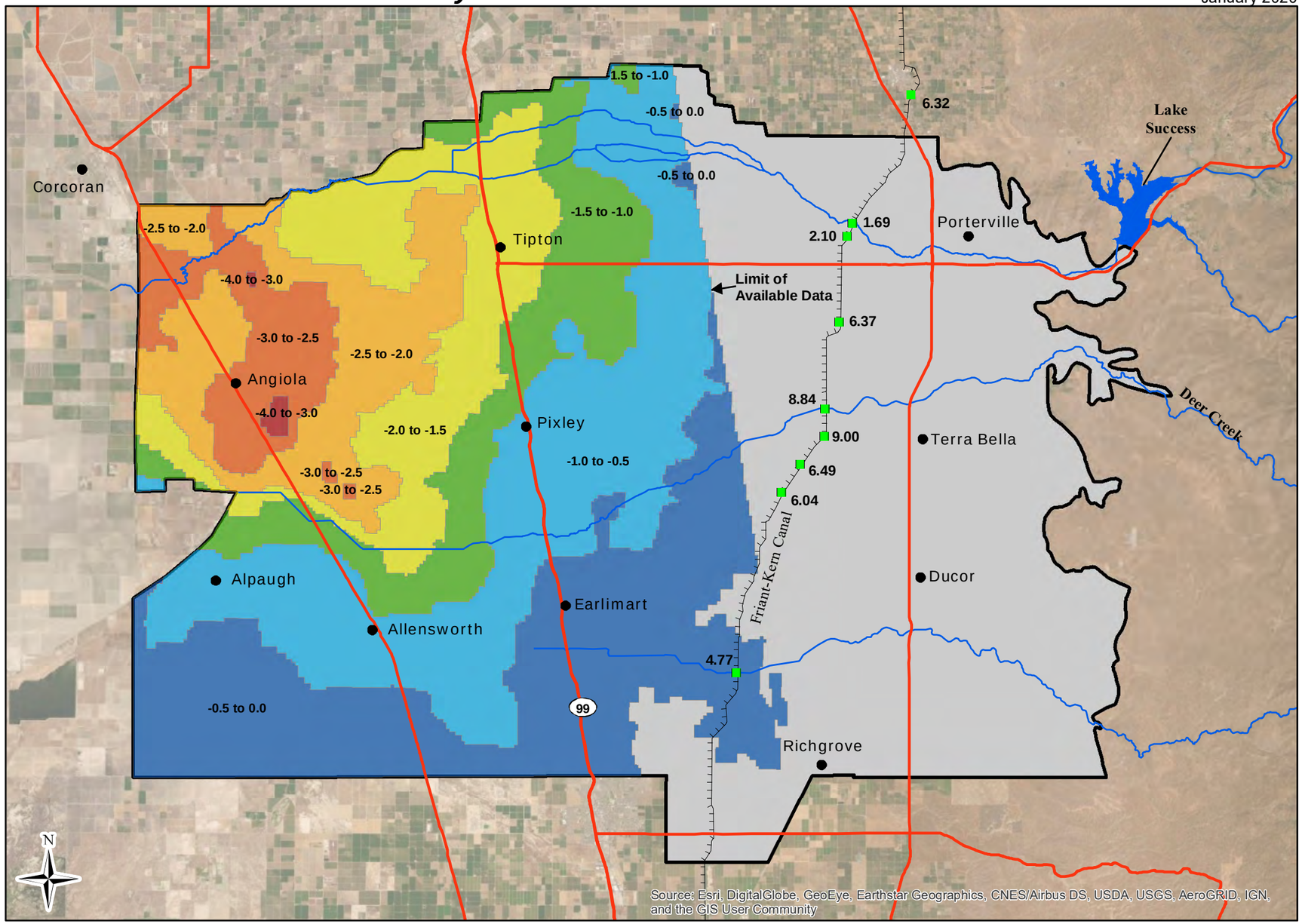


Note:

ft bgs = feet below ground surface.

Tule Subbasin Technical Advisory Committee

January 2020



Thomas Harder & Co.
Groundwater Consulting

Groundwater Flow Model of the Tule Subbasin

Map Features

2007 - 2011 Land Surface Subsidence* (ft)

- -4.0 to -3.0
- -3.0 to -2.5
- -2.5 to -2.0
- -2.0 to -1.5
- -1.5 to -1.0
- -1.0 to -0.5
- -0.5 to 0.0

Measured Subsidence Points along the Friant-Kern Canal (ft) 1959-2017

Friant-Kern Canal

Basin Boundary

City or Community

Major Hydrologic Feature

Freeway/State Highway

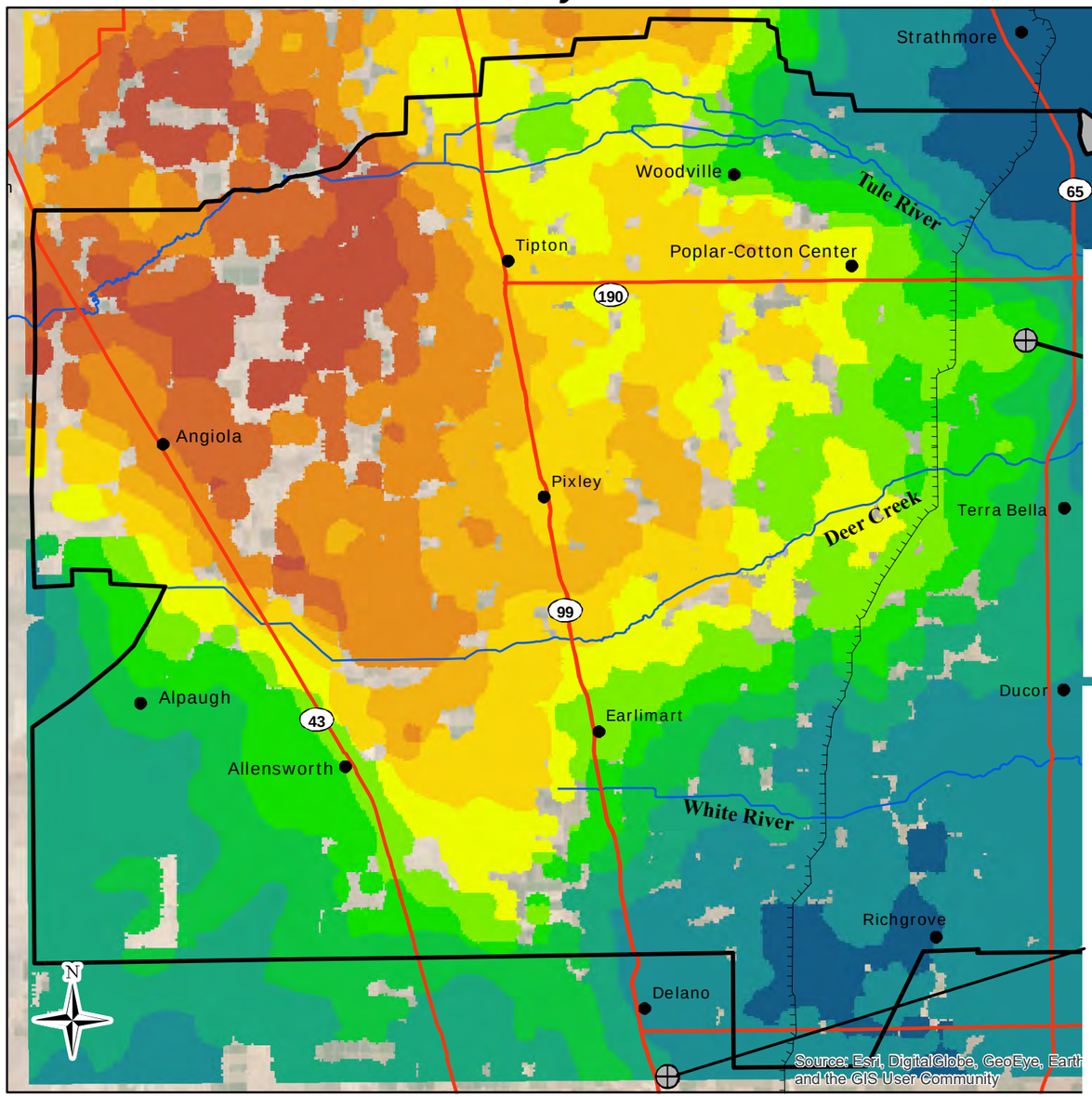
*From LSCE, 2014

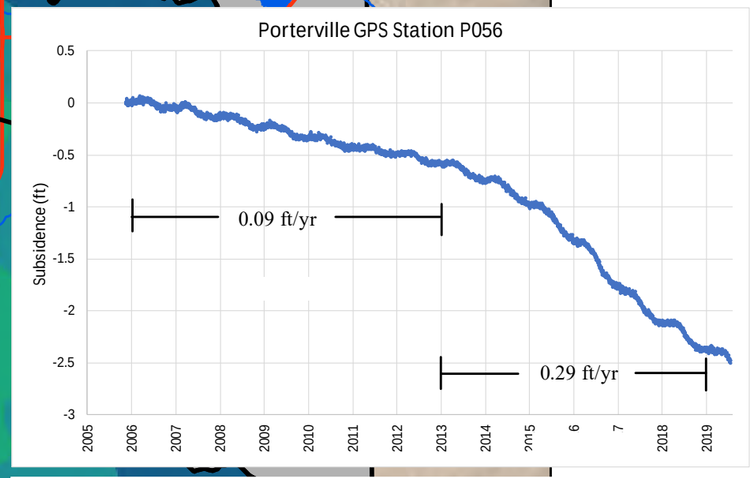
2007 to 2011 Land Subsidence

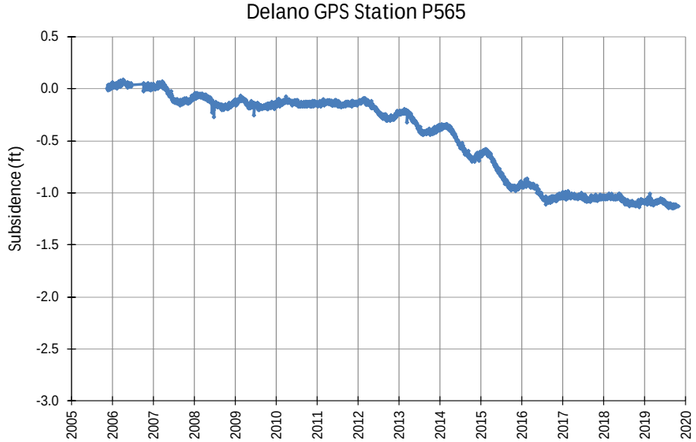
Figure 13

Tule Subbasin Technical Advisory Committee

January 2020







GPS data from UNAVCO 2005 - 2019
InSAR data from Tre Altamira Jan 2015 - June 2018

0 2 4 8 Miles

NAD 83 State Plane Zone 4

Groundwater Flow Model of the Tule Subbasin

Map Features

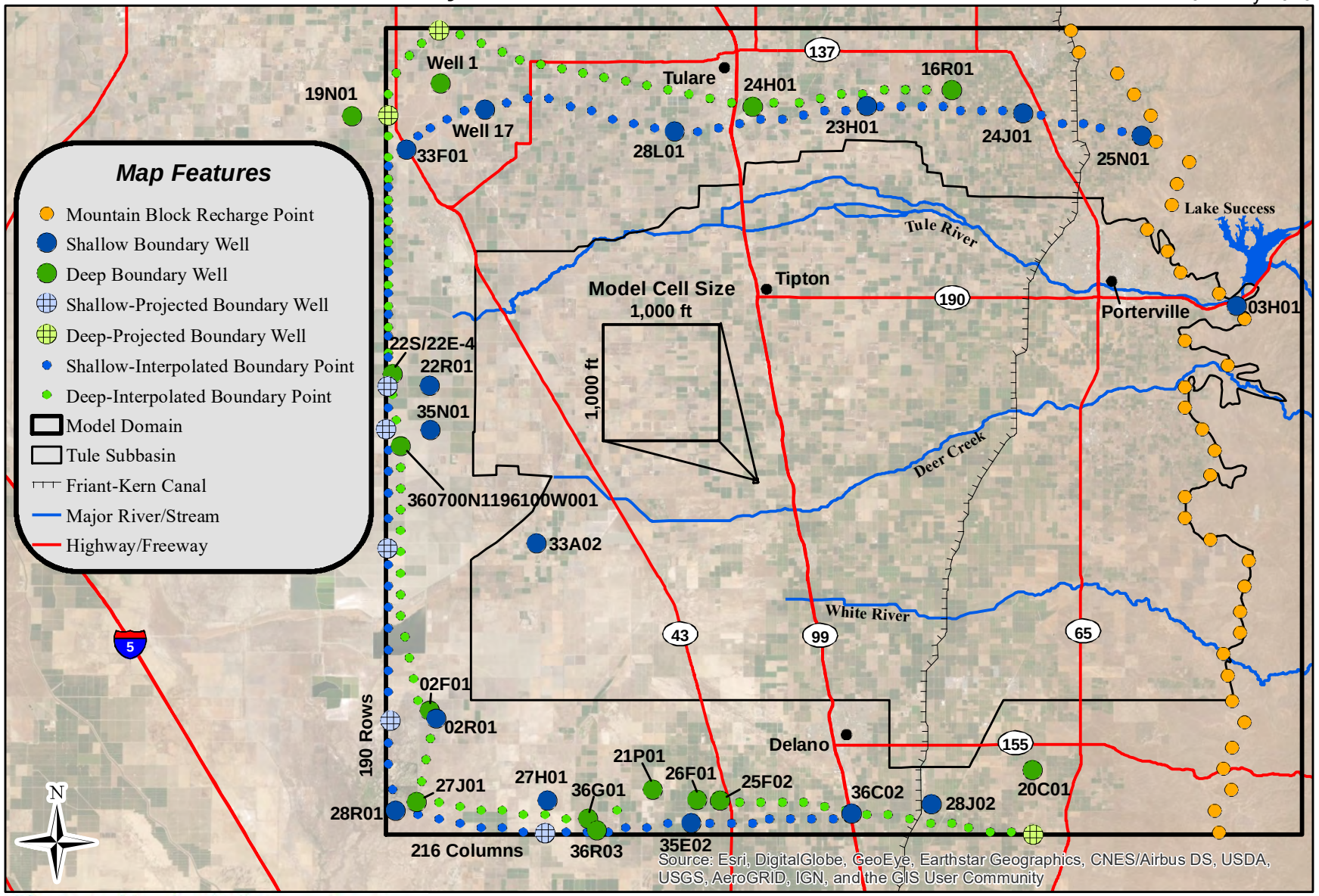
InSAR Subsidence from 2015 to 2018 (ft)

- -2.75 to -2.50
- -2.50 to -2.25
- -2.25 to -2.00
- -2.00 to -1.75
- -1.75 to -1.50
- -1.50 to -1.25
- -1.25 to -1.00
- -1.00 to -0.75
- -0.75 to -0.50
- -0.50 to -0.25
- -0.25 to 0
- 0 to 0.25
- 0.25 to 0.50
- GPS Station
- Friant-Kern Canal
- No Flow Boundary
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road

Thomas Harder & Co.
Groundwater Consulting

2015 to 2018 Land Subsidence

Figure 14



Thomas Harder & Co.
Groundwater Consulting

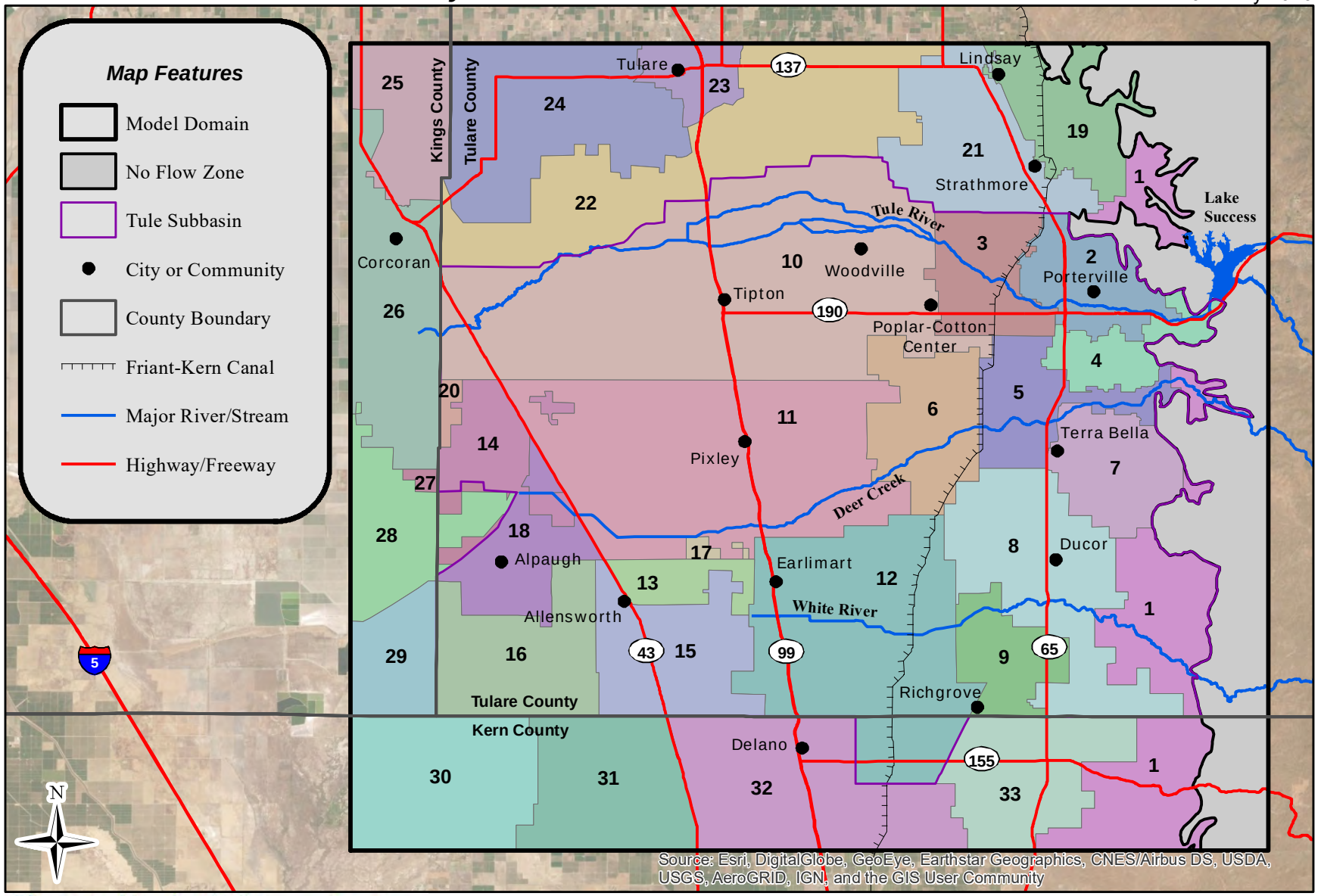
0 2.5 5 10 Miles

NAD 83 State Plane Zone 4

Model Domain and Boundary Conditions

Figure 15

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

0 2 4 8 Miles

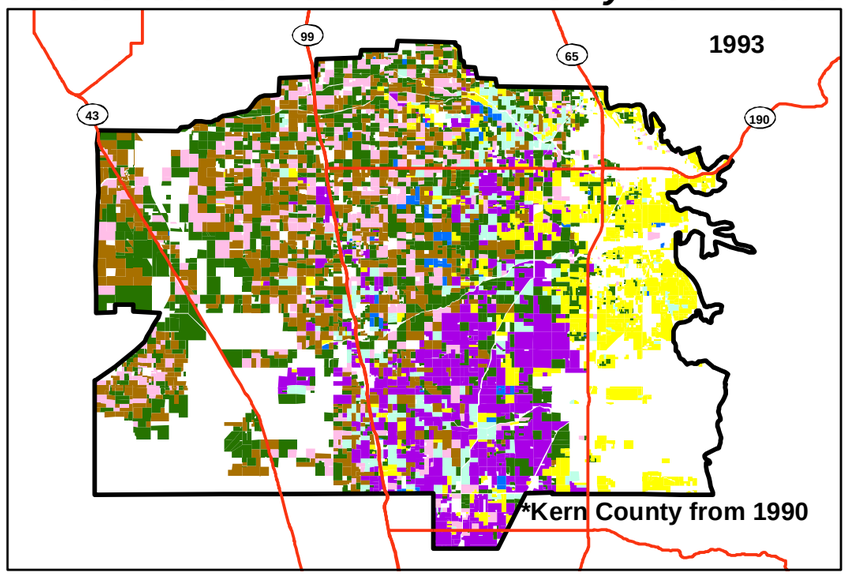
NAD 83 State Plane Zone 4

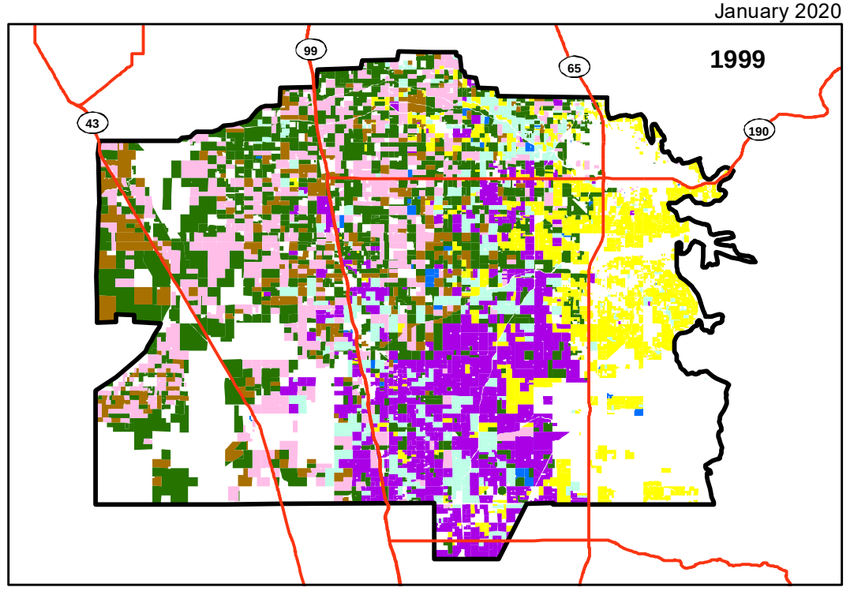
Water Budget Areas

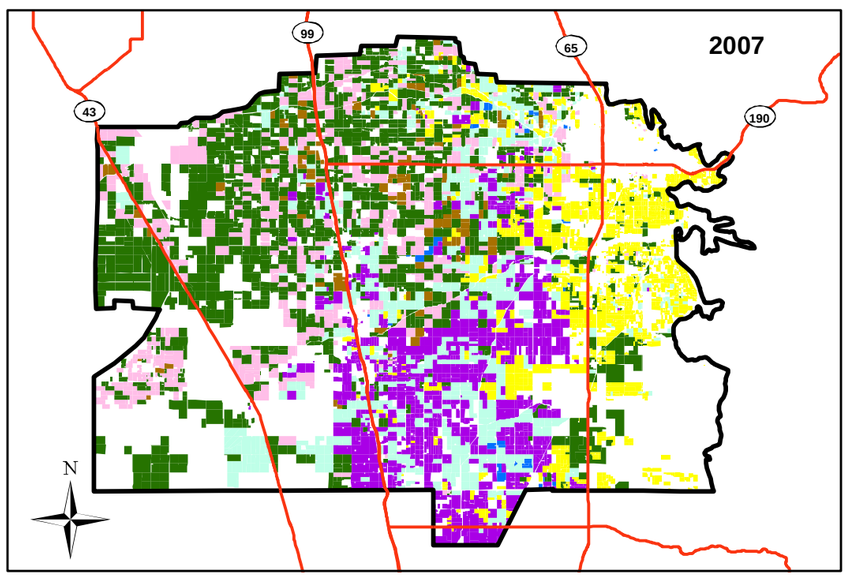
Figure 16

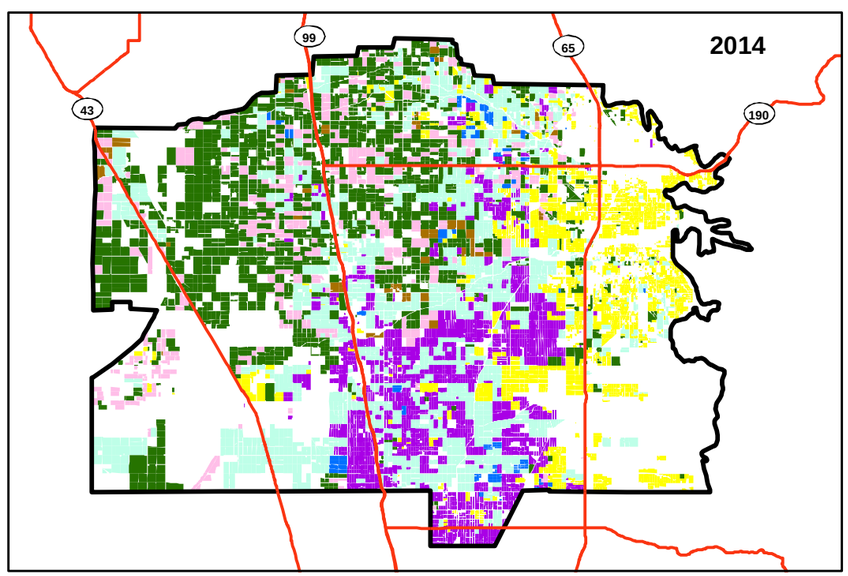
Tule Subbasin Technical Advisory Committee

January 2020









0 3 6 12 Miles

NAD 83 State Plane Zone 4

Groundwater Flow Model of the Tule Subbasin

Map Features

- Tule Groundwater Subbasin
- Alfalfa, Pasture
- Corn, Grain, Grain Hay, and Misc. Field Crops
- Cotton
- Deciduous & Fruit Trees
- Grapes
- Nuts
- Truck Crops
- Major Road

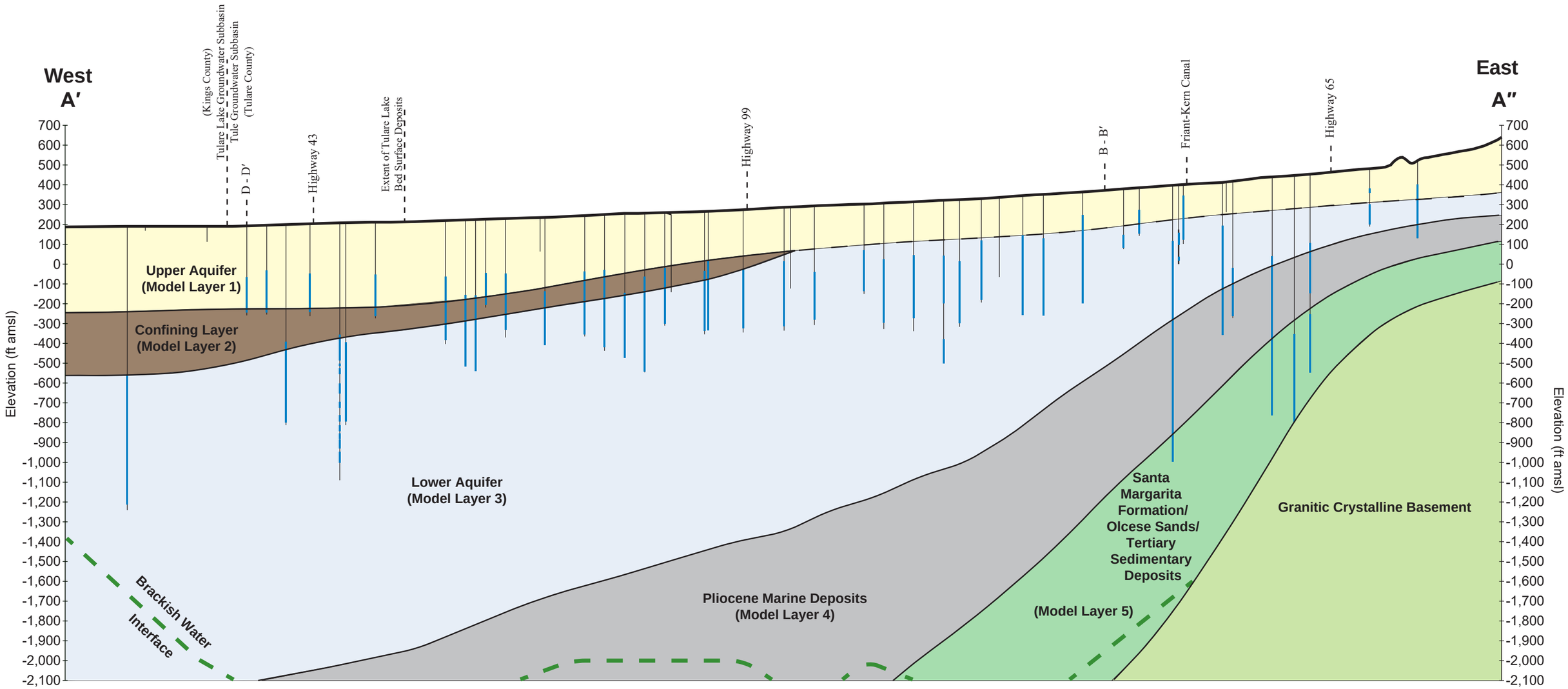
Notes: Data from California Department of Water Resources and Kern County Department of Agriculture and Measurement Standards

Irrigated crops only.

Thomas Harder & Co.
Groundwater Consulting

Tule Groundwater Subbasin Historical Crop Patterns

Figure 17



Vertical Scale
0
100
200
400
Feet

Horizontal Scale
0 1/2 1 2 Miles

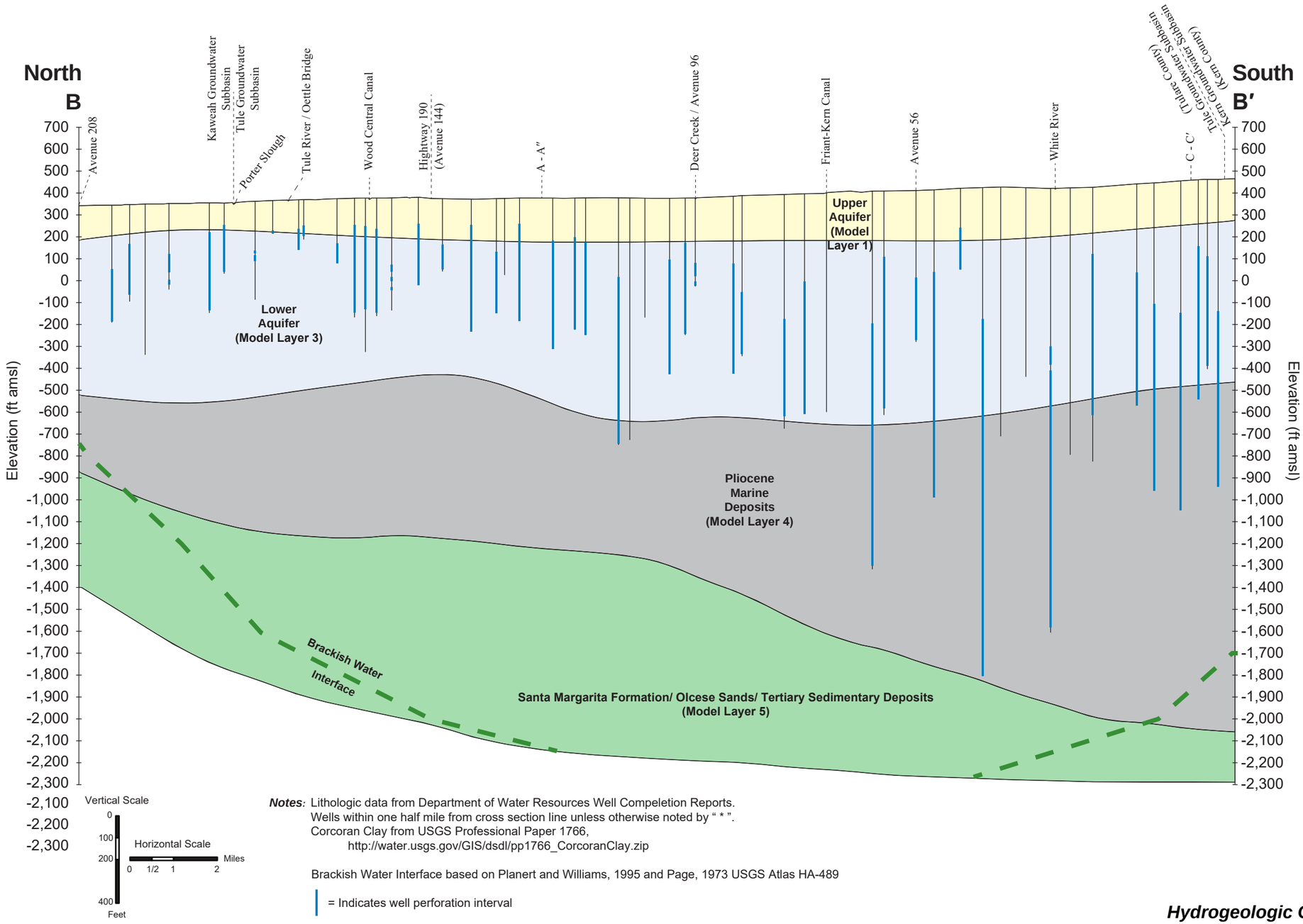
Notes: Lithologic data from Department of Water Resources Well Compeletion Reports.
Wells within one half mile from cross section line unless otherwise noted by " * ".
Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

| = Indicates well perforation interval

Thomas Harder & Co.
Groundwater Consulting

Hydrogeologic Cross Section A'-A"
Tule Groundwater Subbasin
Figure 18
January 2020



Notes: Lithologic data from Department of Water Resources Well Compeletion Reports.
Wells within one half mile from cross section line unless otherwise noted by " * ".
Corcoran Clay from USGS Professional Paper 1766,
http://water.usgs.gov/GIS/dsdl/pp1766_CorcoranClay.zip

Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

| = Indicates well perforation interval

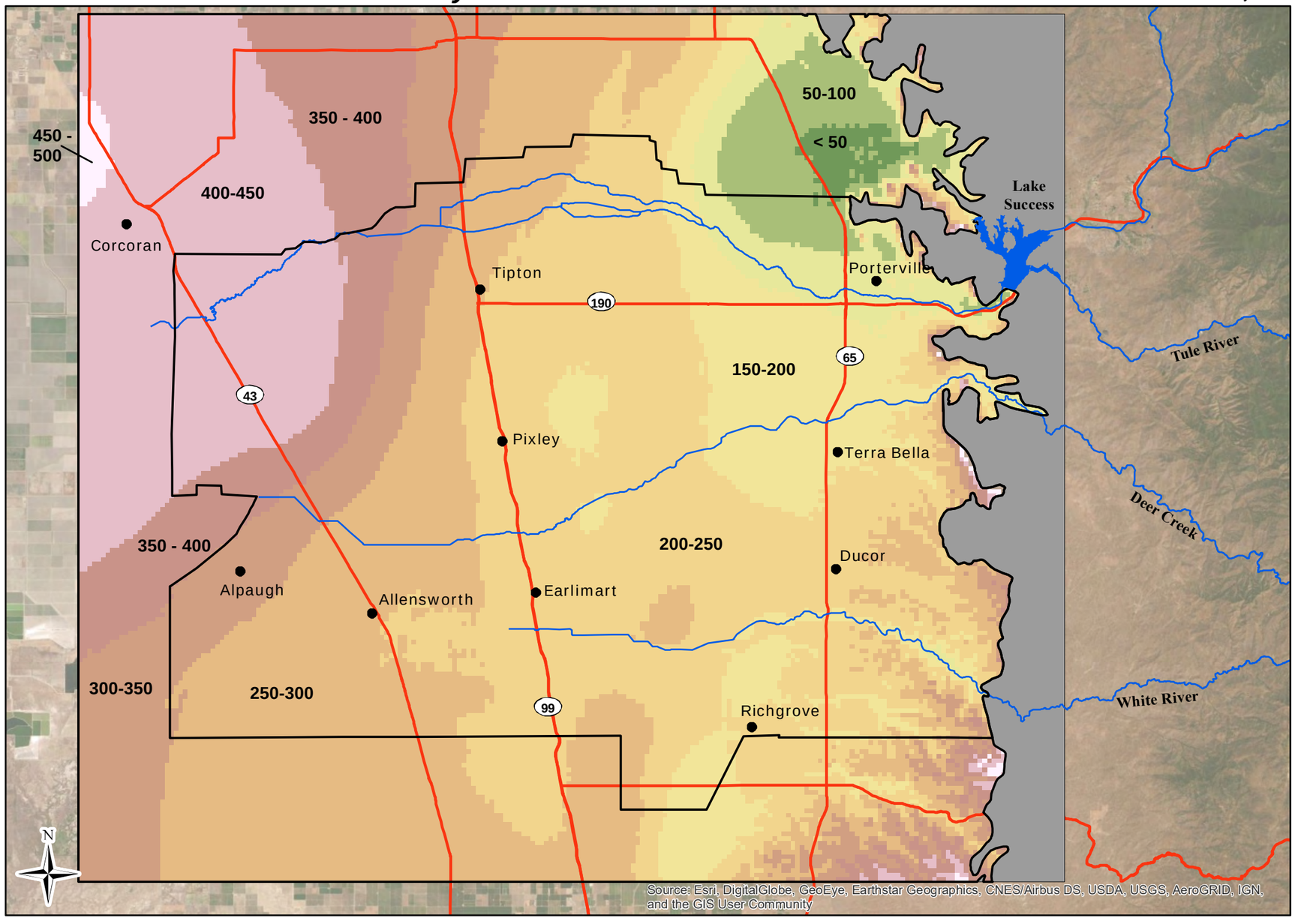
Thomas Harder & Co.
Groundwater Consulting

Hydrogeologic Cross Section B-B'
Tule Groundwater Subbasin
Figure 19
January 2020

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



Map Features

Model Layer 1 Thickness (ft)

- < 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- 300 - 350
- 350 - 400
- 400 - 450
- 450 - 500
- No Flow
- Model Domain
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road

Layer 1 Thickness

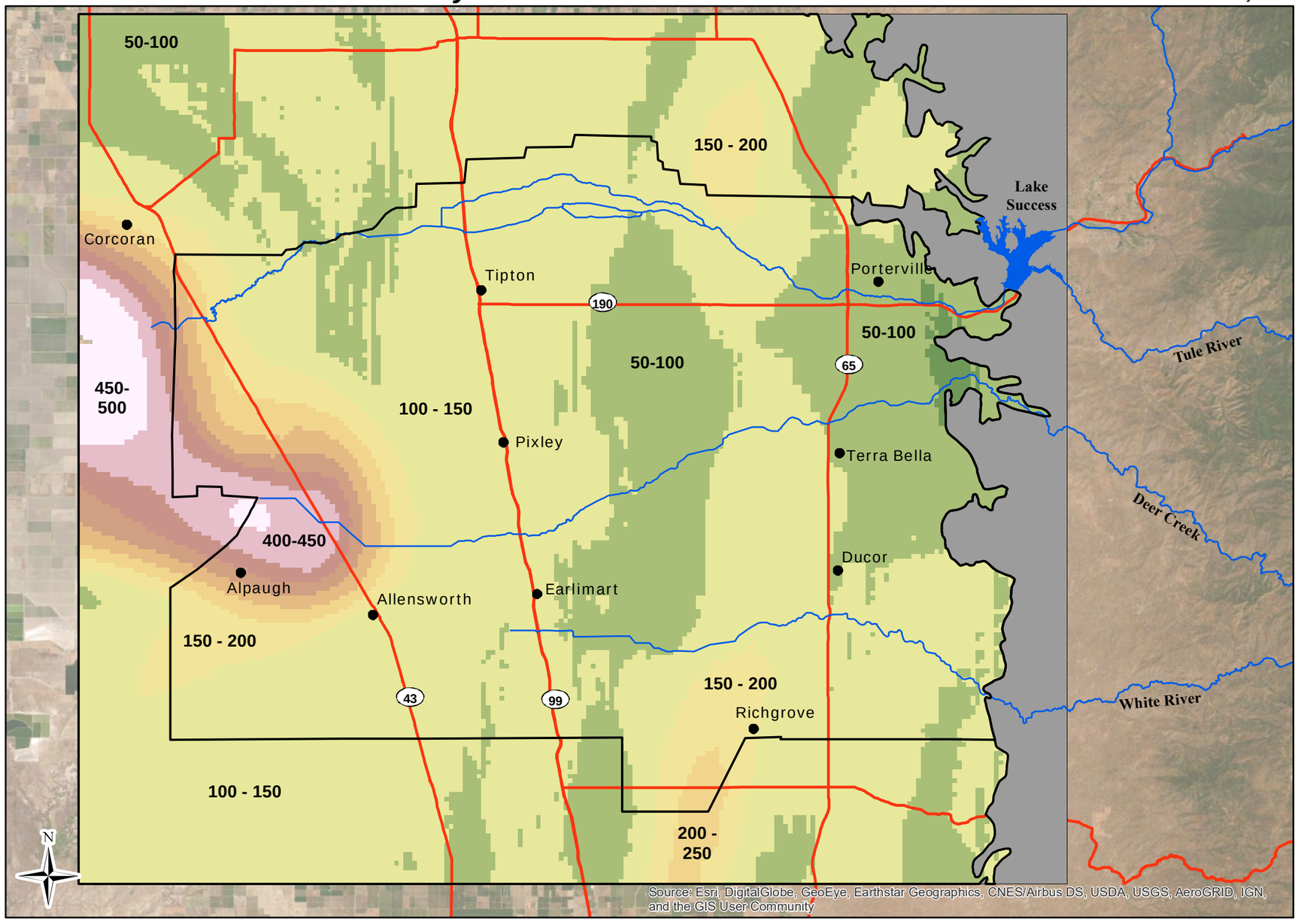
Figure 20

Thomas Harder & Co.
Groundwater Consulting

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



Map Features

Model Layer 2 Thickness (ft)

- < 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 250
- 250 - 300
- 300 - 350
- 350 - 400
- 400 - 450
- 450 - 500
- No Flow
- Model Domain
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road

Thomas Harder & Co.
Groundwater Consulting

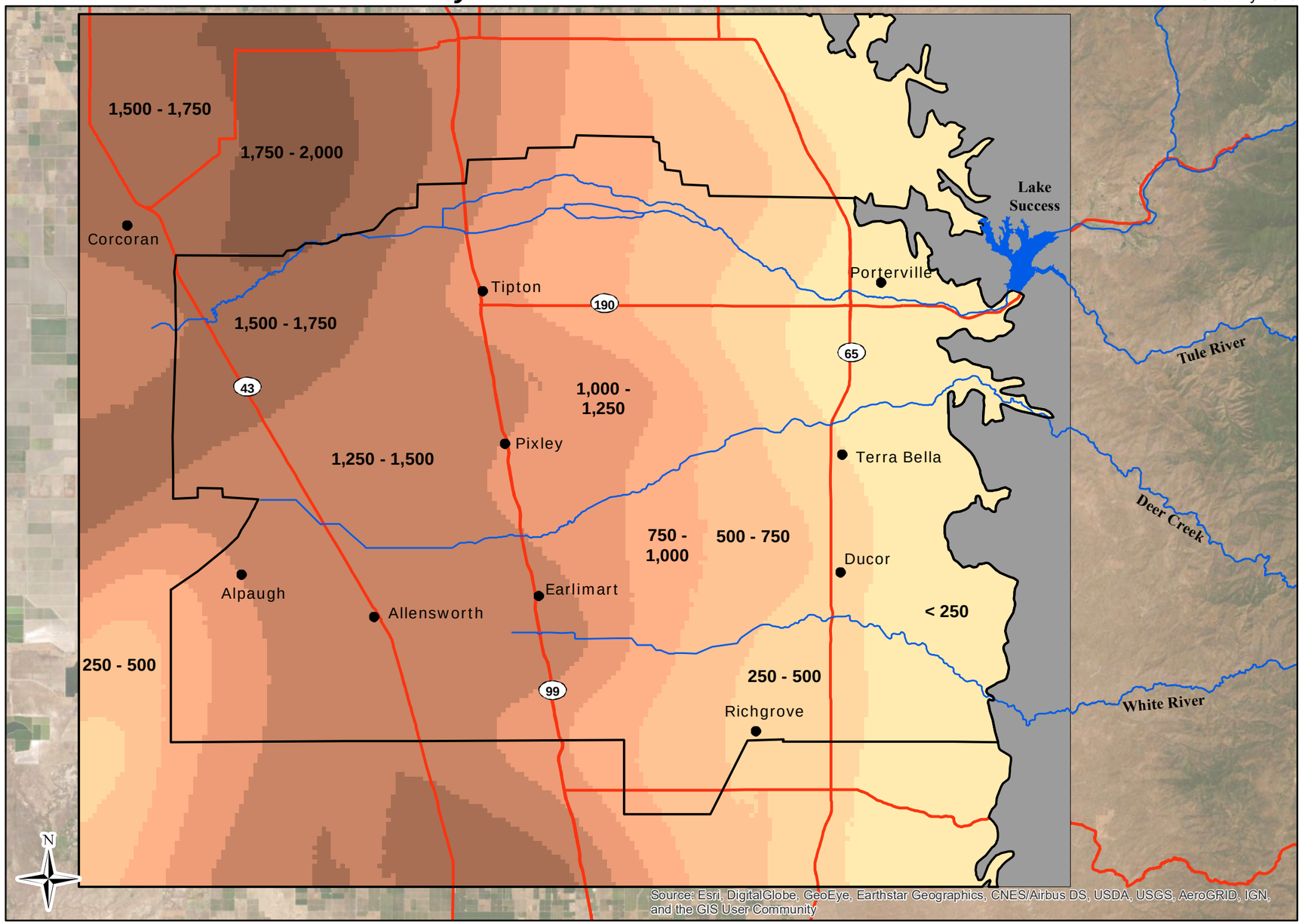
Layer 2 Thickness

Figure 21

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



Map Features

Model Layer 3 Thickness (ft)

- < 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 1,250
- 1,250 - 1,500
- 1,500 - 1,750
- 1,750 - 2,000
- No Flow
- Model Domain
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road

Layer 3 Thickness

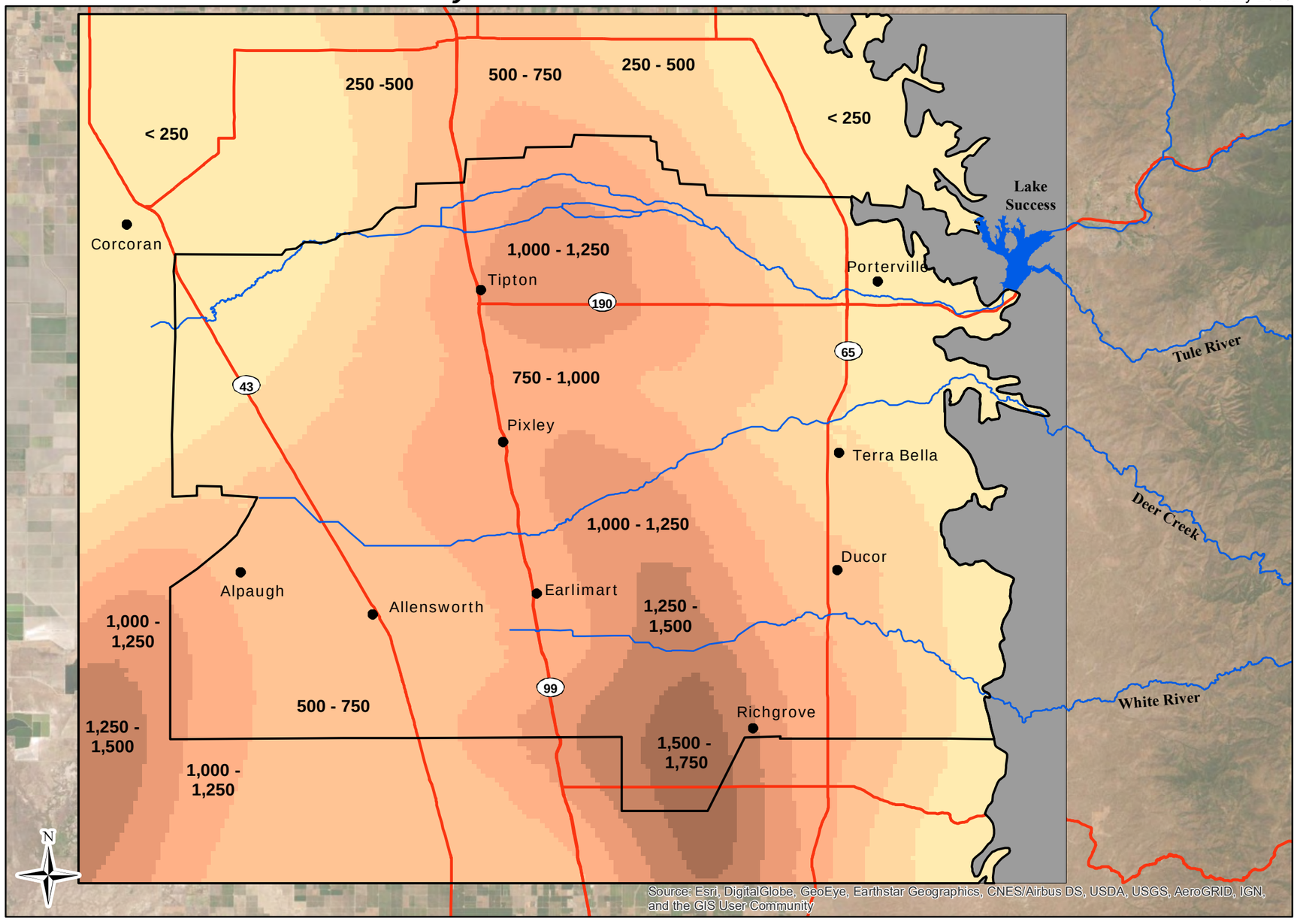
Figure 22

Thomas Harder & Co.
Groundwater Consulting

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



0 5 10 20 Miles

NAD 83 State Plane Zone 4

Map Features

Model Layer 4 Thickness (ft)

- < 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 1,250
- 1,250 - 1,500
- 1,500 - 1,750
- 1,750 - 2,000
- No Flow
- Model Domain
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road

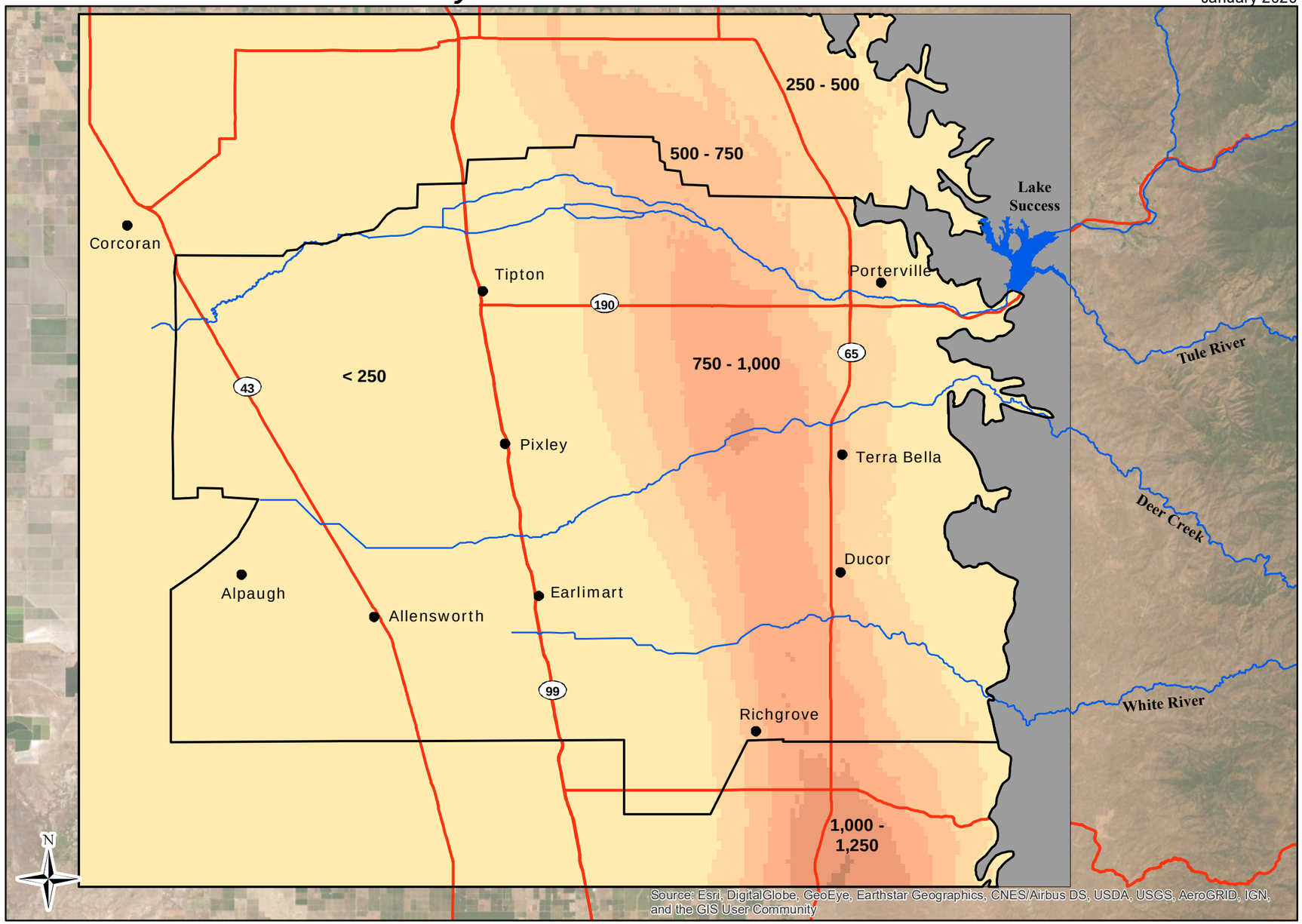
Layer 4 Thickness

Figure 23

Thomas Harder & Co.
Groundwater Consulting

Tule Subbasin Technical Advisory Committee

January 2020



0 5 10 20 Miles

NAD 83 State Plane Zone 4

Thomas Harder & Co.
Groundwater Consulting

Groundwater Flow Model of the Tule Subbasin

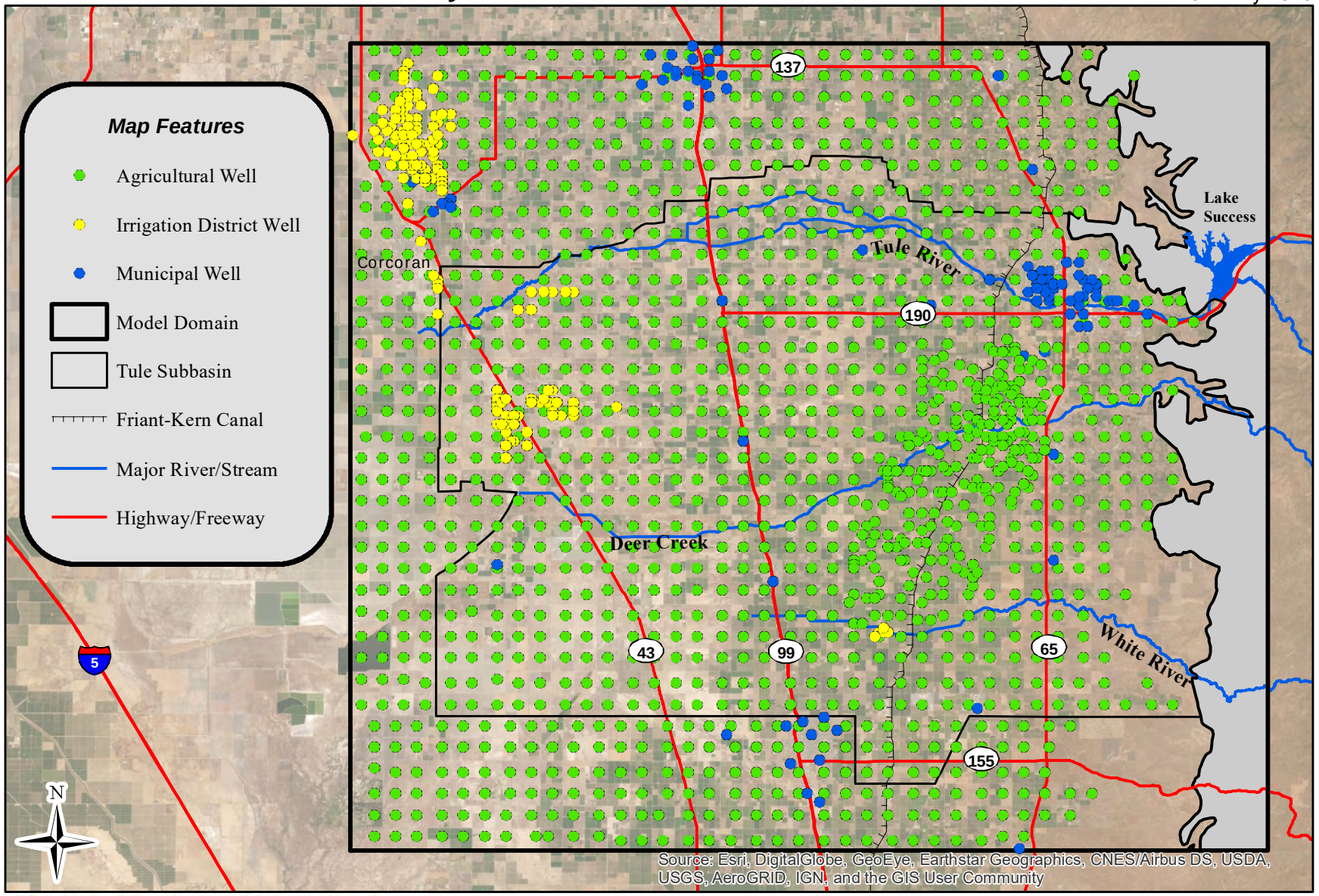
Map Features

Model Layer 5 Thickness (ft)

- < 250
- 250 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 1,250
- 1,250 - 1,500
- 1,500 - 1,750
- 1,750 - 2,000
- No Flow
- Model Domain
- Tule Subbasin
- City or Community
- Major Hydrologic Feature
- State Highway/Major Road

Layer 5 Thickness

Figure 24



Thomas Harder & Co.
Groundwater Consulting

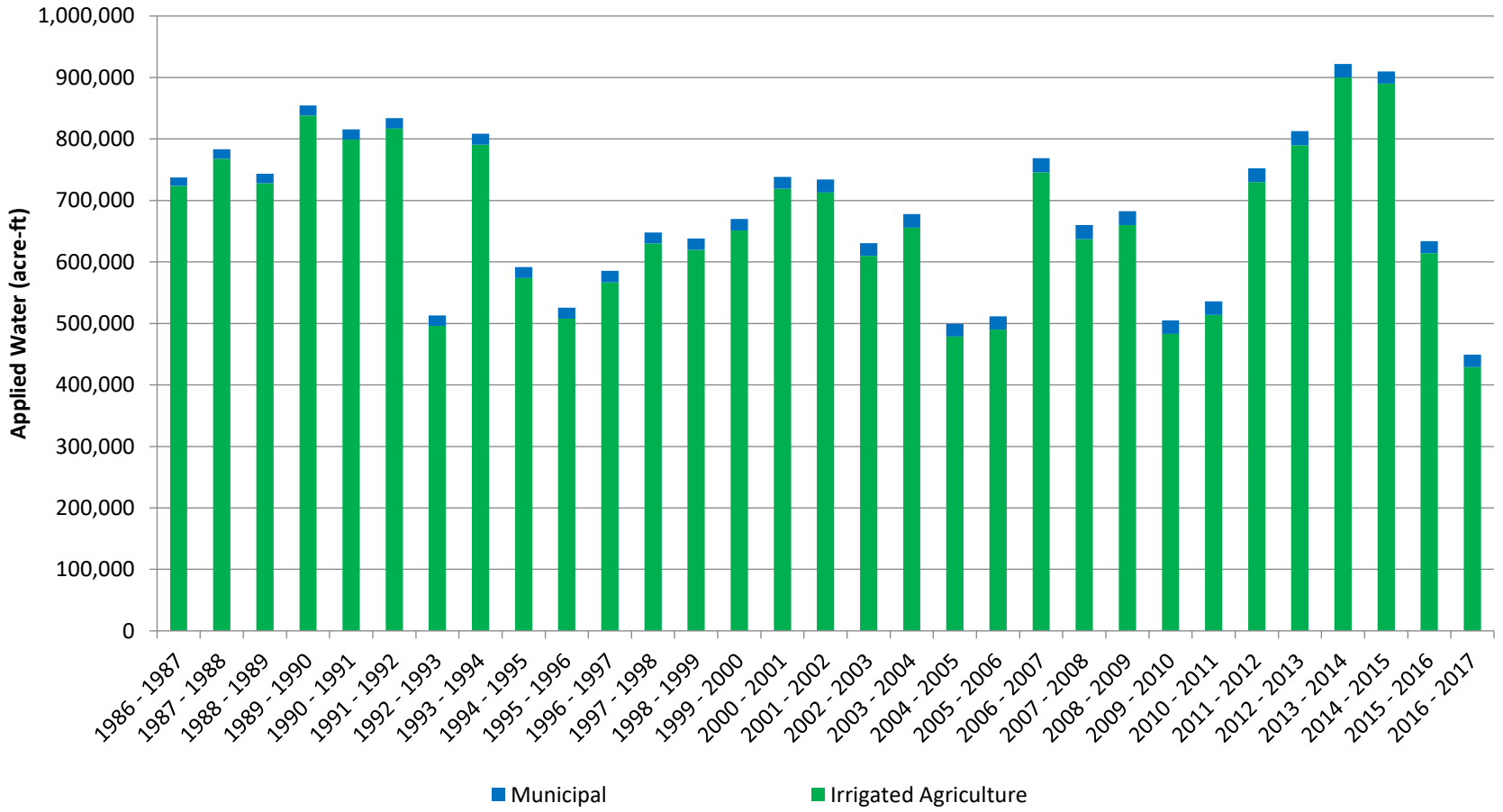
0 2 4 8
Miles
NAD 83 State Plane Zone 4

Wells in the Groundwater Flow Model

Figure 25

Figure 26

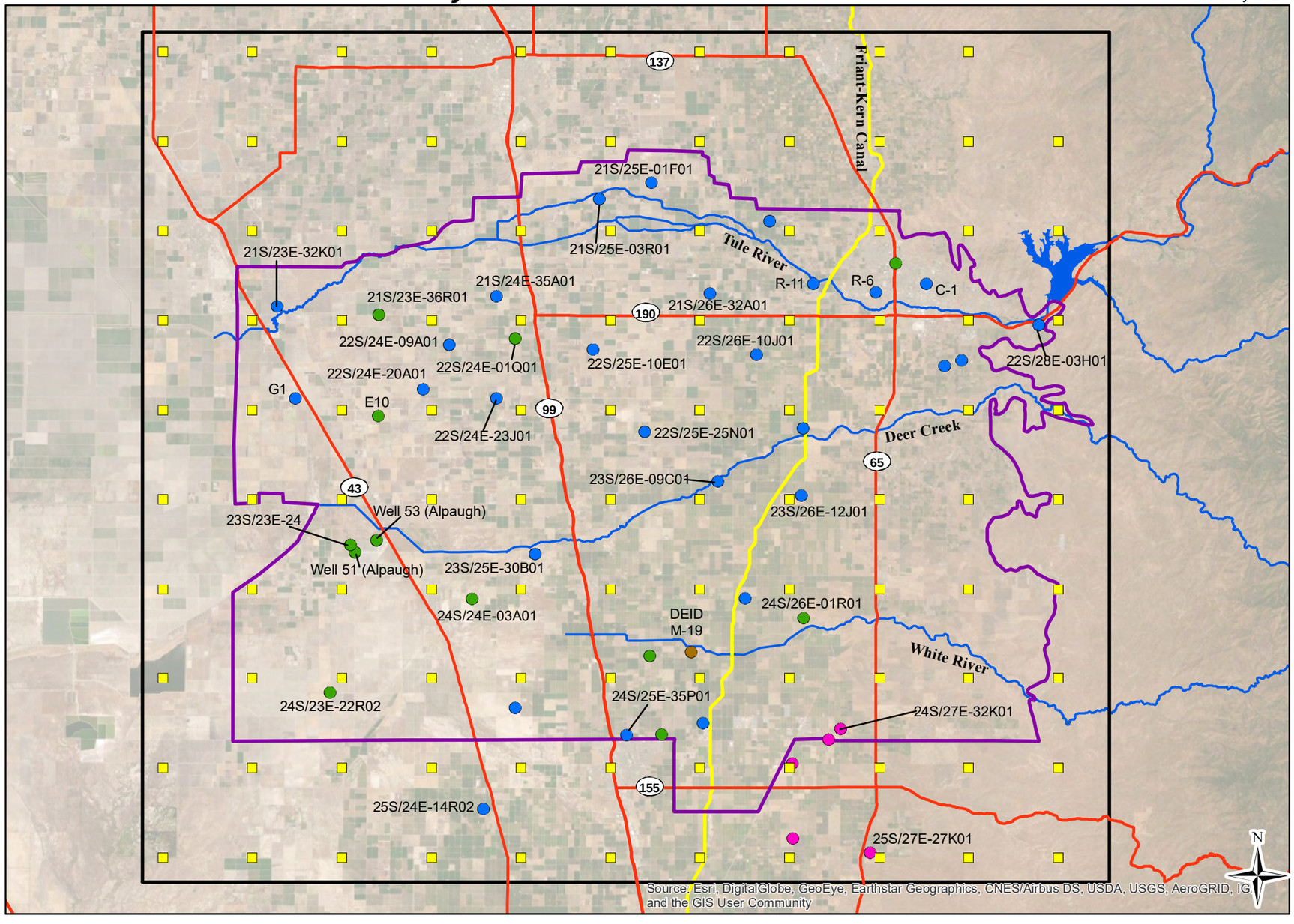
Estimated Historical Groundwater Pumping



Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



0 2.5 5 10 Miles

NAD 83 State Plane Zone 4

Map Features

- Layer 1 - Shallow Well
- Layer 3 - Deep Well
- Layer 4 - Deep Well
- DEID M-19 Nested (L1 and L3)
- Pilot Point
- State Highway/Major Road
- Friant-Kern Canal
- Major Hydrologic Feature
- Tule Subbasin
- Model Domain

Thomas Harder & Co.
Groundwater Consulting

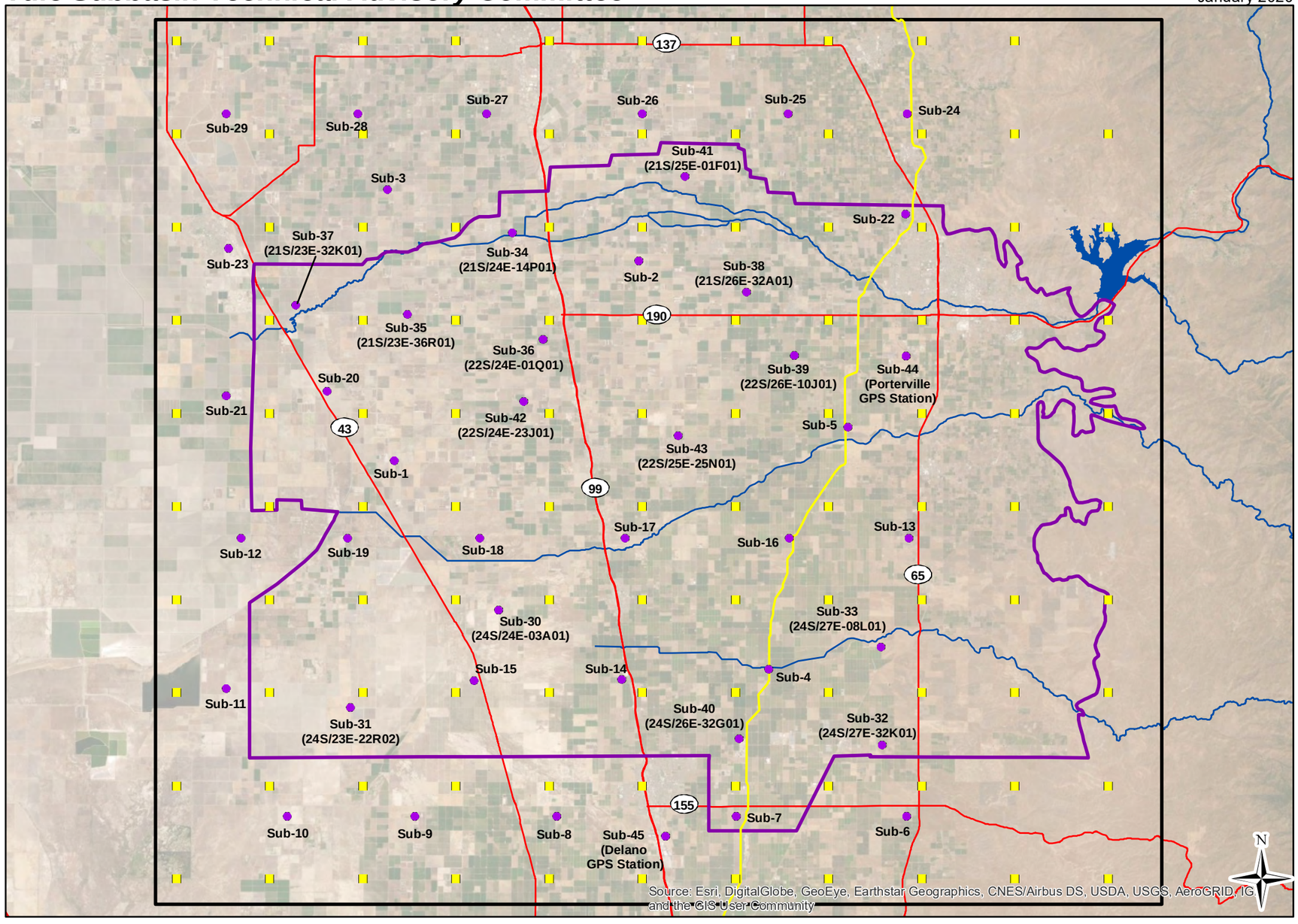
Groundwater Level Calibration Target Wells

Figure 27

Tule Subbasin Technical Advisory Committee

January 2020

Groundwater Flow Model of the Tule Subbasin



0 3 6 12 Miles

NAD 83 State Plane Zone 4

Map Features

- Pilot Point
- Subsidence Target
- Friant-Kern Canal
- Major Hydrologic Feature
- Major Road
- Tule Subbasin
- Model Domain

Subsidence Calibration Targets

Figure 28

Thomas Harder & Co.
Groundwater Consulting

Figure 29

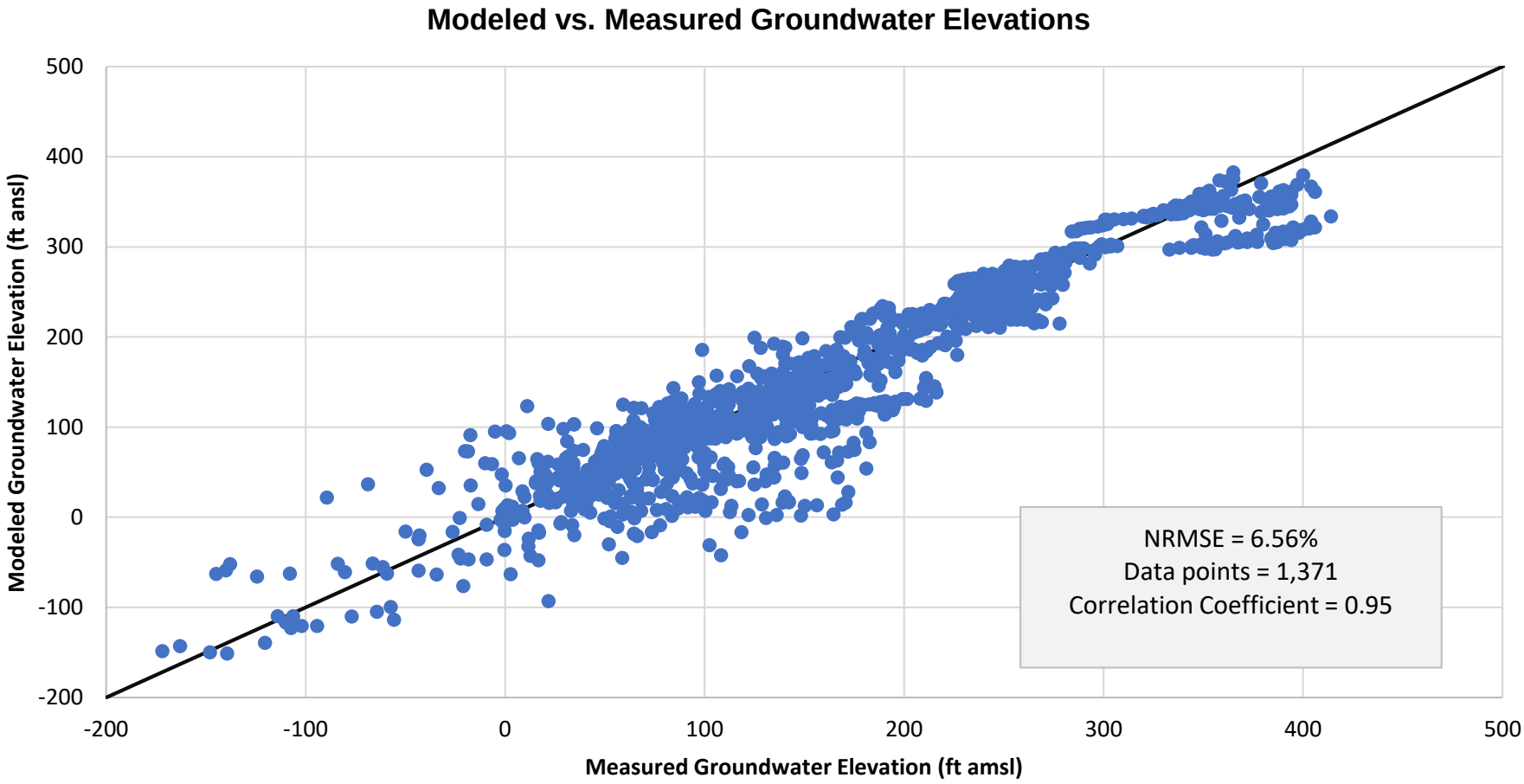
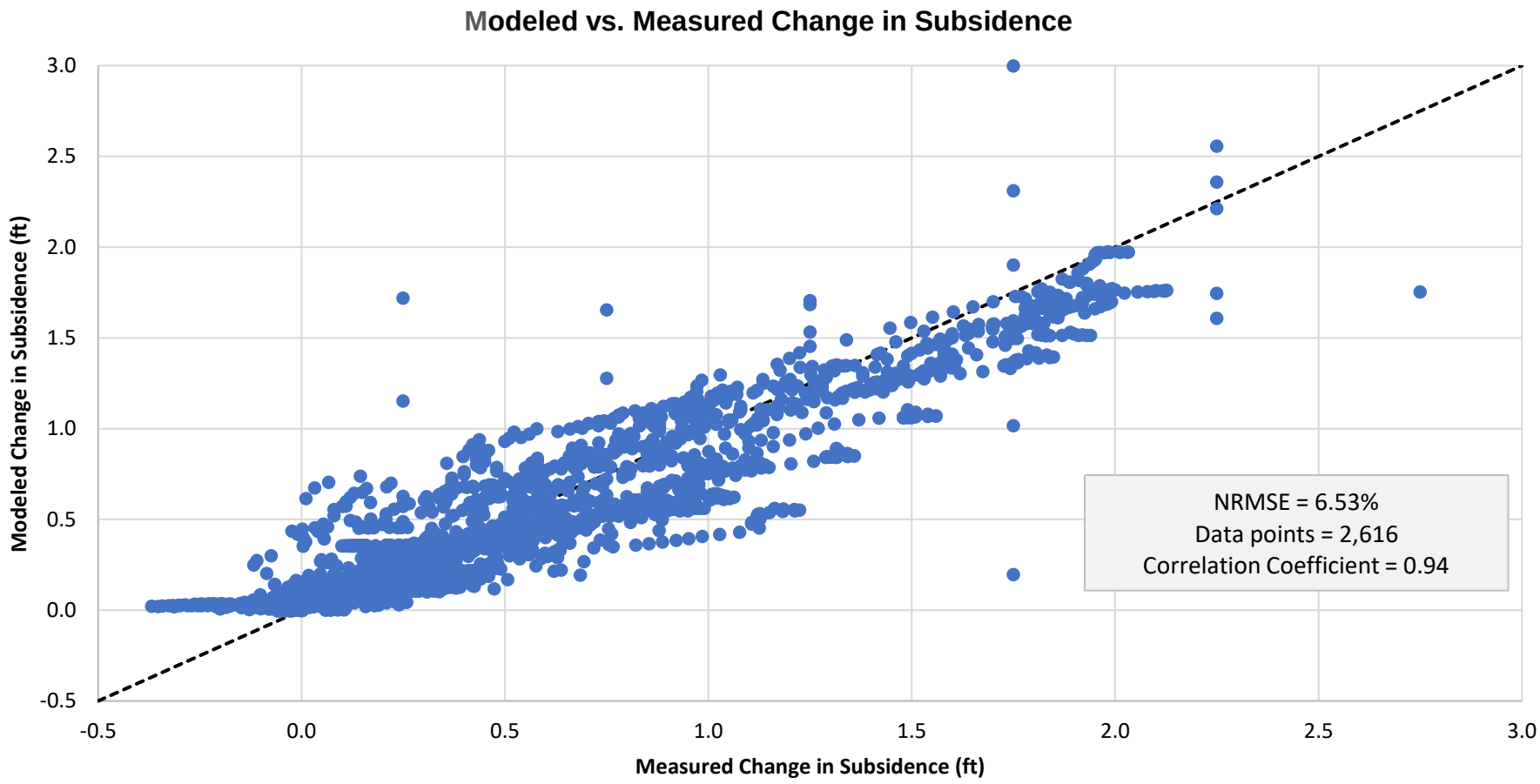
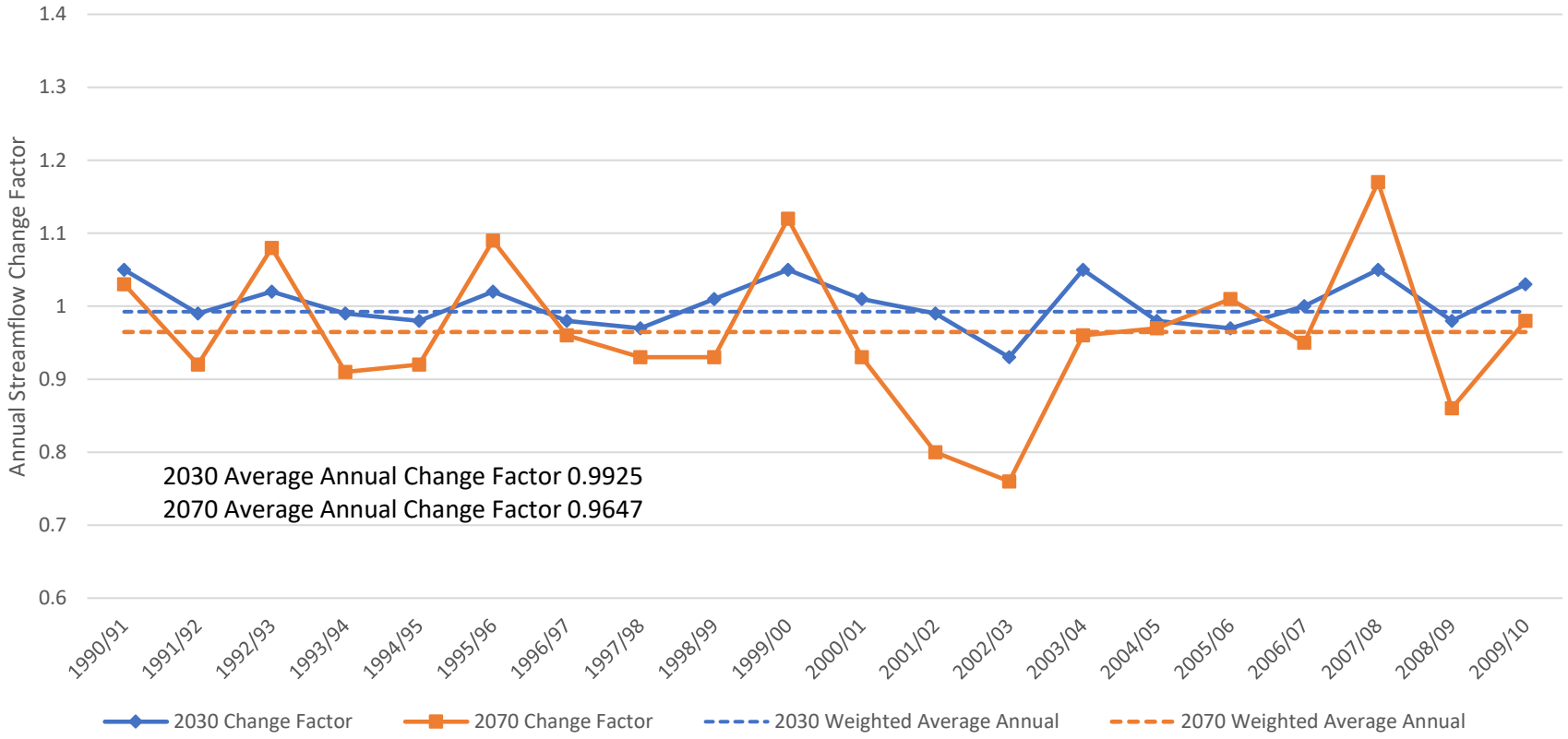

Modeled vs. Measured Groundwater Elevations
Modeled Groundwater Elevation (ft ansl)
Measured Groundwater Elevation (ft amsl)
500
400
300
200
100
0
-100
-200
-200
-100
0
100
200
300
400
500
NRMSE = 6.56%
Data points = 1,371
Correlation Coefficient = 0.95

Figure 30


Modeled vs. Measured Change in Subsidence
Modeled Change in Subsidence (ft)
Measured Change in Subsidence (ft)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
NRMSE = 6.53%
Data points = 2,616
Correlation Coefficient = 0.94

Tule River - Inflow to Success
Future Climate Projections with Baseperiod 1990/91 through 2009/10

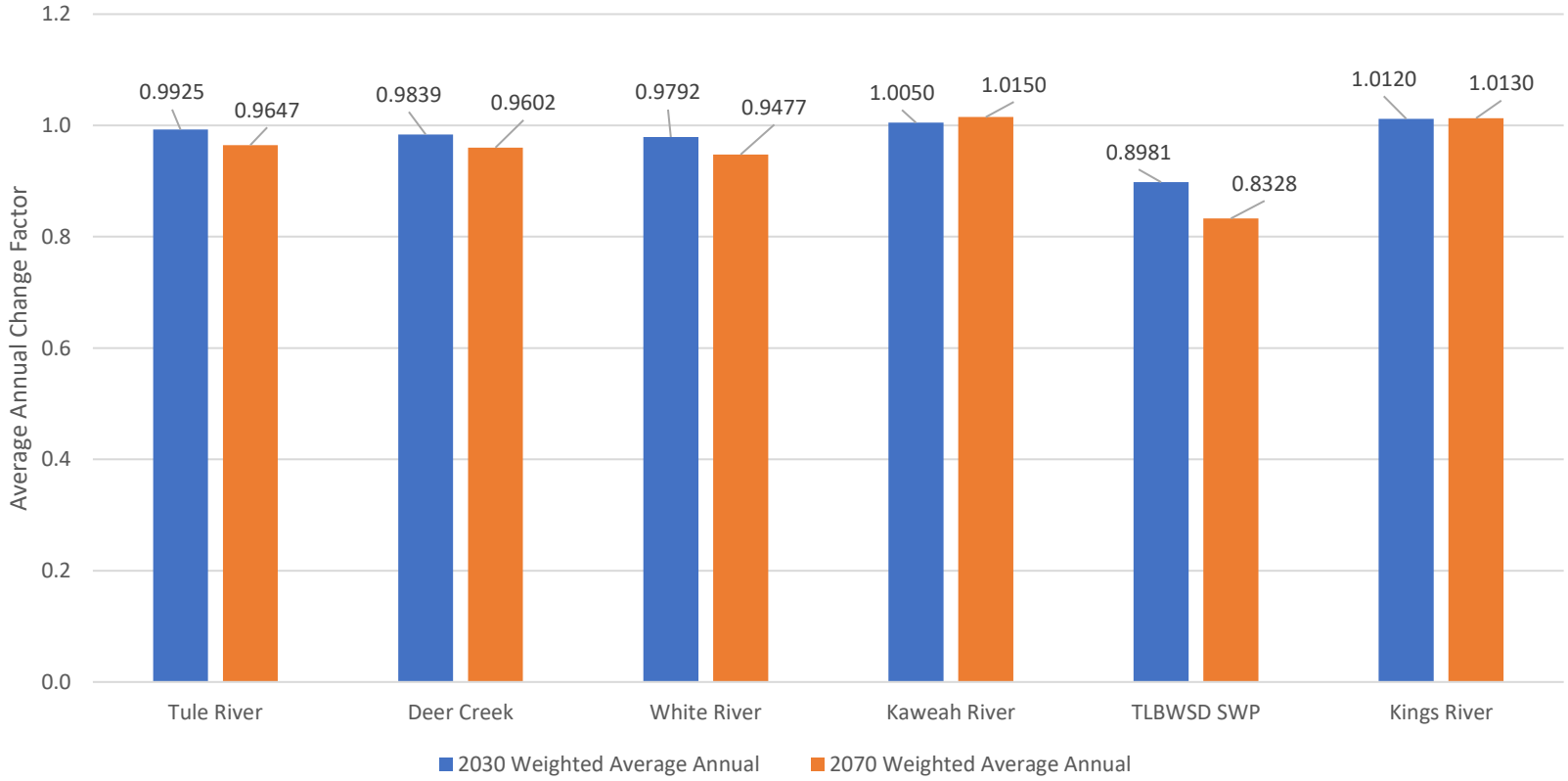


Notes:

Change factors from DWR SGMA Data Viewer, Climate Change Datasets.
2030 climate dataset used for 2017/18 through 2049/50 and 2070 climate dataset used for 2050/51 through 2069/70.

Figure 32

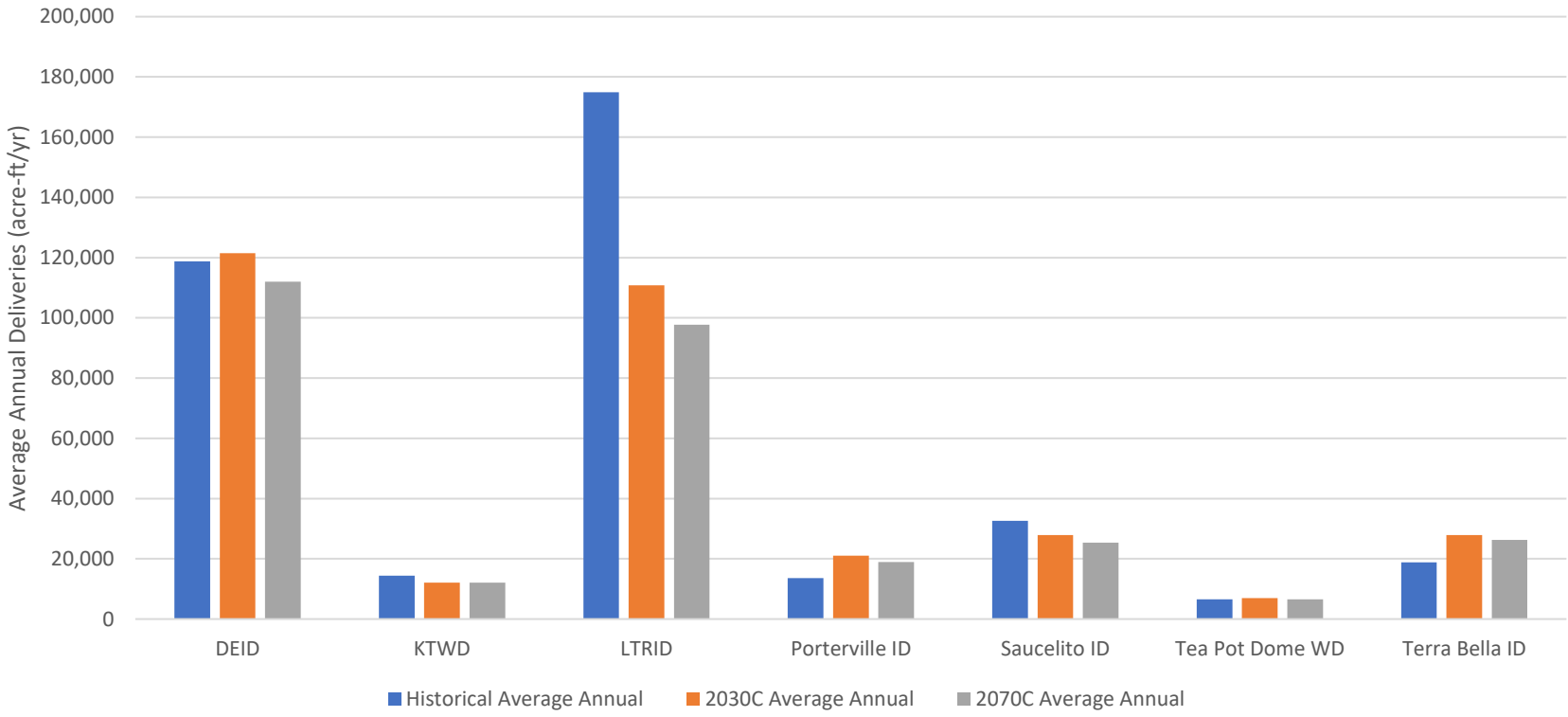
Summary of Average Annual Change Factors for Major Streams (Non Friant-Kern Canal Deliveries)



Notes:

Kaweah River, Tulare Lake Bed Water Storage District State Water Project (TLBWSD SWP), and Kings River for Angiola Water District

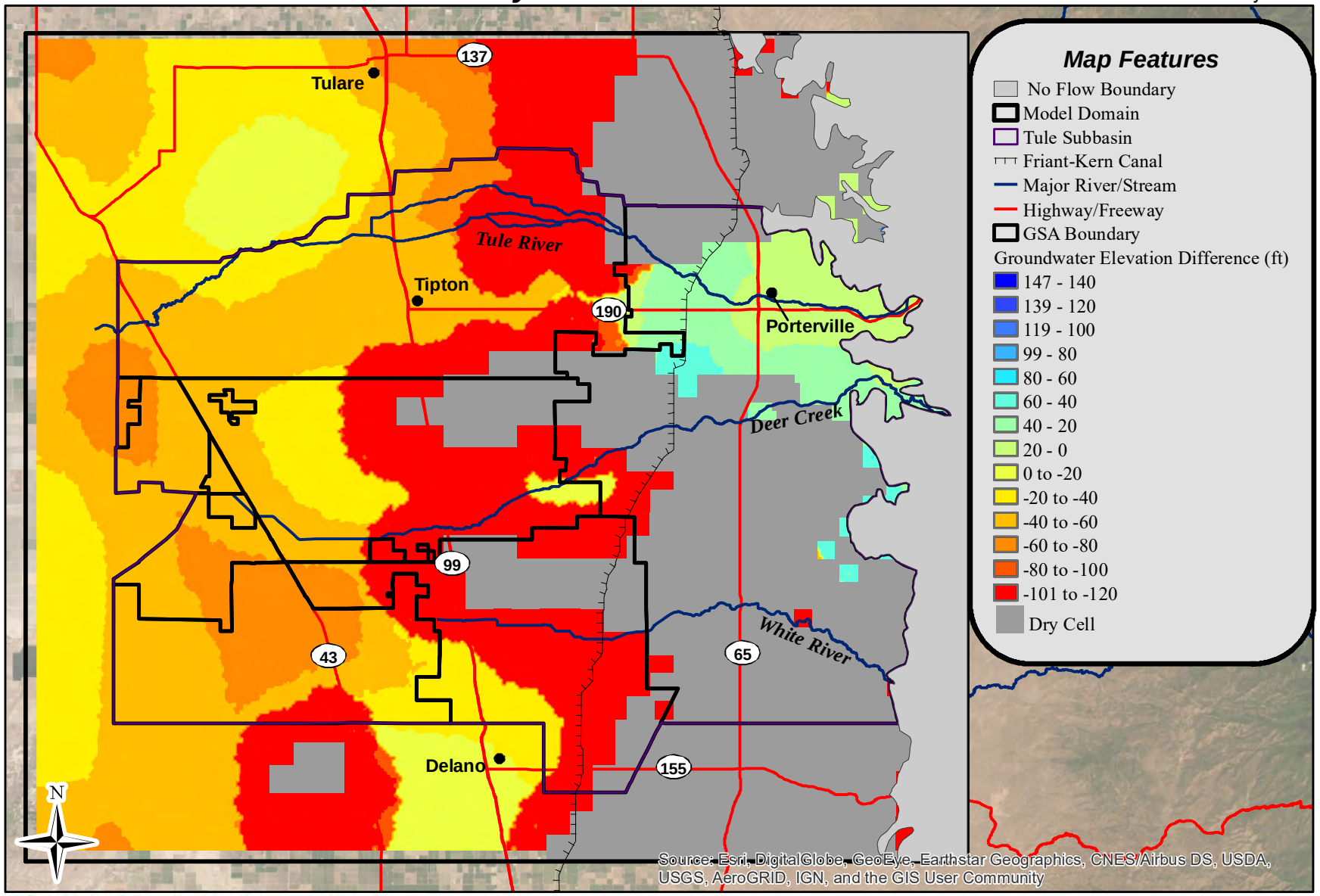
Historical and Future Projection Friant-Kern Canal Deliveries



Notes:

Historical average annual based on 1990/91 through 2009/10
Does not include future projects including transfers.
Include Class 1, Class 2/Other, 16B, and SKRRP Recapture (Class 1 and Class 2/Other)
KTWD projections provided by KTWD. KTWD deliveries within the Tule Subbasin only.

Tule Subbasin Technical Advisory Committee

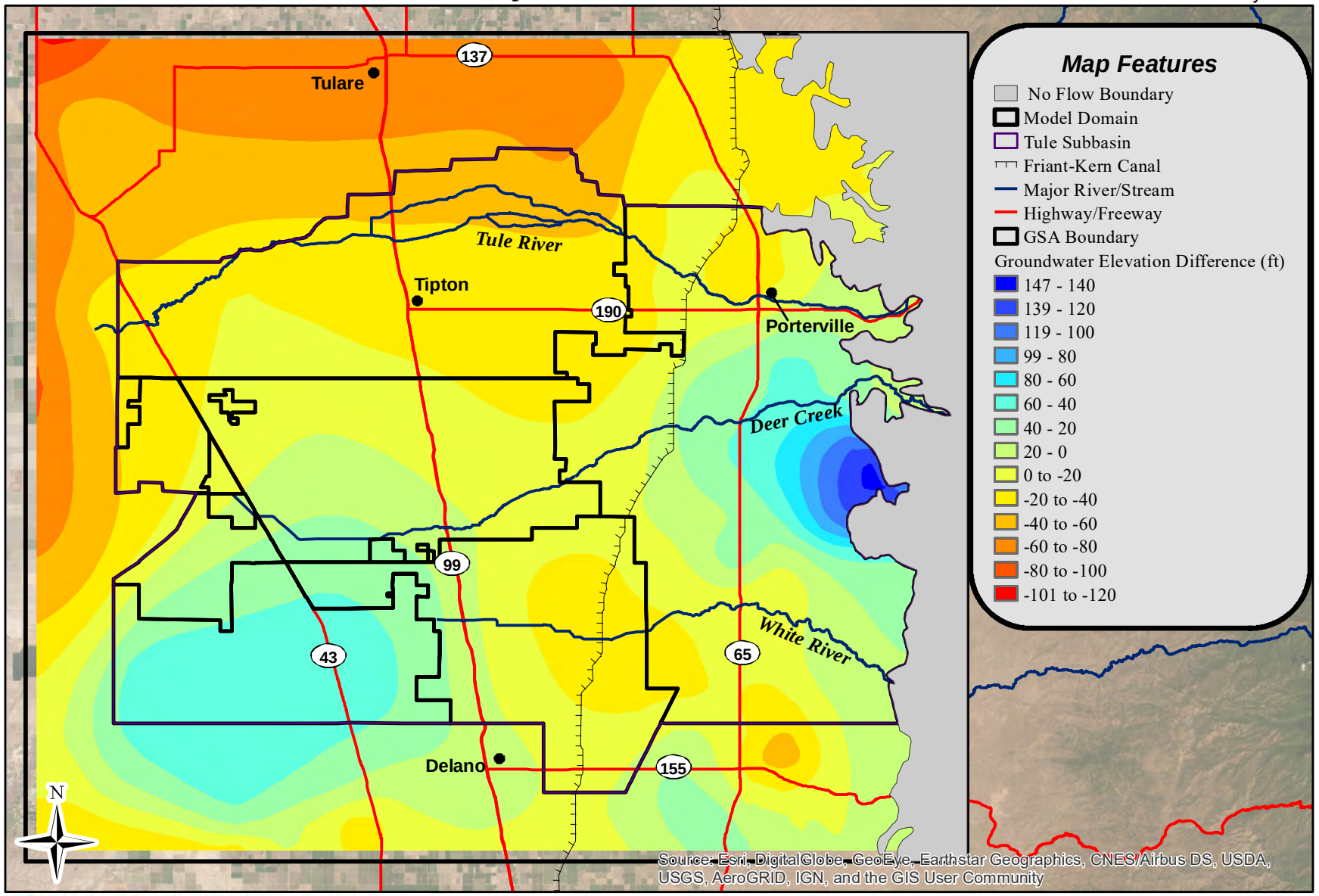


Thomas Harder & Co.
Groundwater Consulting

Model Simulated Change in Groundwater Level Between 2020 and 2040 (Layer 1)

Figure 34

Tule Subbasin Technical Advisory Committee



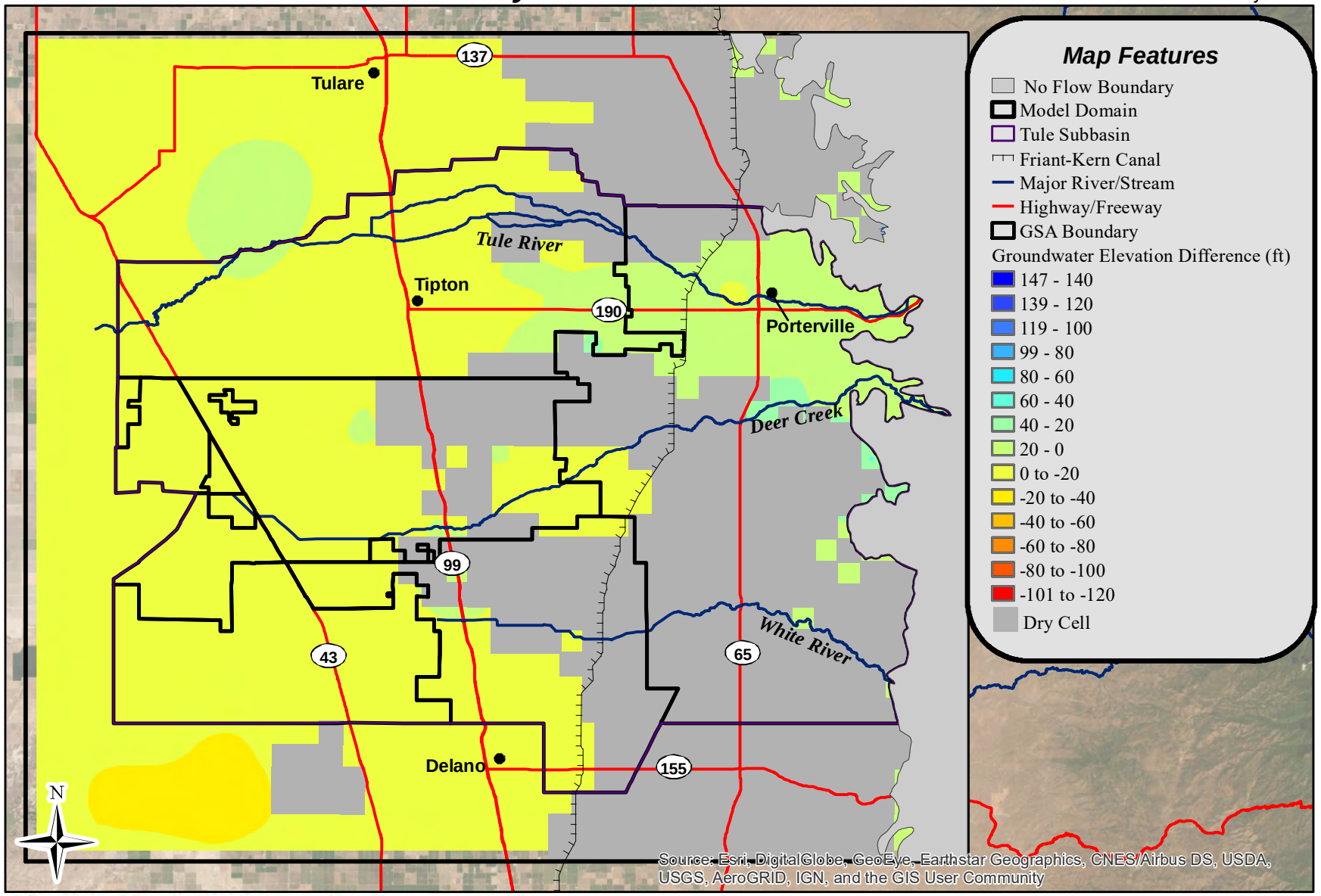
Thomas Harder & Co.
Groundwater Consulting

0 2.5 5 10 Miles

Model Simulated Change in Groundwater Level Between 2020 and 2040 (Layer 3)

Figure 35

Tule Subbasin Technical Advisory Committee

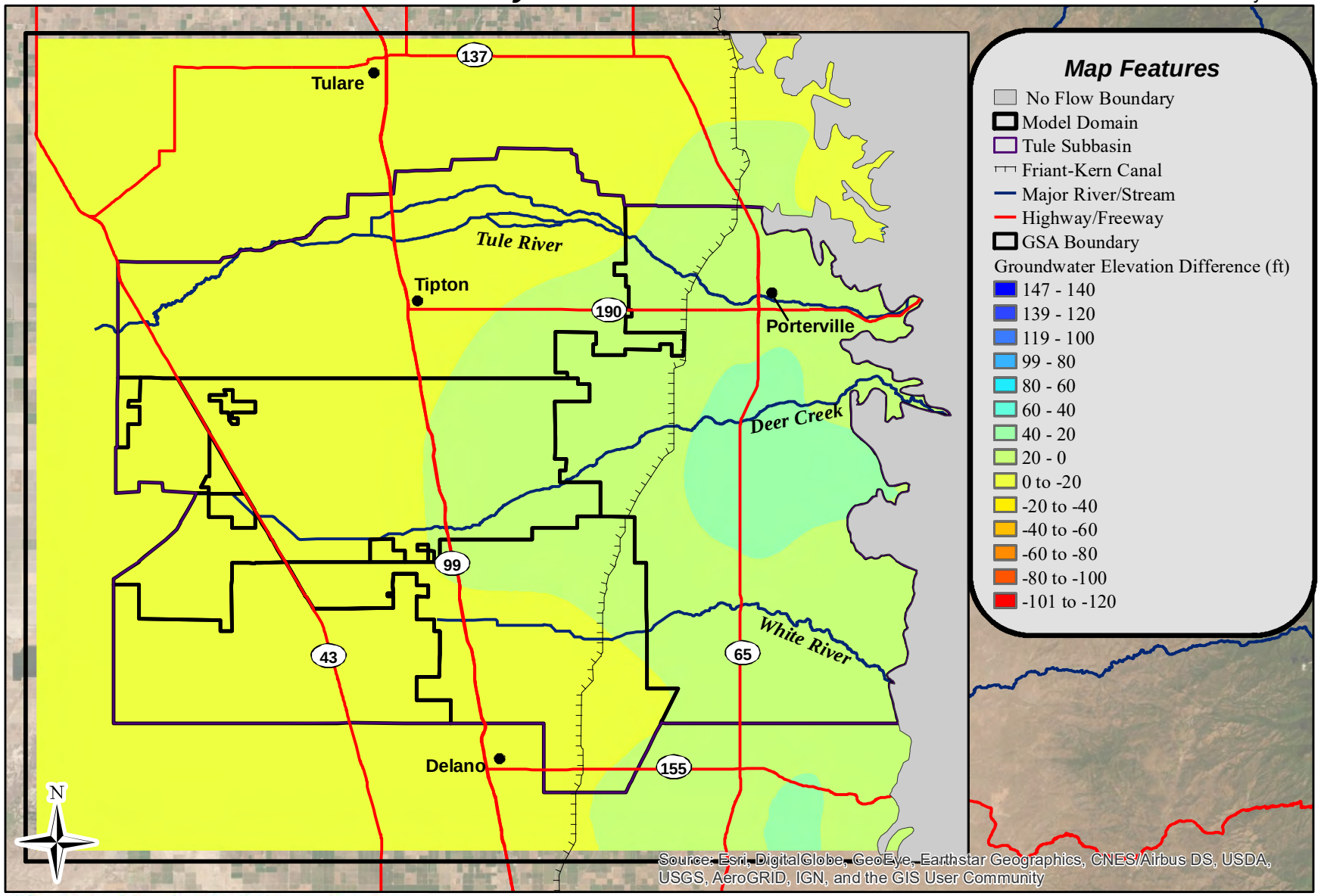


Thomas Harder & Co.
Groundwater Consulting

Model Simulated Change in Groundwater Level Between 2040 and 2050 (Layer 1)

Figure 36

Tule Subbasin Technical Advisory Committee



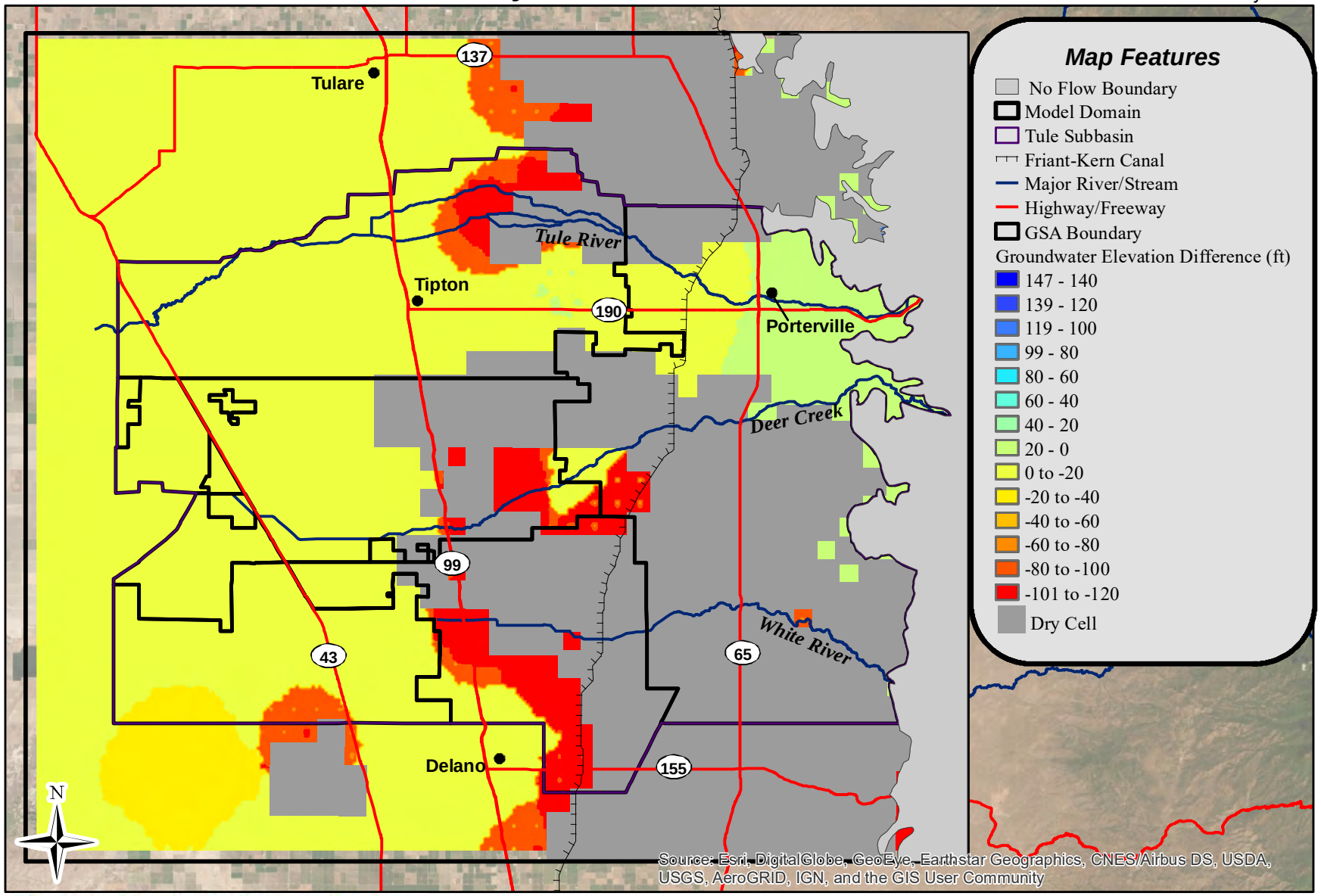
Thomas Harder & Co.
Groundwater Consulting

0 2.5 5 10 Miles

Model Simulated Change in Groundwater Level Between 2040 and 2050 (Layer 3)

Figure 37

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

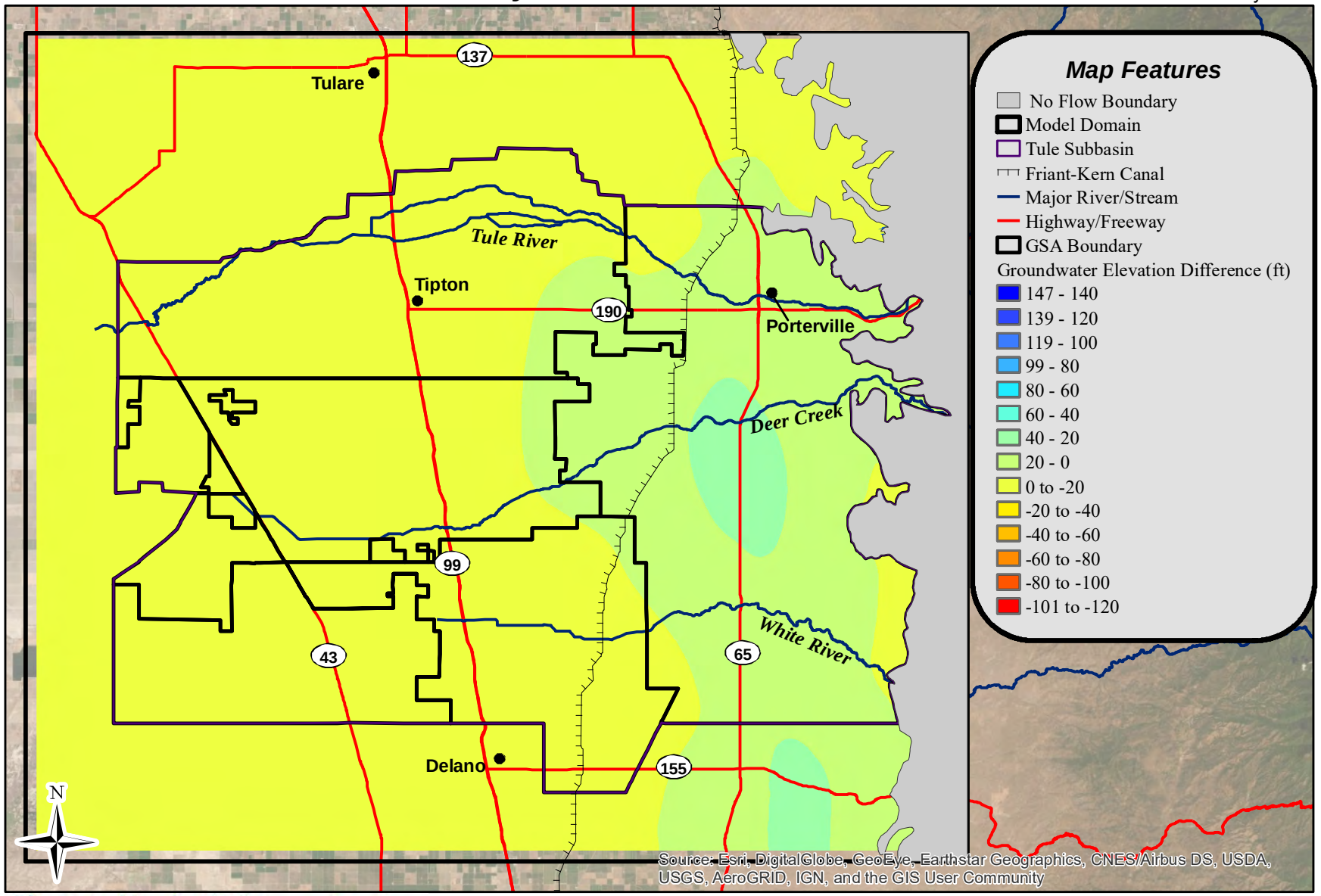
Model Simulated Change in Groundwater Level Between 2050 and 2070 (Layer 1)

Figure 38

Groundwater Flow Model of the Tule Subbasin

January 2020

Tule Subbasin Technical Advisory Committee



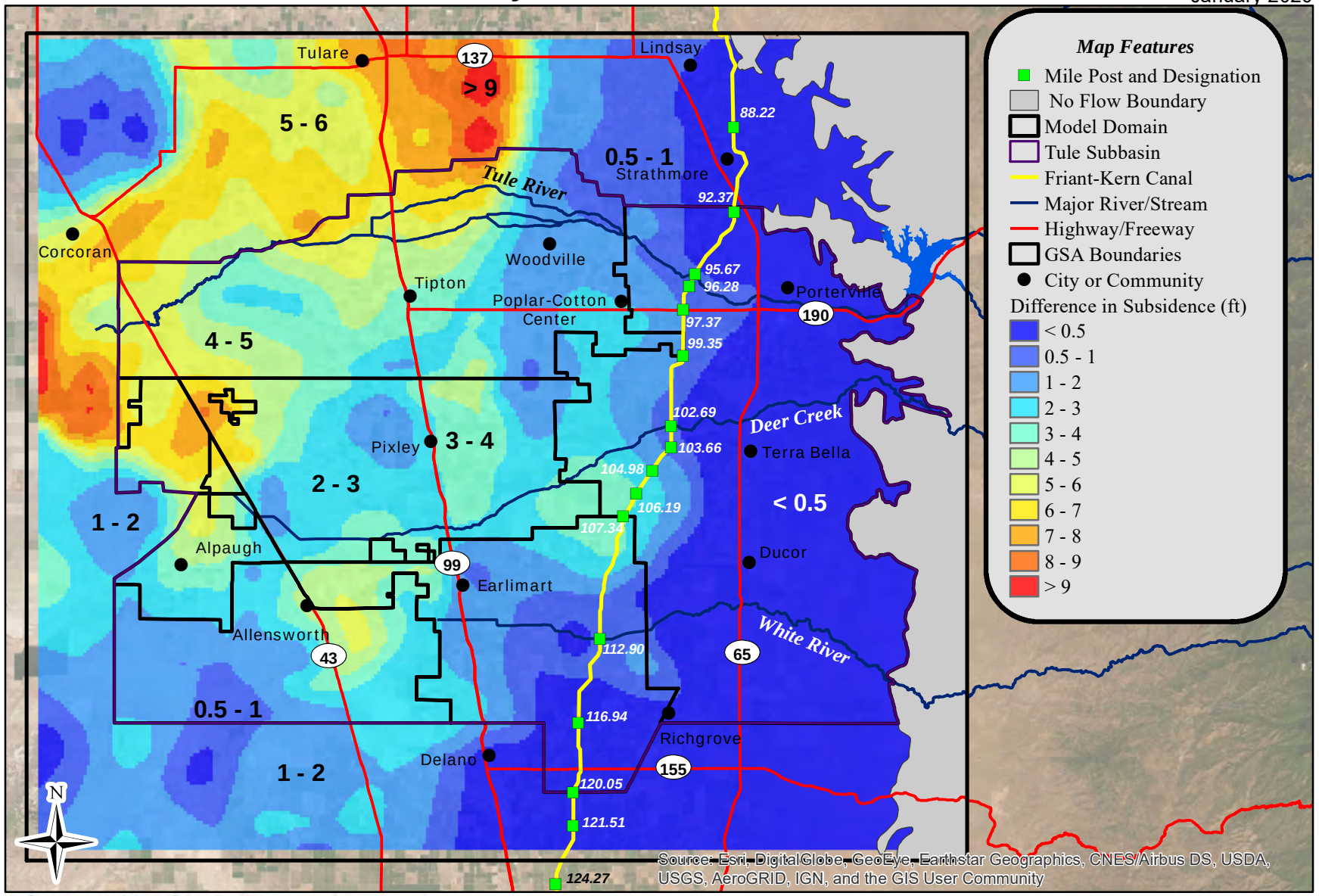
Thomas Harder & Co.
Groundwater Consulting

0 2.5 5 10 Miles

Model Simulated Change in Groundwater Level Between 2050 and 2070 (Layer 3)

Figure 39

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

0 2.5 5 10 Miles

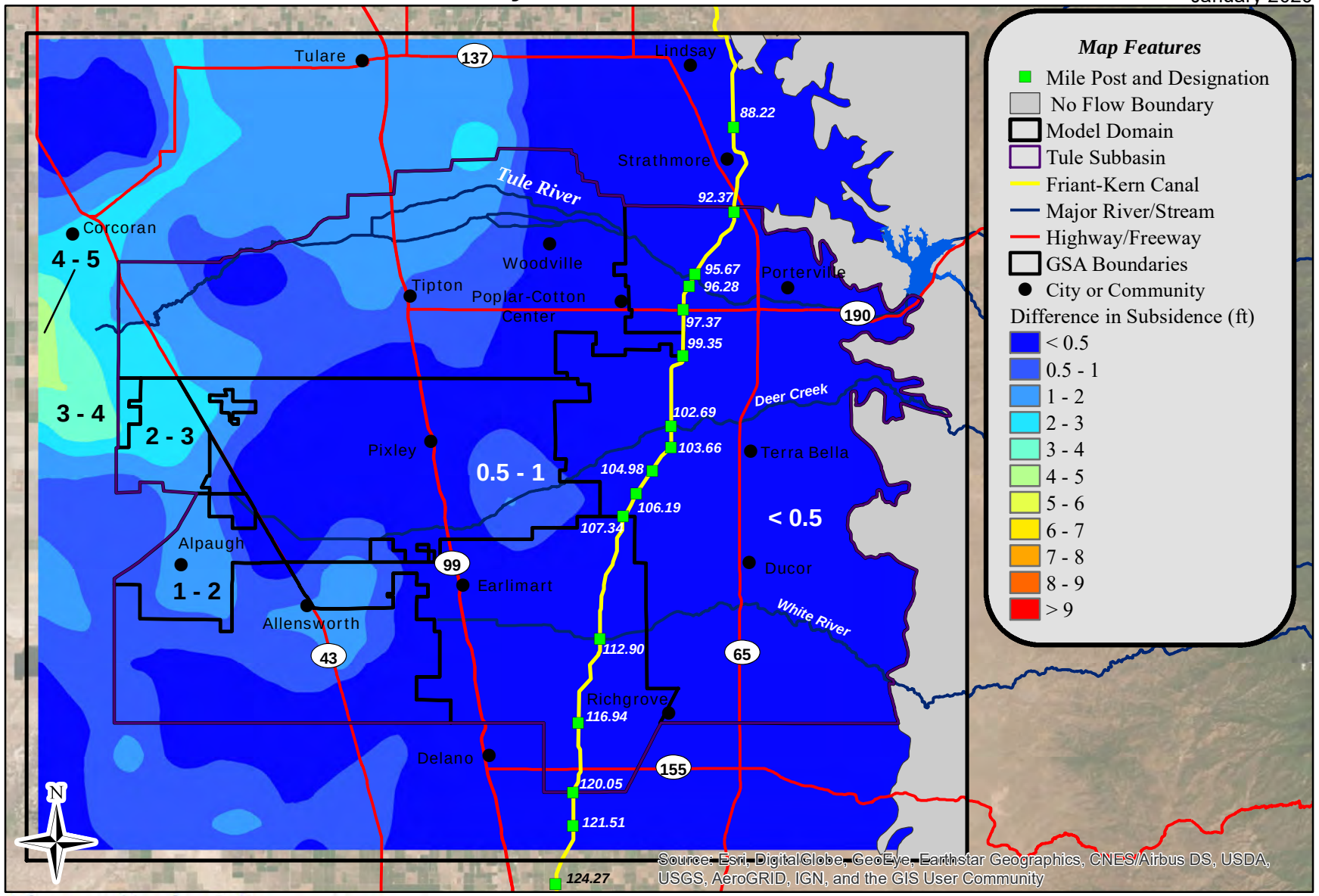
NAD 83 State Plane Zone 4

Cumulative Land Subsidence in the Tule Subbasin from 2020 to 2040

Figure 40

Note: This map shows the difference in subsidence from September 30, 2019 to September 30, 2039.

Tule Subbasin Technical Advisory Committee



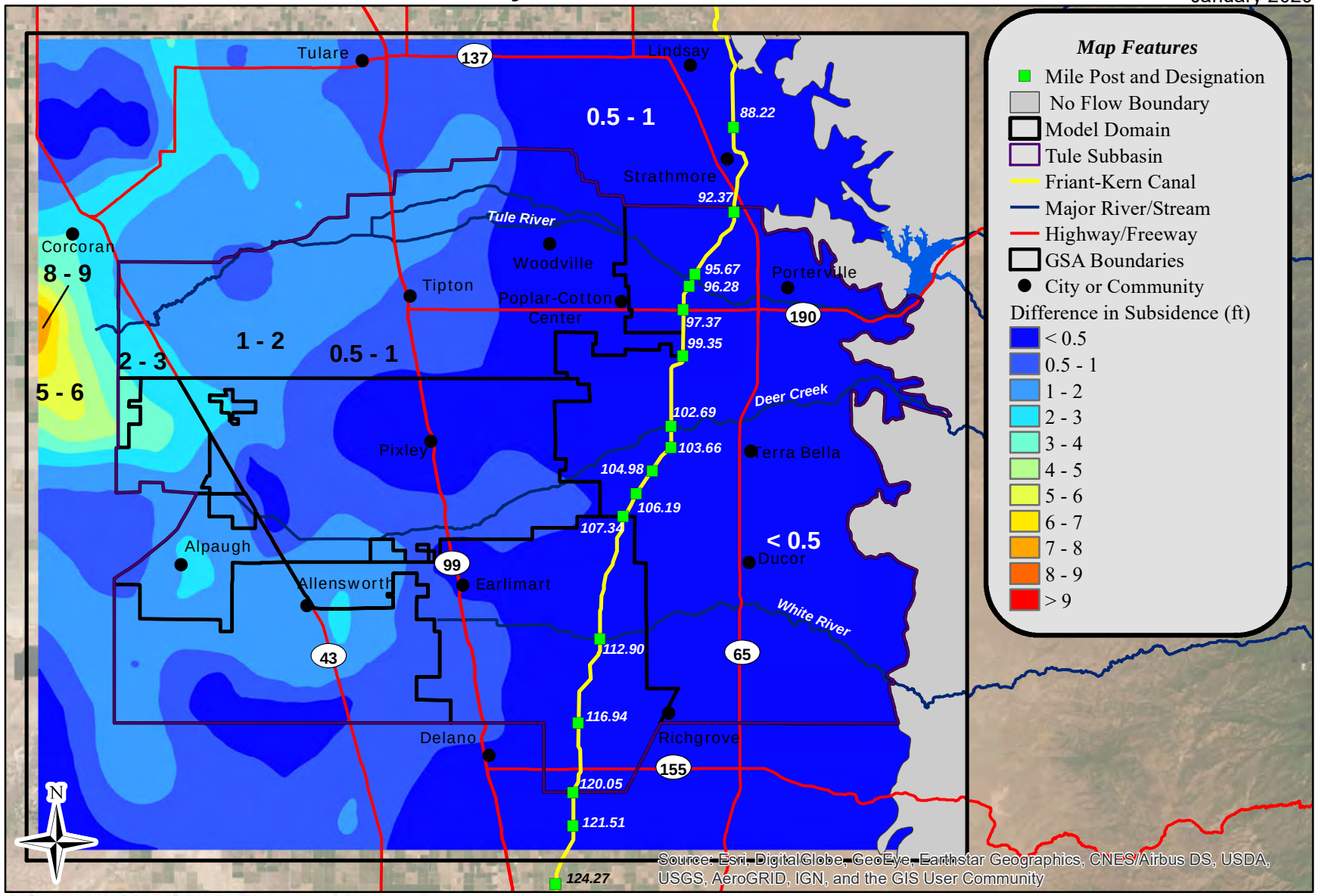
Thomas Harder & Co.
Groundwater Consulting

Cumulative Land Subsidence in the Tule Subbasin from 2040 to 2050

Figure 41

Note: This map shows the difference in subsidence from September 30, 2039 to September 30, 2049.

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

0 2.5 5 10
Miles

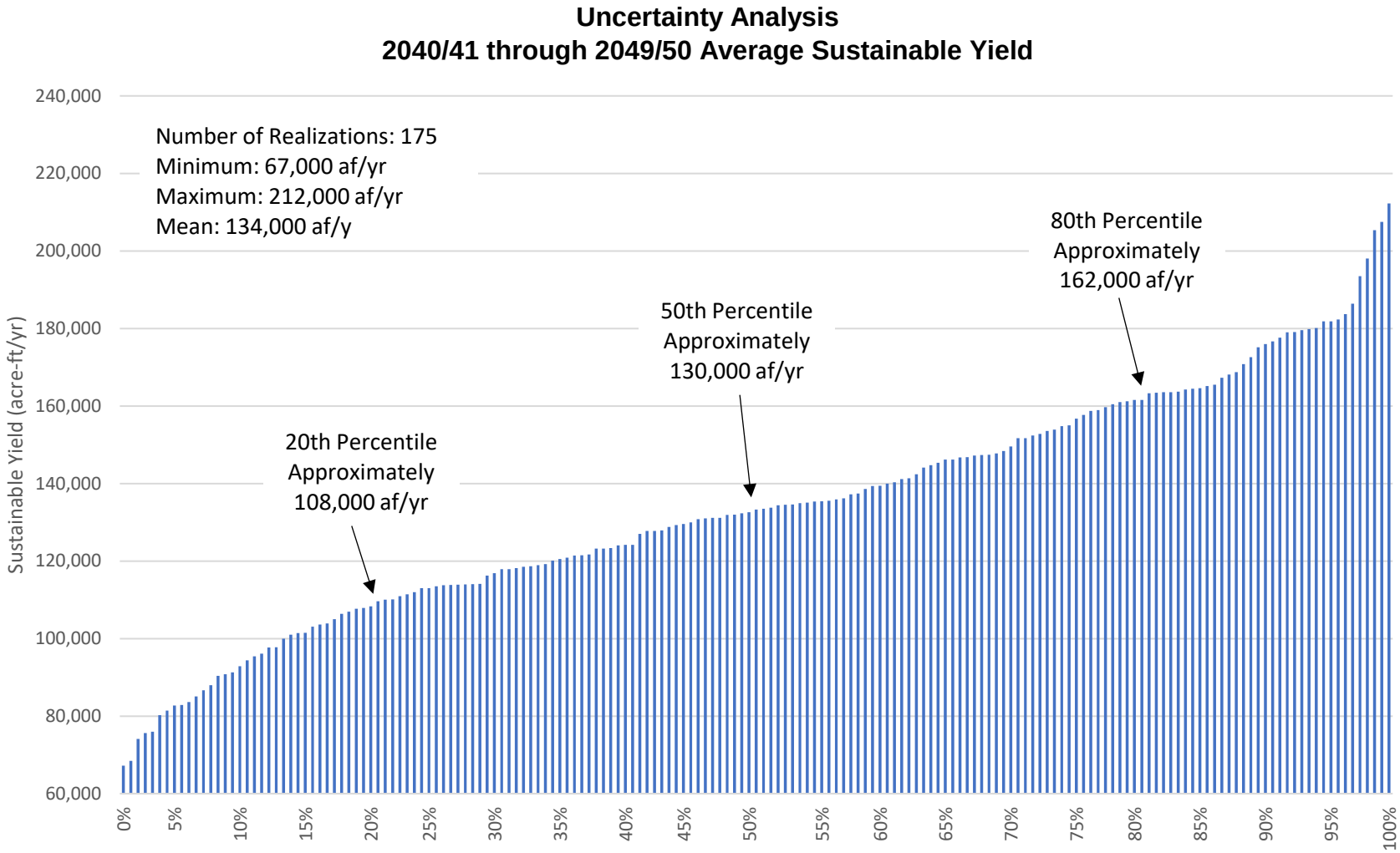
NAD 83 State Plane Zone 4

Cumulative Land Subsidence in the Tule Subbasin from 2050 to 2070

Figure 42

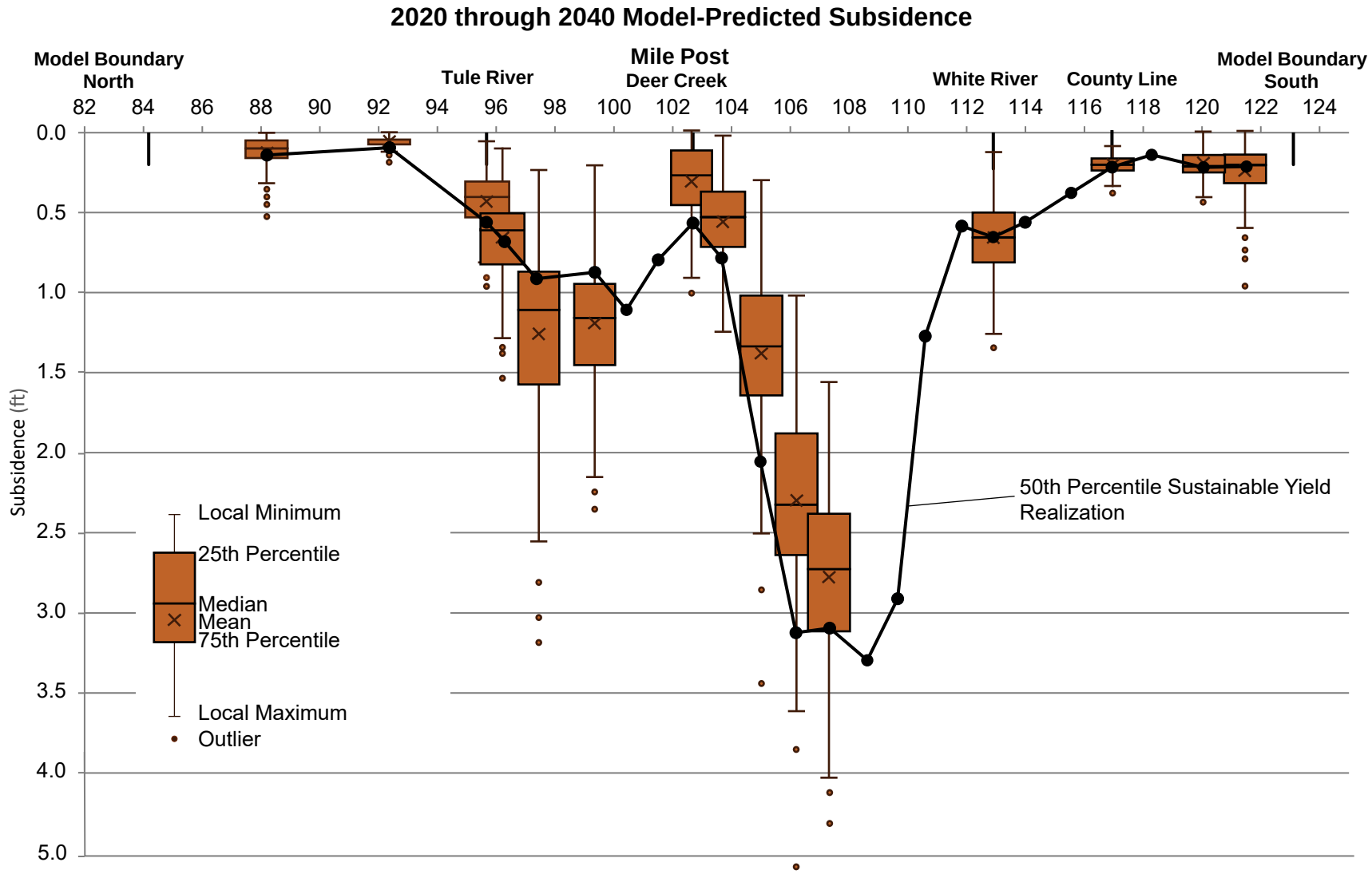
Note: This map shows the difference in subsidence from September 30, 2049 to September 30, 2069.

Figure 43



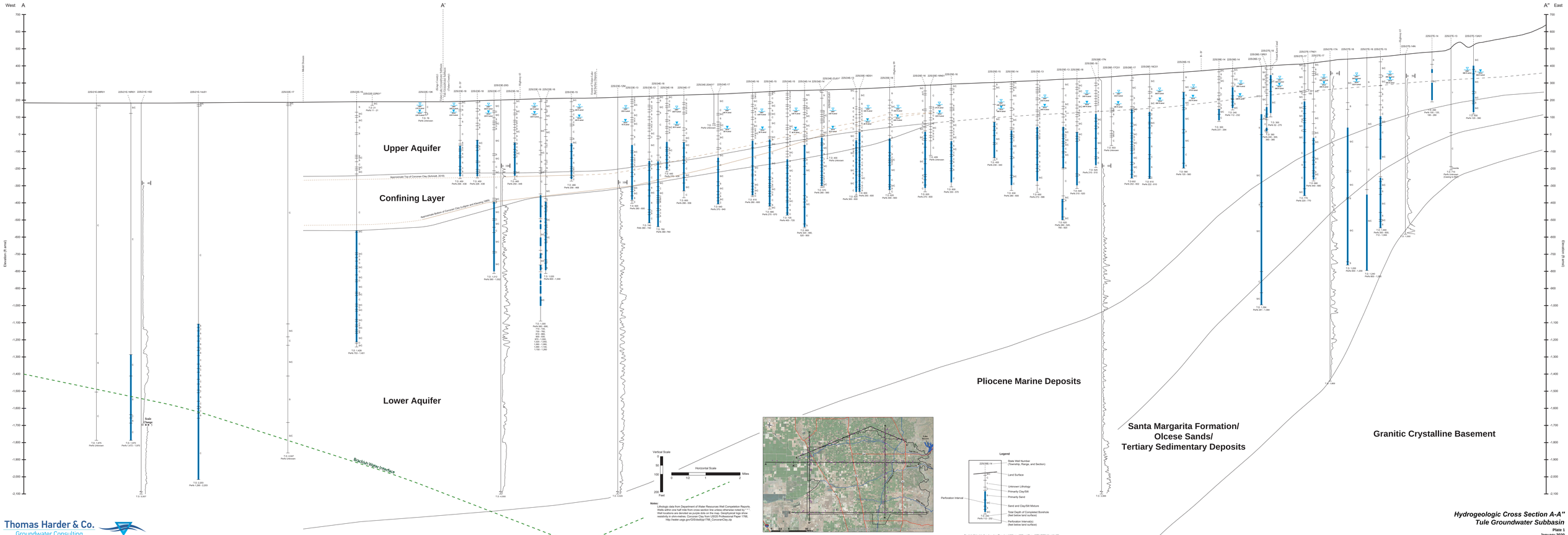
*Realizations with a storage change of -5,000 af/yr or greater

Figure 44


2020 through 2040 Model-Predicted Subsidence
Model Boundary North
Tule River
Mile Post
Deer Creek
White River
County Line
Model Boundary South
82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118 120 122 124
0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 5.0
Subsidence (ft)
Local Minimum
25th Percentile
Median
Mean
75th Percentile
Local Maximum
Outlier
50th Percentile Sustainable Yield Realization

Plates

This page intentionally left blank


West
A
A'
A"
East
Elevation (ft amsl)
Upper Aquifer
Confining Layer
Lower Aquifer
Approximate Top of Corcoran Clay (Schmidt, 2016)
Approximate Bottom of Corcoran Clay (Lofgren and Klausing, 1969)
Brackish Water Interface
Pliocene Marine Deposits
Santa Margarita Formation/
Olcese Sands/
Tertiary Sedimentary Deposits
Granitic Crystalline Basement
Mud Process
Tulare Formation
Tulare Formation
Tulare Formation

North B

B′ South

Elevation (ft amsl)

Upper Aquifer

Lower Aquifer

Pliocene Marine Deposits

Santa Margarita Formation/ Olcese Sands/ Tertiary Sedimentary Deposits

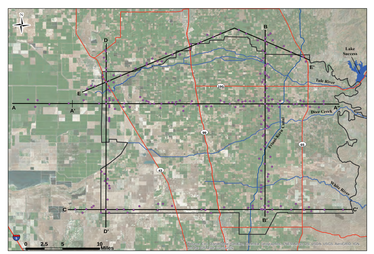
Brackish Water Interface

Brackish Water Interface

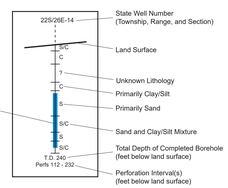
Vertical Scale
0
50
100
200
Feet

Horizontal Scale
0 1/2 1 2 Miles

Notes:
Lithologic data from Department of Water Resources Well Compeletion Reports. Wells within one half mile from cross section line unless otherwise noted by " * ". Well locations are denoted as purple dots on the map. Geophysical logs show resistivity in ohm-metres.



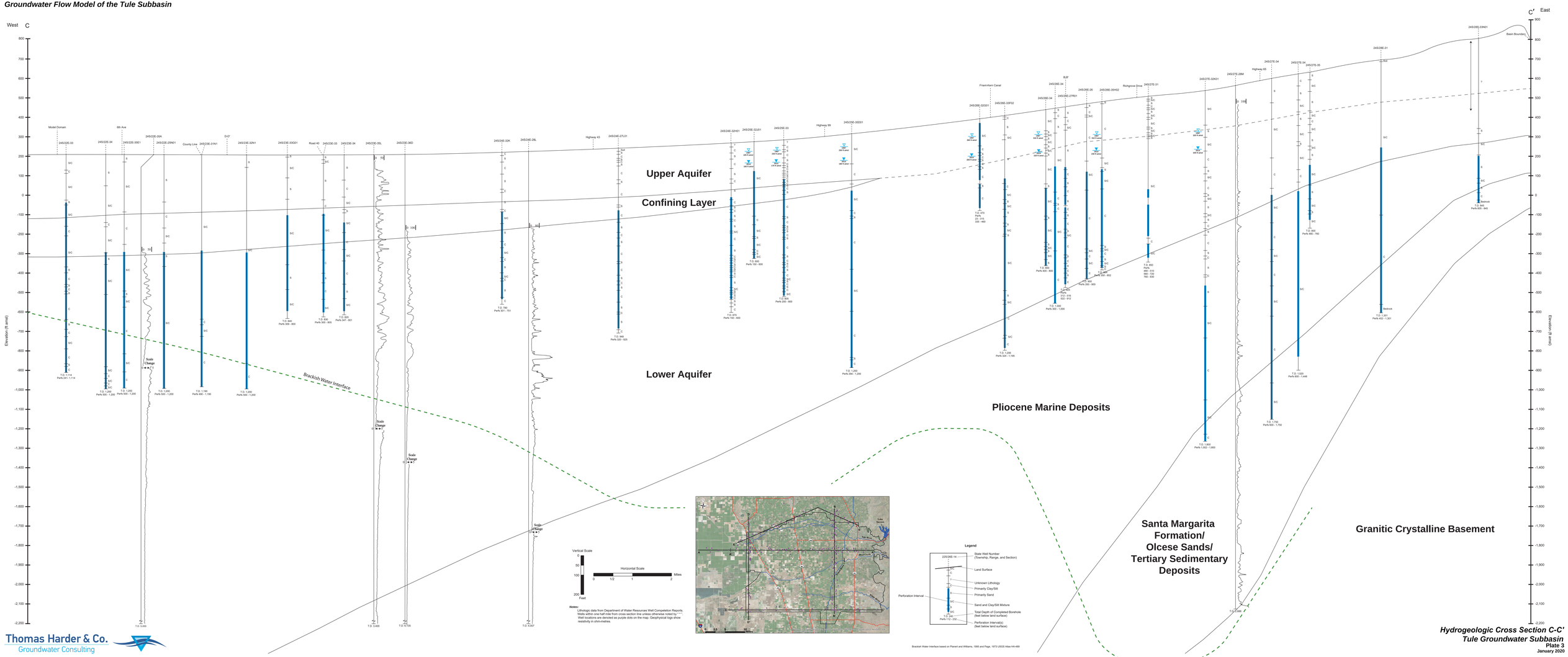
Legend



Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

Thomas Harder & Co.
Groundwater Consulting

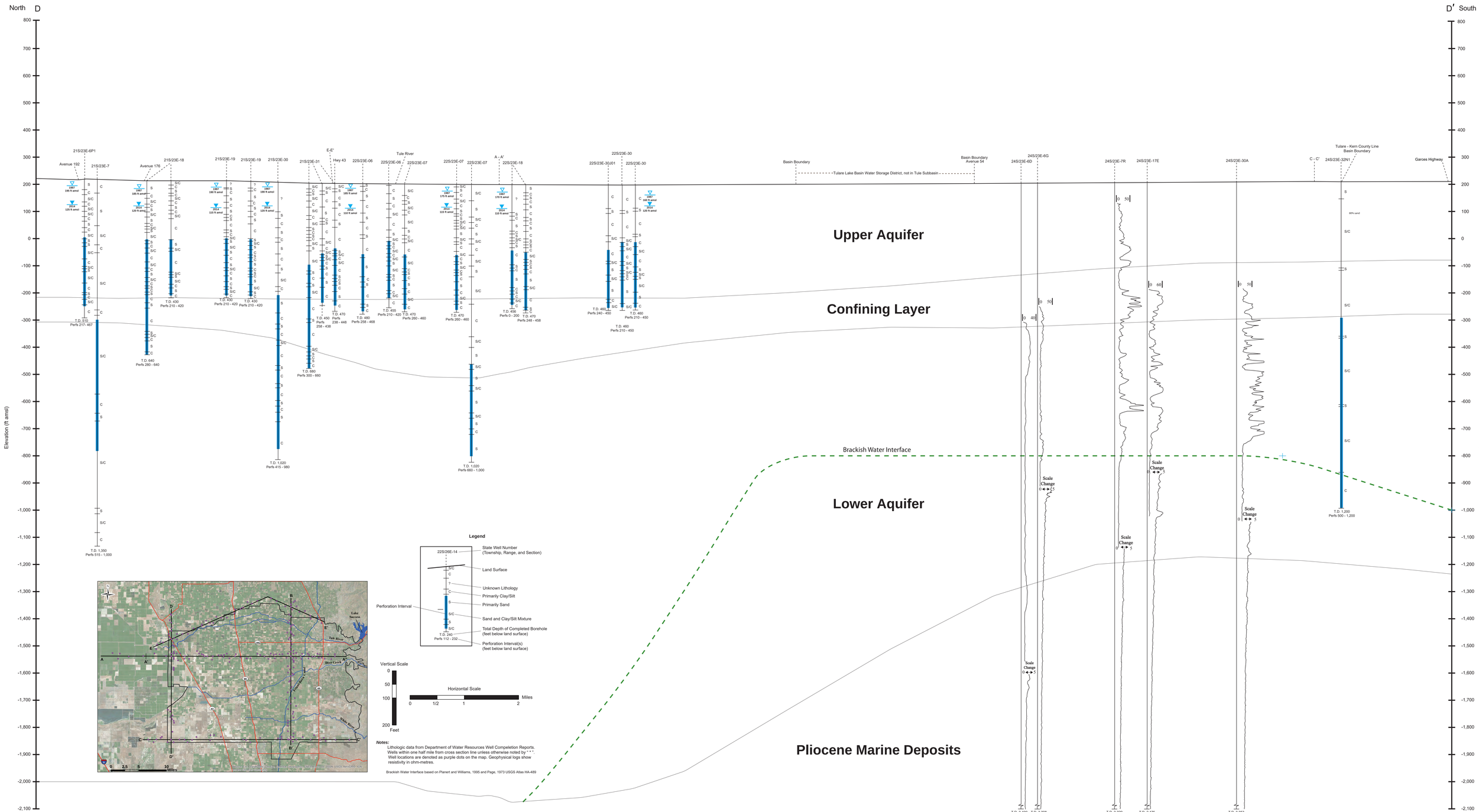
Hydrogeologic Cross Section B-B'
Tule Groundwater Subbasin
Plate 2
January 2020



Thomas Harder & Co.
Groundwater Consulting

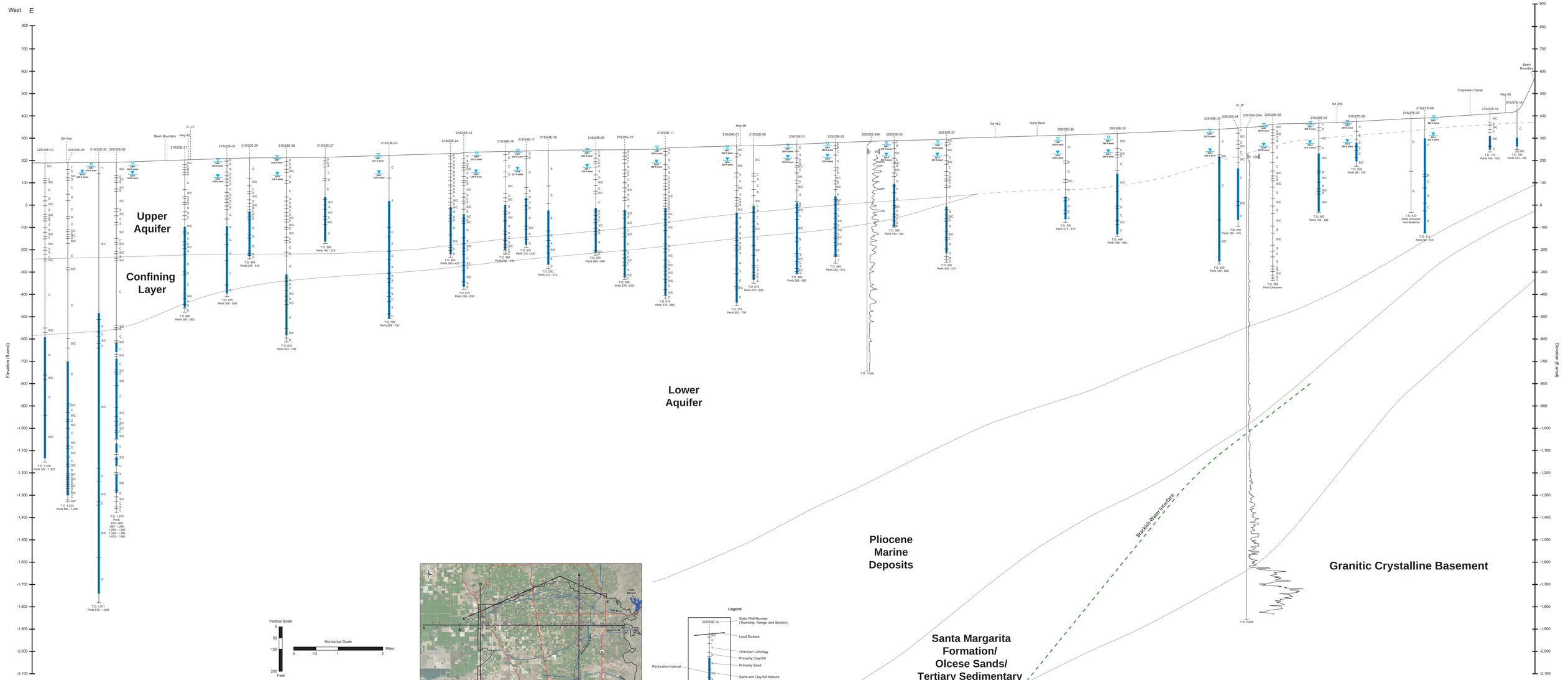
Hydrogeologic Cross Section C-C′
Tule Groundwater Subbasin
Plate 3
January 2020

Tule Subbasin Technical Advisory Committee
Groundwater Flow Model of the Tule Subbasin



Hydrogeologic Cross Section D-D'
Tule Groundwater Basin
Plate 4
January 2020

Thomas Harder & Co.
Groundwater Consulting



Notes:

Lithologic data from Department of Water Resources Well Completion Reports. Wells within one half mile from cross section line unless otherwise noted by " * ". Well locations are denoted as purple dots on the map. Geophysical logs show resistivity in ohm-metres.

Brackish Water Interface based on Planert and Williams, 1995 and Page, 1973 USGS Atlas HA-489

Thomas Harder & Co.
Groundwater Consulting

Hydrogeologic Cross Section E-E'
Tule Groundwater Basin
Plate 5
January 2020

This page intentionally left blank

Appendix A

Historical Agricultural Water Demand

This page intentionally left blank

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Subbasin-Wide																		
1986 - 1987	1,018,097	778,340	239,757	33,127	24,656	8,471	0	0	0	890	736	153	246,037	187,944	58,093	738,044	565,004	173,040
1987 - 1988	1,027,472	785,581	241,891	19,304	13,820	5,483	0	0	0	1,086	899	187	221,803	172,730	49,073	785,280	598,132	187,148
1988 - 1989	1,011,102	776,018	235,084	23,722	17,645	6,077	0	0	0	1,151	953	199	243,085	189,687	53,398	743,144	567,733	175,411
1989 - 1990	1,044,445	800,661	243,784	11,540	8,848	2,693	0	0	0	1,212	1,003	209	176,821	139,541	37,280	854,872	651,270	203,602
1990 - 1991	1,064,120	815,799	248,321	22,633	16,751	5,883	0	0	0	1,255	1,039	217	221,141	173,947	47,194	819,090	624,062	195,028
1991 - 1992	1,059,346	811,169	248,177	14,304	10,779	3,525	0	0	0	1,278	1,058	220	207,636	162,524	45,111	836,129	636,809	199,320
1992 - 1993	1,045,823	794,391	251,432	51,680	34,854	16,826	0	0	0	1,301	1,076	224	469,840	353,131	116,709	523,002	405,329	117,673
1993 - 1994	1,062,526	809,579	252,948	29,745	21,058	8,687	0	0	0	1,340	1,109	231	220,434	168,326	52,109	811,007	619,086	191,921
1994 - 1995	1,080,491	819,827	260,664	106,204	71,560	34,645	3,913	2,916	997	1,318	1,090	227	377,649	287,784	89,865	591,406	456,476	134,931
1995 - 1996	1,099,824	822,408	277,416	94,398	62,565	31,833	4,821	3,593	1,228	1,333	1,103	230	455,430	335,329	120,102	543,842	419,818	124,024
1996 - 1997	1,117,097	826,763	290,334	88,519	57,140	31,379	2,705	2,015	689	1,443	1,194	249	427,903	307,345	120,558	596,528	459,069	137,458
1997 - 1998	1,092,540	829,188	263,352	139,075	97,986	41,089	12,216	9,103	3,113	1,328	1,099	229	275,664	208,571	67,092	664,258	512,429	151,829
1998 - 1999	1,086,161	829,735	256,426	51,812	37,735	14,078	1,312	978	334	1,317	1,090	227	379,051	287,867	91,184	652,669	502,066	150,603
1999 - 2000	1,130,153	858,817	271,337	54,404	39,179	15,225	1,242	926	317	1,423	1,178	245	388,176	292,903	95,273	684,908	524,632	160,276
2000 - 2001	1,058,511	809,159	249,351	29,751	21,906	7,845	0	0	0	1,436	1,189	248	270,555	207,885	62,670	756,768	578,180	178,588
2001 - 2002	1,066,679	813,196	253,483	31,648	22,620	9,028	0	0	0	1,662	1,376	287	281,296	215,391	65,906	752,072	573,810	178,263
2002 - 2003	1,019,118	811,407	207,711	48,979	37,469	11,510	853	661	192	1,602	1,368	234	322,881	256,081	66,800	644,803	515,828	128,975
2003 - 2004	990,274	786,798	203,476	24,403	18,219	6,184	0	0	0	1,733	1,484	248	280,633	221,818	58,815	683,505	545,277	138,228
2004 - 2005	987,899	782,896	205,003	59,084	43,818	15,267	3,160	2,456	704	3,833	3,283	549	410,818	320,240	90,578	511,004	413,098	97,905
2005 - 2006	1,012,782	790,782	222,000	88,078	58,788	29,290	1,703	1,324	379	4,662	3,994	668	395,790	305,223	90,567	522,550	421,453	101,097
2006 - 2007	979,863	779,218	200,645	19,000	14,161	4,839	0	0	0	5,172	4,431	741	184,617	145,921	38,696	771,073	614,705	156,369
2007 - 2008	954,599	764,231	190,368	32,077	24,291	7,786	0	0	0	5,257	4,504	753	251,105	204,677	46,428	666,160	530,759	135,401
2008 - 2009	1,015,720	808,551	207,169	29,902	22,297	7,605	0	0	0	4,905	4,202	703	288,687	231,658	57,029	692,227	550,394	141,832
2009 - 2010	935,584	738,010	197,575	64,651	45,449	19,202	0	0	0	4,522	3,874	648	354,234	276,026	78,208	512,178	412,661	99,517
2010 - 2011	1,050,655	820,262	230,394	95,593	65,342	30,251	6,074	4,721	1,353	4,444	3,807	637	377,299	292,285	85,014	567,247	455,448	111,799
2011 - 2012	1,060,462	839,253	221,209	45,741	33,806	11,934	0	0	0	4,761	4,079	682	231,285	183,556	47,729	778,675	617,739	160,937
2012 - 2013	1,044,061	826,740	217,321	13,733	10,283	3,450	0	0	0	4,917	4,212	704	183,590	147,772	35,818	841,821	664,446	177,375
2013 - 2014	1,028,437	818,430	210,007	3,460	2,436	1,024	0	0	0	4,413	3,780	632	69,509	55,728	13,780	951,056	756,356	194,699
2014 - 2015	987,336	789,506	197,829	3,369	2,284	1,085	0	0	0	3,199	2,741	458	39,068	33,197	5,871	941,700	751,351	190,349
2015 - 2016	897,018	719,836	177,183	25,320	19,389	5,932	0	0	0	3,122	2,675	447	203,620	168,051	35,568	664,956	529,993	134,964
2016 - 2017	1,021,271	782,591	238,681	108,479	67,103	41,376	6,206	4,823	1,382	3,258	2,791	467	432,856	330,160	102,696	470,473	379,639	90,834

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Eastern Tule GSA																		
1986 - 1987	291,005	238,223	52,783	14,521	11,278	3,243	N/A	N/A	N/A	890	736	153	68,741	55,325	13,416	206,853	170,882	35,971
1987 - 1988	294,550	238,223	56,328	14,307	10,228	4,079	N/A	N/A	N/A	1,086	899	187	72,397	57,406	14,991	206,760	169,690	37,071
1988 - 1989	291,431	238,223	53,208	8,212	6,494	1,718	N/A	N/A	N/A	1,151	953	199	76,310	62,038	14,272	205,757	168,738	37,019
1989 - 1990	291,559	238,223	53,336	7,357	5,840	1,517	N/A	N/A	N/A	1,212	1,003	209	68,409	55,915	12,494	214,581	175,465	39,116
1990 - 1991	291,678	238,223	53,455	6,989	5,503	1,486	N/A	N/A	N/A	1,255	1,039	217	65,293	52,784	12,509	218,140	178,897	39,243
1991 - 1992	291,452	238,223	53,230	7,512	5,895	1,617	N/A	N/A	N/A	1,278	1,058	220	75,955	61,625	14,330	206,707	169,644	37,062
1992 - 1993	297,965	238,223	59,742	24,889	15,959	8,930	N/A	N/A	N/A	1,301	1,076	224	91,076	71,113	19,963	180,699	150,074	30,625
1993 - 1994	295,122	238,288	56,834	12,896	8,944	3,952	N/A	N/A	N/A	1,340	1,109	231	74,480	58,768	15,712	206,406	169,468	36,938
1994 - 1995	301,654	238,295	63,359	38,482	23,088	15,394	N/A	N/A	N/A	1,318	1,090	227	81,361	63,793	17,568	180,493	150,324	30,170
1995 - 1996	310,673	240,306	70,367	38,647	22,589	16,058	N/A	N/A	N/A	1,333	1,103	230	107,757	80,692	27,065	162,936	135,922	27,014
1996 - 1997	307,526	240,104	67,421	36,193	21,519	14,674	N/A	N/A	N/A	1,443	1,194	249	97,479	74,189	23,290	172,411	143,203	29,208
1997 - 1998	299,742	240,104	59,638	35,602	23,590	12,012	N/A	N/A	N/A	1,328	1,099	229	68,203	53,764	14,439	194,609	161,652	32,958
1998 - 1999	295,674	240,104	55,570	14,510	10,914	3,596	N/A	N/A	N/A	1,317	1,090	227	94,481	74,773	19,708	185,366	153,327	32,039
1999 - 2000	297,531	240,104	57,427	11,707	8,480	3,227	N/A	N/A	N/A	1,423	1,178	245	98,146	76,665	21,481	186,255	153,782	32,473
2000 - 2001	295,065	240,104	54,960	9,431	7,296	2,135	N/A	N/A	N/A	1,436	1,189	248	83,888	67,147	16,741	200,309	164,472	35,837
2001 - 2002	297,510	240,104	57,406	12,901	9,141	3,760	N/A	N/A	N/A	1,662	1,376	287	81,469	64,126	17,343	201,478	165,462	36,016
2002 - 2003	287,896	240,104	47,791	8,728	6,937	1,791	N/A	N/A	N/A	1,602	1,368	234	87,129	71,358	15,771	190,437	160,442	29,994
2003 - 2004	285,462	238,183	47,280	8,496	6,101	2,395	N/A	N/A	N/A	1,733	1,484	248	84,706	70,150	14,557	190,527	160,448	30,079
2004 - 2005	287,591	238,096	49,496	19,761	13,861	5,900	N/A	N/A	N/A	3,833	3,283	549	91,566	74,679	16,887	172,432	146,272	26,160
2005 - 2006	299,473	238,096	61,377	34,315	18,864	15,451	N/A	N/A	N/A	4,662	3,994	668	101,063	80,013	21,050	159,432	135,225	24,208
2006 - 2007	285,360	238,096	47,265	5,612	3,962	1,650	N/A	N/A	N/A	5,172	4,431	741	67,474	55,917	11,557	207,102	173,786	33,317
2007 - 2008	285,203	238,096	47,107	8,094	6,021	2,073	N/A	N/A	N/A	5,257	4,504	753	79,846	66,040	13,806	192,006	161,531	30,475
2008 - 2009	286,397	238,096	48,301	9,449	6,716	2,733	N/A	N/A	N/A	4,905	4,202	703	90,672	74,176	16,496	181,371	153,002	28,369
2009 - 2010	291,167	238,096	53,072	27,070	18,075	8,995	N/A	N/A	N/A	4,522	3,874	648	94,636	76,085	18,551	164,940	140,063	24,877
2010 - 2011	283,939	226,060	57,879	33,500	18,781	14,719	N/A	N/A	N/A	4,444	3,807	637	92,011	73,468	18,543	153,984	130,587	23,397
2011 - 2012	273,439	227,565	45,874	6,504	4,685	1,819	N/A	N/A	N/A	4,761	4,079	682	67,253	55,676	11,577	194,921	163,375	31,547
2012 - 2013	271,820	226,748	45,072	3,769	2,693	1,076	N/A	N/A	N/A	4,917	4,212	704	64,337	53,438	10,899	198,797	166,501	32,296
2013 - 2014	270,163	225,475	44,688	3,460	2,436	1,024	N/A	N/A	N/A	4,413	3,780	632	29,308	24,235	5,073	232,982	195,089	37,893
2014 - 2015	268,488	224,823	43,665	3,369	2,284	1,085	N/A	N/A	N/A	3,199	2,741	458	19,327	16,691	2,636	242,593	203,174	39,420
2015 - 2016	268,848	225,116	43,733	7,646	5,925	1,721	N/A	N/A	N/A	3,122	2,675	447	64,109	53,549	10,560	193,971	163,239	30,732
2016 - 2017	304,194	225,606	78,588	47,593	20,721	26,872	N/A	N/A	N/A	3,258	2,791	467	109,774	80,486	29,288	143,569	122,208	21,361

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Lower Tule River Irrigation District GSA																		
1986 - 1987	293,688	211,275	82,412	18,606	13,378	5,228	N/A	N/A	N/A	N/A	N/A	N/A	45,292	32,565	12,727	229,790	165,333	64,457
1987 - 1988	303,758	218,516	85,242	4,997	3,593	1,404	N/A	N/A	N/A	N/A	N/A	N/A	32,000	23,008	8,992	266,761	191,915	74,846
1988 - 1989	290,458	208,953	81,505	15,510	11,152	4,358	N/A	N/A	N/A	N/A	N/A	N/A	45,116	32,438	12,678	229,832	165,364	64,469
1989 - 1990	303,361	218,230	85,131	4,183	3,008	1,176	N/A	N/A	N/A	N/A	N/A	N/A	16,882	12,138	4,744	282,295	203,084	79,211
1990 - 1991	322,208	231,781	90,427	15,644	11,248	4,396	N/A	N/A	N/A	N/A	N/A	N/A	47,120	33,879	13,241	259,444	186,654	72,790
1991 - 1992	325,848	234,398	91,450	6,792	4,883	1,908	N/A	N/A	N/A	N/A	N/A	N/A	35,891	25,806	10,086	283,165	203,709	79,455
1992 - 1993	308,296	218,931	89,365	26,791	18,895	7,896	N/A	N/A	N/A	N/A	N/A	N/A	180,980	127,643	53,337	100,525	72,392	28,133
1993 - 1994	313,293	225,371	87,922	16,849	12,114	4,735	N/A	N/A	N/A	N/A	N/A	N/A	43,999	31,635	12,364	252,445	181,622	70,823
1994 - 1995	323,341	231,983	91,358	67,722	48,472	19,250	N/A	N/A	N/A	N/A	N/A	N/A	120,864	86,508	34,356	134,755	97,004	37,752
1995 - 1996	300,478	215,761	84,718	55,751	39,977	15,774	N/A	N/A	N/A	N/A	N/A	N/A	133,347	95,617	37,730	111,381	80,167	31,213
1996 - 1997	307,680	214,148	93,532	52,326	35,621	16,705	N/A	N/A	N/A	N/A	N/A	N/A	134,710	91,703	43,007	120,644	86,825	33,820
1997 - 1998	294,068	211,515	82,553	103,473	74,396	29,076	N/A	N/A	N/A	N/A	N/A	N/A	51,185	36,802	14,383	139,410	100,317	39,093
1998 - 1999	291,448	209,632	81,817	37,302	26,820	10,482	N/A	N/A	N/A	N/A	N/A	N/A	122,489	88,069	34,420	131,657	94,743	36,914
1999 - 2000	322,165	231,717	90,448	42,697	30,699	11,998	N/A	N/A	N/A	N/A	N/A	N/A	117,256	84,306	32,950	162,212	116,711	45,500
2000 - 2001	276,273	198,721	77,552	20,320	14,610	5,710	N/A	N/A	N/A	N/A	N/A	N/A	55,432	39,855	15,577	200,521	144,256	56,266
2001 - 2002	287,661	206,908	80,752	18,747	13,479	5,268	N/A	N/A	N/A	N/A	N/A	N/A	57,673	41,467	16,206	211,241	151,963	59,278
2002 - 2003	272,579	206,819	65,760	40,251	30,532	9,718	N/A	N/A	N/A	N/A	N/A	N/A	85,429	64,803	20,627	146,899	111,484	35,415
2003 - 2004	276,611	210,749	65,862	15,907	12,118	3,789	N/A	N/A	N/A	N/A	N/A	N/A	54,868	41,798	13,070	205,836	156,833	49,003
2004 - 2005	276,208	210,440	65,768	39,323	29,956	9,367	N/A	N/A	N/A	N/A	N/A	N/A	138,498	105,507	32,991	98,387	74,977	23,410
2005 - 2006	263,486	197,520	65,966	53,763	39,925	13,838	N/A	N/A	N/A	N/A	N/A	N/A	114,482	85,015	29,467	95,241	72,580	22,661
2006 - 2007	267,230	203,600	63,630	13,388	10,199	3,189	N/A	N/A	N/A	N/A	N/A	N/A	20,443	15,573	4,870	233,399	177,828	55,571
2007 - 2008	261,534	199,261	62,273	23,983	18,270	5,713	N/A	N/A	N/A	N/A	N/A	N/A	53,024	40,393	12,631	184,527	140,598	43,929
2008 - 2009	295,571	225,190	70,381	20,453	15,581	4,872	N/A	N/A	N/A	N/A	N/A	N/A	73,446	55,951	17,495	201,672	153,659	48,013
2009 - 2010	236,426	174,762	61,664	37,581	27,374	10,207	N/A	N/A	N/A	N/A	N/A	N/A	123,325	89,831	33,494	75,520	57,557	17,963
2010 - 2011	302,825	228,543	74,282	62,093	46,561	15,532	N/A	N/A	N/A	N/A	N/A	N/A	121,727	91,278	30,449	119,005	90,703	28,302
2011 - 2012	312,980	236,874	76,106	39,237	29,121	10,115	N/A	N/A	N/A	N/A	N/A	N/A	42,291	31,389	10,903	231,452	176,364	55,088
2012 - 2013	294,561	224,440	70,121	9,964	7,590	2,373	N/A	N/A	N/A	N/A	N/A	N/A	25,716	19,590	6,126	258,881	197,260	61,621
2013 - 2014	283,682	216,153	67,529	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	283,682	216,153	67,529
2014 - 2015	246,677	187,963	58,714	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	246,677	187,963	58,714
2015 - 2016	219,092	166,949	52,143	17,674	13,464	4,210	N/A	N/A	N/A	N/A	N/A	N/A	46,013	35,052	10,961	155,405	118,433	36,973
2016 - 2017	272,226	206,838	65,388	60,886	46,382	14,503	N/A	N/A	N/A	N/A	N/A	N/A	126,021	95,606	30,415	85,319	65,041	20,278

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Pixley Irrigation District GSA																		
1986 - 1987	153,767	114,587	39,180	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	1,151	858	293	152,616	113,729	38,887
1987 - 1988	153,767	114,587	39,180	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	153,767	114,587	39,180
1988 - 1989	153,767	114,587	39,180	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	3,627	2,702	924	150,141	111,884	38,256
1989 - 1990	174,387	129,953	44,434	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	174,387	129,953	44,434
1990 - 1991	176,516	131,539	44,977	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	176,516	131,539	44,977
1991 - 1992	166,792	124,293	42,499	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	166,792	124,293	42,499
1992 - 1993	165,032	122,982	42,051	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	53,530	39,890	13,639	111,503	83,091	28,411
1993 - 1994	177,163	132,021	45,141	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	177,163	132,021	45,141
1994 - 1995	182,108	135,706	46,401	N/A	N/A	N/A	3,913	2,916	997	N/A	N/A	N/A	29,783	22,194	7,589	148,411	110,596	37,816
1995 - 1996	163,604	121,918	41,687	N/A	N/A	N/A	4,821	3,593	1,228	N/A	N/A	N/A	38,375	28,597	9,778	120,408	89,728	30,680
1996 - 1997	168,324	125,435	42,889	N/A	N/A	N/A	2,705	2,015	689	N/A	N/A	N/A	22,254	16,584	5,670	143,365	106,835	36,530
1997 - 1998	175,112	130,493	44,619	N/A	N/A	N/A	12,216	9,103	3,113	N/A	N/A	N/A	24,467	18,233	6,234	138,430	103,157	35,272
1998 - 1999	178,373	132,923	45,450	N/A	N/A	N/A	1,312	978	334	N/A	N/A	N/A	21,160	15,769	5,392	155,900	116,176	39,724
1999 - 2000	187,825	139,967	47,858	N/A	N/A	N/A	1,242	926	317	N/A	N/A	N/A	26,366	19,648	6,718	160,217	119,394	40,824
2000 - 2001	165,472	123,309	42,163	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	6,410	4,777	1,633	159,062	118,532	40,529
2001 - 2002	159,902	119,159	40,743	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	9,550	7,117	2,433	150,352	112,042	38,310
2002 - 2003	151,591	117,459	34,132	N/A	N/A	N/A	853	661	192	N/A	N/A	N/A	19,578	15,170	4,408	131,160	101,628	29,532
2003 - 2004	143,885	111,838	32,047	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	6,828	5,307	1,521	137,057	106,531	30,526
2004 - 2005	143,267	111,358	31,909	N/A	N/A	N/A	3,160	2,456	704	N/A	N/A	N/A	35,846	27,862	7,984	104,261	81,039	23,222
2005 - 2006	170,036	132,164	37,871	N/A	N/A	N/A	1,703	1,324	379	N/A	N/A	N/A	36,731	28,550	8,181	131,602	102,291	29,311
2006 - 2007	147,335	114,519	32,815	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	4,449	3,458	991	142,886	111,061	31,824
2007 - 2008	133,635	103,871	29,764	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	7,434	5,778	1,656	126,201	98,093	28,108
2008 - 2009	157,297	122,263	35,034	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	14,865	11,554	3,311	142,432	110,709	31,723
2009 - 2010	131,420	102,149	29,271	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	16,593	12,897	3,696	114,827	89,252	25,575
2010 - 2011	169,047	131,396	37,651	N/A	N/A	N/A	6,074	4,721	1,353	N/A	N/A	N/A	31,321	24,345	6,976	131,652	102,330	29,322
2011 - 2012	181,603	141,156	40,448	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	2,291	1,781	510	179,312	139,375	39,937
2012 - 2013	182,553	141,894	40,659	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	3,251	2,527	724	179,302	139,367	39,935
2013 - 2014	184,161	143,144	41,017	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	184,161	143,144	41,017
2014 - 2015	184,057	143,063	40,994	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	0	0	184,057	143,063	40,994
2015 - 2016	121,082	94,114	26,968	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	2,164	1,682	482	118,918	92,432	26,486
2016 - 2017	149,868	116,489	33,379	N/A	N/A	N/A	6,206	4,823	1,382	N/A	N/A	N/A	51,171	39,774	11,397	92,492	71,891	20,600

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Delano-Earlimart Irrigation District GSA																		
1986 - 1987	165,921	128,557	37,363	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	114,782	87,645	27,138	51,138	40,912	10,226
1987 - 1988	162,123	128,557	33,566	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	110,345	87,125	23,221	51,778	41,432	10,345
1988 - 1989	162,104	128,557	33,547	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	105,980	83,591	22,390	56,124	44,966	11,157
1989 - 1990	161,755	128,557	33,198	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	83,837	65,868	17,969	77,918	62,689	15,229
1990 - 1991	160,014	128,557	31,457	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	106,877	86,019	20,858	53,137	42,538	10,599
1991 - 1992	162,084	128,557	33,527	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	92,567	72,699	19,868	69,517	55,858	13,659
1992 - 1993	160,750	128,557	32,193	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	127,775	102,414	25,360	32,976	26,143	6,833
1993 - 1994	163,728	128,160	35,568	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	91,696	70,257	21,439	72,032	57,903	14,129
1994 - 1995	159,899	128,101	31,798	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	119,936	96,276	23,659	39,963	31,825	8,138
1995 - 1996	177,394	132,583	44,811	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	142,817	105,755	37,061	34,577	26,827	7,749
1996 - 1997	182,282	132,512	49,770	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	148,693	106,548	42,145	33,589	25,964	7,625
1997 - 1998	172,420	132,512	39,907	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	116,888	88,704	28,184	55,532	43,808	11,724
1998 - 1999	169,495	132,512	36,983	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	121,365	94,723	26,642	48,130	37,789	10,341
1999 - 2000	171,523	132,512	39,011	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	129,847	99,972	29,875	41,676	32,541	9,135
2000 - 2001	170,597	132,512	38,085	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	117,178	90,422	26,756	53,419	42,090	11,329
2001 - 2002	170,441	132,512	37,929	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	126,740	98,325	28,415	43,702	34,188	9,514
2002 - 2003	163,870	132,512	31,357	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	121,277	97,456	23,820	42,593	35,056	7,537
2003 - 2004	162,319	128,366	33,953	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	127,364	99,687	27,677	34,955	28,679	6,276
2004 - 2005	158,692	128,185	30,506	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	119,767	96,113	23,654	38,925	32,072	6,852
2005 - 2006	158,146	128,185	29,961	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	119,850	96,651	23,200	38,296	31,535	6,761
2006 - 2007	156,416	128,185	28,231	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	78,970	63,155	15,815	77,446	65,030	12,416
2007 - 2008	152,562	128,185	24,376	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	106,470	89,981	16,489	46,092	38,205	7,887
2008 - 2009	155,593	128,185	27,408	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	109,078	89,619	19,459	46,515	38,567	7,948
2009 - 2010	155,866	128,185	27,681	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	112,888	92,645	20,243	42,978	35,540	7,438
2010 - 2011	153,971	124,818	29,153	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	118,032	95,977	22,055	35,939	29,599	6,341
2011 - 2012	152,311	124,812	27,499	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	113,031	92,032	20,998	39,281	32,458	6,823
2012 - 2013	151,444	124,812	26,632	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	87,302	70,960	16,342	64,143	53,729	10,414
2013 - 2014	148,827	124,812	24,015	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	38,106	31,039	7,067	110,722	93,580	17,142
2014 - 2015	147,227	124,812	22,414	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	18,591	15,905	2,685	128,636	108,907	19,729
2015 - 2016	147,227	124,812	22,414	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	90,160	77,138	13,023	57,066	47,675	9,392
2016 - 2017	155,082	124,812	30,270	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	121,326	98,215	23,111	33,756	27,731	6,025

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Tri-County Water Authority GSA																		
1986 - 1987	56,858	42,849	14,009	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8,035	5,776	2,260	48,823	37,074	11,750
1987 - 1988	56,637	42,849	13,788	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,530	2,596	935	53,107	40,254	12,853
1988 - 1989	56,671	42,849	13,822	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,026	4,459	1,567	50,645	38,390	12,255
1989 - 1990	56,692	42,849	13,843	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,847	2,810	1,037	52,845	40,039	12,806
1990 - 1991	56,852	42,849	14,003	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	925	632	293	55,926	42,217	13,710
1991 - 1992	56,585	42,849	13,736	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,611	1,197	414	54,974	41,652	13,322
1992 - 1993	56,890	42,849	14,041	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8,240	6,035	2,205	48,650	36,814	11,836
1993 - 1994	56,610	42,869	13,742	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	5,130	3,833	1,297	51,481	39,036	12,445
1994 - 1995	56,744	42,870	13,874	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12,853	9,506	3,347	43,891	33,364	10,528
1995 - 1996	73,837	55,920	17,917	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16,567	12,333	4,234	57,270	43,587	13,683
1996 - 1997	75,642	57,282	18,361	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12,383	9,161	3,223	63,259	48,121	15,138
1997 - 1998	75,599	57,282	18,318	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7,460	5,534	1,926	68,139	51,748	16,391
1998 - 1999	75,585	57,282	18,304	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9,778	7,267	2,511	65,807	50,015	15,793
1999 - 2000	75,554	57,258	18,296	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8,281	6,156	2,124	67,274	51,102	16,172
2000 - 2001	75,552	57,256	18,296	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,824	2,842	982	71,728	54,415	17,314
2001 - 2002	75,582	57,256	18,326	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,932	2,179	754	72,650	55,078	17,572
2002 - 2003	71,592	57,256	14,335	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,734	3,647	1,087	66,858	53,609	13,249
2003 - 2004	60,999	48,831	12,167	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,434	2,438	995	57,565	46,393	11,172
2004 - 2005	61,070	47,408	13,662	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12,571	8,040	4,531	48,499	39,369	9,131
2005 - 2006	60,821	47,408	13,413	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11,831	7,497	4,335	48,990	39,912	9,078
2006 - 2007	61,761	47,408	14,352	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	6,641	3,909	2,732	55,120	43,500	11,620
2007 - 2008	60,832	47,408	13,424	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,165	1,242	923	58,667	46,166	12,500
2008 - 2009	60,431	47,408	13,023	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	313	179	133	60,118	47,229	12,889
2009 - 2010	60,353	47,408	12,944	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,396	2,284	1,112	56,957	45,125	11,832
2010 - 2011	70,437	54,723	15,714	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7,104	3,608	3,495	63,333	51,114	12,219
2011 - 2012	70,064	54,423	15,641	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	3,210	1,339	1,870	66,854	53,083	13,771
2012 - 2013	71,841	54,423	17,418	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,492	628	864	70,349	53,795	16,555
2013 - 2014	70,802	54,423	16,379	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,048	227	820	69,754	54,195	15,559
2014 - 2015	70,443	54,423	16,021	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	575	300	275	69,868	54,122	15,746
2015 - 2016	70,385	54,423	15,962	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	587	316	271	69,798	54,107	15,691
2016 - 2017	69,951	54,423	15,528	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12,281	8,039	4,242	57,669	46,384	11,286

Historical Agricultural Water Demand

Water Year	Total Applied Water	Total Cons. Use	Total Return Flow	Tule River			Deer Creek			Recycled Water			Imported Water			Groundwater Production		
				Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow	Applied	Cons. Use	Return Flow
Alpaugh GSA																		
1986 - 1987	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1,145	859	286	34,624	25,974	8,650
1987 - 1988	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	35,769	26,833	8,936
1988 - 1989	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	35,769	26,833	8,936
1989 - 1990	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	35,769	26,833	8,936
1990 - 1991	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	35,769	26,833	8,936
1991 - 1992	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	35,769	26,833	8,936
1992 - 1993	35,769	26,833	8,936	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13,821	10,368	3,453	21,948	16,465	5,483
1993 - 1994	35,779	26,841	8,939	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	4,115	3,087	1,028	31,664	23,754	7,910
1994 - 1995	35,780	26,841	8,939	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	9,723	7,294	2,429	26,057	19,547	6,510
1995 - 1996	33,699	25,280	8,419	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12,381	9,288	3,093	21,318	15,992	5,326
1996 - 1997	33,482	25,118	8,365	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	33,482	25,118	8,365
1997 - 1998	33,482	25,118	8,365	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	33,482	25,118	8,365
1998 - 1999	33,482	25,118	8,365	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	33,482	25,118	8,365
1999 - 2000	33,472	25,110	8,362	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	91	68	23	33,381	25,042	8,339
2000 - 2001	33,471	25,109	8,362	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	33,471	25,109	8,362
2001 - 2002	33,471	25,109	8,362	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	33,471	25,109	8,362
2002 - 2003	32,637	25,109	7,528	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	98	75	23	32,540	25,034	7,506
2003 - 2004	30,217	23,308	6,909	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	30,217	23,308	6,909
2004 - 2005	30,556	23,017	7,539	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	13,660	9,985	3,675	16,896	13,032	3,863
2005 - 2006	31,475	23,017	8,458	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15,189	10,454	4,734	16,287	12,563	3,724
2006 - 2007	29,840	23,017	6,823	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	29,840	23,017	6,823
2007 - 2008	29,840	23,017	6,823	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	29,840	23,017	6,823
2008 - 2009	29,840	23,017	6,823	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,009	1,550	459	27,831	21,467	6,364
2009 - 2010	29,840	23,017	6,823	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,518	1,943	576	27,322	21,075	6,247
2010 - 2011	20,679	15,175	5,504	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	10,324	7,188	3,137	10,355	7,987	2,368
2011 - 2012	18,791	14,321	4,470	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	889	513	377	17,902	13,808	4,093
2012 - 2013	18,566	14,321	4,245	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	18,566	14,321	4,245
2013 - 2014	18,566	14,321	4,245	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	18,566	14,321	4,245
2014 - 2015	18,566	14,321	4,245	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	18,566	14,321	4,245
2015 - 2016	18,566	14,321	4,245	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	18,566	14,321	4,245
2016 - 2017	18,566	14,321	4,245	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	2,232	1,721	510	16,335	12,600	3,735

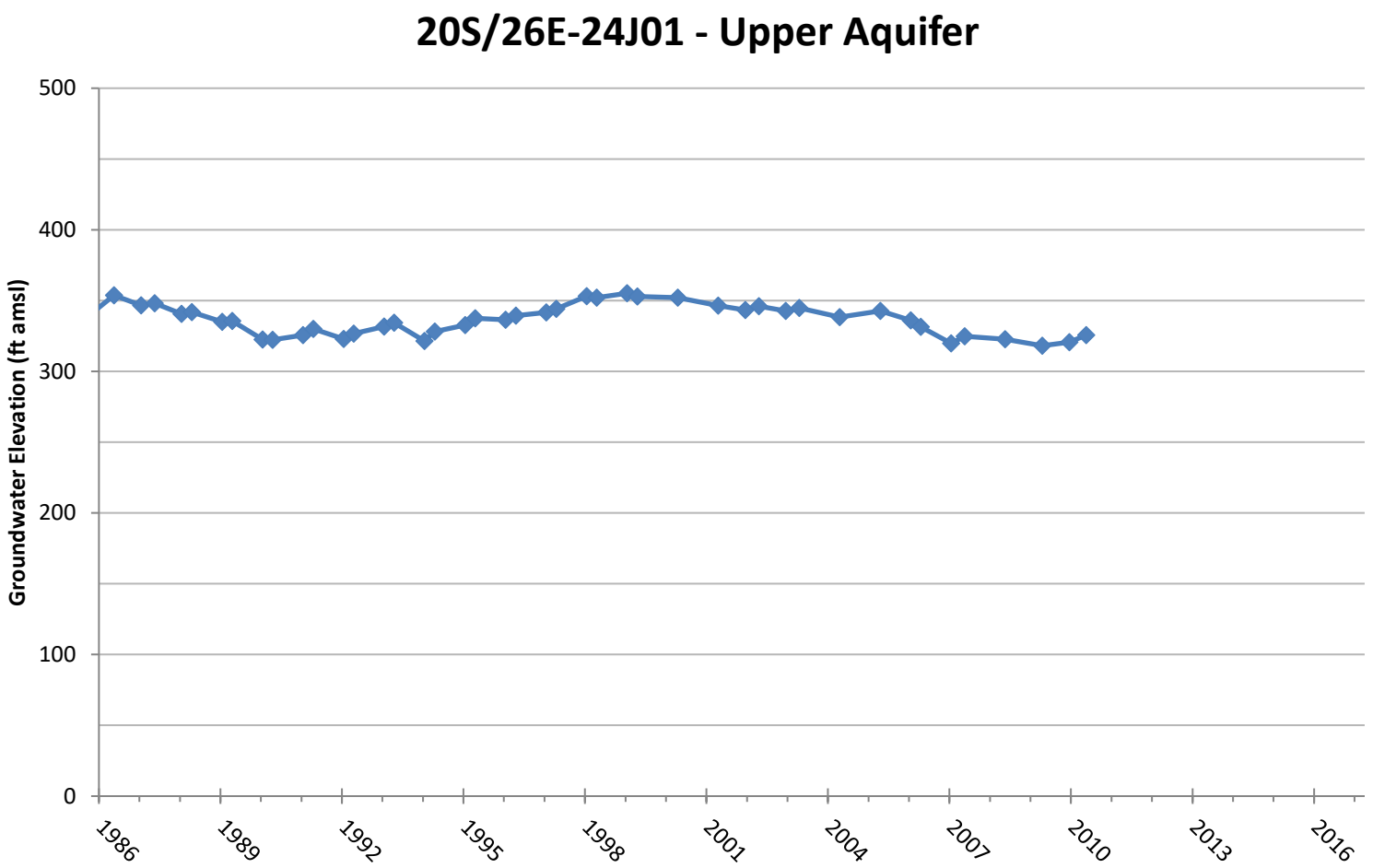
This page intentionally left blank

Appendix B

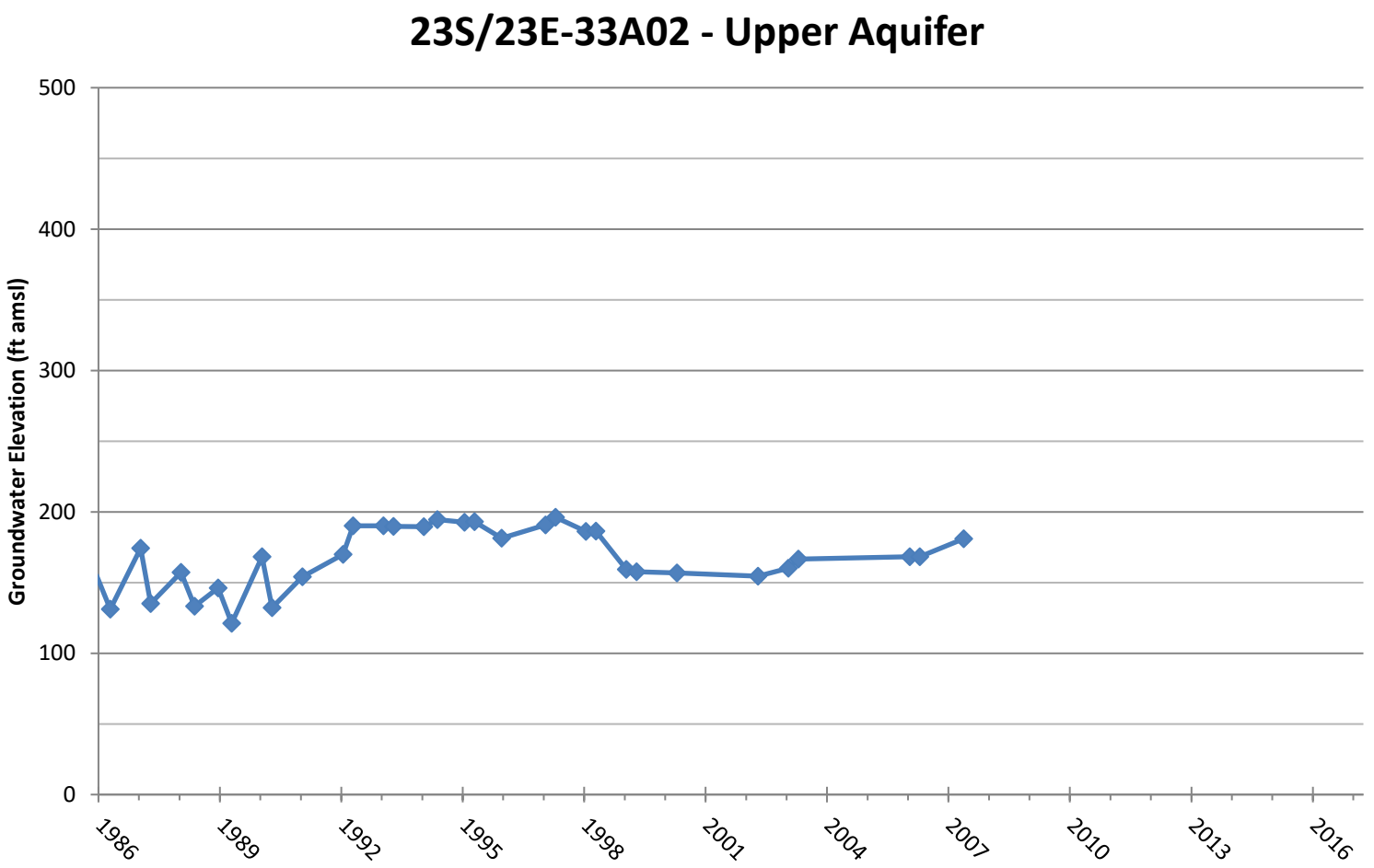
Hydrographs for Boundary Wells

This page intentionally left blank

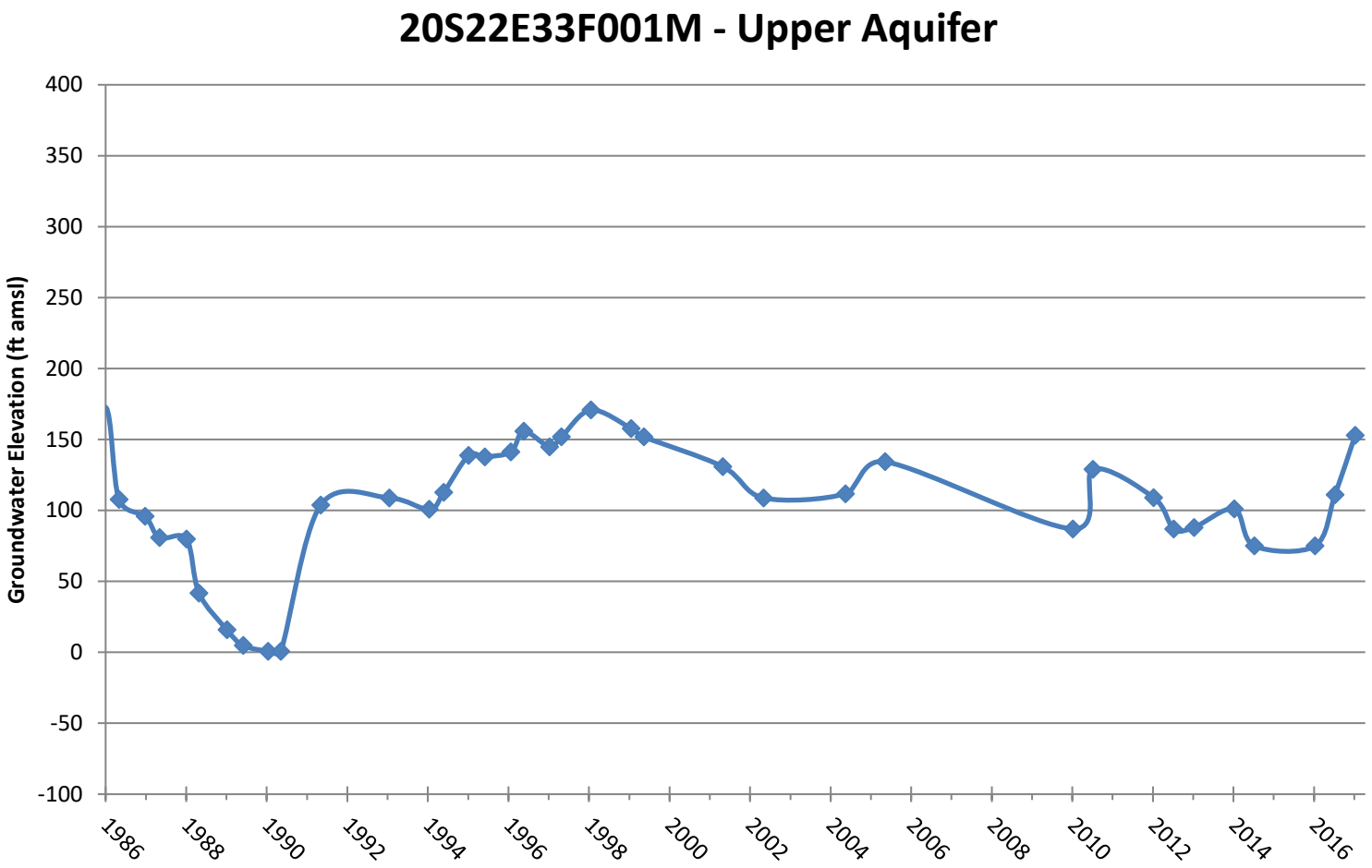
Boundary Condition Well Hydrograph



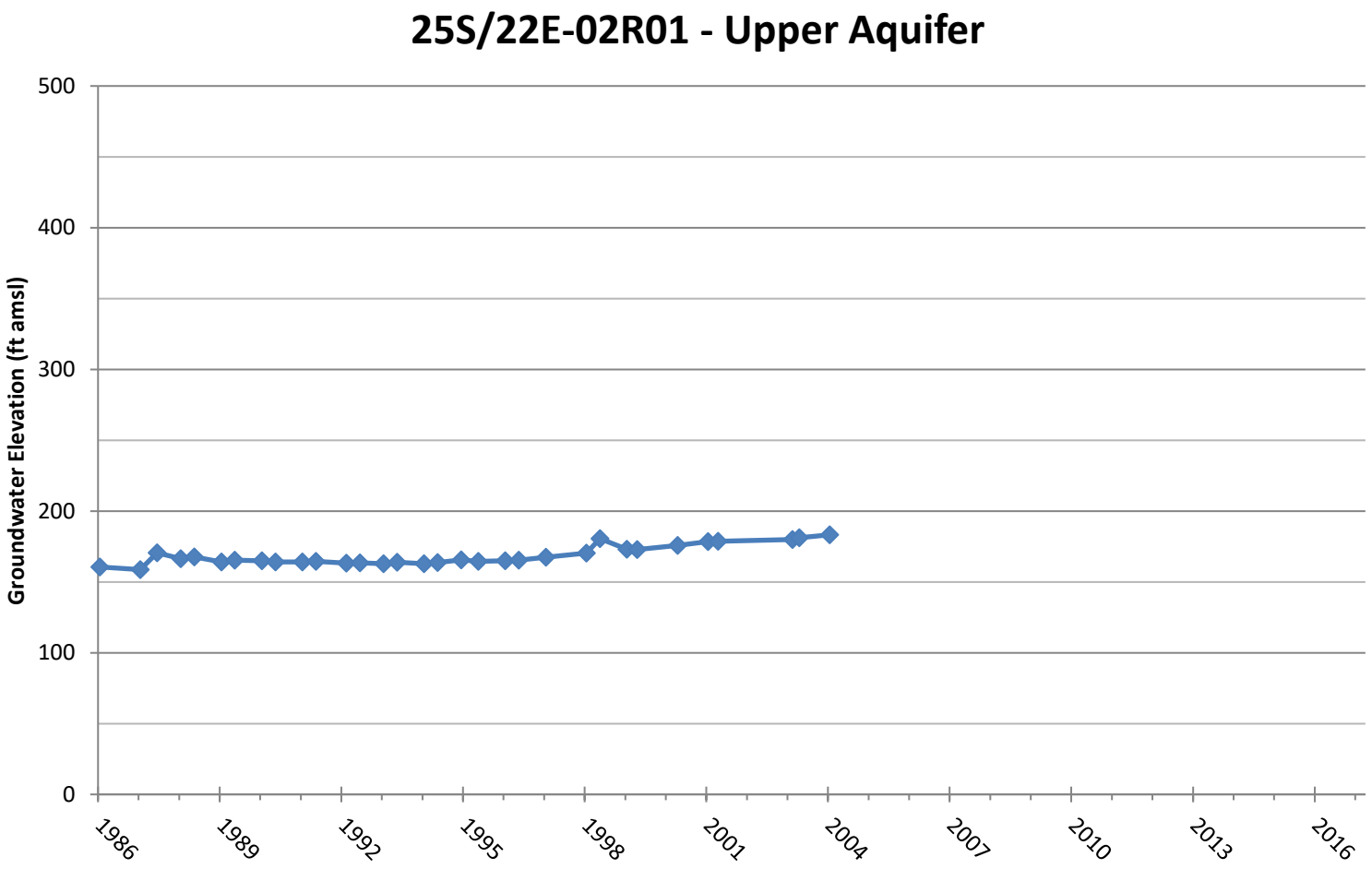
Boundary Condition Well Hydrograph



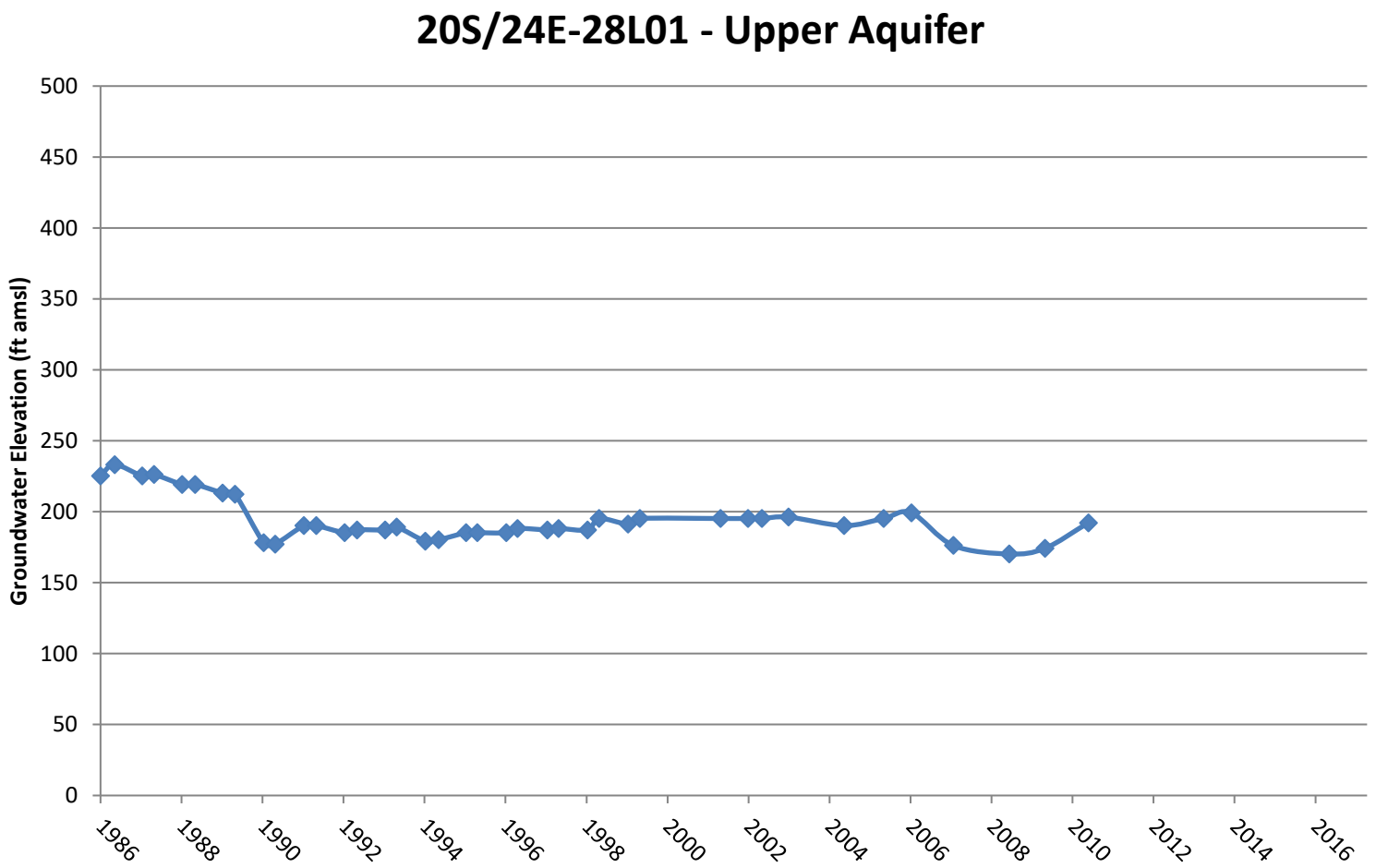
Boundary Condition Well Hydrograph



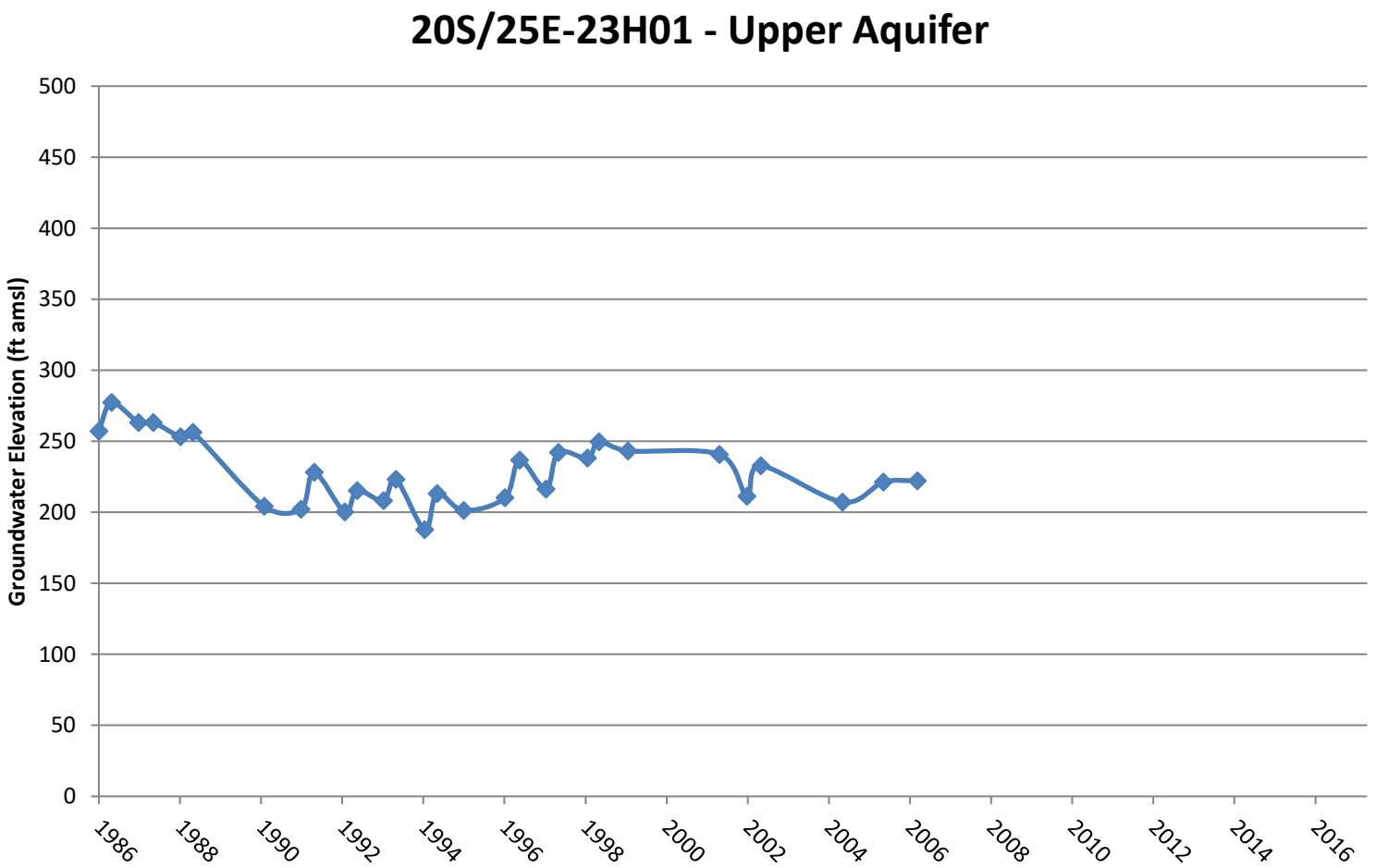
Boundary Condition Well Hydrograph



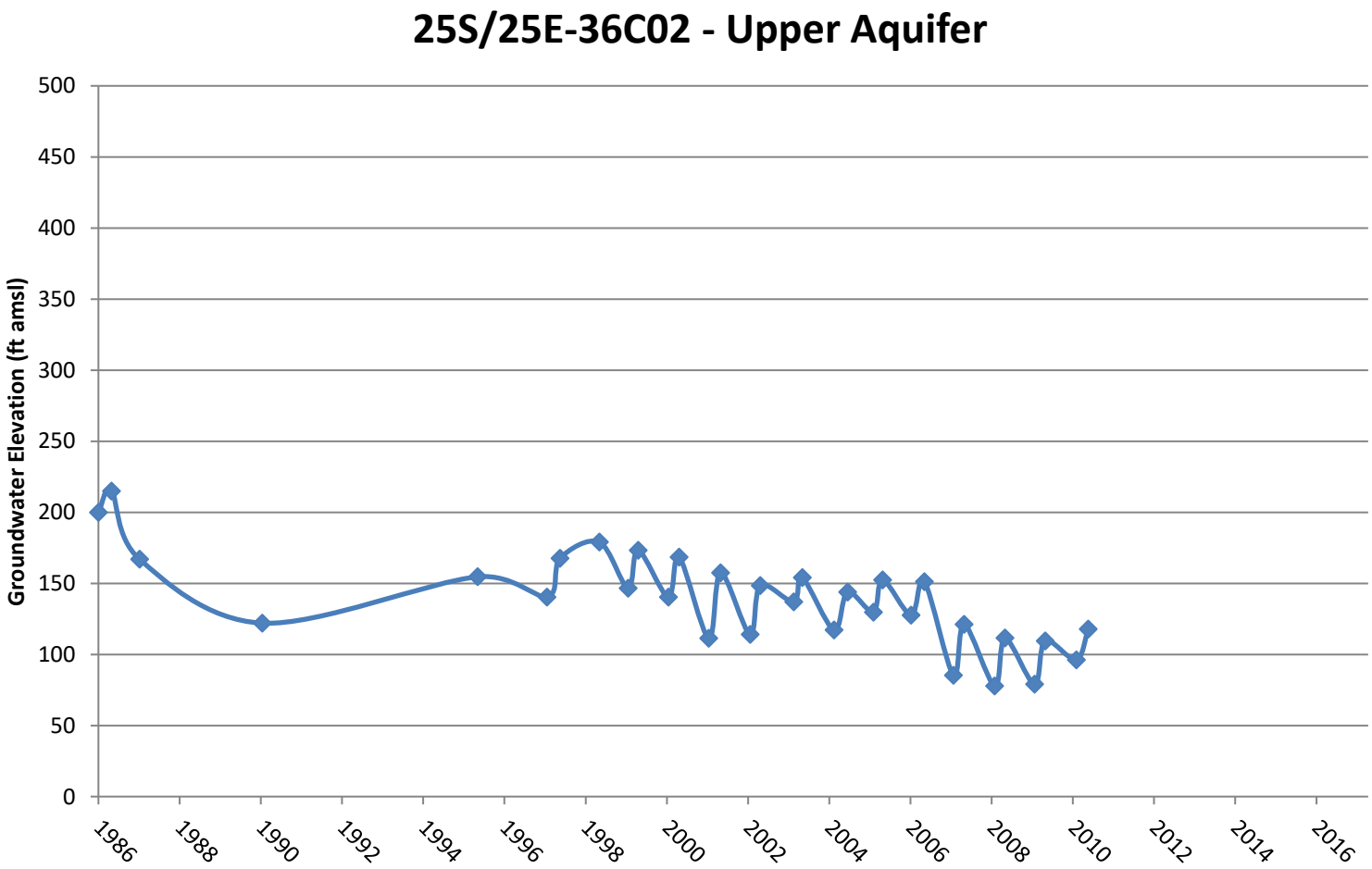
Boundary Condition Well Hydrograph



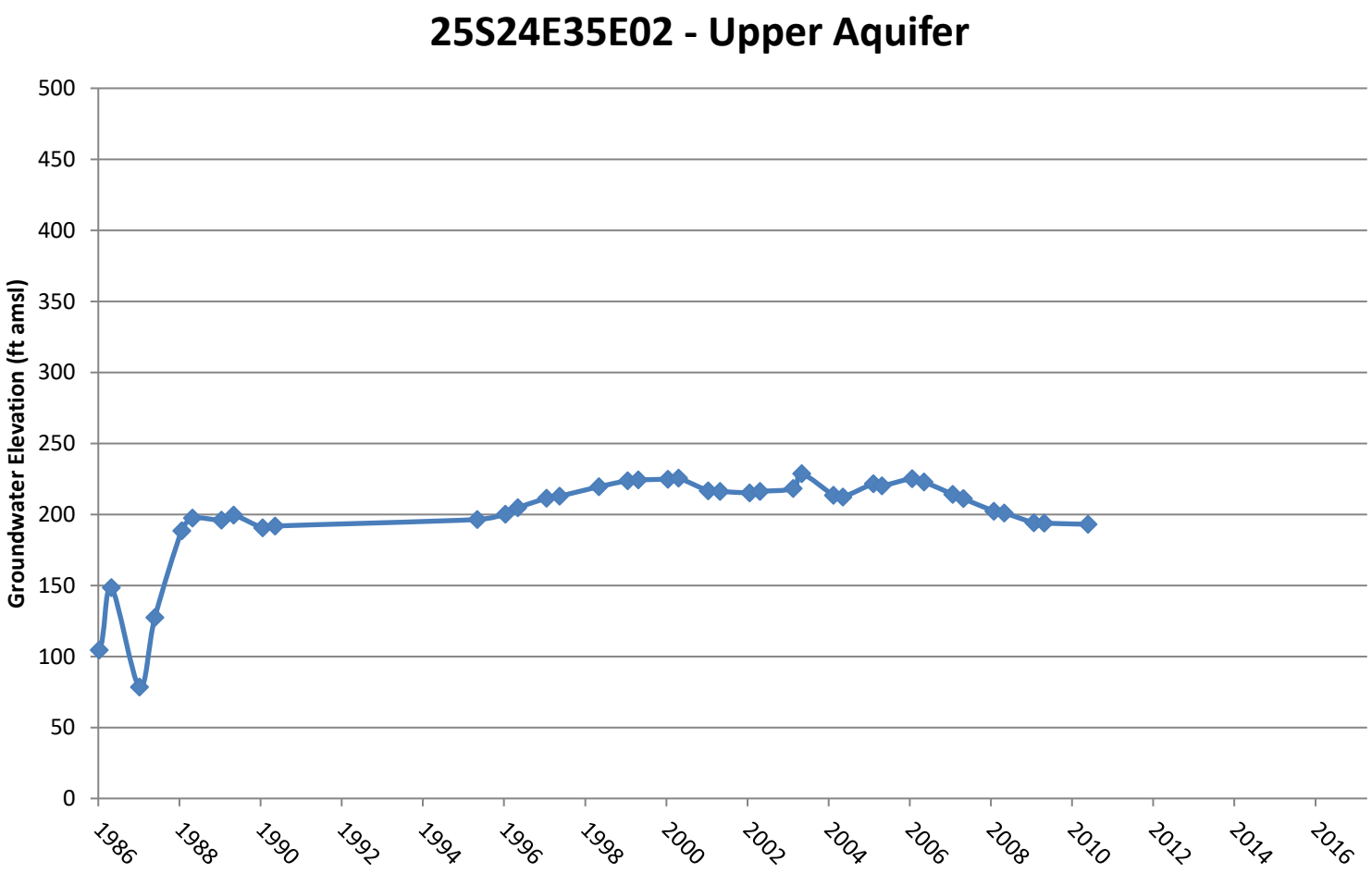
Boundary Condition Well Hydrograph



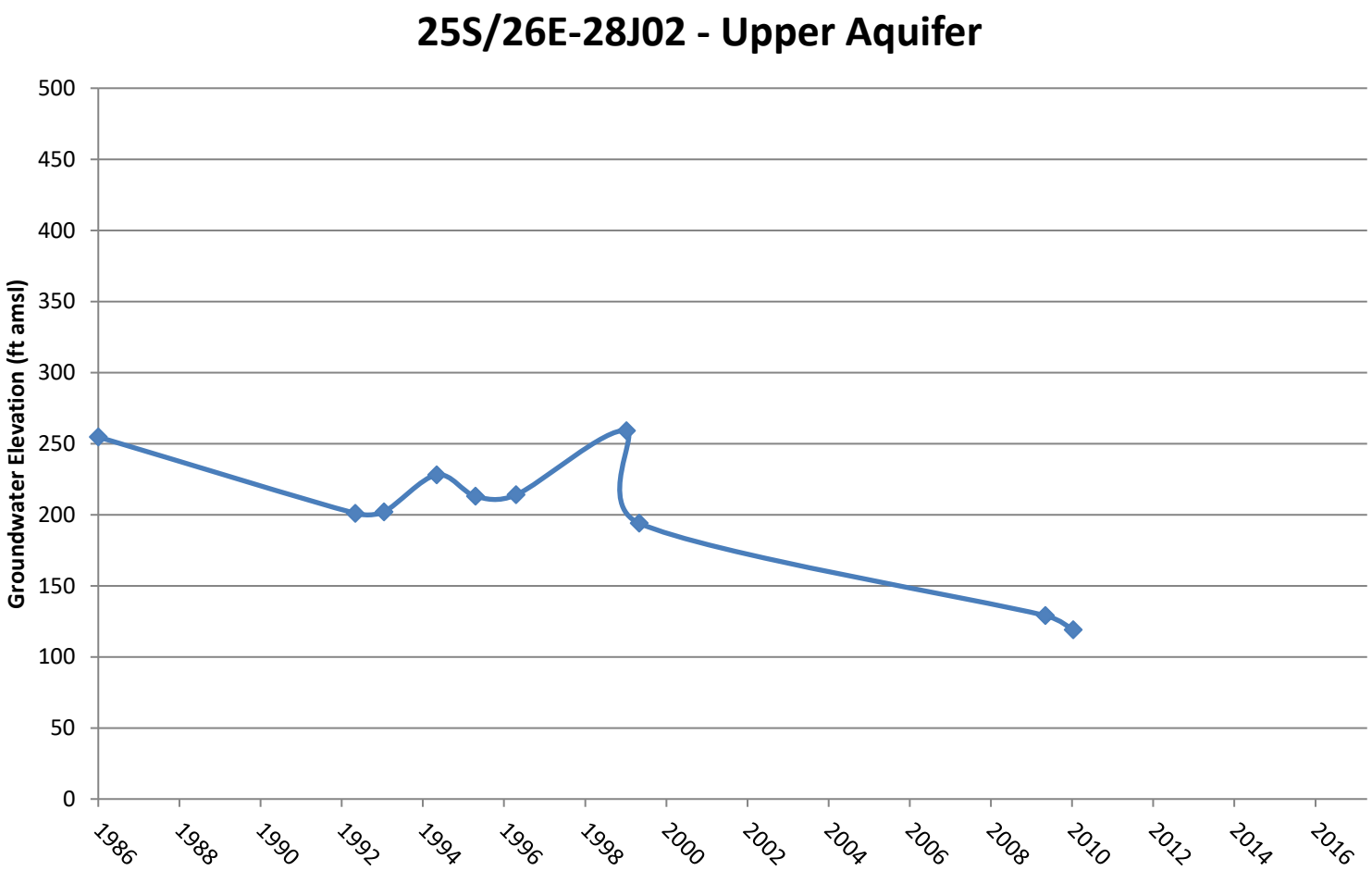
Boundary Condition Well Hydrograph



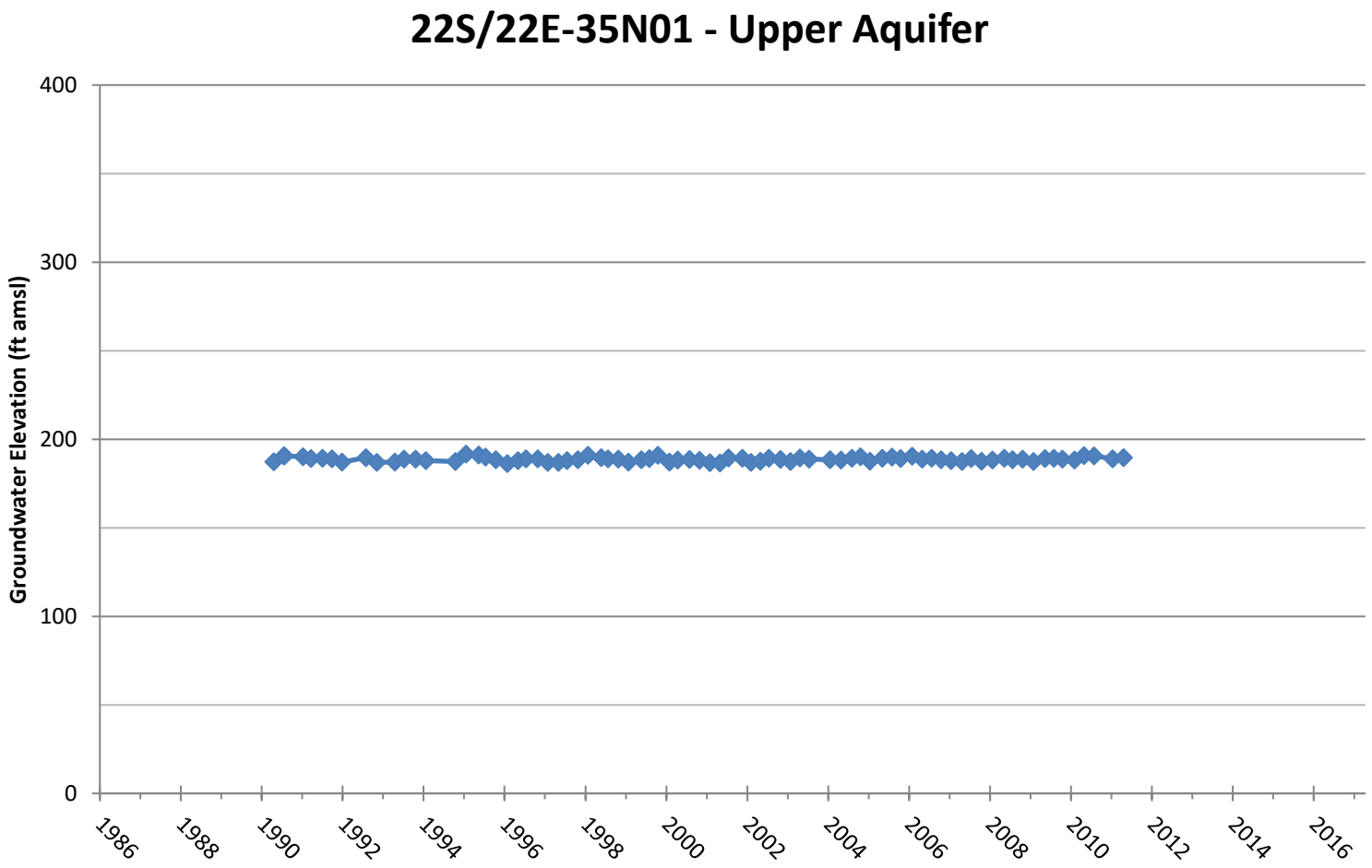
Boundary Condition Well Hydrograph



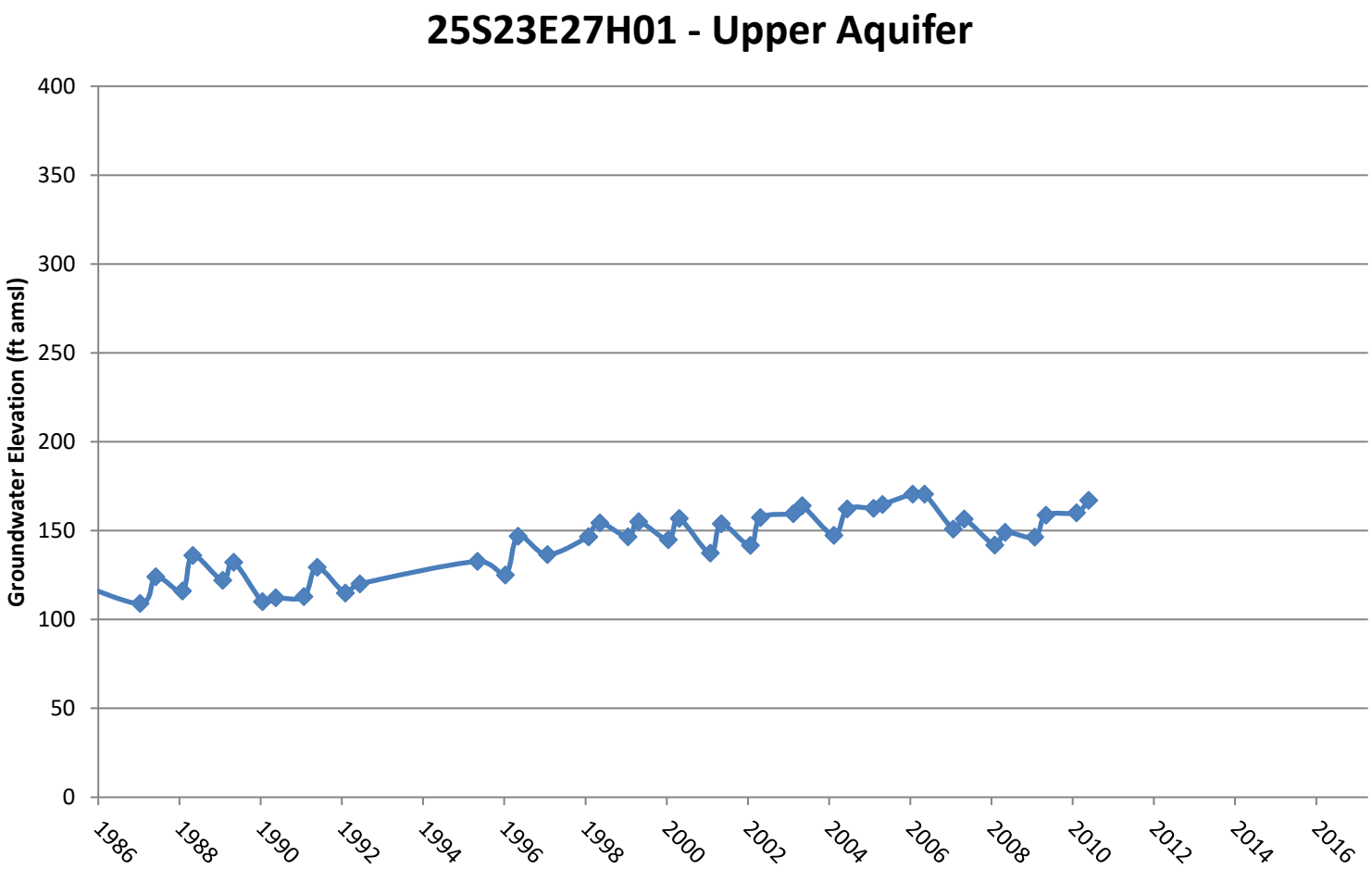
Boundary Condition Well Hydrograph



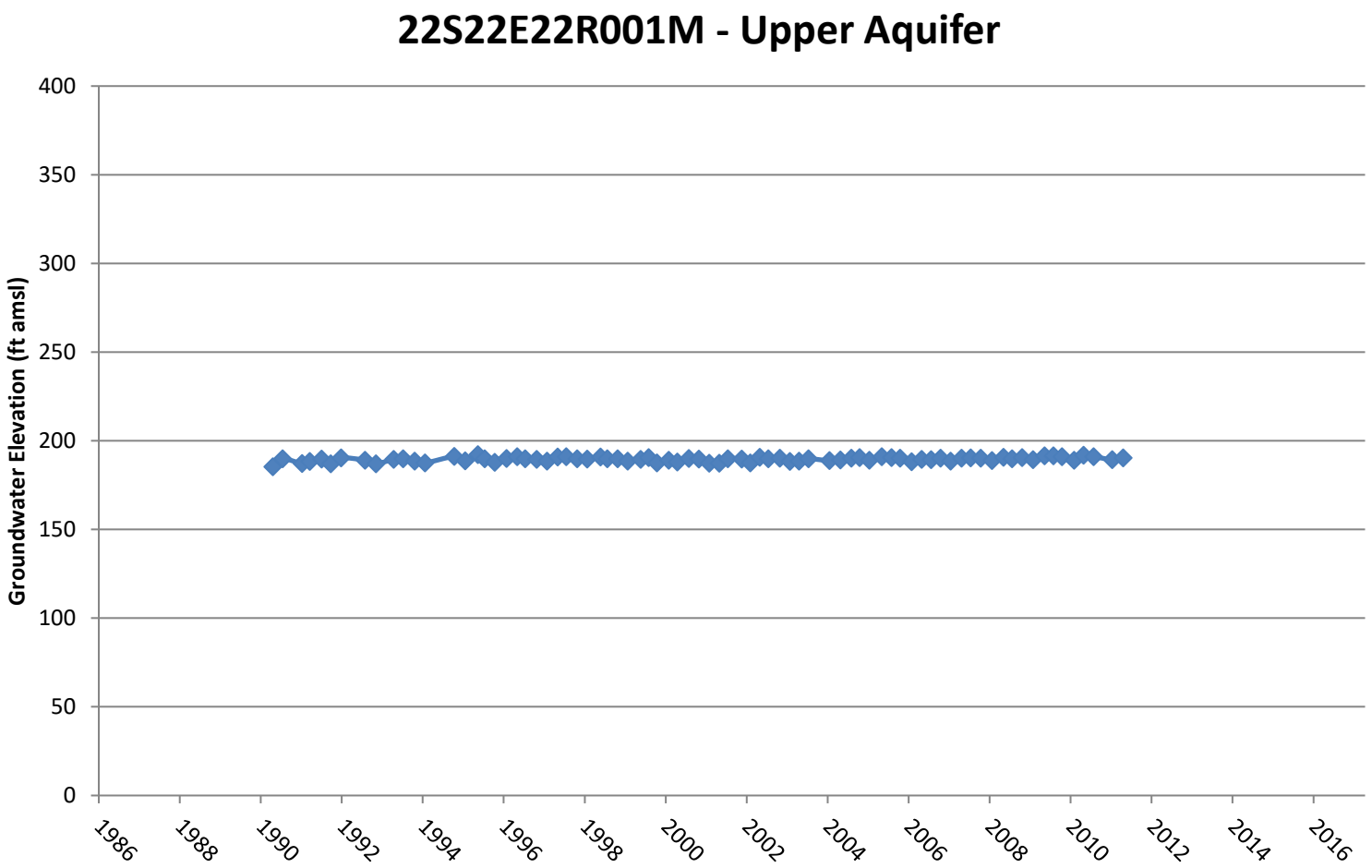
Boundary Condition Well Hydrograph



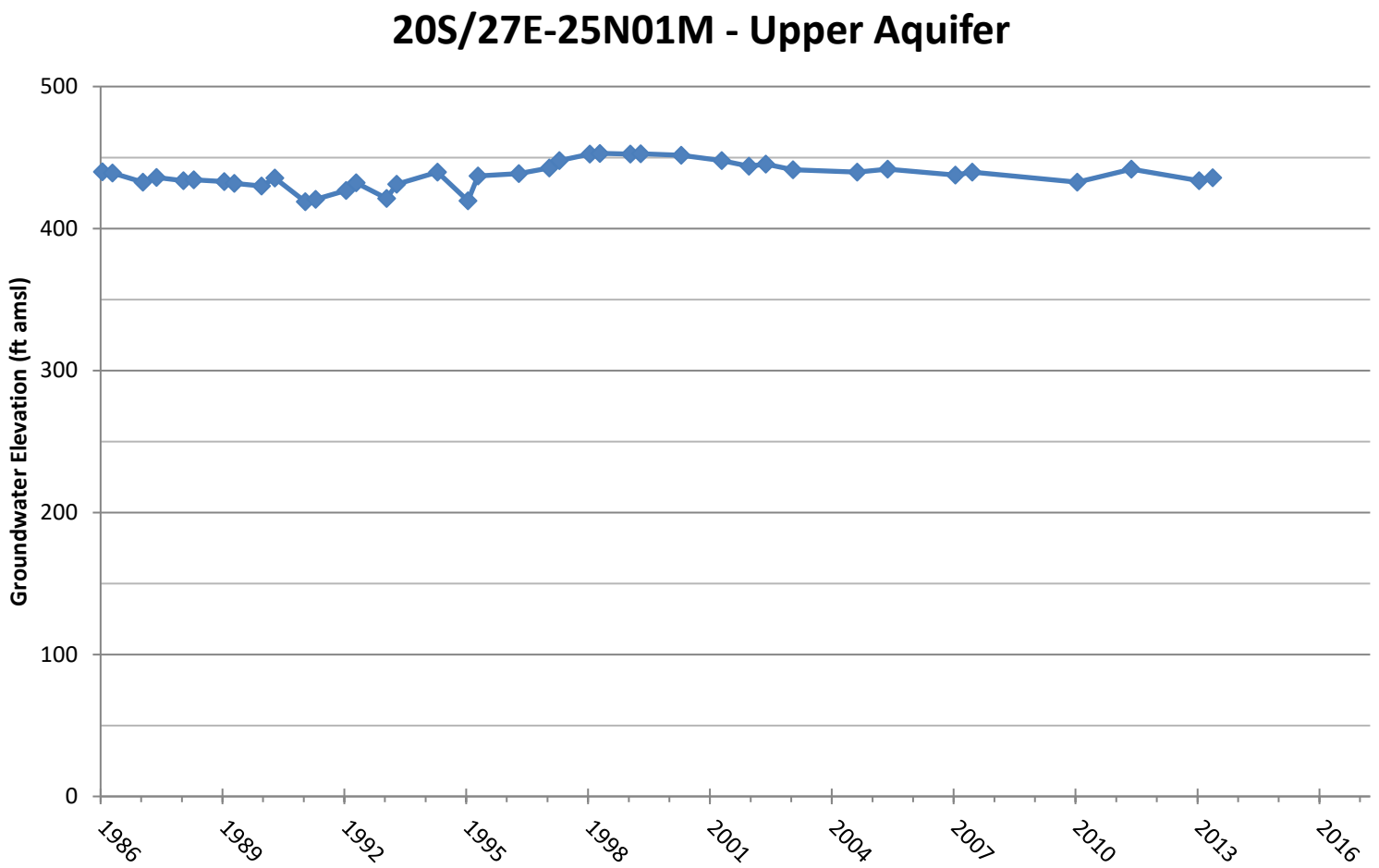
Boundary Condition Well Hydrograph



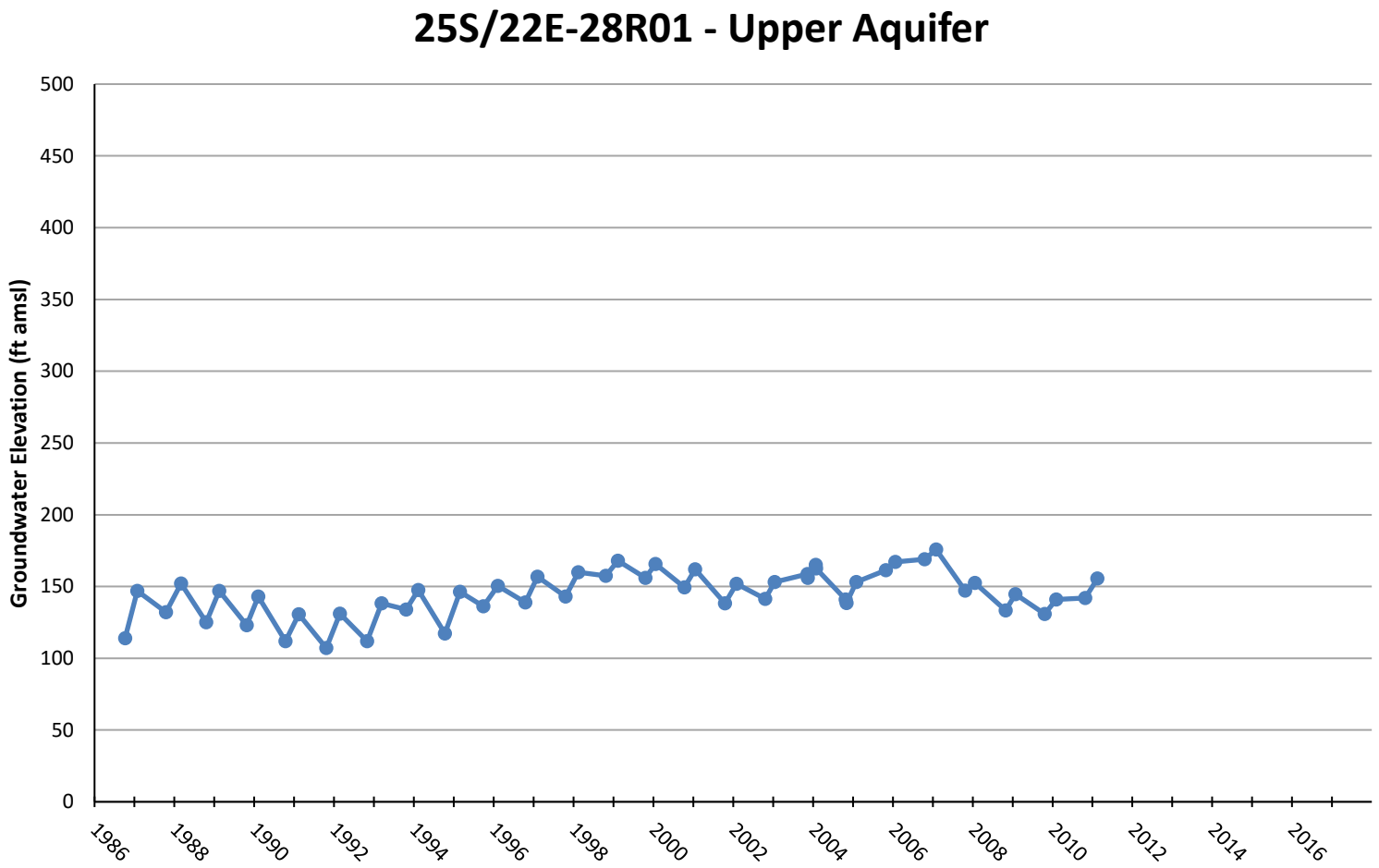
Boundary Condition Well Hydrograph



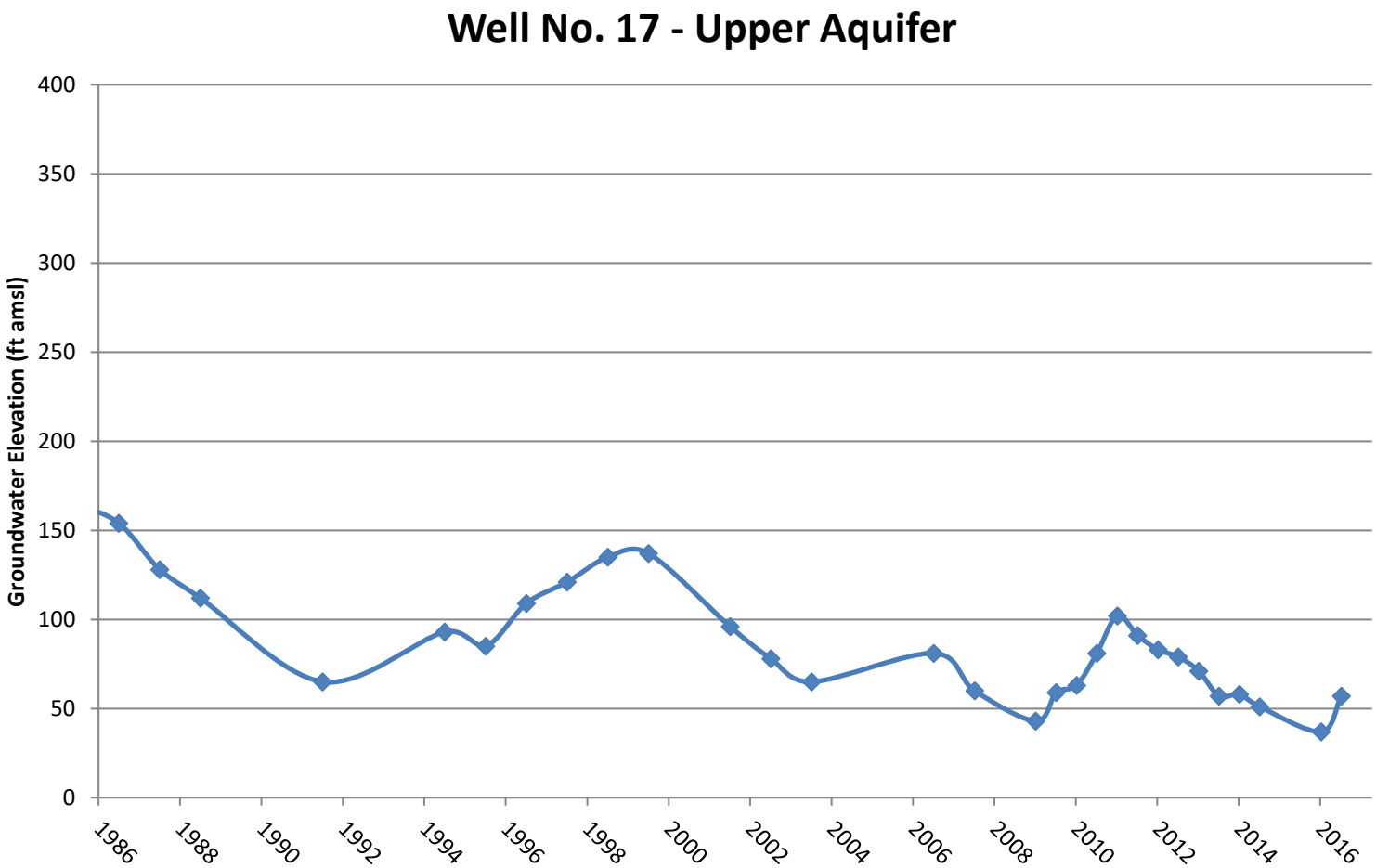
Boundary Condition Well Hydrograph



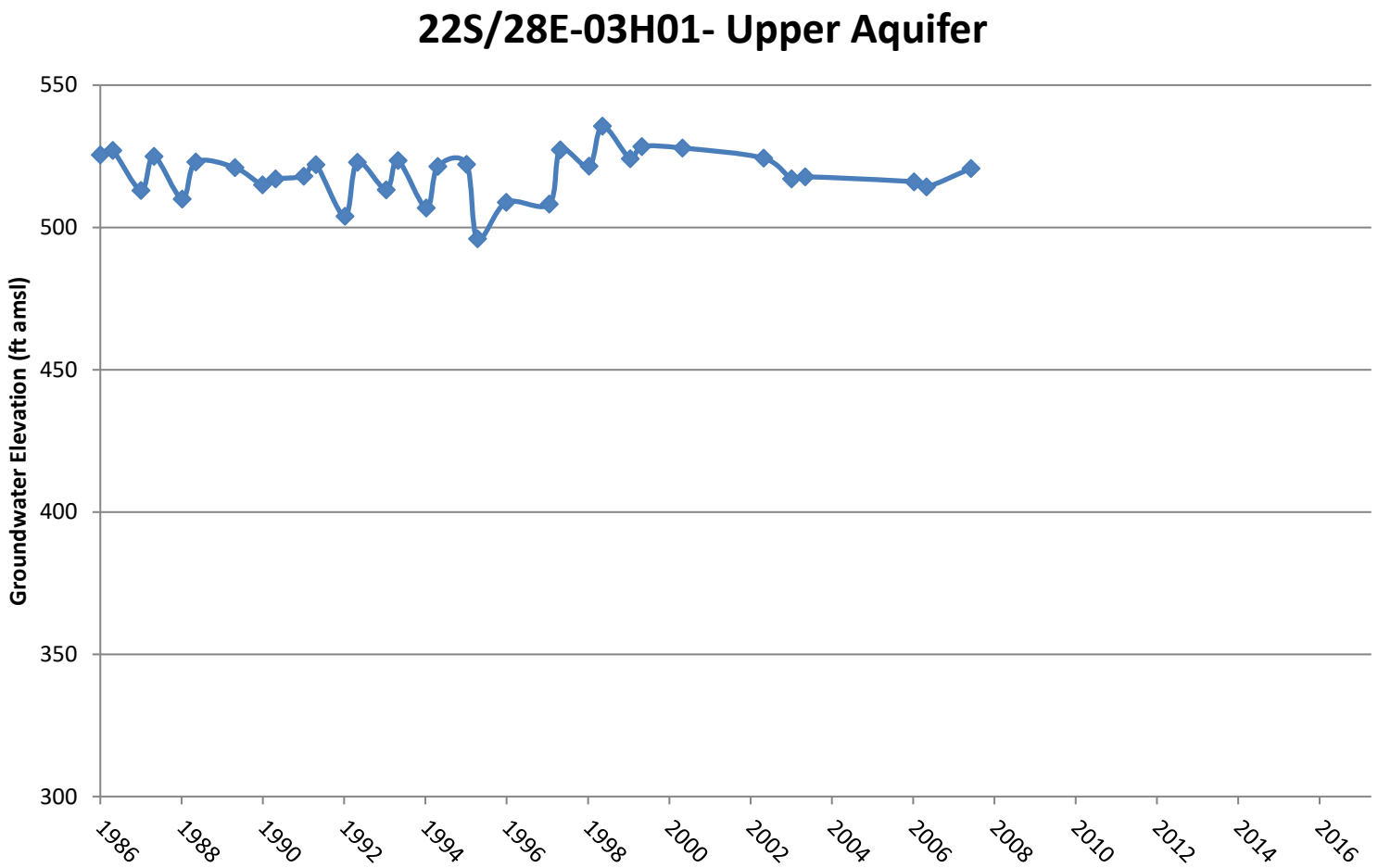
Boundary Condition Well Hydrograph



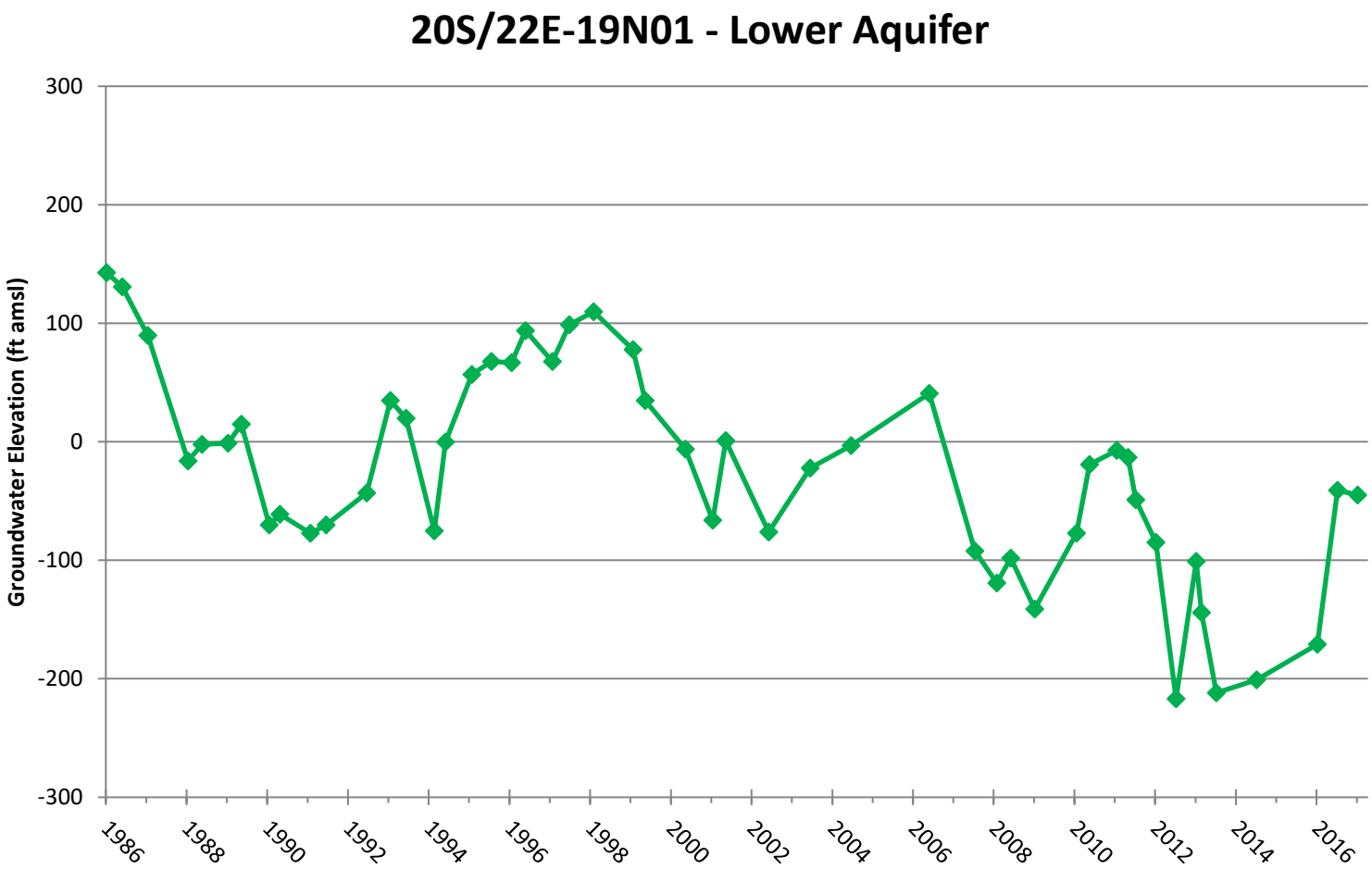
Boundary Condition Well Hydrograph



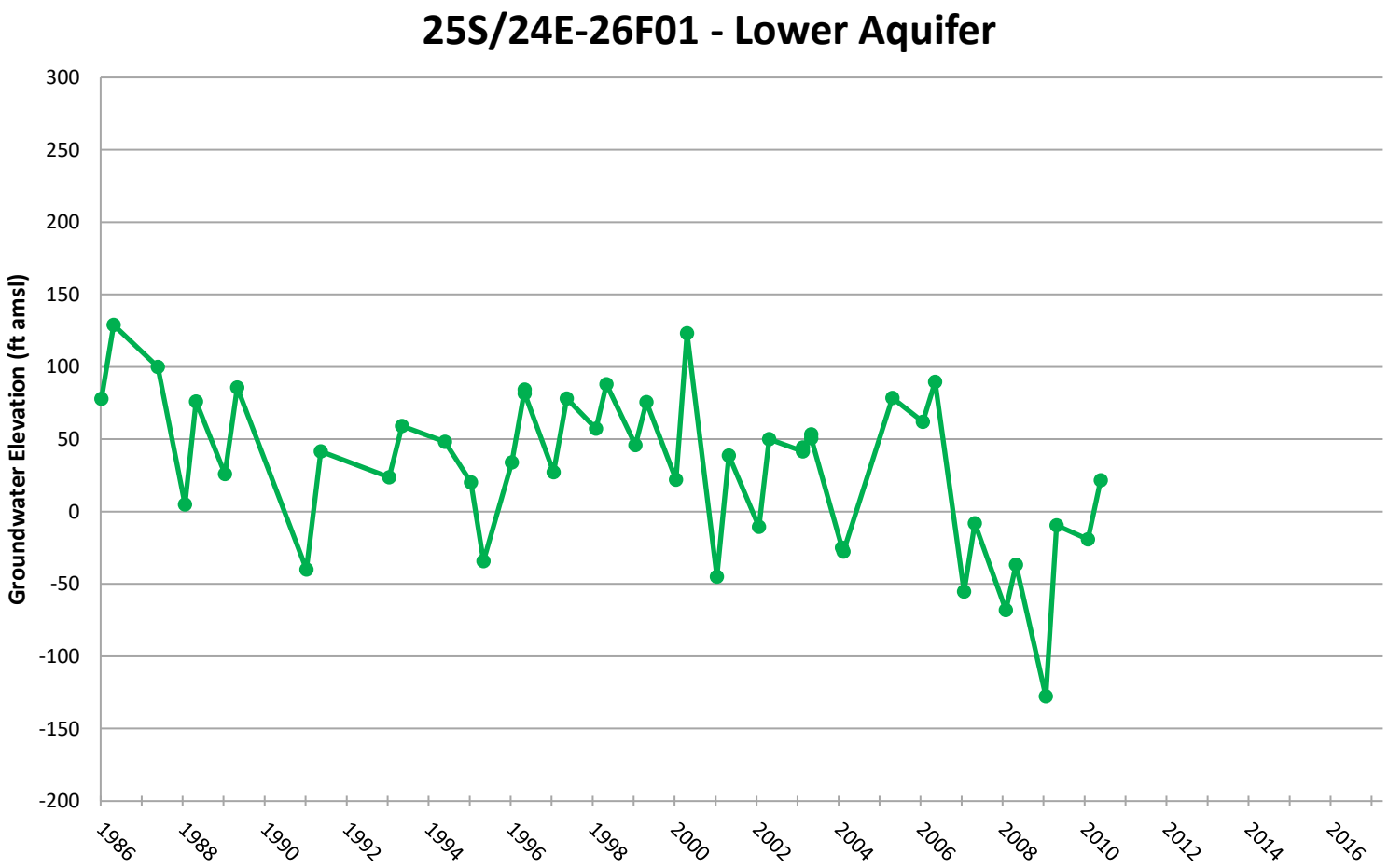
Boundary Condition Well Hydrograph



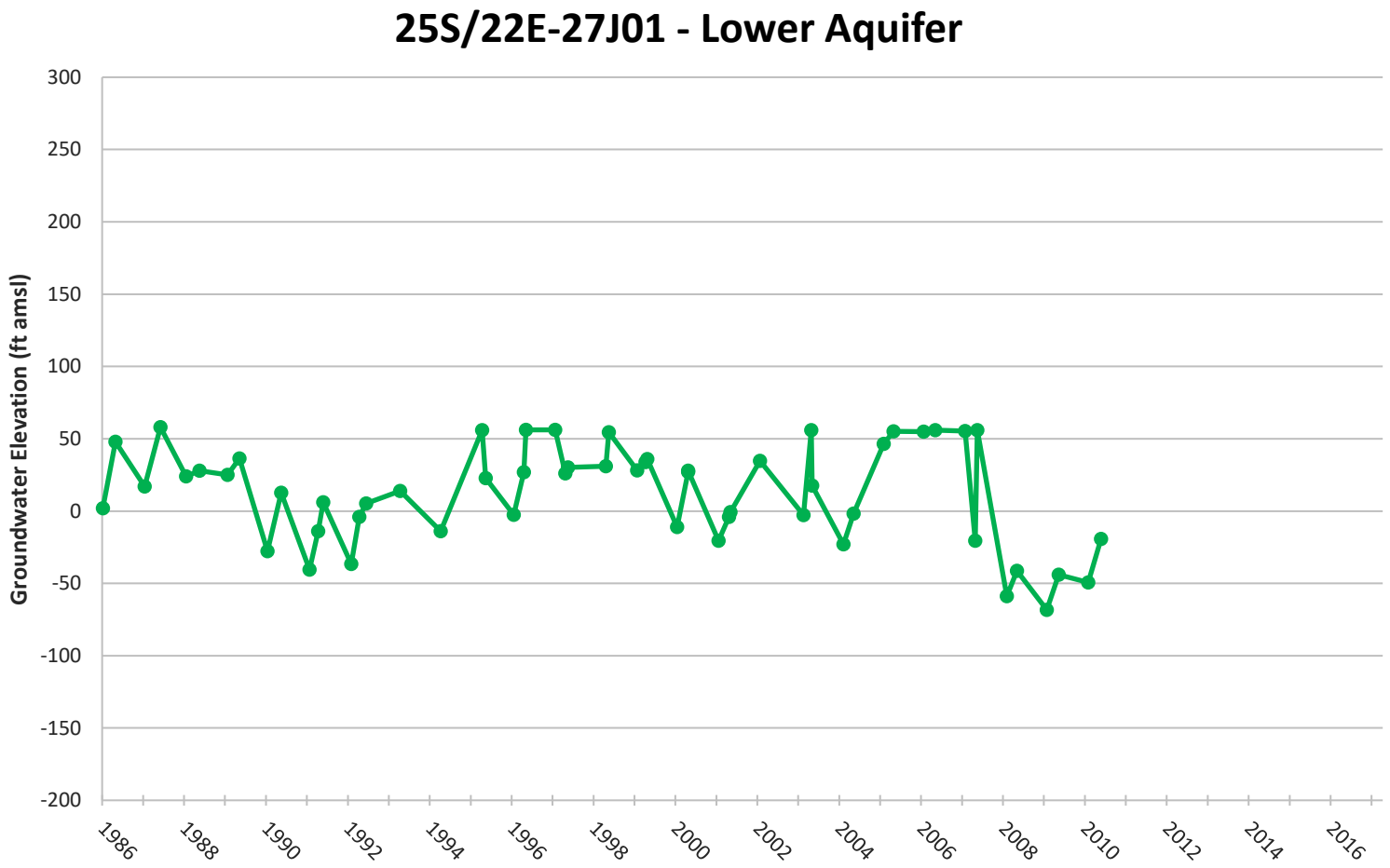
Boundary Condition Well Hydrograph



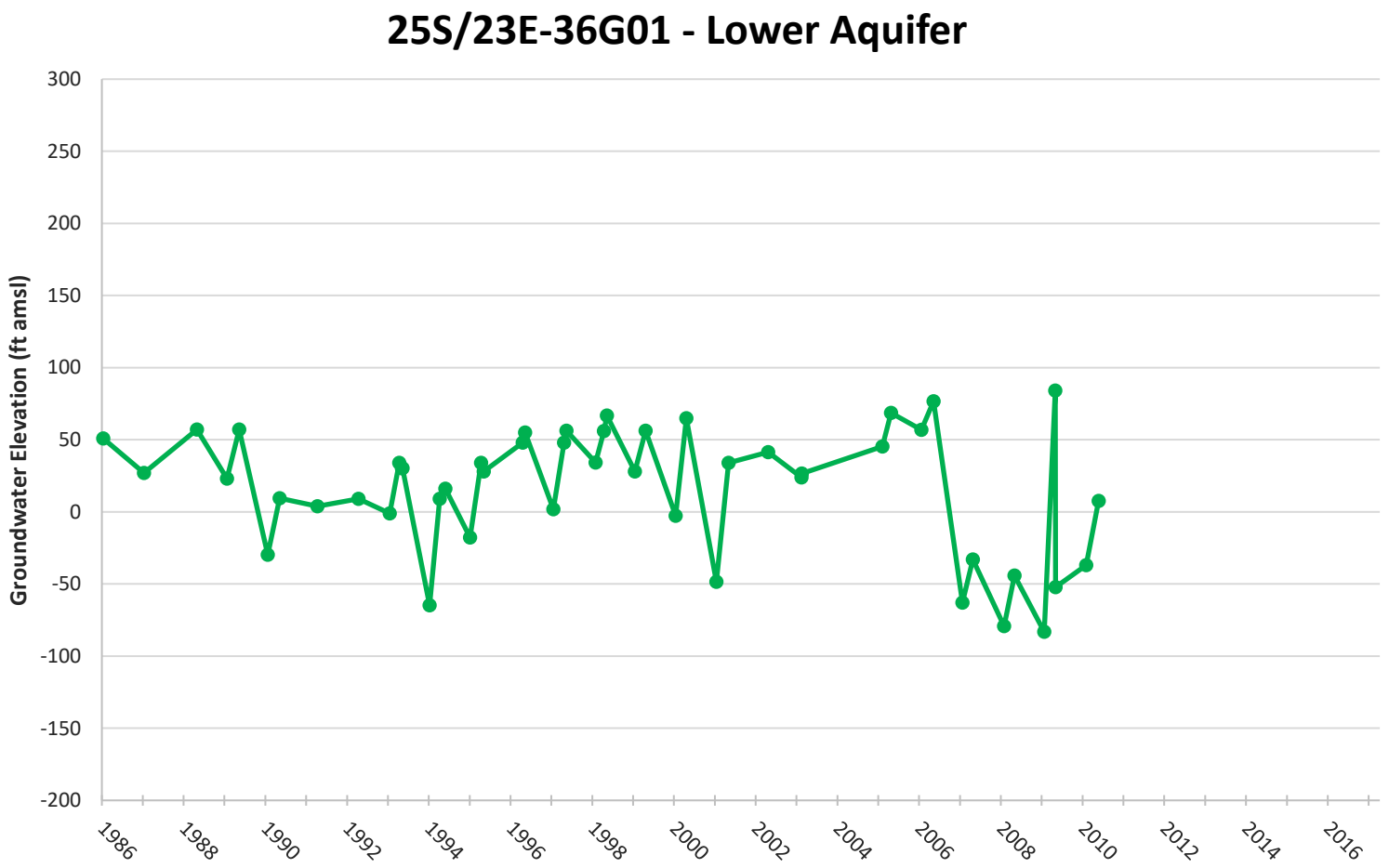
Boundary Condition Well Hydrograph



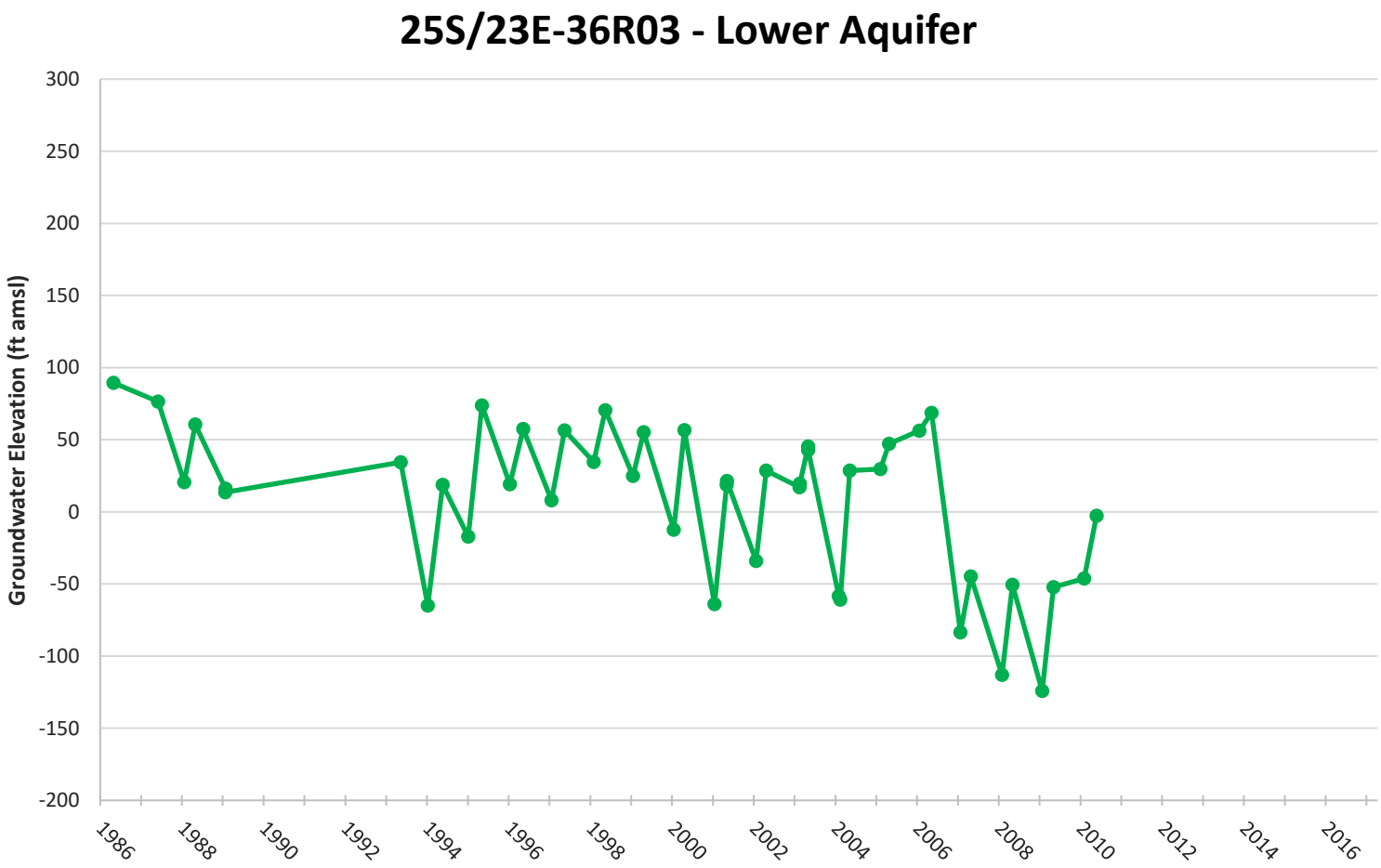
Boundary Condition Well Hydrograph



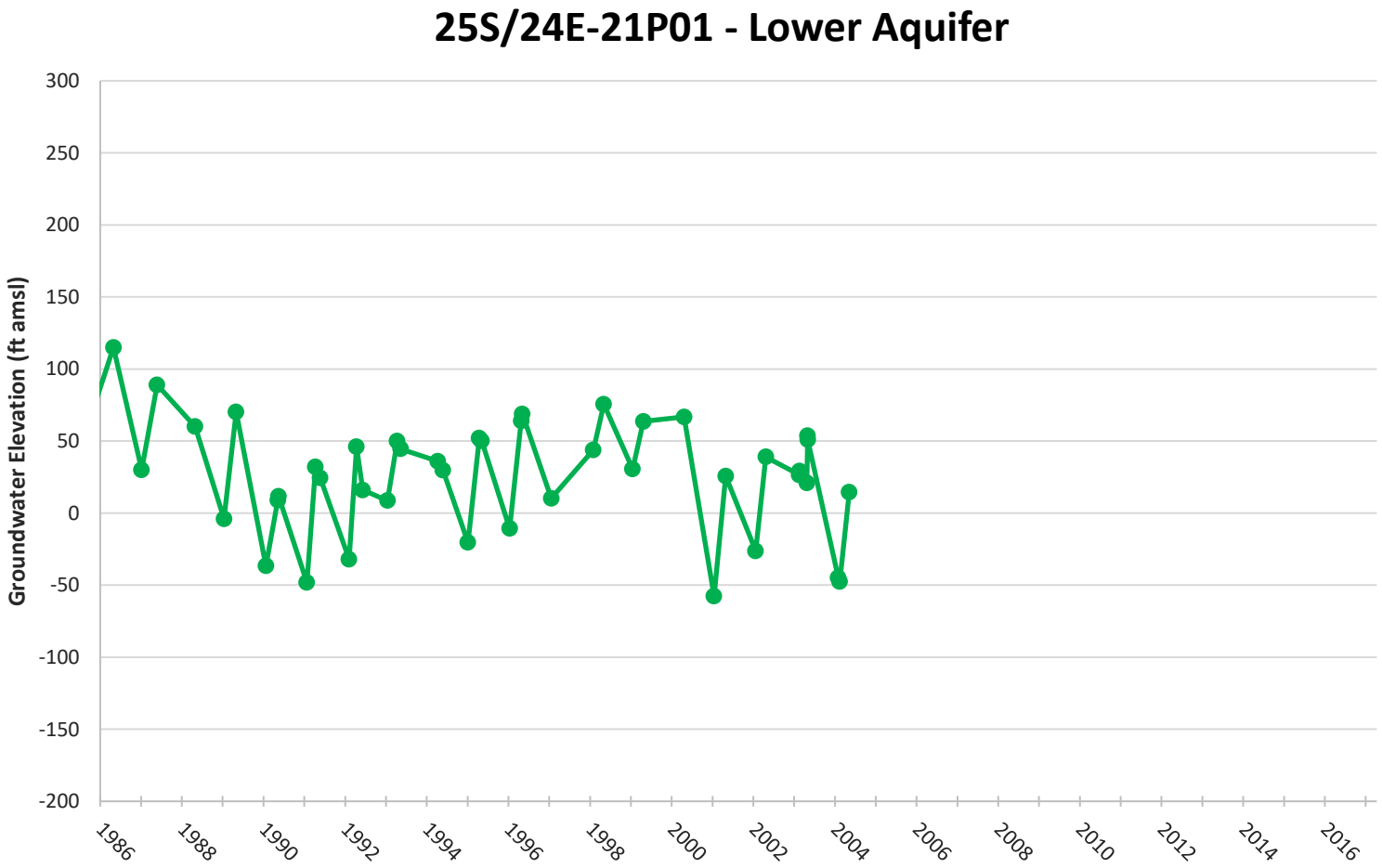
Boundary Condition Well Hydrograph



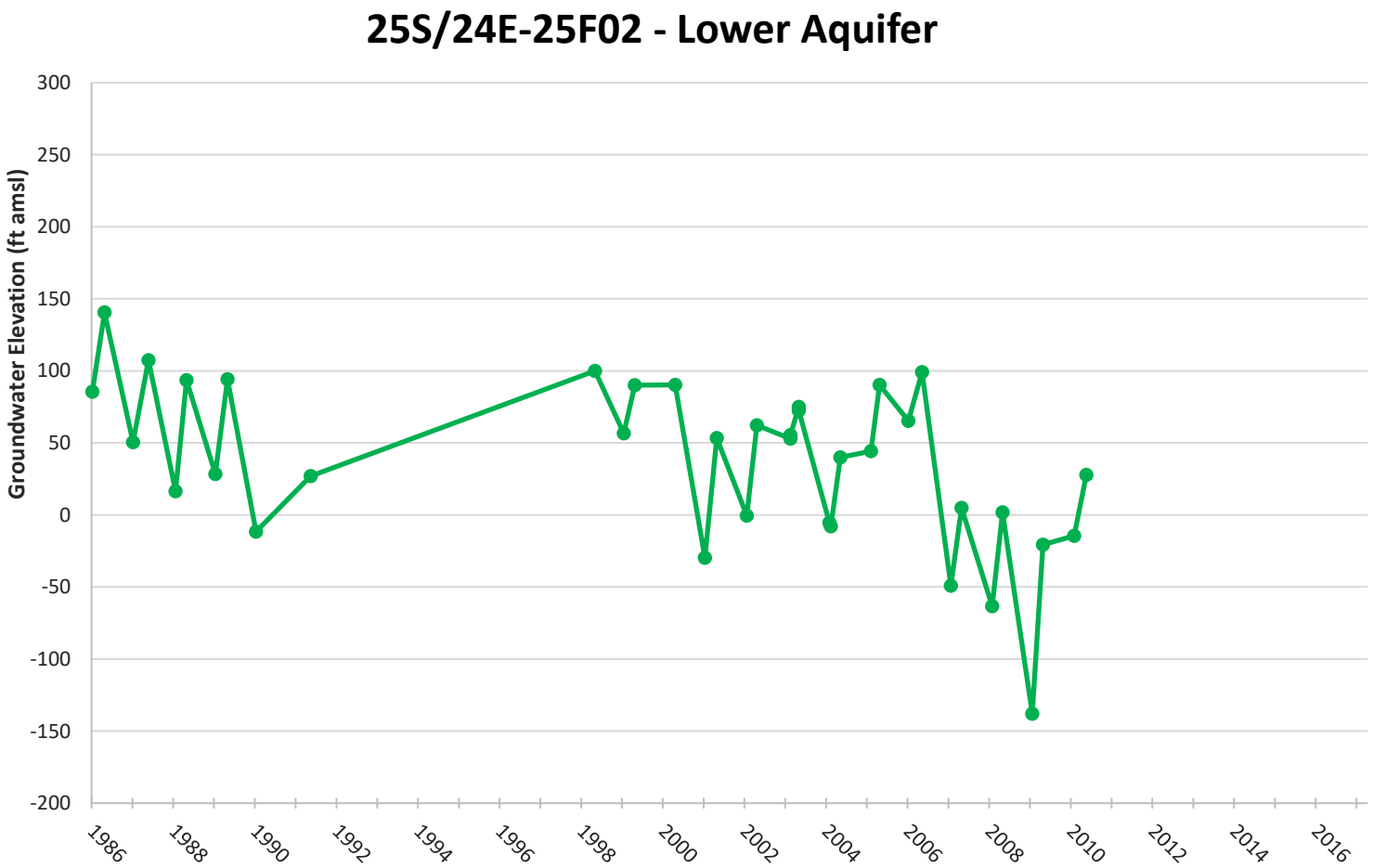
Boundary Condition Well Hydrograph



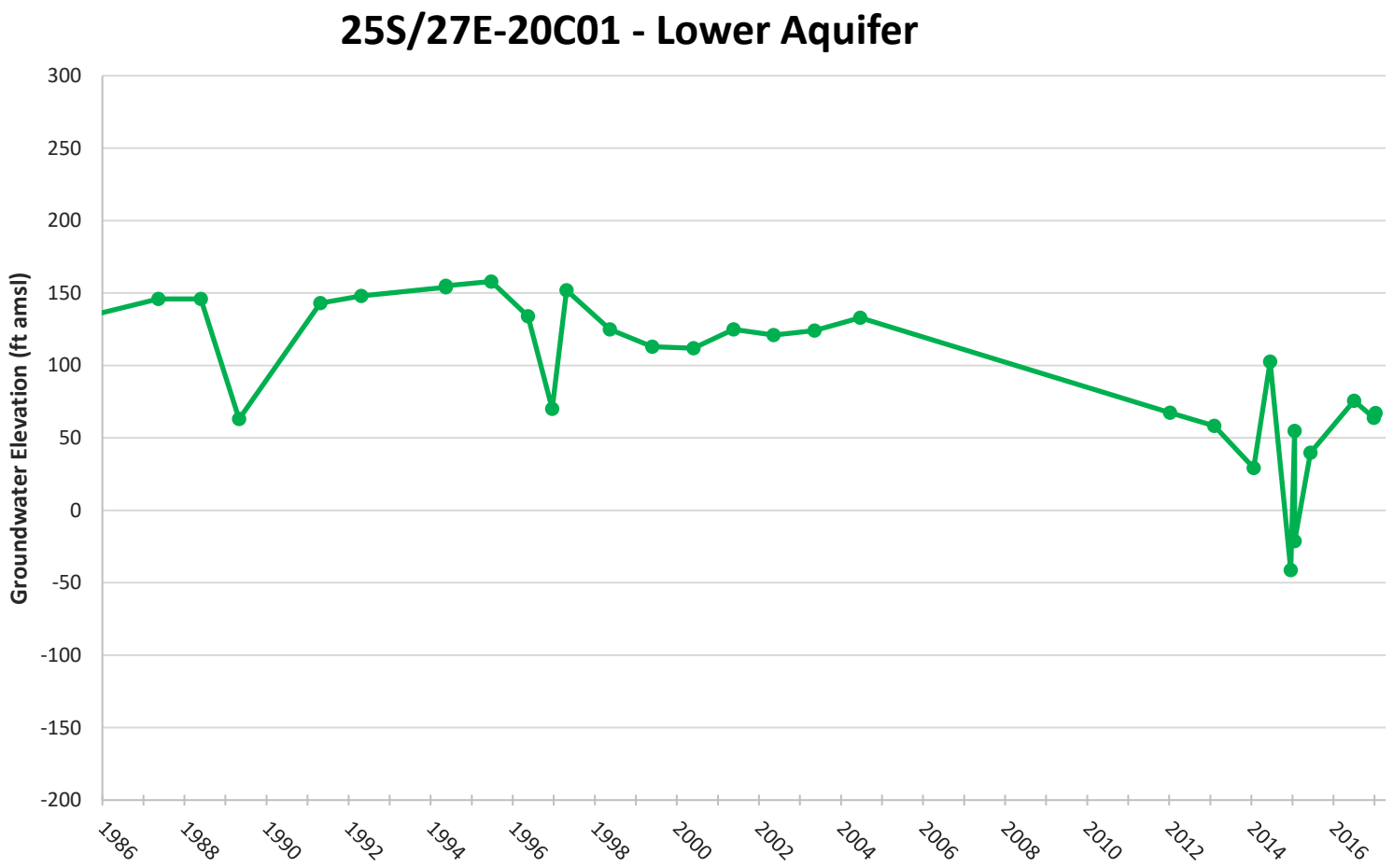
Boundary Condition Well Hydrograph



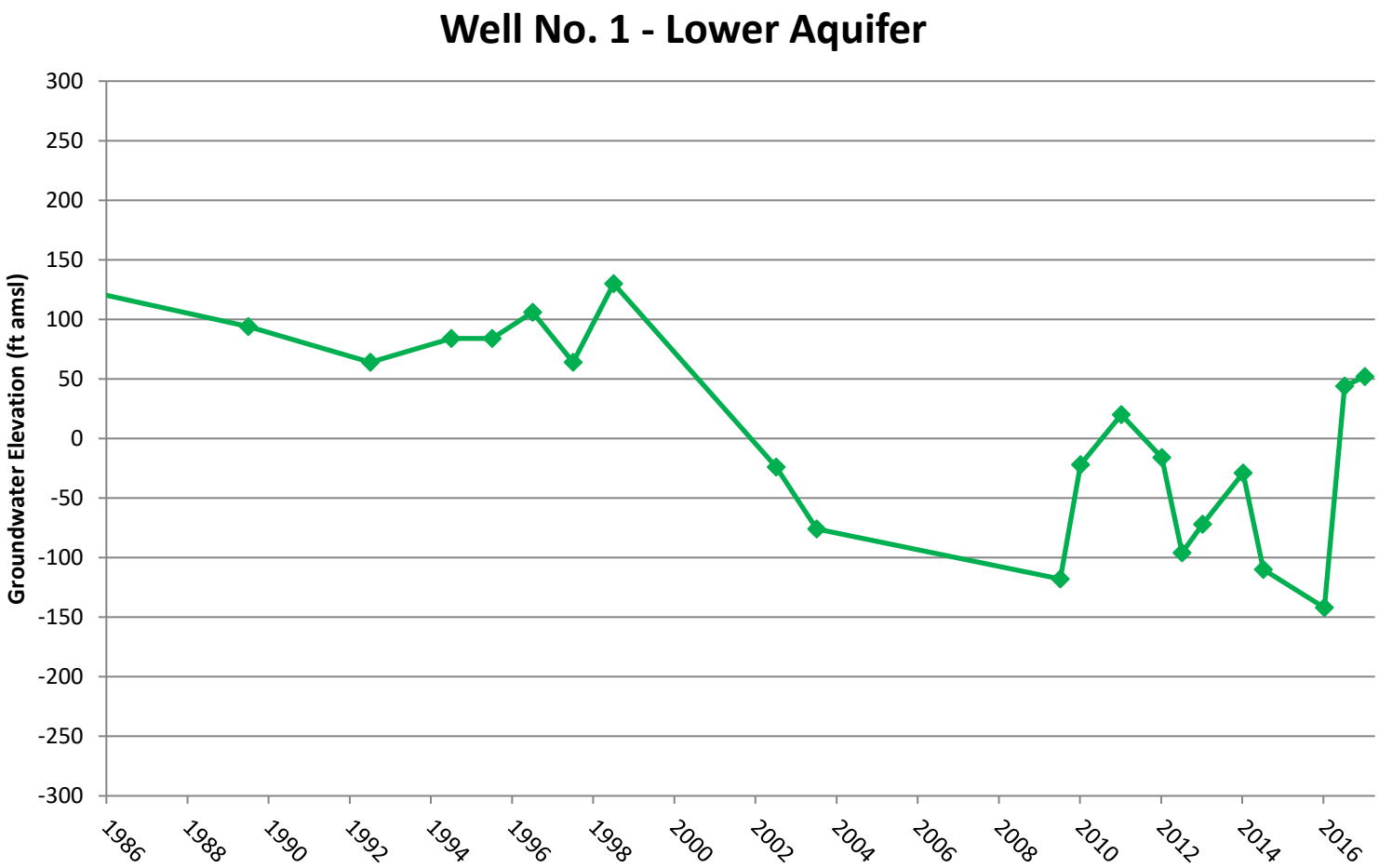
Boundary Condition Well Hydrograph



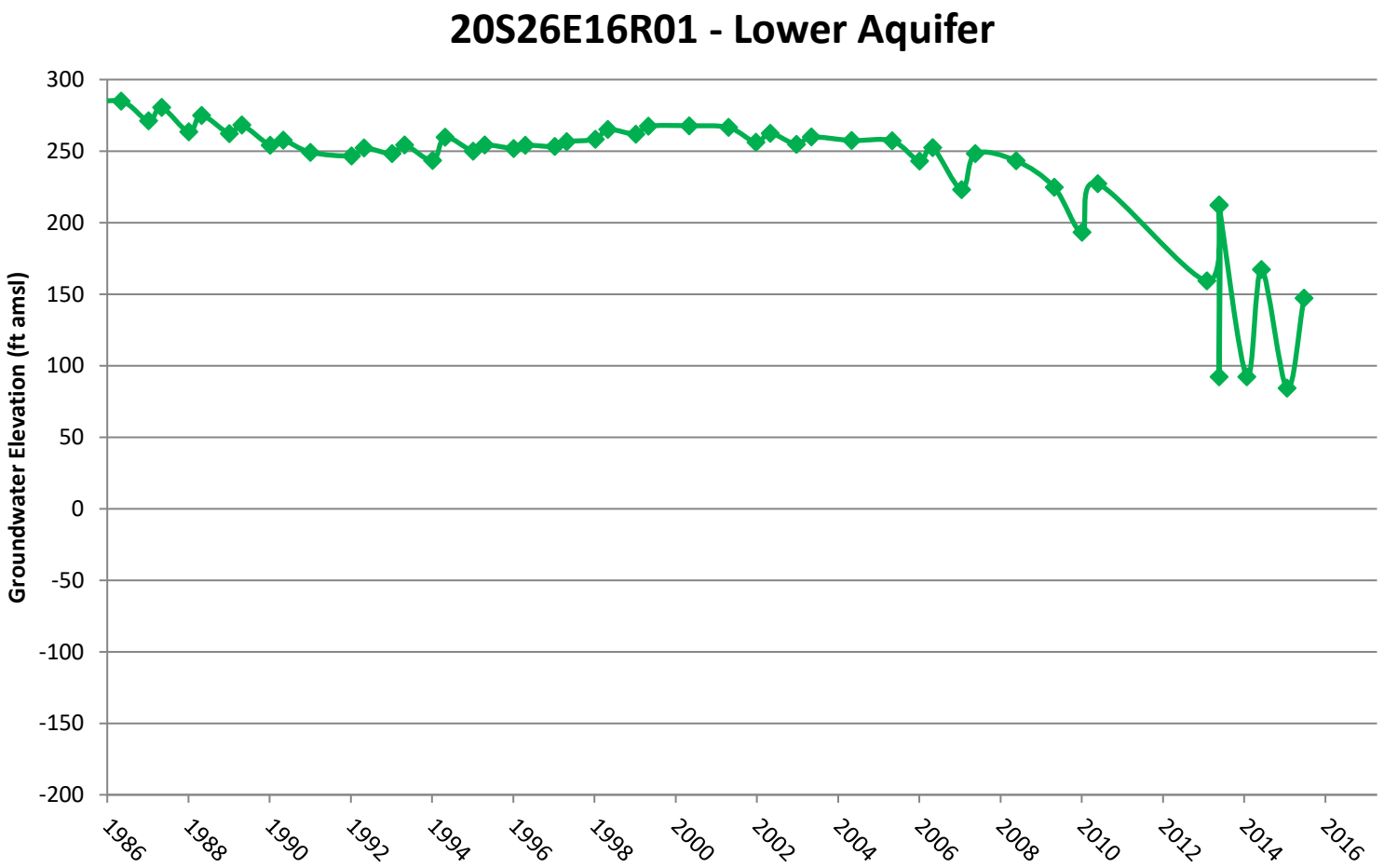
Boundary Condition Well Hydrograph



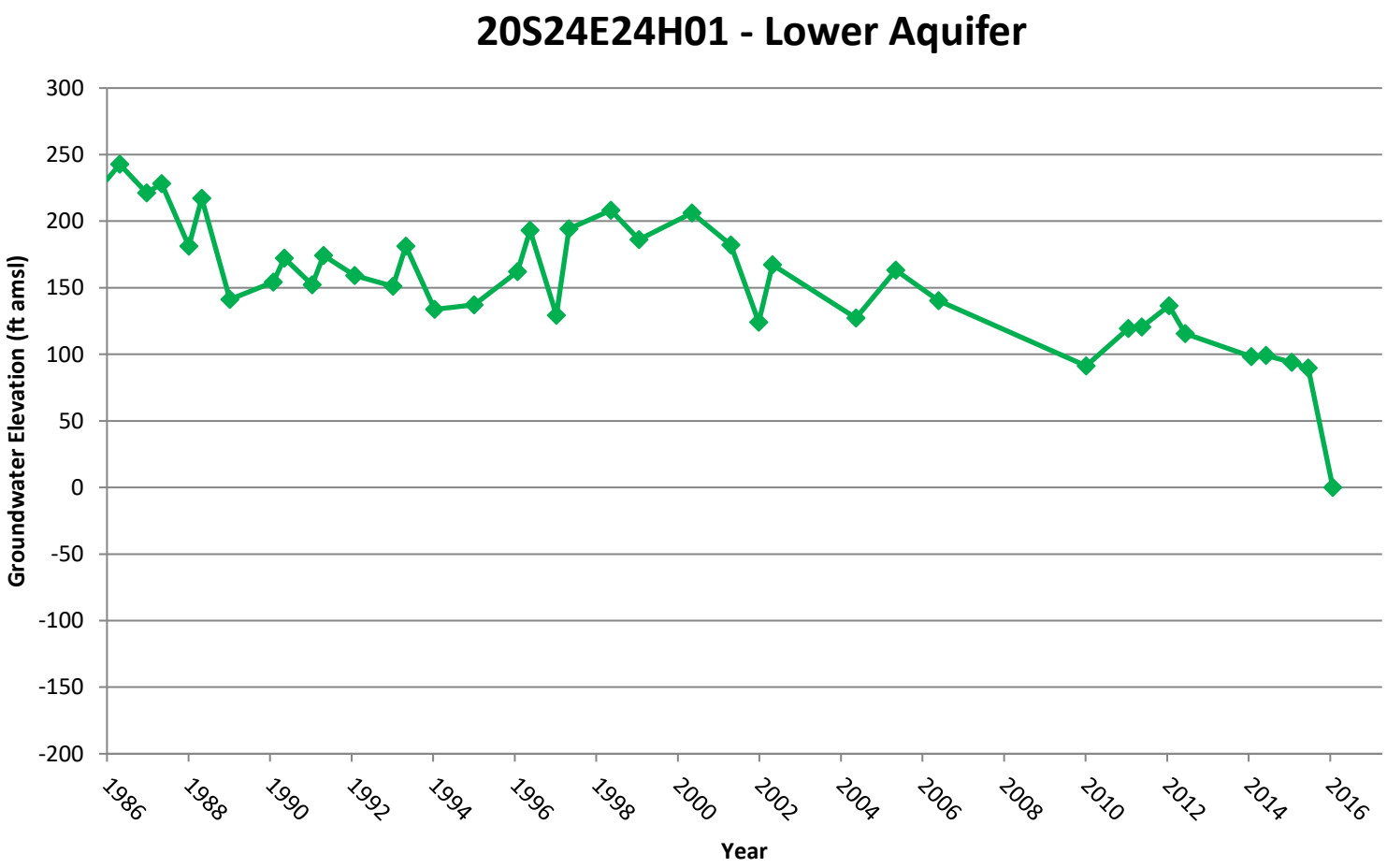
Boundary Condition Well Hydrograph



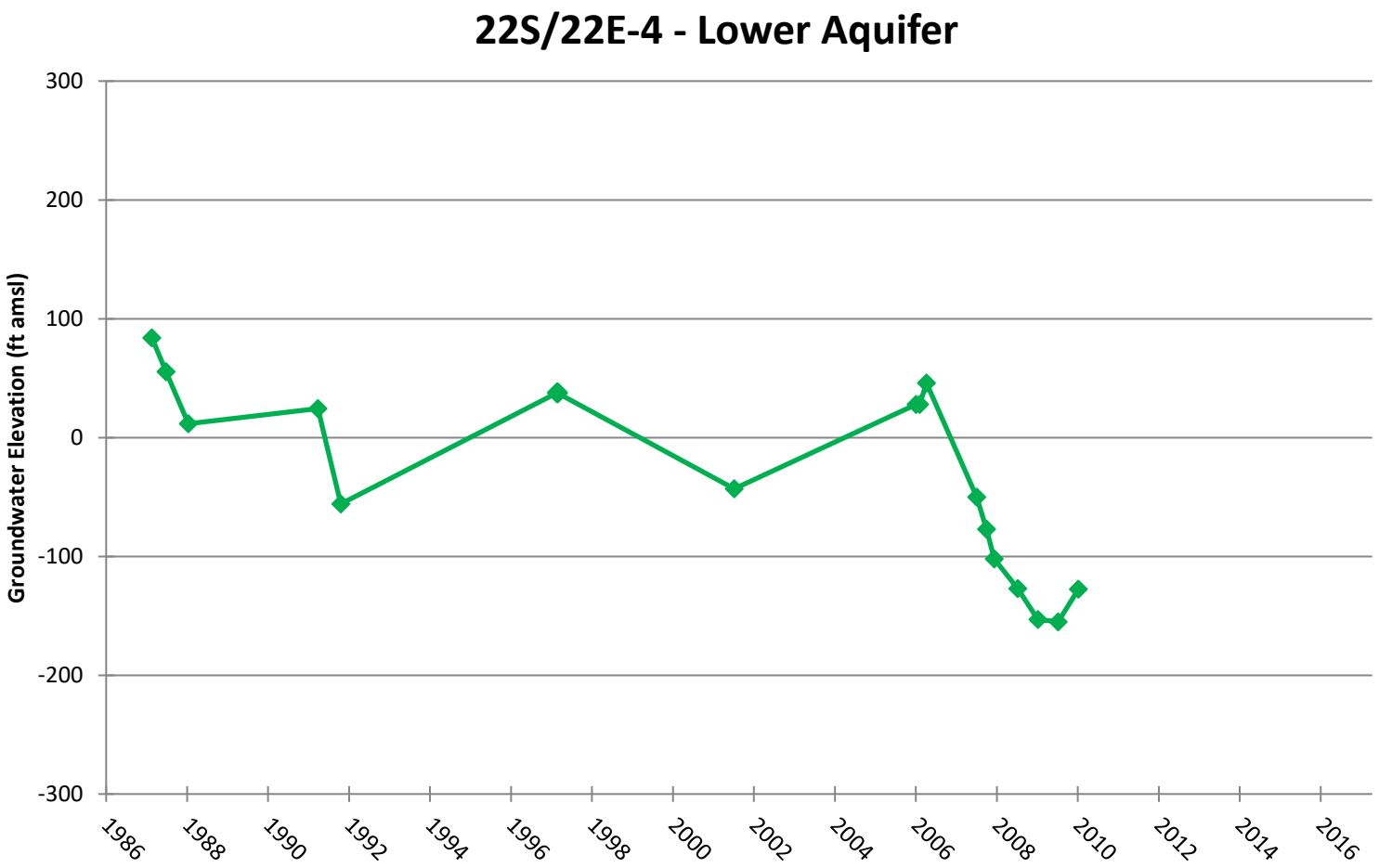
Boundary Condition Well Hydrograph



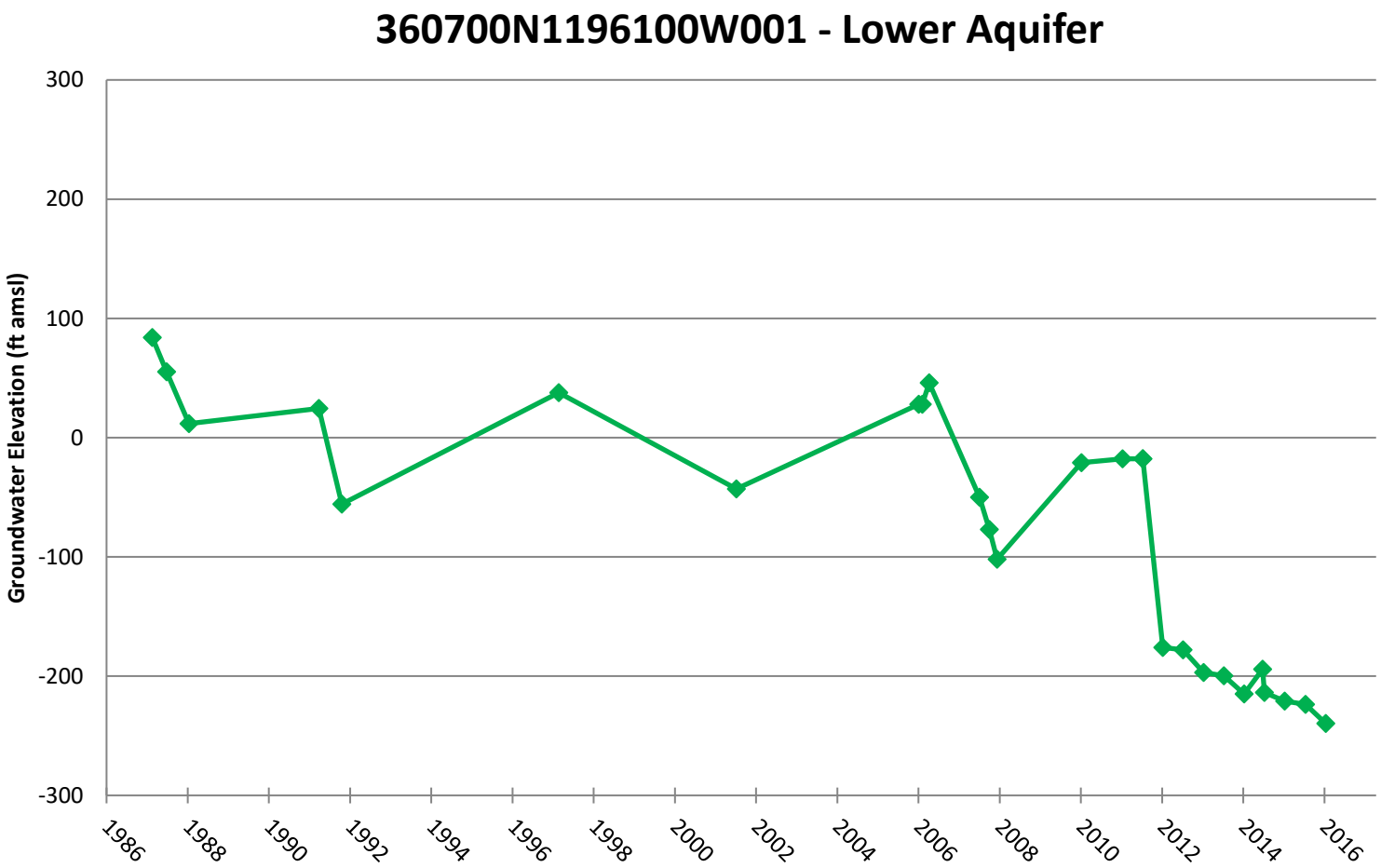
Boundary Condition Well Hydrograph



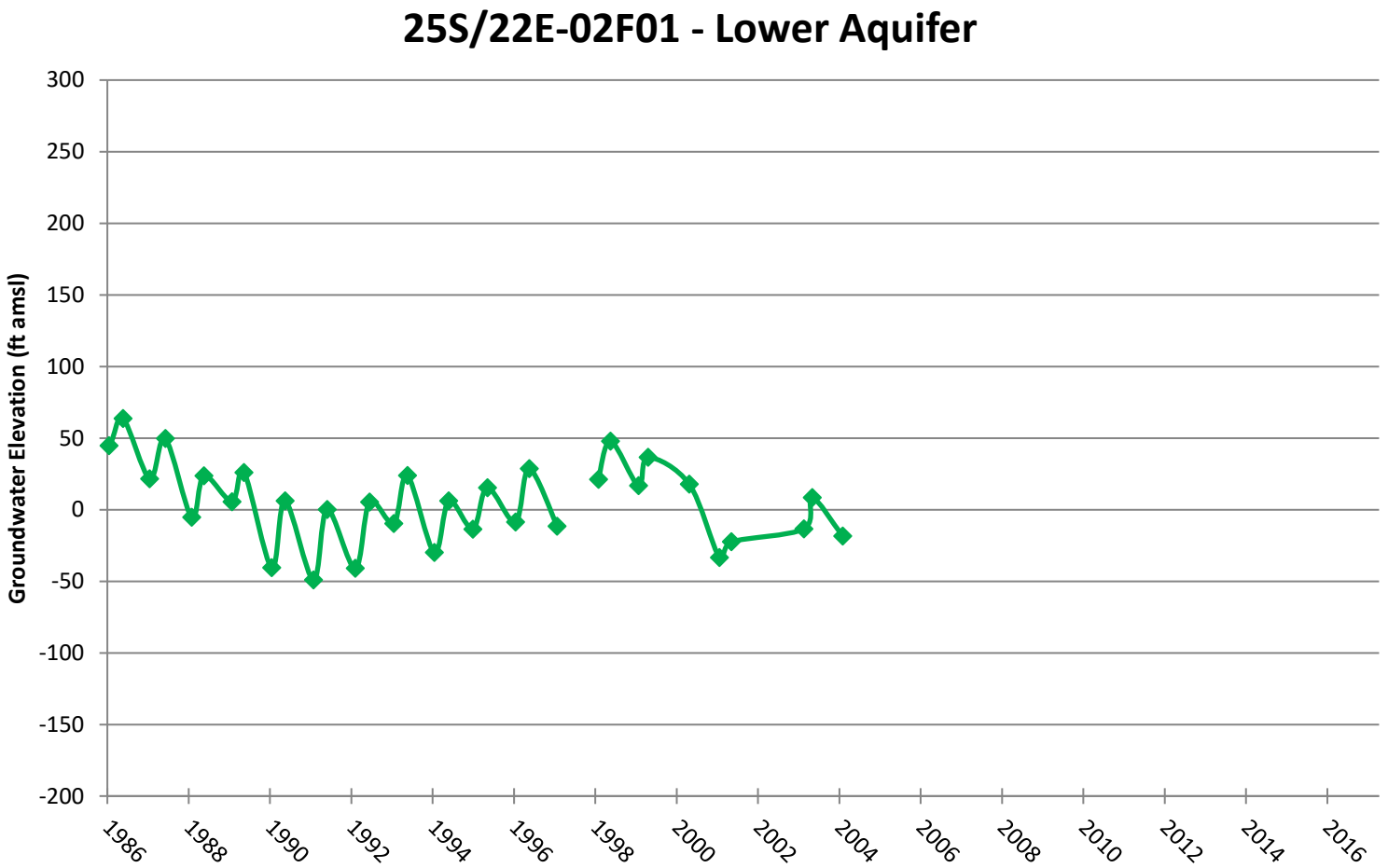
Boundary Condition Well Hydrograph



Boundary Condition Well Hydrograph



Boundary Condition Well Hydrograph



Appendix C

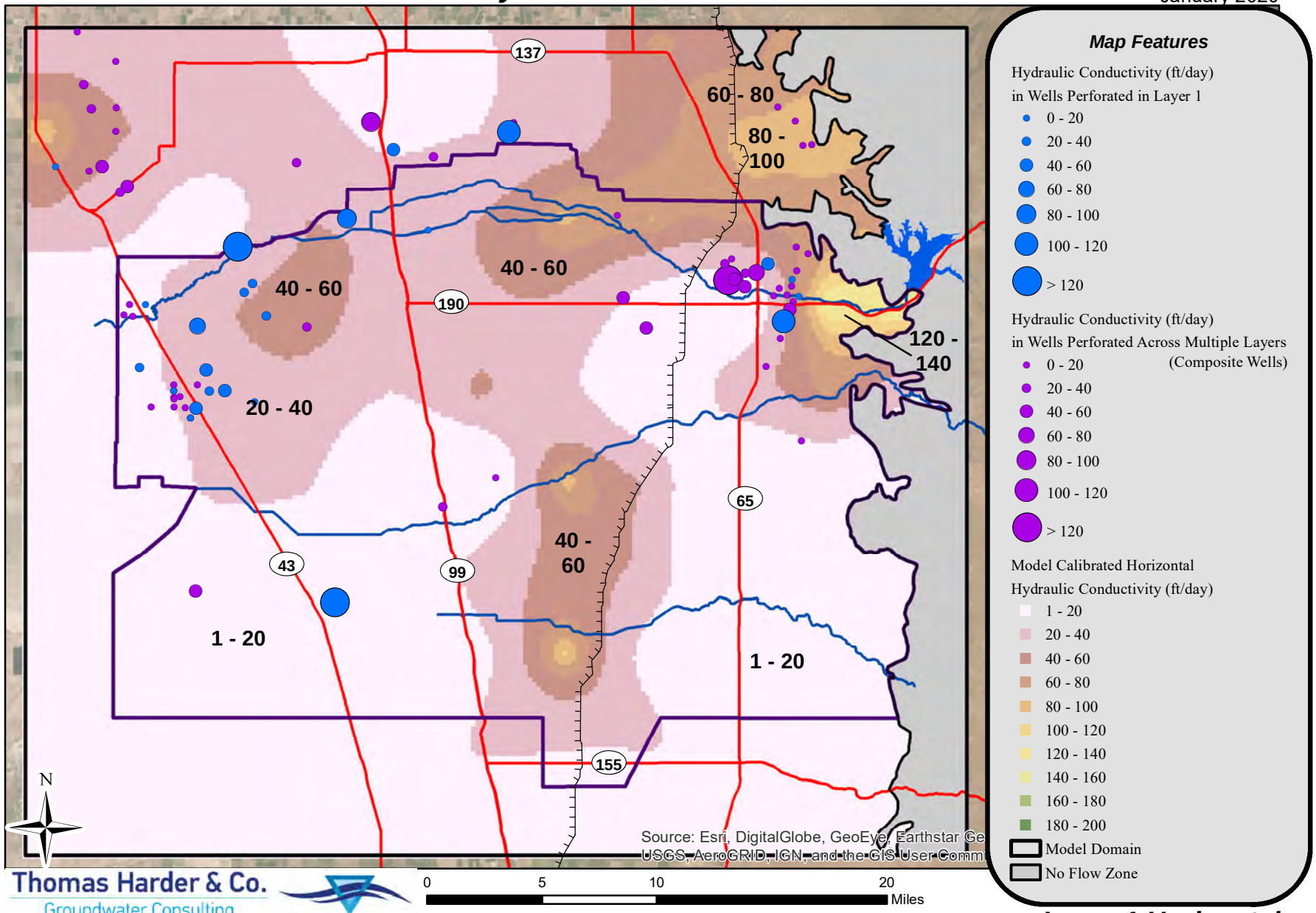
Calibration Parameters

This page intentionally left blank

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Map Features

Hydraulic Conductivity (ft/day) in Wells Perforated in Layer 1

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- > 120

Hydraulic Conductivity (ft/day) in Wells Perforated Across Multiple Layers (Composite Wells)

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- > 120

Model Calibrated Horizontal Hydraulic Conductivity (ft/day)

- 1 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200
- Model Domain
- No Flow Zone

Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

Note: Blue and purple dots indicate Hydraulic Conductivity values derived from controlled pumping tests (see Table 3).

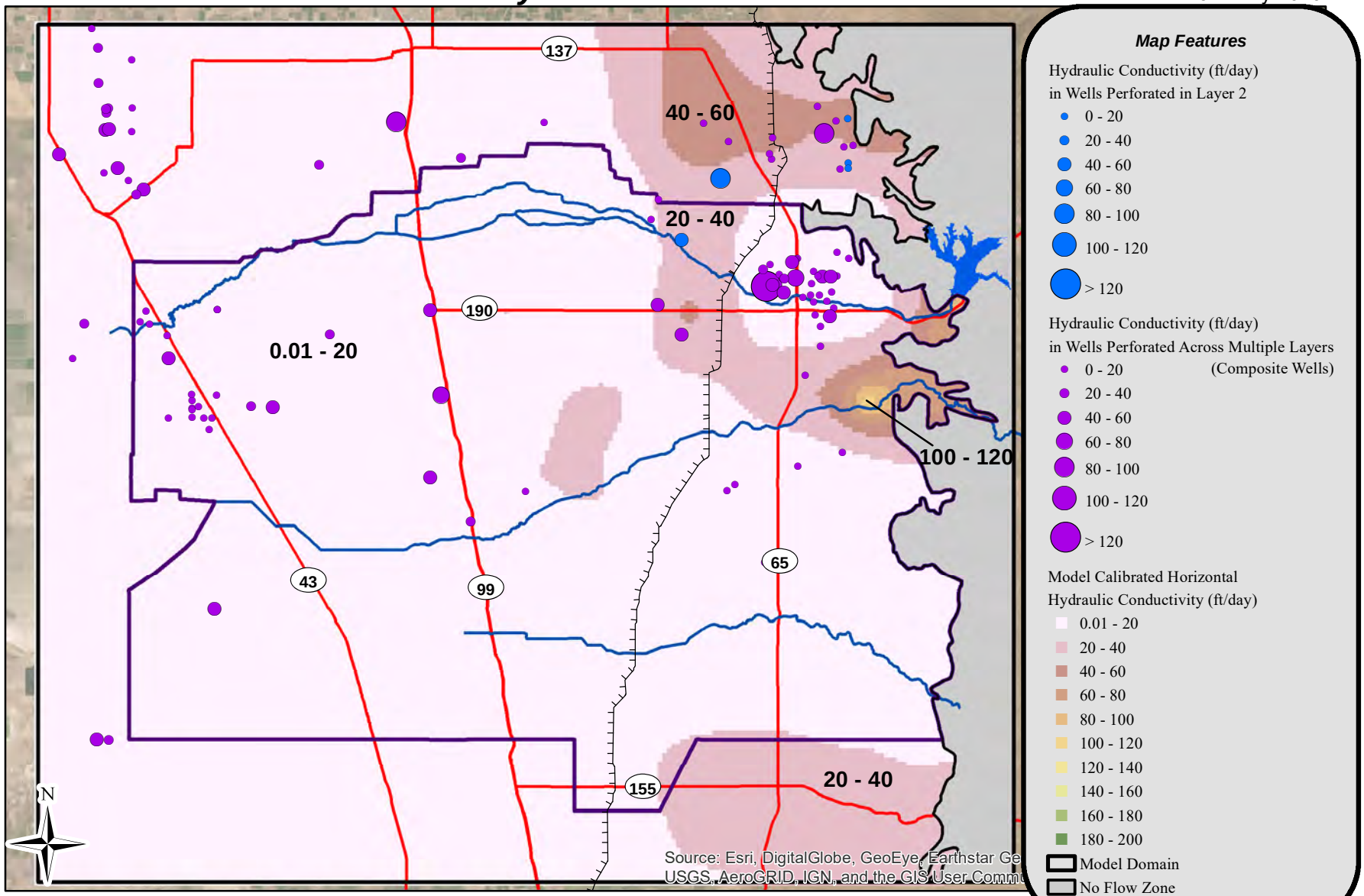
Layer 1 Horizontal Hydraulic Conductivity

Appendix C-1

Groundwater Flow Model of the Tule Subbasin

January 2020

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

Note: Blue and purple dots indicate Hydraulic Conductivity values derived from controlled pumping tests (see Table 3).

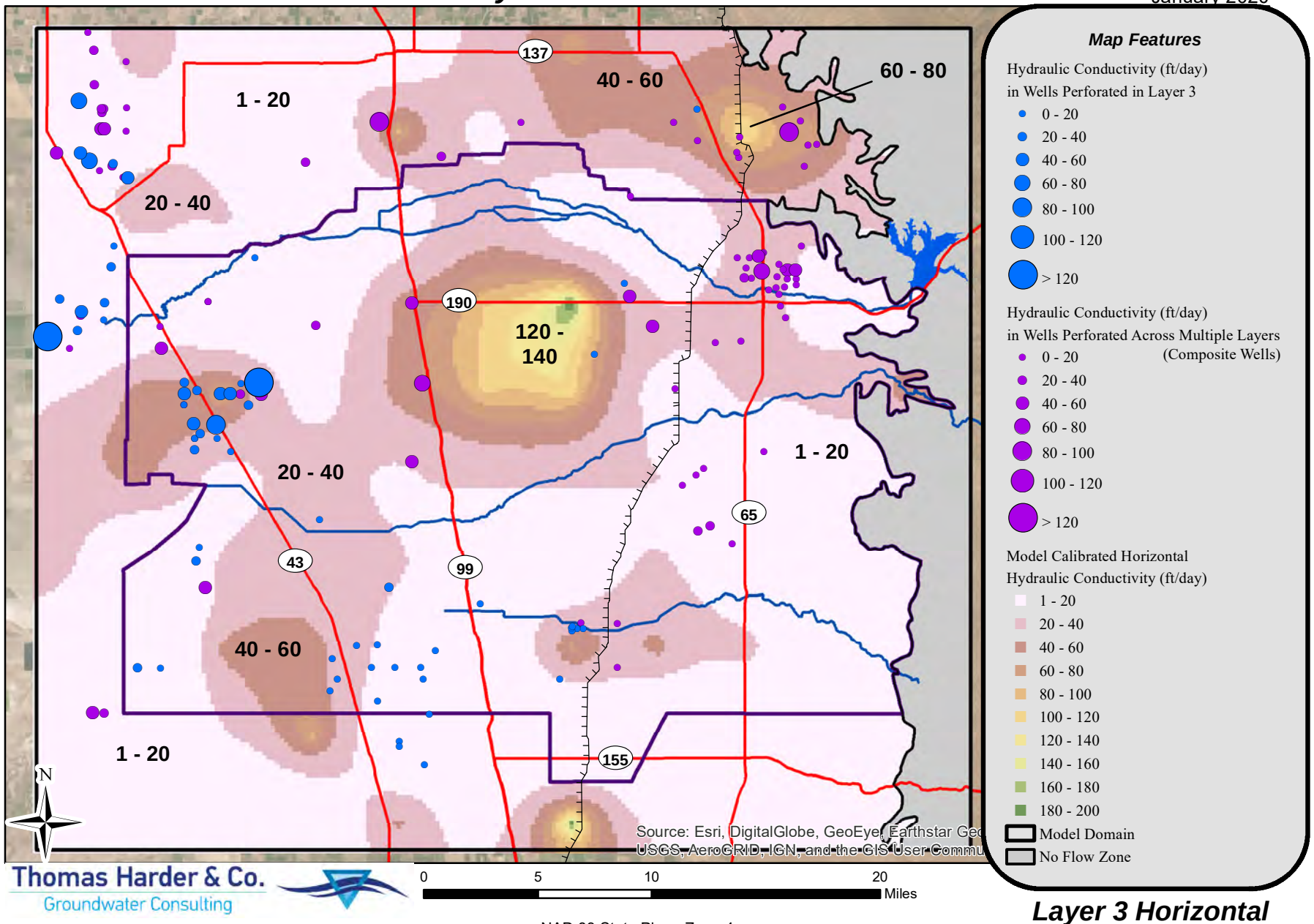
Layer 2 Horizontal Hydraulic Conductivity

Appendix C-2

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Map Features

Hydraulic Conductivity (ft/day) in Wells Perforated in Layer 3

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- > 120

Hydraulic Conductivity (ft/day) in Wells Perforated Across Multiple Layers (Composite Wells)

- 0 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- > 120

Model Calibrated Horizontal Hydraulic Conductivity (ft/day)

- 1 - 20
- 20 - 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200
- Model Domain
- No Flow Zone

Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

Note: Blue and purple dots indicate Hydraulic Conductivity values derived from controlled pumping tests (see Table 3).

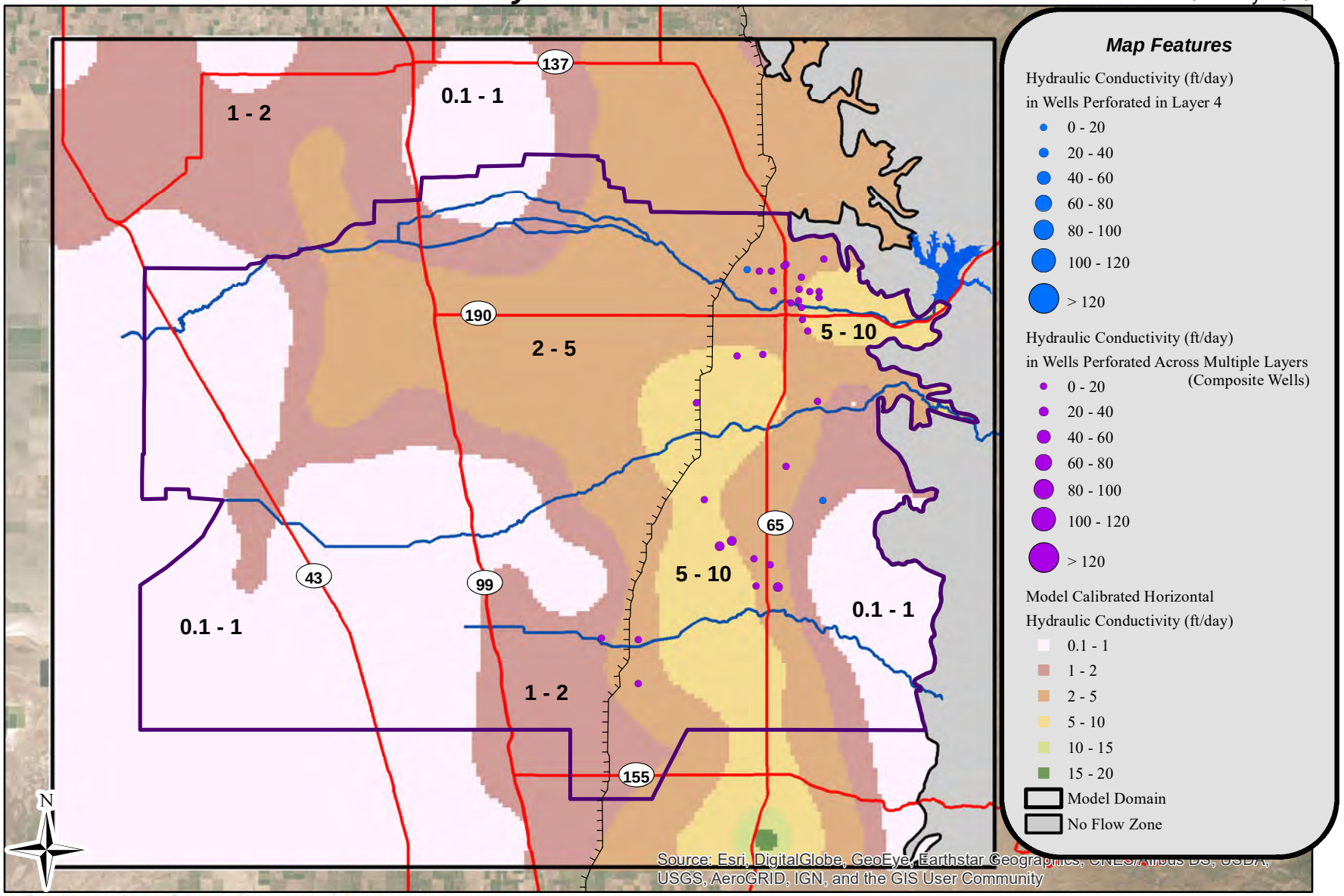
Layer 3 Horizontal Hydraulic Conductivity

Appendix C-3

Groundwater Flow Model of the Tule Subbasin

January 2020

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

Note: Blue and purple dots indicate Hydraulic Conductivity values derived from controlled pumping tests (see Table 3).

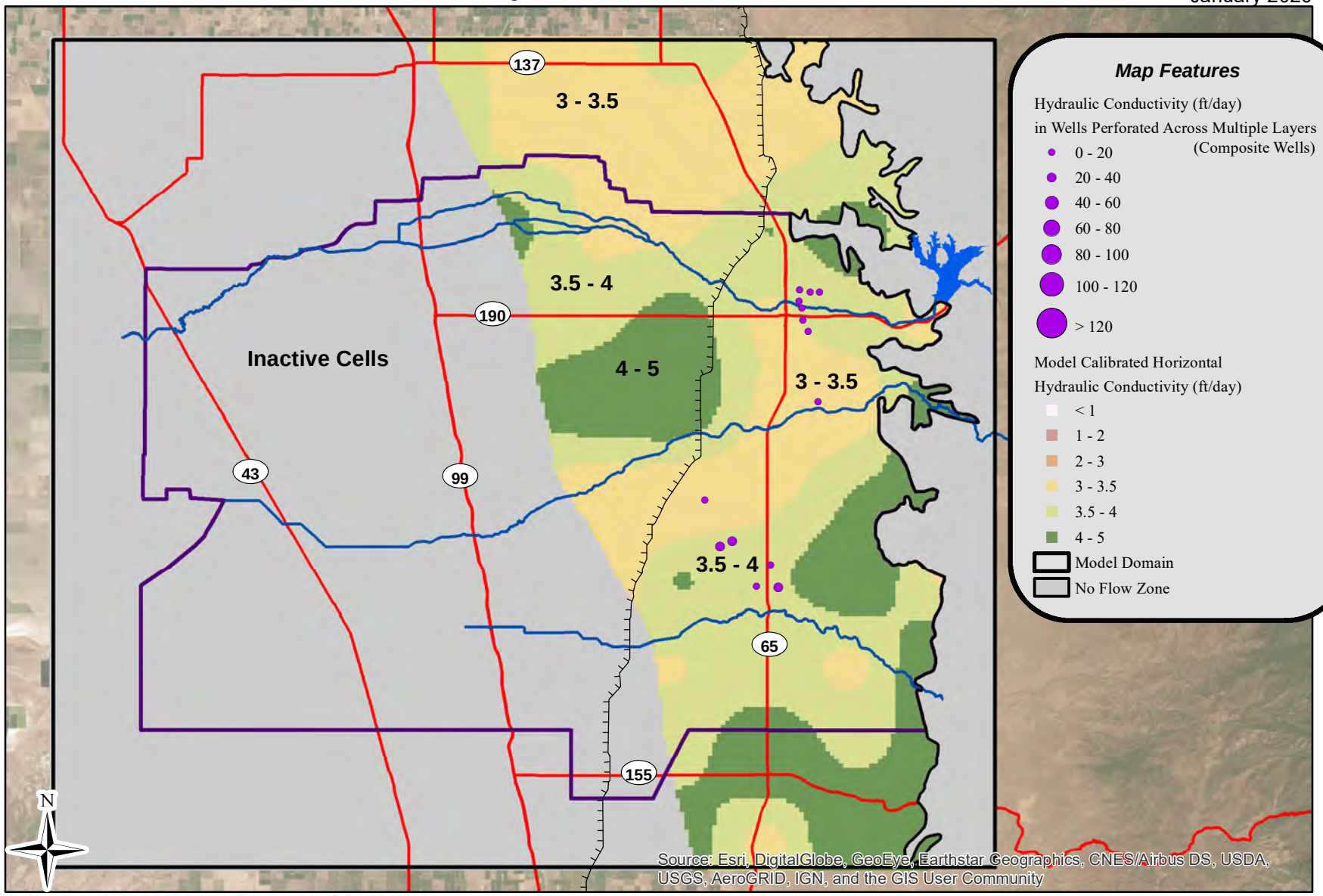
Layer 4 Horizontal Hydraulic Conductivity

Appendix C-4

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

Note: Purple dots indicate Hydraulic Conductivity values derived from controlled pumping tests (see Table 3).

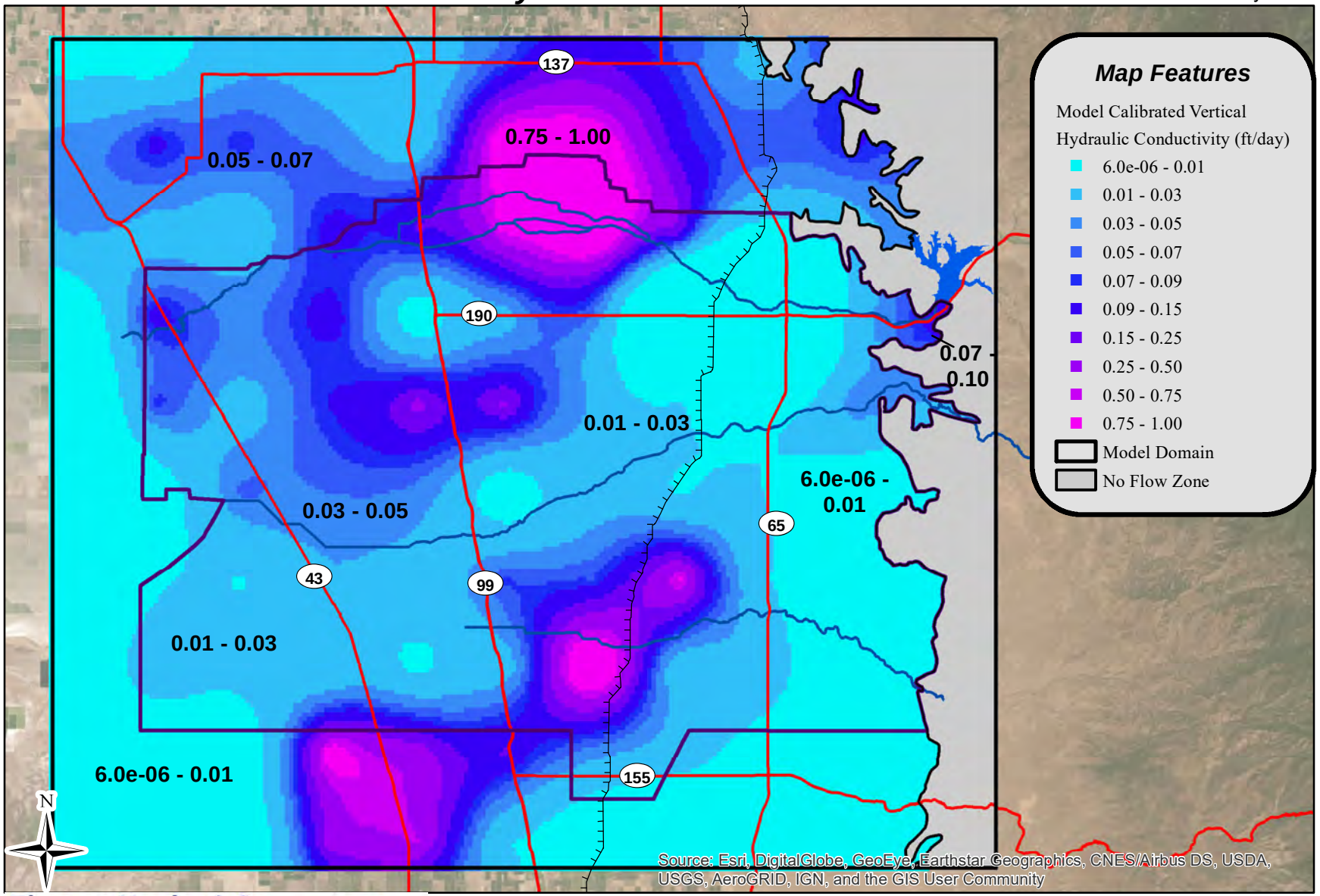
Layer 5 Horizontal Hydraulic Conductivity

Appendix C-5

Groundwater Flow Model of the Tule Subbasin

January 2020

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

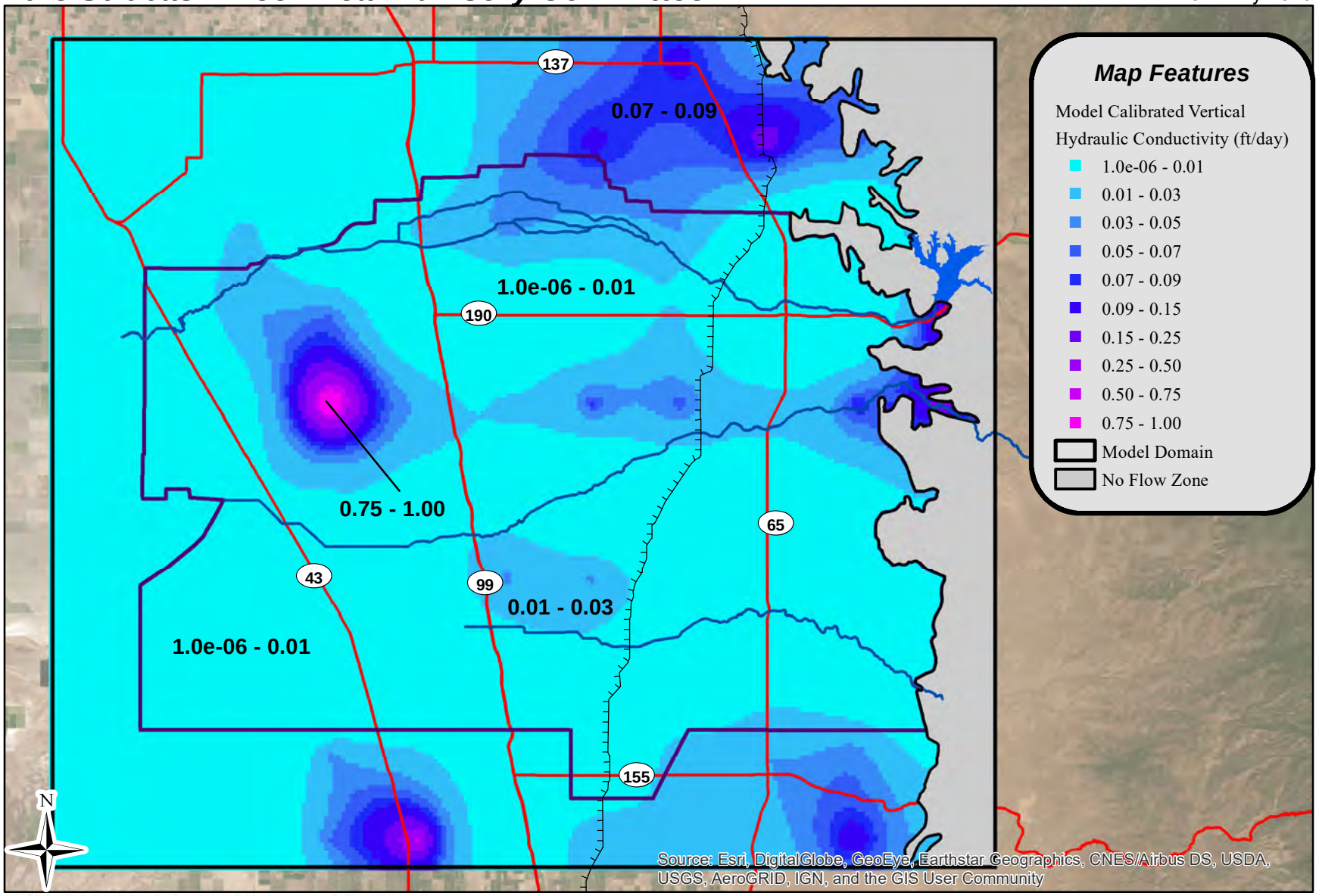
NAD 83 State Plane Zone 4

Layer 1 Vertical Hydraulic Conductivity

Appendix C-6

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

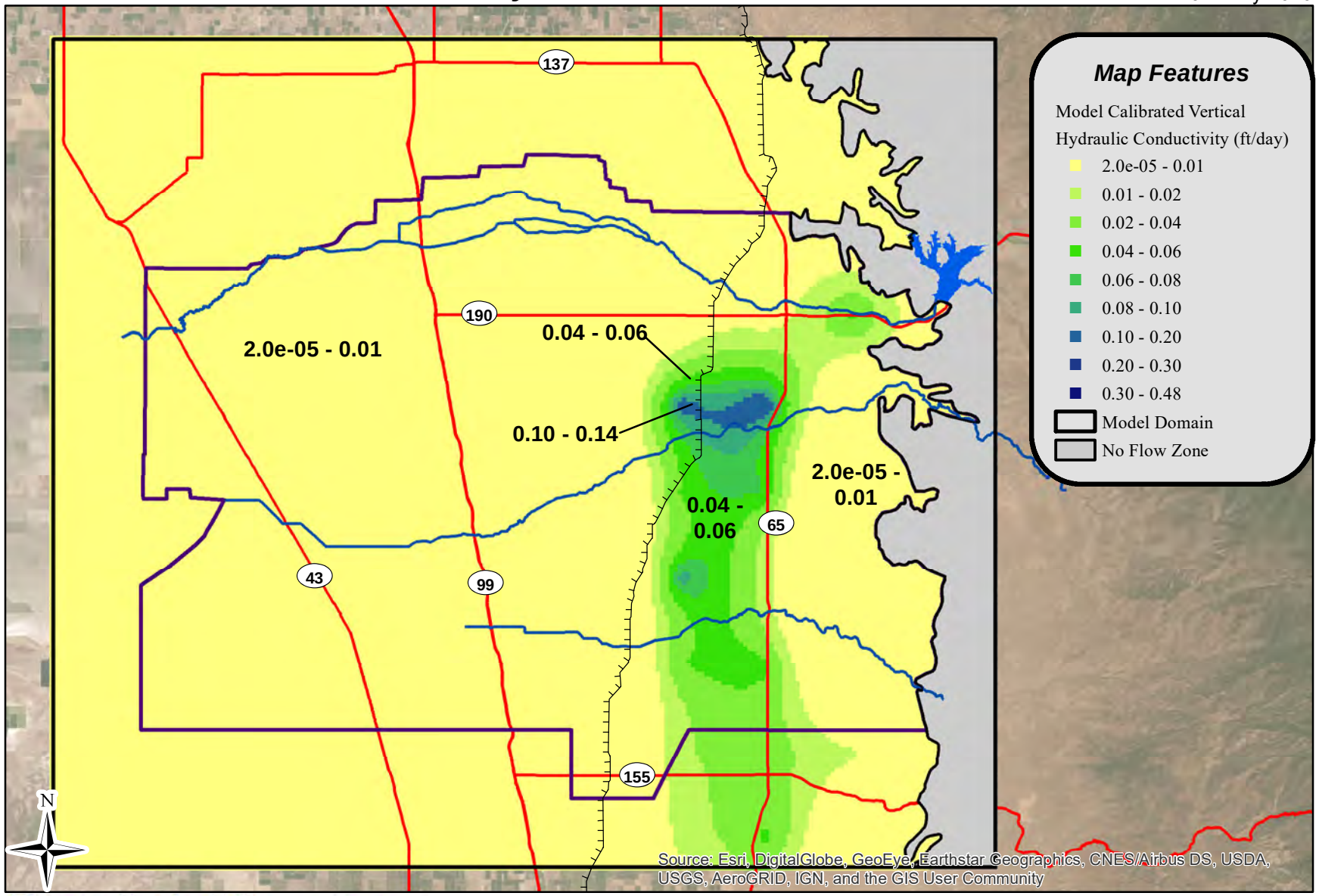
Layer 2 Vertical Hydraulic Conductivity

Appendix C-7

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

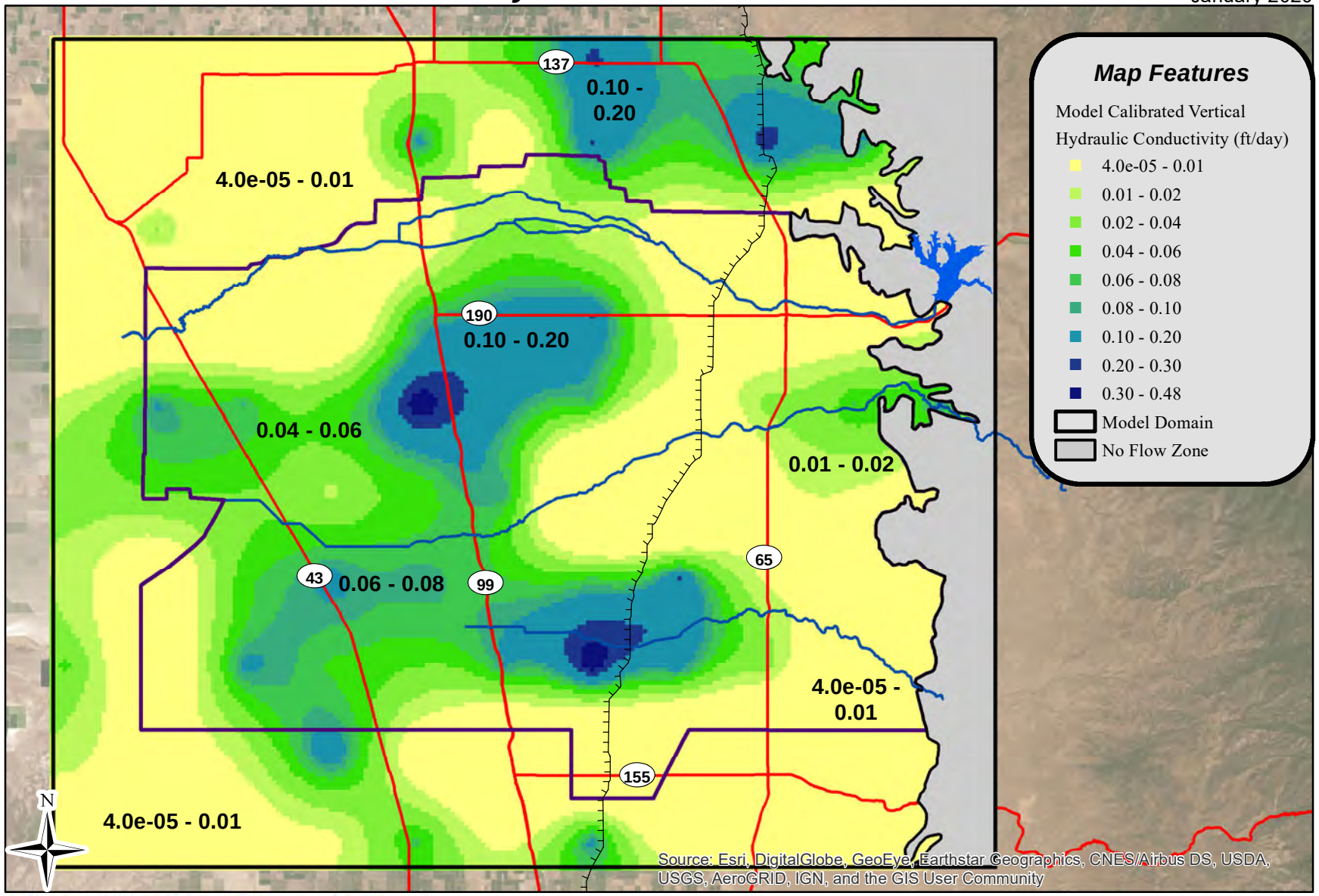
Layer 4 Vertical Hydraulic Conductivity

Appendix C-8

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

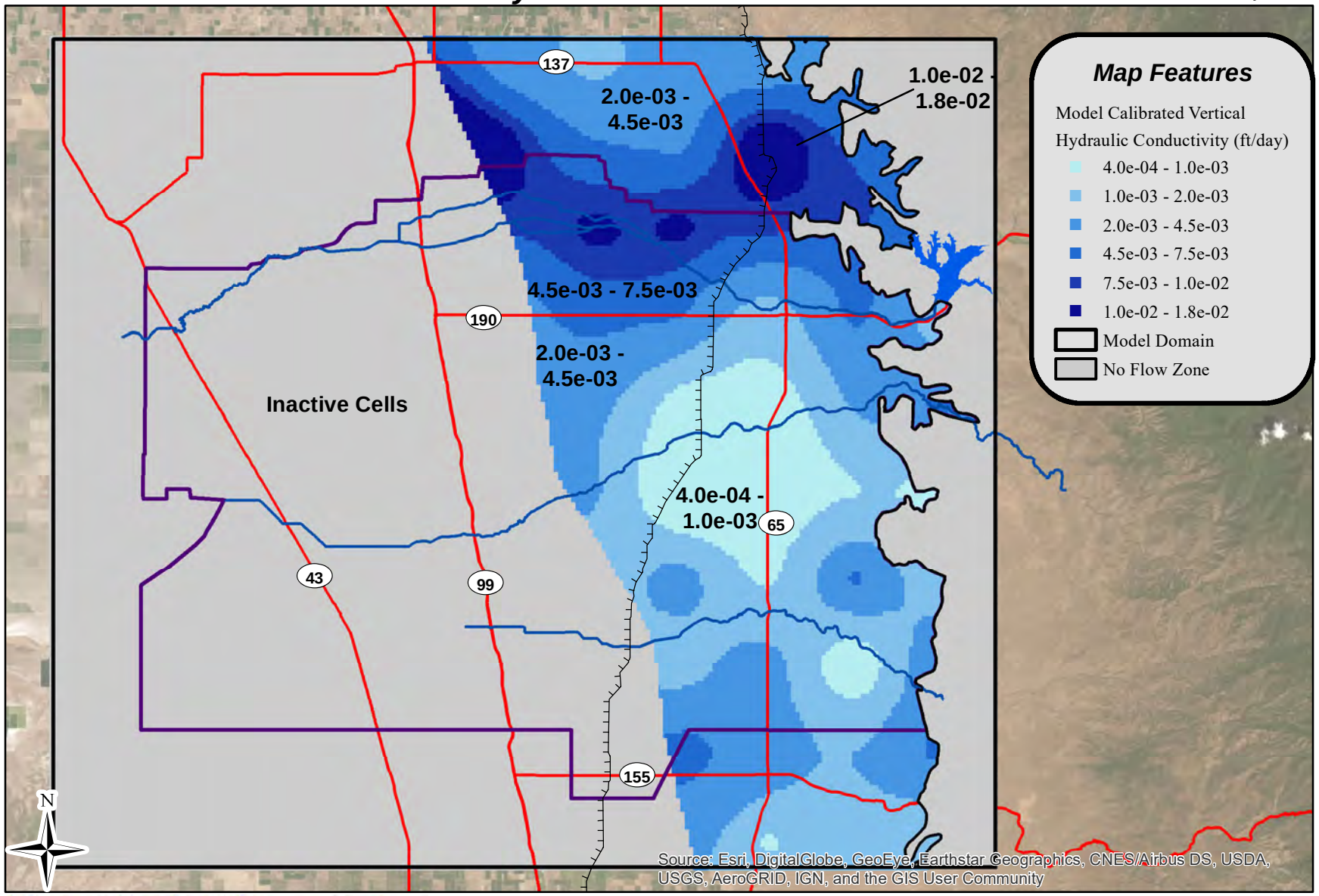
0 5 10 20 Miles

NAD 83 State Plane Zone 4

Layer 3 Vertical Hydraulic Conductivity

Appendix C-9

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

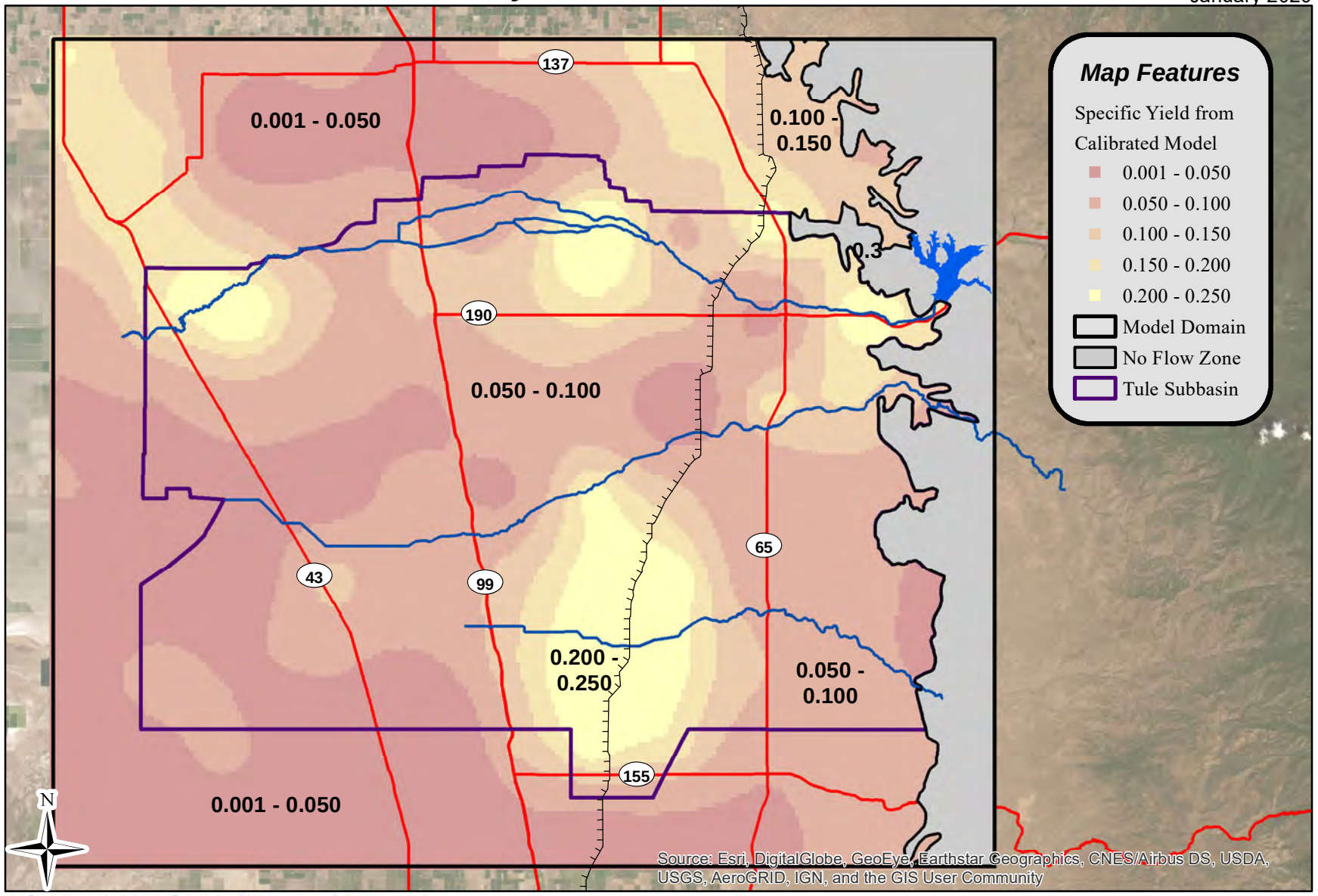
Layer 5 Vertical Hydraulic Conductivity

Appendix C-10

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

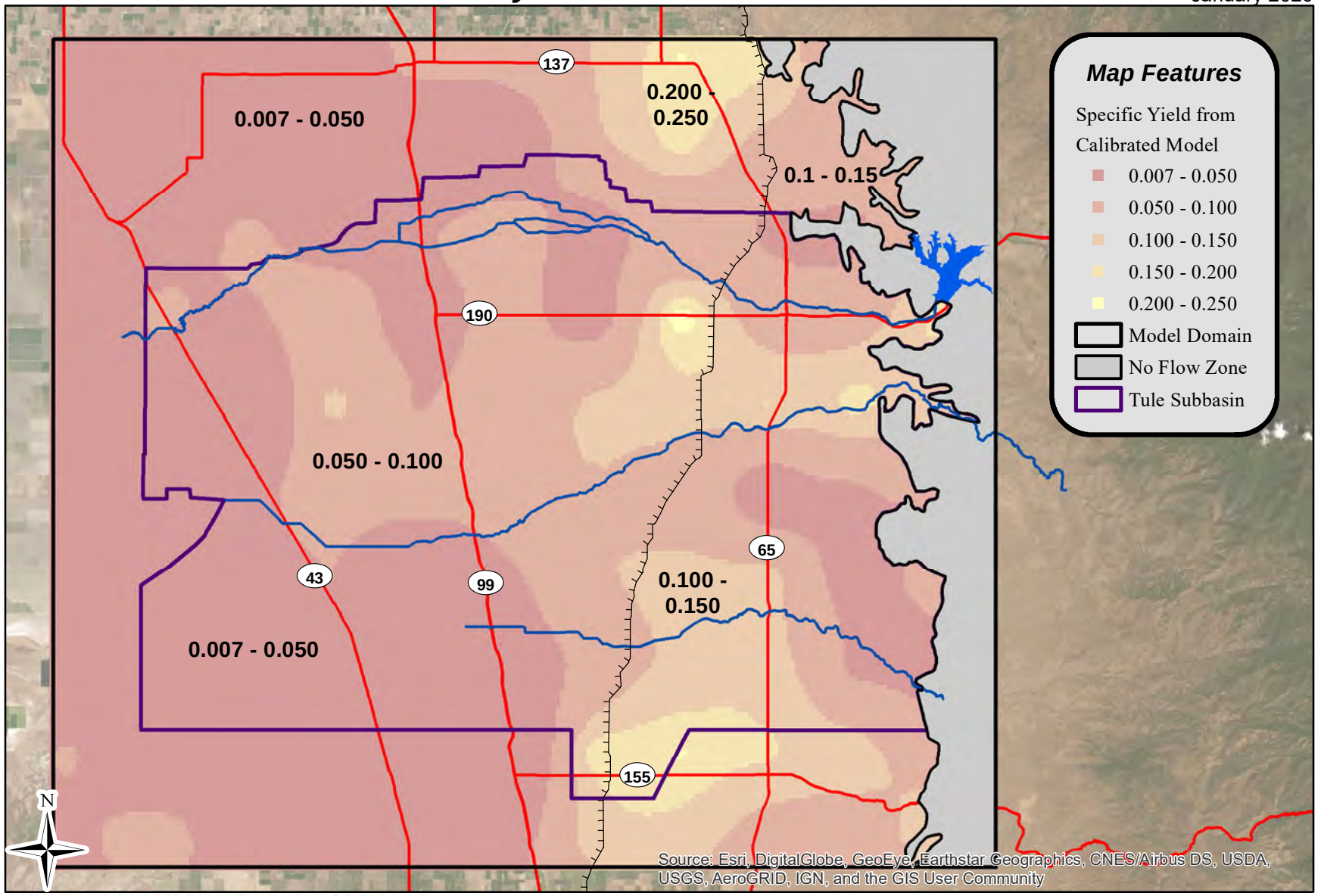
NAD 83 State Plane Zone 4

Layer 1 Specific Yield

Appendix C-11

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

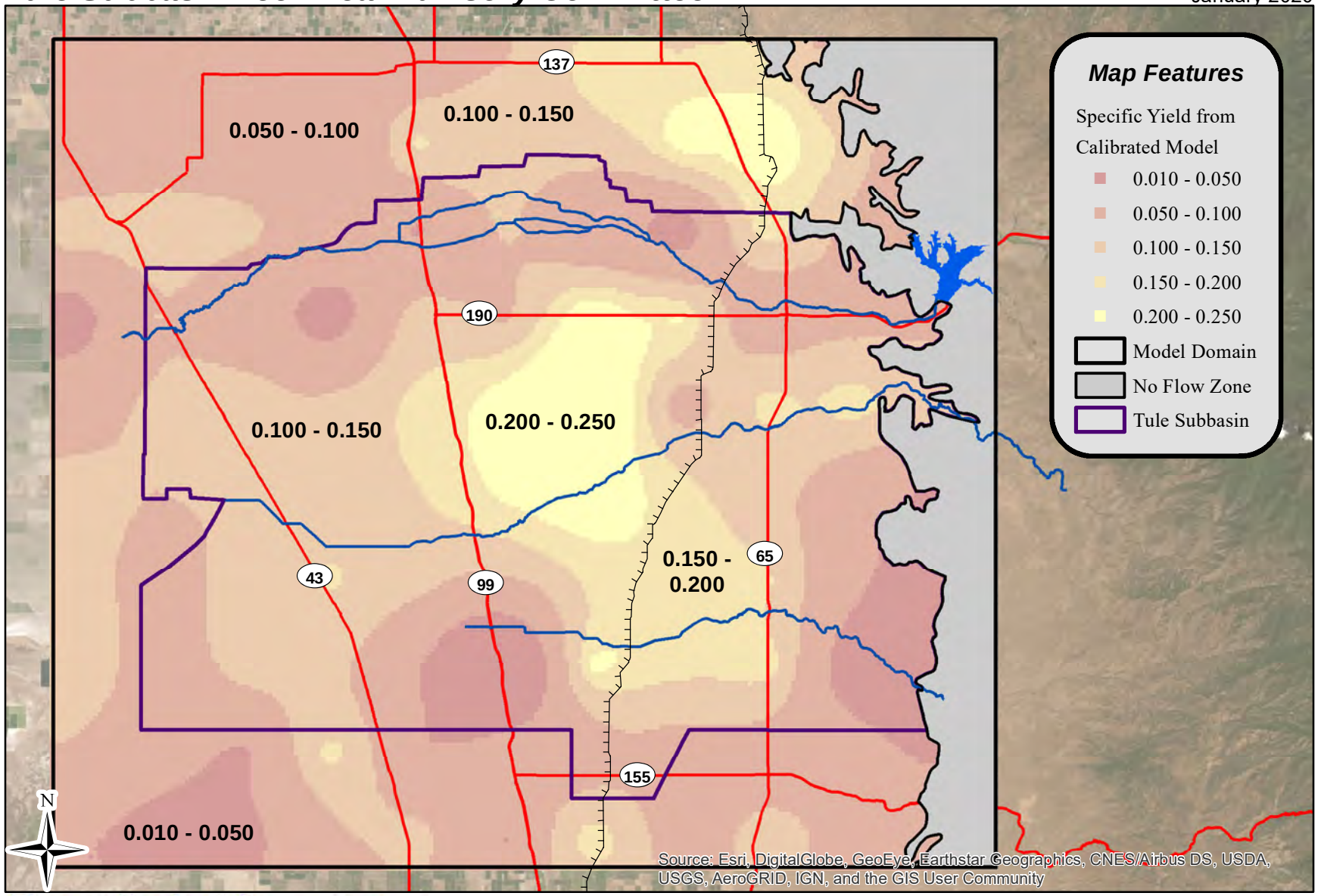
Layer 2 Specific Yield

Appendix C-12

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

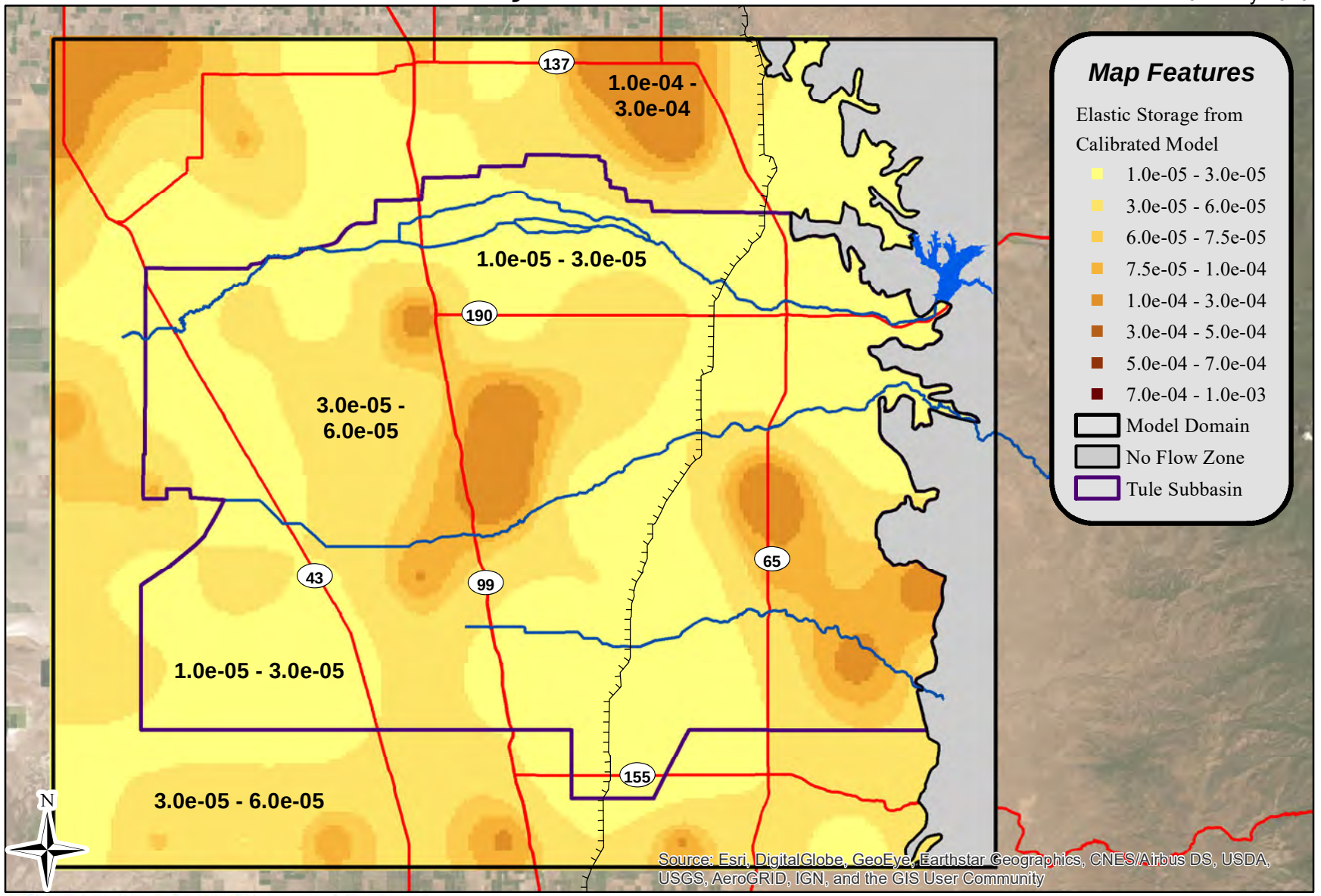
Layer 3 Specific Yield

Appendix C-13

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

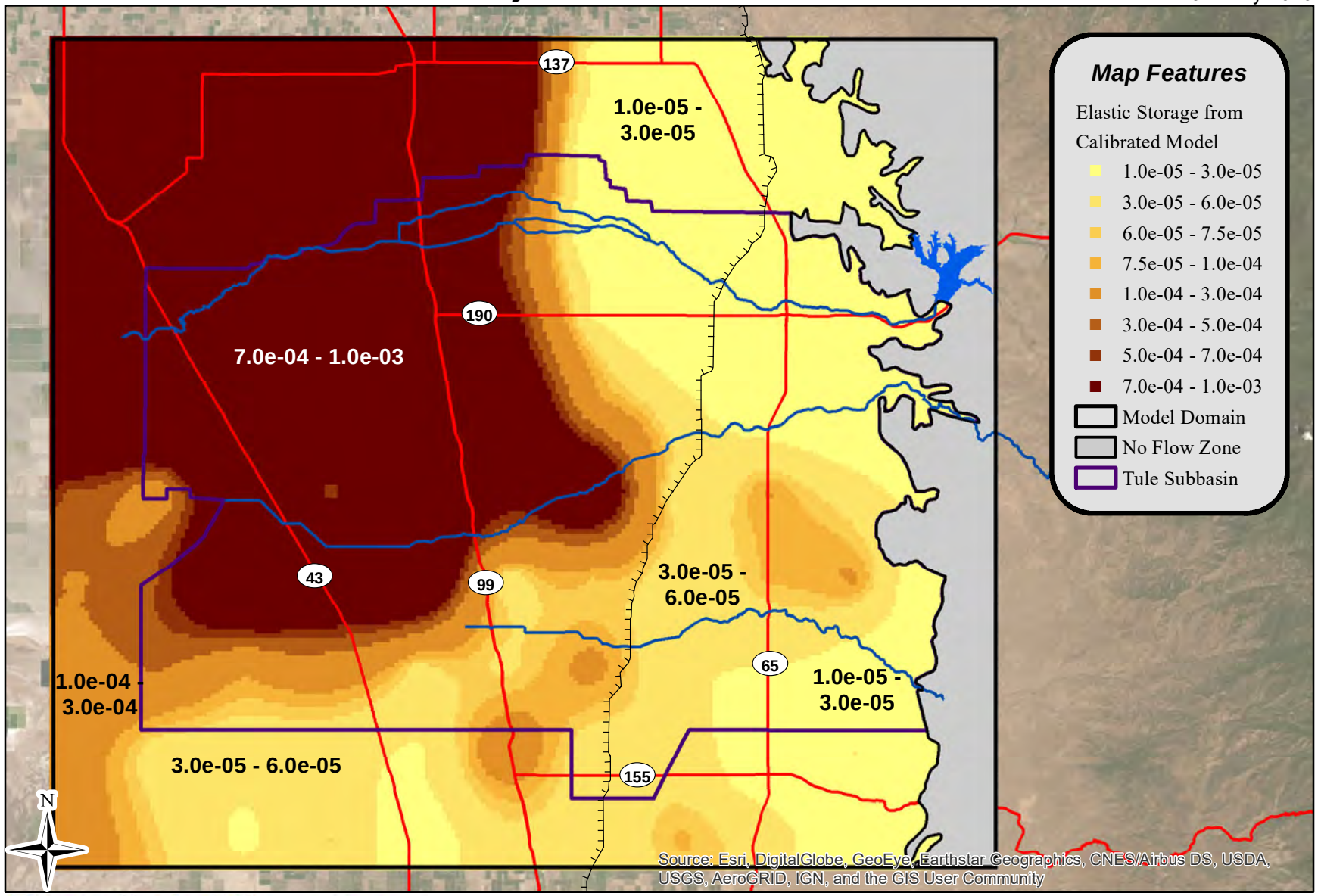
Layer 1 Elastic Storage

Appendix C-14

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

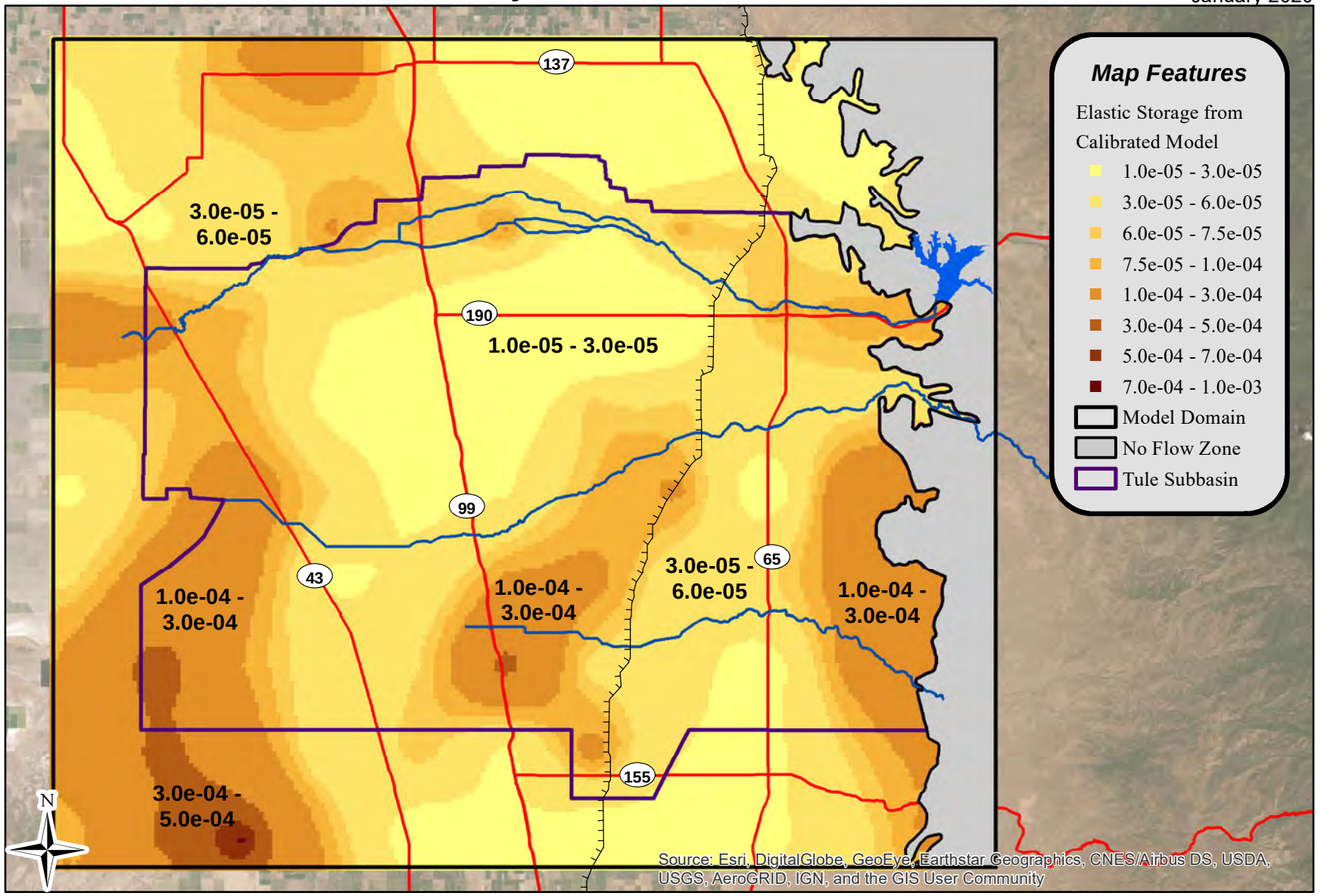
Layer 2 Elastic Storage

Appendix C-15

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

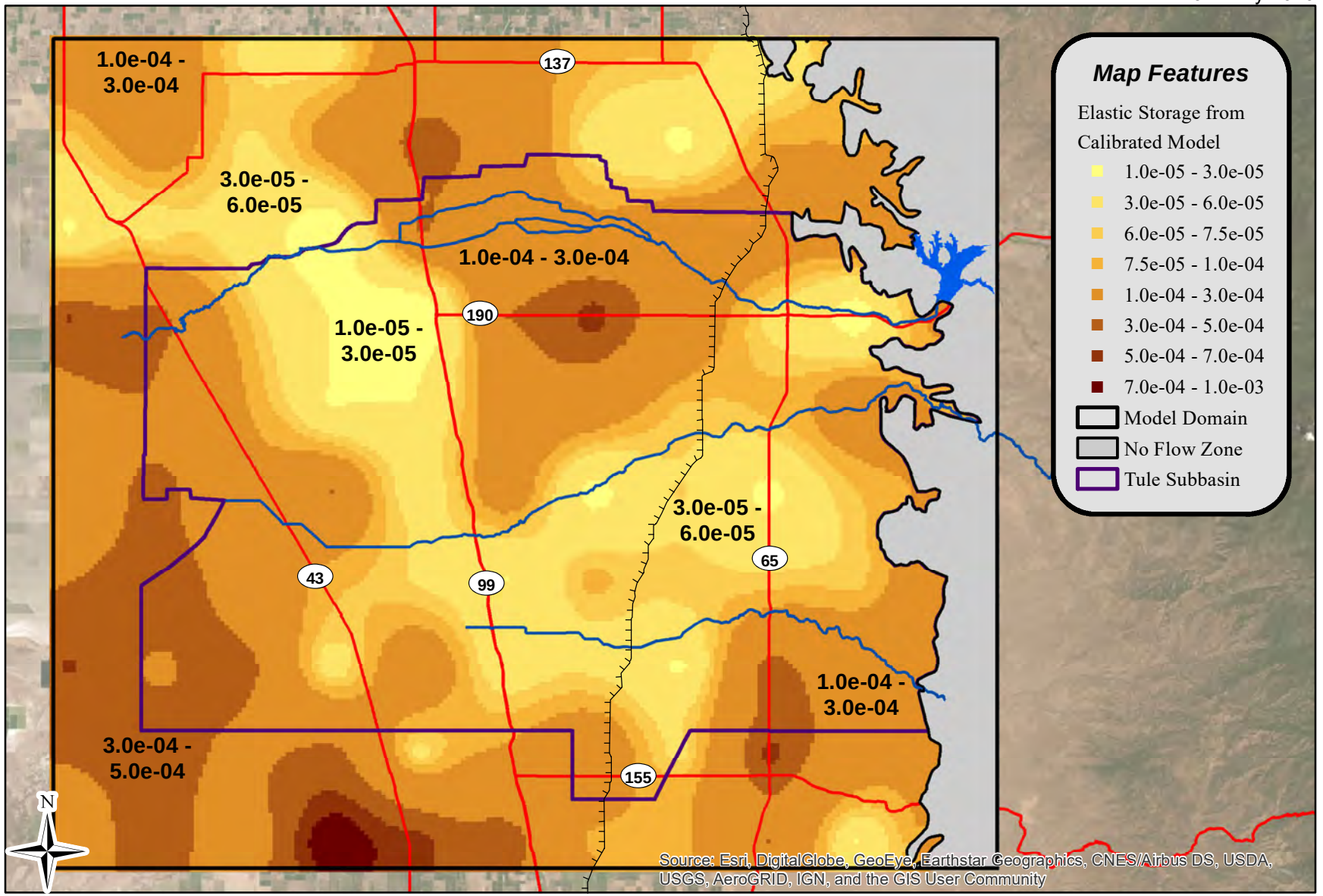
Layer 3 Elastic Storage

Appendix C-16

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



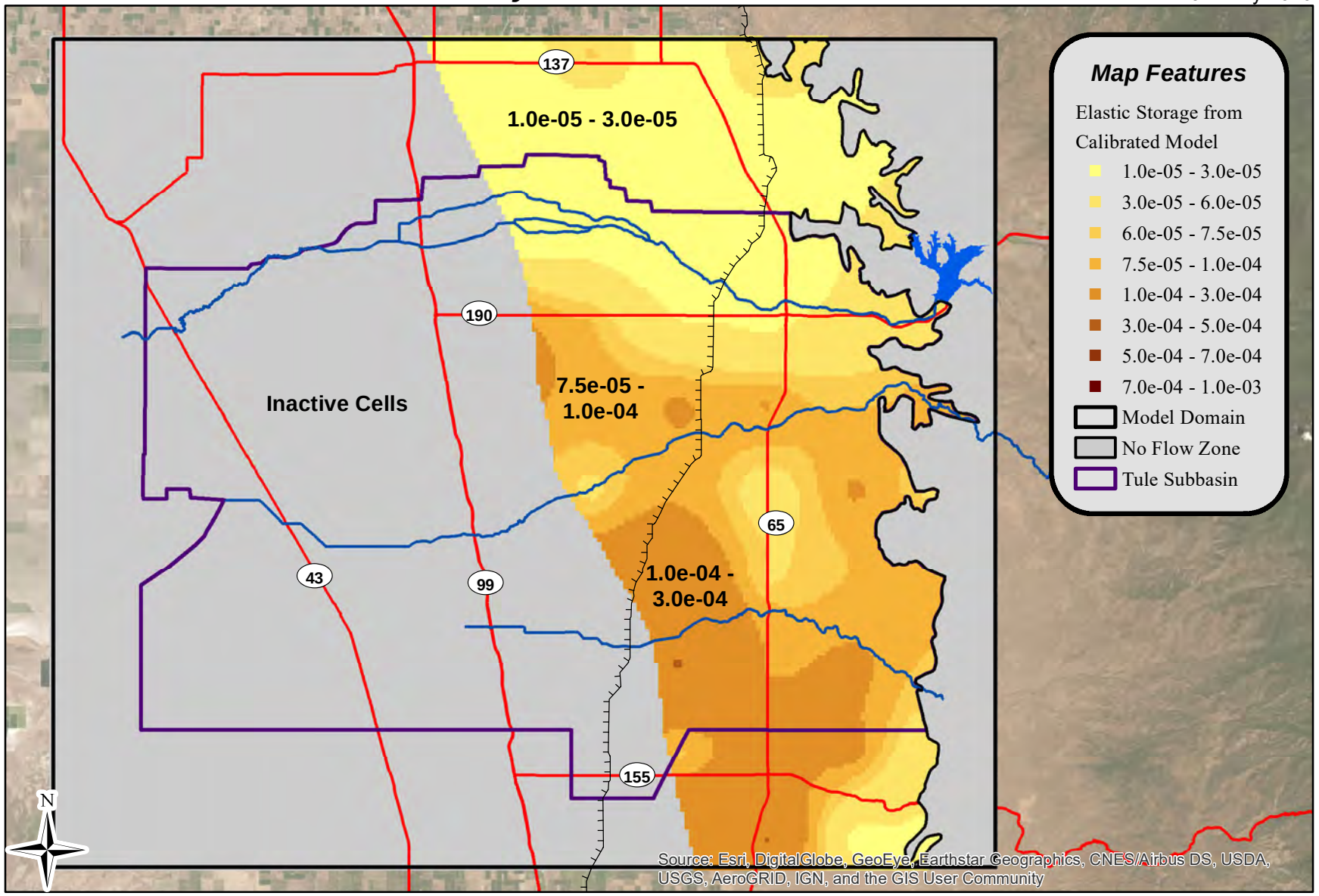
Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

Layer 4 Elastic Storage

Appendix C-17

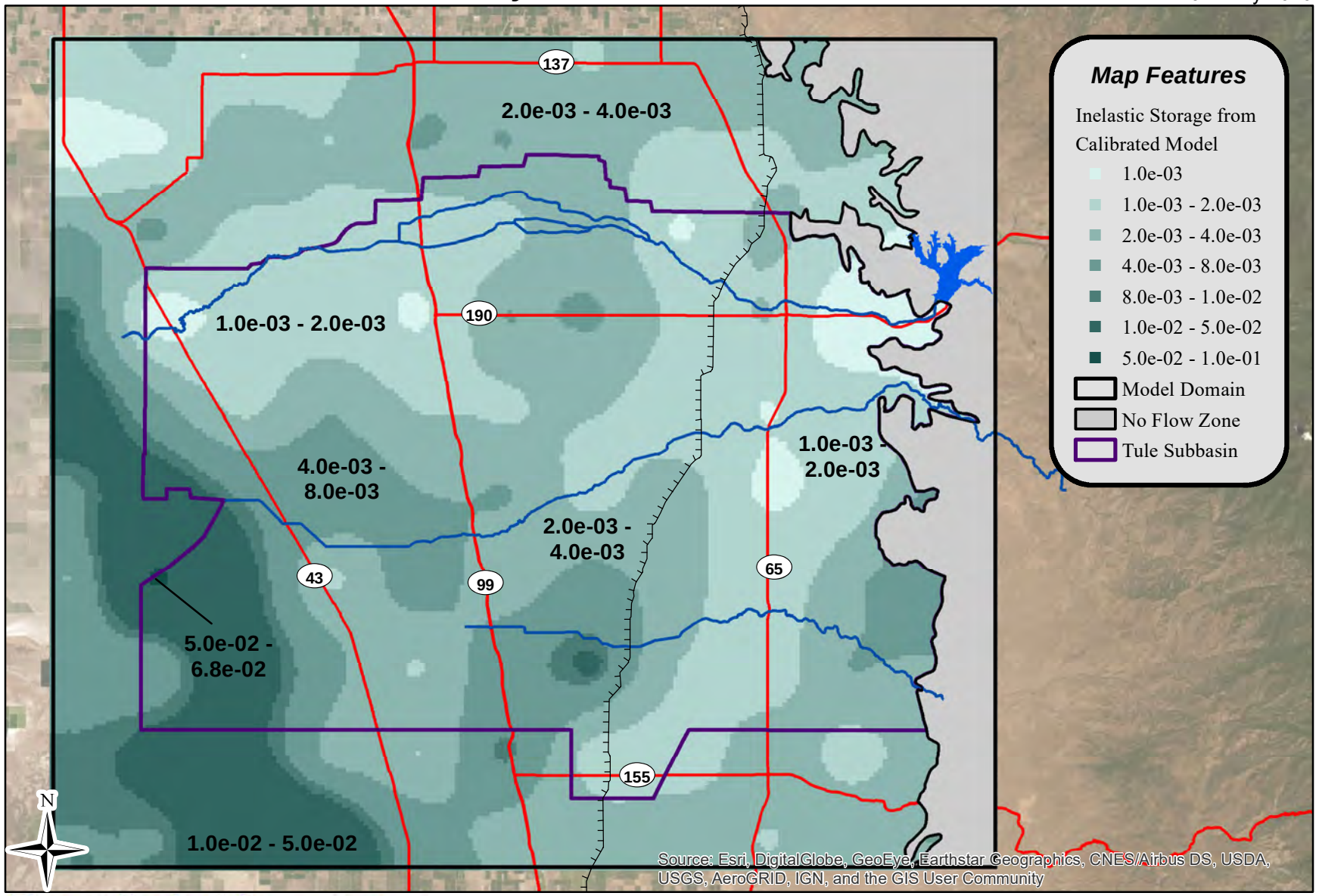


Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

Layer 5 Elastic Storage

Appendix C-18

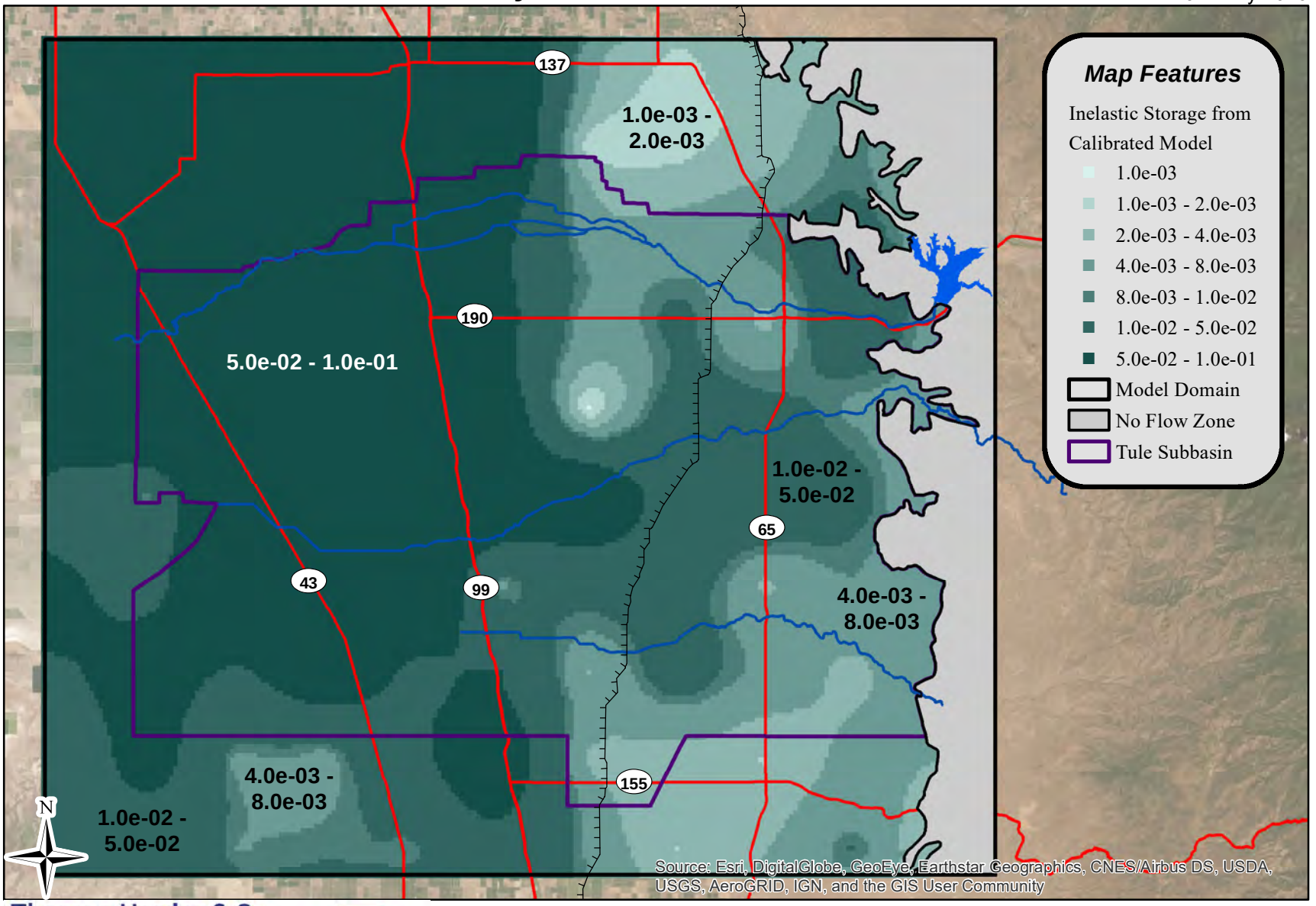


Thomas Harder & Co.
Groundwater Consulting

0 5 10 20
Miles

NAD 83 State Plane Zone 4

Layer 1
Inelastic Storage
Appendix C-19



Thomas Harder & Co.
Groundwater Consulting

5 10 20
Miles

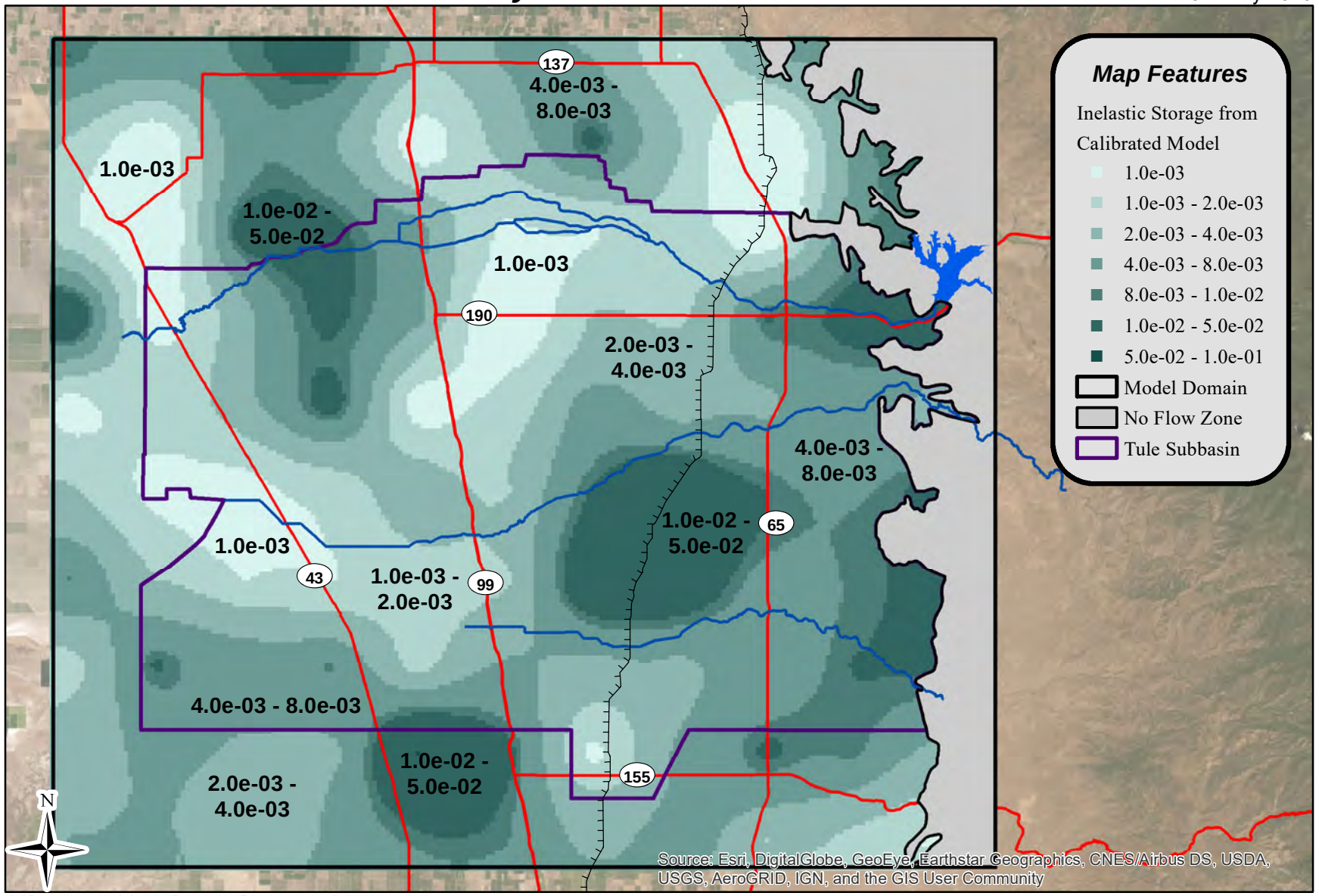
NAD 83 State Plane Zone 4

Layer 2
Inelastic Storage
Appendix C-20

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



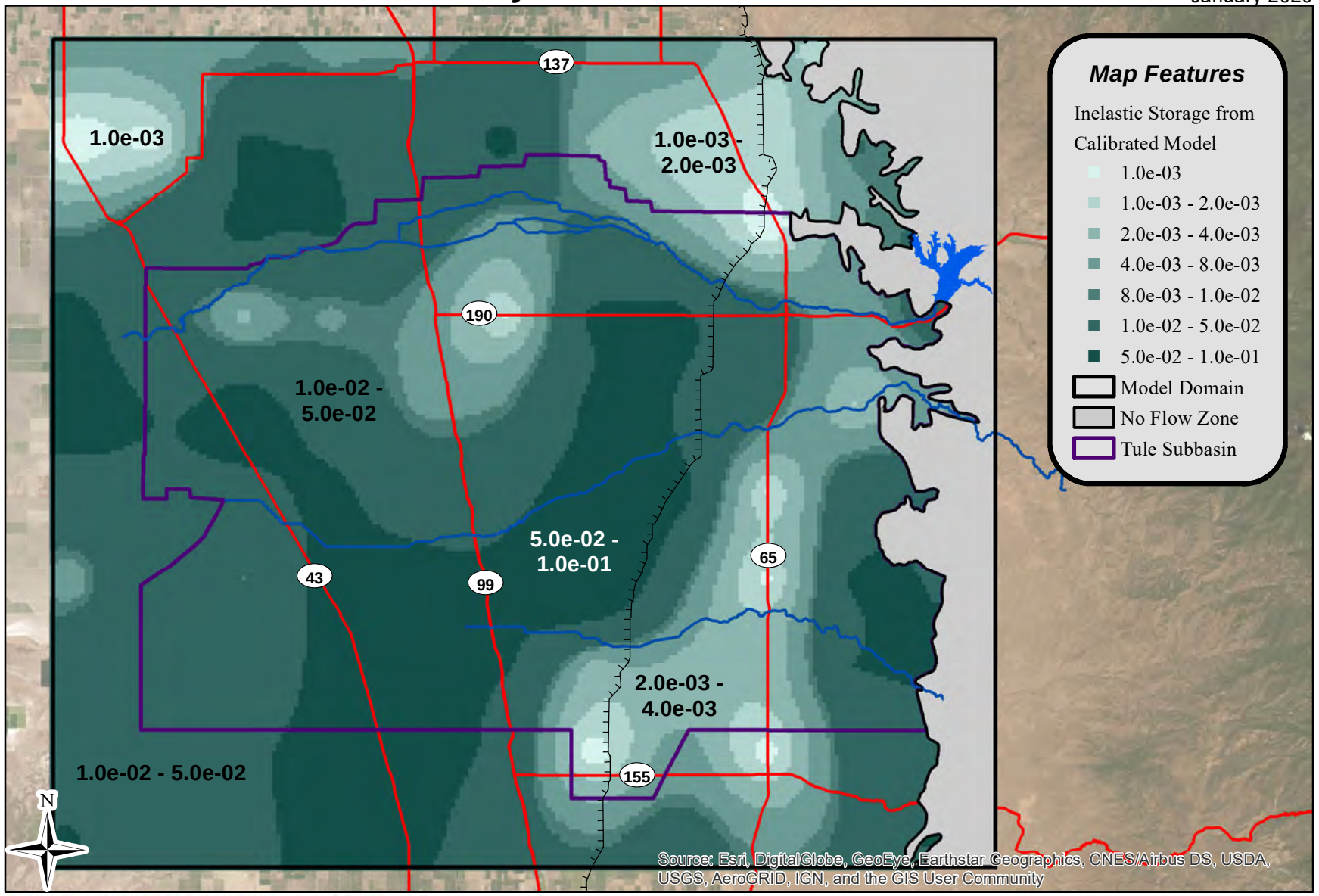
Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

Layer 3
Inelastic Storage

Appendix C-21



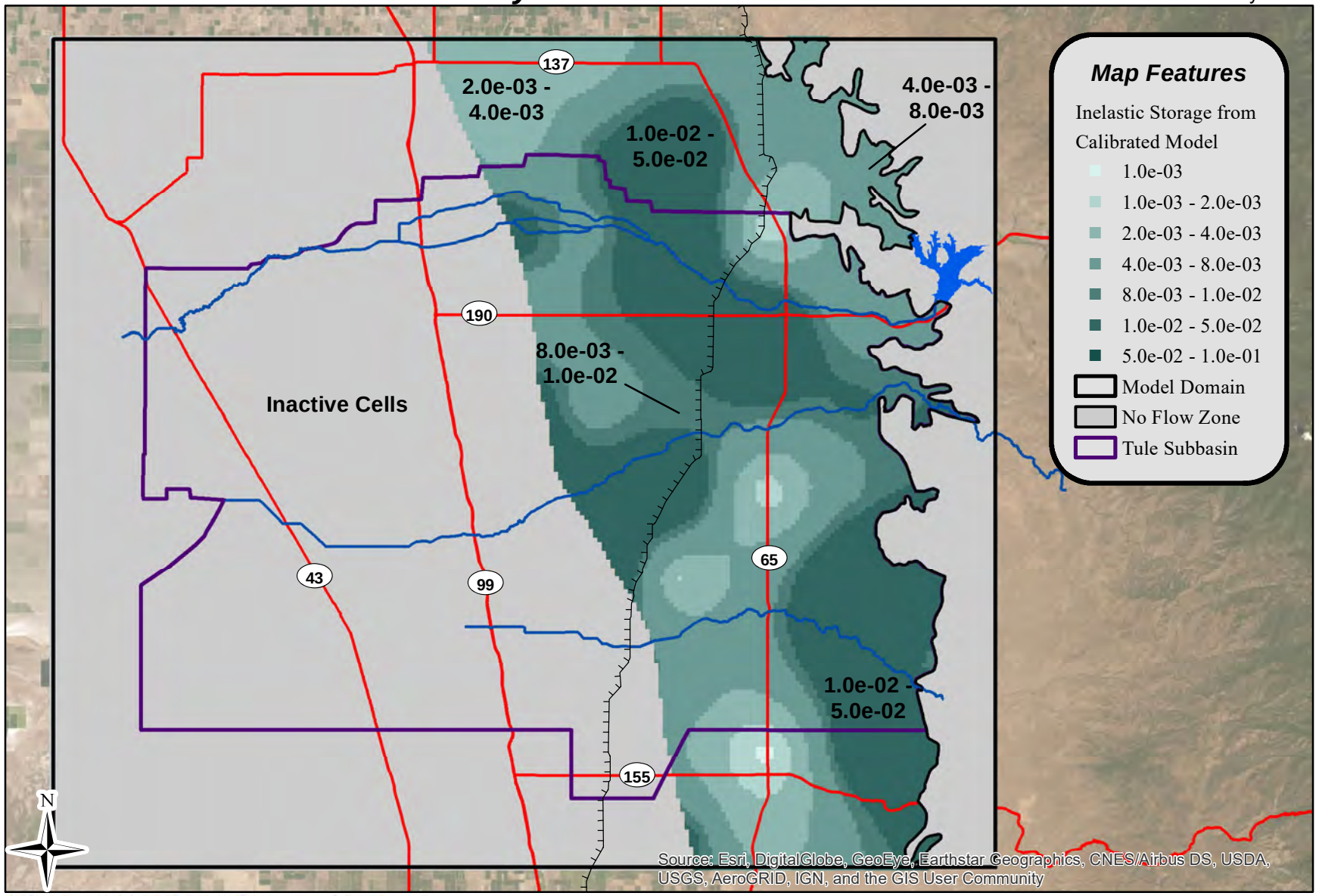
Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

NAD 83 State Plane Zone 4

Layer 4
Inelastic Storage
Appendix C-22

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20 Miles

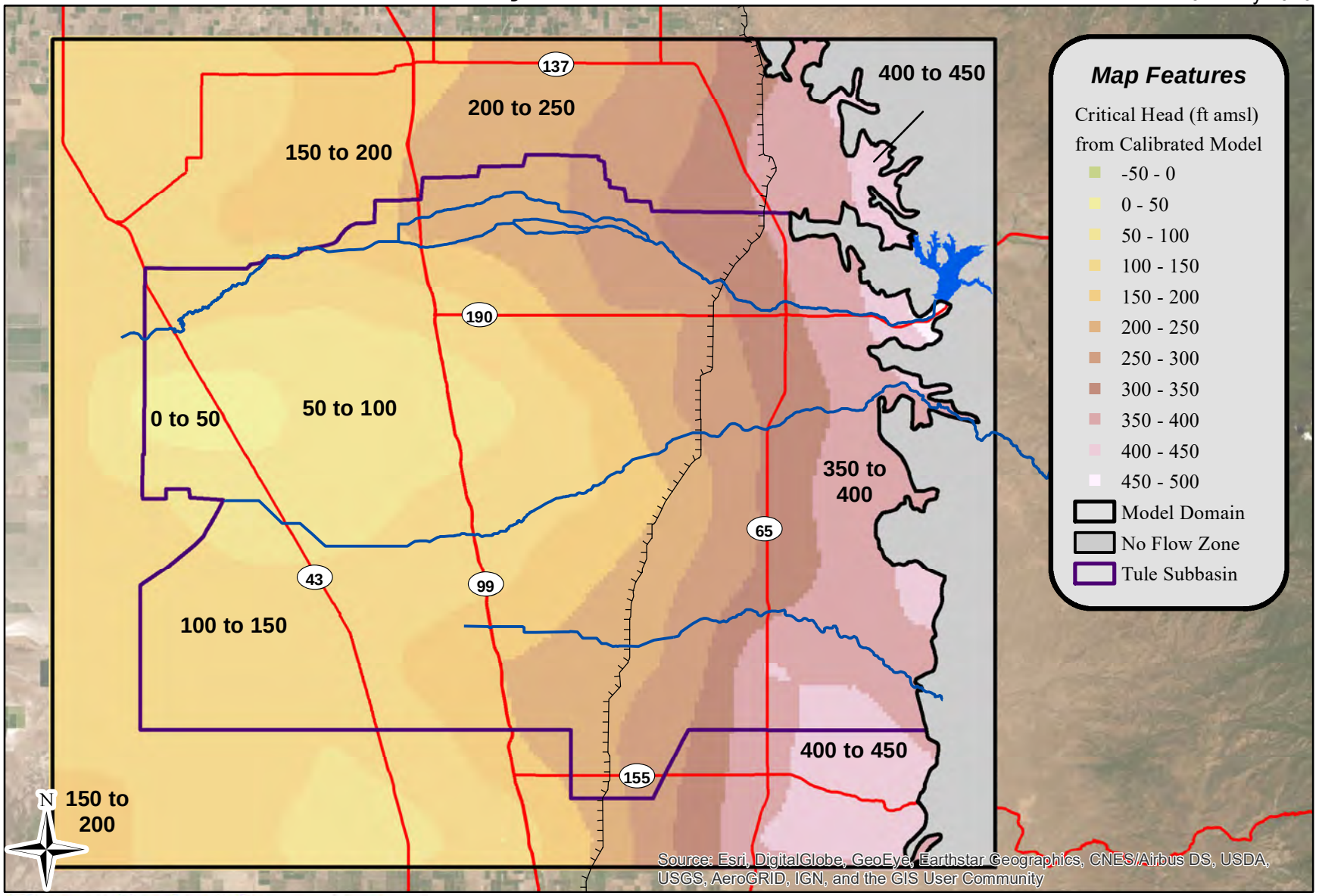
NAD 83 State Plane Zone 4

Layer 5
Inelastic Storage
Appendix C-23

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20
Miles

NAD 83 State Plane Zone 4

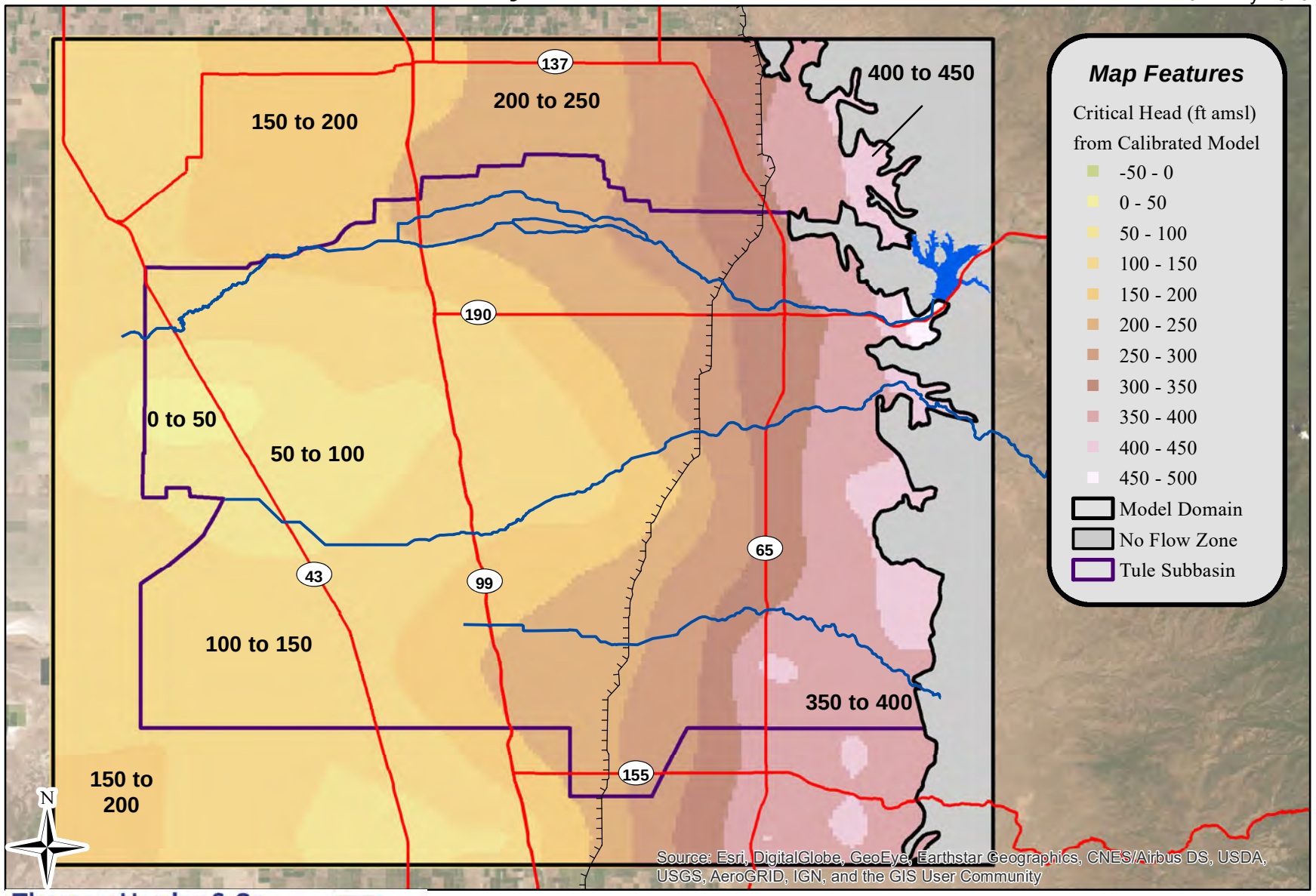
Layer 1 Critical Heads

Appendix C-24

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

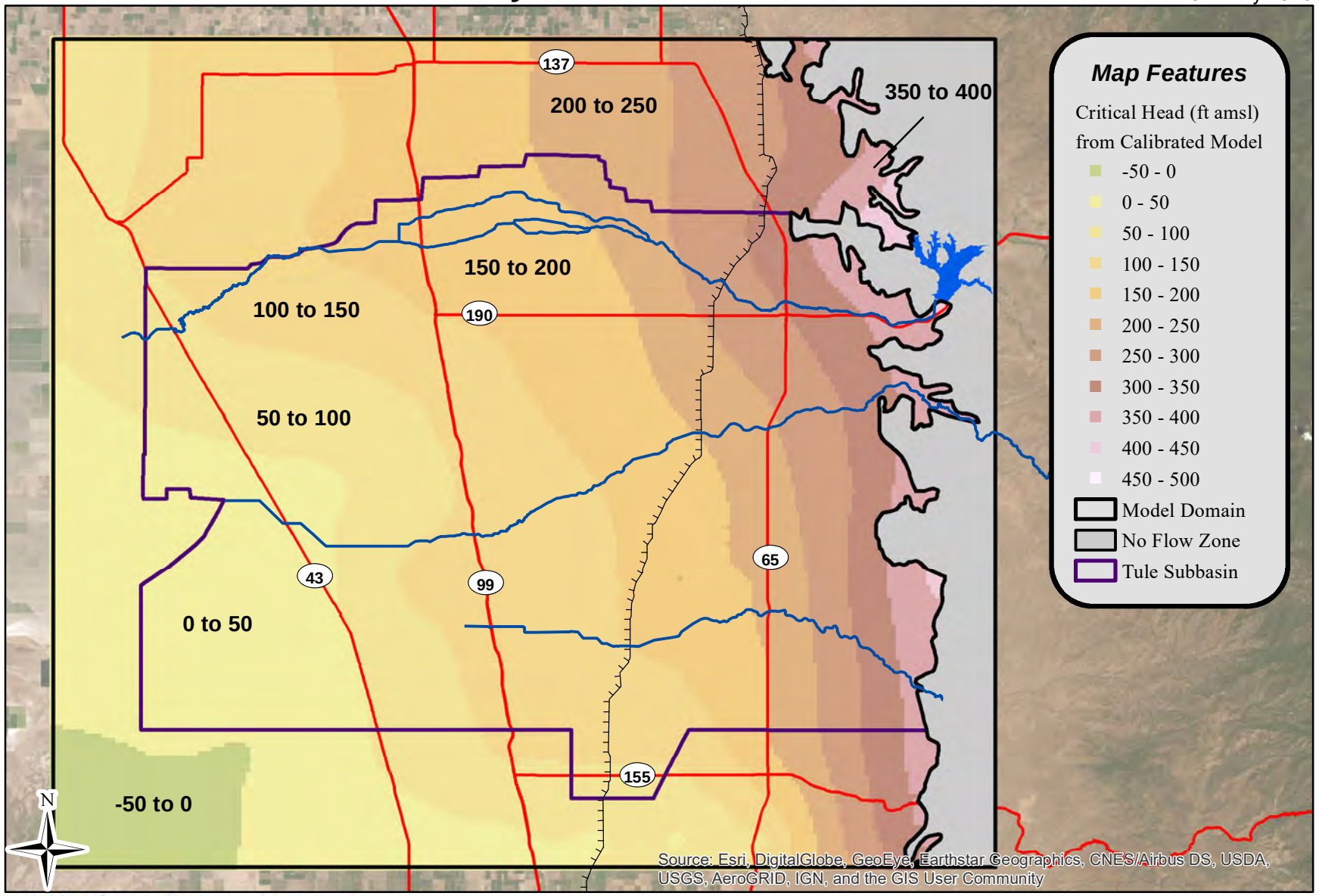
Layer 2 Critical Heads

Appendix C-25

Groundwater Flow Model of the Tule Subbasin

January 2020

Tule Subbasin Technical Advisory Committee



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20
Miles

NAD 83 State Plane Zone 4

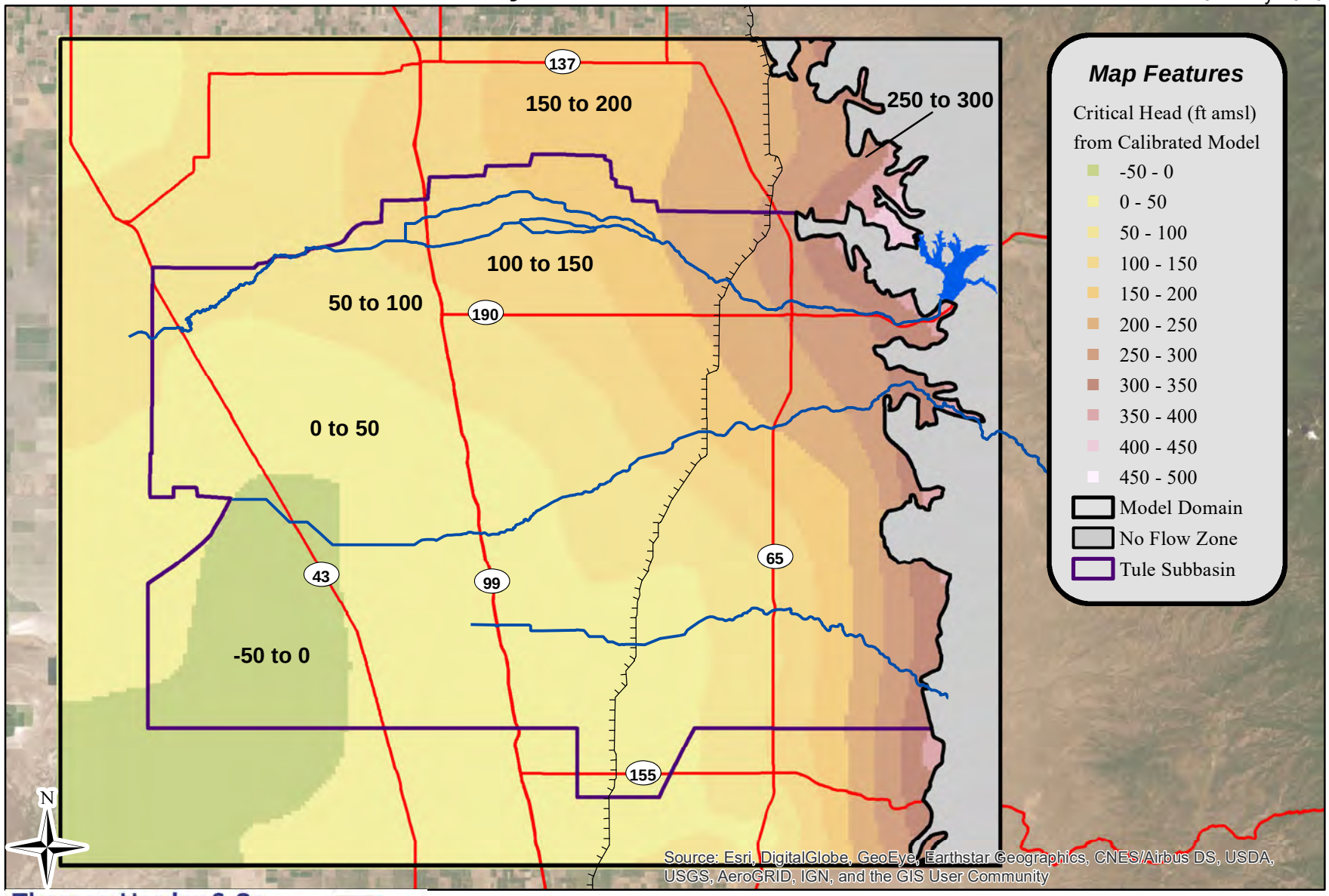
Layer 3 Critical Heads

Appendix C-26

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

NAD 83 State Plane Zone 4

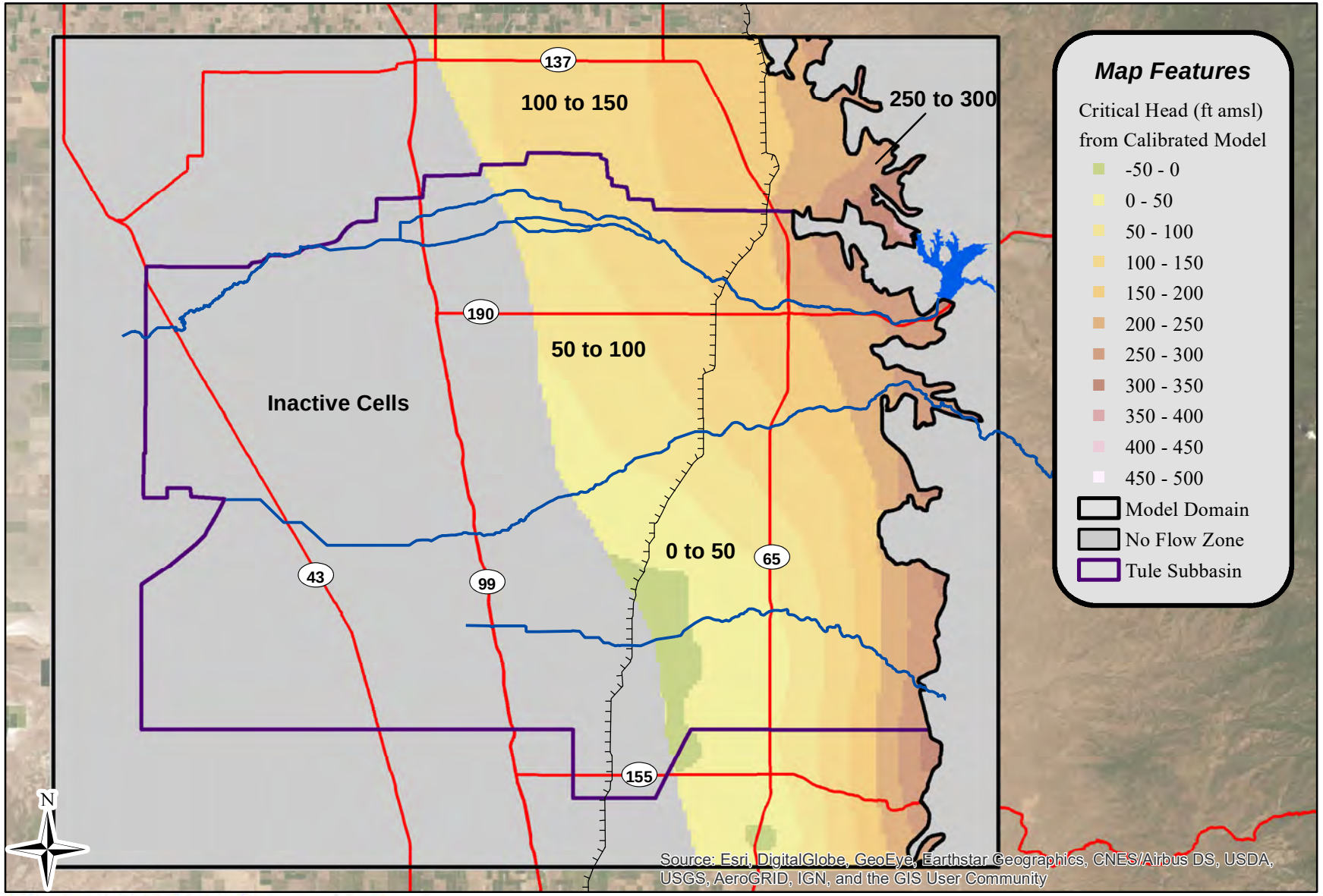
Layer 4 Critical Heads

Appendix C-27

Tule Subbasin Technical Advisory Committee

Groundwater Flow Model of the Tule Subbasin

January 2020



Thomas Harder & Co.
Groundwater Consulting

0 5 10 20
Miles

NAD 83 State Plane Zone 4

Layer 5 Critical Heads

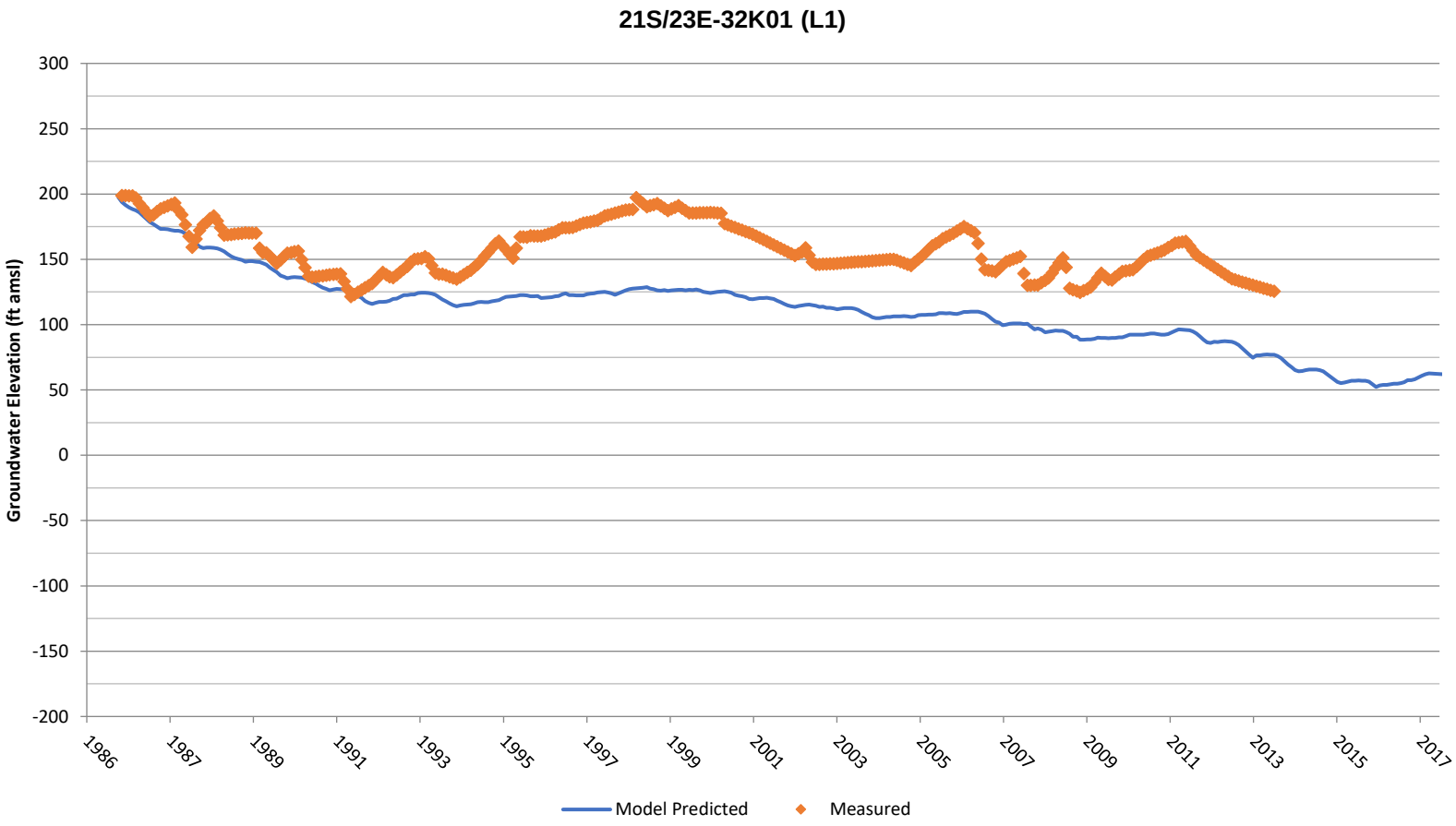
Appendix C-28

Appendix D

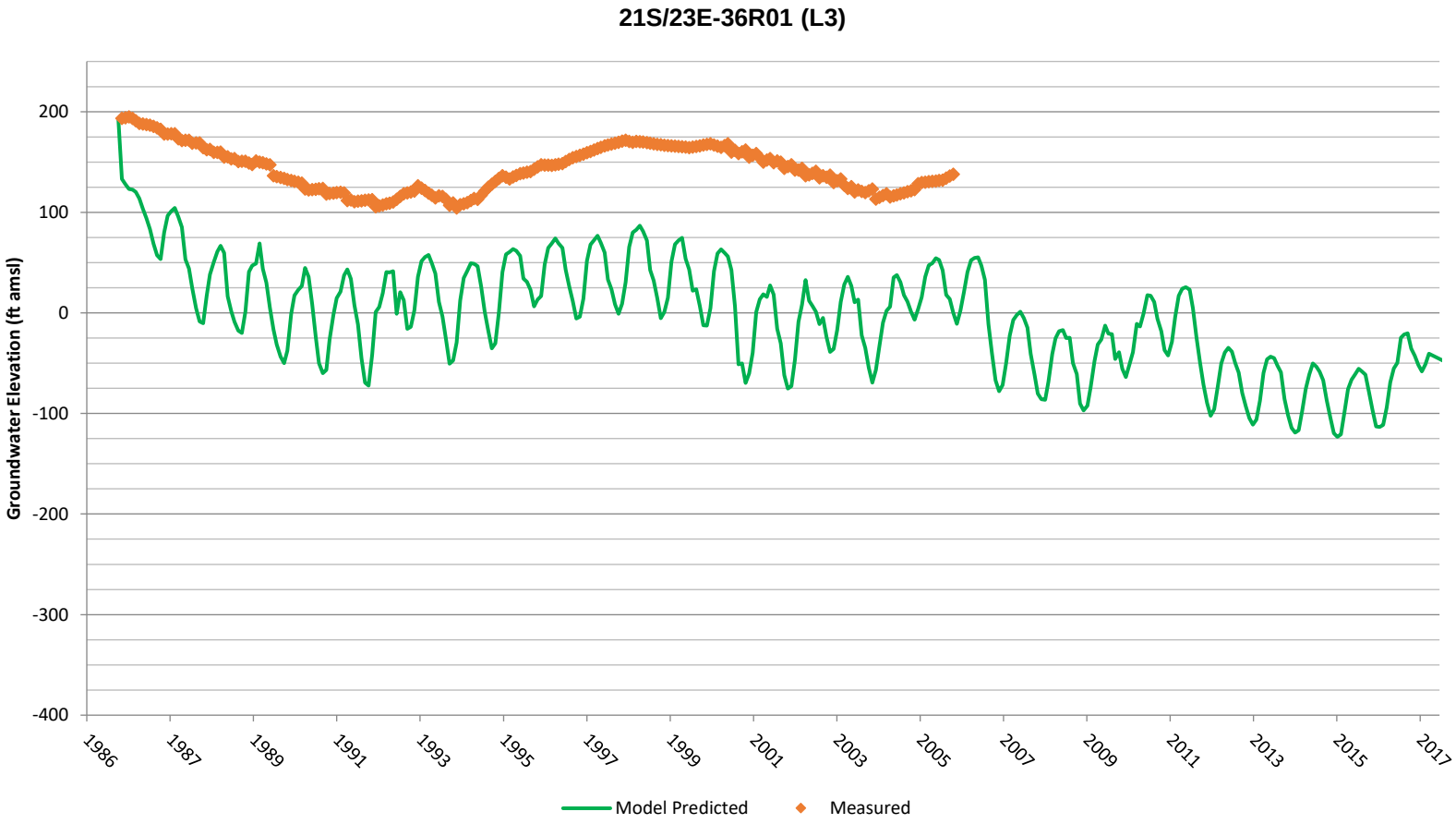
Model Calibration Hydrographs

This page intentionally left blank

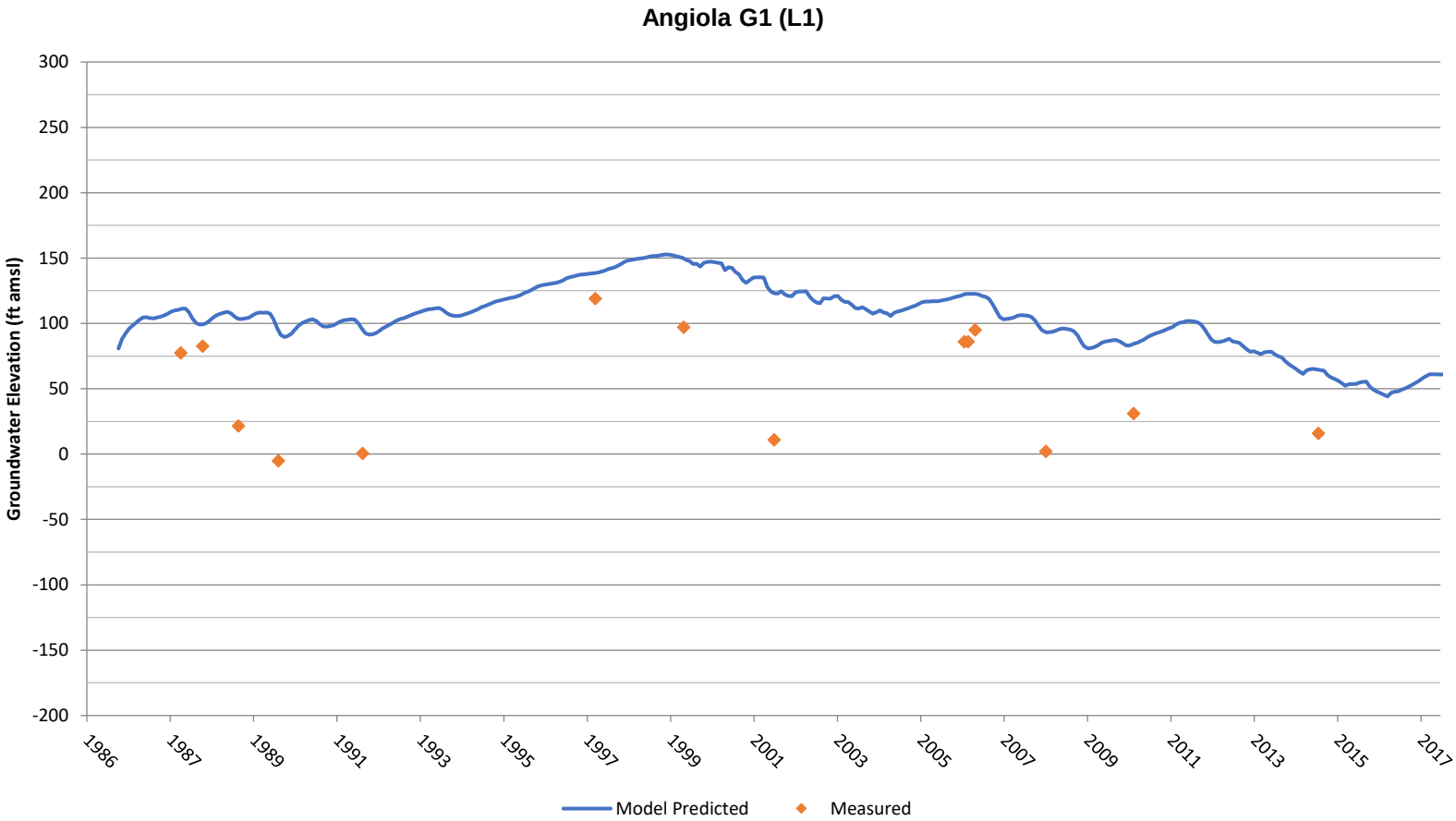
Model Calibration Hydrographs



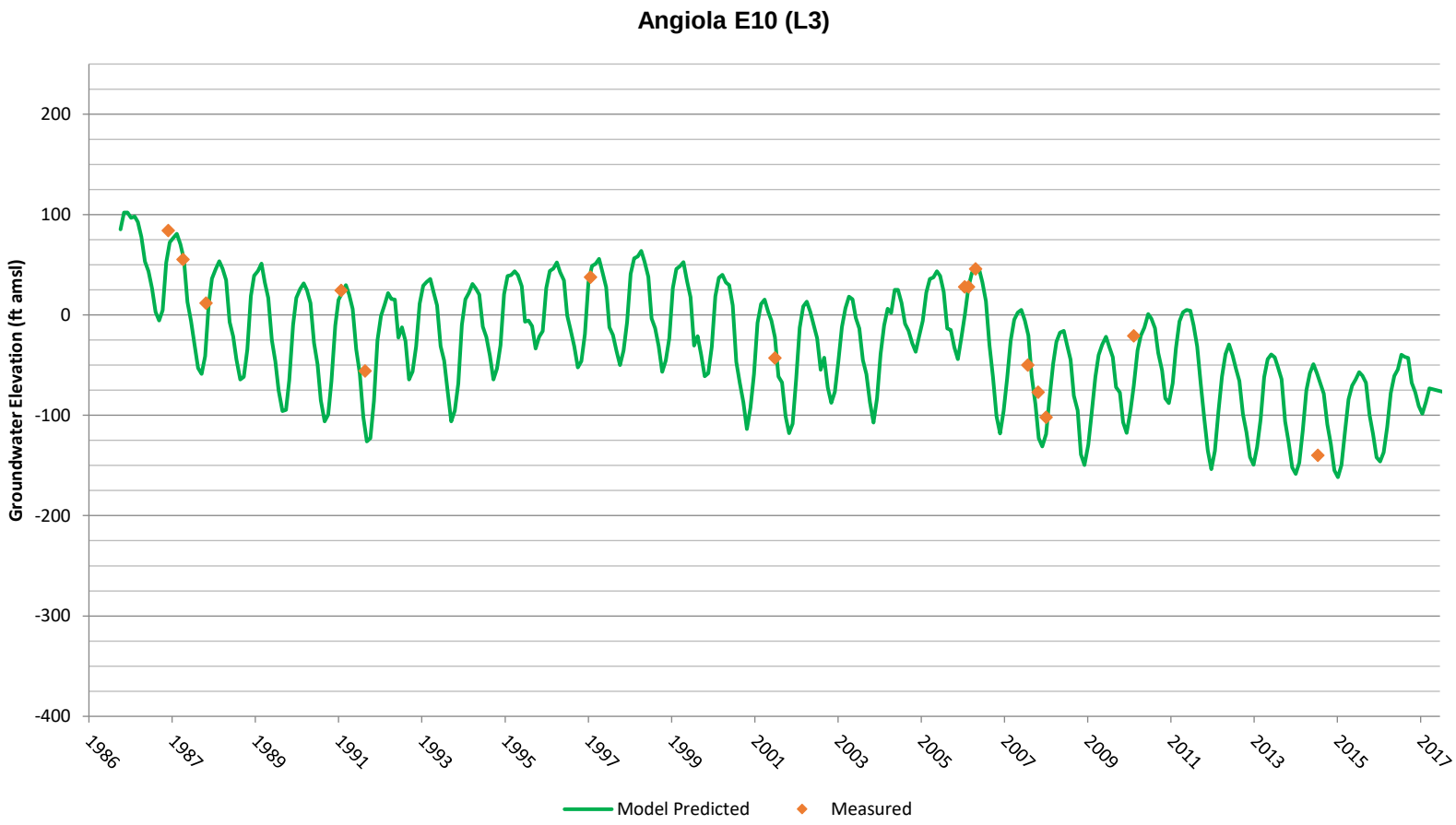
Model Calibration Hydrographs



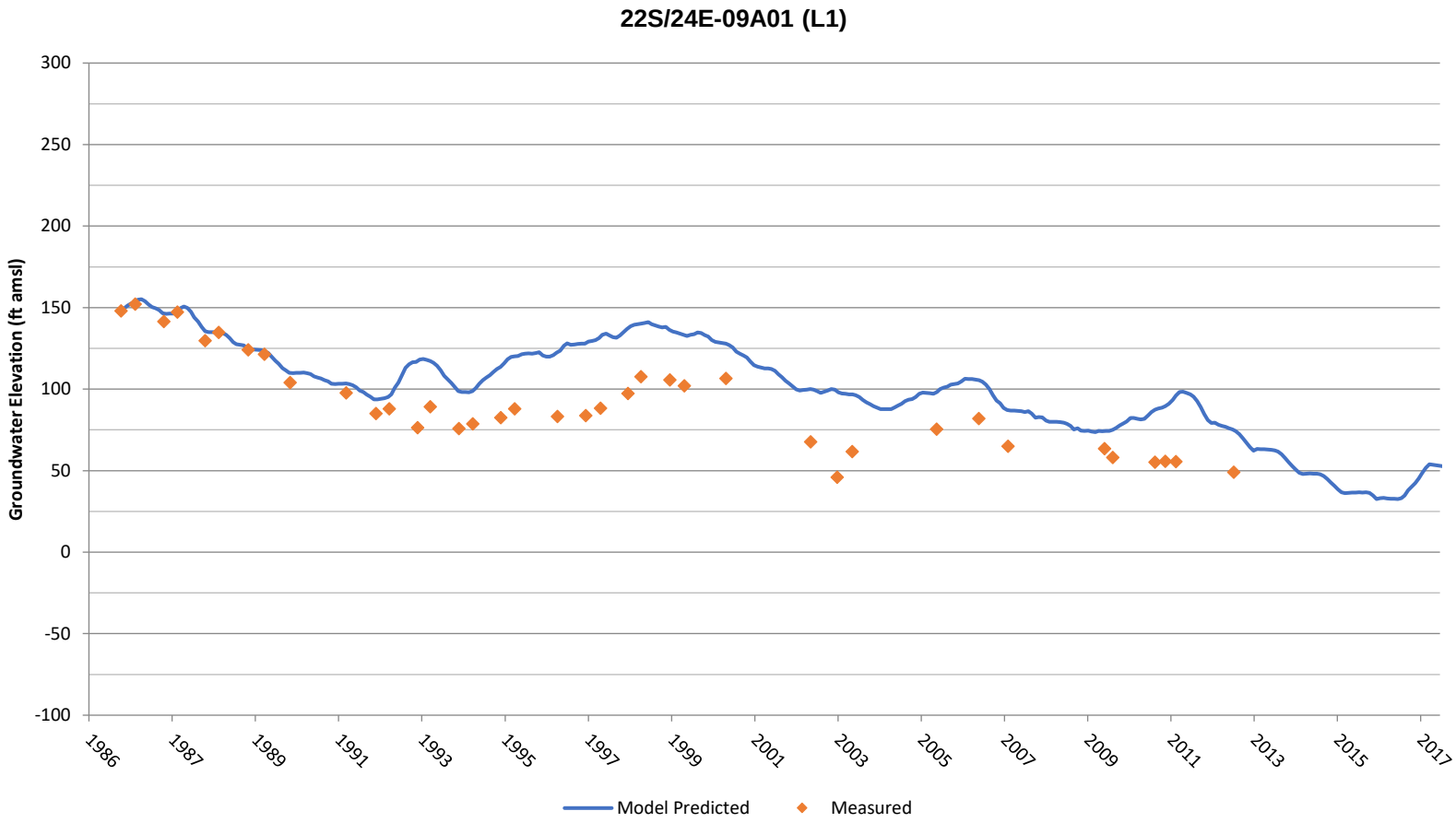
Model Calibration Hydrographs



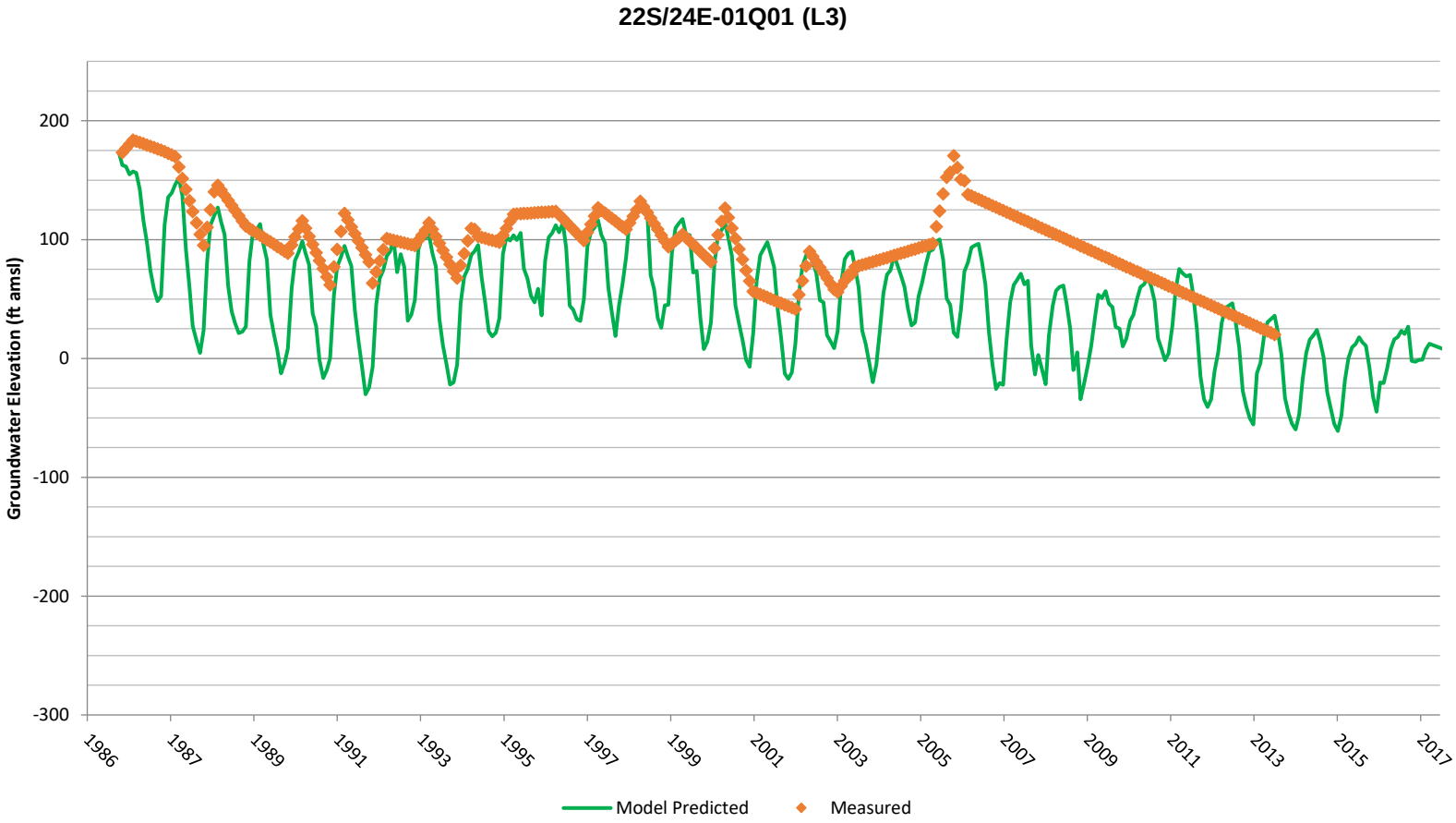
Model Calibration Hydrographs



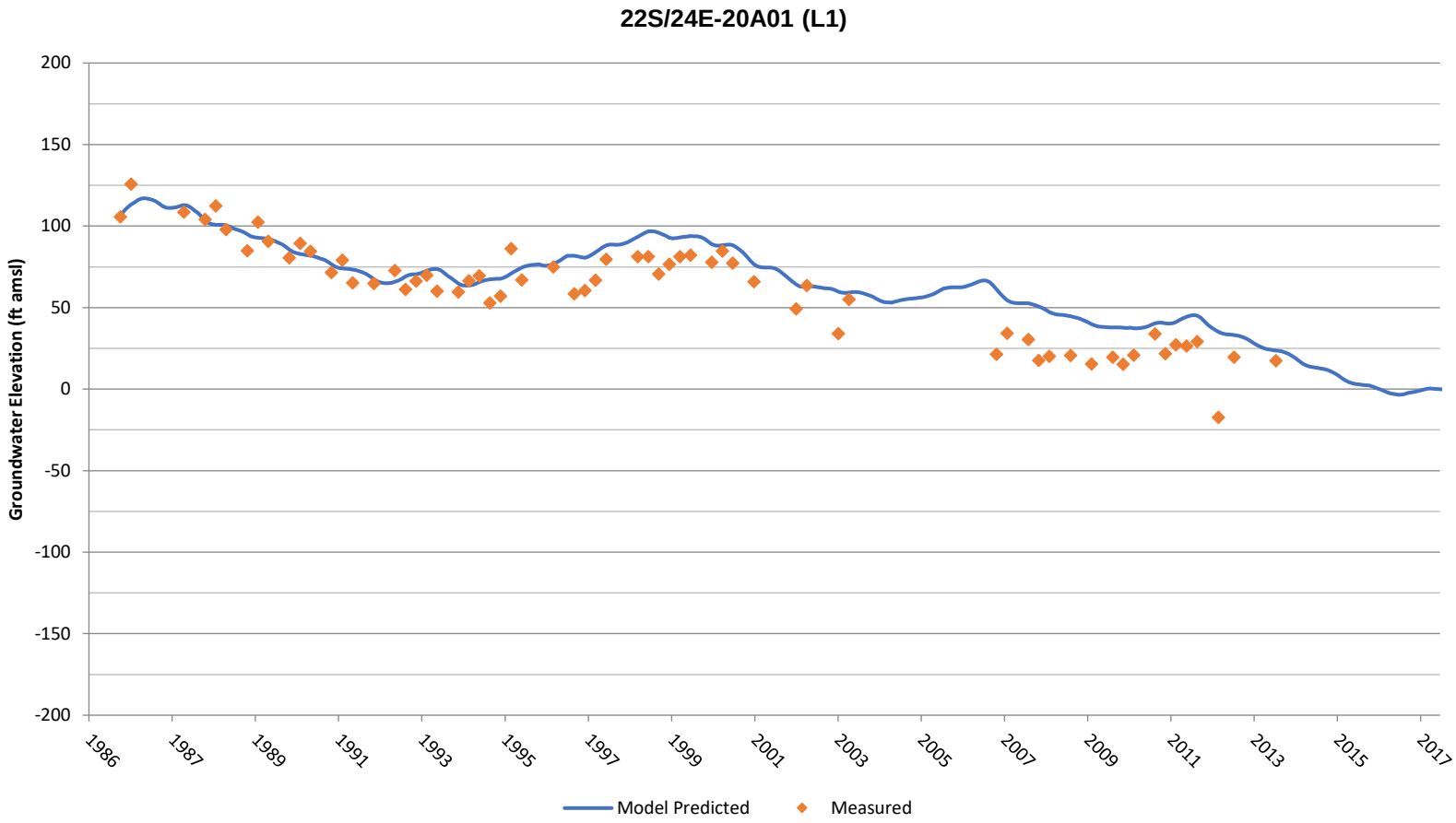
Model Calibration Hydrographs



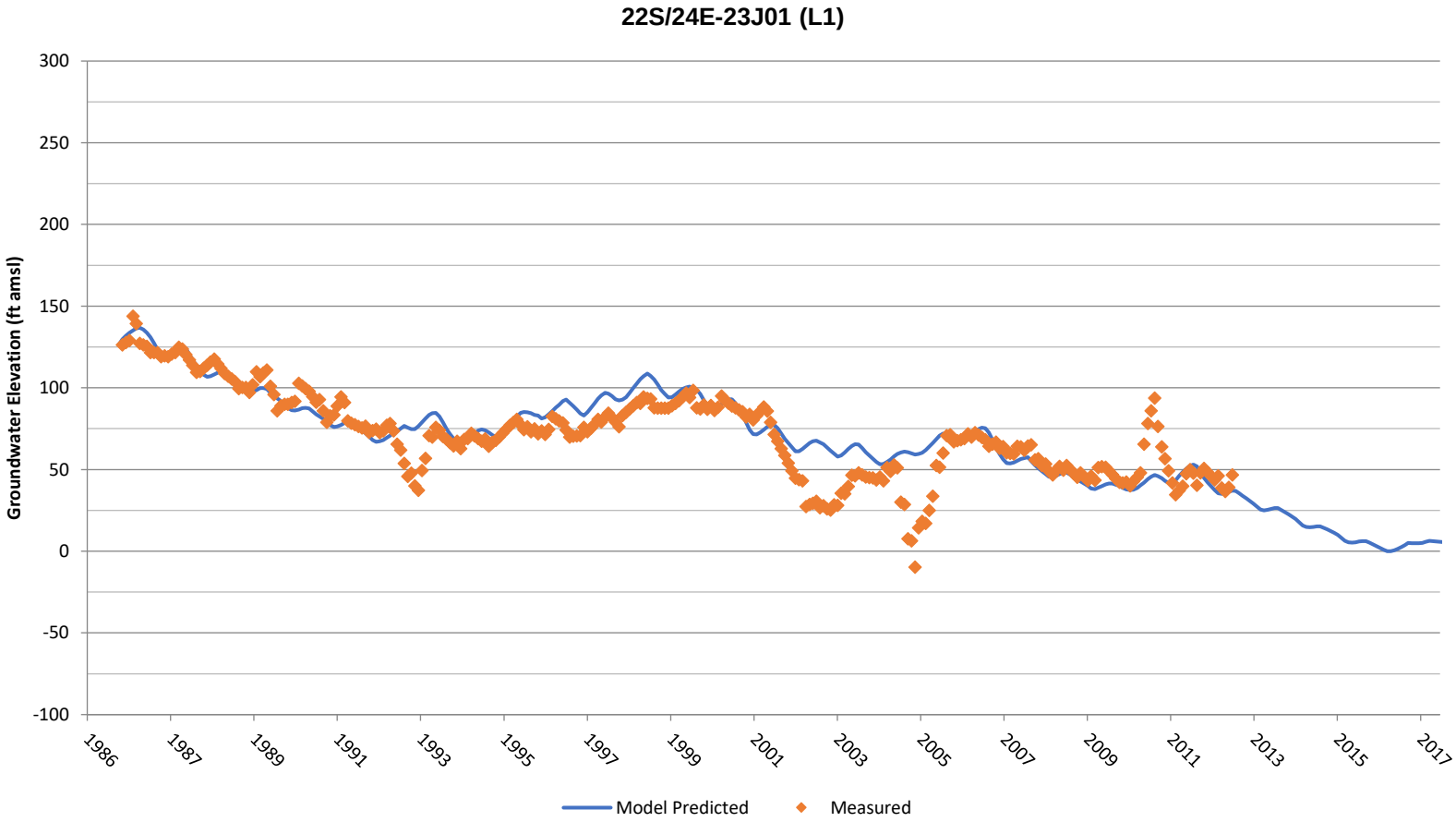
Model Calibration Hydrographs



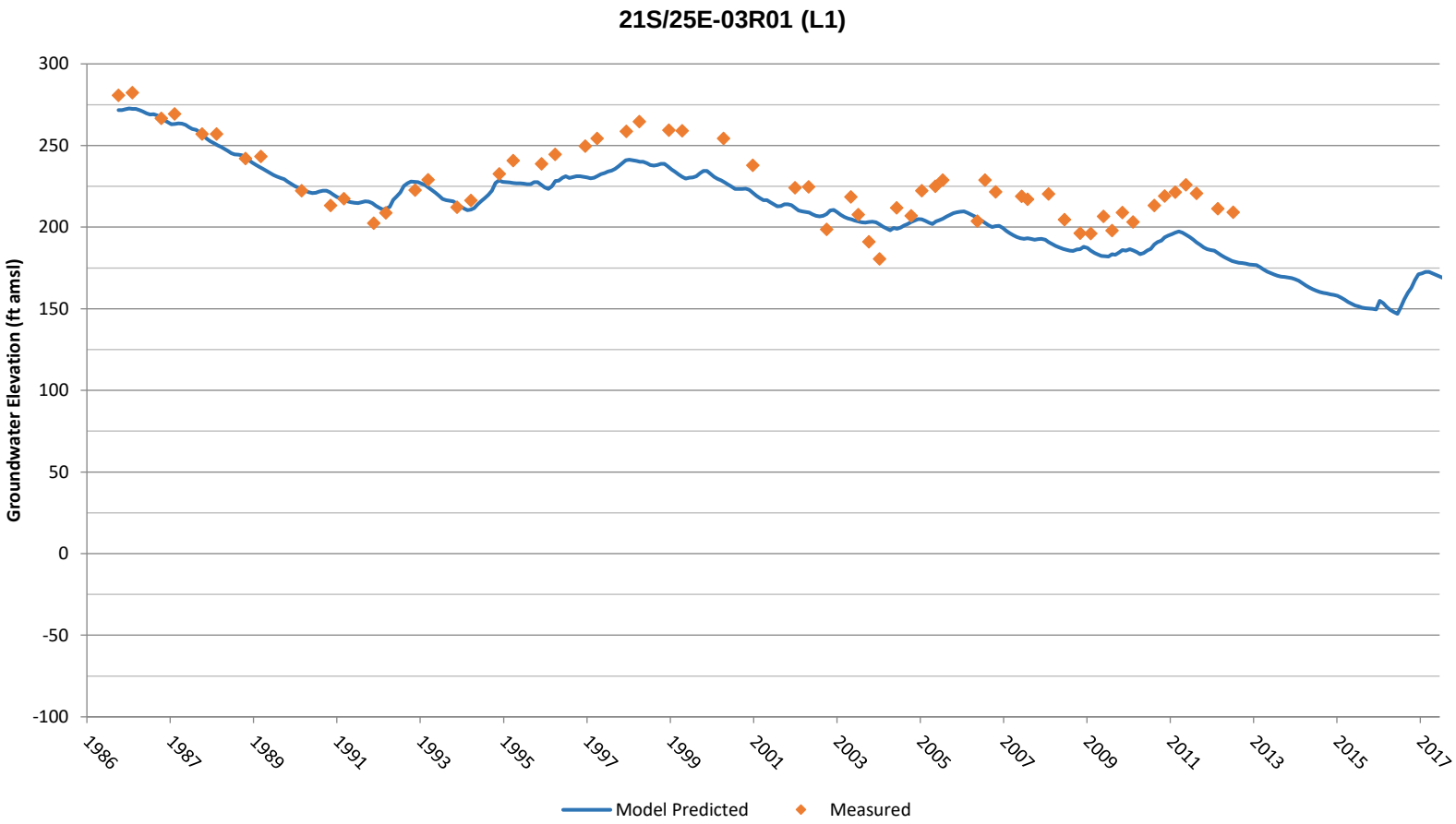
Model Calibration Hydrographs



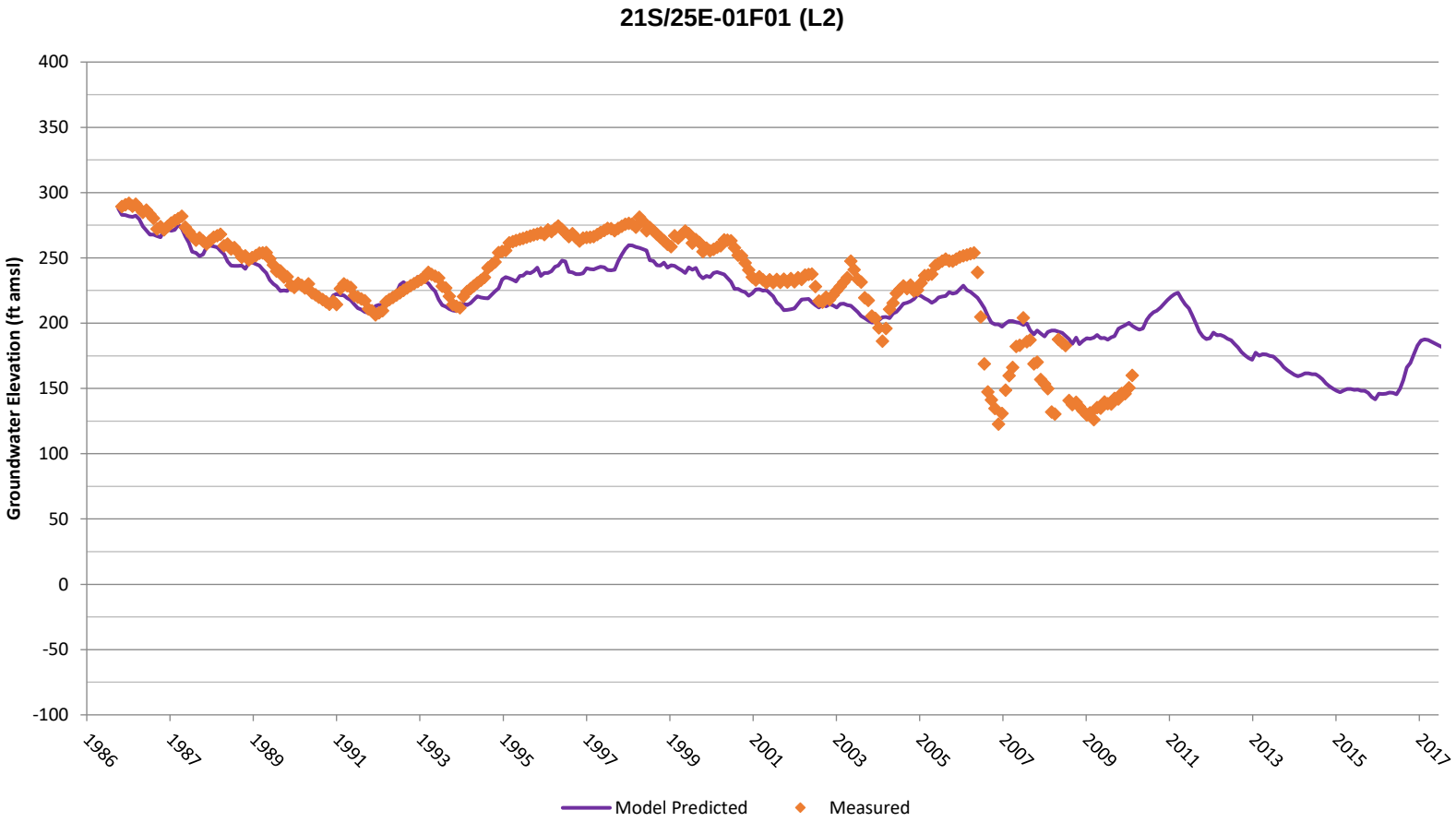
Model Calibration Hydrographs



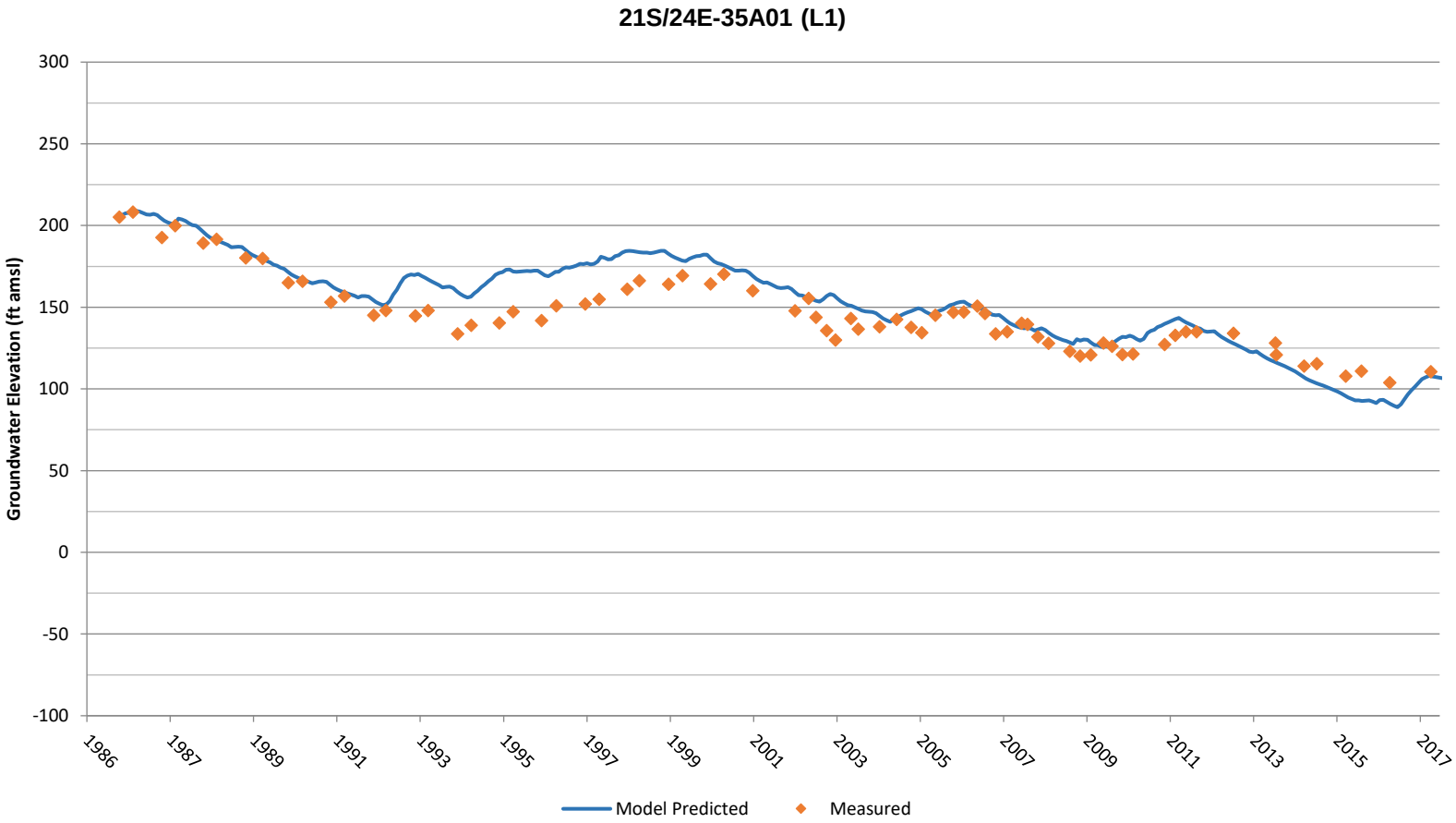
Model Calibration Hydrographs



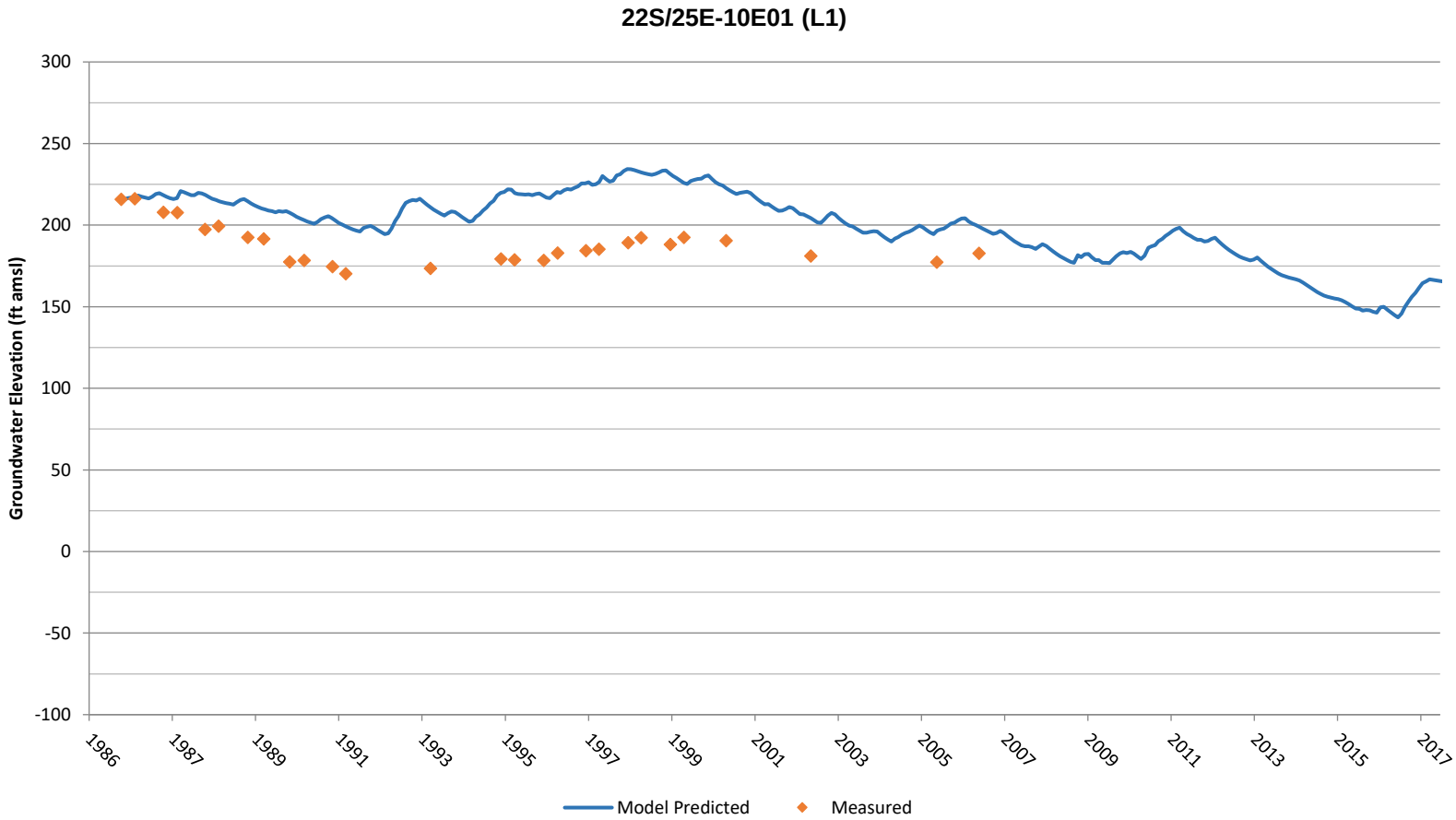
Model Calibration Hydrographs



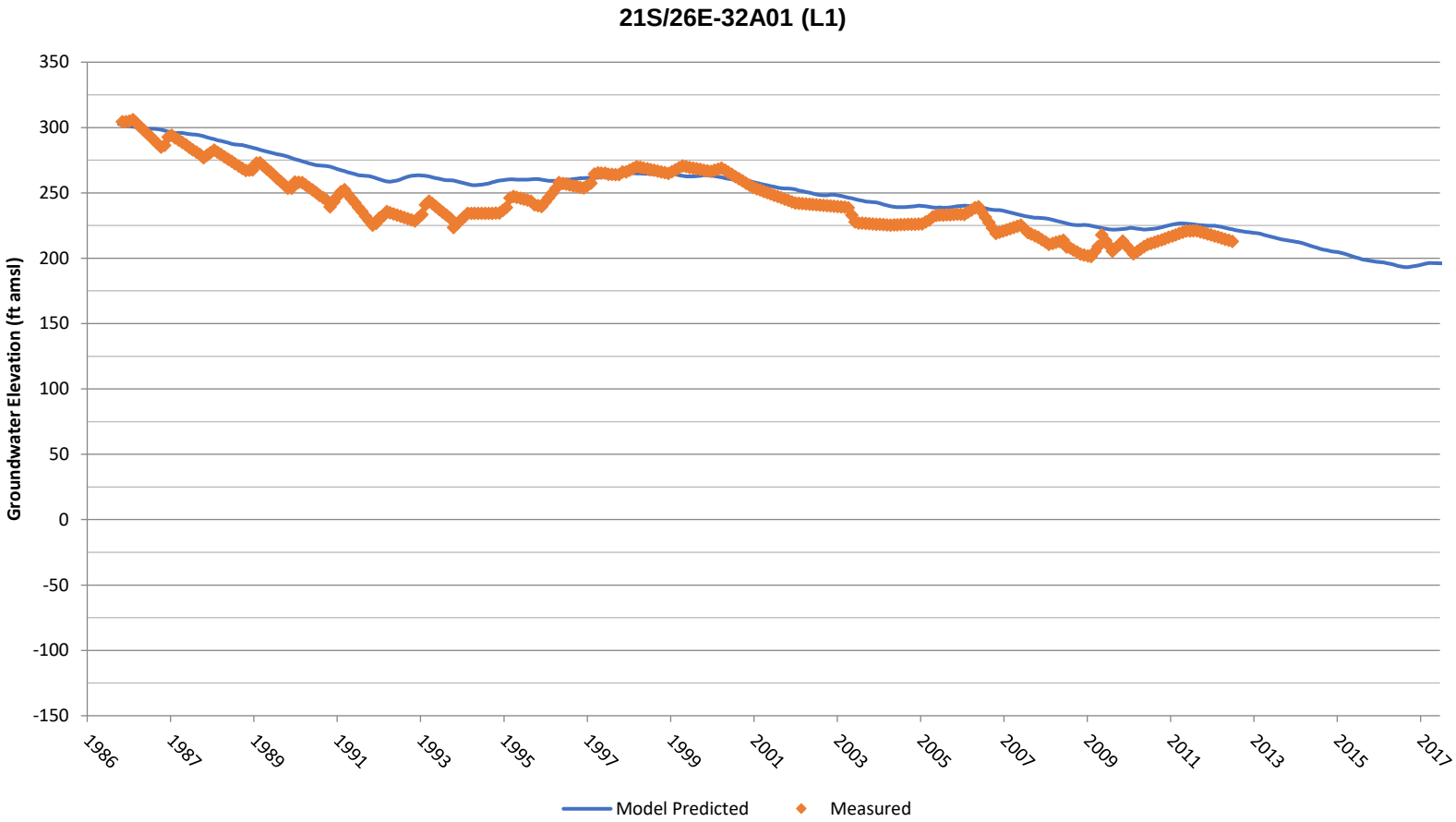
Model Calibration Hydrographs



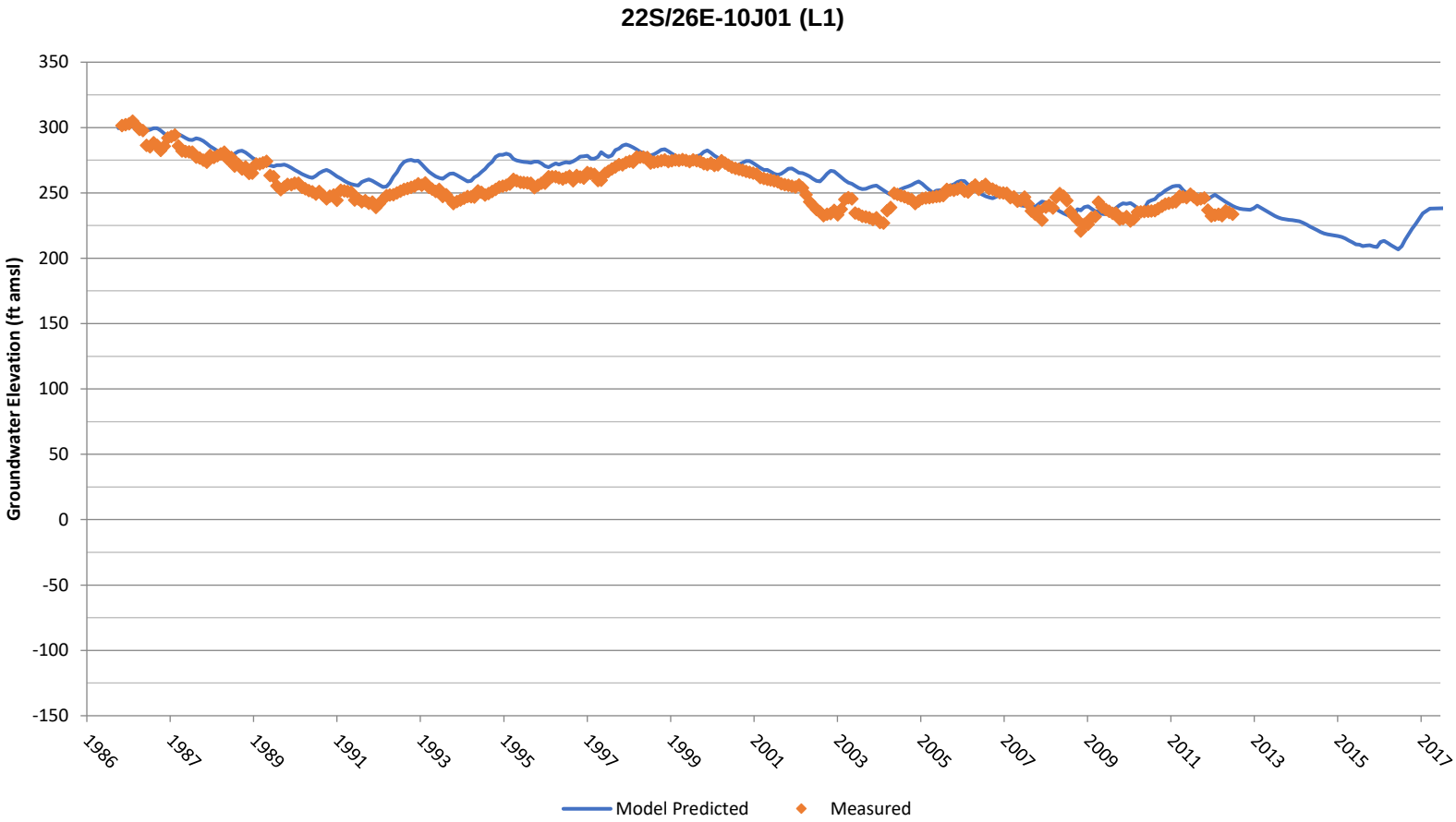
Model Calibration Hydrographs



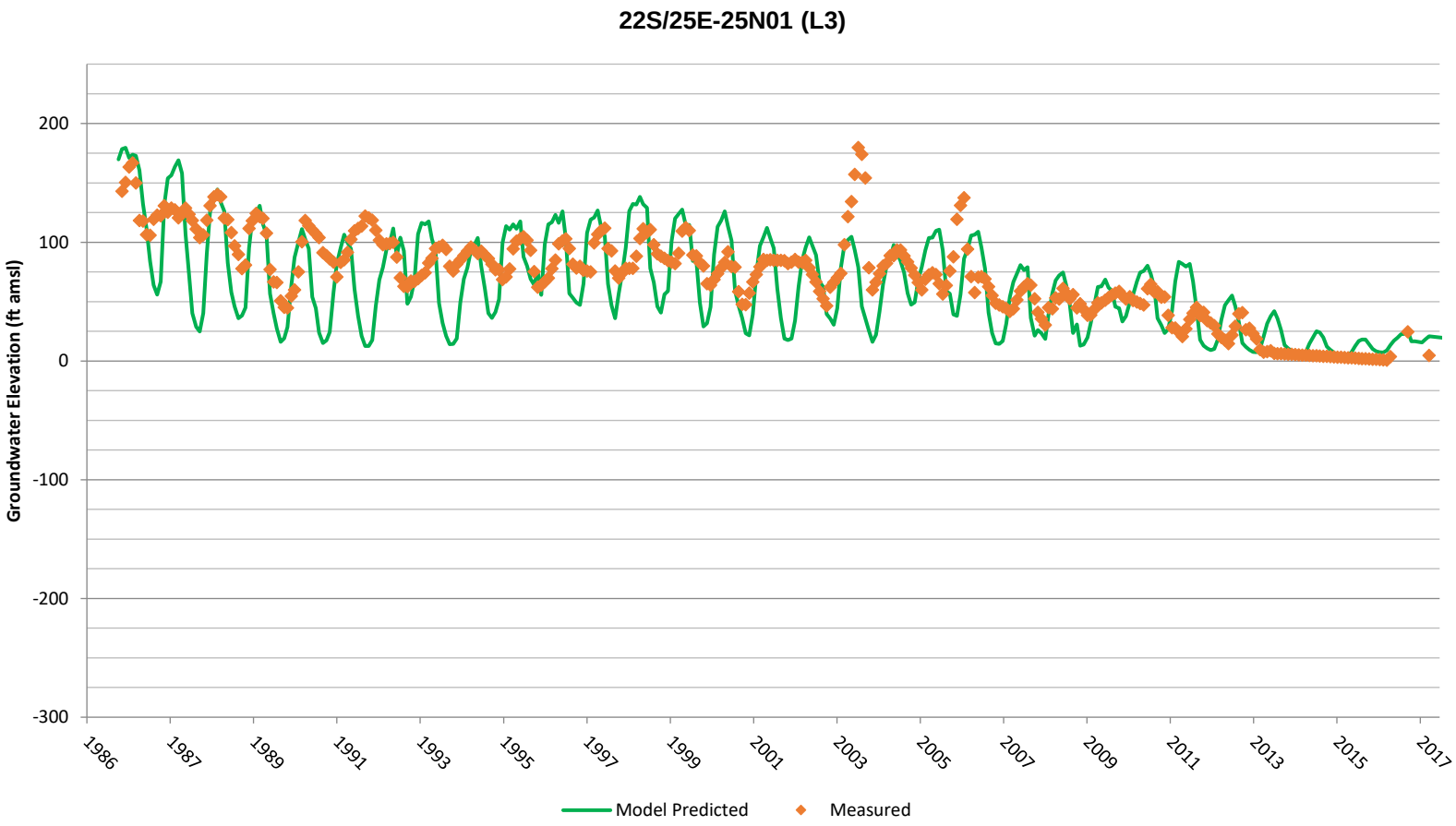
Model Calibration Hydrographs



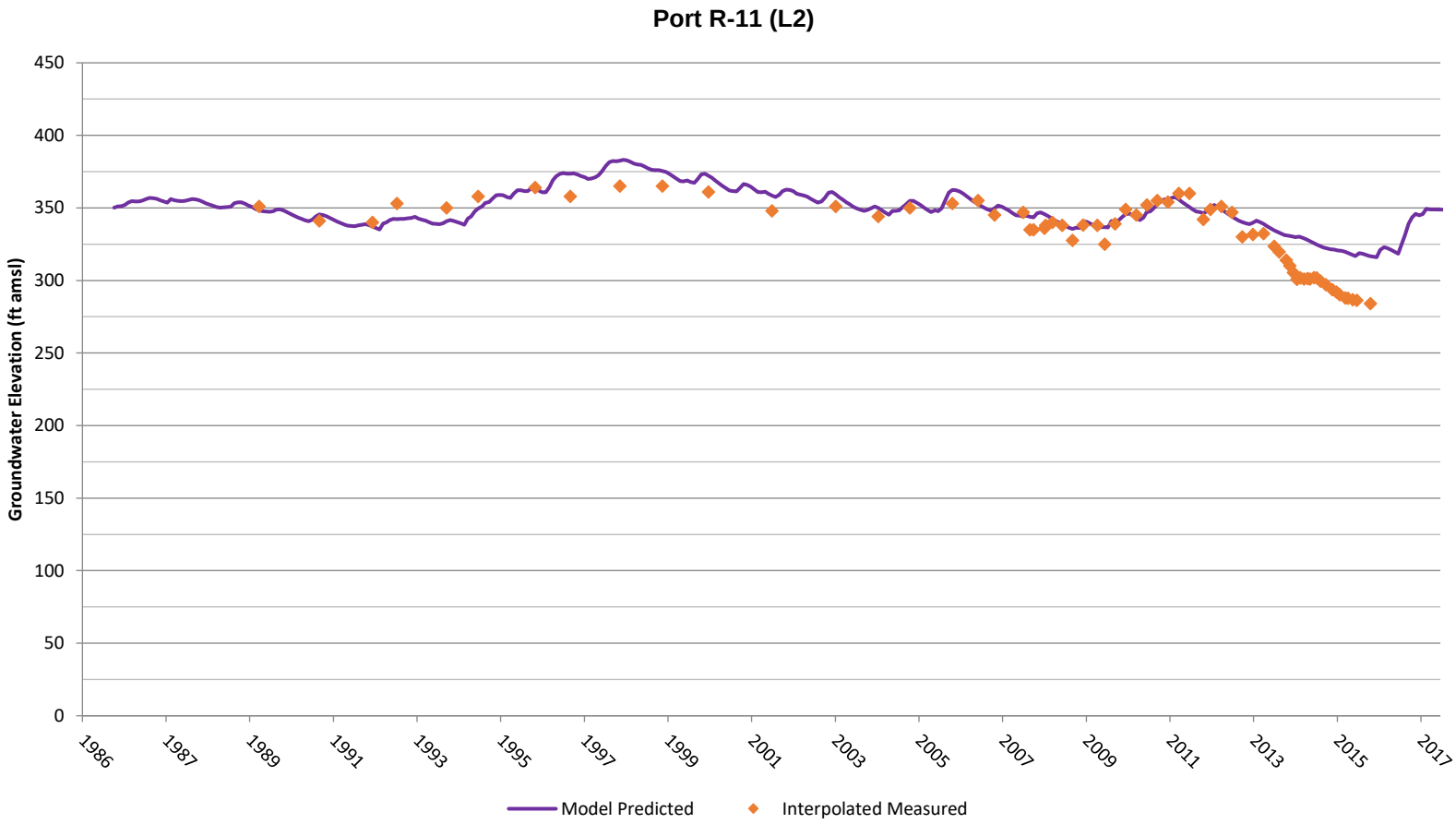
Model Calibration Hydrographs



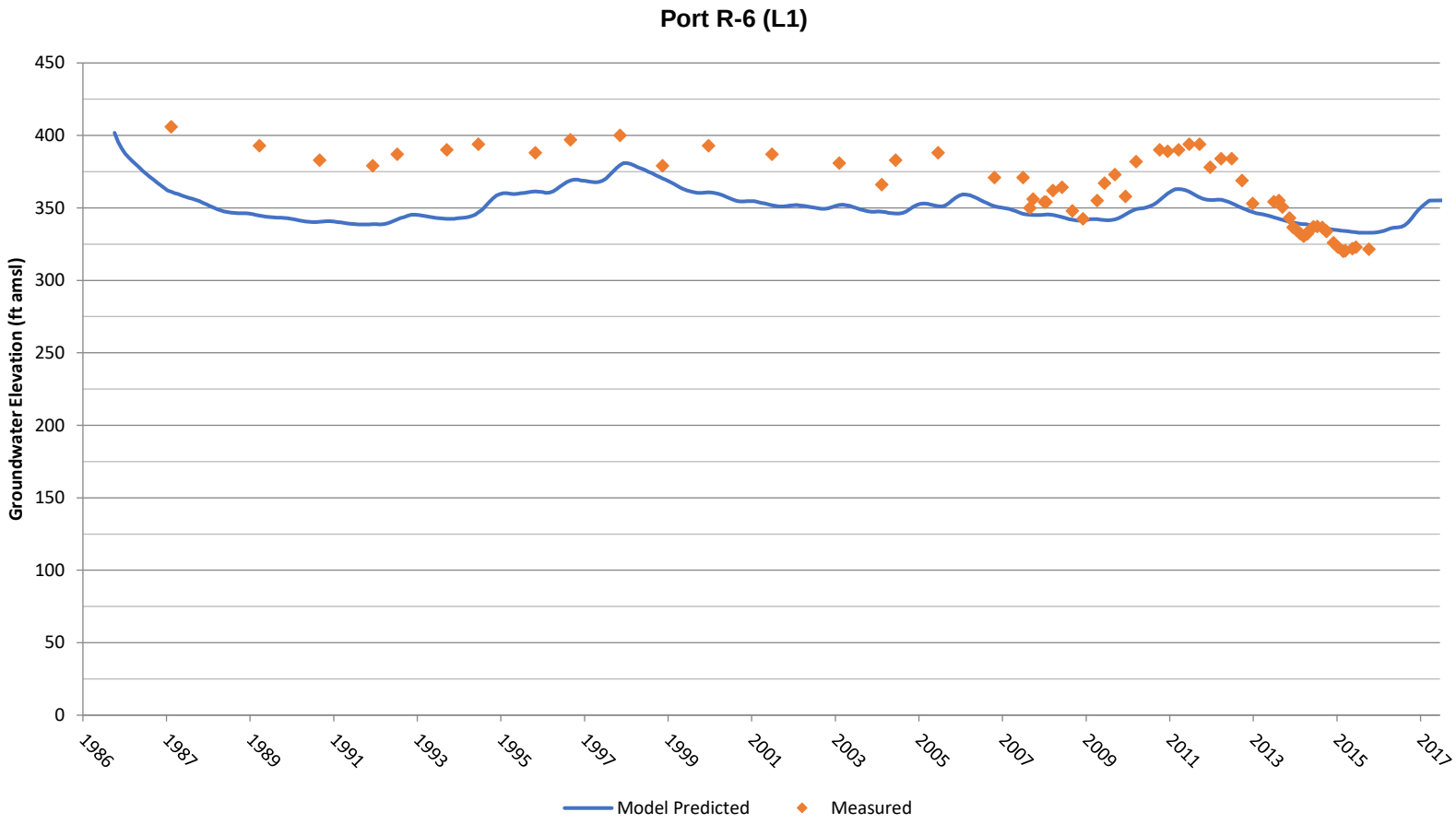
Model Calibration Hydrographs



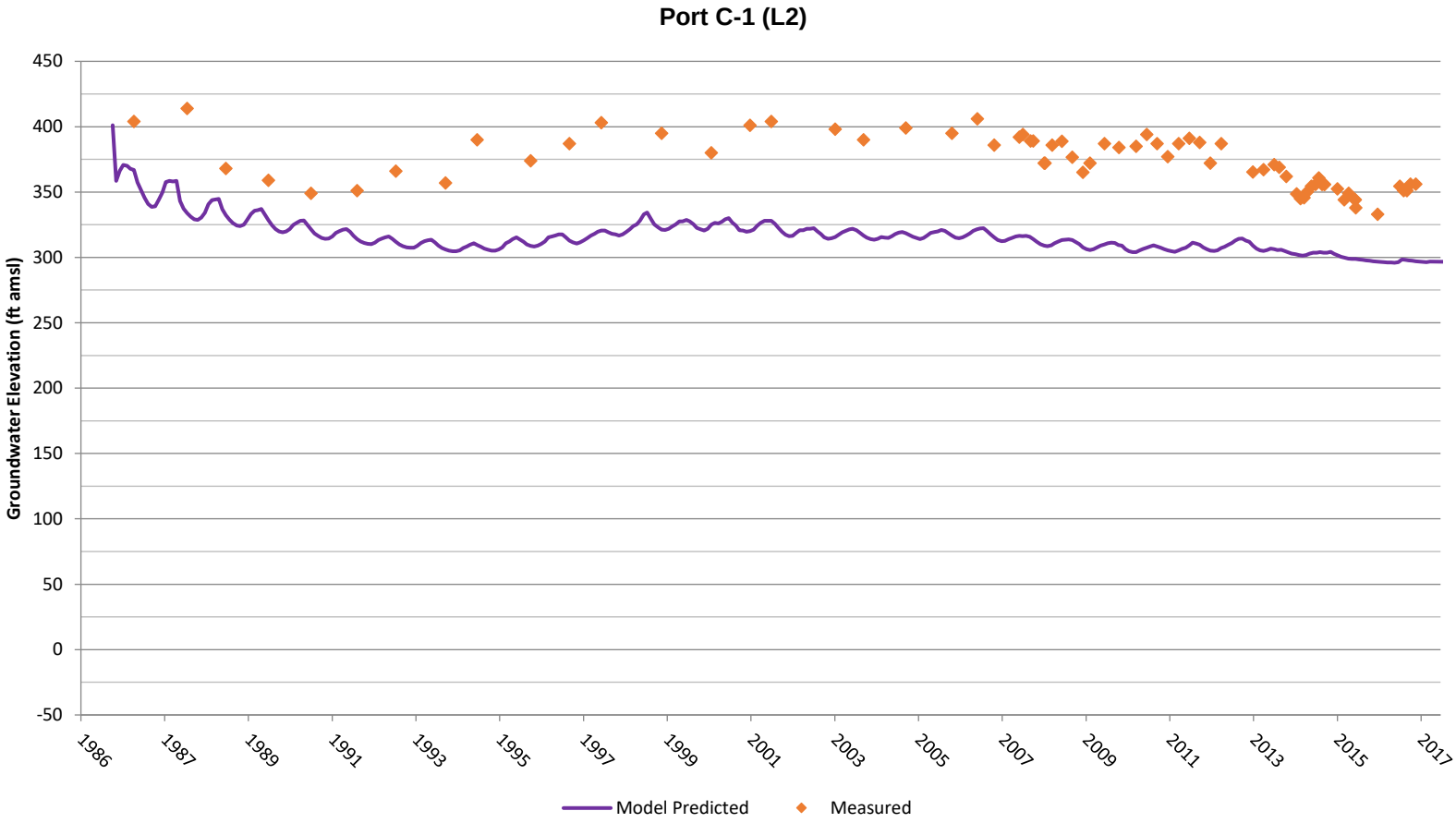
Model Calibration Hydrographs



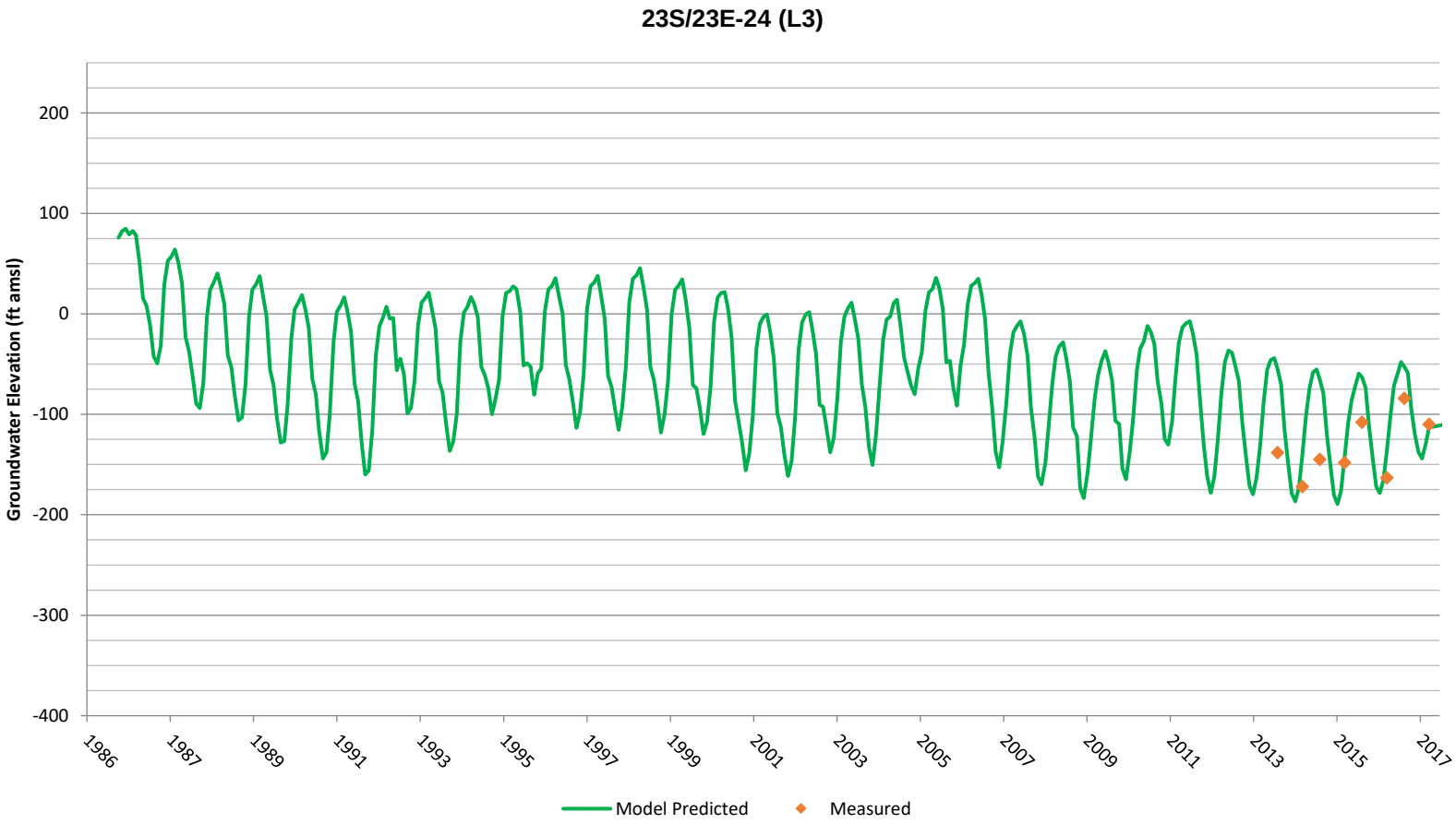
Model Calibration Hydrographs



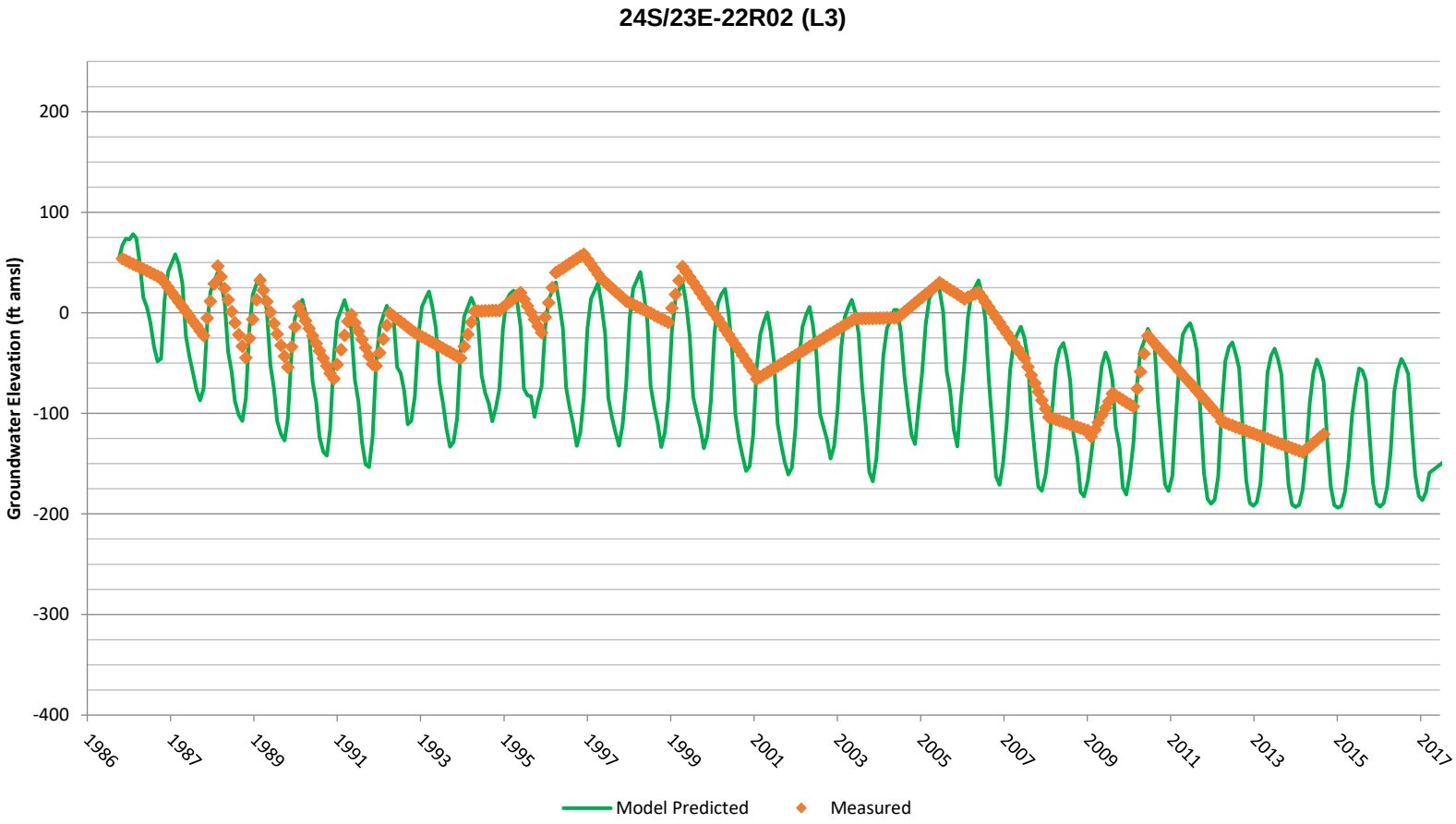
Model Calibration Hydrographs



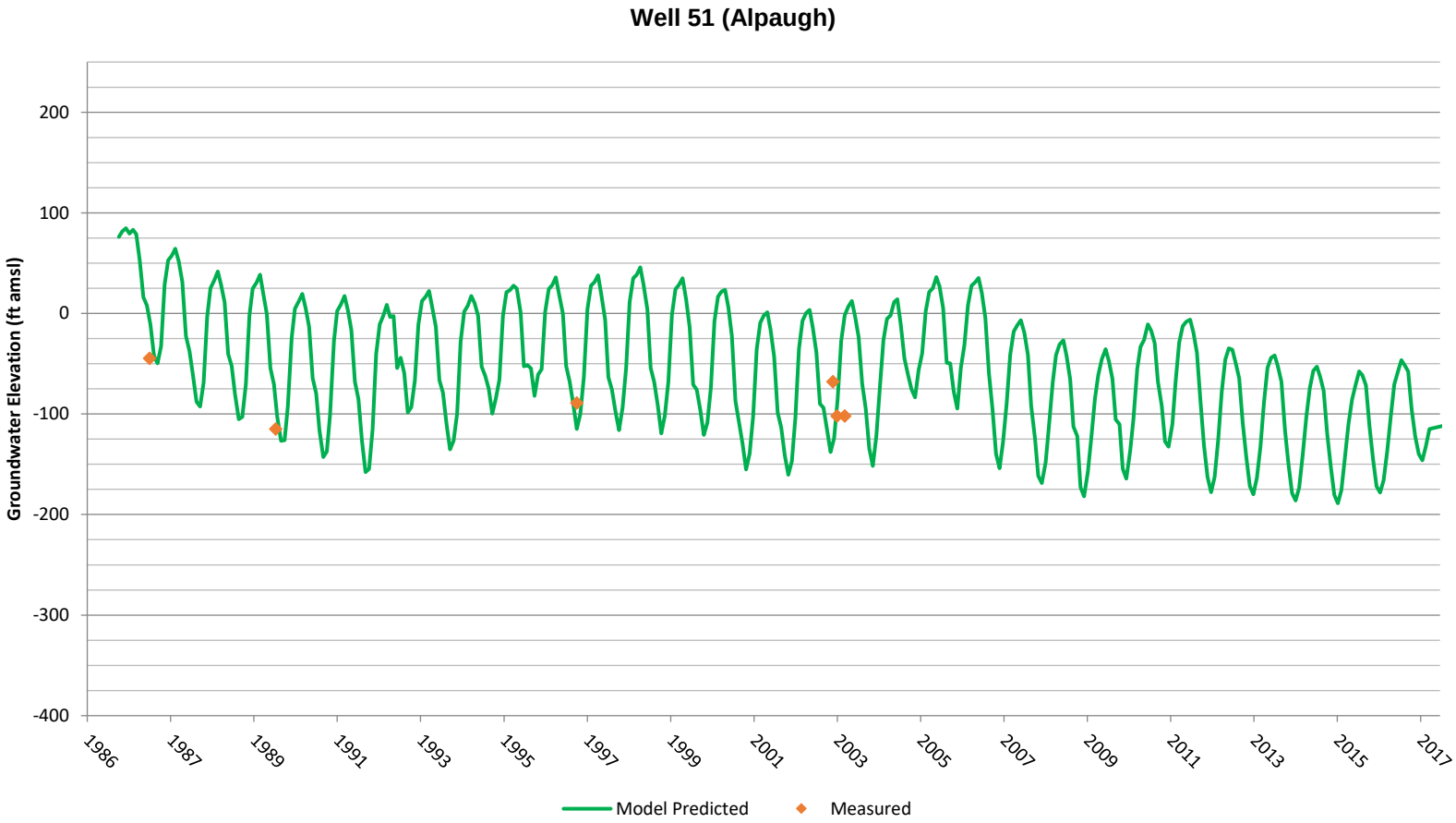
Model Calibration Hydrographs



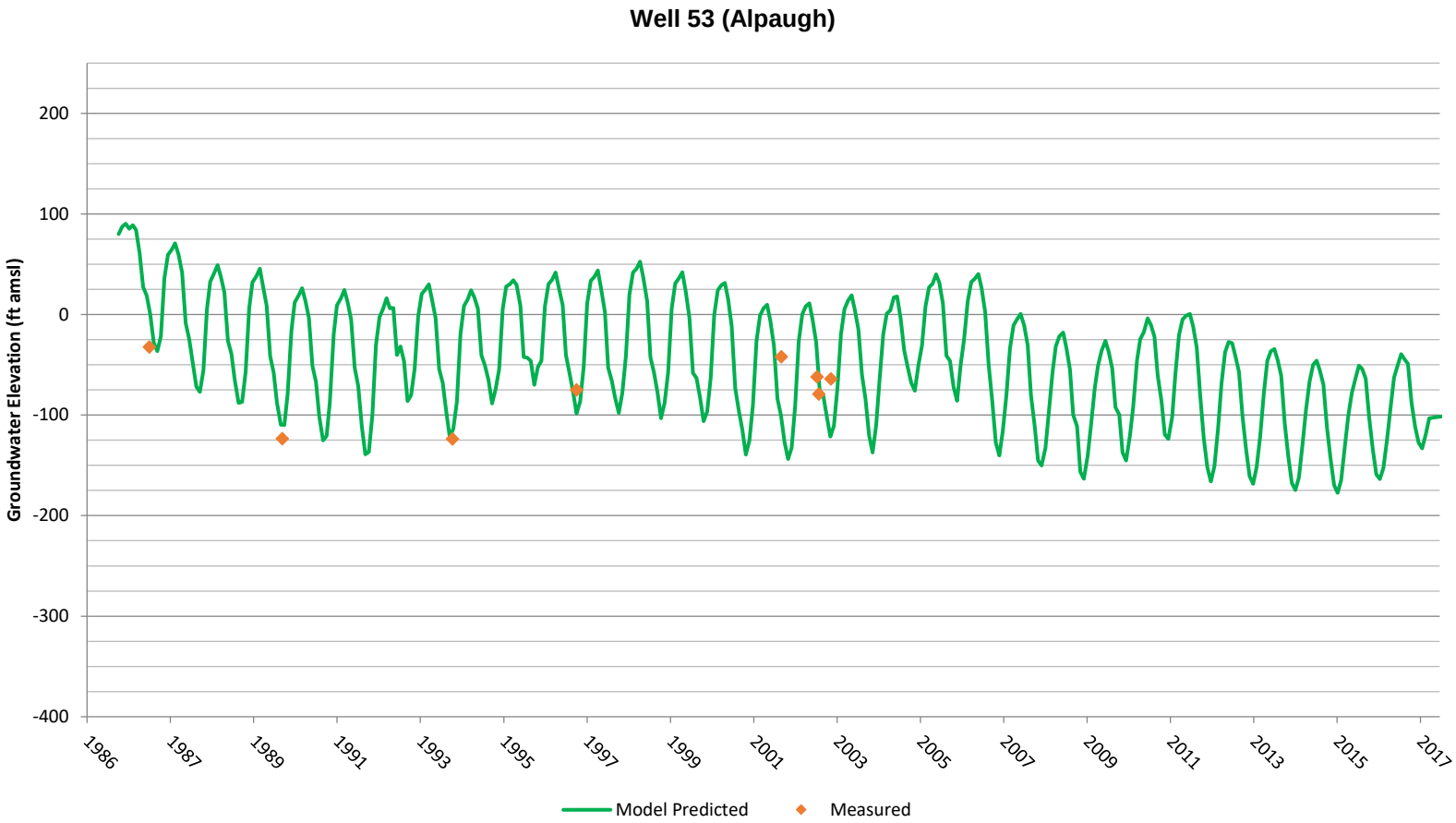
Model Calibration Hydrographs



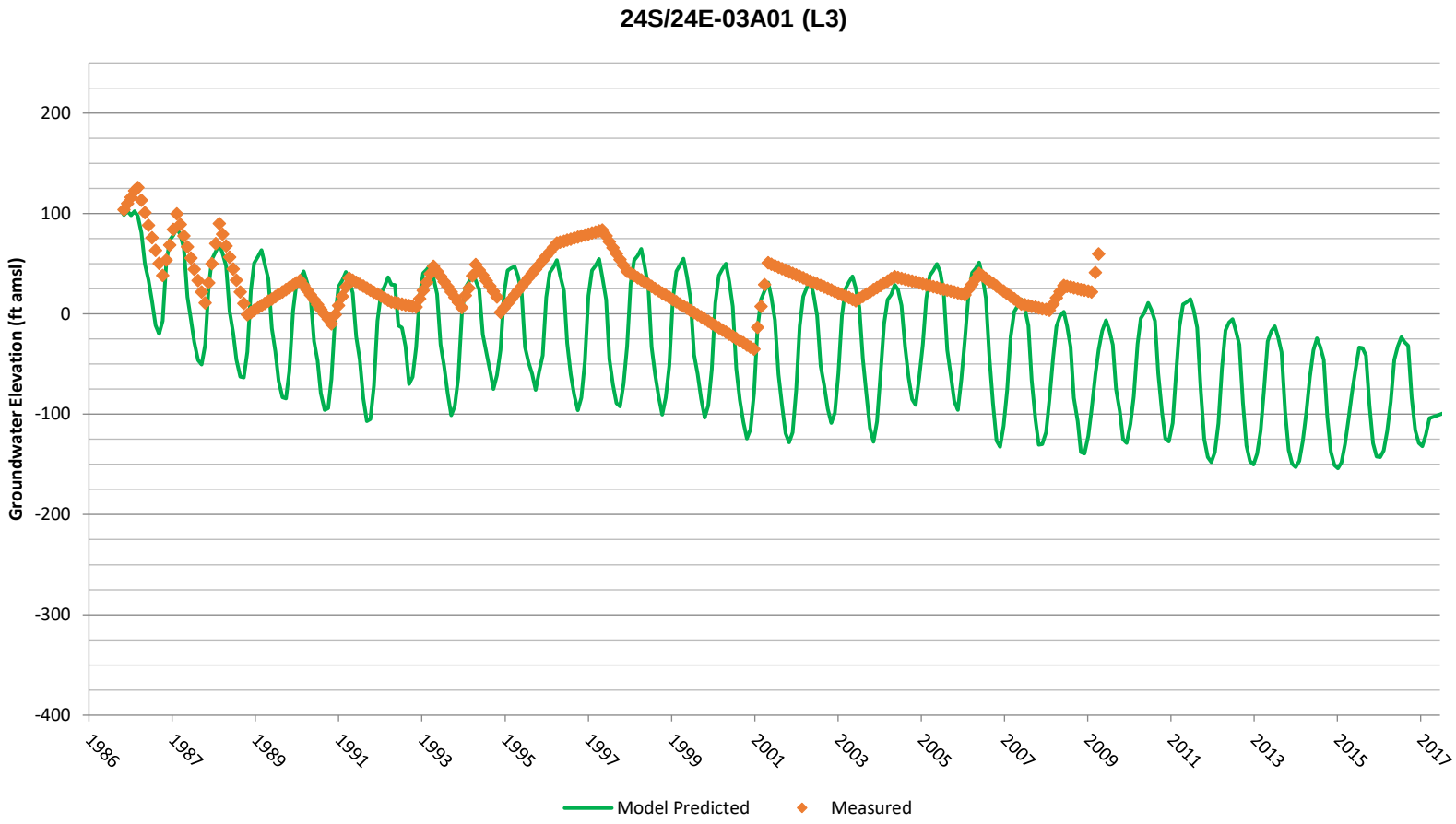
Model Calibration Hydrographs



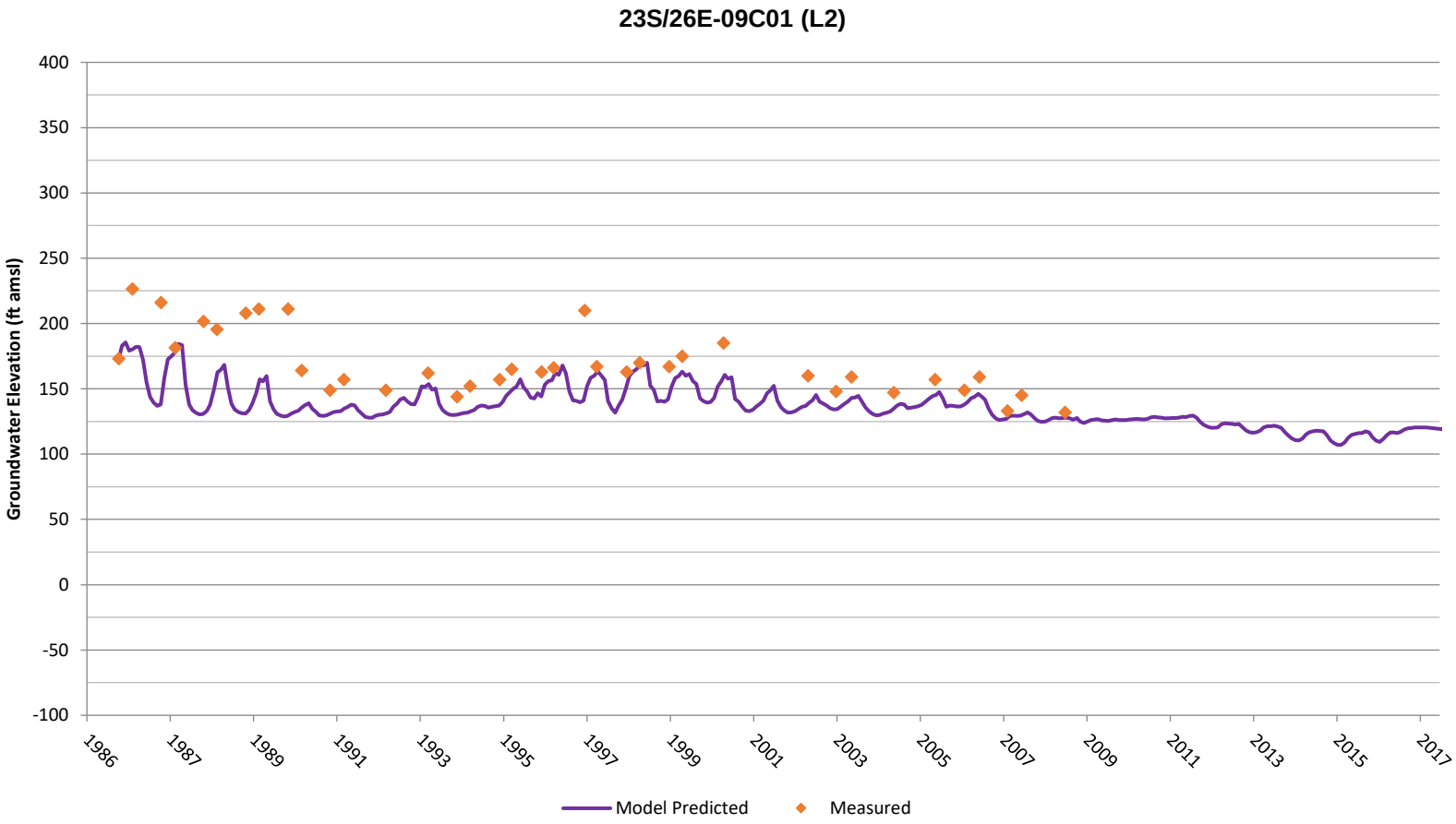
Model Calibration Hydrographs



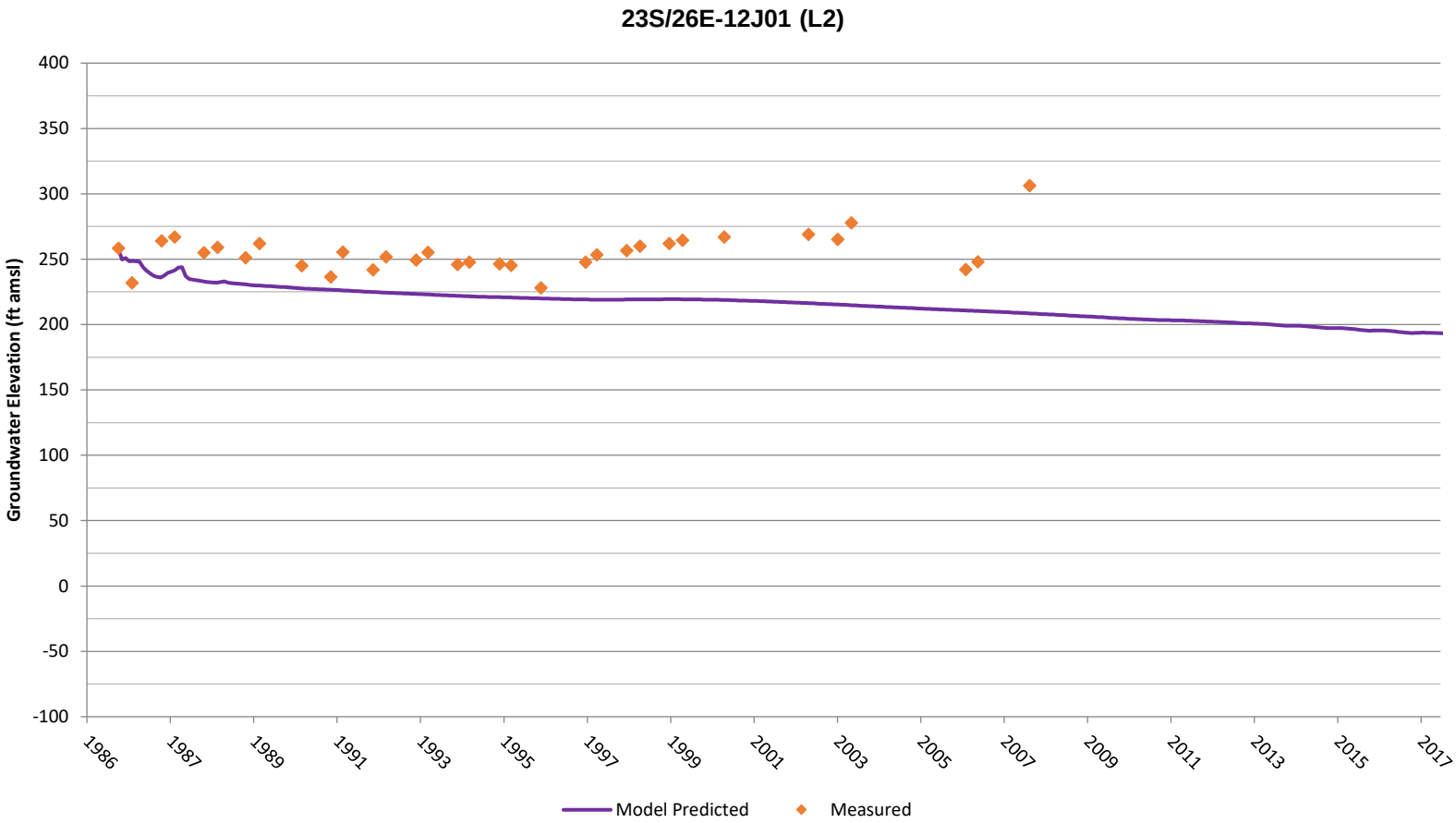
Model Calibration Hydrographs



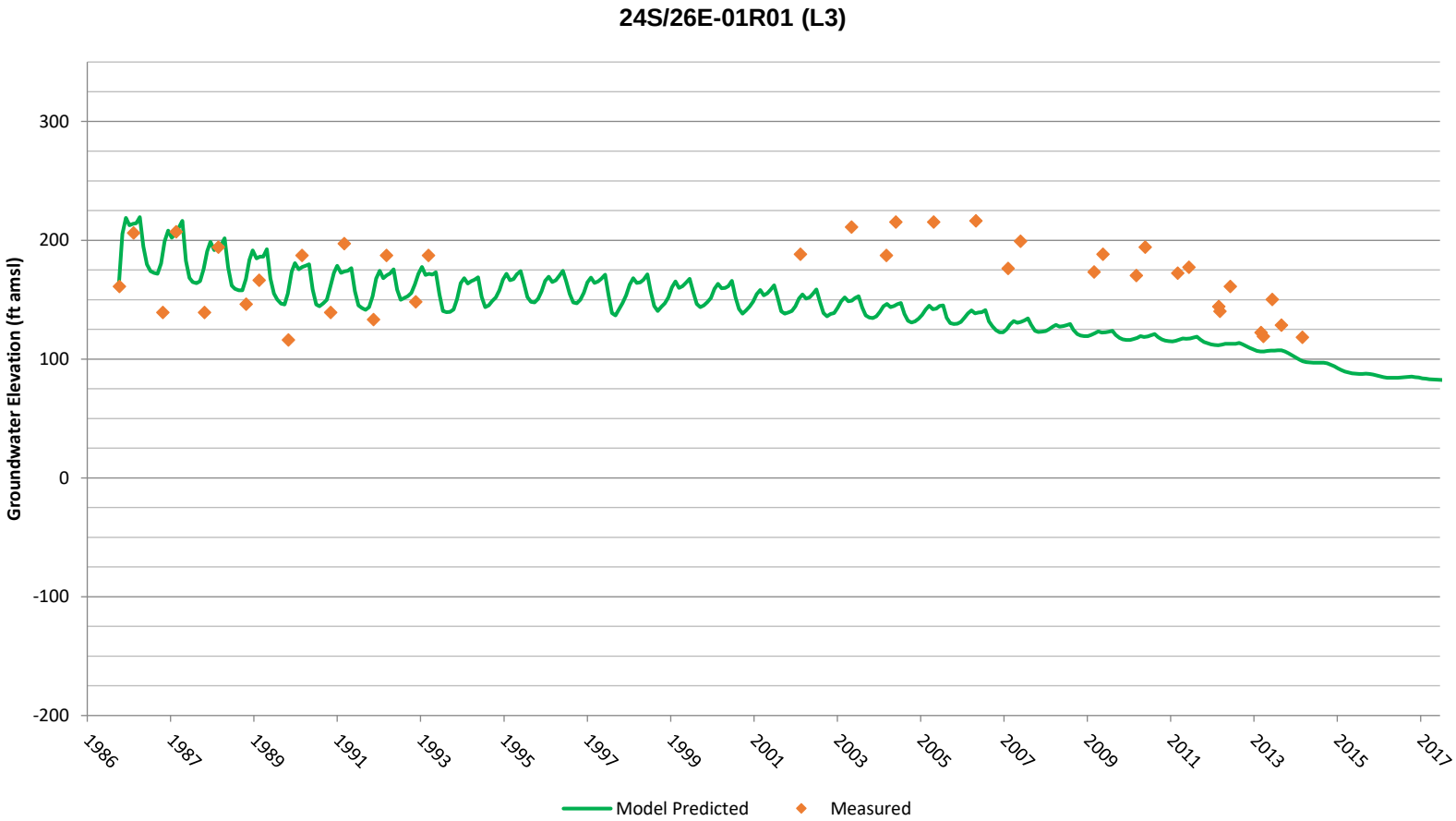
Model Calibration Hydrographs



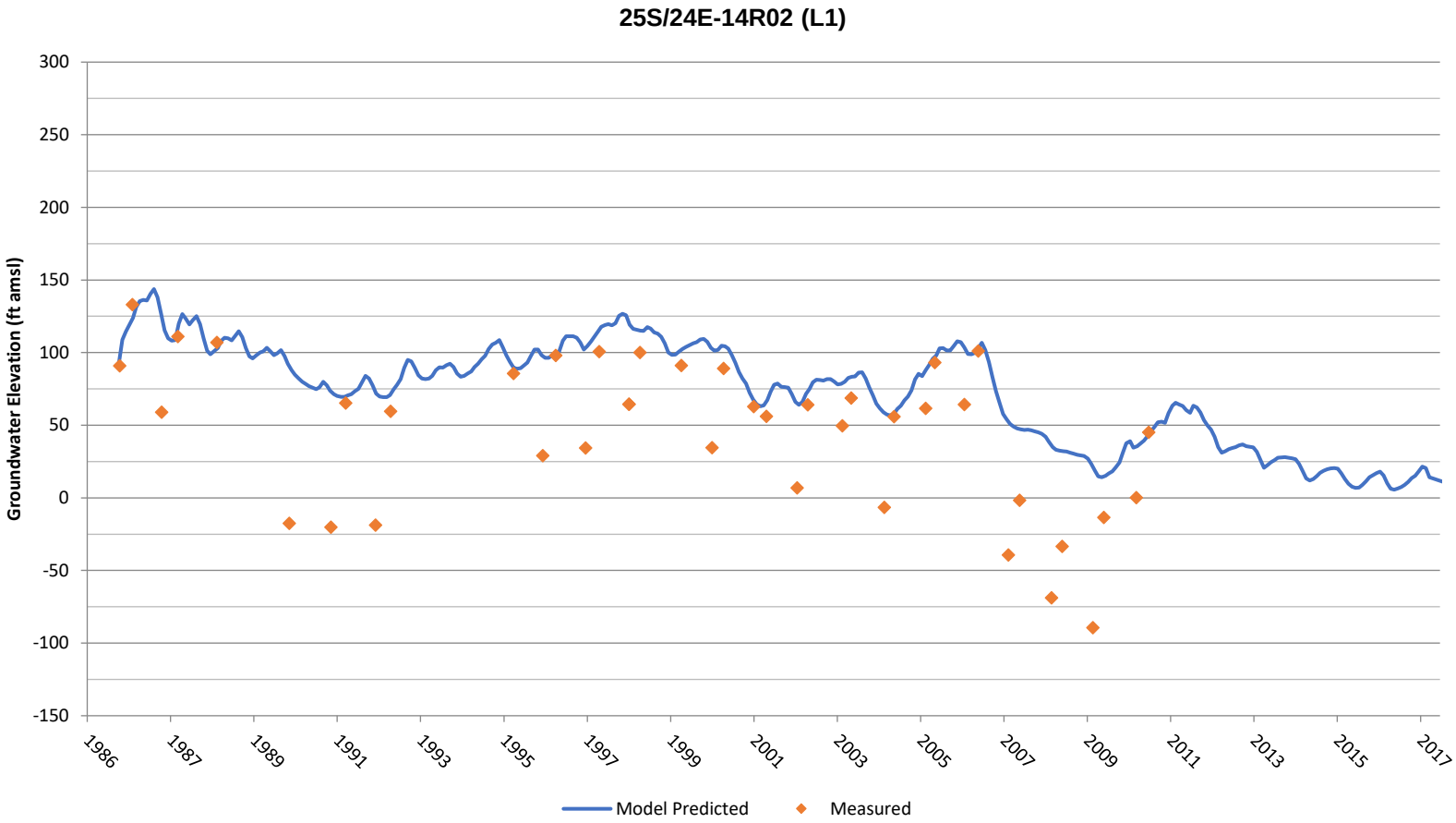
Model Calibration Hydrographs



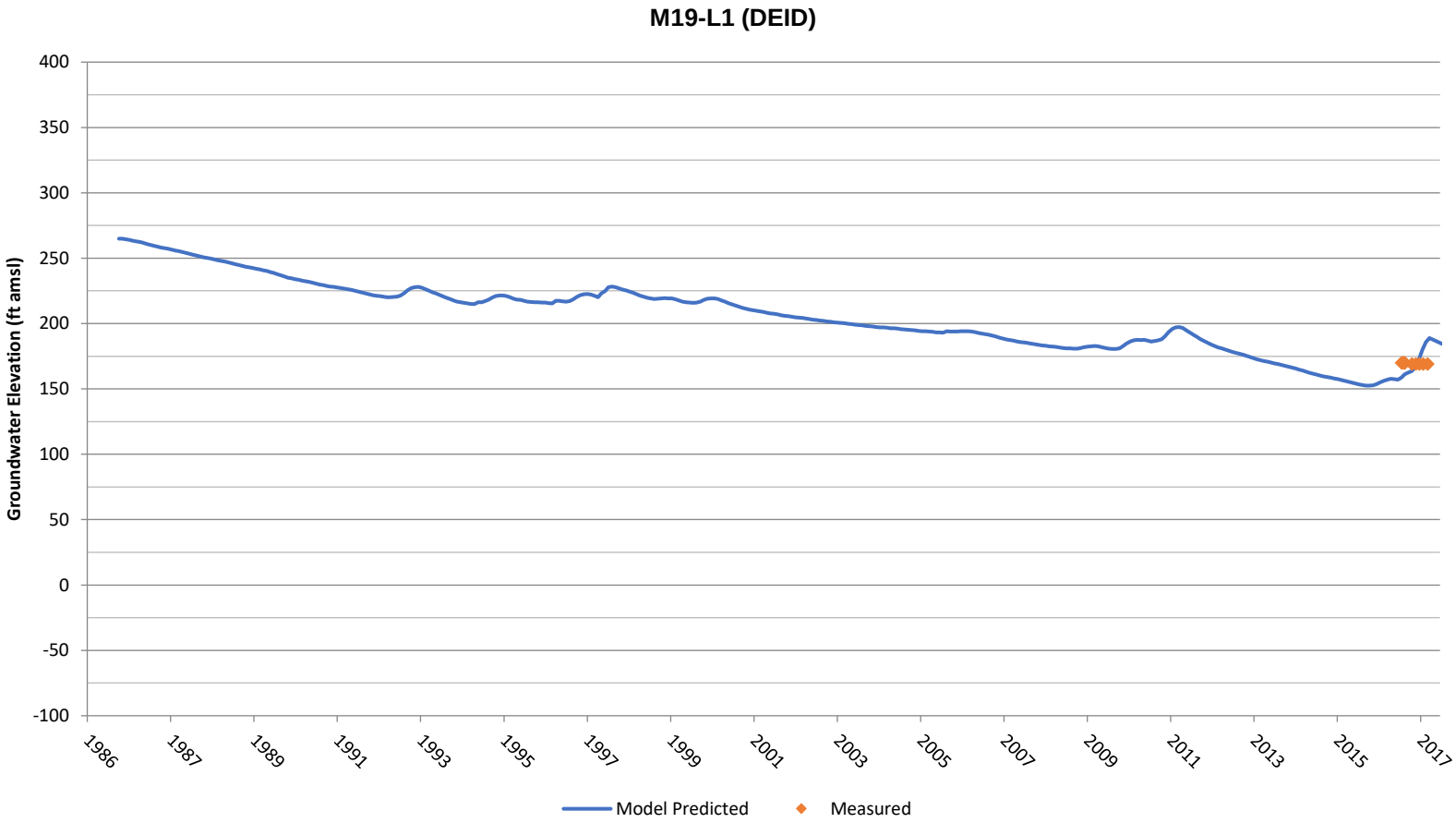
Model Calibration Hydrographs



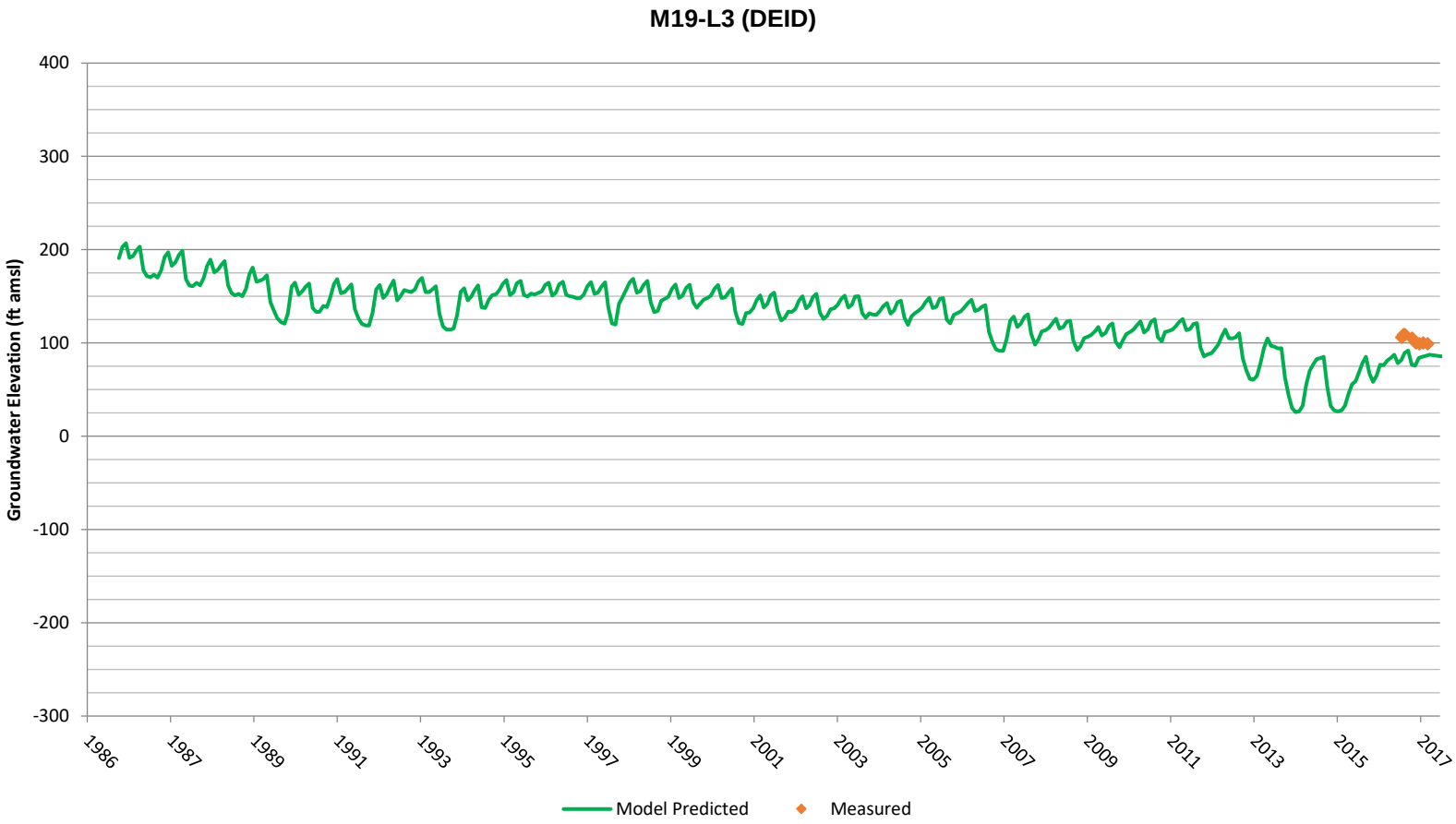
Model Calibration Hydrographs



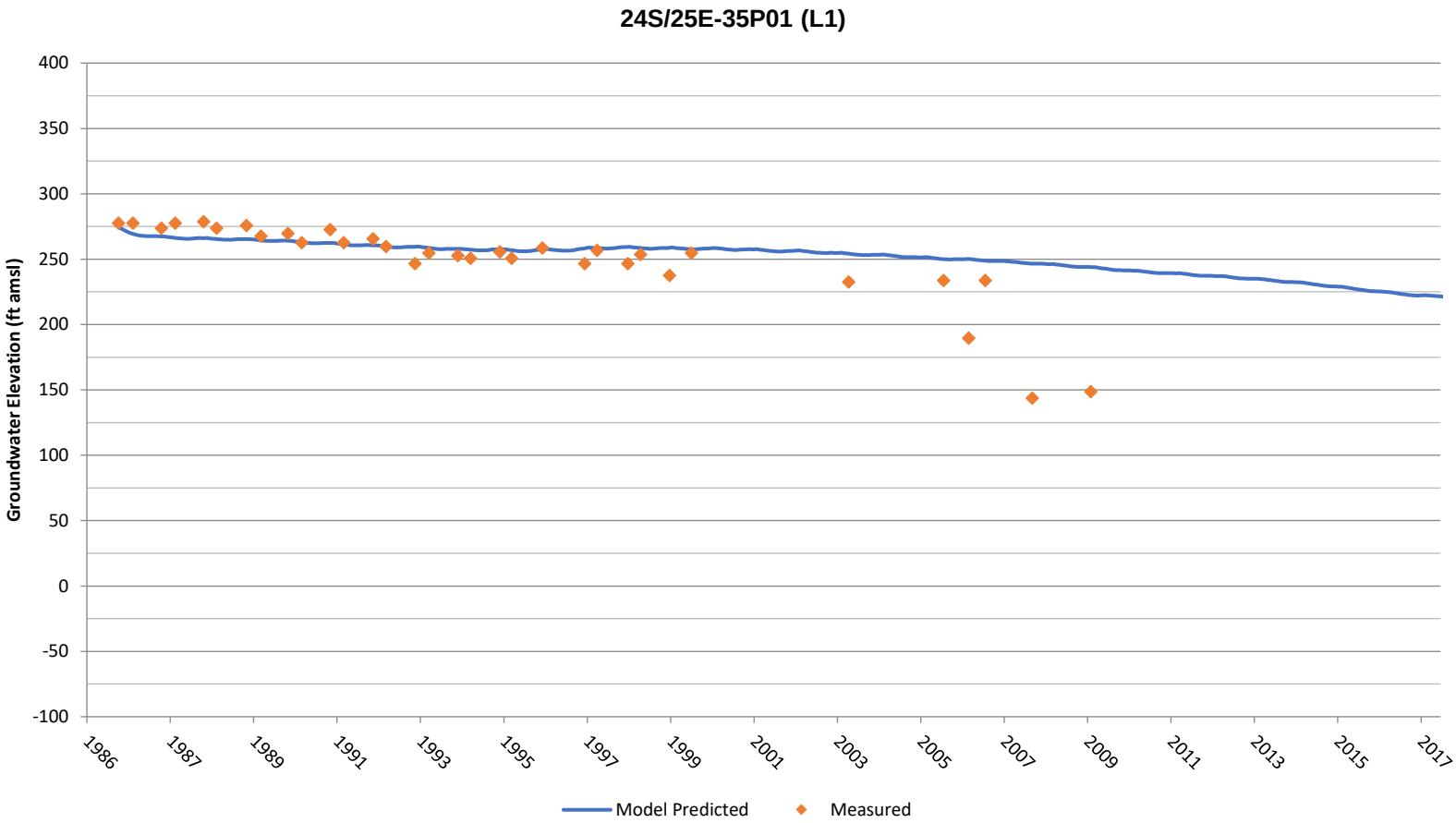
Model Calibration Hydrographs



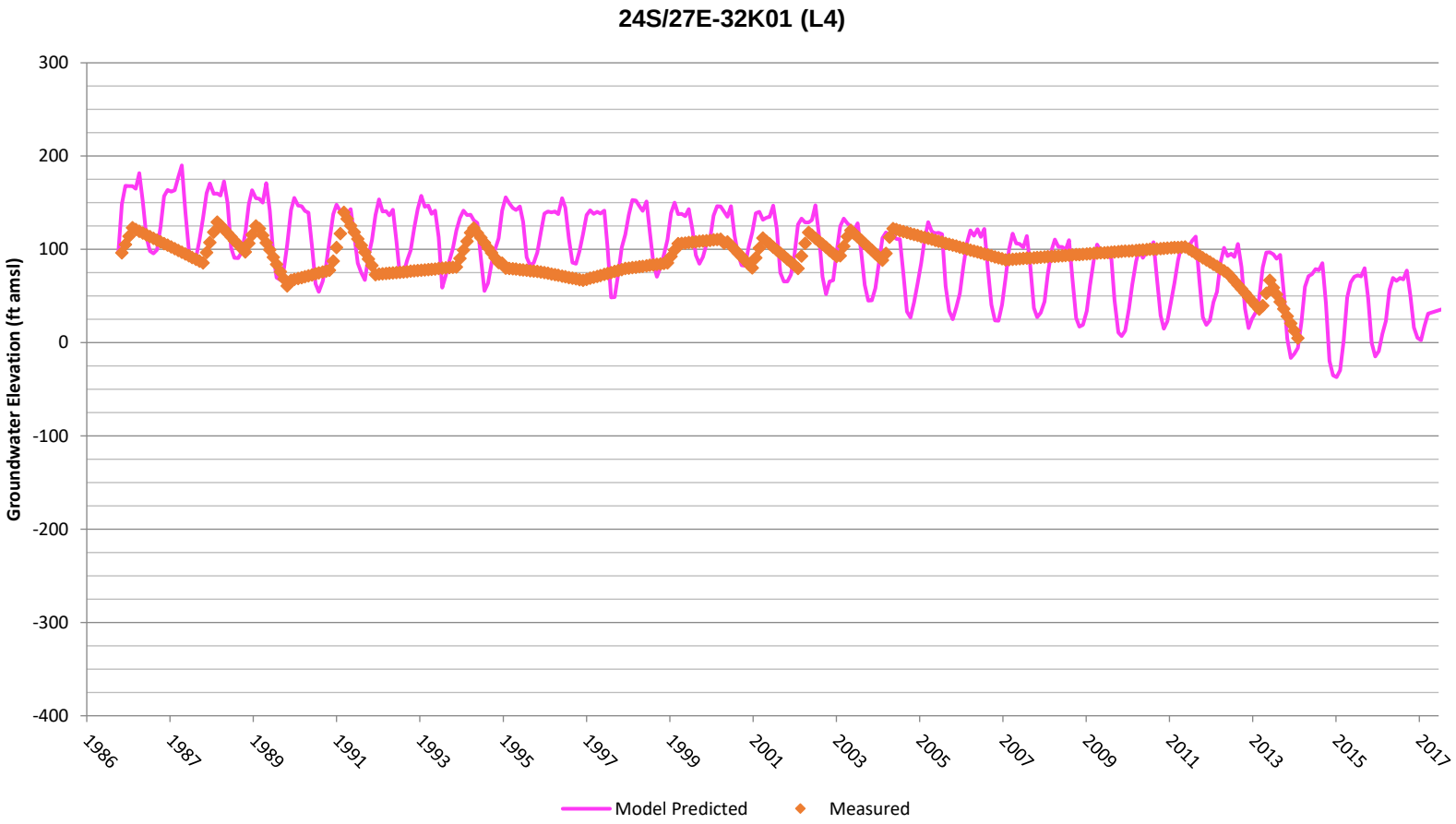
Model Calibration Hydrographs



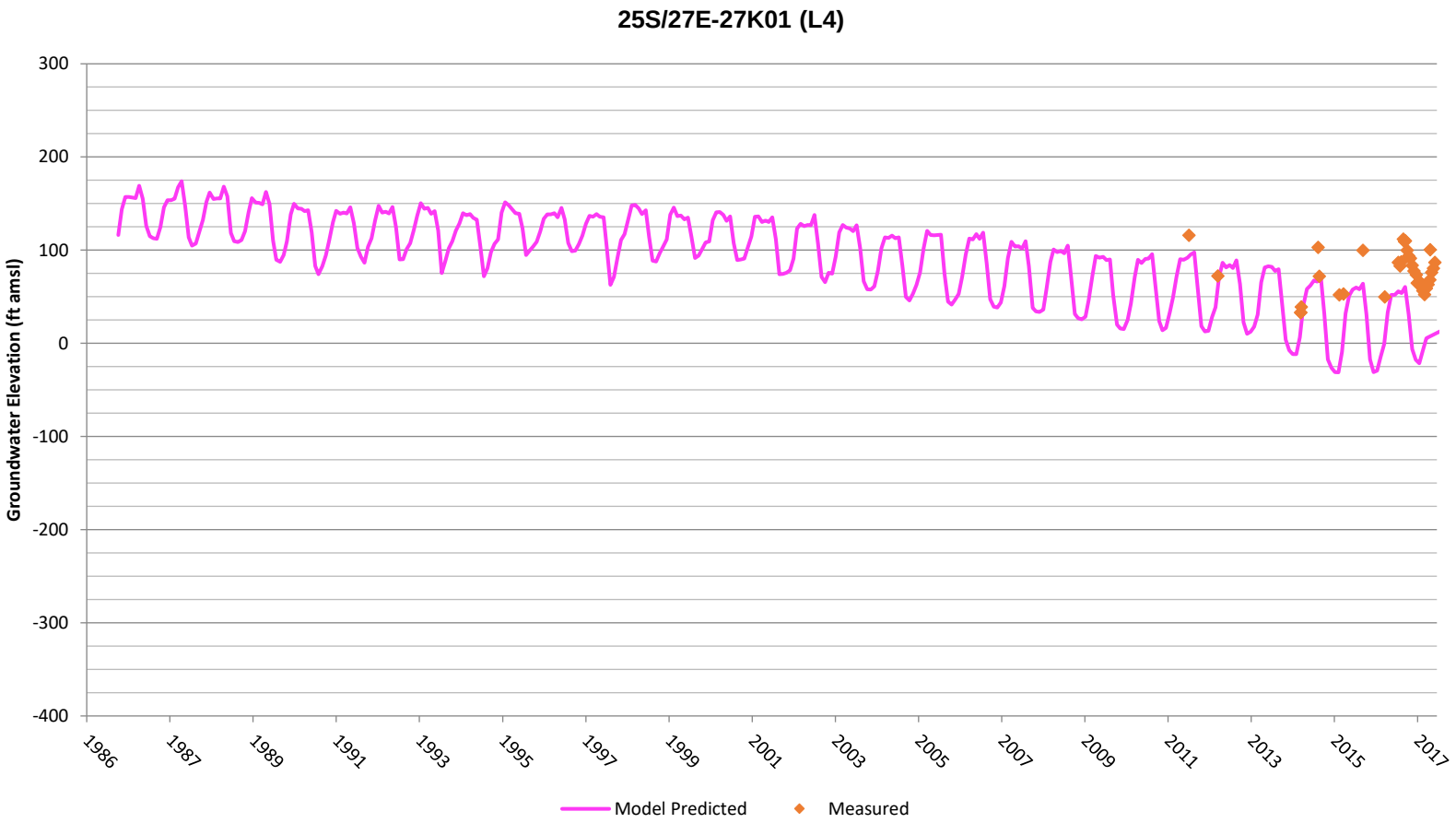
Model Calibration Hydrographs



Model Calibration Hydrographs



Model Calibration Hydrographs



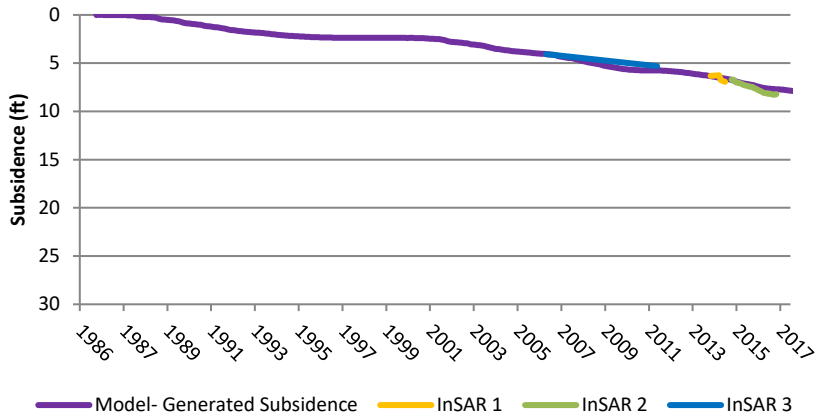
Appendix E

Land Subsidence Calibration Graphs

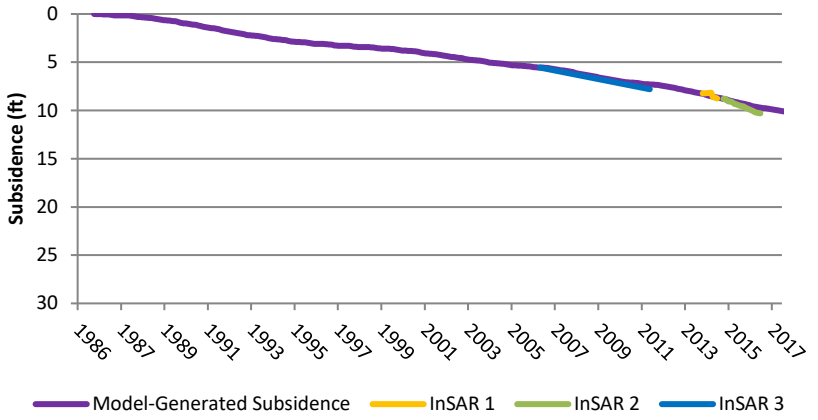
This page intentionally left blank

Land Subsidence Calibration Graphs

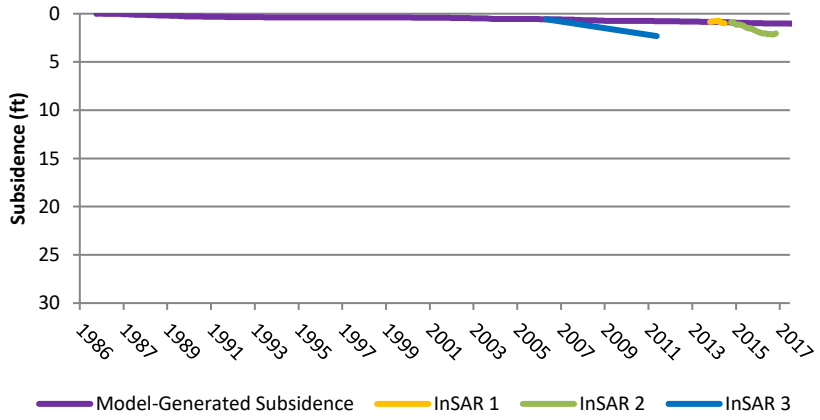
Sub-28



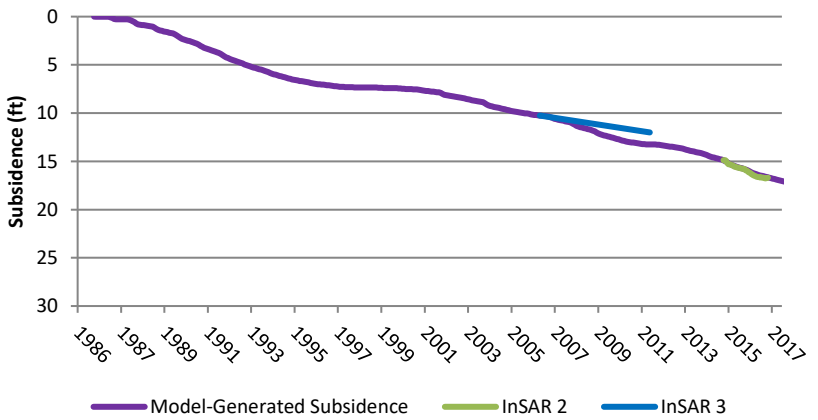
Sub-23



Sub-29

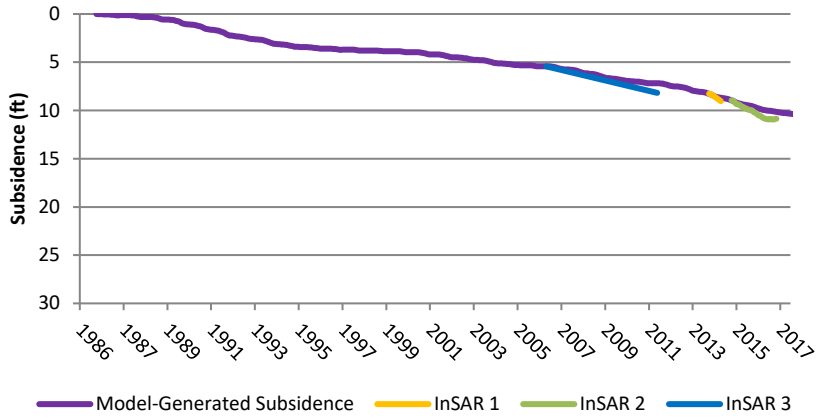


Sub-3

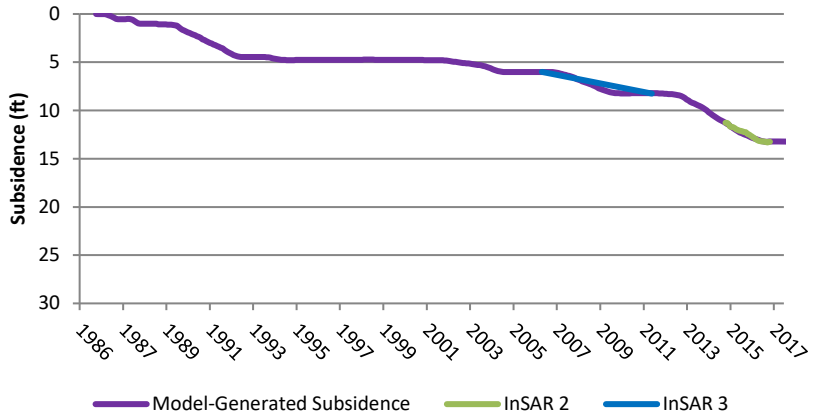


Land Subsidence Calibration Graphs

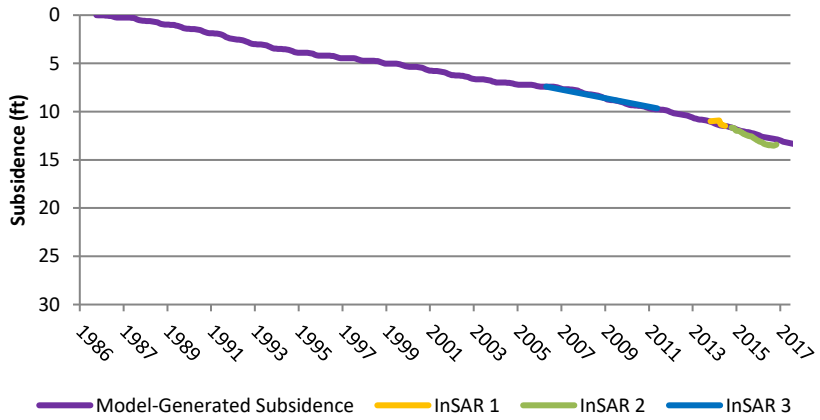
Sub-37 (21S/23E-32K01)



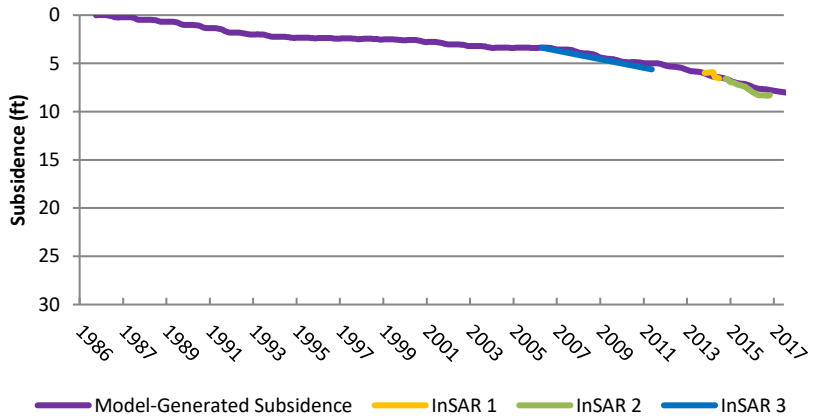
Sub-35 (21S/23E-36R01)



Sub-21

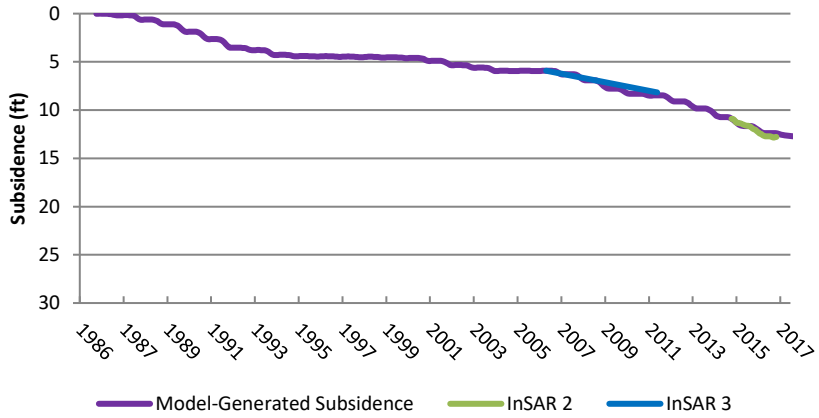


Sub-20

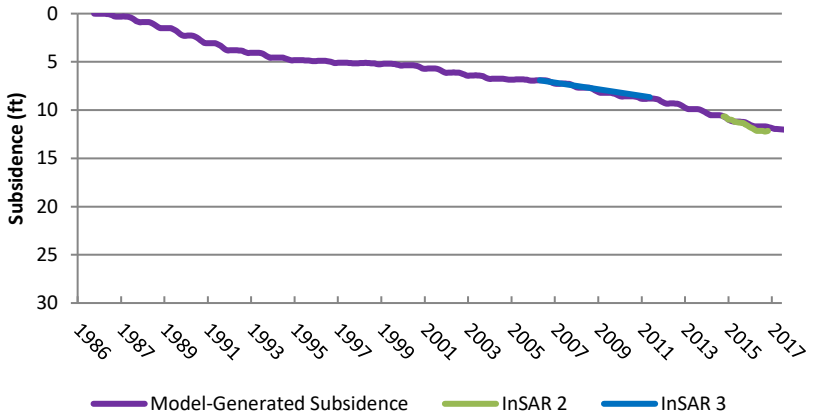


Land Subsidence Calibration Graphs

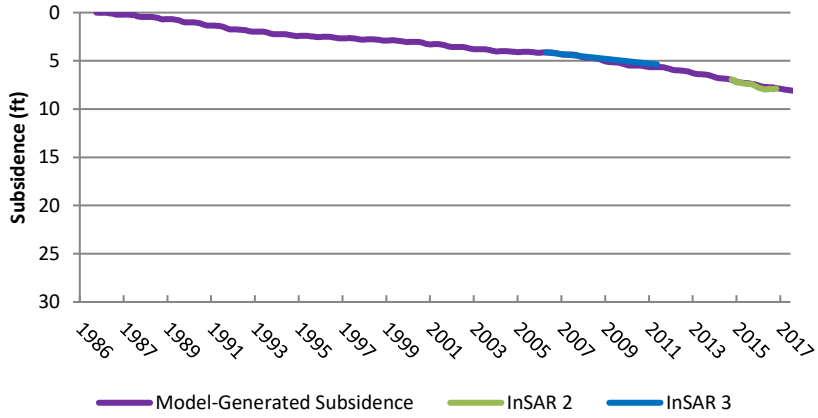
Sub-1



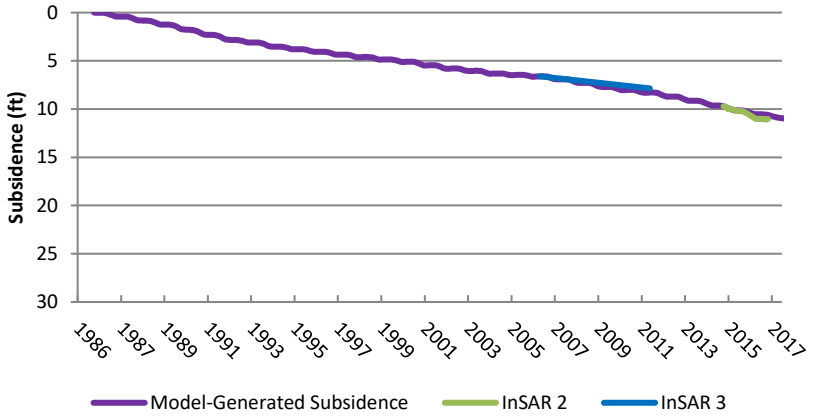
Sub-18



Sub-19

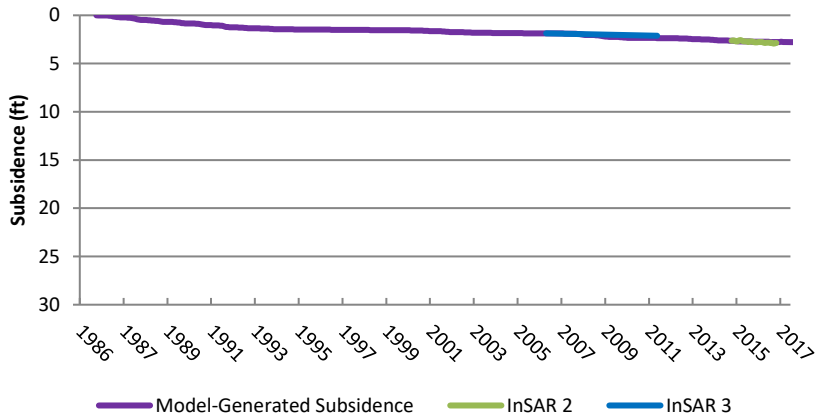


Sub-30 (24S/24E-03A01)

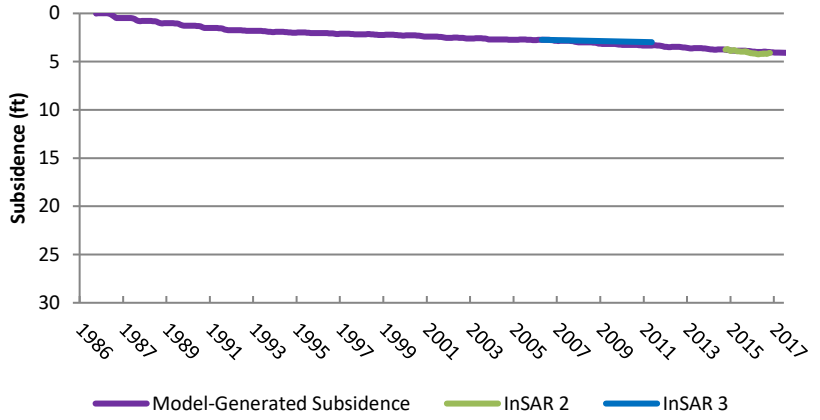


Land Subsidence Calibration Graphs

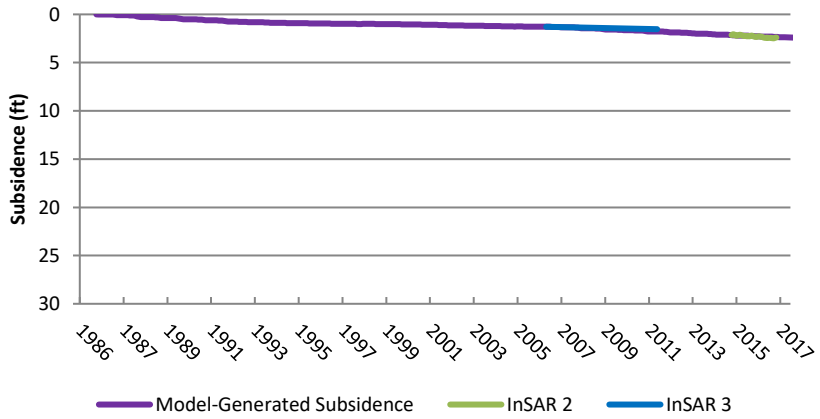
Sub-12



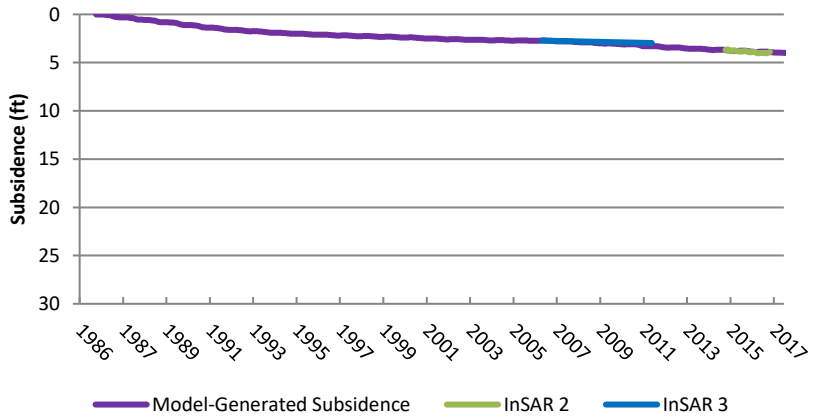
Sub-31 (24S/23E-22R02)



Sub-11

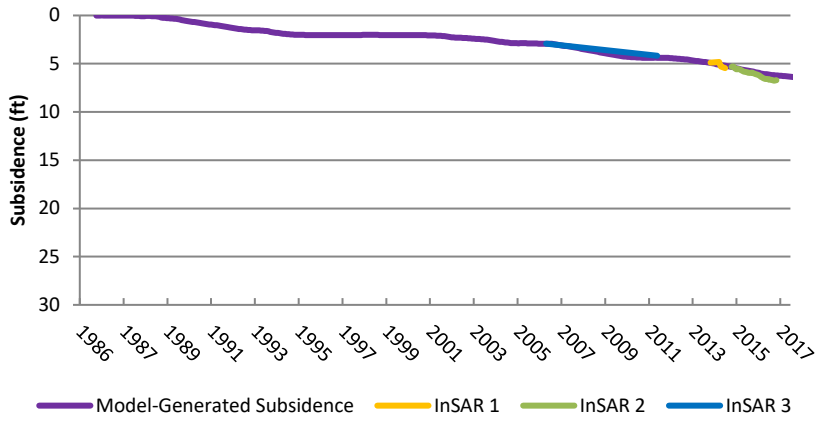


Sub-10

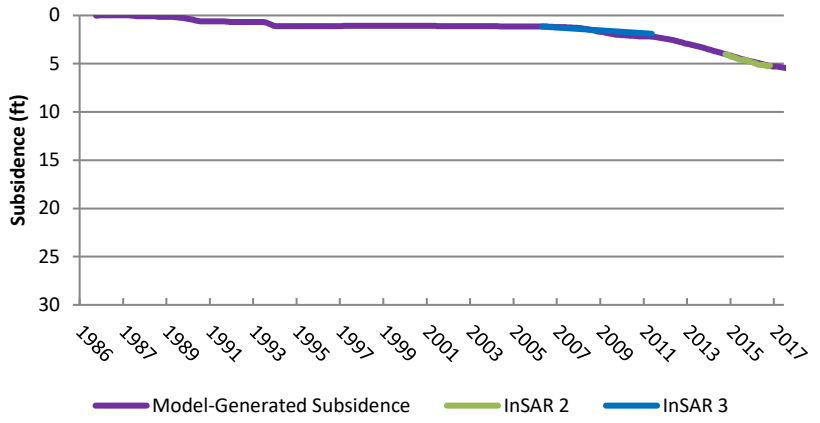


Land Subsidence Calibration Graphs

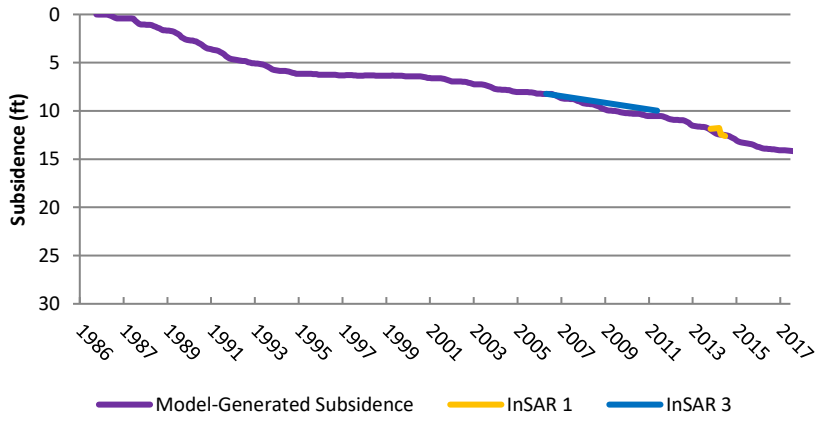
Sub-27



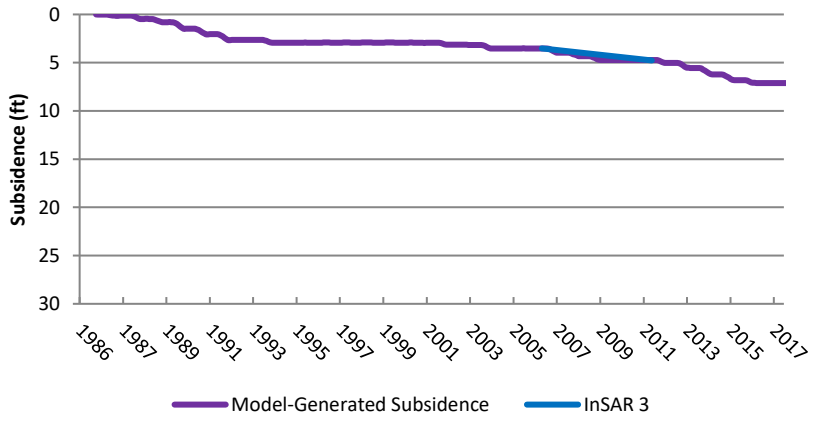
Sub-26



Sub-34 (21S/24E-14P01)

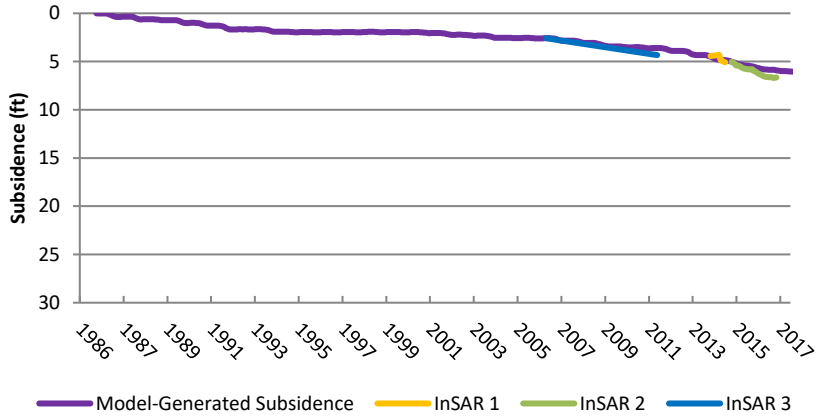


Sub-2

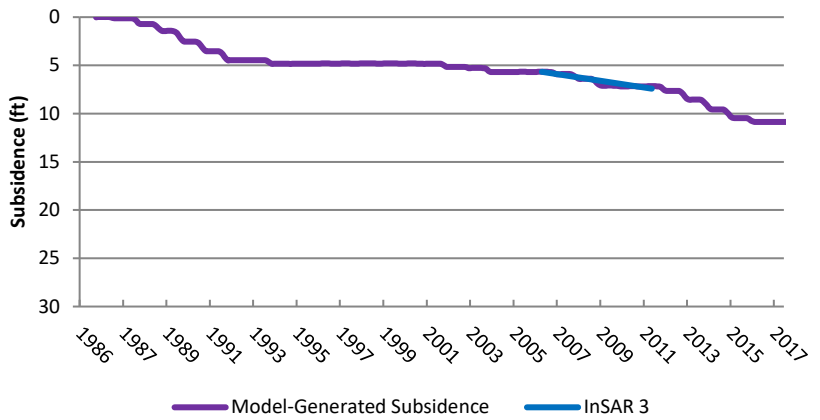


Land Subsidence Calibration Graphs

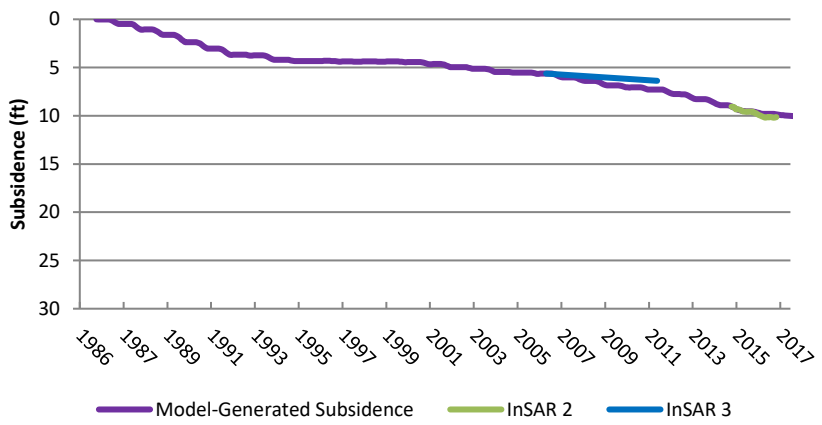
Sub-36 (22S/24E-01Q01)



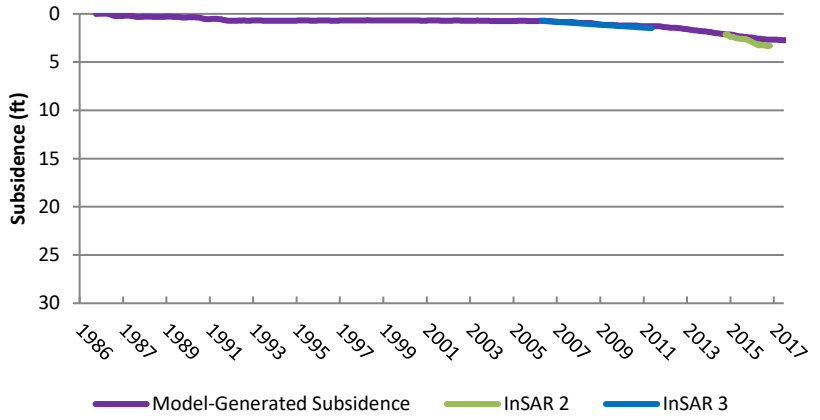
Sub-42 (22S/24E-23J01)



Sub-17

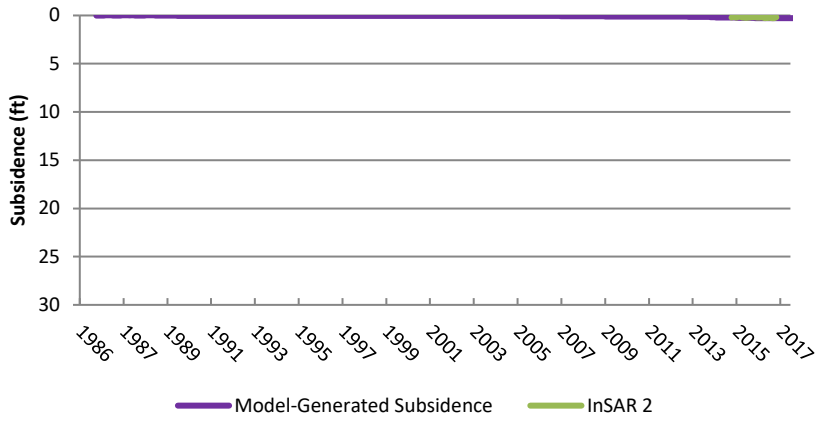


Sub-43 (22S/25E-25N01)

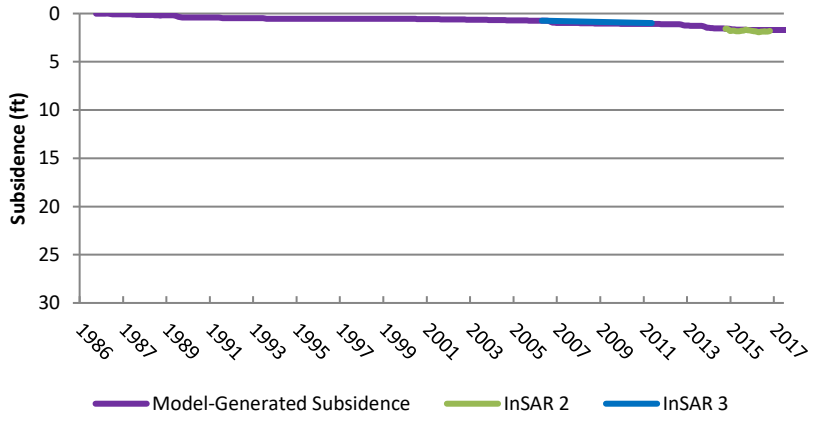


Land Subsidence Calibration Graphs

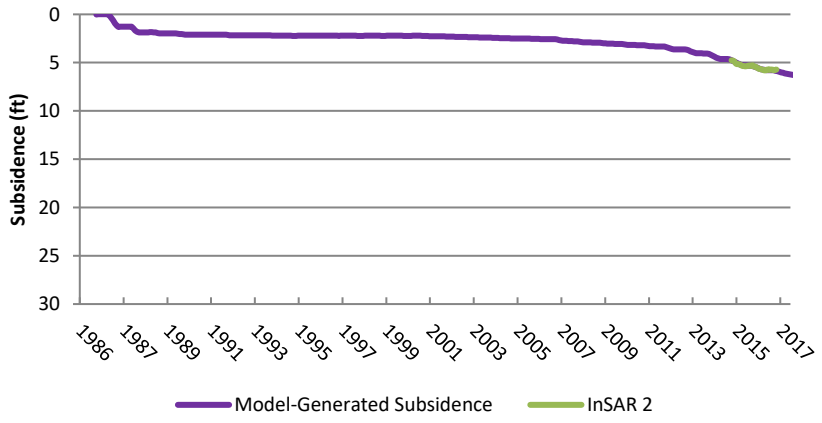
Sub-7



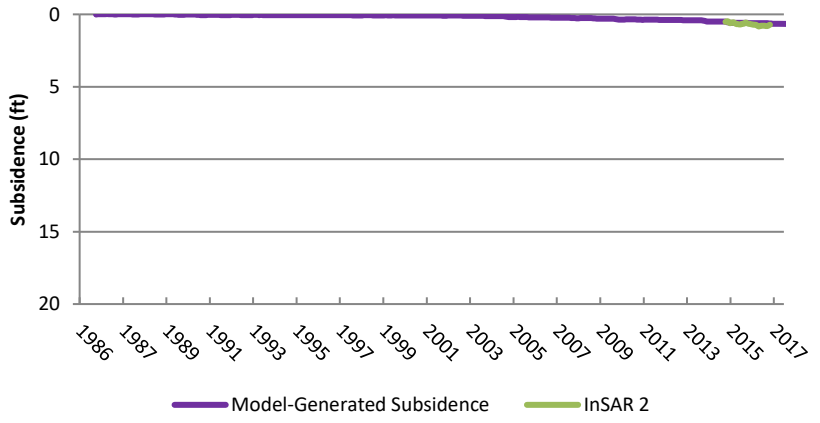
Sub-4



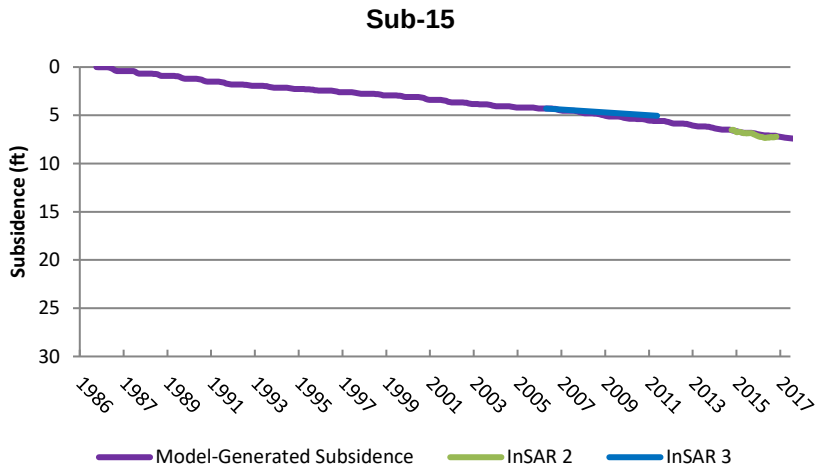
Sub-16

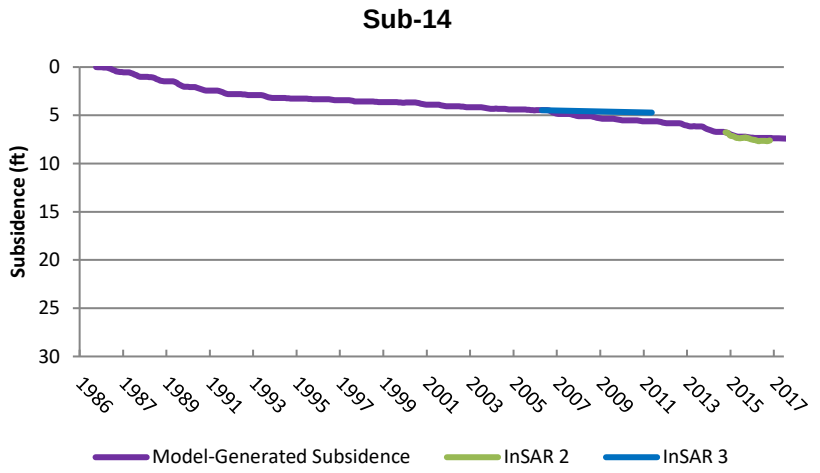


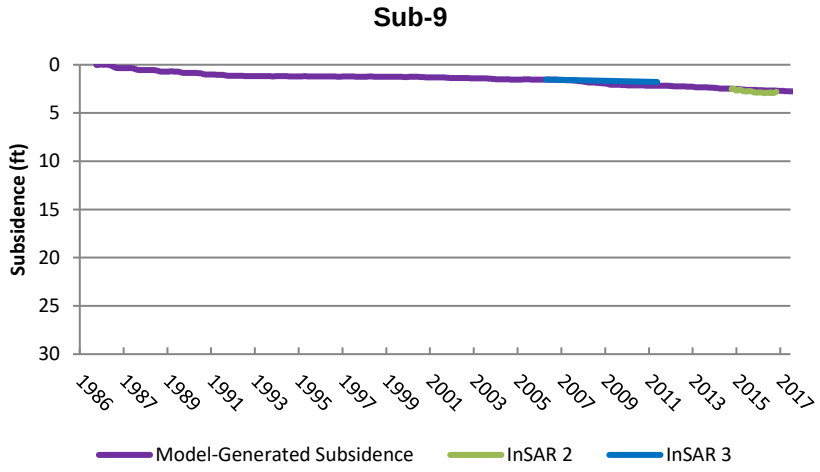
Sub-32 (24S/27E-32K01)

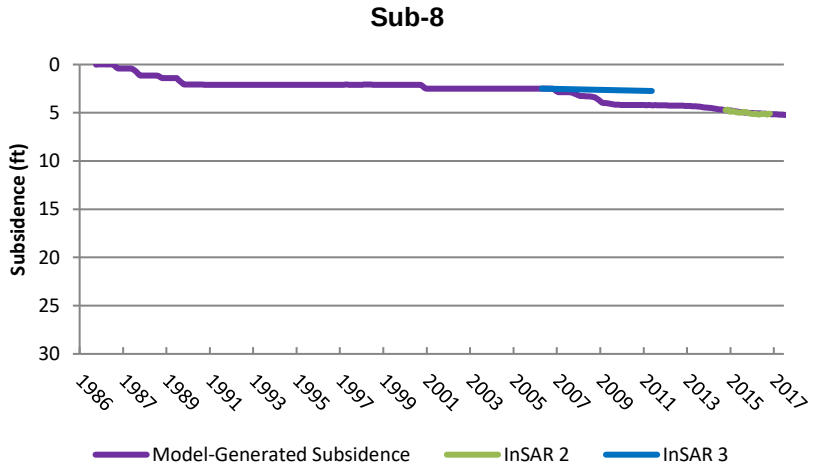


Land Subsidence Calibration Graphs



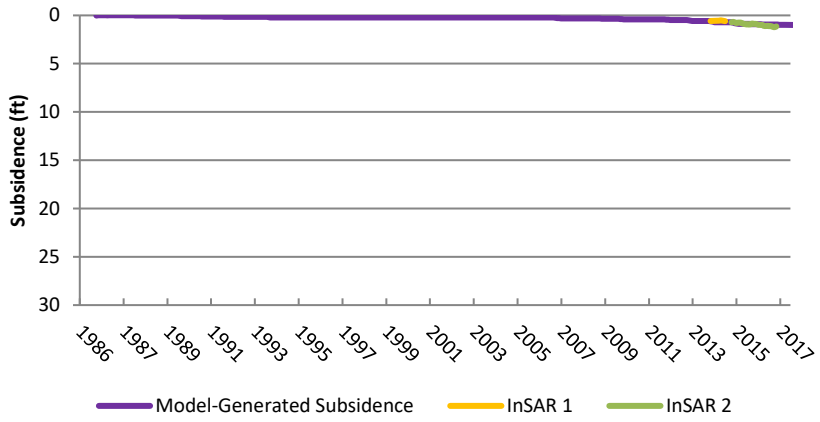




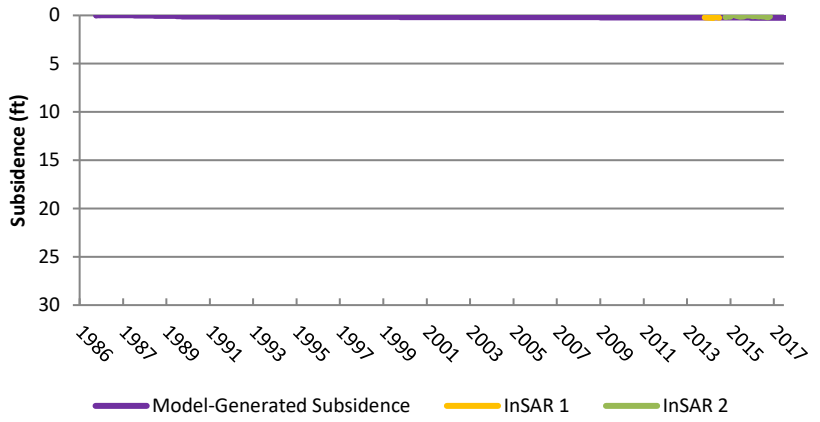


Land Subsidence Calibration Graphs

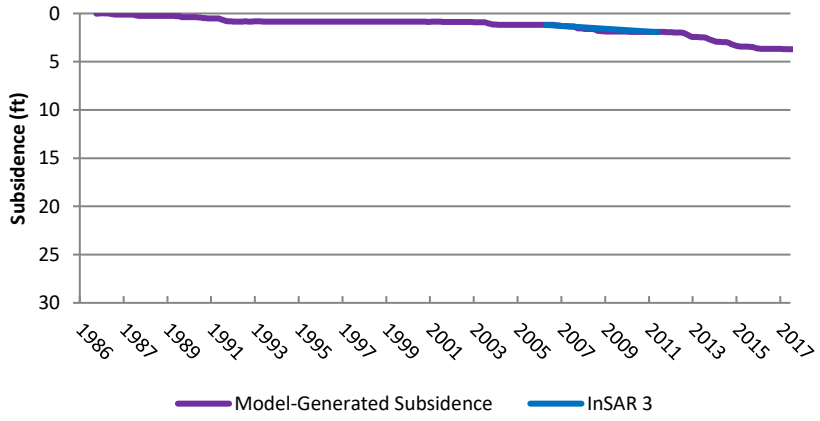
Sub-25



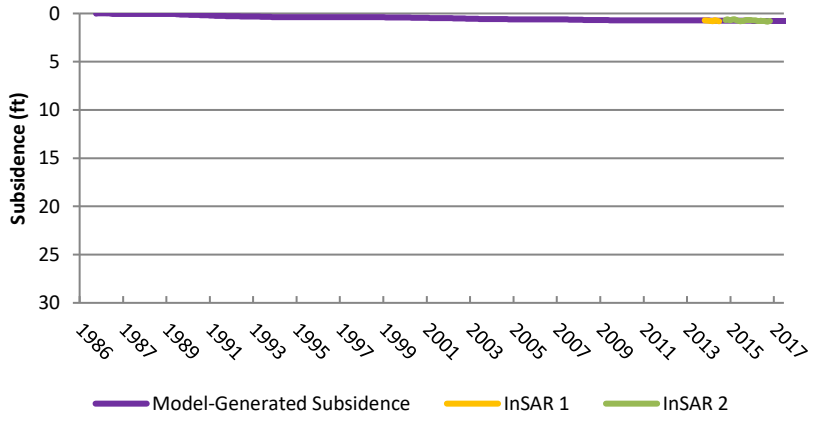
Sub-24



Sub-41 (21S/25E-01F01)

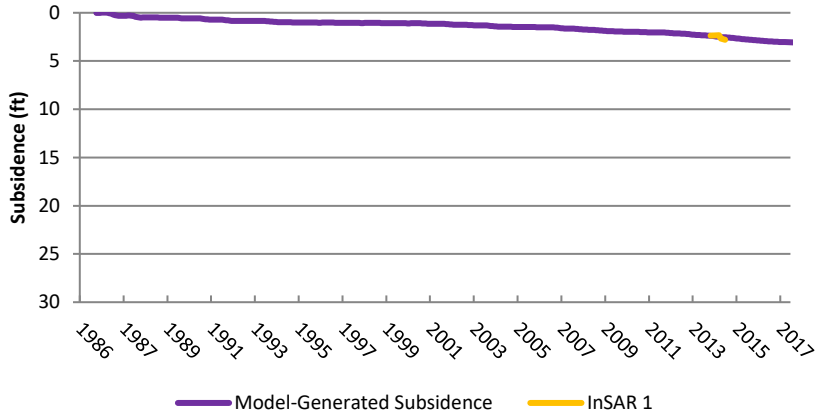


Sub-22

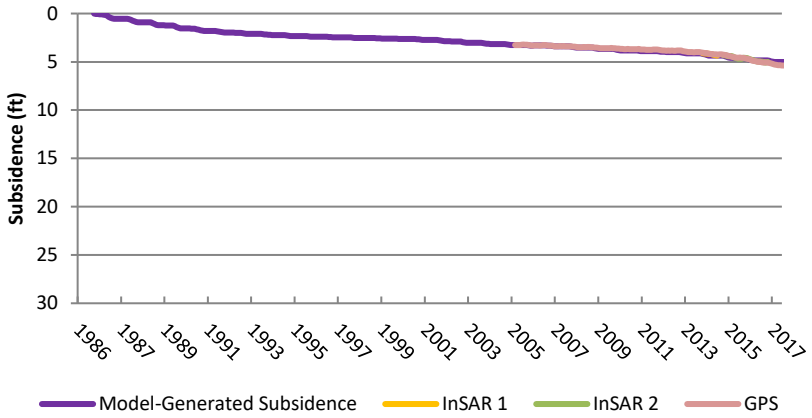


Land Subsidence Calibration Graphs

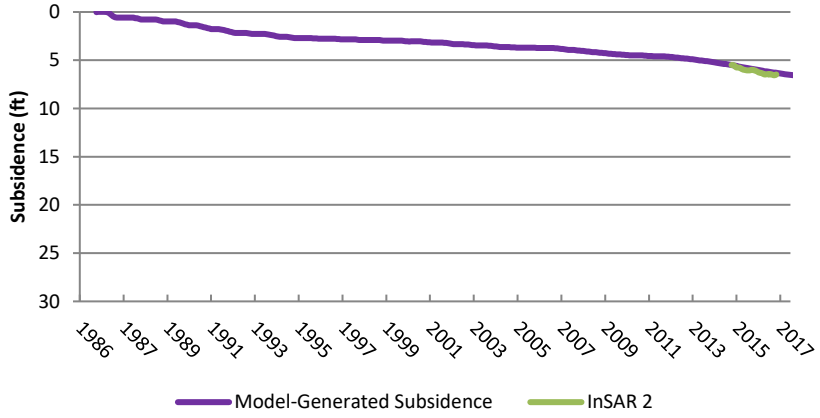
Sub-38 (21S/26E-32A01)



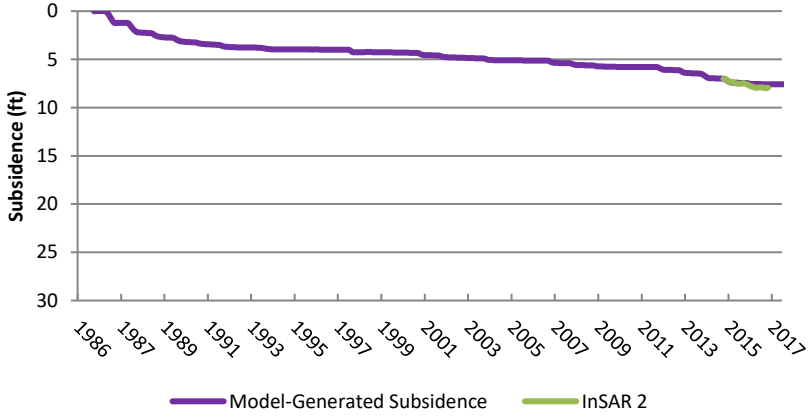
Sub-44 (Porterville GPS)



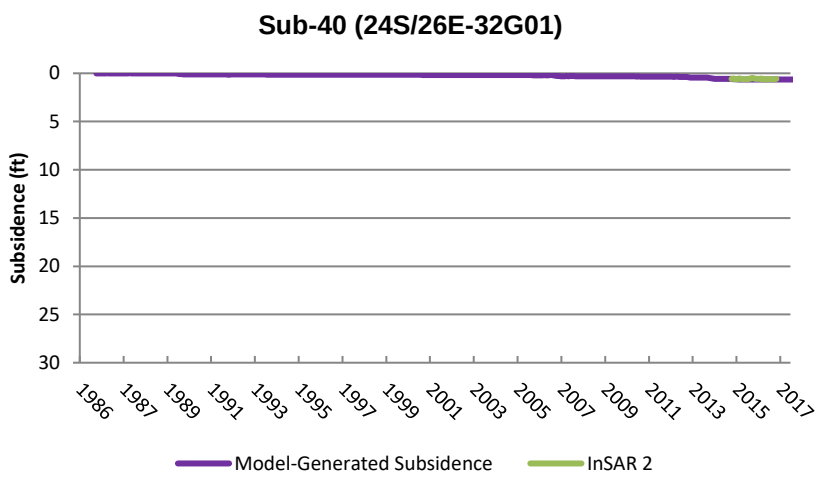
Sub-39 (22S/26E-10J01)

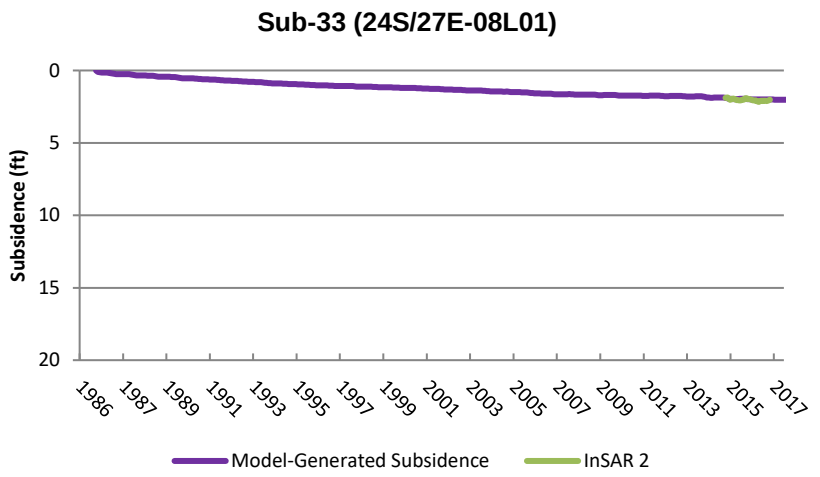


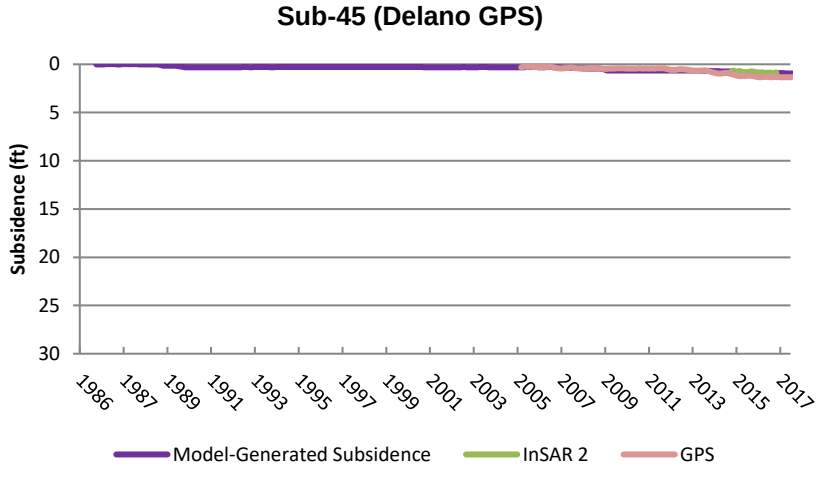
Sub-5

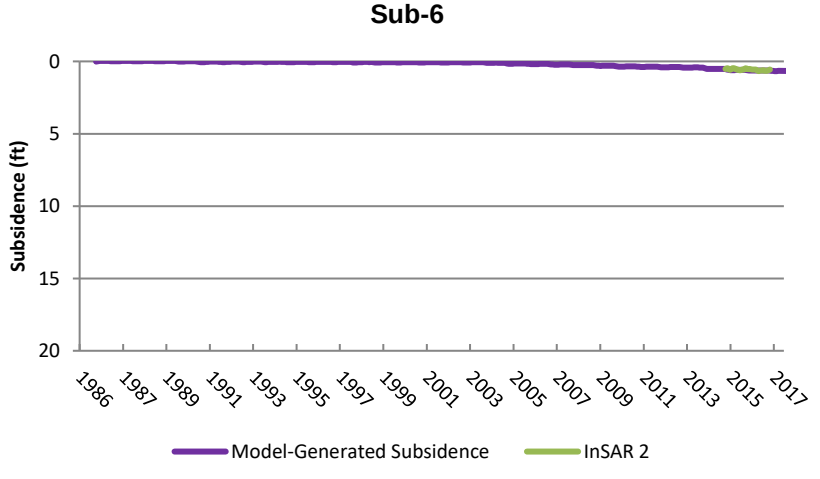


Land Subsidence Calibration Graphs

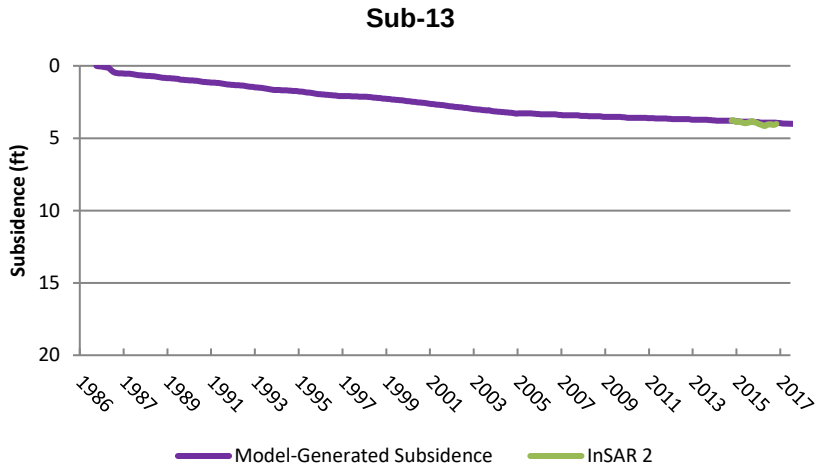








Land Subsidence Calibration Graphs



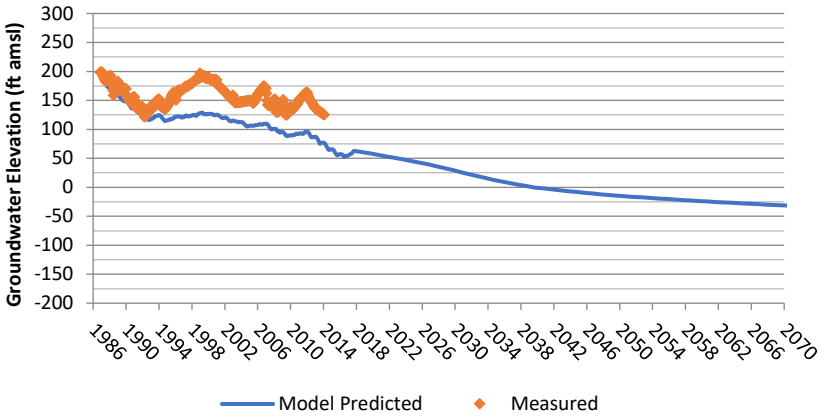
Appendix F

Model Simulated Hydrographs

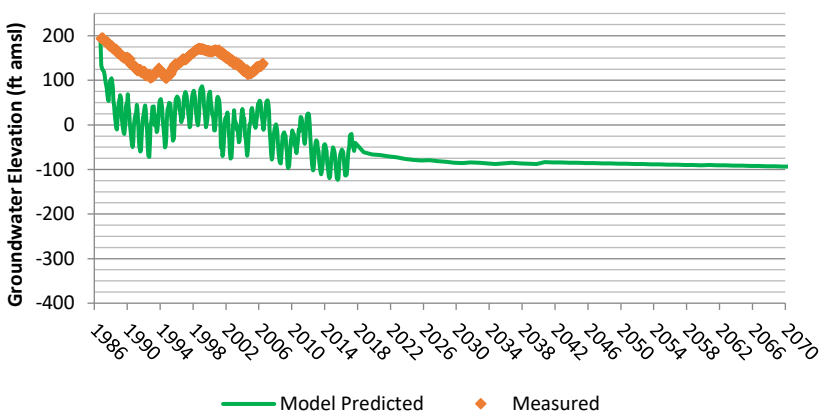
This page intentionally left blank

Model Simulated Hydrographs

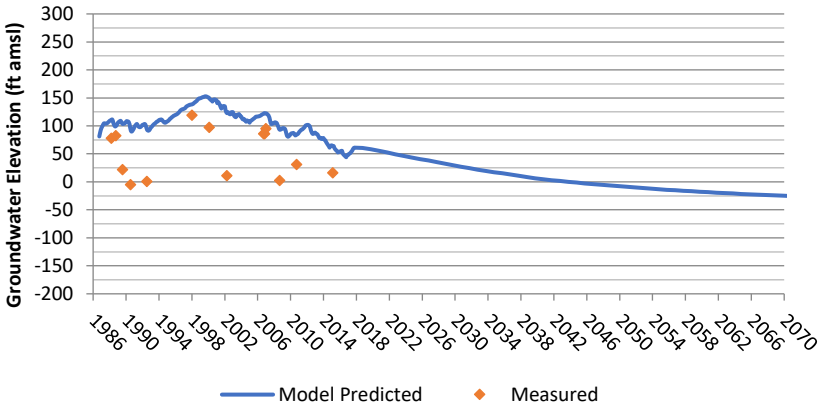
21S/23E-32K01 (L1)



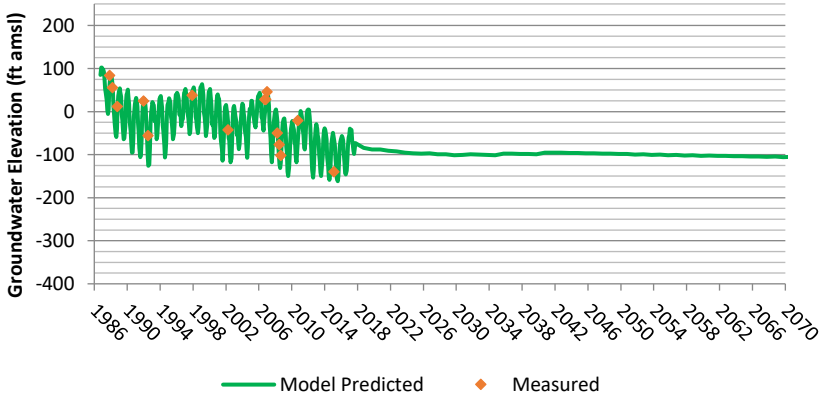
21S/23E-36R01 (L3)



Angiola G1 (L1)

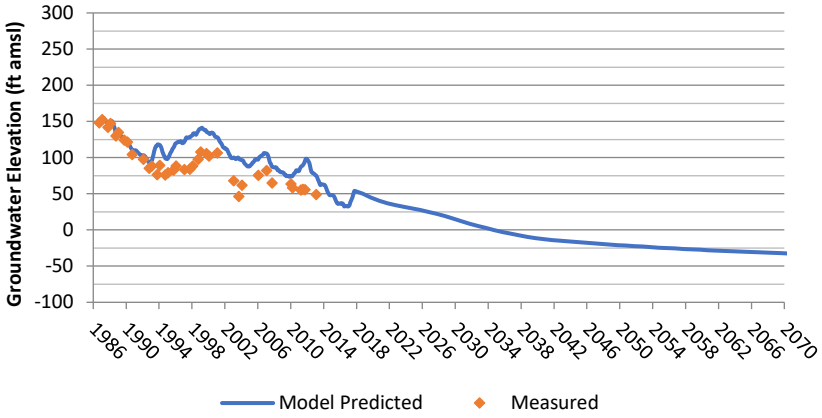


Angiola E10 (L3)

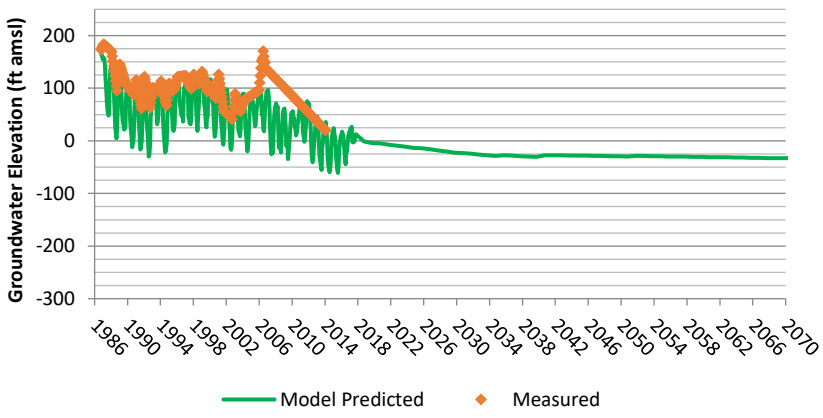


Model Simulated Hydrographs

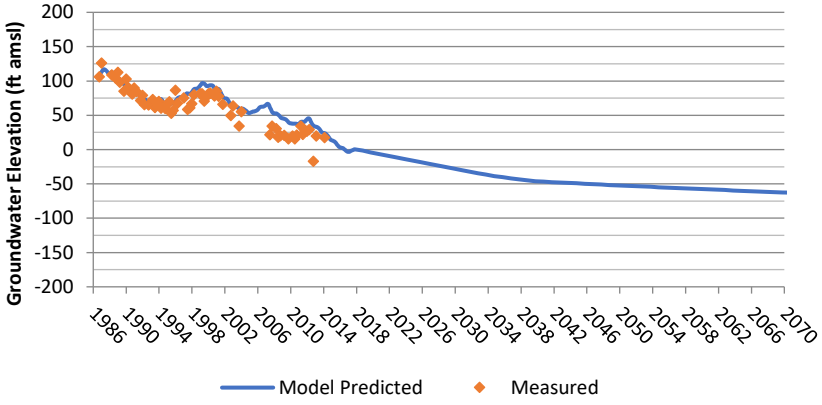
22S/24E-09A01 (L1)



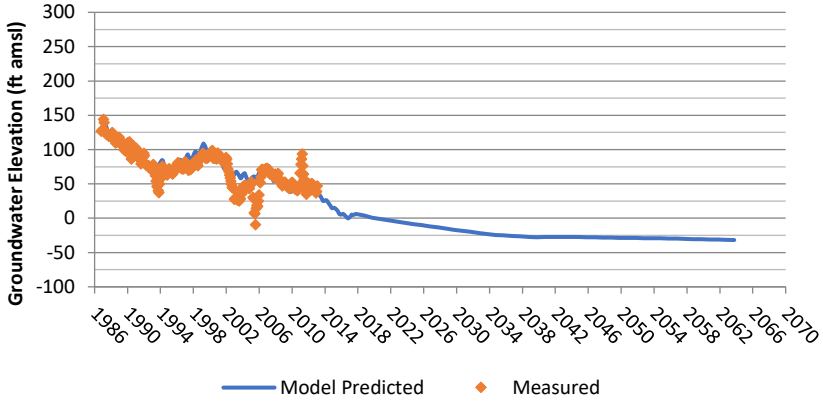
22S/24E-01Q01 (L3)



22S/24E-20A01 (L1)

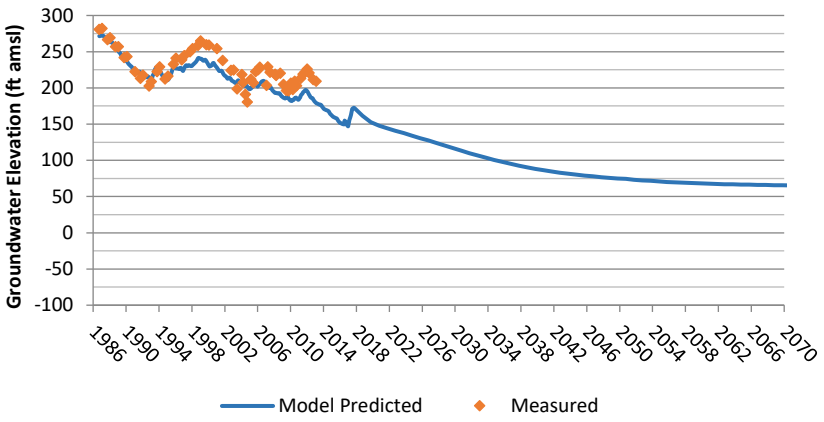


22S/24E-23J01 (L1)

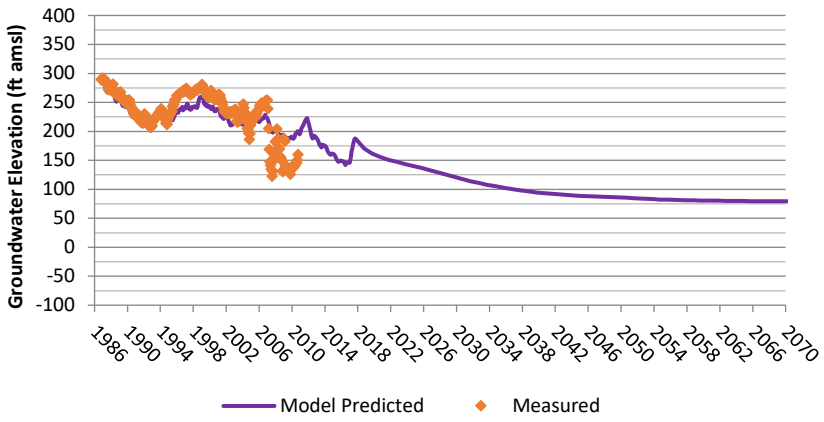


Model Simulated Hydrographs

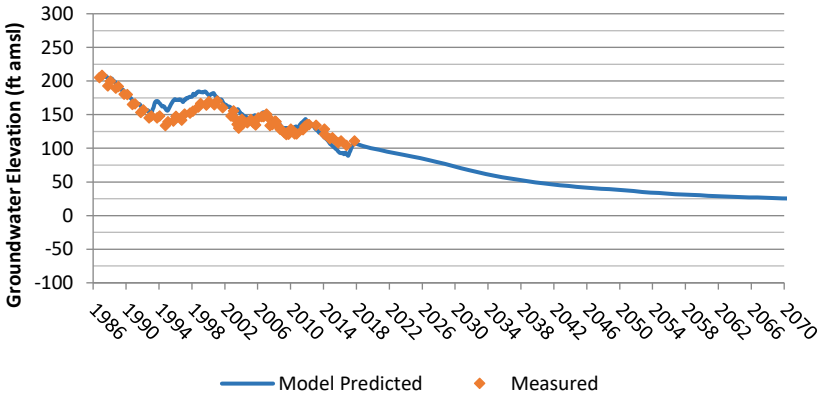
21S/25E-03R01 (L1)



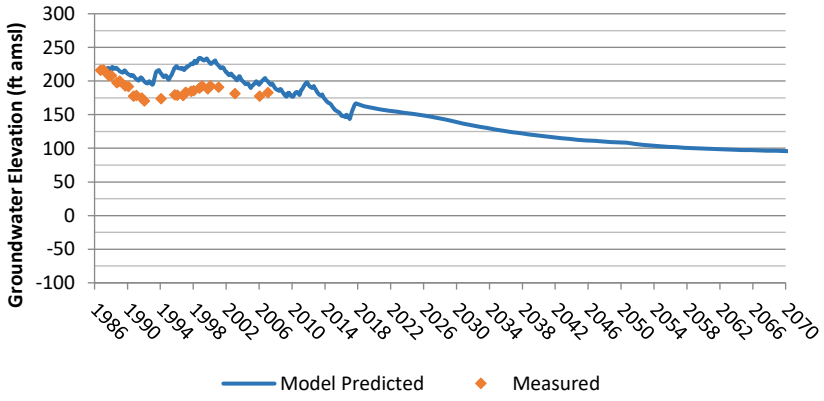
21S/25E-01F01 (L2)



21S/24E-35A01 (L1)

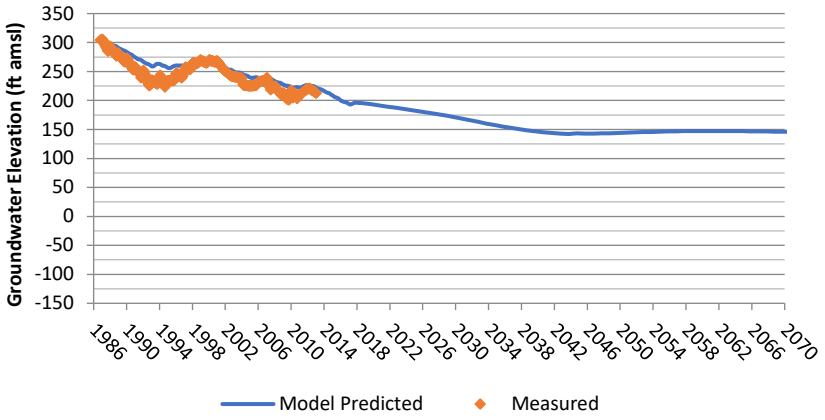


22S/25E-10E01 (L1)

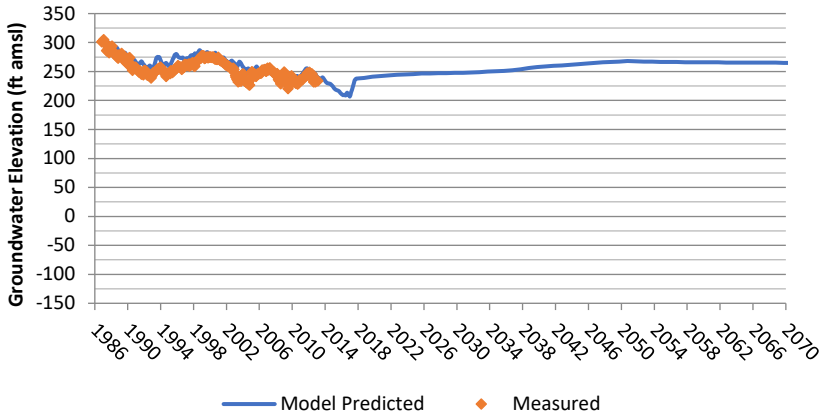


Model Simulated Hydrographs

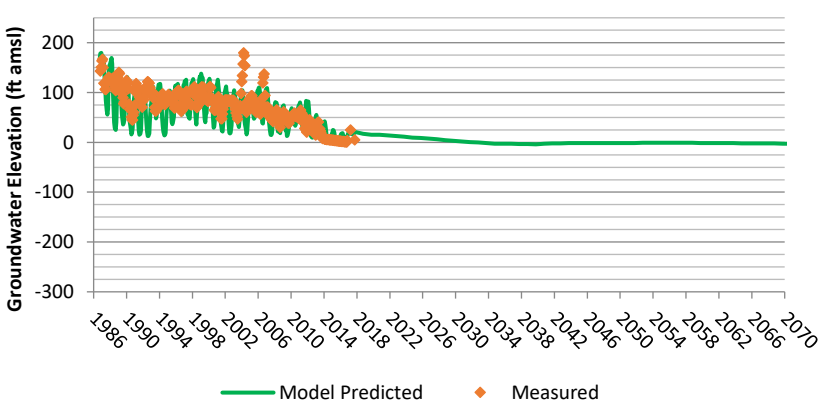
21S/26E-32A01 (L1)



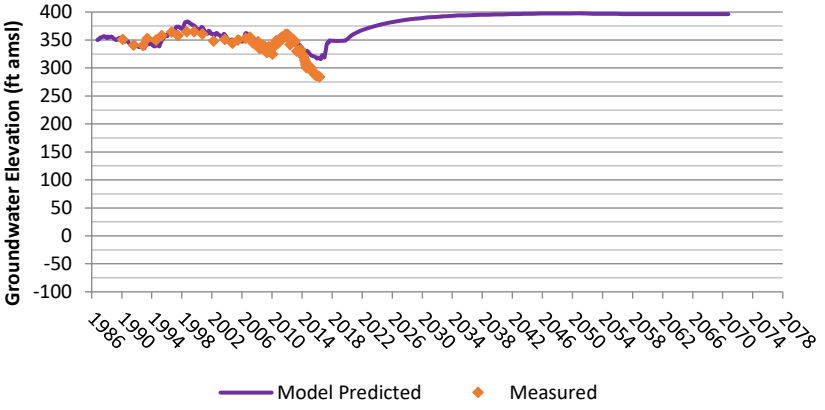
22S/26E-10J01 (L1)



22S/25E-25N01 (L3)

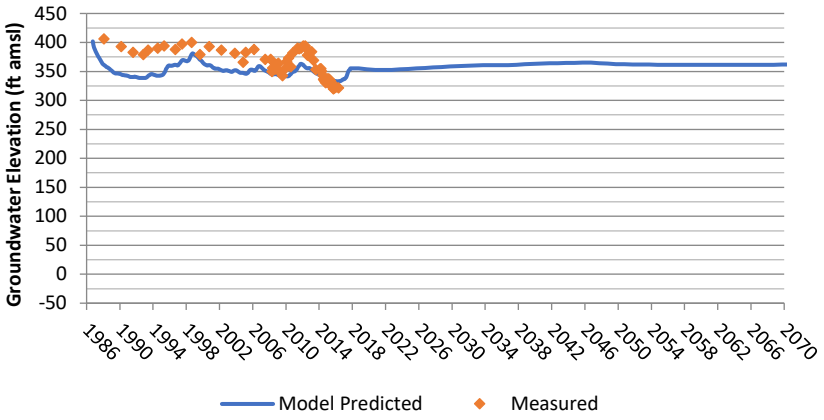


Port R-11 (L2)

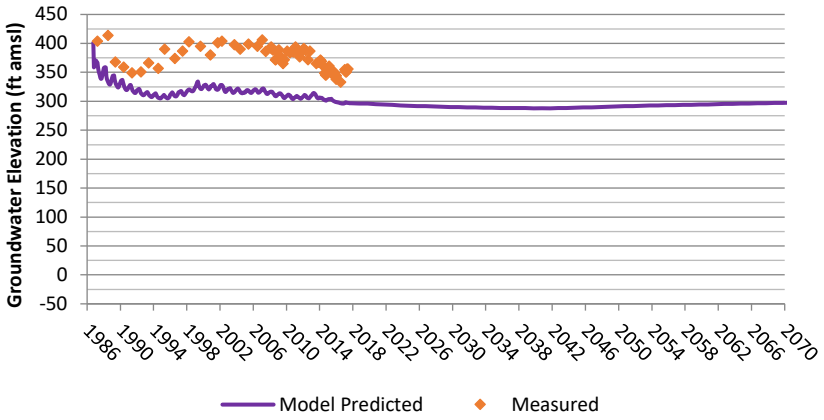


Model Simulated Hydrographs

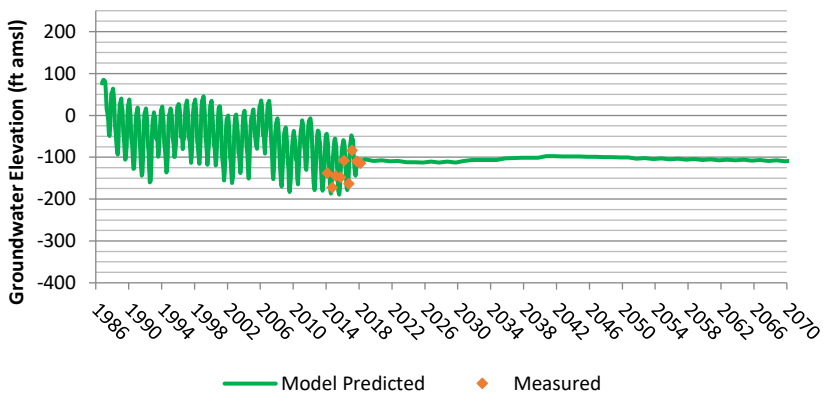
Port R-6 (L1)



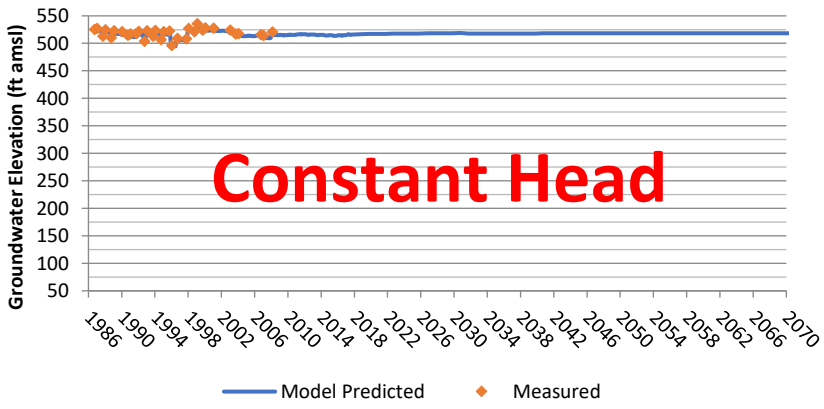
Port C-1 (L2)



23S/23E-24 (L3)

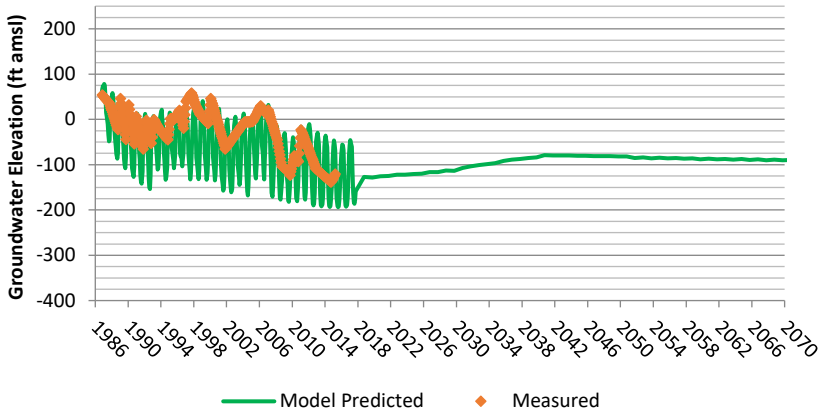


22S28E-03H01 (L1)

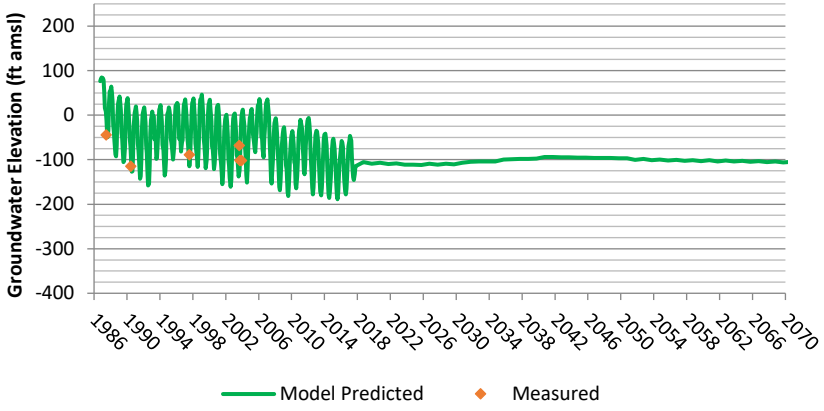


Model Simulated Hydrographs

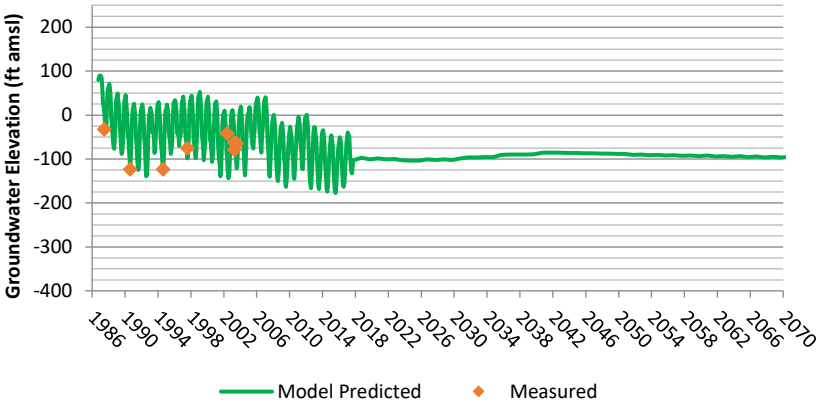
24S/23E-22R02 (L3)



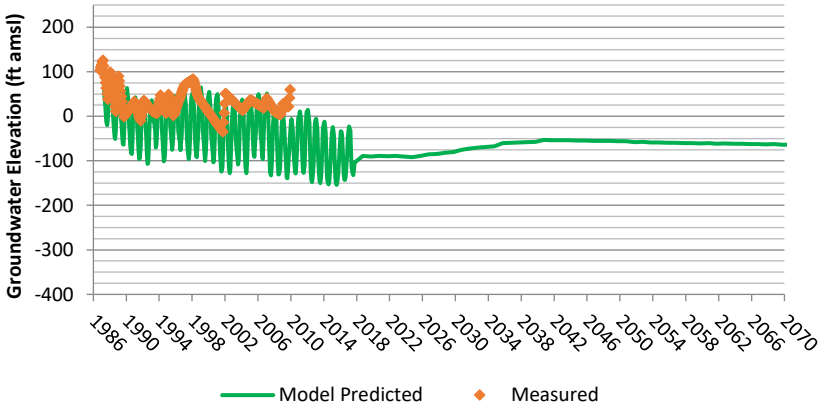
Well 51 (Alpaugh)



Well 53 (Alpaugh)

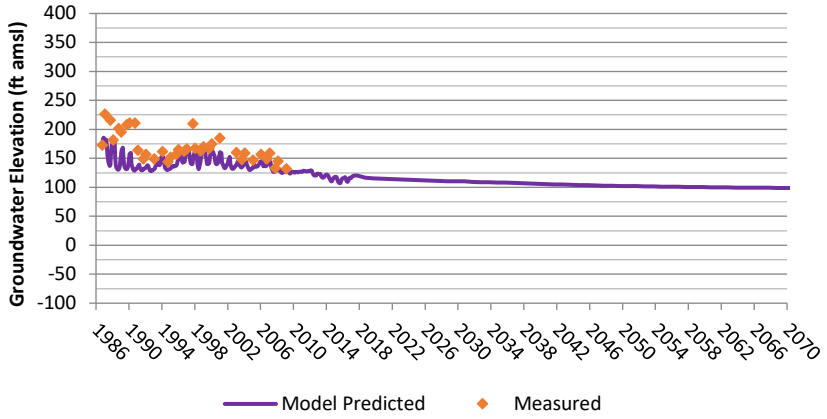


24S/24E-03A01 (L3)

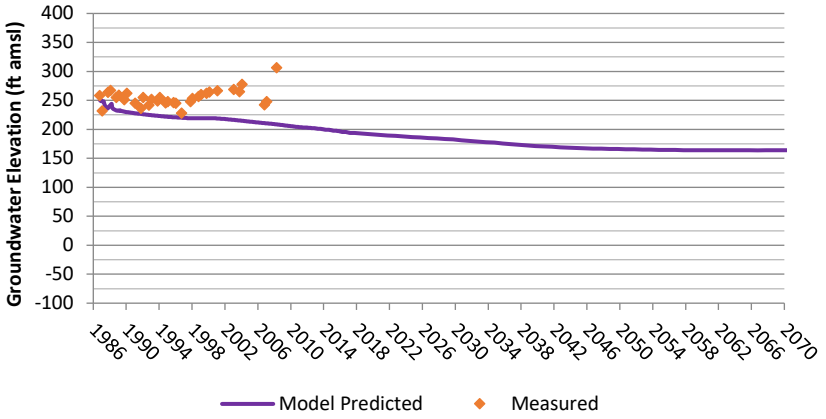


Model Simulated Hydrographs

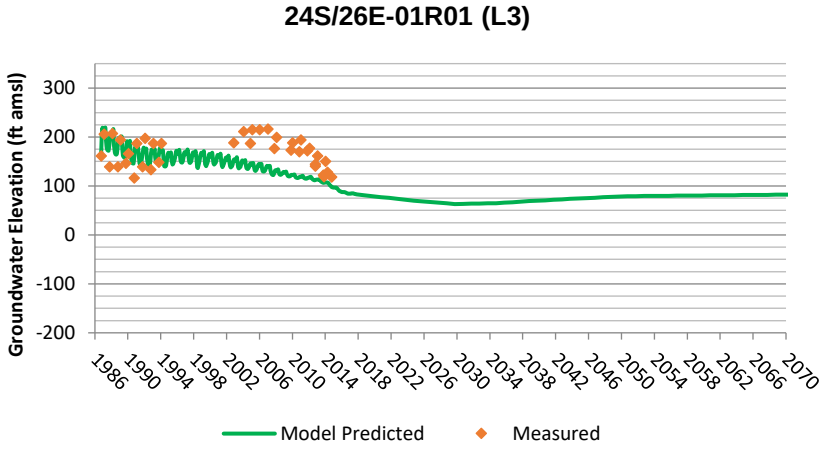
23S/26E-09C01 (L2)



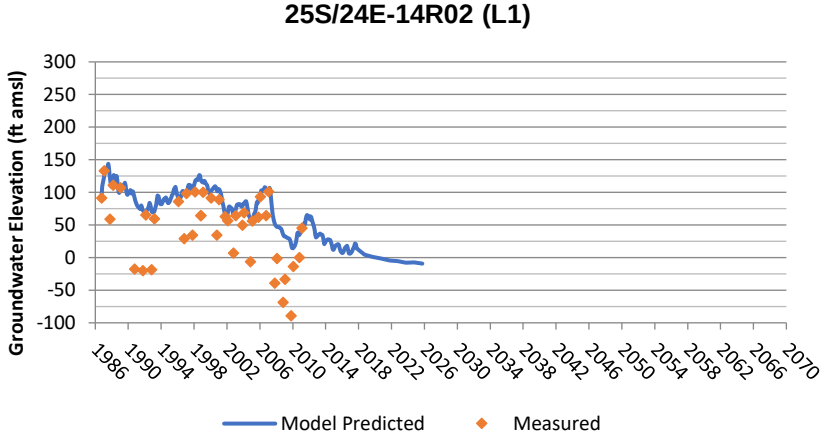
23S/26E-12J01 (L2)



24S/26E-01R01 (L3)

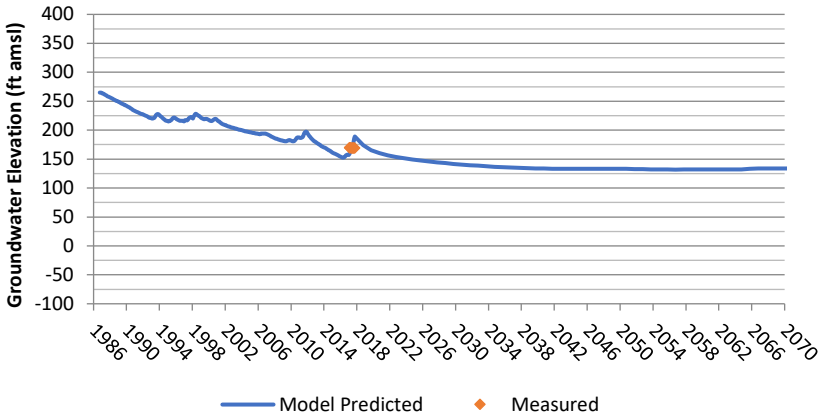


25S/24E-14R02 (L1)

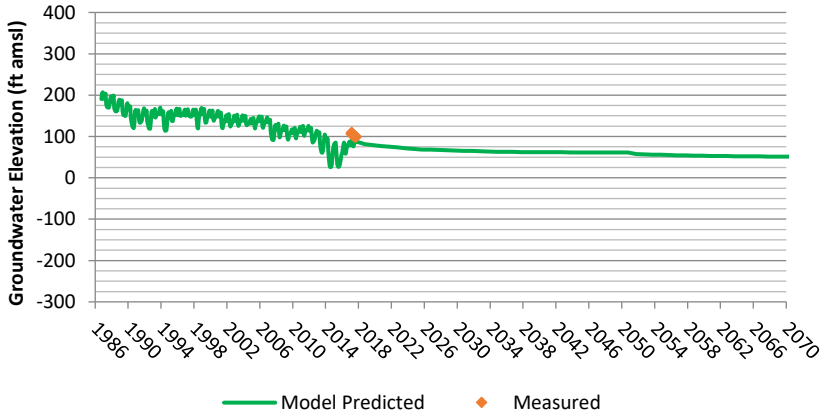


Model Simulated Hydrographs

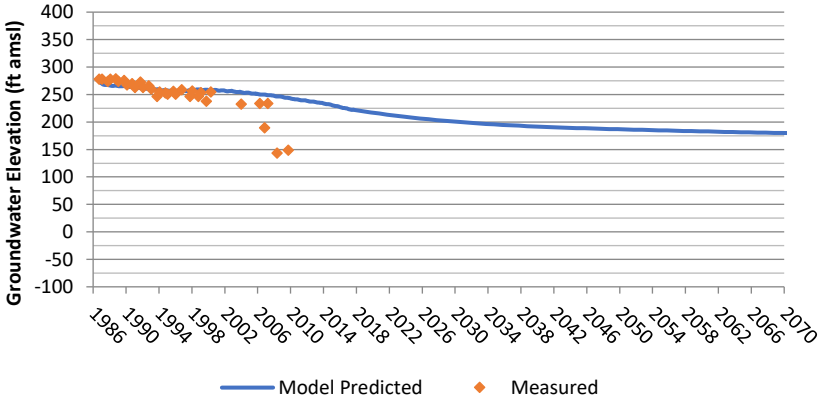
M19-L1 (DEID)



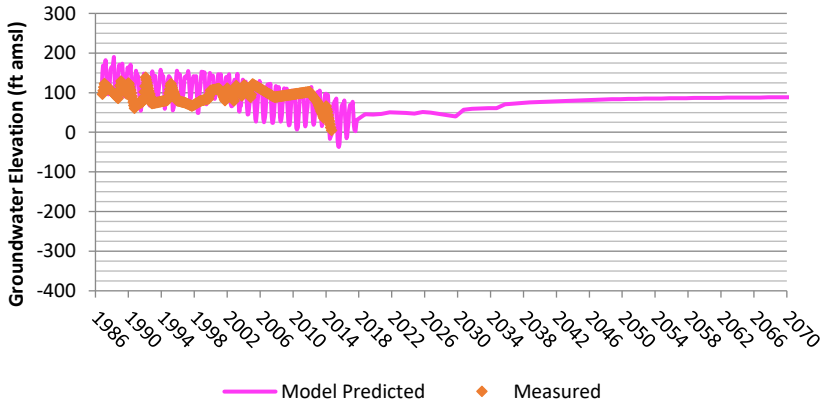
M19-L3 (DEID)



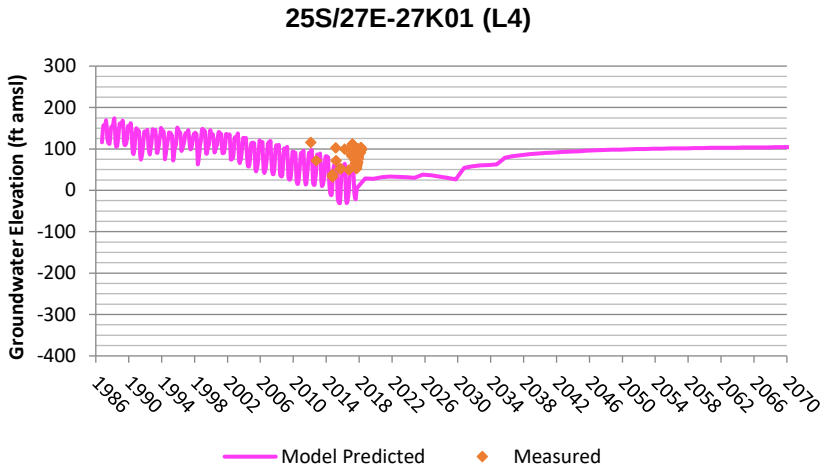
24S/25E-35P01 (L1)



24S/27E-32K01 (L4)



Model Simulated Hydrographs



This page intentionally left blank

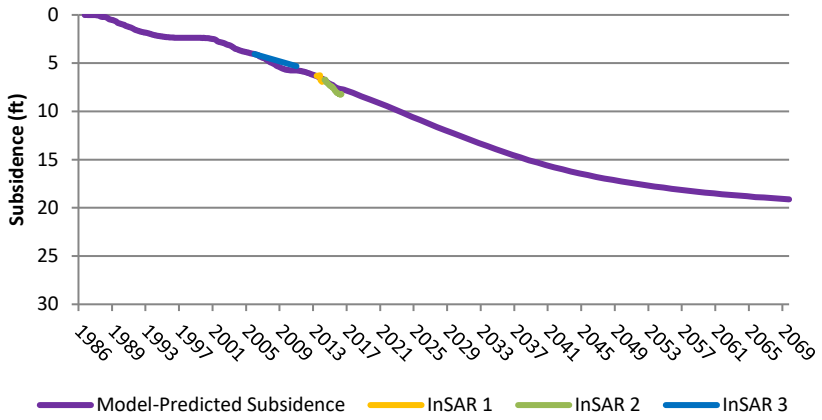
Appendix G

Model Simulation Land Subsidence Graphs

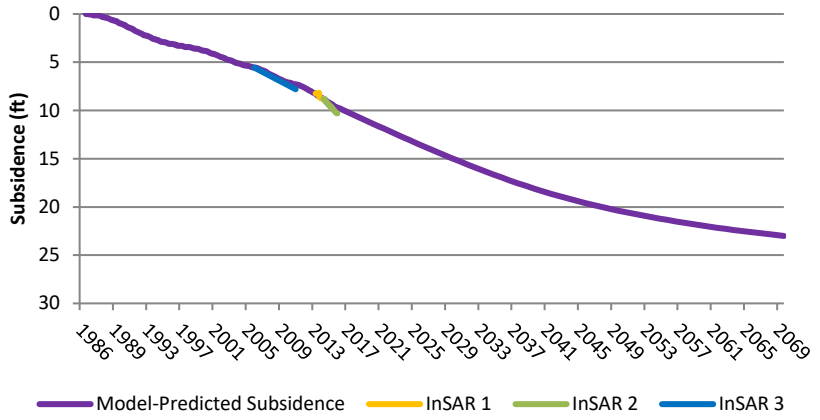
This page intentionally left blank

Model Simulation Land Subsidence Graphs

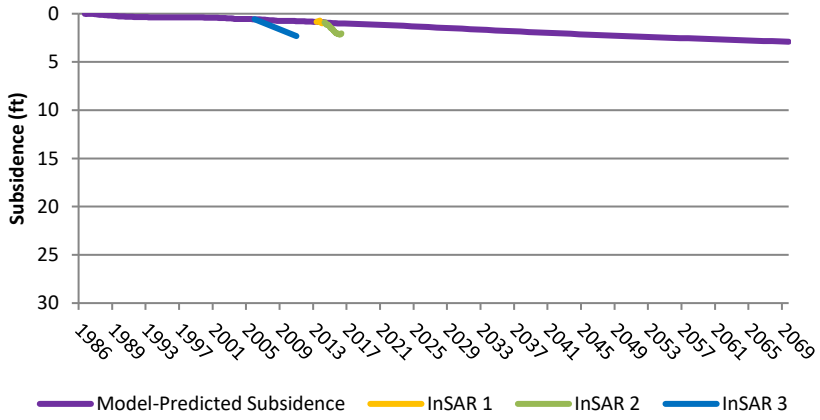
Sub-28



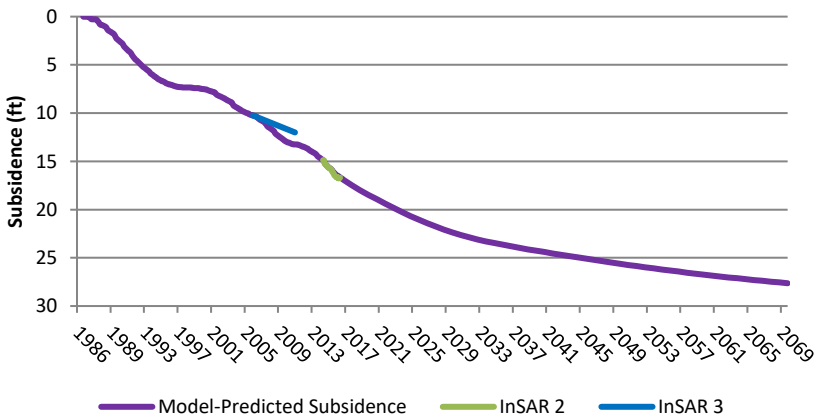
Sub-23



Sub-29

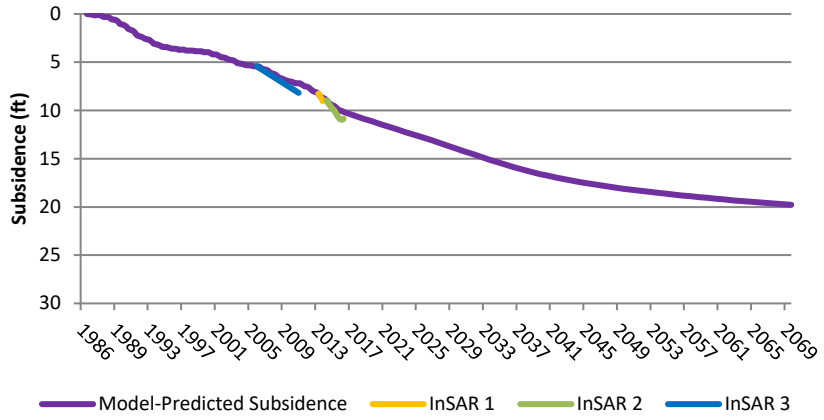


Sub-3

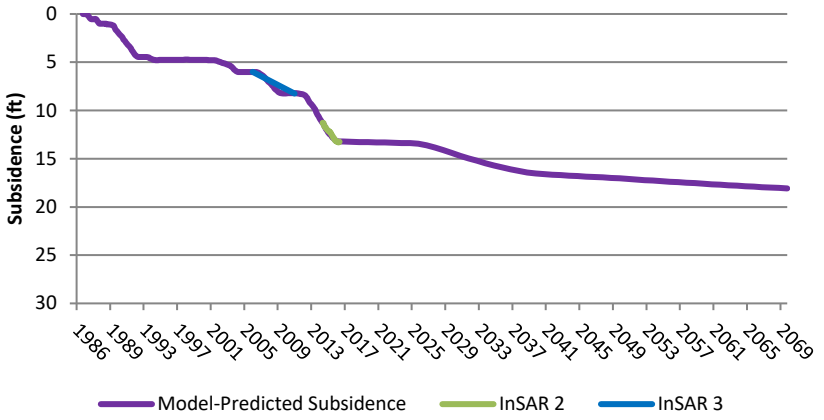


Model Simulation Land Subsidence Graphs

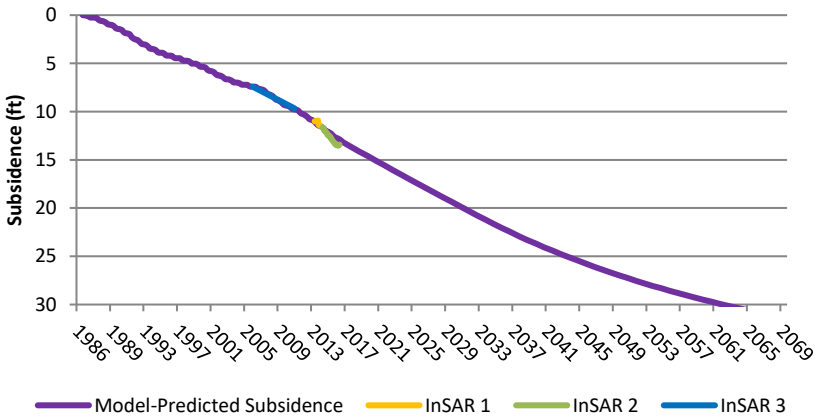
Sub-37 (21S/23E-32K01)



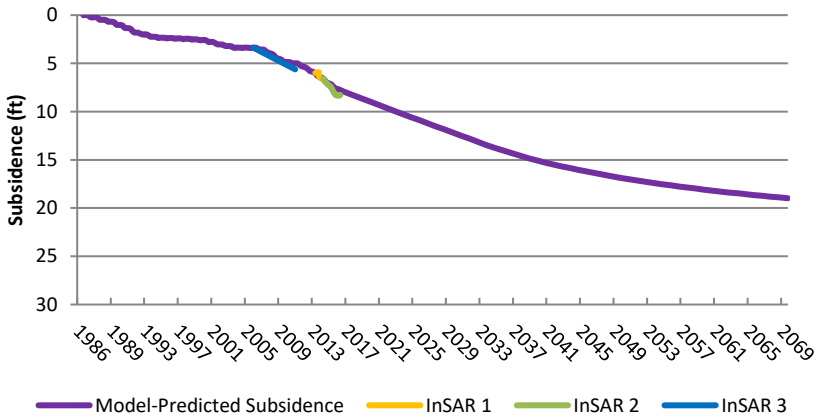
Sub-35 (21S/23E-36R01)



Sub-21

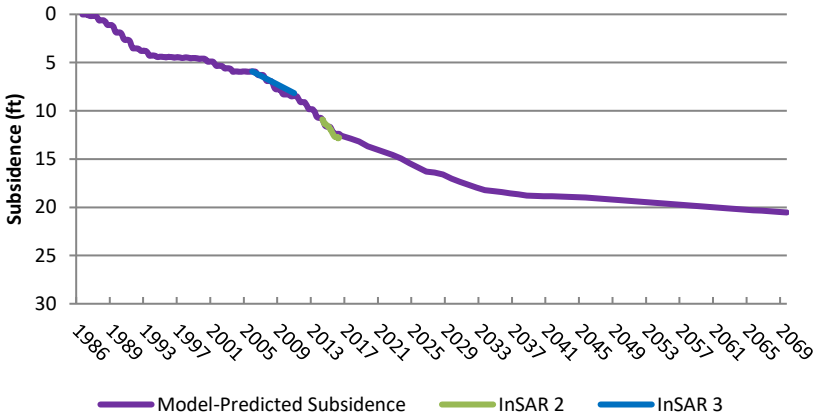


Sub-20

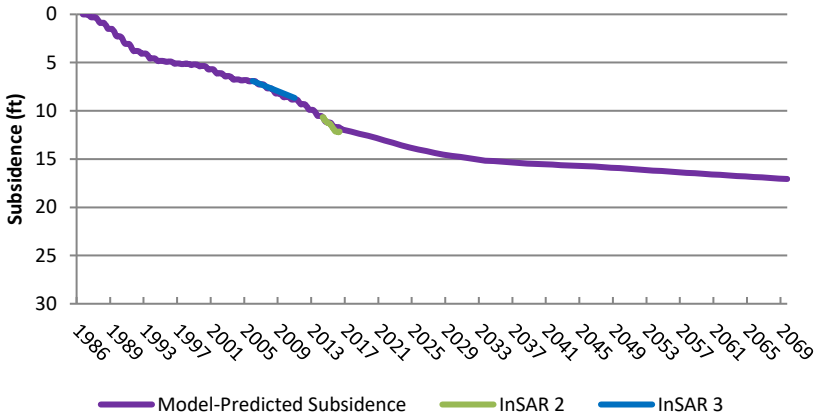


Model Simulation Land Subsidence Graphs

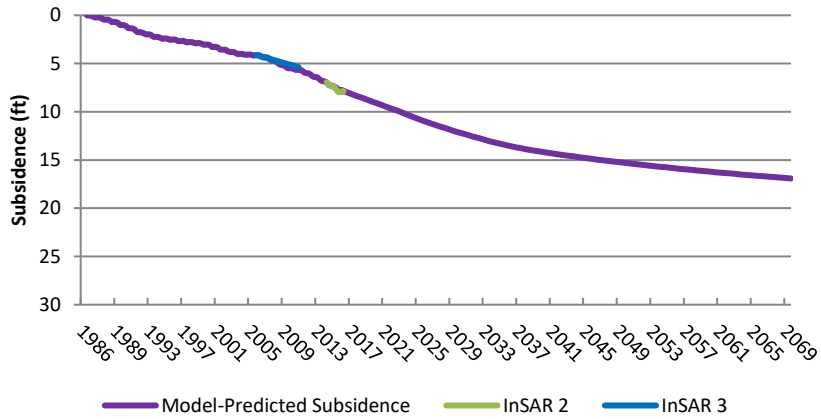
Sub-1



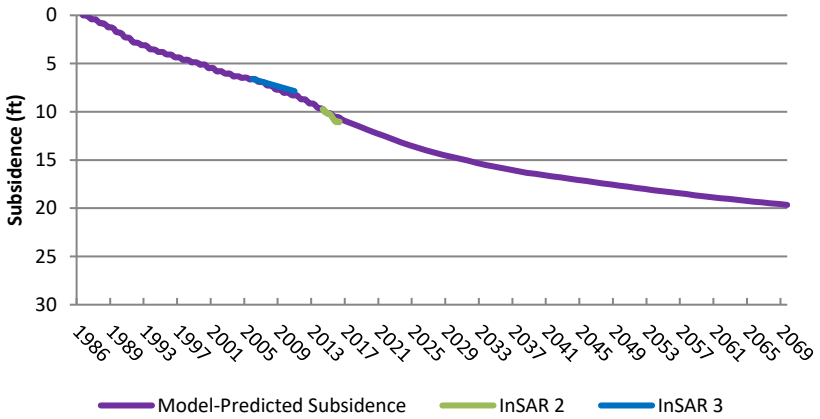
Sub-18



Sub-19

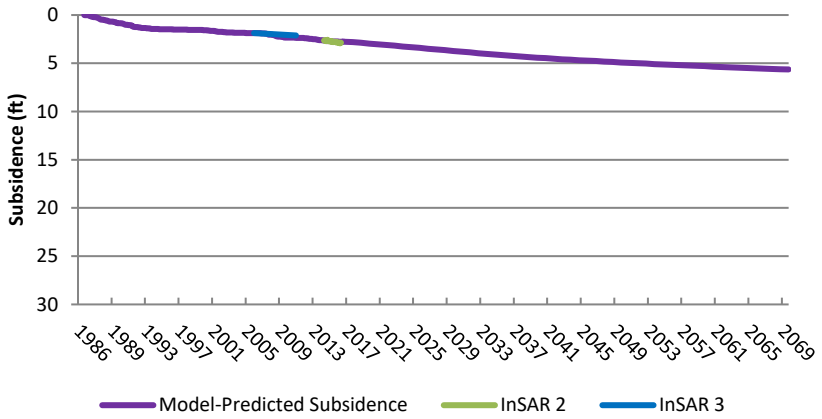


Sub-30 (24S/24E-03A01)

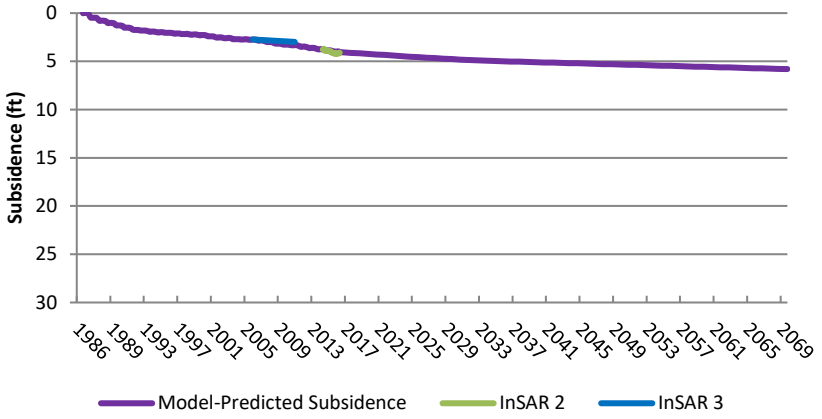


Model Simulation Land Subsidence Graphs

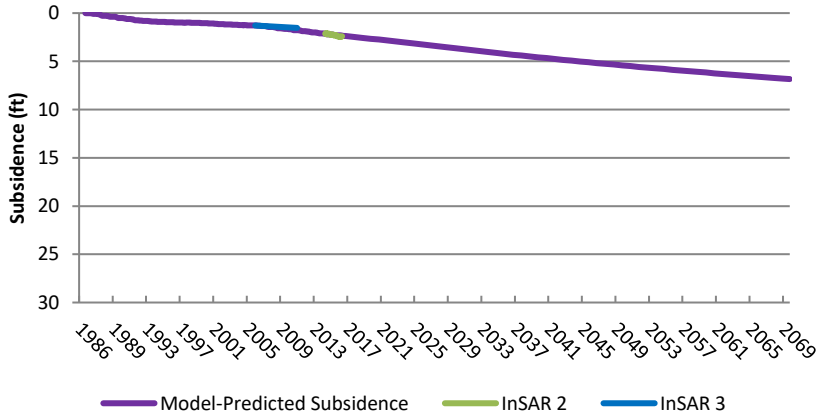
Sub-12



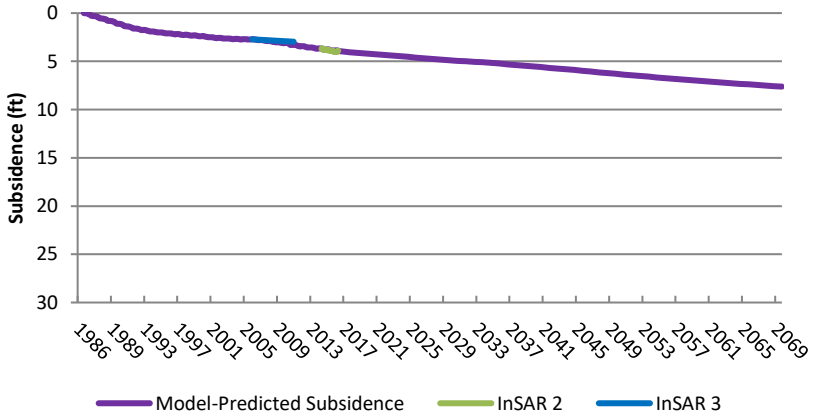
Sub-31 (24S/23E-22R02)



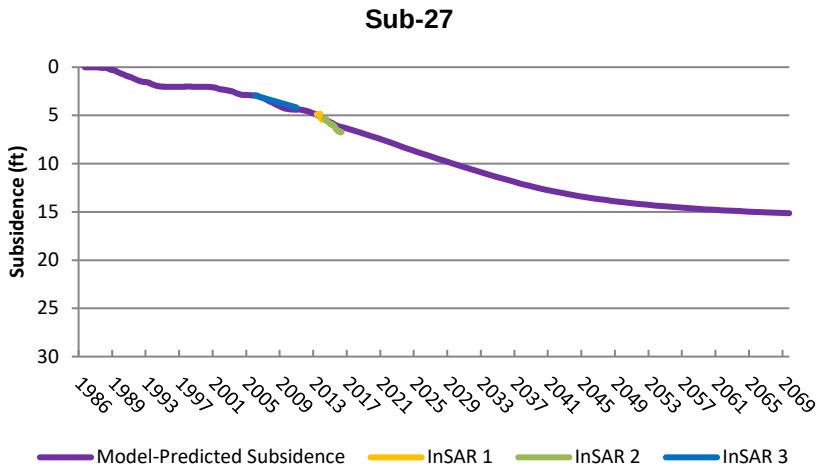
Sub-11

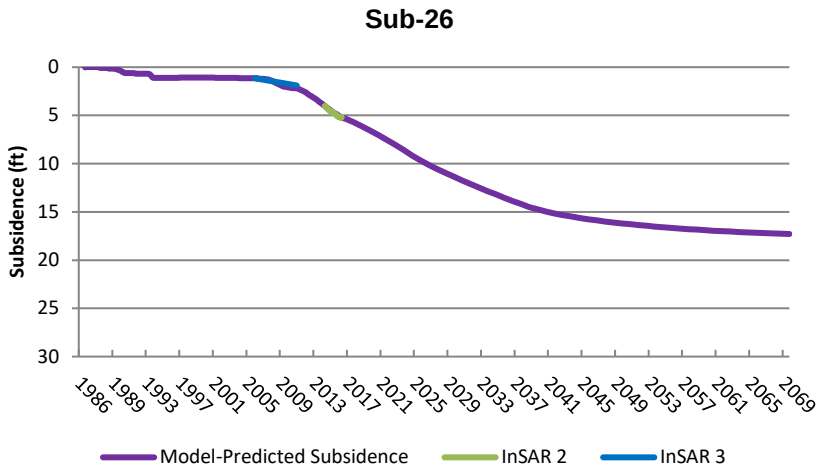


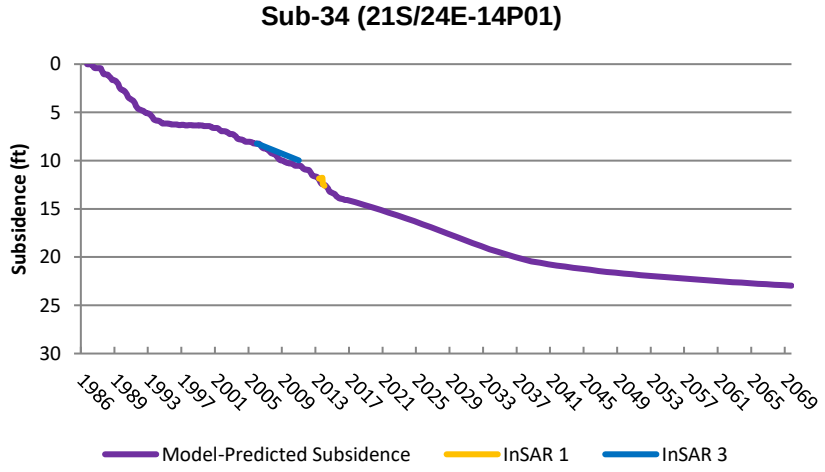
Sub-10

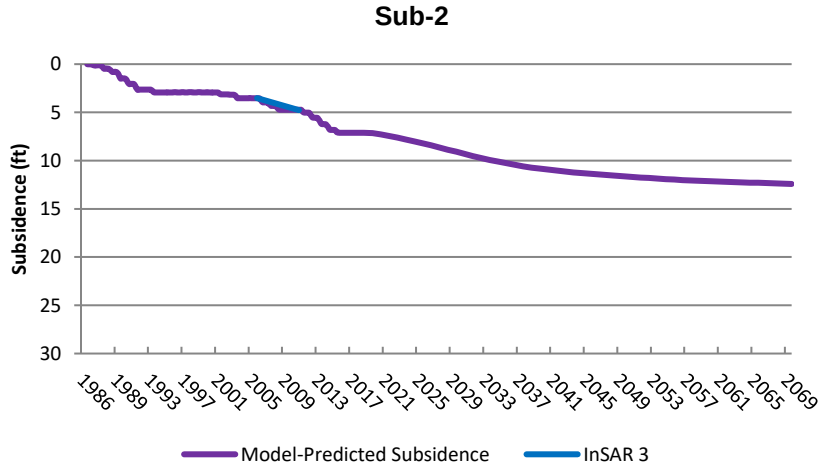


Model Simulation Land Subsidence Graphs

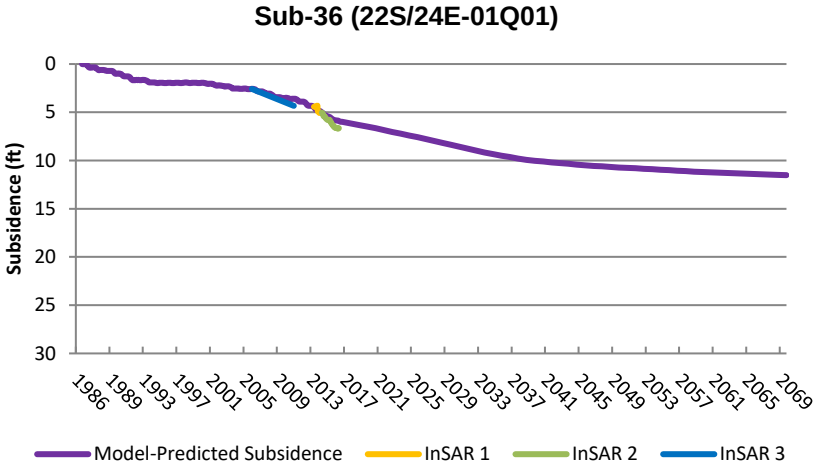


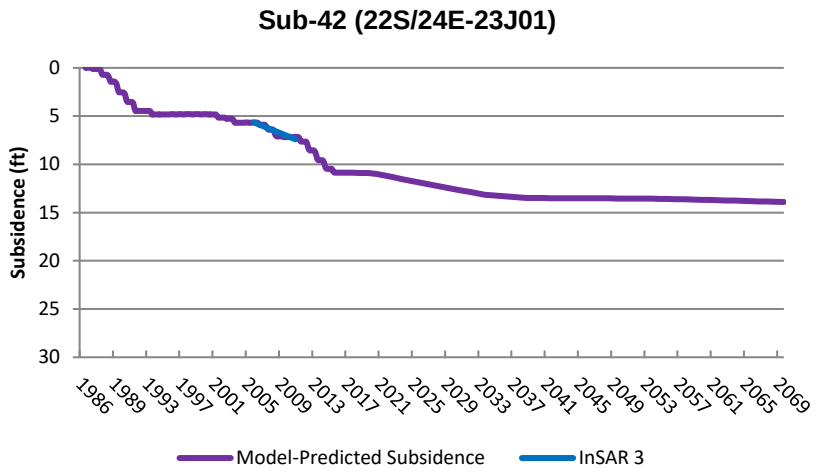


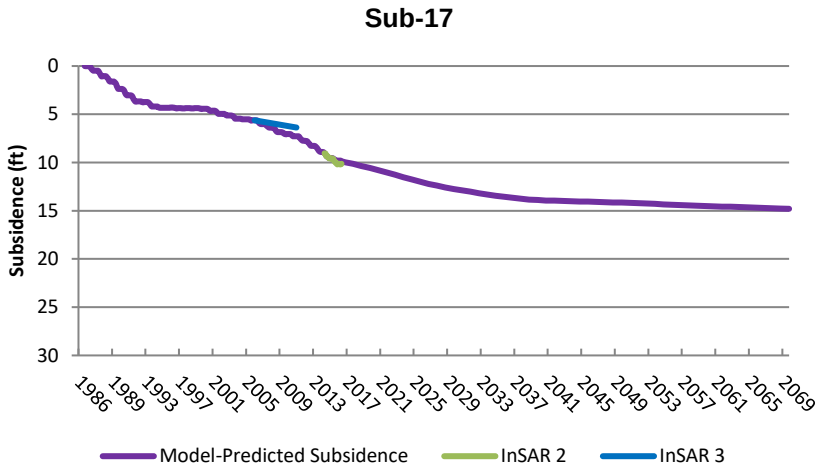


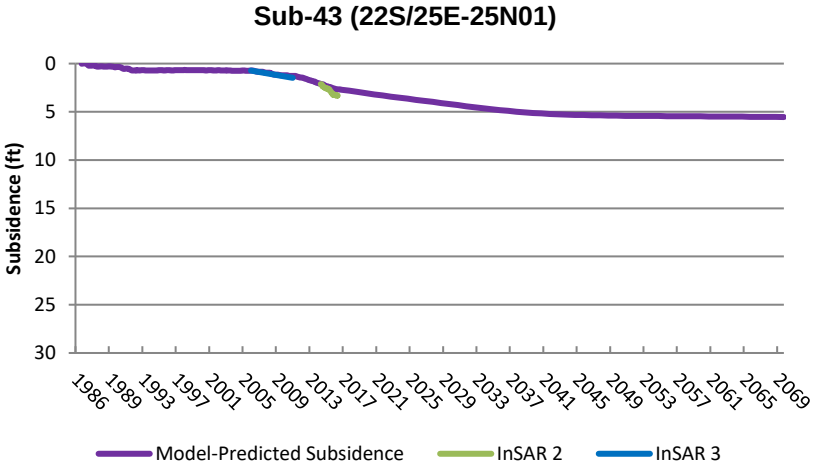


Model Simulation Land Subsidence Graphs



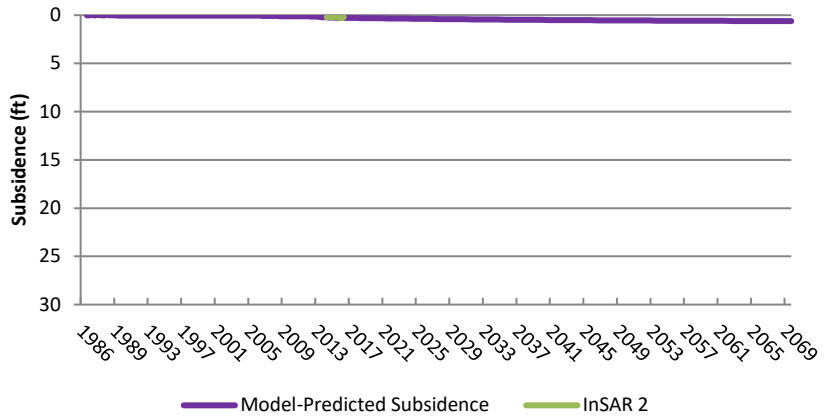




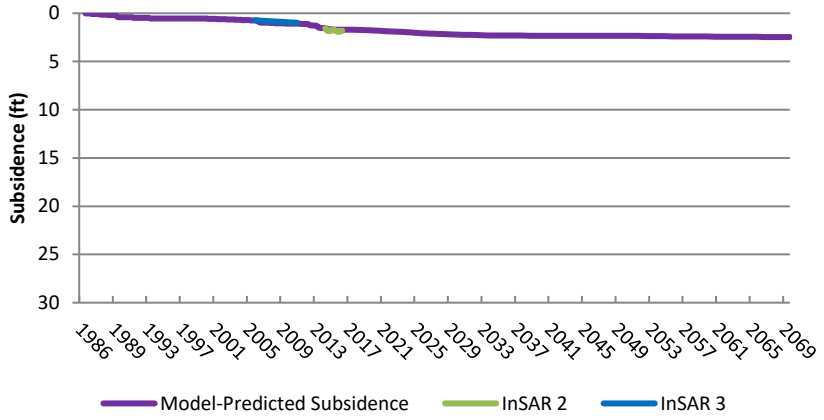


Model Simulation Land Subsidence Graphs

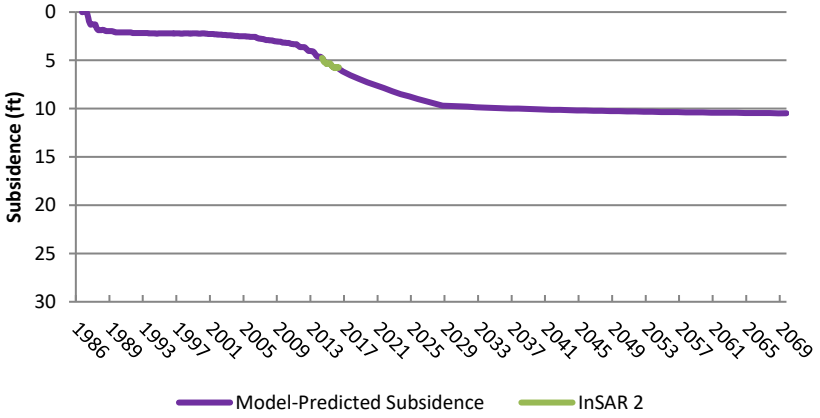
Sub-7



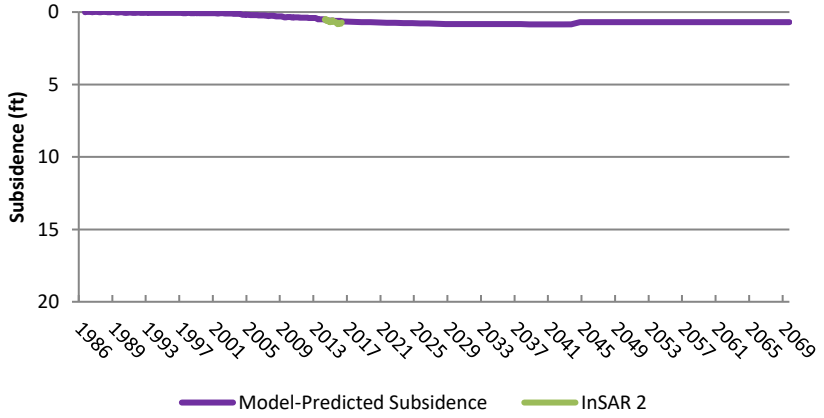
Sub-4



Sub-16

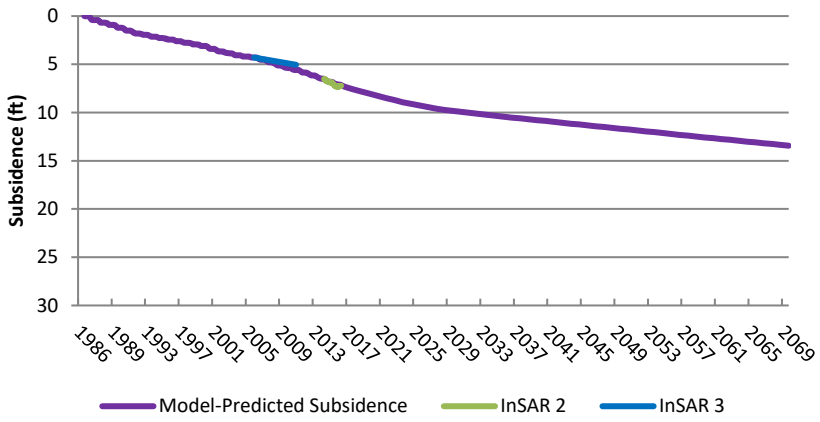


Sub-32 (24S/27E-32K01)

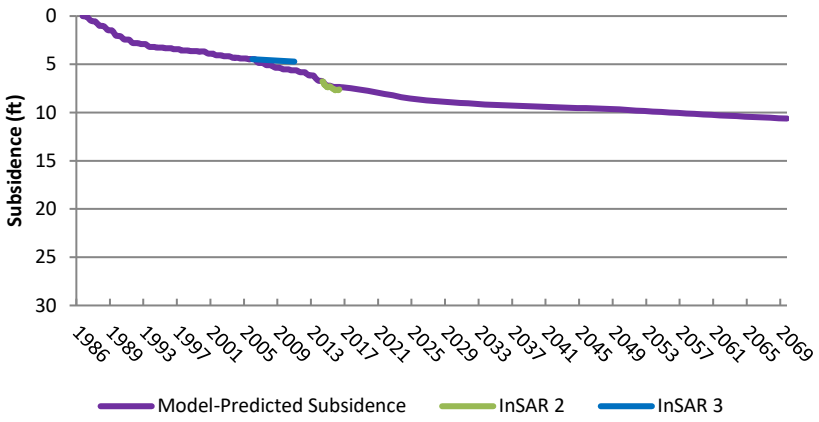


Model Simulation Land Subsidence Graphs

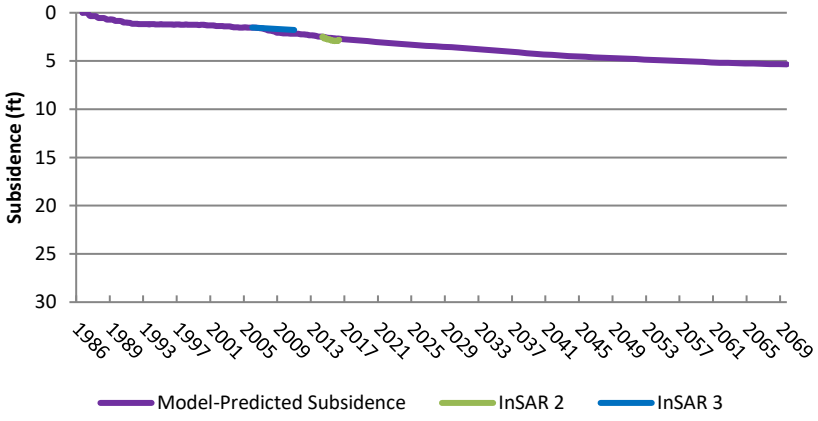
Sub-15



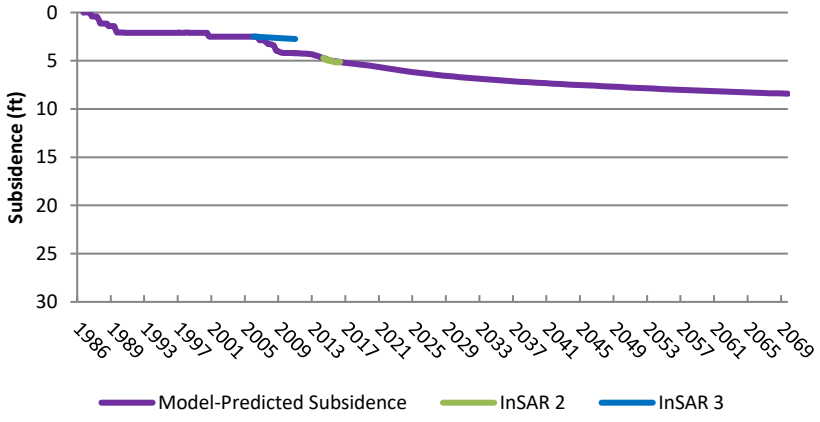
Sub-14



Sub-9

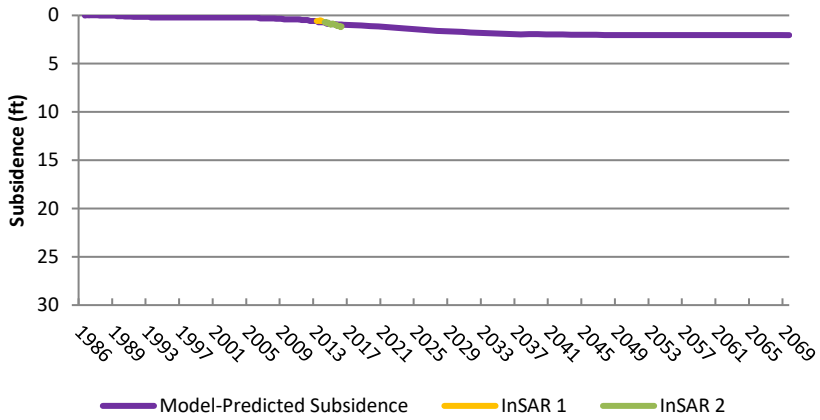


Sub-8

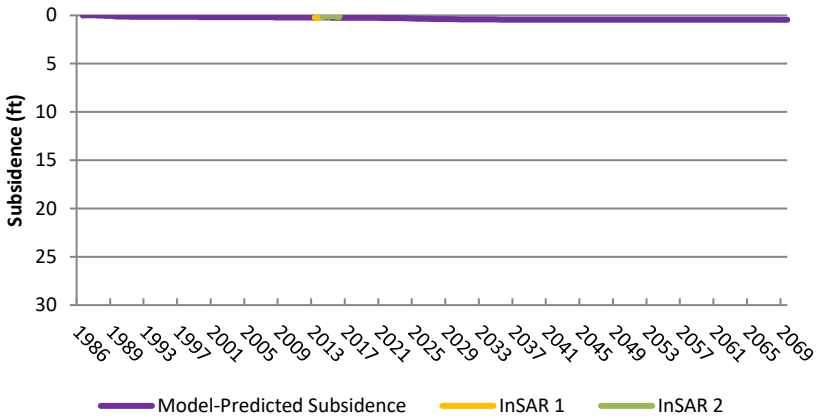


Model Simulation Land Subsidence Graphs

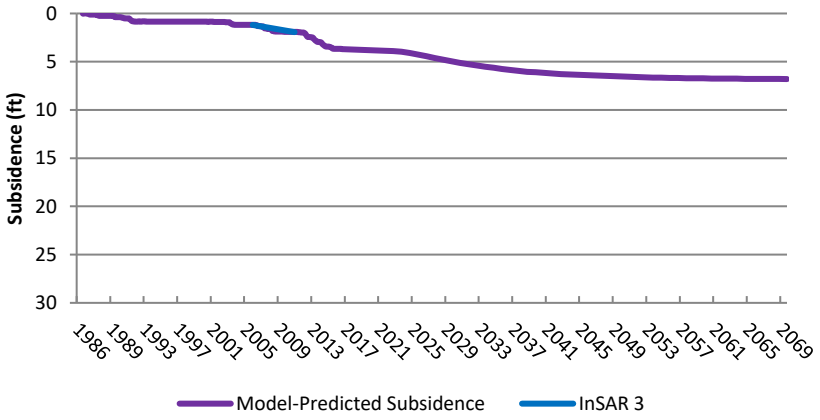
Sub-25



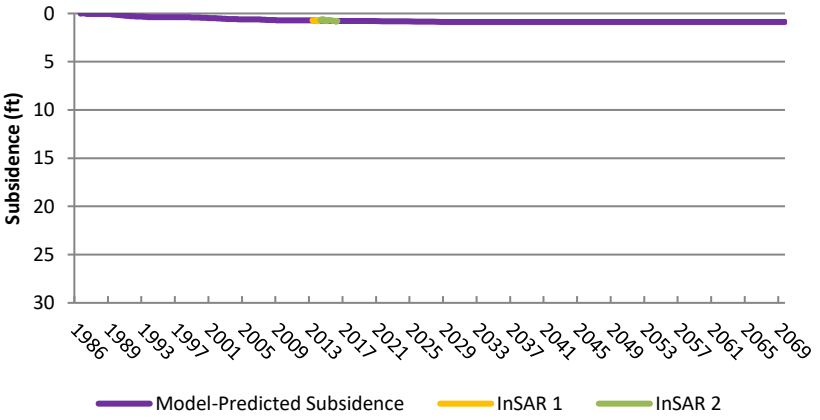
Sub-24



Sub-41 (21S/25E-01F01)

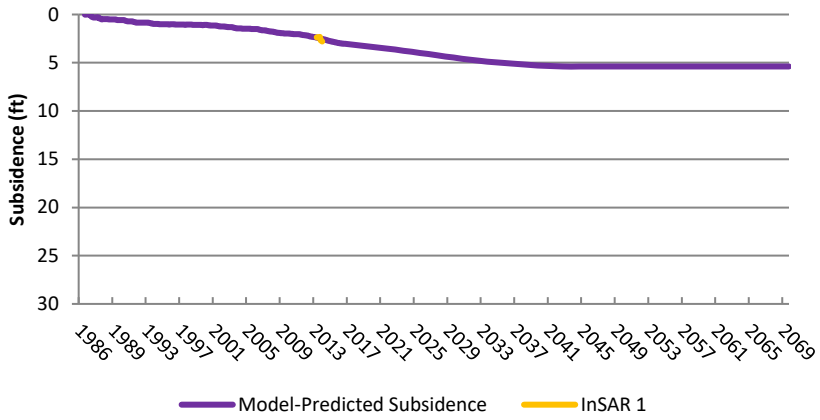


Sub-22

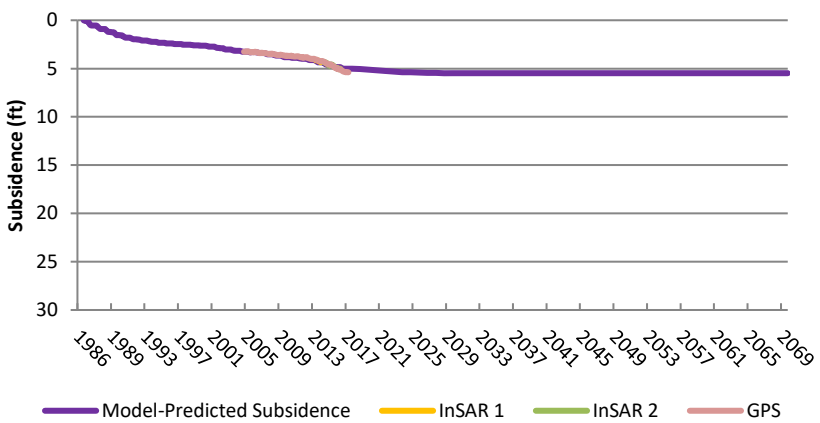


Model Simulation Land Subsidence Graphs

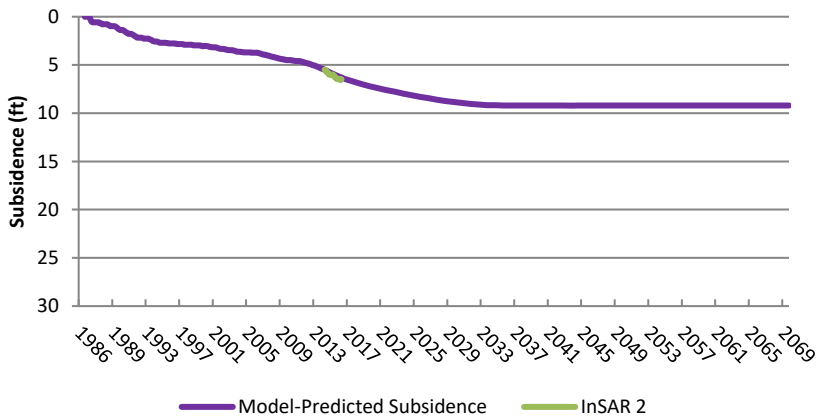
Sub-38 (21S/26E-32A01)



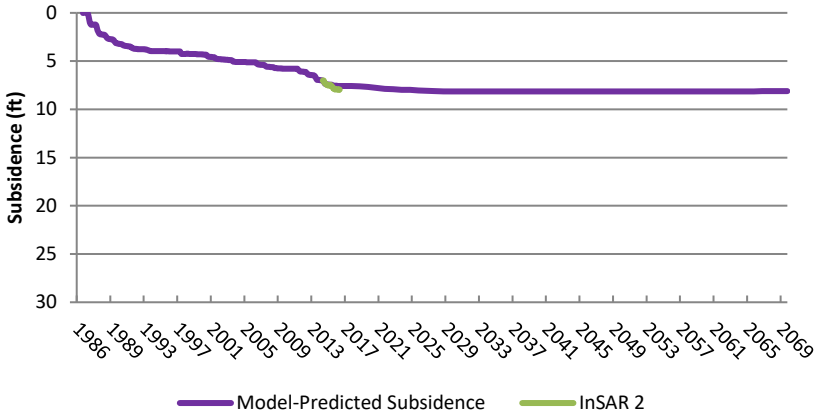
Sub-44 (Porterville GPS)



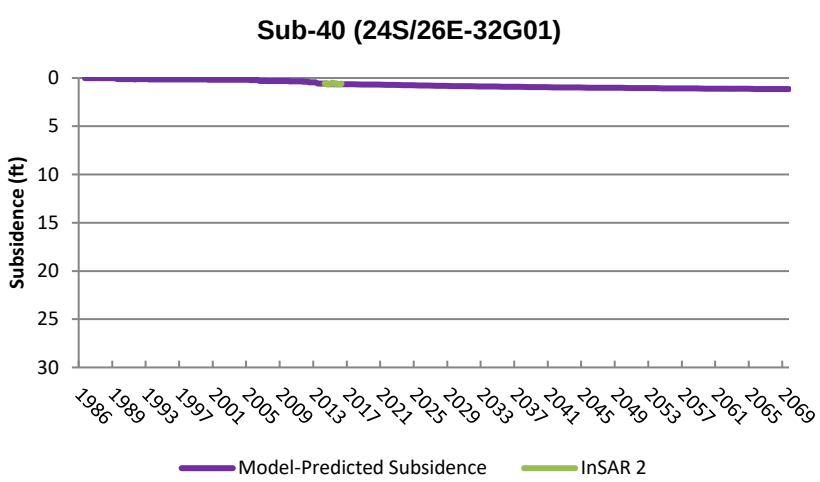
Sub-39 (22S/26E-10J01)

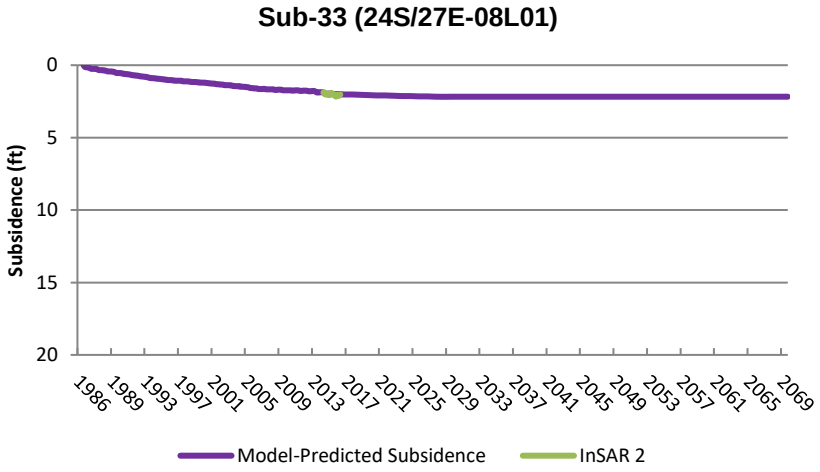


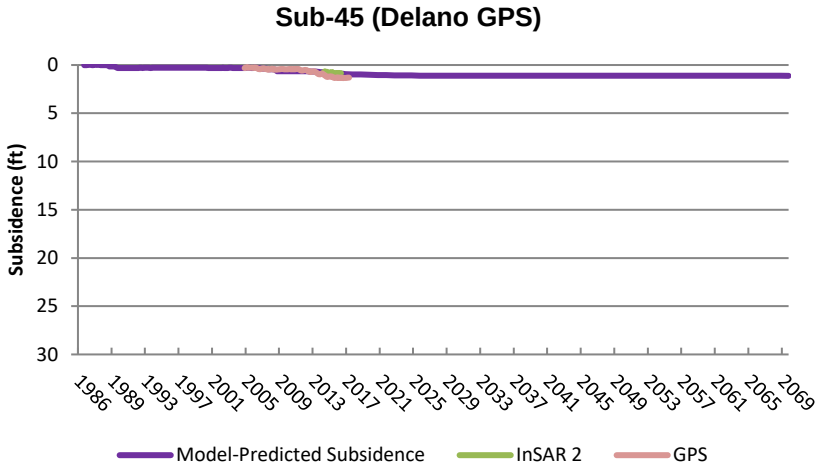
Sub-5

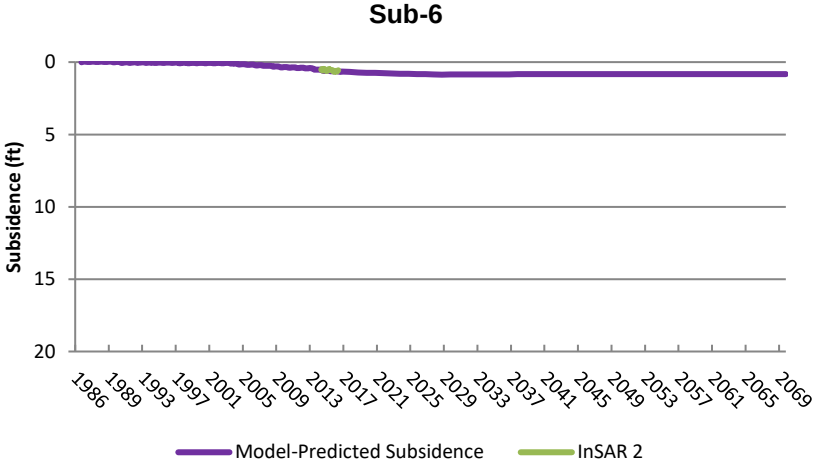


Model Simulation Land Subsidence Graphs

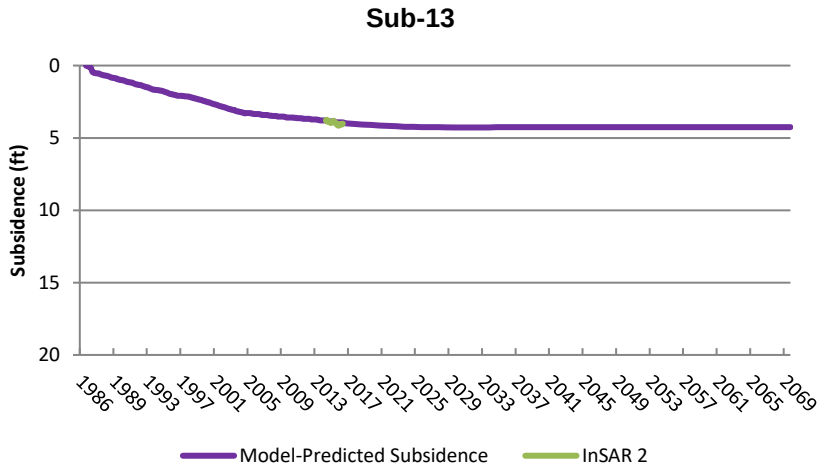








Model Simulation Land Subsidence Graphs



Appendix A Tule Subbasin Coordination Agreement

A4 Technical Support for Groundwater Levels

This page intentionally left blank