

CHOWCHILLA SUBBASIN

Sustainable Groundwater
Management Act (SGMA)

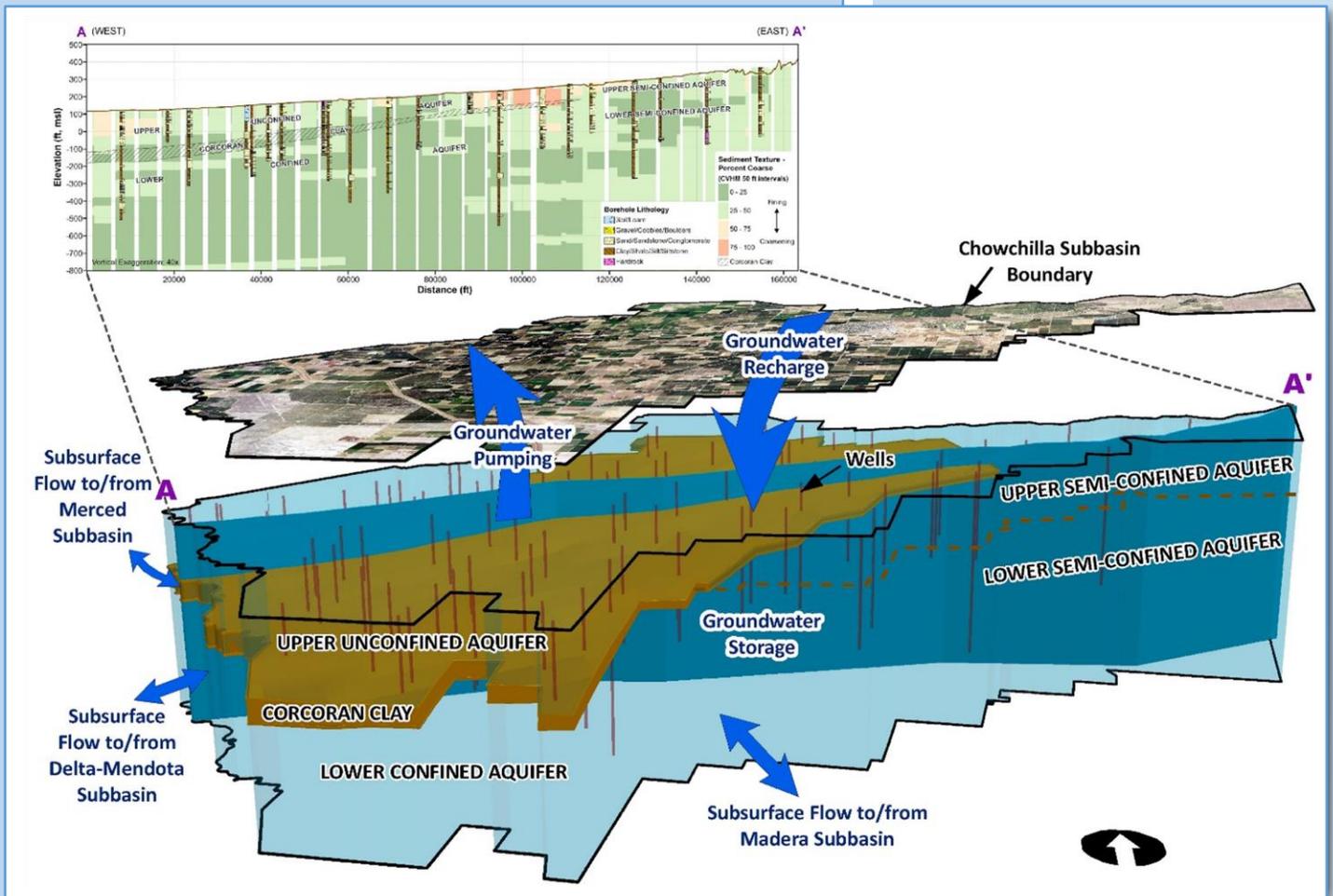
Annual Report

April 2022



Prepared by

Dauids Engineering, Inc
Luhdorff & Scalmanini



Chowchilla Subbasin
Groundwater Sustainability Plan (GSP)

2022 GSP Annual Report

For Water Year 2021
(October 2020 – September 2021)

April 2022

Prepared For

Chowchilla Water District GSA
Madera County GSA – Chowchilla
Merced County GSA – Chowchilla
Triangle T Water District GSA

Prepared By

Dauids Engineering, Inc
Luhdorff & Scalmanini



Table of Contents

Table of Contents	i
List of Tables	iii
List of Figures	iii
List of Appendices	iv
List of Abbreviations	v
Introduction	1
Executive Summary (§356.2.a)	3
1 Groundwater Elevations (§356.2.b.1)	10
1.1 Groundwater Level Monitoring.....	10
1.2 Groundwater Elevation Contour Maps (§356.2.b.1.A).....	16
1.2.1 Upper Aquifer.....	17
1.2.2 Lower Aquifer and Undifferentiated Unconfined Groundwater Zone.....	17
1.3 Groundwater Hydrographs (§356.2.b.1.B).....	21
2 Water Budget Approach for Quantifying Groundwater Extraction, Surface Water Supplies, and Total Water Use	22
2.1 Water Budget Structure.....	22
2.2 Uncertainties in Water Budget Components.....	24
3 Groundwater Extractions (§356.2.b.2)	25
3.1 Quantification and Accuracy.....	25
3.2 Data Sources.....	28
3.2.1 Measured Groundwater Extraction.....	28
3.2.2 Estimated Groundwater Extraction.....	28
3.3 Groundwater Recharge.....	29
4 Surface Water Supplies (§356.2.b.3)	31
4.1 Quantification by Water Source Type.....	31
4.2 Data Sources.....	33
4.2.1 Surface Water Inflows and Surface Water Outflows along Rivers and Streams ...	33
5 Total Water Use (§356.2.b.4)	35
5.1 Quantification by Water Use Sector and Water Source Type.....	35
5.2 Data Sources.....	38
6 Change in Groundwater Storage (§356.2.b.5)	39
6.1 Change in Groundwater Storage Maps.....	39
6.2 Groundwater Use and Change in Groundwater Storage.....	46



6.3	Subsidence Data/Maps.....	48
7	Groundwater Sustainability Plan Implementation Progress (§356.2.c).....	49
7.1	Implementation of Projects and Management Actions (§356.2.c).....	49
7.1.1	DWR’s Review of the Chowchilla Subbasin GSP and Efforts to Address Potential Deficiencies	49
7.1.2	Domestic Well Mitigation Program	50
7.1.3	Projects and Management Actions.....	52
7.1.4	Chowchilla Water District GSA Projects	62
7.1.5	Madera County GSA Projects	62
7.1.6	Sierra Vista Mutual Water Company Projects	66
7.1.7	Triangle T Water District GSA Projects	66
7.2	Additional Projects Identified Since GSP Adoption.....	67
7.2.1	Chowchilla Water District GSA Projects	67
7.2.2	Triangle T Water District GSA Projects	68
7.2.3	Jointly Implemented Projects	68
7.2.4	Other GSA Projects	68
7.3	Implementation of Monitoring and Addressing Data Gaps.....	69
7.4	Interim Milestone Status (§356.2.c).....	69
8	References.....	75



List of Tables

- Table ES-1. Chowchilla Subbasin GSAs and Water Budget Subregions.
- Table 1-1. Summary of Groundwater Level RMS Well Information and Measurements During Report Year (2021).
- Table 3-1. Groundwater Extraction Volumes and Measurement Methods by Water Use Sector, and Uncertainty (2021).
- Table 3-2. Chowchilla Subbasin Groundwater Extractions, by Water Use Sector (acre-feet, rounded).
- Table 3-3. Chowchilla Subbasin Groundwater Recharge (acre-feet, rounded).
- Table 4-1. Surface Water Supplies Used (Surface Water Inflows – Surface Water Outflows), by Water Source Type (acre-feet, rounded).
- Table 4-2. Rivers and Streams System Water Budget Detailed Components and Estimation Techniques.
- Table 5-1. Chowchilla Subbasin Total Water Use, by Water Use Sector and Water Source Type (acre-feet, rounded).
- Table 5-2. Chowchilla Subbasin Consumptive Water Use, by Water Use Sector and Water Source Type (acre-feet, rounded).
- Table 5-3. Chowchilla Subbasin Weather Data Sources.
- Table 6-1. Calculated Change in Groundwater Storage in the Upper Aquifer Zone.
- Table 6-2. Calculated Change in Groundwater Storage in the Combined Lower Aquifer and Undifferentiated Unconfined Zone.
- Table 6-3. Total Calculated Change in Groundwater Storage in the GSP Area.
- Table 7-1. Project and Management Action Implementation Summary.
- Table 7-2. Project and Management Action Benefit Summary.
- Table 7-3. Project and Management Action Cost Summary, 2021.
- Table 7-4. Project and Management Action Cost Summary, Estimated Average for all Projects and Management Actions.
- Table 7-5. Summary of RMS Well Groundwater Levels Relative to Interim Milestones, Minimum Thresholds, and Measurable Objectives.

List of Figures

- Figure ES-1. Chowchilla Subbasin GSAs Map.
- Figure ES-2. Chowchilla Subbasin Water Budget Subregions.
- Figure 1-1. Most Recent Groundwater Level Measurement by Well.
- Figure 1-2. Groundwater Levels Sustainable Indicator Wells.
- Figure 1-3. Contours of Equal Groundwater Elevation Upper Aquifer – Spring 2021.
- Figure 1-4. Contours of Equal Groundwater Elevation Upper Aquifer – Fall 2021.
- Figure 1-5. Contours of Equal Groundwater Elevation Lower Aquifer/Undifferentiated Unconfined Zone – Spring 2021.
- Figure 1-6. Contours of Equal Groundwater Elevation Lower Aquifer/Undifferentiated Unconfined Zone – Fall 2021.
- Figure 2-1. Water Budget Accounting Structure (Source: DWR, 2016).
- Figure 3-1. Agricultural Groundwater Extraction in Irrigated Areas, by Subregion.



Figure 6-1. Change in Groundwater Level in the Upper Aquifer – Spring 2020 through Spring 2021.

Figure 6-2. Change in Groundwater Level in the Lower Aquifer/Undifferentiated Unconfined Zone – Spring 2020 through Spring 2021.

Figure 6-3. Change in Groundwater Storage in the Upper Aquifer – Spring 2020 through Spring 2021.

Figure 6-4. Change in Groundwater Storage in the Lower Aquifer/Undifferentiated Unconfined Zone – Spring 2020 through Spring 2021.

Figure 6-5. Annual Groundwater Storage Changes and Extractions.

Figure 7-1. Chowchilla Subbasin Domestic Well Mitigation Program Draft Workflow.

Figure 7-2. Fall 2021 Water Level Measurements at RMS Wells compared to 2025 Interim Milestone.

Figure 7-3. Fall 2021 Water Level Measurements at RMS Wells compared to Minimum Threshold.

List of Appendices

Appendix A. Contour Maps of the Different Aquifer Units.

Appendix B. Hydrographs of Time-Series Groundwater Level Data for Groundwater Level RMS Wells.

Appendix C. Maps of Change in Groundwater Levels and Change in Groundwater Storage in 2016 through 2020, Separated by Principal Aquifer.

Appendix D. Subsidence Maps for Six Recent Years and Cumulative for 2015 to 2021.

Appendix E. Status of Monitoring Efforts for RMS Wells in Chowchilla Subbasin.



List of Abbreviations

AF	acre-feet	CVHM	Central Valley Hydrologic Model
AG	Agricultural Land	CVP	Central Valley Project
AMSL	above mean sea level	CWC	California Water Code
AN	above normal	CWD	Chowchilla Water District
AWMPs	agricultural water management plans	D	dry
AWS	Automatic Weather Stations	DAC	Disadvantaged Community
Bgs	below ground surface	DDW	Division of Drinking Water
BMP	Best Management Practice	DE	Dauids Engineering
BN	below normal	DMS	Data Management System
C	critical	DQO	data quality objectives
C2VSim	California Central Valley Groundwater-Surface Water Simulation Model	DTW	depth to water
C2VSim-CG	published coarse-grid version of C2VSim, Version R374	DWR	California Department of Water Resources
C2VSim-FG	published fine-grid version of C2VSim	EFH	Essential Fish Habitat
CCC	Columbia Canal Company	ERA	ERA Economics, LLC
CCID	Central California Irrigation District	ET	evapotranspiration
CCP	Consensus and Collaboration Program at California State University, Sacramento	Et _a	actual ET
CCR	California Code of Regulations	ET _{aw}	ET of applied water
CDEC	California Data Exchange Center	ET _c	crop ET
cfs	cubic feet per second	ET _o	grass reference ET
CIMIS	California Irrigation Management Information System	ET _{pr}	ET of precipitation
CSUS	California State University, Sacramento (Consensus and Collaboration Program)	ET _r	alfalfa reference ET
		ET _{ref}	reference crop evapotranspiration
		eWRIMS	Electronic Water Rights Information Management System
		Flood-MAR	Flood Managed Aquifer Recharge
		FTE	full-time-equivalent
		GAMA	Groundwater Ambient Monitoring and Assessment



GDEs	groundwater dependent ecosystems	MCL	maximum contaminant level
GIS	geographic information system	MCWPA	Madera-Chowchilla Water and Power Authority
GMP	Groundwater Management Plan	Merced	Merced Irrigation District
GRF	Gravelly Ford	Merced Co	Merced County
GSA	Groundwater Sustainability Agencies	Merced ID	Merced Irrigation District
GSP	Groundwater Sustainability Plan	mg/L	milligrams/liter
GWE	Groundwater Elevation	MID	Madera Irrigation District
GWS	groundwater system	MIGR	Warm and cold migration habitat
HCM	hydrogeologic conceptual model	MO	measurable objectives
HGL	hydraulic grade line	MSL	mean sea level
IDC	Integrated Water Flow Model Demand Calculator	MT	minimum thresholds
iGDEs	indicators of GDEs	MUN	Municipal and domestic supply
ILRP	Irrigated Lands Regulatory Program	MWELO	Model Water Efficient Landscape Ordinance
IWFM	Integrated Water Flow Model	NASA-JPL	National Aeronautics and Space Administration Jet Propulsion Laboratory
K	hydraulic conductivity	NCCAG	Natural Communities Commonly Associated with Groundwater
Kh	horizontal hydraulic conductivity	NOAA NCEI	National Oceanic and Atmospheric Administration National Centers for Environmental Information
Kv	vertical hydraulic conductivity	NV	Native Vegetation Land
LDC	Little Dry Creek	NWIS	National Water Information System
LSCE	Luhdorff & Scalmanini Consulting Engineers	O&M	operation and maintenance
MA	Management actions	ORP	oxidation-reduction potential
Maf	millions of acre-feet	pCi/L	picocuries per liter
MAR	Managed aquifer recharge	pTb	Pre-Tertiary basement complex
MC	Madera County	PV	Present Value
MCDEH	Merced County Department of Public Health, Division of Environmental Health		



Qb	Quaternary flood-plain deposits	SS	Stillwater Sciences
Qoa	Older Quaternary alluvium	SVMWC	Sierra Vista Mutual Water Company
QTc	Tertiary and Quaternary continental deposits	SWRCB	State Water Resources Control Board
QTcd	Quaternary continental rocks and deposits	SWS	surface water system
Qya	younger Quaternary alluvium	Sy	specific yield
Reclamation	United States Bureau of Reclamation	T	transmissivity
redox	reduction-oxidation	Ta	air temperature
RFP	Request for Proposals	TAF	thousand acre-feet
RH	relative humidity	TDS	total dissolved solids
RMS	Representative monitoring sites	TM	Technical Memorandum
RPE	Reference Point Elevation	TMWA	Truckee Meadows Water Authority
Rs	solar radiation	TpTu	Pre-Tertiary and Tertiary marine and continental sedimentary rocks
SAGBI	Soil Agricultural Groundwater Banking Index	TTWD	Triangle T Water District
SB	Senate Bill	UR	Urban Land
SCS	USDA Soil Conservation Service (renamed Natural Resources Conservation Service)	USACE	United States Army Corps of Engineers
SCS-CN	SCS curve number	USBR	U.S. Bureau of Reclamation, or Reclamation
SEBAL	Surface Energy Balance Algorithm for Land	USDA	U.S. Department of Agriculture
SGMA	Sustainable Groundwater Management Act of 2014	USEPA	U.S. Environmental Protection Agency
SJRRP	San Joaquin River Restoration Program	USGS	United States Geological Survey
SJV	San Joaquin Valley	UWMPs	urban water management plans
SLDMWA	San Luis Delta-Mendota Water Authority	W	wet
SMC	Sustainable Management Criteria	WARM	Warm freshwater habitat
SPWN	Warmwater spawning habitat	WCRs	well completion reports
		WDL	Water Data Library
		WILD	Wildlife habitat



Ws	wind speed
WYI	Water Year Index
YCWA	Yuba County Water Agency
yield	groundwater benefit
µg/L	micrograms per lite



Introduction

The California Code of Regulations Title 23 (23 CCR) §356.2 requires that annual reports be submitted to the California Department of Water Resources (DWR) by April 1 of each year following the adoption of the Groundwater Sustainability Plan (GSP). This Annual Report is the third Annual Report for the Chowchilla Subbasin GSP, which is required to be submitted to DWR by April 1, 2022.

The 2022 Annual Report for the Chowchilla Subbasin GSP has been developed in compliance with all of the requirements of 23 CCR §356.2. This Annual Report describes conditions across the entire Chowchilla Subbasin and the efforts made toward GSP implementation through April 2022.

The Chowchilla Subbasin is managed by four groundwater sustainability agencies (GSAs): Chowchilla Water District (CWD) GSA, Madera County GSA – Chowchilla (Madera County GSA), Merced County GSA – Chowchilla (Merced County GSA), and Triangle T Water District (TTWD) GSA. The jurisdictional areas of these four GSAs have been organized into five subbasin subregions for GSP planning and implementation efforts. These subregions include: CWD GSA, Madera County GSA – East, Madera County GSA – West, Sierra Vista Mutual Water Company (SVMWC), and TTWD GSA. The relationship between the Chowchilla Subbasin GSAs and subregions is described in **Table ES-1**, and shown in **Figures ES-1 and ES-2**. Each subregion represents either one entire GSA (CWD GSA, TTWD GSA), a portion of one GSA (Madera County GSA – East, Madera County GSA – West), or combined areas across more than one GSA (SVMWC).

This Annual Report provides basic information about the Chowchilla Subbasin plan area and presents technical information from water year 2015 (after the end of the historical water budget period) through the current reporting year (water year 2021) (23 CCR §356.2.b.5.B), including:

- Groundwater elevation data from monitoring wells
- Contour maps and hydrographs of groundwater elevations
- Total groundwater extractions
- Surface water supply used, including for groundwater recharge or other in-lieu uses
- Total water use
- Change in groundwater storage
- Progress towards implementing the GSP

Groundwater elevation, groundwater extraction, surface water supply, and groundwater storage are summarized for the entire Subbasin, while progress towards implementing the GSP is described for each subregion. The DWR water year ends on September 30th of the named year and begins on October 1st of the previous year; therefore, the period covered by this Annual Report is October 1, 2020, through September 30, 2021. The structure for the Annual Report generally follows the structure of the requirements outlined in 23 CCR §356.2.



Also included with this Annual Report are appendices that contain the required groundwater maps and hydrographs that must be submitted with each Annual Report. The following appendices are located at the end of this Annual Report:

- Appendix A. Contour Maps of the Different Aquifer Units.
- Appendix B. Hydrographs of Time-Series Groundwater Level Data for Groundwater Level RMS Wells.
- Appendix C. Maps of Change in Groundwater Levels and Change in Groundwater Storage in 2016 through 2020, Separated by Principal Aquifer.
- Appendix D. Subsidence Maps for four recent years and cumulative for 2015 to 2021.
- Appendix E. Status of Monitoring Efforts for RMS Wells in Chowchilla Subbasin.

Table ES-1. Chowchilla Subbasin GSAs and Water Budget Subregions.

GSA	Subregion	Subregion Abbreviation	Subregion Area, Acres
Chowchilla Water District GSA	Chowchilla Water District GSA	CWD GSA	85,200
Madera County GSA	Madera County GSA – East	Madera County GSA – East	11,400
	Madera County GSA – West	Madera County GSA – West	31,200
	Sierra Vista Mutual Water Company	SVMWC	3,800
Merced County GSA			
Triangle T Water District GSA	Triangle T Water District GSA	TTWD GSA	14,700
Total			146,300



Executive Summary (§356.2.a)

In January 2020, the four GSAs in the Chowchilla Subbasin collectively submitted the adopted Chowchilla Subbasin GSP, fulfilling the requirements established under the Sustainable Groundwater Management Act (SGMA). The GSP covers the full extent of the Chowchilla Subbasin (**Figures ES-1 and ES-2**). Coordinated implementation of the GSP is now underway and will result in sustainable operation of the Chowchilla Subbasin by 2040.

Following adoption of the GSP, 23 CCR §356.2 requires that GSAs submit Annual Reports to DWR by April 1 of each year to document the progress made in GSP implementation. This Annual Report is the third Annual Report for the Chowchilla Subbasin GSP, which is required to be submitted to DWR by April 1, 2022. In accordance with GSP Regulations, this Annual Report summarizes groundwater conditions and water use in the entire Chowchilla Subbasin, as well as the progress that has been made to implement projects and management actions and achieve interim milestones established in the GSP. Key data sources and findings of each section are summarized below for 2021 and described in further detail in the associated Annual Report section.

GSP Updates Since the Previous Annual Report

Since the previous Annual Report, DWR has completed a review of the Chowchilla GSP and released an incomplete determination of the Chowchilla Subbasin GSP, initiating a 180-day consultation period between January 28, 2022, and July 27, 2022. In this determination, DWR identified three potential deficiencies that may preclude DWR's approval of the GSP: (1) insufficient information to support the selection of chronic lowering of groundwater levels sustainable management criteria, (2) insufficient information to support the selection of land subsidence sustainable management criteria, and (3) insufficient information to support the determination that interconnected surface water or undesirable results related to depletions of interconnected surface water are not present and are not likely to occur in the Chowchilla Subbasin. Since November 2021, the GSAs have created a plan and have begun efforts to address those potential deficiencies. As of April 1, 2022, the GSAs have held four consultation meetings with DWR to discuss the plans for addressing those potential deficiencies and to ensure that those plans are sufficient and will lead to an updated GSP that is acceptable to DWR. The GSAs plan to continue their consultation with DWR during 2022, and will adopt and submit a modified GSP to DWR for evaluation no later than July 27, 2022.

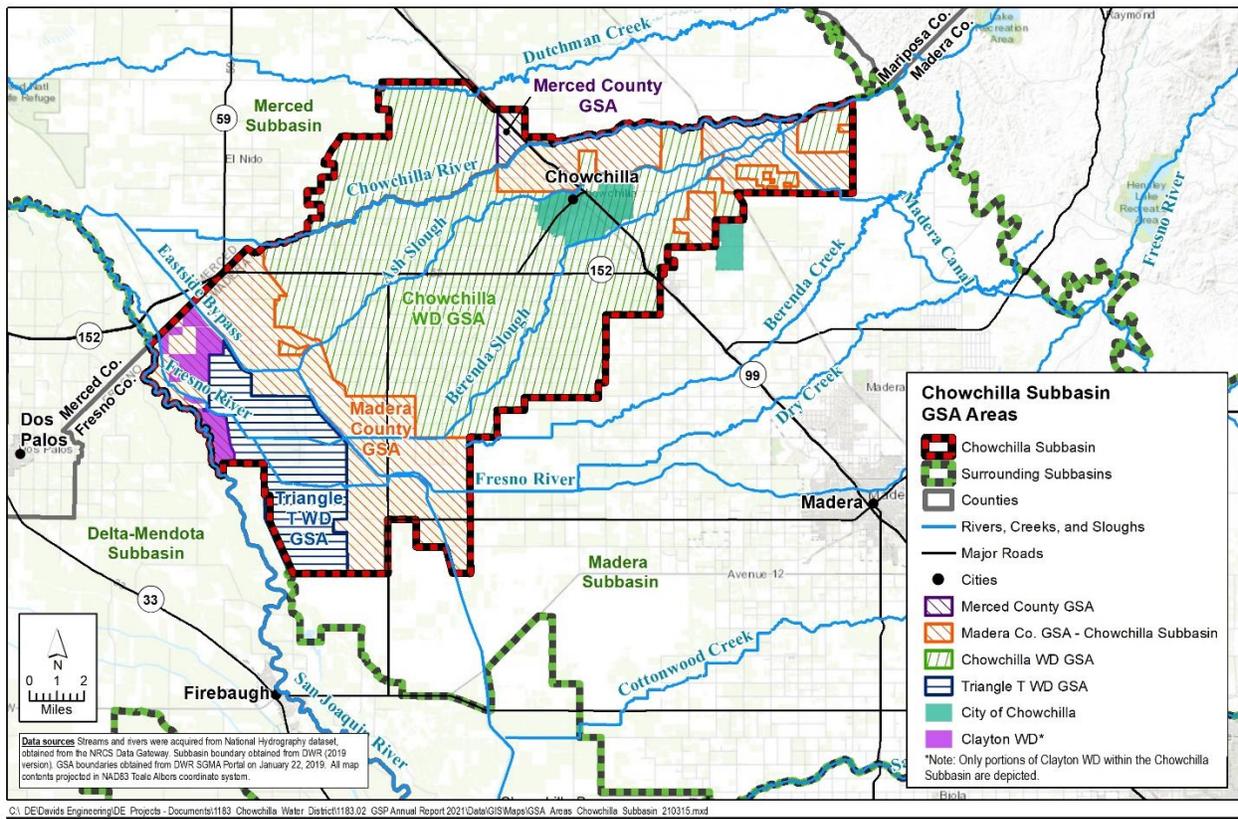


Figure ES-1. Chowchilla Subbasin GSAs Map.

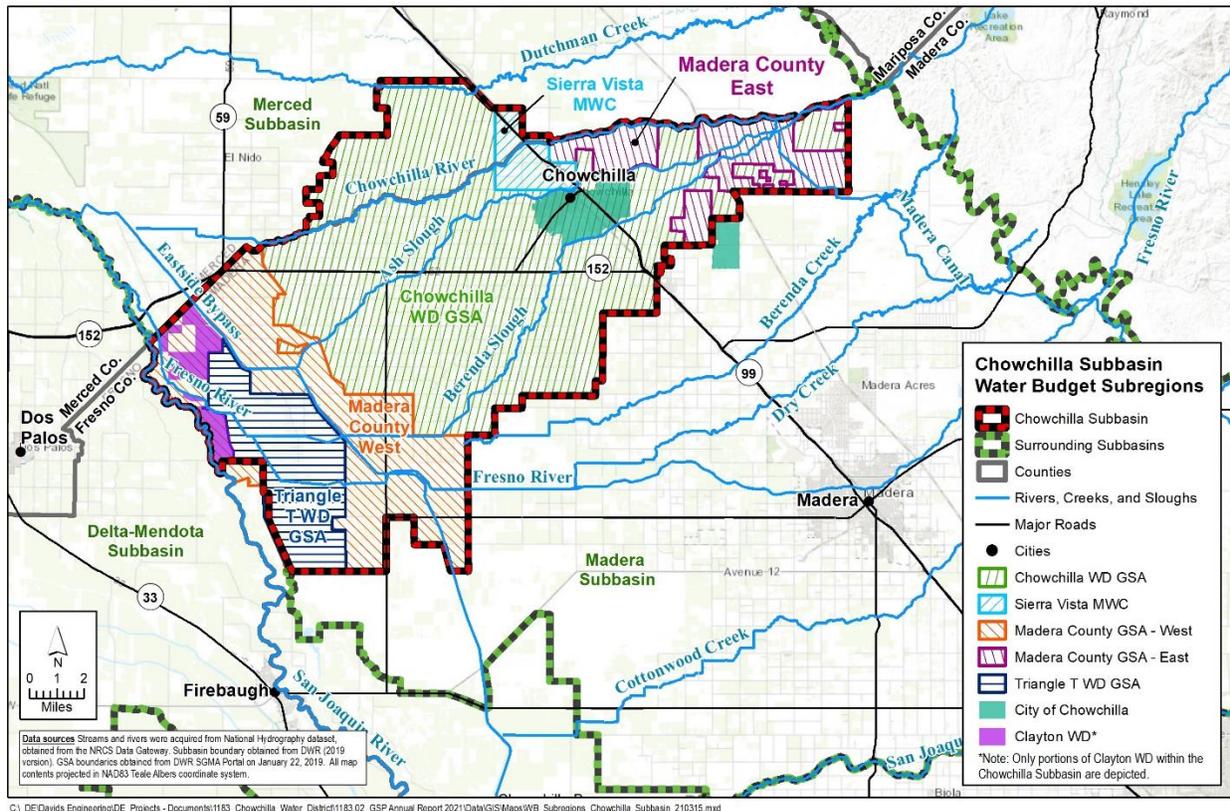


Figure ES-2. Chowchilla Subbasin Water Budget Subregions.

Groundwater Elevations (§356.2.b.1)

Groundwater level monitoring and groundwater elevations are described in **Section 1.1** of this Annual Report. Groundwater level monitoring data was assembled from publicly available and GSA-related sources for the historical period through water year 2021 and for the Fall 2021. Data was collected from various entities, including: CWD, Madera County, TTWD, DWR, USBR, and Geotracker, with some historical data assembled from wells monitoring as part of the CASGEM monitoring program (the Madera-Chowchilla Groundwater Monitoring Group).

The GSAs conducted groundwater level monitoring in available Representative Monitoring Site (RMS) wells in Spring 2021 and Fall 2021 to evaluate seasonal high and low groundwater level conditions, respectively. During Spring 2021, groundwater elevations at available RMS wells in the Subbasin ranged from -90 ft AMSL to 108.3 ft AMSL. During Fall 2021, groundwater elevations at available RMS wells in the Subbasin ranged from -98.9 ft AMSL to 96.7 ft AMSL. Despite attempts at measurement, some RMS water level data were not available in 2021 due to continued challenges encountered during implementation of the RMS monitoring program. Additional information on these challenges is provided in **Section 7.3** and **Appendix E** of this Annual Report.



Groundwater Elevation Contour Maps (§356.2.b.1.A)

Groundwater elevation contour maps are described in **Section 1.2** and shown in **Appendix A** of this Annual Report. Spring 2021 and Fall 2021 groundwater elevation contour maps were prepared. Spring contours are intended to generally represent seasonal high groundwater levels, while fall contours are intended to represent seasonal low groundwater levels. Data was assembled from all known and available groundwater level information in the Chowchilla Subbasin, including from public sources, local GSAs, and other local entities.

In summary, general patterns seen in the Spring 2021 and Fall 2021 groundwater elevation contour maps are similar to patterns observed in previous spring and fall time periods. In the unconfined Upper Aquifer above the Corcoran Clay in the western Subbasin, spring and fall contours generally show higher groundwater elevations near the San Joaquin River with groundwater flow away from the River to the east towards areas of lower groundwater elevations in the south-central portion of Chowchilla Subbasin. In the Lower Aquifer (within the extent of the Corcoran Clay) and undifferentiated unconfined zone outside of the Corcoran Clay, spring and fall contours generally show higher groundwater elevations in the central portion of Chowchilla Subbasin and lower groundwater elevations in the western and eastern portions of the Subbasin.

Groundwater Hydrographs (§356.2.b.1.B)

Groundwater hydrographs are described in **Section 1.3** and shown in **Appendix B** of this Annual Report. All available groundwater level monitoring data were used to prepare groundwater hydrographs for all years spanning the period from January 1, 2015 through the end of 2021 (**Appendix C**). Between 2015 and 2021, most of these hydrographs show trends with stable or declining levels depending on the specific RMS well. It is noted that some wells recorded a lower groundwater elevation in Fall 2021 than was observed in previous years.

Groundwater Extractions (§356.2.b.2)

Groundwater extractions are summarized in **Section 3** of this Annual Report. Groundwater extraction in the Chowchilla Subbasin was estimated using a water budget that provides a complete accounting of all inflows and outflows from the surface water system in each subregion. Flowmeter records are reported and were used to validate these water budget estimates where available; otherwise, groundwater extraction was estimated using the best available information (sources and methods are summarized below).

In total, an estimated 374,360 acre-feet (AF) of groundwater was extracted for use within the Chowchilla Subbasin during water year 2021. Of this total, approximately 97% was extracted for agricultural use (364,430 AF), and approximately 3% was extracted for urban and domestic use (9,930 AF). Total groundwater recharge from the surface water system (combined infiltration of applied water, precipitation, and surface water) was estimated to be 102,600 AF in water year 2021.



Surface Water Supplies (§356.2.b.3)

Surface water supplies used or available for use are summarized in **Section 4** of this Annual Report. Surface water supplies available in the Chowchilla Subbasin include: surface water deliveries (CVP supplies from Millerton Reservoir and Buchanan Dam); transfer water to CWD from LeGrand Athlone Water District or other districts; water purchased by TTWD from San Joaquin River Exchange Contractors, CWD, Madera Irrigation District (MID), and others; riparian and water rights diversions; as well as flood flows and natural flows crossing the Chowchilla Subbasin boundaries. In this Annual Report, surface water supplies used or available for use are assumed to be the difference between surface water inflows and surface water outflows through the Chowchilla Subbasin. During water year 2021, approximately 200 AF of local supplies and approximately 16,800 AF of CVP supplies were used in the Chowchilla Subbasin area (combined irrigation deliveries, recharge, infiltration, and evaporation).

Total Water Use (§356.2.b.4)

Total water use is summarized in **Section 5** of this Annual Report. In this Annual Report, total water use is assumed to equal the total combined applied water and precipitation from all sources in the Chowchilla Subbasin, including all consumptive water use (evapotranspiration) and non-consumptive water use (other water uses, e.g., deep percolation and runoff). During water year 2021, total water use in the Chowchilla Subbasin is estimated to be 404,610 acre-feet. Of this total, 3% is from surface water, 92% is from groundwater, and 5% is from precipitation. Consumptive water use in the Chowchilla Subbasin was estimated to be approximately 323,920 AF in water year 2021.

Change in Groundwater Storage (§356.2.b.5)

Change in groundwater storage is described in **Section 6** and shown in **Appendix C** of this Annual Report. Consistent with §354.18.b, annual changes in groundwater elevation were calculated for each of the principal aquifers between Spring 2020 and Spring 2021 based on the difference in annual spring groundwater elevation contours (representing seasonal high groundwater conditions). Outside of the delineated confined area, changes in groundwater levels (in both the Upper and Lower Aquifers) were multiplied by representative specific yield values to estimate change in groundwater storage. Within the delineated confined area in the Lower Aquifer, groundwater potentiometric surface changes in the Lower Aquifer were multiplied by a much smaller storage coefficient value to calculate annual changes in groundwater storage in the Lower Aquifer. The specific yield and storage coefficient values used in the analysis are derived from values in the calibrated integrated groundwater flow model (MCSim) developed and applied during the preparation of the GSP.

In summary, the combined change in groundwater storage for the GSP area was approximately -104,400 AF from Spring 2020 to Spring 2021. Positive change in storage values indicate accretion of groundwater storage, whereas negative change in storage values represent depletion of groundwater storage.



Implementation of Projects and Management Actions (§356.2.c)

GSP implementation activities, including projects and management actions, are described in **Section 7** of this Annual Report. In the year since the last Annual Report submittal, all GSAs have moved forward with implementation of projects and management actions proposed in the GSP. In addition to the projects and management actions summarized below, progress has also been made in: (1) conducting the domestic well inventory; (2) focused planning for the Domestic Well Mitigation Program, including work to develop a memorandum of understanding (MOU) that will define the starting date, proportionate responsibilities, eligibility criteria, eligible projects, funding limits, interim measures as may be required, staffing responsibilities, and principles for implementing the program; (3) development of new nested monitoring wells that are slated to be installed in 2022; and (4) planning, analysis, and consultation with DWR to address potential deficiencies in the Chowchilla Subbasin GSP.

Due to dry conditions in 2021, recharge was lower than would occur in a wetter year. In spite of these conditions, the GSAs have continued to make significant progress in implementing existing projects as well as being awarded additional grants for new projects.

The CWD GSA is currently implementing six projects. In 2021, CWD completed construction of the Road 19 Groundwater Recharge Basin, the Wood Groundwater Recharge Basin, and the Acconero Groundwater Recharge Basin. Due to dry conditions, no water was available for recharge in 2021.

The Madera County GSA – Chowchilla (Madera County GSA) has continued work on three planning studies in support of a rate study to fund GSP implementation, and has continued implementation of a substantial demand management program and a recharge program that will collectively support achievement of the GSP sustainability goal. In 2021, the Madera County GSA continued development of a rate study that will result in a water rate for extraction of groundwater within the Madera County GSA to fund projects. A penalty for groundwater extraction above the allocation is also being considered. In support of the demand management program, the Madera County GSA completed a virtual pilot water market simulation and conducted stakeholder interviews and outreach with conservation groups to guide development of land repurposing strategies as part of the sustainable agricultural land conservation (SALC) program. The Madera County GSA Board of Directors adopted three resolutions between December 2020 and August 2021 that outline the County's allocation framework and associated implementation guidelines. The Madera County GSA also completed a test year using IrriWatch, a remote sensing platform that is planned to track evapotranspiration of applied water (ET_{aw}) against an ET_{aw} allocation. Finally, the Madera County GSA was awarded grant funding in spring 2021 to support continued planning, design, and construction of the recharge program. Project 1 designs are anticipated to be completed later in 2022, and construction is anticipated to begin in 2022-2023, pending successful completion of CEQA and permitting. In February-March 2022, the Madera County GSA applied for and was awarded Proposition 68 funding to support further development and construction of Project 2.



SVMWC is in the early stages of implementation for the development of up to 300 acres of dedicated recharge basins. In February-March 2022, SVMWC applied for and was awarded Proposition 68 funding to support further development and construction of this project.

The TTWD GSA has several projects in various stages of implementation: (1) utilization of existing recharge basins and purchased surface water, (2) development of additional dedicated recharge basins (funds provided by Proposition 68), (3) the Columbia Canal and Poso Canal pipelines, and (4) the Poso Canal pipeline extension project (funded by Proposition 68). Due to dry conditions, no water was available for recharge or purchase in 2021. TTWD has also installed new monitoring wells and initiated the process of migrating those to the Chowchilla Subbasin monitoring network.

Interim Milestone Status (§356.2.c)

The status of groundwater conditions relative to Interim Milestones (IMs) established in the Chowchilla Subbasin GSP is described in **Section 7.4** of this Annual Report. In the GSP, Interim Milestones (IMs) for chronic lowering of groundwater levels were established at five-year intervals over the Implementation Period from 2020 to 2040, at years 2025, 2030, 2035, and 2040, based on the modeled groundwater level for the month of October in the year preceding the IM date (e.g., October 2024 for the 2025 IM).

For the purpose of tracking groundwater levels in relation to the Sustainable Management Criteria in the GSP, the status of groundwater level RMS wells are presented in relation to the 2025 IMs, Measurable Objectives (MOs), and Minimum Thresholds (MTs) defined in the GSP.

Review of the Fall 2021 groundwater level measurements that are available for 24 RMS wells indicates that groundwater levels remain well above MTs with one exception; and approximately half of Fall 2021 RMS groundwater levels were above the 2025 IMs.



1 Groundwater Elevations (§356.2.b.1)

1.1 GROUNDWATER LEVEL MONITORING

The groundwater level monitoring information presented in this Annual Report includes historical monitoring conducted in the Chowchilla Subbasin by various entities, including some local GSA-coordinated monitoring conducted as part of efforts in establishing the long-term GSP monitoring program that will be continued during the GSP implementation period through 2040. Monitoring data collected as part of early GSP monitoring and additional monitoring data available for the period through water year 2021 (plus Fall 2021) are summarized and presented in this Annual Report. Formal GSP groundwater level monitoring conducted by GSAs was initiated upon adoption and submittal of the GSP in January 2020.

Historically, groundwater level monitoring in the Chowchilla Subbasin has been conducted by a variety of entities including CWD, Madera County, DWR, USBR, landowners, and Geotracker. The California State Groundwater Elevation Monitoring Program (CASGEM) was initiated in 2011, with the Madera-Chowchilla Groundwater Monitoring Group designated as the local monitoring entity. This group includes CWD and Madera County, along with entities in the Madera Subbasin. Groundwater levels have been collected and submitted each fall and spring as part of the CASGEM program, which also satisfies some of the GSP monitoring. The Chowchilla Subbasin GSAs also conducted groundwater level monitoring in select wells in advance of the GSP adoption and submittal. Additional groundwater level data collection from newly installed nested monitoring wells (installed as part of a DWR grant) began in water year 2020. Groundwater level monitoring data available from the entities listed above and all GSAs were assembled for the period through the end of water year 2021 (plus Fall 2021) and are presented in this Annual Report. **Figure 1-1** includes a map presenting the well locations and most recent monitoring date for historical groundwater level monitoring conducted in the Chowchilla Subbasin. All available groundwater level measurements acquired for groundwater level RMS wells identified in the GSP are submitted through the Monitoring Network Module on the SGMA Portal. **Figure 1-2** illustrates the groundwater level RMS well network included in the GSP. A summary of RMS well information and recent groundwater level measurements is presented in **Table 1-1**. Despite attempts at measurement, some RMS water level data were not available in 2021 due to continued challenges encountered during implementation of the RMS monitoring program. Additional information on these challenges is provided in **Section 7.3** and **Appendix E** of this Annual Report.

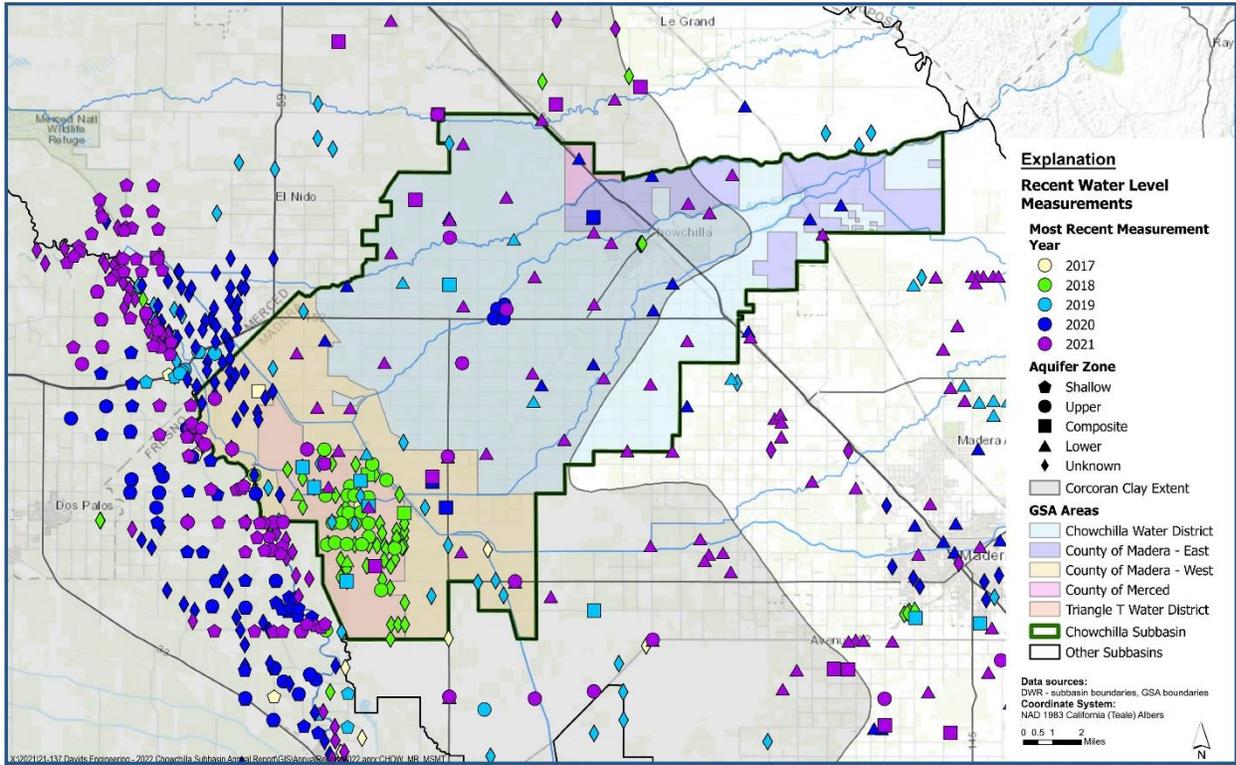


Figure 1-1. Most Recent Groundwater Level Measurement by Well.

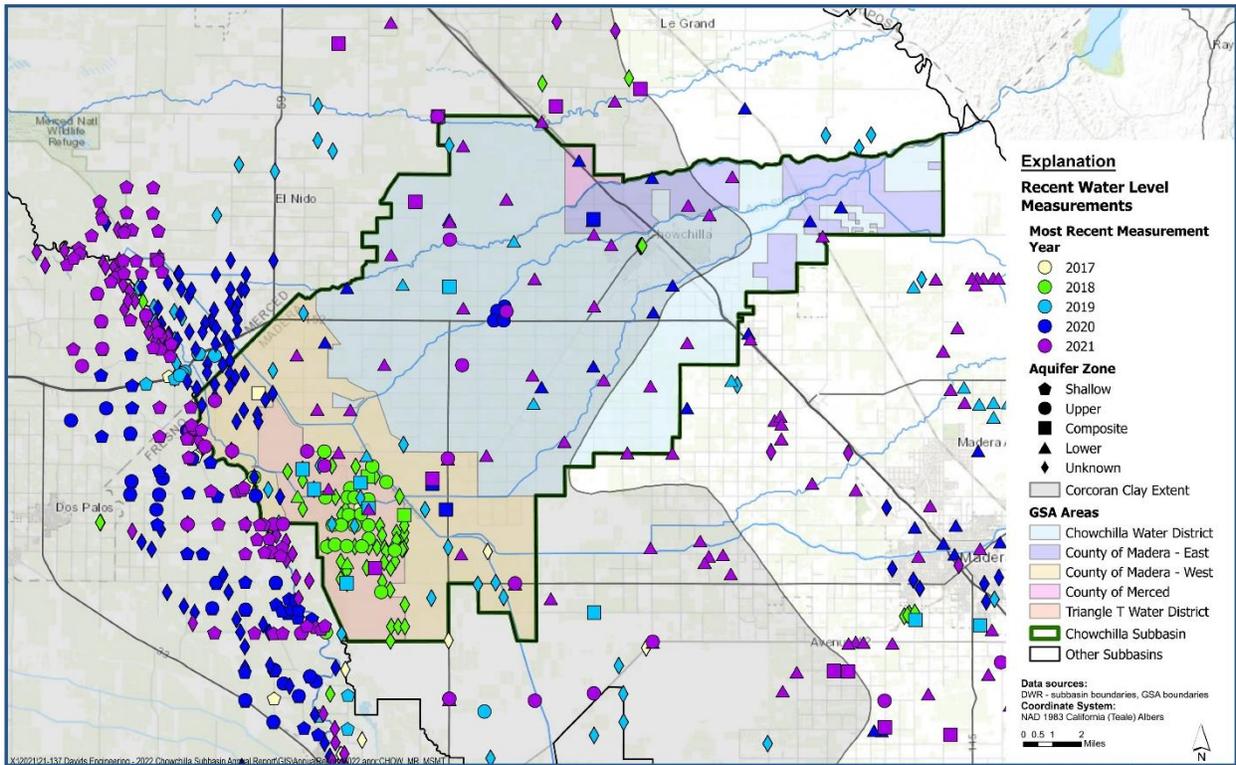


Figure 1-2. Groundwater Levels Sustainable Indicator Wells.



Table 1-1. Summary of Groundwater Level RMS Well Information and Measurements During Report Year (2021).

RMS Well I.D.	Estimated Ground Surface Elevation (msl, feet) ¹	Well Depth	Screen Top-Bottom	Aquifer Designation	Spring 2021 GWE ¹	Date of Spring 2021 Measurement	Fall 2021 GWE ¹	Date of Fall 2021 Measurement	Subregion
CWD RMS-1	171	275	160-275	Lower ²	-90	3/18/2021	NM ⁴	10/20/2021	CWD GSA
CWD RMS-2	193	780	230-775	Lower ²	-19	3/18/2021	-54	10/20/2021	CWD GSA
CWD RMS-3	206	Unknown	Unknown	Lower ²	-38.86	3/18/2021	-70.86	10/12/2021	CWD GSA
CWD RMS-4	225	800	320-800	Lower ²	-54.3	3/18/2021	-75.3	10/12/2021	CWD GSA
CWD RMS-5	207	Unknown	Unknown	Lower ²	53.15	3/18/2021	50.15	10/13/2021	CWD GSA
CWD RMS-6	275	820	257-726	Lower ³	-43	3/18/2021	-73	10/26/2021	CWD GSA
CWD RMS-7	169	330	135-288	Lower ²	-15.5	3/18/2021	-25.5	10/26/2021	CWD GSA
CWD RMS-8	219	Unknown	Unknown	Lower ²	-43.85	3/18/2021	-44.85	10/12/2021	CWD GSA
CWD RMS-9	164	97	82-97	Upper	88	3/19/2021	80	10/12/2021	CWD GSA
CWD RMS-10	182	Unknown	Unknown	Lower ²	-45.32	3/19/2021	-63.32	10/14/2021	CWD GSA
CWD RMS-11	199	529	187-529	Lower ²	82.68	3/19/2021	80.68	10/14/2021	CWD GSA
CWD RMS-12	176	Unknown	Unknown	Upper	69.2	3/19/2021	67.2	10/19/2021	CWD GSA
CWD RMS-13	167	Unknown	Unknown	Lower ²	19.72	3/19/2021	12.72	10/14/2021	CWD GSA
CWD RMS-14	152	455	185-365	Lower ²	-79	3/19/2021	-98	10/14/2021	CWD GSA
CWD RMS-15	213	955	290-935	Lower ³	-72.9	3/19/2021	-89.9	10/18/2021	CWD GSA
CWD RMS-16	212	Unknown	Unknown	Lower ³	-19.8	3/19/2021	-71.8	10/27/2021	CWD GSA
CWD RMS-17	203	624	278-588	Lower ³	-65.9	3/19/2021	-98.9	10/19/2021	CWD GSA
MCE RMS-1	276	Unknown	Unknown	Lower ³	-53.02	3/16/2021	-62.79	11/9/2021	Madera County GSA – East



RMS Well I.D.	Estimated Ground Surface Elevation (msl, feet) ¹	Well Depth	Screen Top-Bottom	Aquifer Designation	Spring 2021 GWE ¹	Date of Spring 2021 Measurement	Fall 2021 GWE ¹	Date of Fall 2021 Measurement	Subregion
MCE RMS-2	272	466	218-464	Lower ²	-72.97	3/16/2021	NM ⁴	11/9/2021	Madera County GSA – East
MCW RMS-1	120	186	Unknown	Upper	95.66	3/30/2021	NM ⁴	11/9/2021	Madera County GSA – West
MCW RMS-2	123	Unknown	Unknown	Upper	98.81	3/15/2021	87.77	11/9/2021	Madera County GSA – West
MCW RMS-3	122	Unknown	Unknown	Upper	103.38	3/15/2021	96.96	11/9/2021	Madera County GSA – West
MCW RMS-4	138	Unknown	Unknown	Lower ²	18.66	3/15/2021	NM ⁴	11/9/2021	Madera County GSA – West
MCW RMS-5	146	Unknown	Unknown	Lower ²	-27.3	3/16/2021	NM ⁴	11/10/2021	Madera County GSA – West
MCW RMS-6	139	Unknown	Unknown	Lower ²	43.23	3/16/2021	NM ⁴	11/10/2021	Madera County GSA – West
MCW RMS-7	138	800	290-400	Lower ²	19.29	3/30/2021	27.59	11/9/2021	Madera County GSA – West
MCW RMS-8	142	480	160-475	Composite	48.13	3/15/2021	27.38	11/9/2021	Madera County GSA – West
MCW RMS-9	155	700	265-696	Lower ²	-20.88	3/12/2021	NM ⁴	11/9/2021	Madera County GSA – West
MCW RMS-10	123	26	44129	Upper	108.27	4/30/2021	96.65	10/1/2021	Madera County GSA – West
MCW RMS-11	127	30	Unknown	Upper	105.94	4/20/2021			Madera County GSA – West
MCW RMS-12	127	29	Unknown	Upper					Madera County GSA – West
MER RMS-1	225	Unknown	Unknown	Lower ²					SVMWC



RMS Well I.D.	Estimated Ground Surface Elevation (msl, feet) ¹	Well Depth	Screen Top-Bottom	Aquifer Designation	Spring 2021 GWE ¹	Date of Spring 2021 Measurement	Fall 2021 GWE ¹	Date of Fall 2021 Measurement	Subregion
TRT RMS-1 ⁵	134	196	158-192	Upper	58.23	2/19/2021	46.23	12/6/2021	TTWD GSA
TRT RMS-2 ⁵	135	500	300-500	Lower ²	51.5	3/4/2021	44.5	12/6/2021	TTWD GSA
TRT RMS-3	137	799	168-790	Lower ²	6.44	2/19/2021	-8.56	11/11/2021	TTWD GSA
TRT RMS-4	141	840	190-260	Composite	17.5	3/4/2021	4.5	11/10/2021	TTWD GSA

¹ Estimated ground surface elevation and groundwater elevations (GWE) are expressed in feet above mean sea level (referenced to the NAVD88 vertical datum).

² Lower Aquifer wells within the Corcoran Clay extent.

³ Lower Aquifer wells outside the Corcoran Clay extent; considered representative of undifferentiated unconfined groundwater zone.

⁴ NM = No Measurement. Measurement attempted on date listed but was unsuccessful. See Appendix E for more information.

⁵ Fall measurements were collected slightly outside of the target time frame of mid-October to mid-November.



1.2 GROUNDWATER ELEVATION CONTOUR MAPS (§356.2.B.1.A)

Groundwater elevation contours for Spring and Fall 2021 were developed from all known and available groundwater level information in the Chowchilla Subbasin, including data from public sources and from local GSAs and other local entities. All contours are presented as feet above mean sea level (referenced to the NAVD 88 vertical datum).

Annual spring and fall contour maps were prepared for each year and for each of the principal aquifers in the Chowchilla Subbasin: Upper Aquifer and Lower Aquifer. Annual spring contours are intended to represent seasonal high groundwater levels, while fall contours are intended to represent seasonal low groundwater levels. For the purpose of mapping groundwater elevations, the aquifer system in areas outside the extent of the Corcoran Clay was treated as a single undifferentiated unconfined aquifer system and interpretation of groundwater levels in these areas utilized data from wells assigned to both the Upper and Lower depth zones. In areas within the extent of the Corcoran Clay, the aquifer system was separated into an Upper Aquifer unconfined system above the Corcoran Clay and a Lower Aquifer below the Corcoran Clay. The Corcoran Clay hydraulically separates the Upper and Lower Aquifer where it is present, and in areas where the Corcoran Clay is shallow, there is perched water on top of the Corcoran Clay with an unsaturated zone directly below the Corcoran Clay. As a result, in the undifferentiated unconfined zone outside of the extent of the Corcoran Clay the groundwater surface represents a continuation of the Lower Aquifer groundwater surface within the Corcoran Clay area.

To evaluate recent groundwater level conditions in the Chowchilla Subbasin, separate groundwater elevation contour maps were prepared for spring and fall of each year for the unconfined Upper Aquifer, where substantial saturation exists, and separately for the Lower Aquifer (within the extent of the Corcoran Clay) and the undifferentiated unconfined zone (outside of the Corcoran Clay). The groundwater elevation contour maps for the Lower Aquifer represent a combination of potentiometric elevations where the aquifer is under confined conditions and water table surface elevations where the groundwater is unconfined. Contour maps of the different aquifer units are presented in **Figure 1-3 through 1-6**, and are discussed below. For comparison to these figures for Spring 2021 and Fall 2021, contour maps for Spring 2020 and Fall 2020, prepared for last year's (2021) GSP Annual Report, are included in **Appendix A**.

It may be noted on some groundwater contour maps that wells relatively close together may show significant differences in groundwater elevations. This can occur for various reasons including: differences in well construction details relative to the depth, screen intervals, and seal depths; influences from nearby and/or recent pumping; and/or hydrogeologic characteristics that affect groundwater occurrence/movement (e.g. variations in stratigraphy). Groundwater elevations commonly vary at a given location at different depths within a single aquifer (whether it be unconfined, semi-confined, or confined) due to interbedding of fine- and coarse-grained layers and uneven vertical distribution of pumping stresses. For example, vertical gradients (meaning different groundwater elevations at different depths within an aquifer) often occur as a result of higher pumping stresses within a certain depth zone of the aquifer. Wells being monitored may



have been measured for groundwater elevation shortly after the measured well or a nearby well has been turned off (or possibly even a nearby well is pumping at the time of measurement); thereby resulting in a lower groundwater elevation at that location. In addition, stratigraphy (i.e., occurrence/sequence of fine- and coarse-grained layers) in the Chowchilla Subbasin has been observed to vary significantly from one well location to another due to layer discontinuity, which may impact groundwater elevations measured in nearby wells. Development of groundwater elevation contour maps for this Annual Report involved application of computerized spatial interpolation algorithms¹ in combination with some professional judgement, recognizing some of the issues described above that can impact groundwater elevations.

1.2.1 Upper Aquifer

A seasonal high groundwater elevation contour map for the Upper Aquifer within the Corcoran Clay area was generated for Spring 2021 (**Figure 1-3**). The Spring 2021 Groundwater Elevation Contour Map (**Figure 1-3**) generally shows higher groundwater elevations near the San Joaquin River with groundwater flow away from the River to the east towards areas of lower groundwater elevations in the south-central portion of Chowchilla Subbasin.

A seasonal low groundwater elevation contour map for the Upper Aquifer within the Corcoran Clay area was generated for Fall 2021 (**Figure 1-4**). Although water level data in the Upper Aquifer are more limited for Fall 2021, similar to the spring contour map, the Fall 2021 Groundwater Elevation Contour Map (**Figure 1-4**) generally shows higher groundwater elevations near the San Joaquin River with prevailing groundwater flow directions away from the River to the east towards areas of lower groundwater elevation in the south-central portion of Chowchilla Subbasin. As would be expected, the fall groundwater level elevations are generally lower than for spring, reflecting conditions at the end of the summer dry months during which much of the annual groundwater pumping occurs.

1.2.2 Lower Aquifer and Undifferentiated Unconfined Groundwater Zone

A seasonal high groundwater elevation contour map for the Lower Aquifer was generated for Spring 2021 (**Figure 1-5**). The Spring 2021 Groundwater Elevation Contour Map for the Lower Aquifer (**Figure 1-5**) generally shows higher groundwater elevations in the central portion of Chowchilla Subbasin and lower groundwater elevations in the western and eastern portions of the Lower Aquifer.

A seasonal low groundwater elevation contour map for the Lower Aquifer was generated for Fall 2021 (**Figure 1-6**). Similar to the spring contour map, the Fall 2021 Groundwater Elevation Contour Map (**Figure 1-6**) generally shows higher groundwater elevations in the central portion

¹ Spatial interpolating methods employed in the analysis involved use of the natural neighbor method with additional consideration of results from the inverse distance weighted method. Both methods interpolate values between points using weighting of nearby point values, beginning with a map of point values (e.g., groundwater elevations at individual wells) and resulting in a raster map of estimated values for the entire area of interest, including area between points (e.g., estimates of groundwater elevations across the entire subbasin, including between wells).



of Chowchilla Subbasin, and lower groundwater elevations in the western and eastern portions of the Lower Aquifer. As would be expected, the fall groundwater elevations are generally lower than for spring.

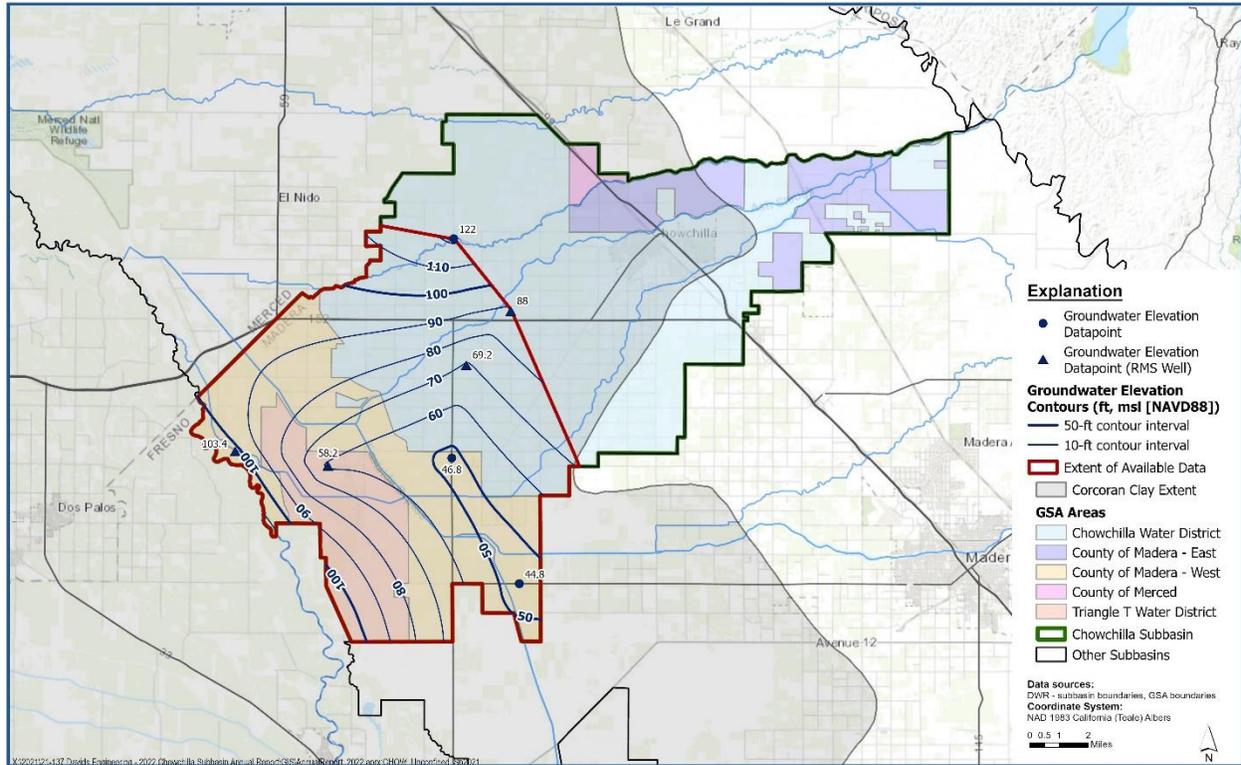


Figure 1-3. Contours of Equal Groundwater Elevation Upper Aquifer – Spring 2021.

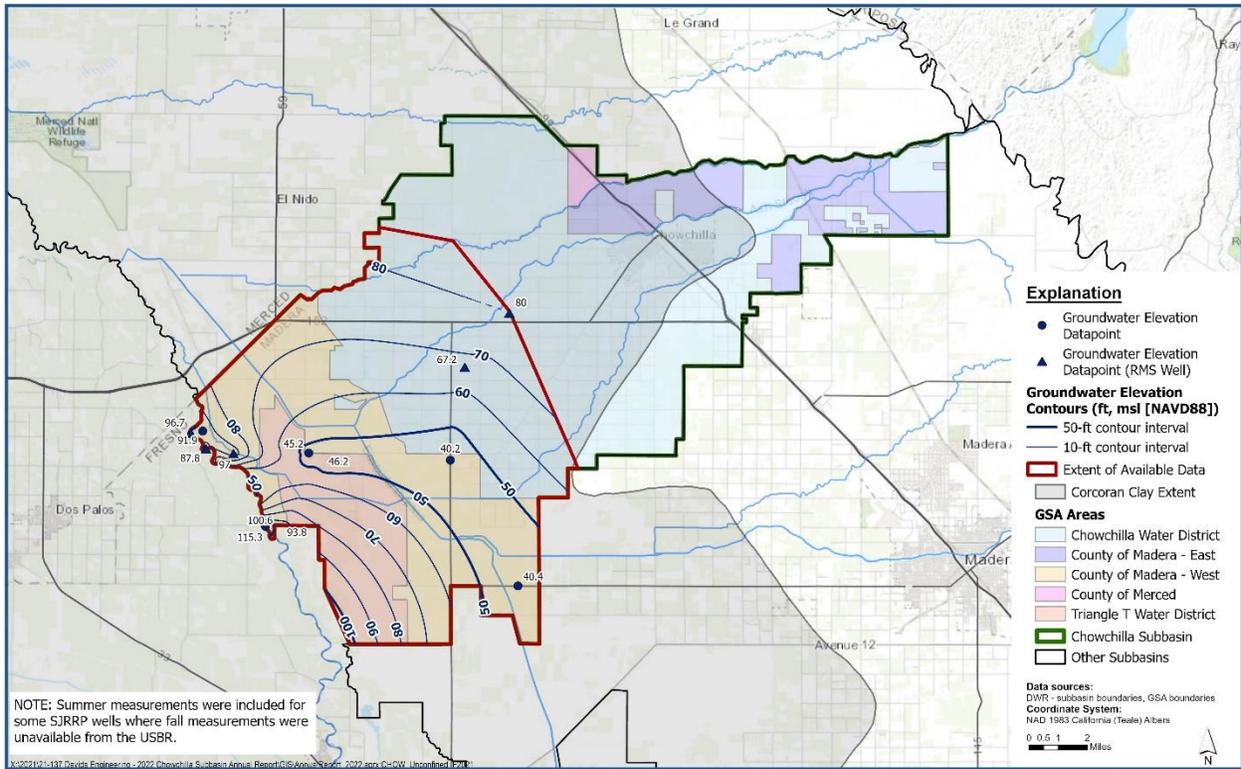


Figure 1-4. Contours of Equal Groundwater Elevation Upper Aquifer – Fall 2021.

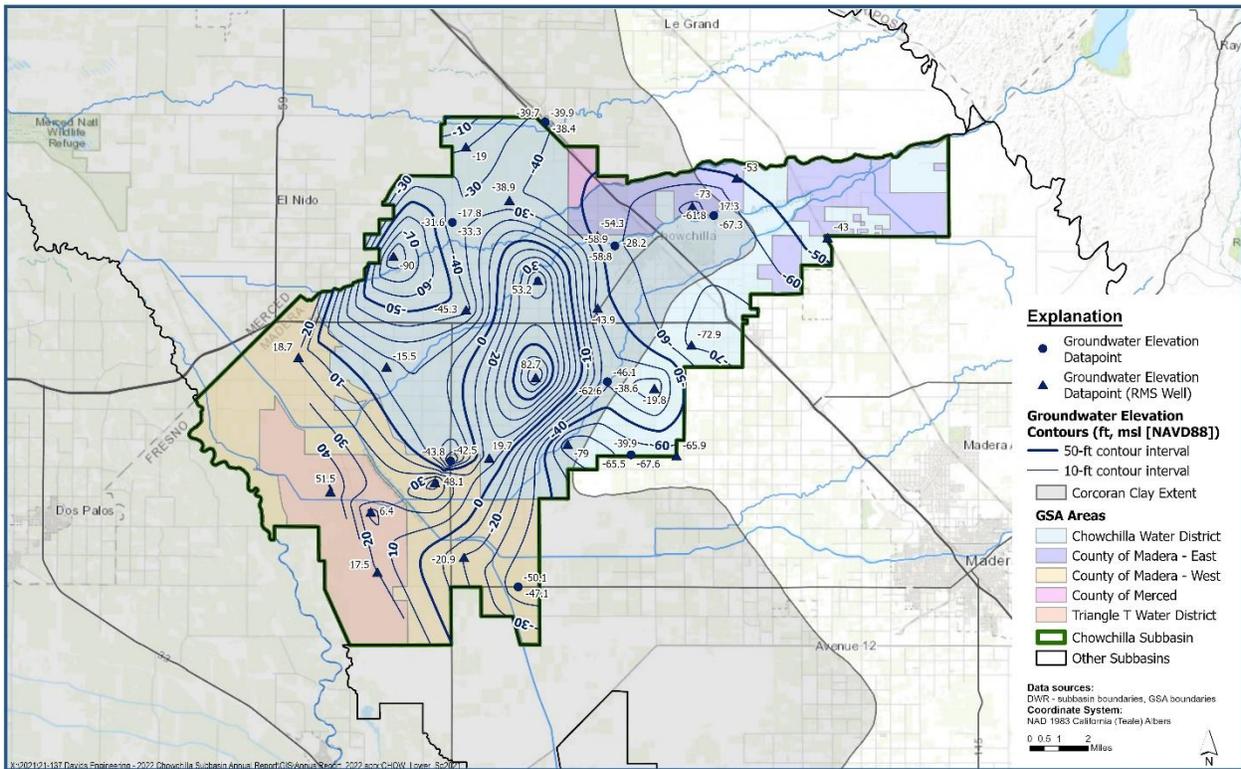


Figure 1-5. Contours of Equal Groundwater Elevation Lower Aquifer/Undifferentiated Unconfined Zone – Spring 2021.

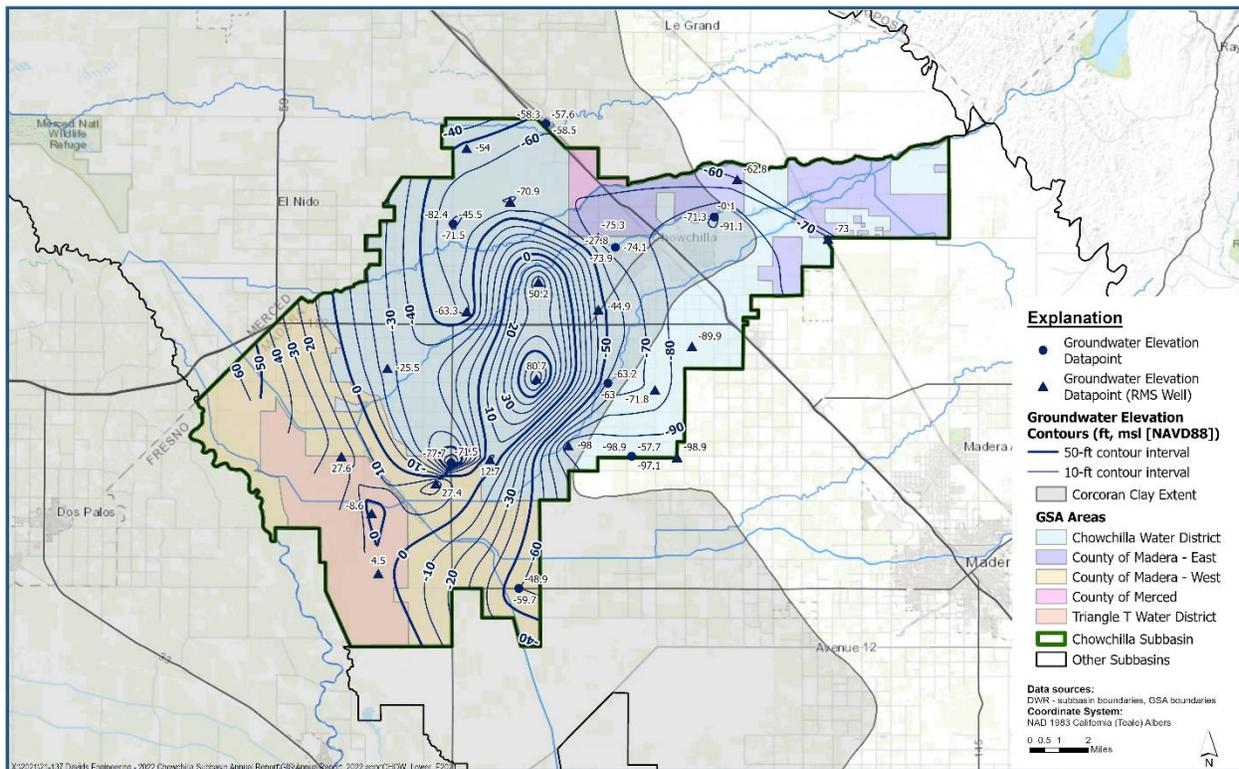


Figure 1-6. Contours of Equal Groundwater Elevation Lower Aquifer/Undifferentiated Unconfined Zone – Fall 2021.

1.3 GROUNDWATER HYDROGRAPHS (§356.2.B.1.B)

Hydrographs of time-series groundwater level data for groundwater level RMS wells were prepared with all available groundwater level monitoring data through water year 2020 (plus Fall 2020) and are contained in **Appendix B**. CWD GSA RMS wells generally showed stable or decreasing groundwater elevations between 2015 and 2020, with the exception of CWD RMS-2 and CWD RMS-9, which showed ongoing increases. Madera County GSA – East RMS wells show variable trends in groundwater elevations over the 2015 to 2019 time period ranging from increasing (MCE RMS-1), to decreasing (MCE RMS-2) levels. Madera County GSA – West RMS wells generally showed increasing groundwater elevations between 2015 and 2020, with the exception of MCW RMS-5 and MCW RMS-7, which showed ongoing declines. TTWD GSA RMS wells generally showed stable groundwater elevations between 2015 and 2020.



2 Water Budget Approach for Quantifying Groundwater Extraction, Surface Water Supplies, and Total Water Use

In fulfillment of the Annual Report requirements, a water budget approach has been used to quantify groundwater extraction, surface water supply availability, and total water use in the Chowchilla Subbasin. This section describes the structure and uncertainties of these water budgets.

2.1 WATER BUDGET STRUCTURE

A water budget is defined as a complete accounting of all water flowing into and out of a defined volume² over a specified period of time. During GSP development, water budgets were prepared for each subregion in the Chowchilla Subbasin to characterize historical, current, and projected water budget conditions. For this Annual Report, the historical water budgets have been extended through the current reporting year to characterize historical water use through 2021.

Water budgets were prepared for the Surface Water System (SWS) and Groundwater System (GWS). The SWS represents the land surface down to the bottom of the plant root zone, within the lateral boundaries of the Chowchilla Subbasin. The GWS extends from the bottom of the root zone to the definable bottom of the subbasin, within the lateral boundaries of the Chowchilla Subbasin.

These systems are referred to as accounting centers. Flows between accounting centers and storage within each accounting center are water budget components. Separate but related water budgets were prepared for each accounting center that together represent the overall water budget for the Chowchilla Subbasin. A schematic of the general water budget accounting structure is provided in **Figure 2-1**.

During GSP development, the SWS water budget accounting center was subdivided further into detailed accounting centers, including the Land Surface System that represents water use in all irrigated and non-irrigated lands. To estimate the water budget components required by the GSP Regulations, the Land Surface System was subdivided into accounting centers representing water use sectors identified in the GSP Regulations as “categories of water demand based on the general land uses to which the water is applied, including urban, industrial, agricultural, managed wetlands, managed recharge, and native vegetation” (23 CCR §351(a)). Across the Chowchilla Subbasin and within each subregion, the water use sector accounting centers include Agricultural Land (AG), Urban Land (UR) (urban, industrial, and semi-agricultural), and Native Vegetation Land (NV). Industrial land covers only a small area of the Chowchilla Subbasin, so industrial water uses have been combined with urban and semi-agricultural uses in the Urban land use sector.

² Where ‘volume’ refers to a space with length, width and depth properties, which for purposes of the GSP means the defined aquifer and associated surface water system.

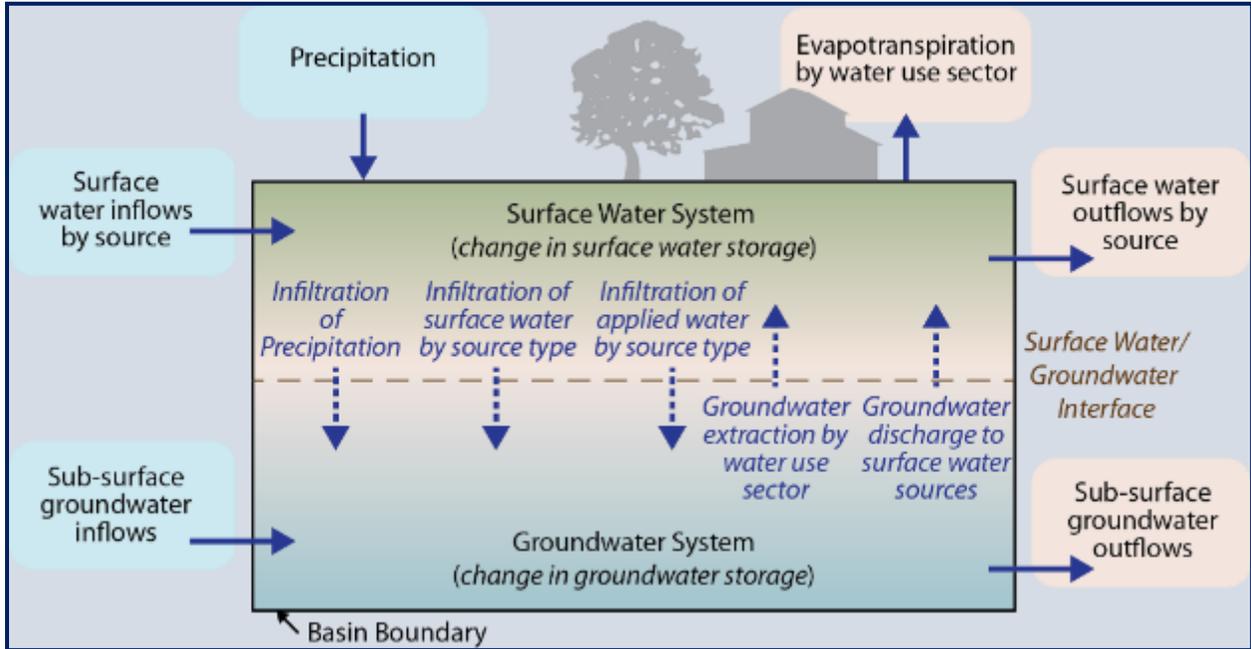


Figure 2-1. Water Budget Accounting Structure (Source: DWR, 2016).

To meet the Annual Report requirements, groundwater extraction and total water use were tracked by water use sector, and surface water supplies were calculated. Water budgets for each water use sector were developed individually for each subregion in the Chowchilla Subbasin, as described in the Chowchilla Subbasin GSP.

For this Annual Report, flows through the SWS in each subregion were accounted for on a monthly timestep using interrelated water budgets. These water budgets resulted in complete accounting of all SWS inflows and outflows in each subregion, including all water budget components required to quantify groundwater extraction, surface water supplies, and total water use:

- **Groundwater Extraction:** Equal to “Groundwater Extraction”
- **Surface Water Supplies (used, or available for use):** Assumed to be equal to the difference between “Surface Water Inflows” and “Surface Water Outflows.”
- **Total Water Use:** Water use is defined by ASCE (2016) as “water that is used for a specific purpose such as domestic use, irrigation, or industrial processing.” This definition includes both consumptive and non-consumptive components. The total consumptive water use (the sum of “Evapotranspiration of Applied Water” and “Evapotranspiration of Precipitation”) is also reported as this the volume of water that is no longer available for use within the Chowchilla Subbasin.



The data sources, calculation procedures, and results pertaining to these key water budget components are described in the sections below for the entire Chowchilla Subbasin.

2.2 UNCERTAINTIES IN WATER BUDGET COMPONENTS

Uncertainties associated with each water budget component have been estimated following the procedure described by Clemmens and Burt (1997), as follows:

1. The uncertainty of each independently-estimated water budget component (excluding the closure term) is calculated or estimated as a percentage that approximately represents a 95% confidence interval. Uncertainties are influenced by the accuracy of available data, the uncertainty of supporting calculations and estimation procedures.
2. Assuming random, normally-distributed error, the standard deviation is calculated for each independently-estimated component as the average uncertainty on a volumetric basis (uncertainty percentage multiplied by the average component volume) divided by two.
3. The variance is calculated for each independently-estimated component as the square of the standard deviation.
4. The variance of the closure term is estimated as the sum of variances of all independently-estimated components.
5. The standard deviation of the closure term is estimated as the square root of the sum of variances.
6. The 95% confidence interval of the closure term is estimated as twice the estimated standard deviation.

Estimated uncertainties were calculated following the above procedure for all GSA water budgets.



3 Groundwater Extractions (§356.2.b.2)

This section summarizes the measurement methods, accuracy, and volumes of groundwater extraction in the Chowchilla Subbasin for the current reporting year (2021).

3.1 QUANTIFICATION AND ACCURACY

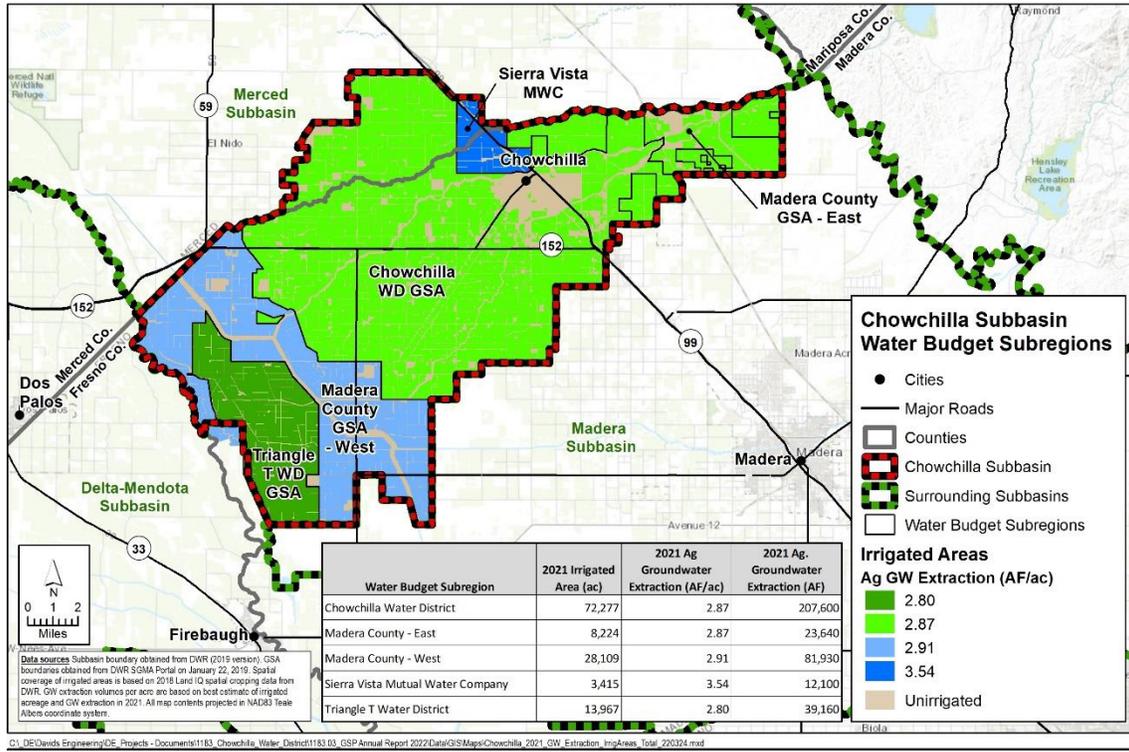
Groundwater extraction in the Chowchilla Subbasin was either measured directly from flowmeters or estimated based on other inflows and outflows from the surface water system. Flowmeter records were used when available; otherwise, groundwater extraction was estimated using the best available information. **Table 3-1** summarizes groundwater extraction in 2021 and the associated measurement methods, by subregion and water use sector.

Figure 3-1 provides a map of the 2021 agricultural groundwater extraction volumes and depths in irrigated areas in the five subregions. Notably, **Figure 3-1** illustrates the average estimated depth of groundwater extraction for agriculture over only the irrigated area in each subregion.

Table 3-2 further summarizes the total groundwater extraction by water use sector in the Chowchilla Subbasin between 1989 (the beginning of the Chowchilla Subbasin GSP historical water budget period) and 2021 (the current reporting year).

Table 3-1. Groundwater Extraction Volumes and Measurement Methods by Water Use Sector, and Uncertainty (2021).

Water Use Sector	Groundwater Extraction, 2021 (acre-feet, rounded)	Measurement Method	Description
Agricultural	364,430	Estimated	Water use sector closure
Managed Recharge	0		
Native Vegetation	0		
Urban	2,986	Measured	City of Chowchilla measured groundwater production
	6,944	Estimated	Water use sector closure, after accounting for measured pumping in City of Chowchilla
Total	374,360	20%	Typical uncertainty when calculated for Land Surface System water balance closure



*Irrigated areas shown are based on the 2018 Land IQ spatial cropping data available from DWR. Irrigated areas listed in the inset table and considered in the calculation of agricultural groundwater extraction are based on 2021 crop data from District records or determined through land use analyses. The groundwater extraction volumes per acre are based on measured or estimated groundwater extraction in 2021, quantified using the IDC root zone water budget methodology used in the Chowchilla Subbasin GSP. In subsequent Annual Reports, results from the IriWatch demand measurement project may be used to quantify groundwater extraction in Madera County GSA.

Figure 3-1. Agricultural Groundwater Extraction in Irrigated Areas, by Subregion.



Table 3-2. Chowchilla Subbasin Groundwater Extractions, by Water Use Sector (acre-feet, rounded).

Water Year (Type)	Agricultural	Managed Recharge	Native Vegetation	Urban and Industrial	Total
1989 (C)	251,330	0	0	3,440	254,770
1990 (C)	283,970	0	0	3,750	287,720
1991 (C)	288,060	0	0	3,820	291,880
1992 (C)	321,910	0	0	4,930	326,840
1993 (W)	214,470	0	10	3,930	218,410
1994 (C)	266,490	0	0	4,880	271,370
1995 (W)	151,330	0	0	2,640	153,970
1996 (W)	208,240	0	0	4,030	212,270
1997 (W)	245,750	0	0	6,650	252,400
1998 (W)	170,830	0	0	3,470	174,300
1999 (AN)	224,010	0	0	5,620	229,630
2000 (AN)	224,820	0	0	4,950	229,770
2001 (D)	254,620	0	0	4,830	259,450
2002 (D)	313,430	0	0	6,580	320,010
2003 (BN)	296,790	0	0	6,670	303,460
2004 (D)	347,960	0	0	8,840	356,800
2005 (W)	205,010	0	0	5,780	210,790
2006 (W)	178,220	0	0	5,830	184,050
2007 (C)	302,980	0	-10	9,650	312,620
2008 (C)	307,640	0	0	9,910	317,550
2009 (BN)	259,270	0	0	10,020	269,290
2010 (AN)	177,000	0	0	5,920	182,920
2011 (W)	181,030	0	0	6,570	187,600
2012 (D)	305,780	0	0	11,110	316,890
2013 (C)	340,050	0	0	11,150	351,200
2014 (C)	399,610	0	0	10,970	410,580
2015 (C)	432,110	0	0	12,080	444,190
2016 (D)	305,980	0	0	7,470	313,450
2017 (W)	194,340	0	0	7,530	201,870
2018 (BN)	284,190	0	0	7,830	292,020
2019 (W)	203,300	0	0	6,670	209,970
2020 (D)	304,360	0	0	9,070	313,430
2021 (C)	364,430	0	0	9,930	374,360
Average (1989-2014)	258,480	0	0	6,380	264,860
Average (1989-2021)	266,950	0	0	6,870	273,820
W	195,250	0	0	5,320	200,570
AN	208,600	0	0	5,500	214,100
BN	280,070	0	0	8,180	288,250
D	305,350	0	0	8,000	313,350
C	323,510	0	0	7,670	331,180



3.2 DATA SOURCES

3.2.1 [Measured Groundwater Extraction](#)

Direct groundwater pumping data were available from City of Chowchilla groundwater flowmeter records for years 2003 through 2021, representing urban groundwater extraction within the City boundaries in CWD GSA.³ Available pumping records were also used as a comparison for validating the groundwater extraction estimation procedures described below.

3.2.2 [Estimated Groundwater Extraction](#)

Estimated groundwater extraction was calculated as the Land Surface System water budget “closure” term – the difference between all other estimated or measured inflows and outflows from each water use sector. Groundwater extraction was selected as the closure term because groundwater pumping data has generally been unavailable across the Chowchilla Subbasin (except the City of Chowchilla in 2003-2021). Also, groundwater extraction serves as a relatively large inflow to the Land Surface System, resulting in lower relative uncertainty when calculated as a closure term compared to smaller flow paths following the procedure given by Clemmens and Burt (1997).

³ The majority, but not all, of the Urban water use sector area in CWD GSA is located within the City of Chowchilla. Prior to 2019, direct measurements of groundwater extraction were compared with the water use sector closure estimates, as opposed to being used directly. In 2019-2020, direct measurements of groundwater extraction were considered, and the remaining groundwater demand was calculated as the water use sector closure.



3.3 GROUNDWATER RECHARGE

As mandated under 23 CCR §354.24, GSAs within the Chowchilla Subbasin have established a “sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline.” The expressed sustainability goal for the Chowchilla Subbasin is “to implement a package of projects and management actions that will, by 2040, balance long-term groundwater system inflows with outflows...” (pg. 3-2 of the Chowchilla Subbasin GSP). To track the GSAs’ progress toward meeting this sustainability goal, both the groundwater system inflows and outflows must be quantified.

As shown in **Figure 2-1**, GWS outflows to the SWS include groundwater extraction (quantified above) and groundwater discharge (assumed to be negligible in the Chowchilla Subbasin, given the substantial depth to groundwater). GWS inflows from the SWS include infiltration of precipitation, infiltration of applied water, and infiltration of surface water. While these inflows are not required to be reported in this Annual Report, the Chowchilla Subbasin GSAs feel that they are necessary to understanding the total contribution of the SWS to groundwater sustainability.

Table 3-3 summarizes the total annual groundwater recharge from the SWS in the Chowchilla Subbasin. The components of recharge are useful for understanding and analyzing the combined effects of land surface processes on the underlying GWS. The data sources and calculations used to develop each recharge component are described in Section 2.2.3.3 (pages 2-60 through 2-73 of the Chowchilla Subbasin GSP).



Table 3-3. Chowchilla Subbasin Groundwater Recharge (acre-feet, rounded).

Water Year (Type)	Infiltration of Applied Water	Infiltration of Precipitation	Infiltration of Surface Water ¹	Total Groundwater Recharge
1989 (C)	87,000	42,500	28,300	157,800
1990 (C)	86,200	35,600	23,400	145,200
1991 (C)	99,100	53,200	42,600	194,900
1992 (C)	93,700	29,200	32,700	155,600
1993 (W)	99,500	68,900	133,900	302,300
1994 (C)	91,200	26,400	59,100	176,700
1995 (W)	86,800	83,900	133,900	304,600
1996 (W)	88,000	42,300	120,000	250,300
1997 (W)	116,300	70,400	126,200	312,900
1998 (W)	91,000	70,200	144,000	305,200
1999 (AN)	87,700	20,600	66,300	174,600
2000 (AN)	94,400	33,000	55,400	182,800
2001 (D)	90,400	30,200	46,800	167,400
2002 (D)	95,400	28,900	31,400	155,700
2003 (BN)	92,400	23,100	34,100	149,600
2004 (D)	94,900	18,600	30,400	143,900
2005 (W)	87,700	34,500	68,600	190,800
2006 (W)	82,100	41,200	107,300	230,600
2007 (C)	89,200	14,700	36,800	140,700
2008 (C)	88,300	22,600	24,800	135,700
2009 (BN)	75,200	17,200	27,400	119,800
2010 (AN)	71,700	36,200	66,000	173,900
2011 (W)	86,800	42,500	120,800	250,100
2012 (D)	87,400	12,600	57,900	157,900
2013 (C)	89,100	22,000	23,200	134,300
2014 (C)	79,600	9,100	400	89,100
2015 (C)	84,600	11,500	4,200	100,300
2016 (D)	83,500	38,700	47,600	169,800
2017 (W)	99,300	47,500	149,200	296,000
2018 (BN)	83,100	21,000	64,400	168,500
2019 (W)	81,600	28,500	129,400	239,500
2020 (D)	78,600	15,200	59,100	152,900
2021 (C)	76,200	5,400	21,000	102,600
Average (1989-2014)	89,700	35,800	63,100	188,600
Average (1989-2021)	88,400	33,300	64,100	185,800
W	91,900	53,000	123,300	268,200
AN	84,600	29,900	62,600	177,100
BN	83,600	20,400	42,000	146,000
D	88,400	24,000	45,500	157,900
C	87,700	24,700	27,000	139,400

¹ Infiltration of Surface Water includes infiltration of surface water in the rivers, streams, and canals within the Chowchilla Subbasin, plus boundary seepage from the San Joaquin River.



4 Surface Water Supplies (§356.2.b.3)

This section summarizes the annual volumes and data sources for surface water supplies used, or available for use, within the Chowchilla Subbasin through the current reporting year (2021).

4.1 QUANTIFICATION BY WATER SOURCE TYPE

Surface water supplies available in the Chowchilla Subbasin include surface water deliveries and surface water flowing across the subbasin boundaries. In this Annual Report, surface water supplies used or available for use are assumed to be the difference between surface water inflows and surface water outflows from the Chowchilla Subbasin.

Per the GSP Regulations, surface water supplies must be reported by water source type. According to the Regulations:

“Water source type” represents the source from which water is derived to meet the applied beneficial uses, including groundwater, recycled water, reused water, and surface water sources identified as Central Valley Project, the State Water Project, the Colorado River Project, local supplies, and local imported supplies.

Table 4-1 summarizes the total surface water supplies used or available for use in Chowchilla Subbasin, by water source type. The supplies included in these totals are described below.

Local Supplies

Local supplies available to water users in the Chowchilla Subbasin include surface water inflows along Chowchilla Bypass; pre-1914, riparian, and prescriptive water rights diversions; and water received from LeGrand Athlone Water District or other local districts. Much of the water flowing along Chowchilla Bypass passes through the Chowchilla Subbasin or infiltrates into the GWS. Water rights deliveries and water received from LeGrand Athlone Water District are largely applied to irrigated land and are assumed to be completely used within the Chowchilla Subbasin.

CVP Supplies

Agencies with CVP contracts can receive CVP supplies in the Chowchilla Subbasin. CVP supplies received via Madera Canal include Millerton Reservoir irrigation and flood releases. CVP supplies are also received from Buchanan Dam irrigation and flood releases along Chowchilla River. Some CVP supply flood releases from Hidden Dam and Millerton Reservoir also flow into the Chowchilla Subbasin along Fresno River. Finally, a small amount of CVP supplies is also delivered to individual irrigators in CWD from Madera Irrigation District (MID).

Local Imported Supplies

Local imported supplies to water users in the Chowchilla Subbasin include water purchased by TTWD from San Joaquin River Exchange Contractors, CWD, MID, and others.



Table 4-1. Surface Water Supplies Used (Surface Water Inflows – Surface Water Outflows), by Water Source Type (acre-feet, rounded).

Water Year (Type)	Local Supplies	CVP Supplies	Local Imported Supplies	Total
1989 (C)	0	62,600	0	62,600
1990 (C)	0	42,400	0	42,400
1991 (C)	2,300	71,000	0	73,300
1992 (C)	1,600	62,600	0	64,200
1993 (W)	40,200	183,400	0	223,600
1994 (C)	3,500	127,100	0	130,600
1995 (W)	50,900	183,200	0	234,100
1996 (W)	36,900	201,900	0	238,800
1997 (W)	29,700	214,700	0	244,400
1998 (W)	49,200	201,600	0	250,800
1999 (AN)	13,900	180,100	0	194,000
2000 (AN)	6,600	174,100	0	180,700
2001 (D)	2,500	145,300	0	147,800
2002 (D)	2,700	90,300	0	93,000
2003 (BN)	5,000	107,000	0	112,000
2004 (D)	3,000	88,200	0	91,200
2005 (W)	19,100	174,100	0	193,200
2006 (W)	46,600	203,200	0	249,800
2007 (C)	3,700	121,200	0	124,900
2008 (C)	4,000	87,900	0	91,900
2009 (BN)	2,200	109,900	0	112,100
2010 (AN)	15,500	187,000	0	202,500
2011 (W)	53,900	215,300	0	269,200
2012 (D)	3,400	157,400	0	160,800
2013 (C)	1,800	74,100	0	75,900
2014 (C)	0	400	0	400
2015 (C)	0	500	0	500
2016 (D)	3,900	106,000	0	109,900
2017 (W)	100,300	239,700	0	340,000
2018 (BN)	8,400	150,200	7,500	166,100
2019 (W)	36,600	239,900	10,400	286,900
2020 (D)	4,500	123,600	7,500	135,600
2021 (C)	200	16,800	0	17,000
Average (1989-2014)	15,400	133,300	0	148,700
Average (1989-2021)	16,700	131,500	800	149,000
W	46,400	205,800	1,000	253,200
AN	12,000	180,400	0	192,400
BN	5,200	122,300	2,500	130,000
D	3,400	118,400	1,300	123,100
C	1,500	60,600	0	62,100



Recycling and Reuse

Recycling and reuse are not a significant source of supply within the Chowchilla Subbasin. However, urban wastewater treated by the City of Chowchilla, as well as water associated with private septic systems, generally returns to the groundwater system within the Chowchilla Subbasin and has been included in the water budget.

4.2 DATA SOURCES

Table 4-2 summarizes the data sources and estimation procedures for all water budget components that are used to quantify surface water supplies available in the Chowchilla Subbasin. Additional detail is given below for each water budget component.

4.2.1 Surface Water Inflows and Surface Water Outflows along Rivers and Streams

The data sources for the inflows and outflows identified in **Table 4-2** are described in Section 2.2.3.3, pages 2-64 through 2-70 of the Chowchilla Subbasin GSP.

A water budget was computed for each reach by following the procedure described in the GSP. Unless otherwise specified, all missing and inaccurate data were replaced by estimates equal to the average monthly value of available data, computed by water year type.



Table 4-2. Rivers and Streams System Water Budget Detailed Components and Estimation Techniques.

Detailed Component	Associated Waterway	Water Source Type	Calculation/Estimation Technique	Information Sources
Surface Inflows	Chowchilla Bypass	Local Supplies	Calculated from SLDMWA CBP station measurements adjusted downstream to the Chowchilla Subbasin boundary for estimated seepage and evaporation	SLDMWA CBP station, NRCS soil survey, Fresno State/Madera/Madera II CIMIS Stations
	Chowchilla River	CVP Supplies	Reported Buchanan Dam flood and irrigation releases	USACE records
	Dutchman Creek	Local Supplies	Estimated as equal to received LeGrand Athlone WD water reported by CWD	CWD monthly water supply reports
	Fresno River	CVP Supplies	Calculated from MID recorder measurements (downstream of convergence with Dry Creek) adjusted downstream to the Madera-Chowchilla Subbasin boundary for estimated seepage and evaporation	MID Recorder 4, NRCS soil survey, Fresno State/Madera/Madera II CIMIS Stations
	Madera Canal	CVP Supplies	Reported Madera Canal flood and irrigation releases	USBR records for Madera Canal Miles 33.6 and 35.6
Surface Outflows	Chowchilla River	Local Supplies	Calculated as the difference of total inflows and total outflows from the GSA Rivers and Streams water budgets. The fraction of water corresponding to each waterway and water source type is estimated based on the fraction of total inflows corresponding to each water source type along each waterway.	Closure Term
	Eastside Bypass	Mixed CVP Supplies / Local Supplies		
	Fresno River	Mixed CVP Supplies / Local Supplies		
TTWD Purchased Water	Poso Canal Pipeline and Columbia Canal Company Pipeline	Local Imported Supplies	Reported purchased water volume	TTWD purchased water annual summary
MID Deliveries to CWD	MID Conveyance System	CVP Supplies	Measured by MID, or reported from other districts' records	MID STORM ¹ delivery database

¹ The water ordering and delivery management software used by Madera Irrigation District.



5 Total Water Use (§356.2.b.4)

This section summarizes the annual volumes and data sources for total water use in the Chowchilla Subbasin through the current reporting year (2021).

5.1 QUANTIFICATION BY WATER USE SECTOR AND WATER SOURCE TYPE

Water use is defined by ASCE (2016) as “water that is used for a specific purpose such as domestic use, irrigation, or industrial processing.” This definition includes both consumptive and non-consumptive components.

In the context of agriculture, consumptive water use is defined as “the part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate water environment” (ASCE, 2016). As most field crops dry to a very low moisture content approaching harvest, total consumptive water use is generally equivalent to the combined evaporation (E) and crop transpiration (T), together referred to as crop evapotranspiration (ET_c). Non-consumptive water use is generally equal to the remaining volume of precipitation and applied water that is not consumptively used. Accordingly, the total water use in the Chowchilla Subbasin is assumed to be equal to the total precipitation and applied water from all sources within the subbasin boundaries.

Water sources available for use include applied water (surface water and groundwater) and precipitation. **Table 5-1** summarizes the total water use in the Chowchilla Subbasin, by water use sector and water source type from 1989 through 2021 (the current reporting year). The methodology and data sources used to develop this table are provided below.

In addition to reporting the total water use in the Chowchilla Subbasin, the total consumptive water use (the sum of “Evapotranspiration of Applied Water” and “Evapotranspiration of Precipitation”) is also reported below, as this represents the volume of water that is no longer available for use within the Chowchilla Subbasin (i.e., unavailable for reuse or groundwater extraction). **Table 5-2** summarizes the consumptive water use in the Chowchilla Subbasin, by water use sector and water source type from 1989 through 2021 (the current reporting year). The methodology and data sources used to develop these tables are provided below.



Table 5-1. Chowchilla Subbasin Total Water Use, by Water Use Sector and Water Source Type (acre-feet, rounded).

Water Year (Type)	Agricultural				Managed Recharge				Native Vegetation				Urban				Total			
	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation
1989 (C)	409,450	40,740	251,330	117,380	0	0	0	0	21,530	0	0	21,530	8,550	0	3,440	5,110	439,530	40,740	254,770	144,020
1990 (C)	420,580	27,270	283,970	109,340	0	0	0	0	20,070	0	0	20,070	8,650	0	3,750	4,900	449,300	27,270	287,720	134,310
1991 (C)	444,570	42,300	288,060	114,210	0	0	0	0	20,890	0	0	20,890	9,080	0	3,820	5,260	474,540	42,300	291,880	140,360
1992 (C)	452,030	36,910	321,910	93,210	0	0	0	0	17,060	0	0	17,060	9,360	0	4,930	4,430	478,450	36,910	326,840	114,700
1993 (W)	485,090	112,750	214,470	157,870	0	0	0	0	28,750	0	10	28,740	11,660	0	3,930	7,730	525,500	112,750	218,410	194,340
1994 (C)	432,280	76,390	266,490	89,400	10	10	0	0	16,220	0	0	16,220	9,390	0	4,880	4,510	457,900	76,400	271,370	110,130
1995 (W)	472,710	129,550	151,330	191,830	0	0	0	0	34,630	0	0	34,630	12,610	0	2,640	9,970	519,950	129,550	153,970	236,430
1996 (W)	462,010	136,480	208,240	117,290	0	0	0	0	20,960	0	0	20,960	10,290	0	4,030	6,260	493,260	136,480	212,270	144,510
1997 (W)	521,420	141,640	245,750	134,030	560	560	0	0	23,740	0	0	23,740	13,990	0	6,650	7,340	559,710	142,200	252,400	165,110
1998 (W)	459,610	127,620	170,830	161,160	420	420	0	0	28,270	0	0	28,270	12,520	0	3,470	9,050	500,820	128,040	174,300	198,480
1999 (AN)	422,050	132,660	224,010	65,380	0	0	0	0	11,360	0	0	11,360	9,380	0	5,620	3,760	442,790	132,660	229,630	80,500
2000 (AN)	462,620	131,180	224,820	106,620	0	0	0	0	18,340	0	0	18,340	11,230	0	4,950	6,280	492,190	131,180	229,770	131,240
2001 (D)	456,800	102,870	254,620	99,310	0	0	0	0	17,120	0	0	17,120	10,850	0	4,830	6,020	484,770	102,870	259,450	122,450
2002 (D)	467,860	64,300	313,430	90,130	0	0	0	0	15,200	0	0	15,200	12,370	0	6,580	5,790	495,430	64,300	320,010	111,120
2003 (BN)	453,500	77,530	296,790	79,180	0	0	0	0	13,040	0	0	13,040	12,080	0	6,670	5,410	478,620	77,530	303,460	97,630
2004 (D)	474,100	60,360	347,960	65,780	0	0	0	0	10,570	0	0	10,570	13,600	0	8,840	4,760	498,270	60,360	356,800	81,110
2005 (W)	447,220	128,760	205,010	113,450	0	0	0	0	17,770	0	0	17,770	14,470	0	5,780	8,690	479,460	128,760	210,790	139,910
2006 (W)	457,110	153,920	178,220	124,970	0	0	0	0	19,080	0	0	19,080	15,910	0	5,830	10,080	492,100	153,920	184,050	154,130
2007 (C)	440,330	86,740	302,980	50,610	0	0	0	0	7,510	0	-10	7,520	13,940	0	9,650	4,290	461,780	86,740	312,620	62,420
2008 (C)	455,540	71,030	307,640	76,870	0	0	0	0	11,120	0	0	11,120	16,740	0	9,910	6,830	483,400	71,030	317,550	94,820
2009 (BN)	413,110	84,430	259,270	69,410	0	0	0	0	9,770	0	0	9,770	16,480	0	10,020	6,460	439,360	84,430	269,290	85,640
2010 (AN)	433,080	136,810	177,000	119,270	0	0	0	0	16,290	0	0	16,290	17,500	0	5,920	11,580	466,870	136,810	182,920	147,140
2011 (W)	469,370	163,230	181,030	125,110	0	0	0	0	16,360	0	0	16,360	19,180	0	6,570	12,610	504,910	163,230	187,600	154,080
2012 (D)	450,940	102,070	305,780	43,090	0	0	0	0	5,080	0	0	5,080	15,380	0	11,110	4,270	471,400	102,070	316,890	52,440
2013 (C)	467,060	53,320	340,050	73,690	0	0	0	0	7,760	0	0	7,760	18,310	0	11,150	7,160	493,130	53,320	351,200	88,610
2014 (C)	436,480	440	399,610	36,430	0	0	0	0	3,380	0	0	3,380	14,440	0	10,970	3,470	454,300	440	410,580	43,280
2015 (C)	482,810	530	432,110	50,170	0	0	0	0	4,300	0	0	4,300	16,690	0	12,080	4,610	503,800	530	444,190	59,080
2016 (D)	502,950	68,790	305,980	128,180	0	0	0	0	9,670	0	0	9,670	18,890	0	7,470	11,420	531,510	68,790	313,450	149,270
2017 (W)	510,760	191,160	194,340	125,260	16,180	16,180	0	0	8,820	0	0	8,820	18,380	0	7,530	10,850	554,140	207,340	201,870	144,930
2018 (BN)	483,150	122,950	284,190	76,010	130	130	0	0	4,950	0	0	4,950	14,280	0	7,830	6,450	502,510	123,080	292,020	87,410
2019 (W)	489,700	166,050	203,300	120,350	8,840	8,840	0	0	7,370	0	0	7,370	16,640	0	6,670	9,970	522,550	174,890	209,970	137,690
2020 (D)	462,950	95,150	304,360	63,440	0	0	0	0	3,890	0	0	3,890	14,330	0	9,070	5,260	481,170	95,150	313,430	72,590
2021 (C)	392,220	11,430	364,430	16,360	0	0	0	0	1,050	0	0	1,050	11,340	0	9,930	1,410	404,610	11,430	374,360	18,820
Average (1989-2014)	452,570	93,130	258,480	100,960	40	40	0	0	16,610	0	0	16,610	13,000	0	6,380	6,620	482,220	93,160	264,870	124,190
Average (1989-2021)	457,310	93,250	266,950	97,110	790	790	0	0	14,300	0	0	14,300	13,590	0	6,860	6,730	486,000	94,050	273,810	118,140
W	477,500	145,120	195,250	137,130	2,600	2,600	0	0	20,570	0	0	20,570	14,560	0	5,310	9,250	515,240	147,720	200,560	166,960
AN	439,250	133,550	208,610	97,090	0	0	0	0	15,330	0	0	15,330	12,710	0	5,500	7,210	467,290	133,550	214,110	119,630
BN	449,920	94,970	280,080	74,870	40	40	0	0	9,250	0	0	9,250	14,280	0	8,170	6,110	473,500	95,010	288,260	90,230
D	469,280	82,260	305,360	81,660	0	0	0	0	10,250	0	0	10,250	14,230	0	7,980	6,250	493,760	82,260	313,340	98,160
C	439,400	40,650	323,510	75,240	0	0	0	0	11,900	0	0	11,900	12,410	0	7,680	4,730	463,710	40,650	331,190	91,870



Table 5-2. Chowchilla Subbasin Consumptive Water Use, by Water Use Sector and Water Source Type (acre-feet, rounded).

Water Year (Type)	Agricultural				Managed Recharge				Native Vegetation				Urban				Total			
	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation	Total	Surface Water	Ground-water	Precipitation
1989 (C)	277,060	25,660	177,930	73,470	0	0	0	0	16,730	0	0	16,730	5,960	0	2,610	3,350	299,750	25,660	180,540	93,550
1990 (C)	295,140	17,130	201,770	76,240	0	0	0	0	16,670	0	0	16,670	6,360	0	2,730	3,630	318,170	17,130	204,500	96,540
1991 (C)	290,960	26,490	203,140	61,330	0	0	0	0	14,820	0	0	14,820	5,780	0	2,690	3,090	311,560	26,490	205,830	79,240
1992 (C)	325,520	23,880	235,750	65,890	0	0	0	0	18,030	0	0	18,030	7,230	0	3,440	3,790	350,780	23,880	239,190	87,710
1993 (W)	312,470	65,830	159,170	87,470	0	0	0	0	17,220	0	0	17,220	7,080	0	2,920	4,160	336,770	65,830	162,090	108,850
1994 (C)	314,570	50,580	200,420	63,570	10	10	0	0	14,280	0	0	14,280	7,190	0	3,640	3,550	336,050	50,590	204,060	81,400
1995 (W)	293,420	73,820	116,350	103,250	0	0	0	0	16,550	0	0	16,550	6,750	0	2,210	4,540	316,720	73,820	118,560	124,340
1996 (W)	328,400	87,010	158,150	83,240	0	0	0	0	17,490	0	0	17,490	7,450	0	2,570	4,880	353,340	87,010	160,720	105,610
1997 (W)	333,910	88,250	177,390	68,270	20	20	0	0	15,470	0	0	15,470	8,070	0	3,780	4,290	357,470	88,270	181,170	88,030
1998 (W)	297,250	73,110	131,660	92,480	30	30	0	0	14,180	0	0	14,180	7,230	0	3,000	4,230	318,690	73,140	134,660	110,890
1999 (AN)	313,390	89,890	170,890	52,610	0	0	0	0	12,940	0	0	12,940	7,480	0	3,670	3,810	333,810	89,890	174,560	69,360
2000 (AN)	335,290	91,970	173,310	70,010	0	0	0	0	14,130	0	0	14,130	8,160	0	4,000	4,160	357,580	91,970	177,310	88,300
2001 (D)	335,770	71,210	194,620	69,940	0	0	0	0	15,330	0	0	15,330	8,260	0	3,610	4,650	359,360	71,210	198,230	89,920
2002 (D)	343,980	43,610	236,820	63,550	0	0	0	0	14,250	0	0	14,250	9,370	0	4,740	4,630	367,600	43,610	241,560	82,430
2003 (BN)	338,240	53,190	226,700	58,350	0	0	0	0	11,140	0	0	11,140	9,630	0	5,370	4,260	359,010	53,190	232,070	73,750
2004 (D)	364,120	42,070	271,110	50,940	0	0	0	0	11,820	0	0	11,820	11,320	0	6,710	4,610	387,260	42,070	277,820	67,370
2005 (W)	323,270	83,370	162,290	77,610	0	0	0	0	12,920	0	0	12,920	10,430	0	4,930	5,500	346,620	83,370	167,220	96,030
2006 (W)	331,270	101,240	146,190	83,840	0	0	0	0	13,790	0	0	13,790	11,180	0	4,840	6,340	356,240	101,240	151,030	103,970
2007 (C)	339,570	60,900	237,180	41,490	0	0	0	0	10,030	0	0	10,030	11,680	0	6,550	5,130	361,280	60,900	243,730	56,650
2008 (C)	342,680	48,010	239,970	54,700	0	0	0	0	10,050	0	0	10,050	13,240	0	7,780	5,460	365,970	48,010	247,750	70,210
2009 (BN)	323,520	60,870	209,080	53,570	0	0	0	0	8,170	0	0	8,170	13,500	0	8,360	5,140	345,190	60,870	217,440	66,880
2010 (AN)	323,730	89,120	149,590	85,020	0	0	0	0	11,330	0	0	11,330	12,590	0	5,540	7,050	347,650	89,120	155,130	103,400
2011 (W)	333,570	102,930	148,320	82,320	0	0	0	0	11,790	0	0	11,790	13,220	0	5,050	8,170	358,580	102,930	153,370	102,280
2012 (D)	353,050	73,040	244,010	36,000	0	0	0	0	6,230	0	0	6,230	12,310	0	7,220	5,090	371,590	73,040	251,230	47,320
2013 (C)	359,330	37,540	271,410	50,380	0	0	0	0	7,040	0	0	7,040	14,320	0	8,770	5,550	380,690	37,540	280,180	62,970
2014 (C)	347,440	310	314,800	32,330	0	0	0	0	3,400	0	0	3,400	11,990	0	8,590	3,400	362,830	310	323,390	39,130
2015 (C)	386,190	370	348,420	37,400	0	0	0	0	3,610	0	0	3,610	13,350	0	9,750	3,600	403,150	370	358,170	44,610
2016 (D)	382,950	49,680	245,060	88,210	0	0	0	0	7,160	0	110	7,050	13,710	0	6,740	6,970	403,820	49,680	251,910	102,230
2017 (W)	363,230	107,400	175,040	80,790	810	810	0	0	6,110	0	0	6,110	12,260	0	5,380	6,880	382,410	108,210	180,420	93,780
2018 (BN)	375,080	88,160	230,770	56,150	120	120	0	0	4,170	0	0	4,170	10,890	0	5,940	4,950	390,260	88,280	236,710	65,270
2019 (W)	377,420	117,650	168,100	91,670	510	510	0	0	5,870	0	0	5,870	12,780	0	5,690	7,090	396,580	118,160	173,790	104,630
2020 (D)	371,800	70,360	249,850	51,590	0	0	0	0	3,760	0	0	3,760	11,470	0	6,430	5,040	387,030	70,360	256,280	60,390
2021 (C)	313,090	8,060	290,830	14,200	0	0	0	0	1,540	0	0	1,540	9,290	0	7,050	2,240	323,920	8,060	297,880	17,980
Average (1989-2014)	326,040	60,810	198,390	66,840	0	0	0	0	12,920	0	0	12,920	9,530	0	4,820	4,710	348,480	60,810	203,200	84,470
Average (1989-2021)	334,740	61,290	208,060	65,390	50	50	0	0	11,150	0	0	11,150	10,040	0	5,220	4,820	355,990	61,340	213,290	81,360
W	329,420	90,060	154,270	85,090	140	140	0	0	13,140	0	0	13,140	9,650	0	4,040	5,610	352,340	90,200	158,300	103,840
AN	324,150	90,330	164,600	69,220	0	0	0	0	12,800	0	0	12,800	9,410	0	4,400	5,010	346,350	90,330	169,000	87,020
BN	345,610	67,410	222,180	56,020	40	40	0	0	7,830	0	0	7,830	11,330	0	6,550	4,780	364,820	67,450	228,740	68,630
D	358,610	58,330	240,240	60,040	0	0	0	0	9,760	0	20	9,740	11,070	0	5,910	5,160	379,440	58,330	246,170	74,940
C	326,510	27,180	247,420	51,910	0	0	0	0	10,560	0	0	10,560	9,670	0	5,780	3,890	346,740	27,180	253,200	66,360



5.2 DATA SOURCES

ET_{aw} and ET_{pr} volumes were calculated by water use sector and water source type using a root zone water balance model as described in Section 2.2.3.3, pages 2-60 through 2-64 of the Chowchilla Subbasin GSP.

Daily ET_o values were computed based on weather data in the study area (**Table 5-3**) and were provided as inputs to the root zone model for calculating crop consumptive use requirements. Daily precipitation inflows to each Land Surface System water use sector were calculated as the daily precipitation depth derived from weather station data (**Table 5-3**) applied over the total area of each water use sector within the Chowchilla Subbasin (in acres). Daily precipitation depths were provided as inputs to the root zone model to compute the fraction of ET_c that is represented by ET_{pr} . The Madera II CIMIS station last day with reported data was June 23, 2018. Beginning June 24, 2018, PRISM data was used for precipitation and spatial CIMIS data was used for reference ET.

Table 5-3. Chowchilla Subbasin Weather Data Sources.

Weather Station	Station Type	Start Date	End Date	Comment
Fresno State	CIMIS	Oct. 2, 1988	May 12, 1998	CIMIS Station #80. Used before Madera CIMIS station was installed.
Madera	CIMIS	May 13, 1998	Apr. 2, 2013	CIMIS Station #145. Moved eastward 2 miles in 2013 and renamed "Madera II."
Madera II	CIMIS	Apr. 3, 2013	Jun. 23, 2018	CIMIS Station #188.
Spatial CIMIS	Spatial CIMIS	Jun. 24, 2018	Sep. 30, 2021	Used for developing ET_o time series in 2018-2021 after CIMIS station data was available.
PRISM	PRISM	Jun. 24, 2018	Sep. 30, 2021	Used for developing precipitation time series in 2018-2021 after CIMIS station data was available.
Madera	NOAA NCEI	Jan. 1, 1928	Sep. 30, 2021	Used for developing ET_o time series for projected water budget period when CIMIS data were available.



6 Change in Groundwater Storage (§356.2.b.5)

6.1 CHANGE IN GROUNDWATER STORAGE MAPS

Consistent with §354.18.b, based on a comparison of the annual spring groundwater elevation contour maps representing seasonal high groundwater conditions, changes in groundwater elevation were calculated between Spring 2020 and Spring 2021. To calculate annual change in groundwater storage from the groundwater level contour maps, the difference in groundwater elevation between annual spring contour maps was calculated for each of the principal aquifers (Upper and Lower Aquifers). Both confined and unconfined groundwater conditions occur within the Chowchilla Subbasin. To accurately estimate change in groundwater storage from changes in groundwater levels, it is important to differentiate areas of confined groundwater conditions from unconfined conditions. Accordingly, the groundwater elevation data were reviewed to estimate an area over which the Lower Aquifer exhibits confined conditions and where the groundwater levels are representative of a potentiometric surface. This was done by comparing groundwater elevations to the elevation of the bottom of the Corcoran Clay confining geologic unit. The extent of the area where groundwater elevations in the Lower Aquifer occur above the bottom of the Corcoran Clay was delineated as the area of confined groundwater conditions for the purpose of calculating change in groundwater storage.

Outside of the delineated confined area, changes in groundwater levels (in both the Upper and Lower Aquifers) were multiplied by representative specific yield values to estimate change in groundwater storage. Within the delineated area of confinement in the Lower Aquifer, groundwater potentiometric surface changes in the Lower Aquifer were multiplied by a much smaller storage coefficient value to calculate annual changes in groundwater storage in the Lower Aquifer. The specific yield and storage coefficient values used in the analysis are derived from values in the calibrated integrated groundwater flow model (MCSim) developed and applied during the preparation of the GSP. The specific yield values in MCSim are lower than some previous values estimated for the Chowchilla Subbasin; however, recent test hole drilling and associated subsurface geologic and geophysical logging conducted at eight nested monitoring well sites across the Chowchilla Subbasin indicate a high fraction of fine-grained sediments in many parts of the Chowchilla Subbasin, which is consistent with the relatively lower specific yield values in MCSim, especially for deeper materials within the Lower Aquifer.

Figures 6-1 and 6-2 show the spatial distribution of calculated annual change in groundwater level for the most recent reporting year between Spring 2020 and Spring 2021 for the Upper Aquifer unconfined groundwater zone and also for the Lower Aquifer. Because there was incomplete spatial coverage of groundwater elevation data within the Chowchilla Subbasin, it was not deemed appropriate to extend groundwater elevation contours into some parts of the Chowchilla Subbasin. In these areas without contour data, the average change in groundwater elevation value calculated for the area with data was applied to areas without data to estimate change in storage amounts for the Lower Aquifer. However, the portion of the Upper unconfined aquifer without groundwater contour data was assumed to have no net storage change because



it is an area comprised primarily of thin saturation and perched groundwater conditions. **Tables 6-1 through 6-3** summarize the calculated annual change in groundwater storage volumes for each year and by principal aquifer for the Chowchilla Subbasin. The discussion of estimated change in storage values presented below is based on the aquifer parameter values derived from MCSim as presented in **Tables 6-1 through 6-3**. Change in storage values for both the unconfined Upper Aquifer and Lower Aquifer zones for representative specific yield and storativity values are presented in **Table 6-1**. Maps of the spatial distribution of change in storage in the principal aquifers for the most recent period from Spring 2020 to Spring 2021 are presented in **Figures 6-3 and 6-4**. All maps of change in groundwater storage utilize specific yield and storage coefficient values derived from MCSim. Maps of change in groundwater levels and change in groundwater storage for each of the years between Spring 2016 and 2020, separated by aquifer, are presented in **Appendix C**.

Using representative aquifer parameter values derived from the calibrated groundwater flow model MCSim, the calculated changes in groundwater levels in the Upper Aquifer translate to annual changes in groundwater storage of about -27,400 AF from Spring 2020 to 2021 (**Table 6-1**). Negative change in storage values indicate depletion of groundwater storage, whereas positive change in storage values represent accretion of groundwater in storage. Between Spring 2020 and Spring 2021, the change in groundwater storage in the Lower Aquifer was about -77,000 AF (**Table 6-2**). The combined change in groundwater storage for the entire Chowchilla Subbasin was about -104,000 AF from Spring 2020 to 2021, indicating a net depletion of groundwater storage (**Table 6-3**). Notably, there is uncertainty in this estimate, and there are also other processes that contribute to the net change in groundwater storage besides groundwater pumping (e.g., subsurface inflows and outflows). These contributing factors were considered in the MCSim groundwater model used in development of the Chowchilla Subbasin GSP, and will be further evaluated in future updates to the MCSim model

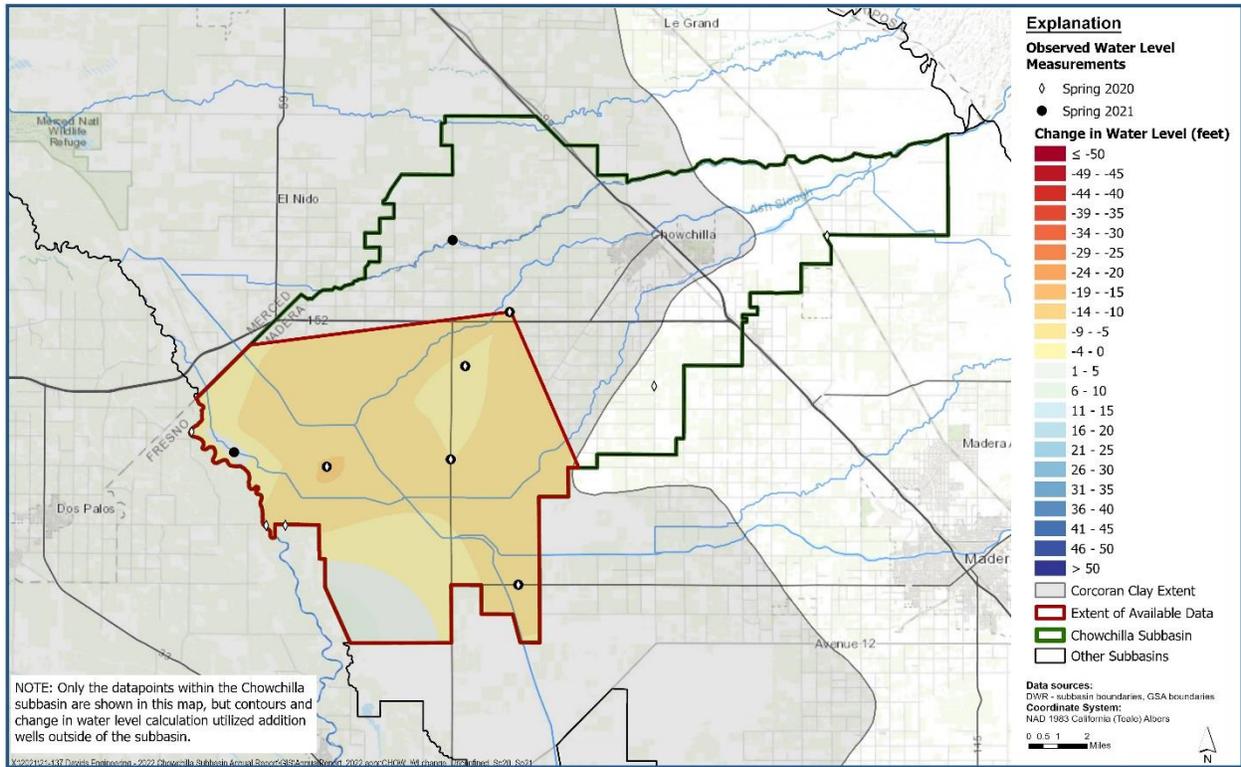


Figure 6-1. Change in Groundwater Level in the Upper Aquifer – Spring 2020 through Spring 2021.

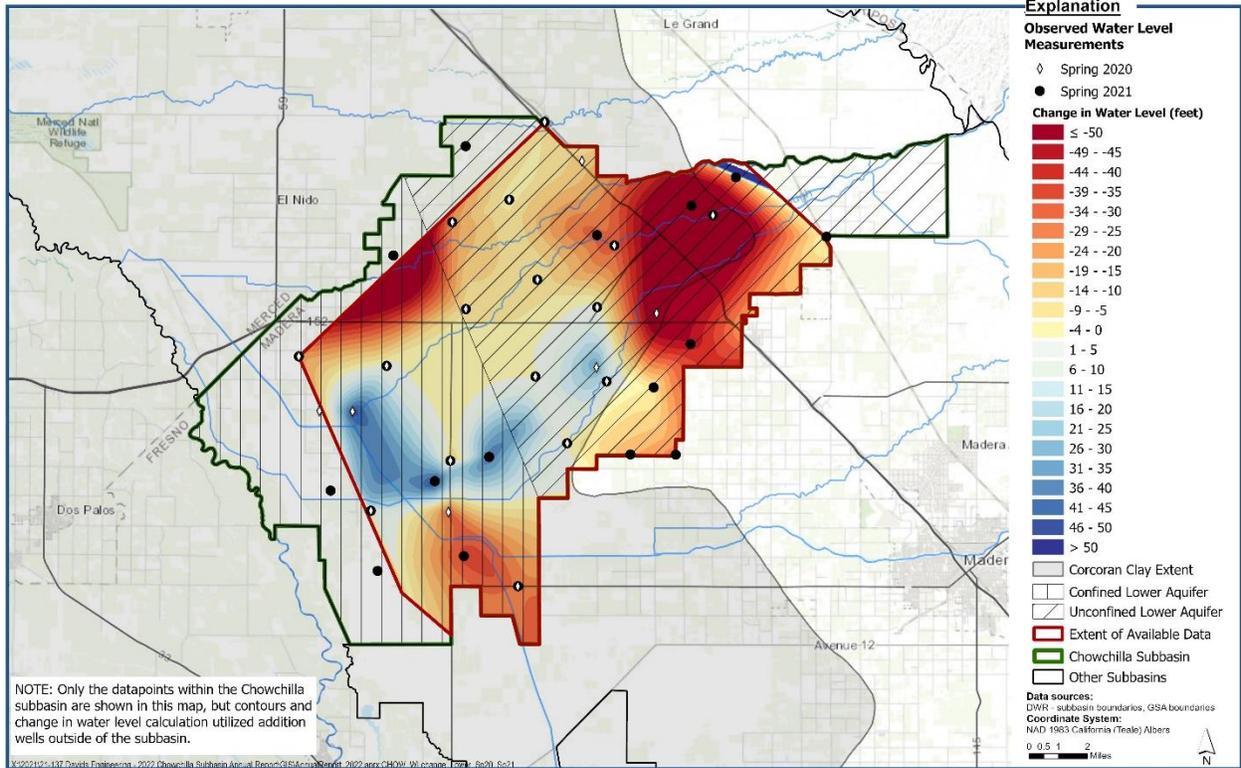


Figure 6-2. Change in Groundwater Level in the Lower Aquifer/Undifferentiated Unconfined Zone – Spring 2020 through Spring 2021.

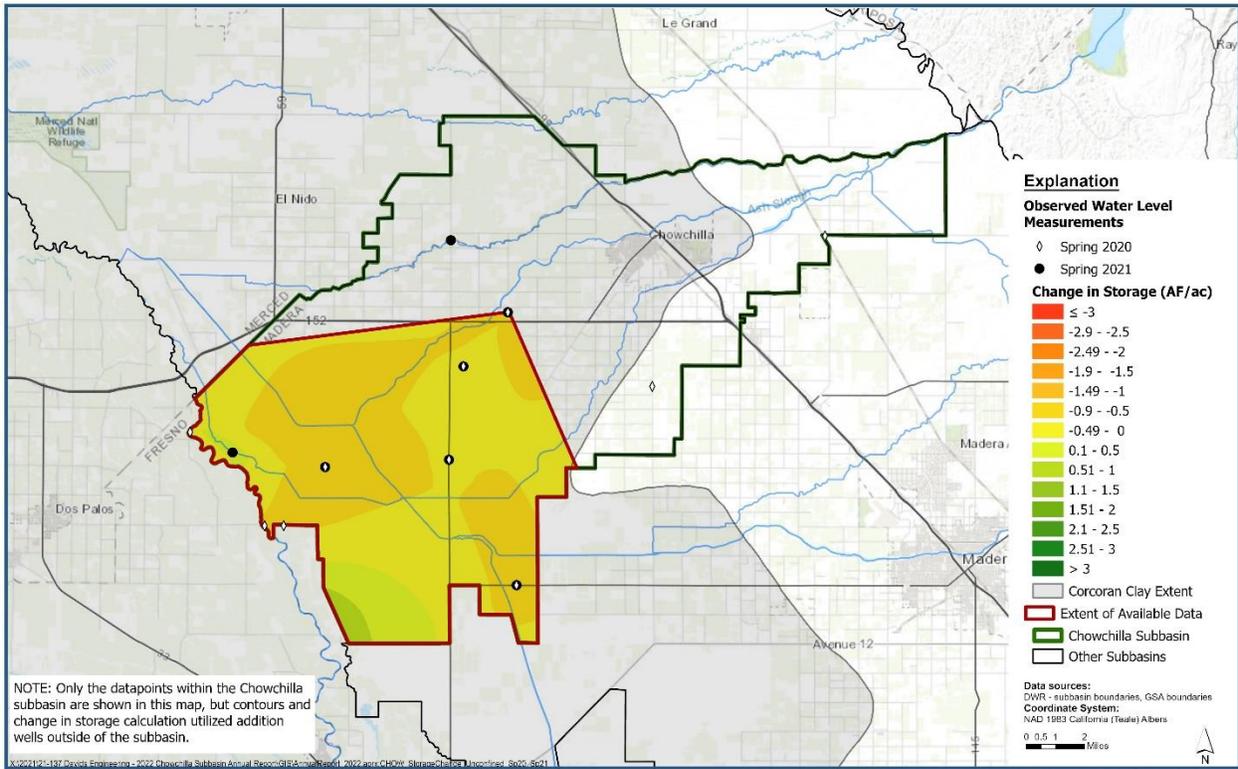


Figure 6-3. Change in Groundwater Storage in the Upper Aquifer – Spring 2020 through Spring 2021.

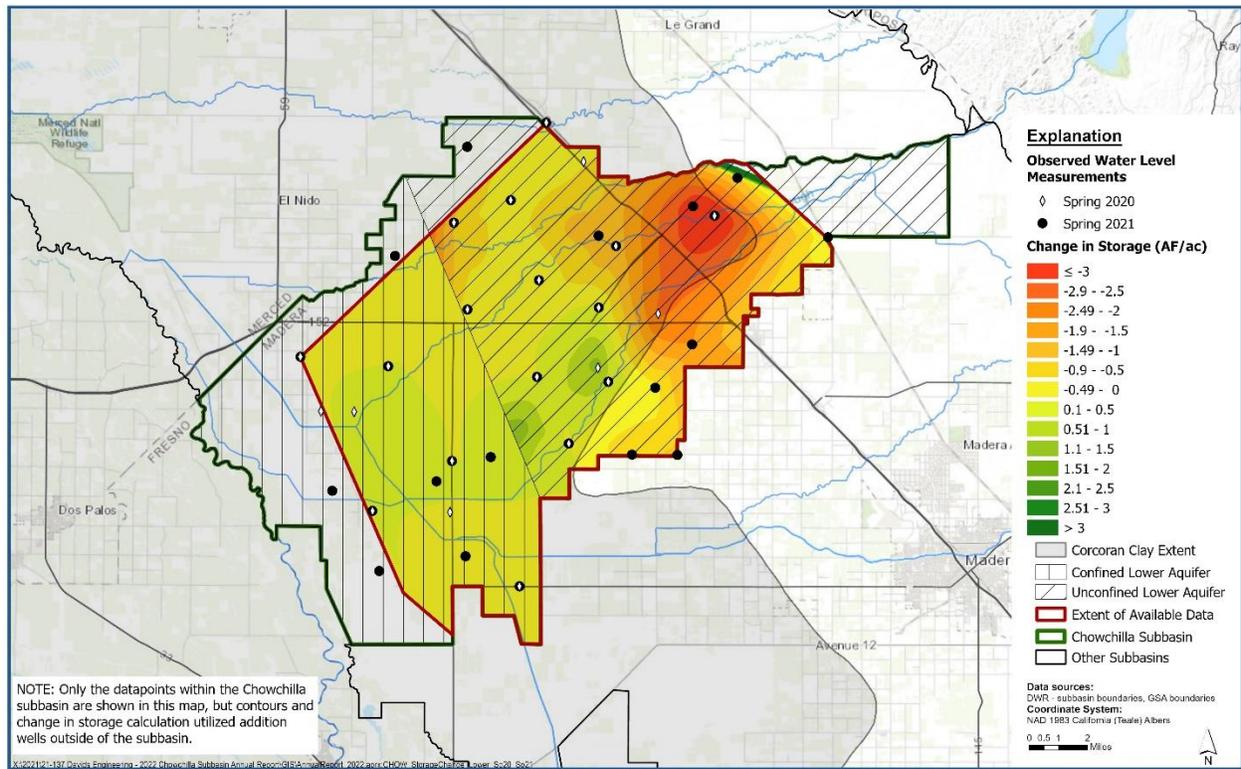


Figure 6-4. Change in Groundwater Storage in the Lower Aquifer/Undifferentiated Unconfined Zone – Spring 2020 through Spring 2021.



Table 6-1. Calculated Change in Groundwater Storage in the Upper Aquifer Zone.

Analysis Time Period	Specific Yield	Average Groundwater Elevation Change (ft)	Average Groundwater Storage Change Per Acre (AF/acre)	Area Used for Estimating Groundwater Storage Change (acres)	Total Unconfined Groundwater Storage Change in Chowchilla Subbasin (AF)	Notes on Specific Yield Basis
Spring 2020-2021	0.086	-4.97	-0.43	64,155	-27,431	Representative value from MCSim model

Table 6-2. Calculated Change in Groundwater Storage in the Combined Lower Aquifer and Undifferentiated Unconfined Zone.

Analysis Time Period	Lower Aquifer Zone	Storage Coefficient ¹	Specific Yield ²	Average Change in Groundwater Potentiometric Surface (ft)	Average Confined Groundwater Storage Change Per Acre (AF/acre)	Area Used for Estimating Confined Groundwater Storage Change (acres)	Total Groundwater Storage Change ³ (AF)	Notes on Storage Coefficient Basis
Spring 2020-2021	Confined	1.52x10 ⁻³		-6.22	-0.01	57,999	-547	Representative value from MCSim model
	Unconfined		0.041	-21.42	-0.87	87,575	-76,444	
	TOTAL				-0.53	145,574	-76,991	

¹ Storage Coefficient value applies to those areas below the Corcoran Clay interpreted to be confined (57,999 acres).

² Specific Yield value applies to those areas below the Corcoran Clay and east of Corcoran Clay extent interpreted to be unconfined (59,76087,575 acres).

³ Total area of the Lower Aquifer within the Chowchilla Subbasin is 145,574 acres.



Table 6-3. Total Calculated Change in Groundwater Storage in the GSP Area.

Analysis Time Period	Average Groundwater Storage Change Per Acre (AF/acre)	Total GSP Area (acres)	Total GSP Area Groundwater Storage Change (AF)
Spring 2020-2021	-0.72	145,574	-104,422

6.2 GROUNDWATER USE AND CHANGE IN GROUNDWATER STORAGE

Annual groundwater extractions and change in groundwater storage in the Chowchilla Subbasin is shown in **Figure 6-5** for water years 2015 to 2021. Groundwater extractions are estimated or directly measured following the procedures described in the corresponding section above. Change in groundwater storage is estimated based on an annual comparison of spring groundwater elevations. Change in groundwater storage is not provided for water years 2015 and 2016, as there was insufficient historical data to accurately calculate change in storage those years. Historical groundwater extractions in water years 1989 through 2014 are shown in Figure 2-85 of the Chowchilla Subbasin GSP (page 2-82). Historical annual changes in groundwater storage and cumulative changes in storage are also shown in the Chowchilla Subbasin GSP (Appendix D.1.a, pages A6.D-467 and A6.D-468). Historical changes in groundwater storage between 1989 and 2014 were calculated based on a water balance of the Chowchilla Subbasin groundwater system using the MCSim numerical groundwater flow model (described in the Chowchilla Subbasin GSP). Total annual groundwater extraction decreases in wetter years and increases in drier years, while the annual change in groundwater storage has fluctuated between approximately 279,000 AF and -104,000 AF since water year 2017 (**Figure 6-5**).

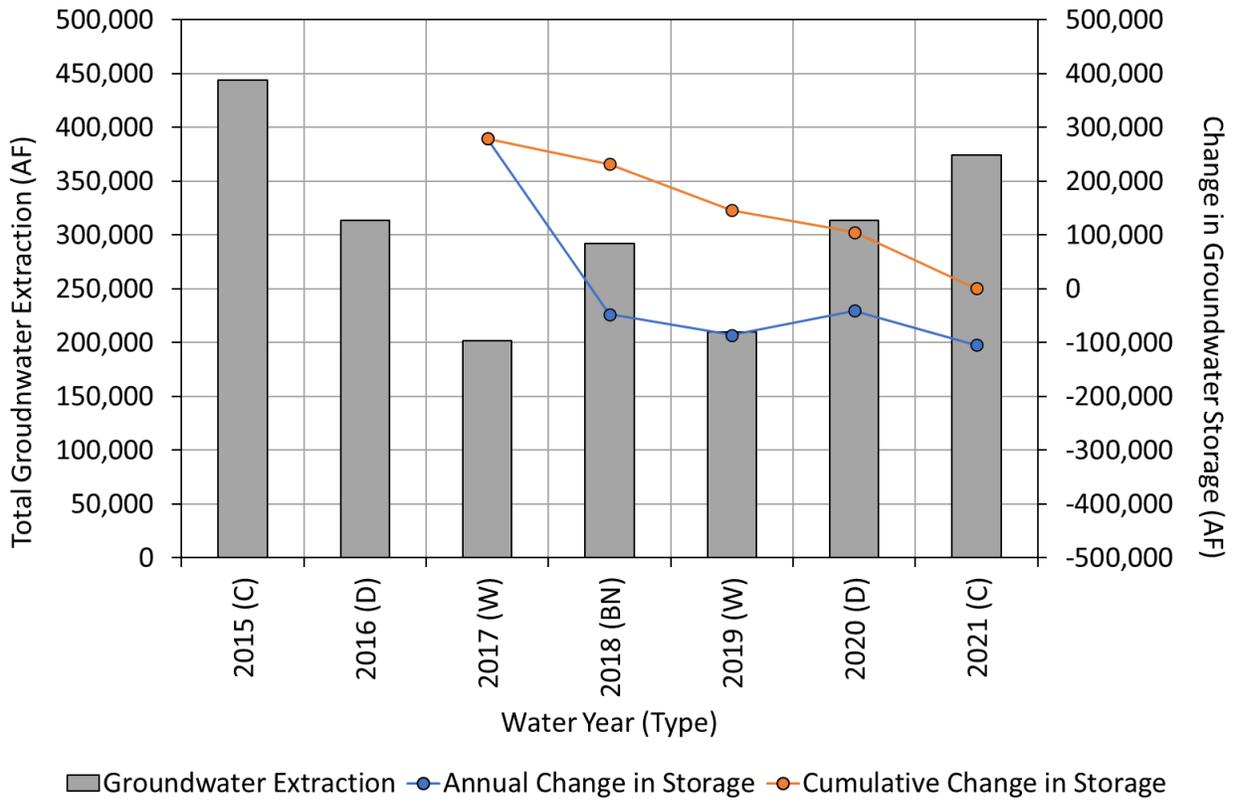


Figure 6-5. Annual Groundwater Storage Changes and Extractions.



6.3 SUBSIDENCE DATA/MAPS

The GSP notes that subsidence data will be reviewed periodically as it becomes available. The amount and rate of subsidence in the Chowchilla Subbasin and surrounding areas is being tracked by various agencies using different methods. InSAR data is collected by satellites and has been collected for the time period from 2015 to 2021. Maps of subsidence for the most recent six years and cumulative for 2015 to 2021 are included in **Appendix D**.

Review of the cumulative subsidence map over the six-year period indicates a range of total subsidence from approximately 1.5 to 3.5 feet over this time span in the western Chowchilla Subbasin area. However, review of the maps for individual years generally indicates more of this subsidence occurred in the early portion of the 2015 to 2021 time period than in the later portion of the time period. While there are substantial areas of missing data on these maps (indicated by white areas), it appears that much of the western portion of Chowchilla Subbasin experienced 0.6 to 1.0 feet of subsidence from March 2015 to March 2016, while most of this same area showed 0.2 to 0.4 feet of subsidence from March 2020 to March 2021. This gradual decrease in subsidence over time may reflect the lag time often associated with subsidence; in this case, a lag from low groundwater elevations experienced in 2015 at the end of the previous drought.

The InSAR maps also indicate the area of greatest subsidence appears to have shifted slightly to the east of the primary subsidence areas prior to 2016 with the highest subsidence rates during the March 2020 to March 2021 located primarily within the more eastern portions of the western Madera County GSA area and to some extent within the westernmost fringes of CWD GSA. However, data is missing in some key areas where the greatest subsidence prior to 2016 was evident, and understanding changes in the spatial distribution of subsidence will require further review as more data become available.

Additional subsidence data are also available for ongoing benchmark surveys performed for the San Joaquin River Restoration Project, with data now available through December 2020 (**Appendix D**). These benchmark subsidence data also indicate decreasing rates of subsidence in western Chowchilla Subbasin from 2015-16 to 2019-20.



7 Groundwater Sustainability Plan Implementation Progress (§356.2.c)

7.1 IMPLEMENTATION OF PROJECTS AND MANAGEMENT ACTIONS (§356.2.C)

The implementation of projects and management actions (PMAs) is critical for achieving and maintaining groundwater sustainability, as described in the GSP. PMAs are scheduled for implementation throughout the 2020 through 2040 implementation period, with different timelines anticipated for implementation of each PMA. The estimated annual costs and benefits (i.e., increased groundwater recharge or reduced groundwater use) of PMAs proposed by the GSAs vary across this implementation period, as described in the GSP.

This section describes progress that has been made toward implementation of the GSP and specific PMAs since the previous Annual Report. First, a brief overview is given regarding DWR's review comments on the Chowchilla Subbasin GSP and the GSAs' initial efforts to address those comments and update the Chowchilla Subbasin GSP. Next, a summary is given regarding the progress that has been made toward implementation of the Domestic Well Mitigation Program as of spring 2022. The remainder of this section describes the progress made for PMAs proposed by each GSA.

7.1.1 DWR's Review of the Chowchilla Subbasin GSP and Efforts to Address Potential Deficiencies

Since submittal of the Chowchilla Subbasin GSP in January 2020, DWR has conducted a review of the GSP to determine whether it deems the GSP to be based on the best available science and information and whether it is reasonably likely to achieve the Chowchilla Subbasin sustainability goals. In November 2021, DWR completed an initial review of the Chowchilla Subbasin GSP and submitted a letter to the GSAs identifying three potential deficiencies that may preclude DWR's approval of the GSP: (1) insufficient information to support the selection of chronic lowering of groundwater levels sustainable management criteria, (2) insufficient information to support the selection of land subsidence sustainable management criteria, and (3) insufficient information to support the determination that interconnected surface water or undesirable results related to depletions of interconnected surface water are not present and are not likely to occur in the Chowchilla Subbasin. On January 28, 2022, DWR released an incomplete determination of the Chowchilla Subbasin GSP, initiating a 180-day consultation period.

Since November 2021, the GSAs have created a plan to address those potential deficiencies, primarily by completing GSP text revisions and additional non-modeling analyses to clarify and refine the selection of sustainable management criteria and the characterization of groundwater conditions in the Chowchilla Subbasin. In February-March 2022, the GSAs applied for and were awarded Proposition 68 funding to support the GSP updates. As of April 1, 2022, the GSAs have held four consultation meetings with DWR to discuss the plans for addressing the potential deficiencies and to ensure that those plans are sufficient and will lead to an updated GSP that is acceptable to DWR. The GSAs will continue their consultation with DWR during 2022. The GSAs plan to adopt and submit a modified GSP to DWR for evaluation no later than July 27, 2022.



7.1.2 Domestic Well Mitigation Program

The first step in development of the Domestic Well Mitigation Program is to inventory the domestic wells in the Chowchilla Subbasin. To accomplish this, the GSAs in the Chowchilla Subbasin applied for and were awarded a Proposition 68 grant from DWR to conduct a domestic well inventory and install nine new monitoring wells at three sites in the Chowchilla Subbasin. The Madera County GSA applied for the grant on behalf of the Chowchilla Subbasin and has led the project since its inception. The Madera County GSA issued an RFP and selected a consultant for the study in 2020. In 2021-2022, the domestic well inventory was conducted. Installation of new nested monitoring wells is pending. As of spring 2022, the project is nearing completion and final documentation is being prepared. In addition to an updated and more accurate domestic well inventory, information collected during this project from the drilling, geologic and geophysical logging, groundwater quality sampling, and automated groundwater level monitoring will aid further in filling data gaps in the monitoring and conceptualization of the Chowchilla Subbasin hydrogeology. The project will also improve understanding and management of groundwater in the Chowchilla Subbasin.

As of spring 2022, the GSAs continue to meet to advance focused plans for creating and administering the Domestic Well Mitigation Program within the Chowchilla Subbasin. Discussions thus far have centered on plans for program development during the 180-day consultation period with DWR. The GSAs have created a draft workflow to guide operation of the Domestic Well Mitigation Program (**Figure 7-1**). The GSAs are also working collaboratively to develop an MOU, which in part, will define the starting date, proportionate responsibilities, eligibility criteria, eligible projects, funding limits, interim measures as may be required, staffing responsibilities, and principles for implementing the Domestic Well Mitigation Program. It is the clear intent of the GSAs to have the MOU completed and fully executed during the 180-day consultation period. The MOU and any updates on implementation of the Domestic Well Mitigation Program will be reported in subsequent Annual Reports.



DRAFT – Preliminary Internal Working Document

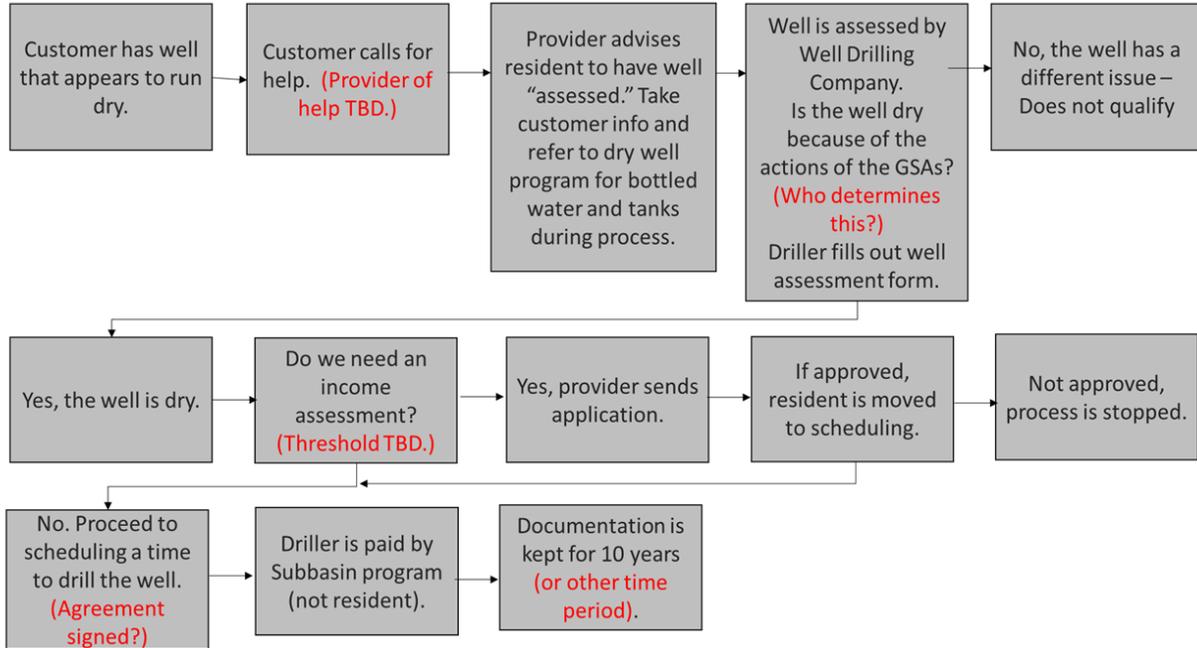


Figure 7-1. Chowchilla Subbasin Domestic Well Mitigation Program Draft Workflow.



7.1.3 Projects and Management Actions

PMAs are listed and described in **Tables 7-1 through 7-4**, followed by a more detailed description of individual PMAs being implemented by each GSA. **Tables 7-1 and 7-2** provide an overview of each PMA from the GSP, its implementation status, a description of activities planned to occur as part of that PMA, and updates on actual activities and actual benefits since implementation. The status of projects and management actions is generally defined as follows:

- **Implemented:** Active efforts to operate the project or management action have begun, though benefits may or may not have been achieved to date.
- **In Progress:** Active efforts needed to initiate the project or management action have begun (e.g., permitting), though development has not reached the point of operability.
- **Planned:** Early conceptual development is still in progress, though active efforts needed to initiate or operate the project or management action have not begun.

Tables 7-3 and 7-4 summarize the actual project costs incurred through the current reporting year (2021) and the estimated overall project costs. All estimated benefits and costs are summarized from the GSP, while actual benefits and costs are presented only for those projects already implemented. These tables provide a comparison of the actual and estimated costs and benefits of PMAs, as well as a measure of the degree of implementation for PMAs that will take multiple years to fully implement. It should be noted that the estimated benefits and costs were developed for full project implementation, not partial implementation.

This Annual Report covers the second full year of project implementation under the GSP. Progress on some projects and stakeholder outreach have slowed since the start of GSP implementation as a result of the health and safety concerns associated with COVID-19 and its repercussions on both public agencies and private parties (e.g., challenges of conducting effective outreach exclusively by online meetings and phone calls). Due to dry conditions in 2021, recharge was also lower than would occur in a wetter year and water was not available for recharge through GSA-owned recharge basins. In spite of these setbacks and dry conditions, the GSAs continued to make significant progress in implementing existing projects as well as being awarded additional grants for new projects.

The GSAs in the Chowchilla Subbasin are committed to adaptive management of this suite of PMAs. As projects are implemented and monitored, the project timelines and volume of demand management necessary will be reviewed. If adjustments are needed to meet the sustainability objective, initial project timelines will be evaluated and adjusted. In addition to continuous monitoring and review of project and management action implementation, each Annual Report represents an important milestone and opportunity to review the status of GSP implementation efforts.



Table 7-1. Project and Management Action Implementation Summary.

Subregion	Project	Project Mechanism	First Year Implemented	Status	Project Description
CWD GSA	Enhanced Management of Flood Releases for Recharge	Increase Recharge	2017	Implemented	Diverted water is spread throughout unlined portions of the distribution system and released into reaches of the Chowchilla River, Ash Slough and Berenda Slough that are not used for water distribution.
CWD GSA	Road 13 Groundwater Recharge Basin	Increase Recharge	2018	Implemented	Develop and utilize one 56 ^{al} -acre groundwater recharge basin
CWD GSA	City Groundwater Recharge Basin	Increase Recharge	2019	Implemented	Deliver water to a storm water retention pond owned by the City of Chowchilla for groundwater recharge. <i>CWD has delivered water to the City Groundwater Recharge Basin since 2005, but has considered this a GSP project since GSP development in 2019.</i>
CWD GSA	Additional Groundwater Recharge Basins	Increase Recharge	2021	Planned	Develop an additional 1,000 acres of groundwater recharge basins by 2040
CWD GSA	Flood-MAR (Winter Recharge)	Increase Recharge	2020	Implemented	Program with voluntary participation to divert surplus flows onto farms and fields for recharge using existing infrastructure
CWD GSA	Merced-Chowchilla Intertie	Increase Recharge or Reduce Groundwater Pumping	2035	Planned	Construct water conveyance facilities and negotiate transfer agreement between Merced ID and Chowchilla WD
CWD GSA	Madera Canal Capacity Increase	Increase Recharge or Reduce Groundwater Pumping	2035	Planned	Increase capacity of Madera Canal
CWD GSA	Buchanan Dam Capacity Increase	Increase Recharge or Reduce Groundwater Pumping	2040	Planned	Increase capacity of Buchanan Dam
CWD GSA	Road 19 Groundwater Recharge Basin	Increase Recharge	2020	Implemented	Develop and utilize 38-acre groundwater recharge basin
CWD GSA	Wood Groundwater Recharge Basin	Increase Recharge	2021	Implemented	Develop and utilize 67-acre groundwater recharge basin



Subregion	Project	Project Mechanism	First Year Implemented	Status	Project Description
CWD GSA	Acconero Groundwater Basin	Increase Recharge	2021	Implemented	Develop and utilize 65-acre groundwater recharge basin
Madera County GSA	Madera County West: Recharge Basins	Increase Recharge	2020	Implemented	Divert water from Eastside Bypass and Ash Slough into basins or fields for recharge when possible. <i>Since GSP adoption, this project has been further refined and is now commonly referred to as part of the Chowchilla Bypass Flood Flow Recharge Phase 1/2 projects. Please see those project descriptions for more information.</i>
Madera County GSA	Madera County East: Water Purchase	Increase Recharge or Reduce Groundwater Pumping	2020	Implemented	Purchase surplus water (e.g. Section 215 flood flow from the CVP Friant Division) or other water that may be available.
Madera County GSA	Demand Management	Reduce Demand	2020	Implemented	Reduce consumptive water use through actions such as water-stressing crops, shifting to lower water-using crops, reducing evaporation losses, and reducing irrigated acreage.
Madera County GSA	Water Imports Purchase	Purchase water from willing partners outside of the basin to increase recharge or reduce GW pumping	2025	Planned	Develop partnerships and import additional water into Madera County for direct or in-lieu recharge.
Madera County GSA	Millerton Flood Release Imports	Purchase water from willing partners outside of the basin to increase recharge or reduce GW pumping	2025	In Progress	Request CVP Section 215 flood water when available for recharge.
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 1	Increase Recharge	2025	Implemented	Construct and operate diversion and conveyance facilities and basins to recharge an average of 12,700 AF per year.
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 2	Increase Recharge	2040	Planned	Construct and operate diversion and conveyance facilities and basins to recharge an average of 25,000 AF per year.



Subregion	Project	Project Mechanism	First Year Implemented	Status	Project Description
SVMWC	Recharge Basins to Capture Floodwater	Increase Recharge	2020	In Progress	Develop up to 300 acres of groundwater recharge basins; operation of recharge ponds is anticipated for 2023
TTWD GSA	Utilize Existing Recharge Basin	Increase Recharge	2017	Implemented	Program to divert surplus flows into existing recharge basin for recharge
TTWD GSA	Additional Recharge Basins to Capture Floodwater	Increase Recharge	2019	Implemented	Develop up to 310 acres of groundwater recharge basins.
TTWD GSA	Poso Canal Pipeline and Columbia Canal Company Pipeline Projects	Increase Recharge or Reduce Groundwater Pumping	2013	Implemented	Construct water conveyance pipelines for delivery of water from San Joaquin River Exchange Contractors and others. The Poso Canal Pipeline and the Columbia Canal Pipeline projects are currently operational.
TTWD GSA	Poso Canal Pipeline Extension Project	Increase Recharge or Reduce Groundwater Pumping	2022	Planned	Construct an additional 1.52 miles of pipeline and connect two regulating reservoirs to the existing Poso Canal Pipeline, providing surface water access to approximately 3,800 acres of irrigated farmland in areas prioritized for subsidence mitigation.

^[a] The GSP describes development and operation of an 80-acre recharge basin. However, the most suitable available land was a 56-acre parcel.



Table 7-2. Project and Management Action Benefit Summary.

Subregion	Project	First Year Implemented	Project Update	2021 Annual Benefit (acre-feet/year)	Gross Benefit to Date (acre-feet)	Estimated Average Annual Benefit at 2040* (acre-feet/year)
CWD GSA	Enhanced Management of Flood Releases for Recharge	2017	No flood releases were available for recharge in water year 2021 due to drought conditions.	0	9,393	9,393
CWD GSA	Road 13 Groundwater Recharge Basin	2018	No water was delivered to the Road 13 Groundwater Recharge Basin in water year 2021 due to drought conditions.	0	2,135	1,359
CWD GSA	City Groundwater Recharge Basin	2019	No water was delivered to the City Groundwater Recharge Basin in water year 2021 due to drought conditions.	0	1,661	1,661
CWD GSA	Additional Groundwater Recharge Basins	2021	<i>This project is being implemented through the individual groundwater recharge basins described below. Estimated benefits for those projects are listed below, and are subtracted from the estimated average annual benefit at 2040 of this project.</i>	0	0	8,800
CWD GSA	Flood-MAR (Winter Recharge)	2020	No flood releases were available for recharge in water year 2021 due to drought conditions.	0	0	5,836
CWD GSA	Road 19 Groundwater Recharge Basin	2020	No water was delivered to the Road 19 Groundwater Recharge Basin in water year 2021 due to drought conditions	0	0	456
CWD GSA	Wood Groundwater Recharge Basin	2021	No water was delivered to the Wood Groundwater Recharge Basin in water year 2021 due to drought conditions	0	0	804
CWD GSA	Acconero Groundwater Recharge Basin	2021	No water was delivered to the Acconero Groundwater Recharge Basin in water year 2021 due to drought conditions	0	0	780
Madera County GSA	Madera County East: Water Purchase	2020	No update.	0	0	3,015



Subregion	Project	First Year Implemented	Project Update	2021 Annual Benefit (acre-feet/year)	Gross Benefit to Date (acre-feet)	Estimated Average Annual Benefit at 2040* (acre-feet/year)
Madera County GSA	Demand Management	2020	The Madera County GSA completed numerous actions toward implementation of demand management in 2020-2021, including: development of a groundwater allocation framework and adoption of three resolutions establishing allocations and rules for credits; implementation of a demand measurement program with IrriWatch; outreach efforts related to Sustainable Agricultural Land Conservation (SALC) and land repurposing strategies; completion of a WaterSMART water market simulation; and development of a rate study with Raftelis to fund program implementation.	0	0	27,550
Madera County GSA	Millerton Flood Release Imports	2025	No flood releases were available for recharge in water year 2021 due to drought conditions.	0	0	7,060
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 1	2025	The Madera County GSA, in conjunction with TTWD, applied for and was awarded funding from DWR through the Proposition 68 grant program. Beginning in 2021, this funding was used to support planning and design of infrastructure for diversions, deliveries, and recharge of flood water from the Chowchilla Bypass. Construction is expected to begin in 2022-2023, pending successful completion of CEQA and permitting. In early 2022, the Madera County GSA applied for and was awarded additional Proposition 68 funding to fund expansion of this project.	0	0	13,500



Subregion	Project	First Year Implemented	Project Update	2021 Annual Benefit (acre-feet/year)	Gross Benefit to Date (acre-feet)	Estimated Average Annual Benefit at 2040* (acre-feet/year)
SVMWC	Recharge Basins to Capture Floodwater	2020	In early 2022, SVMWC applied for and was awarded Proposition 68 funding to support this project.	0	0	4,344
TTWD GSA	Utilize Existing Recharge Basin	2017	No water was recharged in water year 2021 due to drought conditions.	0	19,270	4,994
TTWD GSA	Additional Recharge Basins to Capture Floodwater	2019	No water was recharged in water year 2021 due to drought conditions.	0	0	24,657
TTWD GSA	Poso Canal Pipeline and Columbia Canal Company Pipeline Projects	2013	No water was delivered in water year 2021 due to drought conditions.	0	25,400	7,647
TTWD GSA	Poso Canal Pipeline Extension Project	2022	In early 2022, TTWD applied for and was awarded Proposition 68 funding to support the Poso Pipeline Extension project.	0	0	4,000
Total				0	57,859	125,856

*Note: Estimates developed for full project implementation.



Table 7-3. Project and Management Action Cost Summary, 2021.

Subregion	Project	First Year Implemented	Status	2021 Capital Cost (\$)	Capital Cost to Date (\$)	2021 Annual Operating Cost (\$)
CWD GSA	Enhanced Management of Flood Releases for Recharge	2017	Implemented			
CWD GSA	Road 13 Groundwater Recharge Basin	2018	Implemented		\$168,699	\$0
CWD GSA	City Groundwater Recharge Basin	2019	Implemented			
CWD GSA	Flood-MAR (Winter Recharge)	2020	Implemented			
CWD GSA	Road 19 Groundwater Recharge Basin	2020	Implemented	\$13,389	\$1,037,136	\$0
CWD GSA	Wood Groundwater Recharge Basin	2020	Implemented	\$346,185	\$1,952,713	\$0
CWD GSA	Acconero Groundwater Recharge Basin	2021	Implemented	\$2,009,906	\$2,009,906	\$0
Madera County GSA	Madera County East: Water Purchase	2020	Implemented			
Madera County GSA	Demand Management	2020	Implemented			
Madera County GSA	Water Imports Purchase	2025	Planned			
Madera County GSA	Millerton Flood Release Imports	2025	In Progress			
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 1	2025	Implemented		\$5,000	
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 2	2040	Planned			
SVMWC	Recharge Basins to Capture Floodwater	2020	In Progress			
TTWD GSA	Utilize Existing Recharge Basin	2017	Implemented			
TTWD GSA	Additional Recharge Basins to Capture Floodwater	2019	Implemented		\$273,770	
TTWD GSA	Poso Canal Pipeline and Columbia Canal Company Pipeline Projects	2013	Implemented		\$6,000,000	
TTWD GSA	Poso Canal Pipeline Extension Project	2022	Planned			



Table 7-4. Project and Management Action Cost Summary, Estimated Average for All Projects and Management Actions.

Subregion	Project	First Year Implemented	Status	Estimated Capital Cost ¹ (\$)	Estimated Average Annual Operating Cost ¹ (\$/year)
CWD GSA	Enhanced Management of Flood Releases for Recharge	2017	Implemented	0	0
CWD GSA	Road 13 Groundwater Recharge Basin	2018	Implemented	168,699	10,000
CWD GSA	City Groundwater Recharge Basin	2019	Implemented	0	10,000
CWD GSA	Additional Groundwater Recharge Basins	2021	Planned	38,600,000	150,000
CWD GSA	Flood-MAR (Winter Recharge)	2020	Implemented	0	200,000
CWD GSA	Merced-Chowchilla Intertie	2035	Planned	6,700,000	1,500,000
CWD GSA	Madera Canal Capacity Increase	2035	Planned	61,200,000	300,000
CWD GSA	Buchanan Dam Capacity Increase	2040	Planned	49,200,000	200,000
CWD GSA	Road 19 Groundwater Recharge Basin	2021	Implemented	1,037,136	10,000
CWD GSA	Wood Groundwater Recharge Basin	2021	Implemented	1,952,713	10,000
CWD GSA	Acconero Groundwater Recharge Basin	2021	Implemented	2,009,906	10,000
Madera County GSA	Madera County East: Water Purchase	2020	Implemented	1,000,000	1,100,000
Madera County GSA	Demand Management	2020	Implemented	0	19,600,000
Madera County GSA	Water Imports Purchase	2025	Planned	300,000	2,490,000
Madera County GSA	Millerton Flood Release Imports	2025	In Progress	31,900,000	450,000
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 1 ²	2025	Implemented	38,290,000	224,100
Madera County GSA	Chowchilla Bypass Flood Flow Recharge Phase 2 ²	2040	Planned	37,190,000	856,200
SVMWC	Recharge Basins to Capture Floodwater	2020	In Progress	7,500,000	200,000
TTWD GSA	Utilize Existing Recharge Basin	2017	Implemented	-	-
TTWD GSA	Additional Recharge Basins to Capture Floodwater	2019	Implemented	24,500,000	700,000
TTWD GSA	Poso Canal Pipeline and Columbia Canal Company Pipeline Projects	2013	Implemented	5,200,000	4,600,000
TTWD GSA	Poso Canal Pipeline Extension Project	2022	Planned	\$3,475,000	
Total				310,223,000	32,620,000



Subregion	Project	First Year Implemented	Status	Estimated Capital Cost ¹ (\$)	Estimated Average Annual Operating Cost ¹ (\$/year)
-----------	---------	------------------------	--------	--	--

¹ Note: Estimates developed for full project implementation. Projects have been added to this list since the Chowchilla Subbasin GSP was adopted, so these totals may not equal the totals reported in the GSP. Annual operating costs include the cost of purchasing water, as applicable.² Since the Chowchilla Subbasin GSP was adopted, the Chowchilla Bypass Flood Flow Recharge Project Phases 1 and 2 have been reconfigured into a series of five recharge projects that are expected to undergo planning/design and construction between 2021 and 2030. Phase 1 now corresponds to Projects 1 through 3 with a revised total capital cost of \$38,290,000. Phase 2 now corresponds to Projects 4 and 5, with a revised total capital cost of \$37,190,000. The total combined capital cost of these projects is approximately \$75 million, which is the cost that is being considered during development of the rate study. These costs have been refined from the initial costs identified during GSP development.



7.1.4 [Chowchilla Water District GSA Projects](#)

The CWD GSA – the largest GSA in the Chowchilla Subbasin in terms of overall size and irrigated area – has six projects outlined in the GSP designed to either increase recharge or reduce groundwater pumping. Since GSP adoption, the CWD GSA has identified four additional projects to support groundwater sustainability in the Chowchilla Subbasin. The remaining projects are planned for future implementation.

Since adoption of the GSP, the CWD GSA has purchased three parcels and completed construction of three groundwater recharge basins on those parcels in 2021. The Road 19 Groundwater Recharge Basin was constructed on a 56-acre parcel near Berenda Slough. The land includes 38 acres that has been developed as a dedicated groundwater recharge basin, and 18 acres of additional recharge area in Berenda Slough. A 67-acre recharge basin, known as the Wood Groundwater Recharge Basin, was constructed in 2021. A 63-acre recharge basin, known as the Acconero Groundwater Recharge Basin, was also completed in 2021. No water was delivered for recharge in 2021 due to drought conditions.

A fourth project currently being implemented by the CWD GSA is a flood managed aquifer recharge (Flood-MAR) program. In this program, CWD plans to divert surplus flows (typically winter flood flows) through the existing CWD distribution system and deliver them to fields of growers who have elected to participate in the program. No winter flood flows were available for Flood-MAR in 2021 due to dry conditions.

A fifth project that has been implemented by CWD, which was not described in the GSP, is the Enhanced Management of Flood Releases for Recharge project. More information about this project can be found in Section 7.2, below, and in Appendix E of the GSP Annual Report submitted in 2020.

CWD GSA has also initiated discussions with the United States Army Corps of Engineers to discuss the potential to increase the capacity of Eastman Lake.

Other projects planned to increase surface water availability for the CWD GSA are planned for later implementation in 2035-2040.

7.1.5 [Madera County GSA Projects](#)

Since GSP adoption, Madera County GSA has conducted three planning studies in support of a rate study to fund GSP implementation, and has begun implementation of a recharge program and a substantial demand management program that will collectively support achievement of the GSP sustainability goal. Progress that has been made in each of these efforts is described below.

7.1.5.1 *Rate Studies*

In November 2019, prior to GSP adoption, the Madera County GSA adopted a Proposition 26 exempt administrative fee for irrigated acres within the County GSA of approximately \$24 per irrigated acre; however, this fee can only be used for SGMA-related administration and planning efforts. While the administrative fee is useful, these funds cannot be used for projects, such as purchases of water for irrigation of crops, recharge, or domestic well mitigation.



In 2021, the Madera County GSA continued development of a Rate Study that will result in a water rate for extraction of groundwater within the Madera County GSA. A penalty for groundwater extraction above the allocation is also being considered separately.

7.1.5.2 Recharge Projects

Since GSP adoption, Madera County has initiated a recharge planning study to refine the costs, benefits, and schedule for recharge projects described in the GSP. The recharge planning study will also refine the costs and schedule to construct additional basins and conduct additional Flood-MAR to recharge winter floodwater diverted from the Chowchilla Bypass. A description of the recharge project has been prepared and is available on the Madera County website: <https://www.maderacountywater.com/recharge/>. When completed, this program will provide direct and in-lieu recharge benefits to the Chowchilla Subbasin.

Since 2020, this study has yielded two grant proposals to DWR. In 2021, the first grant proposal was awarded \$4,600,000 from Proposition 68 funds. As of April 2022, those funds are being used toward planning, design, and construction of turnouts on the Eastside Bypass that will supply flood water to recharge areas. The recharge sites were surveyed in March 2022. Further designs are anticipated to be completed later in 2022, and construction is anticipated to begin in 2022-2023, pending successful completion of CEQA and permitting. This project was developed in close coordination with TTWD GSA and Clayton Water District landowners in Madera County who offered to use their farmland for recharge. The second grant proposal – a spending plan that would fund implementation of phase 2 of the recharge program – was submitted to DWR in February 2022 as part of Round 1 of the 2022 SGMA Implementation Grant program. The spending plan received draft approval in March 2022. The rate studies are also anticipated to include costs for phase 2 of the recharge program.

7.1.5.3 Demand Management

As a primary element of its efforts toward groundwater sustainability, Madera County has begun implementation of a demand management program that would oversee a managed reduction in the volume of groundwater consumed by irrigated agriculture over the 20-year GSP implementation period. By 2040, this program is expected to result in approximately 50% reduction of estimated current consumptive use quantities as of 2015.

To implement this overall demand management program, Madera County has developed an allocation framework, has begun implementing a demand measurement program, and is conducting two studies: a water market study and a sustainable agricultural land conservation study. The allocation framework was developed primarily by Madera County GSA staff through a series of public meetings with the Madera County GSA Advisory Committee. The demand measurement program is being implemented in partnership with IrriWatch, providing satellite-based estimates of evapotranspiration of applied water (ET_{aw}) and irrigation scheduling advice for farmers in the Madera County GSA. The following sections briefly describe the progress and results of the allocation framework, the demand measurement program, and the studies.



Water Market Study. The Madera County GSA applied for and was awarded a WaterSMART grant from the United States Bureau of Reclamation (USBR) to develop a comprehensive water marketing strategy. A team of technical experts was selected to conduct the program, and has worked closely with Madera County and stakeholders to develop a comprehensive water marketing strategy that is acceptable to stakeholders and maximizes economic benefits to the regional economy. Three partner workshops and follow-up interviews with local stakeholders were held in 2020 to define opportunities, understand concerns, and develop solutions for the potential water market. A virtual pilot water market simulation then occurred between January 2021 and November 2021, with the goal of testing the effectiveness and implications of the potential market rules over a multi-year time period. The simulation was jointly implemented by the Madera County GSA in both the Madera and Chowchilla Subbasins. A total of 57 unique participants from the Madera and Chowchilla Subbasins were enrolled in the overall simulation, with about 25 regular participants each month. The goal of the pilot program is to test effectiveness and implications of the potential market rules over a multi-year time period. Results are expected to be presented in 2022. Additional information on the water market study and pilot project is available on the Madera County website: <https://www.maderacountywater.com/water-markets/>.

Sustainable Agricultural Lands Conservation (SALC) Study. The Madera County GSA received a grant to fund a planning project to explore the feasibility of adopting a sustainable agricultural land conservation (SALC) easement program within the Madera County GSA. The goal of this project is to develop two primary items:

1. Criteria for identifying and prioritizing agricultural land for protection. These criteria will be based on the land's potential to be farmed or temporarily rested (not used as irrigated farmland), permanently retired, retired and restored, or (when appropriate) permanently protected.
2. An incentive structure for agricultural landowners to rest, retire, restore, or permanently protect their land via various types of water-centric conservation easements.

In 2020-2021, Madera conducted stakeholder interviews to provide feedback on the structure of the SALC program and conducted outreach with conservation groups as land repurposing strategies were developed. Interviews were conducted with individuals representing the following groups:

- California Milk Producers Council
- Madera County Cattlemen's Association
- Leadership Counsel for Justice and Accountability
- Self-Help Enterprises
- Madera County Farm Bureau
- Madera Ag Water Association (MAWA)

The feedback from these groups was summarized into an SALC Assessment Interview Summary, available on the Madera County website. This feedback has been used to inform GSA and County decisions about the timing, flexibility, incentives, and areas for the program. It is anticipated that the rate studies will include costs for land repurposing. Additional information on SALC is available on the Madera County website: <https://www.maderacountywater.com/land-conservation/>.



Allocation Framework. The Madera County GSA has developed an allocation framework through a series of public meetings with the Madera County GSA Advisory Committee. Following discussions in these meetings, the Advisory Committee recommended that the Madera County GSA Board of Directors adopt the allocation framework. Subsequently, the Madera County GSA Board of Directors adopted resolutions in December 2020, June 2021, and August 2021 that describe "per-acre" allocations and rules for credits. Links to the resolution documents are provided below:

- **Resolution 2020-166:** <https://www.maderacountywater.com/wp-content/uploads/2021/09/RES-NO.-2020-166-Allocation-Approach.pdf>
- **Resolution 2021-069:** <https://www.maderacountywater.com/wp-content/uploads/2021/08/Resolution-No.-2021-069.pdf>
- **Resolution 2021-113:** <https://www.maderacountywater.com/wp-content/uploads/2021/08/21.08-Updated-Groundwater-Allocation-Reso.pdf>

Demand Measurement Program. In 2020, the Madera County GSA selected the IrriWatch program to measure consumptive water use (demand) on irrigated acres in the GSA. IrriWatch is a daily irrigation scheduling and crop production information service that uses Surface Energy Balance Algorithm for Land (SEBAL) model outputs to quantify actual consumptive water use from satellite imagery. The main objective of the demand measurement program is to use the IrriWatch program to track evapotranspiration of applied water (ET_{aw}) against an allocation of ET_{aw} established in the Madera County GSA area. Through the IrriWatch program portal, the Madera County GSA can track grower ET_{aw} against an ET_{aw} allocation. Each grower also has access to the portal and can track their actual ET_{aw} against their allocation of ET_{aw} . IrriWatch provides additional benefits to growers by providing information about the irrigation status of fields and irrigation recommendations. Growers with weekly schedules can check the need for corrective actions. This information, together with the allocation, supports grower decision making on the timing and amounts of irrigation. The data portal is suitable for planning and monitoring. The IrriWatch program includes a cell phone application on which growers can check their field irrigation status. In 2020-2021, the Madera County GSA hosted SEBAL trainings and IrriWatch trainings to inform growers about the program. Growers completed a test year with IrriWatch in 2021. On January 1, 2021, IrriWatch began calculating and making data available to the Madera County GSA and growers that enrolled. To date, all irrigated parcels in the Madera County GSA have been auto-enrolled in the program. More than 1,200 irrigated parcels are enrolled as of early 2022, representing nearly 120,000 irrigated acres across the Chowchilla, Madera, and Delta-Mendota Subbasins.

Additional information on the demand measurement program is available on the Madera County website: <https://www.maderacountywater.com/measurement/>.

Demand Management. Through these many efforts, the Madera County GSA is also in the initial stages of implementing demand management. This management action is expected to result in



a large reduction in groundwater pumping at the cost of reduced crop production and related economic activities in Madera County. At this point, the actual costs and benefits of demand management efforts completed to date have not been quantified, but they will be in future years.

Additional Roles. Although neither projects nor management actions, there are number of actions that Madera County has taken towards sustainability of the Chowchilla Subbasin:

1. Madera County serves as the grantee and administrator for the current Proposition 1 and Proposition 68 grants (TTWD will serve as the grantee and administrator for the Proposition 68 grant awarded in early 2022); and
2. Madera County serves as the contractor with the consultant for the data management system.

7.1.6 Sierra Vista Mutual Water Company Projects

Sierra Vista Mutual Water Company (SVMWC), located in the Merced County GSA – Chowchilla and Madera County GSA – Chowchilla, is in the early stages of developing up to 300 acres of dedicated recharge basins. Operation of the recharge basins is anticipated for 2023, and no benefits will be realized until the recharge basins are in operation. The actual costs to date of the project have not been quantified, but they will be in future years. In February-March 2022, SVMWC applied for and was awarded Proposition 68 funding to support further development and construction of this project.

7.1.7 Triangle T Water District GSA Projects

The TTWD GSA has several projects in various stages of implementation.

Since 2017, TTWD has implemented a program to divert surplus flows into 508 acres of existing recharge basins within the GSA. The estimated average annual benefits at 2040 of 4,994 AF, listed in **Table 7-2**, represent the anticipated recharge volume during GSP implementation, although the basins were utilized earlier. In 2017 and 2018, 14,096 AF and 180 AF were recharged in the existing basins, respectively. Since the basins were constructed prior to the GSP and use existing infrastructure, no capital costs have been incurred during GSP implementation. Annual operating costs have not been quantified.

Since 2019, TTWD has initiated work to develop up to 310 acres of additional dedicated recharge basins. This work was formerly supported under an Office of Emergency Services (OES) grant, and was formerly referred to as the OES ponds, but is now funded under Proposition 68. In 2020-2021, TTWD GSA collaborated with the Madera County GSA on the Proposition 68 grant. One of the recharge basins that is currently being designed and planned for construction using those grant funds will be constructed in TTWD. TTWD is also continuing efforts to secure a permanent water rights permit on the Chowchilla Bypass. When water is available, TTWD plans to divert water to existing recharge basins (and later to the additional dedicated recharge basins). Since GSP adoption, a temporary water rights permit has been granted and additional information in support of the permanent water right has been submitted to the SWRCB. The additional dedicated recharge basins have not been completed as of this Annual Report. In total, approximately \$274,000 in capital costs have been incurred thus far.



Since 2013, TTWD has also constructed two water conveyance pipelines, the Columbia Canal pipeline and the Poso Canal pipeline, to import additional surface water supplies to the TTWD. Both pipelines are currently operational. To date, approximately \$6 million in capital costs have been invested in the Poso Canal Pipeline and Columbia Canal pipeline construction projects. Approximately \$7 million has also been used to secure more than 25,000 acre-feet of surface water through the pipelines. This cost is for purchasing the imported water, not for O&M. Future extensions of the Poso Pipeline are anticipated beyond the project described in the GSP. Those extensions are described in **Section 7.2**.

In addition to the recharge basins and pipeline projects, TTWD installed six nested monitoring wells within the District area in 2021. Information about these wells is recorded in well completion reports and electric-gamma ray-temperature logs. These wells will provide additional information about groundwater conditions in TTWD and the Western Management Area of the Chowchilla Subbasin.

7.2 ADDITIONAL PROJECTS IDENTIFIED SINCE GSP ADOPTION

Since GSP adoption, the GSAs have also developed additional projects and management actions to support GSP efforts.

7.2.1 [Chowchilla Water District GSA Projects](#)

Since GSP adoption, the CWD GSA has adopted two additional projects.

Enhanced Management of Flood Releases for Recharge Project. In this project, CWD utilizes its existing distribution system to supply recharge during periods when flood flows are available and when the distribution system is not at its operational capacity. Diverted water is spread throughout unlined portions of the distribution system, allowing for increased groundwater recharge. This project was initiated in 2017 and was conducted again in 2019, with an estimated annual recharge benefit of approximately 26,800 AF in wet years. Average annual benefits are estimated to be approximately 9,400 AF across all years, including drier years when flood flows are unavailable. More information about this project can be found in Appendix E of the GSP Annual Report submitted in 2020.

Land Fallowing. CWD GSA has proposed a land fallowing program as one component of their overall efforts to achieve sustainable groundwater conditions in CWD's portion of the Chowchilla Subbasin. The land fallowing program would be implemented by growers on a voluntary basis. Benefits will be measured by the reduction in the total volume of groundwater previously used to irrigate the fallowed lands.

CWD is planning to conduct a study in 2022 to identify landowners interested in participating in the land fallowing program. Land fallowing proposals will be created for all or a portion of a parcel, and can be implemented for one year, several years, or permanently. Proposals for land fallowing will be evaluated on an individual proposal basis.

Implementation of the land fallowing program will begin in 2023. The target reduction in groundwater pumping from land fallowing is 5,000 to 10,000 AF/Yr. Program costs are estimated to be \$1,000,000 to \$2,000,000 per year. CWD may initially fund this program with general funds,



although CWD may also conduct a Prop 218 election to approve assessments that would provide a funding stream for financing the program. CWD has conducted successful Prop 218 elections where stakeholders voted to approve assessments to fund programs.

7.2.2 [Triangle T Water District GSA Projects](#)

Building on the success of the Poso Canal Pipeline, TTWD has initiated work on an extension of the existing pipeline project to deliver more purchased water for irrigation and recharge within TTWD and in adjacent areas prioritized for subsidence mitigation. As of 2022, the extension is expected to build approximately 1.52 miles of additional pipeline, with a capacity of 20 cfs, and connect two approximately 30-acre regulating reservoirs. With boosting from the regulating reservoirs, the pipeline extension project would provide surface water access to approximately 3,800 acres of irrigated farmland that currently uses groundwater, primarily pumped from beneath the Corcoran Clay which is known to cause subsidence. Water purchased and supplied through the extended pipeline could also be delivered to one of the additional recharge basins that TTWD is developing, as described above. In early 2022, TTWD applied for and was awarded Proposition 68 funding to support further development and extension of the Poso Canal pipeline project. Additional work on this project is expected to continue in 2022.

7.2.3 [Jointly Implemented Projects](#)

In addition to the ongoing development of recharge projects proposed in the Chowchilla Subbasin GSP, the Madera County GSA has initiated work on an emergency recharge plan to achieve more immediate recharge benefits from flood flows available on the Chowchilla Bypass. Under this plan, Madera County GSA and TTWD GSA have worked collaboratively to secure temporary water rights and develop a plan for installation of temporary infrastructure to divert flood flows off the Chowchilla Bypass to the extent they are available ahead of construction of permanent infrastructure. In winter 2021-2022, Madera County initiated the environmental permitting for the points of diversions (PODs) available for use as part of the emergency recharge plan. Madera County also continued development of the plan, and TTWD resubmitted the temporary water rights application used for this project. As of February 2022, approximately \$40,000 in project development costs have been incurred, although no water was available for recharge in winter 2021-2022. The GSAs will continue collaborating and preparing for recharge efforts in the future. It is expected that the emergency recharge plan will be included in the 2023 Annual Report.

7.2.4 [Other GSA Projects](#)

Additional information about other GSA projects will be added to future Annual Reports as they are identified.



7.3 IMPLEMENTATION OF MONITORING AND ADDRESSING DATA GAPS

Since the GSP adoption and submittal in January 2020, the GSAs have been conducting monitoring of RMS wells (**Appendix E**), including coordination with well owners and other monitoring entities. Despite attempts at measurement, some RMS water level data were not available in 2021 due to continued challenges encountered during implementation of the RMS monitoring program. Loss of access to certain RMS sites has persisted for a variety of reasons, such as owners' unwillingness to participate in monitoring, or replacement of a site with another well having slightly different characteristics. The GSAs have worked to resolve these issues where possible, and have begun work to install new dedicated nested monitoring wells that may be added to the monitoring network in place of lost sites. The GSAs may add those new dedicated nested monitoring wells to the Chowchilla Subbasin GSP monitoring network once more data is collected and site-specific sustainable management criteria can be appropriately established.

As part of a Proposition 1 DWR Sustainable Groundwater Management grant award to Madera County for the installation of dedicated monitoring wells in the Chowchilla Subbasin, a total of 25 new monitoring wells at nine different sites have recently been constructed. Information collected from the drilling, geologic and geophysical logging and ongoing groundwater quality sampling and automated groundwater level monitoring, will fill data gaps in the monitoring and conceptualization of the hydrogeology and improve understanding and management of groundwater in the Chowchilla Subbasin. As part of a Proposition 68 DWR Sustainable Groundwater Management grant award to Madera County for a domestic well inventory project, nine additional new monitoring wells at three different sites are also planned for installation in 2022 and will provide additional information on hydrogeologic conditions and trends in areas of domestic wells within the Chowchilla Subbasin.

7.4 INTERIM MILESTONE STATUS (§356.2.C)

In the GSP, interim milestones (IMs) for chronic lowering of groundwater levels were established at five-year intervals over the Implementation Period from 2020 to 2040, at years 2025, 2030, 2035, and 2040. IMs for groundwater levels were established through review and evaluation of measured groundwater level data and future projected fluctuations in groundwater levels utilizing the numerical groundwater flow model, which simulated implementation of projects and management actions. Each IM was developed based on the modeled groundwater level for the month of October in the year preceding the IM date (e.g., October 2024 for the 2025 IM). Where necessary, adjustments were made to account for occasional offsets between historically observed and modeled data.

Measurable objectives (MOs) for groundwater levels were established in accordance with the sustainability goal and provide estimates of the expected groundwater level variability due to climatic and operational variability. MOs for groundwater levels were calculated as the model-derived average groundwater levels over the Sustainability Period from 2040 to 2090, modified if necessary, to account for occasional offsets between historically observed and modeled groundwater levels.



The Regulations define undesirable results as occurring when significant and unreasonable effects are caused by groundwater conditions occurring throughout the Plan area for a given sustainability indicator. Significant and unreasonable effects occur when minimum thresholds (MTs) are exceeded for multiple wells in consecutive years for one or more sustainability indicators. The GSP Regulations provide that the “minimum thresholds for chronic lowering of groundwater levels shall be the groundwater level indicating a depletion of supply at a given location that may lead to undesirable results” (354.28.c.1). Chronic lowering of groundwater levels in the Plan area is determined in the GSP to cause significant and unreasonable declines if they are sufficient in magnitude to lower the rate of production of pre-existing domestic groundwater wells below that necessary to meet the minimum required to support overlying beneficial use(s) where alternative means of obtaining sufficient groundwater resources are not technically or financially feasible.

Table 7-5 and **Figures 7-2 and 7-3** present the status of groundwater level RMS wells in relation to the 2025 IMs, MOs, and MTs defined in the GSP. Note that there are some RMS wells that do not have Fall 2021 measurements to compare with IMs, MOs, and MTs (see **Appendix E**). Review of the Fall 2021 groundwater level measurements that are available for 24 RMS wells indicates that groundwater levels remain well above MTs, with the exception of CWD RMS-17, and about half of groundwater levels are above the 2025 IMs. The interim milestones were based on GSP analyses using a projected hydrologic sequence over the implementation period that was approximately representative of the long-term average hydrology in the area. During the initial years of the GSP implementation, the hydrology has been much drier than average. This has limited the effectiveness of recharge projects in the Chowchilla Subbasin and has also reduced the availability of natural recharge and water supply from precipitation.



Table 7-5. Summary of RMS Well Groundwater Levels Relative to Interim Milestones, Minimum Thresholds, and Measurable Objectives.

RMS Well I.D.	Estimated Surface Elevation ¹ (msl, feet)	Aquifer Designation	2025 Interim Milestone GWEL	MT GWEL	MO GWEL	Fall 2020 GWEL	Date of Fall Measurement	2025 IM Status	MT Status
CWD RMS-1	169	Lower ²	-52	-150	-25				
CWD RMS-2	191	Lower ²	-58	-165	-50	-54	10/20/2021	+4	+111
CWD RMS-3	206	Lower ²	-62	-170	-32	-70.86	10/12/2021	-8.86	+99.14
CWD RMS-4	225	Lower ²	-72	-150	15	-75.3	10/12/2021	-3.3	+74.7
CWD RMS-5	207	Lower ²	-65	-155	-12	50.15	10/13/2021	+115.15	+205.15
CWD RMS-6	275	Lower ³	-74	-130	-29	-73	10/26/2021	+1	+57
CWD RMS-7	162	Lower ²	-12	-100	35	-25.5	10/26/2021	-13.5	+74.5
CWD RMS-8	219	Lower ²	-76	-150	-9	-44.85	10/12/2021	+31.15	+105.15
CWD RMS-9	164	Upper	80	50	80	80	10/12/2021	0	+30
CWD RMS-10	183	Lower ²	-55	-140	-6	-63.32	10/14/2021	-8.32	+76.68
CWD RMS-11	192	Lower ²	-60	-135	9	80.68	10/14/2021	+140.68	+215.68
CWD RMS-12	176	Upper	56	20	70	67.2	10/19/2021	+11.2	+47.2
CWD RMS-13	168	Lower ²	-11	-115	34	12.72	10/14/2021	+23.72	+127.72
CWD RMS-14	152	Lower ²	-47	-100	31	-98	10/14/2021	-51	+2
CWD RMS-15	213	Lower ³	-91	-140	-17	-89.9	10/18/2021	+1.1	+50.1
CWD RMS-16	213	Lower ³	-75	-150	1	-71.8	10/27/2021	+3.2	+78.2
CWD RMS-17	203	Lower ³	-45	-95	32	-98.9	10/19/2021	-53.9	-3.9
MCE RMS-1	277	Lower ³	-47	-100	-20	-62.79	11/9/2021	-15.79	+37.21
MCE RMS-2	254	Lower ²	-57	-140	-12				



RMS Well I.D.	Estimated Surface Elevation ¹ (msl, feet)	Aquifer Designation	2025 Interim Milestone GWEL	MT GWEL	MO GWEL	Fall 2020 GWEL	Date of Fall Measurement	2025 IM Status	MT Status
MCW RMS-1	121	Upper	84	0	74				
MCW RMS-2	123	Upper	102	25	92	87.77	11/9/2021	-14.23	+62.77
MCW RMS-3	124	Upper	93	15	90	96.96	11/9/2021	+3.96	+81.96
MCW RMS-4	137	Lower ²	18	0	11				
MCW RMS-5	146	Lower ²	19	0	28				
MCW RMS-6	139	Lower ²	31	0	32				
MCW RMS-7	138	Lower ²	38	20	45	27.59	11/9/2021	-10.41	+7.59
MCW RMS-8	142	Composite	12	-25	55	27.38	11/9/2021	+15.38	+52.38
MCW RMS-9	155	Lower ²	29	-25	45				
MCW RMS-10	124	Upper	116	75	109	96.65	10/1/2021	-19.35	+21.65
MCW RMS-11	127	Upper	118	80	114				
MCW RMS-12	127	Upper	112	76	110				
MER RMS-1	225	Lower ²	-47	-160	-29				
TRT RMS-1 ⁴	134	Upper	34	-25	49	46.23	12/6/2021	+12.23	+71.23
TRT RMS-2 ⁴	135	Lower ²	54	10	59	44.5	12/6/2021	-9.5	+34.5
TRT RMS-3	137	Lower ²	60	-50	67	-8.56	11/11/2021	-68.56	+41.44
TRT RMS-4	141	Composite	66	0	50	4.5	11/10/2021	-61.50	+4.5

¹ Estimated surface elevation and groundwater elevations (GWE) are expressed in feet above mean sea level.

² Lower Aquifer wells within the Corcoran Clay extent.

³ Lower Aquifer wells outside the Corcoran Clay extent; considered representative of undifferentiated unconfined groundwater zone.

⁴ Fall measurements were collected slightly outside of the target time frame of mid-October to mid-November.

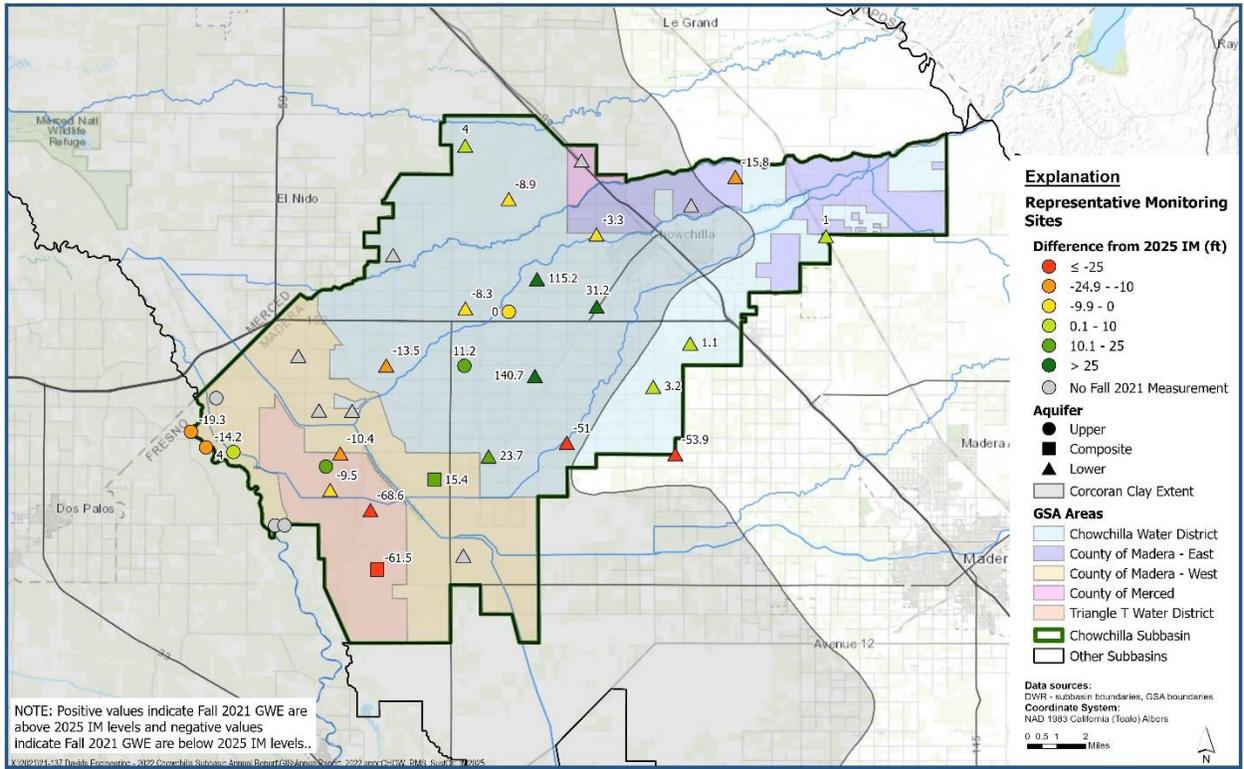


Figure 7-2. Fall 2021 Water Level Measurements at RMS Wells compared to 2025 Interim Milestone.

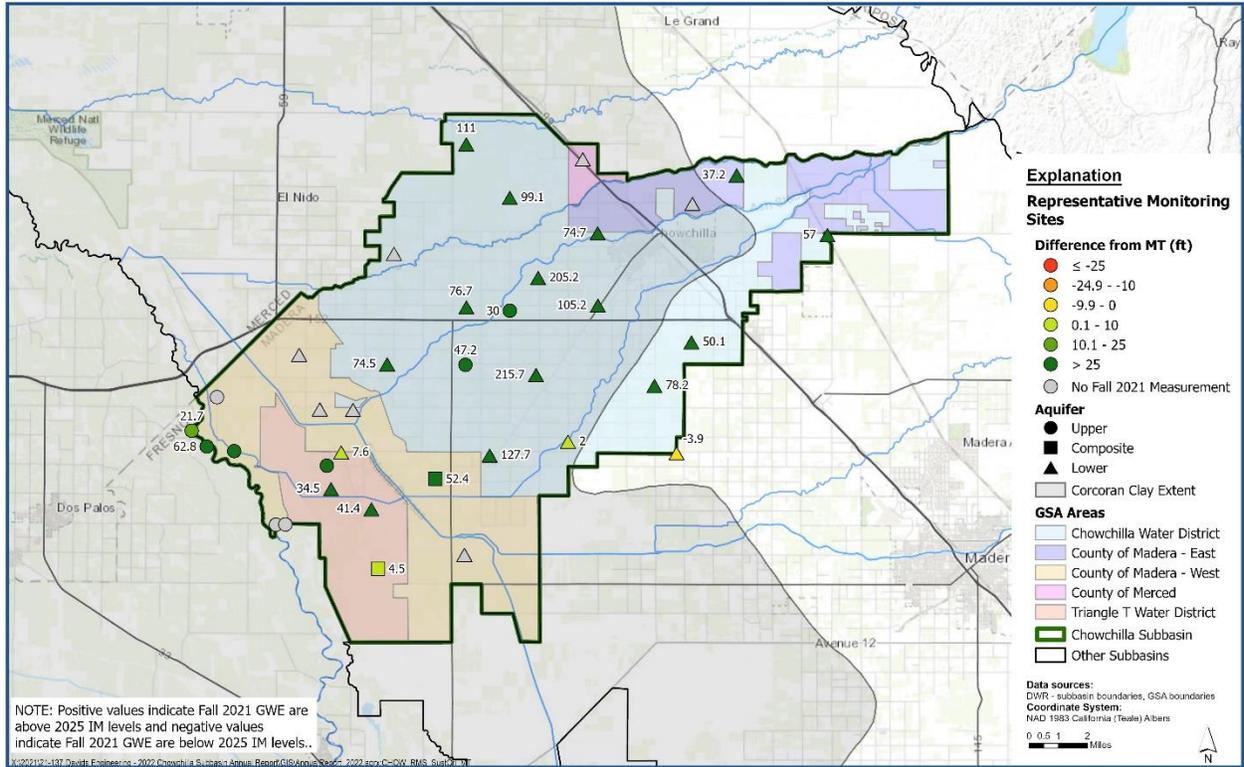


Figure 7-3. Fall 2021 Water Level Measurements at RMS Wells compared to Minimum Threshold.



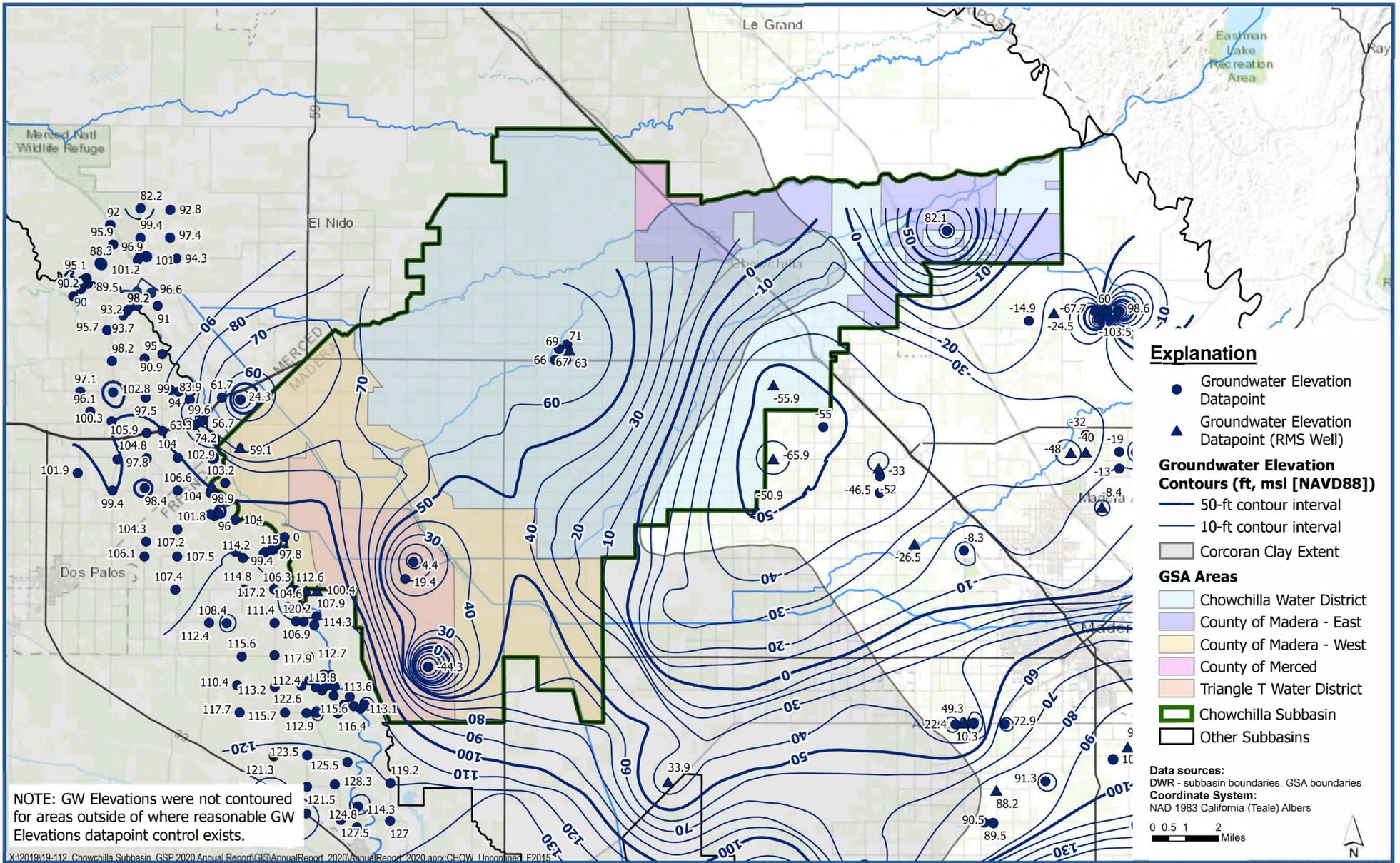
8 References

American Society of Civil Engineers (ASCE). 2016 Evaporation, Evapotranspiration and Irrigation Water Requirements. Manual 70. Second Edition. M. E. Jensen and R. G. Allen (eds). Am. Soc. Civ. Engrs.

California Department of Water Resources (DWR). 2016. Best Management Practices for Sustainable Management of Groundwater, Water Budget, BMP.

Clemmens, A. J. and C. M. Burt. 1997. Accuracy of irrigation efficiency estimates. J. Irrig. and Drain. Engng. 123(6): 443-453.

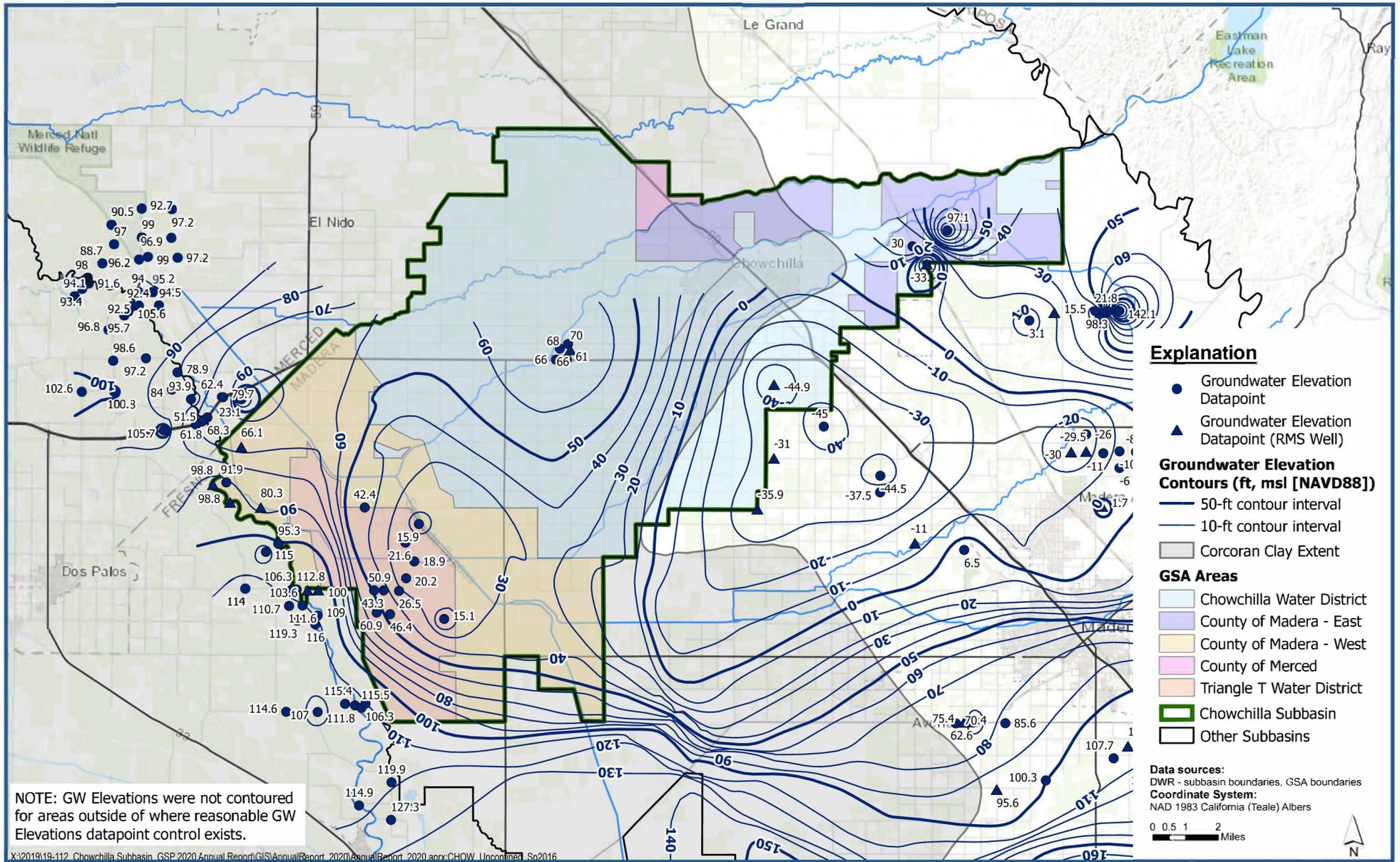
Appendix A. Contour Maps of the Different Aquifer Units.



**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Fall 2015**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-1



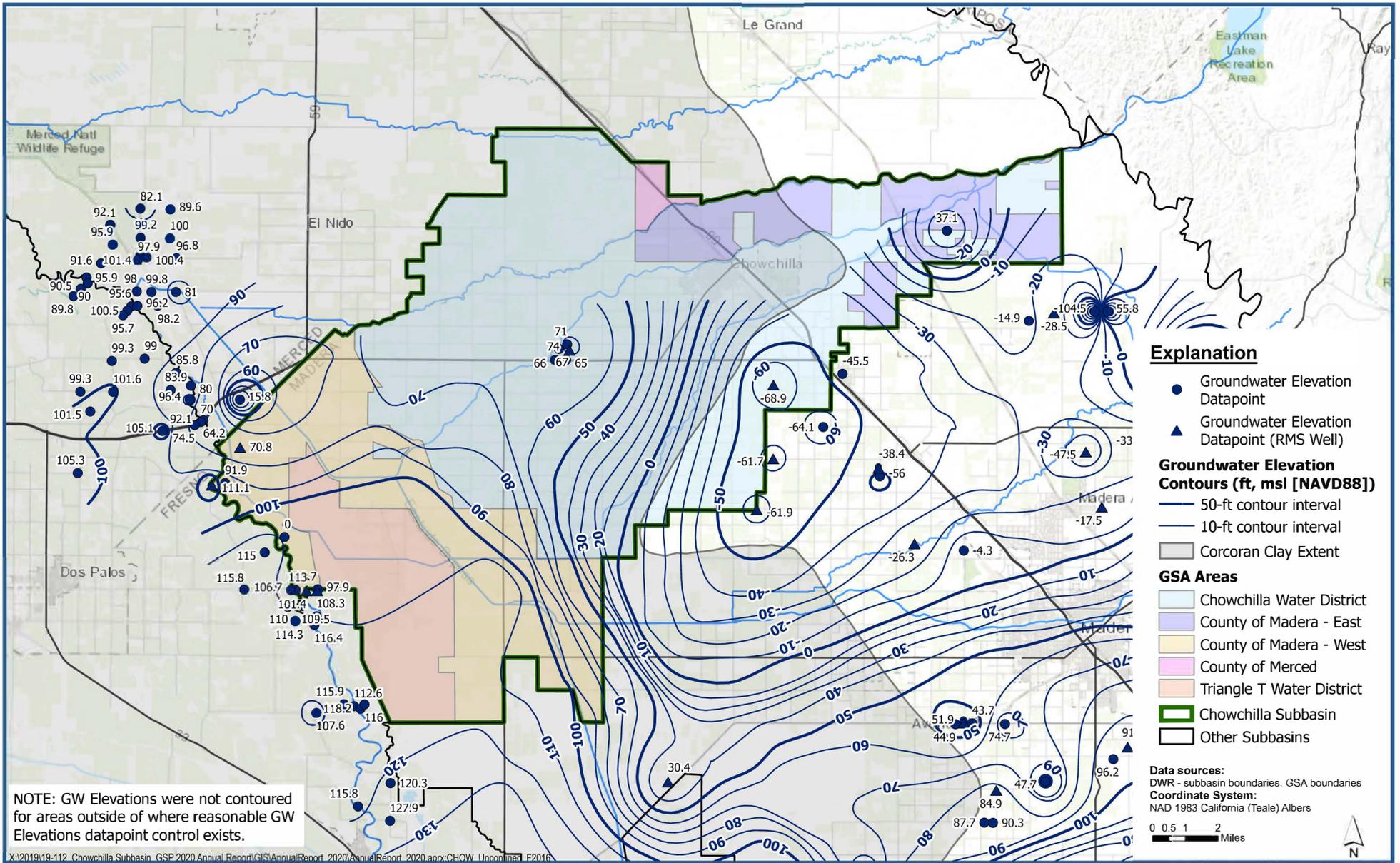
X:\2019\19-112_Chowchilla Subbasin_GSP 2020 Annual Report\GIS\Annual Report_2020\Annual Report_2020.aprx:CHOW_ Uncontoured_Sp2016

Contours of Equal Groundwater Elevation Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2016

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

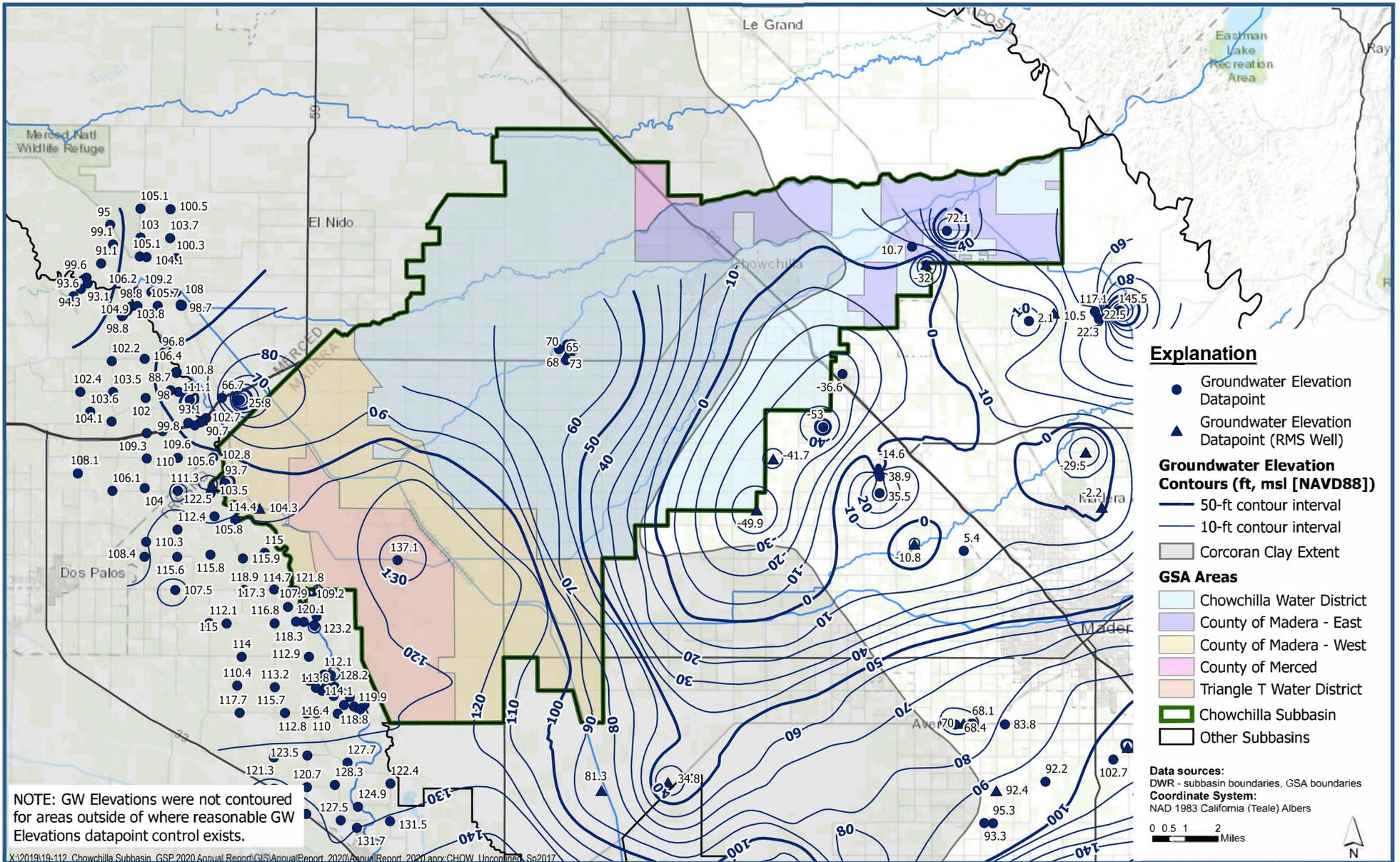
Figure A-2





**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Fall 2016**

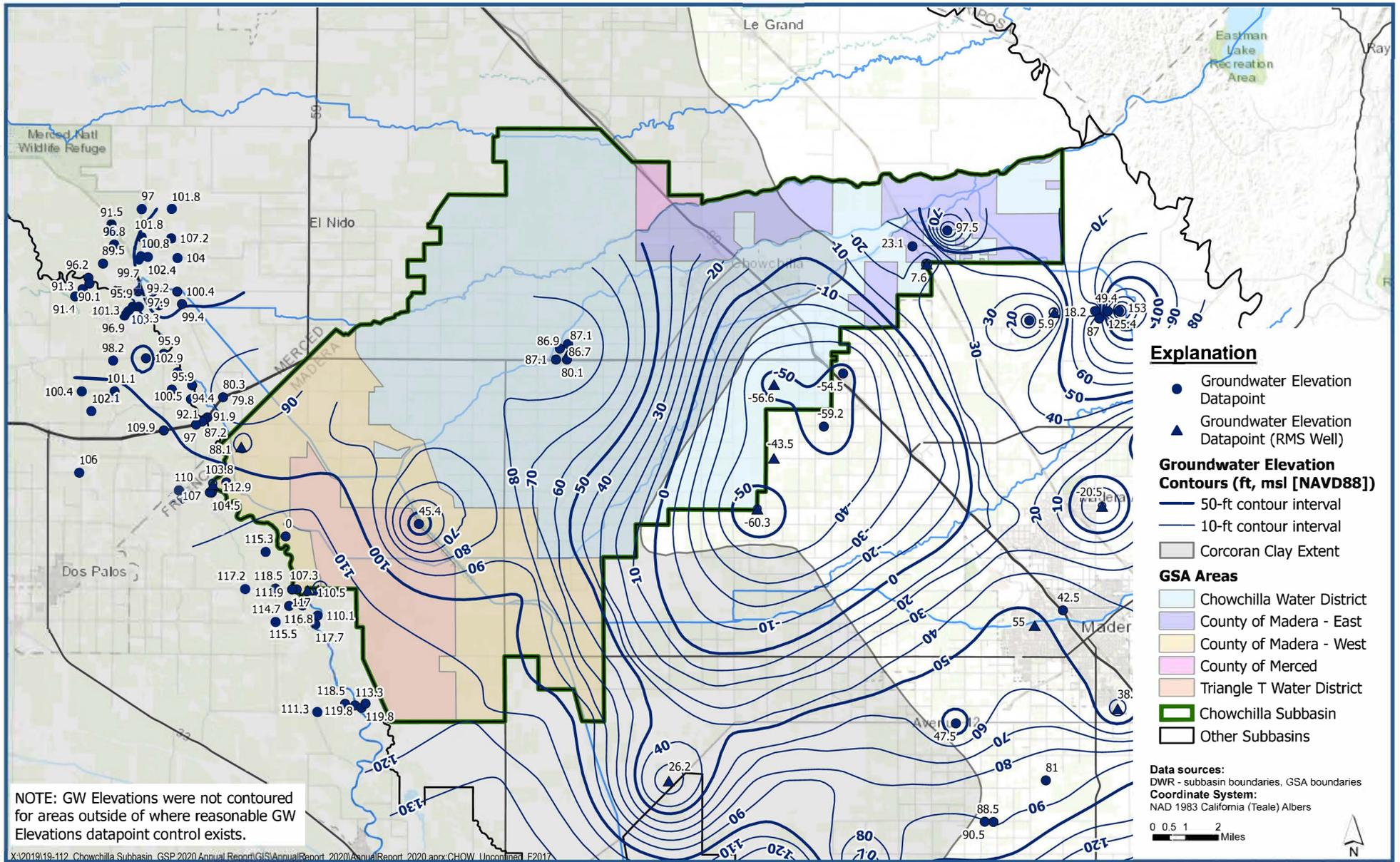
Figure A-3



**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2017**

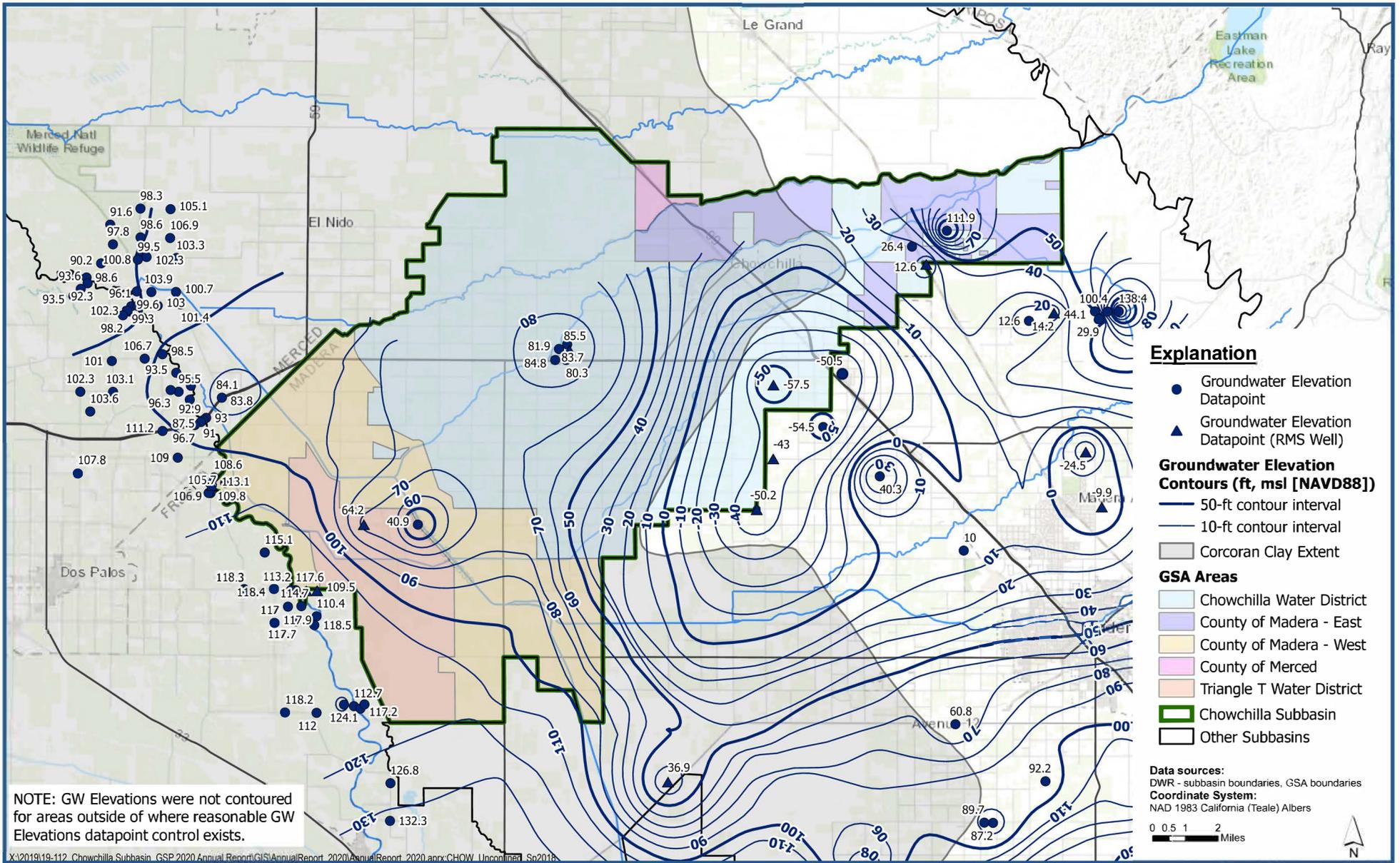
Figure A-4





**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Fall 2017**

Figure A-5

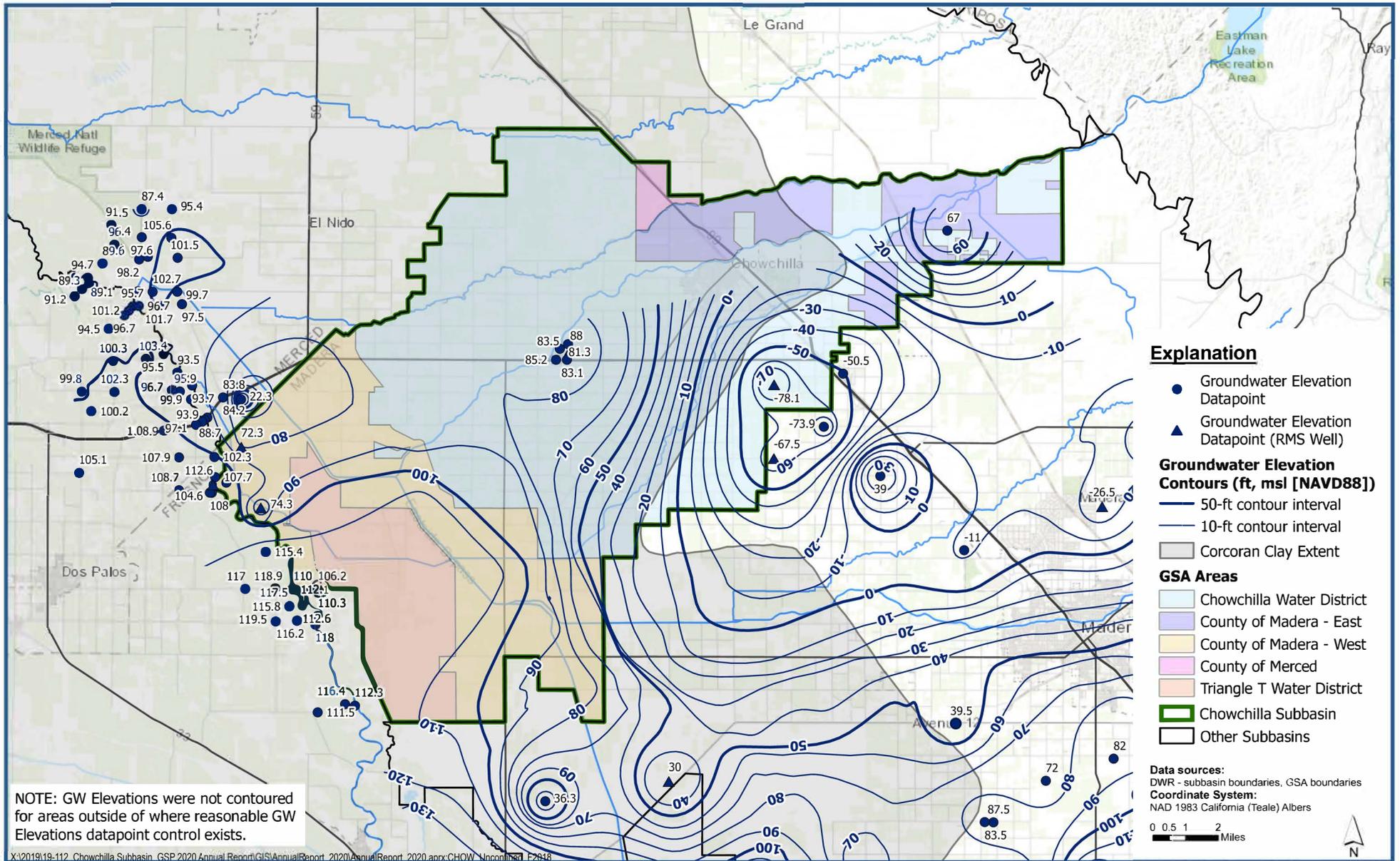


**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2018**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-6



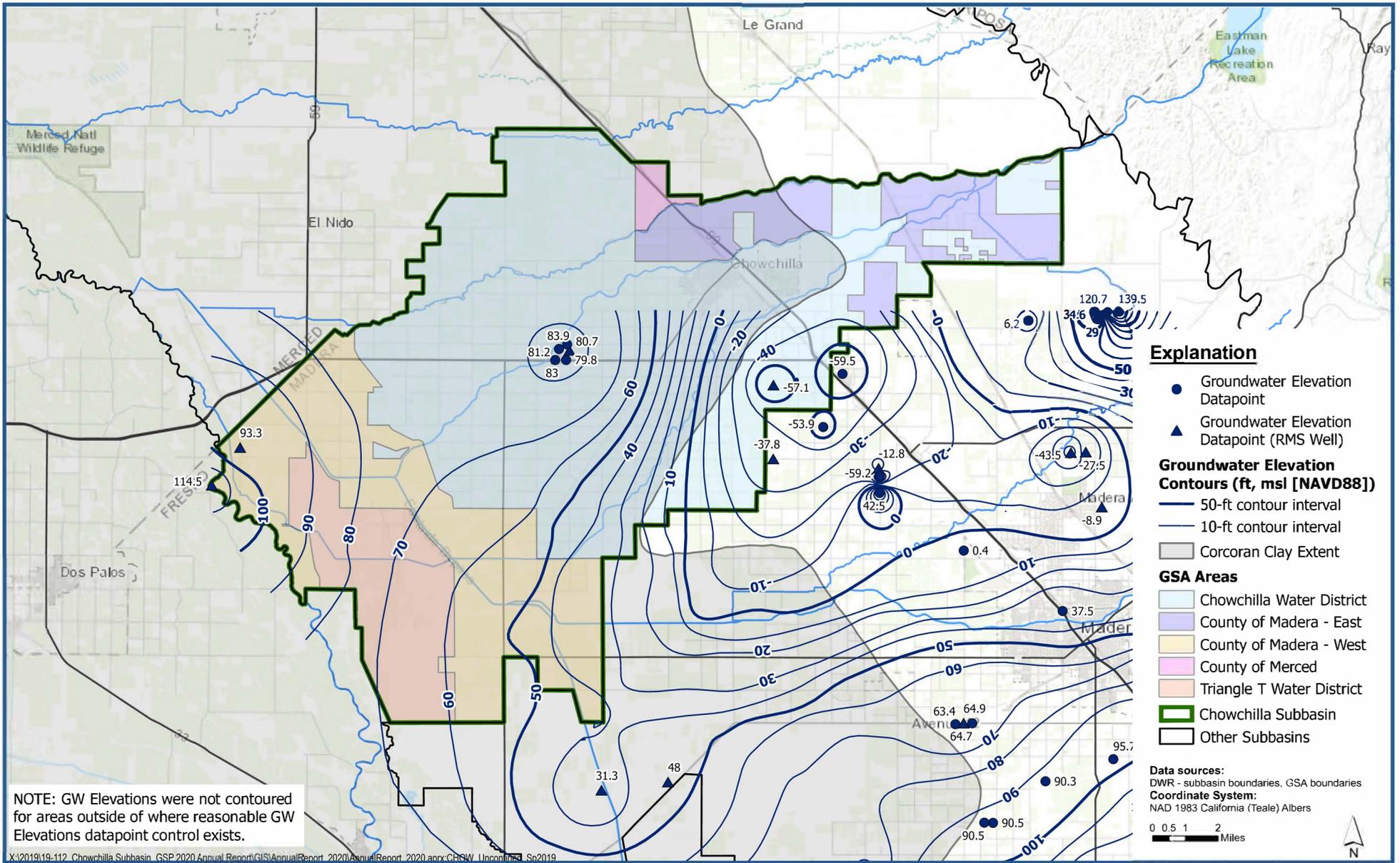


**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Fall 2018**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-7



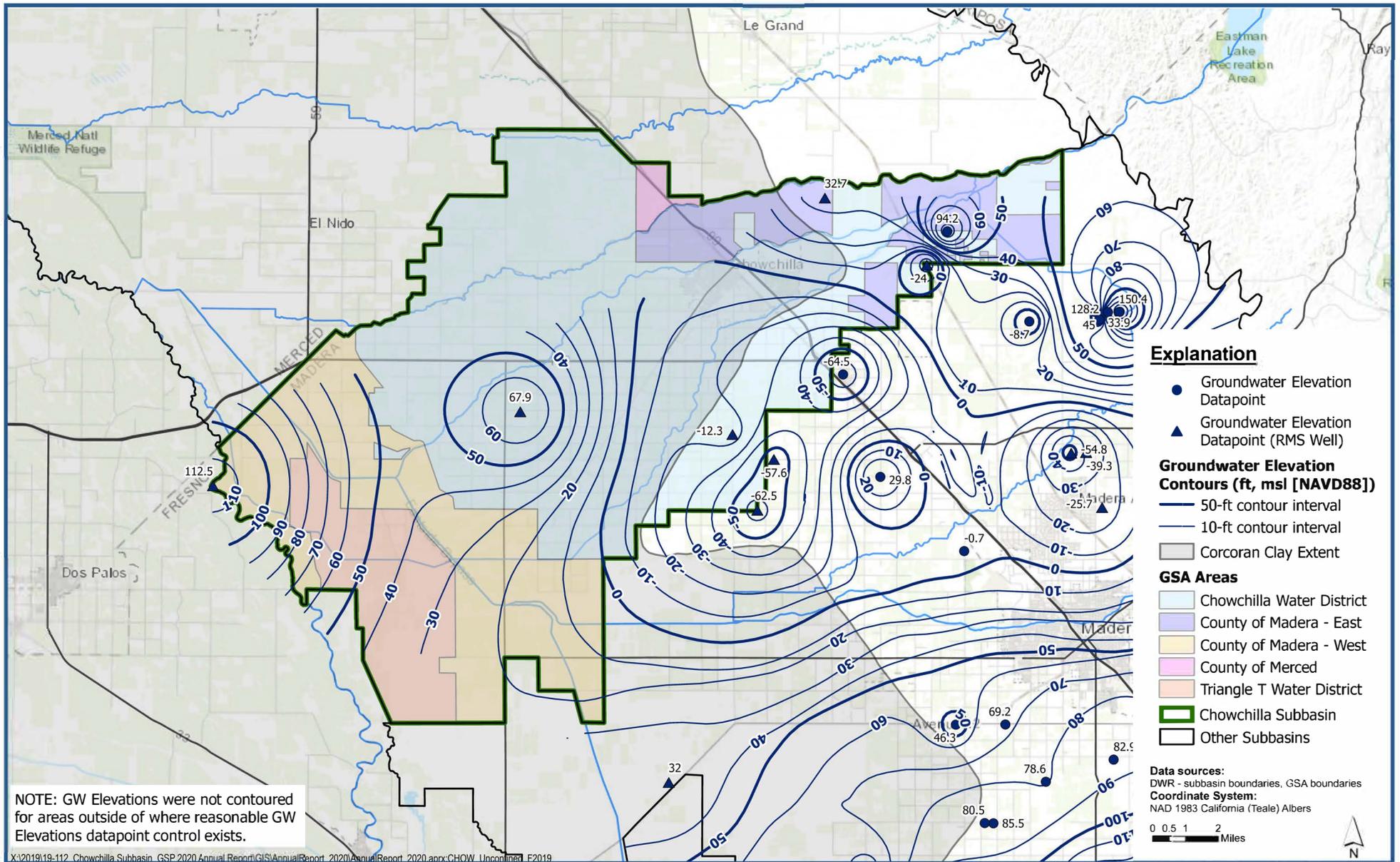


**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2019**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-8



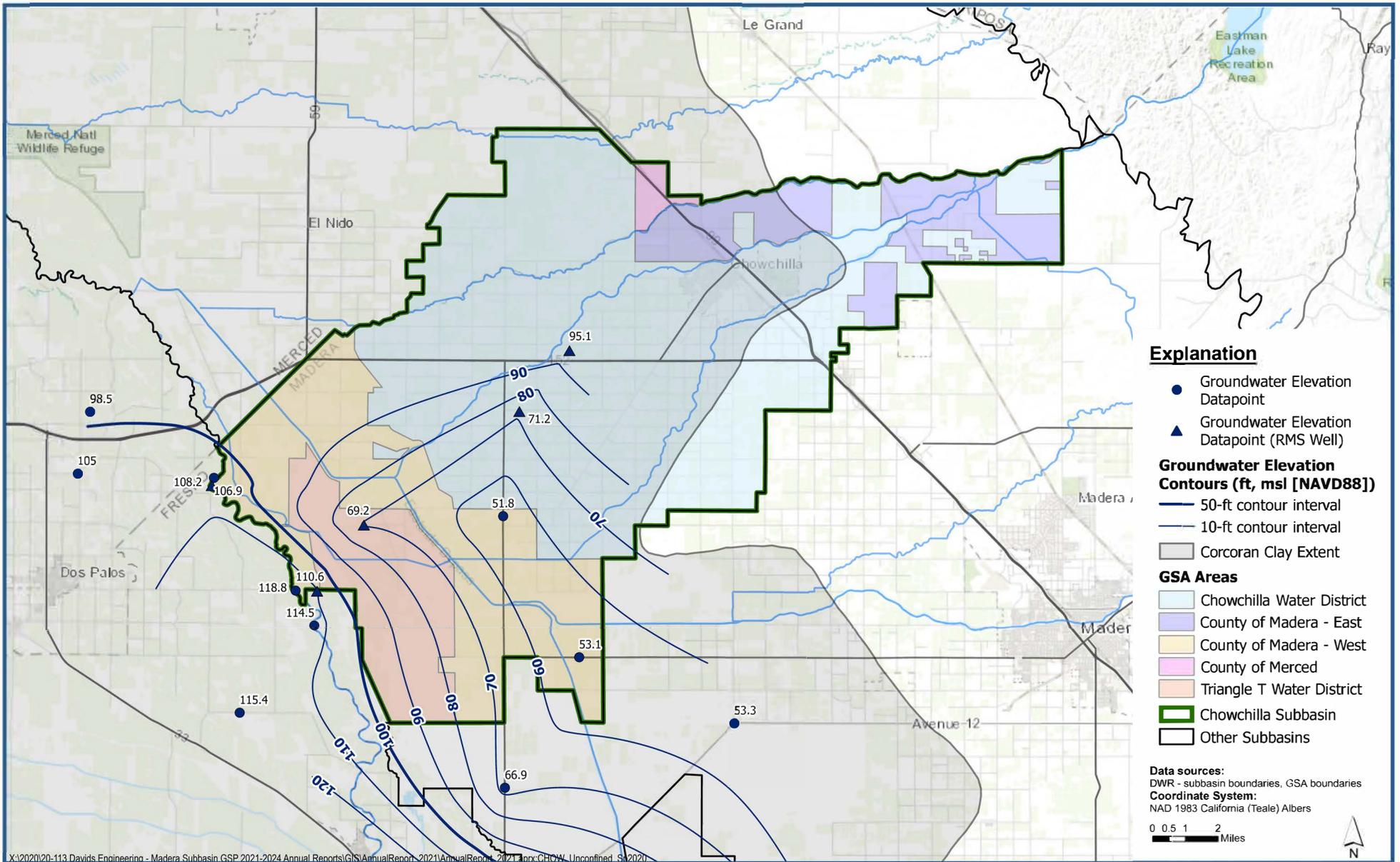


**Contours of Equal Groundwater Elevation
Upper Aquifer/Undifferentiated Unconfined Zone - Fall 2019**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure A-9



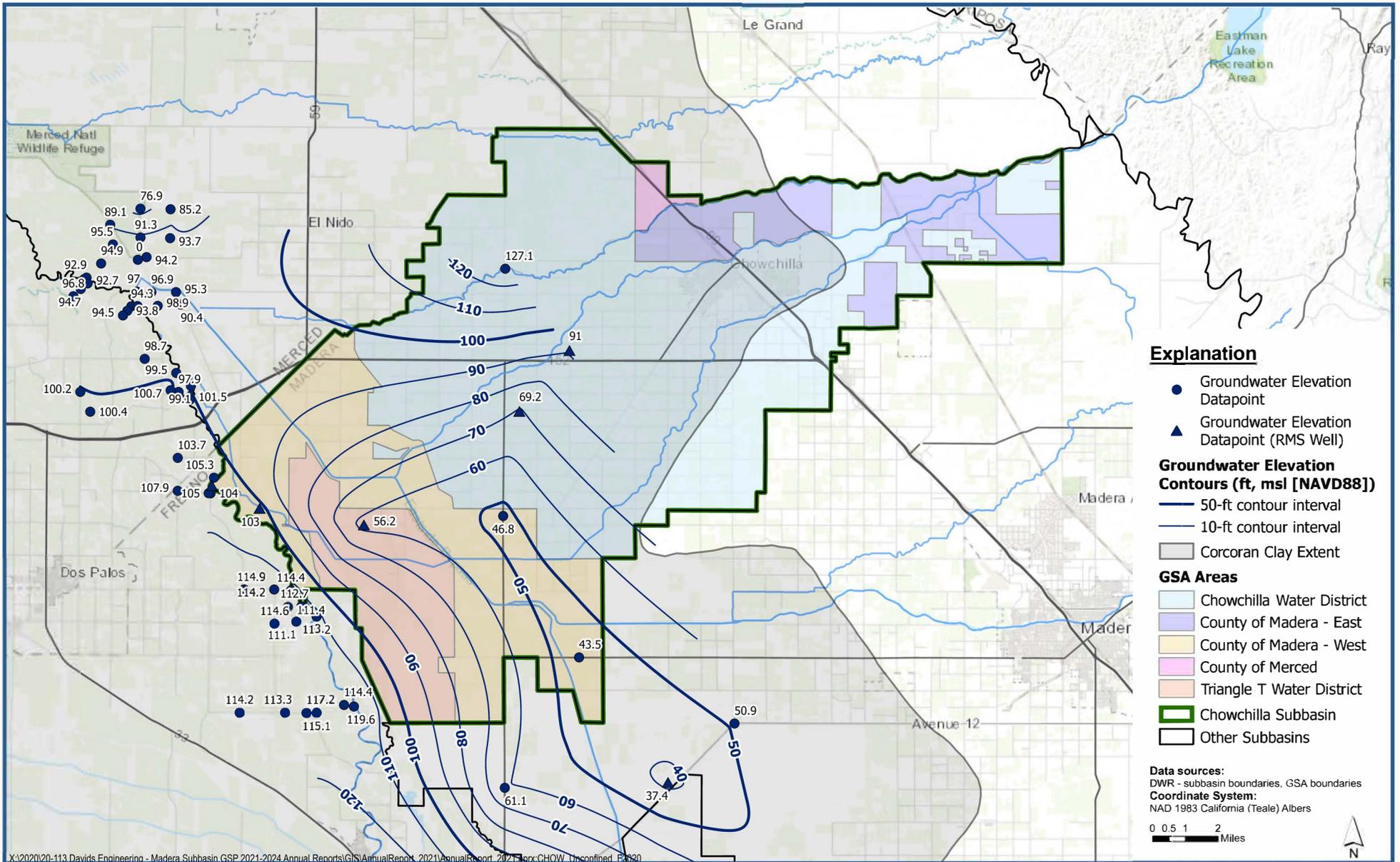


**Contours of Equal Groundwater Elevation:
Upper Aquifer - Spring 2020**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure A-10



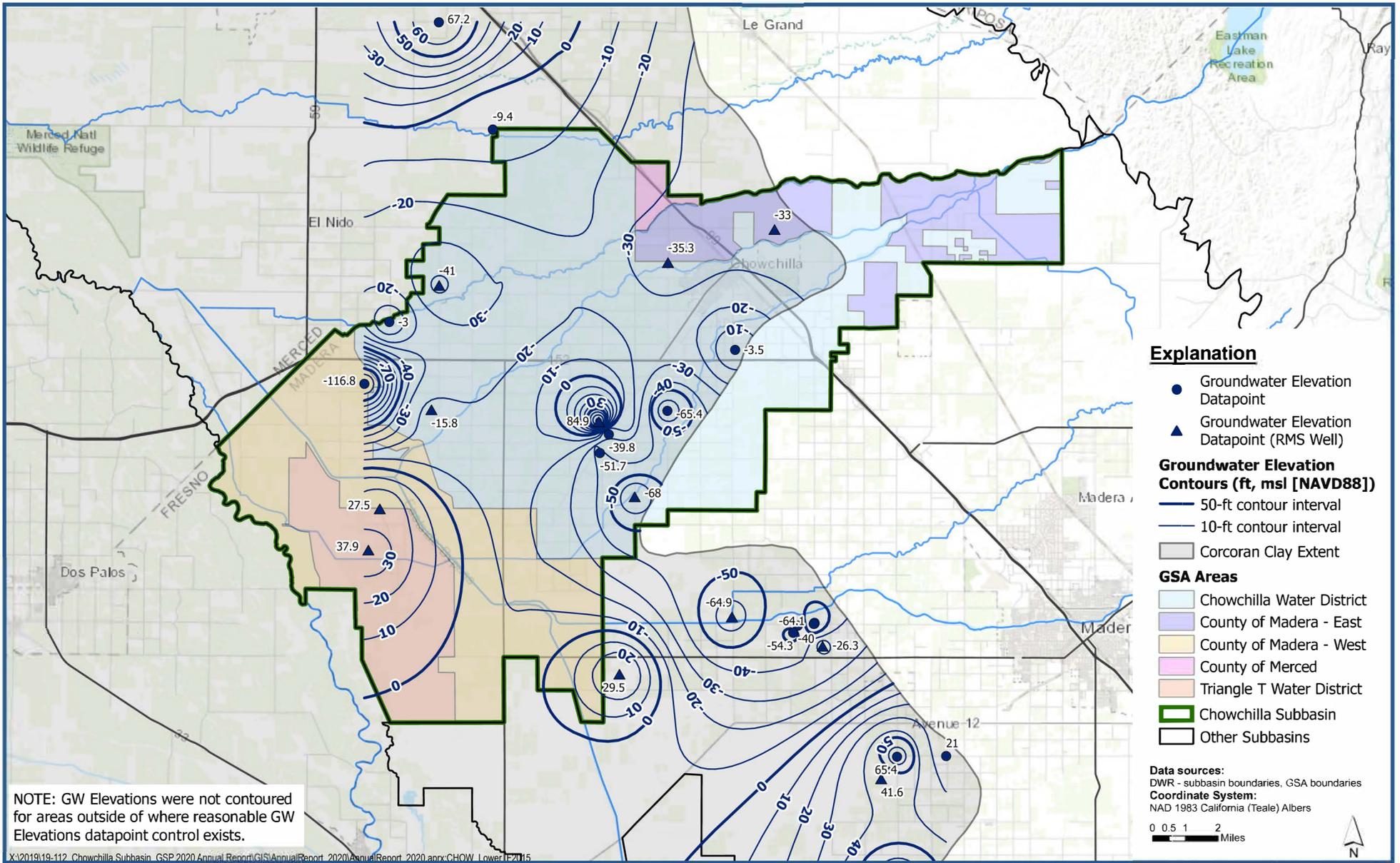


**Contours of Equal Groundwater Elevation:
Upper Aquifer - Fall 2020**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure A-11



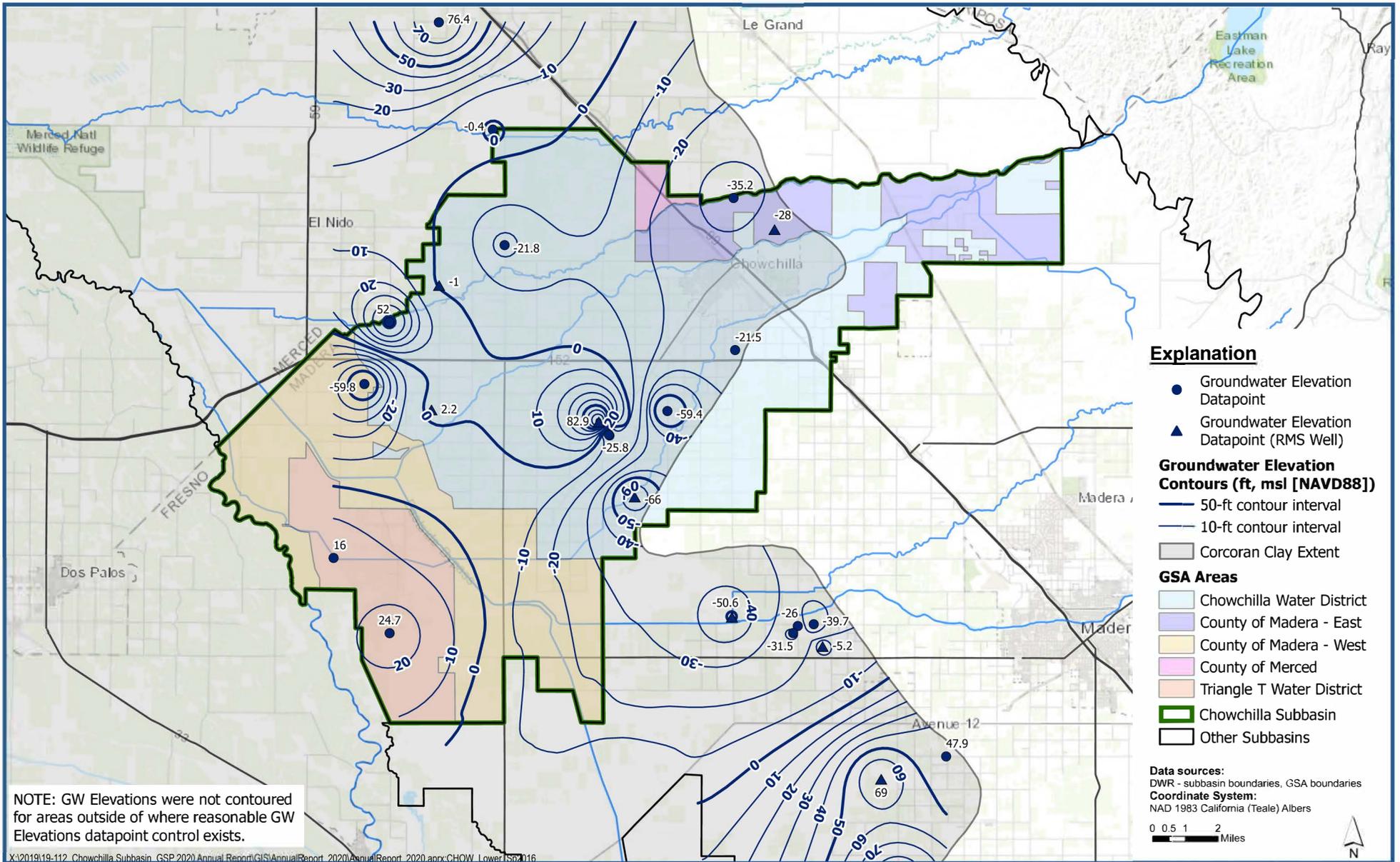


**Contours of Equal Groundwater Elevation
Lower Aquifer - Fall 2015**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure A-12



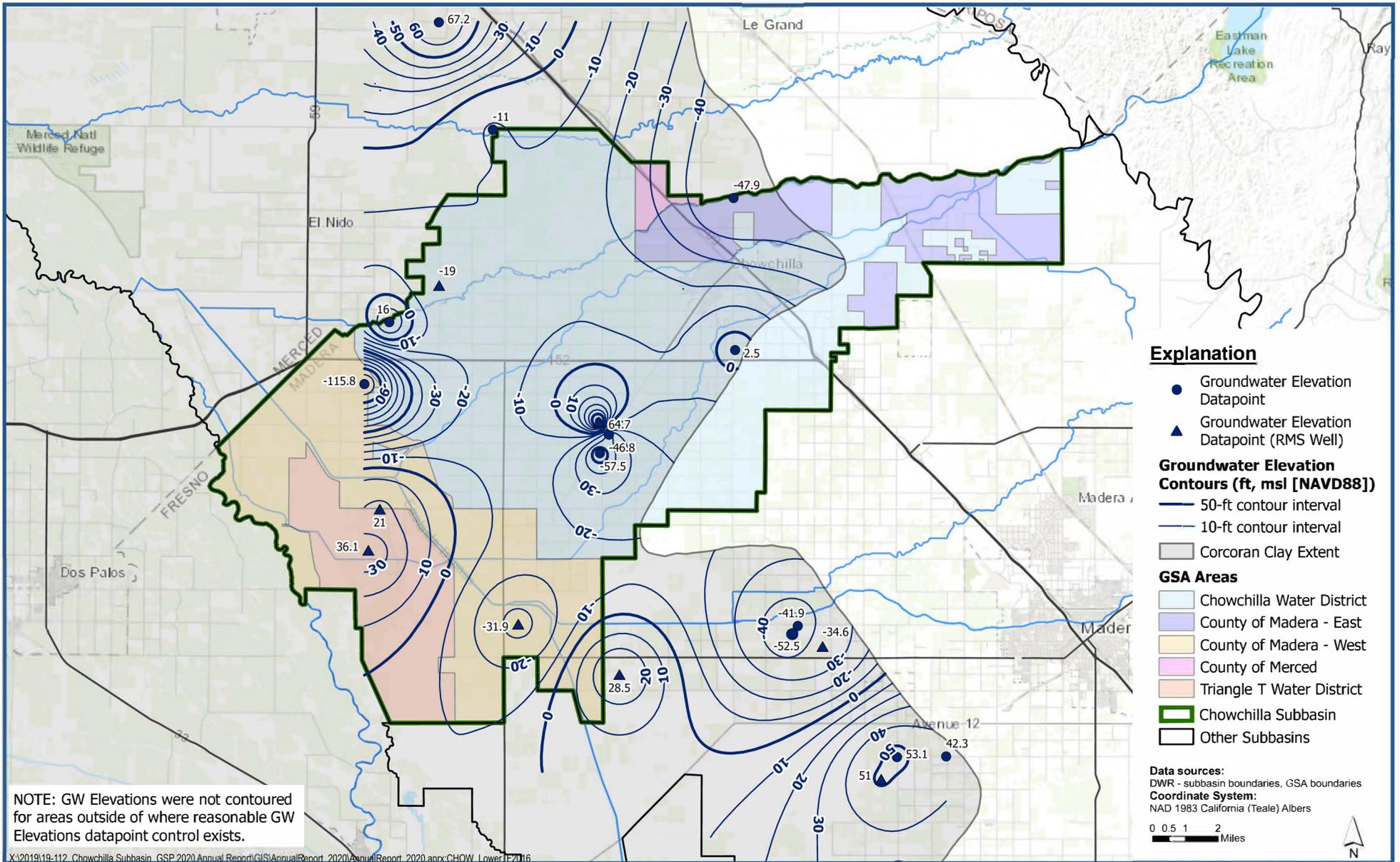


**Contours of Equal Groundwater Elevation
Lower Aquifer - Spring 2016**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-13



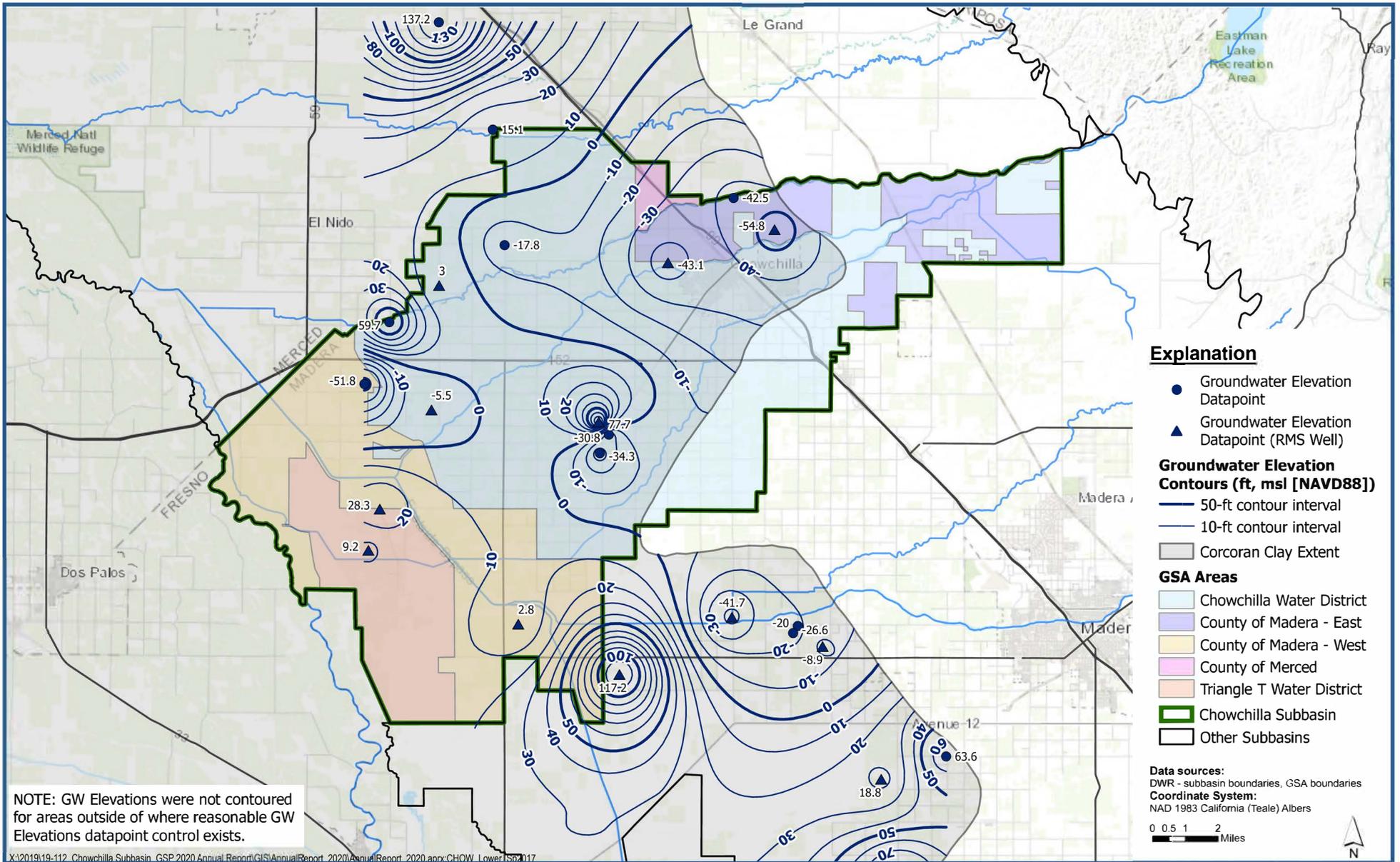


**Contours of Equal Groundwater Elevation
Lower Aquifer - Fall 2016**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-14



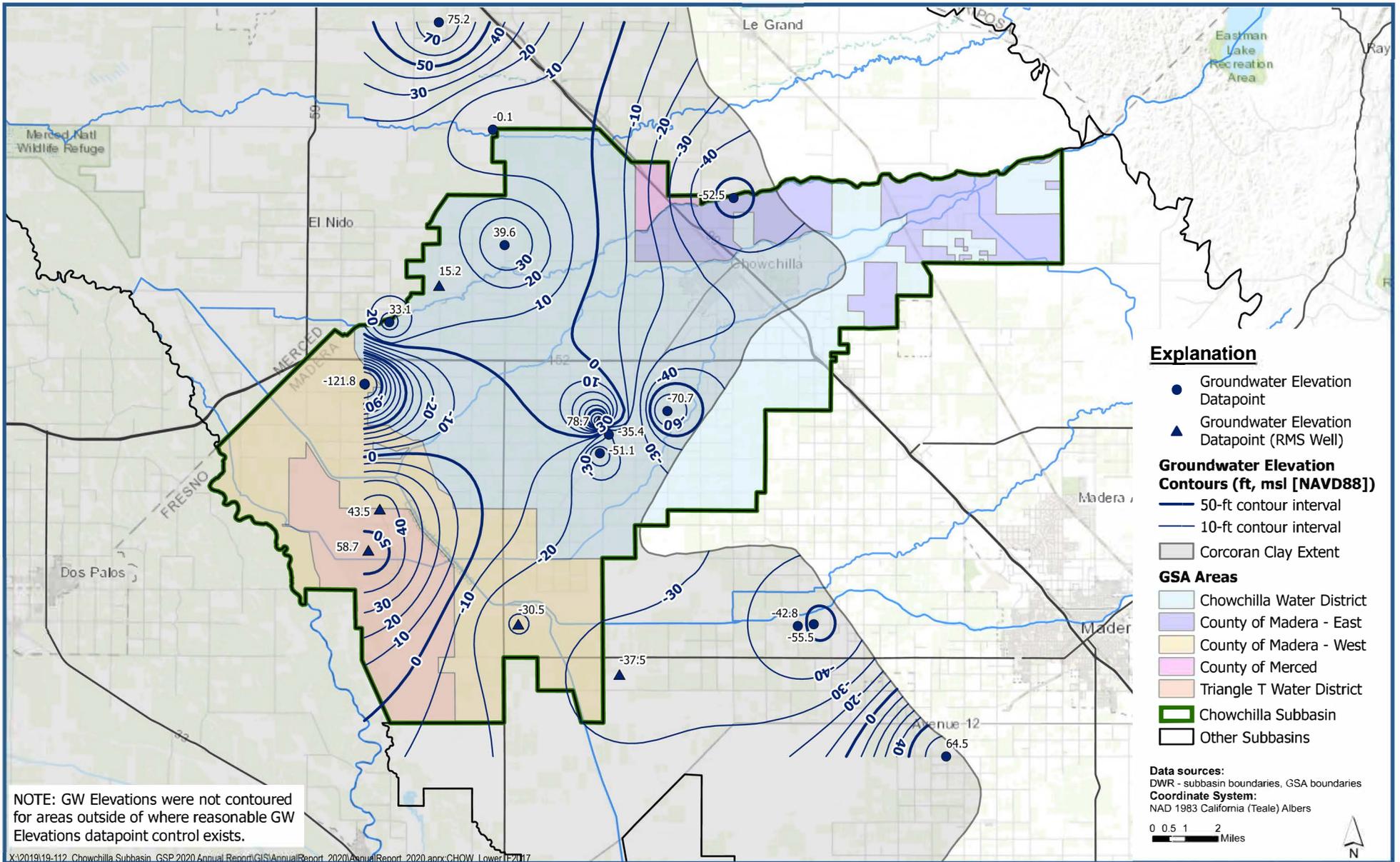


**Contours of Equal Groundwater Elevation
Lower Aquifer - Spring 2017**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-15



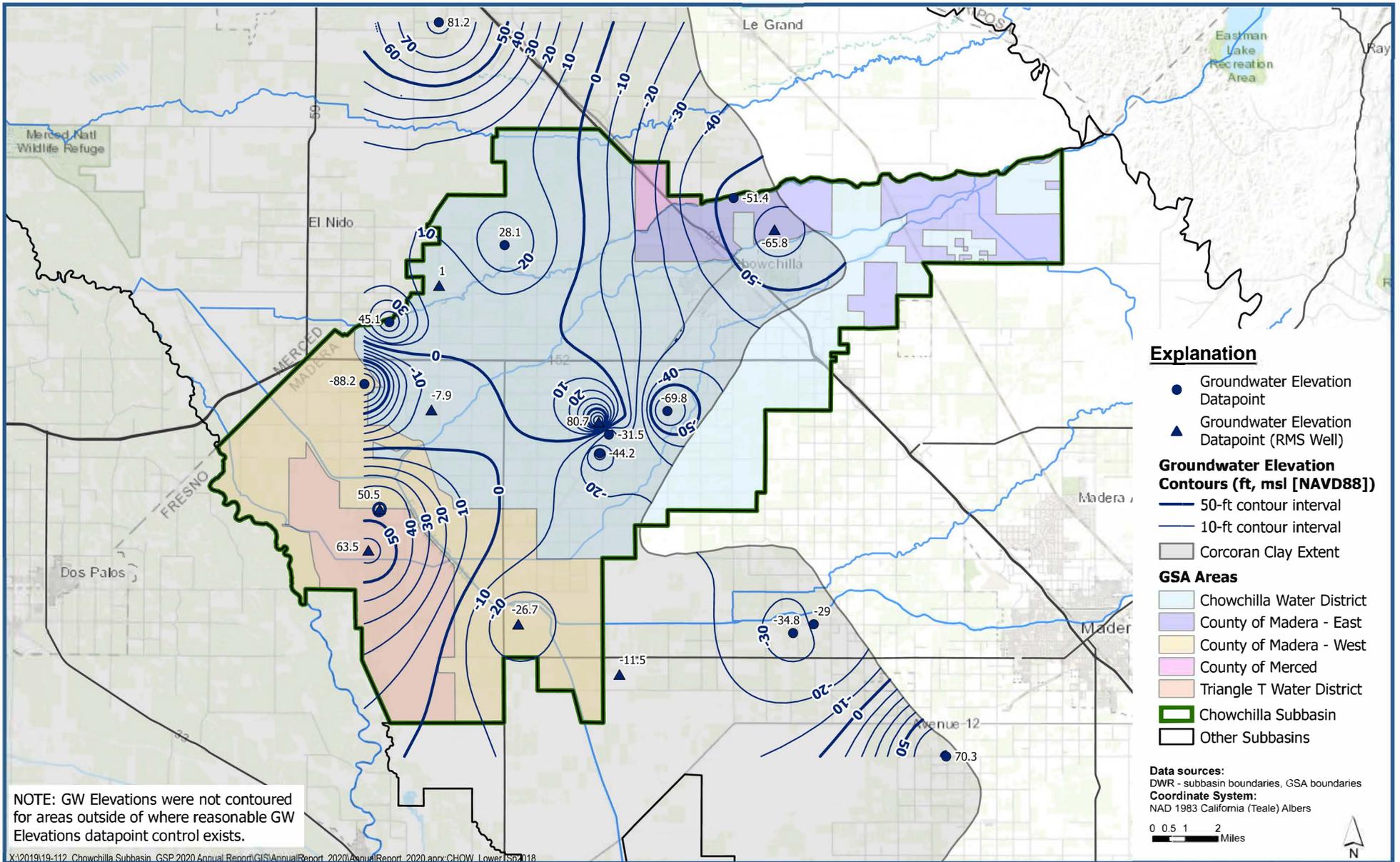


**Contours of Equal Groundwater Elevation
Lower Aquifer - Fall 2017**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-16



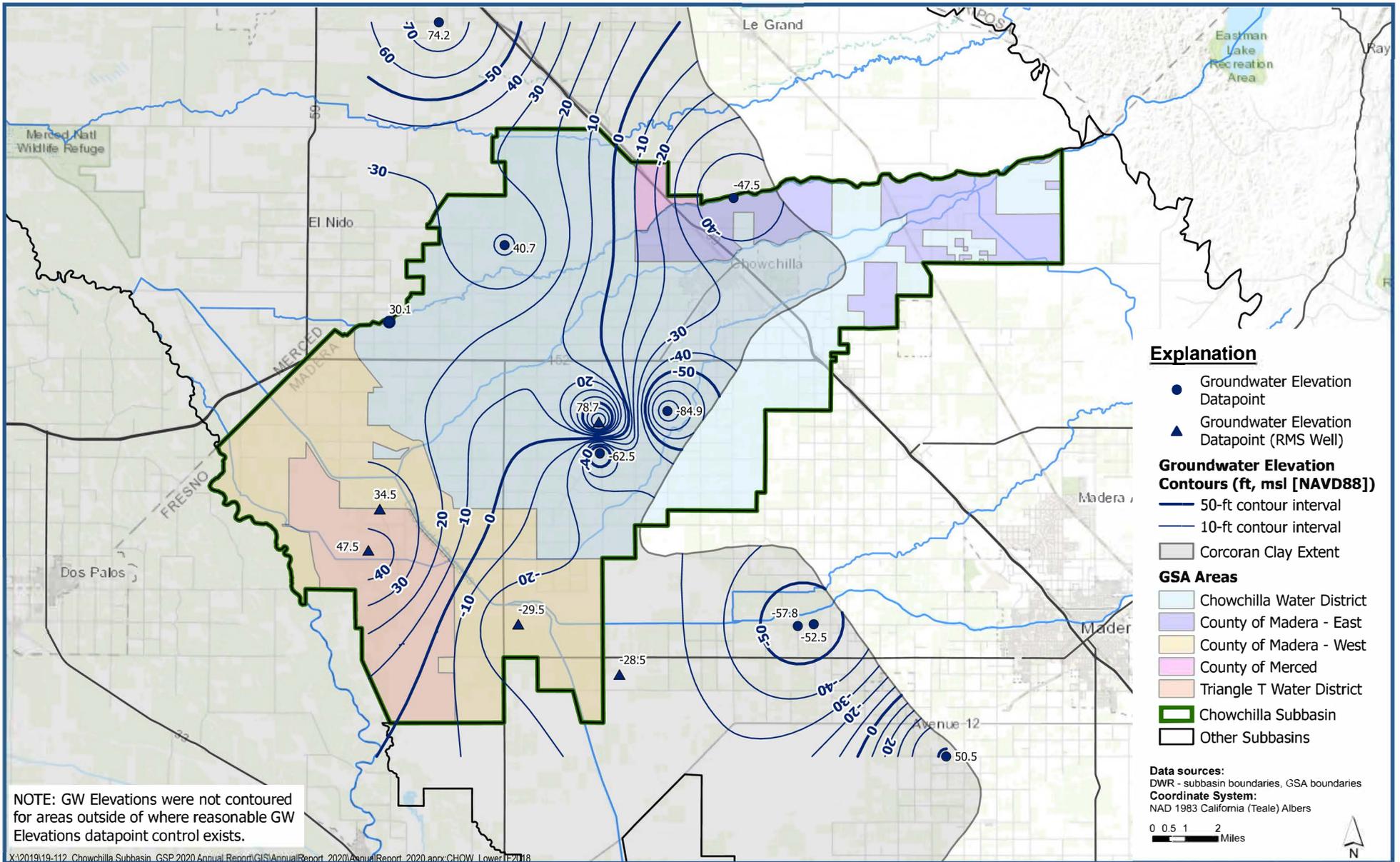


**Contours of Equal Groundwater Elevation
Lower Aquifer - Spring 2018**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-17



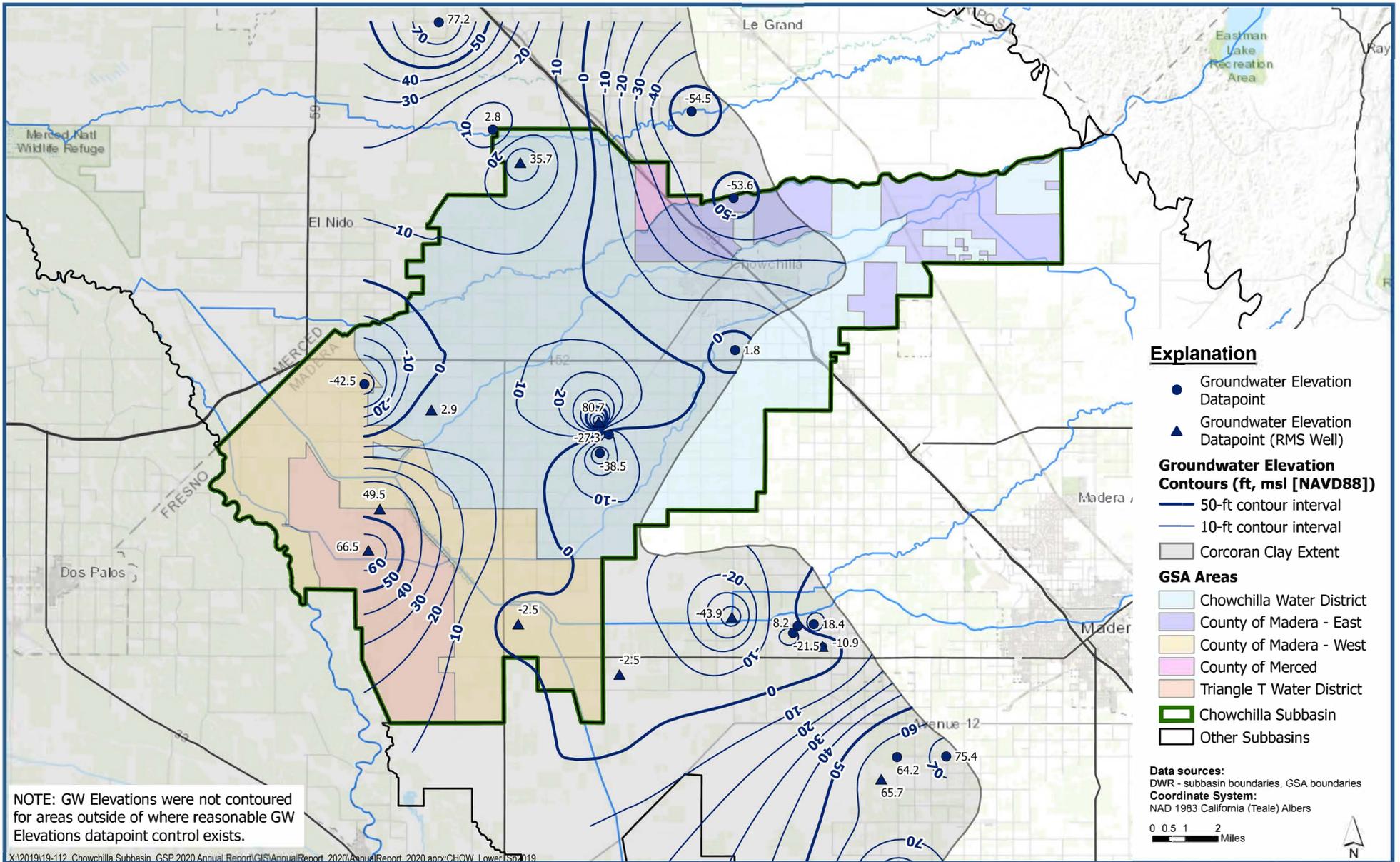


**Contours of Equal Groundwater Elevation
Lower Aquifer - Fall 2018**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure A-18



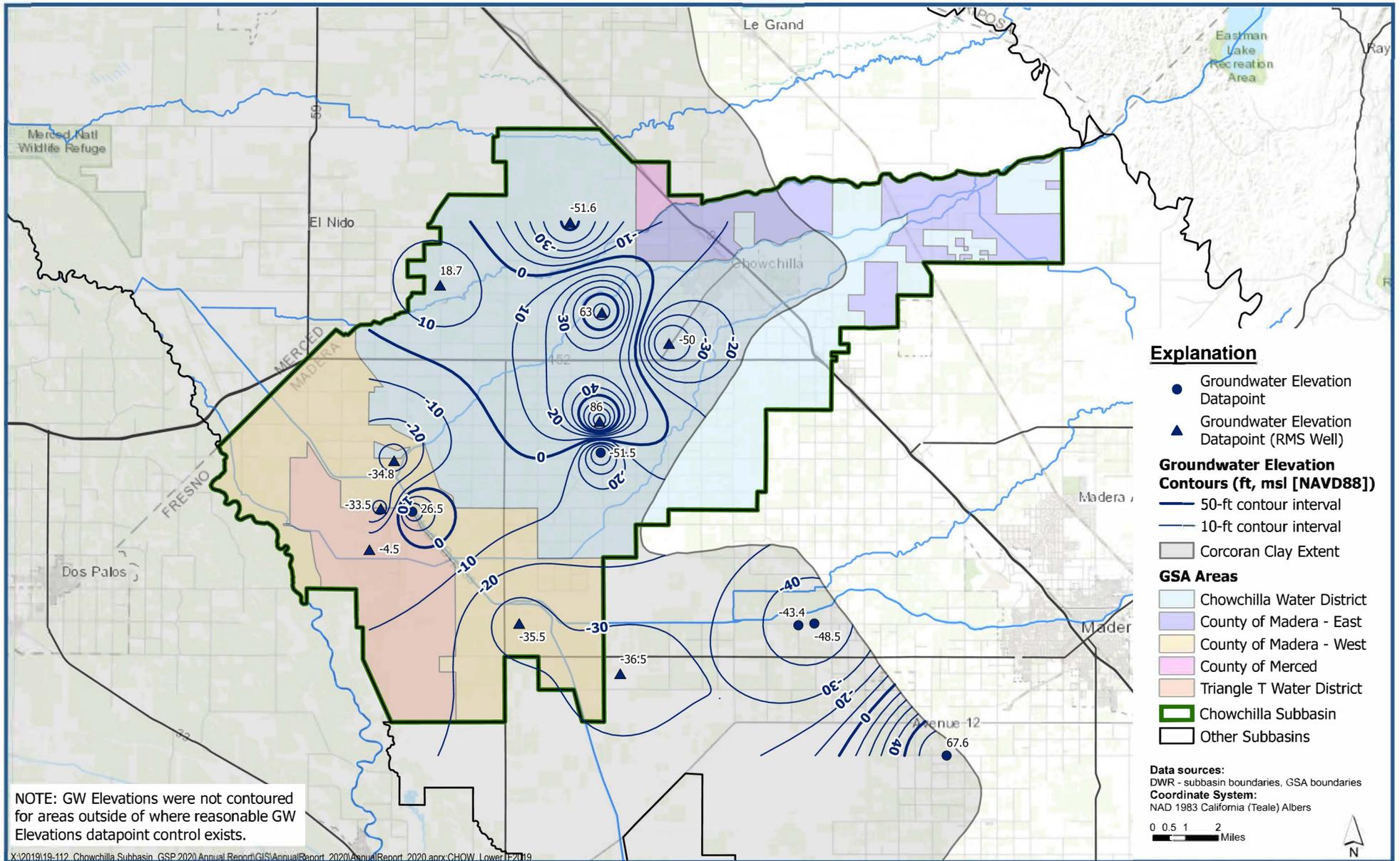


**Contours of Equal Groundwater Elevation
Lower Aquifer - Spring 2019**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-19



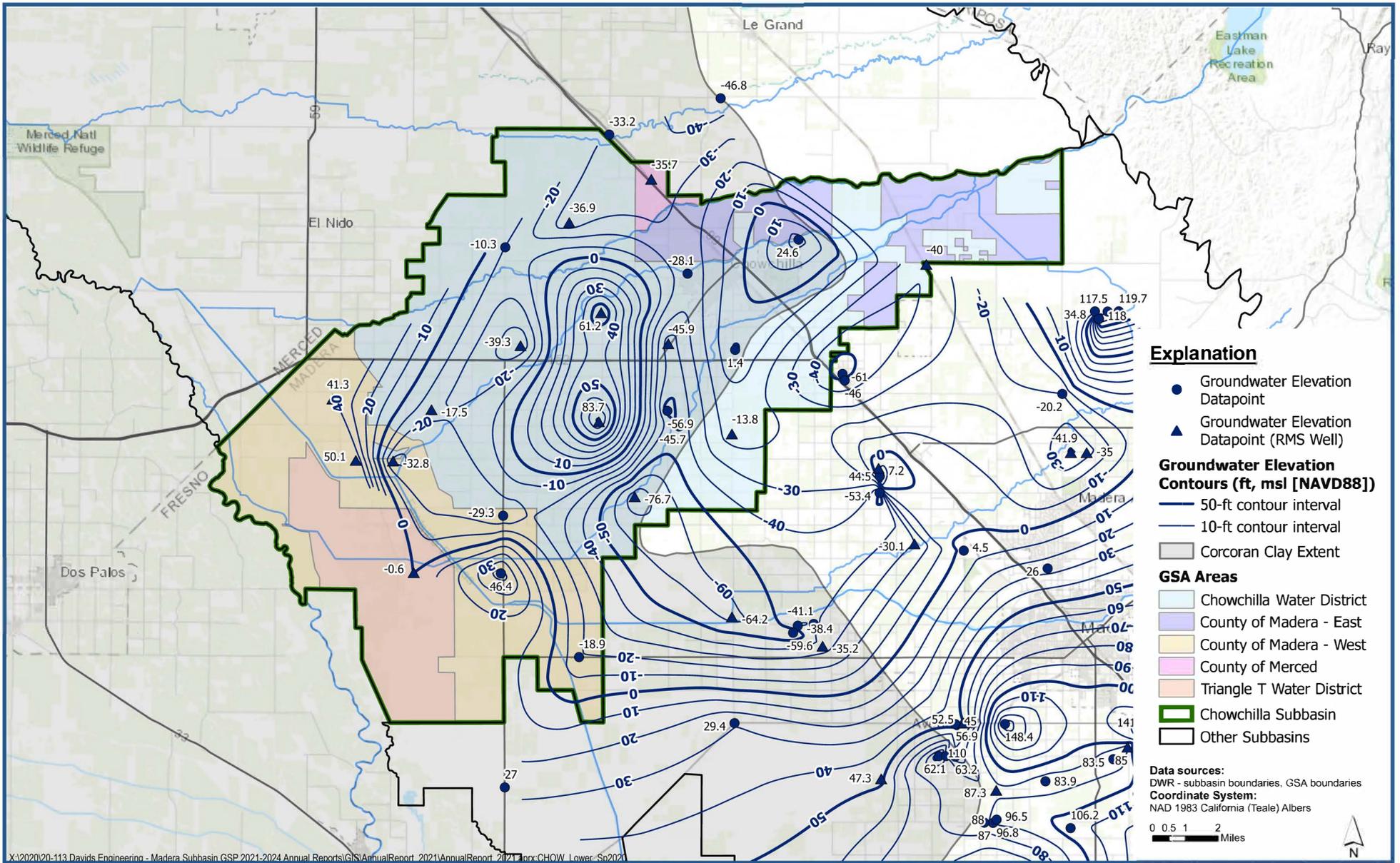


**Contours of Equal Groundwater Elevation
Lower Aquifer - Fall 2019**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure A-20



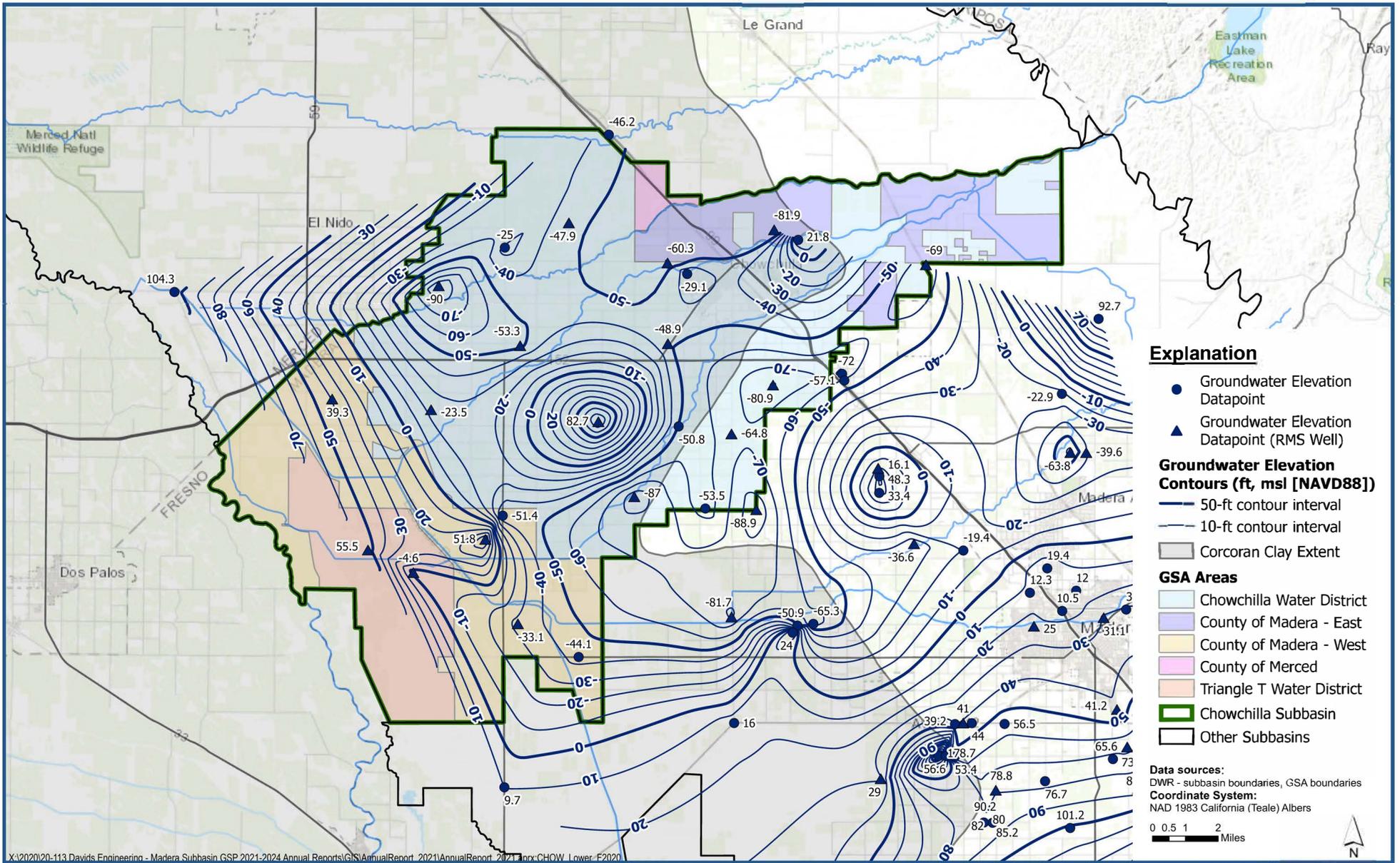


**Contours of Equal Groundwater Elevation:
Lower Aquifer/Undifferentiated Unconfined Zone - Spring 2020**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure A-21





**Contours of Equal Groundwater Elevation:
Lower Aquifer/Undifferentiated Unconfined Zone - Fall 2020**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

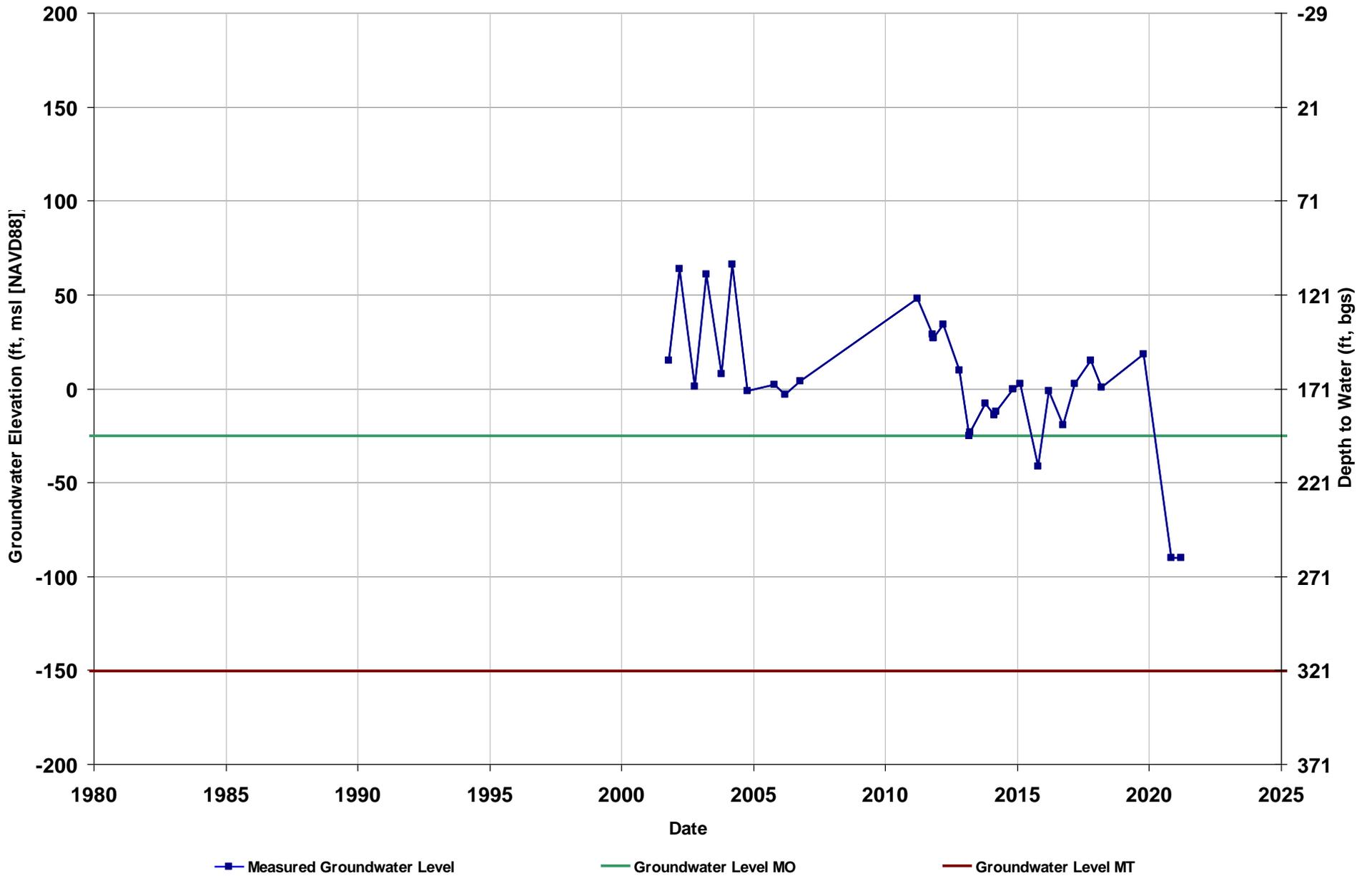
Figure A-22



Appendix B. Hydrographs of Time-Series Groundwater Level Data for Groundwater Level RMS Wells.

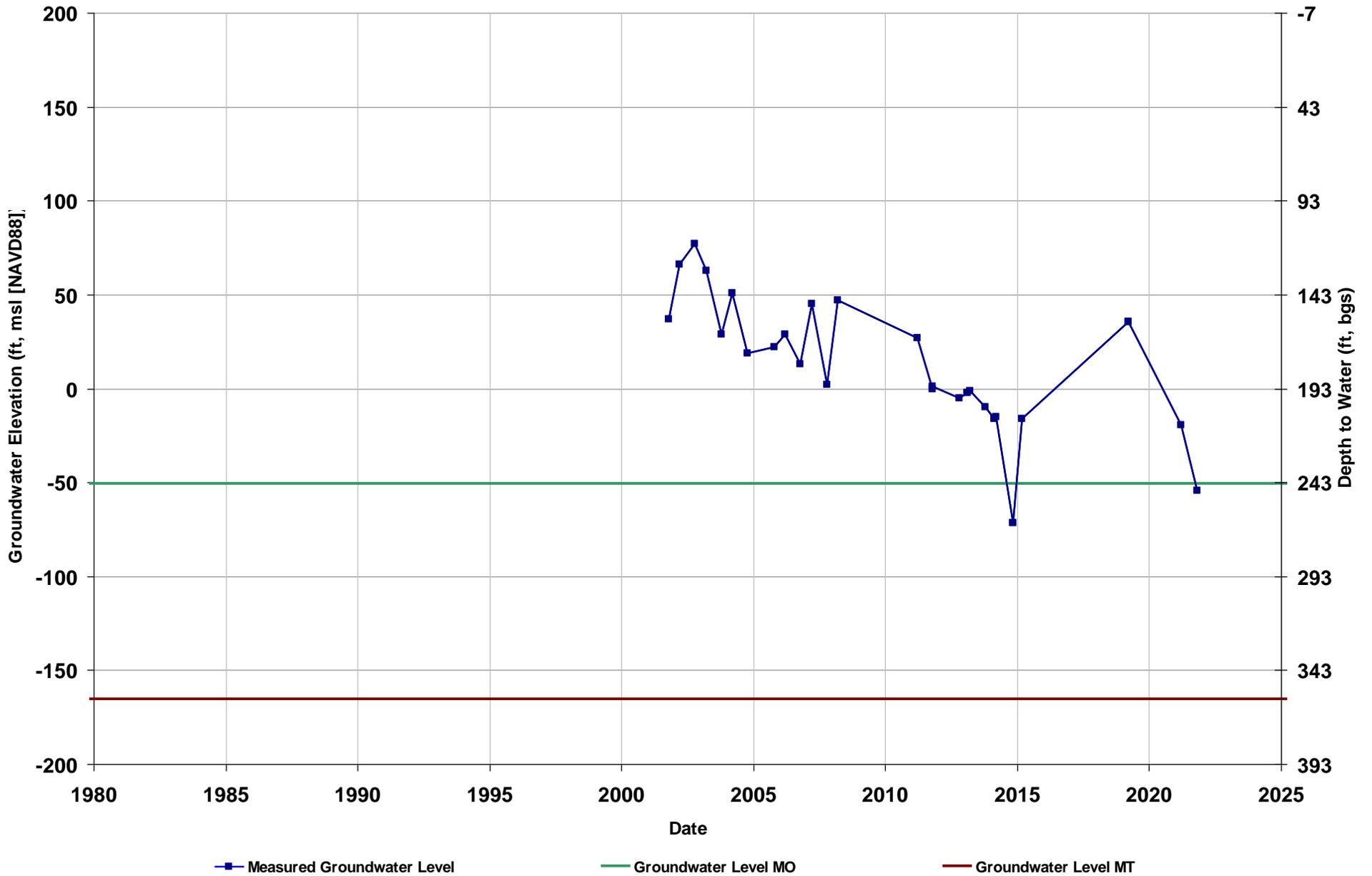
Well Name: CWD RMS-1
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 275
Perf Top (ft): 160
Perf Bottom (ft): 275
GSE (ft, msl): 171



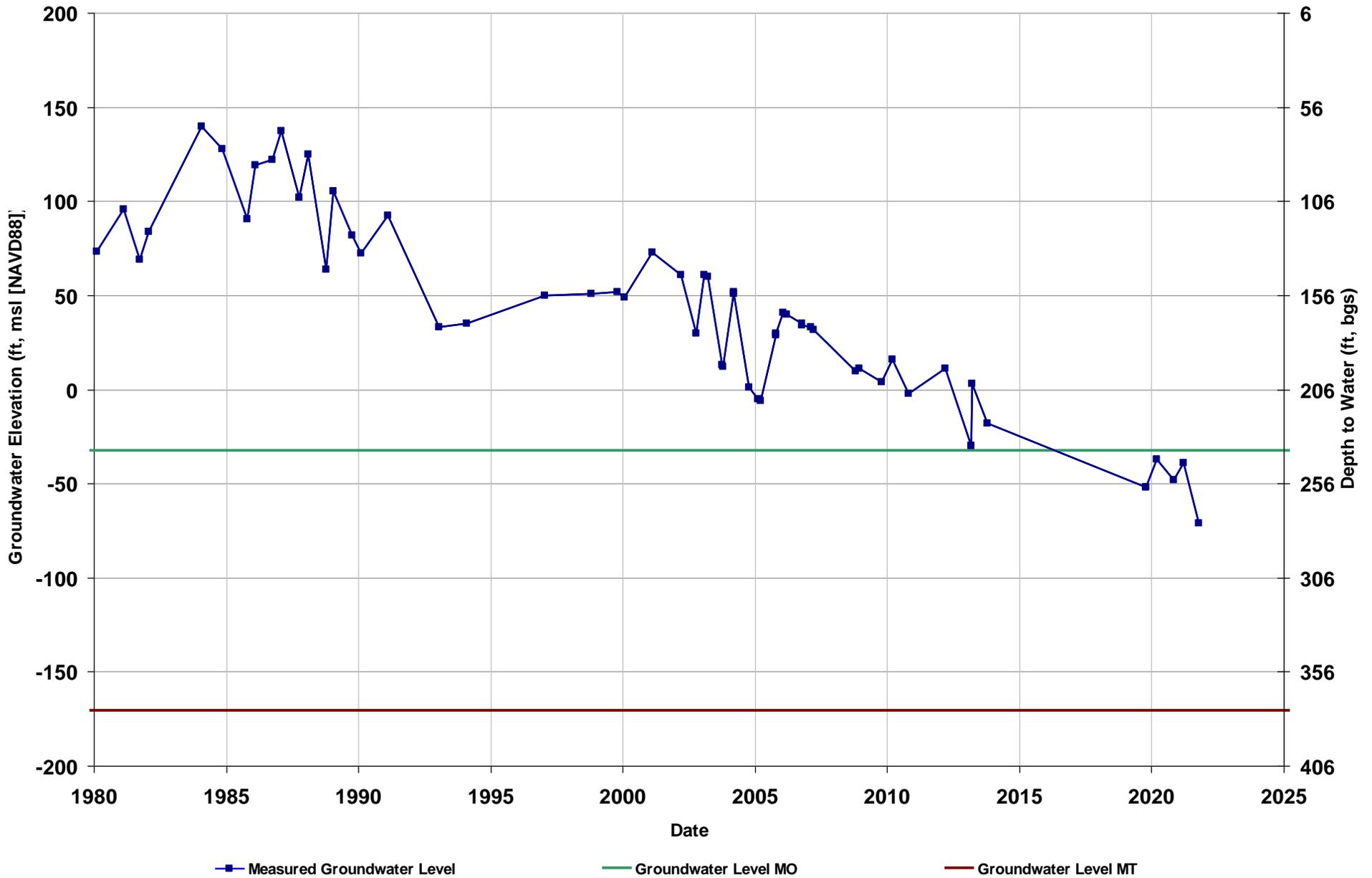
Well Name: CWD RMS-2
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 780
Perf Top (ft): 230
Perf Bottom (ft): 775
GSE (ft, msl): 193



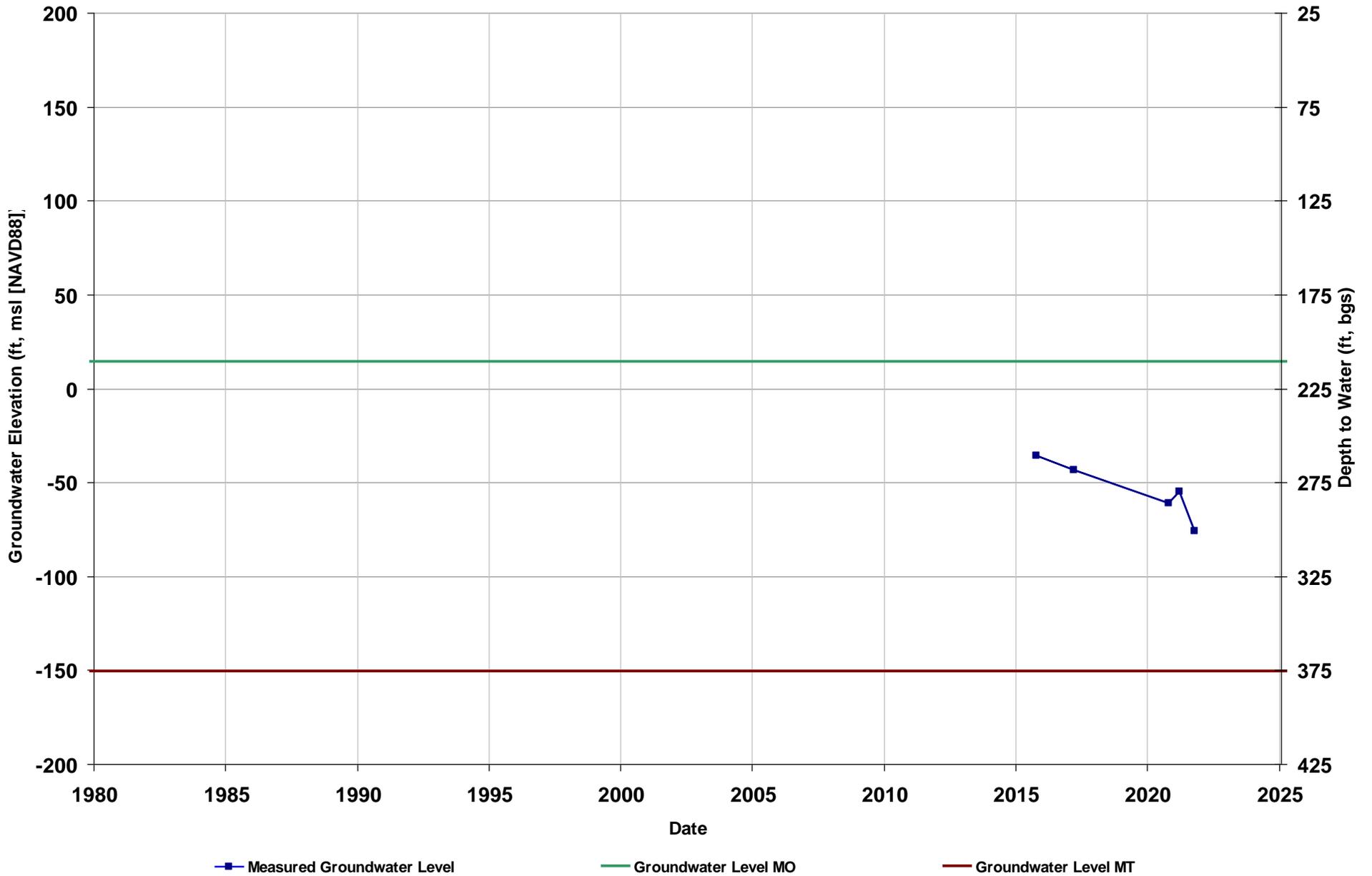
Well Name: CWD RMS-3
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 206



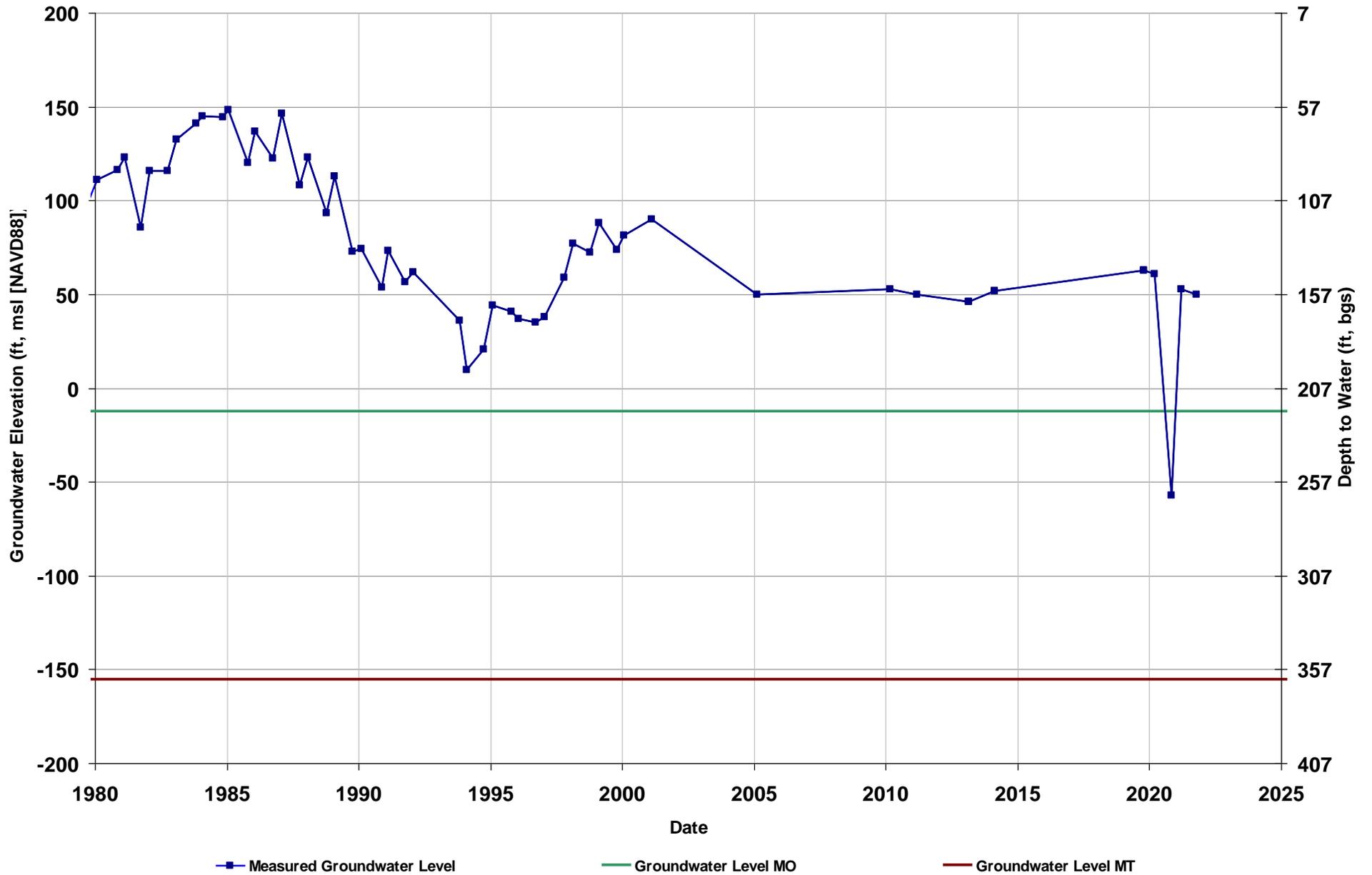
Well Name: CWD RMS-4
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 800
Perf Top (ft): 320
Perf Bottom (ft): 800
GSE (ft, msl): 225



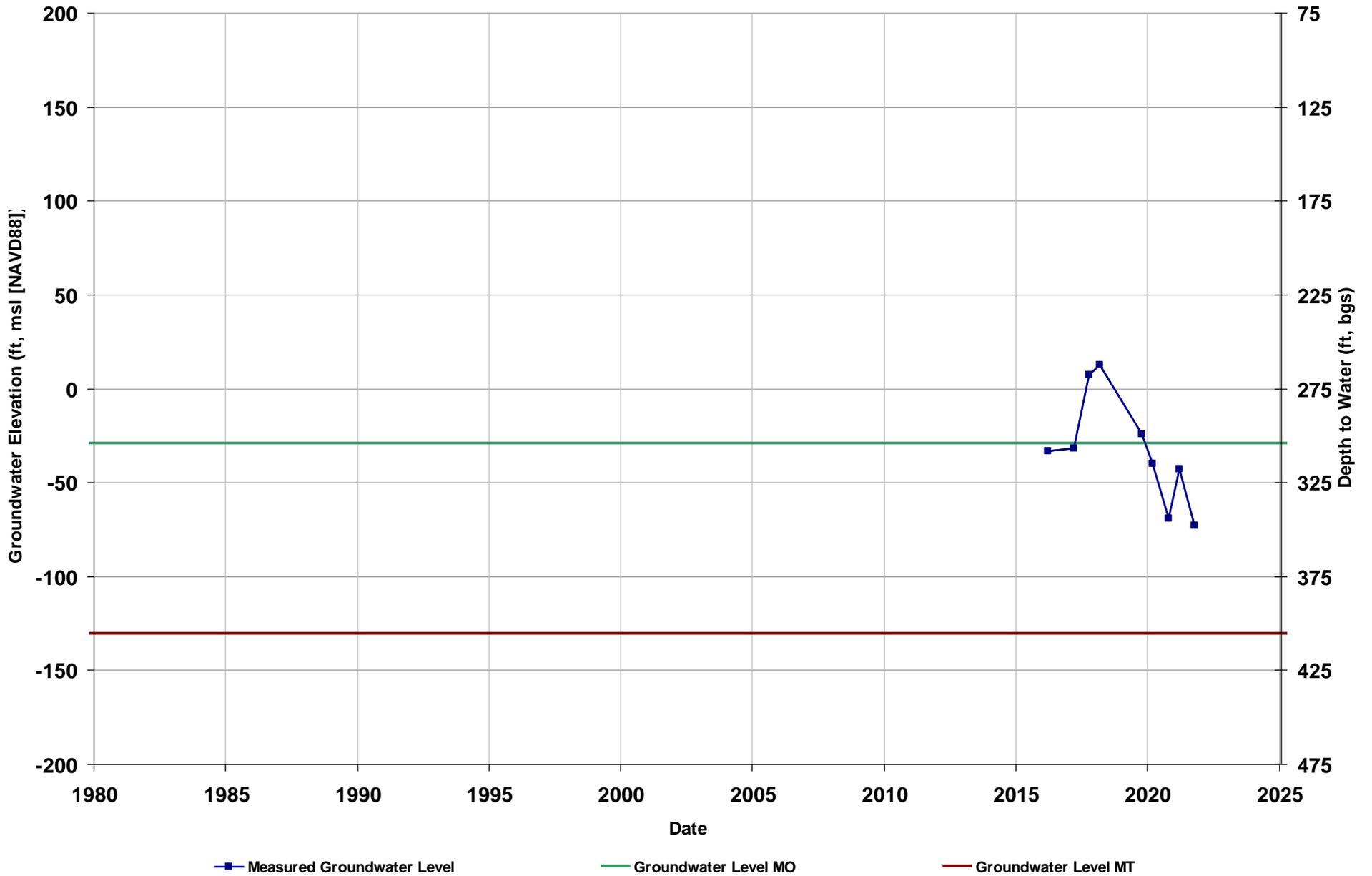
Well Name: CWD RMS-5
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 207



Well Name: CWD RMS-6
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 820
Perf Top (ft): 257
Perf Bottom (ft): 726
GSE (ft, msl): 275



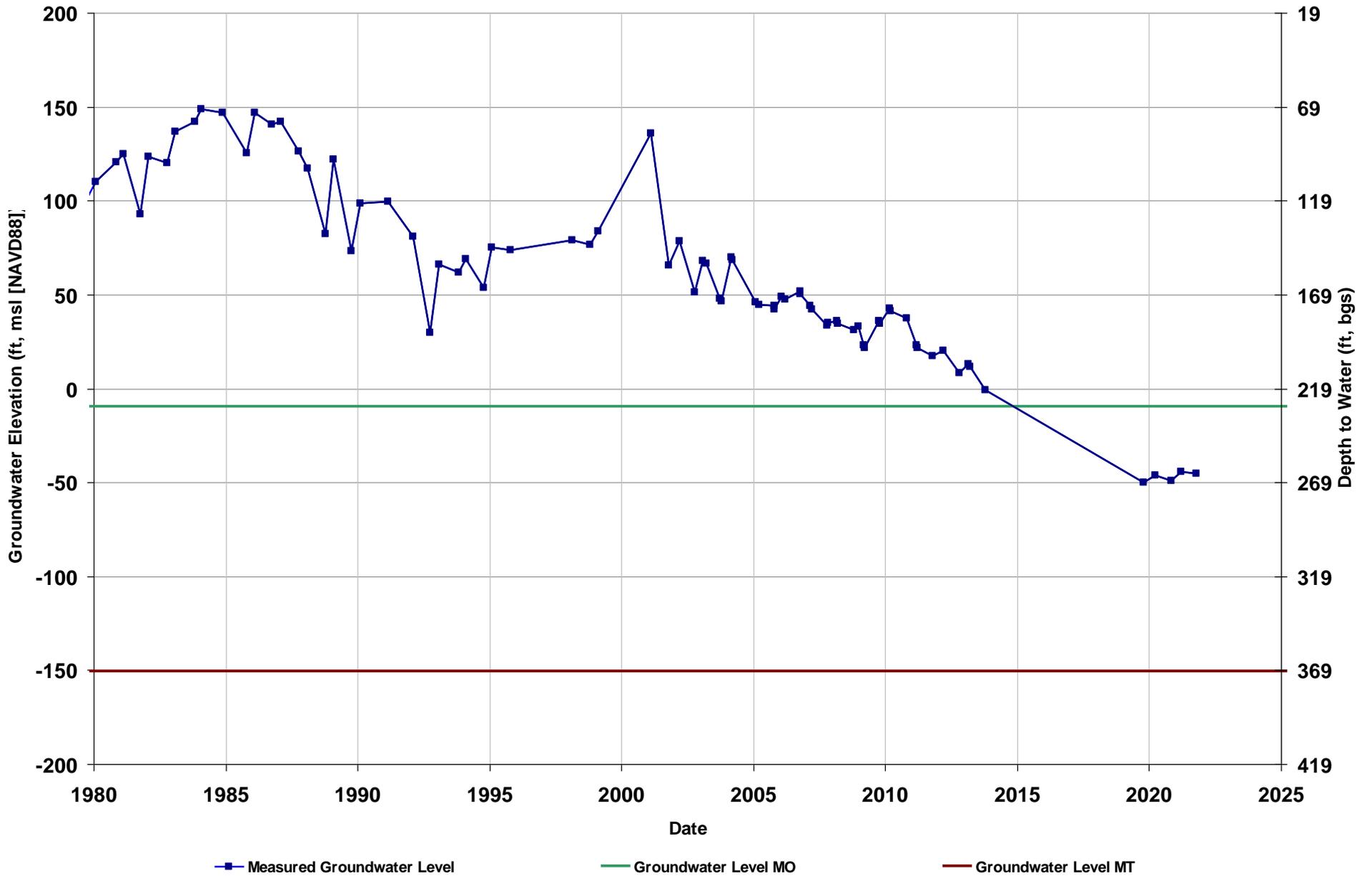
Well Name: CWD RMS-7
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 330
Perf Top (ft): 135
Perf Bottom (ft): 288
GSE (ft, msl): 169



Well Name: CWD RMS-8
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 219



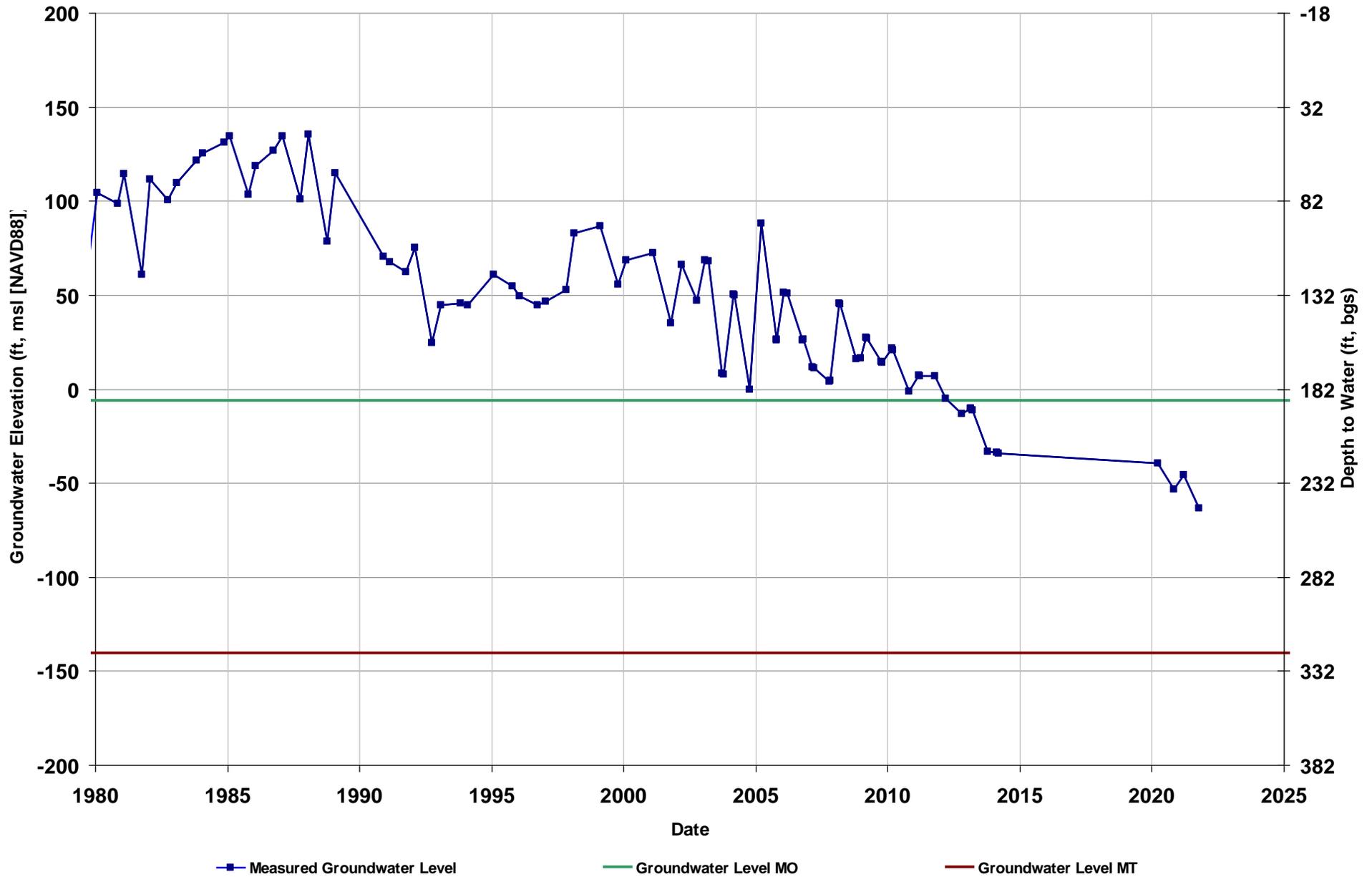
Well Name: CWD RMS-9
Depth Zone: Upper
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 97
Perf Top (ft): 82
Perf Bottom (ft): 97
GSE (ft, msl): 164



Well Name: CWD RMS-10
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 182



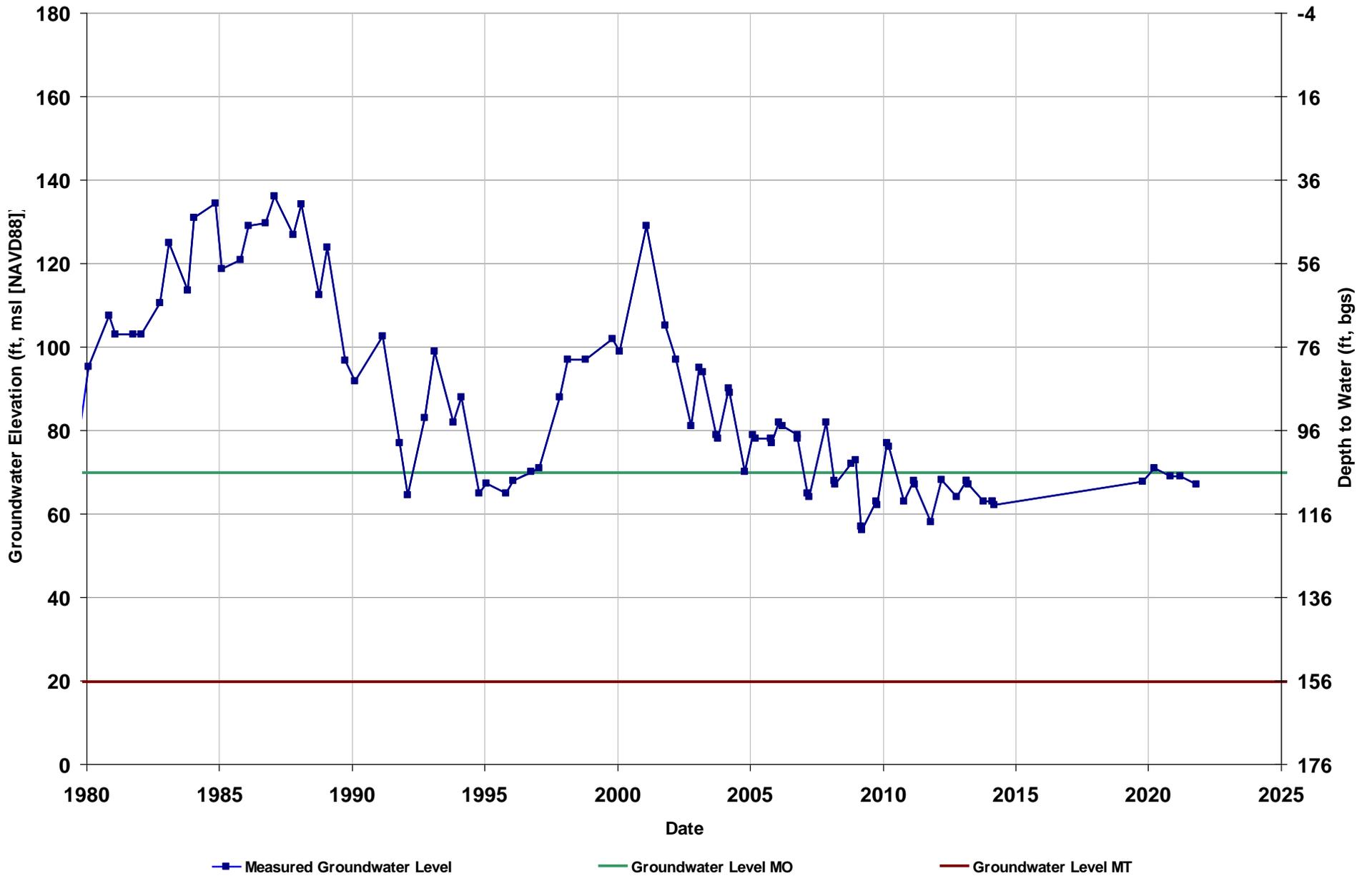
Well Name: CWD RMS-11
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 529
Perf Top (ft): 187
Perf Bottom (ft): 529
GSE (ft, msl): 199



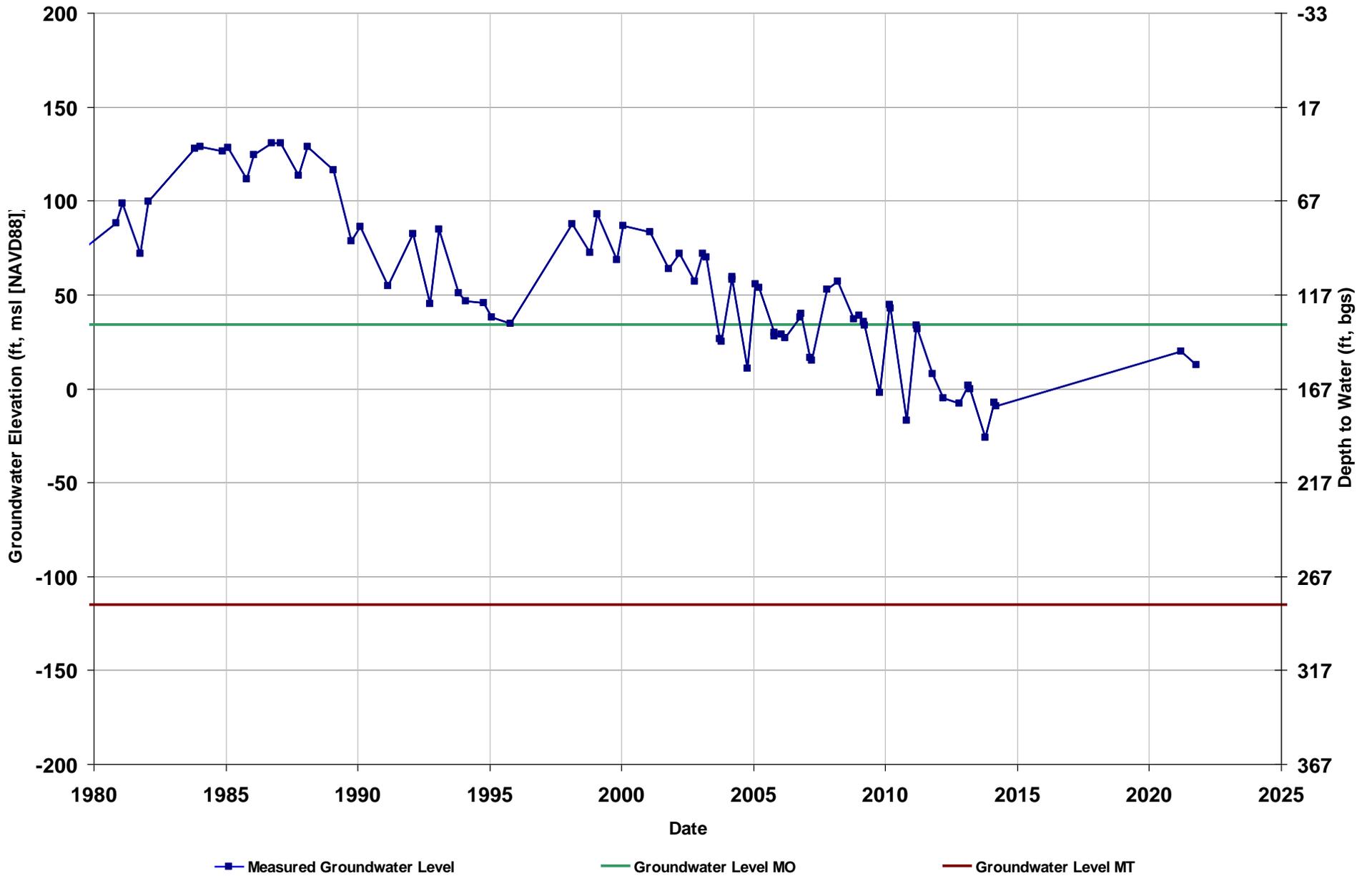
Well Name: CWD RMS-12
Depth Zone: Upper
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 176



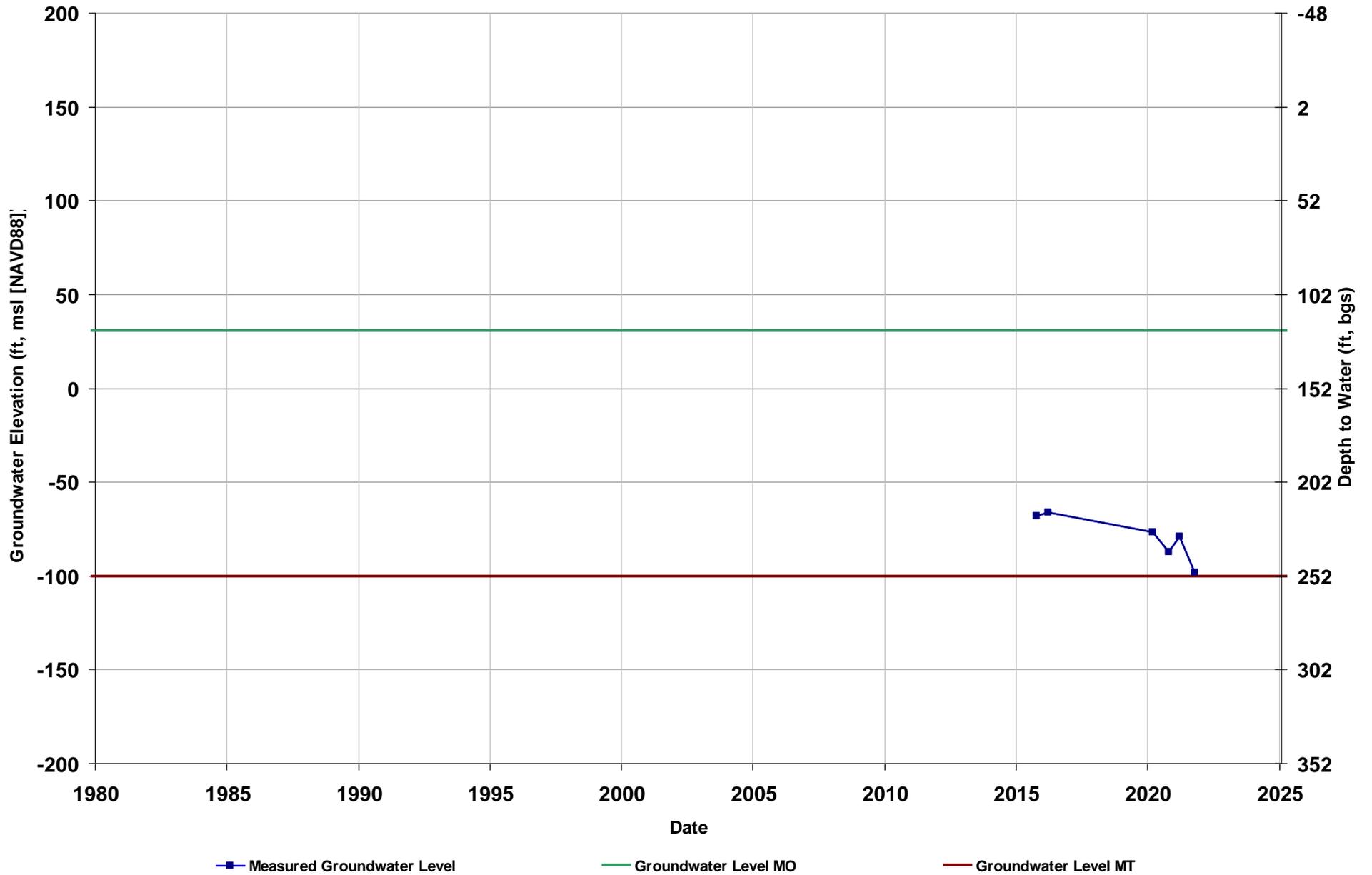
Well Name: CWD RMS-13
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 167



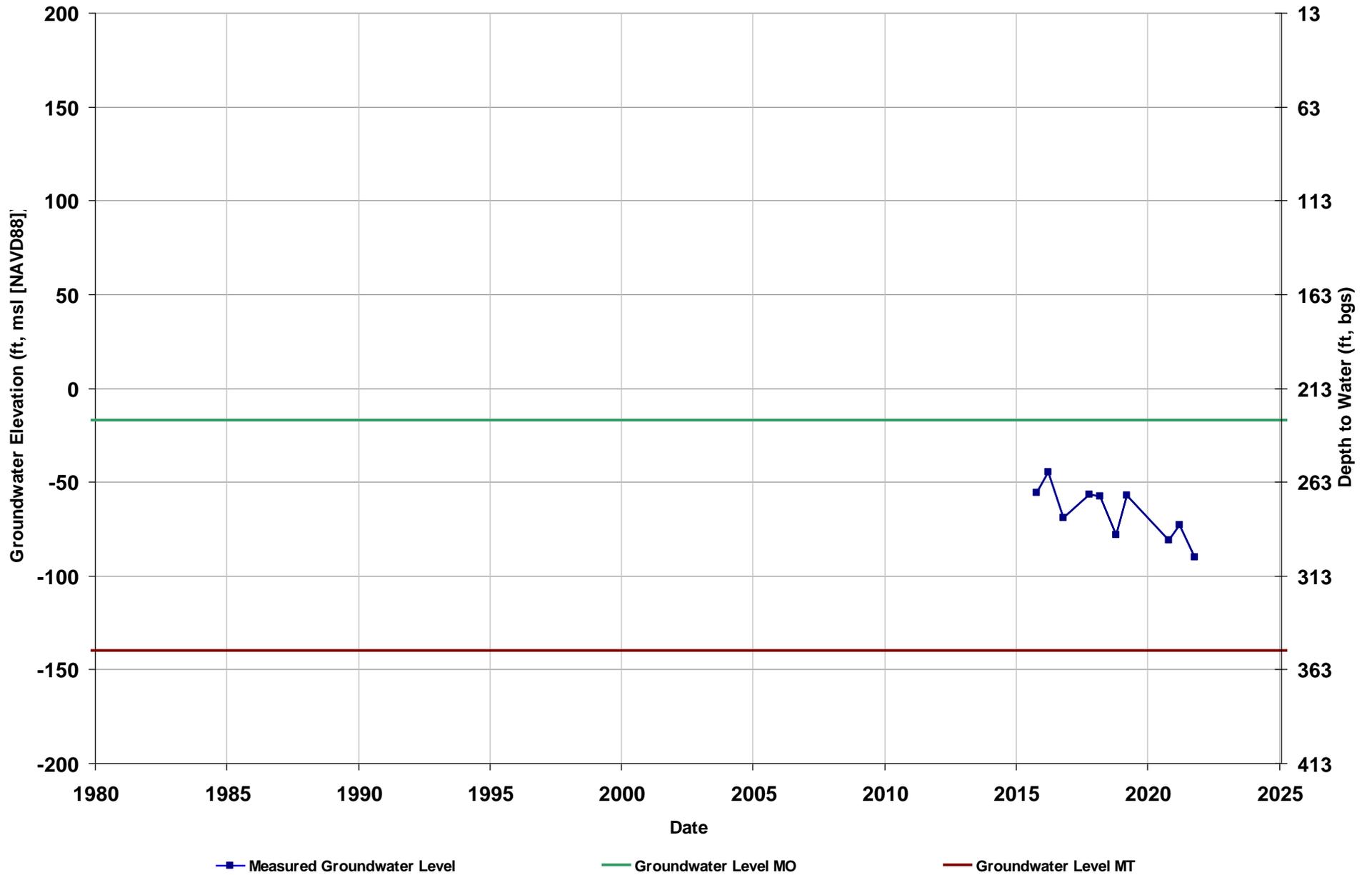
Well Name: CWD RMS-14
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 455
Perf Top (ft): 185
Perf Bottom (ft): 365
GSE (ft, msl): 152



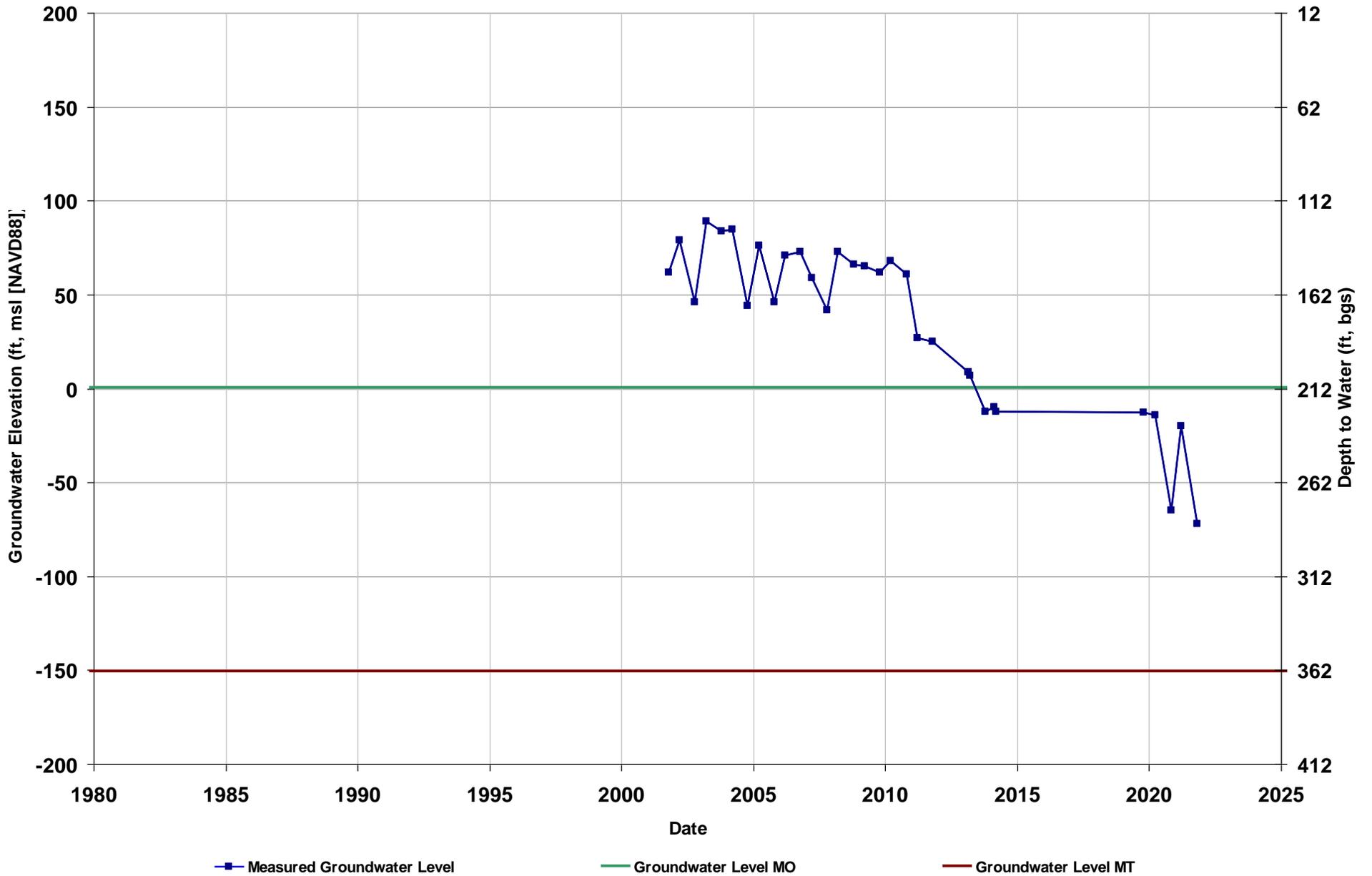
Well Name: CWD RMS-15
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 955
Perf Top (ft): 290
Perf Bottom (ft): 935
GSE (ft, msl): 213



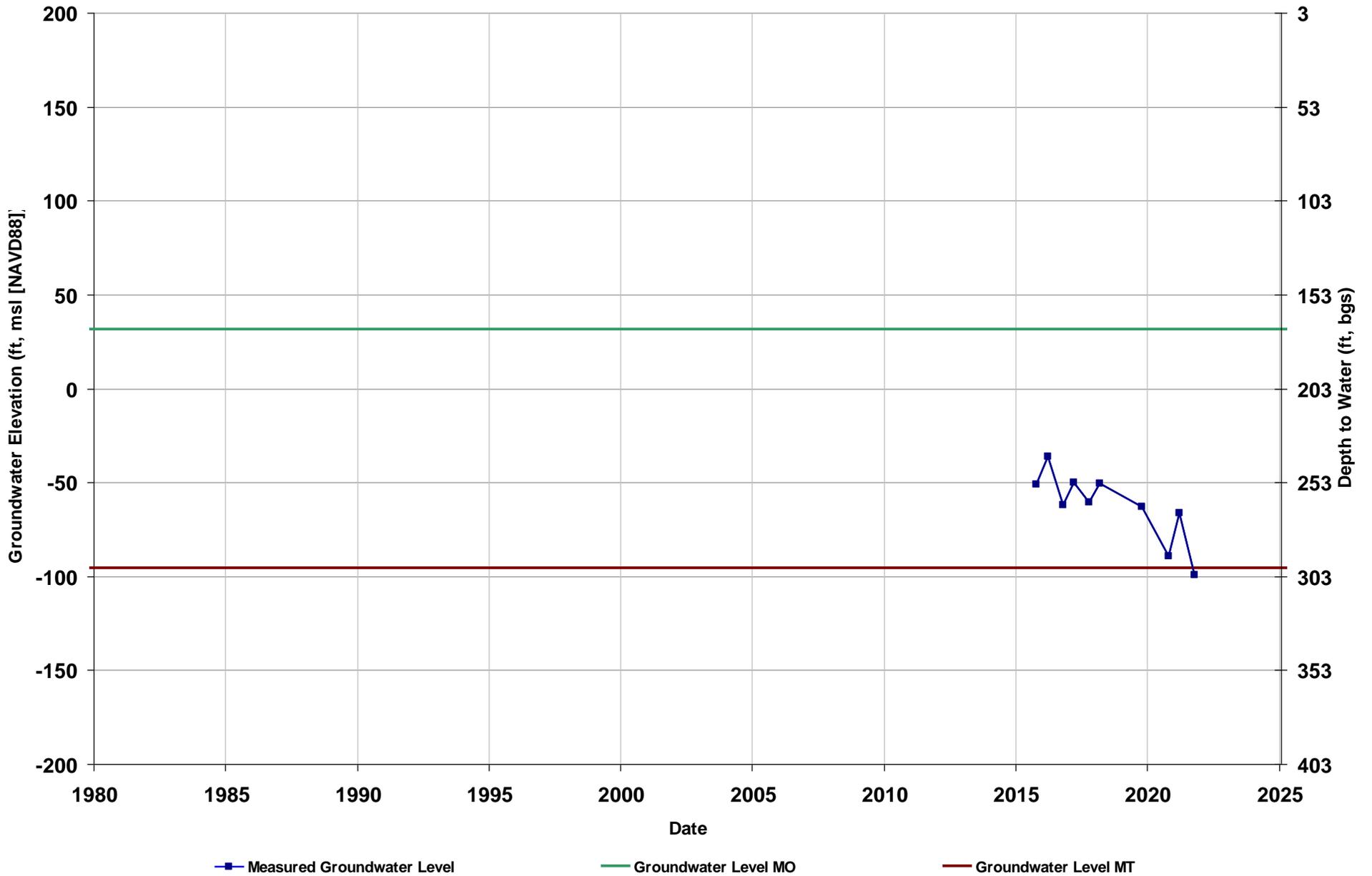
Well Name: CWD RMS-16
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 212



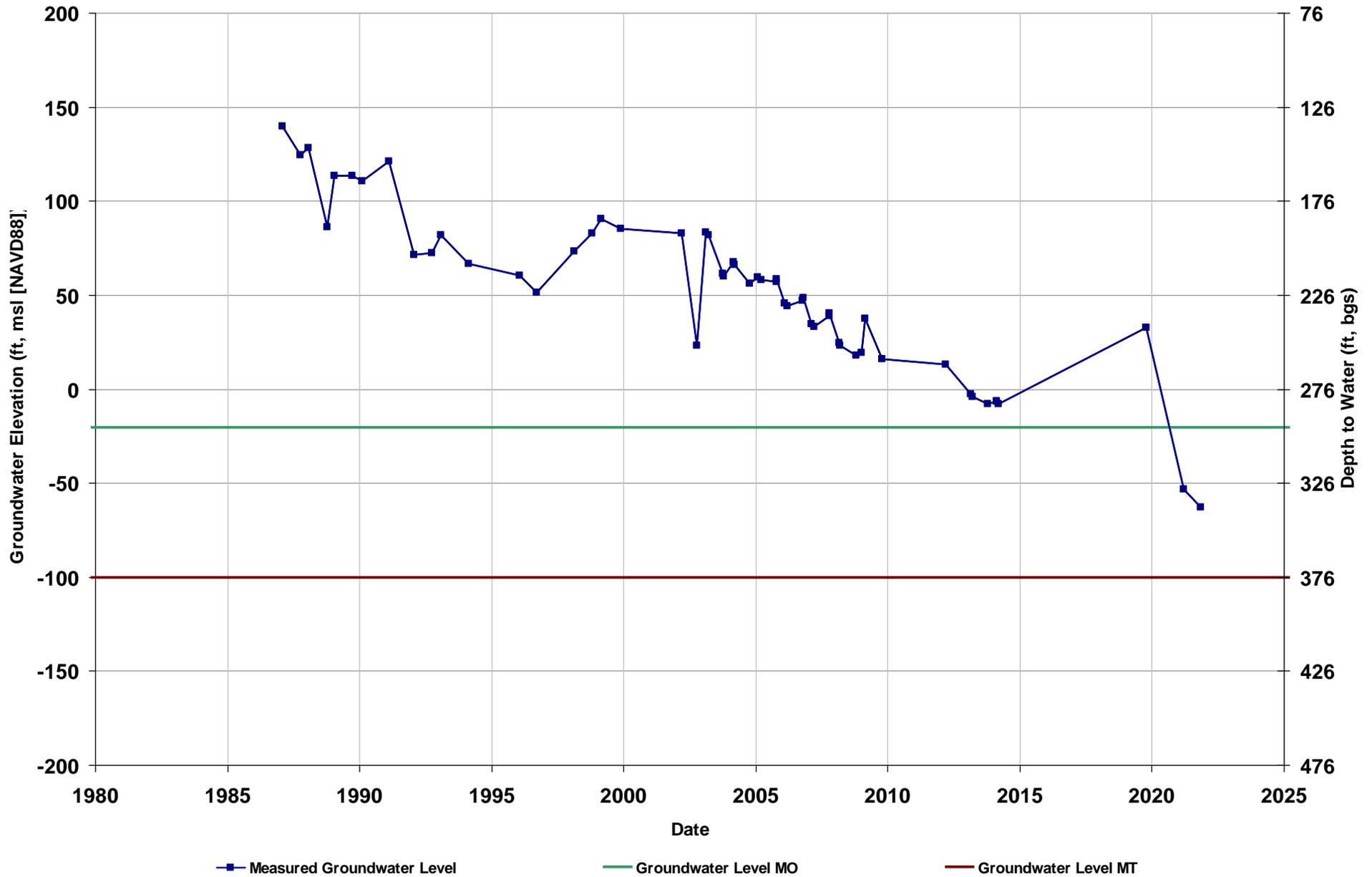
Well Name: CWD RMS-17
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Chowchilla Water District

Total Depth (ft): 624
Perf Top (ft): 278
Perf Bottom (ft): 588
GSE (ft, msl): 203



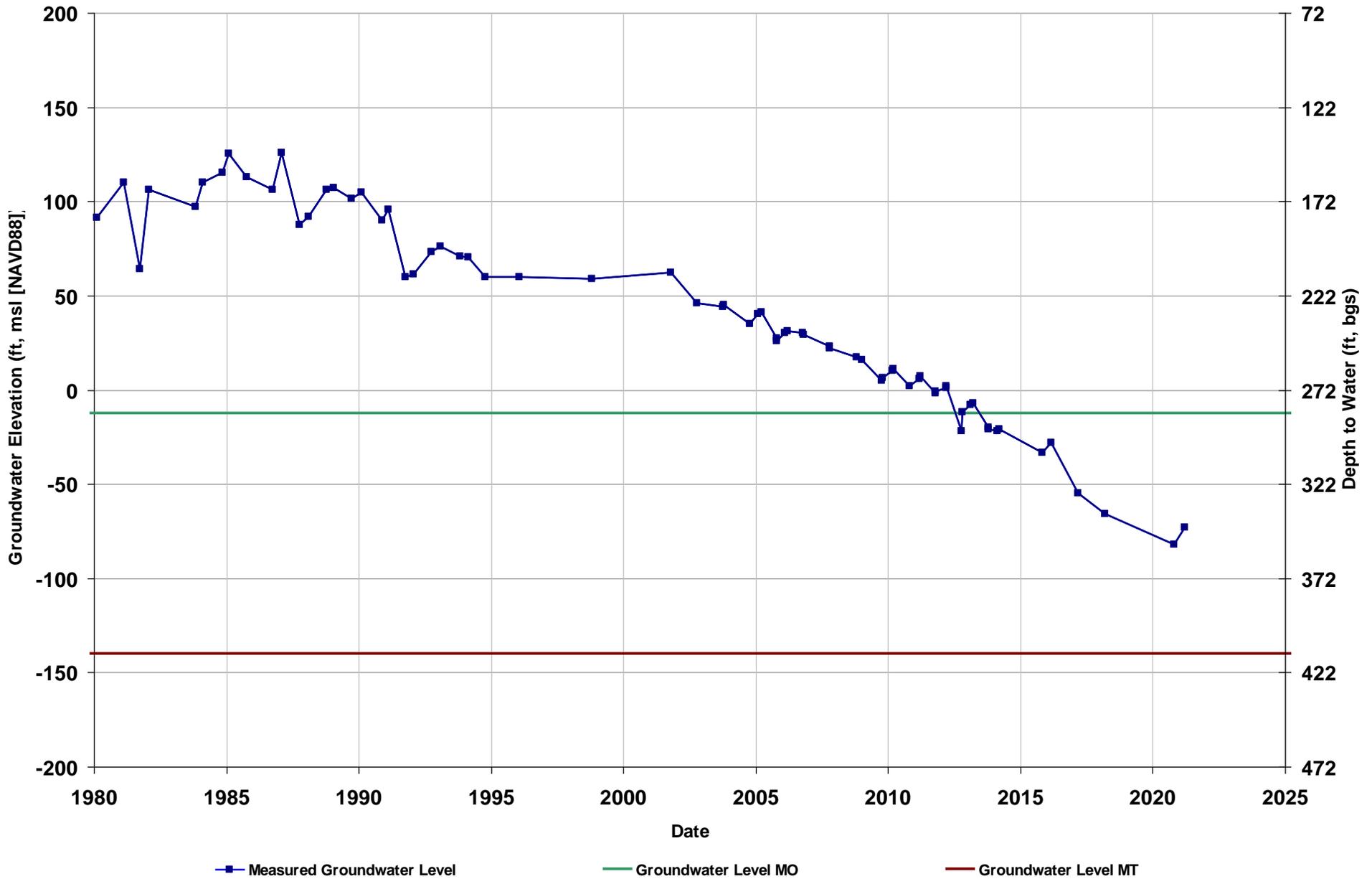
Well Name: MCE RMS-1
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - East

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 276



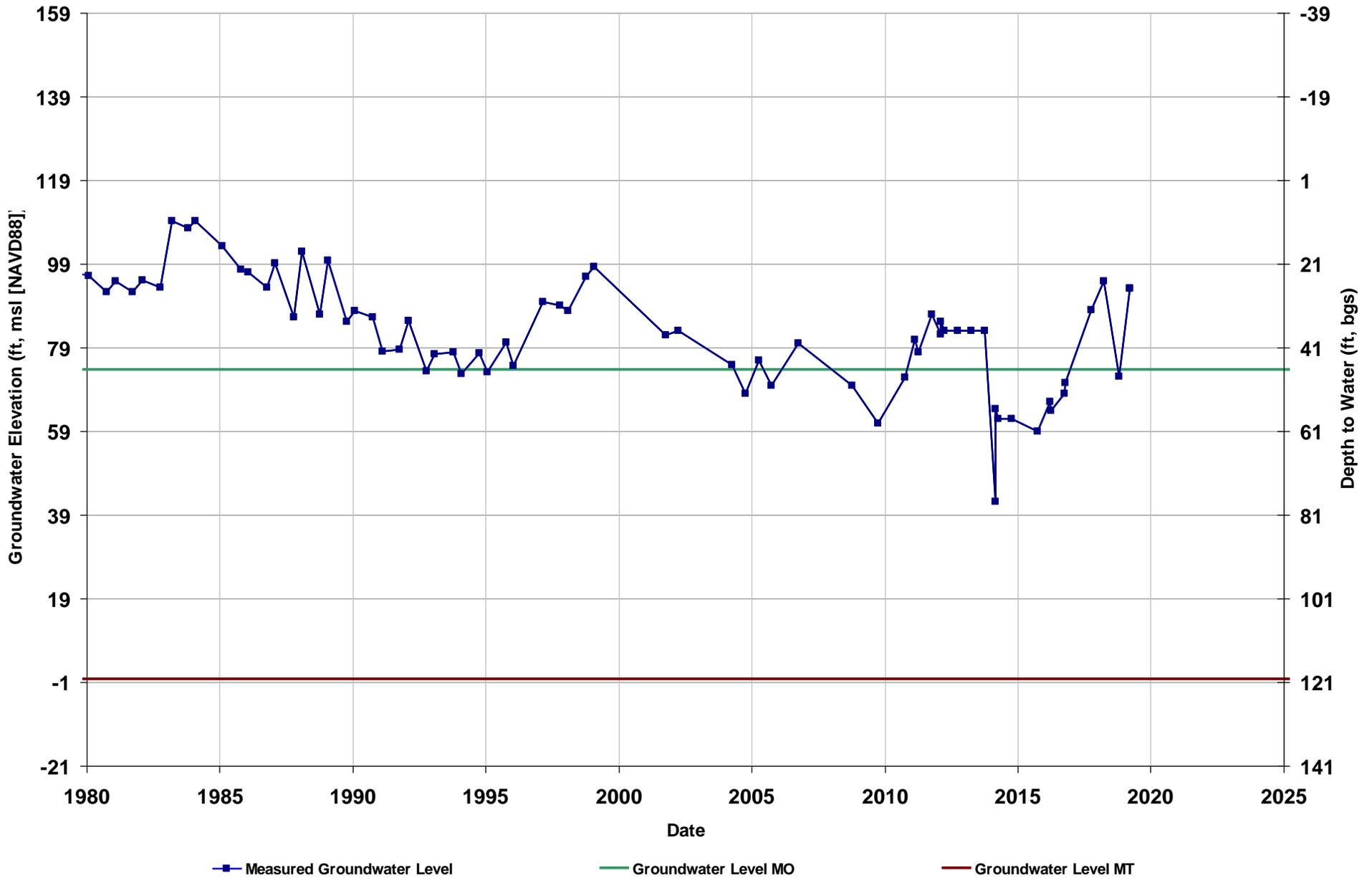
Well Name: MCE RMS-2
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - East

Total Depth (ft): 466
Perf Top (ft): 218
Perf Bottom (ft): 464
GSE (ft, msl): 272



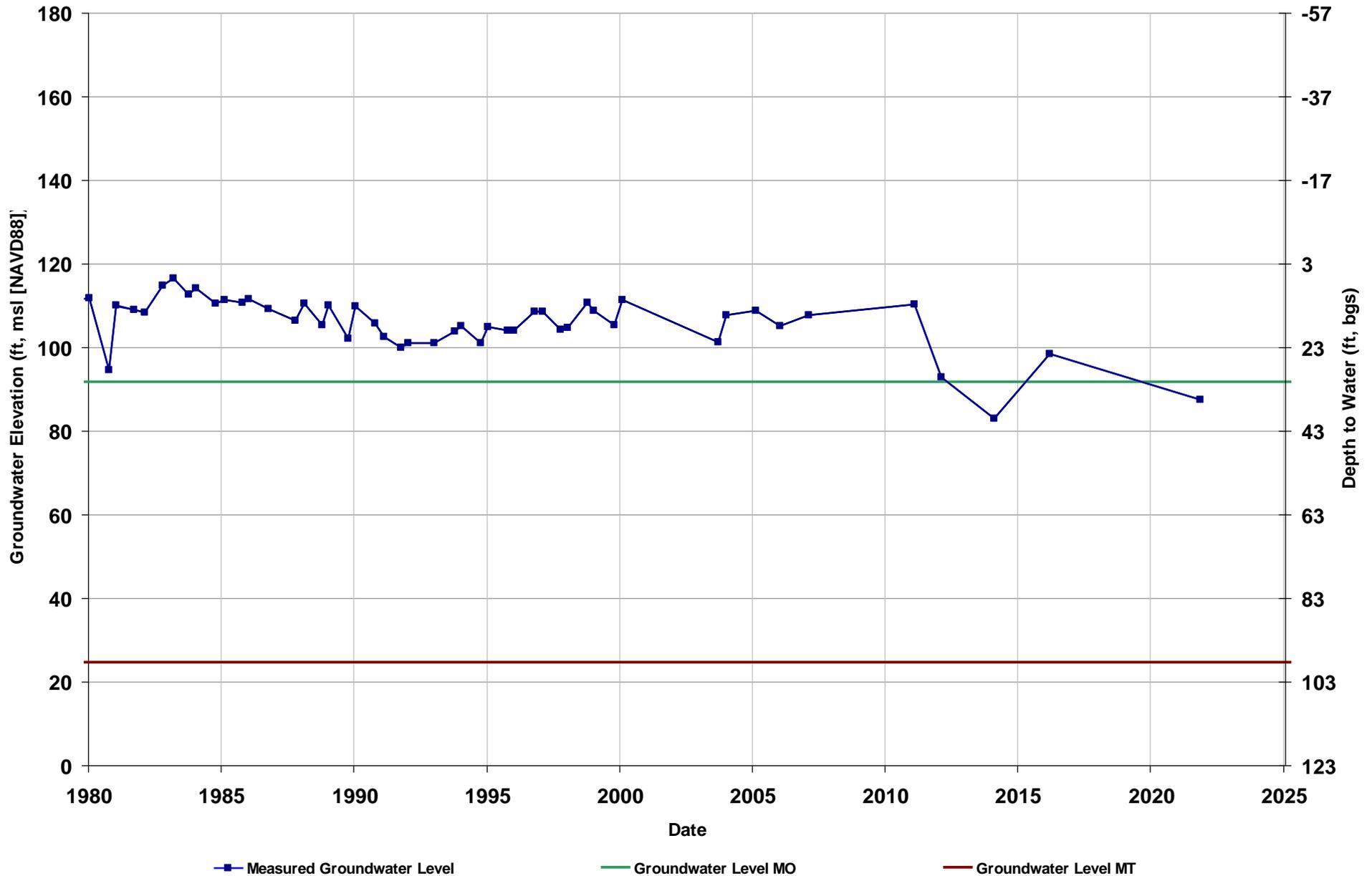
Well Name: MCW RMS-1
Depth Zone: Upper
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 186
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 120



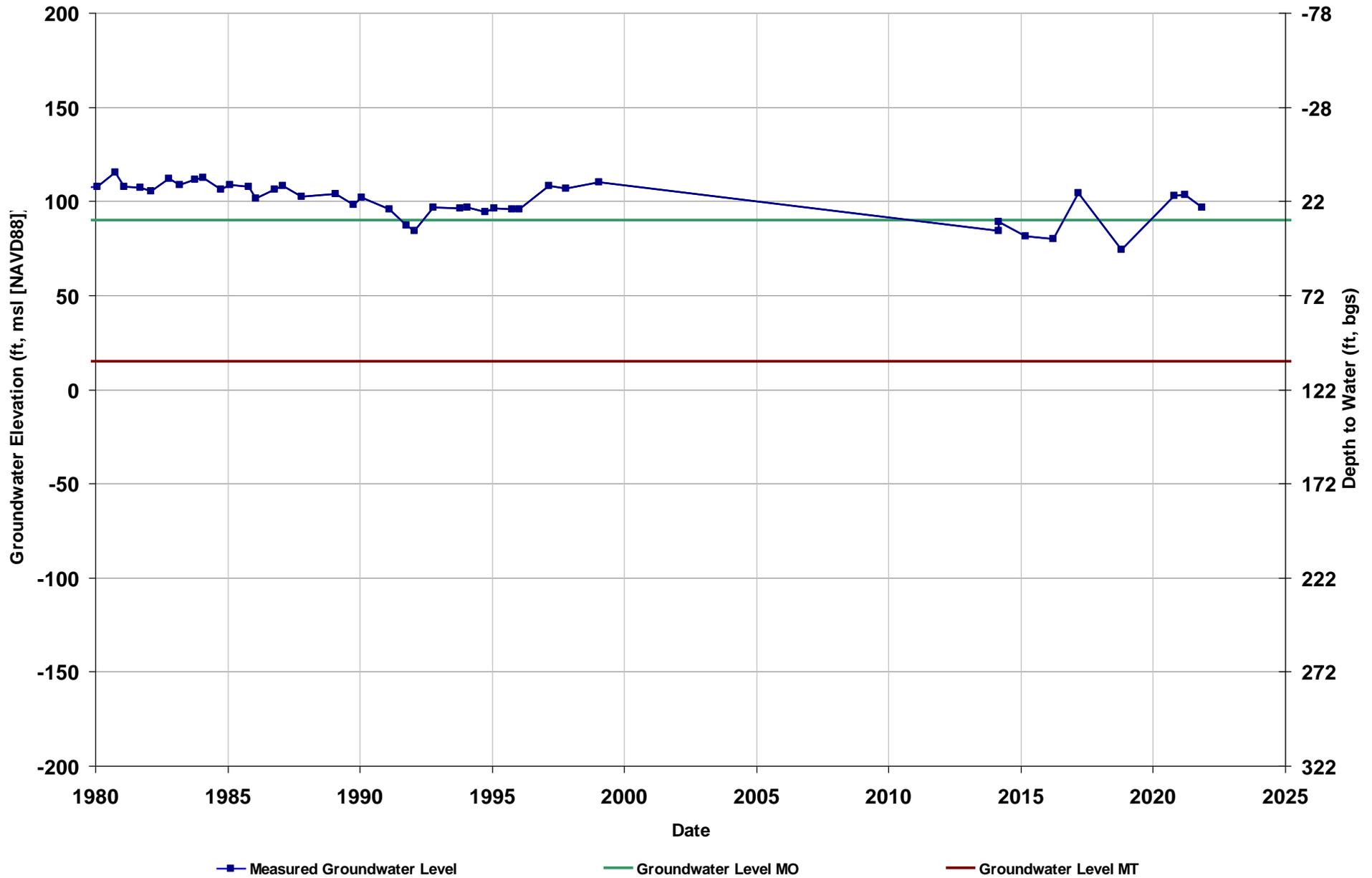
Well Name: MCW RMS-2
Depth Zone: Upper
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 123



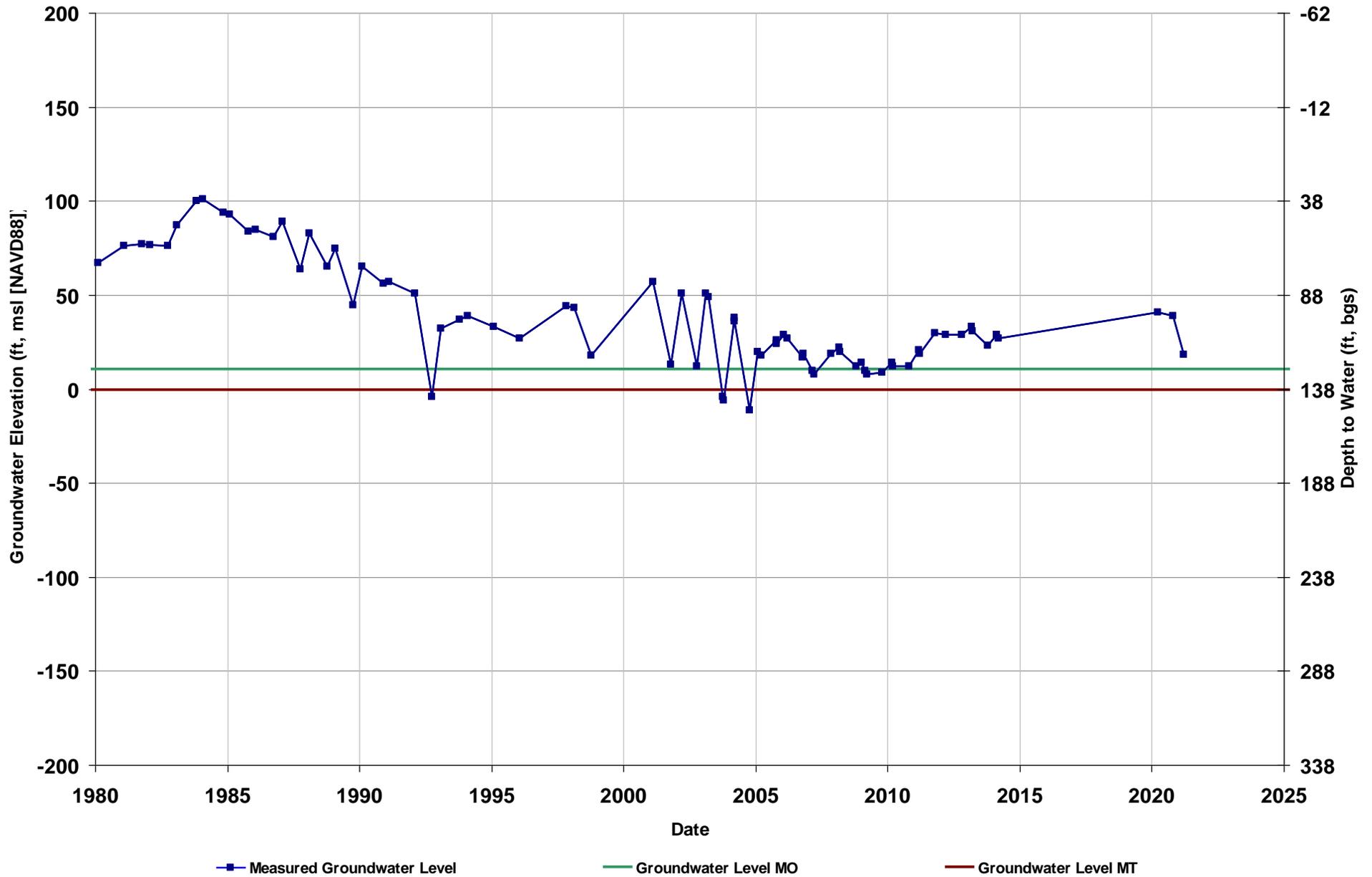
Well Name: MCW RMS-3
Depth Zone: Upper
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 122



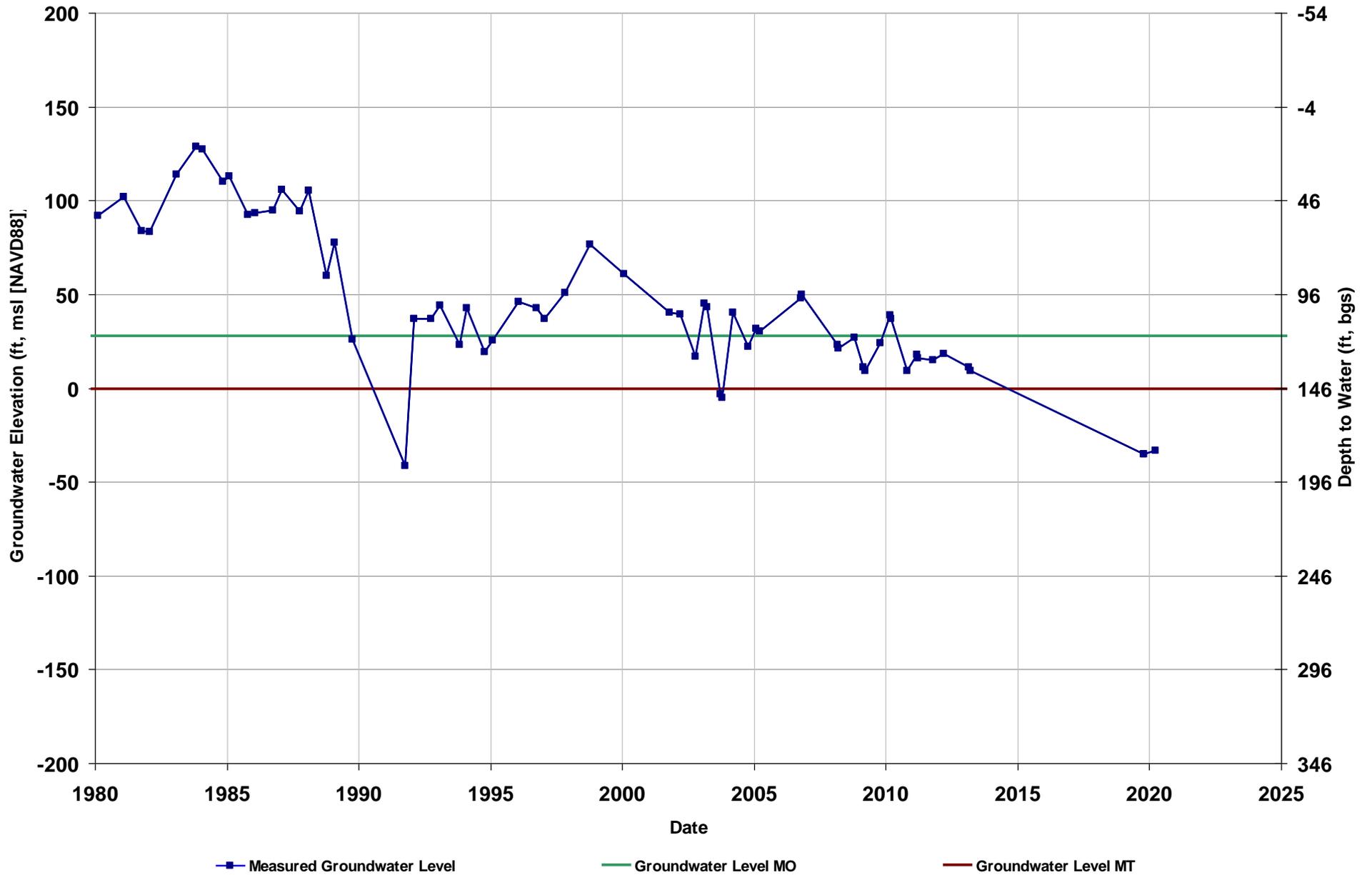
Well Name: MCW RMS-4
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 138



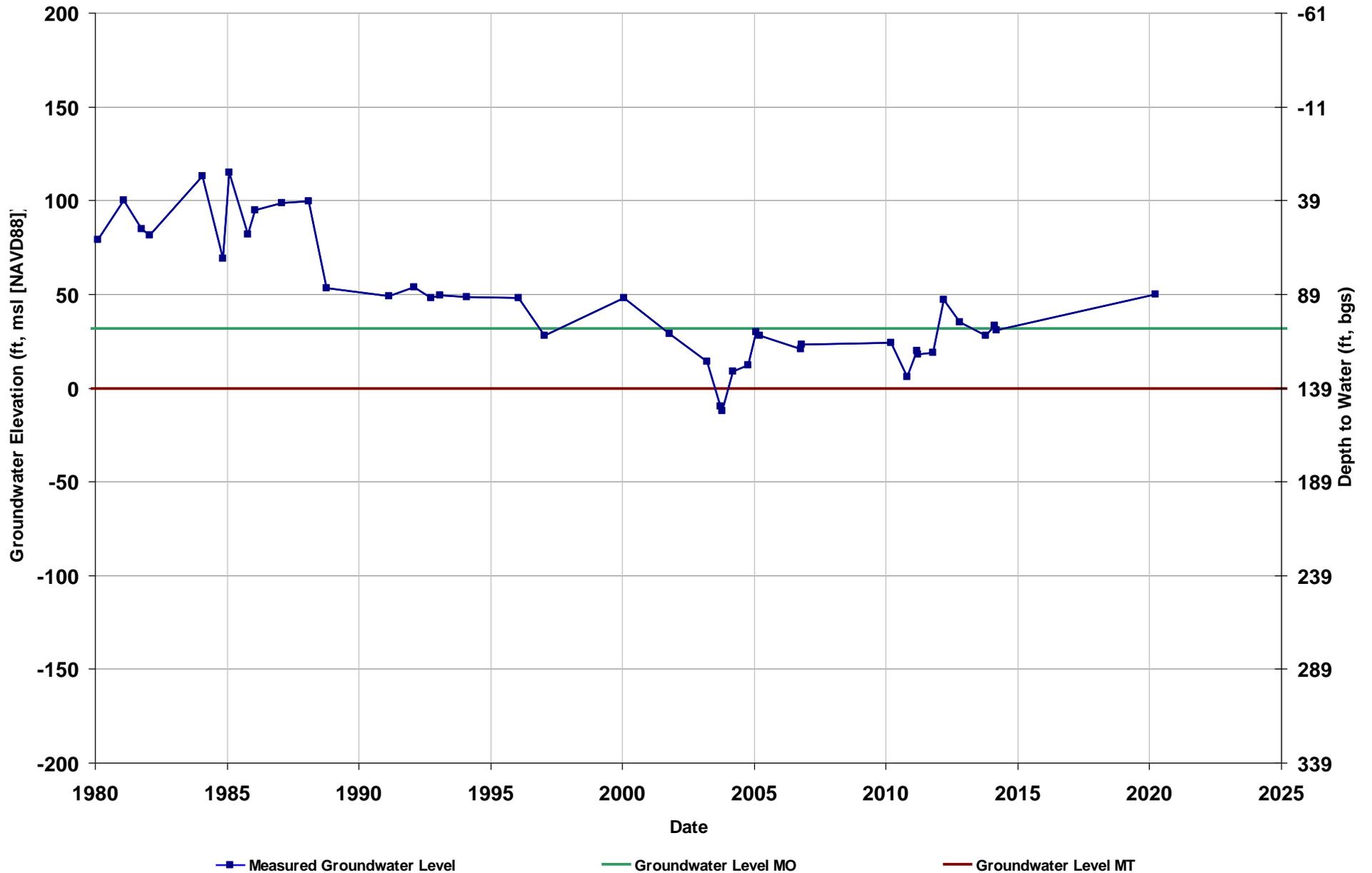
Well Name: MCW RMS-5
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 146



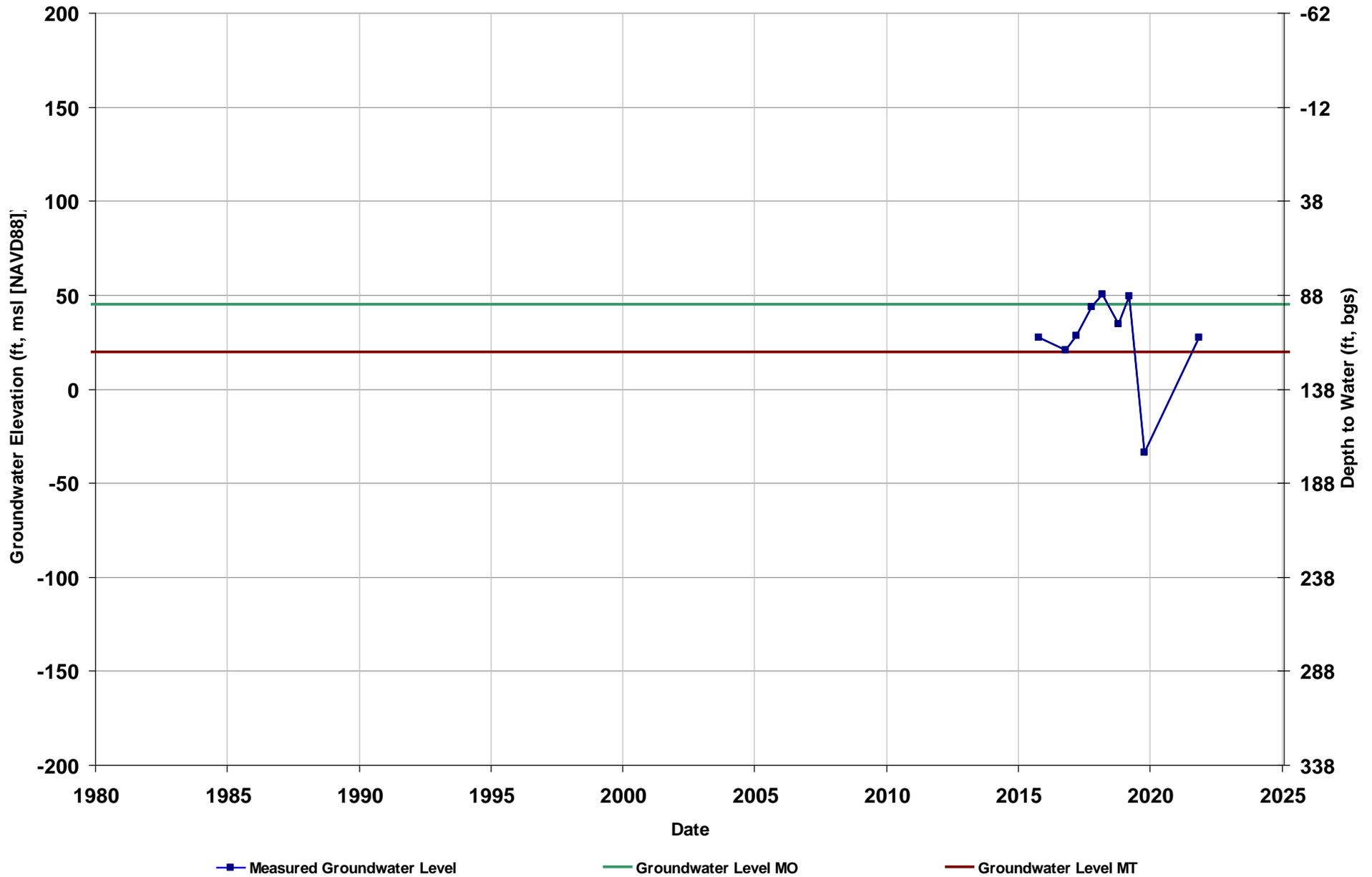
Well Name: MCW RMS-6
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 139



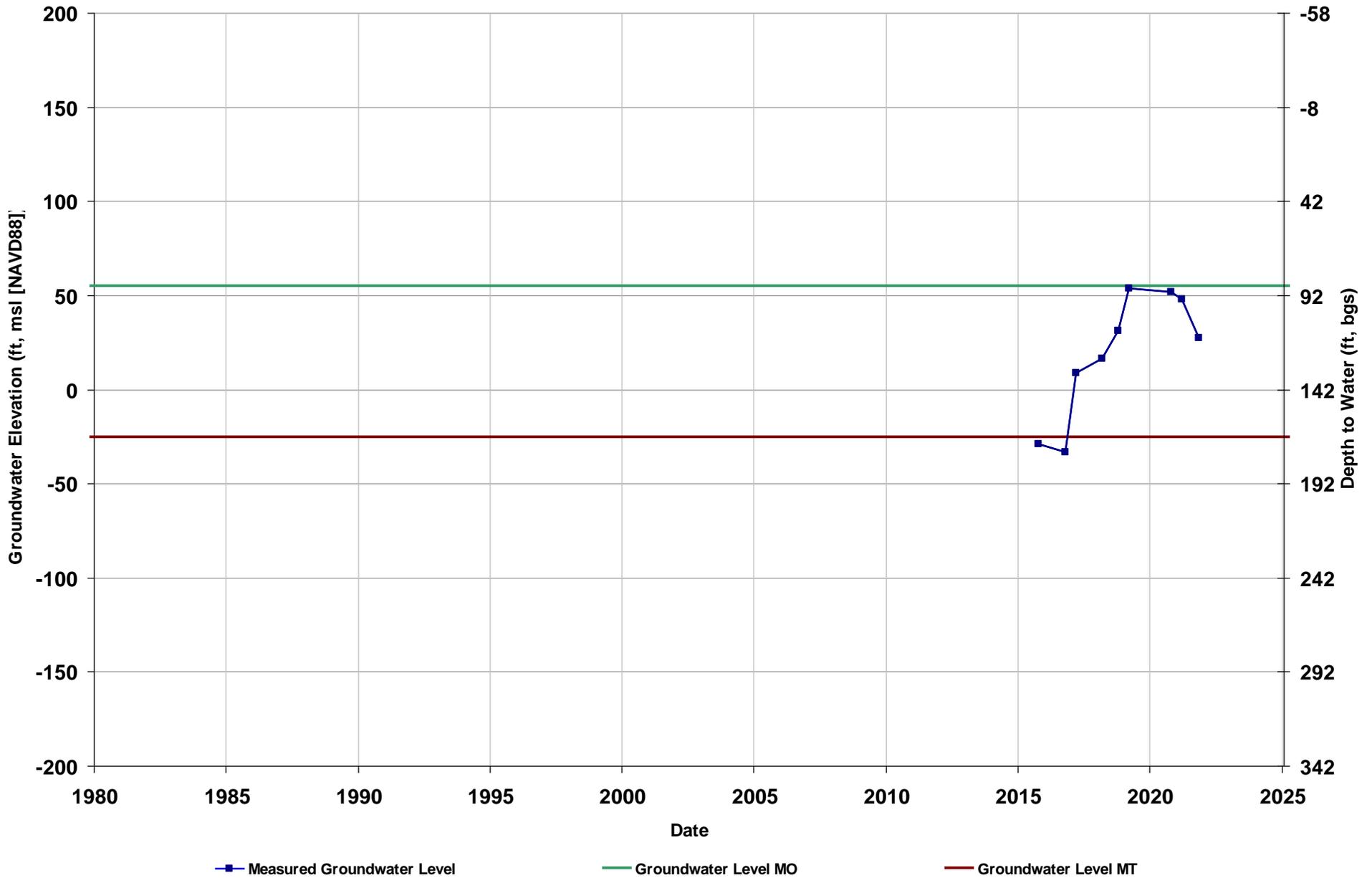
Well Name: MCW RMS-7
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 800
Perf Top (ft): 290
Perf Bottom (ft): 400
GSE (ft, msl): 138



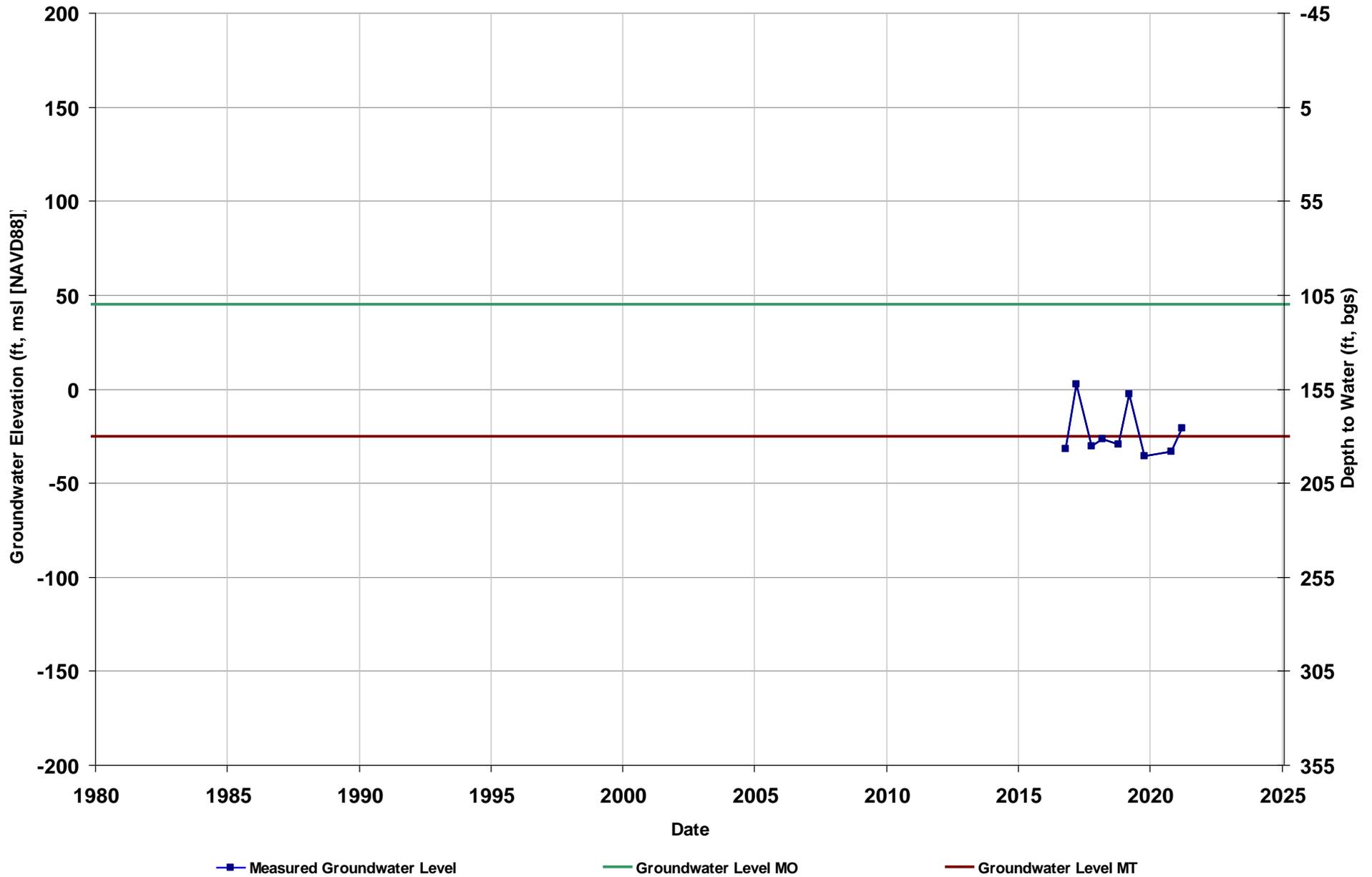
Well Name: MCW RMS-8
Depth Zone: Composite
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 480
Perf Top (ft): 160
Perf Bottom (ft): 475
GSE (ft, msl): 142



Well Name: MCW RMS-9
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 700
Perf Top (ft): 265
Perf Bottom (ft): 696
GSE (ft, msl): 155



Well Name: MCW RMS-10
Depth Zone: Upper
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 26
Perf Top (ft): 10
Perf Bottom (ft): 25
GSE (ft, msl): 123



Well Name: MCW RMS-11
Depth Zone: Upper
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 30
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 127



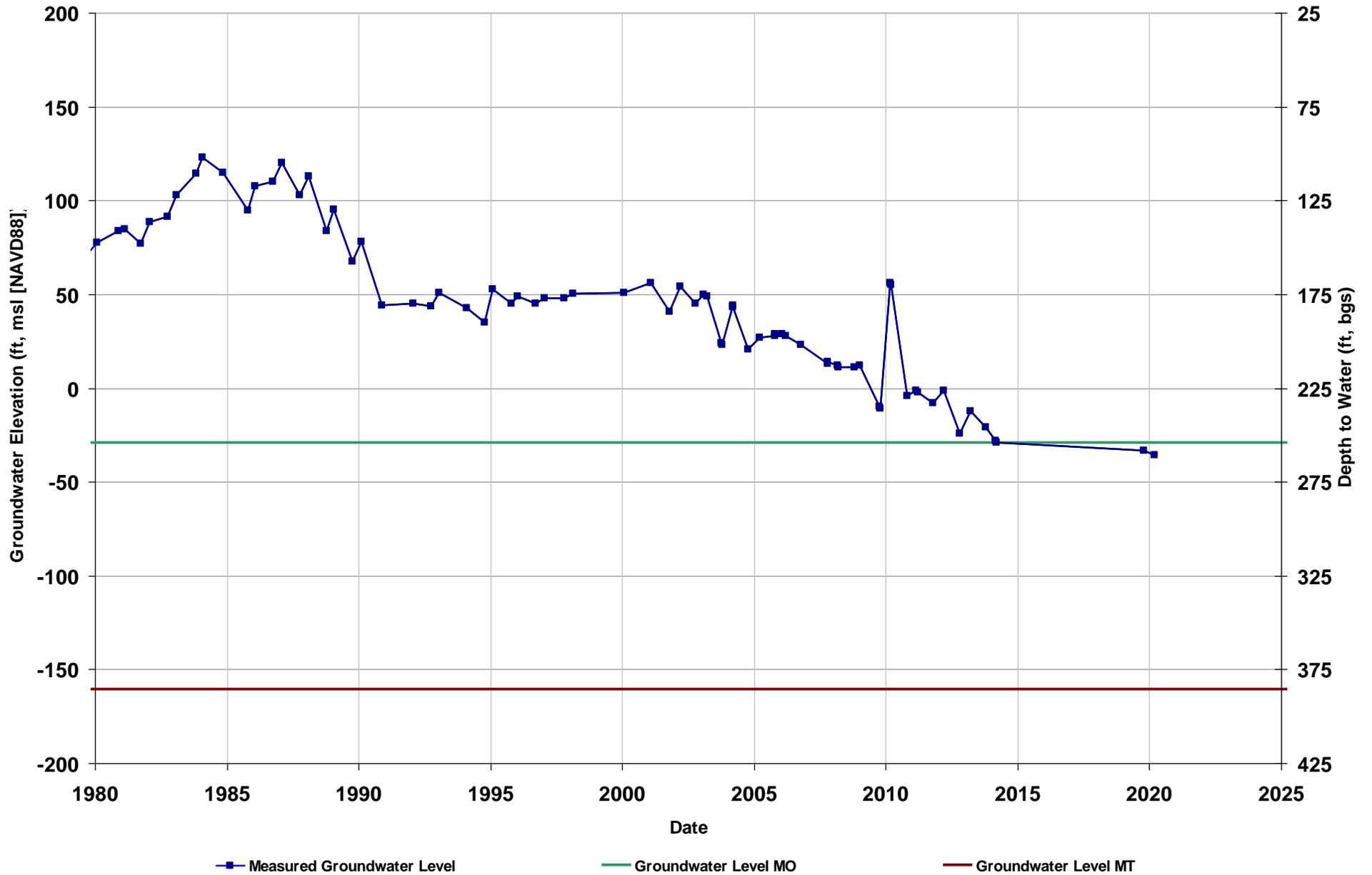
Well Name: MCW RMS-12
Depth Zone: Upper
Subbasin: Chowchilla
GSA: County of Madera - West

Total Depth (ft): 29
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 127



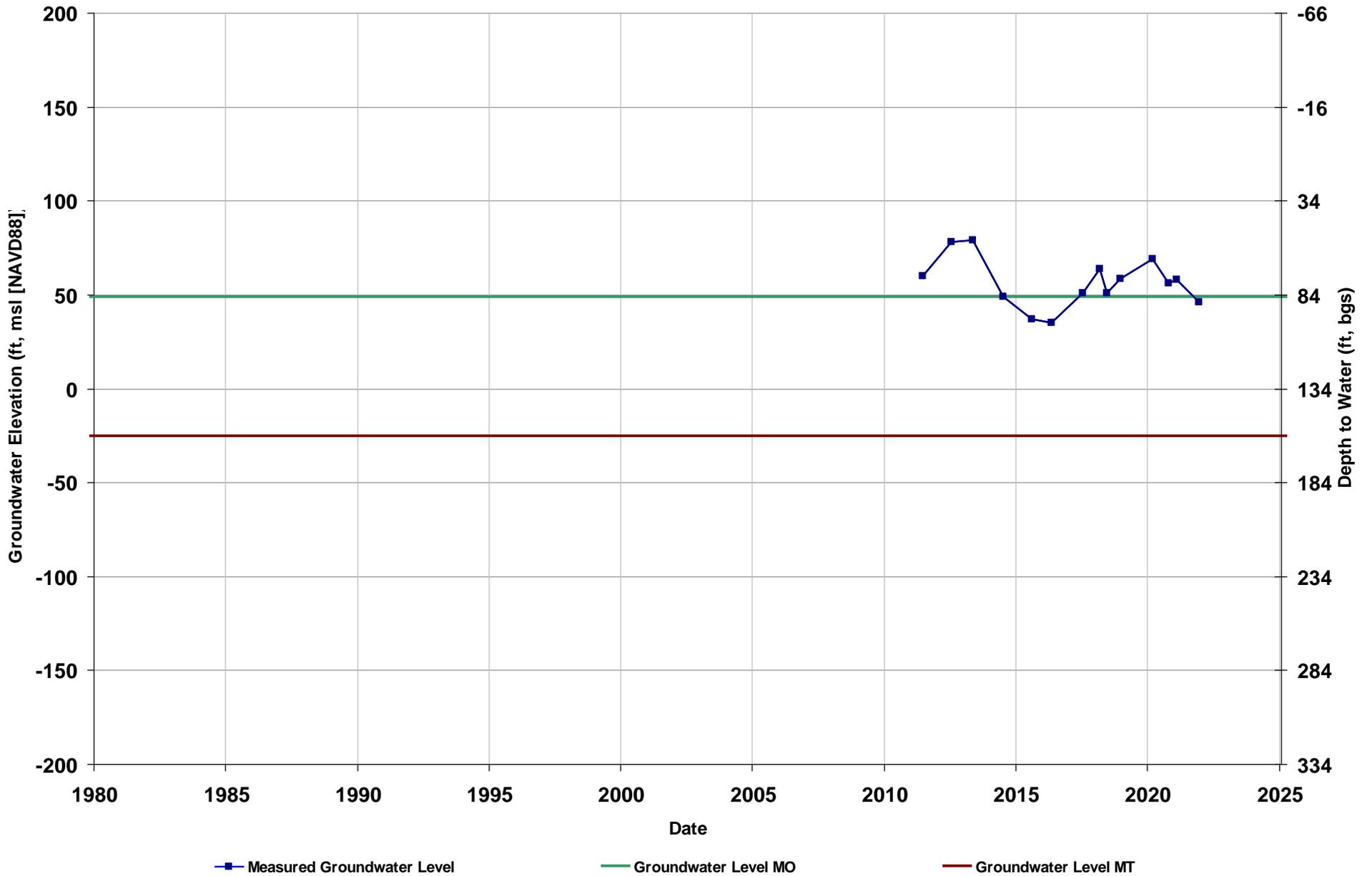
Well Name: MER RMS-1
Depth Zone: Lower
Subbasin: Chowchilla
GSA: County of Merced

Total Depth (ft):
Perf Top (ft):
Perf Bottom (ft):
GSE (ft, msl): 225



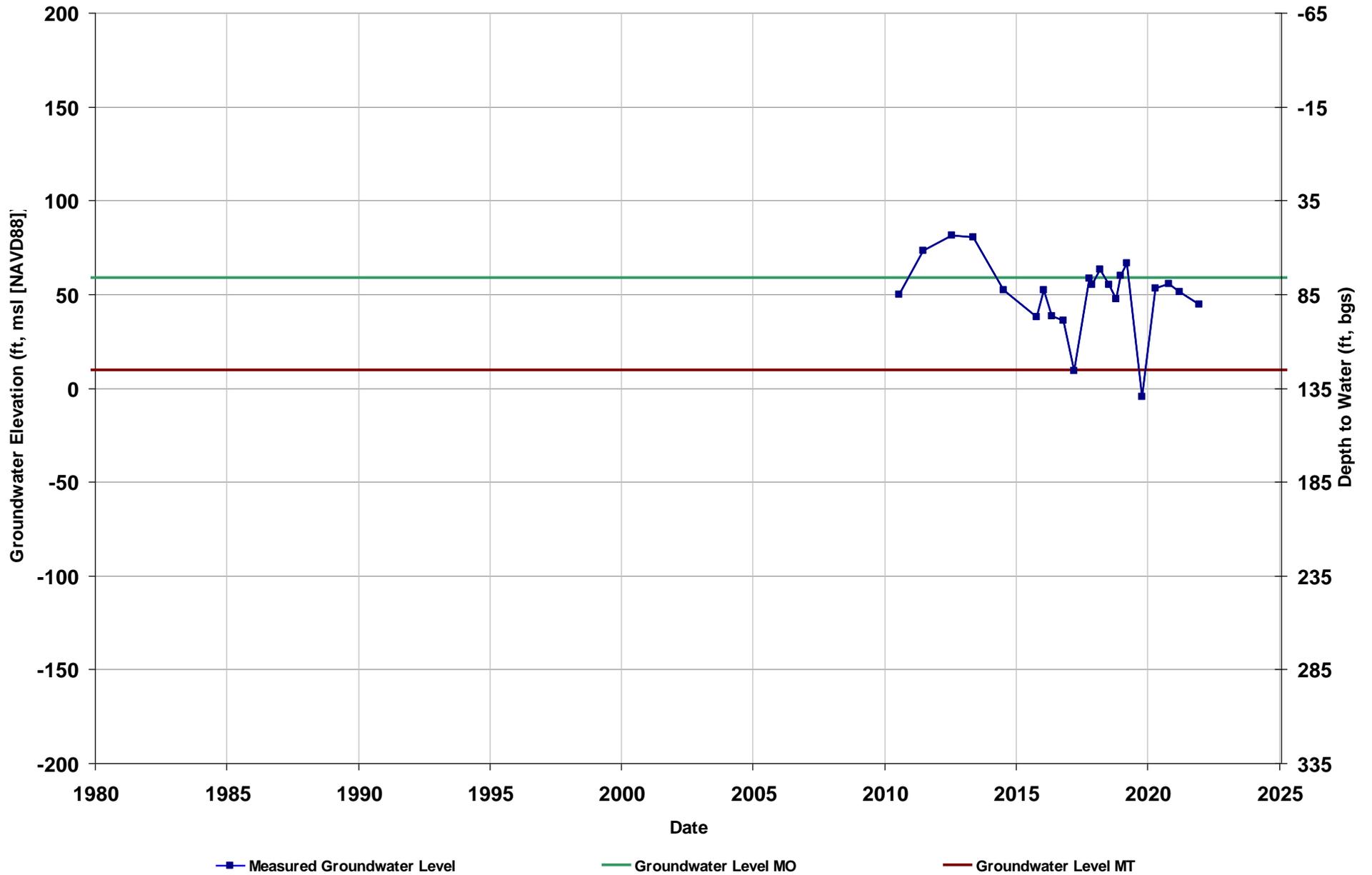
Well Name: TRT RMS-1
Depth Zone: Upper
Subbasin: Chowchilla
GSA: Triangle T Water District

Total Depth (ft): 196
Perf Top (ft): 158
Perf Bottom (ft): 192
GSE (ft, msl): 134



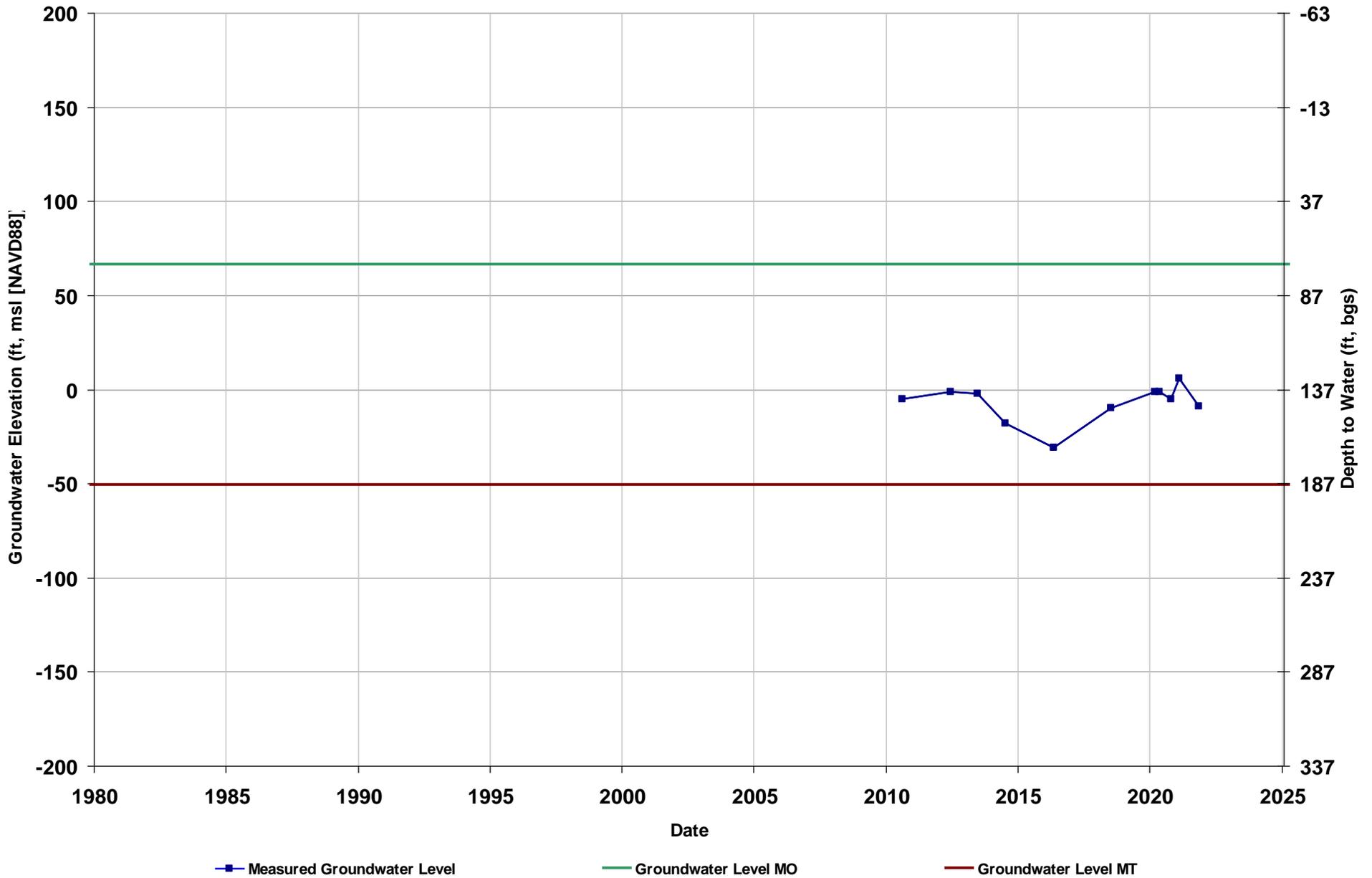
Well Name: TRT RMS-2
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Triangle T Water District

Total Depth (ft): 500
Perf Top (ft): 300
Perf Bottom (ft): 500
GSE (ft, msl): 135



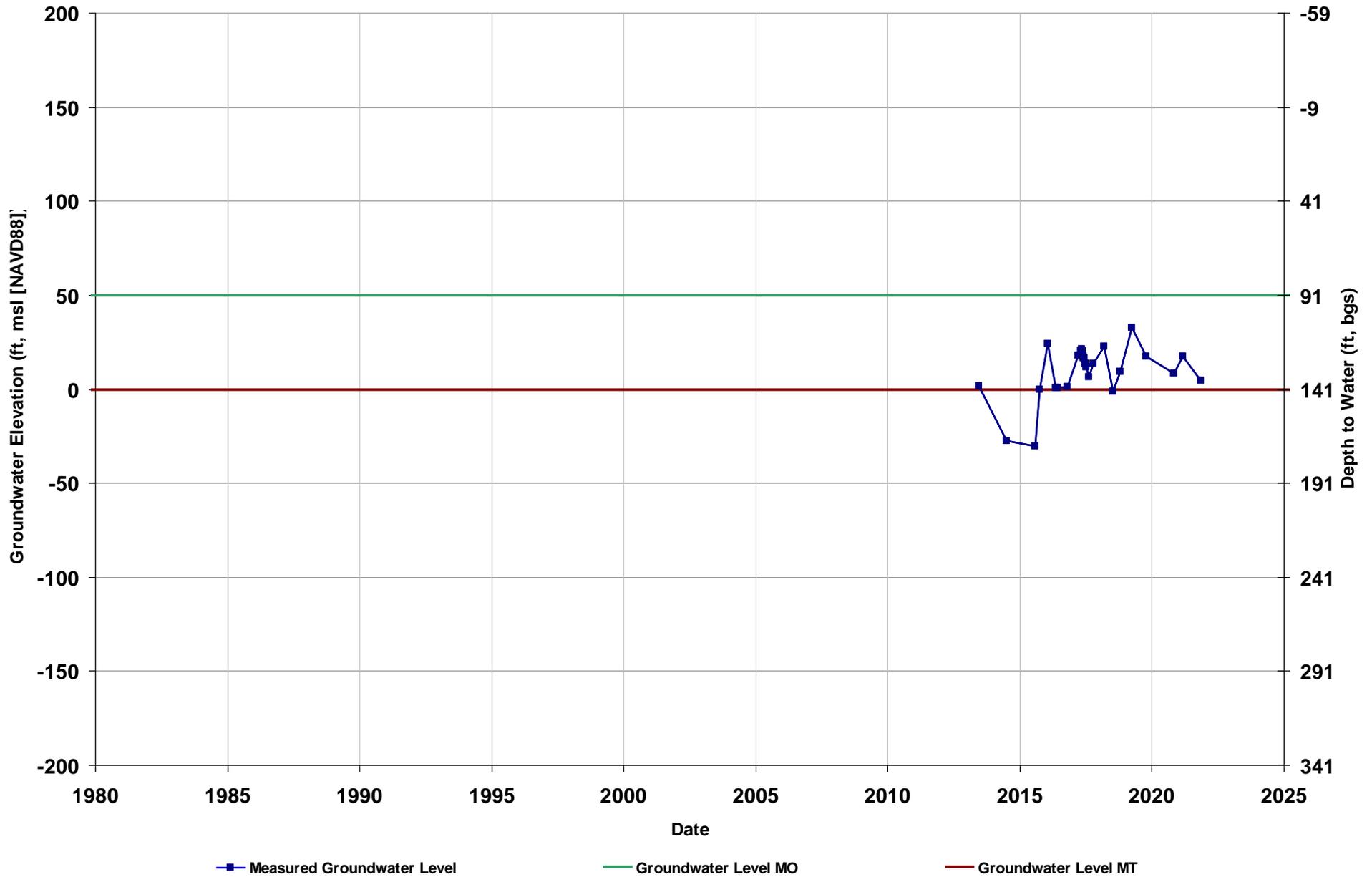
Well Name: TRT RMS-3
Depth Zone: Lower
Subbasin: Chowchilla
GSA: Triangle T Water District

Total Depth (ft): 799
Perf Top (ft): 168
Perf Bottom (ft): 790
GSE (ft, msl): 137

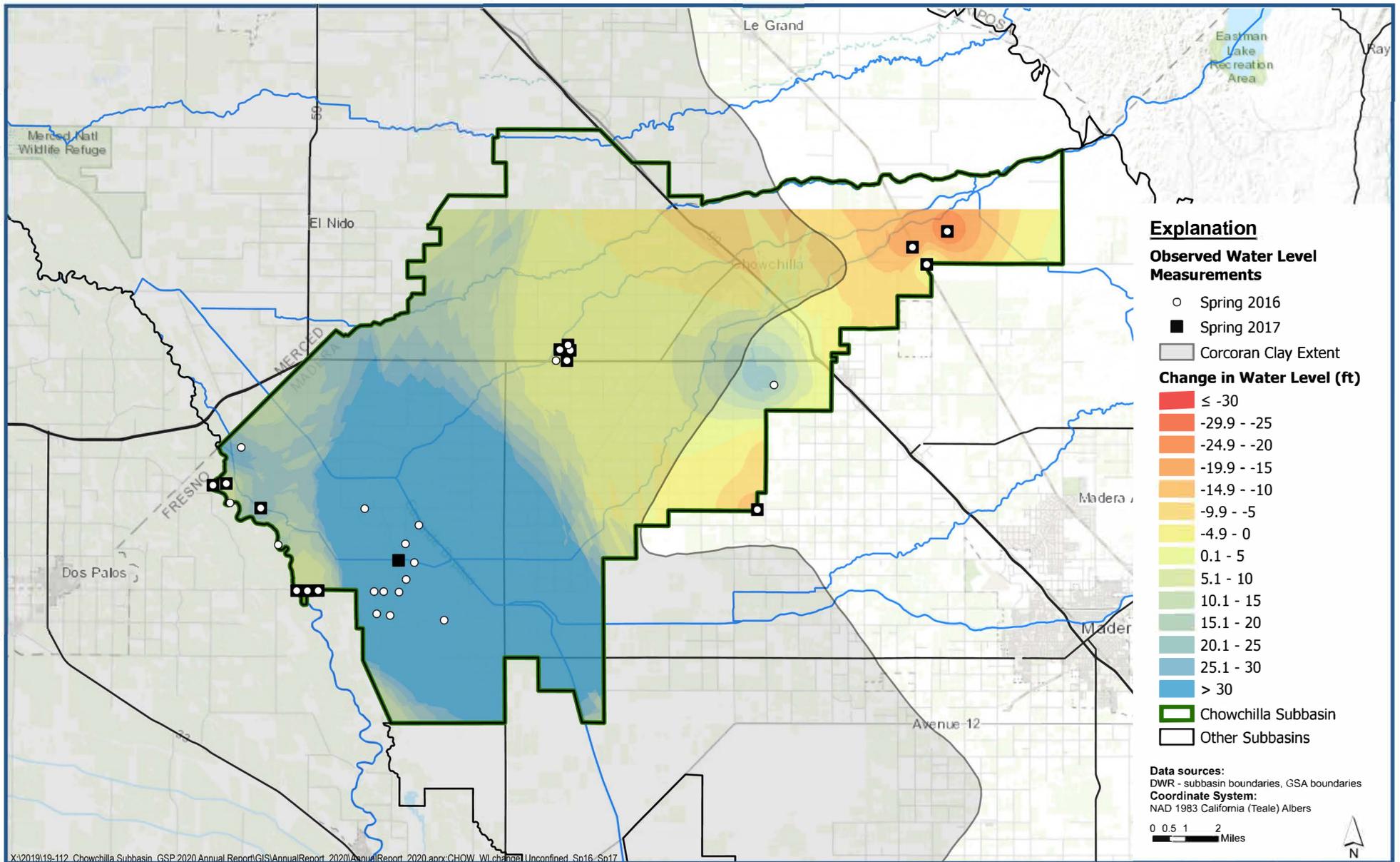


Well Name: TRT RMS-4
Depth Zone: Composite
Subbasin: Chowchilla
GSA: Triangle T Water District

Total Depth (ft): 840
Perf Top (ft): 190
Perf Bottom (ft): 260
GSE (ft, msl): 141



Appendix C. Maps of Change in Groundwater Levels and Change in Groundwater Storage in 2016 through 2020, Separated by Principal Aquifer.

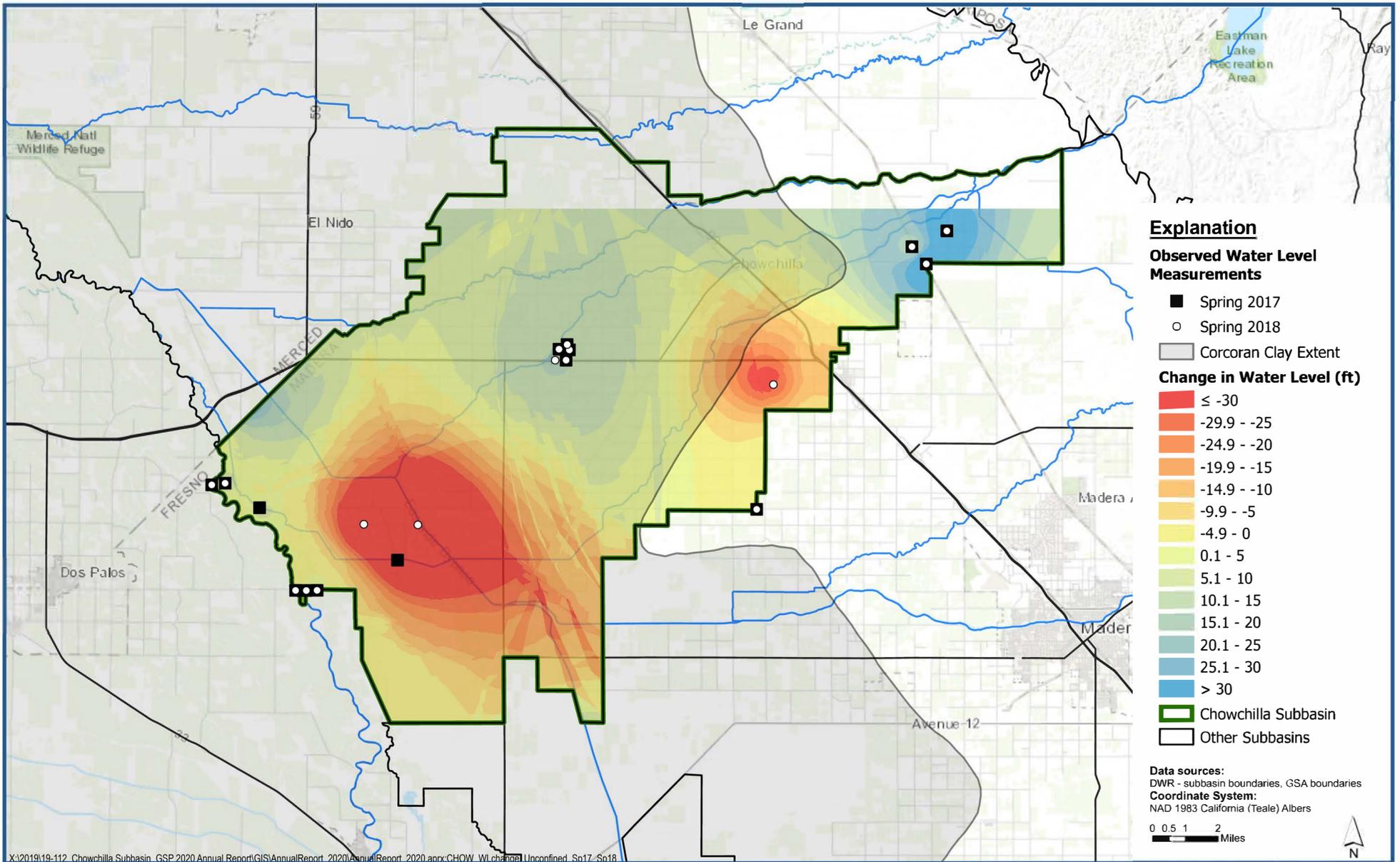


Change in Groundwater Level in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2016 through Spring 2017

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-1



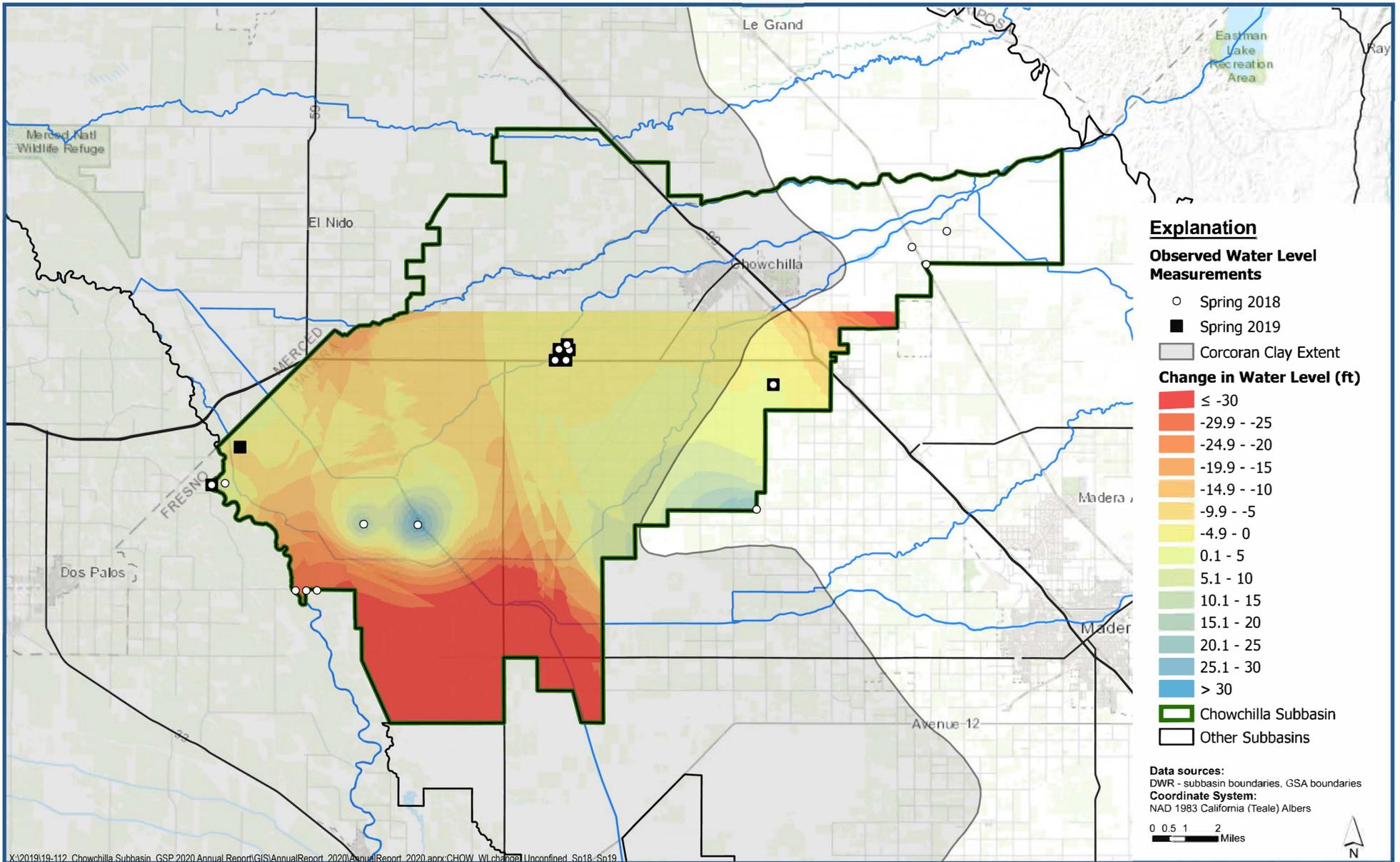


Change in Groundwater Level in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2017 through Spring 2018

*Chowchilla Subbasin
 Groundwater Sustainability Plan 2022 Annual Report*

Figure C-2



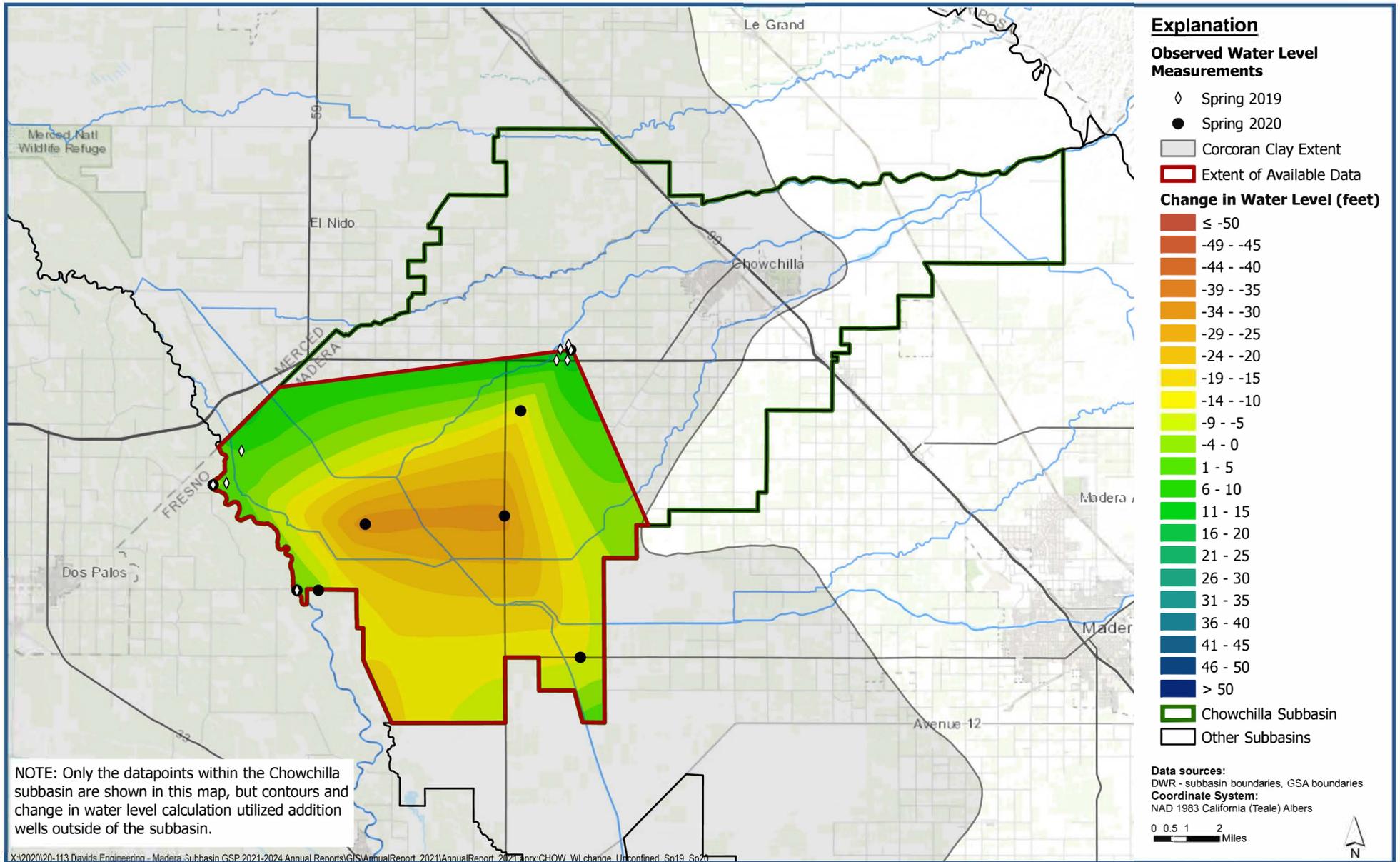


Change in Groundwater Level in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2018 through Spring 2019

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-3



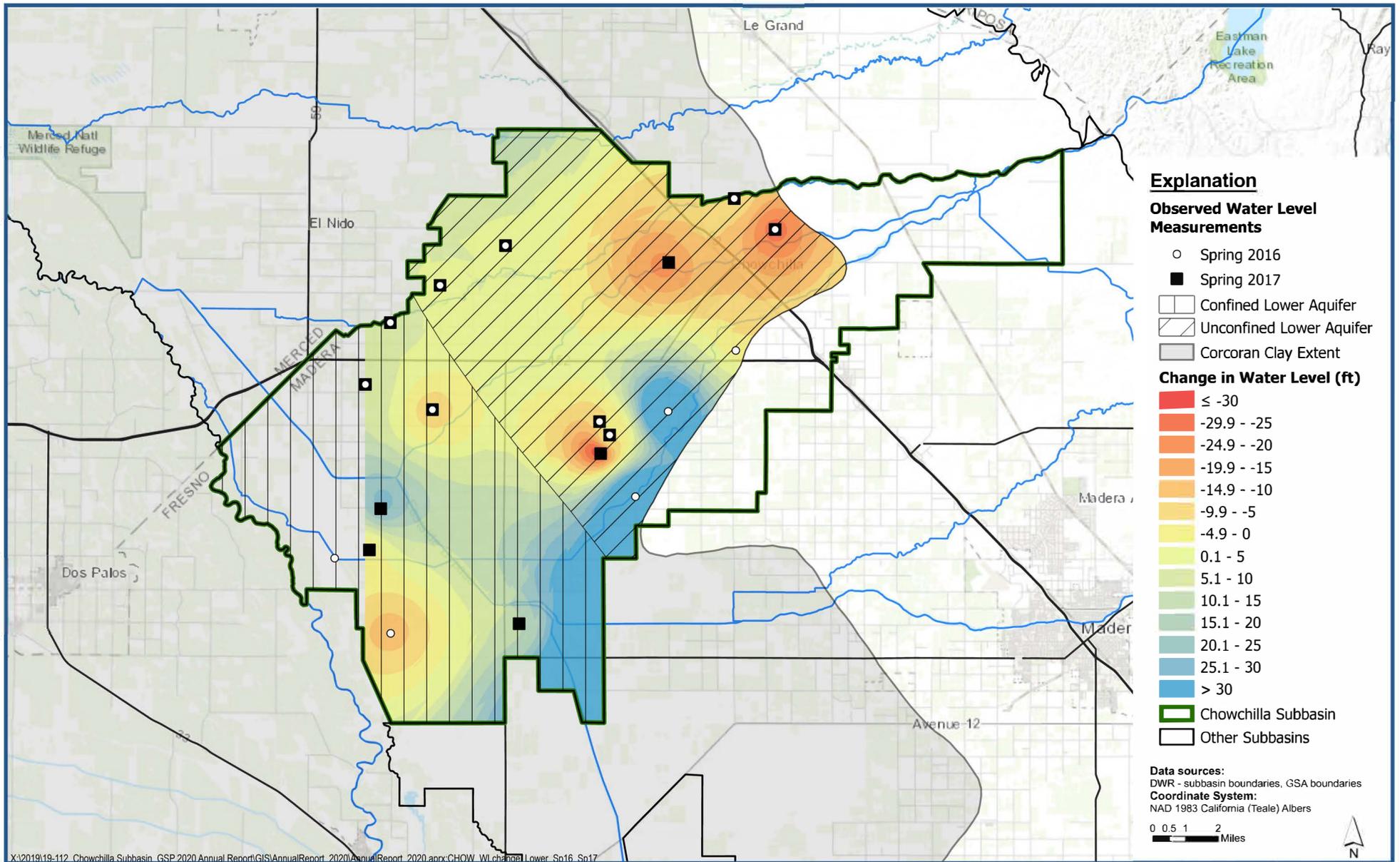


Change in Water Level in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2019 through Spring 2020

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure C-4



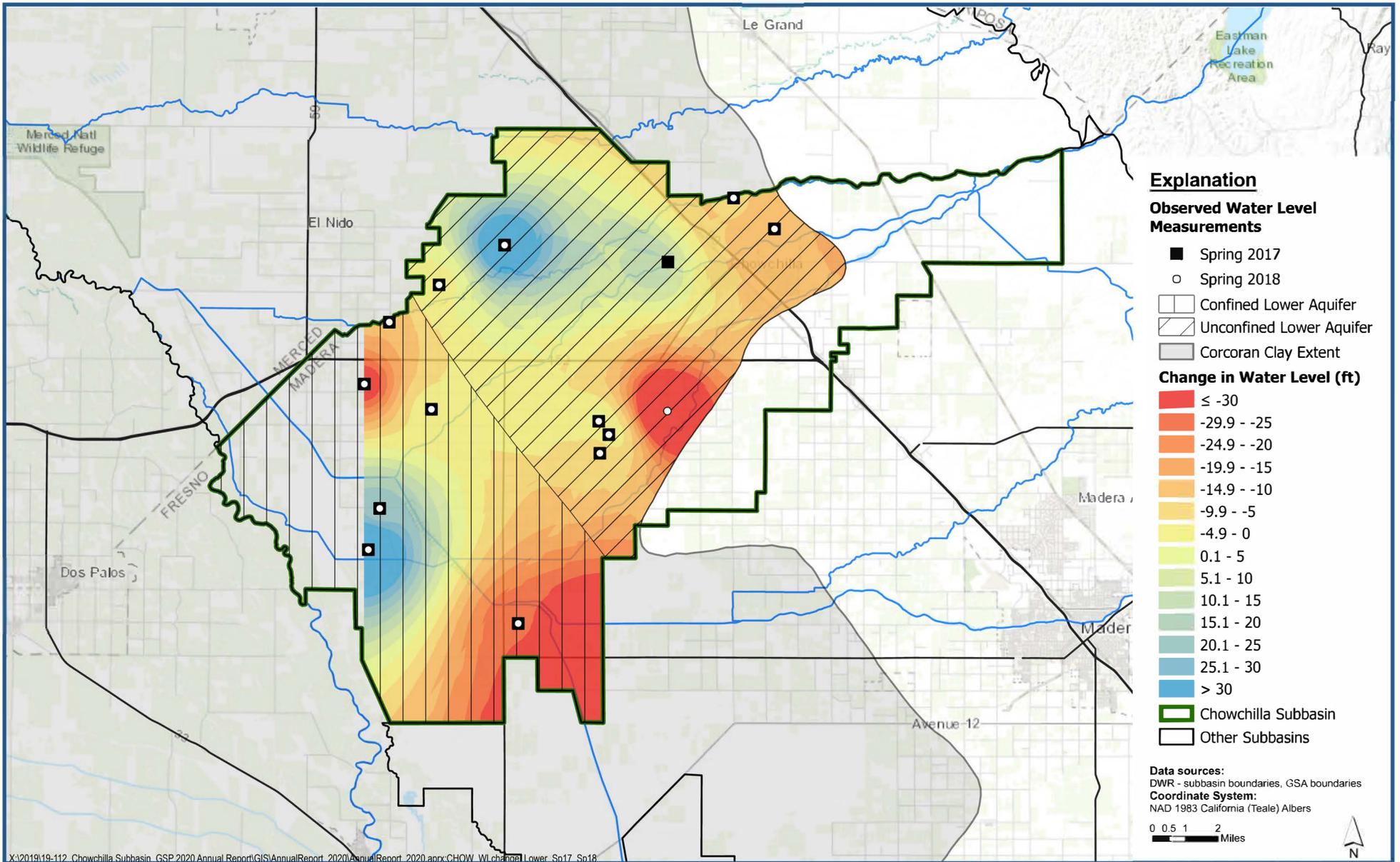


**Change in Groundwater Level in the Lower Aquifer -
Spring 2016 through Spring 2017**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-5



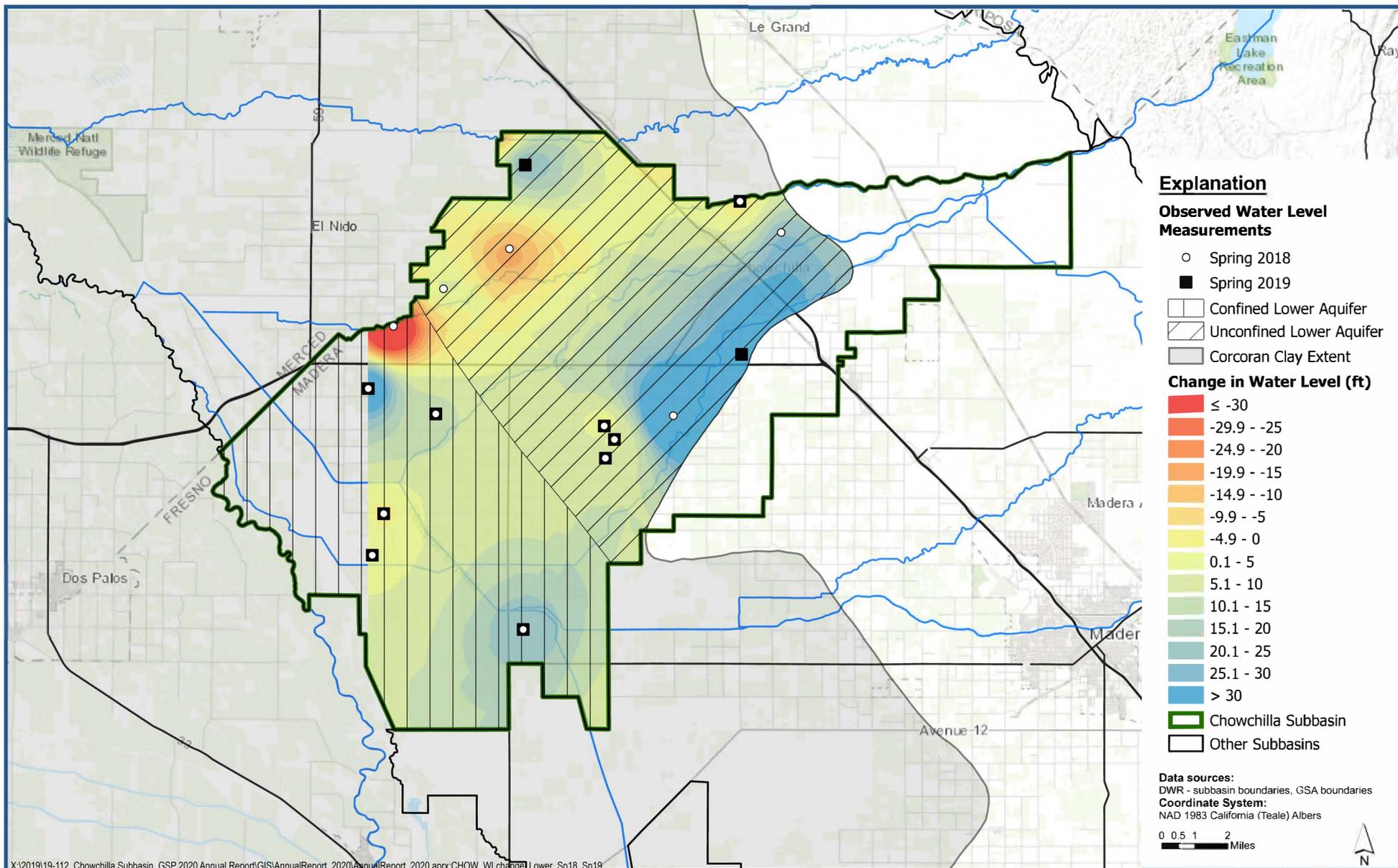


**Change in Groundwater Level in the Lower Aquifer -
Spring 2017 through Spring 2018**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-6



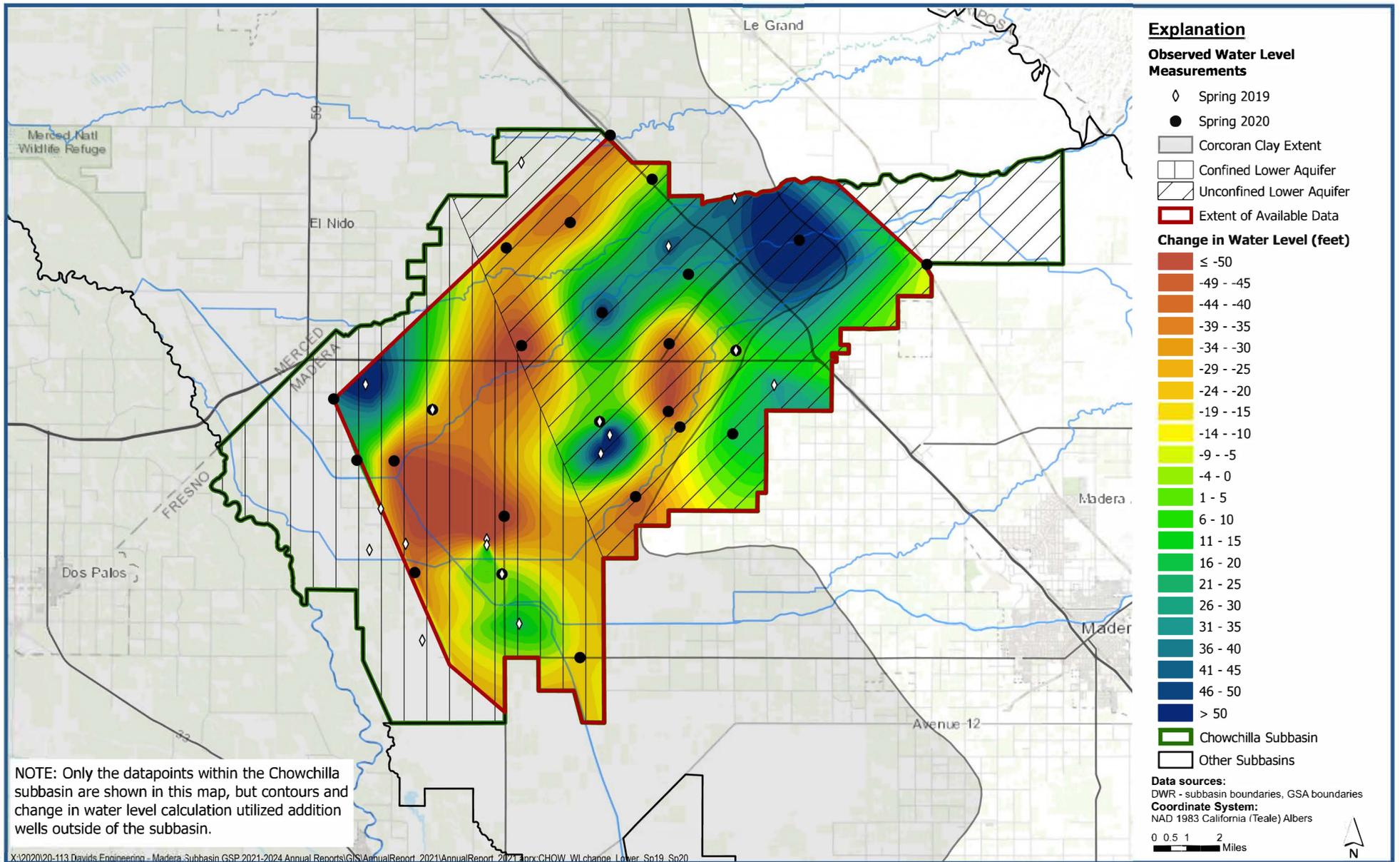


**Change in Groundwater Level in the Lower Aquifer -
Spring 2018 through Spring 2019**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-7



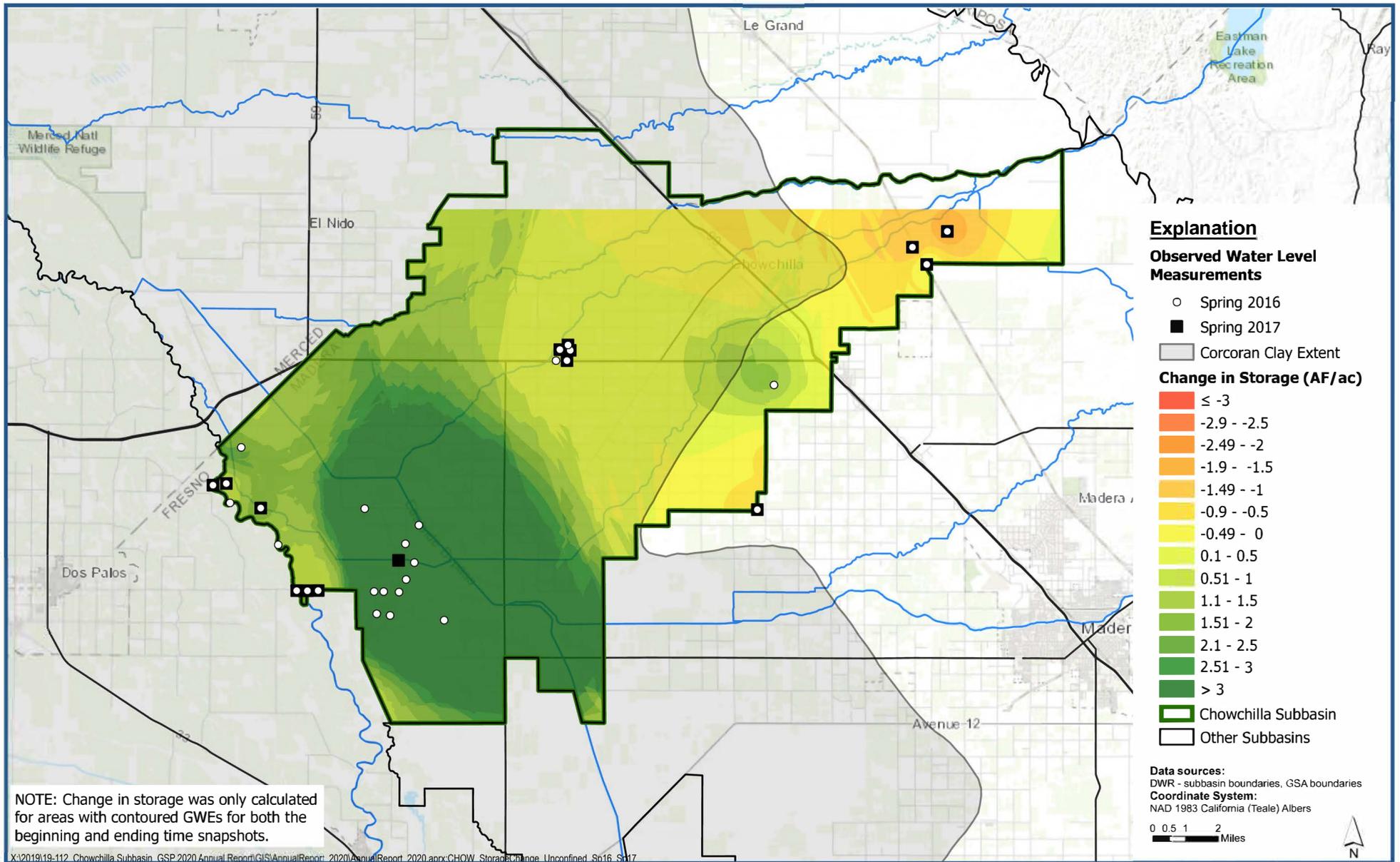


**Change in Water Level in the Lower Aquifer -
Spring 2019 through Spring 2020**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure C-8



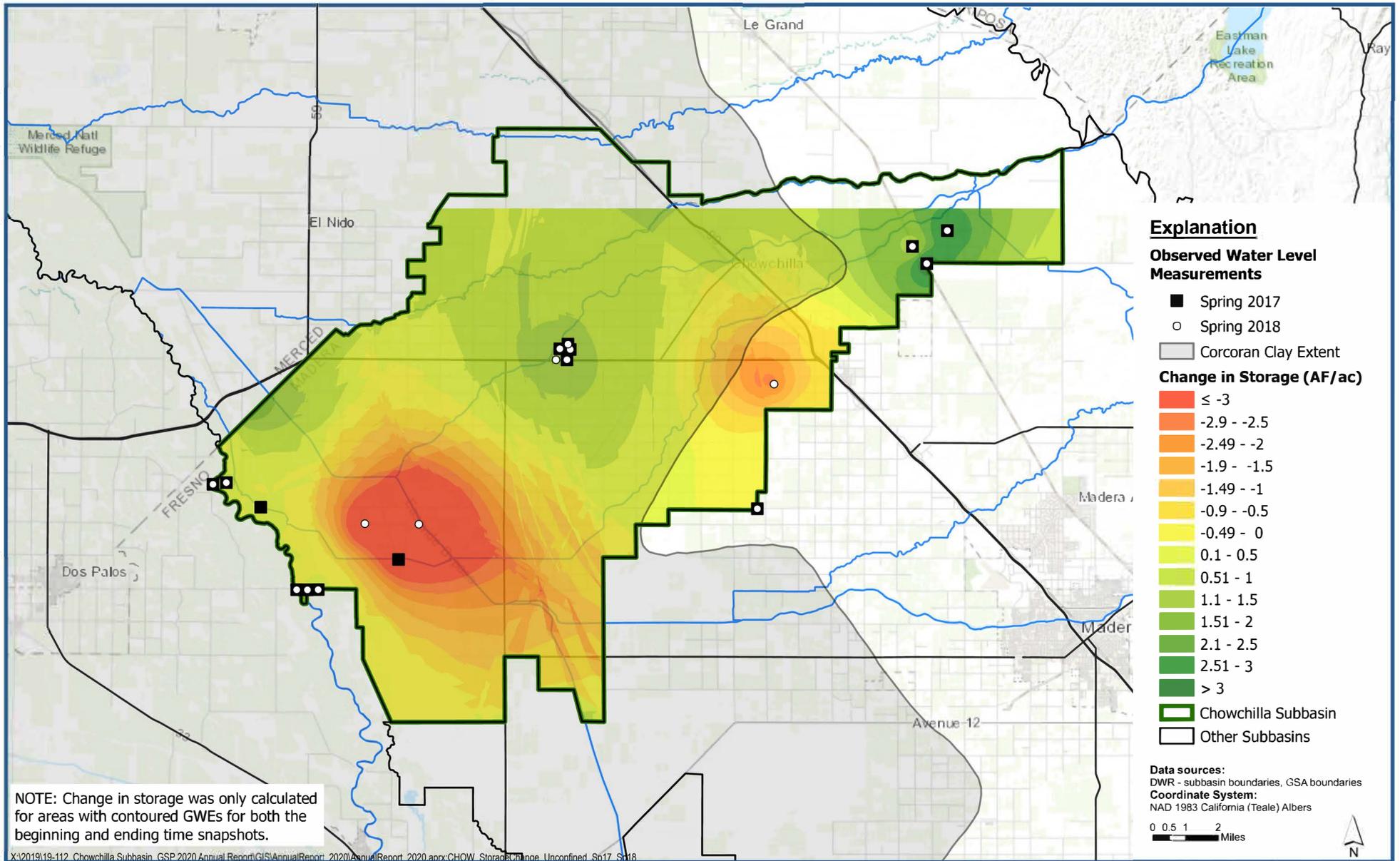


Change in Groundwater Storage in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2016 through Spring 2017

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-9



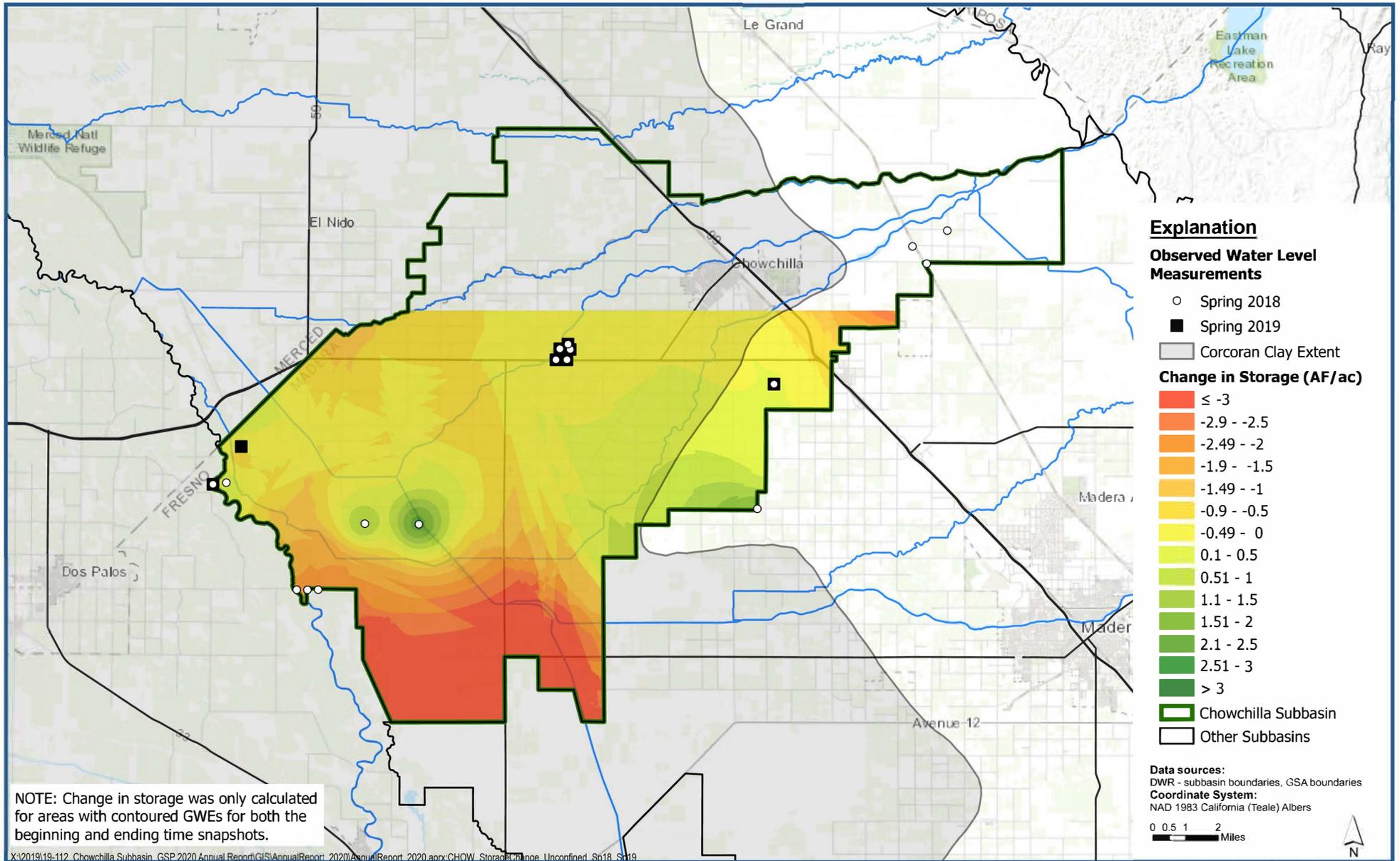


Change in Groundwater Storage in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2017 through Spring 2018

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-10



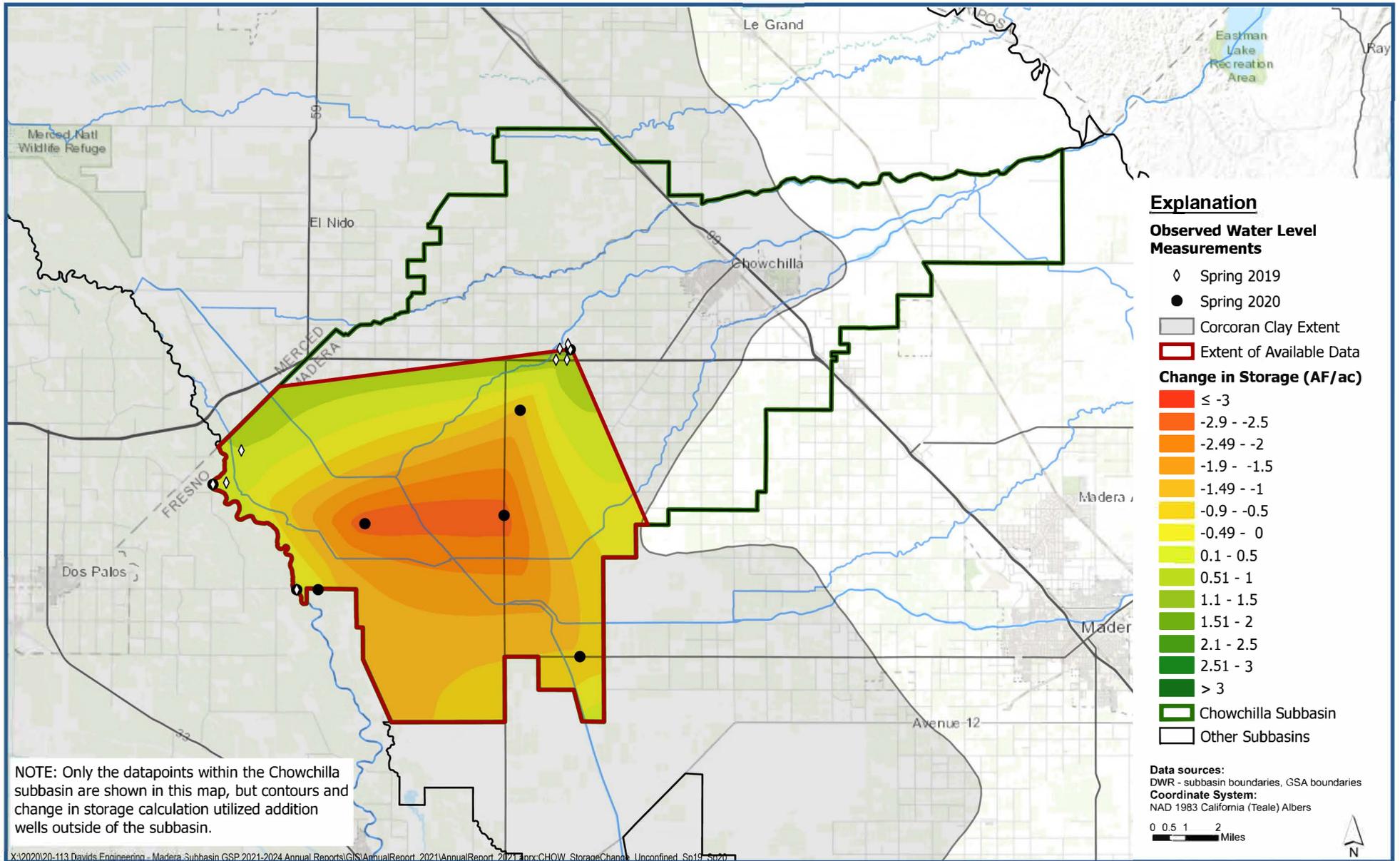


Change in Groundwater Storage in the Upper Aquifer/Undifferentiated Unconfined Zone - Spring 2018 through Spring 2019

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-11



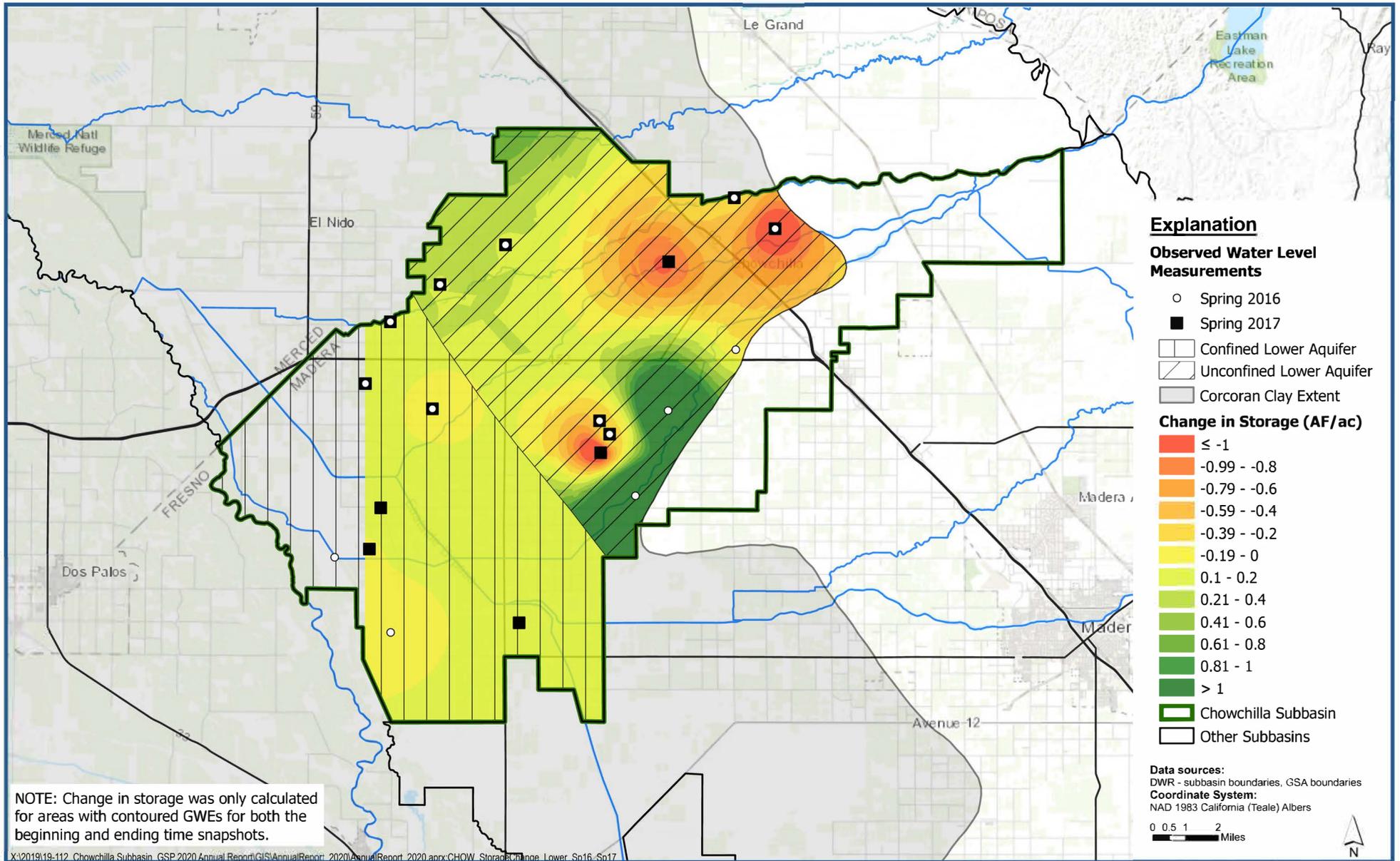


**Change in Groundwater Storage in the Upper Aquifer/
Undifferentiated Unconfined Zone - Spring 2019 through Spring 2020**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure C-12

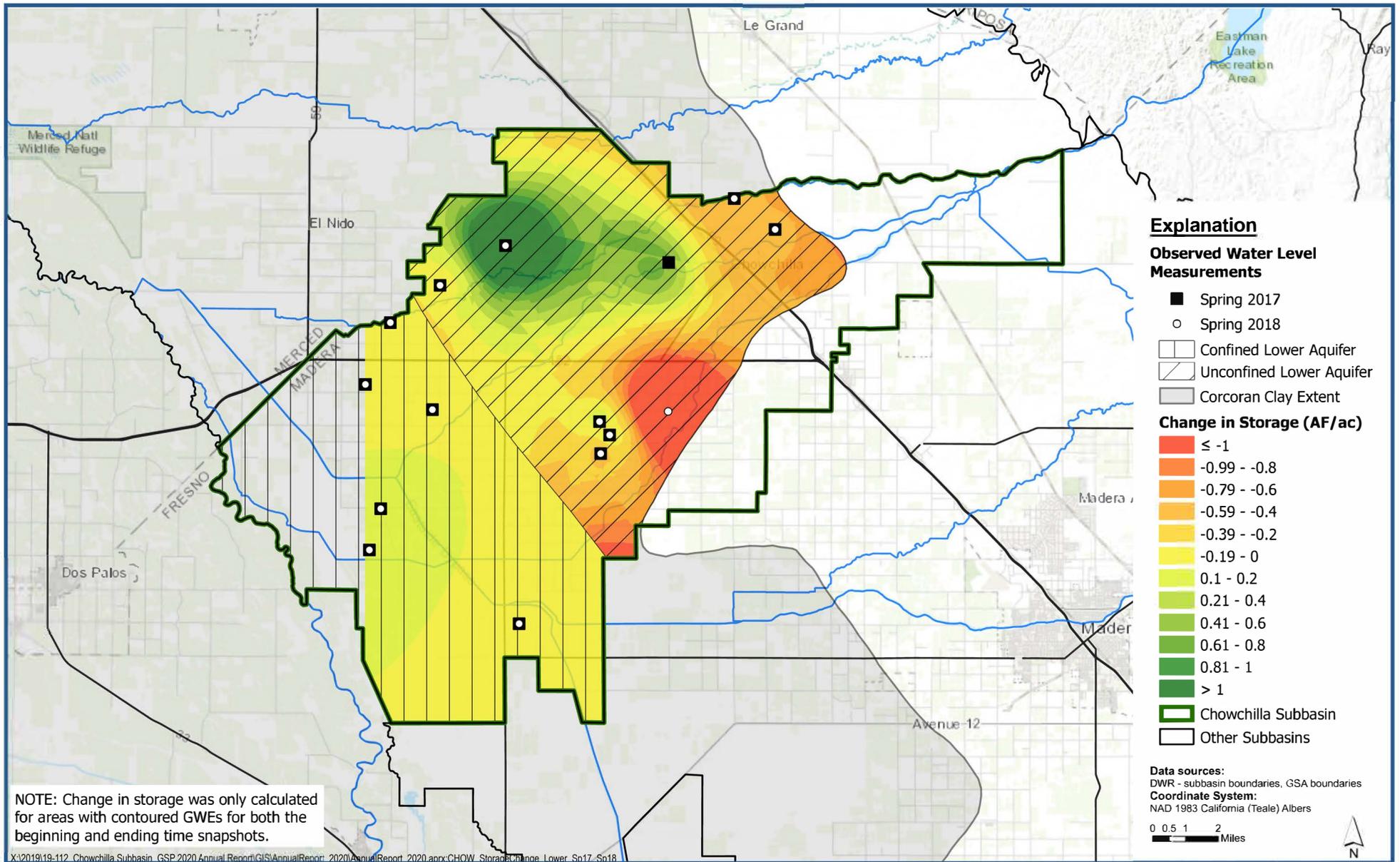




**Change in Groundwater Storage in the Lower Aquifer -
Spring 2016 through Spring 2017**

Figure C-13



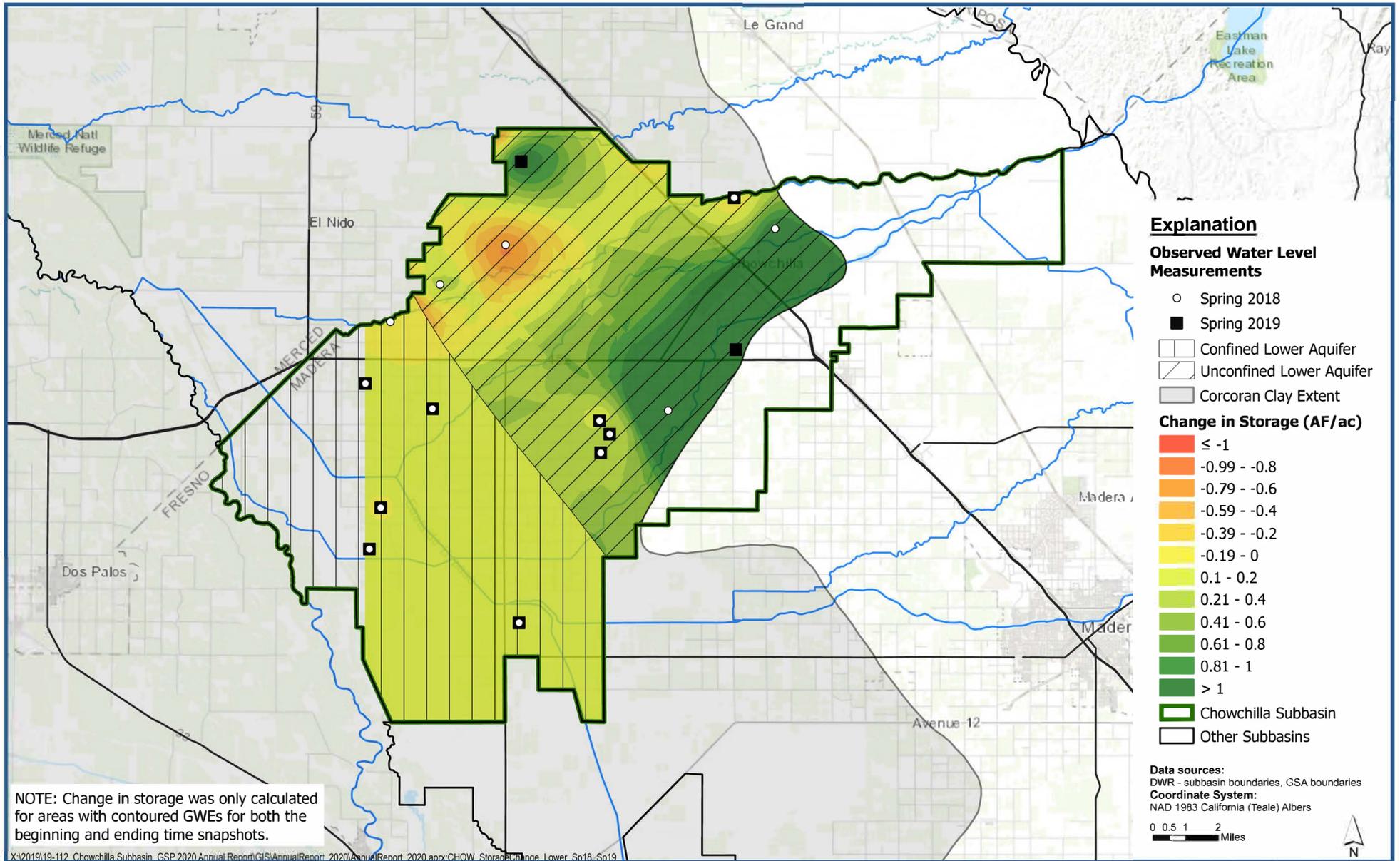


**Change in Groundwater Storage in the Lower Aquifer -
Spring 2017 through Spring 2018**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure C-14



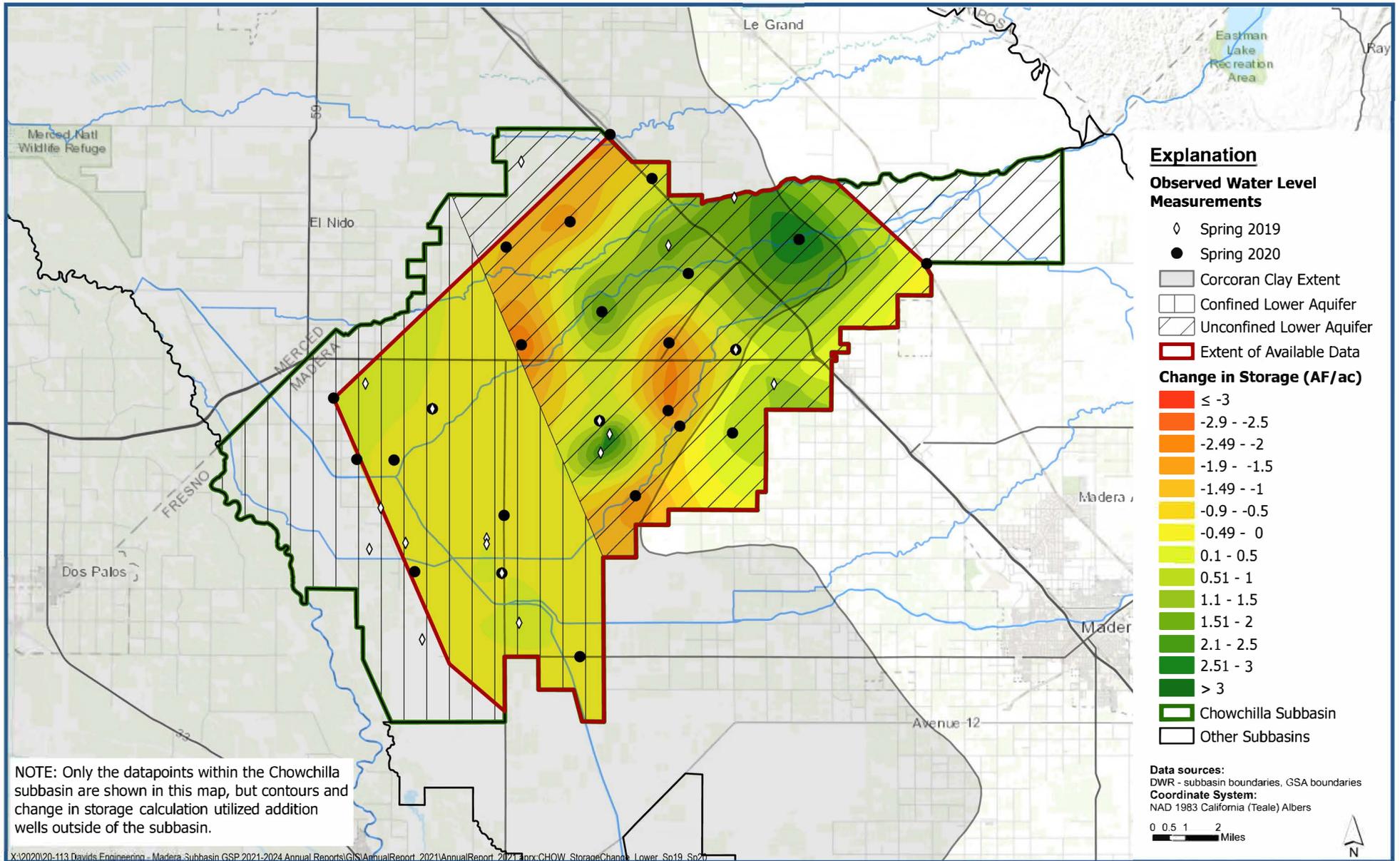


**Change in Groundwater Storage in the Lower Aquifer -
Spring 2018 through Spring 2019**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure C-15





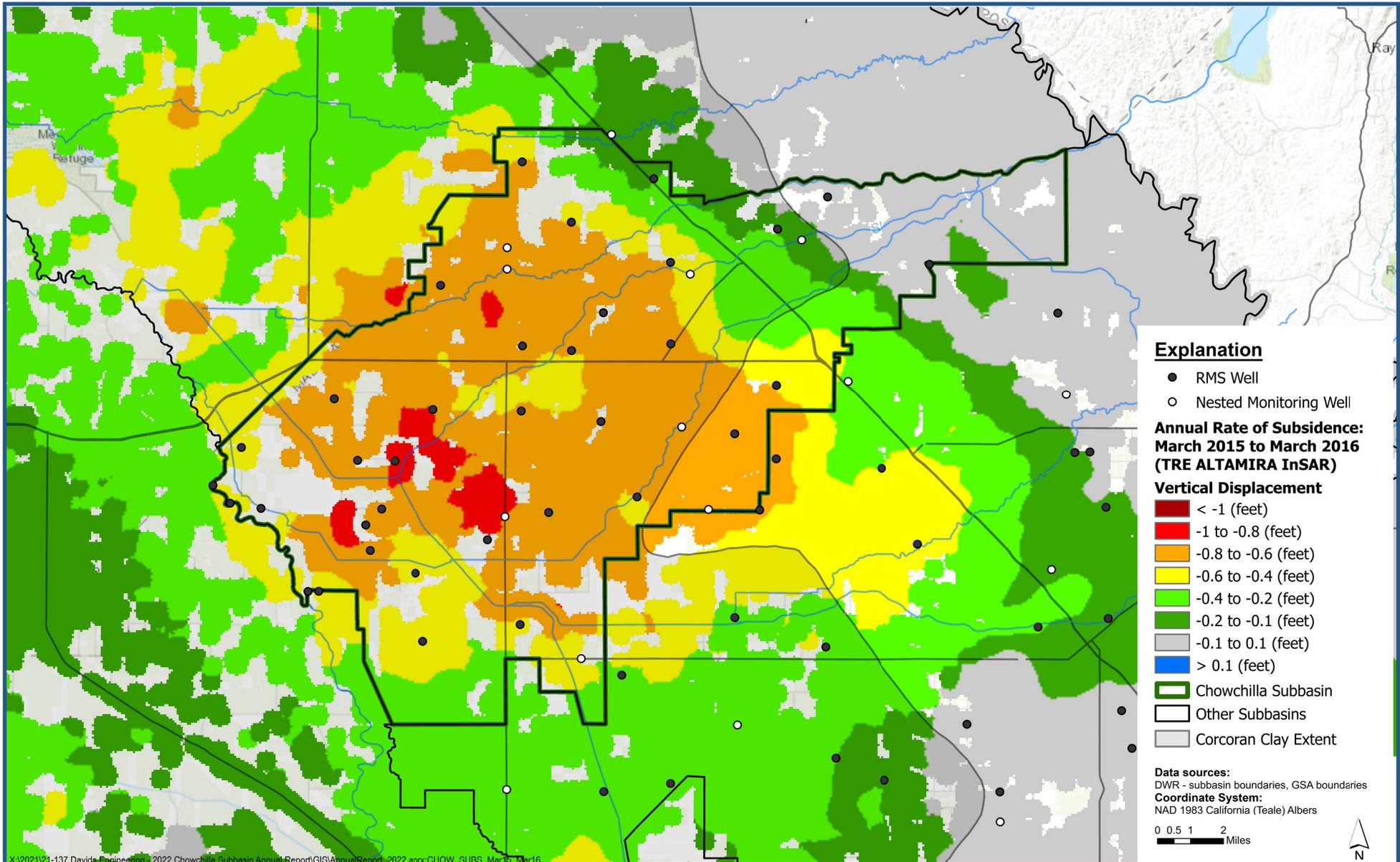
**Change in Groundwater Storage in the Lower Aquifer -
Spring 2019 through Spring 2020**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure C-16



Appendix D. Subsidence Maps for Six Recent Years and Cumulative for 2015 to 2021.

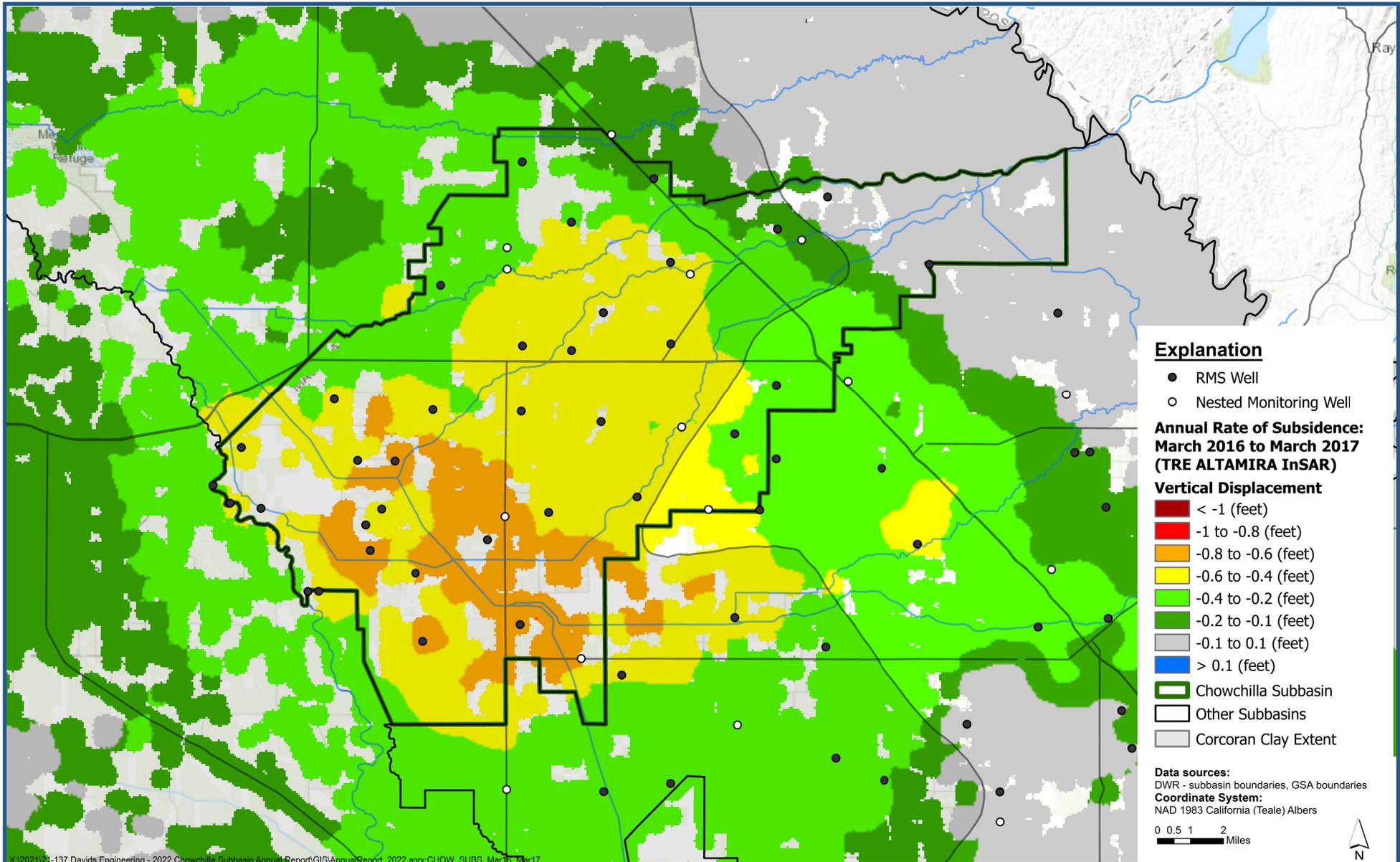


**Annual Rate of Subsidence: March 2015 to March 2016
(TRE ALTAMIRA InSAR)**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-1



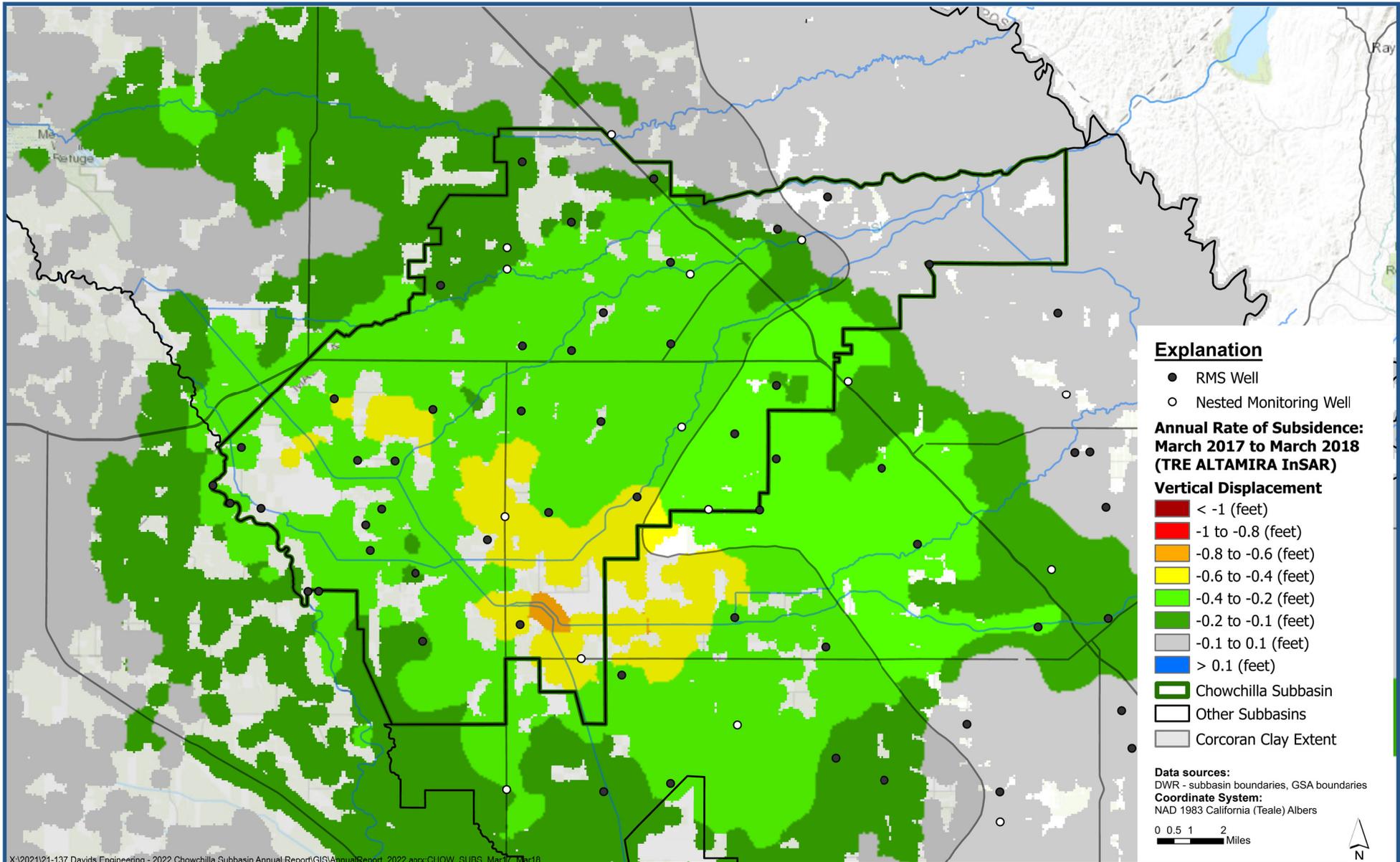


**Annual Rate of Subsidence: March 2016 to March 2017
(TRE ALTAMIRA InSAR)**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-2



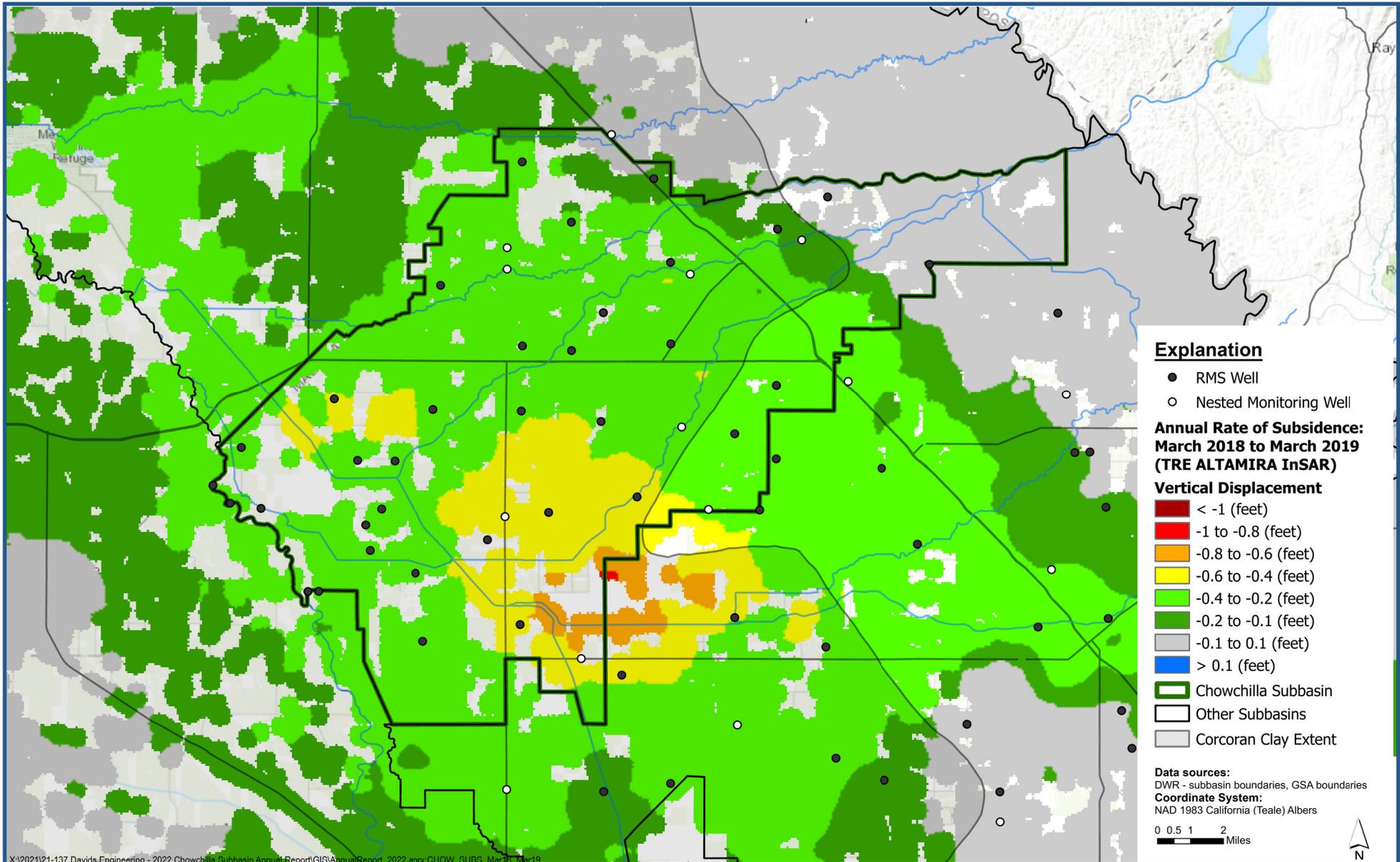


**Annual Rate of Subsidence: March 2017 to March 2018
(TRE ALTAMIRA InSAR)**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-3



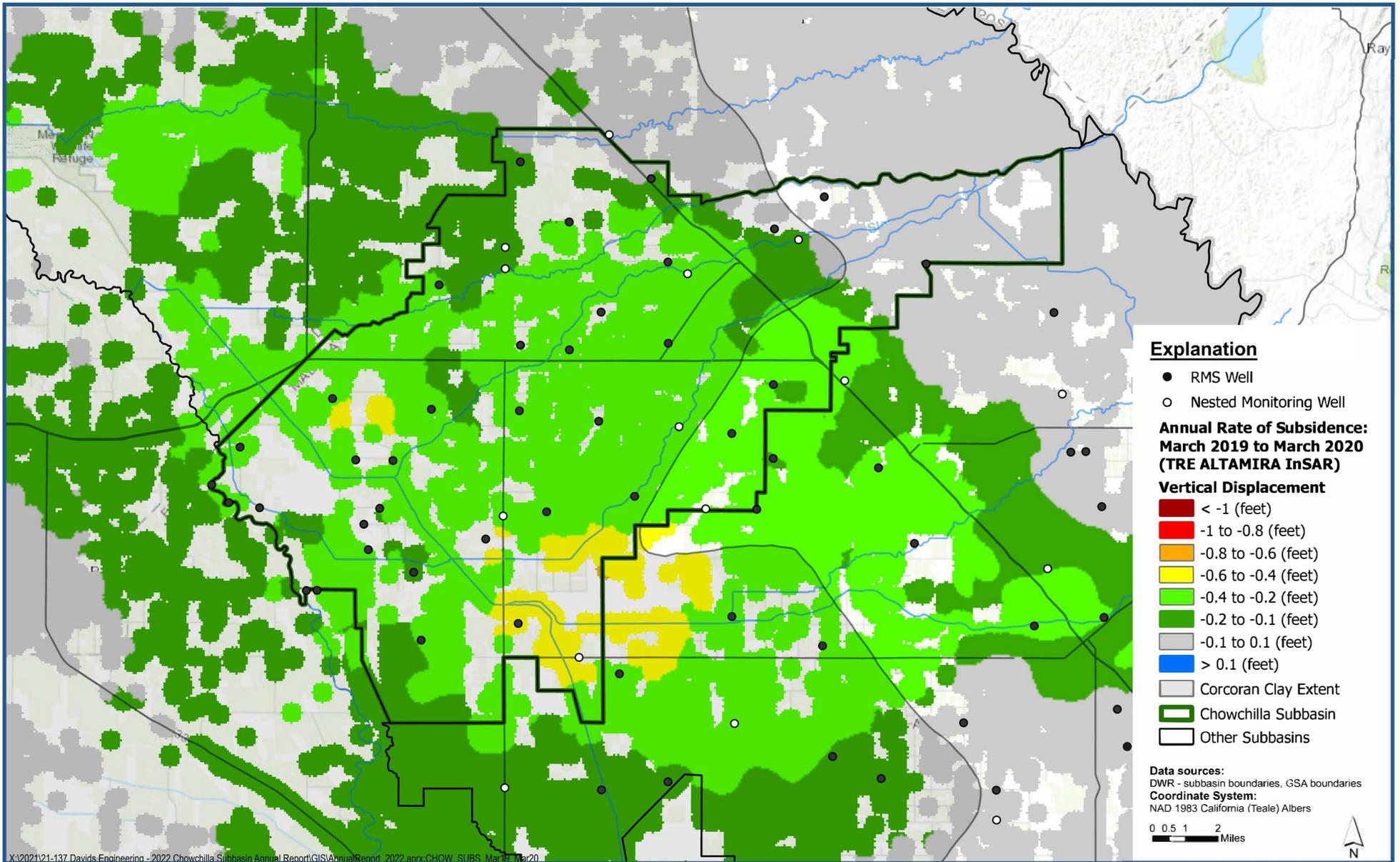


**Annual Rate of Subsidence: March 2018 to March 2019
(TRE ALTAMIRA InSAR)**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-4



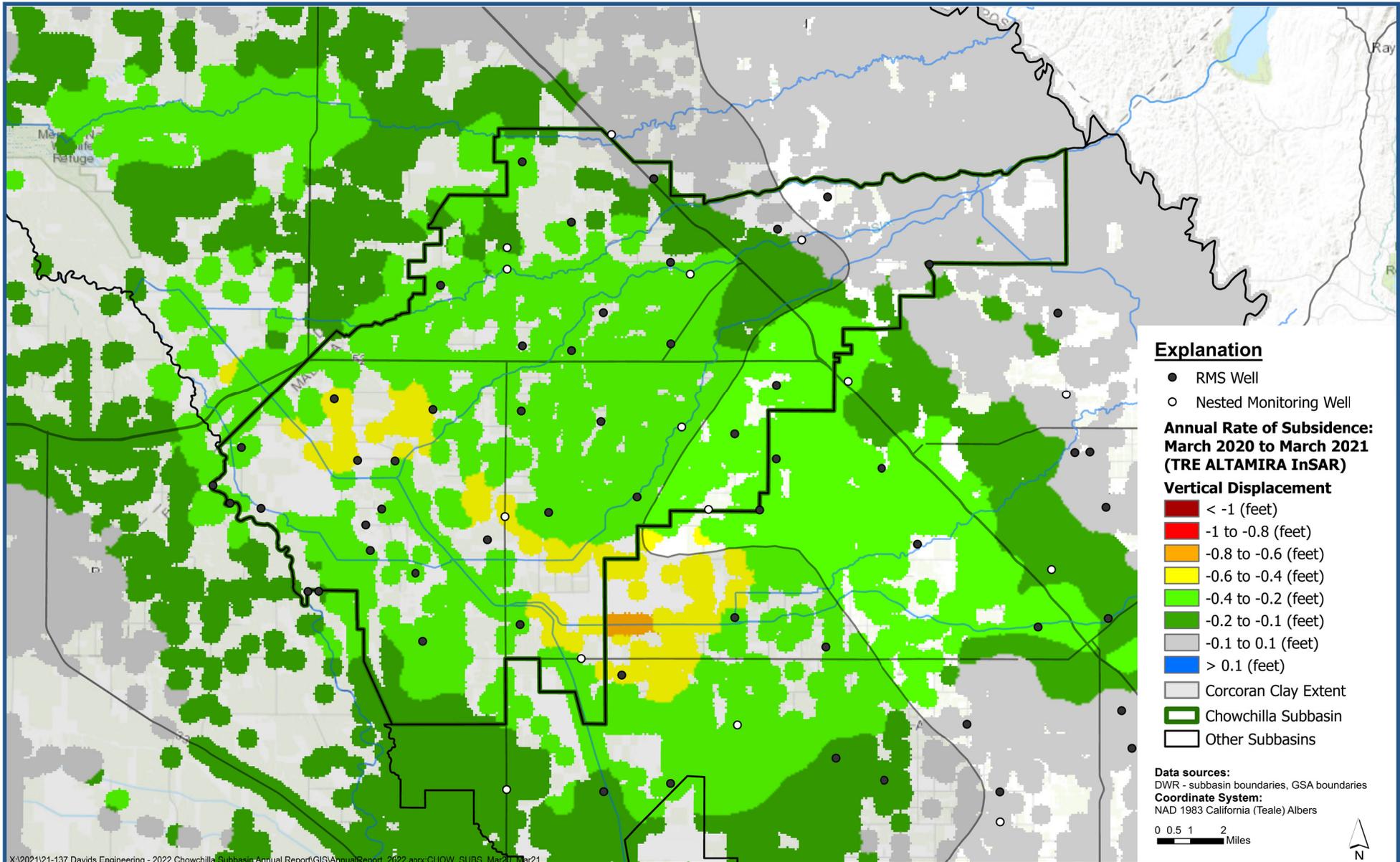


**Annual Rate of Subsidence: March 2019 to March 2020
(TRE ALTAMIRA InSAR)**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure D-5



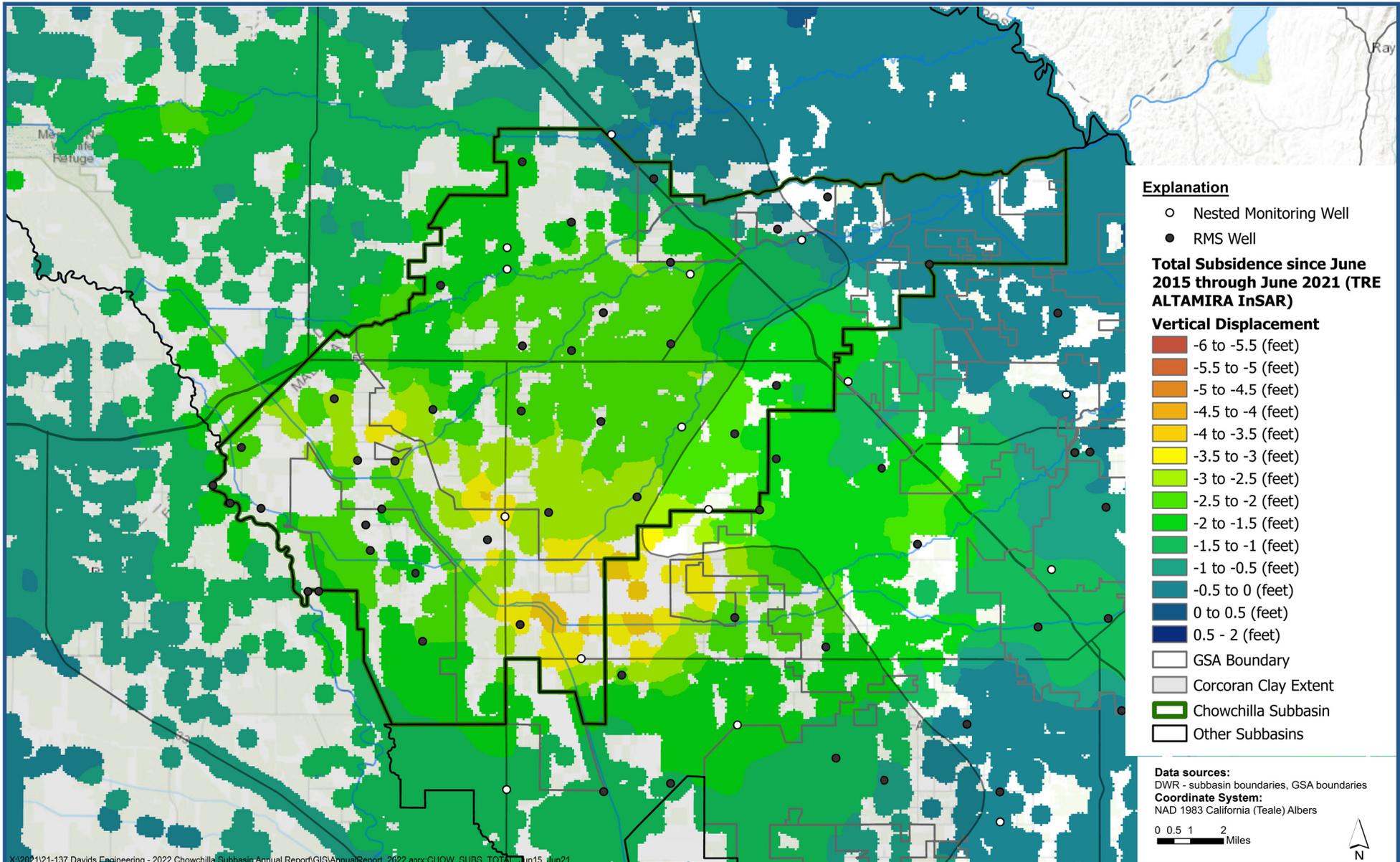


**Annual Rate of Subsidence: March 2020 to March 2021
(TRE ALTAMIRA InSAR)**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-6



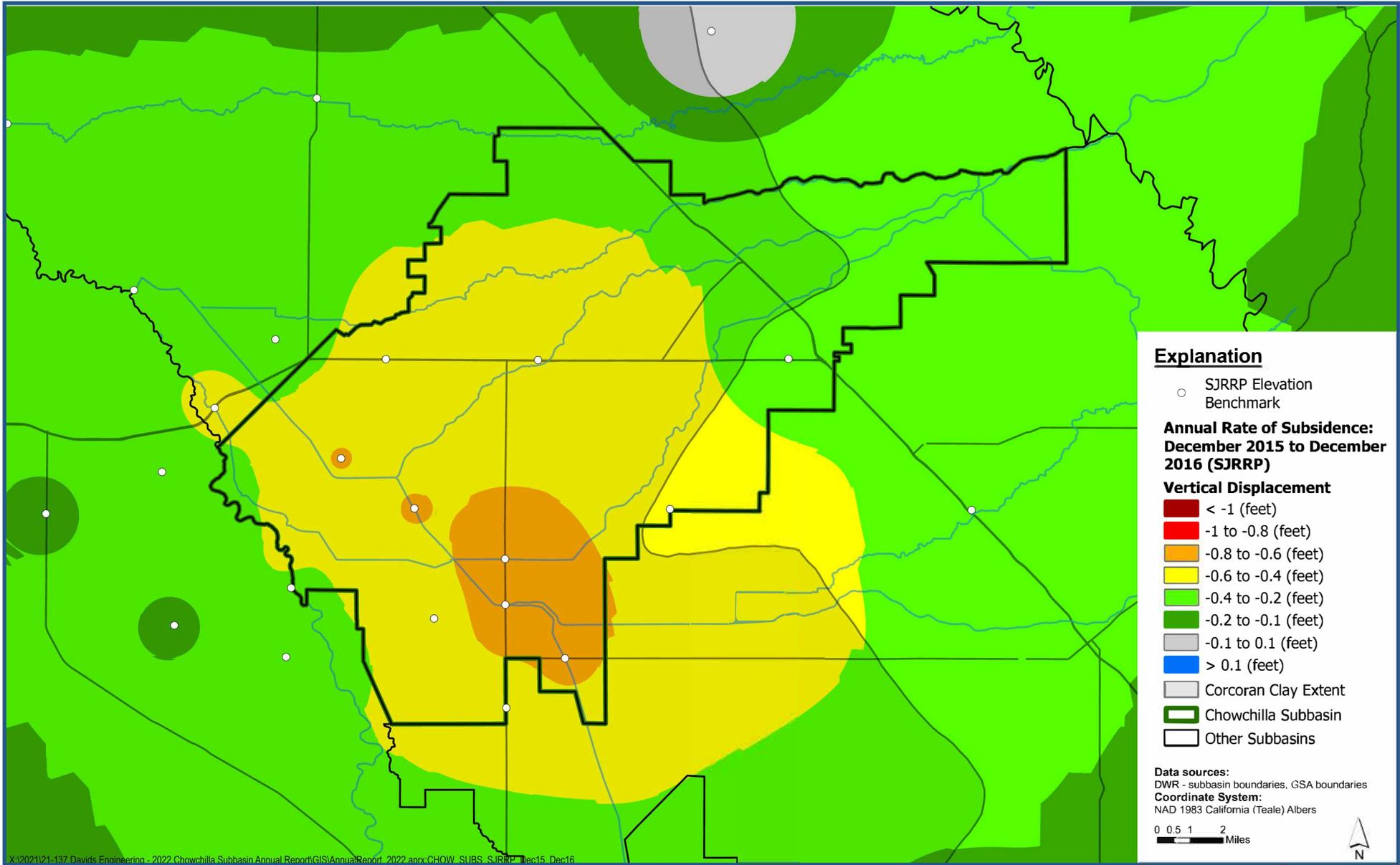


**Total Subsidence since June 2015 through June 2021
(TRE ALTAMIRA InSAR)**

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-7



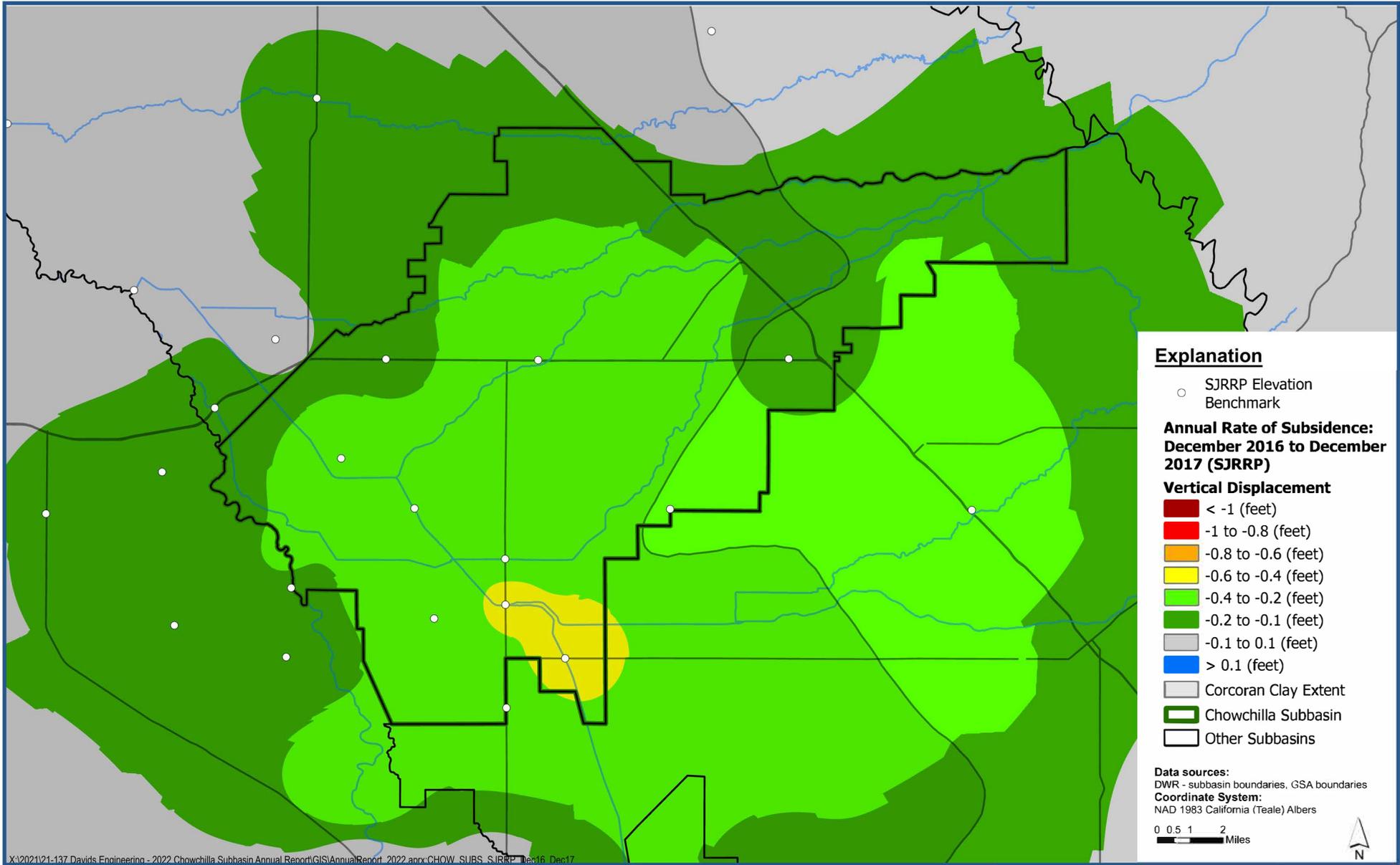


**Annual Rate of Subsidence: December 2015 to December 2016
(SJRRP Elevation Benchmark)**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure D-8

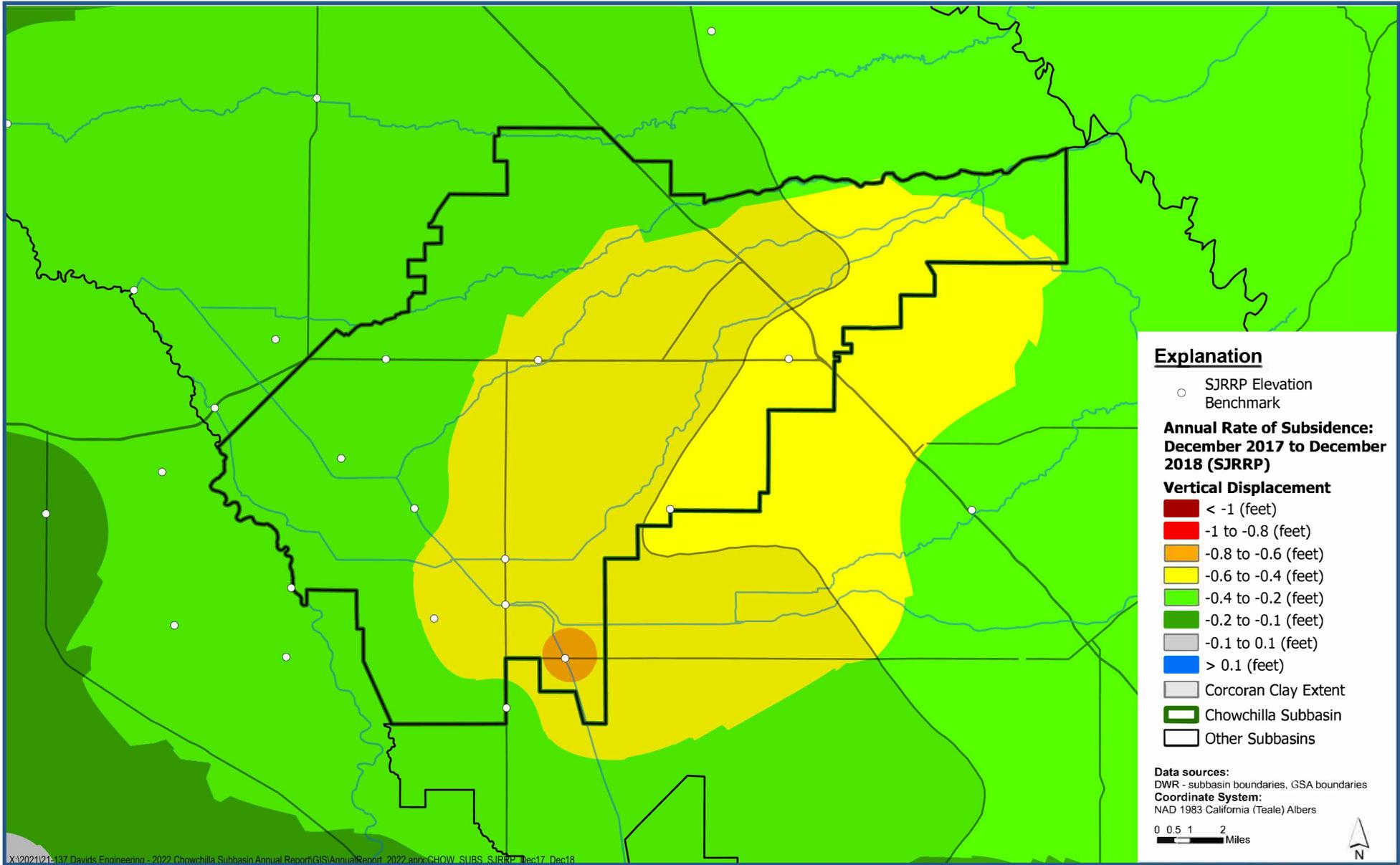




Annual Rate of Subsidence: December 2016 to December 2017 (SJRRP Elevation Benchmark)

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure D-9

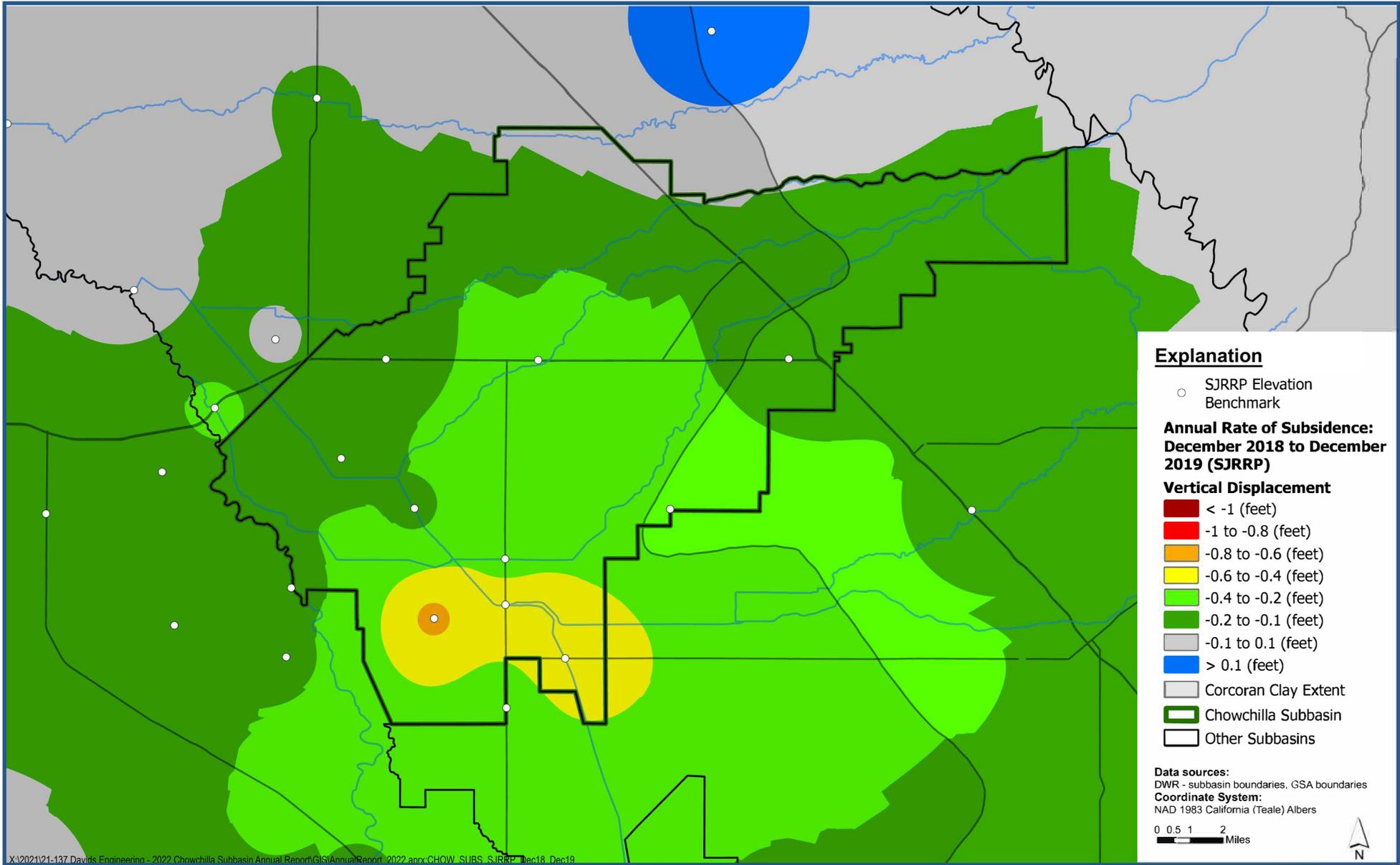


**Annual Rate of Subsidence: December 2017 to December 2018
(SJRRP Elevation Benchmark)**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

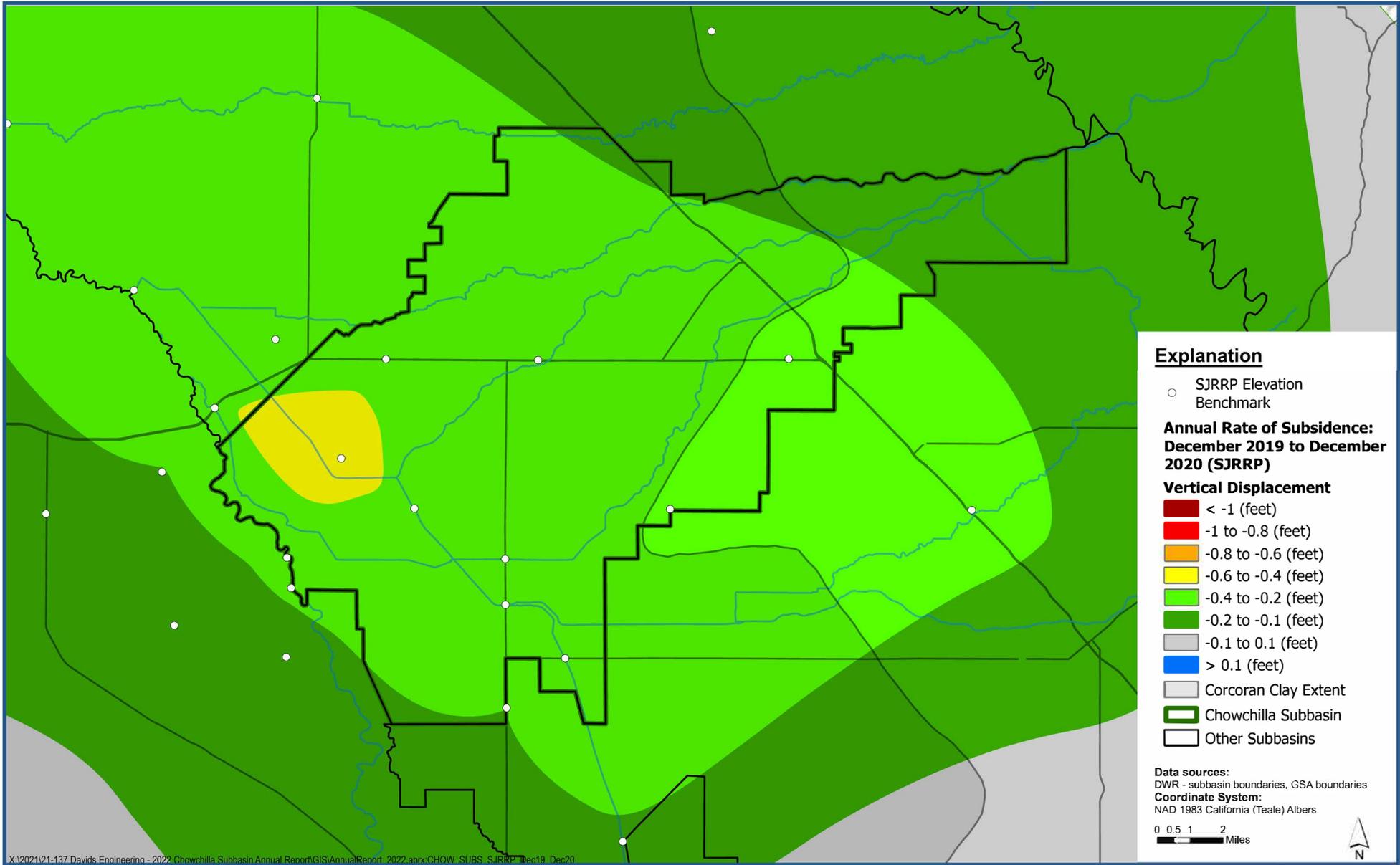
Figure D-10





Annual Rate of Subsidence: December 2018 to December 2019 (SJRRP Elevation Benchmark)

Figure D-11

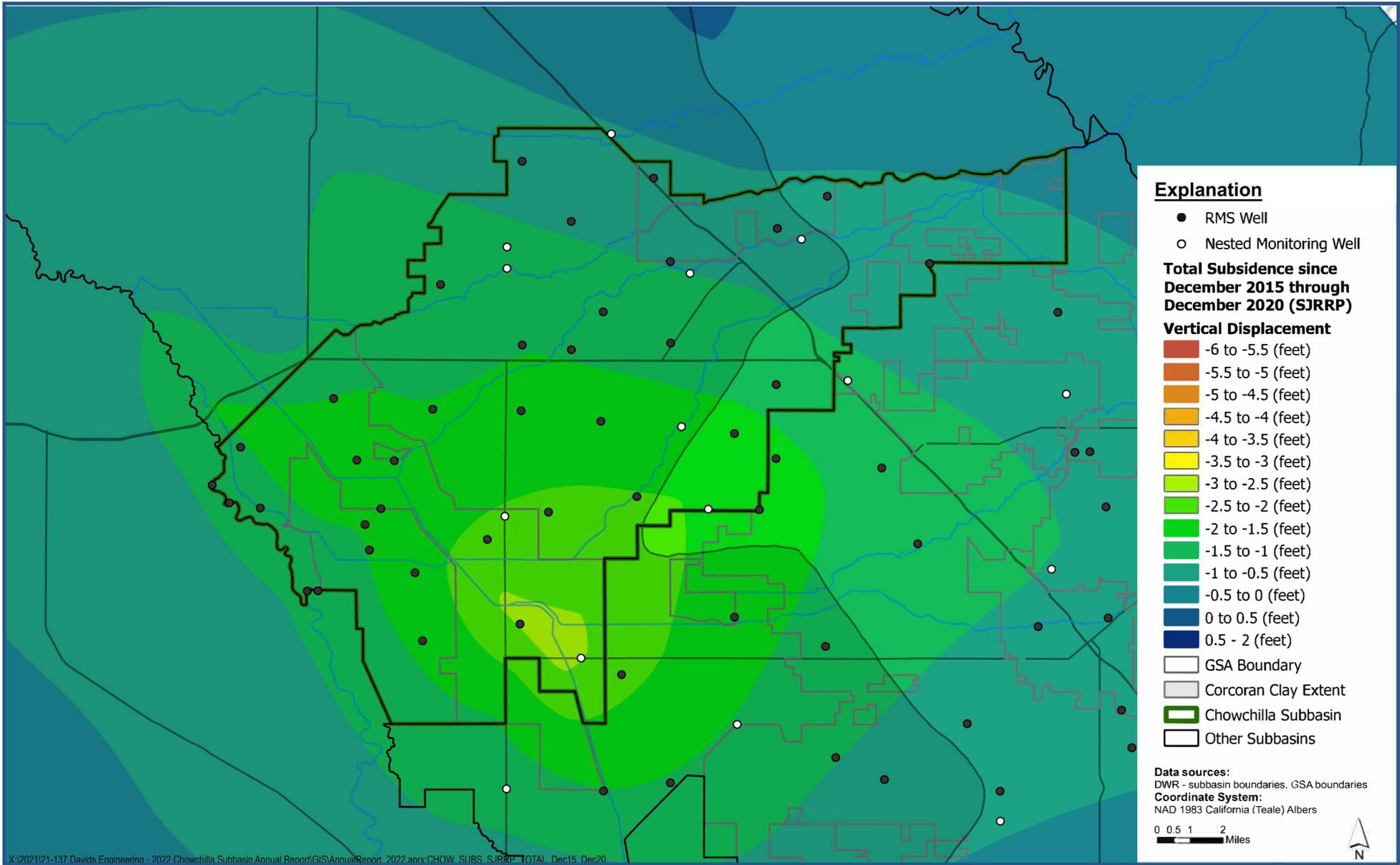


**Annual Rate of Subsidence: December 2019 to December 2020
(SJRRP Elevation Benchmark)**

Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report

Figure D-12





Total Subsidence since December 2015 through December 2020 (SJRRP Elevation Benchmark)

*Chowchilla Subbasin
Groundwater Sustainability Plan 2022 Annual Report*

Figure D-13



Appendix E. Status of Monitoring Efforts for RMS Wells in Chowchilla Subbasin.

Appendix E. Table 1 - Status of Monitoring Efforts for RMS Wells in Chowchilla Subbasin

Subbasin	GSA	RMS ID	Fall 2021 Monitoring Status	Most Recent Successful WL Msmt	Most Recent Successful WL Msmt (Season)
Chowchilla	Chowchilla Water District	CWD RMS-1	NM - Tape hung up	3/18/2021	Spring 2021
Chowchilla	Chowchilla Water District	CWD RMS-2	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-3	Currently Monitored	10/12/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-4	Currently Monitored	10/12/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-5	Currently Monitored	10/13/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-6	Currently Monitored	10/26/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-7	Currently Monitored	10/26/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-8	Currently Monitored	10/12/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-9	Currently Monitored	10/12/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-10	Currently Monitored	10/14/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-11	Currently Monitored	10/14/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-12	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-13	Currently Monitored	10/14/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-14	Currently Monitored	10/14/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-15	Currently Monitored	10/18/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-16	Currently Monitored	10/27/2021	Fall 2021
Chowchilla	Chowchilla Water District	CWD RMS-17	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	County of Madera - East	MCE RMS-1	Currently Monitored	11/9/2021	Fall 2021
Chowchilla	County of Madera - East	MCE RMS-2	NM - Tape hung up	3/16/2021	Spring 2021
Chowchilla	County of Madera - West	MCW RMS-1	NM - Can't get tape in casing	3/30/2021	Spring 2021
Chowchilla	County of Madera - West	MCW RMS-2	Currently Monitored	11/9/2021	Fall 2021
Chowchilla	County of Madera - West	MCW RMS-3	Currently Monitored	11/9/2021	Fall 2021
Chowchilla	County of Madera - West	MCW RMS-4	NM - Can't get tape in casing	3/15/2021	Spring 2021
Chowchilla	County of Madera - West	MCW RMS-5	NM - Tape hung up	3/16/2021	Spring 2021
Chowchilla	County of Madera - West	MCW RMS-6	NM - Tape hung up	3/16/2021	Spring 2021

Appendix E. Table 1 - Status of Monitoring Efforts for RMS Wells in Chowchilla Subbasin

Subbasin	GSA	RMS ID	Fall 2021 Monitoring Status	Most Recent Successful WL Msmt	Most Recent Successful WL Msmt (Season)
Chowchilla	County of Madera - West	MCW RMS-7	Currently Monitored	11/9/2021	Fall 2021
Chowchilla	County of Madera - West	MCW RMS-8	Currently Monitored	11/9/2021	Fall 2021
Chowchilla	County of Madera - West	MCW RMS-9	NM - Tape hung up	3/12/2021	Spring 2021
Chowchilla	County of Madera - West	MCW RMS-10	Fall measurement unavailable at time of report.	8/18/2021	Summer 2021
Chowchilla	County of Madera - West	MCW RMS-11	Fall measurement unavailable at time of report.	8/18/2021	Summer 2021
Chowchilla	County of Madera - West	MCW RMS-12	Fall measurement unavailable at time of report.	8/18/2021	Summer 2021
Chowchilla	County of Merced	MER RMS-1	Attempts are being made to reengage with well owner	3/12/2020	Spring 2020
Chowchilla	Triangle T Water District	TRT RMS-1	Currently Monitored	12/6/2021	Winter 2021
Chowchilla	Triangle T Water District	TRT RMS-2	Currently Monitored	12/6/2021	Winter 2021
Chowchilla	Triangle T Water District	TRT RMS-3	Currently Monitored	11/11/2021	Fall 2021
Chowchilla	Triangle T Water District	TRT RMS-4	Currently Monitored	11/10/2021	Fall 2021

NM = no measurement. Measurement attempted but was unsuccessful.

Appendix E. Table 2 - Status of Monitoring Efforts for Potential RMS Wells in Chowchilla Subbasin

Subbasin	GSA	RMS ID	Fall 2021 Monitoring Status	Most Recent Successful WL Msmt	Most Recent Successful WL Msmt (Season)
Chowchilla	Chowchilla Water District	CSB MW-1-305	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-1-710	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-1-960	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB_MW-2-290	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB_MW-2-490	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB_MW-2-760	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-3-285	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-3-540	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-3-830	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-5-390	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-5-610	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-5-840	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	County of Madera - West	CSB MW-6-197	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	County of Madera - West	CSB MW-6-370	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	County of Madera - West	CSB MW-6-570	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	County of Madera - West	CSB MW-7-230	Currently Monitored	10/21/2021	Fall 2021
Chowchilla	County of Madera - West	CSB MW-7-495	Currently Monitored	10/21/2021	Fall 2021
Chowchilla	County of Madera - West	CSB MW-7-710	Currently Monitored	10/21/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-8-272	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-8-608	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-8-830	Currently Monitored	10/19/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-9-375	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-9-550	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-9-770	Currently Monitored	10/20/2021	Fall 2021
Chowchilla	Chowchilla Water District	CSB MW-10	Currently Monitored	10/20/2021	Fall 2021