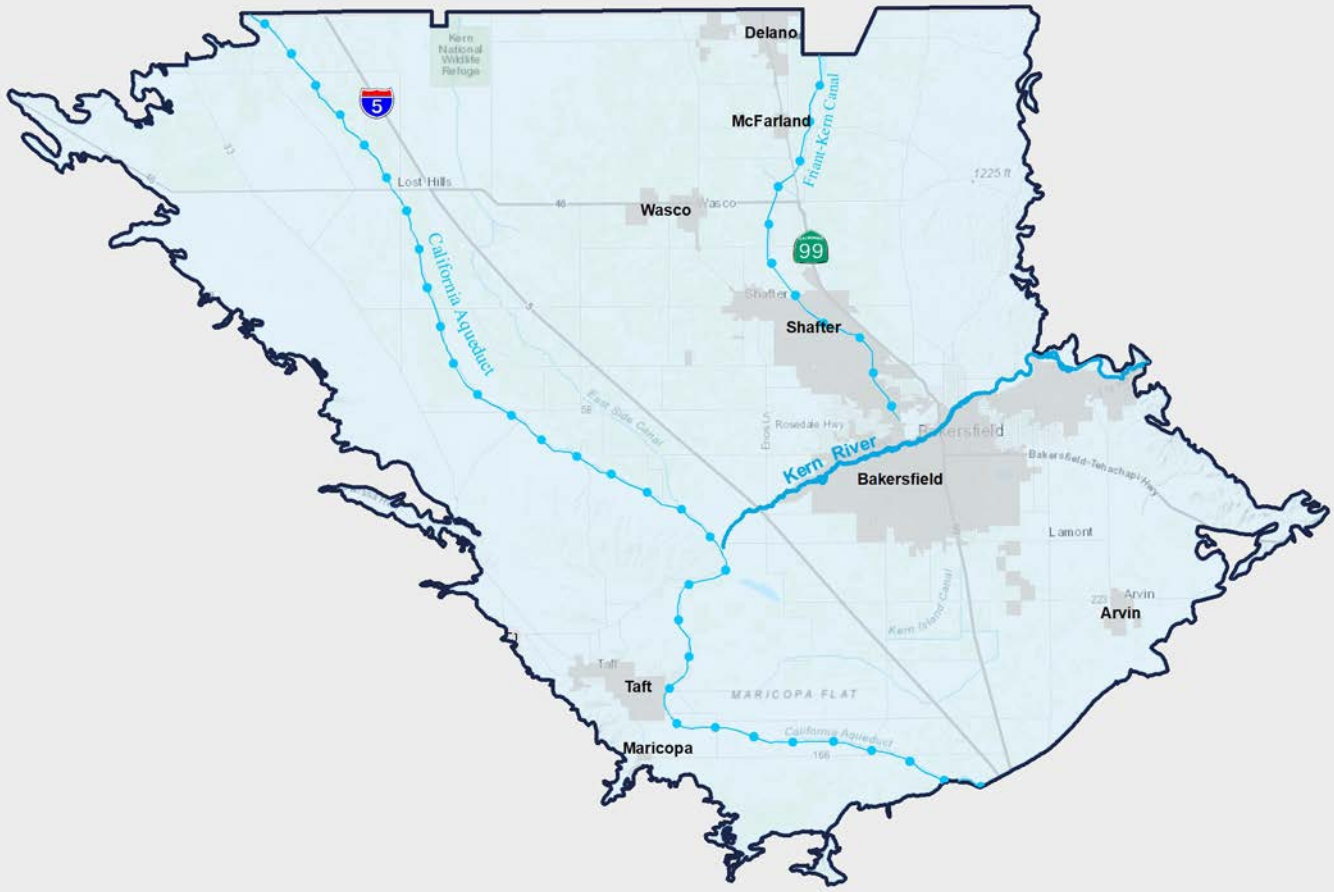
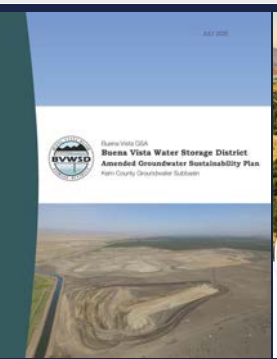
March 2024

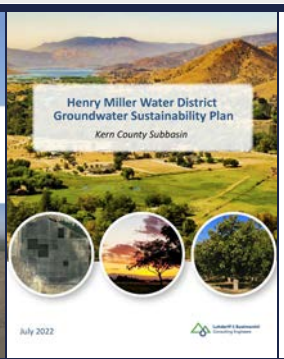
Kern County Subbasin Groundwater Sustainability Plans

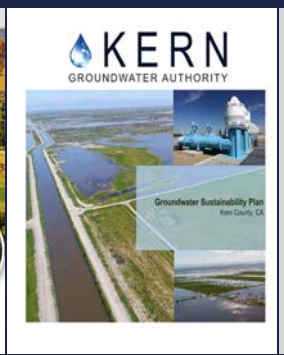
Fifth Annual Report

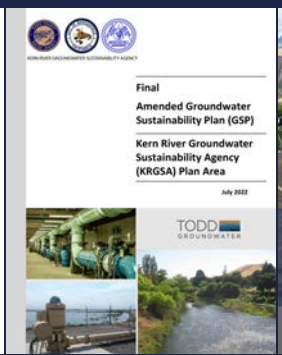


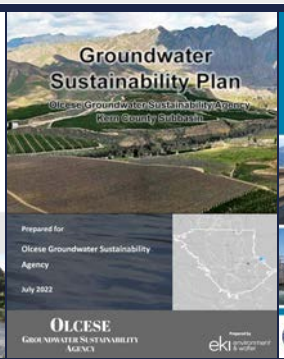
Water Year 2023

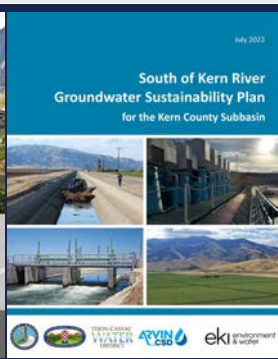












TODD GROUNDWATER

KERN COUNTY SUBBASIN

GROUNDWATER SUSTAINABILITY AGENCIES

Kern County Subbasin

Basin No. 5-022.14

Groundwater Sustainability Plans (GSPs)

Fifth Annual Report
Water Year 2023

(October 2022 through September 2023)

March 29, 2024

TODD GROUNDWATER

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List of Acronyms

AEWSD	Arvin-Edison Water Storage District
AF	acre feet
AFY	acre feet per year
bgs	below ground surface
BMP	Best Management Practices
BVWSD	Buena Vista Water Storage District
CASGEM	California Statewide Groundwater Elevation Monitoring
C2VSim	California Central Valley Groundwater-Surface Water Simulation
C2VSimFG-Kern	California Central Valley Groundwater-Surface Water Simulation Model, Fine-Grid, Kern County Update for the Kern County and White Wolf Subbasin
CC	Coordination Committee of the Kern County Subbasin
CCR	California Code of Regulations
CEQA	California Environmental Quality Act
Cawelo WD	Cawelo Water District
CGSA	Cawelo Groundwater Sustainability Agency
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CVC	Cross Valley Canal
CVP	Central Valley Project
CWD	County Water District
DMS	Data Management System
DWR	Department of Water Resources
ENCSD	East Niles Community Services District
ET	Evapotranspiration
EWMA	Eastside Water Management Area
ft	feet
Greenfield CWD	Greenfield County Water District
GSA	Groundwater Sustainability Agency
GSE	Ground Surface Elevation
GSP	Groundwater Sustainability Plan
HMWD	Henry Miller Water District
ID4	Improvement District 4, Kern County Water Agency
IDC	Independent Demand Calculator

InSAR	Interferometric Synthetic Aperture Radar
ITRC	Irrigation Training and Research Center
IWFM	Integrated Water Flow Model
KCWA	Kern County Water Agency
KDWD	Kern Delta Water District
KFMC	Kern Fan Monitoring Committee
KGA	Kern Groundwater Authority
KRGSA	Kern River Groundwater Sustainability Agency
KTWD	Kern-Tulare Water District
KWB	Kern Water Bank
MA	Management Area
MAP	Management Area Plan
METRIC	Mapping Evapotranspiration at high Resolution with Internalized Calibration
MNP	Monitoring Network Plan
MO	Measurable Objective
MT	Minimum Threshold
msl	mean sea level
NKWSD	North Kern Water Storage District
MNM	Monitoring Network Module, DWR online SGMA portal
PRISM	Parameter-elevation Relationships on Independent Slopes Model
RRBWSD	Rosedale-Rio Bravo Water Storage District
SGMA	Sustainable Groundwater Management Act
SSJMUD	South San Joaquin Municipal Utilities District
Subbasin	Kern County Subbasin (when capitalized)
SWID	Shafter-Wasco Irrigation District
SMC	Sustainable Management Criteria
SWP	State Water Project
SWSD	Semitropic Water Storage District
TCWD	Tejon-Castac Water District
USEPA	United States Environmental Protection Agency
WMA	Water Management Area
WDWA	Westside District Water Authority
WKWD	West Kern Water District
WRMWSD	Wheeler Ridge-Maricopa Water Storage District
WY	Water Year, October 1 through September 30

EXECUTIVE SUMMARY

The Kern County Subbasin (Basin No. 5-022.14) is the largest subbasin in the State, has been designated as critically overdrafted, and is governed by a myriad of water districts, water storage districts, irrigation districts, and municipalities. These agencies manage a complex water supply system, a large portfolio of local and imported water sources, access to flood waters throughout the State, local managed aquifer recharge projects, and numerous large groundwater banking projects, collectively providing both local and State-wide water supply and water quality benefits.

To comply with the Sustainable Groundwater Management Act (SGMA), local agencies were organized in WY 2023 into nineteen (19) Groundwater Sustainability Agencies (GSAs) with one additional GSA pending. These GSAs coordinated to produce six amended Groundwater Sustainability Plans (GSPs) covering the entire Subbasin that were submitted to the Department of Water Resources (DWR) in July 2022. The amended GSPs were submitted in response to a DWR Letter of Determination in January 2022 that identified deficiencies in the original GSPs submitted in January 2020.

Since the submittal of the 2020 GSPs, all of the Subbasin GSAs have coordinated to produce a single comprehensive Annual Report that covers the entire Kern County Subbasin. This Fifth Annual Report demonstrates the collective GSP implementation by all 18 GSAs and 1 SGMA management area. **Figure 1** shows the Kern County Subbasin and adjacent subbasins. **Figures 2 and 3** show the current 19 SGMA agencies and the areas covered by the six GSPs submitted in July 2022, respectively.

Progress Made on Addressing Deficiencies in DWR Determination Letter

During Water Year (WY) 2023, DWR responded to the Amended GSPs submitted in 2022 with an Inadequate Determination Letter (DWR Letter) which identified additional deficiencies requiring corrective action. The following deficiencies were identified in the DWR Letter:

1. The GSPs do not establish undesirable results that are consistent for the entire Subbasin.
2. The Subbasin's chronic lowering of groundwater levels sustainable management criteria do not satisfy the requirements of SGMA and the GSP Regulations.
3. The Subbasin's land subsidence sustainable management criteria do not satisfy the requirements of SGMA and the GSP regulations.

Throughout WY 2023, the Subbasin Coordination Committee (CC) has continued to meet and provide oversight on various Subbasin-wide activities for GSP implementation as required by SGMA, including development of Amended GSPs, in response to the DWR Letter, to preclude a probationary hearing process administered by the State Water Resources Control Board (SWRCB) to determine if State intervention is warranted.

The Subbasin has made significant progress to address the identified deficiencies in the DWR Letter in consultation with SWRCB staff. As currently planned, the Subbasin intends to submit Amended GSP(s) in May 2024 for SWRCB Board consideration prior to a probationary hearing, if any.

Since receipt of the DWR Letter, the Subbasin has participated in bi-weekly meetings to address the deficiencies through development of common and coordinated, revised GSP(s). Throughout this process, the Subbasin has coordinated and held 7 technical meetings with SWRCB staff and held over 117 meetings between landowner representative policy members, GSA/MA managers, and a technical working group (TWG) of 15 consultants representing the GSA/MA. Together, the landowner/manager/technical group has successfully formulated a subbasin-wide coordinated approach to address the identified deficiencies. The meetings to date have addressed the Subbasin's Amended GSPs coordinated approach for:

- Monitoring Network
- Projects and Management Actions
- Sustainable Management Criteria (Water Levels, Water Quality, Subsidence, Storage)
- Water Budgets
- Well Inventory and Well Mitigation Program

Throughout WY 2023, the Subbasin Parties have continued to meet and provide oversight on various Subbasin-wide activities for GSP implementation as required by SGMA, including development of Amended GSP(s) for SWRCB consideration prior to determining if State intervention is warranted through a probationary hearing process administered by the SWRCB.

Approach

This Fifth Annual Report covers WY 2023, from October 1, 2022 through September 30, 2023, as the reporting period. The purpose of the Annual Report is to provide the required data and analyses to demonstrate that the Kern County Subbasin GSPs are being implemented in a manner that will achieve the sustainability goals that have been developed for the Subbasin and individual GSPs.

In support of this WY 2023 Annual Report, over 40 agencies have contributed data and information (listed in **Table 1**). The data compilation process for this Fifth Annual Report was coordinated with data-entry templates for water supply and use data developed using the Kern County Subbasin Data Management System (DMS). Data have been combined and analyzed for use in hydrographs, water level contour maps, and an update of the local C2VSimFG-Kern model. In particular, the C2VSimFG-Kern model provides a technically credible tool to analyze groundwater extractions and changes in groundwater in storage on a Subbasin-wide basis. Various model results are presented from WY 1995 through WY 2023, incorporating the historical period for the GSP water budgets (WY 1995 through WY 2015) and the updated analyses through WY 2023; water year types for that 29-year period are presented on **Figure 6**.

Data templates provided by DWR are employed for consistent reporting of information and data. A narrative progress report on GSP implementation has also been provided by the GSAs and member agencies; those reports are compiled in **Section 8**. In addition to the implementation of the individual GSPs, GSAs and member agencies are also coordinating on a collective effort to accomplish GSP implementation activities on a Subbasin-wide basis, including those documented in the Kern County

Subbasin Coordination Agreement. These efforts, led by the Subbasin Parties, are also summarized in **Section 8**.

The Kern County Subbasin GSAs are collectively committed to successful GSP implementation and attainment of Subbasin Sustainability Goals. Substantial compliance with the Annual Report requirements is demonstrated throughout this report, and additional data are currently being collected to address data gaps.

Groundwater Elevations

Groundwater elevations were compiled from wells in the GSP representative monitoring network for the preparation of hydrographs across the Subbasin (**Figure 5**). Available data, including sustainable management criteria, are presented on 200 well hydrographs, compiled in **Appendix A**. The hydrographs are developed within the Subbasin DMS so that the most complete and current groundwater elevations, ground surface elevation, minimum threshold (MT) and measurable objective (MO) are shown on the hydrographs. A public version of the DMS, including the hydrographs from the GSP representative monitoring network, is accessible to Subbasin GSAs and the public through https://dms.geiconsultants.com/kern.

Data from the SGMA monitoring network were combined with supplemental water level data from the Kern Fan Monitoring Committee and other local monitoring efforts by Kern County Water Agency (KCWA) to prepare groundwater elevation contour maps. Specifically, KCWA developed water level contour maps for Fall 2022 and Spring 2023 for the Primary Principal Aquifer in the Subbasin (**Figures 7** and **8**).

Two additional Principal Aquifers have been identified in four localized areas within the Subbasin as shown on **Figure 9**. Groundwater elevation contour maps for Fall 2022 and Spring 2022 are provided for the Olcese Sand Principal Aquifer on **Figures 10** and **11**, respectively. Groundwater elevations were posted during Fall 2022 and Spring 2023 for the Santa Margarita Principal Aquifer (**Figure 12**). The Subbasin GSPs define any water bearing zone within the areal extent and depth interval of an oilfield aquifer exemption as being located outside of the Kern County Subbasin and are, therefore, not included within any of the Principal Aquifers.

Groundwater Extractions

Groundwater extraction data for the Kern County Subbasin were compiled using two methods:

- Directly measured groundwater extraction data collected by local water agencies.
- Estimated groundwater extractions based on land use methods using the Integrated Water Flow Model (IWFM) Demand Calculator (IDC) tool developed by DWR (Dogrul, Kadir and Brush, 2017), which is dynamically linked to the C2VSimFG-Kern groundwater model.

IDC employs user-specified evapotranspiration (ET) data that are based on monthly satellite data processed by LandIQ as part of the Subbasin's SGM GSP Implementation Round 1 Grant. Surface water supplies are incorporated based on measured data and regional precipitation (PRISM); using these collective data sets, IDC calculates the groundwater extraction necessary to meet the crop demand. Urban demands in C2VSimFG-Kern are based on agency-supplied extraction data and/or population and per-capita water demand.

Table ES-1 summarizes the Kern County Subbasin groundwater extractions by water use type and measurement method for WY 2023. Additional details on water use types and groundwater extractions are provided in **Section 3**. **Figure 13** shows the areal distribution of total groundwater extraction volumes over the Subbasin during WY 2023. **Figure 17** graphically presents historical groundwater extractions from WY 1995 through WY 2023.

Table ES-1. Groundwater Extractions in the Kern County Subbasin for Water Year 2023

Groundwater Extraction	Total Groundwater Extractions	Metered Volume	Electrical Records Volume	Land Use Volume	Groundwater Model Volume	Other Methods Volume
Water Use Type	Acre-ft	Acre-ft	Acre-ft	Acre-ft	Acre-ft	Acre-ft
Urban	157,979	105,511	0	52,468	0	0
Industrial	0	0	0	0	0	0
Agricultural	589,169	20,192	0	568,977	0	0
Managed Wetlands	0	0	0	0	0	0
Managed Recharge	174,504	174,504	0	0	0	0
Native Vegetation	0	0	0	0	0	0
Other	3,811	3,811	0	0	0	0
Total	925,464	304,018	0	621,445	0	0

Surface Water Supply

For the Kern County Subbasin, surface water supplies are measured directly by local water agencies at the point of diversion from a river, stream or canal using measurement devices and monitoring protocols. Surface water data were collected by measurement devices with a high level of accuracy consistent with relevant standards. Measured surface water data were provided by local agricultural districts, urban water purveyors and city water departments for this Annual Report (see **Table 1**). These surface water supplies are tabulated in **Table ES-2** below. Additional details on surface water supplies are provided in **Section 4**. A map showing surface water supply infrastructure and features in the Subbasin is provided on **Figure 14.**

Table ES-2. Surface Water Supplies in the Kern County Subbasin for Water Year 2023

Surface Water Supply	Surface Water Supply Volume
Surface Water Supply Source	**Acre-ft**
Central Valley Project	518,928
State Water Project	814,859
Colorado River Project	0
Local Supplies	1,765,244
Local Imported Supplies	48,040
Recycled Water	36,949
Desalination	0
Other Water Source	148
Total Surface Water Supply	3,184,168

Total Water Use

Based on data and tables in preceding sections, the total water use in the Subbasin is provided by Water Source Type and Water Use Sector on **Tables ES-3** and **ES-4**. Additional details on the tabulation of Total Water Supply and Use are provided in **Section 5**.

Section 5 provides a preliminary assessment of changes in water demand in the Subbasin during the GSP implementation period. The data presented on **Tables ES-1, ES-2, ES-3 and ES-4** are compiled into the data templates provided by DWR and submitted along with this Annual Report for consistent reporting of information and data.

Table ES-3. Total Water Use by Source Type, Kern County Subbasin, Water Year 2023

Total Water Use	Total Water Supply by Volume
Water Source Type	**Acre-ft**
Groundwater	925,464
Surface Water	3,147,071
Recycled Water	36,949
Reused Water	148
Other Water Source Type	0
Total Water Supply	4,109,632

Table ES-4. Total Water Use by Water Use Sector, Kern County Subbasin, Water Year 2023

Total Water Use	Total Water Use Volume
Water Use Sector	**Acre-ft**
Urban	192,425
Industrial	0
Agricultural	2,212,723
Managed Wetland	16,340
Managed Recharge	1,824,171
Native Vegetation	0
Other Water Use	178,315
Total Water Use	4,423,974

*Water Demand and Supply numbers vary slightly due to unaccounted for losses.

The difference in total water supply and total water use is 314,342 acre-feet representing less than 7% of the total water supply. These volumes and percentages are consistent with estimated conveyance losses for the Kern County Subbasin. Therefore, this difference is considered to represent losses primarily due to canal seepage that contribute to groundwater recharge.

Change in Groundwater in Storage

As required by the GSP regulations, the following figures included in the WY 2023 Annual Report illustrate the changes in groundwater in storage over the Subbasin:

- Graph depicting water year type, groundwater use, the annual and cumulative change in groundwater in storage based on historical data to the greatest extent available, including from January 1, 2015 to the current reporting year.
- Change in groundwater in storage maps for Subbasin Principal Aquifers.

The Subbasin GSAs continue to support the annual updating of the C2VSimFG-Kern local model to assist with the change in groundwater in storage analyses. The model results represent the total change in groundwater in storage for the entire Kern County Subbasin that includes all Subbasin Principal Aquifers.

Figure 15 shows the simulated change in groundwater in storage graph for the Kern County Subbasin over the 28-year period from WY 1995 to WY 2023. The graph includes the annual and cumulative change along with the water year type based on the San Joaquin Valley Index (CDEC, 2023). For WY 2023, a wet water year type, the groundwater in storage for the Kern County Subbasin **increased** by 2,289,354 acre-feet (AF).

Figure 17 presents the annual basin-wide change in groundwater in storage map for WY 2023, using the C2VSimFG-Kern model results. The change in groundwater in storage represents the sum of the total inflow components plus the total outflow components. A positive value represents an increase in the

volume of groundwater stored in the aquifer that was typified by a rise in groundwater levels whereas a negative represents a decrease in groundwater in storage typified by a decline in groundwater levels.

WY 2023 was rated as a wet water year under the San Joaquin Valley Index (CDEC, 2023), and the Kern River Index was 320 percent of average Kern River flows (COB, 2023). As such, recharge increased across the Subbasin and water levels have begun to recover for the previous drought years. The change in groundwater in storage is concentrated in the vicinity of the large groundwater banking operations primarily in the center of the Subbasin, representing large volumes of recharge that occurred during the wet water year conditions. Groundwater elevations in the banking areas historically fluctuate over a range of 200 feet in response to recharge and recovery operations. These operations lead to highly variable year-to-year change in groundwater in storage. Therefore, the concentrated change in storage in the banking areas is a highly managed activity that plays a key part in maintaining the groundwater sustainability for the Subbasin.

Current Conditions for Sustainability Indicators

With the critically dry conditions between WY 2020 and WY 2022, groundwater levels declined below MTs in 28 of the 200 monitoring wells (less than 14 percent of network wells), mostly focused in the central Subbasin but also scattered across multiple management areas in the Subbasin. The majority of these MT exceedances (26) occurred early in WY 2023 (Fall 2022) when the Subbasin was still in a critically dry water year condition. Increasing groundwater elevations as a result of the wet water year conditions of WY 2023 reduced the number of MT exceedances to 15 in Spring 2023. During WY 2023 there were a total of six domestic household wells reported dry to the DWR Dry Well Reporting System web site. The Subbasin did not experience Undesirable Results as defined by the 2022 Amended GSPs.

The year-to-year variability in the change in groundwater in storage for the Subbasin reflects these water year types. In WY 2022, a critically dry water year type, the groundwater in storage declined by 1,740,468 acre-feet, whereas in WY 2023, a wet water year type, the groundwater in storage increased by 2,289,354 acre-feet. A comparison of the results from the Historical simulation to the Projected-Future Baseline Scenarios indicates that the Subbasin remains on track with its sustainability plan despite experiencing two critically dry years in WY2021 and WY2022 (**Figure 18**).

The 2022 GSPs do not define a formal, Subbasin-wide water quality monitoring network. However, most GSAs have implemented some independent monitoring programs to establish baseline conditions in their management areas. Collectively, the Kern Subbasin GSAs report that there were no Undesirable Results related to water quality in WY 2023 monitoring period.

Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR indicates that for most of the Subbasin vertical displacement ranged from -0.1 to +0.5 feet (-1.2 to +6 inches) that represents areas with minimal to rising vertical displacement. Vertical displacement between -0.2 to -0.1 feet (-2.4 to -1.2 inches) occurs in localized areas scattered across the Subbasin (**Figure 20**).

Progress on GSP Implementation

The GSAs and member agencies associated with the six GSPs have provided progress reports on their respective GSP implementation activities for WY 2023. These progress reports provided in **Sections 9.1** through **9.6** are organized by the six GSPs, in alphabetical order for the lead GSA. KGA member agencies that have prepared Management Area Plans are listed in alphabetical order within **Section 9.3**. To facilitate DWR review, a consistent reporting format was established, based on the components listed in the GSP regulations (*§356.2(b)(5)(C)*), as follows:

1) Compliance with Sustainable Management Criteria (SMC)
    a. Compliance with SMC
    b. SMC Monitoring Activities
    c. Assessment of Potential Impacts to Beneficial Users
2) Compliance with Additional Sustainable Management Criteria
    a. Water Quality
    b. Subsidence
    c. Interconnected Surface Water
3) Implementation of Projects and Management Actions (PMAs)
4) Coordination with Stakeholders
5) Summary of Other GSP-related Special Studies or Activities

In brief, all the Subbasin GSAs are in the process of implementing their GSPs, or addressing their data gaps, and are committed to coordination for sustainable groundwater management. Many GSP monitoring networks have been fully implemented; others are planning new monitoring sites. Some networks represent areas where local groundwater conditions do not have a long monitoring history and/or where little groundwater pumping occurs due to undeveloped land use (e.g., rangeland), and naturally poor groundwater quality. These areas have proposed new monitoring locations and/or "Watch Areas" to assess for changes, if any, in current land and groundwater use.

To demonstrate the significant progress that GSAs/member agencies have been making on specific projects and management actions, those activities are briefly summarized in **Table ES-5;** the locations of the narrative that describe these actions in more detail are also provided in **Table ES-5** for reference. Additional information is provided in **Sections 8.1** through **8.3** that include a summary on the various outreach and coordination activities conducted by the GSAs/member agencies in WY 2023. Individual GSAs' management area summaries are provided in **Sections 9.1** through **9.6**.

In addition to the implementation of the individual GSPs, GSAs and member agencies are also coordinating on a collective effort to accomplish GSP implementation activities on a Subbasin-wide basis, including those documented in the Kern County Subbasin Coordination Agreement. These efforts, led by the CC, are summarized in **Sections 8.1** through **8.3**. These Subbasin wide efforts are summarized below:

- **Coordination on Amended GSPs** - Following the DWR Incomplete Determination letter on January 28, 2022, the Kern County Subbasin GSA and member agency managers met weekly to

coordinate corrective actions and prepare Amended GSPs. A Kern Subbasin Amended Coordination Agreement and Amended GSPs were submitted to DWR in July 2022.

- **Coordination on Annual Report Data** - Agencies shared in costs to produce this Annual Report. Accordingly, this submittal of the Annual Report represents the completion of an important GSP implementation measure that demonstrates ongoing coordination on a Subbasin-wide basis.
- **Application of the Kern County Subbasin DMS** - The Subbasin GSAs are utilizing the web-based DMS to support GSP monitoring and analyses (Coordination Agreement, Appendix 5). In WY 2023, the DMS continued to be updated as the primary location for water budget data for the annual report and model updates.
- **Successful Grant Application, SGM GSP Implementation Grant Program, Round 1** - The Kern County Subbasin began implementation in WY 2023 of a $7.6 million Round 1 sustainable groundwater management grant for critically overdrafted basins under the Sustainable Groundwater Management (SGM) Grant Program authorized by the California Budget Act of 2021 and Proposition 68. The grant supports projects that encourage sustainable management of groundwater resources as required by SGMA. The grant includes the following components.
    - **Grant Component: Basin Study** - The Kern County Subbasin Study is a systematic, Subbasin-wide analysis to address technical data gaps. In WY 2023, work was conducted towards addressing data gaps in the hydrogeological conceptual model (HCM), watershed hydrology and water budgets. The Basin Study provides the framework for more refined water budget analyses to support ongoing GSP planning and implementation.
    - **Grant Component: Evapotranspiration Analysis & Study – Field By Field** - In WY 2023, the Subbasin GSAs worked with Land IQ to expand their ET monitoring service to all irrigated agricultural areas within the Subbasin. LandIQ began providing monthly ET data in WY 2023. These data were used for the model update in this Annual Report.
    - **Grant Component: Land Subsidence Investigations and Monitoring** - The Subbasin GSAs supported implementation of a regional land subsidence investigation to improve the land subsidence monitoring program (Coordination Agreement, Appendix 3). In WY 2023, the Subbasin GSAs worked in consultation with the United States Geological Survey (USGS) and the Friant Water Authority to plan and design a new extensometer device along the Friant-Kern Canal to assess the causes and magnitude of subsidence along this critical regional infrastructure.
    - **Grant Component: Monitoring Wells** – In WY 2023, Subbasin GSAs used funds for improvements to existing monitoring network throughout the Kern Subbasin by repairing existing monitoring wells, conducting video surveys to document screen intervals, and converting existing municipal and/or ag wells to monitoring wells.

Table ES-5. GSP Implementation Summary for WY 2023

GSP	Management Area (Report Section)	Projects	Management Actions
Buena Vista GSP	Buena Vista Water Storage District GSA (Section 9.1.1)	Two new recharge facilities were used for the first time in 2023; Palms Water Bank recharge facility fully operational (1,142 acres); Continuing to develop out of District recharge facility, James Water Bank.	District growers converted open ground farmland into pistachio orchards; Reduced demand by 2,800 AFY by purchasing land to take out of production.
Henry Miller GSP	Henry Miller Water District GSA (Section 9.2.1)	Optimized recharge and recovery of Pioneer Project banked water including banking and recharge for overdraft correction; Supplemental water supplies were purchased to increase recharge activities for the Pioneer Project.	Utilized available surface water in lieu of groundwater for District demands. Recognizing that surface water supplies meet forecasted District crop demands, virtually no groundwater was pumped in 2023, thus conserving groundwater supplies for long-term sustainability.
Kern Groundwater Authority GSP	Cawelo Water District GSA (Section9.3.1)	New water supply purchases (KR & SWP) for direct recharge (79,000 AF combined); Increased recharge and banking capacity through landowners developing private groundwater recharge facilities; New Cawelo GSA banking partners; Water treatment facilities for recycled water, two projects will be operational in WY2024/2025 (9,000 AF combined); Friant pipeline project phase 2 will be complete in late 2024 (2,160 AF).	Adopted KGA Action Plan for MT Exceedance tracking and response; Several landowners working with North Kern Resource Conservation District to identify areas for crop conversion and irrigation efficiency improvements.
	Eastside Water Management Area (Section 9.3.2)	Further development of oilfield produced water supplies; Annual monitoring of TDS and nitrates; Commencement of a native yield estimation hydrologic study; Approval for the construction of 2 monitoring wells; Continuation of the installation of 5 pressure transducers.	Planning of the reduction in agricultural water use; Continuing to establish a water transfer credit system.
	Pioneer GSA (Section 9.3.3)	Balanced pumping to mitigate any MT exceedances while continuing sustainable operations.	Continued demonstration of maintaining a positive cumulative water budget balance, recharge capacity of 302,000 AF and recovery capacity of 68,415 AF.
	Kern Water Bank (Section 9.3.4)	Recovered approximately 5,000 AF of stored surface water and stored approximately 490,000 AF in the reporting year. The estimated balance of stored water is 1.3 MAF in WY 2023. Continued involvement with other GSAs' implementation strategies for local storage.	Continued operation under Long-term Operations Plan.
	Kern Tulare Water District (Section 9.3.5)	Assisted landowners with metering requirements (88% active irrigation wells metered to district's standard); Continued to pursue CRC Pipeline Project (design 90% complete, 3,000 AF); Evaluating feasibility for 2 new surface reservoirs (8,000 AF combined).	Evaluating distribution system to identify improvements and funding mechanisms to provide full surface water deliveries (identified four projects that could reduce pumping by 2,000 AF).
	North Kern Water Storage District GSA and Shafter-Wasco Irrigation District GSA (Section 9.3.6) (Section 9.3.6)	Bell and Kimberline Recharge Project recharged 7,587 AF and 46,783 AF back into the aquifer, respectively; Farmers Coop Project, while incomplete, recharged 1,473 AF; purchase of 225 acres in total for recharge; Exchange agreements to import 6,202 AF of water supplies; Expansion of in-lieu recharge by delivering water to growers at different times; North Kern Water Resource Conservation District worked with growers to study areas for improvement; Subsurface recharge program (6,909 AF); Lining of the Calloway Canal (1,650 AF); Expanded water banking program (5,000 AF); Groundwater banking conveyance improvements, while incomplete, provided an additional 4,000 AF; Reused oilfield water (7,000 AF); Phase 1 acquiring land for expanded recharge for RRID (4,600 AF).	Coordinated on MT Exceedance Plan; adopted domestic well mitigation plan; Refinement of water budget through consultant; Evaluation of several programs and projects.
	Rosedale-Rio Bravo Water Storage District (Section 9.3.7)	Enns Basins improvement project spread 17,700 AF; Onyx Ranch project delivered 6,114 AF for groundwater storage; James groundwater storage and recovery project (design 90% complete); Kern Fan groundwater storage project delivered 8,000 AF for groundwater storage.	Feasibility study for 2 projects; Water charge demand reduction for District landowners; RRBWSD 3rd Party Recharge and Storage Program, during 2023 approximately 20,000 AF was recharged and stored; Special landowner programs that incentivized recharge on fallow lands, given the extraordinary wet-year, 6,000 AF was recharged and stored.
	Semitropic Water Storage District (Section 9.3.8)	Constructed Leonard Ave intertie project and extended distribution systems to 2,800 acres. Also implemented monitoring water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ); Introduced a fallow land water recharge program to enhance the capability to capture and recharge water; Constructed and operated 1,200 acres of temporary recharge facilities; Constructed and operated 100 acres of permanent recharge facilities.	Provided landowner budgets; Continued to work on well exceedance policy and domestic well mitigation program; Landowner recharge covering 5,800 acres and 4,438 AF; Hearing process for Tulare Lake project; 126,630 AF of additional supplemental water through in-district and Kern County projects; Supporting recharge sites development.

GSP	Management Area (Report Section)	Projects	Management Actions
Kern Groundwater Authority GSP (cont.)	Shafter-Wasco Irrigation District GSA – 7th Standard Annex (Section 9.3.9)	Reduced irrigation demand by 2,700 AF through Voluntary Rotational Land Fallowing Program of 900 acres.	Adopted domestic well mitigation plan;
	Southern San Joaquin Municipal Utility District (Section 9.3.10)	Completion of 75-acre spreading grounds, Regan Recharge Project; Continuing design of additional 80-acre recharge project to Giumarra spreading grounds; Continuing design of additional 160-acre recharge project to Caratan spreading grounds; Fallow land conversion to recharge basins demand reduction.	Domestic well survey to identify vulnerable wells; gathering data for potential allocations of water budget.
	West Kern Water District (Section 9.3.11)	Installed 1,112 AMR systems in Automatic Meter Reading Project; Participated in funding and CEQA compliance of Delta Conveyance Facility; Coordinate water supply management for BVARA.	Continued balanced pumping and recharge; Response level 1 to Governor's drought emergency order; Coordinated with Basin-wide management; Determining whether to file for basin boundary modification; Water elevation monitoring for 20 wells.
	Westside District Water Authority (Section 9.3.12)	335,000 AF of supplemental SWP surface water stored.	Coordination with Kern County Subbasin study and Westside Water Quality Coalition to improve hydrological data; Working with landowners to assess viability of a monitoring well; Well inventory assessment of 60 unknown wells; feasibility study of a phased project to integrate the treatment and use of brackish groundwater and oil field water for multiple uses; Continued financial analysis and research into funding sources, including state and federal grant programs; Collaborative discussions with Kern National Wildlife Refuge to determine potential project partnership.
Kern River GSA GSP	Kern River GSA (Section 9.4.1)	Water Allocation Plan utilized 56,000 AF in Kern Delta for overdraft correction and recharge; Kern River Optimized Conjunctive Use amounted to 232,532 AF of recharge; Wastewater Treatment Plants 2 and 3, reporting 27,671 AF of recycled wastewater used in WY 2023; Cross Valley Canal Extension Lining Project - Pool No. 8, estimated reduction in seepage is 1,695 AF per year.	Continuing to look for opportunities to acquire properties within KDWD for groundwater recharge projects and to reduce demand; Completed environmental review and is still awaiting State comments on the submitted agreements for the consolidation of up to six small water systems into the East Niles Community Service District (ENCSD); Tracking and investigating MT exceedances as they occur in the KRGSA Plan area; ID4 continued funding a share of the Delta Conveyance Project environmental review, planning and design costs at a 100 percent level for 82,946 AF.
Olcese GSA GSP	Olcese Water District (Section 9.5.1)	Collected groundwater level monitoring data from a shallow monitoring well for purposes of evaluating potential hydraulic connection local aquifers.	Collection of transducer-based water level data to study the potential hydraulic connection of local aquifers, beginning in Fall 2020, continued through WY 2023, and is ongoing; Developing a network of subsidence monitoring locations.
South of Kern River GSP	Arvin GSA (Section 9.6.1)	Nearing completion of Sunset groundwater recharge facility construction; Connected several Cal Trans basins to the District and currently taking available surface water for recharge; 8,202 AF of on-farm recharge occurred within the Kern portion of the District; Project construction of the Forrest Frick Pipeline/KDWD Eastside Canal Intertie is complete and deliveries began in February 2023; Conversion of Granite Quarry to Sycamore Reservoir geotechnical study of the quarry; Awarded $2 million from the IRWM Round 2 Grant Program to fund Frick Unit In-Lieu Banking Program; Nearing completion of DiGiorgio Unit In-Lieu Banking Program design phase 2a; Finalizing designs for a new Frick Unit surface water service area;	Provided financial incentives to landowners to conduct on-farm recharge; Completed development and calibration of a numerical groundwater flow model; Published an informational flier describing District groundwater use trends and ongoing GSA management activities.
	Tejon-Castac Water District GSA (Section 8.6.2)	Coordinated with AEWSD on Conversion of Granite Quarry to Sycamore Reservoir.	Continue management under the Tejon Ranch Conservation & Land Use Agreement and associated Ranch Wide Management Plan.
	Wheeler Ridge-Maricopa GSA (Section 9.6.3)	Through on-farm recharge, 9 landowners recharged a total of 5,657 AF; Retained a consultant to develop a 3D geologic model of the district's service area; 189,000 AF of water recharge in out-of-District banking facilities in; purchased 145,000 AF surface Kern River water;	Continued to hold discussions with proponents of certain potential desalination projects; Continued to fund the planning phase of the Delta Conveyance Project (DCP); Approved a Groundwater Service Charge (GWSC) that eventually will be levied on each AF of groundwater extracted within the District's boundaries, with the exception of de minimis and residential use; PMA Committee met several times withmembers of the general public and discussed several alternatives for well metering, allocation transfers, recharge credits, and how to accommodate domestic water users; Crop surveys showed a 9,500-acre reduction in net cropped acres between 2022 and 2023.

1 INTRODUCTION

Following the submission of five Groundwater Sustainability Plans (GSPs) in January 2020 that covered the entire Kern County Subbasin (Subbasin), the Groundwater Sustainability Agencies (GSAs) and member agencies began GSP implementation. Since that time, all of the Subbasin GSAs have coordinated to produce a single comprehensive Annual Report each year that covers the entire Subbasin in compliance with the Sustainable Groundwater Management Act (SGMA). Four Subbasin-wide annual reports have been submitted previously; this Fifth Annual Report covers Water Year (WY) 2023 and demonstrates the collective implementation of the Subbasin GSPs.

GSA management has now occurred over a four-year period (WY 2020 through WY 2023). While WY 2023 was a wet year, the three previous years were a multi-year drought with consecutive critically dry years over WY 2021 and 2022. The Subbasin continues to recover from the resulting groundwater level declines in the Subbasin. The wet conditions in WY 2023 allowed for increased water supply to recharge water to the Subbasin.

The Kern County Subbasin (Basin No. 5-022.14) is the largest subbasin in the State, covering more than 2,700 square miles of the southern San Joaquin Valley Groundwater Basin. The Subbasin is bounded by the Kettleman Plain, Tulare Lake and Tule Subbasins to the north, and by the White Wolf Subbasin to the south. A map of the Subbasin and adjacent subbasins is shown in **Figure 1**. The Kern County Subbasin, along with the Tulare Lake, Tule, and eight additional subbasins, has been designated as critically-overdrafted by the Department of Water Resources (DWR).

Kern County Subbasin relies on a diverse portfolio of local and imported surface water supplies managed with flexible and interconnected water conveyance systems. For more than 100 years, conjunctive use has been a cornerstone of local water resources management, and the Subbasin is dominated by both regional and local groundwater banking/managed aquifer recharge projects of both local and state-wide importance.

These Subbasin water resources are managed by a myriad of water districts, water storage districts, irrigation districts, and municipalities. To comply with SGMA, local water agencies originally organized into 11 GSAs that coordinated on five 2020 GSPs that covered the entire Subbasin. Since the submittal of the 2020 GSPs, agencies have re-organized to form an additional six GSAs for a current total of 20 exclusive GSAs in the Subbasin. The 20 GSAs areas are shown in **Figure 2**, along with the city limits of local municipalities.

In January 2022, DWR notified the Subbasin that, collectively, the five GSPs were incomplete and provided corrective actions for meeting GSP regulations. Subsequently, the Subbasin GSAs reorganized to amend the five GSPs and prepare one additional GSP to address DWR recommendations; these six amended GSPs were submitted to DWR in July 2022 and also cover the entire Subbasin. DWR recently determined that the six amended GSPs were inadequate to fully address the previous corrective actions; Subbasin GSAs are currently consulting with the State Water Resources Control Board (SWRCB) and

DWR, while continuing with coordinated implementation of the six GSPs. **Figure 3** shows the Plan Areas for the current six GSPs in the Subbasin.

As shown on **Figure 3**, the Kern Groundwater Authority (KGA) represents the largest GSP area and consists of nine GSAs including the KGA GSA (**Figure 2**). The KGA GSP represents separate Management Area Plans (MAPs) by individual GSAs and other member agencies of the KGA, which are bound by an "umbrella" GSP that combines the MAPs together. The separate MAPs in the KGA GSP are shown with the other five GSP Plan Areas on **Figure 4**. Collectively, **Figures 2**, **3**, and **4** illustrate the large number of agencies that have coordinated to prepare this GSP Annual Report and implement the six Subbasin GSPs.

Those efforts, including GSP monitoring, analyses of groundwater elevations and water budgets, compliance with sustainable management criteria, progress on implementation of projects and management actions, and other activities, are summarized in this Fifth Annual Report for WY 2023. This Fifth Annual Report demonstrates both coordinated and individual GSA/district progress toward the collective implementation of all six Subbasin GSPs. The location of the 20 GSAs and the six GSP areas are shown on **Figures 2** and **3**, respectively.

This Fifth Annual Report is being prepared under the guidance of Water Code Section 10728 and GSP regulations (in particular, Article 7, §356). The report combines data and information for the entire Kern County Subbasin, as provided by the GSAs that submitted the GSPs and coordinated on the preparation of this report. As such, this Fifth Annual Report is submitted as one comprehensive and coordinated Annual Report that covers the entire Kern County Subbasin.

1.1 PURPOSE OF THE GSP ANNUAL REPORT

The purpose of this Fifth Annual Report for WY 2023 is to demonstrate implementation of the six GSPs in the Kern County Subbasin in a manner that will achieve the sustainability goals. This Fifth Annual Report provides an update on the groundwater conditions for WY 2023 (Reporting Period), and documents continuing progress on GSP implementation.

Data and analyses cover the Reporting Period (October 1, 2022 through September 30, 2023); groundwater elevation hydrographs and the change in groundwater in storage analysis also cover a historical period as required by the regulations. Specifically, these two components are required to use "historical data to the greatest extent available including from January 1, 2015 to the current reporting year." (§356.2 (b)(1)(B) and §356.2 (b)(5)(B)).

1.1.1 Coordinated Submittal

Since the First Annual Report was submitted to DWR April 1, 2020, the Kern County Subbasin GSAs have coordinated on preparation of one combined document for the GSP annual reports. This successful Subbasin-wide coordination continues with the production of this Fifth Annual Report. Various coordination steps taken in development of the Annual Report are summarized below; additional Subbasin-wide coordination activities on GSP implementation are summarized in **Section 8.2**.

1.1.2 Coordinated Historical Data

For the Annual Report analyses that are required to include historical data (i.e., hydrographs and change in groundwater in storage), the Subbasin GSAs are following the same methodology used in the Subbasin GSPs and previous annual reports. In the GSPs, a consistent Subbasin-wide data set with historical data "to the greatest extent available" was developed for the historical and current study period from WY 1995 through WY 2015. This subbasin-wide water budget analysis was conducted over this period using the integrated surface water-groundwater model, C2VSimFG-Kern[1]. This process ensured that the Subbasin uses consistent data and methodologies for the Subbasin-wide water budget analysis as required by GSP regulations.

The First Annual Report updated that model from WY 2016 through WY 2019. Each successive annual report provides updates to the historical data for the preceding water year to support consistent analyses. This Fifth Annual Report updates historical data for the Subbasin through WY 2023.

1.2 COORDINATION COMMITTEE

As described in the Kern County Subbasin Annual Report WY 2022, Subbasin GSAs have organized a Coordination Committee (CC) to provide a forum to coordinate Subbasin GSP implementation. Specifically, the Coordination Agreement states that coordination activities may include "the development, planning, financing, environmental review, permitting, implementation, and long-term monitoring of the multiple GSPs in the Basin, pursuant to SGMA requirements."

Since submittal of GSPs in 2020, the Kern County Subbasin (Subbasin) has coordinated among the GSAs through development of multiple GSPs as described in Subbasin Coordination Agreement (Agreement) in compliance with SGMA regulations 23 CCR§ 357.4. Through the Agreement, 22 Subbasin GSAs and subbasin agencies have organized a Subbasin Coordination Committee (CC) to provide a forum to coordinate Subbasin GSP development and implementation, and other required elements under 23 CCR§ 357.4 (a) through (i). Specifically, Section 3 of the Agreement states that the Coordination Committee are to provide a forum to discuss Subbasin coordination activities such as "… the development, planning, financing, environmental review, permitting, implementation, and long-term monitoring of the multiple GSPs in the [Subbasin], pursuant to SMGA requirements" (Coordination Activities).

Subbasin-wide coordinated implementation activities are discussed in more detail in **Section 8.** *Progress on Subbasin-wide Coordination on GSP Implementation*. Progress on implementing each of the six GSPs, including progress on projects and management actions, is summarized in **Section 9**, *Progress on Implementation of the Six Individual GSPs in the Subbasin*.

[1] Documentation of the local model, along with water budget results, was included as Appendices 2 and 4 of the 2022 Subbasin Coordination Agreement.

1.3 APPROACH

Data and analyses for the GSP Annual Report include compilation of water level data; development of hydrographs and groundwater elevation contour maps; tabulation of groundwater extraction, surface water supply, and total water use data; and analysis of changes in groundwater in storage. Data and analyses cover the Reporting Period of WY 2023 except for hydrographs and changes in groundwater in storage, which are presented from WY 1995 through WY 2023.

1.3.1 Data Compilation

Following guidance from Article 7 of the GSP regulations and the October 2023 guidance provided by DWR, data were compiled from GSAs, member agencies, and other entities throughout the Subbasin. **Table 1** provides a list of 41 agencies who contributed directly measured or reported data in support of this Annual Report. With the recent completion of key modules in the Kern County Subbasin DMS, templates were provided to agencies to report data directly into the online DMS. This Subbasin-wide DMS was described in detail in the Third Annual Report, submitted to DWR in 2022. Expansion and improvements to the DMS are mentioned throughout this Annual Report and described in **Section 8.2**.

The DMS was also used to generate Subbasin-wide hydrographs for the GSP monitoring networks, using the groundwater elevation data as described in **Section 2**. Metered groundwater extractions, surface water supplies, and water use data were uploaded to the DMS by individual agencies and compiled into the DWR data templates that are reported in **Sections 3**, **4**, and **5**. These data were also incorporated into the C2VSimFG-Kern model update, as described in **Section 1.3.2,** which was used to calculate total groundwater extractions and change in groundwater in storage reported in **Sections 3** and **6**, respectively.

1.3.2 C2VSimFG-Kern Model Update

The Amended Kern County Subbasin Coordination Agreement refers to the local groundwater-surface water model (C2VSimFG-Kern) as the agreed upon method for generating coordinated water budgets for the Kern County Subbasin. Appendices 2 and 4 of the Amended Kern County Subbasin Coordination Agreement include a technical report (Maley and Brush, 2020) on the development and application of C2VSimFG-Kern for these purposes.

C2VSimFG-Kern is based on the C2VSim Fine Grid Public Beta model (C2VSimFG-Beta) that was released by DWR for SGMA support in May 2018. For the 2020 GSPs, the C2VSimFG-Beta input files were revised to incorporate locally derived managed water supply and demand data to better represent the local water budgets for the Kern County Subbasin (Maley and Brush, 2020). To meet the requirements for the Annual Report, C2VSimFG-Kern is updated with new input data following this same methodology to maintain consistency in generating coordinated water budgets.

For this Annual Report model update, WY 2023 data were added to the existing data structure and model input files. In addition, new recovery wells and recharge operations that became operational

during the update period were added to the model input. Monthly data were requested and provided by the local agencies through their respective GSA. The monthly data for Kern County Subbasin include:

- Surface water imports and diversions for various uses including agricultural, urban, seasonal refuge, and managed aquifer recharge/groundwater banking.
- Recharge volumes for managed aquifer recharge/groundwater banking operations.
- Measured pumping volumes for managed aquifer recharge/groundwater banking recovery operations for local use and pump-ins to regional aqueducts.
- Urban water supply, both surface water and groundwater, for the larger cities in Kern County Subbasin with emphasis on the Metropolitan Bakersfield Area.
- Stream inflows to the Subbasin for the Kern River and Poso Creek.
- Other locally important water supply or demand data provided by local agencies.

In addition to the agency data in **Table 1**, regional data sets were also updated to provide climatic data sets for the C2VSimFG-Kern update. These data sets include the following:

- Precipitation data were updated using publicly available rainfall data for WY 2023. These data were downloaded from the Oregon State University PRISM Climate Group (PRISM, 2023) web site in March 2024.
- ET rates for Kern County were determined using satellite-based data following the same process used for the original C2VSimFG-Kern development (Maley and Brush, 2020) and for previous annual reports. Prior to WY 2023, ET data were developed by the Irrigation Training & Research Center (ITRC) at California Polytechnic State University, San Luis Obispo (Howes, 2023). Starting in WY 2023, ET data are provided by LandIQ under the Subbasin's SGM GSP Implementation Round 1 Grant.

The agricultural, urban and native vegetation land use areas used the same assumptions as in the projected-future Baseline scenarios for the Kern County Subbasin GSPs (Maley and Brush, 2020). Model input for areas outside of the Kern County Subbasin use data from an analogous water year type. This is the same approach that was used for the projected-future Baseline scenarios for the Kern County Subbasin GSPs (Maley and Brush, 2020).

The 2020 GSP water budgets used WY 1995 to WY 2014 as the historical base period. During this period, C2VSimFG-Kern results show an average annual decline of groundwater in storage of 277,114 AFY. Based on the methodologies used, known data gaps and the availability of historical data, the estimated level of uncertainty of the overall water budget generated by C2VSimFG-Kern is determined to be on the order of 10 to 20 percent (Maley and Brush, 2020). Notwithstanding these limitations, C2VSimFG-Kern is considered to be the best available information and well-suited as a planning tool to estimate the impacts of the proposed SGMA projects and management actions on groundwater conditions in the Kern County Subbasin.

Table 1. List of Kern County Subbasin Agencies Contributing Data

Agency	Metered Groundwater Extractions	Surface Water Supply	Total Water Use	Groundwater Elevations
Agricultural Water Agencies				
Arvin-Edison WSD	X	X	X	X
Belridge WSD		X	X	X
Berrenda Mesa WD		X	X	X
Buena Vista WSD	X	X	X	X
Cawelo WD	X	X	X	X
Eastside WMA	X	X	X	X
Henry Miller WD	X	X	X	X
Kern Delta WD	X	X	X	X
Kern-Tulare WD	X	X	X	X
Lost Hills WD		X	X	X
North Kern WSD	X	X	X	X
Olcese WD	X	X	X	X
Rosedale-Rio Bravo WSD	X	X	X	X
Rosedale Ranch Improvement District		X	X	
Semitropic WSD	X	X	X	X
Shafter-Wasco ID		X	X	X
7th Standard Annex WMA		X	X	X
Southern San Joaquin MUD		X	X	X
Tejon-Castac WD	X		X	X
Wheeler Ridge-Maricopa WSD	X	X	X	X
Urban Water Agencies				
Arvin CSD	X			
Buttonwillow CWD	X		X	
Cal Water - Bakersfield	X	X	X	X
City of Bakersfield	X	X	X	X
City of Delano	X	X	X	
City of McFarland	X	X	X	
City of Shafter	X	X	X	X
City of Wasco	X	X	X	
East Niles CSD	X	X	X	X
Greenfield CWD	X		X	X
Kern County Water Agency ID4	X	X	X	X
Lamont PUD	X	X	X	X
North of the River Sanitation District	X	X	X	
Oildale MWC	X	X	X	
Vaughn Water Company	X		X	
West Kern WD	X	X	X	X
Other Agencies				
Berrenda Mesa Banking Project	X	X	X	X
County of Kern Parks & Rec. - BVARA	X			
Pioneer Banking Project	X	X	X	X
Kern Water Bank Authority	X	X	X	X
Kern National Wildlife Refuge		X		

The C2VSimFG-Kern water budgets and sustainable yield estimates are based on available data and the current level of model calibration and are considered appropriate to support SGMA planning efforts. C2VSimFG-Kern water budgets are not intended for determination of individual landowner allocations or groundwater rights. Additional technical, policy, and legal analysis, along with stakeholder involvement, is necessary to fully quantify the sustainable and native yields in the Kern County Subbasin.

1.3.3 DWR Data Templates

DWR has provided Microsoft Excel data templates for agencies to report their Subbasin-wide groundwater extraction volumes, measurement methods, surface water supplies, and total water use. DWR requires the GSAs to use these templates to provide for consistent statewide reporting of water use. A description of the data provided for these templates is included in the following sections. These include:

- **Part A. Groundwater Extractions** – Description of groundwater extractions by water use sector data (23 CCR §356.2(b)(2)) is presented in **Section 3**.
- **Part B. Groundwater Extraction Methods** – Description of groundwater extraction measurement methods (23 CCR §356.2(b)(2)) is presented in **Section 3**.
- **Part C. Surface Water Supply** – Description of surface water supply by water source type (23 CCR §356.2(b)(3)) is presented in **Section 4**.
- **Part D. Total Water Use** – Description of total water supply and use (23 CCR §356.2(b)(4)) is presented in **Section 5**.

As part of the submission of this Annual Report, the DWR data templates will be uploaded to the Monitoring Network Module (MNM) on the SGMA Portal, the same system used to upload GSP monitoring data.

1.4 REPORT ORGANIZATION

This GSP Annual Report is organized according to the order of topics presented in Article 7 of the GSP regulations. Topics include groundwater elevations (**Section 2**), groundwater extractions (**Section 3**), surface water supply (**Section 4**), total water use (**Section 5**), change in groundwater in storage (**Section 6**), summary of current conditions for sustainability indictors (**Section 7**), Subbasin progress towards GSP implementation (**Section 8**) and a GSA narrative descriptions of progress towards GSP implementation (**Section 9**). Groundwater elevation hydrographs are presented in **Appendix A**. Also included are an Executive Summary and general information summarized in this first section.

During WY 2023, the Kern County Subbasin GSAs have made significant progress with GSP implementation and are collectively committed to achieving sustainable groundwater management. Regularly scheduled meetings continue to be held by the CC, GSA manager groups, and technical

consultants leading coordinated Subbasin-wide GSP activities. Substantial compliance with the requirements of the Annual Report is demonstrated throughout this WY 2023 Annual Report.

2 GROUNDWATER ELEVATIONS

This Fifth Annual Report presents the semi-annual monitoring groundwater elevations measured in the GSP Representative Monitoring Wells for WY 2023 (**Figure 5**). These data have been compiled for the Kern County Subbasin through WY 2023 to provide the following required analyses:

- Preparation of water level hydrographs for GSP Representative Monitoring Wells to illustrate long-term trends and fluctuations and to demonstrate compliance relative to sustainable management criteria. The location of GSP Representative Monitoring Wells that had an MT exceedance in WY 2023 are shown symbolically on **Figure 5**.
- Development of water level contour maps for Kern County Subbasin Principal Aquifers, illustrating the seasonal high and seasonal low levels during the Reporting Period of WY 2023 (i.e., Fall 2022 and Spring 2023).

The WY 2023 data were also uploaded to the DWR Monitoring Network Module (MNM) as required in June and December 2023 in compliance with DWR semi-annual reporting requirements (by January 1, 2023 for Fall 2022 water levels and July 1, 2023 for Spring 2023 water levels). These data uploads are now coordinated through the Kern County Subbasin DMS.

2.1 HYDROLOGIC WATER YEAR TYPE

GSP regulations require that hydrographs of groundwater elevations, groundwater use, the annual change in groundwater in storage, and the cumulative change in groundwater in storage be shown with respect to the water year type representative for the Subbasin (§356.2(b)(1)(B) and §356.2(b)(5)(B). Previous annual reports have included both the San Joaquin Valley Index and the average Kern River April-July runoff to represent the water year type for the Kern County Subbasin. These two indices are maintained in this Fifth Annual Report with modifications and updates as described below and presented on **Figure 6**.

The annual water year type as represented by the San Joaquin Valley Index is shown by the graph on the bottom of **Figure 6**. The San Joaquin Valley index is calculated by DWR as inflow from the Stanislaus, Tuolumne, Merced and San Joaquin Rivers inflow into downstream reservoirs. The WY 2023 San Joaquin Valley Index, calculated by DWR, was 6.4, which is classified as a wet water year type (CDEC, 2023). The water year type based on the San Joaquin Valley Index over the historical period from WY 1995 through WY 2023 is shown on **Figure 6**.

The City of Bakersfield calculates the regulated flow, as computed at First Point of Measurement, for the Kern River annual hydrographic reports. This flow rate is also calculated as a percentage of the average long-term flow rate for the Kern River since 1894 for April through July runoff, by calendar year, and by water year. For this Fifth Annual Report, Kern River indices by water year have been updated by the City for WY 1995 through WY 2023 to align with the San Joaquin Valley Index and the Reporting Period (see top graph on **Figure 6**). As shown by the Kern River index for WY 2023, the Kern River regulated flow at First Point was 320 percent of the long-term average (COB, 2022). This index indicates a wet year through the Subbasin. However, the previous three years of drought conditions resulted in water level

declines across the Subbasin. This one wet year helps water levels recover but many wells still show impacts from the past drought.

A comparison of the San Joaquin Valley and Kern River indices shows relatively good agreement for wet and dry cycles over the historical period from 1995 through 2023. In particular, the recent drought years of 2013, 2014, 2015, 2021, and 2022 represent the five most critically dry years in the period for both the Kern River and the San Joaquin Valley. For both the San Joaquin Valley and Kern River, WY 2015 was the driest on record. The last seven years of the period represent three wet years (WY 2017, WY 2019, and WY 2023) and four below normal years (WY 2018, WY 2020, WY 2021 and WY 2022) with WY 2021 and WY 2022 being critically dry years. This oscillation between wet and critically dry years highlights the need to be able to recharge water when available and recover when needed. Since the beginning of the 2012 drought, nine of the last 12 years are characterized by the San Joaquin Valley Index as drought years with one Below Normal (BN), three Dry (D), and five Critically Dry (CD) Water Year Types. For each of those nine years, the Kern River hydrographic reports (COB, 2022) indicated flows at or below 60 percent of its long-term average, with five of those WYs at or below 30 percent (**Figure 6**). While the wet conditions help improve conditions in the basin, recovery may require additional wet years.

2.2 COORDINATED BASIN-WIDE MONITORING

The Kern County Subbasin GSAs have combined the representative monitoring wells from the six Subbasin GSPs into a Subbasin-wide GSP Representative Monitoring Network as shown on **Figure 5**. Although developed locally, networks were combined to facilitate coordination and evaluation of sustainable management criteria across GSP boundaries and throughout the Subbasin.

The Kern County Subbasin GSAs have also coordinated on monitoring protocols, as documented in each of the Subbasin GSPs and in the executed Coordination Agreement. Monitoring protocols considered Best Management Practices (BMPs), CASGEM[2] monitoring protocols, and protocols from other long-established Kern County Subbasin monitoring programs (e.g., the Kern Fan Monitoring Committee). In consideration of the variable monitoring schedules already developed for existing Subbasin programs, the following time frames were included in the protocols to allow monitoring flexibility for collection of seasonal high and low levels as experienced across this large and complex Subbasin.

- *Collection of water level data between the two approved time frames only:*
    - *January 15th to March 30th representing the seasonal high-water levels.*
    - *September 15th to November 15th representing the seasonal low water levels.*

Some GSP monitoring network wells are measured more frequently, either as part of a separate monitoring program or in compliance with GSP-specific requirements. In addition, groundwater elevation data compiled for the WY 2023 reporting period are incomplete for some wells in the network. Some of these wells were either inaccessible or not measured during the approved time frames for various reasons including collapsed casing, inconsistent readings, etc.. In addition, some of the

[2] California Statewide Groundwater Elevation Monitoring (CASGEM) program.

monitoring wells have been recently installed and/or recently added to the network; as such, some wells do not have available historical water level data.

The Subbasin GSAs have recently taken steps to address some of these issues through coordinated management actions and revised monitoring protocols developed as part of the Amended Coordination Agreement and amended GSPs, submitted to DWR in July 2022. For management of inaccessible monitoring wells going forward, GSAs have approved revised monitoring protocols that require GSAs to substitute measurements from a nearby well or evaluate trends in inaccessible wells when a semi-annual measurement is missed. This process was developed to ensure that a missed measurement would not have triggered a local management area exceedance. Details of this coordinated process, along with a description of the revised monitoring protocols, are provided in **Section 8.2**.

Appendix A provides hydrographs for each of the 200 wells in the collective Subbasin GSP Representative Monitoring Network in WY 2023. Hydrographs in **Appendix A** are divided into six sections, one for each of the six GSPs and organized alphabetically by the lead GSA as follows:

- Appendix A1 – Buena Vista WSD GSA
- Appendix A2 – Henry Miller WD GSA
- Appendix A3 – Kern Groundwater Authority GSA
- Appendix A4 – Kern River GSA
- Appendix A5 – Olcese GSA
- Appendix A6 – South of Kern River GSAs

Each hydrograph label includes the following:

- Name of the reporting agency,
- Common local well name,
- DWR Site Code, and
- Graph identification number (Graph ID).

The DWR Site Code provides a link to the well information and water level data already uploaded on the MNM, whereas the local well name allows for easier identification by local agencies. The Graph ID is also included as a well identifier label on each of the hydrographs in **Appendix A** to allow linkage back to **Figure 5**.

2.3 HYDROGRAPHS FROM WY 1995 THROUGH WY 2023

Hydrograph development and observations on trends and fluctuations, along with information on compliance with sustainable management criteria, are described below. The groundwater elevation data were used to generate hydrographs for GSP monitoring network wells where Minimum Thresholds (MTs) and Measurable Objectives (MOs) – and, in some cases, interim milestones – have been established. MTs and MOs are provided on each hydrograph in **Appendix A**.

2.3.1 Hydrograph Development

Hydrographs in this Fifth Annual Report are presented for each of the monitoring network wells shown on **Figure 5.** The hydrographs are developed within the Subbasin DMS so that the most complete groundwater elevations, well completion data and MT/MOs are used. The hydrographs are publicly available on the Subbasin DMS.

Over 200 hydrographs have been developed for this Fifth Annual Report and are presented in a consistent format in **Appendix A**. For each hydrograph, a solid black horizontal line shows the ground surface elevation (GSE), and the MT and MO are represented by orange and green lines, respectively. Groundwater elevation data are shown in blue. As described previously, hydrographs are presented in alphabetical order of the lead GSA for the six GSPs and then alphabetical by monitoring agency; page numbers for each agency's group of hydrographs in the respective section of **Appendix A (Section A1 – Section A6)** are tabulated in **Table 2**.

To comply with GSP regulations, hydrographs include "historical data to the greatest extent available, including from January 1, 2015, to current reporting year" (§356.2(b)(1)(B)). For the Kern County Subbasin, the time period from WY 1995 through WY 2023 was selected based on the 20-year historical study period (WY 1995 – WY 2014) and updated data through the reporting period (WY 2023). Accordingly, the hydrographs show the historical record of measured groundwater elevations of each well within the 30-year period from WY 1995 through WY 2023. Some wells have a long historical record whereas new monitoring wells may only have a limited number of recent measurements. The water year type for this time period uses the San Joaquin Valley Index as illustrated by the bottom graph on **Figure 6**.

Most of the hydrographs represent the Primary Principal Aquifer, composed of the alluvial continental deposits in the Subbasin. However, three local Principal Aquifers in addition to the Primary Principal Aquifer are represented by the following hydrographs in **Appendix A**:

- Six hydrographs prepared by Kern-Tulare Water District (KTWD) for the Santa Margarita Formation (note that KTWD hydrographs also include wells monitored north of the Kern County Subbasin) (see **Appendix A3-20** through **A3-25**)
- Six hydrographs prepared by Eastside Water Management Area (EWMA) for the Santa Margarita Formation and the Olcese Sand (see **Appendix A3-8** through **A3-14**)
- Two hydrographs prepared by Olcese Water District (Olcese WD) for the Olcese Sand (see **Appendix A5-1** through **A5-2**).

In compliance with GSP regulations Article 4, the hydrographs are submitted electronically and labeled with a unique site identification number (Site Code and Local Identifier), monitoring agency, and the GSE. In addition, hydrographs have incorporated the same datum and scaling to the greatest extent practical (§352.4(e)). Some vertical scales are adjusted to allow the GSE, MT, and MO to be displayed.

Table 2. Location of Hydrographs in Appendix A by GSA and Agency

GSP	Reporting Agency	Graph ID (Appendix A)
Buena Vista Water Storage District GSA	Buena Vista Water Storage District GSA	A1-1 to A1-9
Henry Miller Water District GSP	Henry Miller Water District GSA	A2-1 to A2-5
Kern Groundwater Authority GSA	Cawelo Water District GSA	A3-1 to A3-7
Kern Groundwater Authority GSA	Eastside Water Management Area	A3-8 to A3-14
Kern Groundwater Authority GSA	Pioneer GSA	A3-15 to A3-19
Kern Groundwater Authority GSA	Kern Tulare Water District GSA	A3-20 to A3-25
Kern Groundwater Authority GSA	North Kern Water Storage District GSA	A3-26 to A3-35
Kern Groundwater Authority GSA	Rosedale-Rio Bravo Water Storage District	A3-36 to A3-54
Kern Groundwater Authority GSA	Semitropic Water Storage District	A3-55 to A3-69
Kern Groundwater Authority GSA	Shafter-Wasco Irrigation District GSA	A3-70 to A3-79
Kern Groundwater Authority GSA	Southern San Joaquin Municipal Utility District	A3-80 to A3-89
Kern Groundwater Authority GSA	West Kern Water District	A-90 to A-112
Kern Groundwater Authority GSA	Westside District Water Authority	A-113 to A-115
Kern River GSA	Kern River GSA	A4-1 to A4-38
Olcese Water District GSA	Olcese Water District	A5-1 to A5-2
South of Kern River GSAs	Arvin GSA	A6-1 to A6-16
South of Kern River GSAs	Tejon-Castac GSA	A6-17
South of Kern River GSAs	Wheeler Ridge-Maricopa GSA	A6-18 to A6-31

2.3.2 Water Level Trends and Fluctuations

In general, the groundwater elevation trends seen on the hydrographs for the Primary Principal Aquifer (**Appendix A**) are consistent with the water year types illustrated on **Figure 6**. As a result, groundwater elevations generally increased in response to wet conditions in WY 2023; however, these trends vary across the Subbasin.

Historically, groundwater elevation trends in the Subbasin generally show an increase during the wet periods and a decrease during dry periods. This was observed during the wetter years of WYs 1995-1998, WYs 2005-2006, WYs 2010-2011 and the recent wet years of WY 2017, WY 2019, and WY 2023. During these wet years, there was an increase in both natural and managed aquifer recharge accompanied with a rise in groundwater elevations. This increase in groundwater elevations was more pronounced in the areas with managed aquifer recharge and banking operations. Conversely, dry periods have decreased natural recharge and also increased recovery of managed aquifer recharge by groundwater pumping. As expected, groundwater elevations generally decreased across the Subbasin during these intervening dry years. Even though WY 2023, groundwater levels remain low in many areas of the Subbasin but have begun to recover.

During the extended drought period from WY 2013 through WY 2016 and WY 2020 through WY 2022, several areas in the Subbasin experienced historic low groundwater elevations. Since that time, drought conditions have persisted with four out of the last seven years characterized as below normal, dry, or critically dry, based on both the San Joaquin Valley Index and the Kern River flows (**Figure 6**). After groundwater elevations recovered somewhat during the wet years of WY 2017, WY 2019, and most recently WY 2023, groundwater elevations have begun to recover but are still remain low in many areas of the Subbasin (**Figure 6**).

As anticipated, the areas with the largest increases in groundwater elevations in WY 2023 are in the central Subbasin in the vicinity of the Kern Fan banking operations where increased recharge occurred due to the wet conditions. In the banking areas, groundwater elevations historically fluctuate more than 200 feet from wet to dry water year types as a result of varying recharge and recovery banking operations (e.g., see hydrograph for the Pioneer GSA on page **A3-19** in **Appendix A**). The groundwater elevations in WY 2023 are consistent with that pattern. This high variability in groundwater elevations is also reflected in the annual change in groundwater in storage maps in the large Kern Fan banking areas (as described in **Section 6**).

2.4 GROUNDWATER ELEVATION CONTOURS FOR SUBBASIN PRINCIPAL AQUIFERS

GSP monitoring network data were supplemented with additional local groundwater elevation data to construct groundwater elevation contour maps for the Principal Aquifers in the Subbasin. Supplemental data include wells monitored by the Kern Fan Monitoring Committee and other available water level data. Kern County Water Agency (KCWA) typically compiles water level data on an annual basis for the Kern Fan Monitoring Committee to monitor conditions in and adjacent to the central Subbasin groundwater banking projects. To provide additional accuracy for water level contour mapping, KCWA has been combining the Kern Fan Monitoring Committee data with other available water level data over

time. To support the Kern County Subbasin GSP annual reports, KCWA has been combining these two datasets with the GSP monitoring network data to prepare water level contour maps for the Primary Principal Aquifer, as described in **Section 2.4.1** below.

In addition to the KCWA mapping of the regional Primary Principal Aquifer, groundwater elevation maps were also provided by others for two of the three local Principal Aquifers in the Subbasin. All local Principal Aquifers are much more limited in extent than the Primary Principal Aquifer as shown on **Figure 9**. Specifically, Olcese Water District GSA provided contour maps for the Olcese Sand Principal Aquifer in the Olcese GSA. KTWD provided groundwater elevations for the local Santa Margarita Principal Aquifer, although data were not yet sufficient to interpret groundwater elevation contours. In addition, data are not available for the remaining local Principal Aquifer area (i.e., Upper Aquifer in the northeast on **Figure 9**). The local agencies are working to address data gaps associated with these local Principal Aquifers.

Portions of the Kern County Subbasin overlap active oil fields that have been exempted under the United States Environmental Protection Agency (USEPA) definition of protected groundwater *(40 CFR §144.3).* An aquifer exemption is an action by USEPA to remove an aquifer or portion of an aquifer from protection as an underground source of drinking water (USDW) under the Safe Drinking Water Act (SDWA) because it does not serve as a source of drinking water either currently or will in the future. An aquifer exemption allows the exempted portion of the aquifer to be used by energy and mining companies for oil or mineral extraction or disposal purposes in compliance with USEPA's (Underground Injection Control) UIC requirements. The Subbasin GSPs define any water bearing zone within the areal extent and depth interval of an aquifer exemption as being located outside of the Kern County Subbasin and, therefore, is not included within any of the Principal Aquifers. The Basin Study is also working to better define the extent of the USEPA-approved exempt aquifers to better integrate this information into the Subbasin wide hydrological conceptual model.

2.4.1 Primary Principal Aquifer

Using the groundwater level monitoring data collected from the Subbasin representative monitoring wells, KCWA prepared groundwater elevation contour maps for the Primary Principal Aquifer, which consists mostly of continental alluvial deposits that extend throughout most of the Subbasin. As mentioned above, KCWA has been responsible for implementation of the Kern Fan Monitoring Committee program and has constructed similar basin-wide groundwater elevation contour maps for decades. Although KCWA has prepared contour maps for both seasonal highs (Spring) and lows (Fall), more data are typically collected in Spring when water levels are less affected by a long irrigation season and more accurately reflect the natural hydrologic conditions in the Subbasin. For this Fifth Annual Report, data were compiled and contoured for both Fall 2022 and Spring 2023, as shown on **Figures 7** and **8**, respectively, to comply with the GSP reporting period of WY 2023. Contours are represented as feet with respect to mean sea level (msl). Negative contours represent feet below msl.

Groundwater elevations are highest along the southeastern boundary of the Subbasin in the Sierra Nevada foothills. The highest groundwater elevations on **Figure 7** are along the Kern River (generally above 200 feet msl), which traverses across the central Subbasin from northeast to southwest (see also

Figure 1). Kern River water infiltrates alluvial deposits in the channel and local unlined canals to recharge the groundwater basin. Groundwater elevations remain relatively high in the central Subbasin but are more variable. Multiple groundwater banking projects store large volumes of recharged water for subsequent recovery in the areas along the Kern River referred to as the Kern Fan area. As reported in the First Annual Report (WY 2019), more than 1,100,000-acre feet (AF) of water were available for managed aquifer recharge, primarily associated with the Kern Fan banking projects, due to relatively wet conditions in WY 2019. In WY 2023, water levels are locally complex in this banking area due to the timing and volumes of recovery pumping from the groundwater banks, as a result of the dry conditions during Fall 2022 (**Figure 7**).

Groundwater elevation contours on **Figure 7** indicate that groundwater flows radially away from the Kern River area. Within several miles, water levels are more than 50 feet lower compared to levels areas along the river channel. Groundwater elevations continue to decline with distance both north and south of the Kern River. To the south, water levels are generally above 100 feet msl except for two areas to the south and southwest, the Buena Vista Lakebed and southern Subbasin boundary, as indicated on **Figure 7**. Groundwater elevations have declined below sea level over most of the northern Subbasin north of the Kern River. The lowest water levels (more than 100 feet below msl) occur in the northwestern Subbasin and along the northern boundary of **Figure 7** near the Subbasin subsurface outflow to adjacent subbasins to the north.

Similar patterns of water levels and groundwater flow directions are indicated for Spring 2023 conditions as shown on **Figure 8**. During this period, water levels in the Kern Fan banking areas remain highly variable with lower groundwater elevations due to concentrated areas of recovery pumping. WY 2023 is characterized by groundwater recharge in the banking areas rather than recovery due to an abundance of surface water supplies. Some areas north and south of the Kern River are higher in Spring 2023 (**Figure 8**) than in Fall 2022 (**Figure 7**) due, in part, to the migration of previously recharged water from the Kern River, the Kern Fan banking areas, and other banking areas across Kern County.

Even though Spring conditions generally represent a time of higher water levels, **Figure 8** indicates that groundwater elevations remained below sea level in a similar area of the Subbasin in Spring 2023 as compared to Fall 2022. In addition, measured groundwater elevations in this area are lower in Spring 2023 than in Fall 2022.

2.4.2 Local Principal Aquifers

Although most of the Subbasin production occurs within the Primary Principal Aquifer, two additional Principal Aquifers have been identified in the Subbasin GSPs. Although the exact extents of these three local Principal Aquifers are currently being defined for the Subbasin-wide GSP, local aquifers have been generally delineated as shown on **Figure 9** and listed in **Table 3**. Other localized areas or geologic formations within the Kern County Subbasin with wells that directly provide groundwater for beneficial use, but have not been identified as separate Principal Aquifers, are considered as part of the Primary Principal Aquifer.

As shown on **Figure 9**, three of the local aquifers occur along the northeastern margin of the Subbasin and consist of deeper consolidated units including the Santa Margarita Formation and the Olcese Sand. In those areas, groundwater is produced primarily from the Santa Margarita Formation in KTWD, both the Santa Margarita and Olcese Sand in EWMA, and the Olcese Sand in Olcese WD. In addition, a local Upper Aquifer has been observed mostly within Semitropic WSD in the northern portion of the Subbasin. Water levels in these local principal aquifers are shown on **Figures 10, 11 and 12** and discussed below.

Table 3. Local Principal Aquifers in the Kern County Subbasin

Principal Aquifer	Responsible Agency	Subbasin Area
Olcese Sand	Olcese WD GSA	East, near the Subbasin boundary adjacent to the Kern River
Santa Margarita Formation	Kern-Tulare WD GSA	Northeast
Combined Santa Margarita Formation and Olcese Sand	Eastside WMA	East-Northeast

Groundwater elevation contour maps were provided for the Olcese Sand Principal Aquifer by Olcese WD GSA; maps for Fall 2022 and Spring 2023 are presented on **Figures 10** and **11**, respectively. As indicated on **Figure 10**, Fall 2022 groundwater elevations are about 320 feet higher in the Canyon View Ranch Well in the eastern GSA than in wells to the west. A steep hydraulic gradient is evident between the Canyon View Ranch well and the deeper downgradient wells. Groundwater elevations are significantly flatter in Wells #2, #3, and #4. In Spring 2022 (**Figure 11**), groundwater elevations were relatively stable in the Canyon View Ranch Well while water levels rose an average of about 62 feet in other wells. For the Santa Margarita Formation in the northeastern Subbasin, KTWD provided groundwater elevations measured in wells from both the previously implemented CASGEM program as well as the ongoing GSP monitoring network established by KTWD. Groundwater elevations are posted on **Figure 12** for Fall 2022 and Spring 2023. As presented in previous Annual Reports, groundwater elevations both within and north of the Subbasin are posted by KTWD to provide context for the local aquifer that extends to the north (see the Kern County line on **Figure 12**).

As evidenced by the data on **Figure 12**, water levels are variable geographically and not readily conducive to water level contouring. Nonetheless, review of the data shows that water levels rebounded significantly in Spring 2023 compared to Fall 2022. Increases in groundwater elevations for Spring 2022 averaged about 100 feet for the five southern monitoring wells. Even though the increase in groundwater elevations between the two posted measurements for Fall 2021 and Spring 2022 is less in Well 8L1 than in the southern wells (only about nine feet), the overall seasonal fluctuations for that well are similar to the remaining wells (see KTWD hydrographs in **Appendix A3**). The production zone represents a narrow band of Santa Margarita sandstone that is structurally complex. Nonetheless, it provides an important local resource that is being investigated and monitored by KTWD.

3 GROUNDWATER EXTRACTIONS

The volume of groundwater extraction in the Kern County Subbasin is provided for WY 2023 per GSP Regulations (23 CCR §356.2(b)(2)). Data presentation follows the DWR data templates that list groundwater extractions by water use sector and identify the method of measurement and accuracy of measurements (**Table 4**). A map of groundwater extractions (**Figure 13**) is provided to illustrate the general location and volume of groundwater extractions in the Kern County Subbasin.

3.1 GROUNDWATER EXTRACTION DATA METHODS

Total groundwater extractions for the Subbasin for WY 2023 have been compiled and summarized for this section. The data were collected using the "best available measurement methods." For the Kern County Subbasin the groundwater extraction data were compiled using two methods:

- Directly measured groundwater extraction data collected by local water agencies.
- Estimated groundwater extractions using the IWFM Demand Calculator (IDC) tool developed by DWR (Dogrul, Kadir and Brush, 2017).

Directly measured groundwater extractions were collected using meters and other appropriate comparable measuring devices by local water agencies (**Table 1**), in accordance with the monitoring protocols of the respective local water agency. This data were compiled and provided by the local water agency to support this Annual Report. These directly measured data were obtained using high accuracy measuring devices and methodologies (see **Section 3.4**).

The remaining estimated groundwater extractions are based on DWR's IDC tool (Dogrul, Kadir and Brush, 2017) to estimate agricultural, urban and other pumping. IDC is a standalone module used in the IWFM-based C2VSimFG-Kern model that solves the soil moisture balance in the root zone using local soil properties to compute the monthly agricultural and urban water demand for each model element. If water demand is not satisfied with precipitation and applied surface water, the IDC tool calculates the groundwater pumping needed to eliminate any assumed deficit (Dogrul, Kadir and Brush, 2017). The groundwater extraction calculated by IDC is dynamically linked to the C2VSimFG-Kern to provide the overall pumping data for the groundwater model component.

For the Kern County Subbasin, IDC calculates only the groundwater extraction necessary to meet the crop and soil moisture demand after accounting for the contribution from surface water supplies and precipitation. WY 2023 surface water supplies are based on measured data provided by local agencies (**Table 1**), and regional distribution of WY 2023 precipitation is based on data developed by the PRISM Climate Group based at Oregon State University (PRISM, 2023). The determination of agricultural pumping follows the same approach used for the GSP model-derived water budgets (Maley and Brush, 2020).

IDC calculates agricultural demand based on annual crop type distribution mapping from the Kern County Agricultural Commissioner, member agency data and evapotranspiration (ET) rates for twenty irrigated crop types, the urban areas, and the managed seasonal wetlands at the Kern National Wildlife

Refuge. From WY 1993 through WY 2022, ET rates were developed by applying the METRIC process to satellite-based data processed at the Irrigation Training & Research Center (ITRC) at California Polytechnic State University, San Luis Obispo (Howes, 2023). Starting in October 2022, monthly WY 2023 ET rates were developed by Land IQ. The Land IQ has provided instrumentation over the agricultural areas within the Subbasin as part of the Round 1 sustainable groundwater management (SGM) grant from DWR (see **Section 8.2.4**). These stations provide improved field-scale ET data based on approximately 24 instrumentation stations.

Similarly, urban demands in C2VSimFG-Kern are based on agency supplied information and/or regional population and per-capita water demand. Population information was from projected-future baseline population used for the GSPs (Maley and Brush, 2020). The per-capita water demand was recalculated for the metropolitan Bakersfield area based on water supply data provided by the local water purveyors. For areas outside of the metropolitan Bakersfield area, per-capita water demand is based on urban water management plans and available local water use data. IDC calculates urban water demands for specified urban delivery zones, allocates specified surface water and groundwater supplies to meet these demands, and can optionally pump additional groundwater to satisfy unmet urban (indoor and outdoor) demands in each zone following the same approach as used for the GSP model-derived water budgets (Maley and Brush, 2020).

3.2 SUMMARY EXTRACTIONS BY SUBBASIN FOR WY 2023

Using the methods described above, the total groundwater extractions in the Kern County Subbasin for WY 2023 were tabulated. **Table 4** summarizes the Kern County Subbasin groundwater extractions by water use type and measurement method, consistent with the DWR data templates, for WY 2023.

Table 4. Groundwater Extractions in the Kern County Subbasin for WY 2023

Groundwater Extraction	Total Groundwater Extractions	Metered Volume	Electrical Records Volume	Land Use Volume	Groundwater Model Volume	Other Methods Volume
Water Use Type	Acre-ft	Acre-ft	Acre-ft	Acre-ft	Acre-ft	Acre-ft
Urban	157,979	105,511	0	52,468	0	0
Industrial	0	0	0	0	0	0
Agricultural	589,169	20,192	0	568,977	0	0
Managed Wetlands	0	0	0	0	0	0
Managed Recharge	174,504	174,504	0	0	0	0
Native Vegetation	0	0	0	0	0	0
Other	3,811	3,811	0	0	0	0
Total	925,464	304,018	0	621,445	0	0

The data show that 925,464 acre-feet of groundwater extractions occurred in WY 2023. The WY 2023 pumping volume represents a significant decrease in pumping from the previous two years due to the

increased availability of imported local surface water supplies. The total pumping volume during the critically dry WYs 2021 and 2022 was 253% higher than in WY 2023. For the Kern County Subbasin, the water use sectors are described as follows:

- **Urban** – This category includes groundwater extractions for all urban uses including residential, commercial, municipal, industrial, food processing, oilfield use, landscaping and other uses. Reported data are provided by urban water purveyors with metered data. Non-reported data are derived from land use assumptions in the IDC tool within the C2VSimFG-Kern groundwater model. The total urban groundwater extraction for WY 2023 is 157,979 acre-feet, with most of this based on metered data. Urban pumping accounts for about 17 percent of the WY 2023 total pumping.
- **Industrial** – Current data do not allow for tabulation of groundwater extraction of industrial groundwater use on a consistent basin-wide basis; therefore, industrial water use is included in the urban water use sector for WY 2023.
- **Agricultural** – These are groundwater extractions for irrigated crops and pasture (including non-district lands). Also included in this category is groundwater used for food processing and dairy operations that is then applied to nearby crops for disposal. Reported data are pumping volumes by local water agencies for agricultural use. Private agricultural pumping is determined using the IDC tool within C2VSimFG-Kern based on the Land IQ data. The WY 2023 total agricultural groundwater extraction is 589,169 acre-feet, which accounts for about 64 percent of the total pumping.
- **Managed Wetlands** – The Kern National Wildlife Refuge has historical groundwater use, but currently relies on surface water supplies. No managed wetland groundwater extractions were reported for WY 2023 for the Kern National Wildlife Refuge.
- **Managed Recharge** – This category includes groundwater extractions of stored surface water from prior water years as part of local district-managed recharge operations and large groundwater banking projects. This recovered surface water is then applied to water sector uses or are returned to the California Aqueduct or Friant-Kern Canal (i.e., “Pump-In”) as part of a water exchange. Groundwater recovery pumping amounts by local agencies for use within their jurisdiction for a specific water use are listed on **Table 4** under the appropriate water use sector (e.g., agricultural or urban). The total groundwater extraction for managed recharge recovery, as defined above, is 174,504 acre-feet, which accounts for about 19 percent of the WY 2023 total pumping.
- **Native Vegetation** – Currently, no groundwater extractions are used for maintaining native vegetation in the Kern County Subbasin.
- **Other Sector** – This category includes groundwater extractions for water use sectors that do not fit within the categories listed above. Examples include groundwater pumping for use in areas adjacent to the Kern County Subbasin, lake level management, and pumping for unspecified or multiple water-use sectors. The total groundwater extraction for other uses in the Kern County Subbasin is 3,811 acre-feet, which accounts for less than one percent of the WY 2023 total pumping.

In accordance with 23 CCR §356.2 (b)(2), the user must define the method of measurement (direct or indirect) and the accuracy of measurements. The other criteria required for presenting the groundwater extraction data is by method of measurement. As shown on **Table 4**, the groundwater extractions in the Kern County Subbasin are categorized into two of the methods listed by DWR. These include:

- **Meters** – direct measurement of groundwater extraction collected by local water agencies using meters and other appropriate measurement devices. The total groundwater extraction from metered data is 304,018 acre-feet which accounts for about 33 percent of the WY 2023 total pumping.
- **Land Use Calculation** – indirect estimate of groundwater extractions based on land use methods using the IDC tool (Dogrul, Kadir and Brush, 2017), a component of the C2VSimFG-Kern model. The total groundwater extraction based on land use calculations is 621,445 acre-feet which accounts for about 67 percent of the WY 2023 total pumping in the basin.

Groundwater extractions presented here represent the current best estimate of groundwater pumping in the Kern County Subbasin. The use of C2VSimFG-Kern, including the IDC tool, provides a consistent, basin-wide method for estimating the unmeasured pumping in accordance with the Kern County Subbasin Coordination Agreement.

3.3 GROUNDWATER EXTRACTIONS MAP

In accordance with 23 CCR §356.2 (b)(2), this Annual Report includes a map (**Figure 13**) illustrating the general location and volume of groundwater extractions. For WY 2023, a total groundwater extractions map was derived from the simulation results of C2VSimFG-Kern. The specified metered pumping is directly input into C2VSimFG-Kern while the IDC tool estimates the unmeasured portion of agricultural and urban pumping based on land use calculations (Maley and Brush, 2020).

Developing a map showing the distribution of groundwater extraction required accessing the groundwater extraction for each element from the binary output files of model results. The model output is the total volume of groundwater extracted within a model element. Because model elements vary in size, the simulated groundwater extraction rate from C2VSIMFG-Kern was normalized to the rate of acre-feet per square mile. These groundwater extraction rates were then interpolated onto a uniform one-square mile grid superimposed over the Kern County Subbasin. Therefore, the model represents the total pumping per square mile over the groundwater basin included in C2VSimFG-Kern.

Figure 13 shows the distribution of total groundwater extractions over the Kern County Subbasin. Because agricultural pumping accounts for 64 percent of the total WY 2023 groundwater extractions, the pumping distribution generally corresponds to the distribution of irrigated agriculture. The exception is in the northwestern Subbasin where irrigated agriculture depends solely upon imported surface water supplies due to poor local groundwater quality, which is unsuitable for irrigation. In general, groundwater extraction in the irrigated areas ranges between 250 to 2,000 acre-feet per square mile.

Areas of concentrated pumping are typically associated with groundwater banking recovery operations. The areas where groundwater pumping exceeds 2,000 acre-feet per square mile are located in the vicinity of managed aquifer recharge operations where the pumping is recovering previously "banked" surface water for use. Recovery of stored surface water from managed recharge operations and large groundwater banking projects were concentrated during October to December 2022. Starting in January 2023, the wide availability of imported surface water essentially eliminated demand for recovered surface water.

3.4 PART A AND B DWR DATA TEMPLATES

As part of the Annual Report submittal, DWR requires that a series of Excel spreadsheets be completed to summarize key water supply and use volumes for WY 2023 for the entire Subbasin. For groundwater extraction, DWR requires submittal of two spreadsheets with the Annual Report in accordance with 23 CCR §356.2 (b)(2):

- **Part A. Groundwater Extractions** - groundwater extractions for WY 2023 by water use sector (23 CCR §356.2(b)(2))
- **Part B. Groundwater Extraction Methods** - the volume of groundwater extractions for WY 2023 by different measurement methods (23 CCR §356.2(b)(2)).

Data summarized in **Table 4** follow the Part A and B DWR Template reporting requirements for groundwater extractions and were collected using the best available measurement methods.

The accuracy of measurement is required on the DWR templates. For the Kern County Subbasin, the groundwater extractions are based on either reported metered pumping data or simulation results of the C2VSimFG-Kern model. These data were collected by experienced agency staff from agricultural, urban and county water agencies (**Table 1**) in accordance with their monitoring protocols. The measuring devices used by these agencies are considered to be well maintained and consistently monitored; therefore, reported data meet high accuracy levels in compliance with AWWA (2006, 2012) and other relevant standards. In accordance with these standards, meter accuracy is considered high, ranging between 0 percent and 5 percent.

Estimated groundwater extractions are based on simulation results of the IDC tool within C2VSimFG-Kern model. The water balance accuracy of the groundwater model is considered medium, approximately ranging between 10 percent and 20 percent. Input data based on metering, as noted above, are assumed to have an accuracy of 0 percent and 5 percent. The agricultural pumping, which is the largest component of groundwater extraction, is estimated on ET rates and land use from Land IQ. Utilizing LandIQ data is anticipated to improve the relative accuracy of the ET rates and land use data.

4 SURFACE WATER SUPPLY

The volume of surface water supplies delivered to the Kern County Subbasin is provided for WY 2023 per GSP Regulations (23 CCR §356.2(b)(3). Data are summarized in a table that follows DWR reporting requirements for surface water supplies by water supply source and identifies the method used to determine the reported volume.

4.1 SURFACE WATER DATA METHODS

Surface water supplies for the Subbasin for WY 2023 were compiled from data collected using the "best available measurement methods." For the Kern County Subbasin, surface water supplies are directly measured by local water agencies at the point of diversion from a river, stream or canal. Water supply from natural sources (e.g., precipitation and natural runoff) are not included in **Section 4**. The contribution of these sources to the Subbasin is included in the calculation of the change in groundwater in storage based on the C2VSimFG-Kern model provided in **Section 6**.

The measured surface water supplies were provided by local agricultural water districts, urban water purveyors and city water departments (**Table 1**) for this Annual Report. These meter data were compiled by local water agencies following their monitoring protocols. Therefore, these data were obtained using a "high accuracy" method consistent with typical accuracy ranges of surface water diversions.

4.2 SURFACE WATER BY SOURCE TYPE

Using the methods described above, the surface water supply by source in the Kern County Subbasin for WY 2023 was tabulated and is summarized in **Table 5**. The water source types are defined in 23 CCR §351 (a-k). The user can identify a different water source type than those predefined by selecting "*other source type*" in the template and providing a description of the source type with the data. **Figure 14** is a map showing the primary surface water supply infrastructure and features in the Kern County Subbasin.

Table 5. Surface Water Supplies in the Kern County Subbasin for WY 2023

Surface Water Supply	Surface Water Supply Volume
Surface Water Supply Source	**Acre-ft**
Central Valley Project	518,928
State Water Project	814,859
Colorado River Project	0
Local Supplies	1,765,244
Local Imported Supplies	48,040
Recycled Water	36,949
Desalination	0
Other Water Source	148
Total Surface Water Supply	3,184,168

The data show that 3,184,168 acre-feet of surface water was supplied to the Kern County Subbasin in WY 2023. This is an increase of 387% increases in the imported and local surface water supplies due to the wet water year conditions of WY 2023 relative to the critically dry WY 2021 and WY 2022.

Following the DWR templates, the surface water supplies are presented by water source. For the Kern County Subbasin, the water supply sources are described as follows:

- **Central Valley Project (CVP)**: surface water deliveries from the CVP diverted from the Friant-Kern Canal and/or California Aqueduct (westside CVP – Cross Valley Contractors, San Joaquin River Restoration Program Recapture and Recirculation). In WY 2023, 518,928 acre-feet of CVP water were reported as delivered to local agencies, representing about 16 percent of total surface water supplies.
- **State Water Project (SWP)**: surface water deliveries from the SWP diverted from the California Aqueduct. In WY 2023, 814,859 acre-feet of SWP water were reported as delivered to local agencies, representing about 26 percent of total surface water supplies.
- **Colorado River Project**: Currently, no surface water from the Colorado River is delivered to the Kern County Subbasin.
- **Local Supplies**: surface water diversions from local surface water sources. The primary local supply is from the Kern River, but also includes other local sources such as Poso Creek and water exchanges. In WY 2023, 1,765,244 acre-feet of local surface water were reported as delivered to local agencies, representing about 55 percent of total surface water supplies.
- **Local Imported Supplies:** surface water from local sources imported from areas outside of the Kern County Subbasin. The primary source of local imported water is from treated oilfield produced water[3]. In WY 2023, 48,040 acre-feet of local imported water supplies were delivered, representing about 2 percent of total surface water supplies.
- **Recycled Water:** wastewater and recovered stormwater that is treated and used for either agriculture or groundwater recharge. In WY 2023, 36,949 acre-feet of recycled water were used, representing about 1 percent of total surface water supplies.
- **Desalination Water:** poor-quality surface water or groundwater that is treated to levels where it can be used for irrigated agriculture, urban water supply or groundwater recharge. Currently, no desalination water is available in the Kern County Subbasin; however, proposed SGMA projects include this source as a future water supply.
- **Other Water Source**: surface water obtained from sources other than those listed above or from unspecified sources. In WY 2023, 148 acre-feet of local surface water were delivered to the Kern County Subbasin. This is primarily reuse of tailwater or irrigation return flow that re-enters

[3] Produced water is water entrained with the oil and gas produced from hydrocarbon reservoirs. Produced water is primarily used for enhanced oil recovery operations (e.g., water flood, steam injection etc.); however, excess is injected into exempt aquifers. In recent years some produced water, processed at a treatment plant to meet regulatory requirements for beneficial use, is provided to water agencies as local imported surface water derived from outside of the Kern County Subbasin.

the local surface water system and is then diverted back for irrigated agriculture water supply, representing less than 1 percent of total surface water supplies.

The surface water supplies in the Kern County Subbasin vary from year-to-year due to water year type, statewide water demand and operational considerations. WY 2023 was a wet year according to the San Joaquin Valley Index; flows on the Kern River were 320 percent of the long-term average, which is also consistent with wet conditions (**Figure 6**).

4.3 PART C DWR DATA TEMPLATE

As part of the Annual Report submittal, DWR requires that a series of Excel spreadsheets be completed to summarize key water supply and use volumes for WY 2023 for the Subbasin. The volume of surface water reported in the template is by water source type. For the surface water supply, DWR requires submittal of one spreadsheet with the Annual Report in accordance with 23 CCR §356.2 (b)(3):

- **Part C. Surface Water Supply** – the surface water supply for WY 2023 based on quantitative data and listed by water source type (23 CCR §356.2(b)(3)).

Data summarized in **Table 5** follow the Part C DWR Template reporting requirements for surface water supply and were collected using the best available measurement methods.

Measurement of surface water supplies for the Kern County Subbasin includes a variety of methods, but all are considered reliable and accurate. Water agencies typically measure surface water deliveries with a combination of weirs and meters that are read and reported by agency staff. Senate Bill x7-7 (SBx7-7) requires flow measurement devices to be maintained within an acceptable range of accuracy that is defined as a volumetric flow measurement within +/- 12 percent (§597.3(a)(1))). Weirs and meters used in the Kern County Subbasin conform to the SBx7-7 volumetric accounting standards (ITRC, 2012, USBR, 2001, AWWA 2006, 2012) as documented in local water district agricultural water management plans. Procedures employed by water agencies have been standardized to further reduce potential sources of error to range between 1 percent to 10 percent depending on the measurement device. In the Part C template, an error range of 5 percent to 10 percent is listed as a conservative assumption for this Annual Report.

5 TOTAL WATER USE

The total water supply and use for the Kern County Subbasin is provided for WY 2023 per GSP Regulations 23 CCR §356.2(b)(4). Data are summarized following the DWR data templates for total water supply and use.

5.1 TOTAL WATER SUPPLY BY SOURCE

The total water supply utilizes the same data compiled for WY 2023 groundwater extractions and surface water supplies as presented in **Section 3** and **4**. The data show a total water use for the Kern County Subbasin of 4,109,632 acre-feet in WY 2023. The total water supply is summarized in **Table 6.** The water supply types shown on **Table 6** are described as follows:

- **Groundwater** includes groundwater extractions for all uses. In WY 2023, the groundwater supply totaled 925,464 acre-feet representing about 23 percent of total supplies in WY 2023.
- **Surface water** includes surface water deliveries for all uses. In WY 2023, the surface water supply totaled 3,147,071 acre-feet representing about 77 percent of total water supplies in WY 2023.
- **Recycled water** includes treated wastewater and stormwater for all use. In WY 2023, recycled water supply totaled 36,949 acre-feet representing less than one percent of total water supplies in WY 2023.
- **Reused water** includes reuse of tailwater, or irrigation return flow that re-enters local surface water system and is then diverted back for irrigated agriculture water supply. In WY 2023, reused water supply totaled 148 acre-feet representing less than 0.01 percent of total water supplies in WY 2023.
- **Other Water Source Type** - No *other* water source type is noted for the Kern County Subbasin.

Table 6. Total Water Supply by Source in the Kern County Subbasin for WY 2023

Total Water Supply	Total Water Supply by Volume
Water Source	**Acre-ft**
Groundwater	925,464
Surface Water	3,147,071
Recycled Water	36,949
Reused Water	148
Other Water Source Type	0
Total Water Supply	4,109,632

In this case, the total surface water supply from **Section 4** that is shown distributed by water source in **Table 5** is presented in **Table 6** distributed by water supply type. The total surface water supply shown on **Table 5** is distributed among surface water, recycled water and reused water on **Table 6**.

5.2 TOTAL WATER USE BY WATER USE SECTOR

The total water use also utilizes the same data that was compiled for WY 2023 groundwater extractions and surface water supplies presented in **Sections 3** and **4**. In this case, the total urban and agricultural water use is taken from the IDC tool within the C2VSimFG-Kern model. The data show a total water use for the Kern County Subbasin was 4,423,974 acre-feet in WY 2023 as summarized by water use sector in **Table 7**.

Table 7. Total Water Use by Sector in the Kern County Subbasin for WY 2023

Total Water Use	Total Water Use Volume
Water Use Sector	**Acre-ft**
Urban	192,425
Industrial	0
Agricultural	2,212,723
Managed Wetland	16,340
Managed Recharge	1,824,171
Native Vegetation	0
Other Water Use Type	178,315
Total Water Use	4,423,974

The water use sectors shown on **Table 7** are described as follows:

- **Urban** includes total water use for all urban water uses including residential, commercial, municipal, industrial, landscaping and other uses. In WY 2023, urban water use totaled 192,425 acre-feet, representing about 4 percent of the total water use.
- **Industrial** includes total water use for industrial use. Current data does not allow for tabulation of industrial water use on a consistent Subbasin-wide basis; therefore, industrial water use is included in the urban water use sector for WY 2023.
- **Agricultural** includes total applied water for all agricultural water uses including consumptive use and return flows. In WY 2023, total applied water for agricultural use totaled 2,212,723 acre-feet, representing about 50 percent of the total water use.
- **Managed Wetlands** includes total water use for maintaining managed wetlands at the Kern National Wildlife Refuge. In WY 2023, managed wetlands water use totaled 16,340 acre-feet, representing less than 1 percent of the total water use.

- **Managed Recharge** includes total water use for active recharge at the managed recharge and groundwater banking operations. In WY 2023, managed recharge use totaled 1,824,171 acre-feet, representing about 41 percent of the total water use.
- **Native Vegetation** includes total water use for maintaining native vegetation. In WY 2023, no groundwater extractions or surface water deliveries were used on native vegetation.
- **Other Water Use** includes total water use for uses other than those listed above or from unspecified uses. Groundwater recovery pumping from managed recharge operations listed on **Table 3** are also listed here. In WY 2023, Other Water Uses totaled 178,315 acre-feet, representing 4 percent of the total water use.

The total water use also utilizes the same data that was compiled for WY 2022 groundwater extractions and surface water supplies presented in Sections 3 and 4. In this case, the total urban and agricultural water use is taken from the IDC tool within the C2VSimFG-Kern model. The difference in total water supply and total water use is 314,342 acre-feet representing less than 7% of the total water supply. These volumes and percentages are consistent with estimated conveyance losses for the Kern County Subbasin. Therefore, this difference is considered to represent losses primarily due to canal seepage that contribute to groundwater recharge.

5.3 PART D DWR DATA TEMPLATE

As part of the Annual Report, DWR requires completion of a series of Excel spreadsheets that summarize key water supply and use volumes for WY 2023 for the Subbasin. For the total water use, DWR requires that one spreadsheet be submitted in accordance with 23 CCR §356.2 (b)(3):

- **Part D. Total Water Use** – the total water supply by water use type and total water uses by water use sector for the preceding water year (WY 2023) for the entire Kern County Subbasin (23 CCR §356.2(b)(4)).

Data summarized in **Tables 6** and **7** follow the Part D DWR Template reporting requirements for total water supply and use and were collected using the best available measurement methods.

6 CHANGE IN GROUNDWATER IN STORAGE

GSP regulation §356.2(b)(5) requires inclusion of the following maps and graphs in the Annual Report for the entire Kern County Subbasin:

(A) Change in groundwater in storage maps for each principal aquifer in the basin.

(B) A graph depicting water year type, groundwater use, annual change in groundwater in storage, and cumulative change in groundwater in storage for the basin based on historical data to the greatest extent available, including from January 1, 2015, to the current reporting year.

This section provides a description of the methodology used to develop the required annual change in groundwater in storage maps and graphs.

6.1 METHODOLOGY

The Kern County Subbasin GSAs have coordinated on the approach and documentation (in maps and graphs) of change in groundwater in storage for the entire Subbasin; these were based on the updated C2VSimFG-Kern model results. The Kern County Subbasin Coordination Agreement refers to the local groundwater-surface water model (C2VSimFG-Kern) as the agreed upon method for generating coordinated water budgets for the Kern County Subbasin. C2VSimFG-Kern uses comparable data sets and methodologies over the entire Subbasin that meet the numerous technical requirements for basin-wide coordination in §357.4.

This current approach for continued update and use of the primary DWR modeling tool (with our local Kern County updates for evaluating basin conditions) will maintain consistency of method for presenting the basin-wide change in groundwater in storage. A summary of C2VSimFG-Kern development is provided in **Section 1.3.2**, and additional documentation is available as Appendix 2 and 4 of the Kern County Subbasin Coordination Agreement (Maley and Brush, 2020).

6.2 GRAPHS OF CHANGE IN GROUNDWATER IN STORAGE

GSP Regulation §356.2(b)(5)(B) requires that the Annual Report include graphs of the following basin-wide information. The graphs are to include historical data, to the greatest extent available, including from January 1, 2015, to the current reporting year. These graphs are to include the following information:

- Water year type (Wet, Above Normal, Below Normal, Dry, Critically Dry)
- Groundwater use
- Annual change in groundwater in storage
- Cumulative change in groundwater in storage

6.2.1 Change in Groundwater in Storage Graph

Figure 15 shows the simulated change in groundwater in storage graph for the Kern County Subbasin over the 28-year period from WY 1995 through WY 2023. The updated C2VSimFG-Kern results for change in groundwater in storage for the Kern County Subbasin and the water year type based on the San Joaquin Valley Index (CDEC, 2023) are summarized on **Figure 15**.

The variation in the simulated change in groundwater in storage over the historical period generally corresponds with the variation in climatic conditions and surface water supply availability (**Figure 15**). During the periods WY 1995 to WY 1999, WY 2005 to WY 2006 and WY 2011, the groundwater storage volume was stable to increasing; this correlates to the above average rainfall and surface water availability during these times. During the periods WY 2000 to WY 2004, WY 2007 to WY 2010 and WY 2012 to WY 2015, groundwater storage volume decreased, correlated to periods of drought and low surface water availability.

For WY 2023, a wet water year type, the groundwater in storage increased by 2,239,354 acre-feet. This is significantly higher than the historical average change in groundwater in storage over the 20-year base period (WYs 1995 through 2014), which was a decline of 277,119 AFY. However, the change reflects the abundant surface water supplies and other improved water conditions related to the wet water year conditions of WY 2023 including the increased ability of the Subbasin GSAs to recharge and store and increased amount of this available surface water in the aquifer for use in critically dry water years (**Figure 6**).

6.2.2 Groundwater Use Graph

For WY 2023, a wet water year type, the Kern County Subbasin had a total groundwater use of 925,464 acre-feet, of which 64 percent was for agricultural use, 17 percent for urban and industrial use, 19 percent for groundwater bank recovery[4] and less than one percent for other uses. Other uses include local lake level management and water use outside of the Subbasin. **Figure 16** shows the simulated groundwater use based on updated C2VSimFG-Kern model results along with the water year type based on the San Joaquin Valley Index (CDEC, 2023). The total groundwater pumping and distribution by water use for WY 2023 is similar to the other recent wet years of WY 2017 and WY 2019.

In general, total groundwater pumping in the Kern County Subbasin is about 60 percent lower during WY 2023 compared to the previous two critically dry years. This is primarily driven by the availability of surface water for irrigated agriculture during the wet years which led to a decrease to groundwater pumping. Therefore, lower groundwater use is anticipated for a wet year such as WY 2023.

Agricultural pumping in WY 2023 was similar period other wet water year types (WYs 1998, 2011 and 2017), and was about 662,000 acre-feet lower, or about 60% less, than the average agricultural pumping during the historical base period for the Subbasin (WYs 1995 to 2014). Urban pumping in WY 2023

[4] Recovery pumping associated with groundwater banking extracts local and imported water that was recharged in previous years.

remains slightly lower than during the historical period due to increased use of surface water and implementation of water conservation measures. Groundwater recharge for groundwater banking was high in WY 2023, but similar to that for WYs 2011, 2017 and 2019.

6.3 MAP OF CHANGE IN GROUNDWATER IN STORAGE FOR THE SUBBASIN

GSP regulation §356.2(b)(5)(A) requires inclusion in the Annual Report of an annual change in groundwater in storage map. In the Kern County Subbasin, four principal aquifers were defined; however, three of these principal aquifers are small, localized aquifers that currently have limited data. Therefore, the WY 2023 Annual Report presents the change in groundwater in storage for the entire Subbasin rather than separate estimates for each principal aquifer.

6.3.1 WY 2023 Change in Groundwater in Storage Map

The change in groundwater in storage map was developed following a similar process as used for the groundwater extraction map. The C2VSimFG-Kern binary output files were accessed to extract the change in groundwater in storage for each element and model layer. C2VSimFG-Kern output provides the total volume of storage change within a model element for all four model layers. To compensate for the fact that model elements vary in size, the data were normalized to the rate of acre-feet per square mile. The normalized rates were then interpolated onto a uniform one-square mile grid superimposed over the Kern County Subbasin. The map on **Figure 17** shows the C2VSimFG-Kern model results as the total change in groundwater in storage per square mile over the entire Kern County Subbasin.

Figure 17 presents the annual basin-wide change in groundwater in storage map for WY 2023. The change in groundwater in storage represents the sum of the total inflow components plus the total outflow components. A positive value represents an increase in the volume of groundwater stored in the aquifer, which is physically represented as a rise in groundwater levels whereas a negative represents a decrease in groundwater in storage typified by a decline in groundwater levels.

As stated previously, WY 2023 was rated a wet water year under the San Joaquin Valley Index (CDEC, 2023), and the Kern River Index was 320 percent of average Kern River flows (COB, 2022). The largest change in groundwater in storage is concentrated in the center of the Kern County Subbasin in the vicinity of the large groundwater banking operations along the Kern River. Other areas of concentrated groundwater recharge are noted to the north and southeast near those large managed recharge operations. Widespread increases in groundwater in storage are observed with areas along the margin showing minor changes likely associated with the delay effect of recharge benefitting groundwater in the more undeveloped areas of the Subbasin. Agricultural and urban areas show lower magnitude annual changes on **Figure 17**, but these are more widespread over the Subbasin. Localized recharge along the major streams and from runoff from the surrounding watersheds is significant in wet years.

Figure 17 illustrates how managed recharge and groundwater banking operations produce the most significant localized changes in groundwater in storage due to the magnitude and concentration of such activities. For the wet water year conditions of WY 2023, these activities are dominated by large volumes of recharge occurring for the purpose of storing surface water in the aquifer that will be used to

provide a critical water supply when other surface water supplies are scarce. During the recovery periods, these managed recharge and groundwater banking operations will experience a decline in groundwater in storage associated with the recovery pumping occurs. However, these operations have rules to not recover more than has been previously recharged and have a portion of the recharge water designated as a "leave-behind" ranging from 6% to 50% to further benefit the Subbasin.

6.3.2 Accuracy of Change in Groundwater in Storage Maps

Using WY 1995 to WY 2014 as the base period, C2VSimFG-Kern results show declining groundwater levels and long-term reduction of groundwater storage, with an average-annual decline in groundwater in storage of 277,114 AFY. An estimated level of uncertainty of the overall water budget was determined to be on the order of 10 percent to 20 percent for the historical C2VSimFG-Kern results used in the Kern County Subbasin GSPs (Maley and Brush, 2020). This range is based on a weighted average of the simulation results compared to the relative accuracy of the input values (see **Section 3.4**).

7 CURRENT CONDITIONS FOR SUSTAINABILITY INDICATORS

This Fifth Annual Report includes information about the five sustainability indicators relevant in the Kern Subbasin (no sea water intrusion is present). Consistent with the regulations 23 CCR § 356.2(c), the GSAs should describe, tabulate, and provide graphical representation of current sustainability indicators. These SGMA indicators include:

- Chronic lowering of groundwater levels
- Reduction of groundwater storage
- Degradation of water quality
- Land subsidence
- Groundwater-related surface water depletions

7.1 CHRONIC LOWERING OF GROUNDWATER LEVELS

The hydrographs for GSP monitoring network wells illustrate how groundwater elevations compared to their assigned MOs and MTs during the reporting period (**Appendix A**). Note that the water level declines below MTs occurred in some wells prior to the submission of the GSPs and prior to GSP implementation. The location of the GSP Representative Monitoring Wells that exceeded an MT in WY 2023 are shown symbolically on **Figure 5**.

With the persistence of dry conditions from WY 2020 into early WY 2023, groundwater levels have declined below MTs in 28 of the 200 monitoring wells (14 percent of network wells), mostly focused in the central Subbasin but also scattered across multiple management areas in the Subbasin. The majority of these MT exceedances (26) occurred early in WY 2023 (Fall 2022) when the Subbasin was still in a critically dry water year condition (**Table 8**). Increasing groundwater elevations as a result of the onset of wet water year conditions in January 2023 reduced the number of MT exceedances to 15 in Spring 2023.

Similar to WY 2022, the only Management Area Exceedance for WY 2023 occurred in the Urban MA of the KRGSA, covering about five percent of the Kern County Subbasin. Water levels in three wells fell below MTs for more than three consecutive months. These wells have begun to recover and are above or within ten feet of the MTs. It is anticipated the water levels in these wells will continue to recover due to the current wet conditions. This Management Area Exceedance did not cause undesirable results in the Subbasin as defined in the Kern County Subbasin Coordination Agreement.

Discussions of MT exceedances and Management Area Exceedances are provided in the GSAs' and member agencies' GSP Progress Summaries in **Section 9**. Currently, the Subbasin is developing new Sustainable Management Criteria for water levels and the next Annual Report will use the new methodology.

Table 8. MT Exceedances by GSA

GSA	MT Exceedances Fall 2022	MT Exceedances Spring 2023
Arvin GSA	4	0
Cawelo GSA*	2	1
Kern River GSA	12	10
KCWA Pioneer GSA	1	0
West Kern WD GSA	4	2
Westside DWA GSA	1	0
Wheeler Ridge-Maricopa GSA	2	1
TOTAL	**26**	**15**

*The Spring 2023 measurement in Cawelo GSA was identified as a bad reading (see **Section 9.3.1**)

Groundwater levels are discussed in detail in **Section 2** and groundwater storage is discussed in **Section 6**. In addition to the current conditions of levels and storage in the basin, these indicators could also point to impacts in domestic wells. During WY 2023 there were a total of six domestic, household wells were reported to the DWR Dry Well Reporting System web site[5] (**Table 9**). Three of the wells, within the Kern River GSA area, were reported to have a reduction in water pressure. Two of the wells, located in the Kern Groundwater Authority GSA and Kern River GSA, were reported to be completely dry. One well collapsed within the Rosedale-Rio Bravo Water Storage District GSA.

Table 9. Reported Dry Wells in WY 2023

ID	Status	Water Issues	Approximate Issue Start Date	GSA
22068	Resolved	Well is dry (no longer producing water).	17-Apr-2023	Kern Groundwater Authority GSA
22268	Undefined	Well is dry (no longer producing water).	01-May-2023	Kern River GSA
22347	Undefined	Reduction in water pressure, lower flows.	01-Jan-2023	Kern River GSA
22371	Undefined	Reduction in water pressure, lower flows.	06-Mar-2023	Kern River GSA
22654	Undefined	Reduction in water pressure, lower flows.	01-Aug-2023	Kern River GSA
22826	Undefined	Well collapsed.	01-Aug-2023	Rosedale-Rio Bravo Water Storage District GSA

[5] https://mydrywatersupply.water.ca.gov/report/

7.2 REDUCTION OF GROUNDWATER IN STORAGE

Change in groundwater in storage is an important indicator for evaluating performance with respect to sustainability. As shown on **Figure 6**, the annual change in groundwater in storage in the Kern County Subbasin can vary substantially from year-to-year due to water year type, statewide imported surface water availability and water use. The year-to-year variability in the change in groundwater in storage for the Subbasin reflects these water year types. In WY 2022, a critically dry water year type, the groundwater in storage declined by 1,740,468 acre-feet, whereas in WY 2023, a wet water year type, the groundwater in storage increased by 2,289,354 acre-feet.

As the GSP implementation progresses, the Subbasin will be evaluating performance towards attaining sustainability. A key indicator is the water budget, and the current tool for evaluating the water budget is the C2VSimFG-Kern model. For the Annual Report, the historical simulation using the C2VSimFG-Kern model has been updated through WY 2023 (see **Section 1.3.2**). Because of the year-to-year variability, a comparison of the results from the Historical simulation to the Projected-Future *Baseline* Scenarios (Maley and Brush, 2020) provides a means to assess the overall progress of the Subbasin GSAs towards implementing their GSP plans.

Figure 18a compares the change in groundwater in storage of Historical simulation with the Projected-Future Baseline Scenarios, both with and without Subbasin GSP PMAs (shown on **Figure 18a** as *"Baseline + Projects"* and Baseline, respectively). Both the Historical and Projected-Future Baseline Scenarios forecast that this year-to-year variability will persist over the SGMA implementation period (**Figure 18a**). The Historical simulation results show that the declines and increases during WYs 2020 to 2023 in the Historical scenario are in line with the *"Baseline + Projects"* Scenario.

The difference between Baseline and *"Baseline + Projects"* Scenarios shows the annual effects of the implementation of Subbasin GSP PMAs over time. The summation of the annual effects provides the cumulative change in groundwater in storage (**Figure 18b**). The *"Baseline + Projects"* Scenario illustrates the plan for the Subbasin to reach groundwater sustainability by WY 2040. Figure 18b shows that the cumulative change in groundwater in storage from the Historical simulation compares favorably to the *"Baseline + Projects"* Scenario. This indicates that the Subbasin has started out on track with its sustainability plan despite experiencing two critically dry years in WY 2021 and WY 2022.

A comparison for groundwater pumping shows a similar variability. The total groundwater pumping in WYs 2021 and WY2022 are consistent with the maximum pumping rates (representing critically dry water years) for the *"Baseline + Projects"* Scenario, but less than the groundwater pumping reported for WYs 2014 and WY2015 (**Figure 19a**). In WY 2023, total groundwater pumping decreased with the increased availability of surface water that are also consistent with the minimum pumping rates (representing wet water years) for the *"Baseline + Projects"* Scenario. **Figure 19b** provides a similar comparison for agricultural pumping that shows the Historical simulation results are comparable to below the *"Baseline + Projects"* Scenario during WYs 2021 to 2023. This indicates that groundwater pumping has been maintained consistent with the GSA sustainability plans. Despite the Subbasin experiencing two critically dry years in WY2021 and WY2022, agricultural pumping does not show an

increasing trend by comparing pumping to similar water years and is a key factor in keeping the change in groundwater in storage for the Subbasin on track.

To further evaluate factors affecting agricultural pumping, **Figure 20a** summarizes the change in irrigated land acreage in the Subbasin over time based on an evaluation of multiple land use and ET data sets. **Figure 20a** shows that irrigated agriculture acreage for the Subbasin has declined from 900,000 acres in the 1990s to less than 700,000 acres during WYs 2018 to WY2023. The agricultural demand based on the crop evapotranspiration (ETc) shows a similar decrease in volumetric demand over time (**Figure 20b**). There are multiple potential factors contributing to the observed agricultural land use changes including water supply availability, economic factors, drought response and other issues. However, the Subbasin GSAs also began implementation of their Subbasin GSP PMAs in WY 2020. Several GSAs implemented PMAs for drought mitigation measures that included land fallowing that were implemented during the critically dry years of WY 2021 and WY 2022 to provide temporary demand reduction. The results of these PMAs contribute to the observed decreased demand observed in WYs 2021 to 2023.

This is a preliminary assessment of factors contributing to change of groundwater in storage estimates. The Subbasin GSAs are currently coordinating on several Subbasin-wide management actions to improve the ability to determine the ET crop demand, upgrade the C2VSimFG-Kern model and conduct a Basin Study to address data gaps and better calculate water budgets. These projects, summarized in Section 8.2.4, will allow the Subbasin GSAs to better track and evaluate performance of the GSP implementation over time.

7.3 WATER QUALITY

The 2022 GSPs do not define a formal, Subbasin-wide water quality monitoring network or sampling protocol. However, most GSAs have implemented some independent monitoring programs to establish baseline conditions in their management areas. GSAs who have not implemented a monitoring program are relying in Irrigated Lands Regulatory Program (ILRP) or Division of Drinking Water (DDW) Title 22 water quality monitoring programs.

In the North Subbasin, Kern River Fan, and South Subbasin areas, arsenic is the primary constituent of concern, particularly where municipalities are impacted. Throughout the North Subbasin and Kern River Fan, water levels are used as a proxy for water quality degradation (increasing arsenic concentrations). During 2023, groundwater levels increased throughout the Subbasin due to the wet water year conditions and as such arsenic concentrations are not expected to increase due to declining water levels. Additionally, analysis of GSA samples results and DDW data indicate there were no new arsenic detections or increasing trends. In the South Subbasin, sample results show arsenic concentrations were measured at values lower than their respective MTs.

The primary Constituent of Concern in the East Margin of the Subbasin is salinity, which is represented by total dissolved solids (TDS), to monitor potential migration of brackish groundwater in the Santa Margarita Formation and Olcese Sands from the west. KTWD GSA and the EMWA's TDS monitoring of the representative monitoring wells confirms salinity is not increasing along the brackish/freshwater

interface. No groundwater quality samples have exceeded the minimum threshold of 750 milligrams per liter (mg/L) of TDS. The East Margin south of Kern River Fan has de minimis groundwater extractions and is not presently monitored for groundwater quality.

The Western Fold Belt of the Subbasin is naturally high in salinity, limiting agricultural and municipal beneficial uses of groundwater. As a result, there are no present MTs for water quality. Baseline monitoring for general minerals, TDS, and nitrate has been conducted in some wells and does not indicate any significant changes in groundwater quality. Similar to the East Margin, the southern portion of the Western Fold Belt does not have any known groundwater uses.

Collectively, the Kern Subbasin GSAs report that there were no Undesirable Results related to water quality in WY 2023 monitoring period. The Kern Subbasin is currently working to revise their GSP, which includes establishing Subbasin-wide SMCs and monitoring protocols. It is anticipated these revised plans will be implemented in fall 2024. Additionally, the Subbasin is using a web-based DMS for reporting on SMCs. Water Quality data will be entered into the DMS to allow the public to easily access water quality data for the Representative Monitoring Network.

7.4 SUBSIDENCE

Land subsidence has been documented in the southern San Joaquin Valley for more than 100 years and recent investigations using satellite imagery, global positioning system (GPS) stations and spirit leveling indicate continuing land subsidence in much of the basin. To assess land subsidence occurring during WY 2023, **Figure 21** uses a color ramp to depict the areal distribution of vertical displacement derived from Interferometric Synthetic Aperture Radar (InSAR) data provided by DWR. DWR has commissioned studies (TRE Altamira, 2019, 2023) to evaluate the accuracy of remote sensing and identify additional processing and calibration methods for accuracy.[6] The benefit of InSAR is that large areas of land can be accurately surveyed with no invasive actions or land surface access complications.

From **Figure 21**, vertical displacement of -0.2 feet (-2.4 inches) is limited to a small area along the northern Subbasin boundary, which is connected to a broader area of subsidence north of the Subbasin. Vertical displacement between -0.2 to -0.1 feet (-2.4 to -1.2 inches) occurs in localized areas scattered across the Subbasin. Over most of the Subbasin, vertical displacement ranged from -0.1 to +0.1 feet (-1.2 to +1.2 inches) that represents areas with minimal vertical displacement. Areas of the Subbasin with greater observed vertical displacement (-0.2 to -0.6 feet) may be influenced by factors other than GSA-related pumping. Several areas show increases in vertical displacement of 0.1 to 0.5 feet (1.2 to 6 inches). These areas of the Subbasin suggest elastic rebound occurring due to the wet conditions of WY 2023. The review of the WY 2023 InSAR map indicates that areas of potential land subsidence are highly localized with most of the Subbasin experiencing minimal to increasing levels of vertical displacement.

[6] The InSAR accuracy is 0.06 feet at a 95% confidence level according to Towill (2023).

7.5 INTERCONNECTED SURFACE WATER

While the six GSPs submitted reviewed potential groundwater dependent ecosystems (GDEs) none were identified. In addition, the surface water in the Subbasin was assessed and found to be generally disconnected from the groundwater systems. As such the six GSPs did not set any SMCs for interconnected surface water depletion. However, two GSPs identified PMAs (Olcese WD and Semitropic WSD) to conduct further monitoring of potential ecosystems dependent on shallow perched water. Monitoring continues and if any GDEs are identified, additional SMCs may be developed in future GSPs or periodic evaluations.

8 PROGRESS ON GSP IMPLEMENTATION

GSP regulations (*§356.2(b)(5)(C)*) require GSAs to describe progress towards implementing a GSP in the Annual Report "including achieving interim milestones, and implementation of projects or management actions." GSPs were originally submitted to DWR in January 2020 and amended in July 2022. In March 2023, the Subbasin received notification of a determination by DWR that the GSPs were collectively inadequate. Since March 2023, a variety of Subbasin-wide coordination activities were conducted to amend the 2022 GSPs. **Section 8** summarizes these activities and provides a summary of those Subbasin-wide coordination efforts for ongoing GSP implementation of the six GSPs.

8.1 PROGRESS MADE ON ADDRESSING DEFICIENCIES IN DWR DETERMINATION LETTER

The CC and Subbasin GSAs have coordinated on a variety of Subbasin-wide GSP implementation activities as demonstrated by the accomplishments summarized below.

Since submittal of GSPs in 2020, the Kern County Subbasin has coordinated among the GSAs through development of multiple GSPs as described in Subbasin Coordination Agreement (Agreement) in compliance with SGMA regulations 23 CCR§ 357.4. Through the Agreement, 22 Subbasin GSAs and agencies have organized multiple set of meetings to coordinate Subbasin GSP development and implementation, and other required elements under 23 CCR§ 357.4 (a) through (i). Specifically, Section 3 of the Agreement states that the Coordination Committee are to provide a forum to discuss Subbasin coordination activities such as "… the development, planning, financing, environmental review, permitting, implementation, and long-term monitoring of the multiple GSPs in the [Subbasin], pursuant to SMGA requirements" (Coordination Activities).

As described in the WY 2022 Annual Report, the CC provided oversight on the submittal of Amended GSPs and an Amended Agreement in response to DWR on the 2022 Subbasin Preliminary Determination Letter which indicated the Subbasin GSPs were collectively "incomplete" and required additional correction actions. During WY 2023, DWR responded to the Amended GSPs submitted in 2022 with an Inadequate Determination Letter (DWR Letter) which identified additional deficiencies requiring corrective action. The following deficiencies were identified in the DWR Letter:

- The GSPs do not establish undesirable results that are consistent for the entire Subbasin.
- The Subbasin's chronic lowering of groundwater levels sustainable management criteria do not satisfy the requirements of SGMA and the GSP Regulations.
- The Subbasin's land subsidence sustainable management criteria do not satisfy the requirements of SGMA and the GSP regulations.

Throughout WY 2023, the Subbasin Parties have continued to meet and provide oversight on various Subbasin-wide activities for GSP implementation as required by SGMA, including development of Amended GSP(s) to determine if State intervention is warranted through a probationary hearing process administered by the SWRCB.

The Subbasin has made significant progress to address the identified deficiencies in the DWR Letter in consultation with SWRCB staff. As currently planned, the Subbasin intends to submit Amended GSP(s) in May 2024 for SWRCB Board consideration prior to a probationary hearing.

Since receipt of the DWR Letter, the Subbasin has participated in bi-weekly meetings to address the deficiencies through development of common and coordinated revised GSP(s). Throughout this process, the Subbasin has coordinated and held 7 technical meetings with SWRCB staff and held over 117 meetings between landowner representative policy members, GSA/MA managers, and a technical working group (TWG) of 15 consultants. Together, the group has successfully formulated a subbasin-wide coordinated approach to address the identified deficiencies. The meetings to date have addressed the Subbasin's Amended GSPs coordinated approach for:

- Monitoring Network
- Projects and Management Actions
- Sustainable Management Criteria (Water Levels, Water Quality, Subsidence, Storage)
- Water Budgets
- Well Inventory and Well Mitigation Program

8.2 PROGRESS ON SUBBASIN-WIDE COORDINATION FOR GSP IMPLEMENTATION

In addition to development of Amended GSPs during WY 2023, Subbasin-wide coordinated implementation activities are discussed in more detail in **Section 8.1** *Progress on Subbasin-wide Coordination on GSP Implementation*. Progress on implementing each of the six GSPs, including progress on projects and management actions, is summarized in **Section 9**, *Progress on Implementation of the Six Individual GSPs in the Subbasin*.

8.2.1 Coordination on GSP Monitoring Data

The Subbasin GSAs continue to coordinate for collecting and reporting of GSP monitoring data. The Subbasin GSAs perform semi-annual GSP monitoring for groundwater elevations and water quality in accordance with their respective GSPs. Compilation and reporting of the semi-annual monitoring data are now conducted using the DMS.

All semi-annual water level measurements are entered into the Subbasin DMS. These data are reviewed by the GSA managers for accuracy using the DMS mapping and graphing capability to aid in their review. This early quality assurance/quality control (QA/QC) process allows the data to be checked and corrected before submittal to the DMS and MNM. Once approved, data are moved to the public DMS and reported to the SGMA portal. GSP monitoring data were uploaded to the MNM on the SGMA portal in January and July 2023 during WY 2023.

To further support the GSA managers in tracking the basin wide performance of the GSP monitoring data with respect to their GSP sustainability compliance criteria, the DMS includes a feature to email notifications were developed to alert agency and GSA managers when a minimum threshold exceedance

occurs. Managers can also use the DMS to track minimum threshold exceedances either through online mapping or downloading reports.

8.2.2 Coordination on Annual Report Data

As documented in previous sections throughout this Fifth Annual Report, GSAs and associated member agencies in the Subbasin have collaborated and contributed to the technical analyses and the tabulation of water use data presented in this report. More than 40 agencies provided data and information to update the C2VSimFG-Kern local model in support of the Annual Report water budgets. Accordingly, this submittal of the Fifth Annual Report represents continued cooperation on an important GSP implementation measure demonstrating ongoing Subbasin-wide coordination. Additional information on this coordinated data compilation effort is provided below.

8.2.3 Application of the Kern County Subbasin DMS

The data compilation process for this Fifth Annual Report was coordinated with data-entry templates developing during last water year's Annual Report. These templates streamline water supply and use data developed using the Kern County Subbasin DMS. These agency-specific templates were developed for each of the agencies contributing data to the Annual Report; publicly available data to support the Annual Report were also incorporated when available. Agencies logged into the DMS and completed their agency data templates, which were then transmitted to the technical team developing the Annual Report analyses. This process improved the efficiency of compiling data for the update of the C2VSimFG-Kern local model and other analyses supporting the Annual Report. The DMS has been in use for agencies to upload their water level data since Spring 2021. For context, a brief summary of the DMS and its development process is provided below.

As documented in the previous Third Annual Report for WY 2021, the CC and Subbasin GSAs coordinated on the development of a customized, web based DMS to support GSP monitoring and analyses (Coordination Agreement, Appendix 5). The DMS was developed by GEI Consultants, Inc. (GEI) based on their experience in working with DWR on the development of its online SGMA Portal and MNM, as well as their knowledge of Subbasin GSPs, local groundwater conditions, and monitoring data. Additional modules continue to be built as agency managers work through SGMA implementation and identify modules that enable them to better review and coordinate with data management. The project has been funded by a DWR grant under Round 3 of the SGM Grant Program (Proposition 68). Subbasin GSAs coordinated successful grant applications and provided additional funding.

8.2.4 Ongoing SGM GSP Implementation Grant Program, Round 1

The Kern County Subbasin received a Round 1 SGM grant for critically overdrafted basin under the SGM Grant Program authorized by the California Budget Act of 2021 and Proposition 68 for projects that encourage sustainable management of groundwater resources that support SGMA. The contract between DWR and the KGA on behalf of the Kern County Subbasin GSAs was signed on August 8, 2022. The work has continued over WY 2023 and in many cases is still ongoing.

The Work Plan for this grant includes five Components that will develop a more complete understanding of the groundwater subbasin to support long-term sustainable groundwater management. The five components include:

- Component 1: Grant Agreement Administration
- Component 2: Kern County Subbasin – Basin Study
- Component 3: Kern County Subbasin – Evapotranspiration Analysis & Study – Field by Field
- Component 4: Subsidence Investigation and Study - Priority Area #1
- Component 5: New or Converted Monitoring Wells

COMPONENT 1: GRANT ADMINISTRATION

Grant administration supports development of Environmental Information Form, Grant Completion Report, project reports and invoices, and other grant management requirements for the grant.

COMPONENT 2: BASIN STUDY

The Subbasin GSAs are cooperating on the implementation of their recently completed GSPs. The Basin Study is a systematic, basin wide analysis to address technical data gaps in the HCM, water budgets and model calibration. To make the results of the Basin Study more accessible, a series of GIS maps and geodatabases will be developed. Incorporated in the Basin Study are multiple meetings to provide opportunities to update progress of the technical work and to answer questions, address comments and receive guidance.

A key objective of the model recalibration is to improve the simulation of groundwater elevations relative to MT/MOs across the Subbasin and provide improved support to long-term GSP implementation planning. The calibrated IWFM-Kern model will produce an updated historical water budget and change in groundwater storage estimates for the Subbasin. The Basin Study is also intended to provide technical data to support future policy decisions for achieving long-term sustainability of groundwater in the Subbasin. Although the Basin Study is currently ongoing, data from the Basin Study is being used to provide a more coordinated technical basis to support the amended GSP effort to address the DWR Deficiency Letter planned for WY 2024.

- **Task 1: Data Compilation and GIS Mapping –** Multiple efforts were conducted to collect data and information from local agencies, The emphasis on Task 1 was the compilation of data on the physical setting including the climate, hydrology, watersheds, geology, land use and water use from local and state agencies, publicly available data and other resources. These data are being incorporated into GIS, databases and other appropriate means for the sharing of these data.
- **Task 2: Hydrological Evaluation** – Various methods and published reports of the local hydrology and small watershed runoff for the Subbasin were evaluated to address data gaps related to hydrology. These methods were compared and showed overall consistency of results among the various methods. The general rainfall-runoff correlations were developed through a local analysis of gauged watershed in the Subbasin and adjacent areas. These will be used to improve the representation of the hydrology in the updated Subbasin model.
- **Task 3: Hydrogeological Evaluation** – A detailed assessment was conducted to combine geologic data and interpretations from multiple sources including the USGS, DWR, CalGEM, local

agencies, and other published reports to address data gaps by developing a consistent basin wide hydrogeological interpretation of the Subbasin. This effort included compiling hundreds of geological and geophysical logs from local agencies and CalGEM. From these a series of maps cross sections were developed to tie together local interpretations include a more coordinated basin wide approach that will be used to better represent the local HCM in ongoing analysis and model updates.

- **Task 4: Water Budget Methodology Upgrades** – A comprehensive evaluation was conducted to address data gaps for updating land use and evaluation of agricultural and urban water demands. A comprehensive evaluation of land use from the County Agricultural Commission and Planning Agencies, DWR land use analysis, and ET data from ITRC (Howes, 2023) and LandIQ grant Component #3 data to better represent local land use in ongoing analyses.
- **Task 5: IWFM-Kern Model Upgrades –** Initial work on developing the updated IWFM-Kern model were started in WY 2023 and will continue into WY 2024.
- **Task 6: IWFM-Kern Calibration** – Calibration of the IWFM Model is planned to be initiated in WY 2024.
- **Task 7: Technical Report**– A comprehensive report is planned to be initiated in WY 2024.
- **Task 8: Project Coordination and Meetings** – Nine technical presentations were given during WY 2023 primarily for technical review by local agencies, policymakers and GSAs. Multiple meetings with local agencies on technical issues in their areas related to the Basin Study were also conducted.

The goal of the Basin Study is to support multiple aspects of future GSP planning and implementation work by the Subbasin GSAs that will provide multiple benefits for a wide range of communities, water users and stakeholders including Underrepresented Communities. The objective is to improve the understanding of groundwater response to the implementation of projects and management actions, (particularly with reference to MTs and MOs), to determine the native yield of the Subbasin, and to assess subsurface flow within and out of the Subbasin.

COMPONENT 3: EVAPOTRANSPIRATION ANALYSIS & STUDY – FIELD BY FIELD

Irrigated agriculture represents the largest water use within the Subbasin. Currently, agricultural water demands are estimated based on ET rates; therefore, ET needs to be estimated as accurately as possible. Beginning with the 2023 water year, the entire Kern Subbasin uses a service provided by Land IQ to calculate ET rates based on satellite remote sensing data on a field-by-field basis.

The Kern County Subbasin uses the service provided by Land IQ for all irrigated agricultural areas within the Subbasin. This will provide a consistent basin wide methodology for calculating ET based on local climatic and cropping data.

The Land IQ approach is to provide instrumentation over the agricultural areas within the Subbasin that are not already instrumented. These stations provide improved calculation of ET on a field-by-field and crop-by-crop basis; field data are used for the calibration and validation of ET models using satellite imagery. Approximately 24 stations are installed in areas where improved ET values would support more accurate groundwater extraction estimates, especially in agricultural areas. Using the calibration data

from the climatic stations, basin wide ET rates are then modeled on a field-by-field basis and delivered on a monthly timestep.

A web tool is used to relay the results each month to the Subbasin GSAs. All of these spatial results significantly enhance the ability to better understand the overall water balance within the Subbasin and comply with necessary regulatory requirements. Because the results are landscape-wide for the Kern Subbasin, they will serve all communities within the subbasin.

COMPONENT 4: SUBSIDENCE INVESTIGATION AND STUDY – PRIORITY AREA #1

As provided in the Coordination Agreement (Appendix 3), the Subbasin GSAs committed to implementation of a regional land subsidence investigation to improve the land subsidence monitoring program. This regional effort was developed to supplement the local monitoring of land subsidence in each individual GSP and focused on potential impacts to critical infrastructure of regional importance, such as the California Aqueduct and the Friant-Kern Canal. Five areas of interest (AOIs) were identified for further investigation. Currently, the Subbasin GSAs are investigating sources of funding to subsidize efforts to close this data gap at two key AOIs (No. 1 and 3) along the Friant-Kern Canal (FKC) and two key AOIs (No. 2 and 4) along the California Aqueduct (**Figure 1**).

Component 4 consists of purchase, placement, and construction of an extensometer to provide subsidence data along the Friant-Kern Canal (Area of Interest #1). During WY 2023, the planning, siting and design work was conducted for the extensometer in close consultation with the Friant Water Authority and the USGS. Installation of the implementation extensometer is planned for WY 2024. The data from this extensometer will provide data to better evaluate the cause and/or activity that is triggering subsidence in this area as well as the actual rate of subsidence. This will assist in working with the California Aqueduct and Friant-Kern Canal within the basin to understand subsidence in the Subbasin.

Additional subsidence studies were conducted to further evaluate the causes of subsidence and to help site the monitoring devices for future monitoring installations. The study conducted additional InSAR assessment and coordination with scientists at Lawrence Berkeley National Laboratory to better characterize the potential for geo-mechanical stresses in the Kern Subbasin on critical infrastructure that may be induced by land subsidence.

COMPONENT 5: MONITORING WELLS

Component 5 is underway in WY 2023 to improve the existing monitoring network by repairing existing monitoring wells, conducting video surveys to document screen intervals, and converting existing municipal and/or ag wells to monitoring wells.

8.3 OUTREACH AND COORDINATION ACTIVITIES

As demonstrated by the individual progress reports below, GSAs and member agencies conduct frequent meetings with a wide variety of stakeholders and beneficial users to provide meaningful engagement regarding GSP implementation. All GSAs and member agencies hold regularly scheduled public meetings of their Board of Directors/City Councils where they address SGMA and GSP-related activities. GSA/member agency websites provide calendars with noticed meetings and agenda. Most

GSA/member agency websites also provide resources and information regarding GSP implementation. GSA monitoring data and mapping functions are available to the public on the Subbasin online DMS. In addition to these online tools, agencies also have provided flyers and informational materials on GSP projects and management actions. GSAs and member agencies have also engaged in both coordination meetings and individual communications with non-member agencies in the respective GSA service area and with agencies in adjacent Management Areas.

Finally, as demonstrated in **Section 8.1** and throughout this Annual Report, Subbasin-wide coordination occurs on a regular basis through both the CC and frequent managers' meetings on a variety of topics including the preparation of this Fifth Annual Report, the ongoing Basin Study, the Subbasin-wide ET Study, monitoring activities, and DMS upgrades. During WY 2023, Subbasin managers held weekly meetings to coordinate responses and corrective actions regarding the 2022 DWR Inadequate Determination Letters, including meetings with personnel from the California Aqueduct Subsidence Program (CASP). The wide variety of meeting types is illustrated by the partial list below of outreach and coordination meetings with stakeholders during WY 2023:

- Regularly scheduled and noticed Public Board of Directors meetings held by both member agencies and GSAs.
- Informational meetings with landowners, growers, urban water purveyors, small water systems, and other beneficial users of groundwater.
- Coordination meetings with non-member agencies in the GSA.
- Coordination meetings with adjacent Management Areas.
- Coordination meetings with local stakeholders regarding GSP projects, such as local recharge project benefits, metering programs, water distribution rules and regulations, and other activities.
- Outreach associated with the Proposition 218 Process.
- Public access to Online DMS – mapping features and data viewing.
- Coordination meetings on Amended GSPs.
- Outreach and Adoption Hearings for Amended GSPs.
- Outreach and Public Hearings on GSA formation.
- Direct communication between stakeholders and GSA Managers/Directors.

These and other activities associated with GSP implementation are documented in the 19 individual narratives that follow below. Narratives are organized alphabetically by the lead agencies of each of the six GSPs and then by member agencies as applicable.

9 GSA NARRATIVES

This **Section 9** provides the regulatory-required information on the progress on GSP implementation of the six GSPs in WY 2023. To meet these requirements, GSAs and/or member agencies have provided brief progress reports regarding agency specific GSP implementation, which are compiled in **Section 9.1** through **Section 9.6** below.

To provide consistent information and a reasonable level of effort for the numerous agencies coordinating on this Fifth Annual Report, the outline below has been developed from GSP regulations (§356.2(c)) and used as a guide for the progress report summaries. Responses by each agency are organized around the following topics:

1) Compliance with Groundwater Levels SMC
    a) Compliance with SMC
    b) SMC Monitoring Activities
    c) Assessment Of Potential Impacts to Beneficial Users
    d) Compliance with Additional Sustainable Management Criteria
    e) Water Quality
    f) Subsidence
    g) Interconnected Surface Water
2) Implementation of Projects and Management Actions (PMAs)
3) Coordination with Stakeholders
4) Summary of Other GSP-related Special Studies or Activities

Changes to the GSP monitoring networks are also documented in the individual reports. As required in the Coordination Agreement, the CC reviewed these changes to better understand how any new sustainable management criteria could impact adjacent monitoring being conducted by others, thereby providing coordinated GSP monitoring on a Subbasin level.

Information regarding compliance with sustainable management criteria has been addressed, in part, through the preparation of hydrographs (which also show MTs and MOs) and compliance with these criteria based on recent water level data, as available. That compliance is summarized herein; as noted in **Section 2**, the compliance hydrographs are provided in **Appendix A**. Hydrographs related to each individual GSP/agency progress report is noted in the associated sections below. Hydrographs in **Appendix A** are organized by the six GSPs (**A1 – A6**) and referred to by page number (**A1-1, A1-2**, etc.).

To demonstrate the significant progress that GSAs/member agencies have been making on specific projects and management actions, those activities are briefly summarized in **Table 10;** the locations of the narrative that describe these actions in more detail are also provide in **Table 10** for reference. Finally, the individual GSP progress reports are presented in alphabetical order by the lead agency of each of the six GSPs (**Sections 9.1 through 9.6** below). For the KGA GSP, material is presented in alphabetical order for each of the 12 KGA member agencies (at the time of the GSP) that provided a separate Management Area Plan for its service area (see **Sections 9.1 through 9.6** below). Some, but not

all, of the KGA member agencies are also separate GSAs. GSAs/member agencies have provided meaningful narratives that address the most significant progress toward GSP implementation; however, narratives are purposefully concise and do not repeat all details associated with each project or management action in the GSP. The reviewer is referred to a more complete description of each project/management action in the respective GSP.

Table 10. GSP Implementation Summary for WY 2023

GSP	Management Area (Report Section)	Projects	Management Actions
Buena Vista GSP	Buena Vista Water Storage District GSA (Section 9.1.1)	Two new recharge facilities were used for the first time in 2023; Palms Water Bank recharge facility fully operational (1,142 acres); Continuing to develop out of District recharge facility, James Water Bank.	District growers converted open ground farmland into pistachio orchards; Reduced demand by 2,800 AFY by purchasing land to take out of production.
Henry Miller GSP	Henry Miller Water District GSA (Section 9.2.1)	Optimized recharge and recovery of Pioneer Project banked water including banking and recharge for overdraft correction; Supplemental water supplies were purchased to increase recharge activities for the Pioneer Project.	Utilized available surface water in lieu of groundwater for District demands. Recognizing that surface water supplies meet forecasted District crop demands, virtually no groundwater was pumped in 2023, thus conserving groundwater supplies for long-term sustainability.
Kern Groundwater Authority GSP	Cawelo Water District GSA (Section9.3.1)	New water supply purchases (KR & SWP) for direct recharge (79,000 AF combined); Increased recharge and banking capacity through landowners developing private groundwater recharge facilities; New Cawelo GSA banking partners; Water treatment facilities for recycled water, two projects will be operational in WY2024/2025 (9,000 AF combined); Friant pipeline project phase 2 will be complete in late 2024 (2,160 AF).	Adopted KGA Action Plan for MT Exceedance tracking and response; Several landowners working with North Kern Resource Conservation District to identify areas for crop conversion and irrigation efficiency improvements.
	Eastside Water Management Area (Section 9.3.2)	Further development of oilfield produced water supplies; Annual monitoring of TDS and nitrates; Commencement of a native yield estimation hydrologic study; Approval for the construction of 2 monitoring wells; Continuation of the installation of 5 pressure transducers.	Planning of the reduction in agricultural water use; Continuing to establish a water transfer credit system.
	Pioneer GSA (Section 9.3.3)	Balanced pumping to mitigate any MT exceedances while continuing sustainable operations.	Continued demonstration of maintaining a positive cumulative water budget balance, recharge capacity of 302,000 AF and recovery capacity of 68,415 AF.
	Kern Water Bank (Section 9.3.4)	Recovered approximately 5,000 AF of stored surface water and stored approximately 490,000 AF in the reporting year. The estimated balance of stored water is 1.3 MAF in WY 2023. Continued involvement with other GSAs' implementation strategies for local storage.	Continued operation under Long-term Operations Plan.
	Kern Tulare Water District (Section 9.3.5)	Assisted landowners with metering requirements (88% active irrigation wells metered to district's standard); Continued to pursue CRC Pipeline Project (design 90% complete, 3,000 AF); Evaluating feasibility for 2 new surface reservoirs (8,000 AF combined).	Evaluating distribution system to identify improvements and funding mechanisms to provide full surface water deliveries (identified four projects that could reduce pumping by 2,000 AF).
	North Kern Water Storage District GSA and Shafter-Wasco Irrigation District GSA (Section 9.3.6) (Section 9.3.6)	Bell and Kimberline Recharge Project recharged 7,587 AF and 46,783 AF back into the aquifer, respectively; Farmers Coop Project, while incomplete, recharged 1,473 AF; purchase of 225 acres in total for recharge; Exchange agreements to import 6,202 AF of water supplies; Expansion of in-lieu recharge by delivering water to growers at different times; North Kern Water Resource Conservation District worked with growers to study areas for improvement; Subsurface recharge program (6,909 AF); Lining of the Calloway Canal (1,650 AF); Expanded water banking program (5,000 AF); Groundwater banking conveyance improvements, while incomplete, provided an additional 4,000 AF; Reused oilfield water (7,000 AF); Phase 1 acquiring land for expanded recharge for RRID (4,600 AF).	Coordinated on MT Exceedance Plan; adopted domestic well mitigation plan; Refinement of water budget through consultant; Evaluation of several programs and projects.
	Rosedale-Rio Bravo Water Storage District (Section 9.3.7)	Enns Basins improvement project spread 17,700 AF; Onyx Ranch project delivered 6,114 AF for groundwater storage; James groundwater storage and recovery project (design 90% complete); Kern Fan groundwater storage project delivered 8,000 AF for groundwater storage.	Feasibility study for 2 projects; Water charge demand reduction for District landowners; RRBWSD 3rd Party Recharge and Storage Program, during 2023 approximately 20,000 AF was recharged and stored; Special landowner programs that incentivized recharge on fallow lands, given the extraordinary wet-year, 6,000 AF was recharged and stored.
	Semitropic Water Storage District (Section 9.3.8)	Constructed Leonard Ave intertie project and extended distribution systems to 2,800 acres. Also implemented monitoring water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ); Introduced a fallow land water recharge program to enhance the capability to capture and recharge water; Constructed and operated 1,200 acres of temporary recharge facilities; Constructed and operated 100 acres of permanent recharge facilities.	Provided landowner budgets; Continued to work on well exceedance policy and domestic well mitigation program; Landowner recharge covering 5,800 acres and 4,438 AF; Hearing process for Tulare Lake project; 126,630 AF of additional supplemental water through in-district and Kern County projects; Supporting recharge sites development.

GSP	Management Area (Report Section)	Projects	Management Actions
Kern Groundwater Authority GSP (cont.)	Shafter-Wasco Irrigation District GSA – 7th Standard Annex (Section 9.3.9)	Reduced irrigation demand by 2,700 AF through Voluntary Rotational Land Fallowing Program of 900 acres.	Adopted domestic well mitigation plan;
	Southern San Joaquin Municipal Utility District (Section 9.3.10)	Completion of 75-acre spreading grounds, Regan Recharge Project; Continuing design of additional 80-acre recharge project to Giumarra spreading grounds; Continuing design of additional 160-acre recharge project to Caratan spreading grounds; Fallow land conversion to recharge basins demand reduction.	Domestic well survey to identify vulnerable wells; gathering data for potential allocations of water budget.
	West Kern Water District (Section 9.3.11)	Installed 1,112 AMR systems in Automatic Meter Reading Project; Participated in funding and CEQA compliance of Delta Conveyance Facility; Coordinate water supply management for BVARA.	Continued balanced pumping and recharge; Response level 1 to Governor's drought emergency order; Coordinated with Basin-wide management; Determining whether to file for basin boundary modification; Water elevation monitoring for 20 wells.
	Westside District Water Authority (Section 9.3.12)	335,000 AF of supplemental SWP surface water stored.	Coordination with Kern County Subbasin study and Westside Water Quality Coalition to improve hydrological data; Working with landowners to assess viability of a monitoring well; Well inventory assessment of 60 unknown wells; feasibility study of a phased project to integrate the treatment and use of brackish groundwater and oil field water for multiple uses; Continued financial analysis and research into funding sources, including state and federal grant programs; Collaborative discussions with Kern National Wildlife Refuge to determine potential project partnership.
Kern River GSA GSP	Kern River GSA (Section 9.4.1)	Water Allocation Plan utilized 56,000 AF in Kern Delta for overdraft correction and recharge; Kern River Optimized Conjunctive Use amounted to 232,532 AF of recharge; Wastewater Treatment Plants 2 and 3, reporting 27,671 AF of recycled wastewater used in WY 2023; Cross Valley Canal Extension Lining Project - Pool No. 8, estimated reduction in seepage is 1,695 AF per year.	Continuing to look for opportunities to acquire properties within KDWD for groundwater recharge projects and to reduce demand; Completed environmental review and is still awaiting State comments on the submitted agreements for the consolidation of up to six small water systems into the East Niles Community Service District (ENCSD); Tracking and investigating MT exceedances as they occur in the KRGSA Plan area; ID4 continued funding a share of the Delta Conveyance Project environmental review, planning and design costs at a 100 percent level for 82,946 AF.
Olcese GSA GSP	Olcese Water District (Section 9.5.1)	Collected groundwater level monitoring data from a shallow monitoring well for purposes of evaluating potential hydraulic connection local aquifers.	Collection of transducer-based water level data to study the potential hydraulic connection of local aquifers, beginning in Fall 2020, continued through WY 2023, and is ongoing; Developing a network of subsidence monitoring locations.
South of Kern River GSP	Arvin GSA (Section 9.6.1)	Nearing completion of Sunset groundwater recharge facility construction; Connected several Cal Trans basins to the District and currently taking available surface water for recharge; 8,202 AF of on-farm recharge occurred within the Kern portion of the District; Project construction of the Forrest Frick Pipeline/KDWD Eastside Canal Intertie is complete and deliveries began in February 2023; Conversion of Granite Quarry to Sycamore Reservoir geotechnical study of the quarry; Awarded $2 million from the IRWM Round 2 Grant Program to fund Frick Unit In-Lieu Banking Program; Nearing completion of DiGiorgio Unit In-Lieu Banking Program design phase 2a; Finalizing designs for a new Frick Unit surface water service area;	Provided financial incentives to landowners to conduct on-farm recharge; Completed development and calibration of a numerical groundwater flow model; Published an informational flier describing District groundwater use trends and ongoing GSA management activities.
	Tejon-Castac Water District GSA (Section 8.6.2)	Coordinated with AEWSD on Conversion of Granite Quarry to Sycamore Reservoir.	Continue management under the Tejon Ranch Conservation & Land Use Agreement and associated Ranch Wide Management Plan.
	Wheeler Ridge-Maricopa GSA (Section 9.6.3)	Through on-farm recharge, 9 landowners recharged a total of 5,657 AF; Retained a consultant to develop a 3D geologic model of the district's service area; 189,000 AF of water recharge in out-of-District banking facilities in; purchased 145,000 AF surface Kern River water;	Continued to hold discussions with proponents of certain potential desalination projects; Continued to fund the planning phase of the Delta Conveyance Project (DCP); Approved a Groundwater Service Charge (GWSC) that eventually will be levied on each AF of groundwater extracted within the District's boundaries, with the exception of de minimis and residential use; PMA Committee met several times withmembers of the general public and discussed several alternatives for well metering, allocation transfers, recharge credits, and how to accommodate domestic water users; Crop surveys showed a 9,500-acre reduction in net cropped acres between 2022 and 2023.

9.1 Buena Vista GSP

9.1.1 Buena Vista GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

a) Compliance with SMC

Water levels were still above MOs and MTs during the Reporting Period.

b) SMC Monitoring Activities

The network of monitoring wells includes all existing District owned monitoring wells which have been in use for many years. Several of these wells are part of the data collected for the Kern Fan Monitoring Committee's monthly hydrographs. The installation of the network is 100 percent complete. DMW 04 data issues have been resolved.

There have been no changes to the GSP Monitoring Networks in WY 2023.

c) Assessment Of Potential Impacts to Beneficial Users

No interim milestones were required or set. WY 2023 water levels raised some due to the large recharge operation. They were improving following cessation of irrigation, and expectations are that they should continue to improve all through into early 2024.

2) Compliance with Additional Sustainable Management Criteria

No interim milestones were required or set. WY 2023 water levels raised some due to the large recharge operation. They were improving following cessation of irrigation, and expectations are that they should continue to improve all through into early 2024.

a) Water Quality

The BVGSA monitors groundwater quality through the IRLP and the Buena Vista Coalition and its groundwater monitoring. This information is shared with the BVGSA.

b) Subsidence

BV pumps exclusively from the upper, non-confined zone and has no subsidence. BV participates in all of the subsidence studies and plan preparations to stay informed, despite not having and subsidence.

c) Interconnected Surface Water

There is no interconnected surface water in BV. There used to be some but with no flood and furrow irrigation to the west of BV, the perched water table has dried out and dropped. With pipelines installed BV does not run water in the unlined canals in the area where the perched water exists. Levels have dropped so that there is no surface water to connect to, and the perched water level has dropped so that if there was water in the canals, they still would not connect.

3) Implementation of Projects and Management Actions (PMAs)

BVGSA made progress towards implementing several of its planned GSP Projects in Water Year 2023 as summarized by the following:

- **New Recharge Facility:** The BVWSD/BVGSA was able to use its Daley Ranch Recharge Facility for the first time in 2023. While successful, it's banking rate slowed earlier than expected. However, its location for inputting high quality Kern River water is outstanding. This was the first time the facility had been able to be used since completion of construction in December 2021.
- **New Recharge Facility:** The BVWSD/BVGSA completed construction in 2021 on the Corn Camp Recharge Facility. Staff is working with consultants to get this facility listed as a Federal Water Bank through the NEPA process. This project also was used for the first time in 2023.
- **New Recharge Facility:** The Palms Water Bank was able to recharge in the full recharge area for the first time in 2023. About 165 acres was developed and used in 2017. Approximately 530 acres were available in 2019 for recharge. In 2023 all 1142 acres was available and used for recharge the entire recharge season. This facility met its overall targets.
- **New Recharge Facility:** The BVWSD/BVGSA continues to work through regulatory hurdles in the development of a 2,072 acre water bank. BVWSD is an 85 percent owner of this project. This project is not in District. The FEIR is close to completion. This project is known as the James Water Bank at McAlister Ranch.
- **Demand Reduction:** In 2023, BVWSD (similar to BVGSA) had no District programs to reduce demand. District growers continued to convert open ground (farmed) into pistachio orchards. This reduces the overall ET in the District in the short term but will increase the demand in the long run. This increase is anticipated in the District's estimates for 2040. The increase may be a little less than anticipated to date.
- **Demand Reduction:** The District has purchased 280 acres in 2021 in addition to the 600 acres of white lands farmland previously taken it out of production. These 700 acres of previously farmed land is still fallow. This land is white land within the KGA. The BVGSA has reduced demand in the KGA by approximately 2800 AF/year by the fallowing of these 700 acres on its 880-acre holding. The four banking facilities mentioned above have all been taken out of production, the Palms, Daley Ranch and Corn Camp were all farmed in the District prior to their conversion into recharge facilities. The land at McAlister Ranch has been fallowed ever since 2013.

4) Coordination with Stakeholders

BVWSD and BVGSA are in ongoing discussions with the Buttonwillow County Water District (CWD) to assess BVWSD groundwater recharge in the vicinity of groundwater wells that supply water to Buttonwillow CWD for use in their community.

5) Summary of Other GSP-related Special Studies or Activities

- BVGSA is coordinating with the KRGSA and KGA to address a minor GSA boundary issues.

- BVGSA continues to participate in the Subbasin-wide coordinated GSP implementation activities as described above in Section 7.1.

- BVWSD continues to install its piping system throughout the District. BVWSD has delivered water to its growers through unlined canals for over 140 years. In 2016 the District embarked on an ambitious plan to deliver water via pipelines, in addition to delivering by canals. In 2023 BVWSD did not install pipeline projects. Rather its crews were performing other flood control tasks. The most notable was installing 35-36" siphons over a sandplug in the Kern River at the Coffee Road Weir. This allowed the sandplug to remain in place and keep water backed up for diversions. installed an additional 11 miles of pipe connecting most of the remaining growers to the pipeline. In a year like 2023 BVWSD was able to keep its water recharge facilities (including its miles of unlined canals) full of water and recharging throughout the basin. In one-year BVWSD was able to almost 100% offset the three drought years of 2020-2022.

- BVWSD granted a $300,000 grant to ITRC at Cal Poly San Luis Obispo to study the correlation between groundwater recharge and evaporation. The purpose of the grant is to correlate the data gathered by current satellites with actual ET so that Water Banks can accurately report water into the ground. BVWSD thinks a study of this type is required to keep up with the SGMA mandate of using the best science. Very little science has been developed on this subject despite the millions of acre-feet recharged to the groundwater in Kern County. A piece of ground in BVWSD was used as a study field in 2023.

- Open water evapotranspiration (ET) has proven difficult to measure due to variations in water depth, current or flow rates, turbidity, water temperatures, wind, mixing, and seasonality. Cal Poly - Irrigation Training & Research Center (ITRC) has been granted funds to investigate more accurate methodologies to measure open water ET that range from sophisticated instrumentation to a regionally scaled remote sensing model. ITRC's approach uses the Eddy Covariance (EC) technique to directly measure rates of open water ET. BVWSD proposed this grant funding opportunity to all of the Basin, and Rosedale Rio-Bravo WSD did step up. It was vetoed as a basin wide proposal.

9.2 HENRY MILLER WATER DISTRICT GSP

9.2.1 Henry Miller Water District GSA

The Henry Miller Water District GSA continues to be a leader in the Kern County Subbasin in demonstrating sustainable groundwater management. With above-normal Kern River and Statewide hydrology in the 2023 Water Year, available surface water supplies were plentiful for the District. With abundant surface water supplies, virtually no groundwater was pumped in 2023. Furthermore, the District recharged tens of thousands of AF of groundwater through delivery of surface water to the Pioneer groundwater banking project.

From the continued implementation of projects and management actions such as demand reduction through land fallowing and groundwater recharge operations from banking projects, the GSA's estimated average annual net groundwater use from 2016-2023 is less than the sustainable yield, demonstrating that the GSA has achieved sustainability.

1) COMPLIANCE WITH GROUNDWATER LEVELS SUSTAINABLE MANAGEMENT CRITERIA (SMC)

Progress towards compliance with sustainable management criteria for groundwater levels in the Henry Miller GSA during WY 2023 is summarized as follows:

a) COMPLIANCE WITH SMC

The goal of the GSA is to comply with all sustainable management criteria for groundwater levels and groundwater storage over the implementation period as the Kern Subbasin experiences seasons of drought, normal, and above- normal hydrologic conditions. SMC compliance for WY 2023 is summarized as follows:

Progress in Achieving Interim Milestones: Groundwater level reporting data indicate that water levels for monitoring wells in the GSA are on track with interim milestones identified in its GSP, with 2/5 wells with water levels above the IM, and 3/5 wells below the IM.

According to available data, interim milestones for reduction in groundwater storage are on track with interim milestones identified in the District's GSP.

Compliance with Measurable Objectives: Seasonal groundwater level data for 2023 indicate that the GSA is complying with measurable objectives, with groundwater levels above the MO for 4/5 GSP monitoring network wells, and 1/5 wells being less than 10 feet lower than the MO.

According to available data, the GSA is in compliance with measurable objectives for reduction in groundwater storage identified in the District's GSP.

Compliance with Minimum Thresholds: Seasonal groundwater level data for 2023 indicate that the GSA is complying with minimum thresholds, with groundwater levels above the MT for all five GSP monitoring network wells.

According to available data, the GSA is in compliance with minimum thresholds for reduction in groundwater storage identified in the District's GSP.

b) SMC Monitoring Activities

GSP monitoring activities in the Henry Miller Water District GSA during WY 2023 consisted of the following actions:

Groundwater level data for all five monitoring wells was successfully collected in the fall and spring for the annual report to represent the seasonal high and low groundwater levels, following the recommended protocols for the Subbasin.

All groundwater extraction wells within the GSA were equipped with flow meters to accurately report groundwater use for the GSA. Changes in groundwater storage data was collected following the recommended protocols for the Subbasin.

c) Assessment Of Potential Impacts to Beneficial Users

There were no observed or reported impacts to beneficial users in WY 2023.

2) Compliance with Additional Sustainable Management Criteria

Progress towards compliance with sustainable management criteria for additional sustainable management criteria in the Henry Miller GSA during WY 2023 is summarized as follows:

a) Water Quality

The most recently collected groundwater quality reporting data indicates that water quality constituent levels for monitoring wells in the GSA are on track with interim milestones and measurable objectives for 3/4 constituents of concern. No minimum thresholds were exceeded at the monitoring locations for all constituents of concern. For monitoring activities, water quality samples were successfully collected for the monitoring network following the recommended protocols for the Subbasin. The samples were analyzed for the constituents listed in the GSP.

b) Subsidence

Available land subsidence reporting data indicate that the GSA is complying with the interim milestones identified in its GSP. According to the latest available data, no minimum thresholds were exceeded at the monitoring locations. For monitoring activities, the GSA continues to monitor land subsidence by monitoring California Aqueduct Pools 29 and 30, evaluating elevations of project surveying benchmarks as reported by CASP, and evaluating INSAR data collected by the Subbasin.

c) Interconnected Surface Water

Since interconnected surface water does not exist within the GSA, there were no monitoring activities or reportable sustainable management criteria compliance/non-compliance.

3) Implementation of Projects and Management Actions (PMAs)

Implementation of Projects: In the latest GSP, the GSA's sole project is to optimize the recovery of Pioneer Project banked supplies in dry years. While the GSA has not recovered banked water in the

Pioneer Project in recent years, it has delivered significant quantities of surface water to the Pioneer Project for groundwater banking and overdraft correction in recent years, including substantial quantities in 2017, 2019, and 2023. The GSA also took opportunities in WY 2023 to purchase supplemental water supplies to increase its recharge activities for the benefit of its Project. Therefore, the GSA has made considerable progress towards the future implementation of its Project by increasing available supplies that could be used to avoid groundwater overdraft and combat declining groundwater levels within the GSA in future years.

Implementation of Management Actions: With above-normal Kern River and Statewide hydrology in the 2023 Water Year, the GSA utilized available surface water in lieu of groundwater for District demands. Recognizing that surface water supplies would be adequate to meet forecasted District crop demands early in the water year, virtually no groundwater was pumped in 2023, thus conserving groundwater supplies for long-term sustainability for the GSA.

4) Coordination with Stakeholders

SGMA related topics were discussed during the District's publicly noticed Board of Directors meetings throughout the year. Stakeholders evaluated District operations and management to assess and pursue actions that would bring long-term sustainability to the District to comply with SGMA.

5) Summary of Other GSP-related Special Studies or Activities

With above-normal Kern River and Statewide hydrology in the 2023 Water Year, available surface water supplies were plentiful for the District. Recognizing that surface water supplies would be adequate to meet forecasted District crop demands early in the water year, virtually no groundwater was pumped in 2023. The District purchased just under 13,000 AF of supplemental surface water supplies in 2023 and delivered the entire amount to the Pioneer Project for groundwater recharge. Over the course of the year, the District delivered approximately 33,000 AF of surface water to the Pioneer Project for groundwater recharge.

To further the effort to reduce net historical groundwater use, the District also purchased available overdraft correction (ODC) water supplies from previously recharged surface water from local groundwater banking projects that were credited to the District.

With the groundwater recharge operations that took place in 2023, the District's estimated average annual net groundwater use from 2016-2023 is less than the sustainable yield, demonstrating that the GSA has achieved sustainability.

Additionally, District staff engaged with other local entities to discuss both ongoing and new Kern County Subbasin groundwater and surface water issues that arose throughout the year.

9.3 KERN GROUNDWATER AUTHORITY GSP

9.3.1 Cawelo Water District GSA

Progress towards compliance with Sustainable Management Criteria (SMC) in the Cawelo Groundwater Sustainability Agency (CGSA) Management Area during the WY2023 is summarized below.

1) COMPLIANCE WITH GROUNDWATER LEVELS SUSTAINABLE MANAGEMENT CRITERIA (SMC)

CGSA has established SMCs for the Chronic Lowering of Groundwater Levels and Reduction in Groundwater Storage sustainability indicators.

a) COMPLIANCE WITH SMC

Compliance with the Chronic Lowering of Groundwater Levels and Reduction in Groundwater Storage sustainability indicators for the WY2023 is provided below. Groundwater levels are used as a proxy for Reduction in Groundwater Storage sustainability indicators in the CGSA Management Area.

- Fall 2022 and Spring 2023 groundwater levels were obtained at all seven (7) representative monitoring wells (RMWs) in CGSA.
    - The monitoring network is a subset of a preexisting groundwater monitoring network, and groundwater level measurement of the preexisting network occurred in WY2023.
- Fall 2022 groundwater elevations were greater than (i.e., did not exceed) their respective Minimum Threshold (MT) elevations in five (5) of the seven (7) RMWs. Spring 2023 groundwater elevations were greater than (i.e., did not exceed) their respective MT elevations in six (6) of the seven (7) RMWs.
    - In Fall 2022, two (2) RMWs exceeded the established MT levels for the respective RMW (RMW-172 and RMW-173). The two (2) RMWs that exceeded the MT levels are generally located within the central portion of the CGSA Management Area. However, it should be noted that the MT level exceedance for RMW-172 was within 11-feet and RMW-173 was within 1-foot.
    - In Spring 2023, one (1) RMW exceeded the established MT level (RMW-167). However, it should be noted, subsequent groundwater level measurements were obtained at RMW-167 after the reporting period, and the original reported Spring 2023 water level measurement was determined to be erroneous. RMW-167 had a confirmed water surface elevation of 73-feet mean sea level, above the MT of 25-feet mean sea level.
- RMW groundwater level data collected within the CGSA Management Area during WY2023 indicate:
    - Fall 2022 groundwater elevations generally continue to fluctuate near or above the 2025 Interim Milestone for five (5) of the seven (7) RMWs.
    - Spring 2023 groundwater elevations fluctuate near or above the 2025 Interim Milestone for all seven (7) RMWs.
    - Groundwater elevations were greater than or near their respective Measurable

Objective at two (2) RMWs in Fall 2022 and four (4) RMWs in Spring 2023.

- As per the CGSA Revised Groundwater Sustainability Plan (GSP) submitted July 2022, a Management Area Exceedance is triggered when groundwater levels decline below the established MT in 40% or more of the RMWs over four (4) consecutive bi-annual SGMA required monitoring events; a single MT exceedance is not considered an Undesirable Result. Furthermore, CGSA will utilize the Action Plan Related to Exceedance of Minimum Thresholds for Chronic Lowering of Groundwater to proactively address MT level exceedance for RMW-172 and RMW-173.

b) SMC Monitoring Activities

SMC monitoring activities in the CGSA Management Area during WY2023 consist of the following:

- Fall 2022 and Spring 2023 groundwater levels obtained at all seven (7) RMWs.
    - The monitoring network is a subset of a preexisting groundwater monitoring network, and groundwater level measurement of the preexisting network occurred in WY2023.
- Groundwater levels are used as a proxy for Reduction in Groundwater Storage in the CGSA Management Area. Fall 2022 and Spring 2023 groundwater levels were obtained at all seven (7) RMWs.
- Water quality samples were collected from all seven (7) monitoring wells.
- Groundwater levels are used as a proxy for Land Subsidence in the CGSA Management Area. Fall 2022 and Spring 2023 groundwater levels were obtained at all seven (7) RMWs.

CGSA has identified a potential eighth (8th) RMW that is owned by a local small community water system. CGSA has contacted the local small community water system to discuss including the groundwater well in the CGSA Management Area RMWs.

c) Assessment Of Potential Impacts to Beneficial Users

During WY2023 there were no observed impacts to beneficial users in the CGSA Management Area resulting from groundwater conditions. CGSA will utilize the Action Plan Related to Exceedance of Minimum Thresholds for Chronic Lowering of Groundwater to proactively address MT level exceedance for RMW-172 and RMW-173. As previously noted, the Spring 2023 RMW-167 MT exceedance was identified to be erroneous.

2) Compliance with Additional Sustainable Management Criteria

Compliance with additional SMC in the CGSA Management Area during WY2023 is detailed below:

a) Water Quality

Water quality data collected in WY2023 indicate that no Minimum Thresholds were exceeded; thus, Undesirable Results for Degraded Water Quality are not occurring in the CGSA Management Area.

b) Subsidence

Groundwater levels are used as a proxy for Land Subsidence in the CGSA Management Area. Groundwater level data collected in WY2023 indicate that two (2) MT for the Chronic Lowering of Groundwater Levels were exceeded in Fall 2022. As per the CGSA Revised GSP submitted July 2022, a Management Area Exceedance for the Land Subsidence sustainability indicator is triggered when groundwater levels decline below the established MT level at a single RMW. Because of the uncertainty associated with subsidence, CGSA will take the following steps:

- Verify if land subsidence is occurring at the locations utilizing DWR InSAR data;
- Assess whether any management area critical infrastructure is being affected by the land subsidence;
- Evaluate whether land subsidence is associated with groundwater pumping or another mechanism.

CGSA is not aware of any observed impacts to beneficial users related to subsidence during WY2023.

c) Interconnected Surface Water

There are no interconnected surface waters in the CGSA Management Area.

3) Implementation of Projects and Management Actions (PMAs)

- Progress towards implementing planned PMAs in the CGSA Management Area includes the following:
    - **P1 - New Water Supply Purchases:**
        - Negotiations continue with potential new program partners to purchase water supplies from outside the Kern Subbasin area. Due to the WY2023 hydrology, Cawelo Water District (CWD) was able to acquire surplus water (Kern River Water, State Water Project Article 21) for direct groundwater recharge and conjunctive use operations during the WY2023. Approximately 79,000 AF of surplus water was purchased and delivered within CWD in WY2023.
    - **P2 - Increase Recharge and Banking Capacity:**
        - The CWD Board of Directors approved the Landowner Groundwater Recharge and Banking Project in 2021 that allows for landowners to develop private groundwater recharge facilities increasing recharge and banking capacity within CWD. This provides an opportunity for landowners to bank privately-owned surface water and provides CWD with access to additional recharge and banking facilities (second priority right).
            - CWD is currently working with interested landowners in CWD to develop private recharge and banking projects. It is anticipated that a landowner groundwater recharge and banking project will be authorized in WY2024.
    - **P3 - New Cawelo GSA Banking Partners:**
        - Negotiations continue with potential new groundwater banking partners.

- The CWD Board of Directors approved the Landowner Groundwater Recharge and Banking Project in 2021 that allows for landowners to develop private groundwater recharge facilities increasing recharge and banking capacity within CWD. This provides an opportunity for landowners to bank privately-owned surface water and provides CWD with access to additional recharge and banking facilities (second priority right).
    - CWD is currently working with interested landowners in CWD to develop private recharge and banking projects. It is anticipated that a landowner groundwater recharge and banking project will be authorized in WY2024.

- **P4 - Water Treatment Facilities:**
    - CWD continues to review and discuss additional potential water treatment facilities/operations to process other treated recycled produced water to a level that is safe for crop irrigation.
    - CWD is currently in the process of developing two (2) recycled produced water projects that are estimated to yield 9,000 AF/year combined. It is estimated that these projects will be operational in WY2024/WY2025.
- **P5 - Friant Pipeline Project:**
    - Construction on Phase 1 (pipeline from Famoso Recharge Basins to Friant-Kern Canal) was completed December 2021.
    - Phase 2 (Friant-Kern Canal turn-in/out structure and pump station) is currently in construction. The construction of the Friant-Kern Canal turn-in/out structure was substantially completed April 2023 and it is anticipated that the construction of the pump station will occur late 2024. The project is estimated to yield 2,160 AF/year.
- **P6 - Poso Creek Flood Water Capture:**
    - This project remains in the conceptual planning phase.
- **P7 - Surface Water Storage:**
    - This project remains in the conceptual planning phase.
- **P8 - Out of Cawelo GSA Banking:**
    - CWD continues to discuss and review potential outside water banking opportunities.
- **MA1 - KGA Action Plan:**
    - The CGSA Board of Directors adopted the Action Plan Related to Exceedance of Minimum Thresholds for Chronic Lowering of Groundwater and this will be implemented to proactively address the two (2) MT exceedances that occurred in Fall 2022.
- **MA2 - Domestic Well Mitigation Policy:**
    - This management action has not been implemented. There have been no known impacts to beneficial uses or users of groundwater within Cawelo GSA during WY2023.
- **MA3 - Voluntary Land Conversion:**

- There has been no voluntary land conversion to recharge facilities in CGSA.

- **MA4 - Crop Conversion and Irrigation Efficiency:**
  - Several landowners within CGSA worked with the North Kern Resource Conservation District to examine their irrigation systems and identify areas for irrigation efficiency improvement. This activity is expected to occur again in WY2024.

- **MA5 - Land Acquisition:**
  - This management action has not been implemented.

4) Coordination with Stakeholders

- The CGSA holds a public Board of Directors meeting every second Thursday of the month. The agenda is posted on the website and the public in attendance are invited to participate and discuss agenda items.
- CGSA regularly participates in Kern Subbasin-wide meetings with other GSAs, Management Areas, and other agency representatives.
- Coordination is other neighboring GSAs, Management Areas, Eastern Water Management Area, and Kern- Tulare Water District are ongoing to discuss groundwater studies, monitoring, and other localized joint efforts.

5) Summary of Other GSP-related Special Studies or Activities

CGSA continues to support the Kern Subbasin efforts for the DMS planning and implementation. CGSA is supporting and actively engaged with the Kern Subbasin Basin Study project to update the basin wide groundwater model. The Basin Study consists of a systematic, basin wide analysis to address technical data gaps in the hydrogeological conceptual model (HCM), water budgets, and model calibration.

9.3.2 Eastside Water Management Area GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Progress towards compliance with sustainable management criteria in the Eastside Water Management Area (EWMA) during WY 2023 is summarized as follows:

a) Compliance with SMC

During Water Year 2023, no Representative Monitoring Wells (RMW) exceeded the minimum thresholds set in the EWMA and groundwater levels at two (2) of the seven (7) RMWs remained above the measurable objective.

b) SMC Monitoring Activities

Semiannual groundwater level measurements continue to occur in the EWMA according to the Kern Groundwater Authority GSA monitoring protocols.

c) Assessment Of Potential Impacts to Beneficial Users

No known impacts from to beneficial users occurred during Water Year 2023 related to groundwater levels.

2) Compliance with Additional Sustainable Management Criteria

EWMA made progress towards implementing several of its planned GSP Projects in Water Year 20232 as summarized below:

a) Water Quality

During Water Year 2023, no EWMA RMWs exceeded the secondary MCL of 500 mg/L.

b) Subsidence

No known "critical infrastructure" has been identified within the EWMA that would be significantly affected by the magnitude of subsidence observed in the available data, and no Undesirable Results are defined within the EWMA for subsidence.

c) Interconnected Surface Water

Groundwater levels in the principal aquifers generally are hundreds of feet below the ground surface, and therefore interconnected surface water is unlikely to be significant in the EWMA. Because depletion of interconnected surface water is not considered to be an issue in the EWMA, no Undesirable Results for this Sustainability Indicator are defined.

3) Implementation of Projects and Management Actions (PMAs)

EWMA progress on implementing projects and management actions during Water Year (WY) 2023 is included below:

Projects:

- **Development of oilfield produced water supplies:** Minimal programmatic progress was made on this project during WY 2023. However, individual landowners continue to implement produced water projects.

- **Investigation of groundwater quality:** Annual monitoring of TDS and nitrates continues to occur.

- **Native Yield Estimation:** Todd Groundwater has been contracted to complete the basin-wide hydrogeologic study and during WY 2023, Todd Groundwater continued to perform data collection efforts and updating model components required to complete the project. The EWMA previously performed hydrogeologic studies which are being incorporated by Todd Groundwater. The study is expected to be completed by the end of 2024 or early 2025 and an updated native yield is a project deliverable.

- **Monitor Well Construction:** The EWMA submitted an application to the California Department of Water Resources (DWR) Technical Support Services (TSS) program and was approved for the construction of two (2) dedicated monitoring wells in the EWMA near Hwy 65. The application was submitted jointly with Cawelo Water District and Kern Tulare Water District and the construction of aquifer-specific monitoring wells in data gap areas which will provide information to better understand regional hydraulic heads and gradients. The TSS program was delayed due to operational issues and COVID impacts but the wells are scheduled to be constructed in late 2024 or early 2025.

- **Installation of pressure transducers:** As part of the DWR SGM Round 1 grant, the EWMA was approved for the installation of five (5) pressure transducers to measure groundwater levels. During WY 2023, a contract was executed with Provost & Pritchard to purchase the equipment and coordinate equipment installation.

- **Surface runoff capture:** Minimal progress was made on the surface runoff capture and enhanced infiltration in impoundments project. A high-level legal water rights analysis is expected to occur during WY 2024 or 2025 in conjunction with the completion of the basin-wide hydrogeologic study.

Management Actions:

- **Reduction in Agricultural Water Use:** Reduction of irrigated acreage, or modification of irrigation techniques or crop types to reduce water usage is still being planned. Prior to implementing demand reduction, the sustainable yield needs to be established which is expected to be completed by the end of 2024 or early 2025 via the basin hydrologic study.

  One important data gap missing in the Kern C2VSim model is the deeper aquifers that many EWMA members rely on for their water supply. These aquifers include the locally productive

Santa Margarita, Olcese, and Vedder/Pyramid Hills units. Staff has communicated this model deficiency with Todd Groundwater and were informed that the model would be updated during the basin hydrologic study expected to be completed by the end of 2024 or early 2025.

- **Groundwater Fees:** No progress was made on a determination to assess fees for groundwater use to encourage reduced pumping or curtailment until the sustainable yield is established following the completion of the basin-wide hydrologic study.

- **Water Transfer Credit System:** Efforts continue to establish a system of transferrable water credits in the EWMA. The EWMA previously developed an internal sustainable yield policy and, during WY 2023, has started formalizing a system via draft Rules and Regulations. The EWMA expects to implement a water transfer credit system at the conclusion of the basin hydrogeologic study in 2025.

4) Coordination with Stakeholders

One important data gap missing in the Kern C2VSim model is the deeper aquifers that many EWMA members rely on for their water supply. These aquifers include the locally productive Santa Margarita, Olcese, and Vedder/Pyramid Hills units. Staff have communicated this model deficiency with Todd Groundwater and were informed that the model would be updated during the basin hydrologic study expected to be completed by the end of 2024.

5) Summary of Other GSP-related Special Studies or Activities

The EWMA Board and Members have directed staff to begin the process of forming a water district for SGMA purposes. During WY 2023, a surveyor was hired to develop the mapping and legal descriptions required for the notice of petition and district formation efforts are expected to conclude in early 2025.

9.3.3 Kern County Water Agency – Pioneer GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Progress towards compliance with sustainable management criteria in the Kern County Water Agency - Pioneer GSA Management Area during WY 2022 is summarized as follows:

a) Compliance with SMC

The Pioneer Project records water level data for 42 monitoring and production wells (in the GSA Area). While most of the wells have associated water level data, production well data can be misleading, since measurements can be taken during or after groundwater pumping, which can artificially lower levels below ambient conditions.

The Pioneer GSA's groundwater level representative network consists of five wells, one of which is a nested well. Current conditions show that all wells have groundwater levels above minimum thresholds (MTs), with one above its measurable objectives and four within the margin of operational flexibility. One well did have an MT exceedance during WY 2023, but water levels have since recovered and no longer exceed the MT. Current conditions within the Pioneer GSA do not meet the definition of an undesirable result and do not contribute to subbasin wide undesirable result conditions. Groundwater conditions within the Pioneer GSA were and continue to be sustainable and support all beneficial users. During GSP development, all wells were above the MO, and therefore interim milestones (IMs) were not set for the wells.

b) SMC Monitoring Activities

Groundwater levels for the representative monitoring network are collected during two periods as designated by Subbasin-wide coordination; Fall measurements between September 15 through November 15, and Spring Measurements from January 15 through March 30. Water level measurements are conducted using level transducers.

Of the five representative monitoring network wells, one well is above their MO, four wells are in the margin of operational flexibility (MoOF) above their minimum thresholds, and zero are exceeding their minimum threshold. Due to drought conditions experienced in California during WY2023, managed recovery occurred in the Pioneer GSA area and one representative well.

(RMW-048) fell just below its minimum threshold level at the end of WY 2022 and the beginning of WY 2023. Levels have since improved and no longer exceed the minimum threshold. Despite this exceedance, Undesirable Results conditions as defined in the Chapter and Umbrella GSP have not been experienced. According to the Pioneer Chapter GSP Section 5.4 Chronic Lowering of Groundwater Levels, "an undesirable result would occur when the minimum threshold for groundwater levels is exceeded in at least three adjacent management areas that represent at least 15 percent of the Subbasin, or that represent greater than 30 percent of the Subbasin."

Drought and recovery conditions and operational strategies were anticipated and incorporated into the methodology used to set thresholds within the Pioneer GSA area. This has allowed the Pioneer GSA to functionally operate primarily within the margin of operational flexibility as described in the submitted Chapter GSP while remaining sustainable through the implementation horizon. Balanced

pumping, as described in the Pioneer Chapter GSP, will be used to mitigate and minimize exceedances in the future, but it should be noted that the Pioneer GSA is currently operating sustainably.

Current conditions in the representative wells do not indicate or trigger an undesirable result for Chronic Lowering of Groundwater Levels as currently defined.

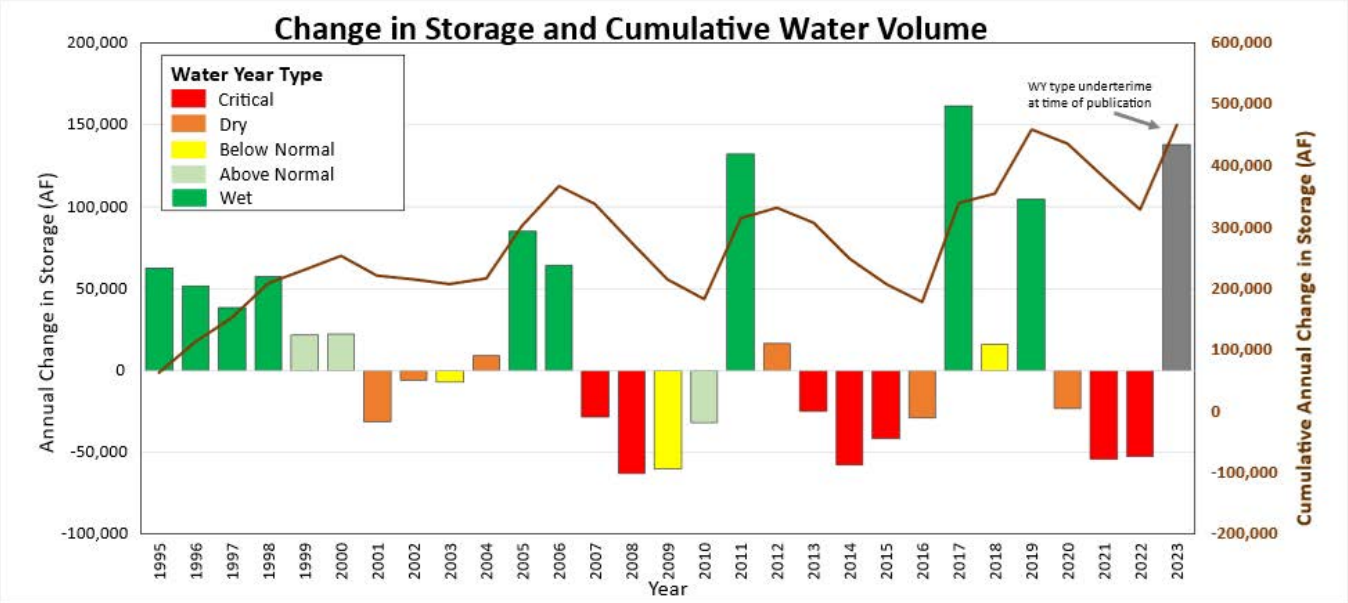
c) Assessment Of Potential Impacts to Beneficial Users

There were no impacts to beneficial users in the Pioneer GSA during WY 2023. As described in the Pioneer GSP and Umbrella GSP, beneficial users are stakeholders who have an interest or a need in groundwater use within the boundaries of the KGA, and the only beneficial use of water within the Pioneer GSA is the Pioneer Project. Pioneer did not experience any impacts to their beneficial use during WY 2023.

2) Compliance with Additional Sustainable Management Criteria

The following subsections provide brief updates and compliance status of the remaining sustainable management criteria.

Reduction in Groundwater in Storage: The graph provided below in this subsection shows the change in storage volume by year, water type and cumulative annual change in storage volume for the 29-year period from 1994 to 2022 within the Pioneer GSA boundary.



3) Water Quality

The Pioneer Project collects water quality data from both production and monitoring wells. As part of Pioneer Project operations, water quality is sampled regularly in production wells. Each well is sampled every nine years on a rotational schedule for Title 22 analysis, and data are added to a blending model that forecasts expected water quality results of the blended water that is entering the SWP from the Pioneer and surrounding projects. Further quarterly water quality sampling is undertaken during extraction/recovery operations on blended water in the Cross Valley Canal (CVC) and Kern Water Bank Canal to determine efficacy of the model.

Additional water quality sampling for specific constituents occurs on all operating wells during recovery operations and annually on monitoring wells in the Pioneer Project (if accessible). Monitoring wells are sampled for a specified list of constituents and results are shown in the Kern Fan Area Operations and Monitoring Report.

a) Subsidence

Subsidence monitoring for the Pioneer GSA Area includes an extensometer and InSAR remote sensing data. While there are no extensometers in the Pioneer GSA Area, data collected from a DWR-maintained station in the Kern Water Bank will be used in the future, given the extensometer's proximity to the Pioneer GSA Area.

b) Interconnected Surface Water

Surface water can fall into two categories: natural stream channels and water conveyance infrastructure. The Pioneer GSA Area is bordered to the north by the CVC and is bisected by the Kern River Canal in the south. Both canals are monitored as part of regular banking activities. Although the Kern River runs through the middle of two Pioneer GSA portions, it is not part of the GSA Area. Therefore, there are no surface water features in the Pioneer GSA Area, and no surface water monitoring is needed.

4) Implementation of Projects and Management Actions (PMAs)

The Kern County Water Agency - Pioneer GSA Management Area made progress towards implementing several of its planned GSP Projects and Management Actions in Water Year 2023 as summarized by the following:

Management Action 1: Continued balanced pumping and recharge is the standard operating procedure for the Pioneer GSA. Under this management action, pumping has continued to be balanced by recharge activities in the Pioneer GSA Area. Pioneer GSA has continued to closely monitor water that is pumped from the Subbasin and water that recharges the Subbasin with the goal of a balanced groundwater budget over the long term. The Pioneer Project uses a mix of SWP, Kern River and other imported water supplies for groundwater recharge. In the Pioneer GSA Area, the Pioneer Project has a recharge capacity of 302,000 AFY, and a recovery capacity of 68,415 AFY. Recovery capacity is limited by recovery well capacity. KCWA continues to be responsible for management of the Pioneer Project and is the only agency operating groundwater banking and pumping within the Pioneer GSA Area on behalf of the Participants.

To ensure the balance between pumping and recharge, all recharge and recovery in the Pioneer GSA Area is accounted for and metered, including recovery from the Pioneer Project that occurs outside the Pioneer GSA Area boundary. This management action has continued to maintain the balance between recharge and pumping through WY 2023 within normal operational expectations and strategies.

5) Coordination with Stakeholders

As a member of the KGA, the Pioneer GSA has participated in outreach efforts through the KGA. For additional details regarding outreach, please refer to the KGA stakeholder and outreach section.

6) Summary of Other GSP-related Special Studies or Activities

As a member of the KGA, the Pioneer GSA has participated in special studies or activities through the KGA. For additional details regarding special activities, please refer to the KGA special studies or activities section.

9.3.4 Kern Water Bank GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

a) Compliance with SMC

The Kern Water Bank (KWB) is a storage program within the Kern Groundwater Authority Groundwater Sustainability Agency (KGAGSA). Although the KWB is not responsible for implementing a GSP, the KWB program is critical to assisting GSAs in achieving sustainable management of the Kern County Subbasin. In addition, the KWB is involved in other agencies' GSP implementation strategies as referenced throughout Section 7.2 of this WY 2023 Annual Report; accordingly, this summary of the KWB is provided for context and completeness. KWB members within the Kern County Subbasin include Improvement District 4 (ID4) of the Kern County Water Agency, Semitropic Water Storage District (SWSD), Tejon-Castac Water District (TCWD), portions of the Westside District Authority (WDWA), and Wheeler Ridge-Maricopa Water Storage District (WRMWSD).

SGMA recognizes the uniqueness of storage programs and their role within a GSA in Water Code Section 10726.2.(b) which states: "…the agency shall not alter another person's or agency's existing groundwater conjunctive use or storage program except upon a finding that the conjunctive use or storage program interferes with implementation of the agency's groundwater sustainability plan." The KGA GSA also recognizes this unique aspect of storage programs within its boundaries with the following provision in its Joint Powers Agreement: "the Authority shall not restrict or otherwise limit the extraction of water stored (whether through direct recharge or in lieu deliveries) in the Kern County Subbasin as a part of any banking or recharge project or program, or otherwise seek to regulate the operation any such project or program..." .

b) SMC Monitoring Activities

With respect to environmental documents, DWR developed extensive mitigation measures, including a long-term operations plan, in an Environmental Impact Report for the continued operations of the KWB that reduces potential groundwater impacts to less-than-significant (DWR, 2016). Importantly, the KWB only recovers water previously stored and cannot contribute to basin overdraft. As indicated above, the KWB program is a critical component of the members' ability to reach sustainability as it provides critical dry-year water that reduces their need to pump groundwater. For more information regarding the benefits the KWB provides toward basin sustainability, see Attachment I6 to the KGAGSP.

c) Assessment Of Potential Impacts to Beneficial Users

The Joint Operating Committee received two claims related to lowered groundwater levels during the reporting year. Two models used to evaluate the claims indicate KWB activities did not trigger mitigation measures. However, the activities of other members of the Committee did trigger mitigation measures for one of the claims.

The Kern Water Bank recovered approximately 5,000 AF of stored surface water and stored approximately 490,000 AF of in the reporting year. The estimated balance of stored water is 1.3 MAF.

2) Compliance with Additional Sustainable Management Criteria

a) Water Quality

Salt balance summaries are not yet compiled for the year.

No newly discovered surface contamination sources have been identified for the year.

Quarterly point of delivery sampling results follow for the 2022 calendar year. Note that no downstream samples exceeded respective MCLs. Water was recharged in 2023, so no samples were collected.

A DWR Water Quality Assessment of Non-project Turn-ins Technical Memorandum is not yet available for the year.

b) Subsidence

No incidents of subsidence have been reported by the Kern County Water Agency or the City of Bakersfield for the Cross Valley Canal or Kern River Canal, respectively.

c) Interconnected Surface Water

N/A

3) Implementation of Projects and Management Actions (PMAs)

N/A

4) Coordination with Stakeholders

N/A

5) Summary of Other GSP-related Special Studies or Activities

N/A

9.3.5 Kern-Tulare Water District GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Progress towards compliance with sustainable management criteria in the Kern-Tulare Water District (KTWD) Management Area during WY 2022 is summarized as follows:

a) Compliance with SMC

Fall of 2023 groundwater levels in the Santa Margarita Formation were all above their Interim Milestones.

The measurable objective for groundwater quality in the Santa Margarita Formation was set at a TDS of 500 mg/L. 2022 samples collected in wells that represent the Santa Margarita Formation all returned TDS values well above the measurable objective, ranging from 260-350 mg/L. These wells were not running in 2023 and therefore no groundwater quality samples were collected.

b) SMC Monitoring Activities

KTWD monitors groundwater levels and quality in three aquifers beneath the district: the Continental Deposits, the Santa Margarita Formation, and the Olcese Sands. The primary source of groundwater within KTWD is from the Santa Margarita Formation, which is a confined aquifer that is hydraulically separate from the remainder of the basin.

The District has been monitoring groundwater levels for all three aquifers in 20 wells (11 wells are measured semi- monthly and 9 wells semi-annually). 6 of the wells that monitor groundwater levels in the Santa Margarita were selected as the District's representative monitoring wells. In 2023, the District collected 78 water level measurements for the representative monitoring wells which can be seen on the hydrographs included with the Annual Report. In addition, the District collected 189 water level measurements in the other 14 supplemental wells that include the Continental Deposits and the Olcese Sands.

Groundwater quality data is also collected for all three aquifers from 15 wells within and around the District. Groundwater quality samples are collected during the peak irrigation season when the wells are actively pumping. In 2021, the District collected 8 water quality samples (3 samples represented the Continental Deposits, 3 for the Santa Margarita Formation, and 2 for the Olcese Sands). In 2022, the District collected 3 more water quality samples in the Santa Margarita Formation.

Changes in GSP Monitoring Network

In 2020, two adjacent dedicated monitoring wells were completed within the Tule subbasin portion of KTWD and are included as part of the supplemental wells measured semi-annually. One well was completed exclusively in the Continental Deposits and the other in the Santa Margarita Formation. These wells will help fill spatial data gaps and better characterize the groundwater conditions in these primary aquifers.

In 2021, KTWD removed 3 wells from the groundwater quality network: 24S26E24Q1, 25S27E24M2, and 25S27E30D. These wells were removed primarily due to poor construction characteristics for monitoring.

3 wells were also added to the groundwater quality network: 24S26E13H, 25S26E01H, and 25S26E12A2. These wells are located on the District's western edge and were added to better monitor the potential migration of saline water in the Santa Margarita Formation from the west.

No further changes were made to the monitoring network this year. The District intends to add wells in the Continental Deposits to its representative monitoring network and develop minimum thresholds and measurable objectives for those wells in the resubmitted GSP. The District intends to improve the representative monitoring network in the future to include dedicated monitoring wells and to replace active agricultural wells with inactive agricultural wells converted to monitoring wells. The District is currently pursuing DWR Technical Support Services and grant funds to drill more dedicated monitoring wells in the Continental Deposits and Santa Margarita Formation.

c) Assessment Of Potential Impacts to Beneficial Users

There were no observed impacts to beneficial users in 2023.

2) Compliance with Additional Sustainable Management Criteria

To date, KTWD has not experienced undesirable results for any of the sustainability indicators. No groundwater levels have exceeded the minimum threshold of -150 ft msl. No groundwater quality samples have exceeded the minimum threshold of 750 mg/L of TDS.

a) Water Quality

No further changes were made to the monitoring network this year.

b) Subsidence

There were no observed impacts to beneficial users in 2023.

c) Interconnected Surface Water

There were no observed impacts to beneficial users in 2023.

3) Implementation of Projects and Management Actions (PMAs)

Action 1 – Modify District Pricing Structure: In 2021, the District focused on evaluating the best approach to implement a groundwater charge. The District proposed a Groundwater Extraction Metering Plan and hosted a landowner workshop to receive input on the procedures of groundwater metering. The District elected to measure groundwater pumping by requiring meters on all active groundwater wells within the District. The District amended its Rules and Regulations for the Sale and Distribution of Water to include the new metering requirements and metering standards. The District retained a contractor to inspect all wells within the District for a compliant meter and to assist landowners with installing or modifying meters to meet the District's standards.

Every month since January 2022, District staff reads the meters and mails out monthly groundwater extraction information to all landowners with their regular billing statement. The statement reports the metered groundwater pumping for each well and the calculated groundwater pumping based

upon ET for each ranch. The District now also has a customer portal where landowners can access all their information online.

In 2022, the District passed a Proposition 218 Election that provided the Board of Directors with the authority to implement a groundwater pumping charge of up to $175 per acre-foot of groundwater pumped within the District. The groundwater charge passed with only 396 acres out of 19,790 acres (2%) in protest. The District continues to assist landowners with groundwater metering compliance and, to date, approximately 97% of active irrigation wells within the District have a meter installed. So far, 88% of the meters meet District's standards and are installed per manufacturer's specifications to ensure accurate meter readings.

The District's first groundwater pumping charges will begin March 2024.

Action 2 – CRC Pipeline Project: KTWD has continued to pursue the CRC Pipeline Project which would provide an additional produced water supply of about 3,000 AFY. The District recently completed construction of a 684 AF storage reservoir in October of 2020 that would act as the pipeline's terminus. The pipeline design is 90% complete and all environmental permits for the pipeline alignment have been obtained.

- **Action 3 – In-District Surface Storage:** The District is evaluating the feasibility of constructing two surface reservoirs with a total storage capacity of 8,000 AF. If found feasible, the construction of these facilities is not anticipated until 2025-2030.
- **Action 4 – Distribution System Improvements:** The District has been evaluating its distribution system to identify improvements and funding mechanisms to provide full surface water deliveries to all lands within its service area. Action 1 provides financial incentives for landowners to take deliveries of surface water rather than pump groundwater; however, the District desires to increase the capacity of the distribution systems in order to deliver more surface water and reduce groundwater pumping. Distribution System Improvements were not originally included as an Action item in the 2020 GSP but will be added to the 2025 update.

  In 2023, the District performed an engineering evaluation of its distribution system to identify improvements and funding mechanisms to increase surface water delivery capability to all lands within its service area. As a result of this evaluation, the District has designed and is pursuing construction of four distribution system projects that are scheduled to be completed within the next 2 years. These four projects are estimated to reduce groundwater pumping by over 2,000 AF per year. In addition, the District has identified another four distribution system projects that can potentially be completed within the next 5-10 years. These four projects are estimated to further reduce groundwater pumping by over 9,000 AF per year. These distribution system improvements will have a significant impact upon the District's ability to maintain groundwater sustainability in the future.

4) Coordination with Stakeholders

KTWD holds a public Board meeting the second Thursday of every month at 2:30pm. All Board members are landowners within the District and are the elected representatives of the landowners within the District. District staff provides an update on SGMA implementation at each monthly meeting.

In 2021, District staff prepared and distributed additional memos and letters regarding the Groundwater Extraction Metering Plan to involve all landowners and water users in the process. A

landowner workshop was specifically hosted on this topic at the September 9, 2021 Board Meeting. Following the Board's adoption of the Amended Rules and Regulations for the Sale and Distribution of Water, the District mailed a notice letter along with a full copy of the new document to all landowners. The District also prepared an informational flyer providing an update on the District's SGMA activities which was mailed out to all landowners and posted on the District's website.

In 2022, the District prepared the Prop 218 Engineer's Report proposing the implementation of the groundwater charge and presented the report in draft for public review at the District's May Board meeting. In June, the Board adopted the report and District staff mailed letters notifying the landowners of the Engineer's Report and Prop 218 majority protest hearing. A public hearing was held in August of 2022 and the groundwater charge passed with only 396 acres out of 19,790 acres (2%) in protest.

District staff also prepared the 2022 Amended KTWD GSP and presented the revisions in draft for public review at the District's June Board meeting. After receiving public input, District staff made further revisions and the Board adopted the Amended GSP at the District's July Board meeting. The revisions to the GSP were circulated in the District's Board meeting packet that is mailed out to all interested landowners and water users and the completed document was posted to the District's website.

In 2023, Kern-Tulare Water District became its own GSA (KTWD GSA) which includes the entire boundary of the District. The District has been coordinating with the rest of the Kern Subbasin, including the Kern Coordination Committee and the Kern Technical Working Group to revise GSPs for submittal to the State Water Resources Control Board (State Board). In January 2024, the District mailed out its 3rd annual newsletter updating landowners on the status of the GSA and the State Board process.

5) Summary of Other GSP-related Special Studies or Activities

Salinity Study for the Santa Margarita Formation and Olcese Sands in the Vicinity of Kern-Tulare Water District (2020): One of the concerns addressed within the KTWD GSP is the potential migration of brackish groundwater in the Santa Margarita Formation from the west which could adversely impact groundwater quality. KTWD and EWMA made a commitment in their GSPs to work together to monitor and manage the potential movement of brackish groundwater from the west. In October 2020, KTWD in coordination with EWMA created a report titled "Salinity Study for the Santa Margarita Formation and Olcese Sands in the Vicinity of Kern-Tulare Water District." The report defines the saltwater interface in the Santa Margarita and Olcese aquifers within the area and proposed additional wells to monitor groundwater quality specifically for TDS. KTWD has been monitoring these additional wells and has seen no indication of an increase in salinity along the western-border of the District.

Supplemental Groundwater Study (2022): Since completion of the GSP, the District has collected additional information to better inform groundwater management and provide updated information for the 2025 GSP. The District prepared a 2022 Supplemental Groundwater Study that provides the best and most recent technical information to assist in a hydrogeologic evaluation for the District and lands to the east. This report was provided to both Kern and Tule subbasin consultants who are performing groundwater modeling and analysis for the 2025 subbasin-wide updates. Topics included in the report were: 1) an updated inventory of all active wells in the study area and identification of the deepest aquifer penetrated by each well; 2) a pumping test at a well adjacent to two monitoring wells to determine aquifer characteristics of the Santa Margarita Formation and the Continental

Deposits; 3) an estimation of the porosity of the Santa Margarita Formation; 4) updated hydrographs; 5) updated groundwater quality results and; 6) an evaluation of e-logs from active wells within KTWD to determine the percentage of groundwater pumping from the Santa Margarita Formation and the Continental Deposits.

Filling Data Gaps: When the District's GSP was prepared, the District had limited information related to privately owned wells within the District. Starting in 2020, the District located every well within the GSA, both agricultural and domestic, and has collected all available information on each well. The District now has a complete well database, consisting of 96 agricultural wells and 8 domestic wells, and requires all future agricultural wells to be registered with the District.

9.3.6 North Kern Water Storage District and Shafter-Wasco Irrigation District

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

North Kern Water Storage District and Shafter-Wasco Irrigation District (NKWSD/SWID) have established SMCs for groundwater levels. The objective in this Management Area is to maintain groundwater levels above the Measurable Objective: all Water Year 2023 seasonal measurements complied with this criterion. Groundwater level elevations in the joint management areas significantly improved from 2022 levels.

a) Compliance with SMC

There have been no MT exceedances, and thus no undesirable results. In fact, with the groundwater levels trending upwards, SWID and NKWSD are on track for being consistent with interim milestones and are on track to meet the Measurable Objective as well. A healthy water budget is to be credited for this. In 2023, SWID and NKWSD recharged over 200,000 AF within the joint management area.

b) SMC Monitoring Activities

The measuring and monitoring methods this year were consistent with the measurement and monitoring methods of last year.

c) Assessment Of Potential Impacts to Beneficial Users

With water levels trending upwards, there were no negative impacts to beneficial users. If anything, pumping costs for growers and domestic users have decreased, and water quality will have improved, due to recharge of over 200,000 AF of high-quality water.

2) Compliance with Additional Sustainable Management Criteria

a) Water Quality

In the 2022 GSP that was submitted, the Water Level SMC was a proxy for Water Quality. As such, please see responses regarding water levels. Please note that with increasing water levels, water quality has only improved.

b) Subsidence

In the 2022 GSP that was submitted, the Water Level SMC was a proxy for Subsidence. As such, please see responses regarding water levels.

c) Interconnected Surface Water

There are no interconnected surface waters in the SWID and NKWSD GSAs.

3) Implementation of Projects and Management Actions (PMAs)

SWID:

Diltz/Leonard Interties: The Diltz and Leonard interties were used to deliver water to Semitropic Water Storage District. While good for the Subbasin, this did not result in a water supply improvement for SWID. There was no adverse impact because of this, and future operation of this facility is expected to be consistent with this year's operations.

Bell Recharge Project: The Bell Recharge project was used to recharge 7,587 AF back into the aquifer. This project is fully implemented and is yielding encouraging results in its ability to recharge 1 AF/acre/day. There are no adverse impacts from this activity. We are expecting to use this project again in 2024. This 35-acre project also represents a 122.5 AFY demand reduction due to conversion of the site from irrigated agriculture to a recharge project.

Kimberlina Recharge Project: The Kimberlina Recharge Project was used to recharge 46,763 AF back into the aquifer. This project is fully implemented and is yielding encouraging results. There are no adverse impacts from this activity, and we are expecting to use this project again in 2024. This 285-acre project also represents 997.5 AFY demand reduction due to conversion of the site from irrigated agriculture to a recharge project.

Improved Water Level Measurement: This project is in the planning stages and is scheduled for implementation in 2026. In the meantime, we are monitoring groundwater levels using the 3 recovery wells.

Other Recharge: In 2023, the Farmers Coop Recharge project was used to recharge 1,473 AF. This was at a reduced operation because the full pipeline had not been constructed yet. The pipeline construction is underway and will be finished in the next couple of weeks, and thus the Farmers Coop project is expected to yield even more benefit in 2024. This 25-acre project also represents 87.5 AFY demand reduction due to conversion of the site from irrigated agriculture to a recharge project.

Furthermore, SWID GSA has taken steps to greatly increase recharge capacity in the future. In 2023 it purchased a 35-acre recharge project known as Southeast Recharge. This represents a demand reduction of 122.5 AFY due to conversion of the site from irrigated agriculture. It is scheduled for construction in 2024 and is currently going through the NEPA process to be able to access grant funds that were awarded by United States Bureau of Reclamation. SWID also entered into a Purchase and Sale Agreement for an additional 195 acres (representing a demand reduction of 682.5 AFY) and is undergoing an eminent domain proceeding for an additional 112 acres (392 AFY of demand reduction). Much of this will be purchased in 2024 and will be built in 2025 and 2026.

Exchange Agreements: SWID executed four 2:1 exchange agreements that will greatly expand its water supplies in the future. As a result of these programs, SWID imported an additional 6,202 AF in 2023. There are already exchanges underway for 2024, so this is expected to continue to have an impact for SWID.

Expansion of in-lieu recharge: In most years, SWID growers have an allocation that requires the use of landowner wells to supplement surface supplies. This year, the surface allocation to growers was unlimited, so grower wells were used sparingly. Additionally, the District enacted a program to specifically service carrot growers, who due to the hours of service required have typically relied on wells to feed their crop. This year, we were able to reduce well usage by changing District operations to deliver water to growers at different times.

On-Farm Efficiency: As usual, the North Kern Water Resource Conservation District worked with several SWID growers to examine their systems and study areas for improvement as it relates to system efficiency. This activity is expected to happen again in 2024.

Subsurface Recharge: Through the subsurface recharge program (and grower recharge program), SWID imported an additional 6,909 AF in 2023. The results of this work were very encouraging. SWID is also working with Natural Resources Conservation Service to establish subsurface recharge as a grant-funded work product for the future in an effort to expand this program.

Refinement of water budget: SWID hired a consultant to dive deep into the history and projections of water importation to SWID, and refined the water budget substantially, to ensure that the projects and management actions of SWID are sufficient to meet future sustainability deficits. Based on that study, since 2016 (going through 2023), SWID has met its sustainability goal with regards to its water budget. The increased recharge and demand reduction in the future will only aide to make that better.

Conversion of ag land to urban use: This is coming in the future, there is no update to provide for 2023.

Urban Water Conservation Programs: This is an ongoing effort by the cities of Shafter and Wasco. There is no significant update to provide at this time.

Mitigation Program for Impacts to wells: A mitigation program was developed in SWID and is currently being implemented. There were no requests for mitigation by landowners in 2023, due to the extremely wet nature of the year.

In-District Allocation Structure: There is no need for an in-district allocation structure at this time.

Voluntary land fallowing: There was no voluntary land fallowing in 2023.

Pumping Restrictions: There were no pumping restrictions in 2023.

MT Exceedance Action Plan: The MT Exceedance Action Plan was followed, but due to a lack of MT Exceedances, no action was taken.

Coordinate with Water Quality Programs: In progress, due to a wet year with no water quality impacts, there was no action on this management action.

Evaluate GW Levels and WQ Trends: GW Levels rose this year, and SWID staff has been studying the reaction of groundwater levels to learn how recharge placed in various locations in the District impacts groundwater levels and water quality trends.

NKWSD:

Calloway Canal and Water Delivery Improvements: Calloway Canal Improvements is part of NKWSD's continued effort to concrete line the Calloway Canal from the northern terminus of the CVC (west of Coffee Road) to Calloway Canal Intertie (CVC Intertie Canal) to 7th Standard Road. Lining Calloway Canal reduces seepage and allows the efficient delivery of water supplies from the west side of the San Joaquin Valley into NKWSD for recharge and other beneficial uses. It also accommodates the possible future conveyance of supplies from NKWSD back to the CVC and the California Aqueduct. The current phase of this project consists of concrete lining approximately 6,500 linear feet of currently unlined

portion of the Calloway Canal between Snow Road and 7th Standard Road (at NKWSD's District Boundary) to increase surface water reliability and prevent seepage. This portion lies outside the service areas of the district. Grant funding has been awarded for construction of this segment, the CVC Intertie to Fruitvale Avenue segment, and the 7th Standard Road to Pump Station 8-1. There have been delays in lining the current project segment due to land surface right-of-way conflicts and are currently being litigated. Construction is anticipated to begin in 2024. Expected water benefit is approximately 1,650 AFY.

Installation of advanced metering, SCADA, and telemetry has been completed and additional installations continue.

Expanded Water Banking Program: The district adopted its project in 1950 and initiated operation of one of the first large "conjunctive use" projects in California. The district recharges wet-period surface water supplies in available groundwater storage and subsequently recovers it during times of need (typically, dry periods). NKWSD is implementing a new program in phases to increase its existing conjunctive use (or water banking) facilities and subsequently expand these facilities. Phase I, primarily relying on unused capacity in existing facilities which is available from time to time (with some additional conveyance) and seeks to increase the utilization of the district's proven recharge and recovery assets. Phase II would involve the construction of additional direct recharge and recovery facilities to further expand water banking in the district. Both the District and District landowners will receive water supply benefits from this program. Project is in progress evaluating new facility construction and well selection. No new water benefits were realized in 2023 but planned expected benefits are estimated to be 5,000 AFY.

Groundwater Banking Conveyance improvements: Project includes improvements to existing wells to increase return capacity of third-party water banked within NKWSD. Increased return capacity incentivizes banking partners to bring more water into the NKWSD are and in turn provide additional supplies for the district (more leave behind water). There were no well improvements during the 2023 year but in 2022 two wells were improved creating an additional 6 cubic feet per second (cfs) of return capacity and four wells are planned for 2024 for an additional estimated 12 cfs return capacity. Project is approximately 1/3 complete and is estimated to provide an additional 4,000 AFY of new water supply. Completion is expected by the end of 2025 and due to the nature of increased banking projects, realizing the water benefits will occur over an extended period.

Beneficial Reuse of Oilfield Produced Water: Currently NKWSD beneficially uses oilfield produced water (OPW) with good water quality which is permitted by an existing Waste Discharge Requirement Permit. In 2023 the District received 7,000 AF of OPW that was almost entirely delivered to groundwater recharge basins. NKWSD continues to evaluate options to acquire additional OPW supplies with an estimated total benefit of 11,000 AFY over the next 10 years. Because of NKWSD's water budget surplus of, groundwater credit from the OPW is planned to be routinely transferred to Rosedale Ranch Improvement District (See below project).

Poso Creek Weir: The installation of a weir structure on Poso Creek remains in the conceptual phase.

Expanded Recharge for RRID: Implementation of the Rosedale Ranch Improvement District (RRID) Expanded Recharge project is currently being implemented. In 2023, a Proposition 218 election was successful to increase landowner assessments to fund the construction of groundwater recharge basins and acquisition of wet year water supplies. Phase 1 of the project has begun and NKWSD is in the

process of acquiring land. The completed project is estimated to yield 7,200 AFY of additional water supplies with a target completion in 2036 for construction of the last recharge basin.

Expanded Recharge for RRID: As noted above in the Beneficial Use of OPW project, NKWSD utilizes OPW and has agreed to transfer an annual average of 6,000 AFY to RRID as groundwater credit. The successful Proposition 218 election included the ability to assess landowner properties to cover the cost of acquiring the OPW groundwater credit. That process has been initiated and RRID is currently funding that acquisition providing RRID with a new annual benefit of 6,000 AFY. This OPW benefit will be deducted from the NKWSD benefit.

In-lieu Recharge Program: Program intended to implement fees for groundwater pumping when surface water is available within the NKWSD area. This program remains in the conceptual phase.

On-Farm Efficiency/Deficit Irrigation Practices Incentive Program: Program intended to implement improved farming operation and water efficiency to help protect and improve groundwater sustainability. This program is on-going and future program elements remain in the conceptual phase. No reportable beneficial water supply gains at this time.

On-Farm Recharge Activities Incentives Program/Subsurface Recharge Feasibility Study: Completed the evaluation of a Subsurface Recharge Program and began implementing a joint NKWSD/Landowner banking program. In 2023, 1,120 acres of active farmland had subsurface recharge facilities allowing surface agricultural activities to continue. In 2023 over 5,400 AF of surface water was delivered to the new subsurface recharge facilities providing a benefit of 4,600 AF of additional groundwater supplies to NKWSD.

Refinement of Water Budget Components: Process is ongoing.

Conversion of Agriculture to Urban Use: Process is ongoing and there are no reportable net water supply benefits to report at this time.

Urban Water Conservation Program: Process is ongoing and there are no reportable net water supply benefits to report at this time.

Mitigation Program for Potential Impacts to Domestic Wells: NKWSD developed a set of draft principles for a Well Mitigation Program and there were no reported domestic wells going dry within NKWSD. Completion of a mitigation plan will shift to a subbasin wide coordination on well mitigation.

In-District Allocation Structure: NKWSD is evaluating a potential groundwater allocation structure to allow landowner groundwater credits to be transferred to other areas. This remains in the conceptual phase.

Voluntary Land Fallowing: NKWSD is evaluating a potential land fallowing program to reduce demand on water supplies. This remains in the conceptual phase.

Pumping Restrictions: NKWSD is evaluating a potential pumping restriction program in response to potential MT exceedances caused by operations within NKWSD. This remains in the conceptual phase.

MT Exceedance Policy: NKWSD is coordinating with the Subbasin to develop an Exceedance Policy that defines a process to evaluate the cause(s) for any MT exceedance and determine an appropriate response or action to prevent future exceedances.

Coordinate with Water Quality Programs: In progress, due to a wet year with no water quality impacts, there was no action on this management action. This is ongoing.

Evaluate GW Levels and WQ Trends: NKWSD monitored the rising GW Levels in 2023 to better understand the impacts of 2023 groundwater recharge activities. There are no reportable impacts on groundwater quality impacts or trends.

4) Coordination with Stakeholders

Coordination with Stakeholders was consistently monthly at the board meetings, where updates on progress towards sustainability was given. On top of that, landowner letters were sent to growers to remind them of the importance of relying on District water to achieve sustainability under SGMA.

5) Summary of Other GSP-related Special Studies or Activities

Nothing to report.

9.3.7 Rosedale-Rio Bravo Water Storage District GSA

As a Kern Groundwater Authority (KGA) member, Rosedale-Rio Bravo Water Storage District (RRBWSD) prepared a Groundwater Sustainability Plan (GSP) Chapter for the KGA GSP covering the Rosedale-Rio Bravo Water Storage District GSA (RRBWSD GSA). During 2023 Rosedale-Rio Bravo Water Storage District formed a RRBWSD GSA.

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

a) Compliance with SMC

Chronic Lowering of Water Levels: Groundwater levels were monitored monthly in

19 representative monitoring wells within the RRBWSD GSA. The wells are a combination of agricultural, domestic, and dedicated monitor wells of well-known construction and offer reliable long-term data.

Reduction in Groundwater Storage: A sustainable yield was calculated for the water users in the RRBWSD GSA. RRBWSD also prepared an annual operations report including an updated groundwater checkbook balance for 1995-2022. Groundwater elevations for each Fall measurement cycle were also compared and groundwater storage volume was calculated using RRBWSD's numerical groundwater model.

Water Quality: Groundwater quality was monitored annually in 11 representative monitor wells within the RRBWSD GSA. The wells are a combination of agricultural, domestic, and dedicated monitor wells. Each well is sampled twice a year for each of the four constituents identified in the RRBMA Plan.

Land Subsidence: Subsidence data was gathered via publicly available InSAR data (provided by DWR for GSP development and implementation) at the five identified monitoring locations. Each monitoring location is near RRBWSD GSA critical infrastructure throughout the RRBWSD.

Interconnected Surface Water: Not applicable.

b) SMC Monitoring Activities

Chronic Lowering of Water Levels: Groundwater levels were monitored monthly in 19 representative monitoring wells within the RRBWSD GSA, no changes were made in the GW levels monitoring network.

Reduction in Groundwater Storage: RRBWSD has no changes in the monitoring network for the Groundwater Storage Calculation.

Water Quality: Groundwater quality was monitored annually in 11 representative monitor wells within the RRBWSD GSA. To be representative of all beneficial users in the RRBWSD GSA, RRBWSD includes domestic, agricultural, and municipal wells in the water quality monitoring network. The list of Water Quality wells includes the following: RBG School, Frito-Lay #1, Mayer, Enos, Greeley, Schweikart, Clarisse #2, Brock North, Brock South, Shop, 32N.

Land Subsidence: No change in the Land Subsidence monitoring network.

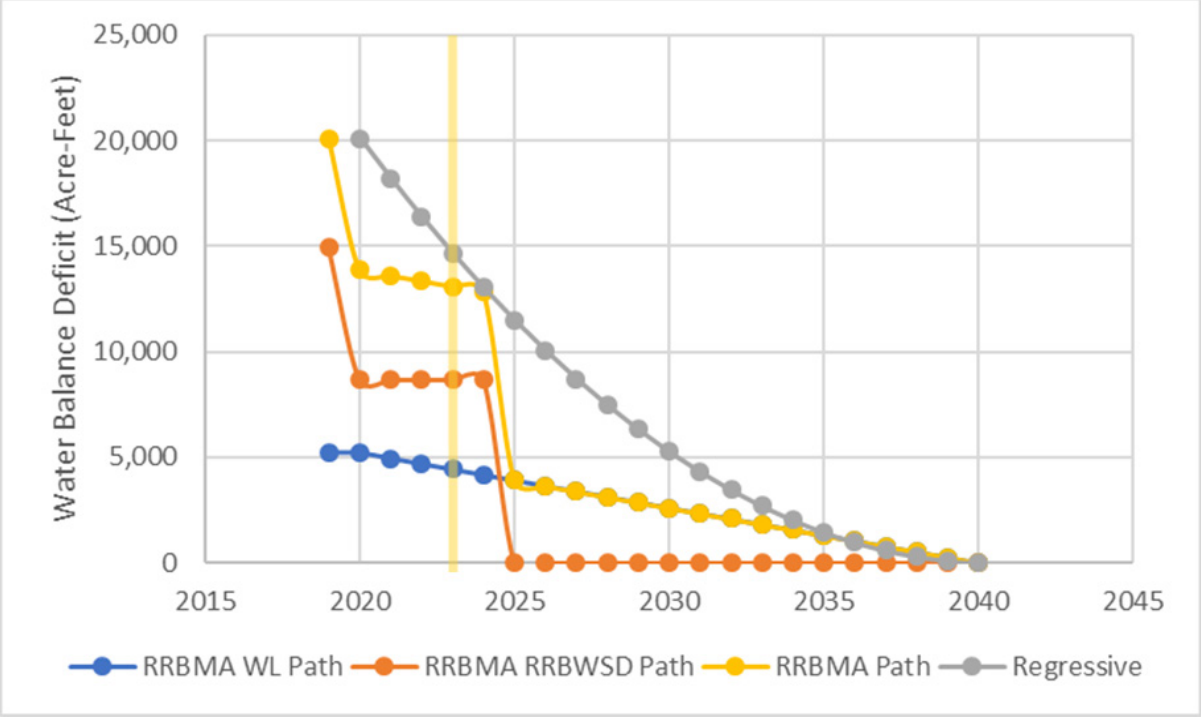
Interconnected Surface Water: Not applicable.

c) Assessment Of Potential Impacts to Beneficial Users

Through the RRBWSD GSA, all potential impacts to beneficial users have been thoroughly examined and studied when establishing minimum thresholds. This is especially important to beneficial users impacted by groundwater levels and groundwater quality. No exceedances in the groundwater levels or the water quality thresholds were observed in 2023. One report of a dry domestic well was received. RRBWSD investigated the claim and determined the bottom portion of the well had collapsed most likely due to age (>50 years old).

Another method for the GSA to assess potential impacts and prevent adverse effects to beneficial users is by tracking interim milestones. These interim milestones are key to preventing any potential impacts to Beneficial Users. If the GSA remains on track with their interim milestones, potential impacts are to be very minimal. There are three identified interim milestone goals that RRBWSD GSA has outlined in their GSP.

Path to Sustainability: The RRBWSD GSA is on its regressive path to sustainability as shown by the red dots on the graph below.



Projects and Management Action Implementation: The RRBWSD GSA, as of the end of 2023, has successfully exceeded its 2020 Implementation Milestone by 1,250 AF and has implemented 83% of its 2025 16,800 AF Implementation Milestone goal (see Figure below).

RRBWSD - GSP Projected Project and Management Action Milestones									
Year	Projects (AFY)			Management Actions (AFY)			Total (AFY)		
	Actual	Milestone	Status	Actual	Milestone	Status	Actual	Milestone	Status
2020	6,500	5,000	Complete	1,250	1,250	Complete	7,750	6,250	Complete
2022	**10,500**		**Current**	**1,901**		**Current**	**14,401**		**Current**
2025	TBD	11,500	Not Met	TBD	5,300	Not Met	TBD	16,800	Not Met
2030	TBD	10,000	Not Met	TBD	1,300	Not Met	TBD	11,300	Not Met
2035	TBD	1,000	Not Met	TBD	1,300	Not Met	TBD	2,300	Not Met
2040	TBD	0	Not Met	TBD	1,300	Not Met	TBD	1,300	Not Met

White Land Demand Reduction: White Lands Allowable Imbalance Calculation - As part of the White Land Demand reduction action implementation, demand (AF) is tracked monthly using ET data. Supplies are compared based on developed acres and a straight-line reduction as seen on the blue line in the "Path to Sustainability" chart above. The District is actively monitoring water use on White Land's with the first interim milestone occurring at the end of 2024, when adaptive management actions may be taken against White Land's using more than their allowable water during 2020-2024.

White Lands Allowable Imbalance Calculation						
Name	Developed Acres	2020	2021	2022	2023	Sum 2020-2
Landowner A1	118	92	83	90	160	425
Landowner A2	558	(125)	157	512	47	590
Landowner A3	60	80	91	129	128	427
Landowner A4	44	26	32	48	72	178
Landowner A5	315	782	989	1041	739	3551
Landowner A6	38	63	(21)	64	(283)	(177)
Landowner A7	318	232	309	439	316	1296
Landowner A8	637	282	(90)	339	944	1475
Landowner A9	208	(110)	207	243	168	509
Landowner A10	60	139	191	187	143	660
Landowner A11	371	911	1026	470	252	2659
Landowner A12	58	(11)	(21)	(7)	21	(18)
Landowner A13	139	105	19	62	13	199
Total Allowable Imbalance Used	2924	2465	2973	3616	2721	11775
Total Allowable Imbalance (GSP)		5936	5640	5343	5046	21964

2) Compliance with Additional Sustainable Management Criteria

Chronic Lowering of Water Levels: RRBWSD GSA groundwater levels trends changed and began to slope upwards as a result of a historical wet year. Water levels in the representative monitoring wells (RMWs) increased by 5-10 feet from Fall 2022 to Fall 2023. No exceedances occurred in 2023 within the RRBWSD GSA. RRBWSD GSA will continue to monitor and report the RMWs in accordance with SGMA guidelines.

Reduction in Groundwater Storage: A Sustainable Yield for the Rosedale-Rio Bravo District Lands within the RRBWSD GSA is calculated as the sum of Native Yield, Precipitation, and Project Water. A 20-year average is used as a representative long-term average for Management Action implementation

purposes. For the 2022-2023 period, Project Water supplies were approximately 60,595 AFY. District Assessed

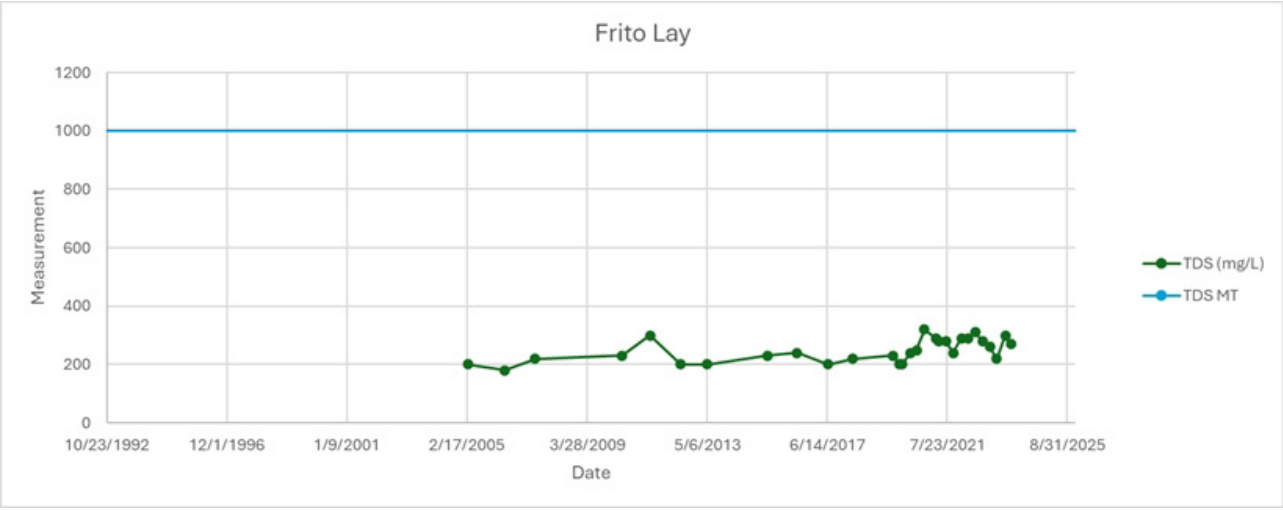
Acres total 39,468 acres, resulting in Project Water of 1.54 AF/acre/yr. The Shafter #5 CIMIS Station's annual average precipitation is 5.04 inches (0.42 ft) or 16,577 AFY. The KGA has allocated a value of 0.15 AF per acre to all developed lands, or 5,920 AFY. The total 20-year average Sustainable Yield for RRBWSD calculates to be 83,092 AFY or 2.11 AF/acre/yr.

RRBWSD prepares an annual operations report including an updated checkbook groundwater balance. For the period of 1995-2022, RRBWSD has a cumulative storage balance of 149,229 AF. In 2022 the overall balance was reduced by about 36,313 AF due to dry hydrology.

Groundwater elevations for each Fall measurement cycle were also compared and groundwater storage volume was calculated using RRBWSD's numerical groundwater model. The model area includes the RRBWSD GSA and portions of other neighboring management areas and RRBWSD GSA's. In the model area, based on the Fall 2023 measurement, there was 406,673 AF estimated to be in storage above the RRBWSD GSA Minimum Thresholds. The amount of water estimated in storage increased by 162,710 AF between Fall 2022 and Fall 2023.

a) Water Quality

Water Quality: The current monitoring wells offer reliable long-term data. Data collection continues and results have been graphed. Per the GSP, the baseline calculations for the Minimum Thresholds (MT's) and Measurable Objectives (MO's) are complete, with RRBWSD set to collect samples in 2024. To streamline the semiannual data reporting, KGA developed the web-based Data Management System (DMS) for accessing groundwater level and water quality data. Water Quality is a feature that is currently being developed within the DMS. See below for an example of one constituent of water quality graphed versus the MT. Each well and each constituent in the water quality network has been graphed similarly to below. No exceedances were reported in the 2023 reporting period.



b) Subsidence

Land Subsidence: No exceedances occurred in 2023 within the RRBWSD GSA. The annual subsidence rate for the five locations (2018-2023) ranged from 0.007 feet to 0.018 feet (or 0.06 feet in total over six years), which is well below the Minimum Threshold of 0.6 feet over the six-year period. InSAR data for 2023 is still being finalized, and unavailable at multiple locations.

c) Interconnected Surface Water

Interconnected surface water: Not applicable.

3) Implementation of Projects and Management Actions (PMAs)

Projects:

- **Enns Basins Improvement Project (McCaslin Ponds)**: This project was added in 2019 as an adaptive management action and includes a 195-acre project west of Bakersfield to recharge, store, and recover water. RRBWSD completed relevant environmental analysis and applied for grant funding. Subsequent addenda to a previous conjunctive-use EIR were adopted. WaterSmart grants were awarded in 2020 and 2021 towards development and construction. Almond trees were removed from the property in 2021, construction of recharge ponds and intake was completed in 2022, and approximately 17,700 AF was spread in 2023 that otherwise would not have been stored. The construction of two Conjunctive-Use banking wells is scheduled for 2024.
- **Onyx Ranch Project**: This project is connected to RRBWSD-owned lands and water rights in the Kern River Valley. The project involves a change in the point of diversion that would bring water supplies to the Kern Subbasin. A Draft EIR was circulated, and the FEIR was certified in January 2021. During 2023 approximately 6,114 AF was delivered for groundwater storage in the Kern Subbasin.
- **James Groundwater Storage and Recovery Project**: This project is a proposed 2,070-acre project in southwest Bakersfield designed to recharge, store, and recover water to provide a cost effective and reliable water supply for landowners within RRBWSD. A conceptual design and feasibility analysis was completed in 2019 and awarded grant funding is tentative. The environmental analysis was re-initiated with the distribution of a DEIR in 2022, and certification of the FEIR expected in 2024. The design of an intake from the Kern River to the James Project across the Pioneer Project stands at 90% status.
- **Kern Fan Groundwater Storage Project**: This project would develop a regional water bank in the Kern Fan area to store State Water Project (SWP) Article 21 water when surface water is abundant. The Kern Fan Project's feasibility analysis was completed in March 2020 and a FEIR was certified in December 2020. RRBWSD has commenced permitting and design efforts, having now acquired 350 acres of property for new recharge and recovery. On these properties, recharge improvement plans and specifications stand at 90% with construction expected in 2024 - 2025. Pilot recharge operations were commenced on 150 acres during 2023 and approximately 8,000 AF was delivered for groundwater recharge that otherwise would not have been stored.
- **Western Rosedale Lands In-Lieu Service Area Project**: This project includes the construction and operation of up to ten miles of water conveyance pipelines, including appurtenant facilities,

to provide surface water to agricultural users within a portion of RRBWSD's service area located west of Interstate 5. Project status is shovel ready; feasibility and environmental analysis are complete. No implementation date is known at this time.

- **Ten Section Project**: This project is located in the South of the River Monitoring Area within the RRBWSD GSA. A feasibility study of 200+ acre groundwater recharge, storage, and recovery project are currently underway. No implementation date is known at this time.

Management Actions:

- **Water Charge Demand Reduction**: This action imposes a water charge on District landowners for the use of water over Native Yield, precipitation, and Project Water supplies. A web-based water budget platform was completed in 2020 and real-time evapotranspiration (ET) data incorporation commenced in 2021 allowing users the ability to track their water usage for background information. RRBWSD Board approved water charge implementation in late 2023 for the 2024 calendar year and assessed $95/AF to incentivize water conservation and project financing.
- **RRBWL (White Land) Water Supplies and Demand Imbalance Reduction**: This action has been implemented for demand reduction on a linear basis over the planning period of 2020-2040. It is expected that Rosedale-Rio Bravo White Lands would seek to acquire water supplies for in lieu and direct groundwater recharge via banking agreements with RRBWSD, or others to offset demands. A web-based water budget platform was completed in 2020 to allow users to begin tracking water usage for initial 2020-2024 reduction requirements. Landowners are being regularly updated as to their demands and remaining balances requiring balance by the end of 2024. Ten out of the thirteen landowners are within their allocated supply.
- **RRBWSD 3rd Party Recharge and Storage Program**: This action will be developed by RRBWSD for 3rd-party recharge for use in the RRBWSD GSA or other downgradient areas in the Kern Subbasin. RRBWSD would offer existing conveyance and recharge facilities in exchange for a portion of the imported water supply and payments of yet-to-be-developed costs and/or fees. RRBWSD executed one such program in 2022 for up to 50,000 AF of groundwater recharge of which RRBWSD would retain 1 AF for every 2 AF stored. During 2023 approximately 20,000 AF was recharged and stored under this new program.

  The District also offered special landowner programs that incentivized recharge on fallow lands given the extraordinary wet year. Approximately 6,000 AF was recharged and stored under this program that otherwise would not have been stored.

4) Coordination with Stakeholders

RRBWSD held monthly Board meetings during all of 2023 which included briefing the Board on SGMA-related activities. Six stakeholder meetings were also held in person at the District's office with a virtual option. RRBWSD provided updates on groundwater monitoring results, plan revisions associated with DWR comments, and implementation of projects and management actions.

5) Summary of Other GSP-related Special Studies or Activities

RRBWSD GSA engaged in significant GSP-related studies in 2023, focused on the development of a basin wide amended GSP for with the hopes of submittal to the SWRCB by mid-2024.

9.3.8 Semitropic Water Storage Distract GSA

In 2023, the Semitropic Water Storage District (SWSD) Groundwater Sustainability Agency (GSA) continued implementation of its 2022 Amended Groundwater Sustainability Plan (GSP). Additionally, the SWSD GSA was and continues to be actively engaged with all Kern Subbasin GSAs in developing a coordinated response to the California Department of Water Resources (DWR) and State Water Resources Control Board (SWRCB) Probationary Determination for the Kern Subbasin. The SWSD GSA is committed to working with all Kern Subbasin GSAs and the SWRCB to develop a revised GSP that satisfies the legislative requirements of the Sustainable Groundwater Management Act (SGMA) and achieves sustainability within the SWSD GSA and the Kern Subbasin.

The SWSD GSA continues to implement projects and management actions to satisfy the Sustainable Management Criteria (SMCs) set in the 2022 Amended GSP, as demonstrated in this Annual Report. The following summarizes activities for the SWSD GSA during 2023 toward continued compliance with SGMA.

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

The SWSD GSA continues to implement projects and management actions to manage groundwater levels above the adopted Measurable Objectives (MO) and Minimum Thresholds (MT). Within the GSA, Demand Management is the primary management action for achieving sustainability, while simultaneously maximizing water supply and recharge opportunities when available to maintain groundwater levels at or above adopted MOs and for avoiding exceedances of MTs.

The results of SWSD GSA's demand management actions have been the steady decline of irrigated acres and total Et demand within the GSA boundaries. In 2023 there were 126,400 irrigated acres in the GSA versus 126,750 in 2022, a reduction of 350 acres. There were 134,750 irrigated acres in the GSA in 2017, when the GSA began implementation of its demand management programs. The reduction of irrigated acres between 2017 and 2023 equals a total of 8,350 acres over that implementation period. The reduction of irrigated acres has generally resulted in a reduction in consumptive use on irrigated lands within the GSA over the implementation period, with 2022-2023 being an exemption due to wet conditions. In 2023 consumptive use was 369,510, in 2022 consumptive use was 361,440, and in 2017 consumptive use was 405,320. While irrigated acres decreased slightly between 2023 and 2022, consumptive use increased by 8,070 AF due to extremely wet conditions and high precipitation in the GSA. However, between 2023 and 2017 consumptive use on irrigated acres as decreased by 35,810 AF, supporting a downward trend in Et demand in the GSA resulting from to its demand management program.

The SWSD GSA's Demand Management Program has been implemented in phases since 2016 described in the following text.

2016 Assembly Bill 453: This bill authorized the SWSD to collect groundwater extraction information, to require reporting of groundwater information, and authorize the imposition of fees on the extraction of groundwater. In 2016 SWSD also initiated monitoring of water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ).

2016 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total [1]:	135,690	Acres
Demand of Irrigated Acreage as Et [2]:	409,470	AF
Total Supply [3]:	217,800	AF
Total Supply (-) Demand of Irrigated Acreage	(191,670)	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.
4)

2016 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	30,520	AF
Recovery from Storage:	25,260	AF
Total in Storage at EOY:	656,410	AF

2017 New Lands Surcharge Program: Any new land developed after July 1, 2017 is charged $500/AF of consumptive use greater than the allocated native groundwater yield. This interim program was replaced with the Landowner Water Budget and Tiered Pricing Structure in 2022. SWSD continued monitoring water demand as Et using remote sensing technology (LandIQ)

2017 Fallow Water Recharge Program: Due to significantly wet conditions, SWSD implemented a fallow land recharge program to enhance its capacity to capture and recharge water on fallowed agricultural properties with access to the SWSD's water conveyance facilities. The surface water recharged and stored in 2017 is available for use during future dry conditions.

2017 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total [1]:	134,750	Acres
Demand of Irrigated Acreage as Et [2]:	405,320	AF
Total Supply [3]:	378,480	AF
Total Supply (-) Demand of Irrigated Acreage	(26,840)	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.

2017 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	229,010	AF
Recovery from Storage:	0	AF
Total in Storage at EOY:	885,420	AF

2018 Expansion of In-Lieu Distribution Facilities: in 2018 SWSD constructed in-lieu distribution systems serving approximately 8,500 acres of existing agricultural lands within SWSD. These lands were formerly 100% reliant upon groundwater. In 2018 SWSD continued monitoring water demand as Et utilizing remote sensing technology (LandIQ).

2018 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total[1]:	128,460	Acres
Demand of Irrigated Acreage as Et[2]:	408,380	AF
Total Supply[3]:	353,100	AF
Total Supply (-) Demand of Irrigated Acreage	(55,280)	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.

2018 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	49,340	AF
Recovery from Storage:	11,580	AF
Total in Storage at EOY:	923,180	AF

2019 Basin Sustainability Charges/Credits: A program whereby the SWSD GSA utilizes remote sensing data to determine the consumptive use (as Et) for each parcel and the aggregate by Landowner of Record in the SWSD. The consumptive use for an irrigated parcel is compared to the average consumptive use of all irrigated fields. If the consumptive use for a single parcel is in excess of the average, then the parcel was levied a charge (the basin sustainability charge). If the consumptive use of a parcel is less than the average, then the parcel is due a credit (the basin sustainability credit). This interim program was replaced with the Landowner Water Budget and Tiered Pricing Structure in 2022. In 2019 SWSD also initiated monitoring of water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ).

2019 Fallow Land Water Recharge Program: Due to significantly wet conditions, SWSD implemented a fallow land recharge program to enhance the capability to capture and recharge water on fallow agricultural properties with access to the SWSD's water conveyance facilities. The surface water recharged and stored in 2019 is available for use during future dry conditions.

2019 Enhanced Conveyance Project: The SWSD installed temporary high-capacity pumps to transfer available high flow Kern River water from Buena Vista Water Storage District into SWSD for recharge.
2019 (Jan-Dec) Summary of Supply and Demand

2019 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total [1]:	128,530	Acres
Demand of Irrigated Acreage as Et [2]:	389,750	AF
Total Supply [3]:	418,880	AF
Total Supply (-) Demand of Irrigated Acreage	29,130	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.

2019 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	192,450	AF
Recovery from Storage:	4,470	AF
Total in Storage at EOY:	1,111,160	AF

2020 Adopted the Kern Groundwater Authority GSP in coordination with the Kern Groundwater Authority (KGA) the SWSD GSA developed the KGA GSP and adopted the same as the Semitropic GSP: The SWSD GSA worked with the KGA to prepare a GSP which included a specific "Chapter" pertaining to the SWSD GSA. Upon adoption of the GSP, SWSD initiated development of Management Action 1: Landowner Water Budgets and continued the interim Basin Sustainability Charge/Credits Program. In 2022 SWSD also initiated monitoring of water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ).

2020 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total [1]:	125,340	Acres
Demand of Irrigated Acreage as Et [2]:	362,830	AF
Total Supply [3]:	131,880	AF
Total Supply (-) Demand of Irrigated Acreage	(230,950)	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.

2020 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	2,240	AF
Recovery from Storage:	60,810	AF
Total in Storage at EOY:	1,052,590	AF

2021 Conveyance Improvements: SWSD constructed improvements to the interconnection between the SWSD and Shafter Wasco Irrigation District (Diltz Intertie Pipeline Improvements). In 2021 SWSD also initiated monitoring of water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ).

2021 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total (1):	128,570	Acres
Demand of Irrigated Acreage as Et (2):	367,520	AF
Total Supply (3):	113,940	AF
Total Supply (-) Demand of Irrigated Acreage	(253,550)	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.

2021 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	2,450	AF
Recovery from Storage:	153,730	AF
Total in Storage at EOY:	901,310	AF

2022 Landowner Water Budgets (Management Action 1): Beginning in 2022 the SWSD GSA allocates the total annual water supply of SWSD to each landowner based on the landowner class. The water budgets developed for each landowner define the required reduction in consumptive water demand and associated groundwater extractions necessary to balance the SWSD's total water budget and eliminate local overdraft from within the boundaries of the SWSD GSA. Landowner Water Budgets were delivered to all landowners in 2021 and became effective in calendar year 2022. In 2022 SWSD also initiated monitoring of water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ).

2022 Constructed Semitropic WSD/Buena Vista WSD Intertie (Cox Canal Pumping Plant): The Cox Canal Pumping Plant allows for the conveyance of up to 200 CFS from Buena Vista Water Storage District to SWSD to allow for conveyance of Kern River Water in times of excess conditions.

2022 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total (1):	126,750	Acres
Demand of Irrigated Acreage as Et (2):	361,440	AF
Total Supply (3):	94,010	AF
Total Supply (-) Demand of Irrigated Acreage	(267,430)	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.

2022 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	1,850	AF
Recovery from Storage:	146,320	AF
Total in Storage at EOY:	756,840	AF

2023 Leonard Ave Intertie Project: Constructed the SWSD / Shafter Wasco Irrigation District Leonard Ave Intertie Project and extended in-lieu distribution systems to approximately 2,800 acres of existing agricultural lands that were formerly 100% reliant on groundwater. In 2023 SWSD also initiated monitoring of water demand as evapotranspiration (Et) utilizing remote sensing technology (LandIQ).

2023 Fallow Land Water Recharge Program: Due to significantly wet conditions, SWSD implemented a fallow land recharge program to enhance the capability to capture and recharge water on fallow agricultural properties with access to the SWSD's water conveyance facilities. The surface water recharged and stored in 2023 is available for use during future dry conditions.

2023 Temporary Recharge Project: The SWSD constructed and operated 1,200 acres of temporary recharge facilities on SWSD owned properties.

2023 Permanent Recharge Projects: The SWSD constructed and operated 100 acres of permanent recharge facilities within SWSD.

2023 (Jan-Dec) Summary of Supply and Demand

Irrigated Acreage Total [(1)]:	126,400	Acres
Demand of Irrigated Acreage as Et [(2)]:	369,510	AF
Total Supply [(3)]:[(4)]	485,770	AF
Total Supply (-) Demand of Irrigated Acreage	116,260	AF

Note:

1) Spring Crop Survey
2) LandIQ Data Set, Monthly Et
3) Does not include Water Delivered to banking project with future recovery obligation.
4) Preliminary Supply Estimate Pending Reconciliation

2023 (Jan-Dec) Summary of Banking Activities for Out of Basin Banking Partners

Delivery to Storage:	126,170	AF
Recovery from Storage:	0	AF
Total in Storage at EOY:	883,000	AF

a) Compliance with SMC

The wet conditions experienced in 2023 resulted in higher-than-average imports of State Water Project supplies, other supplemental water supplies, and banking water for benefit of SWSD and third-party banking entities. The result of these high levels of supply, groundwater conditions improved throughout the GSA. Groundwater levels in the SWSD

GSA were above adopted MOs in 2023 and no exceedances of MTs for Chronic Lowering of Groundwater Levels or Reduction of Groundwater Storage were experienced in the GSA.

b) SMC Monitoring Activities

SWSD GSA continues to collect data from its dedicated SGMA Representative Monitoring Wells (RMW), as well as other wells in its management areas. The GSA utilizes data from these wells to evaluate changes in groundwater conditions associated with water management activities. During 2023, SWSD GSA collected and reported groundwater elevation for its existing 15 RMWs to the KGA.

Additionally, SWSD conducted annual land use/crop surveys in coordination with Et monitoring performed by Land IQ.

c) Assessment Of Potential Impacts to Beneficial Users

The SWSD GSA did not experience any impacts to beneficial users in 2023. Groundwater levels generally improved throughout the GSA in 2023, as described above, which benefited all beneficial users in the GSA.

2) Compliance with Additional Sustainable Management Criteria

SWSD GSA's demand management program continues to benefit groundwater conditions in the GSA and is expected to continue to benefit groundwater conditions through the remainder of the SGMA implementation period. The benefits have been and are expected to continue to benefit the other sustainability indicators in the GSA.

a) Water Quality

The 2022 Amended GSP for SWSD GSA justifies groundwater levels as the proxy for the Degradation of Water Quality sustainability indicator. The MOs and MTs for Degradation of Water Quality are set equal to the groundwater elevations of Chronic Lowering of Groundwater Levels MOs and MTs. As groundwater levels were maintained above the MOs in all SGMA represent monitoring wells within the GSA, by proxy groundwater quality conditions were also maintained above MOs.

No exceedances of Degradation of Water Quality MTs were experienced in the GSA.

There were no reported dry or dewatered wells in the SWSD GSA in 2023.

b) Subsidence

MO and MTs for subsidence within the SWSD GSA have not been established relative to impacts to local infrastructure or beneficial uses and users. While it is acknowledged that land subsidence currently occurs and is expected to continue if groundwater levels continue to decline or even become stable. The SWSD GSA has not historically experienced impacts to local infrastructure from the levels of subsidence historically experienced.

The SWSD GSA is actively engaged with all other GSAs in the Kern Subbasin to develop appropriate sustainable management criteria that will satisfy the legislative requirements of SGMA and will achieve sustainable conditions relative to subsidence impacts on local, regional, and state infrastructure that are important for beneficial users.

TRE Altamira In SAR Dataset analysis for water year 2023 shows significantly less subsidence in the Kern Subbasin when compared to water year 2022. The reduction in overall subsidence can be directly linked to higher-than-average imported surface water supplies available in Kern County and a reduced reliance on groundwater extractions to meet subbasin demands. Subsidence is still persistent, however, in the Subbasin as a result of longer-term overdraft in areas to the north of the Subbasin (Tulare and Kings counties) and other non-SGMA related activities

c) Interconnected Surface Water

Interconnected surface waters are not present in the SWSD GSA.

3) Implementation of Projects and Management Actions (PMAs)

The SWSD GSA continues to implement projects and management actions to manage groundwater levels above the adopted MOs and MTs. Within the GSA demand management is the primary management action for achieving sustainability and maintaining groundwater levels at or above adopted MOs and for avoiding exceedances of MTs. Implementation of projects and management actions in 2023 are described below.

Landowner Water Budgets (MA #1): Beginning in 2022 the SWSD GSA began allocating the total water supply of SWSD to each landowner based on the landowner class. The water budgets developed for each landowner define the required reduction in consumptive water demand and associated groundwater extractions necessary to balance the

SWSD's total water budget and eliminate local overdraft from with the boundaries of the SWSD GSA. Landowner Water budgets were delivered to all landowners in 2021 and became effective in calendar year 2022.

Additionally, in 2023 the SWSD implemented a number of projects and management actions aimed at reducing the overall demand on local groundwater resources. Recent projects include:

KGA Well Exceedance Policy (MA #3): The SWSD GSA continues to work on the revision and adoption of the Kern Subbasin Well Exceedance Policy.

Domestic Well Mitigation Program (MA #4): While the SWSD GSA adopted a domestic well mitigation program in its 2022 Amended GSP, it is currently working with all Kern Subbasin GSAs on a joint collaborative mitigation policy that serves the entire subbasin.

Land Fallowing and Landowner Recharge (MA #6): The SWSD rolled out its Fallow Land Recharge Program and processed over 50 applications covering more than 5,800 acres from interested growers wishing to participate in the Program. A total 4,438 AF was reported for landowner recharge projects.

Tulare Lake Project (MA #12): The SWSD continue to support development of the Tulare Lake Project as it navigates through the State Water Resources Board water rights hearing process.

Increase Acquisition of Supplemental Water Supplies (MA #13): Wet conditions in 2023 made significant amounts of supplemental water available to water districts throughout the state. SWSD took

advantage of its capacity to acquire and recharge supplemental water both in-district and in other Kern County banking projects. The SWSD acquired 126,630 AF of supplemental water in 2023.

Expansion of SWSD recharge capabilities (MA #6, 11, 15, and 18): The SWSD continues to support development of additional recharge sites within the district and in 2023 evaluated additional sites to serve as spreading sites for recharge for the benefit of all District landowners. District recharge consists of the following sites to date:

- Pond Poso Spreading Grounds - 550 acres
- SWSD/Shuster Pit - 20 acres
- District Property (Peterson & Bell Road) - 313 acres
- District Property (Pond & Wilderwood Road) - 145 acres
- Elo Fabbri (North of Schuster) - 100 acres

Leonard Avenue System (MA #19): The SWSD continued construction of the Leonard Avenue System Intertie during 2023.

4) Coordination with Stakeholders

The SGMA GSA held Board of Directors meeting in each month of 2023. SGMA related topics were discussed at each meeting and stakeholders were given the opportunity to evaluate SWSD operations and management actions to assess and pursue actions toward achieving long-term sustainability and comply with SGMA.

5) Summary of Other GSP-related Special Studies or Activities

The SWSD GSA continues to develop tools to evaluate current and future groundwater conditions associated with the SWSD's SGMA related activities, including water management operations and landowner demand management programs. These tools included a groundwater model covering the SWSD GSA and neighboring areas, continued consumptive use analysis, as Et, using remote sensing protocols, and detailed landowner and district level water budget accounting processes.

9.3.9 Shafter-Wasco Irrigation District 7th Standard Annex GSP

The 7th Standard Annex management area, also referred to as Shafter-Wasco Irrigation District (SWID) MA-2, consisted of former "white lands" in the Kern County Subbasin that have been annexed into SWID.

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

SMCs have been established for groundwater levels and water quality (arsenic). Groundwater levels are used as a proxy for depletion of groundwater in storage. No SMCs have been set for land subsidence in the 7th Standard Management Area. Seawater Intrusion and Interconnected Surface Waters are not applicable in the Kern Subbasin.

a) Compliance with SMC

Water levels have stayed above the MT across the board.

b) SMC Monitoring Activities

Monitoring has been consistent during the reported period.

c) Assessment Of Potential Impacts to Beneficial Users

There were no impacts to beneficial users during this time.

2) Compliance with Additional Sustainable Management Criteria

Compliance with SMC's has been successful thus far, as discussed in the subpoints below.

a) Water Quality

No issues with regards to water quality SMC's

b) Subsidence

No subsidence SMCs in this area, as there is no critical infrastructure.

c) Interconnected Surface Water

Not applicable.

3) Implementation of Projects and Management Actions (PMAs)

The big change for Seventh Standard Annex is the implementation of water budgets. WY 2023/2024 is the last year of the rotational fallowing program, which is leading to about 900 acres fallowed, a demand reduction of about 2700 AF or so. This program has been successful, but it is clear it is not big enough to handle the subsidence problem in Seventh Standard Annex. As such, a letter was sent to growers in 2023 announcing water budgets, planned during 2024, implemented in 2025. The water

budget will allocate 3 AF/Acre to all irrigated lands and will decrease to 0.57 AF/Acre by 2040, unless Seventh Standard is able to bring in additional supplies. If they are, the AF/Acre allocation will stabilize at some higher amount (1 AF/Acre, 1.5 - based on a historical average of what they're able to bring in). We are working with growers this year to set up the database so they can monitor their usage and keep in adherence to the water budgets.

4) Coordination with Stakeholders

Staff met with 7th Standard growers to explain the water budget and give frequent updates on SGMA activities. We will continue meeting with them as we move to implement the water budgets.

5) Summary of Other GSP-related Special Studies or Activities

We have been actively working to secure supplemental water supplies for 7th Standard but have not succeeded in buying supplies yet.

9.3.10 Southern San Joaquin Municipal Utility District GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Southern San Joaquin Municipal Utility District (SSJMUD) established SMCs for groundwater levels. All Water Year 2023 seasonal groundwater level measurements (Spring and Fall) were above the Measurable Objective (MO) and Minimum Threshold (MT) for each well to comply with the SMCs for Chronic Lowering of Groundwater levels. The MOs and MTs for the reduction in groundwater storage are based on the MTs and MOs for the chronic lowering of groundwater levels and also comply with the SMCs for Reduction in Groundwater Storage.

a) Compliance with SMC

All Water Year 2023 seasonal measurements were above the SMCs. As such, there are no undesirable results in the basin and the current sustainability indicator conditions are on track to meet the interim milestones for Chronic

Lowering of Groundwater Levels and Reduction in Groundwater Storage. Based on the data provided by SSJMUD and the cities of Delano and McFarland for the 2023 Annual SGMA Report, the plan area covered by the SSJMUD Management Area Plan is meeting the SMCs established in the 2022 revised GSP.

b) SMC Monitoring Activities

All Water Year 2023 seasonal measurements were monitored using an acoustic or sonic sounder. One representative well (RMW 208) was destroyed between measurements for Spring 2023 and Fall 2023. The monitoring network will be re-evaluated to determine if a replacement is needed for this well.

c) Assessment Of Potential Impacts to Beneficial Users

Water Year 2023 was a wet year and water levels have increased compared to the previous water year. The average water level for representative wells increased 45 feet in Spring 2023 as compared to Spring

2022 and increased 44 feet in Fall 2023 as compared to Fall 2022. There were no dry wells or emergency water shortages reported.

Implemented management actions are as follows:

- **Implement the KGA MT Exceedance Action Plan:** Initiated in summer 2022. No specific implementation actions have been necessary since water levels are above the MTs.

- **Mitigation Program for Potential Impacts to Domestic Wells:** SSJMUD's Board of Directors approved a domestic well mitigation plan, which was included with their revised GSP in July 2022. A domestic well survey was conducted in 2023 to identify the number of vulnerable wells in the Management Area.

- **In-District Allocation Structure/Refinement of Water Budget Components:** SSJMUD consistently evaluates consumptive water use throughout its Management Area. No water use allocations or water budgets have been assigned yet, but the district continues to gather background data to prepare for potential future allocations.

2) Compliance with Additional Sustainable Management Criteria

Water Quality, Subsidence and Interconnected Surface Water SMCs in the SSJMUD management area all remain in compliance with SGMA and no undesirable results have been observed.

a) Water Quality

The 2022 revised GSP established agricultural thresholds compared to Drinking water standards for constituents of concern in the subbasin. The constituents of concern prevalent to SSJMUD's Management Area include Arsenic, Chloride, Sodium, and 1,2,3-Trichloropropane (TCP). The existing 2023 Water Year water quality measurements indicate that with respect to the Water Quality SMCs there are no undesirable results in the SSJMUD management area.

b) Subsidence

The revised 2022 GSP established SMCs for the Lower reach of the Friant Kern Canal. The MO rate from 2022 to 2025 is -0.1 feet per year and the MT rate from 2022 to 2025 is -0.2 feet per year. Based on information from the DWR's California Groundwater Live Website, subsidence in Water Year 2023 was measured as an increase greater than 0.1 feet of vertical displacement. Thus, the subsidence SMC is in compliance and there are no undesirable results. There were no reported subsidence related infrastructure damages in water year 2023.

c) Interconnected Surface Water

As stated in the 2022 revised GSP, interconnected surface waters do not apply to the Kern Subbasin as there are no natural surface waters hydraulically connected by a continuous saturated zone to an underlying aquifer in the water systems near SSJMUD. The Poso Creek channel is the only channel that experiences natural recharge, but this is limited to wet months in wet years.

3) Implementation of Projects and Management Actions (PMAs)

Progress towards implementing projects and management actions in the SSJMUD MA during WY 2023 is summarized as follows:

- **Regan Recharge Project:** In 2023, SSJMUD completed construction for the Regan Spreading Grounds, approximately 75 acres.
- **Giumarra Additional 80-acre Spreading Ground:** In 2023, SSJMUD continued the preliminary design and environmental permitting on the approximately 80-acre recharge project.
- **Caratan Spreading Grounds:** In 2023, SSJMUD continued the preliminary design and environmental permitting on the approximately 160-acre recharge project.
- **Fallow Land demand reduction:** By converting agricultural land to recharge basins, agricultural demand is also reduced.
- **Additional Spreading Grounds:** In 2023, additional potential spreading ground locations were evaluated for future management actions.

Table 1. Quantify Table of Water Supply Augmentation

Recharge Basin	Project Status	Basin Volume of Recharge (AFY)				Total Recharged (WY2020 - WY2023)
		WY 2020	WY 2021	WY 2022	WY 2023	
Pandol Spreading Grounds	Active	570	0	8.6	3,496	**4,075**
In-District Spreading Grounds	Active	--	--	--	8,459	**8,459**
City of Delano Spreading Grounds	Active	633	0	0	1,439	**2,073**
Giumarra Recharge Project	Active	--	7.75	121	1,311	**1,440**
Regan Spreading Grounds	Active	--	--	--	509	**509**

Table 2. Implementation of Projects and Management Actions

PMA Number	Project	Project Status and Schedule	Description of Benefits	2024 WY benefit expected*	Any adverse impacts to other sustainability indicators or beneficial uses
SSJMUD-1	Pandol Spreading Grounds (Pond Road Spreading Grounds)	Operational since 2019	Water Supply Augmentation: Demand Reduction:	620 AFY 72 AFY	None
SSJMUD-2	City of Delano Spreading Grounds	Operational since 2019	Water Supply Augmentation:	327 AFY	None
SSJMUD-3	In District Spreading Grounds	Operational since 2020	Water Supply Augmentation:	3,384 AFY	None
SSJMUD-4	Giumarra Recharge Project (In District Spreading and Recovery Facility)	Operational since 2022	Water Supply Augmentation: Demand Reduction:	525 AFY 158 AFY	None
SSJMUD-5	Regan Recharge Project	Operational since 2023	Water Supply Augmentation: Demand Reduction:	398 AFY 187 AFY	None
SSJMUD-6	Giumarra Additional Spreading Grounds	In Design, Completion by 2025	Average annual expected benefit of 441 AFY of water supply augmentation and 171	--	

PMA Number	Project	Project Status and Schedule	Description of Benefits	2024 WY benefit expected*	Any adverse impacts to other sustainability indicators or beneficial uses
			AFY of Demand reduction.		
SSJMUD-7	Caratan Spreading Grounds	In Design, Completion by 2025	Average annual expected benefit of 881 AFY of water supply augmentation and 315 AFY of Demand reduction.	--	None
SSJMUD-8	Additional Spreading Grounds	Conceptual, Completion by 2030	Average annual expected benefit of 2782 AFY of water supply augmentation and 1078 AFY of Demand reduction.	--	None
SSJMUD-9	Additional Spreading Grounds	Conceptual, Completion by 2035	Average annual expected benefit to be determined	--	None

*The 2024 Water Year Benefit expected is based on the average annual benefit developed since the expected water supply for the next water year is not yet known

4) Coordination with Stakeholders

SGMA related topics are discussed at each of the district's monthly Board of Directors meetings. Topics include information on Subbasin-wide activities, progress on management actions, and results of seasonal water level measurements and compliance with the established SMCs. Additional coordination includes:

- Meetings with the Cities of Delano and McFarland regarding water supplies and new water users.
- Coordination meetings with neighboring water districts.

5) Summary of Other GSP-related Special Studies or Activities

No special studies are being conducted exclusively in the SSJMUD Management Area. However, SSJMUD is actively participating in the Subbasin-wide Basin Study and subsidence studies on the Friant-Kern Canal to better assess the impacts of lowering groundwater levels.

9.3.11 West Kern Water District GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Progress towards compliance with sustainable management criteria in the West Kern Water District (WKWD) Management Area during WY 2023 is summarized as follows:

a) Compliance with SMC

The WKWD GSA's groundwater level representative network consists of 23 wells, many of which are nested, multi-completion, or multi-depth wells. Current conditions show that all wells have groundwater levels above minimum thresholds (MTs), with 19 above their measurable objectives and four within the margin of operational flexibility. Four wells did have MT exceedances during WY 2023, but water levels have since recovered and no longer exceed the MT. The exceedances did not impact beneficial users in the area (WKWD). Current conditions within the WKWD GSA do not meet the definition of an undesirable result and do not contribute to subbasin wide undesirable result conditions.

Groundwater conditions within the WKWD were and continue to be sustainable and support all beneficial users. During GSP development, all wells were above the MO, and therefore interim milestones (IMs) were not set for the wells.

b) SMC Monitoring Activities

Monitoring frequency for groundwater levels is coordinated Subbasin-wide through the KGA GSP (Umbrella GSP). The Umbrella GSP requires Chapter GSPs to report monitoring twice per year: once between January 15 through March 30 and another between September 15 through November 15. During normal operations, WKWD samples monitoring and production wells on a monthly schedule and has used data collected on this schedule to meet reporting requirements of the Umbrella GSP. WKWD has monitored and will continue to monitor on this schedule to comply with the Umbrella GSP and to provide additional data for GSA planning and monitoring purposes.

The WKWD GSA's groundwater representative monitoring network includes WKWD monitoring wells in its North and South well fields (North Project Management Area and South Project Management Area respectively). In addition, WKWD GSA monitors wells in the Little Santa Maria Valley (LSMV) for purposes described later in this report. The Western Management Area does not have groundwater use and is not monitored by WKWD. The Lake Management Area, more specifically, the Buena Vista Aquatic Recreation Area (BVARA), was identified in the WKWD GSP as a data gap for groundwater level monitoring. BVARA is owned and maintained by Kern County and efforts to coordinate and increase monitoring and data collection at BVARA are underway, as discussed in further detail below.

The WKWD GSA received DWR implementation funding to convert three WKWD production wells to dedicated monitoring wells in late 2022, early 2023. This project was completed in late 2023, and those wells now provide monitoring data for the Subbasin and WKWD. Formal adoption of those wells into the monitoring network is in progress and expected to be completed in 2024.

In addition to the converted monitoring wells, WKWD has begun the process of making other changes to the representative monitoring network as part of addressing the incomplete GSP determination and

further Subbasin-wide coordination. Details and the final changes to the representative monitoring network will be included in the WY 2024 annual report and updated GSP.

c) Assessment Of Potential Impacts to Beneficial Users

Groundwater levels for the representative monitoring network are collected during two periods as designated by Subbasin-wide coordination; Fall measurements between September 15 through November 15, and Spring Measurements from January 15 through March 30. Of the 23 representative monitoring network wells, 19 wells are above their MO, four well are in the margin of operational flexibility (MoOF) above their minimum thresholds, and zero have exceeded its minimum threshold. Of the 19 wells in the MoOF, four of those wells did exceed their MT for a short period during the water year but have since recovered and no longer exceed the MT. According to the WKWD Chapter GSP Section 5.4 Chronic Lowering of Groundwater Levels, "an undesirable result would occur when the minimum threshold for groundwater levels is exceeded in at least three adjacent management areas that represent at least 15 percent of the Subbasin, or that represent greater than 30 percent of the Subbasin." Current conditions in the representative wells do not indicate or trigger an undesirable result for Chronic Lowering of Groundwater Levels as currently defined. A review of available data suggests that prolonged recovery, due to extended drought conditions, in adjacent groundwater banking projects may be contributing to deeper than anticipated readings. These readings are currently being investigated by WKWD and the WKWD GSA, in coordination with adjacent entities, and any changes or additional flag or notes will be attached the appropriate measurements and reflected in the DMS and future Annual Reports.

There were no impacts to beneficial users in the WKWD GSA during WY 2023. As described in the WKWD GSP and Umbrella GSP, beneficial users are stakeholders who have an interest or a need in groundwater use within the boundaries of the KGA, and the only beneficial use of water within the WKWD GSA is the West Kern Water District that provides municipal and industrial water for customers in and around Taft, California. WKWD did not experience any impacts to their beneficial use during WY 2023.

2) Compliance with Additional Sustainable Management Criteria

The following subsections provide brief updates and compliance status of the remaining sustainable management criteria.

Groundwater Storage: Groundwater levels are used as a proxy for determining changes in groundwater storage. Therefore, the WKWD GSA has used data collected from its groundwater level monitoring network to monitor changes in storage.

Analysis is conducted on groundwater level data and groundwater levels over the previous year have generally increased, suggesting an increase in groundwater storage compared to the previous year's Annual Report. According to the WKWD Chapter GSP Section 5.5 Chronic Lowering of Groundwater Levels, "An undesirable result would occur when the volume of storage (i.e., above the groundwater level minimum thresholds) was depleted to an elevation lower than the groundwater level minimum threshold in at least three adjacent management areas that represent at least 15 percent of the Subbasin or represent greater than 30 percent of the Subbasin (as measured by the acreage of each management area)." Recent groundwater levels for all representative groundwater monitoring wells were reported above the calculated minimum thresholds, meaning the WKWD GSA is still operating

within the identified margin of operational flexibility and an undesirable result, as defined, has not been triggered. Further information regarding modeled storage for the Kern Subbasin is included in the KGA Umbrella GSP Annual Report.

Seawater Intrusion: The GSA area is geographically and geologically isolated from the Pacific Ocean, and any other large source of saline water. As a result, the Kern Subbasin is not at risk for seawater intrusion.

a) Water Quality

As discussed in detail in the WKWD Chapter GSP Section 3.5, groundwater quality was relatively consistent throughout the measurement period of 1993-2015, including during the drought period and historically low groundwater levels of 2015. This suggests groundwater quality in the Kern Subbasin within the WKWD GSA does not degrade significantly with changes in groundwater elevations. Therefore, it is reasonable that groundwater levels be used as a proxy for the management of degraded groundwater quality in the WKWD GSA area. Groundwater quality in the WKWD GSA is monitored as required for a community water system by state and local regulations.

b) Subsidence

Currently there are no subsidence monitoring stations in the WKWD GSA area. There is one extensometer one mile north of the South Project Management Area that is monitored by DWR. InSAR spatial imagery provided by NASA's Jet Propulsion Laboratory is available for the majority of the Kern Subbasin. The combination of extensometer and InSAR spatial imagery provide data about potential land subsidence in the GSA area.

Land subsidence monitoring was identified as a data gap in the Kern County Subbasin Umbrella

GSP and any additional data gathering efforts will be a coordinated effort between all member GSAs. WKWD GSA will continue to participate and coordinate with the KGA, as further described in the Management Actions section below.

c) Interconnected Surface Water

There is little surface water in the WKWD GSA area. All streams are ephemeral and there are currently no surface stream or river gages in the GSA area. The Kern River flows through a small part of the GSA area only during rare high flow events. The Kern River is also considered fully appropriated and characterized as a losing stream. Due to these natural and legal characteristics, surface water monitoring is not conducted in the GSA area.

3) Implementation of Projects and Management Actions (PMAs)

Several projects and management actions were identified in the WKWD Chapter GSP that will help achieve sustainability goals for the portion of the Kern Subbasin that lies within the WKWD GSA's boundaries. The following subsection briefly describes projects and their implementation status as well as the status of management actions.

Automatic Meter Reading (AMR) Project: WKWD began installing AMR systems for all industrial and outlying customers in 2015. The annual AMR conversion rate is shown below:

- 2015 233 AMR system installations
- 2016 231 AMR system installations
- 2017 161 AMR system installations
- 2018 641 AMR system installations
- 2019 839 AMR system installations
- 2020 434 AMR system installations
- 2021 274 AMR system installations
- 2022 3,401 AMR system installations
- 2023 1,112 AMR system installations

From 2015 through 2023, WKWD has installed 7,326 AMR systems on residential and industrial service connections. Currently, about 99 percent of WKWD's active meter connections are connected to the ARM infrastructure.

The AMR System installation project was completed during 2023 with the installation of the remaining meters as part of this program. This project was initiated prior to the development of the Chapter GSP but directly supports the groundwater management goals of the WKWD GSA and was incorporated into the implementation plan.

Participation in Delta Conveyance Facility: The Delta Conveyance Facility (DCF) is intended to address the challenges of pumping water from the Delta by diverting water upstream of the current diversion points and conveying it to existing pump stations for the SWP and the Central Valley Project (CVP). Under current operation, the SWP and CVP are unable to consistently deliver State and federal water contractors their full contract supplies. The Delta Conveyance Facility is intended to address some of the conditions that impact the ability to export water from the Delta.

WKWD will participate in the DCF to increase water supply reliability for its customers. While the exact increase in water supply from the DCF remains uncertain until final design, approvals, and agreements are in place, WKWD anticipates that any water supply benefits from the projects would be allocated in proportion to its level of participation.

The timing and circumstance of implementation of this project is beyond the control of the GSA, because the DCF would be implemented by the State. The U.S. Army Corps of Engineers (USACE) issued a Notice of Intent in August 2020 for the development of an Environmental

Impact Report (EIR) and a preliminary cost assessment has been prepared by the Delta Conveyance Design and Construction Authority. In October 2020, the WKWD Board agreed to fund its portion of the planning and environmental review cost for the DCF. The draft EIR for the DFC was released for public review on July 27, 2022. The comment period ended December 16, 2022. The Final EIR for the project was certified by DWR in December 2023. The Final EIS for the project should be issued by the USACE in mid-2024.

Buena Vista Aquatic Recreation Area (BVARA) Water Supply Management Coordination: The BVARA boundary is in and adjacent to the WKWD GSA area. The 1,585-acre BVARA is home to two manmade lakes, Lake Webb and Lake Evans, boating facilities, playgrounds and volleyball courts, camp sites, and

picnic areas. The lakes lie outside of the GSA area but the park facilities such as picnic areas, restrooms, and parking areas are within the GSA area.

Kern County has a contractual obligation to replenish the lake losses and maintain a "minimum pool" elevation to support BVWSD deliveries to its Maples Service area. With only minor diversions for agricultural use, most water from the lakes evaporates with little percolating into the groundwater basin. Kern County pumps groundwater from wells located within the GSA area to supplement losses at the lakes. Supplemental water delivered to the lakes is included in Subbasin's water balance. In 2020, WKWD GSA began measuring depth to water in wells at BVARA.

Due to uncertainty regarding BVARA water demands and groundwater conditions near the extraction wells at BVARA, this project requires ongoing coordination between the GSA and Kern County to understand BVARA's water management needs and related impacts to the GSA area and Subbasin. WKWD GSA has begun coordination with local stakeholders adjacent to BVARA including Henry Miller WD, Buena Vista WD, KGA, Kern Water Bank Authority, and Kern County to develop an approach for improved management of this area of the Subbasin. Coordination efforts between the WKWD GSA, Kern County, and surrounding local stakeholders will continue into 2024.

Continued Balanced Pumping and Recharge Management Action: Continued balanced pumping and recharge of imported supplies has and will continue to be the operational standard for WKWD. Under this management action, recharge and recovery activity has and will continue to be monitored closely by WKWD to maintain balanced conditions.

Implement Water Shortage Response Plan (WSRP) Management Action: An updated WSRP is incorporated into the WKWD Urban Water Management Plan (UWMP) 2020 Update. The WSRP establishes six levels of response actions to be implemented in times of shortage (Response Level 1 through Response Level 6), with increasing restrictions on water use in response to worsening drought conditions and decreasing available supplies. The policy establishes progressive response levels including regulations to be implemented during times of declared water shortages in order to attain escalating conservation goals. At this time, WKWD has implemented Response Level 1 in response to the Governor's Drought Emergency Order.

Continued Participation in Basin-Wide Coordination Management Action: The WKWD GSA is one of eleven GSAs in the Kern Subbasin. Coordination among these GSAs is necessary for sustainable management of the Subbasin as a whole and has been ongoing during development of the Chapter GSPs. Coordination during GSP development has included regular in-person meetings and calls to discuss sustainability thresholds, potential projects and management actions, plus specific issues and concerns. This management action involves attending KGA manager meetings and coordination meetings which are held monthly, and KGA stakeholder meetings which are held as needed. These meetings, and participation in them, will continue into 2024.

File for Basin Boundary Modification for LSMV Management Action: Basin boundaries define the geographic area included in each groundwater basin. Under SGMA, a process was provided for local agencies to request that DWR revise the boundaries of groundwater basins or subbasins to assist with local governance and control. Requests for modifications can be submitted for either scientific or jurisdictional reasons. Scientific modifications are based on geologic or hydrologic conditions while jurisdictional modifications change boundaries to promote sustainable groundwater management.

WKWD GSA will coordinate with local LSMV stakeholders, KGA staff and DWR to determine whether pursuing a basin boundary modification request in 2024 is warranted.

Continued Monitoring and Sustainable Management of LSMV as Part of WKWD Chapter GSP Management Action: As discussed above, water elevation is currently being recorded biannually for 20 monitoring wells within the LSMV. This data is reported to the WKWD GSA and will be provided in annual reports for informational purposes.

4) Coordination with Stakeholders

WKWD conducts monthly board meetings where GSP and SGMA related information and updates are provided. These meetings are open to the public and have publicly posted agendas and meeting minutes (https://www.wkwd.org/menus/board-meeting-agendas.html).

5) Summary of Other GSP-related Special Studies or Activities

WKWD GSA continues to coordinate on Subbasin-wide issues related to subsidence, consumptive use (ET) and better understanding the hydrogeologic complexities of the Kern Subbasin.

In 2022 DWR determined the Kern Subbasin GSPs to be insufficient and in noncompliance with SGMA regulations. DWR referred the Kern Subbasin to the State Water Board (Board) for intervention in which the Board uses "state intervention" to guide and/or fix the GSP into compliance. This process is ongoing and the WKWD GSA is actively participating and coordinating with the other GSAs in the Subbasin and the Board.

9.3.12 Westside District Water Authority GSA

In 2022, the WDWA GSA began the process to become a Groundwater Sustainability Agency (GSA). On September 9, 2022, WDWA was granted exclusive GSA status by the Department of Water Resources. WDWA GSA's compliance with sustainable management criteria, progress report on the implementation of projects and management actions, and coordination with stakeholders for WY 2023 is summarized below.

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Progress towards compliance with groundwater level and groundwater storage sustainable management criteria in the Westside District Water Authority (WDWA) Management Area during WY 2023 is summarized as follows:

a) Compliance with SMC

WDWA GSA has three representative monitoring wells (RMW) within the GSA boundary designated for monitoring groundwater levels. After two years of drought and 5% State Water Project allocations, the groundwater levels at RMW 279 in Fall 2022 exceeded the minimum threshold by 1.01 ft (groundwater level of 148.99 ft MSL vs. minimum threshold of 150 feet). In the Spring 2023 monitoring event, groundwater levels rebounded to 213.31 ft MSL, which is above the measurable objective of 200 ft MSL. Given that this minimum threshold exceedance is the first in this RMW's history, occurred after a significant drought, and groundwater levels immediately rebounded, this one-time minimum threshold exceedance does not contribute to an undesirable result in the subbasin.

b) SMC Monitoring Activities

WDWA GSA monitors groundwater levels at its RMWs twice annually (Spring and Fall) following the Kern Subbasin Monitoring Network and Protocols (June 2022 version). Groundwater level measurements are taken using an acoustic sounder. Groundwater level measurements are uploaded to the Kern County Subbasin Data Management System.

c) Assessment Of Potential Impacts to Beneficial Users

After the minimum threshold exceedance at RMW 279, WDWA GSA investigated if there were any negative impacts to beneficial users, such as dry wells. No negative impacts were reported to the GSA.

2) Compliance with Additional Sustainable Management Criteria

Progress towards compliance with water quality, subsidence, and interconnected surface water sustainable management criteria in the Westside District Water Authority (WDWA) Management Area during WY 2023 is summarized as follows:

a) Water Quality

Water quality within WDWA GSA is naturally high in salinity, limiting agricultural and municipal beneficial uses of groundwater within WDWA GSA. As a result, WDWA GSA's management area plan did not set minimum thresholds for water quality. Groundwater quality sentry monitoring for general

minerals, total dissolved solids, and nitrate has not indicated any significant changes in groundwater quality in the lands east of the California Aqueduct adjacent to the shared boundaries with other GSAs.

b) Subsidence

The only critical infrastructure impacted by subsidence within WDWA GSA is the California Aqueduct. Specifically, Mileposts 195-215 of the CA Aqueduct have experienced subsidence that has negatively impacted the amount of freeboard available and reduced Aqueduct conveyance capacity. In the 2022 revised KGA umbrella plan and WDWA GSA management area plan, an interim minimum threshold rate of -0.1 ft/year (over a rolling six-year period averaging Pools 23-32) was set for this reach of the Aqueduct. However, subsidence that occurs due to oil or gas production, natural compaction of shallow underlying soils beneath or near the Aqueduct, or any other cause that is not within the jurisdiction of a GSA (i.e. Non-SGMA related subsidence) does not contribute towards a minimum threshold exceedance. WDWA GSA has asserted, and continues to assert, that subsidence along the CA Aqueduct is caused by non-SGMA related factors; thus, no interim minimum threshold exceedances occurred in WY 2023.

Completed in August 2023, the Earth Consultants International and Lawrence Berkeley Laboratory subsidence studies contribute to a growing body of evidence that subsidence along Mileposts 195-215 of the CA Aqueduct is not related to agricultural or municipal groundwater pumping. In WY 2023, WDWA GSA, via KGA, continued to collaborate with the California Aqueduct Subsidence Program (CASP) to determine the cause and magnitude of subsidence by funding, submitting for review, and discussing the aforementioned subsidence studies to contribute to the collective understanding of the cause of subsidence along the CA Aqueduct.

c) Interconnected Surface Water

Within WDWA GSA, there are no identified groundwater dependent ecosystems or bodies of surface water that could be depleted by groundwater pumping. The only natural surface waterways within WDWA GSA are ephemeral creeks fed by stormwater flows from the mountains to the northwest that typically dissipate prior to reaching the valley floor. Historical Irrigated Lands Regulatory Program surface water monitoring program data indicate that these ephemeral creeks only run in extremely wet water years and that flows may last less than one day in length.

3) Implementation of Projects and Management Actions (PMAs)

In WY 2023, WDWA GSA has been actively engaged in assessing and moving forward with the three Management Actions described in its management area plan.

Management Action #1 – Collect Representative Hydrogeologic Data: Historically, because of the brackish and naturally degraded quality of groundwater in the WDWA GSA, growers have relied almost exclusively on surface water from the SWP for their irrigation needs. Groundwater is used primarily for blending when annual SWP deliveries are less than expected. As a result, there is currently little representative hydrogeologic data in the WDWA GSA. This lack of data represents a significant data gap that must be addressed in order to refine the current understanding of the WDWA GSA Hydrologic Conceptual Model (HCM), including key elements such as native yield/sustainable yield, groundwater elevations, pumping, and changes to groundwater in storage as well as the overall water budget. Progress made in WY 2023 includes:

- WDWA GSA continues to coordinate with the 2025 Kern County Subbasin Basin Study update efforts by providing regionally specific data to better calibrate the Basin Study model. When completed in 2025, the Basin Study will provide significantly improved information for WDWA GSA's native yield, subsurface flow, evapotranspiration, groundwater elevations, and water budget.
- WDWA GSA continues to collaborate with Westside Water Quality Coalition, the Irrigated Lands Regulatory Program (ILRP) Third-Party Coalition covering the WDWA GSA's boundary, to share groundwater monitoring data and design monitoring networks that are efficient and compatible.
- WDWA GSA worked with landowners to assess four wells for viability as a representative monitoring well to improve RMW network spatial representation.
- WDWA GSA, in coordination with the rest of the Kern County Subbasin, began developing a well inventory assessment to improve the accuracy of DWR's Online System of Well Completion Reports "OSWCR". To assist in this effort, WDWA GSA confirmed via field surveys, aerial imagery, landowner interviews, and review of well completion report information the use type and/or lack of existence of over 60 wells listed as "unknown" well types in the OSWCR database.

Management Action #2 – Water Resources Coordination: The landowners in the WDWA have historically made significant investment in efficient irrigation technologies and methods that promote water conservation and sustainable management. They have also coordinated amongst themselves as individuals or via the various water districts to implement focused reduction demand measures, and trade or purchase surplus water when deliveries from the SWP have been reduced. Progress made in WY 2023 includes:

- WDWA GSA member agencies acquired and stored over 335,000 AF of supplemental surface water from State Water Project Contractors, Article 21, local Kern River supplies, agencies with pre-1914 appropriative rights, and other long-term water purchase agreements for use in later dry years.

Management Action #3 – Conjunctive Reuse of Naturally Degraded Brackish Groundwater: WDWA GSA is evaluating the feasibility of an innovative, phased project that will integrate the treatment and conjunctive use of brackish groundwater and oil field produced water for multiple beneficial uses including, among other things:

- A new water supply for adjacent and nearby disadvantaged communities (DACs) in order to improve water reliability and drought resiliency;
- A reliable supplemental source of better-quality water that, together with the Aqueduct supplies, can be used for irrigation and other uses;
- Provide for potential environmental flows to the adjacent Kern National Wildlife Refuge; and,
- Protect groundwater quality adjacent to the WDWA and reduce potential changes to groundwater storage by reducing the volume of naturally degraded groundwater migrating north and east.

Progress made in WY 2023 includes:

- Continued financial analysis and research into funding sources, including state and federal grant programs.
- Collaborative discussions with Kern National Wildlife Refuge to determine potential project partnership.

4) Coordination with Stakeholders

Stakeholder engagement activities WDWA GSA completed during WY 2023 are summarized below:

- WDWA GSA continues to participate in the coordinated Subbasin-wide GSP implementation activities such as analysis of subsidence and development of related science-based MOs/MTs along the California Aqueduct in the westside of Kern County.
- As a result of the March 2023 DWR inadequate determination for the Kern County Subbasin, WDWA GSA has been in active weekly collaboration with the other Kern County Subbasin GSAs and their technical consultants to develop coordinated data sources and sustainable management criteria to address DWR's remaining deficiencies.
- WDWA GSA met with CASP staff four times to subsidence along the CA Aqueduct.
- To improve the Subbasin well inventory, WDWA GSA conducted one-on-one phone calls/field visits with landowners.
- WDWA GSA held regularly scheduled Board meetings on the first Wednesday of each month at 11 AM that are open and accessible to stakeholders and other interested parties. Board meeting agendas are posted on WDWA GSA's public website (www.westsidedwa.org) and an interested stakeholders list is maintained.
- The contact information for WDWA GSA's Regulatory Manager is available on WDWA GSA's public website for any interested stakeholder requesting additional information.

5) Summary of Other GSP-related Special Studies or Activities

N/A

9.4 KERN RIVER GSP

9.4.1 Kern River GSA

The KRGSA continues to make progress on GSP implementation and has already realized benefits from several GSP projects. Progress is also being made on additional projects and management actions as summarized in the information below.

6) COMPLIANCE WITH GROUNDWATER LEVELS SUSTAINABLE MANAGEMENT CRITERIA (SMC)

Since the submittal of the original 2020 GSP, the KRGSA has faced a multi-year drought, with the last three consecutive water years characterized as dry or critically dry. While WY2023 was a wet year, effects of the previous drought conditions remain. These droughts conditions led to declining water levels over much of the KRGSA and the Kern County Subbasin. In WY 2023, the wet hydrologic conditions have resulted in the increase in water levels but many wells remain below their MTs.

However, the challenges have also provided an opportunity for the KRGSA to test sustainable management criteria and to learn how best to adjust groundwater management to control local water level declines across the KRGSA Plan Area. Monitoring activities, compliance with sustainable management criteria, and implementation of GSP projects and management actions during this critically dry reporting period are discussed in the following sections.

a) COMPLIANCE WITH SMC

The KRGSA GSP monitoring network consists of 37 representative monitoring wells (RMWs) distributed across three Management Areas (MAs) which are based on primary land uses: the Urban MA (approximately 93,350 acres), the Banking MA (approximately 5,045 acres), and the Agricultural MA (approximately 134,100 acres). During the reporting period, all of the RMWs were monitored for groundwater elevations and compared to the MTs for sustainable management criteria.

Currently there are 16 urban MA RMWs, 20 agricultural MA RMWs and one banking RMW. During the reporting period, the RMWs were monitored for groundwater elevations and compared to the MTs for the applicable sustainability indicators.

During WY 2023, 27 RMWs were above their designated MT value. The remaining ten RMWs exceeded their designated MT value. This represents an improvement over previous water years- an additional five wells have exceeded their MTs since 2019 but have increased over time to no longer be in exceedance. KRGSA continues to investigate these wells and assess the potential impacts for beneficial users in the area. Several of the wells with exceedances are active pumping wells and located nearby active wells. KRGSA is currently assessing their monitoring network and may adjust the wells in the network to minimize pumping inference in water level measurements. The table below shows the wells with ongoing and past exceedances.

Table KRGSA - 1. MT Exceedances

Well ID	MT Exceedance	MA	WY23 Exceedance
Ongoing Exceedance			
RMW-017	Fall 2021 - Current	Urban	Yes
RMW-19R	Fall 2023	Urban	Yes
RMW-025	Spring 2022 - Current	Urban/Banking	Yes
RMW-030	Fall 2018	Agricultural	Yes
	Fall 2019		
	Fall 2020 - Current		
RMW-034	Spring 2020 - Current	Agricultural	Yes
RMW-211	Fall 2022- Current	Urban	Yes
RMW-213	Fall 2022 - Current	Urban	Yes
RMW-214	Fall 2019	Urban	Yes
	Spring 2020		
	Fall 2021		
	Fall 2022 - Current		
RMW-217	Fall 2019 - Current	Agricultural	Yes
RMW-218	Spring 2021 - Current	Agricultural	Yes
RMW-032	Spring 2022 - Fall 2022	Urban	Yes
Past Exceedance			
RMW-026	Spring 2020 – Spring 2023	Urban	No
RMW-040	Spring 2020	Agricultural	No
RMW-215	Spring 2022	Urban	No
RMW-216	Fall 2019	Agricultural	No

KRGSA Urban MA:

- RMW-017 is an active production well in the Urban MA, which is located in the far northwestern corner of the KRGSA, near active agricultural wells both in the KRGSA and in adjacent MAs. WY 2023 measurements indicate that RMW-017 did exceed the MT, but water levels were above the MT for part of the year.

- RMW-019R is an active landscape irrigation well in the Urban MA, which is located in the far northwestern corner of the KRGSA. Measurements indicated that RMW-019R slowly declined halfway through WY 2023, to be below the MT value.

- RMW-025 is an inactive monitoring well in the Urban/Banking MA, which is located along the western Kern River, adjacent to the Banking MA. Measurements for WY 2023 indicated that water levels were stable, but still slightly exceeded MT.

- RMW-211 is an inactive well in the Urban MA, in the north-central KRGSA, within about 750 feet of two active municipal production wells (Cal Water). WY 2023 measurements indicate that RMW-211 has maintained stable water elevation, but still slightly exceeded MT.

- RMW-213 is an inactive well in the Urban MA, which is in the north-central KRGSA (central Urban MA), south of the Kern River (southwest of RMW-211 - see above). This well, like many of the RMWs in the Urban MA, is surrounded by active municipal production wells. The water elevation has been below the MT since Fall 2022 but water levels steadily rose in WY 2023.

- RMW-214 is an inactive well in the Urban MA, which is in the south-central Urban MA, within about one-half mile of multiple active municipal wells. WY 2023 measurements indicate that RMW-214 has maintained stable water elevation below the MT value.

KRGSA Agricultural MA:

- RMW-030 - inactive irrigation well in the Agricultural MA, which is located in the central-east KRGSA and is within about 1,000 feet of an active irrigation well and in an area with limited surface water sources. Measurements indicate that RMW-030 has water elevation below the MT value.

- RMW-034 - active production well in the Agricultural MA, which is located in the southeastern KRGSA. This active production well is often pumping when field visits are made. Measurements indicate that RMW-034 has water elevation below the MT value.

- RMW-217 - active production well in the eastern Agricultural MA, which is located east of RMW034 on the eastern boundary of the KRGSA near local pumping from both agricultural and small water systems wells. Measurements indicate that RMW-217 has water elevation below the MT value.

- RMW-218 - active production well in the Agricultural MA, which is located in the southern KRGSA. Measurements indicate that RMW-218 has water elevation below the MT value.

KRGSA Banking MA:

- No wells in the Banking MA exceeded their MTs.

b) SMC Monitoring Activities

Two changes to the monitoring network occurred during this reporting period. One monitoring well in the Banking MA, RMW-028, was destroyed during land development activities and has been removed from the program. A nearby RMW in the relatively small KRGSA Banking MA (RMW-029) exhibits nearly identical trends and fluctuations as previously measured in the now-destroyed well and is located in the same area of the Banking MA. The data demonstrate that RMW-029 is capable of monitoring groundwater elevations in this area without a new replacement well.

One monitoring well in the Urban MA, RMW-019, was found to have casing integrity issues that made water level measurements unreliable. A suitable nearby replacement well was selected for additional analysis. Historical water level data dating back to 2015 provided sufficient information for selection of sustainable management criteria. Designated as RMW-019R (for replacement well), this well has been added to the monitoring network to replace RMW-019 and is currently being monitored monthly to match the frequency of other selected wells in the Urban MA.

Active monitoring of groundwater levels throughout the Kern Delta Water District in 2023 included supplementary reviews associated with areas where MTs have been encroached upon.

c) Assessment Of Potential Impacts to Beneficial Users

The KRGSA continued to seek feedback on impacts to beneficial users as a result of MTs being exceeded in certain RMWs. For example, the KRGSA met with urban Purveyors on June 1, 2023 to discuss the groundwater levels experienced in WY 2022 and any impacts they experienced or were continuing to experience as a result. The KRGSA also notified purveyors when an exceedance occurred to determine if there were impacts observed. No impacts to beneficial users, dry wells or emergency shortages were reported at the urban Purveyor meeting.

7) Compliance with Additional Sustainable Management Criteria

a) Water Quality

Water levels in the RMWs are used as a proxy for the Water Quality sustainability indicator to allow for tracking of water quality impacts that could potentially be related to GSP management of groundwater levels.

Declining water levels in the Urban MA were correlated directly to elevated concentrations of naturally occurring arsenic in groundwater. Accordingly, groundwater levels provide a surrogate for increasing arsenic, which is used as an indicator chemical for GSP management purposes. Although municipal wellfields are managing arsenic and other constituents through wellhead treatment, active management of water levels was identified to be a viable strategy for protection of future drinking water supply wells from GSA management impacts.

b) Subsidence

Water levels are also used as a proxy for the Land Subsidence sustainability indicator in specified wells in the southern Agricultural MA where historical subsidence has been documented. These groundwater levels are supplemented with InSAR data, which is published annually by DWR and applied as a screening tool for the entire KRGSA. In addition, average InSAR data in 13 square-mile cells are analyzed and reported to the Board annually for tracking of land subsidence rates, including both inside and outside areas of historical subsidence. The KRGSA is also participating in regional subsidence investigation and monitoring activities in the Subbasin coordinated among all Kern County Subbasin GSAs.

c) Interconnected Surface Water

Interconnected surface water and seawater intrusion are not applicable to conditions in the KRGSA and no RMWs are required.

8) Implementation of Projects and Management Actions (PMAs)

The KRGSA continues to make progress on GSP implementation and has already realized benefits from several GSP projects. Progress is also being made on additional projects and management actions as summarized in the information below. The section numbers in the Amended KRGSA GSP that describe

the projects and management actions are provided in parentheses by the project/action name for reference.

Water Allocation Plan (WAP) - Kern Delta Water District: Via implementation of the Water Allocation Plan, KDWD was able to utilize 56,000 AF of water, which prior to 2018, would otherwise have been unavailable to KD. This water was utilized to support surface water deliveries throughout the District as well as for groundwater recharge efforts.

Kern Delta continued to implement their conjunctive use program to maximize surface water supplies and applied recharge. Kern Delta Water District employed a management action to prioritize water delivery in its Smith & Judd Canal system. In doing so, Kern Delta was able to deliver 3,509 AF of direct recharge into the Stonefield Recharge Facility, and 1,200 AF related to operational recharge in the Smith & Judd canal system. Both the Smith & Judd canal system and the Stonefield Recharge Facility are near KRGSA monitoring well RMW 218; as a result of this management action a rebound of water levels has been seen in the surrounding area.

Kern Delta's Eastside Canal was able to benefit from a prolonged water delivery season, running from February 13, 2023 through November 16, 2023; this extended period provided an extra 123 days of water in the canal supporting surface water deliveries and operational recharge. The fully operational AEWSD intertie brought an additional 12,311 AF of water to Kern Delta's eastside service area. Through this project 3,402 AF of water was delivered to the Sunset Groundwater Recharge Project in 2023. The Sunset Groundwater Recharge Project is a 140 acre joint recharge facility between Kern Delta Water District and Arvin-Edison Water Storage District. Although the Sunset Project is not complete, both districts utilized as much of the available project capacity as possible to take advantage of available supplies during water year 2023.

Kern Delta was able to utilize its water supplies to accomplish in-district groundwater recharge of 55,900 AF. Utilizing its share of capacity in the KCWA Pioneer Project, Kern Delta was able to recharge 20,225 AF (Overdraft Correction: 13,593 AF, Recharge: 6,632 AF). Taking advantage of a historic water year, Kern Delta was able to supplement water supplies by acquiring additional water from North Kern Water Storage District (5,000 AF), City of Bakersfield (10,000 AF), as well as from the Lower Kern River entitlement (19,304 AF). This additional surface supply allowed Kern Delta to continue to serve demand for a longer period of time, thereby reducing demand on groundwater levels while simultaneously recharging groundwater.

Kern River Optimized Conjunctive Use - City of Bakersfield: During WY 2023, KRGSA continued to implement this conjunctive use project through the member agencies' ongoing water operations and maintenance within the City-owned reaches of the Kern River and canals (see discussion in WY 2020 Annual Report). The total amount of water recharged within the City-owned properties from canals, Kern River, City facilities, and 2,800 Acre Groundwater Recharge Facility amounted to 232,532 AF. This amount represents more recharge than occurred in WY 2022; this additional recharge provides protection for City and Cal Water wells and adds to drinking water supplies for City residents.

Expand Recycle Water Use in the KRGSA - City of Bakersfield: The City of Bakersfield continues to reuse recycled water through its ongoing operations of Wastewater Treatment Plants 2 and 3, reporting 27,671 AF used in WY 2023. Treated effluent from Wastewater Treatment Plant 3 is recycled for multiple purposes, including the application of tertiary treated water for sports park irrigation and the recharge of denitrified water into the groundwater basin via onsite ponds. The City is still in the process

of conducting a master study for expanding treatment plant capacity and enhancing treatment processes to provide increased recycled water for irrigation of nearby City-owned parks.

Land Use Conversion - Urbanization of Agricultural Lands: Although this GSP project was originally envisioned for urbanization of agricultural lands, the primary benefit of the land use conversion project is to reduce water demand through changes in land use. To that end, KDWD continues to look for opportunities to acquire properties within KDWD for groundwater recharge projects and to reduce demand by simultaneously taking these properties out of production. There was no acreage converted in 2023.

ENCSD Water System Consolidation and Other Small Water System Consolidation Projects: This project involves consolidation of up to six small water systems into the East Niles Community Service District (ENCSD) to provide a more reliable and high-quality water supply to local disadvantaged communities. At the time of this Annual Report, ENCSD has completed the environmental review and is still awaiting State comments on the submitted agreements for the project. As soon as the State responds, ENCSD is ready to execute the agreements and begin project construction.

Additional small water system consolidation projects are also being planned in the KRGSA as summarized below. City Consolidation of two small water systems: The City of Bakersfield is coordinating with the Division of Drinking Water (DDW), University of Sacramento, and Carollo Engineers regarding consolidation of two small water systems located in underrepresented communities. Specifically, plans are moving forward for consolidation of the South Kern Mutual Water Company and Old River Mutual Water Company into the City's domestic water system for improvements to drinking water quality. As reported in last year's Annual Report, a consolidation engineering report has been completed and additional coordination efforts are ongoing with the DDW.

Lamont PUD Water System Consolidation: In addition, Lamont Public Utilities District (Lamont PUD) reached a significant milestone with its ongoing consolidation of El Adobe Property Owners Association (El Adobe POA) into the District's water system. The SWRCB announced an award of grant funding through the SAFER program to support key infrastructure including three replacement municipal wells. This grant supports the consolidation of the 80-home community of El Adobe POA, where residents have been waiting nearly a decade for grant support of the consolidation. This grant is the single largest SAFER grant that has been awarded in the program's four-year existence. This project will provide safe and reliable drinking water supply in the POA. Current drinking water quality has been impacted by elevated arsenic concentrations that exceeded MCLs for years prior to GSA management of the area.

Implement Action Plan if Water Levels Fall below MTs: As documented in item 1) d) above, KRGSA managers are tracking and investigating MT exceedances as they occur in the KRGSA Plan area. Specifically, KRGSA managers have taken steps toward mitigation of potential local water level declines and avoidance of inaccurate static water level measurements in pumping RMWs. Actions include focused operational recharge in nearby canals to manage groundwater levels, coordination of monitoring with well owner pumping schedules, increasing frequency of field visits for tracking RMW pumping, considerations for redistribution of pumping in municipal wellfields, review of permits for new wells, application for grant funding to install dedicated monitoring wells in disadvantaged communities, and other actions.

Implement Groundwater Extraction Reporting Program: To allow KDWD to better understand local water use and crop demands, the District has invested in an evapotranspiration (ET) analysis program,

developed by Land IQ specifically for field conditions in the District. The Land IQ ET system involves a data-driven model for detailed water use estimation. The analysis includes a ground - truthing component, which greatly improves its accuracy. This program, which has been operating since January of 2022, has benefitted the District by providing better identification and quantification of water use and demand. In addition, this allows for indirect estimates of groundwater extraction as the District continues to develop policies and programs to improve groundwater extraction estimation and reporting.

Support California Delta Conveyance Project to Preserve Imported Water Supplies (see KRGSA GSP Section 7.2.5): ID4 continued funding a share of the Delta Conveyance Project environmental review, planning and design costs at a 100 percent level for 82,946 AF.

Incorporate Climate Change Adaption Strategies: ID4 developed a 2020 UWMP update that included climate change impacts on the availability of future imported water supplies as provided in DWR's 2019 Delivery Capability Report. The Cross Valley Canal Extension Lining Project - Pool No. 8, was identified in ID4's 2020 UWMP update as an implementation project to increase the reliability of water supplies during dry year conditions and was awarded funding through DWR's Urban and Multi-benefit Drought Relief Grant Program for construction. The project was constructed in WY 2023. The lining will reduce seepage, increase water delivery reliability, reduce maintenance efforts and reduce the potential for canal breaches. The estimated reduction in seepage is 1,695 AF per year.

Improve Groundwater Monitoring Network: As mentioned previously throughout this progress report, the KRGSA managers are making improvements to the current monitoring network. In particular, protocols are being considered to better manage monitoring in actively pumping RMWs. Not only are these wells difficult to access when pumping, but it has also been difficult to determine if water levels have recovered sufficiently after pumps are turned off such that representative static water levels are being measured. Several of the past MT exceedances are in active pumping wells where hydrographs suggest that measurements are being influenced by recent pumping water levels. The objective of the monitoring program is to provide a reasonable representation of water levels in the aquifer rather than to record pumping- influenced water levels in an inefficient production well.

Accordingly, KRGSA managers are taking steps to mitigate these problems, including the following:

- working directly with well owners to coordinate on their operational schedules to access the well during non-pumping periods (e.g., RMW-026),
- increasing measurement frequency to improve measurements of a representative static water level,
- researching data for inactive replacement wells in key areas, and
- applying for grant funds to install dedicated monitoring wells in critical areas.

9) Coordination with Stakeholders

The KRGSA managers have incorporated various methods for interaction with GSP stakeholders. Some of these ongoing efforts are summarized below.

Public Board Meetings: During the reporting period, the KRGSA has continued regular monthly Board meetings that are open to the public and attended by numerous stakeholders in the Subbasin. GSP

implementation, including results of the GSP Annual Reports, are presented and discussed in these open meetings. During WY 2023, all meetings were conducted as in-person meetings.

Urban Purveyor Meeting: On June 1, 2023, the KRGSA met with urban Purveyors to provide updates on the SWRCB review of GSPs determined to be Inadequate, introduce the new Plan Manager for the Kern Subbasin and seek feedback on any impacts and/or issues the Purveyors experienced in relation to WY 2022 groundwater levels.

Public Access to Online Data Management System: The KRGSA managers have coordinated with all of the Subbasin GSAs for the development of an online Data Management System (DMS). The system serves as a convenient portal for uploading, storing, viewing, and analyzing GSP data. The portal is open to stakeholders and the public for data viewing and contains a mapping feature that allows the public to see GSA boundaries, locations of monitoring sites, and hydrographs of groundwater elevations throughout the Subbasin.

KRGSA managers continue to communicate with stakeholders by direct communication on a case-by-case basis, through requested informational meetings, and via grower outreach meetings.

10) Summary of Other GSP-related Special Studies or Activities

Agricultural MA Evapotranspiration (ET) Study: As described in Item 2) above, a program with Land IQ is ongoing for improved estimates of ET in the Agricultural MA. This study supports several of the GSP management actions including the groundwater extraction reporting program.

Isabella Dam Improvement Project: The Isabella Dam improvement project, impacting reservoir storage levels, is substantially complete. Completion of the project allows for filling of the reservoir to unrestricted levels, which will provide greater storage during peak runoff periods. Consequently, those who contract for storage capacity in Isabella Dam, including the City of Bakersfield, will have restored storage capabilities as an additional water management tool that had previously been restricted since 2006.

Additional Studies:

- The KRGSA continues to coordinate with the Subbasin GSAs on investigations regarding land subsidence and the key studies proposed for grant funding as part of the recent SGM grant application to DWR.
- KDWD provided resources to domestic well owners where applicable and when needed or requested.
- KDWD also continued to reach out to DACs through Lamont PUD as well as Greenfield CWD, in keeping them apprised of SGMA-related activities.

9.5 Olcese Water District GSP

9.5.1 Olcese Water District GSA

1) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Compliance with sustainable management criteria (SMC) for the Chronic Lowering of Groundwater Levels sustainability indicator in the Olcese GSA area during WY 2023 is summarized as follows:

a) Compliance with SMC

Groundwater elevations in both Representative Monitoring Wells for the Chronic Lowering of Groundwater Levels sustainability indicator (and for the Reduction of Groundwater Storage sustainability indicator, by proxy) were above the wells' respective Minimum Thresholds in both Fall 2022 and Spring 2023 and were above the wells' Measurable Objectives in Spring 2023. In Fall 2022, the groundwater elevation in one Representative Monitoring Well (Well #4) was 27 feet below its Measurable Objective, and the groundwater elevation in the other Representative Monitoring Well (Canyon View Ranch) was above its Measurable Objective.

b) SMC Monitoring Activities

Both Representative Monitoring Wells for the Chronic Lowering of Groundwater Levels sustainability indicator were monitored in Fall 2022 and Spring 2023. No changes were made to the monitoring networks.

c) Assessment Of Potential Impacts to Beneficial Users

There were no impacts to beneficial users from groundwater level conditions within the Olcese GSA area during Water Year 2023.

2) Compliance with Additional Sustainable Management Criteria

Compliance with sustainable management criteria (SMC) for additional sustainability indicators in the Olcese GSA area during WY 2023 is summarized as follows:

a) Water Quality

Due to no observable mechanisms by which water management actions by the Olcese GSA could affect groundwater quality conditions within the Olcese GSA Area, SMCs are not defined in the Olcese GSA area for Degraded Water Quality. Water quality samples were collected in several Olcese Water District wells as part of the District's regular water management operations.

b) Subsidence

Monitoring at the two benchmark survey locations comprising the Representative Monitoring Network for land subsidence in the Olcese GSA area will be conducted in spring 2024.

c) Interconnected Surface Water

SMCs for interconnected surface water in the Olcese GSA area are not defined. Olcese GSA performed monitoring of groundwater levels in the shallow monitoring well located near Olcese Water District Well #2 in fall 2022 and spring 2023 as part of its non-contingent project #1, discussed below.

3) Implementation of Projects and Management Actions (PMAs)

Olcese GSA has made progress in WY 2023 towards implementing one of the Projects included in the Olcese GSP:

- **Non-contingent Project #1**: Installation of a shallow monitoring well in the vicinity of Olcese Water District Well #2 for purposes of evaluating potential hydraulic connection between the Olcese Sand Aquifer Unit and the Shallow Alluvium. Olcese GSA installed this well in Summer 2019 and has collected groundwater level monitoring data since Fall 2019, including measurements in Fall 2022 and Spring 2023. Monitoring data was collected manually until November 2020 when a data-logging pressure transducer was installed in the well to collected continuous water level data.
- **Non-contingent Management Action #2:** Conduct a study of the potential hydraulic connection between the Olcese Sand Aquifer Unit and the Shallow Alluvium. The Olcese GSA has begun implementation of its study to assess the degree of hydraulic connection between the shallow alluvium and the Olcese Sand Aquifer Unit (i.e., the principal aquifer underlying the Olcese GSA Area identified in the GSP). The study is based primarily on groundwater level data collected from two wells - one in the shallow alluvium and one in the Olcese Sand Aquifer Unit - using high-frequency data logging transducers. Collection of the transducer-based water level data began in Fall 2020, continued through WY 2023, and is ongoing. Results from the study will be used to inform decisions about sustainable management criteria in the next periodic (5-year) GSP update.
- **Non-contingent Project #3 (from original 2020 Olcese GSP):** Develop a network of subsidence monitoring locations. As discussed above, the Olcese GSA has established a network of subsidence monitoring locations consisting of two benchmark survey locations along the Olcese Water District Canal as part of the Amended Olcese GSP submitted in July 2022. Thus, Olcese GSA has completed implementation of this Project, originally included in the 2020 Olcese GSP, to develop a network of subsidence monitoring locations.

4) Coordination with Stakeholders

Olcese GSA has continued to coordinate with interested stakeholders by holding regular meetings of the Olcese Water District Board of Directors which are open to the public. Such meetings were held in February, May, August and November 2023. Olcese GSA members have also regularly attended inter-basin meetings with members of the other GSAs in the Kern County Subbasin.

5) Summary of Other GSP-related Special Studies or Activities

No other GSP-related special studies or activities were performed in WY 2023 in the Olcese GSA area. However, the Olcese GSA has participated in basin-wide activities related to Kern County Subbasin hydrogeologic conceptual model refinement.

9.6 SOUTH OF KERN RIVER GSP

9.6.1 Arvin GSA

The following narrative serves to summarize progress made by the Arvin GSA towards achieving its Sustainability Goal throughout Water Year (WY) 2023.

1) COMPLIANCE WITH GROUNDWATER LEVELS SUSTAINABLE MANAGEMENT CRITERIA (SMC)

The following subsections describe Arvin GSA's compliance with SMCs defined for Chronic Lowering of Groundwater Levels and Reduction of Groundwater Storage:

a) COMPLIANCE WITH SMC

In the aftermath of two consecutive critically dry years (i.e., WY 2021-2022), groundwater elevations improved significantly within the Arvin GSA throughout the course of WY 2023 owing to a historically wet winter and a subsequent record volume of imported surface water supplies to AEWSD. Groundwater level monitoring data collected from the Arvin GSA SGMA Representative Monitoring Network during WY 2023 indicate the following:

- Groundwater elevations were measured above (i.e., did not exceed) their respective Minimum Thresholds (MTs) at 12 of the 16 (i.e., 75%) SGMA Water Level Representative Monitoring Wells (RMWs) within the Arvin GSA during the Fall 2022 SGMA monitoring event. Water level MT exceedances occurred at wells RMW-005, RMW-006, RMW-009, and RMW-013. An additional 5 RMWs were measured below their Measurable Objectives (MOs), and the remaining 7 RMWs were measured above their MOs, in Fall 2022.
- Groundwater elevations were measured above (i.e., did not exceed) their respective MTs at all 16 (i.e., 100 %) RMWs within the Arvin GSA during the Spring 2023 SGMA monitoring event. 7 RMWs were measured below their Measurable Objectives (MOs), and the remaining 9 RMWs were measured above their MOs, in Spring 2023.

It is considered an Undesirable Result (UR) for Chronic Lowering of Groundwater Levels if MTs are exceeded in 40% or more of the SGMA Water Level RMWs (i.e., 7 out of 16 sites) over four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods). Furthermore, URs for Reduction of Groundwater Storage are defined within the Arvin GSA using the Sustainable Management Criteria (SMCs) for Chronic Lowering of Groundwater Levels as a proxy. Therefore, URs for Chronic Lowering of Groundwater Levels and Loss of Groundwater Storage did not occur within the Arvin GSA during WY 2023 despite the MT exceedances observed at 4 out of 16 (i.e., 25%) Water Level RMWs during the Fall 2022 monitoring event.

b) SMC MONITORING ACTIVITIES

During WY 2023, AEWSD implemented its portion of the Arvin GSA SGMA Representative Monitoring Network through the following actions:

- Collection of groundwater level monitoring data: Monthly water level measurements were collected at all 15 SGMA Water Level Representative Monitoring Wells (RMWs) within AEWSD throughout WY 2023.
- Collection of ground surface elevation survey data: Land surface elevations were surveyed at all five SGMA Land Subsidence Representative Monitoring Sites in Fall 2022 and Spring 2023.
- Collection of groundwater quality monitoring data: Groundwater quality samples were collected at six of the seven SGMA Water Quality RMWs within AEWSD once during WY 2023. Measured constituents included Arsenic, for which Degraded Water Quality SMCs is defined, as well as five additional constituents of concern (COCs) to the Arvin GSA as identified in the SOKR GSP (i.e., total dissolved solids, nitrate, boron, iron, and manganese). RMW 32S28E33R002M was not sampled during WY 2023 as the well was inactive for the duration of the water year and thus a sample could not be collected from the wellhead. If water quality sampling continues to be infeasible at 32S28E33R002M moving forward, AEWSD will consider adding and/or replacing this RMW with another nearby monitoring well to ensure sufficient continued coverage in the SGMA Water Quality Representative Monitoring Network.

In addition, ACSD implemented its portion of the Arvin GSA SGMA Representative Monitoring Network in WY 2022 through the following actions:

- Collection of groundwater level RMW data: Monthly water level measurements were collected at the one SGMA Water Level RMW under ACSD's jurisdiction (ACSD Well #14) throughout WY 2023.
- Collection of groundwater quality monitoring data: Groundwater quality samples were collected at all three SGMA Water Quality RMW under ACSD's jurisdiction during seasonal low (Fall) and seasonal high (Spring) periods during WY 2023. Measured constituents included Arsenic, for which Degraded Water Quality SMCs are defined, along with all other constituents required by California Code of Regulations (CCR) Title 22 for public water systems.

In addition to the above activities related to groundwater level, groundwater quality and land subsidence representative monitoring, AEWSD and ACSD collected additional groundwater level, groundwater quality, and land surface elevation monitoring data from additional locations throughout the Arvin-Edison Management Area in WY 2023 which are being evaluated as part of local SGMA implementation, along with relevant information collected by others.

c) Assessment Of Potential Impacts to Beneficial Users

In the aftermath of two consecutive critically dry years (i.e., WY 2021-2022), groundwater elevations improved significantly within the Arvin GSA throughout the course of WY 2023 owing to a historically wet winter and a subsequent record volume of imported surface water supplies to AEWSD. Furthermore, AEWSD recharged an additional 152,735 AF (AF) of excess imported surface water supplies into the groundwater system during WY 2023 using its various spreading basin facilities. As such, nearly all beneficial users of groundwater experienced the benefit of increased groundwater elevations within the Arvin GSA and there were no reported adverse impacts attributable to changes in groundwater conditions during WY 2023.

2) Compliance with Additional Sustainable Management Criteria

The following subsections describe Arvin GSA's compliance with SMCs defined for Degraded Water Quality, Land Subsidence, and Depletion of Interconnected Surface Water:

a) Water Quality

Arsenic is the only constituent of concern for which Degraded Water Quality SMCs are defined within the Arvin GSA. Arsenic concentrations were measured at values lower than their respective MTs at all nine SGMA Water Quality RMWs sampled during WY 2023, and at values lower than their respective MOs at eight of the nine RMWs, Therefore, URs for Degraded Water Quality did not occur within the Arvin GSA during WY 2023.

b) Subsidence

Ground surface elevation data collected from the Arvin GSA Land Subsidence Representative Monitoring Network in October 2022 and June 2023 indicates land subsidence occurred at rates less than the specified MT rate at all five Land Subsidence RMS. Furthermore, cumulative land subsidence extents remain well below the defined MT and MO extents at each RMS. Therefore, URs for Land Subsidence did not occur within the Arvin GSA during WY 2023. AEWSD continues to examine the potential cause of subsidence in the vicinity of critical water infrastructure within its Management Area and determine appropriate mitigation actions, if any.

c) Interconnected Surface Water

Based on available data and information, groundwater conditions within the Kern Subbasin show that Interconnected Surface Water is not present within the Subbasin due to the great depths to groundwater observed in the Principal Aquifer and is not anticipated to be present in the future. Therefore, consistent with the rest of the Kern Subbasin, no SMCs for this Sustainability Indicator are defined within the Arvin GSA.

3) Implementation of Projects and Management Actions (PMAs)

AEWSD has made progress towards implementing several of its planned Projects in WY 2023. This progress has included an effort to prioritize and score all of its Projects, but more specifically progress was made on the following:

- **PMA #1 AEWSD Sunset Groundwater Recharge Facility:** Project construction is nearing completion and preliminary deliveries began in February 2023. AEWSD and Kern Delta Water District entered into an operations and maintenance agreement for the facility.
- **PMA #2 Private and Caltrans Basin Connections:** Several Cal Trans basins have been connected to AEWSD and are currently taking available surface water for recharge.
- **PMA #6 On-Farm Recharge:** AEWSD has expanded its initial 2019 Landowner Recharge program through continued outreach and investigation and has increased the total acreage of on-farm recharge in WY 2023. During WY 2023 approximately 8,202 AF of on-farm recharge occurred within the Kern portion of the District. Future deliveries for on-farm recharge will remain largely dependent on the availability of imported surface water supplies.

- **PMA #10 AEWSD Wasteway Basin Improvements:** AEWSD continues to seek grant funding for this project.
- **PMA #11 Forest Frick Pipeline/KDWD Eastside Canal Intertie:** Project construction is complete and deliveries began in February 2023.
- **PMA #14 Conversion of Granite Quarry to Sycamore Reservoir:** AEWSD continues to discuss funding opportunities, the permitting process, and next steps for environmental work, if any. Additionally, AEWSD performed a geotechnical study of the quarry.
- **PMA #17 Frick Unit In-Lieu Banking Program:** AEWSD was awarded $2 million from the IRWM Round 2 Grant Program to fund project design and implementation.
- **PMA #17 DiGiorgio Unit In-Lieu Banking Program:** AEWSD is nearing completion of project design of Phase 2a consisting of a half mile 48" pipeline to serve future phases. Construction is anticipated to be complete by the end of 2024.
- **PMA #18 General In-Lieu Banking Program:** AEWSD submitted a DWR grant application through the Kern Integrated Regional Water Management Plan to support the construction of the new Frick Unit surface water service area. The final design of the Frick Units is expected to be complete in 2024 and construction will begin soon thereafter. In-Lieu water service contracts with landowners in the Frick Unit are being finalized and will be executed before construction begins. Also, AEWSD continues to design the new "Sandrini Unit", formally called the Tejon Expansion.

AEWSD has also initiated a new Project: ***Expansion of North Canal Spreading Works.*** The Project will convert approximately 160 acres of permanently cropped agricultural lands into additional groundwater recharge facilities as part of the District's existing North Canal Spreading Works. The Project water supply benefits include approximately 500 AFY due to the land use change (vineyards and almond orchards to basins), plus an average annual recharge benefit of 5,200 AFY (or 13,000 AF in an unconstrained year). Project Planning and design has been initiated, with Project construction anticipated to begin in October 2025 (duration ~6 months).

AEWSD has also made progress towards implementing several of its planned Management Actions. This progress has included the following:

- **PMA #21 Incentives for Land Conversion:** AEWSD provided financial incentives to landowners to conduct on-farm recharge (see PMA #6). The AEWSD Board will consider formalizing an incentive policy in late 2024.
- **PMA #24 Groundwater Extraction Quantification Method:** AEWSD completed development and calibration of a numerical groundwater flow model for its service area (i.e., the "Arvin-Edison Groundwater Flow Model" or "AEGFM") and applied the model to refine projected water budget estimates within the Arvin GSA under long-term baseline and climate-change impacted hydrologic conditions. AEWSD also developed a coupled, interactive Decision Support Tool (DST) that allows the District to evaluate the impacts of ongoing operational and management decisions (e.g., delivery of imported water, groundwater banking and recovery operations) on local groundwater level conditions under variably hydrology. The DST has a user-friendly front-end interface that allows the District to create model scenarios, run a five-year projected AEGFM simulation, and evaluate and compare results with only a few clicks. Model projected groundwater levels are compared to SMCs defined at each of AEWSD's RMWs within the Arvin

GSA and in the neighboring White Wolf GSA, and key quantitative metrics such as the 5-year projected water budget are graphically displayed to inform ongoing groundwater management policies and practices. This enables rapid evaluation of groundwater conditions and SGMA compliance under variable hydrologic conditions and/or operational management schema. Furthermore, AEWSD has also paid to obtain monthly satellite crop evapotranspiration (ET) data through LandIQ as a means of improving estimates of private groundwater extraction rates.

- **PMA #27 Education of Groundwater Use per Acre:** In late 2023, AEWSD published an informational flier describing District groundwater use trends and ongoing GSA management activities.

Additionally, ACSD has made progress towards implementing several of its planned Projects in WY 2023.

- **PMA #28 Emergency 1,2,3-TCP Treatment Well #12 (EPA Replacement CW-1):** Well #12 was completed and commissioned in May of 2021. All samples so far have shown no sign of 1,2,3-TCP and Arsenic levels are under the MCL. The well will continue to be sampled on a quarterly basis.
- **PMA #29 Arsenic Mitigation Project - Phase II:** The Arsenic Mitigation Project Phase II is now fully complete, with two of the three wells (#16 and #17) completed in WY 2022 and the third well (#18) completed in December 2023. All other components of the project have been completed including a 1million-gallon storage tank with booster station, 15,000 feet of new conveyance pipe, the abandonment of six old well sites, and SCADA implementation for system automation.
- **PMA #12 ACSD Well #12 Construction:** Well #12 was completed and commissioned in May of 2021.

4) Coordination with Stakeholders

AEWSD discusses SGMA matters during its regular monthly Board of Directors meetings. In addition, in WY 2023 AEWSD staff participated in the following:

- 21 meetings of the South of Kern River (SOKR) Managers and/or Executive Committee;
- 7 meetings with state regulators and staff including DWR and the SWRCB;
- 40 inter-basin meetings with representatives of other GSAs/basins; and
- 54 miscellaneous meetings related to SGMA and groundwater matters with various entities.

ACSD's stakeholder activities include discussion of SGMA matters during its regularly scheduled Board of Directors meetings. In addition, in WY 2023 ACSD staff participated in the following:

- 21 meetings of the South of Kern River (SOKR) Managers and/or Executive Committee;
- 7 meetings with state regulators and staff including DWR and the SWRCB;
- 40 inter-basin meetings with representatives of other GSAs/basins; and
- 18 miscellaneous meetings related to SGMA and groundwater matters with various entities.

5) Summary of Other GSP-related Special Studies or Activities

In addition to the above activities related to Projects and Management Actions specifically included in the SOKR GSP, the following SGMA-related studies and activities were conducted in WY 2023:

- Continued analysis of critical water budget components, including agricultural (evapotranspirative) water demands and return flow estimates;
- Continued involvement in review of and comments on various water banking project CEQA documents potentially affecting AEWSD's Central Valley Project / Friant-Kern Canal surface water supplies from the standpoint of both water quantity, water quality, and land subsidence concerns;
- Continued participation in water quality studies related to Friant-Kern Canal Reverse Flow/Pump-Back Program;
- Continued participation in Basin-wide initiatives including the Basin Study, DMS development, and the AEM data collection effort;
- Responded to County of Kern requests for GSA review of well permit applications;
- Review of statewide well mitigation policies for development of a local policy;
- Participated in public awareness initiatives regarding the social benefits of maintaining agricultural economy;
- Assisted Friant Division to effect an exchange of supplies between Millerton Lake and San Luis Reservoir to minimize water supply impact to Friant districts;
- Continued to engage in statewide lawsuits involving projects/programs that threaten AEWSD's water supplies;
- Investigated and sought grant funding to expand capacity for an interconnection with neighboring Wheeler- Ridge Maricopa WSD for transfer/exchanges of water supplies;
- Continued to follow and review DWR and SWRCB responses, comments, and decisions regarding SGMA in other basins throughout the state;
- Received a $25 million bond and finance package for implementing SGMA projects.
- Investigated land repurposing within the District and the DWR LandFlex grant program;
- Researched potential properties to purchase for recharge;
- Increased flow capacity in existing recharge facilities;
- Received Drought Resiliency Project Grant application to install two new supply wells and fund the development of the AEGFM and DST.
- Applied for a USBR Applied Sciences Grant to help fund ongoing refinements and improvements to the AEGFM and DST.

9.6.2 Tejon-Castac Water District GSA

6) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

Progress towards compliance with groundwater levels SMC in the Tejon-Castac Water District (TCWD) GSA Area during WY 2023 is summarized as follows:

a) Compliance with SMC

Groundwater levels for both Fall 2022 and Spring 2023 were above the established Minimum Threshold (MT) and below the established Measurable Objective (MO).

b) SMC Monitoring Activities

Collection of groundwater level data in Fall 2022 (11/1/2022) and in Spring 2023 (6/8/2023) in the one groundwater level Representative Monitoring Well.

c) Assessment Of Potential Impacts to Beneficial Users

Groundwater levels throughout the TCWD GSA remained stable during WY 2023. As such, there were no known adverse impacts attributable to changes in groundwater conditions.

7) Compliance with Additional Sustainable Management Criteria

There are no additional sustainable management criteria identified in the TCWD GSA Area.

a) Water Quality

The Degraded Water Quality sustainability indicator is not applicable to the TCWD GSA.

b) Subsidence

The Land Subsidence sustainability indicator is not applicable to the TCWD District GSA.

c) Interconnected Surface Water

The Interconnected Surface Water sustainability indicator is not applicable to the TCWD GSA.

8) Implementation of Projects and Management Actions (PMAs)

With respect to its planned Projects and Management Actions (PMAs), TCWD GSA has taken the following steps in Water Year 2023:

- **Conversion of Granite Quarry to Sycamore Reservoir**: In WY 2023, TCWD continued to participate in discussions with Arvin-Edison Water Storage District (AEWSD) and others about this PMA regarding the permitting process and next steps for environmental work. It is anticipated that operations at the Granite Quarry facility will cease in WY 2024, after which implementation of this PMA will begin.

- **Recharge of Carrot Wash Water**: This PMA is underway and ongoing, and on average, recharges approximately 300 AFY of carrot wash water to the groundwater basin. However, in Water Year 2023, this PMA did not recharge any carrot wash water
- **Tejon Ranch Conservation & Land Use Agreement and Ranch Wide Management Plan (RWMP):** The TCWD GSA Area is almost entirely covered by and managed under the Tejon Ranch Conservation & Land Use Agreement and associated Ranch Wide Management Plan (RWMP), which includes land use policies and restrictions on groundwater extraction.

9) Coordination with Stakeholders

TCWD GSA has continued to coordinate with interested stakeholders by holding regular meetings of the TCWD Board of Directors which are open to the public. Such meetings were held five times in Water Year 2023.

Additionally, TCWD GSA has conducted stakeholder engagement through its participation in the South of Kern River (SOKR) Executive Committee meetings. Executive Committee meetings are held monthly and are open to the public. Such meetings were held eight times in Water Year 2023 and focused primarily on updating the public on the Subbasin's ongoing coordinated response to the California Department of Water Resources (DWR)'s inadequate determination and the State Water Resources Control Board (SWRCB) pre-probationary hearing process.

Representatives of TCWD have also attended intra-basin meetings with members of the other GSAs in the Kern County Subbasin for purposes of SGMA implementation and coordination.

10) Summary of Other GSP-related Special Studies or Activities

No additional GSP-related special studies or activities were conducted by TCWD GSA in the Kern County Subbasin in Water Year 2023

9.6.3 Wheeler Ridge-Maricopa GSA

11) Compliance with Groundwater Levels Sustainable Management Criteria (SMC)

The following narrative serves to summarize progress made by the Wheeler Ridge-Maricopa Water Storage District GSA (WRMGSA) toward compliance with sustainable management criteria during Water Year (WY) 2023.

a) Compliance with SMC

Following two consecutive critically dry years (i.e., WY 2021-2022), groundwater elevations improved significantly within the WRMGSA throughout the course of WY 2023. Groundwater level monitoring data collected from the WRMGSA SGMA Representative Monitoring Network during WY 2023 indicate the following:

- Groundwater elevations were measured above (i.e., did not exceed) their respective Minimum Thresholds (MTs) at 12 of the 14 (i.e., 86%) SGMA Water Level Representative Monitoring Wells (RMWs) within the WRMGSA during the Fall 2022 SGMA monitoring event. Water level MT exceedances occurred at wells RMW-232 and RMW-234. One additional RMW (RMW-235R) was measured below its Measurable Objective (MO), and the remaining 11 RMWs were measured above their MOs in Fall 2022.

- Groundwater elevations were measured above (i.e., did not exceed) their respective MTs at 13 of the 14 (i.e., 93%) SGMA RMWs within the WRMGSA during the Spring 2023 SGMA monitoring event. A water level MT exceedance occurred at RMW-232. Two additional wells (RMW-234 and RMW-235R) were measured below their MOs, and the remaining 11 RMWs were measured above their MOs in Spring 2023.

It is considered an Undesirable Result (UR) for Chronic Lowering of Groundwater Levels if MTs are exceeded in 40% or more of the SGMA Water Level RMWs (i.e., 6 out of 14 sites) over four consecutive seasonal measurements (i.e., measurements spanning a total of two years, including two seasonal high groundwater level periods and two seasonal low groundwater level periods). Furthermore, URs for Reduction of Groundwater Storage are defined within the WRMGSA using the Sustainable Management Criteria (SMCs) for Chronic Lowering of Groundwater Levels as a proxy. Therefore, URs for Chronic Lowering of Groundwater Levels and Loss of Groundwater Storage were not experienced within the WRMGSA during WY 2023.

b) SMC Monitoring Activities

The WRMGSA further implemented its SMC Monitoring Network in Water Year 2022 through the following actions:

- Groundwater levels were observed once per month in 14 wells in the groundwater level Representative Monitoring Network.
- Updated subsidence information was obtained from the Department of Water Resources for 40 benchmark sites that comprise part of the WRMGSA land subsidence Representative Monitoring Network.
- Water samples were collected from two wells in the water quality Representative Monitoring

Network that were equipped with pumps and capable of producing water

- Previously in 2021, the KGA was awarded a grant under Round 1 of Proposition 68 that included certain funds for improvements to WRMWSD GSA monitoring networks. Pursuant to that grant, the WRMWSD retained a consultant to provide oversight and other support for the equipping all Level Network wells with dedicated dataloggers.

c) Assessment Of Potential Impacts to Beneficial Users

Within the WRMWSD's Surface Water Service Area (SWSA), most groundwater production wells remained idle during the year. Consequently, groundwater levels throughout the WRMGSA stabilized or rose during the year and nearly all beneficial users of groundwater saw reduced pumping lifts in 2023.

Outside of the SWSA, approximately 17,000 acres of WRMGSA land continued to farm in reliance on groundwater, consistent with agricultural practices going back many decades. Nonetheless, there were no known adverse impacts attributable to changes in groundwater conditions in these areas outside the SWSA or elsewhere in 2023.

12) Compliance with Additional Sustainable Management Criteria

a) Water Quality

Water samples were collected from two out of nine approved WRMGSA Groundwater Quality Network wells during the water year. These two monitoring wells, known respectively as RMW-246 and RMW-247, were found to be below their respective Minimum Thresholds (MT) and Measurable Objectives (MO) for arsenic. Arsenic concentration is the only water quality SMC contained in the SOKR GSP. The remaining seven network monitoring wells could not be sampled, because they were equipped with dedicated deep pumps, as is typical for extraction wells in the WRMGSA, and it was not possible to place a sample pump or bailer inside them.

Arguably, network wells, including RMW-246 and RMW-247, appear to shown either a leveling off or slight decrease in arsenic in the past three years, although it is difficult to infer any trend at all, because the sample set is small and the variability is large compared to the mean.

b) Subsidence

In WY 2023 the WRMGSA continued to rely on the Department of Water Resources' California Aqueduct Land Subsidence Program (CASP) annual land subsidence monitoring program to provide ground surface elevation survey data for the 40 benchmark sites along the California Aqueduct that comprise the WRMGSA land subsidence Representative Monitoring Network. In the 2022 South of Kern River (SOKR) GSP, Minimum Thresholds and Measurable Objectives for land subsidence are stated in terms of an average rate and extent within an entire Aqueduct pool. Based on the most recent CASP monitoring data (collected in June 2023), all five out of five pools within the WRMGSA appeared to be stable or subsiding at rates less than their Measurable Objective rates.

Furthermore, no individual benchmark within Pools 31-35 appeared to be subsiding at or above the Measurable Objective rates defined for its pool.

In conjunction with the other SOKR GSAs, WRMGSA held multiple meetings with CASP representatives to discuss a potential methodology for defining land subsidence SMCs within the WRMSGA that more strictly aligns with the recommendations that CASP provided to the Kern Subbasin GSAs in its comment letter on September 30, 2022.

Specifically, the proposed land subsidence SMC methodology would define unique Minimum Threshold and Measurable Objective rates and amounts at each individual benchmark within the WRMGSA and these limits would be tied directly to CASP-recommended minimum freeboard heights at each location. During these meetings, CASP provided verbal support for WRMGSA's proposed revised SMC methodology, and work is ongoing to reach Kern Subbasin-wide consensus on a revised SMC framework.

c) Interconnected Surface Water

Interconnected Surface Water is not present within the WRMWSD GSA and is not anticipated to be present in the future. Accordingly, there are no local SMCs for this Sustainability Indicator, and the notion of implementation progress does not apply.

13) Implementation of Projects and Management Actions (PMAs)

WRMWSD has made progress towards implementing several of its planned Projects and Management Actions. Examples include the following:

WRM-1, On-Farm Recharge: In April 2023, the WRMWSD's Board of Directors established the Landowner Recharge Program, which paid participating landowners $75 per acre-foot to spread certain low-cost water supplies available to the WRMWSD on their private lands. The WRMWSD's Engineer-Manager was given discretion to approve applications to ensure that water was not percolated on lands subject to perched water or overlying poor quality groundwater. The District covered all costs associated with acquiring and delivering the water, while the landowner was responsible for building and operating all spreading facilities such as berms, ponds, pumps, and pipelines.

Between April and December 2023, nine landowners recharged a total of 5,657 AF of surplus water within the WRMGSA footprint.

WRM-2, In-District Banking Facilities: One of the major obstacles to creating new banking facilities within the WRMGSA is the occurrence of the Corcoran Clay and other similar impeding clays across large portions of the GSA footprint, and it is generally held that the locations of future recharge projects should be informed by a better understanding of stratigraphy and lithology in the local groundwater basin. To that end, in 2023 the WRMWSD retained a consultant to develop a 3D geologic model of the district's service area.

WRM-3, Increase Out-of-District Banking Operations: During Water Year 2023, approximately 24,000 AF of water were recharged in the City of Bakersfield's Pioneer Project on the WMRWSD's behalf together with approximately 165,000 AF recharged in the Kern Water Bank. In total, this amounted to a record-breaking 189,000 AF of water recharge on behalf of the WRMWSD in out-of-District banking facilities in a single year. Of course, this was only possible because decades of coordinated effort and millions of dollars of local investments in recharge facilities came together with favorable hydrology in 2023, but it demonstrated the WRMGSA's commitment to take maximum advantage of circumstances to increase banking operations.

WRM-5, Purchase Additional Supplies: During Water Year 2023, the WRMWSD purchased approximately 145,000 AF of "opportunistic" surface water, comprised of Kern River water, Article 21 water, and other available State Water Project supplies, in addition to purchasing its full contract allocation of State Water Project Table A supplies. It is believed that about 15% of these additional supplies were delivered within the Kern Subbasin, with the balance going to the White Wolf Subbasin and various Kern Fan banking projects.

WRM-6, Desalination Facilities: The District continued to explore ways to utilize desalination facilities to mitigate localized impacts of pumping in the WRMGSA. To that end, the District continued to hold discussions with proponents of certain potential desalination projects.

WRM-7, Delta Conveyance Project: The District continued to fund the planning phase of the Delta Conveyance Project (DCP) in 2023. Previously in 2020, The WRMWSD Board of Directors elected to participate in the planning phase of the Delta Conveyance Project at a level of 32% (63,100 AF) of its State Water Project entitlement. Ultimately, participation in the DCP will allow the District to firm up its existing State Water Project entitlement and may also enable participants to gain access to additional non-firm supplies that can be conveyed through the Delta.

WRM-8, Acreage Assessment: Although neither an acreage assessment nor a GSA program, in July 2023 WRMWSD landowners approved a Groundwater Service Charge (GWSC) that eventually will be levied on each acre- foot of groundwater extracted within WRMWSD boundaries with the exception of de minimis and residential use. The GWSC was passed pursuant to a Proposition 218 balloting process as detailed below under section "4) Coordination with Stakeholders". The charge recognizes that the importation of surface water relieves stress on the local groundwater basin, providing a benefit to groundwater users as well as surface water users. In contrast, the vast majority of costs to import surface water are currently borne only by surface water contract holders. Funds derived from the GWSC will be used to help offset the cost of State Water Project water and other supplemental supplies for water contract holders. As a secondary effect, the charge will help equalize the cost of local groundwater compared to more expensive surface water, no doubt reducing the overall demand for groundwater.

WRM-9, Groundwater Allocation: In mid-2023, the WRMGSA formed a Projects & Management Actions (PMA) Committee to seek public input on SGMA implementation. The PMA Committee met several times during 2023, undertaking the development of demand reduction options, including a potential groundwater allocation, as its first task. By the end of the water year, committee members and members of the general public had discussed several alternatives for well metering, allocation transfers, recharge credits, and how to accommodate domestic water users.

WRM-12, Land Retirement: Although not an intentional management action, crop surveys showed a 9,500-acre reduction in net cropped acres between 2022 and 2023 within the WRMGSA. In this instance, it is believed that chronic water shortages together with market forces may have influenced individual water users to fallow about 8,100 acres of former trees and vines. At the same time, a recent trend continued toward converting farmland into large and small commercial solar projects. For example, construction continued at a privately owned 300-MW solar generation facility situated on 3,400 acres of land, a large portion of which was previously farmed, and a number of smaller solar projects were either proposed or in various stages of construction on former farmlands. In 2023, the WRMWSD began taking delivery of power produced by a new 6 MW solar generation project located on 56 acres within WRMGSA boundaries.

14) COORDINATION WITH STAKEHOLDERS

The WRMWSD's Board of Directors approved a Groundwater Service Charge (GWSC) pursuant to a Proposition 218 balloting process in May of 2023. This occurred only after WRMWSD staff held multiple public meetings and workshops on the topic, and after meeting one-on-one with local landowners and stakeholders in many cases.

The WRMWSD's Board also discussed many items relating to rules and procedures, funding, and budgets that related directly or indirectly to SGMA during its normal public Board meetings, which are held regularly on the second Wednesday of every month.

In early 2023, the WRMGSA established a Project & Management Actions (PMA) Committee which held various public meetings to discuss and engage with stakeholders. The PMA Committee also allowed for direct stakeholder and landowner feedback on the development of WRMGSA policies. District staff and Board members also participated in regular KGA meetings throughout Water Year 2023 and met regularly with other South of Kern River (SOKR) GSP participants. SOKR Executive Committee meetings are held monthly and are open to the public; such meetings were held eight times in Water Year 2023.

15) SUMMARY OF OTHER GSP-RELATED SPECIAL STUDIES OR ACTIVITIES

Sites Reservoir Project: Beginning in 2019, multiple District landowners entered into funding agreements for up to 3,200 AF of storage capacity within Sites Reservoir, with participation at the landowner level continuing through Water Year 2023. While not a District project, Sites Reservoir will provide additional dry-year surface supplies and storage flexibility to participants.

Quantification of Groundwater Extraction: During the water year, WRMWSD developed a calculator for the estimation of groundwater extraction as the net of applied water and crop water use at the field level. This calculator will form the accounting backbone for assessing future GWSC charges.

10 REFERENCES

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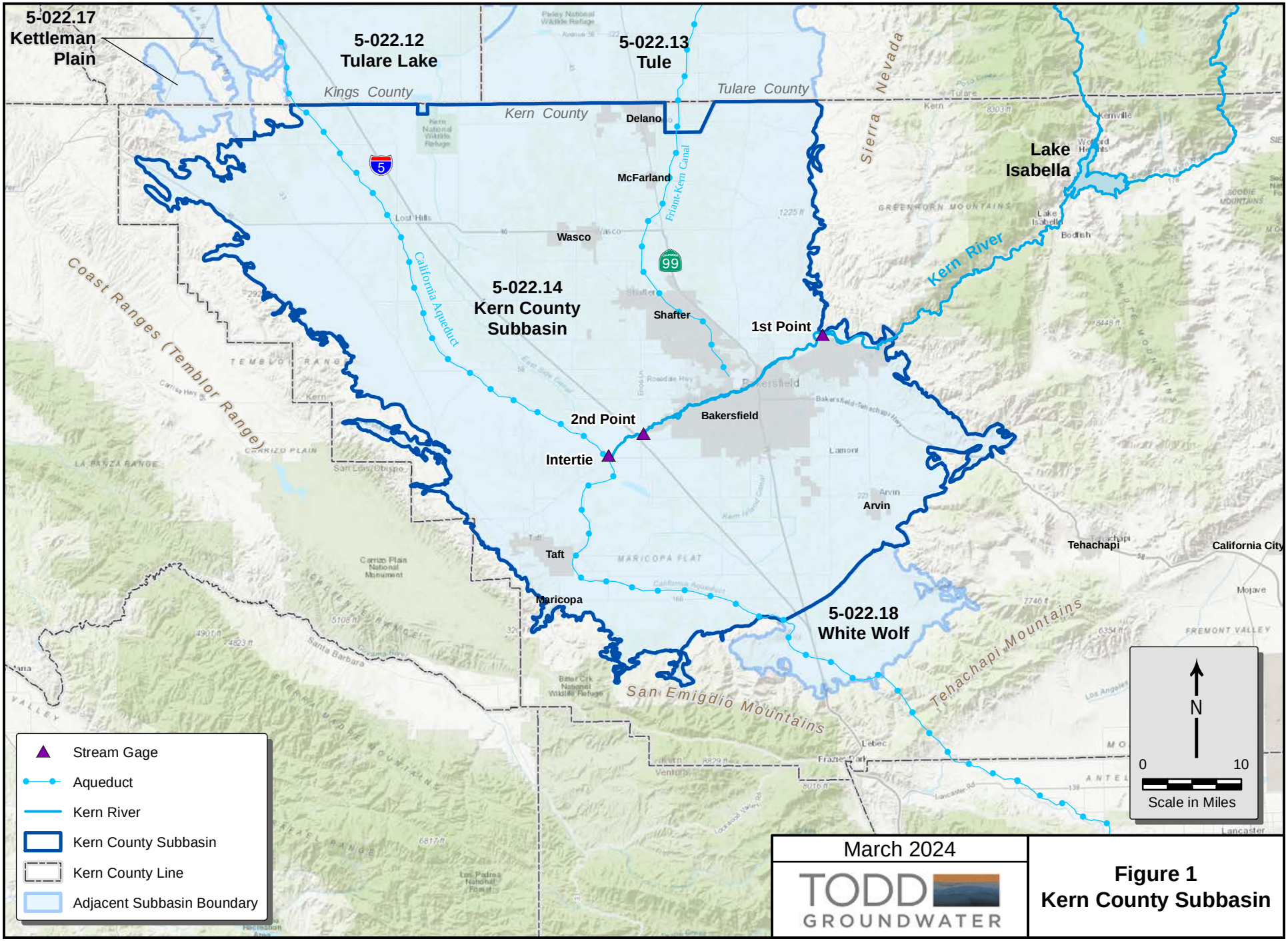
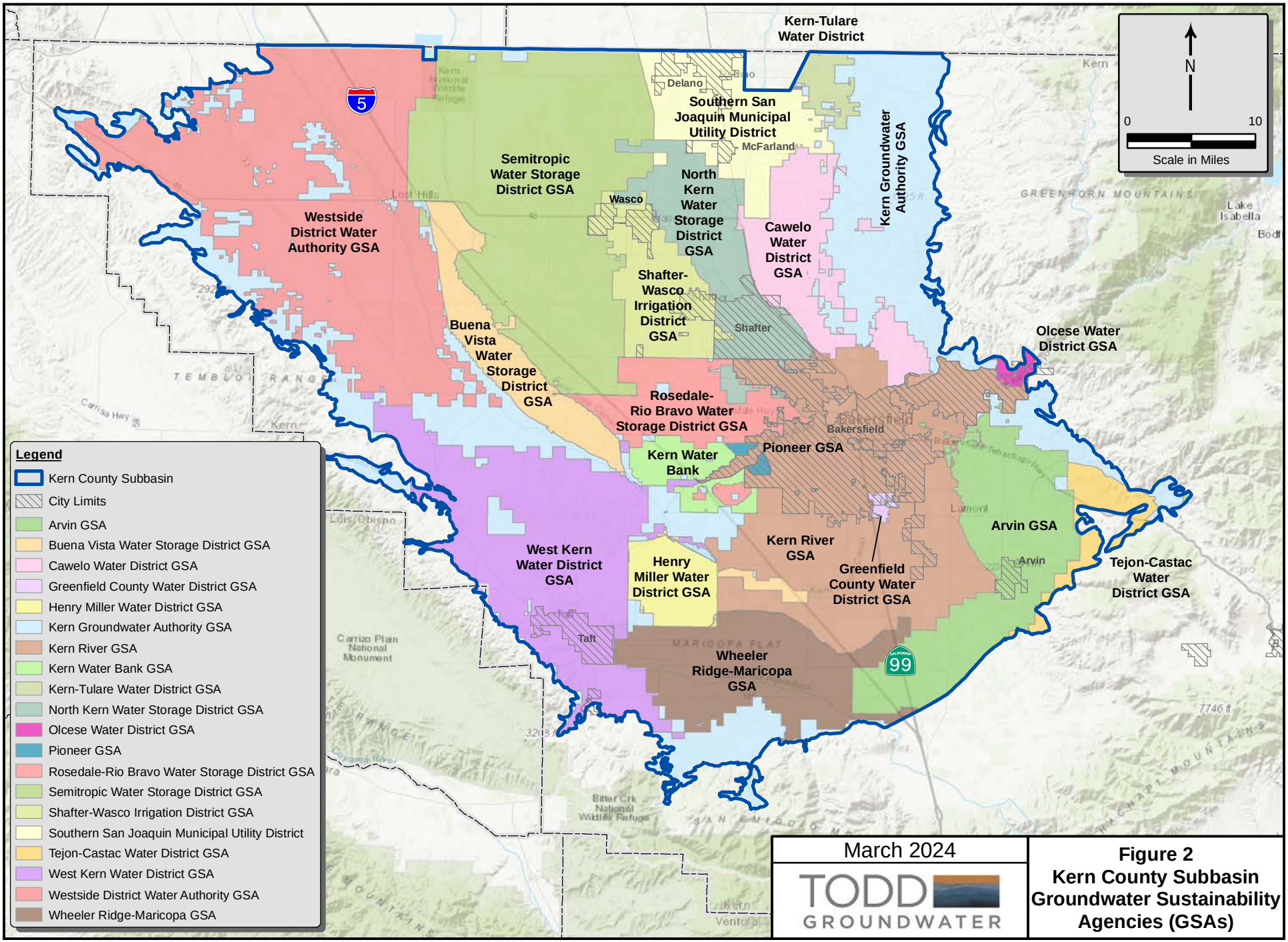
FIGURES


5-022.17
Kettleman
Plain
5-022.12
Tulare Lake
5-022.13
Tule
Kings County
Kern County
Tulare County
Delano
McFarland
Wasco
Shafter
Lost Hills
Friant-Kern Canal
California Aqueduct
Sierra Nevada
Lake
Isabella
Kern River
Coast Ranges (Temblor Range)
5-022.14
Kern County
Subbasin
1st Point
2nd Point
Intertie
Bakersfield
Arvin
Taft
Maricopa
Tehachapi
California City
5-022.18
White Wolf
San Emigdio Mountains
Tehachapi Mountains
Stream Gage
Aqueduct
Kern River
Kern County Subbasin
Kern County Line
Adjacent Subbasin Boundary
N
0
10
Scale in Miles
March 2024
TODD GROUNDWATER
Figure 1
Kern County Subbasin



March 2024

TODD GROUNDWATER

Figure 2
Kern County Subbasin Groundwater Sustainability Agencies (GSAs)

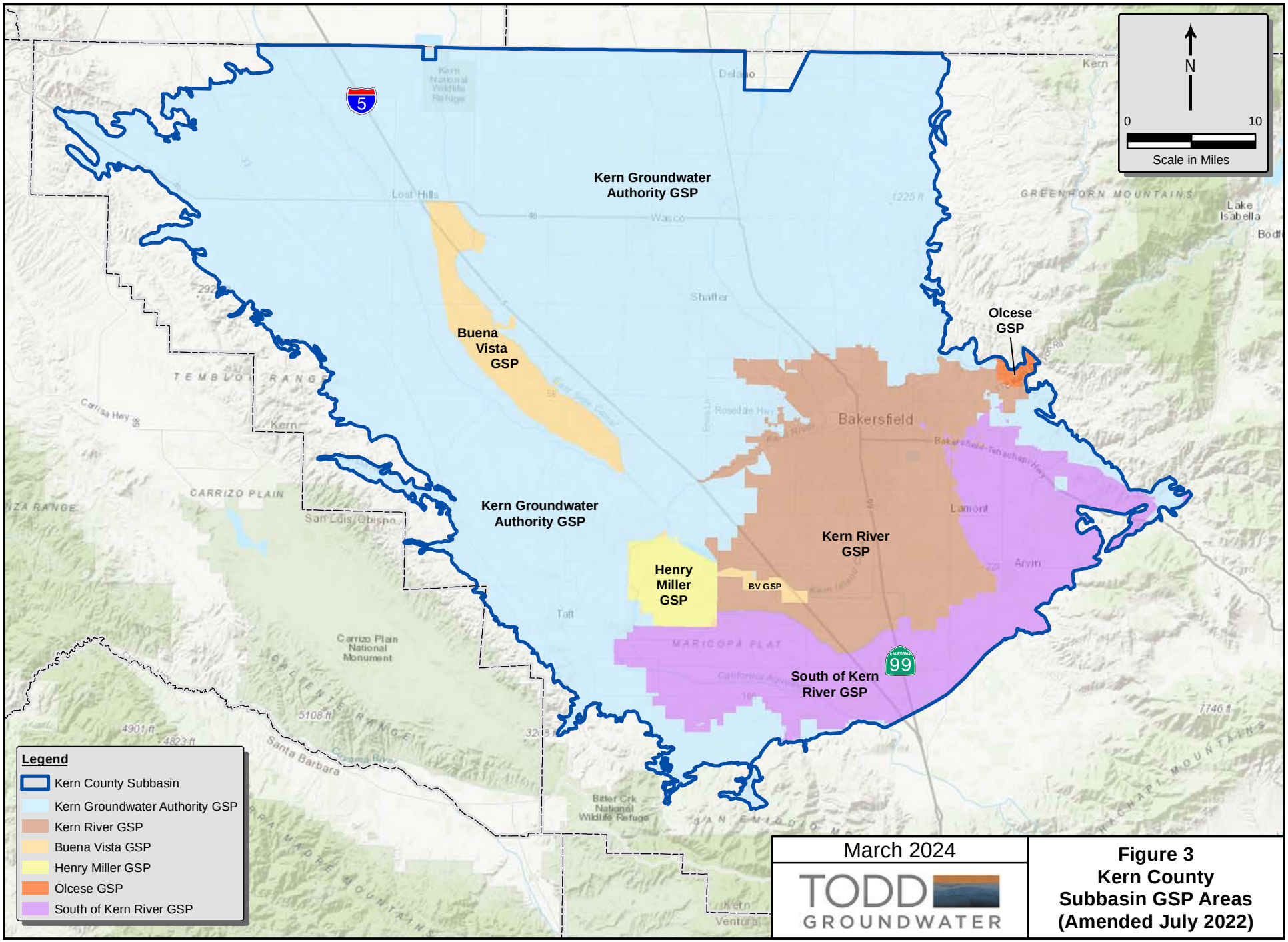
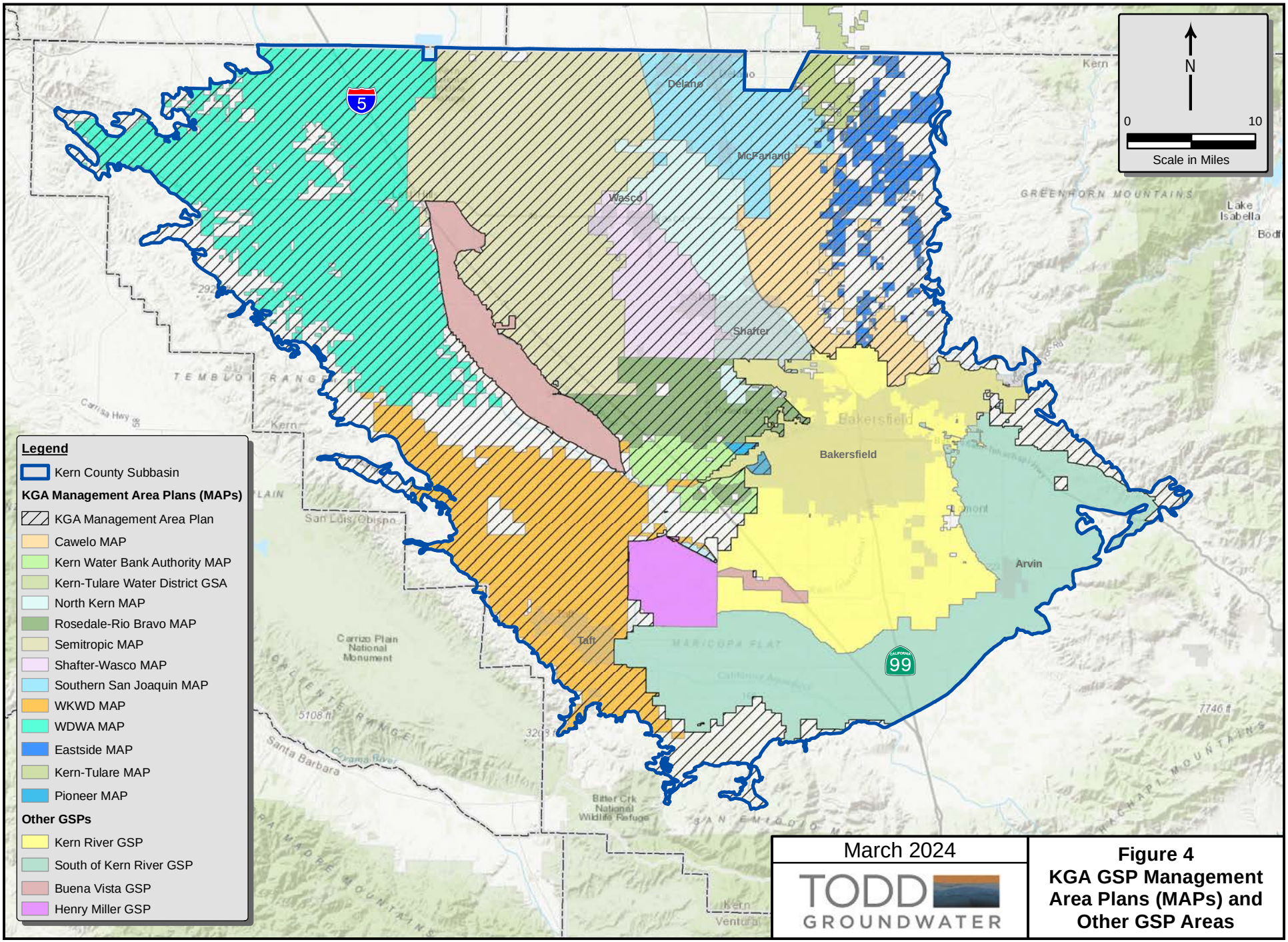


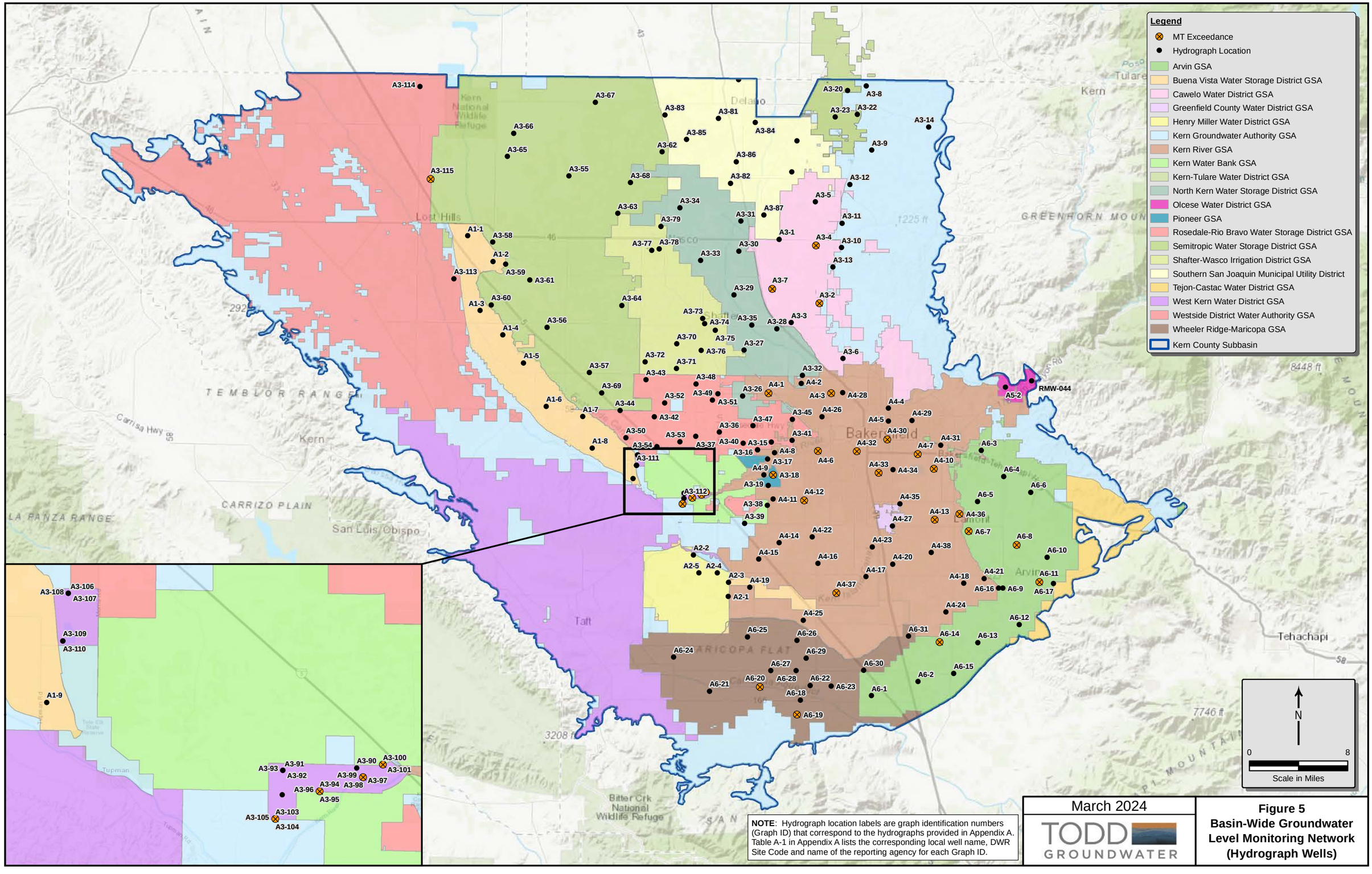
Figure 3
Kern County Subbasin GSP Areas (Amended July 2022)



March 2024

TODD GROUNDWATER

Figure 4
KGA GSP Management Area Plans (MAPs) and Other GSP Areas

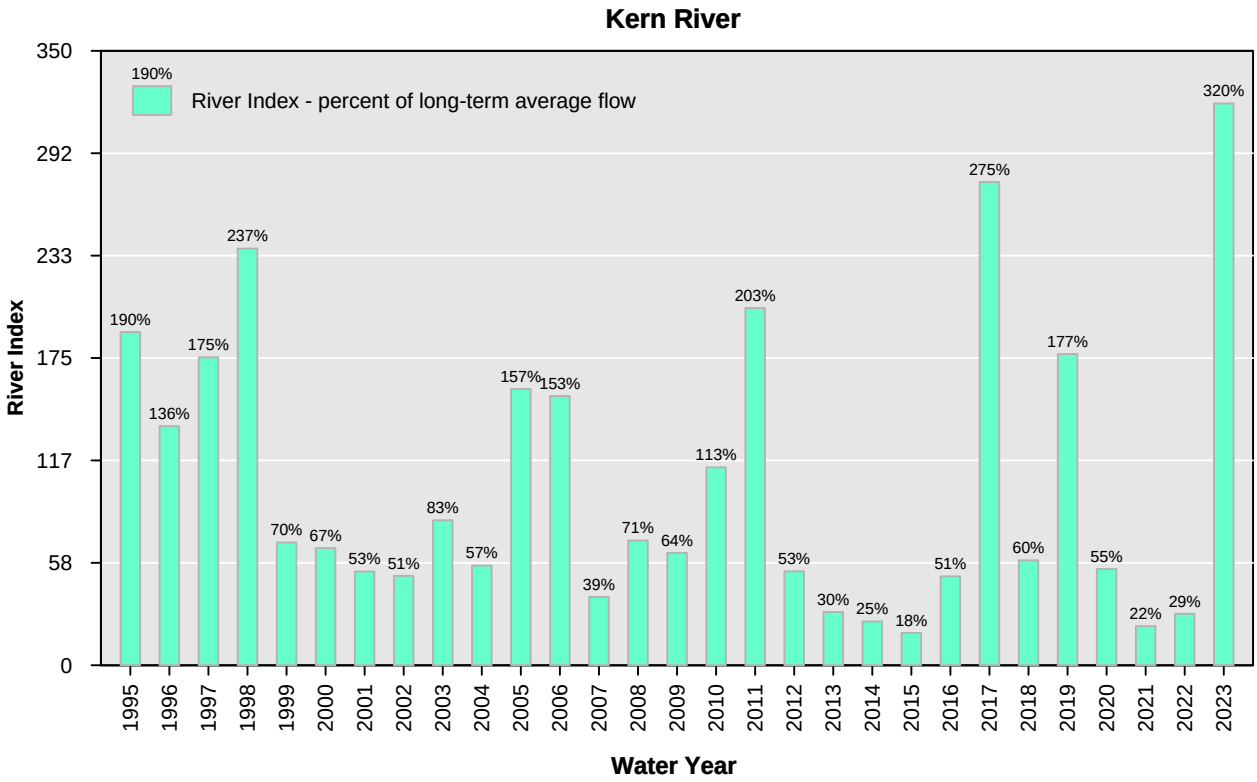


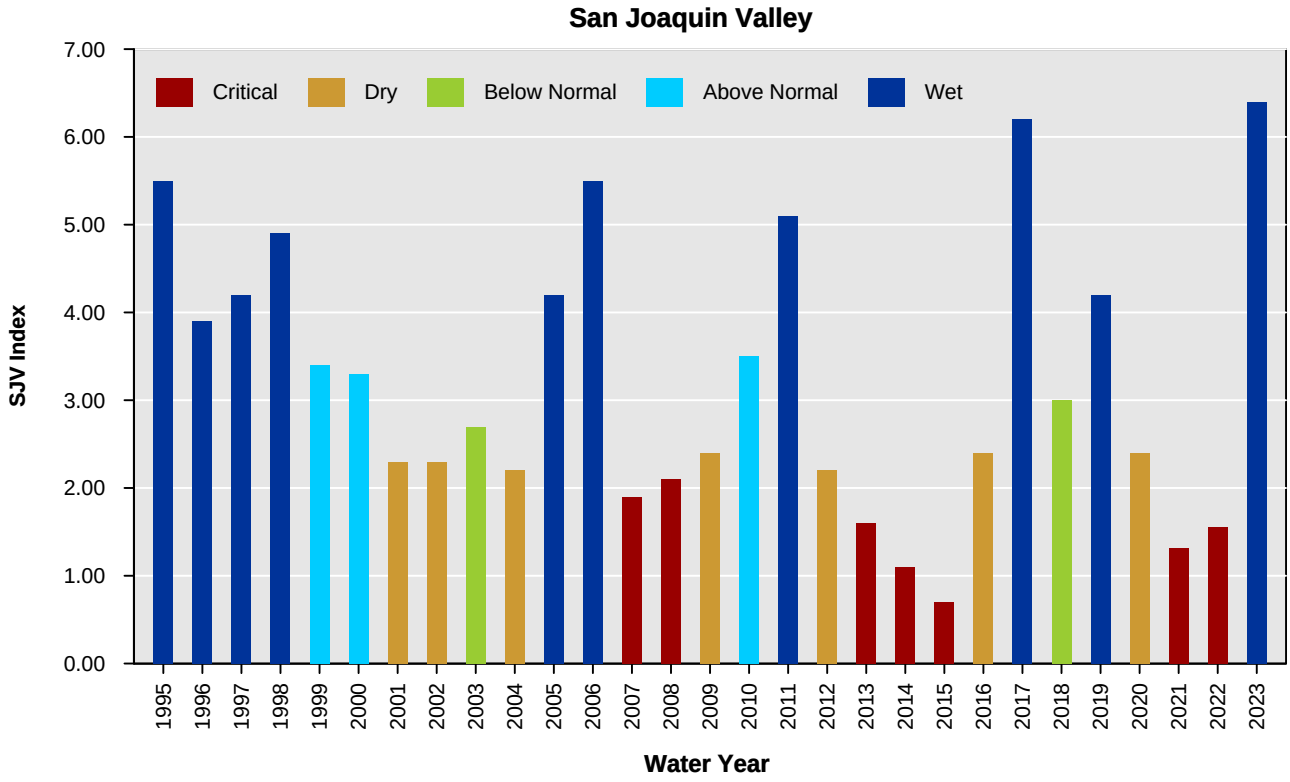
NOTE: Hydrograph location labels are graph identification numbers (Graph ID) that correspond to the hydrographs provided in Appendix A. Table A-1 in Appendix A lists the corresponding local well name, DWR Site Code and name of the reporting agency for each Graph ID.

March 2024

TODD GROUNDWATER

Figure 5
Basin-Wide Groundwater Level Monitoring Network (Hydrograph Wells)





Data Sources:
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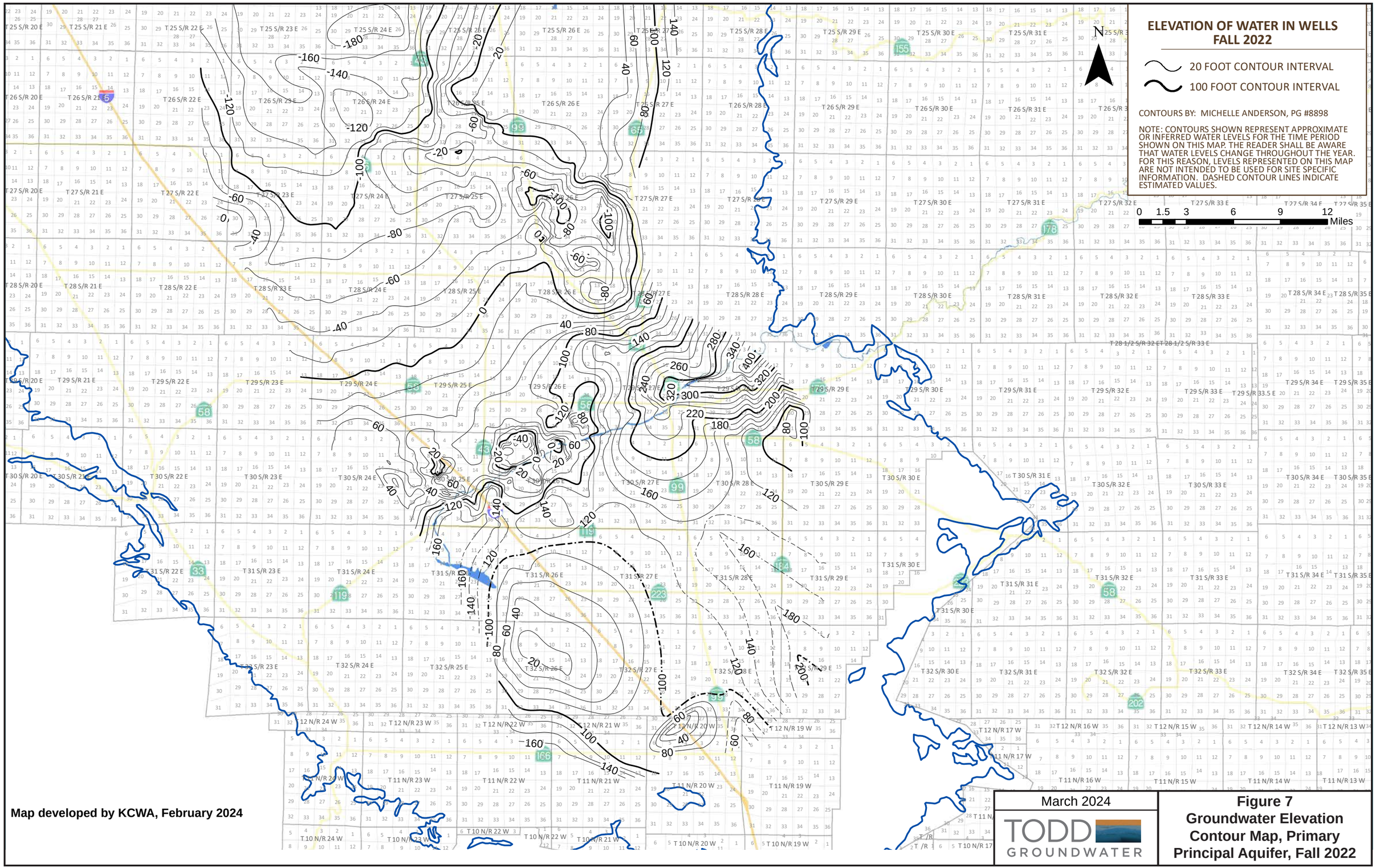
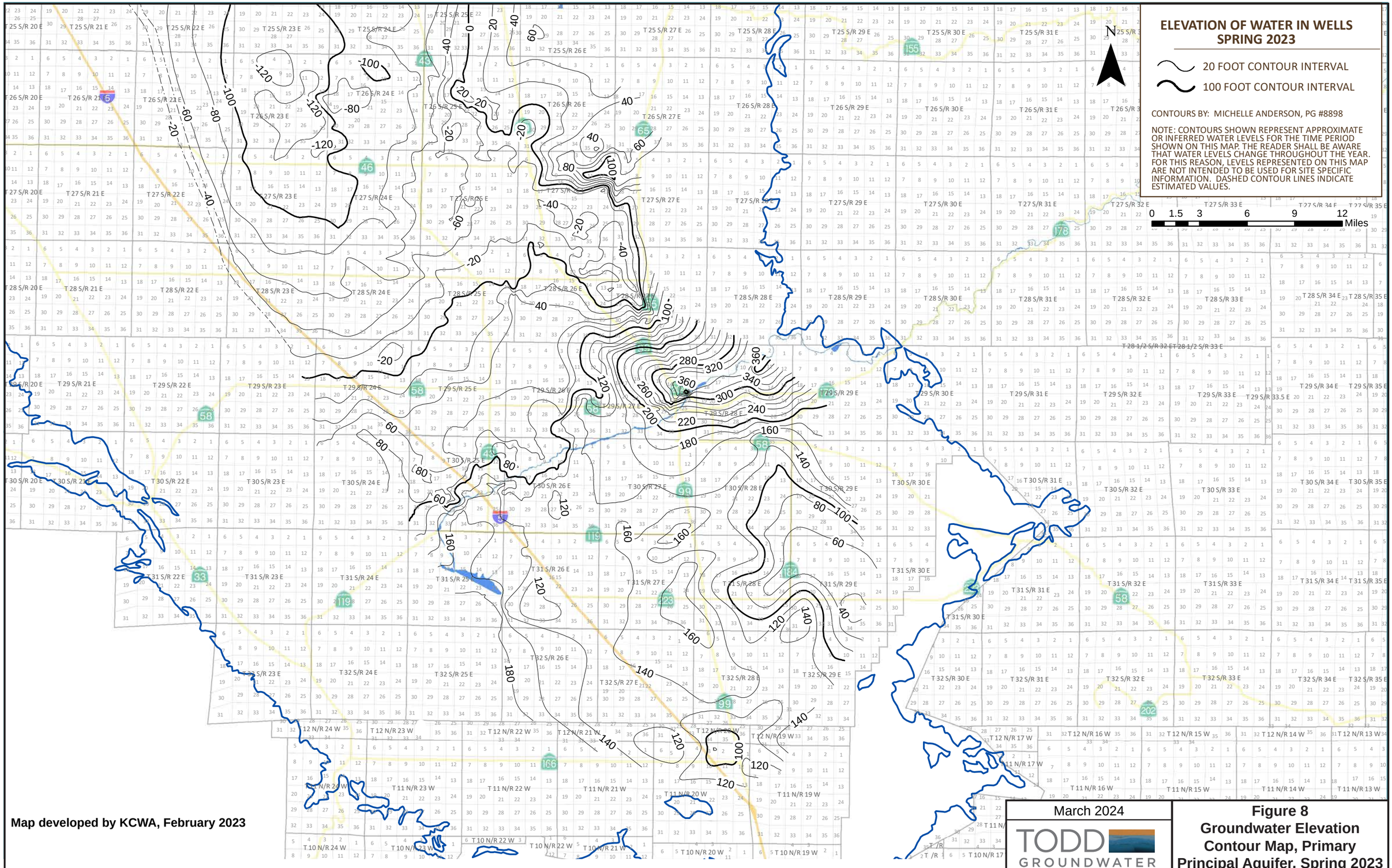
City of Bakersfield, Updated Kern River Indices by WY (received 2/15/2023)

March 2024

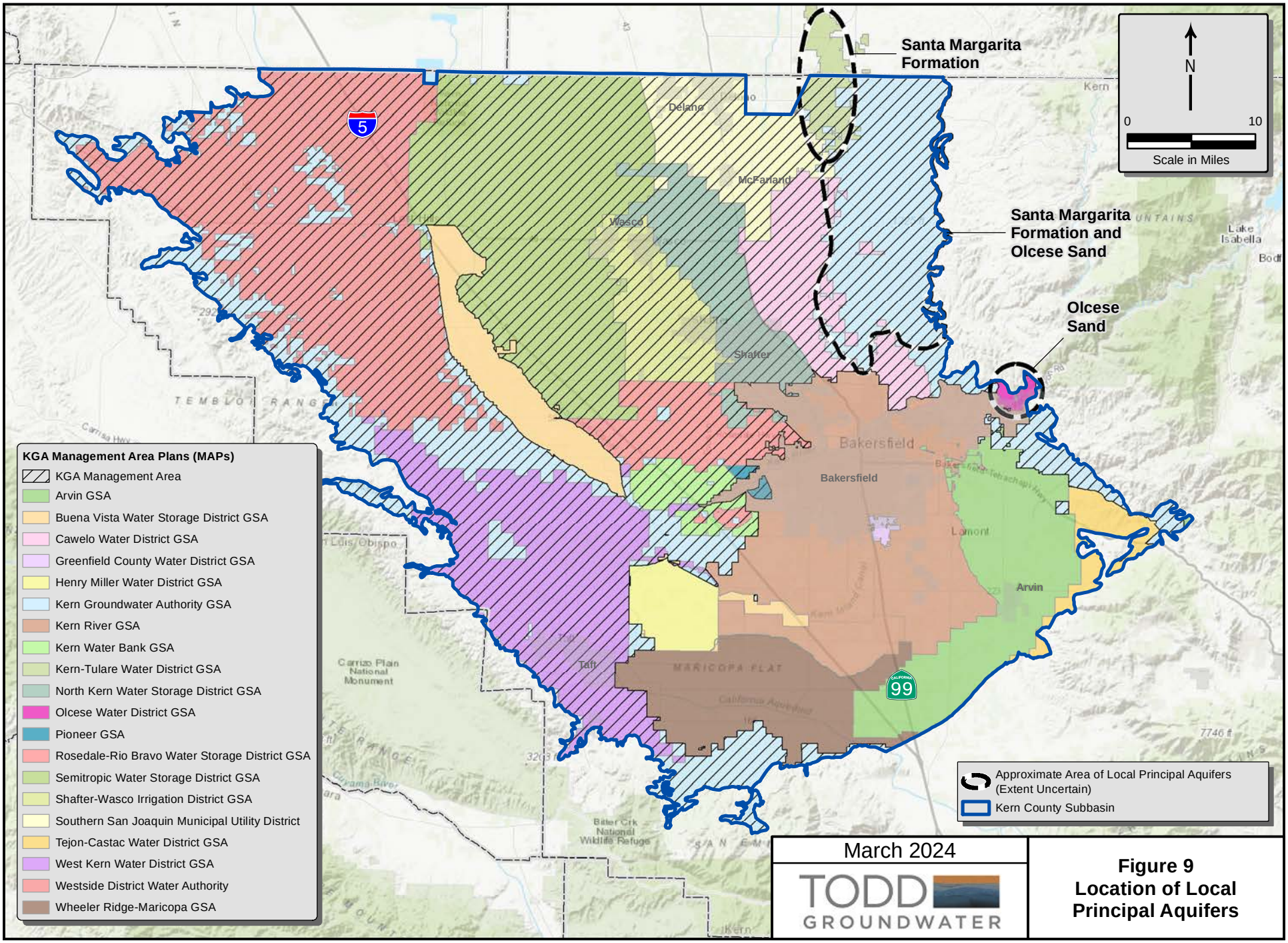
TODD GROUNDWATER

Figure 6
Water Year Types, Kern River and San Joaquin Valley Indices, WY 1995-2023


ELEVATION OF WATER IN WELLS
FALL 2022
20 FOOT CONTOUR INTERVAL
100 FOOT CONTOUR INTERVAL
CONTOURS BY: MICHELLE ANDERSON, PG #8898
NOTE: CONTOURS SHOWN REPRESENT APPROXIMATE OR INFERRED WATER LEVELS FOR THE TIME PERIOD SHOWN ON THIS MAP. THE READER SHALL BE AWARE THAT WATER LEVELS CHANGE THROUGHOUT THE YEAR. FOR THIS REASON, LEVELS REPRESENTED ON THIS MAP ARE NOT INTENDED TO BE USED FOR SITE SPECIFIC INFORMATION. DASHED CONTOUR LINES INDICATE ESTIMATED VALUES.
N
0 1.5 3 6 9 12
Miles
Map developed by KCWA, February 2024
March 2024
TODD GROUNDWATER
Figure 7
Groundwater Elevation Contour Map, Primary Principal Aquifer, Fall 2022



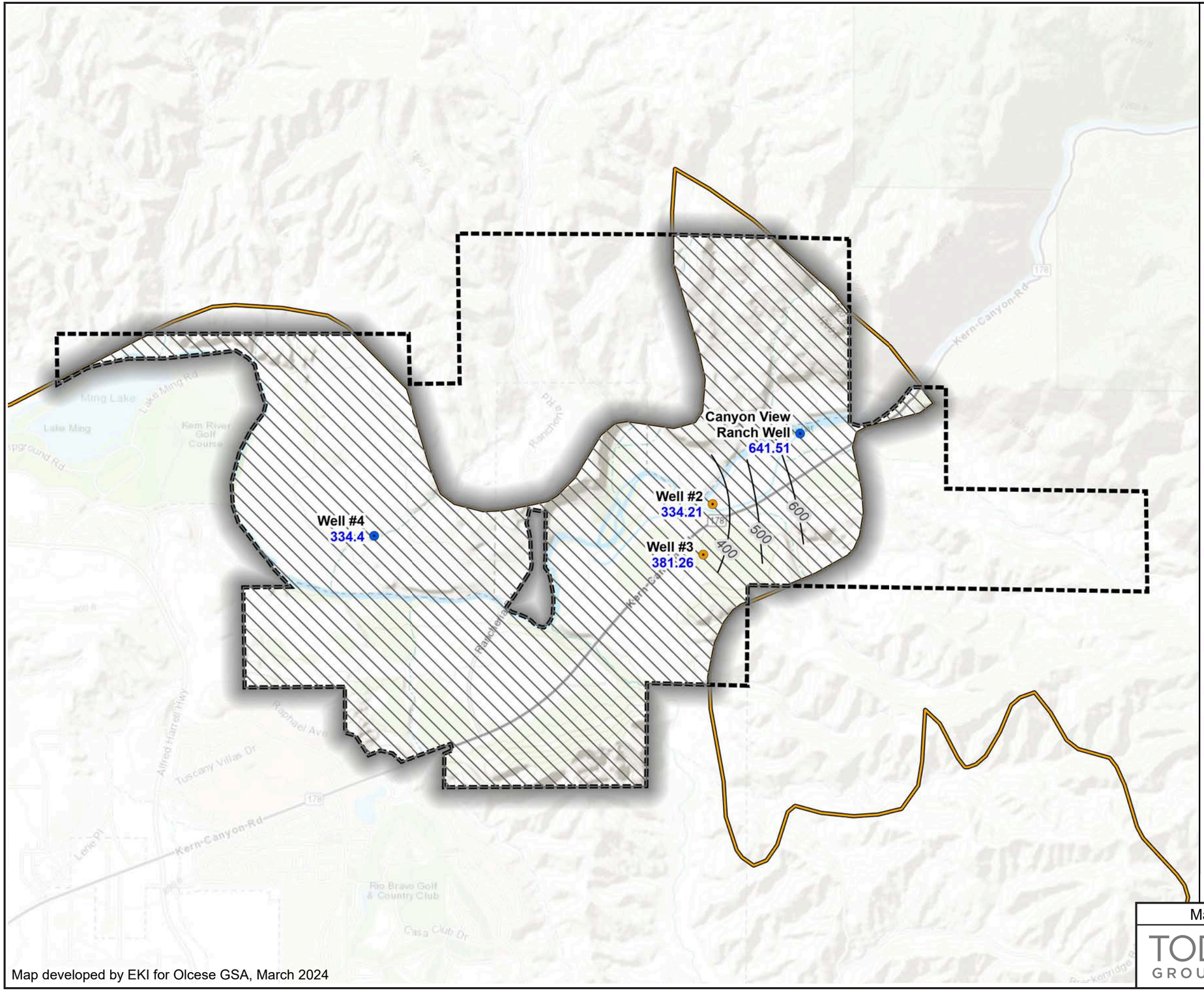
BY: M. ALLEN
FILENAME: SGMA - Elevation of Water in Wells (Spring 2023).mxd



March 2024

TODD GROUNDWATER

Figure 9
Location of Local Principal Aquifers



Legend

- Olcese Water District
- Olcese Water District GSA
- Kern County Subbasin (DWR 5-022.14)
- GW Level Contour
- GW Level Representative Monitoring Site
- Other GW Level Measurement Location

Abbreviations

DWR	= California Department of Water Resources
GSA	= Groundwater Sustainability Agency
GW	= groundwater

Notes

1. All locations are approximate.
2. Groundwater levels measured on 26 October 2022.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 March 2024.

N

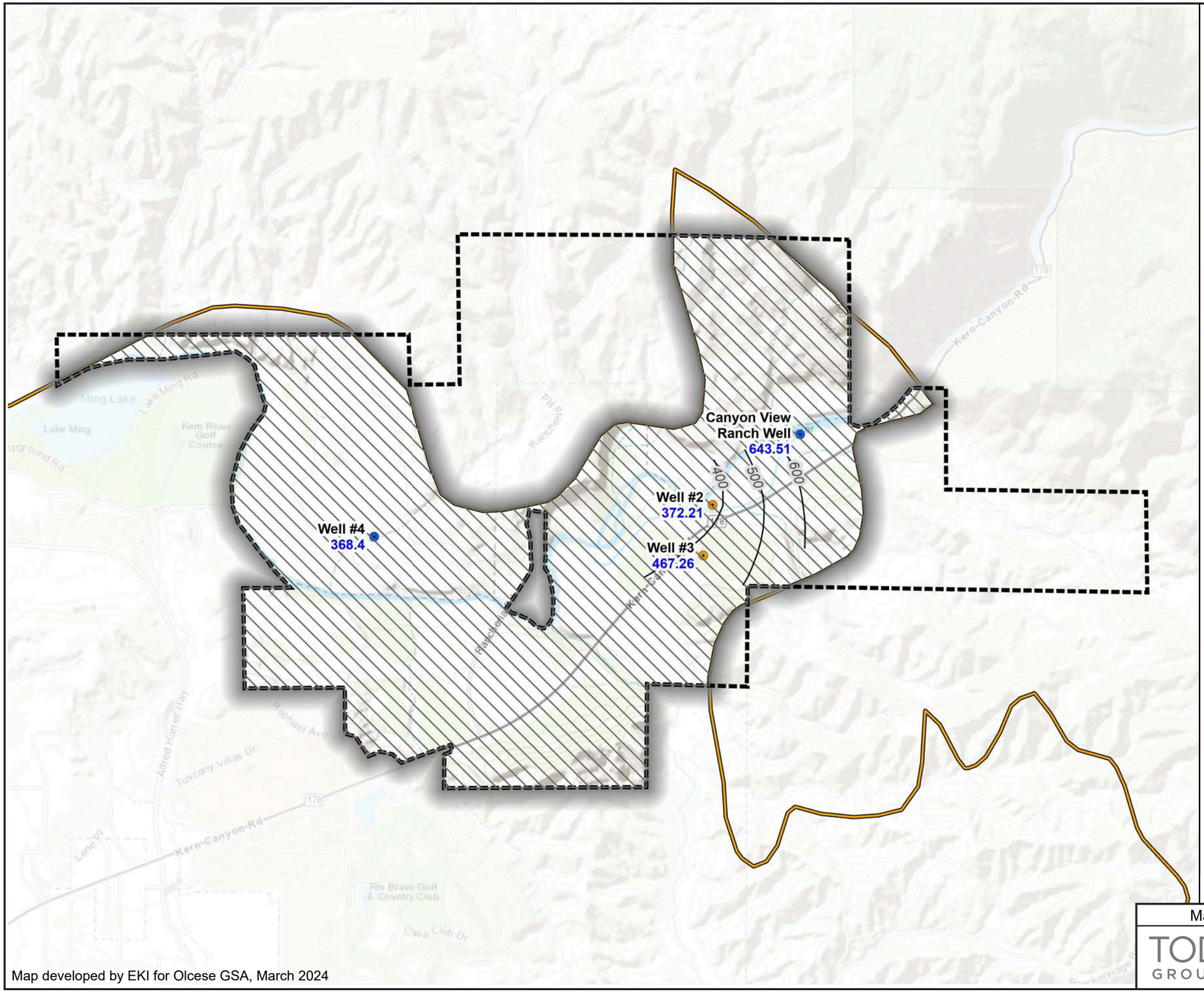
0 0.5 1
Miles

Map developed by EKI for Olcese GSA, March 2024

March 2024

TODD GROUNDWATER

Figure 10
Groundwater Elevation Contour Map, Olcese Sand Principal Aquifer, Fall 2022



Legend

- Olcese Water District
- Olcese Water District GSA
- Kern County Subbasin (DWR 5-022.14)
- GW Level Representative Monitoring Site
- Other GW Level Measurement Location
- GW Level Contour

Abbreviations

DWR	= California Department of Water Resources
GSA	= Groundwater Sustainability Agency
GW	= groundwater

Notes

1. All locations are approximate.
2. Groundwater levels measured on 30 March 2023.

Sources

1. Basemap is ESRI's ArcGIS Online world topographic map, obtained 18 March 2024.

N

0 0.5 1
Miles

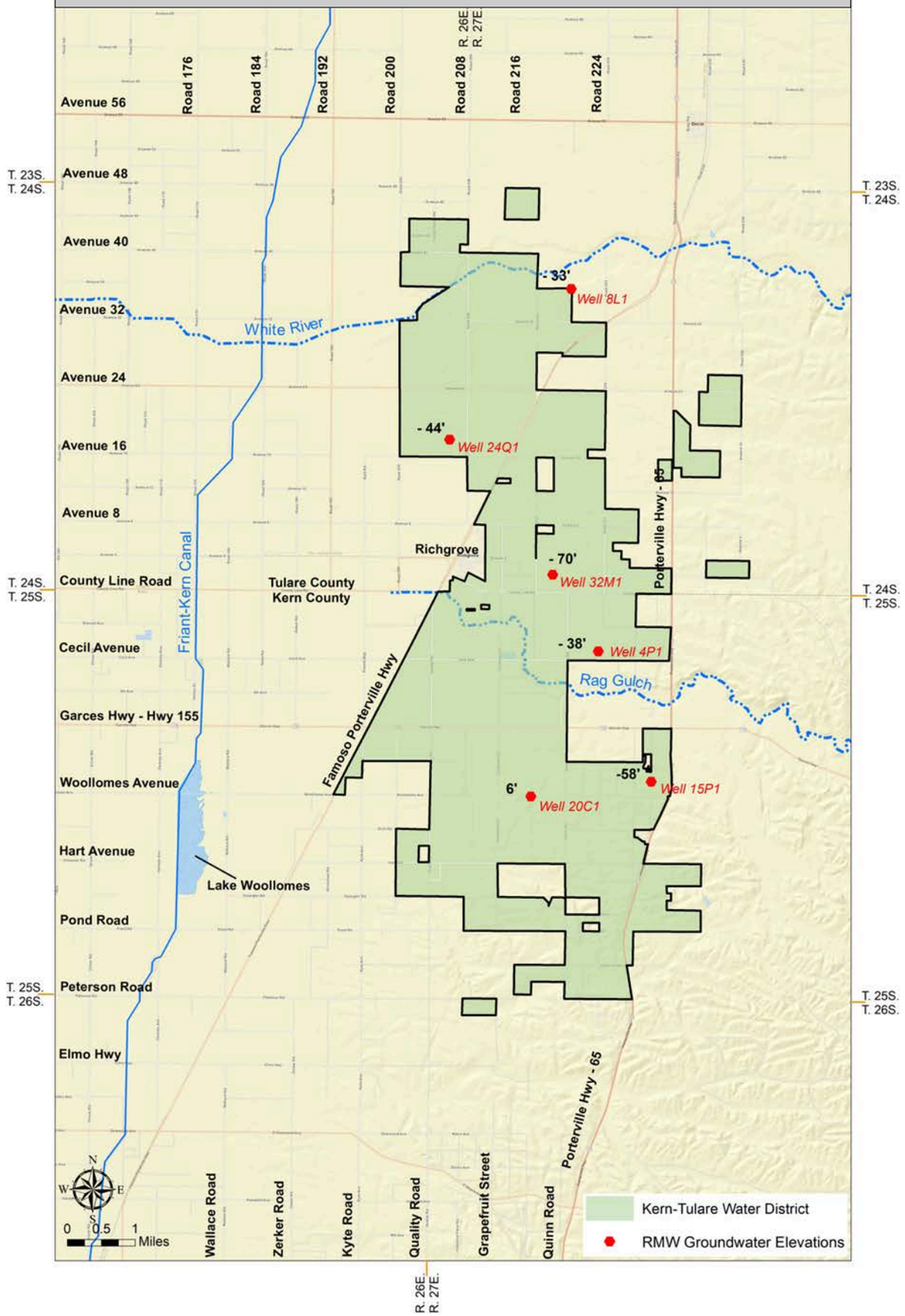
Map developed by EKI for Olcese GSA, March 2024

March 2024

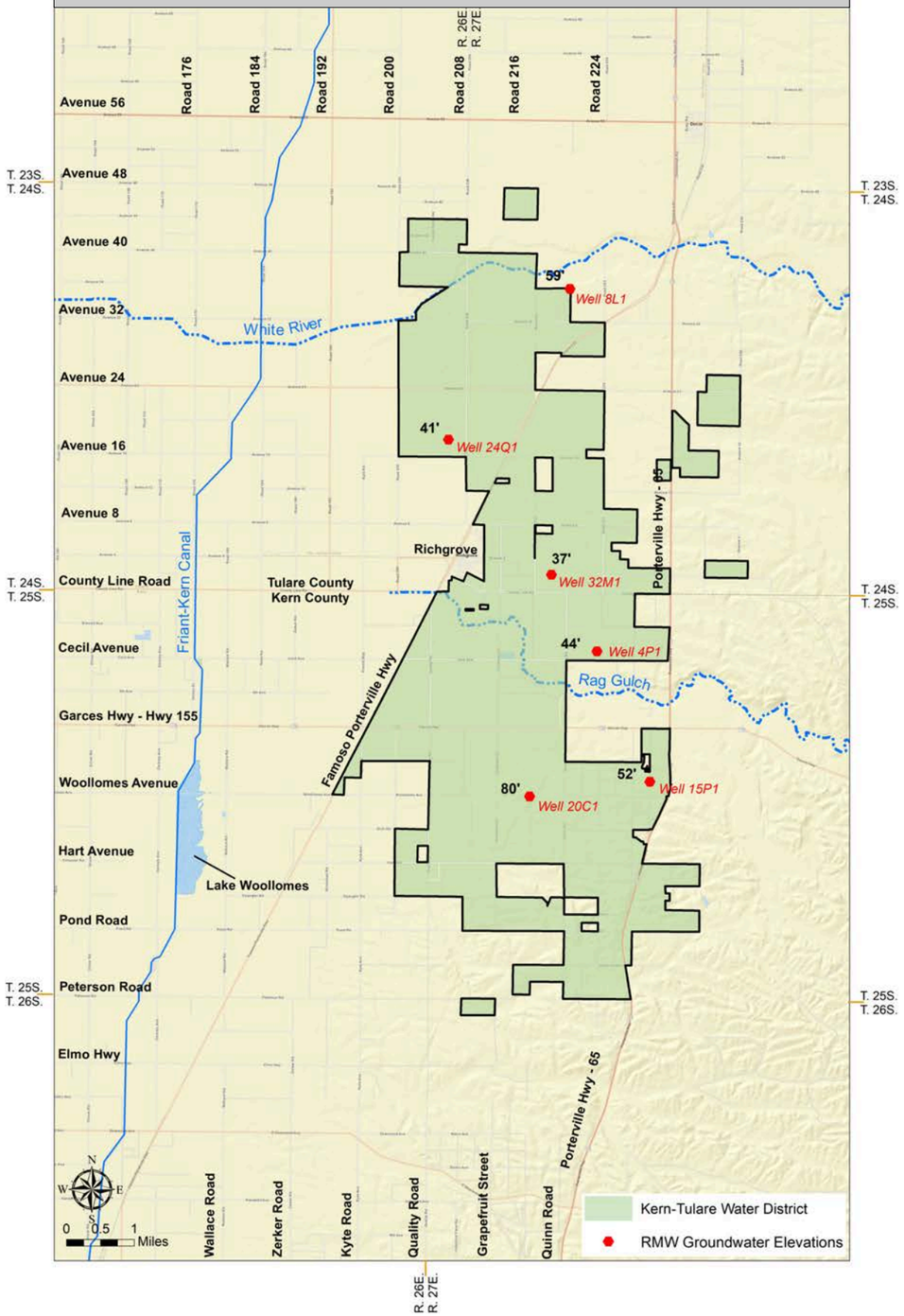
TODD GROUNDWATER

Figure 11
Groundwater Elevation Contour Map, Olcese Sand Principal Aquifer, Spring 2023

Fall 2022 Santa Margarita Groundwater Elevations



Spring 2023 Santa Margarita Groundwater Elevations

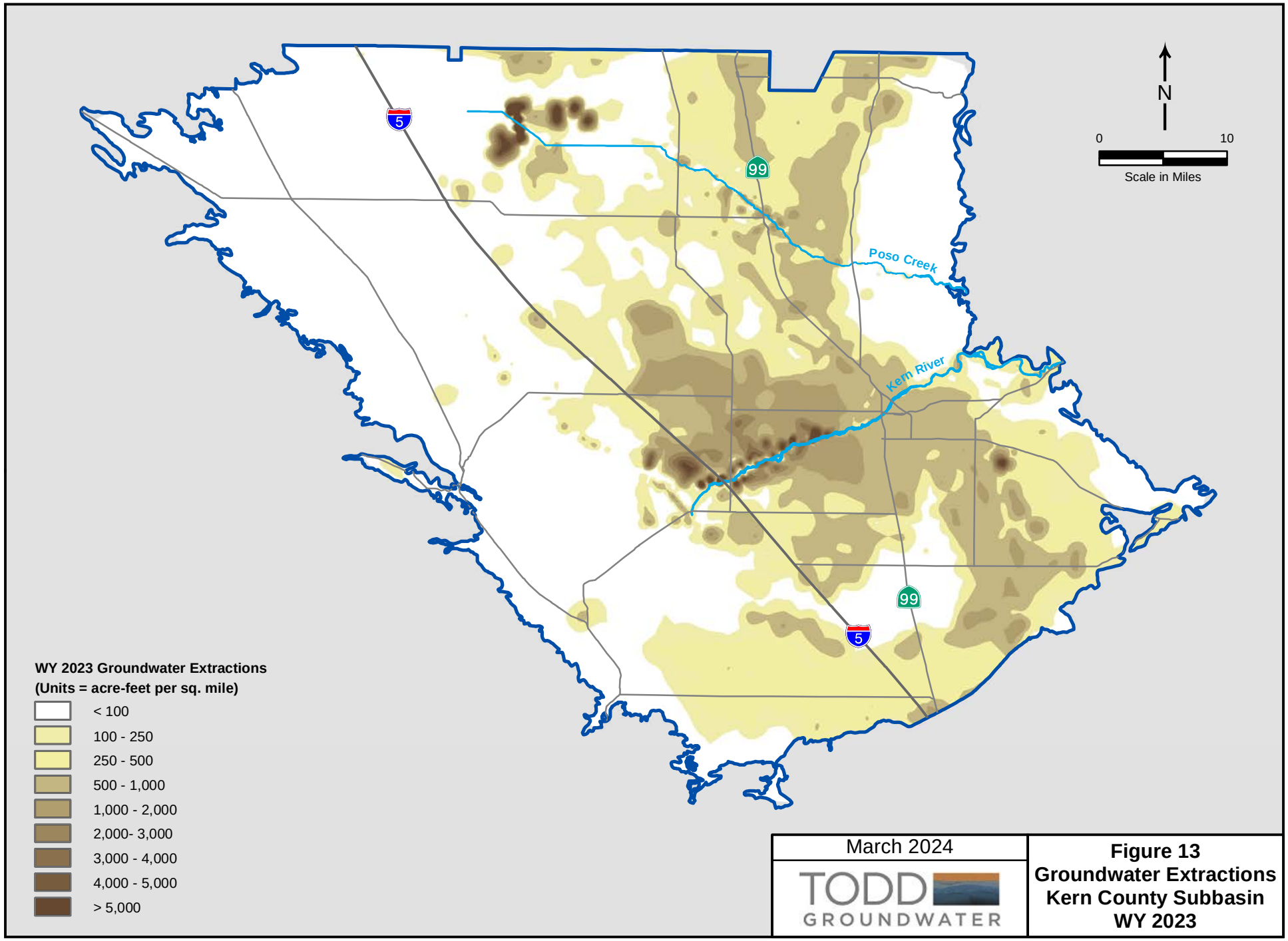


Source:
Kern-Tulare Water District (KTWD), March 2023.

Figure 12
Groundwater Elevations, Santa Margarita Principal Aquifer, Fall 2022 and Spring 2023

March 2024

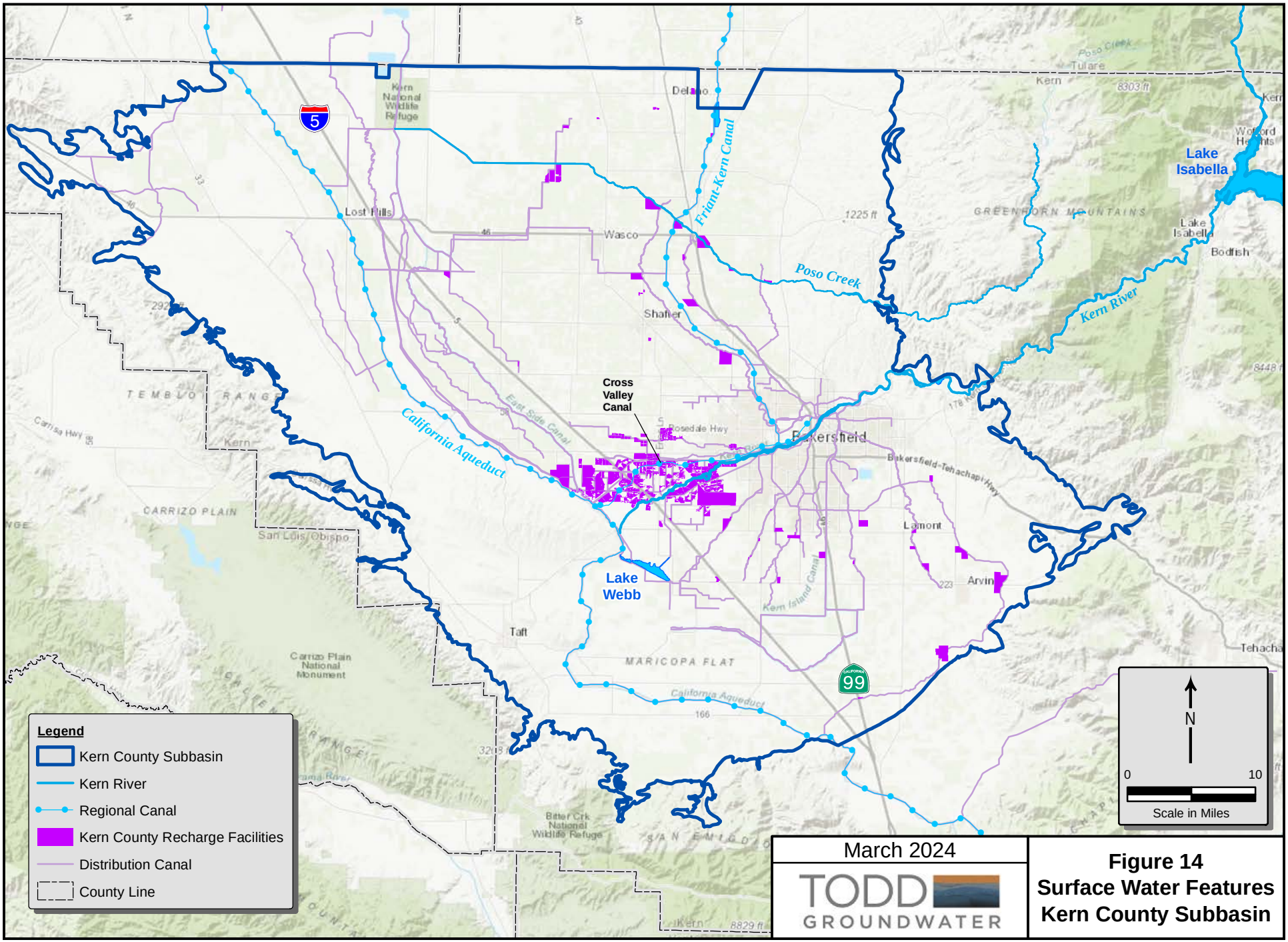
TODD GROUNDWATER



March 2024

TODD GROUNDWATER

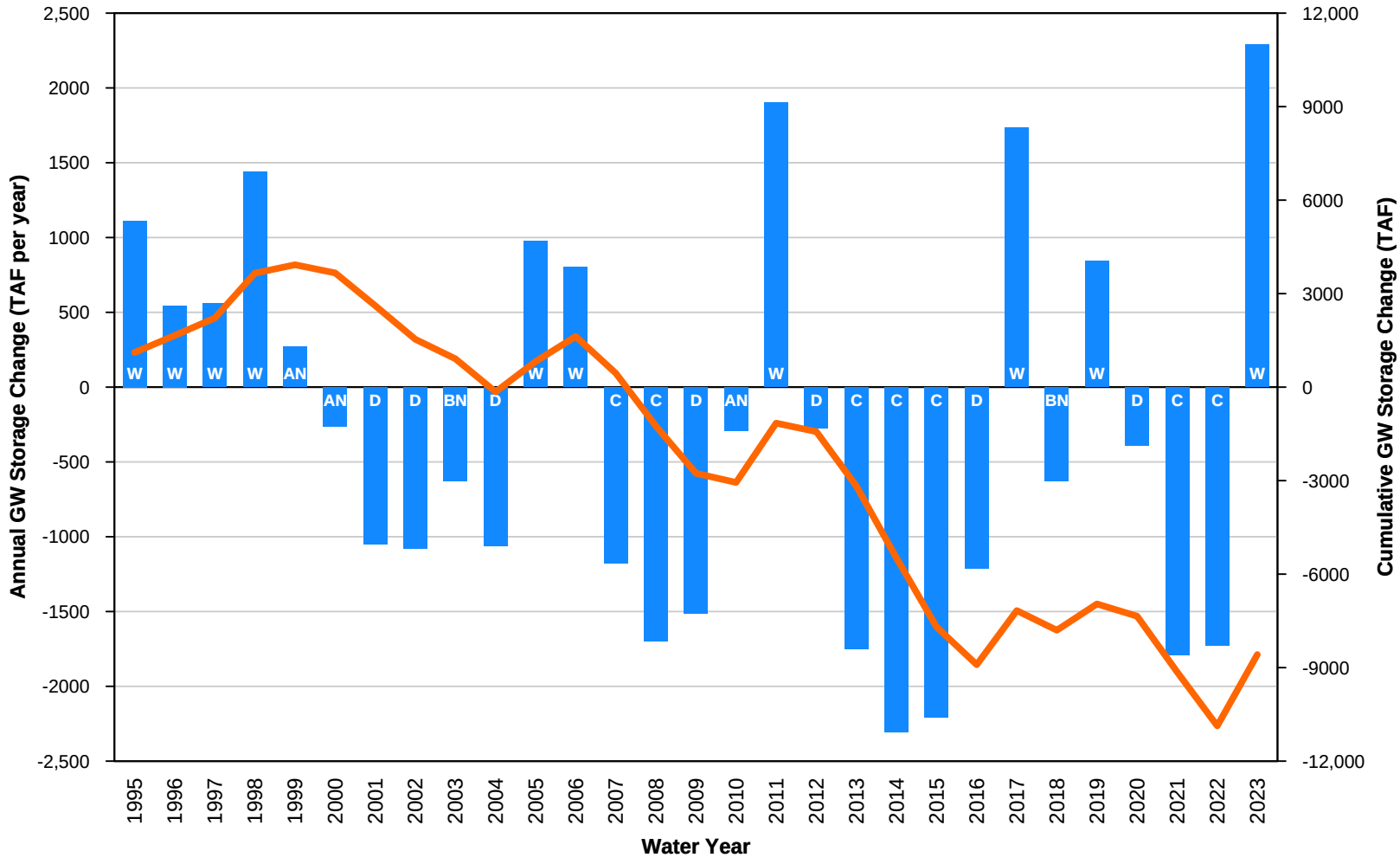
Figure 13
Groundwater Extractions
Kern County Subbasin
WY 2023



March 2024

TODD GROUNDWATER

Figure 14
Surface Water Features
Kern County Subbasin



Annual Change in Groundwater Storage (TAF per year)

Cumulative Change in Groundwater Storage (TAF)

W	Wet
AN	Above Normal
BN	Below Normal
D	Dry
C	Critically Dry

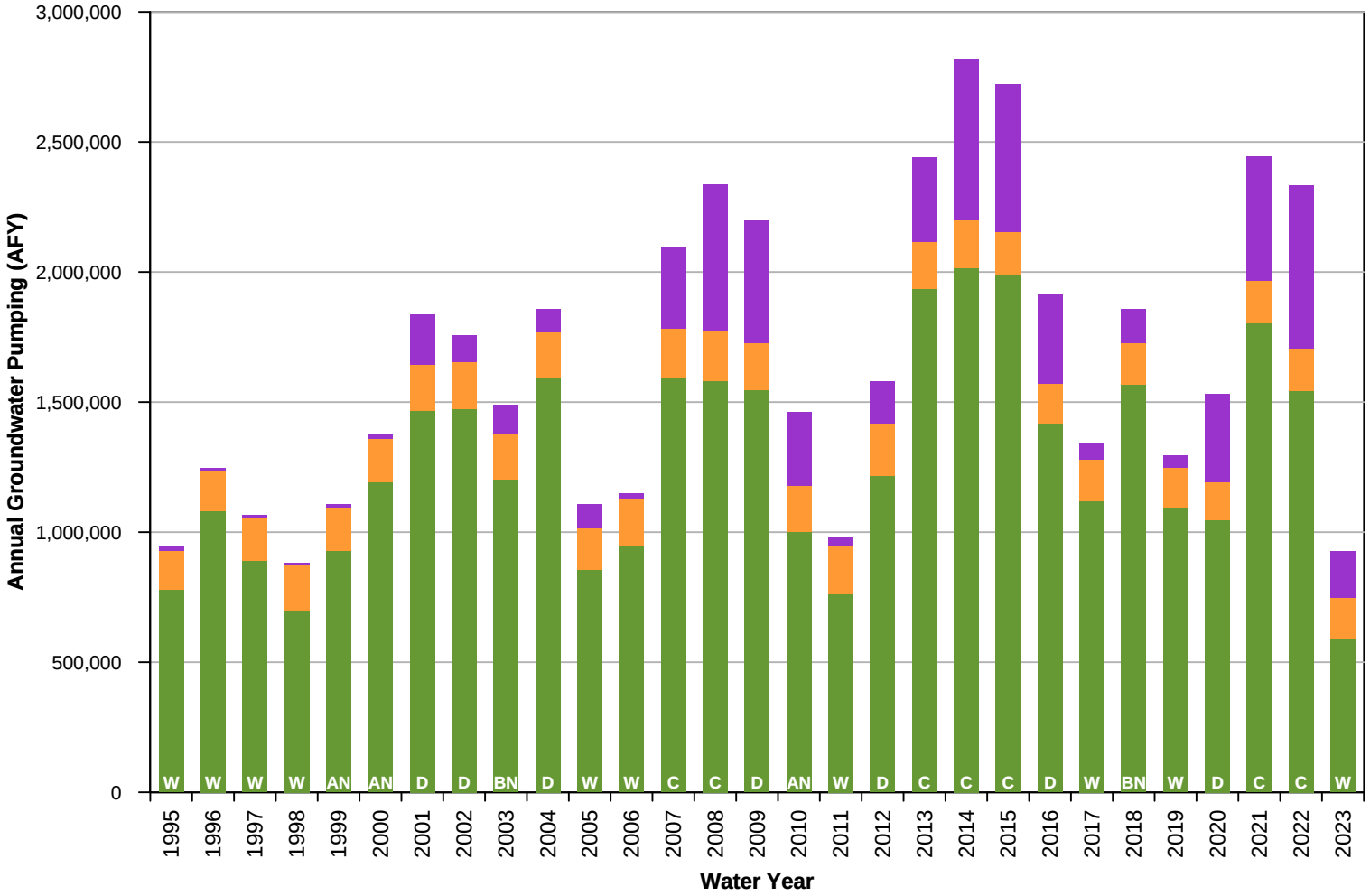
March 2024

TODD GROUNDWATER

Figure 15
Change in Groundwater in Storage
Kern County Subbasin
WYs 1995 to 2023

Path: T:\Projects\Kern 5th ANNUAL REPORT 62319\GRAPHICS\Figure15_Change in Groundwater in Storage Kern County Subbasin WYs 1995 to 2023.gpj

Kern County Subbasin Groundwater Extractions for WYs 1995-2023
WY2023 Annual Report Update



Agricultural Pumping
Urban Pumping
GW Banking, Exchanges, and "Pump-ins"

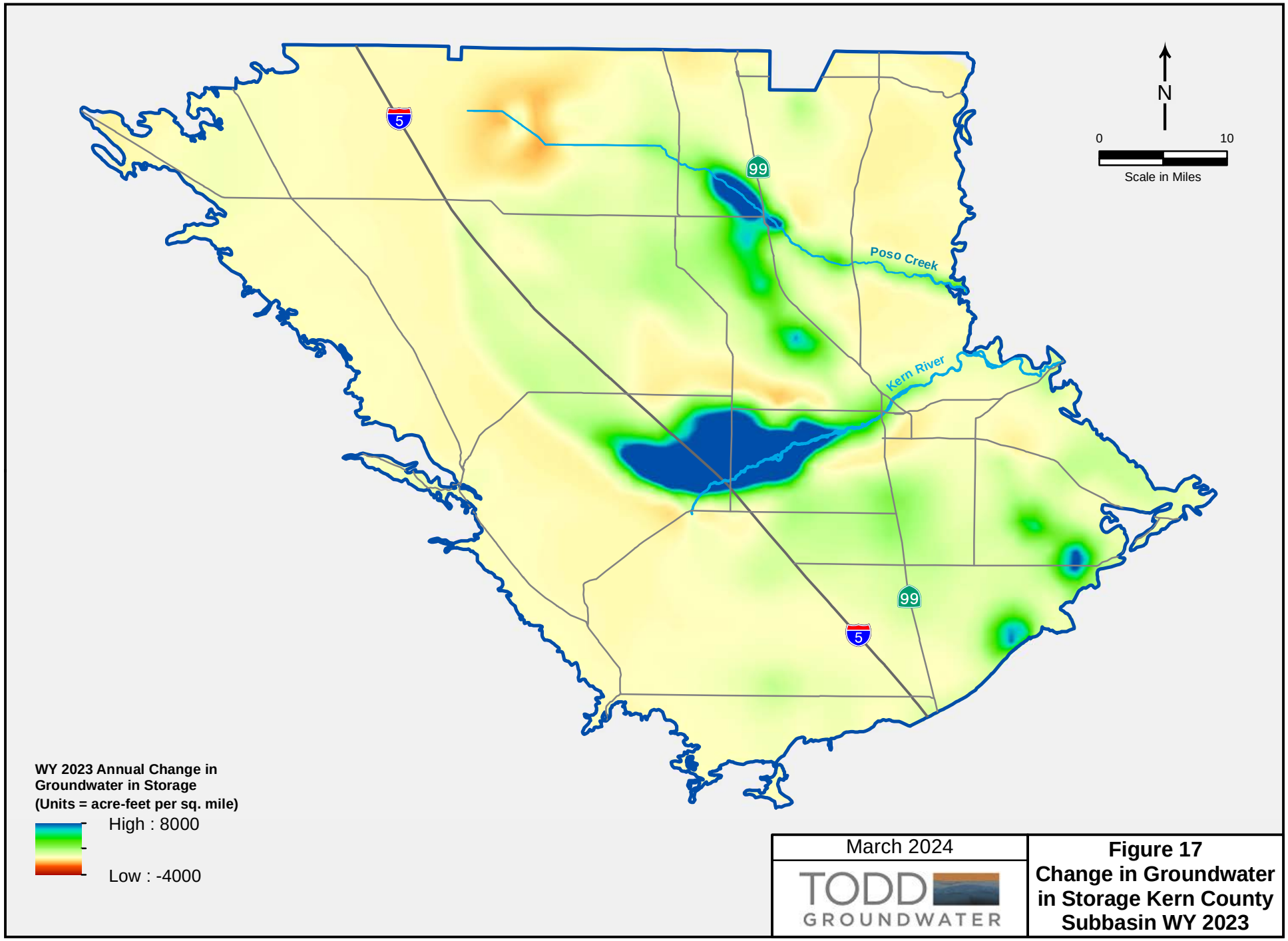
W Wet
AN Above Normal
BN Below Normal
D Dry
C Critically Dry

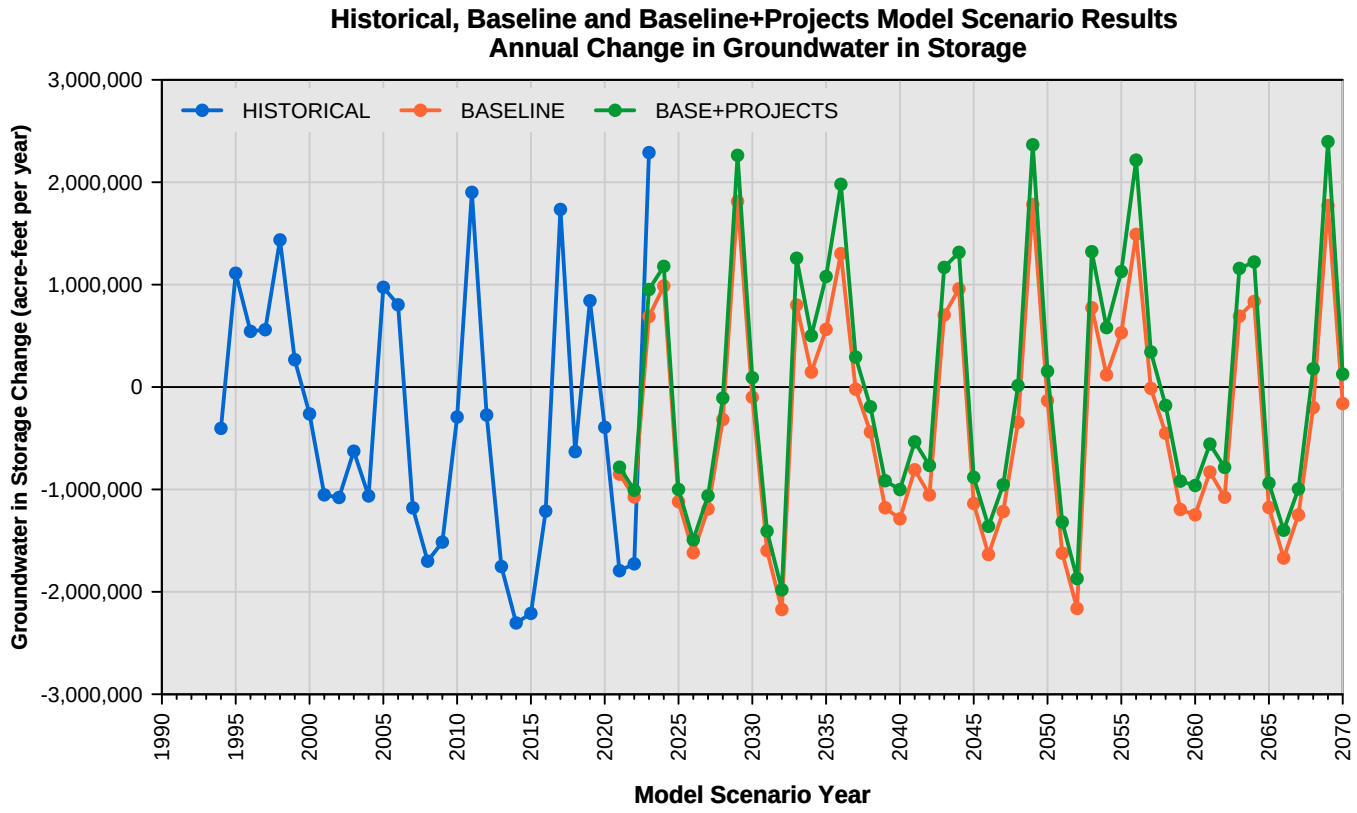
March 2024

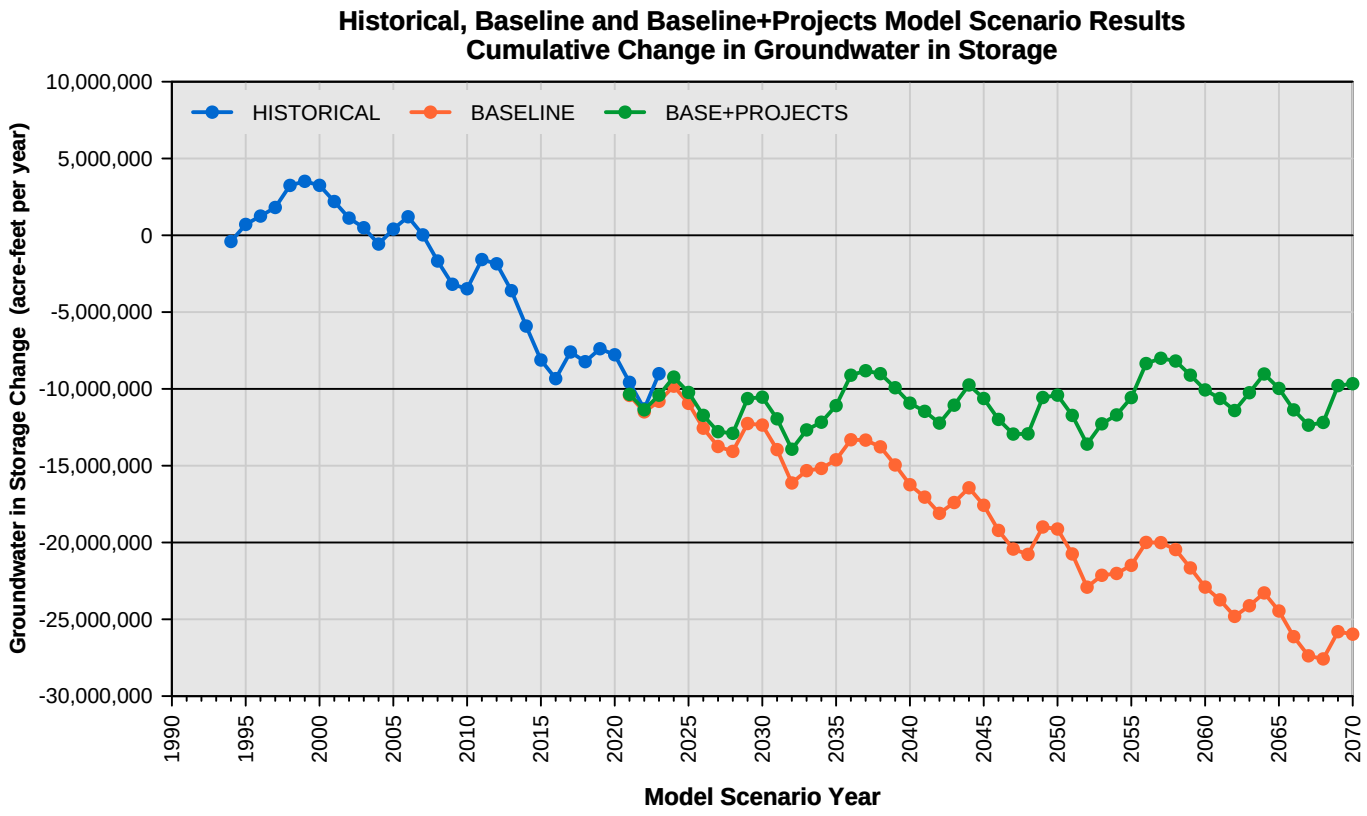
TODD GROUNDWATER

Figure 16
Groundwater Extractions
Kern County Subbasin
WYs 1995 to 2023

Path: T:\Projects\Kern 5th ANNUAL REPORT 62319\GRAPHICS\Figure16_Groundwater Extractions Kern County Subbasin WYs 1995 to 2023.gpj


N
0
10
Scale in Miles
5
99
Poso Creek
Kern River
99
5
WY 2023 Annual Change in Groundwater in Storage
(Units = acre-feet per sq. mile)
High : 8000
Low : -4000
March 2024
TODD GROUNDWATER
Figure 17
Change in Groundwater in Storage Kern County Subbasin WY 2023



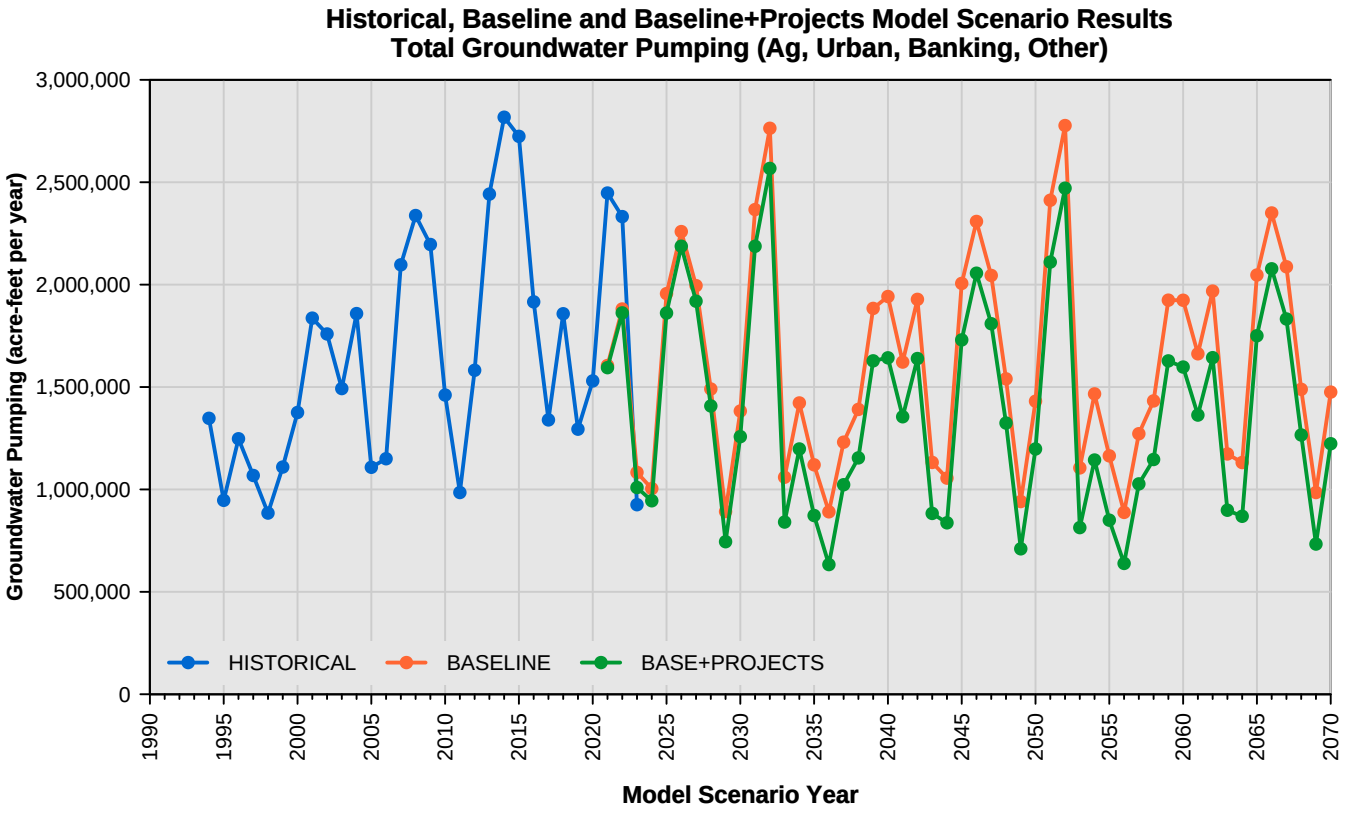


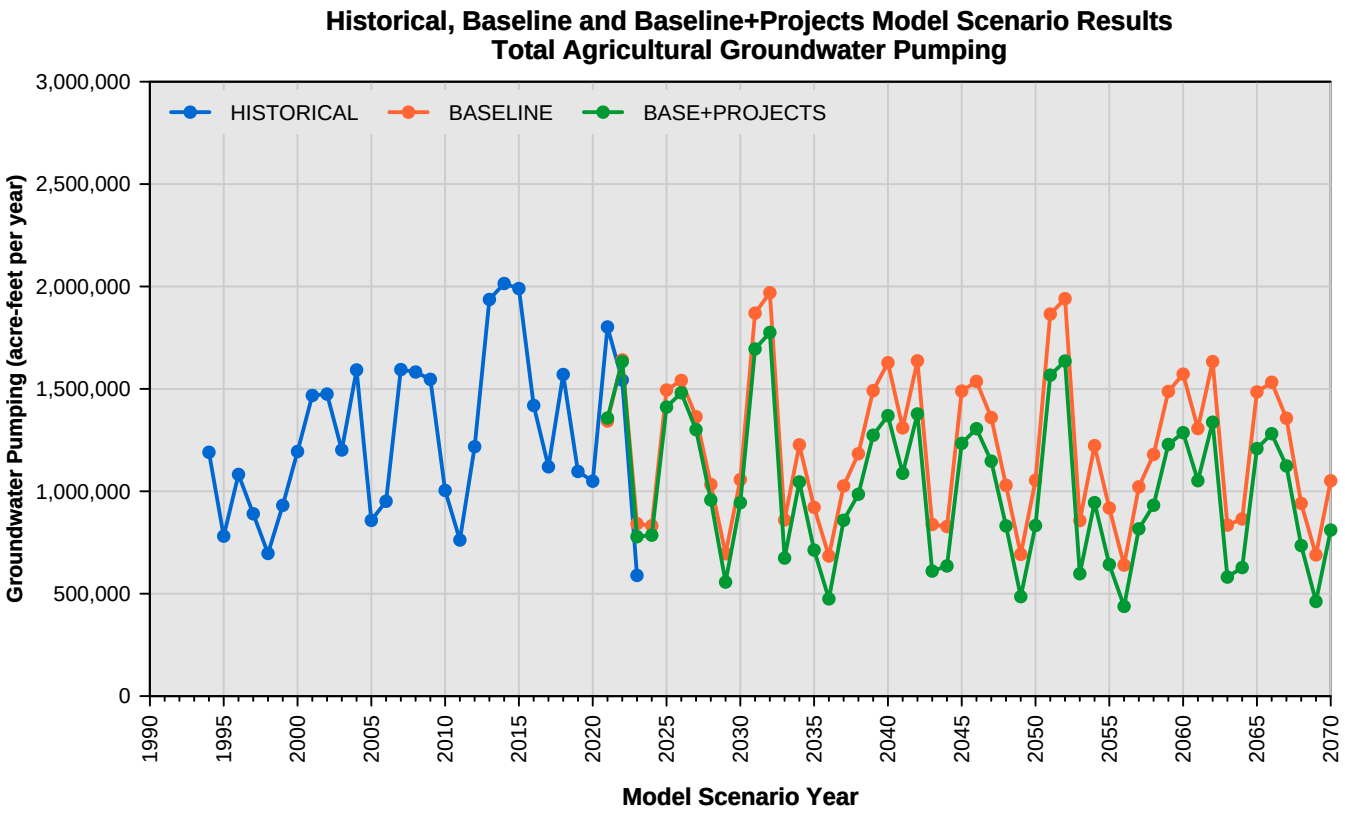
March 2024

TODD GROUNDWATER

Figure 18
Change in Storage
Historical to Projected-Future
Scenario Comparison

Path: T:\Projects\Kern 5th ANNUAL REPORT 62319\GRAPHICS\Figure18_Change in Storage Historical to Projected-Future Scenario Comparison.gpj

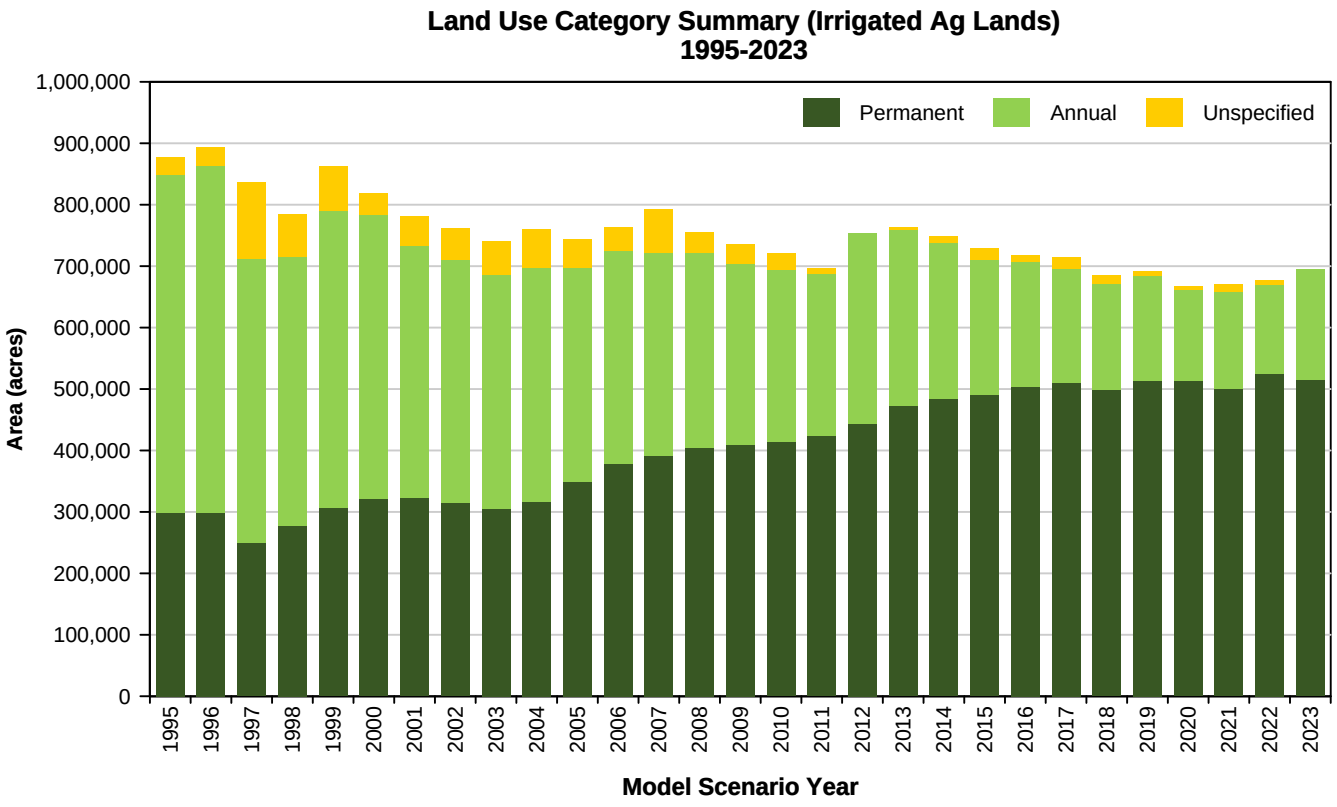


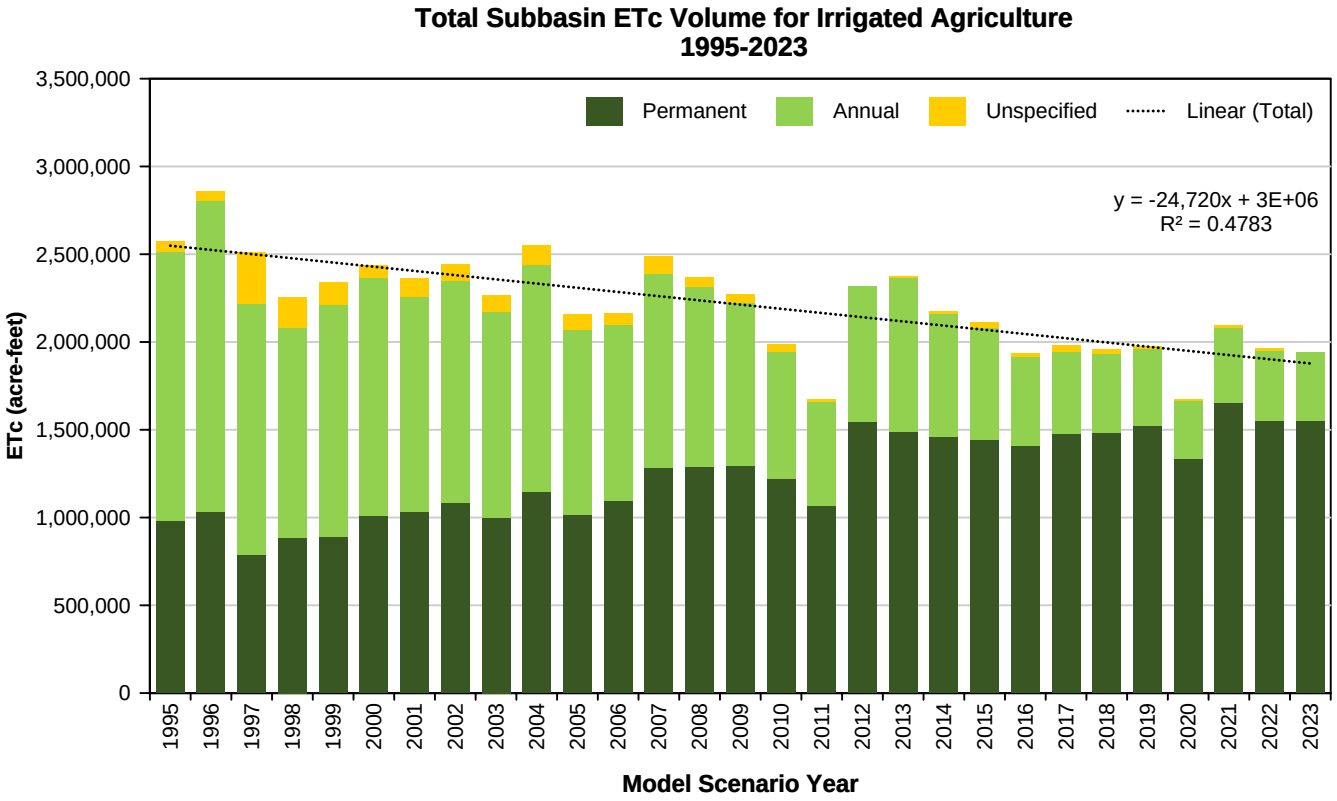


March 2024

TODD GROUNDWATER

Figure 19
Groundwater Pumping
Historical to Projected-Future
Scenario Comparison

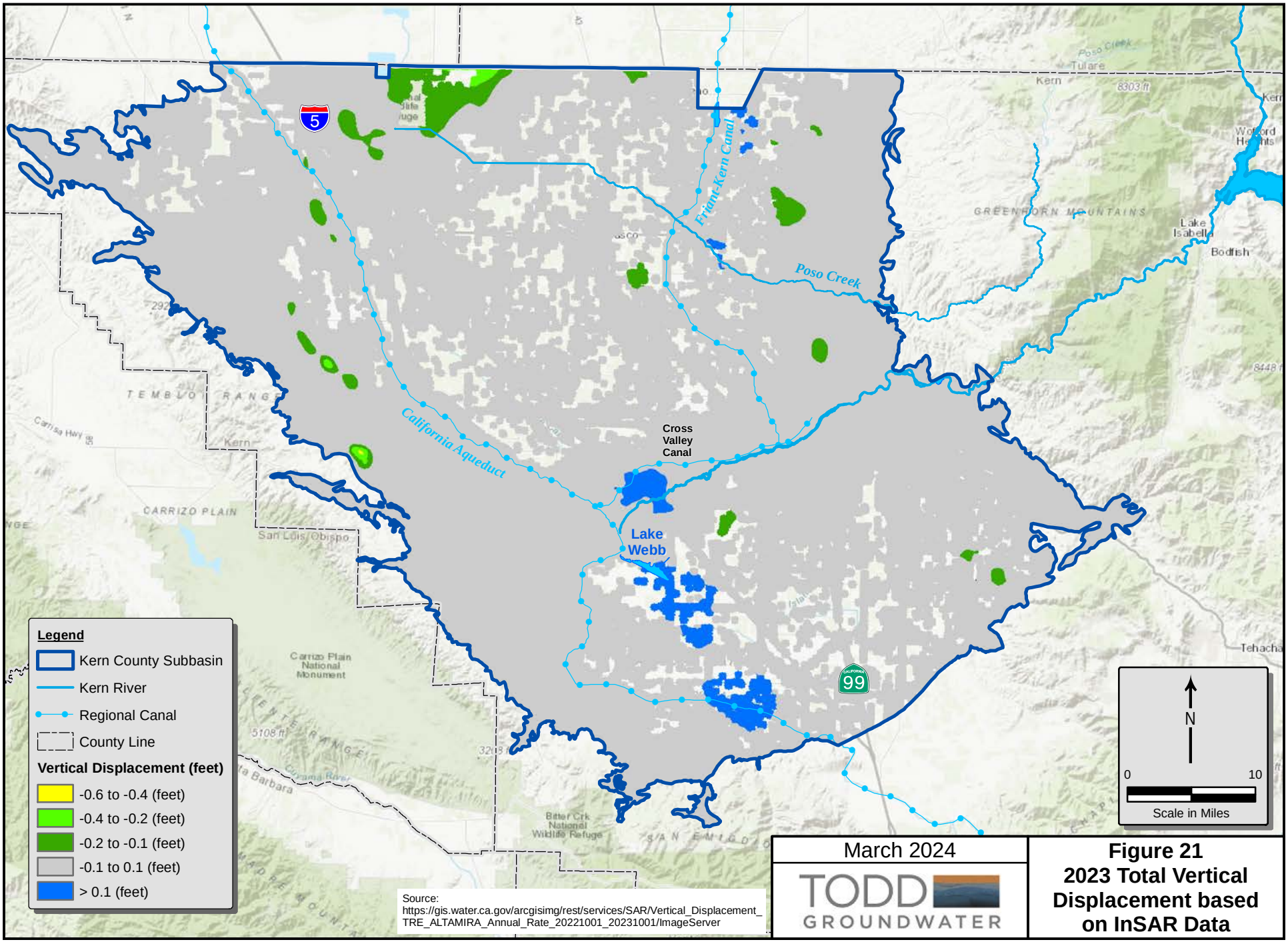




March 2024

TODD GROUNDWATER

Figure 20
Land Use and ETc Change
WYs 1995 to 2023



Source: https://gis.water.ca.gov/arcgisimg/rest/services/SAR/Vertical_Displacement_TRE_ALTAMIRA_Annual_Rate_20221001_20231001/ImageServer

March 2024

TODD GROUNDWATER

Figure 21
2023 Total Vertical Displacement based on InSAR Data

APPENDIX A

Groundwater Elevation Hydrographs of

GSP Representative Monitoring Wells

Kern County Subbasin

WY 2023 Annual Report

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A1-1	DMW01	Buena Vista WSD GSA	356014N1196176W001	Buena Vista GSA	
A1-2	DMW02	Buena Vista WSD GSA	355716N1195808W001	Buena Vista GSA	
A1-3	DMW04	Buena Vista WSD GSA	355137N1195985W001	Buena Vista GSA	
A1-4	DMW05	Buena Vista WSD GSA	354854N1195648W001	Buena Vista GSA	
A1-5	DMW06	Buena Vista WSD GSA	354527N1195347W001	Buena Vista GSA	
A1-6	DMW07	Buena Vista WSD GSA	354021N1195011W001	Buena Vista GSA	
A1-7	DMW08	Buena Vista WSD GSA	353905N1194480W001	Buena Vista GSA	
A1-8	DMW10a	Buena Vista WSD GSA	353536N1194341W001	Buena Vista GSA	
A1-9	DMW12b	Buena Vista WSD GSA	353187N1193747W001	Buena Vista GSA	
A2-1	HMWD #18	Henry Miller WD GSA	351811N1192358W001	Henry Miller GSA	
A2-2	HMWD #20	Henry Miller WD GSA	352294N1192865W001	Henry Miller GSA	
A2-3	HMWD #26	Henry Miller WD GSA	351976N1192358W001	Henry Miller GSA	
A2-4	HMWD #27	Henry Miller WD GSA	352088N1192520W001	Henry Miller GSA	
A2-5	HMWD #28	Henry Miller WD GSA	352086N1192783W001	Henry Miller GSA	
A3-1	Well 4R	Cawelo Water District GSA	356023N1191690W001	KGA GSA	
A3-2	Well 6C	Cawelo Water District GSA	355274N1191100W001	KGA GSA	**X**
A3-3	Well 11M	Cawelo Water District GSA	355044N1191502W001	KGA GSA	
A3-4	Well 12H	Cawelo Water District GSA	355954N1191160W001	KGA GSA	**X**
A3-5	Well 24R	Cawelo Water District GSA	356469N1191175W001	KGA GSA	
A3-6	Well 28L	Cawelo Water District GSA	356023N1191691W001	KGA GSA	
A3-7	Well 33C	Cawelo Water District GSA	355439N1191781W001	KGA GSA	**X**
A3-8	EWMA #04	Eastside Water Management Area	357840N1190456W001	KGA GSA	
A3-9	EWMA #10	Eastside Water Management Area	357085N1190370W001	KGA GSA	
A3-10	EWMA #21	Eastside Water Management Area	355935N1190787W001	KGA GSA	
A3-11	EWMA #23	Eastside Water Management Area	356220N1190790W001	KGA GSA	
A3-12	EWMA #30	Eastside Water Management Area	356421N1190690W001	KGA GSA	
A3-13	EWMA #41	Eastside Water Management Area	355706N1190911W001	KGA GSA	
A3-14	EWMA #49	Eastside Water Management Area	357364N1189549W001	KGA GSA	
A3-15	30S26E04D003M	Pioneer GSA	353543N1191966W001	KGA GSA	
A3-16	30S26E04J002M	Pioneer GSA	353434N1191816W001	KGA GSA	
A3-17	30S26E04J003M	Pioneer GSA	353434N1191816W002	KGA GSA	

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A3-18	30S26E10P004M	Pioneer GSA	353250N1191739W001	KGA GSA	X
A3-19	30S26E15N003M	Pioneer GSA	353123N1191805W001	KGA GSA	
A3-20	Well 4P1	Kern-Tulare Water District	357781N1190720W001	KGA GSA	
A3-21	Well 8L1	Kern-Tulare Water District	358561N1190806W001	KGA GSA	
A3-22	Well 15P1	Kern-Tulare Water District	357503N1190578W001	KGA GSA	
A3-23	Well 20C1	Kern-Tulare Water District	357464N1190898W001	KGA GSA	
A3-24	Well 24Q1	Kern-Tulare Water District	358231N1191126W001	KGA GSA	
A3-25	Well 32M1	Kern-Tulare Water District	357944N1190845W001	KGA GSA	
A3-26	DW097	North Kern WSD	354172N1192190W001	KGA GSA	
A3-27	3361-62	North Kern WSD	354714N1192174W001	KGA GSA	
A3-28	88-03-009R	North Kern WSD	354970N1191706W001	KGA GSA	
A3-29	88-09-009	North Kern WSD	355364N1192330W001	KGA GSA	
A3-30	88-21-005	North Kern WSD	355878N1192269W001	KGA GSA	
A3-31	88-29-014	North Kern WSD	356232N1192245W001	KGA GSA	
A3-32	99-00-003	North Kern WSD	354424N1191332W001	KGA GSA	
A3-33	99-00-081	North Kern WSD	355764N1192818W001	KGA GSA	
A3-34	99-22-084	North Kern WSD	356380N1193124W001	KGA GSA	
A3-35	Shafter Well 18	North Kern WSD	355010N1192067W001	KGA GSA	
A3-36	25M Enos	Rosedale-Rio Bravo WSD	353760N1192498W002	KGA GSA	
A3-37	27N_Mayer	Rosedale-Rio Bravo WSD	353699N1192856W002	KGA GSA	
A3-38	28J Triple	Rosedale-Rio Bravo WSD	352889N1191814W001	KGA GSA	
A3-39	32N Triple	Rosedale-Rio Bravo WSD	352673N1192138W002	KGA GSA	
A3-40	31H Greeley	Rosedale-Rio Bravo WSD	353618N1192169W001	KGA GSA	
A3-41	35H RRBWSD Shop	Rosedale-Rio Bravo WSD	353620N1191457W002	KGA GSA	
A3-42	Blacco HQ	Rosedale-Rio Bravo WSD	353915N1193454W001	KGA GSA	
A3-43	Bushnell	Rosedale-Rio Bravo WSD	354350N1193586W001	KGA GSA	
A3-44	Cauzza	Rosedale-Rio Bravo WSD	353986N1193948W001	KGA GSA	
A3-45	Chet Reed	Rosedale-Rio Bravo WSD	353890N1191471W001	KGA GSA	
A3-46	Harvest Ranch	Rosedale-Rio Bravo WSD	353634N1191766W001	KGA GSA	
A3-47	Home Place	Rosedale-Rio Bravo WSD	353824N1192035W001	KGA GSA	
A3-48	L.R. Stout	Rosedale-Rio Bravo WSD	354309N1192859W001	KGA GSA	

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A3-49	P. Enns Domestic	Rosedale-Rio Bravo WSD	354121N1192623W001	KGA GSA	
A3-50	Parsons	Rosedale-Rio Bravo WSD	353663N1193859W001	KGA GSA	
A3-51	RBG School	Rosedale-Rio Bravo WSD	354197N1192544W001	KGA GSA	
A3-52	Section 18	Rosedale-Rio Bravo WSD	354090N1193318W001	KGA GSA	
A3-53	Virgil Bussell	Rosedale-Rio Bravo WSD	353619N1193099W001	KGA GSA	
A3-54	West I-5	Rosedale-Rio Bravo WSD	353564N1193412W001	KGA GSA	
A3-55	26S-23E-15A1	Semitropic WSD	356736N1194735W001	KGA GSA	
A3-56	28/23/16/G	Semitropic WSD	354950N1195013W001	KGA GSA	
A3-57	28/23/36/R	Semitropic WSD	354426N1194398W001	KGA GSA	
A3-58	S-1	Semitropic WSD	355944N1195814W001	KGA GSA	
A3-59	S-2	Semitropic WSD	355687N1195623W001	KGA GSA	
A3-60	S-4	Semitropic WSD	355205N1195821W001	KGA GSA	
A3-61	S-5	Semitropic WSD	355506N1195271W001	KGA GSA	
A3-62	S-6	Semitropic WSD	357036N1193392W001	KGA GSA	
A3-63	S-8A Cluster 1 of 2	Semitropic WSD	356305N1194021W001	KGA GSA	
A3-64	S-9A Cluster 1 of 2	Semitropic WSD	355219N1193943W001	KGA GSA	
A3-65	S-11	Semitropic WSD	356956N1195623W001	KGA GSA	
A3-66	S-12	Semitropic WSD	357228N1195538W001	KGA GSA	
A3-67	S-13A Cluster 1 of 2	Semitropic WSD	357609N1194366W001	KGA GSA	
A3-68	S-14B Cluster 2 of 2	Semitropic WSD	356668N1193841W002	KGA GSA	
A3-69	948L02 Cluster1 of 2	Semitropic WSD	354189N1194216W001	KGA GSA	
A3-70	7th Standard 19G	Shafter-Wasco Irrigation District	354779N1193145W001	KGA GSA	
A3-71	7th Standard 31J	Shafter-Wasco Irrigation District	354494N1193182W001	KGA GSA	
A3-72	7th Standard 35C	Shafter-Wasco Irrigation District	354561N1193595W001	KGA GSA	
A3-73	Shafter Well 7	Shafter-Wasco Irrigation District	355080N1192777W001	KGA GSA	
A3-74	Shafter Well 12	Shafter-Wasco Irrigation District	355020N1192748W001	KGA GSA	
A3-75	Shafter Well 14	Shafter-Wasco Irrigation District	354943N1192593W001	KGA GSA	
A3-76	Shafter Well 15	Shafter-Wasco Irrigation District	354705N1192792W001	KGA GSA	
A3-77	Wasco 8A	Shafter-Wasco Irrigation District	355874N1193523W001	KGA GSA	
A3-78	Wasco 11	Shafter-Wasco Irrigation District	355891N1193417W001	KGA GSA	
A3-79	Wasco 12	Shafter-Wasco Irrigation District	356157N1193397W001	KGA GSA	

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A3-80	Delano 30	Southern San Joaquin MUD	357898N1192302W001	KGA GSA	
A3-81	Delano 34	Southern San Joaquin MUD	357436N1192587W001	KGA GSA	
A3-82	McFarland Taylor Ave Well	Southern San Joaquin MUD	356675N1192402W001	KGA GSA	
A3-83	SSJMUD-8	Southern San Joaquin MUD	357470N1193360W001	KGA GSA	
A3-84	SSJMUD-14	Southern San Joaquin MUD	357395N1192052W001	KGA GSA	
A3-85	SSJMUD-23	Southern San Joaquin MUD	357185N1193042W001	KGA GSA	
A3-86	SSJMUD-42	Southern San Joaquin MUD	356930N1192320W001	KGA GSA	
A3-87	SSJMUD-53	Southern San Joaquin MUD	356307N1191912W001	KGA GSA	
A3-88	SSJMUD-59	Southern San Joaquin MUD	356820N1191517W001	KGA GSA	
A3-89	SSJMUD-62	Southern San Joaquin MUD	357184N1191449W001	KGA GSA	
A3-90	Well 6-04	West Kern Water District	353028N1192780W001	KGA GSA	
A3-91	21L-S	West Kern Water District	353020N1193011W001	KGA GSA	
A3-92	21L-M	West Kern Water District	353020N1193011W002	KGA GSA	
A3-93	21L-D	West Kern Water District	353020N1193011W003	KGA GSA	
A3-94	21R-S	West Kern Water District	352967N1192895W001	KGA GSA	
A3-95	21R-M	West Kern Water District	352967N1192895W002	KGA GSA	
A3-96	21R-D	West Kern Water District	352967N1192895W003	KGA GSA	**X**
A3-97	22K-S	West Kern Water District	353005N1192761W001	KGA GSA	
A3-98	22K-M	West Kern Water District	353005N1192761W002	KGA GSA	
A3-99	22K-D	West Kern Water District	353005N1192761W003	KGA GSA	**X**
A3-100	23M-S	West Kern Water District	353037N1192699W001	KGA GSA	
A3-101	23M-M	West Kern Water District	353037N1192699W002	KGA GSA	
A3-102	23M-D	West Kern Water District	353037N1192699W003	KGA GSA	**X**
A3-103	28E-S	West Kern Water District	352895N1193032W001	KGA GSA	
A3-104	28E-M	West Kern Water District	352895N1193032W002	KGA GSA	
A3-105	28E-D	West Kern Water District	352895N1193032W003	KGA GSA	**X**
A3-106	NWM1-S	West Kern Water District	353464N1193684W004	KGA GSA	
A3-107	NWM1-M	West Kern Water District	353464N1193684W006	KGA GSA	
A3-108	NWM1-D	West Kern Water District	353464N1193684W007	KGA GSA	
A3-108	NWM2-S	West Kern Water District	353342N1193700W004	KGA GSA	
A3-110	NWM2-M	West Kern Water District	353342N1193700W006	KGA GSA	

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A3-111	NWM2-D	West Kern Water District	353342N1193700W007	KGA GSA	
A3-112	WKWD 7	West Kern Water District	352958N1193011W001	KGA GSA	
A3-113	7106-63	Westside District Water Authority	355505N1196368W001	KGA GSA	
A3-114	7108-66	Westside District Water Authority	357762N1196902W001	KGA GSA	
A3-115	S#14	Westside District Water Authority	356675N1196724W001	KGA GSA	X
A4-1	RMW-017	Kern River GSA	354206N1191817W001	Kern River GSA	X
A4-2	RMW-018	Kern River GSA	354344N1191337W001	Kern River GSA	
A4-3	RMW-019R	Kern River GSA	354199N1190930W001	Kern River GSA	X
A4-4	RMW-020	Kern River GSA	354048N1190102W001	Kern River GSA	
A4-5	RMW-021	Kern River GSA	353898N1190087W001	Kern River GSA	
A4-6	RMW-025	Kern River GSA	353539N1191118W001	Kern River GSA	X
A4-7	RMW-026	Kern River GSA	353512N1189673W001	Kern River GSA	X
A4-8	RMW-028	Kern River GSA	353508N1191723W001	Kern River GSA	
A4-9	RMW-029	Kern River GSA	353247N1191870W001	Kern River GSA	
A4-10	RMW-030	Kern River GSA	353328N1189409W001	Kern River GSA	X
A4-11	RMW-031	Kern River GSA	352964N1191741W003	Kern River GSA	
A4-12	RMW-032	Kern River GSA	352953N1191285W001	Kern River GSA	X
A4-13	RMW-034	Kern River GSA	352747N1189435W001	Kern River GSA	X
A4-14	RMW-35R	Kern River GSA	352450N1191640W001	Kern River GSA	
A4-15	RMW-037	Kern River GSA	352269N1191923W001	Kern River GSA	
A4-16	RMW-038	Kern River GSA	352233N1191281W001	Kern River GSA	
A4-17	RMW-040	Kern River GSA	352083N1190362W001	Kern River GSA	
A4-18	RMW-041	Kern River GSA	352027N1188996W001	Kern River GSA	
A4-19	RMW-042	Kern River GSA	351922N1192052W001	Kern River GSA	
A4-20	RMW-192	Kern River GSA	352220N1190000W001	Kern River GSA	
A4-21	RMW-193	Kern River GSA	352080N1188710W001	Kern River GSA	
A4-22	RMW-195	Kern River GSA	352510N1191160W001	Kern River GSA	
A4-23	RMW-196	Kern River GSA	352410N1190280W001	Kern River GSA	
A4-24	RMW-197	Kern River GSA	351656N1189234W001	Kern River GSA	
A4-25	RMW-200	Kern River GSA	351541N1191289W001	Kern River GSA	
A4-26	RMW-201	Kern River GSA	353941N1191043W001	Kern River GSA	

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A4-27	RMW-202	Kern River GSA	352662N1190015W001	Kern River GSA	
A4-28	RMW-209	Kern River GSA	354226N1190748W001	Kern River GSA	
A4-29	RMW-210	Kern River GSA	353907N1189752W001	Kern River GSA	
A4-30	RMW-211	Kern River GSA	353681N1190101W001	Kern River GSA	X
A4-31	RMW-212	Kern River GSA	353618N1189334W001	Kern River GSA	
A4-32	RMW-213	Kern River GSA	353536N1190539W001	Kern River GSA	X
A4-33	RMW-214	Kern River GSA	353286N1190221W001	Kern River GSA	X
A4-34	RMW-215	Kern River GSA	353325N1190016W001	Kern River GSA	
A4-35	RMW-216	Kern River GSA	352924N1189911W001	Kern River GSA	
A4-36	RMW-217	Kern River GSA	352800N1189080W001	Kern River GSA	X
A4-37	RMW-218	Kern River GSA	351867N1190820W001	Kern River GSA	X
A4-38	RMW-219	Kern River GSA	352389N1189485W001	Kern River GSA	
A5-1	Canyon View Ranch	Olcese Water District	354386N1188035W002	Olcese GSA	
A5-2	Well #4	Olcese Water District	354310N1188411W002	Olcese GSA	
A6-1	11N20W05J001S	Arvin-Edison WSD	350669N1190295W001	SOKR GSA	
A6-2	12N20W36G001S	Arvin-Edison WSD	350833N1189632W001	SOKR GSA	
A6-3	29S29E33N001M	Arvin-Edison WSD	353577N1188771W001	SOKR GSA	
A6-4	30S29E11N001M	Arvin-Edison WSD	353269N1188418W001	SOKR GSA	
A6-5	30S29E29A001M	Arvin-Edison WSD	352958N1188807W001	SOKR GSA	
A6-6	30S30E19E001M	Arvin-Edison WSD	353072N1188037W001	SOKR GSA	
A6-7	31S29E05E001M	Arvin-Edison WSD	352605N1188932W001	SOKR GSA	X
A6-8	31S29E12M001M	Arvin-Edison WSD	352452N1188243W001	SOKR GSA	X
A6-9	31S29E34A001M	Arvin-Edison WSD	351944N1188423W001	SOKR GSA	
A6-10	31S30E17K001M	Arvin-Edison WSD	352311N1187790W001	SOKR GSA	
A6-11	31S30E30J001M	Arvin-Edison WSD	352017N1187987W001	SOKR GSA	X
A6-12	32S29E12P001M	Arvin-Edison WSD	351522N1188199W001	SOKR GSA	
A6-13	32S29E20H001M	Arvin-Edison WSD	351300N1188781W001	SOKR GSA	
A6-14	32S28E23H001M	Arvin-Edison WSD	351300N1189357W001	SOKR GSA	X
A6-15	32S29E31N001M	Arvin-Edison WSD	350931N1189123W001	SOKR GSA	
A6-16	ACSD Well #14	Arvin-Edison WSD	351942N1188484W001	SOKR GSA	
A6-17	Caratan Well (RMS-1)	Tejon-Castac Water District	352002N1187698W001	SOKR GSA	

Table A-1 – Identification information for GSP Representative Monitoring Well hydrographs for DWR Basin 5-022-14 (Kern County Subbasin). Graph ID is shown on Figure 5 showing the well location.

Graph ID	Well Name	Reporting Agency	DWR Master Site Code	GSA	WY2023 MT Exceedance
A6-18	11N21W09C001S	Wheeler Ridge-Maricopa WSD	350592N1191328W001	SOKR GSA	
A6-19	11N21W16E001S	Wheeler Ridge-Maricopa WSD	350428N1191355W001	SOKR GSA	**X**
A6-20	11N22W01D001S	Wheeler Ridge-Maricopa WSD	350750N1191892W001	SOKR GSA	**X**
A6-21	11N22W06H001S	Wheeler Ridge-Maricopa WSD	350686N1192609W001	SOKR GSA	
A6-22	12N21W34N001S	Wheeler Ridge-Maricopa WSD	350772N1191178W001	SOKR GSA	
A6-23	12N21W35Q001S	Wheeler Ridge-Maricopa WSD	350769N1190871W001	SOKR GSA	
A6-24	32S25E29Q001M	Wheeler Ridge-Maricopa WSD	351083N1193140W001	SOKR GSA	
A6-25	32S26E20G001M	Wheeler Ridge-Maricopa WSD	351303N1192078W001	SOKR GSA	
A6-26	32S26E24K001M	Wheeler Ridge-Maricopa WSD	351304N1191366W001	SOKR GSA	
A6-27	32S26E34P001M	Wheeler Ridge-Maricopa WSD	350943N1191736W001	SOKR GSA	
A6-28	32S26E36P002M	Wheeler Ridge-Maricopa WSD	350947N1191370W001	SOKR GSA	
A6-29	32S27E30N001M	Wheeler Ridge-Maricopa WSD	351092N1191270W001	SOKR GSA	
A6-30	32S27E35R001M	Wheeler Ridge-Maricopa WSD	350961N1190435W001	SOKR GSA	
A6-31	32S28E16P001M	Wheeler Ridge-Maricopa WSD	351397N1189767W001	SOKR GSA	

APPENDIX A1

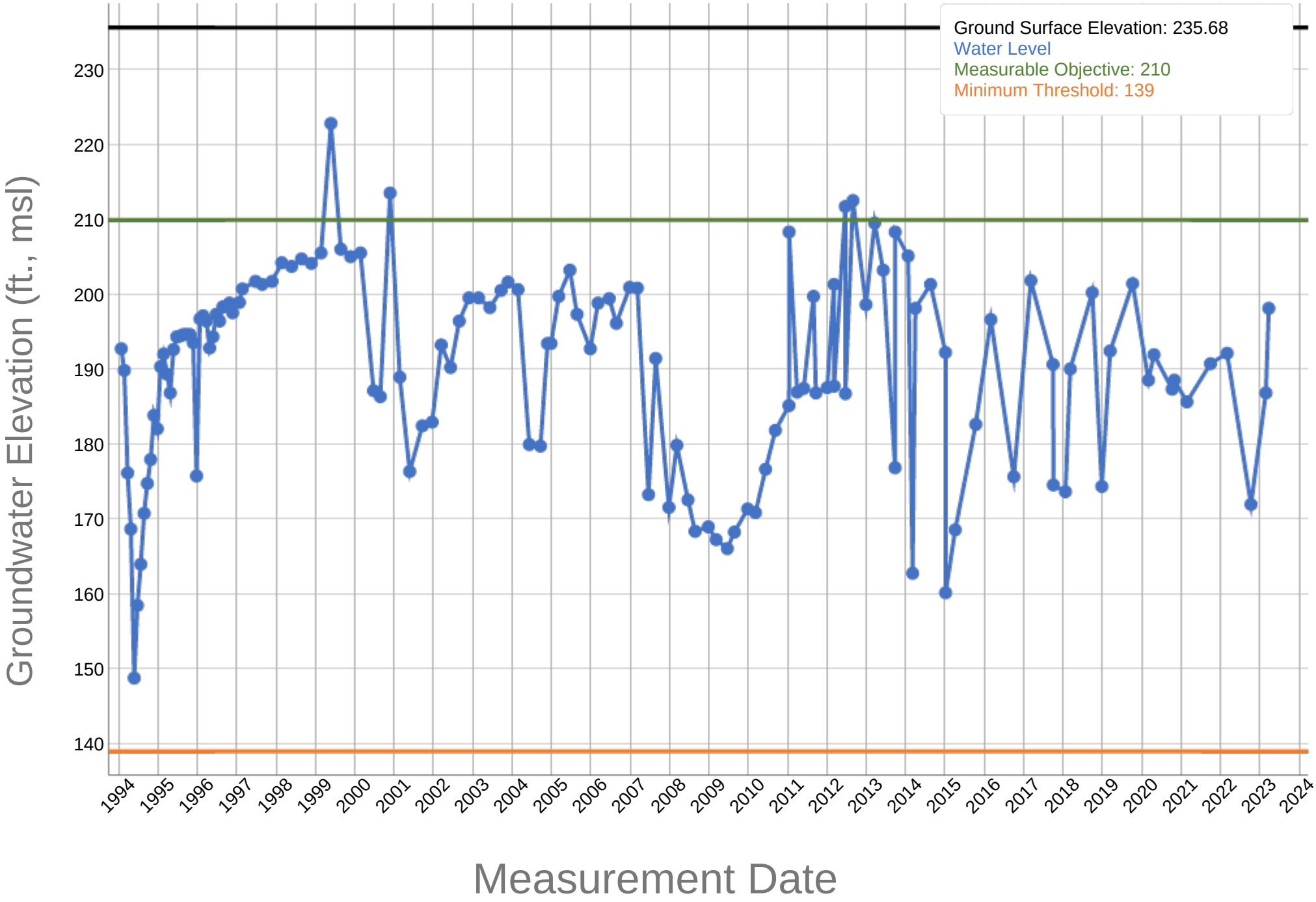
Hydrographs of Groundwater Elevations

GSP Monitoring Network Wells

Buena Vista WSD GSA

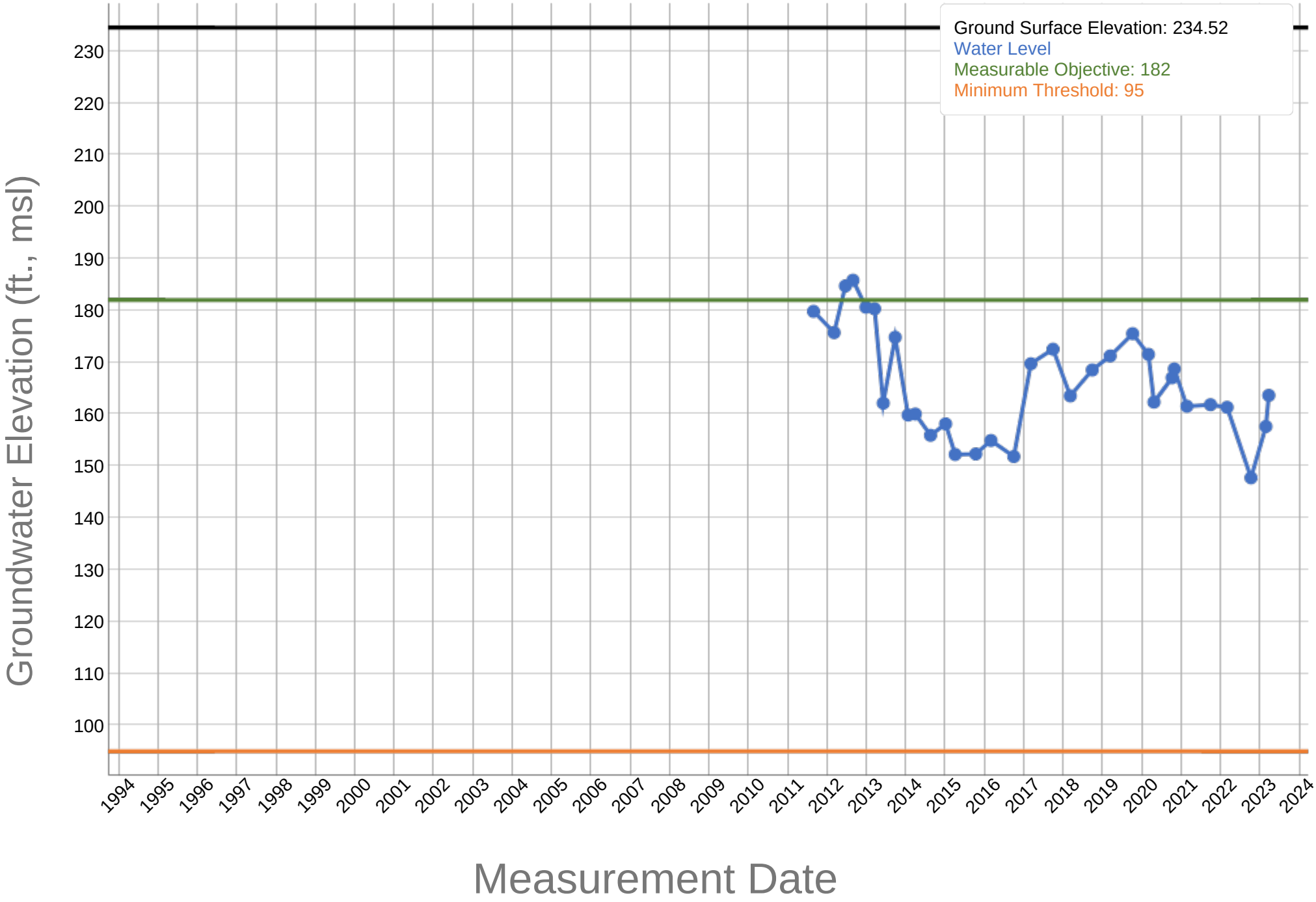
A1-1

Buena Vista Water Storage District GSA - DMW01 - 356014N1196176W001



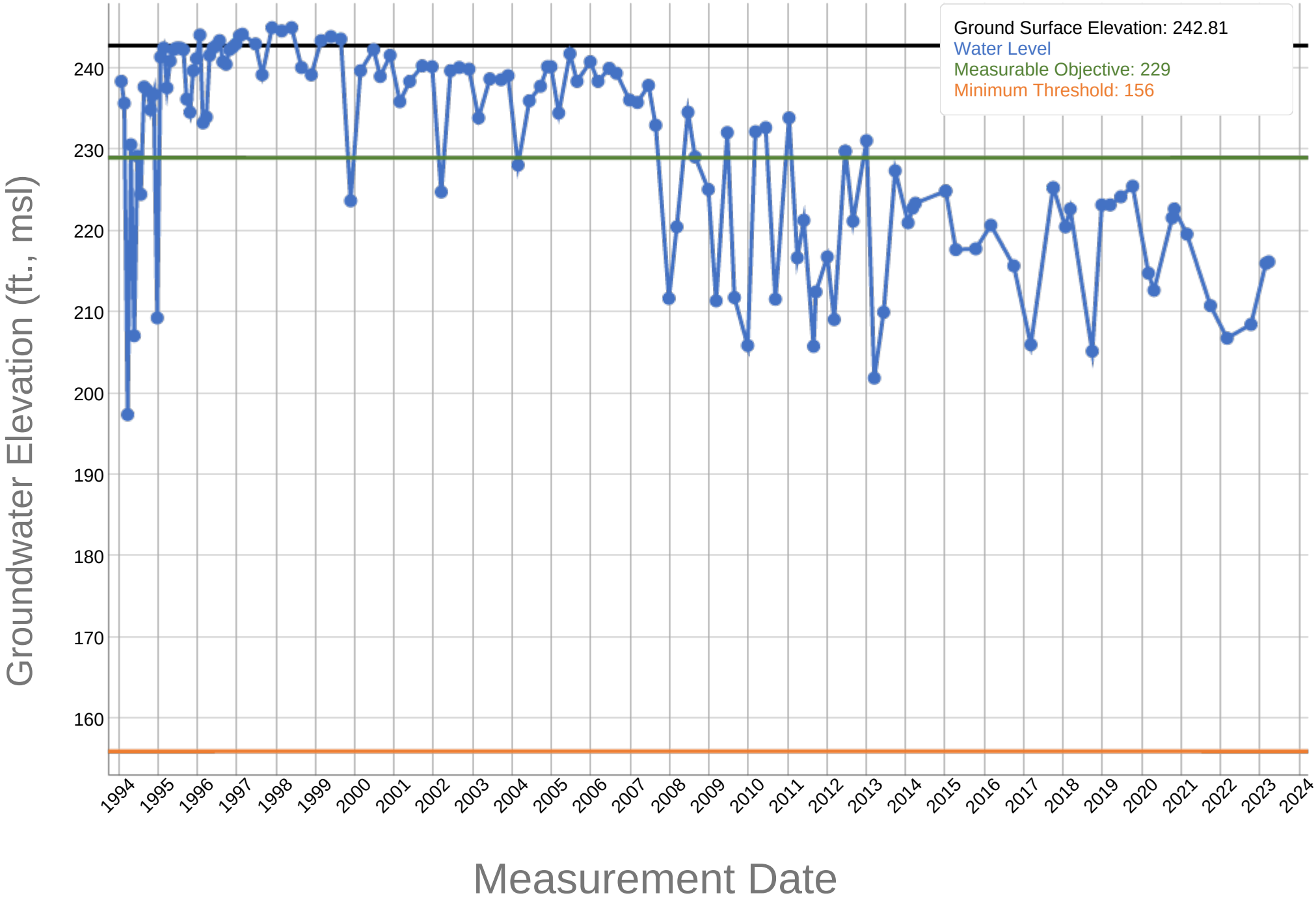
A1-2

Buena Vista Water Storage District GSA - DMW02 - 355716N1195808W001



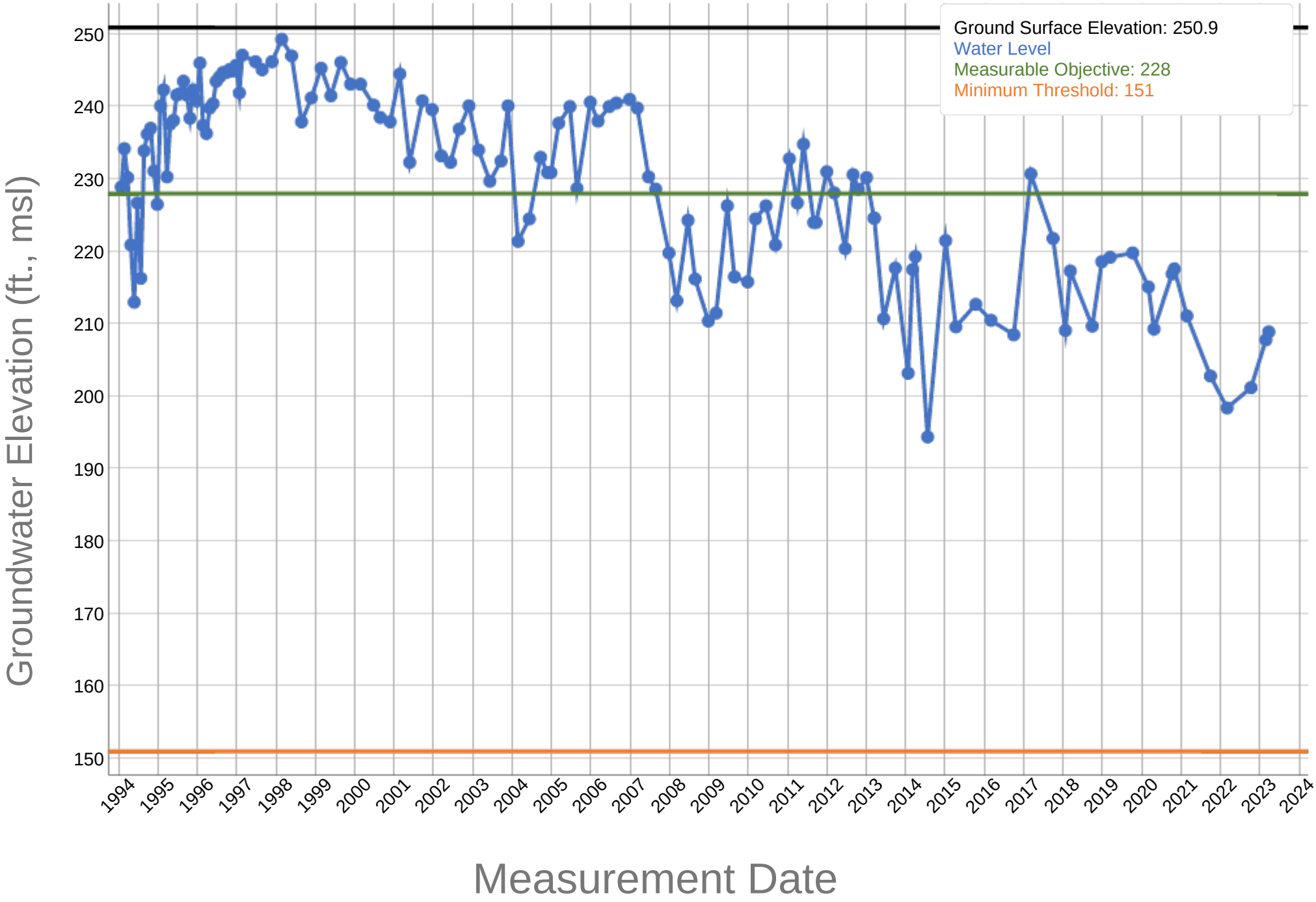
A1-3

Buena Vista Water Storage District GSA - DMW04 - 355137N1195985W001



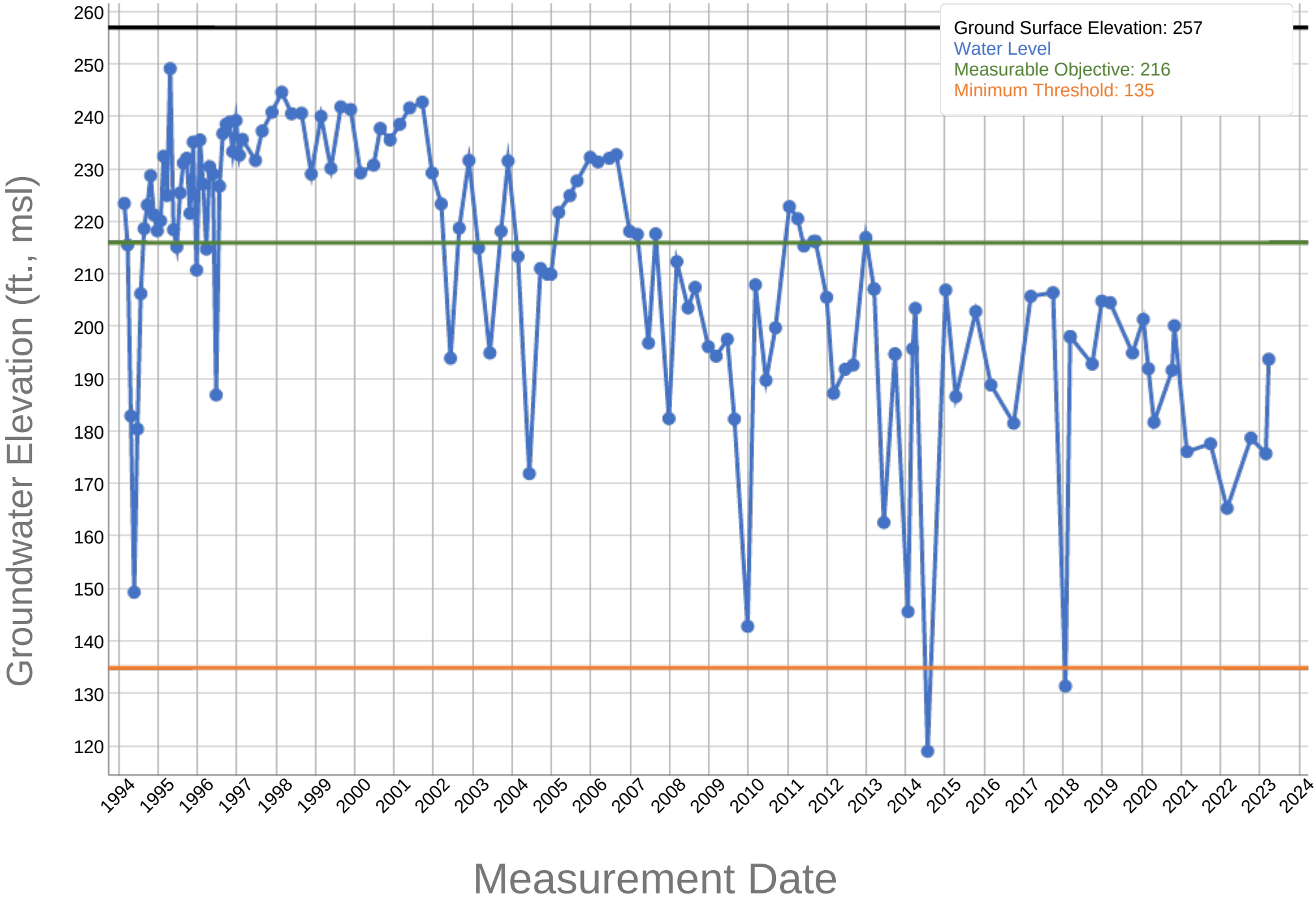
A1-4

Buena Vista Water Storage District GSA - DMW05 - 354854N1195648W001



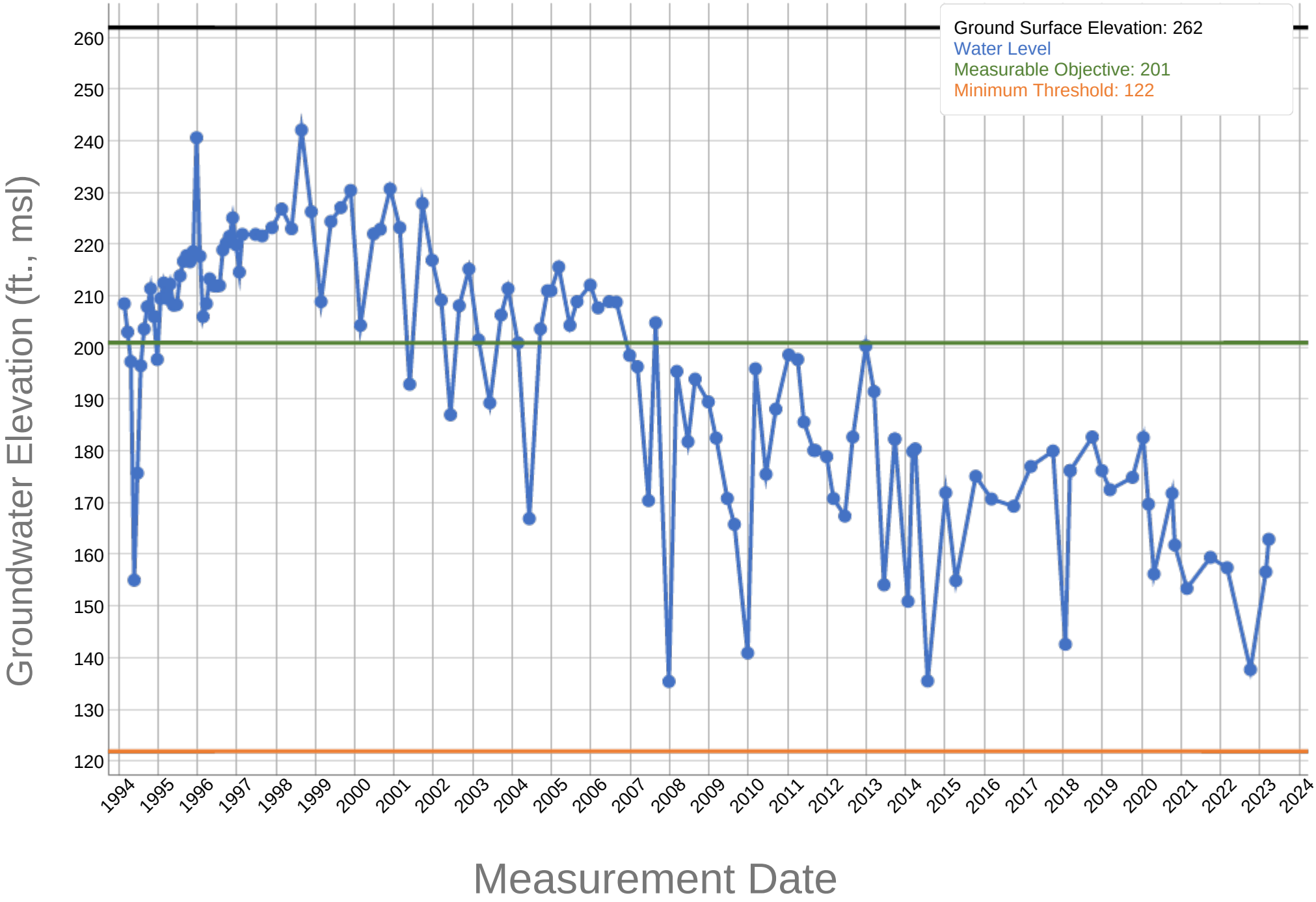
A1-5

Buena Vista Water Storage District GSA - DMW06 - 354527N1195347W001



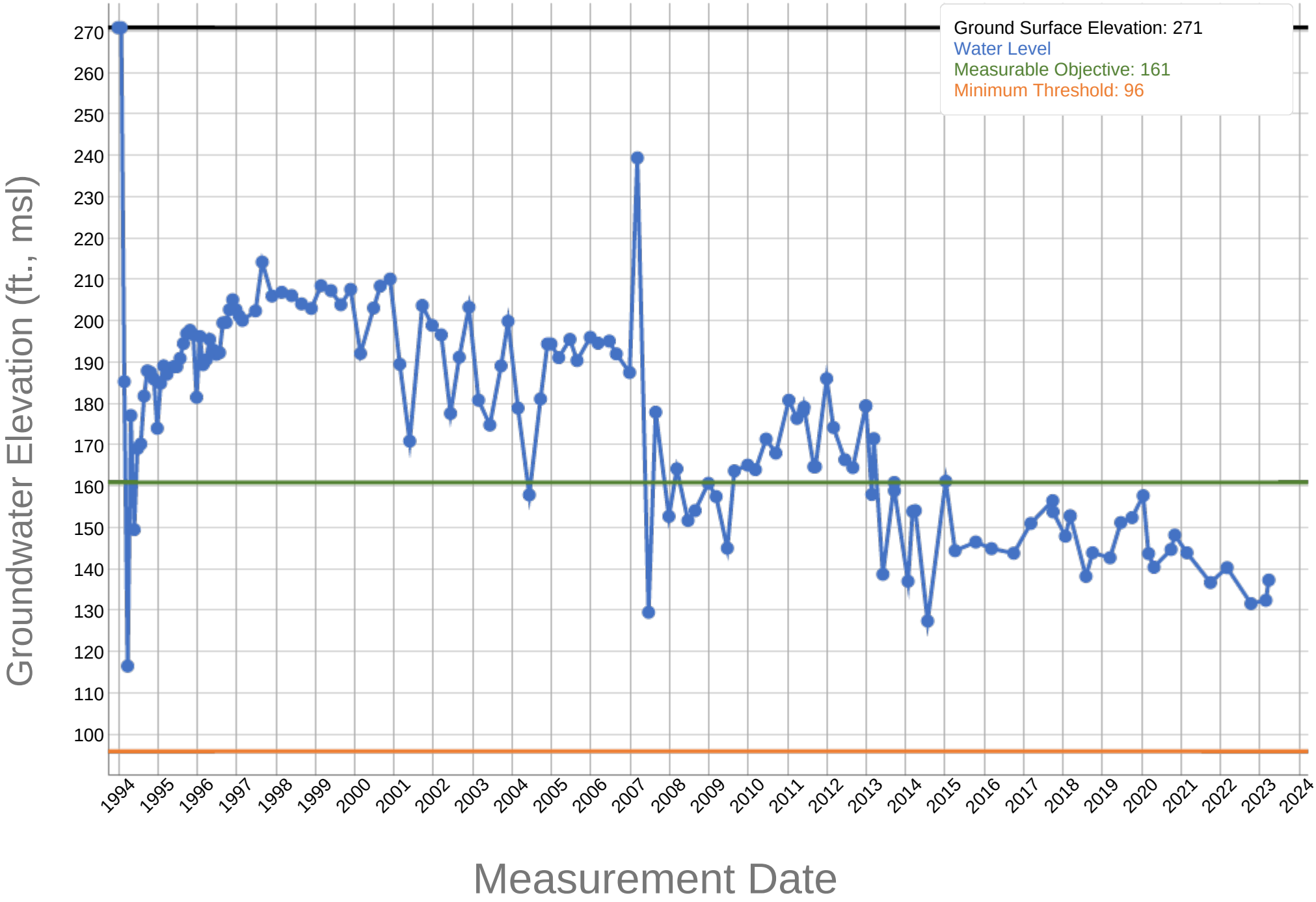
A1-6

Buena Vista Water Storage District GSA - DMW07 - 354021N1195011W001



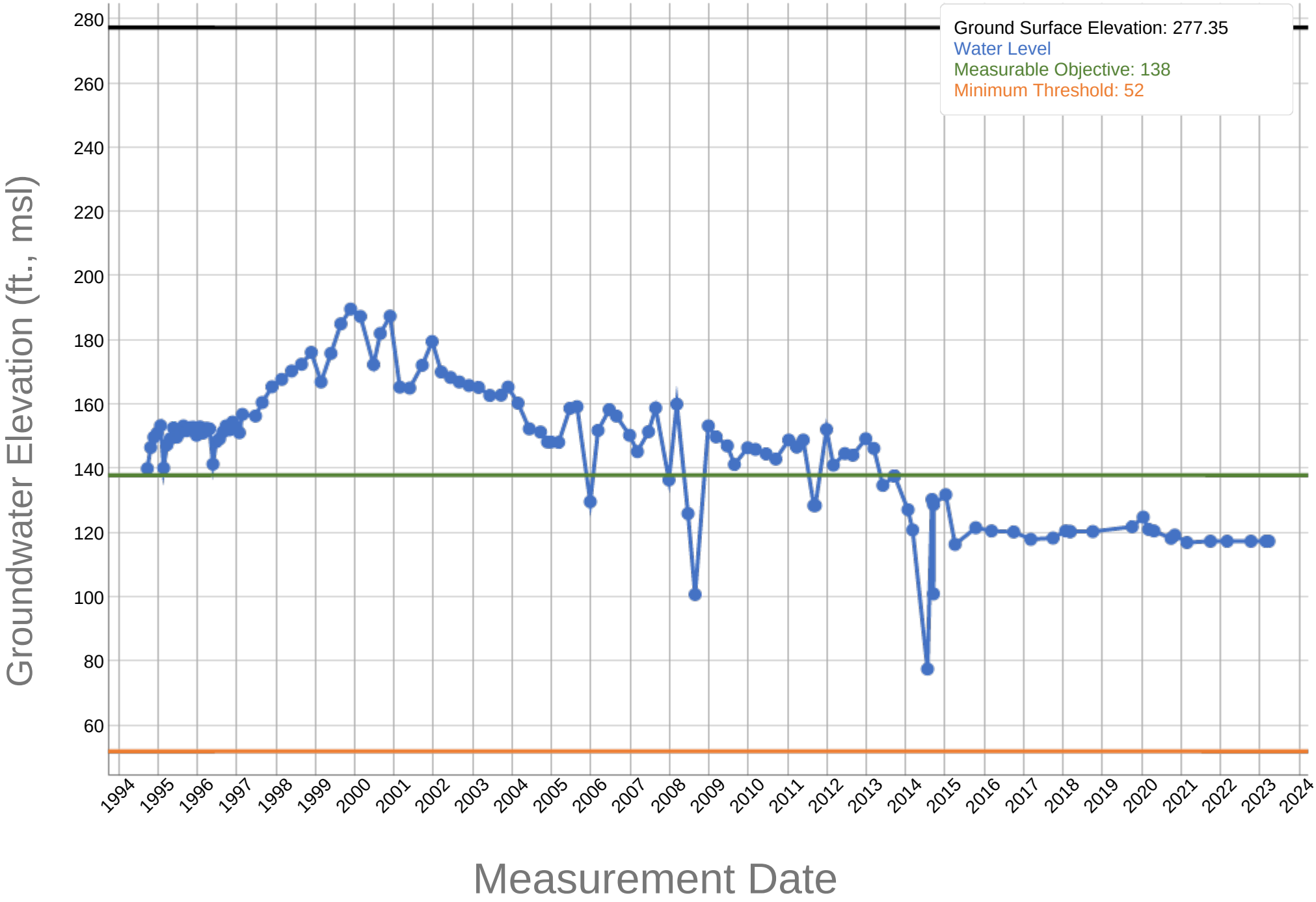
A1-7

Buena Vista Water Storage District GSA - DMW08 - 353905N1194480W001



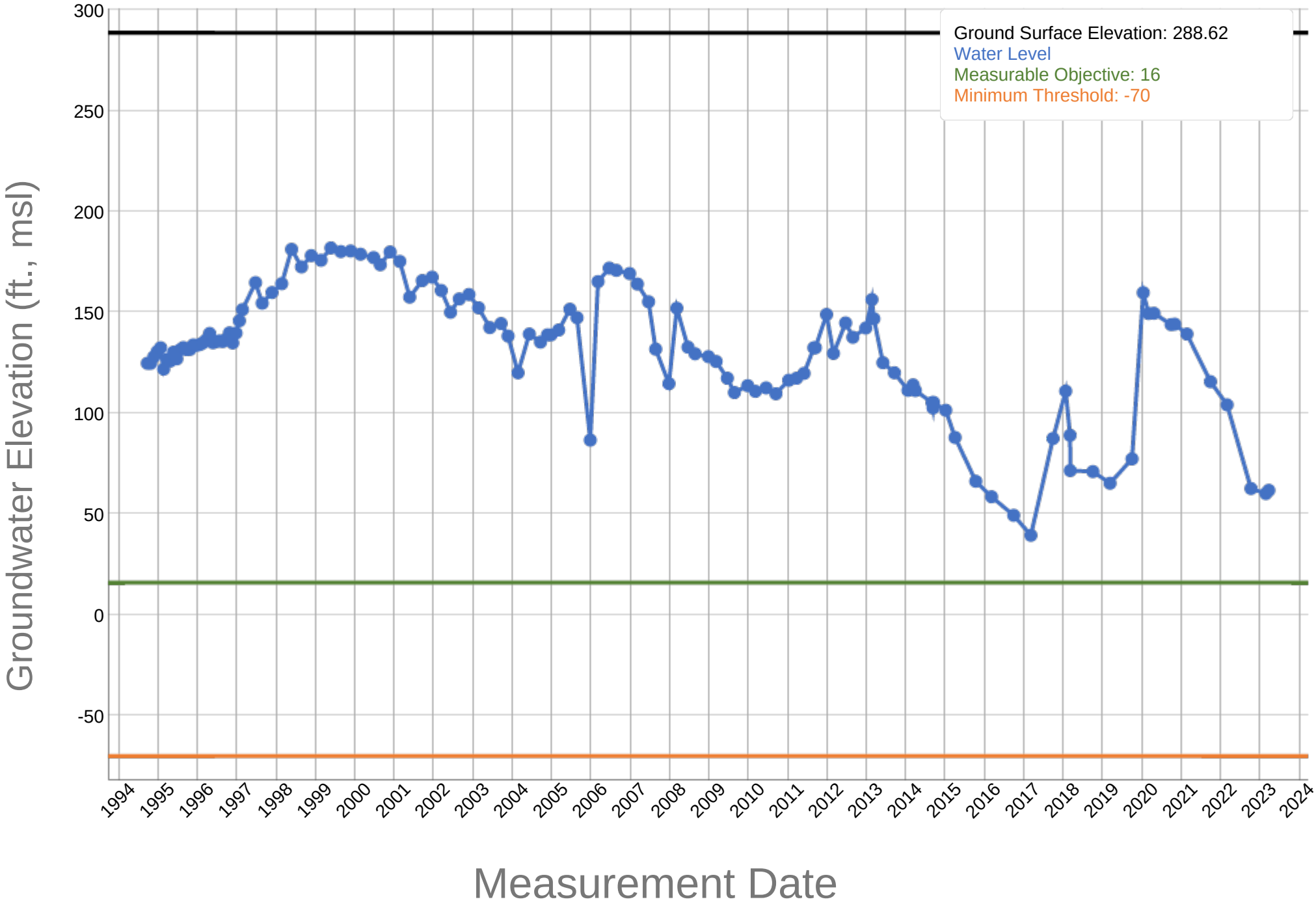
A1-8

Buena Vista Water Storage District GSA - DMW10a - 353536N1194341W001



A1-9

Buena Vista Water Storage District GSA - DMW12b - 353187N1193747W001



APPENDIX A2

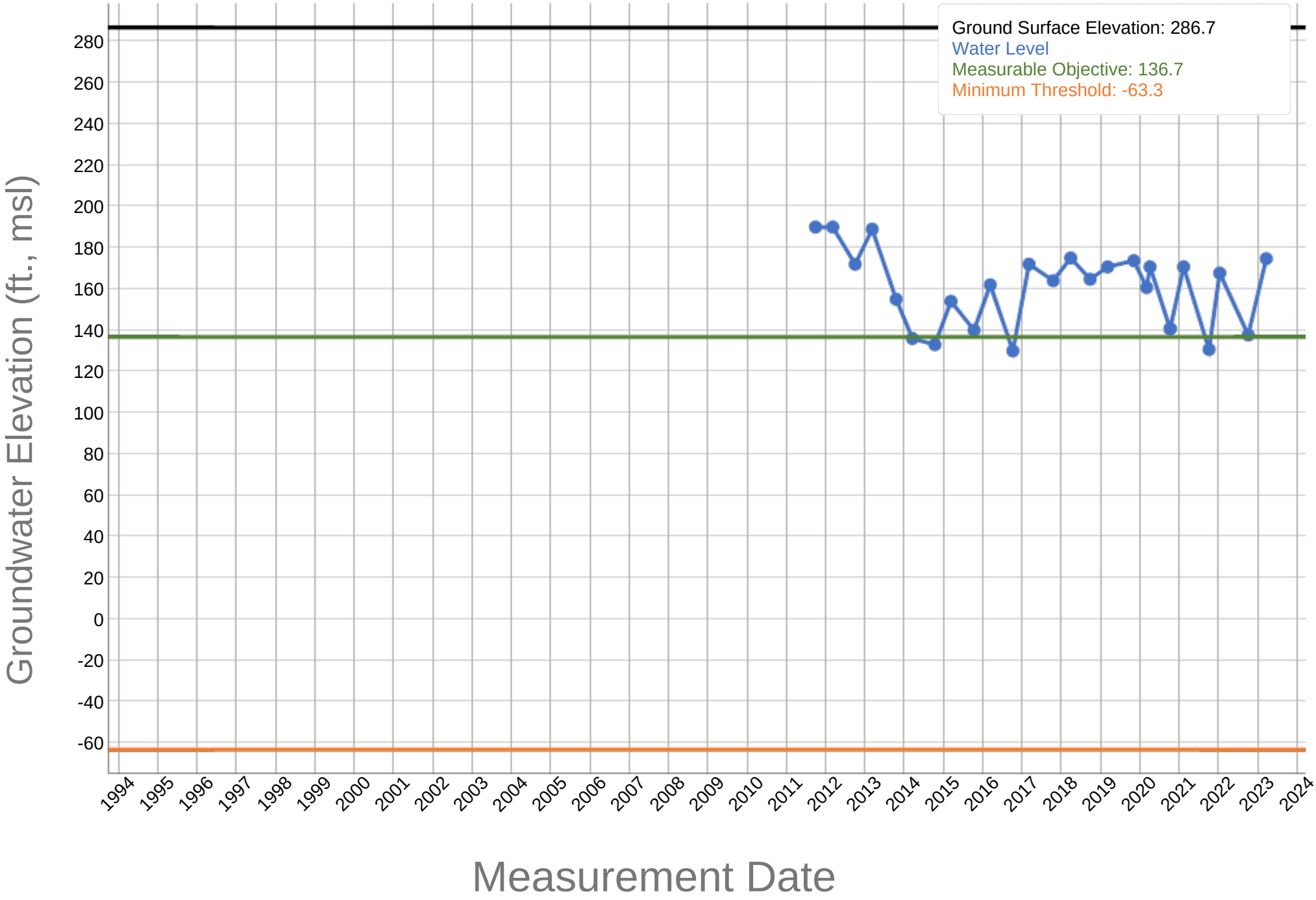
Hydrographs of Groundwater Elevations

GSP Monitoring Network Wells

Henry Miller WD GSA

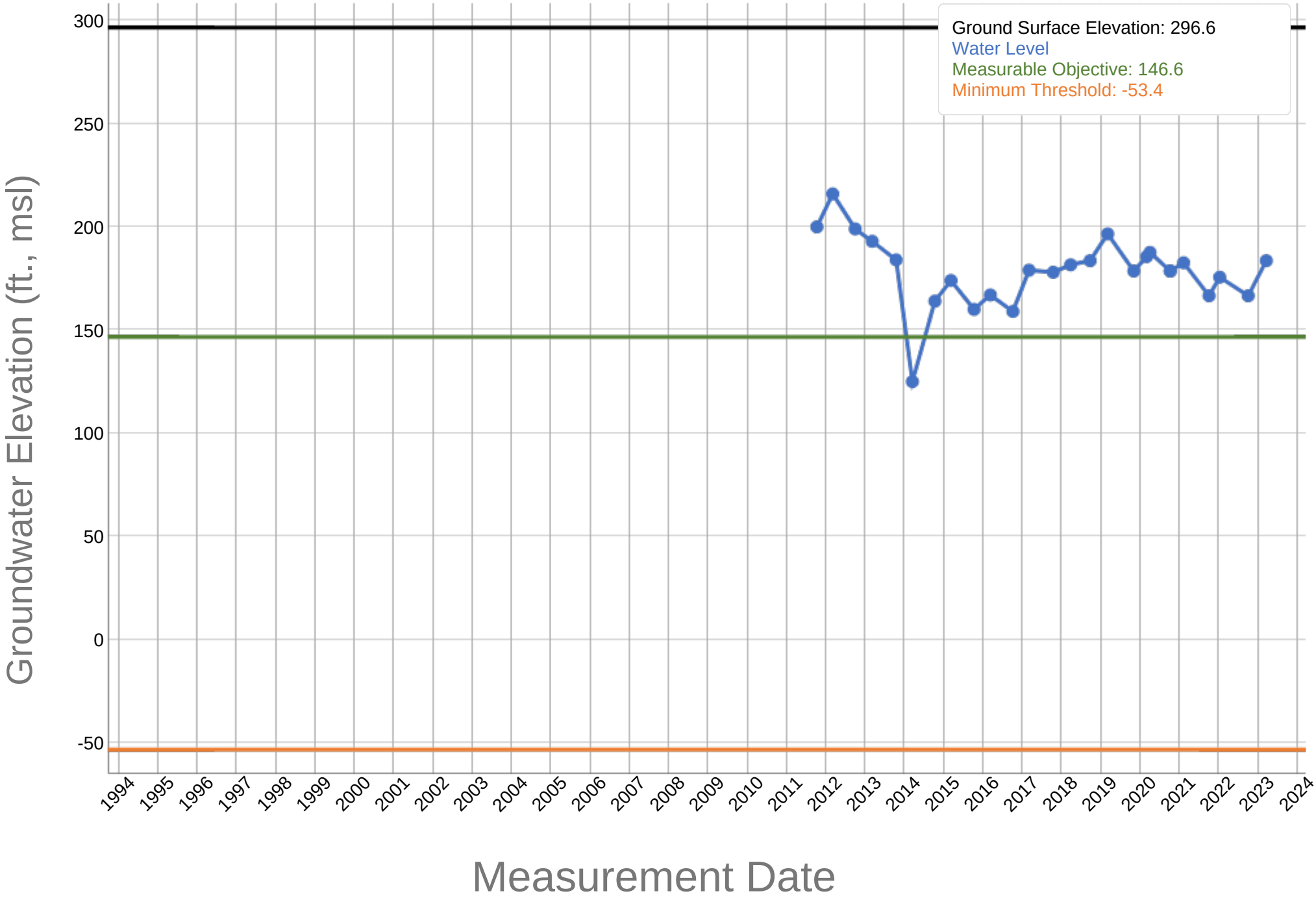
A2-1

Henry Miller Water District GSA - HMWD #18 - 351811N1192358W001



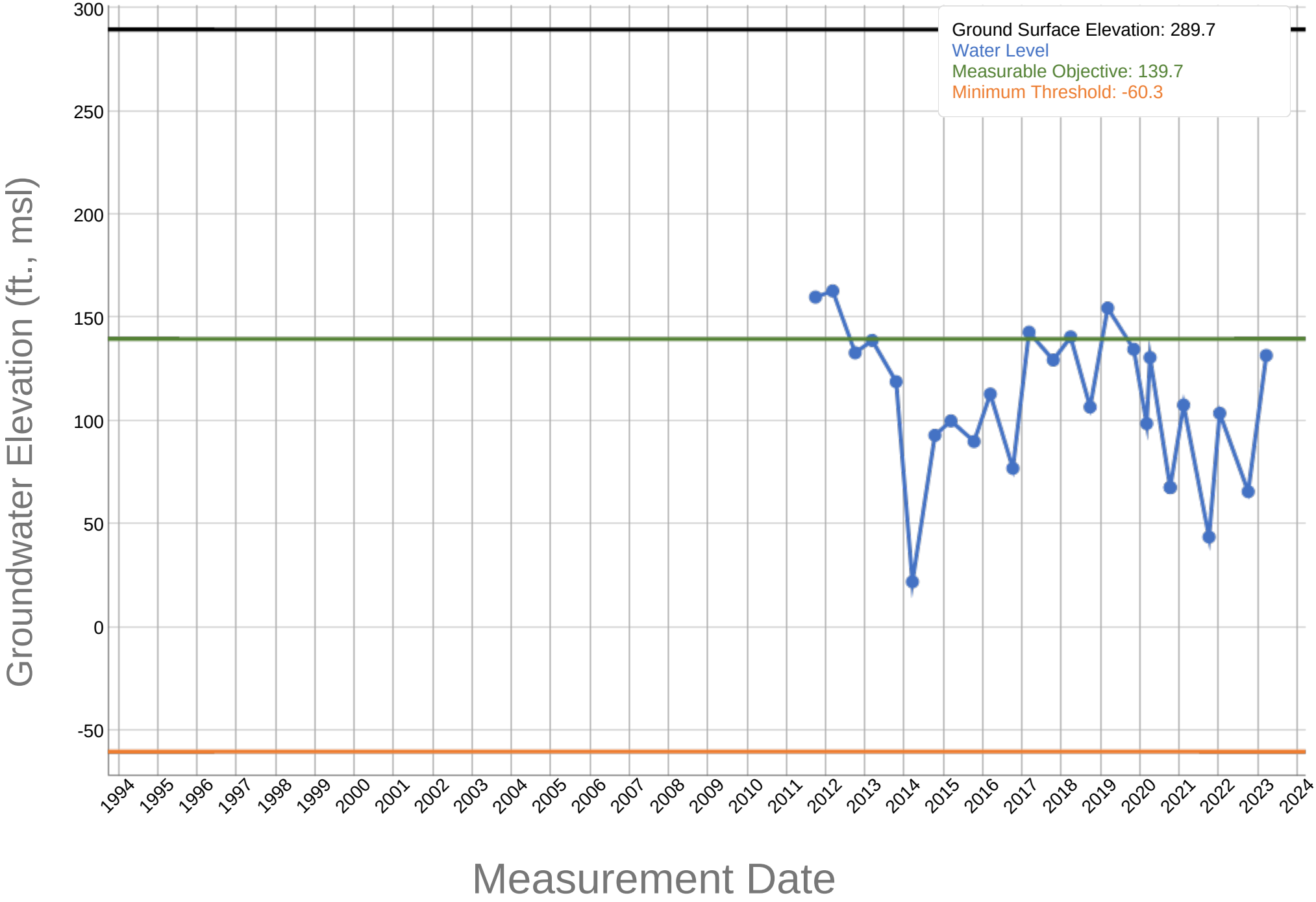
A2-2

Henry Miller Water District GSA - HMWD #20 - 352294N1192865W001



A2-3

Henry Miller Water District GSA - HMWD #26 - 351976N1192358W001

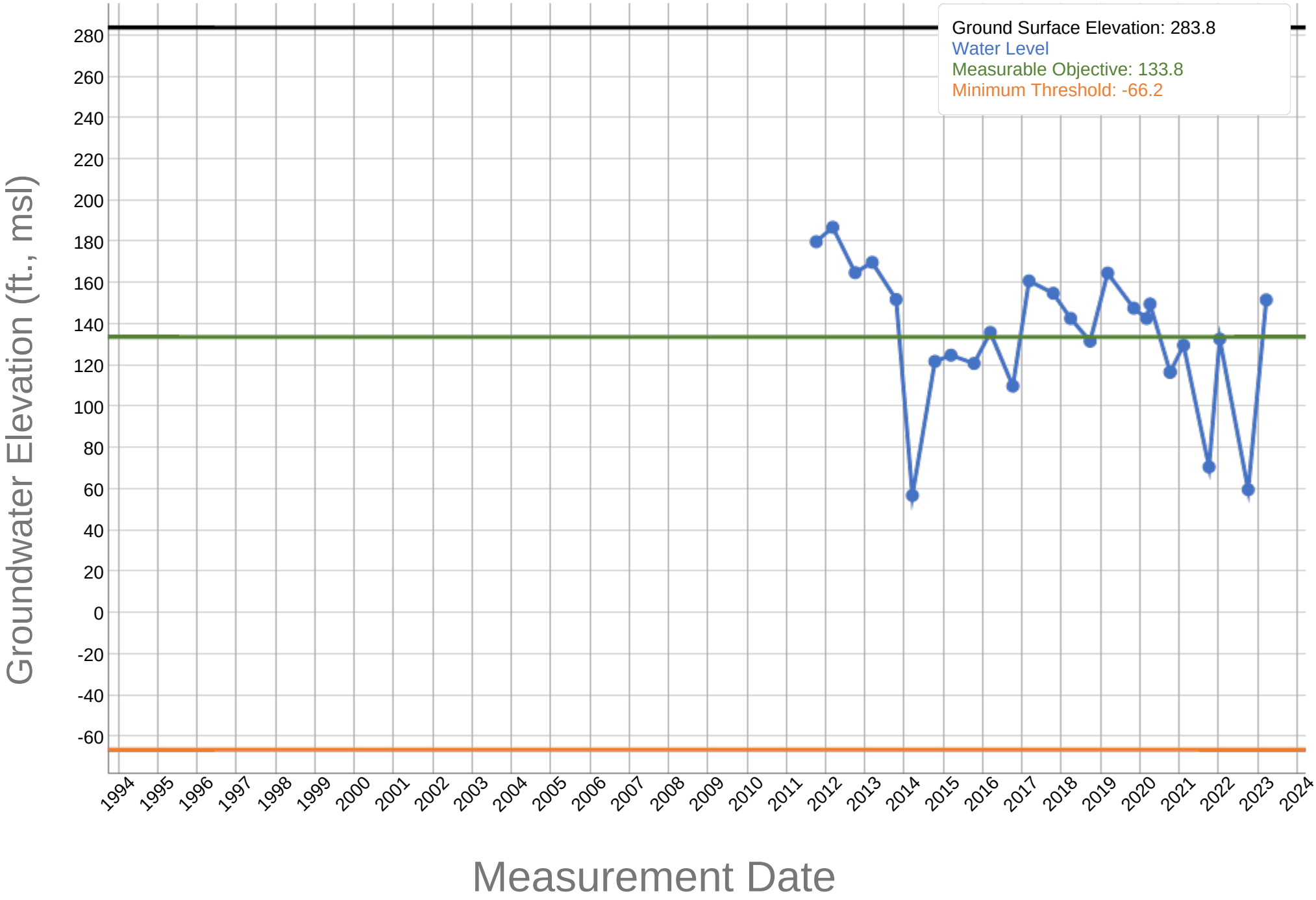


A2-4

Henry Miller Water District GSA - HMWD #27 - 352088N1192520W001

A2-5

Henry Miller Water District GSA - HMWD #28 - 352086N1192783W001



APPENDIX A3

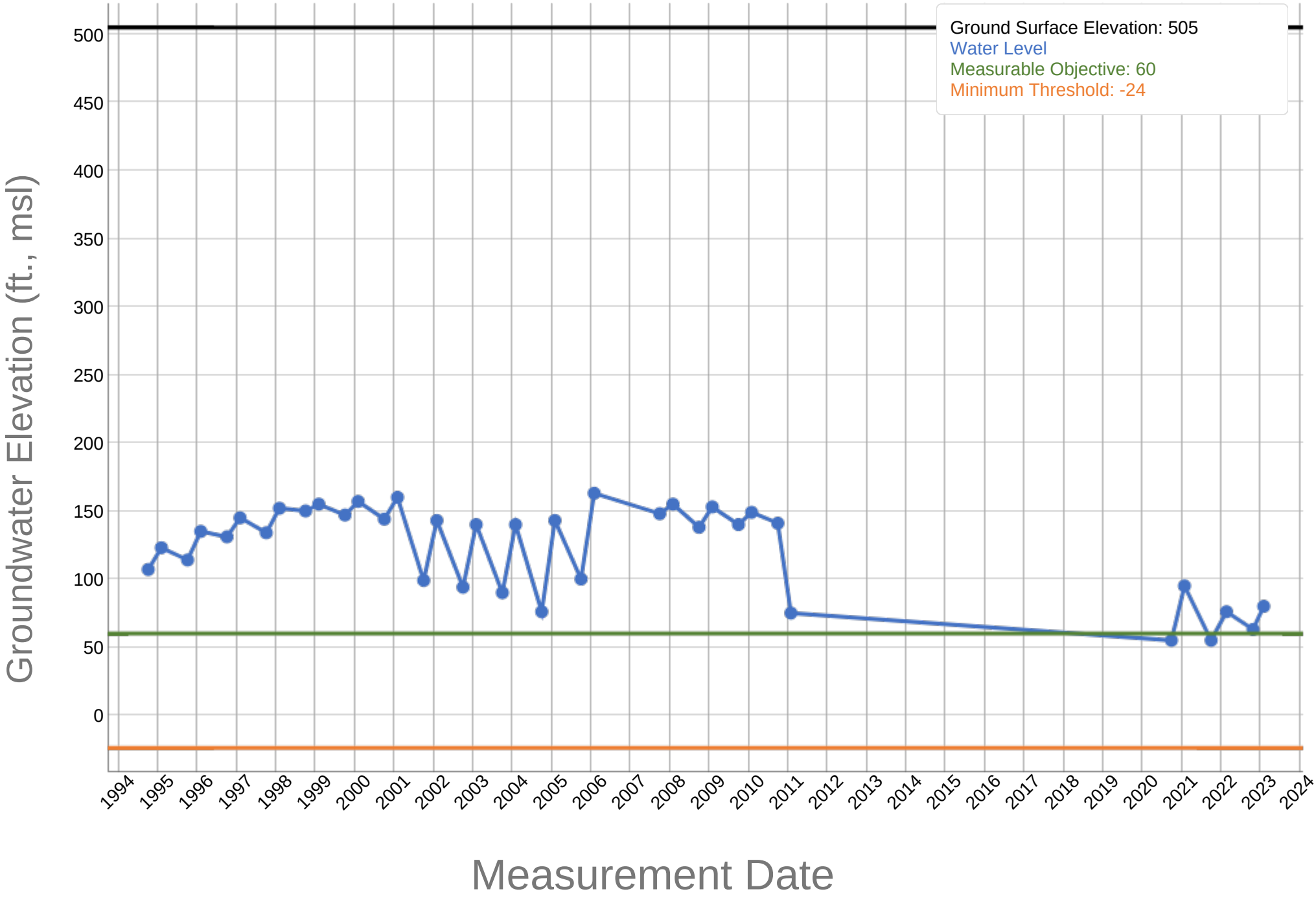
Hydrographs of Groundwater Elevations

GSP Monitoring Network Wells

Kern Groundwater Authority GSA

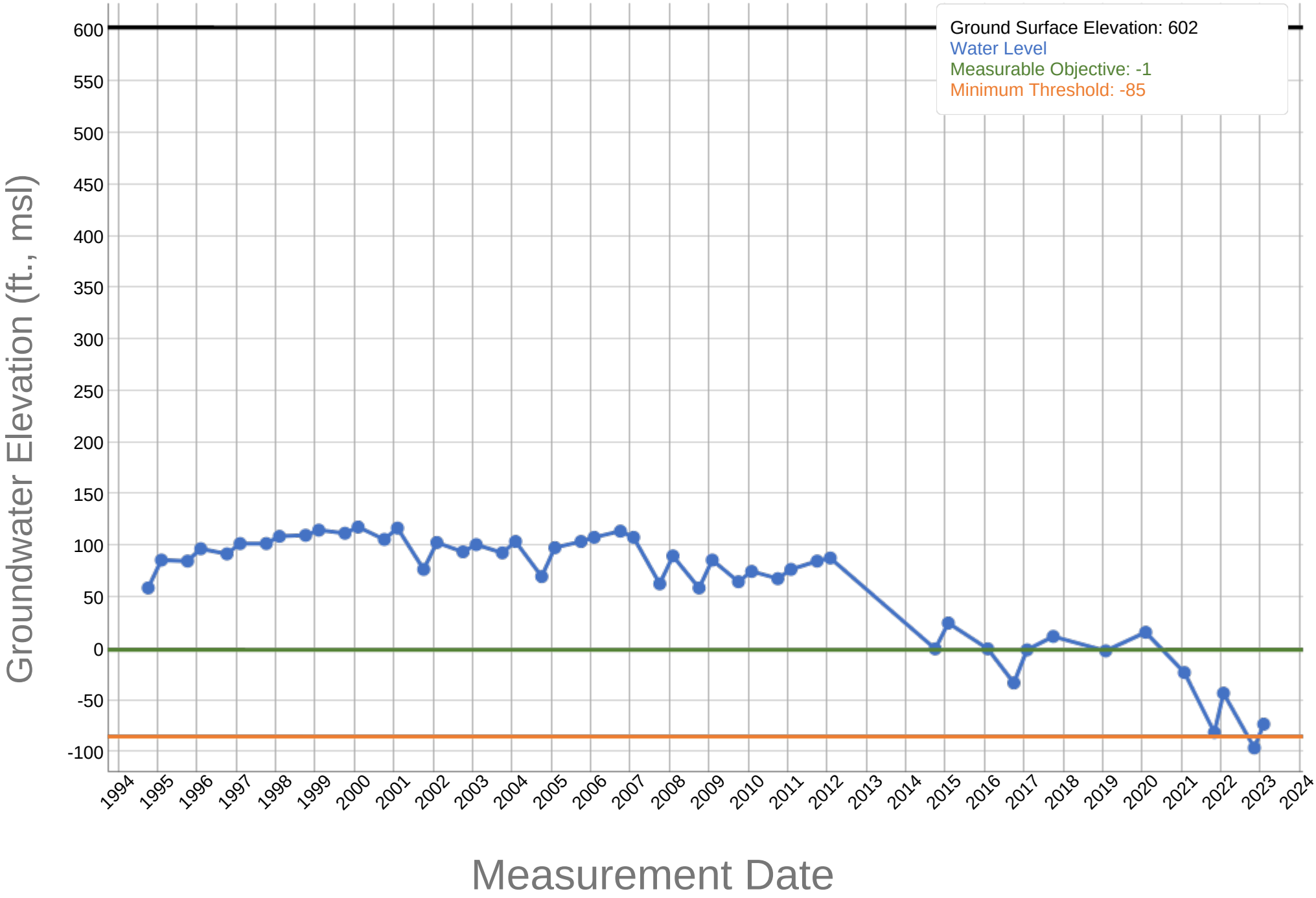
A3-1

Cawelo Water District GSA - Well 4R - 356023N1191690W001



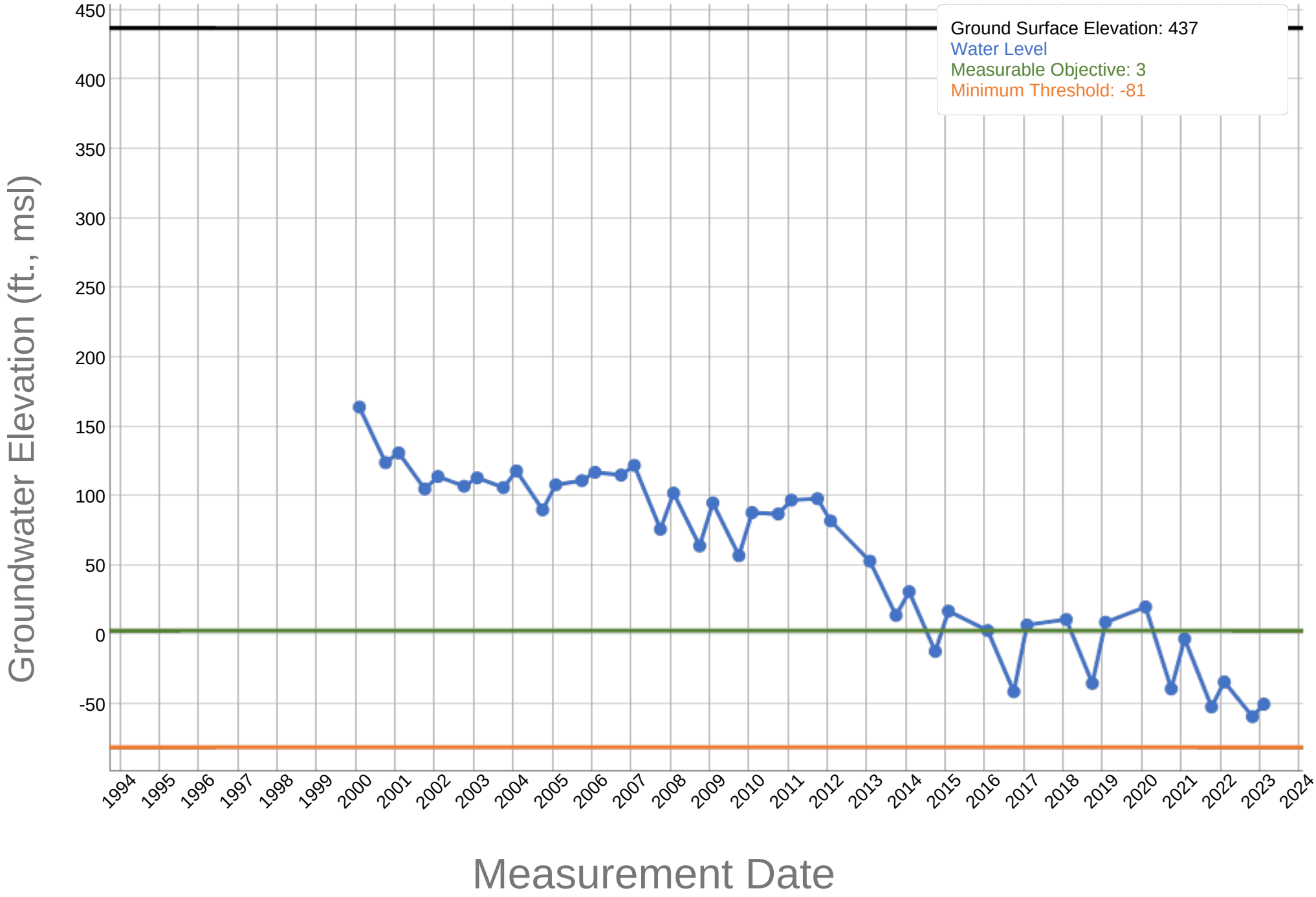
A3-2

Cawelo Water District GSA - Well 6C - 355274N1191100W001



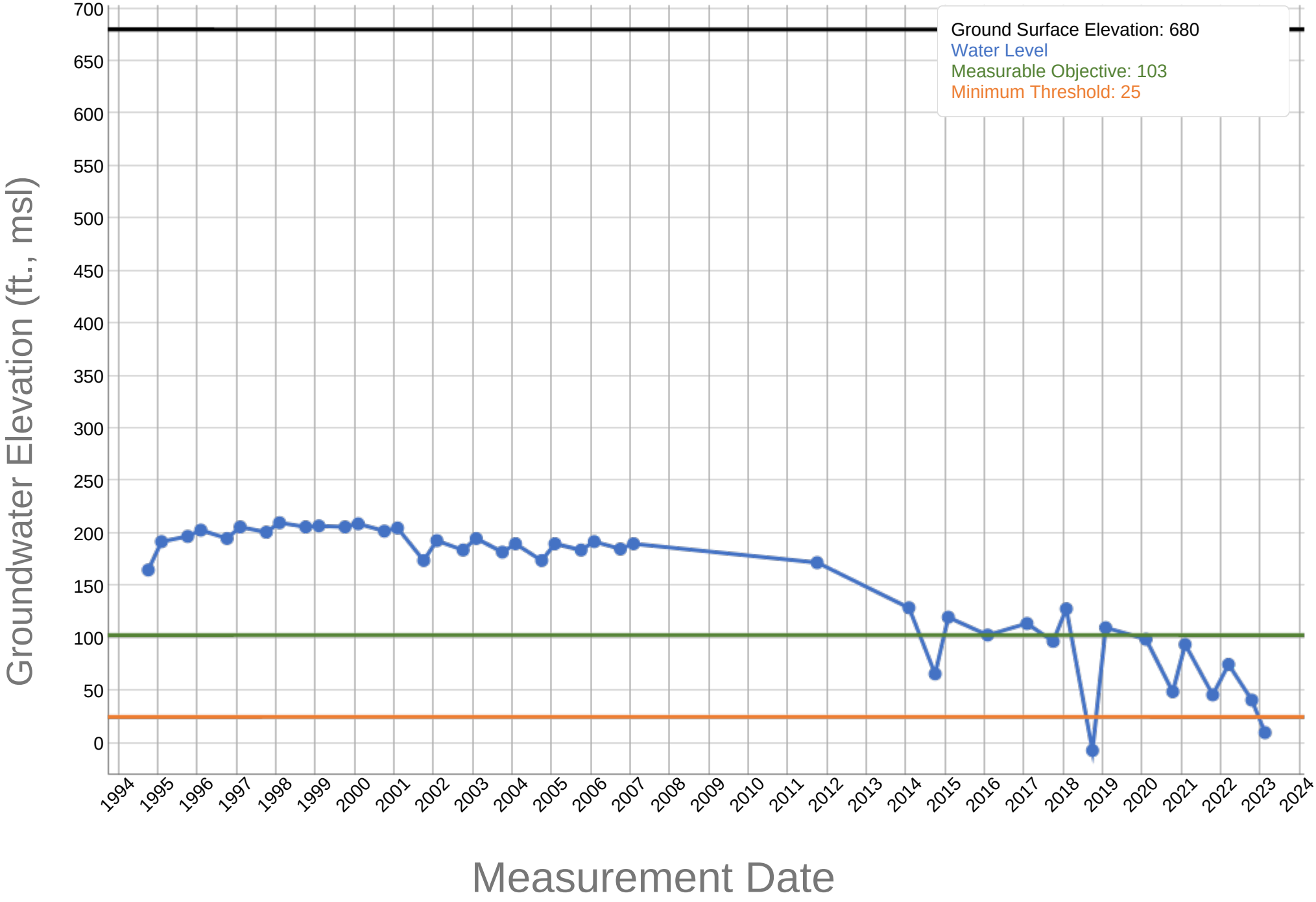
A3-3

Cawelo Water District GSA - Well 11M - 355044N1191502W001



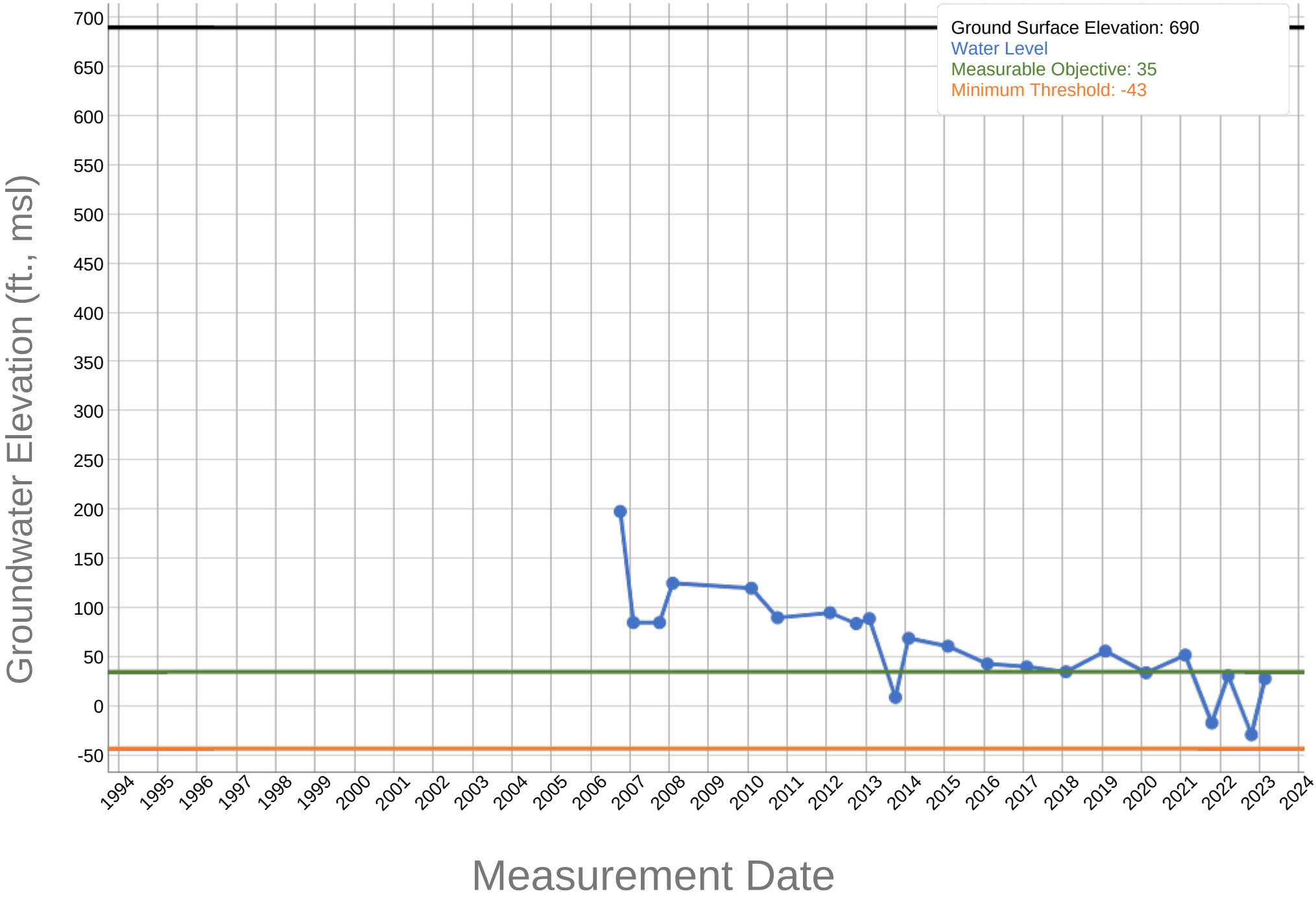
A3-4

Cawelo Water District GSA - Well 12H - 355954N1191160W001



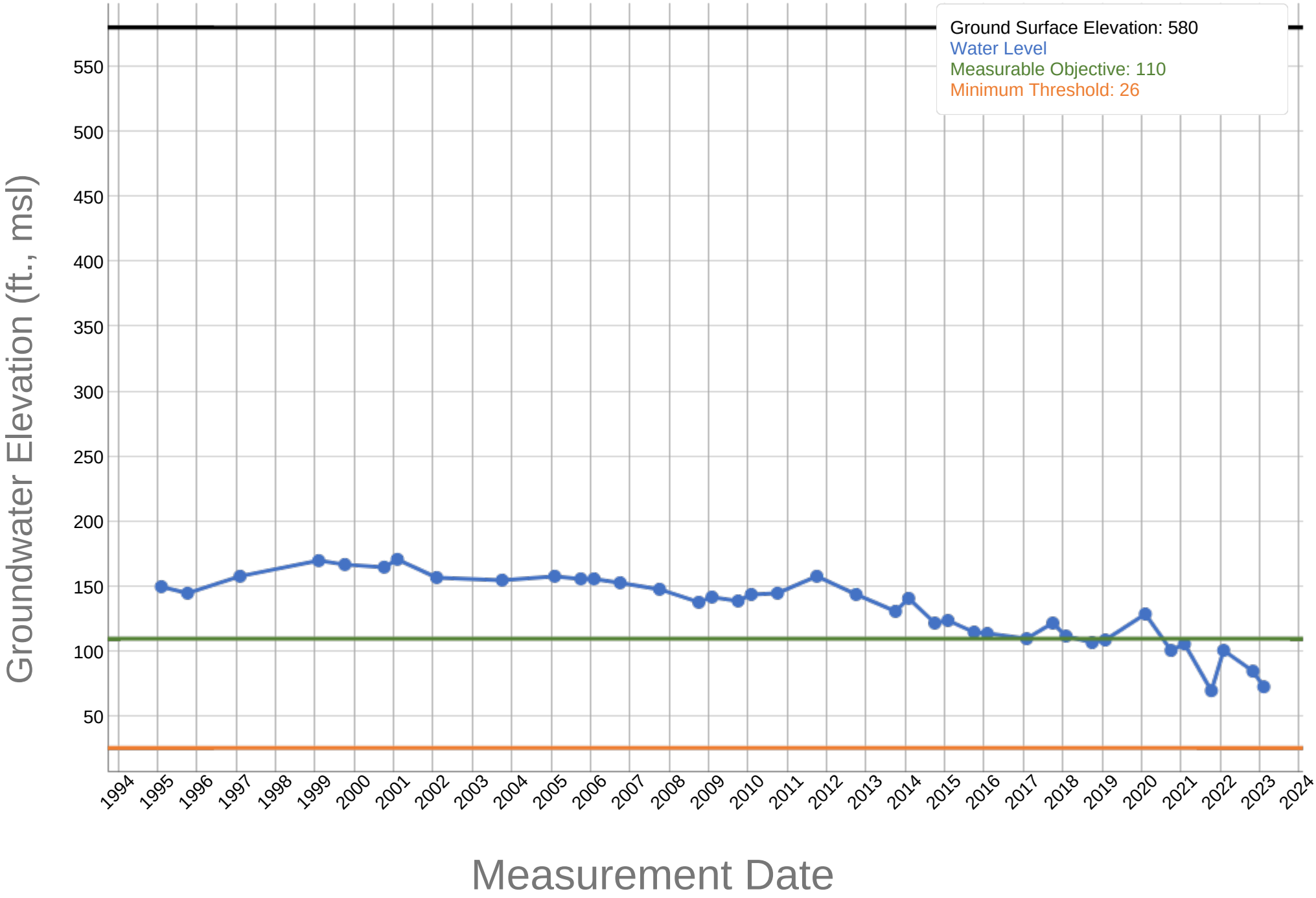
A3-5

Cawelo Water District GSA - Well 24R - 356469N1191175W001



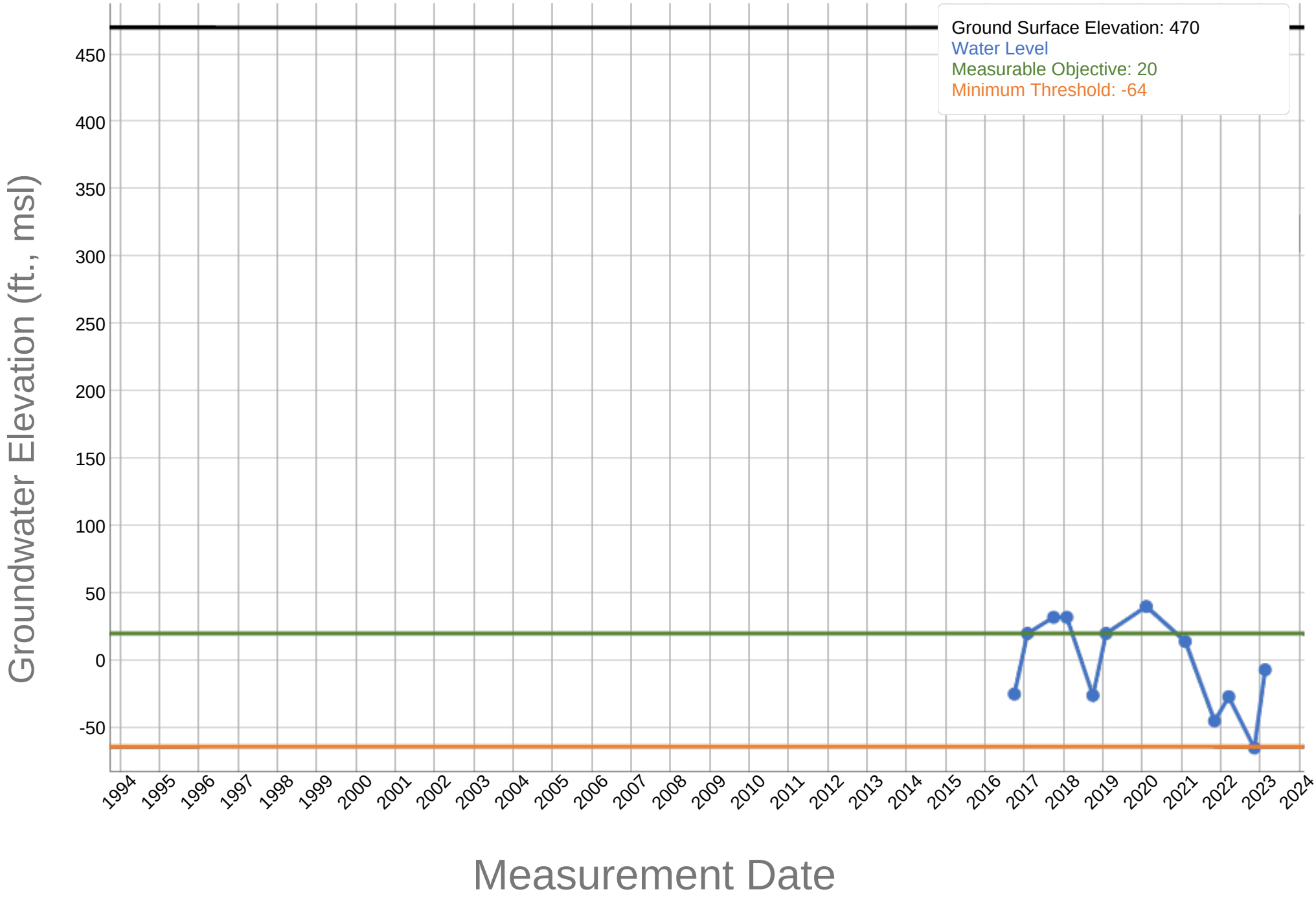
A3-6

Cawelo Water District GSA - Well 28L - 356023N1191691W001



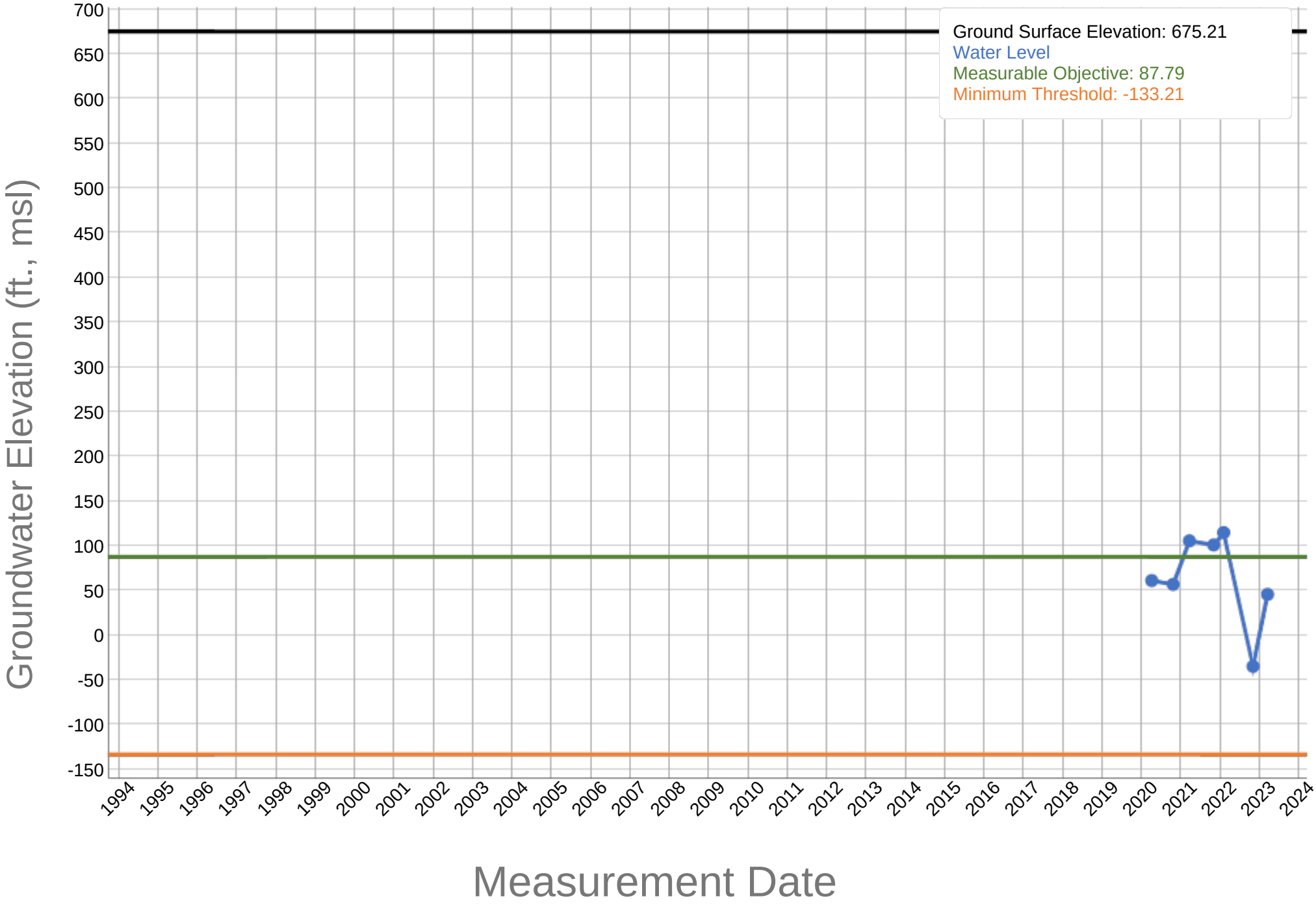
A3-7

Cawelo Water District GSA - Well 33C - 355439N1191781W001



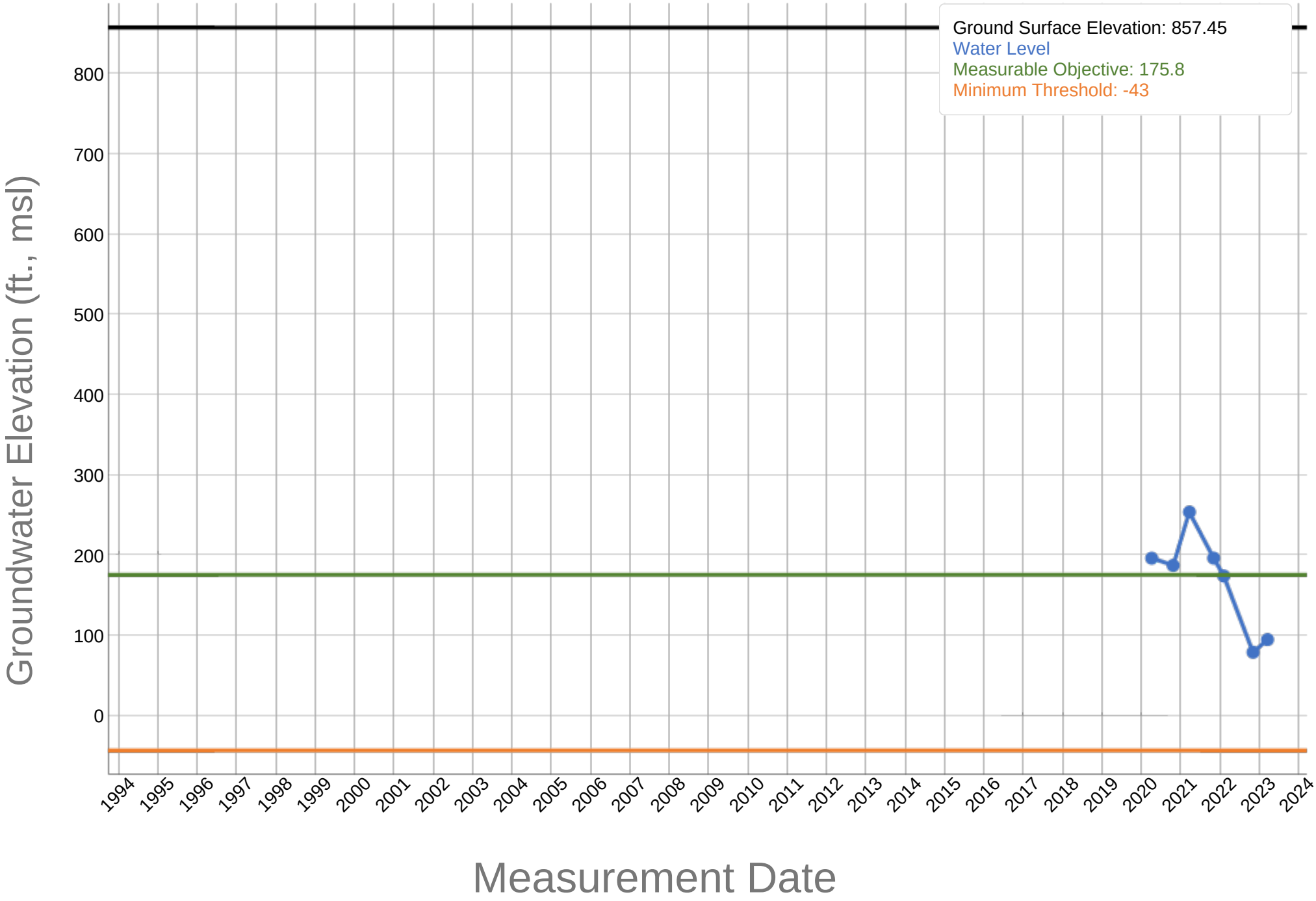
A3-8

Eastside Water Management Area - EWMA #04 - 357840N1190456W001



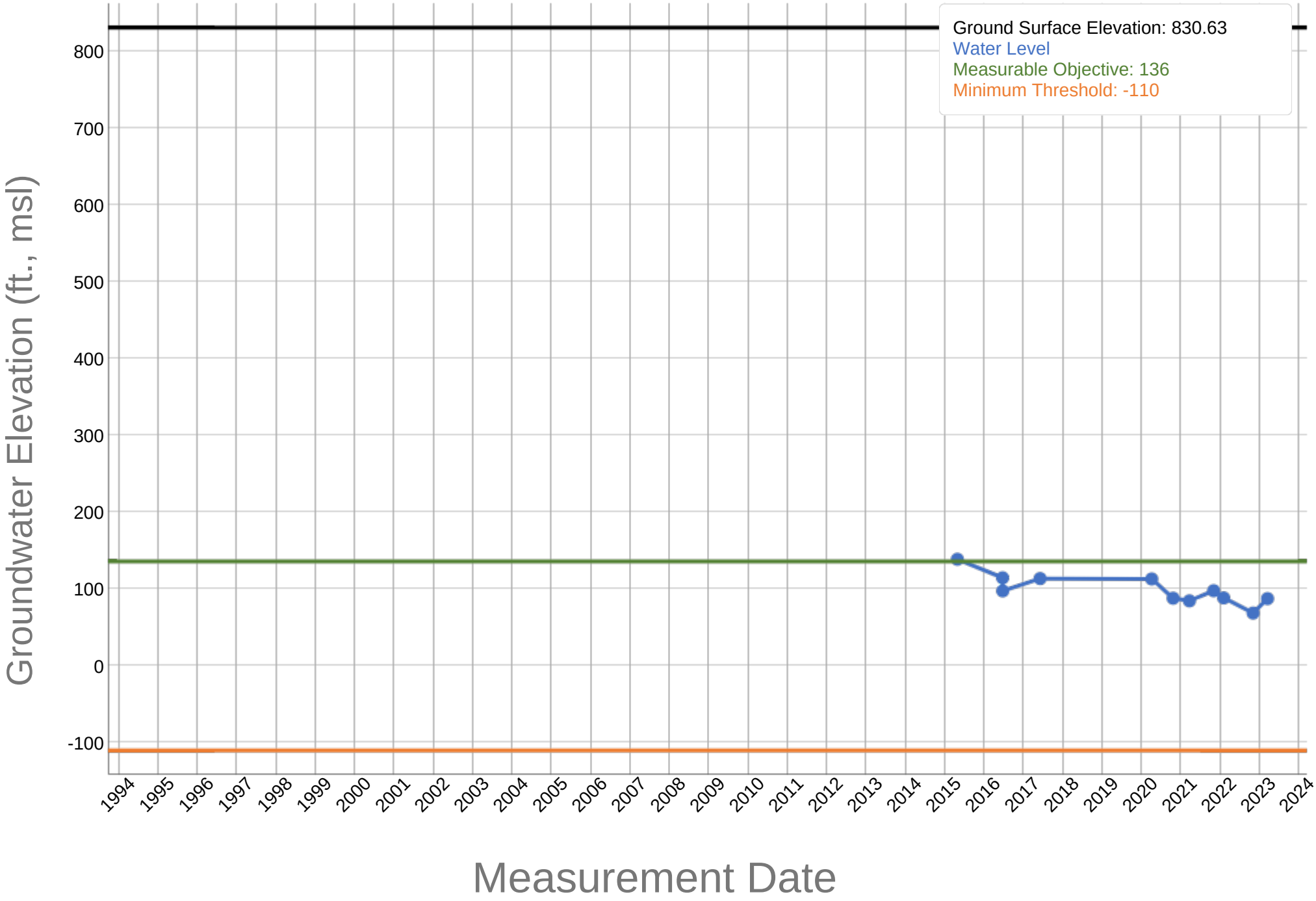
A3-9

Eastside Water Management Area - EWMA #10 - 357085N1190370W001



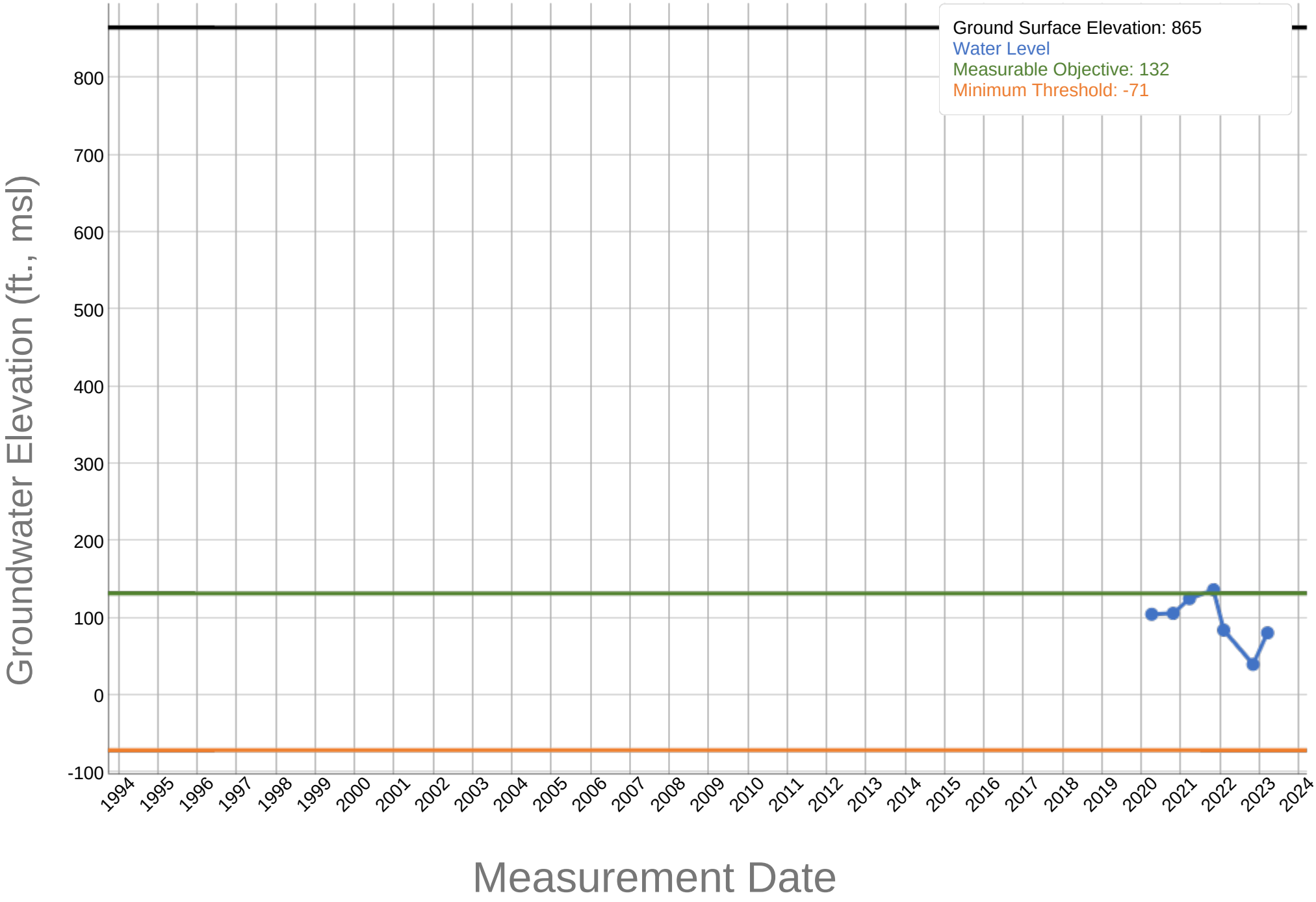
A3-10

Eastside Water Management Area - EWMA #21 - 355935N1190787W001



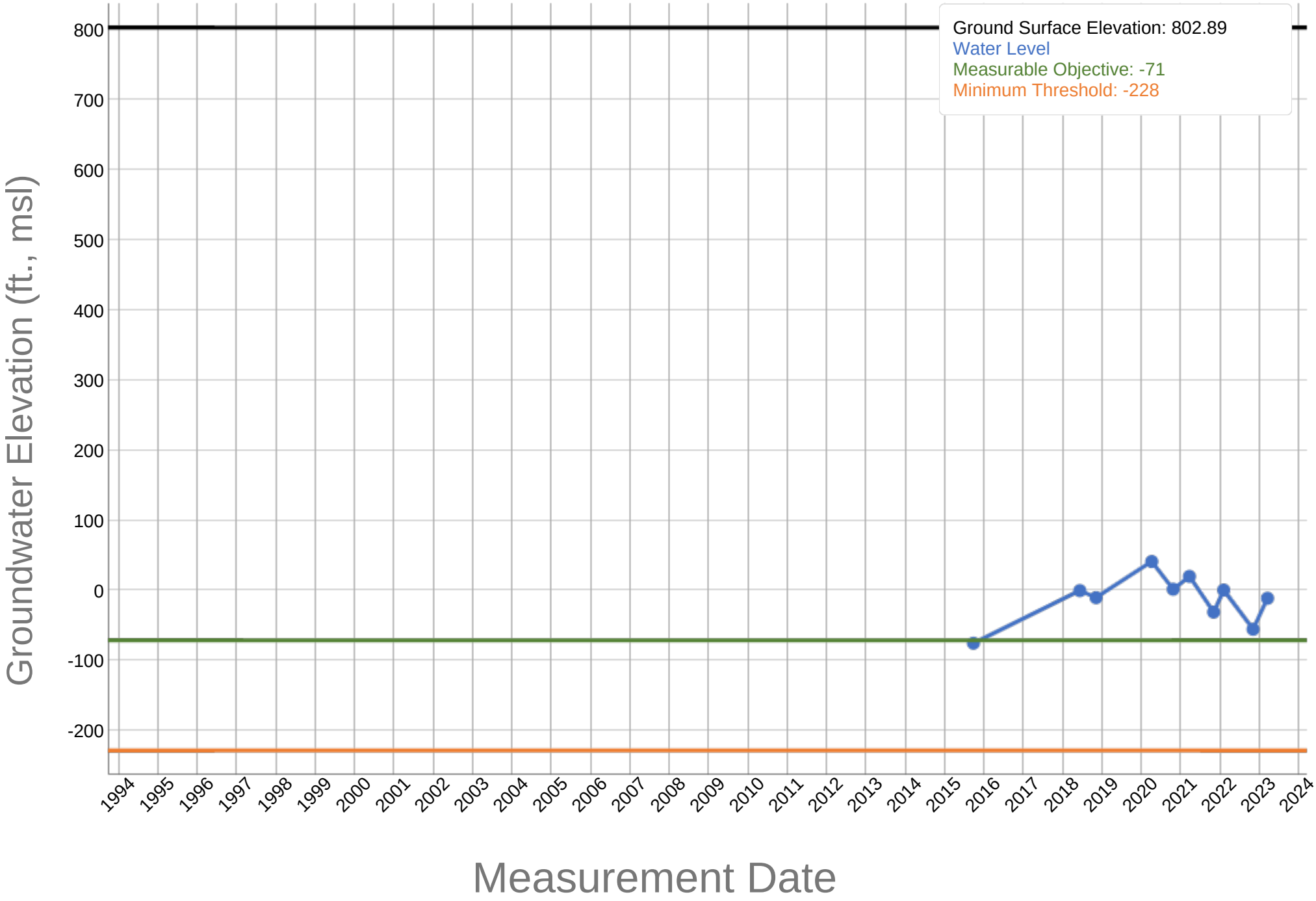
A3-11

Eastside Water Management Area - EWMA #23 - 356220N1190790W001



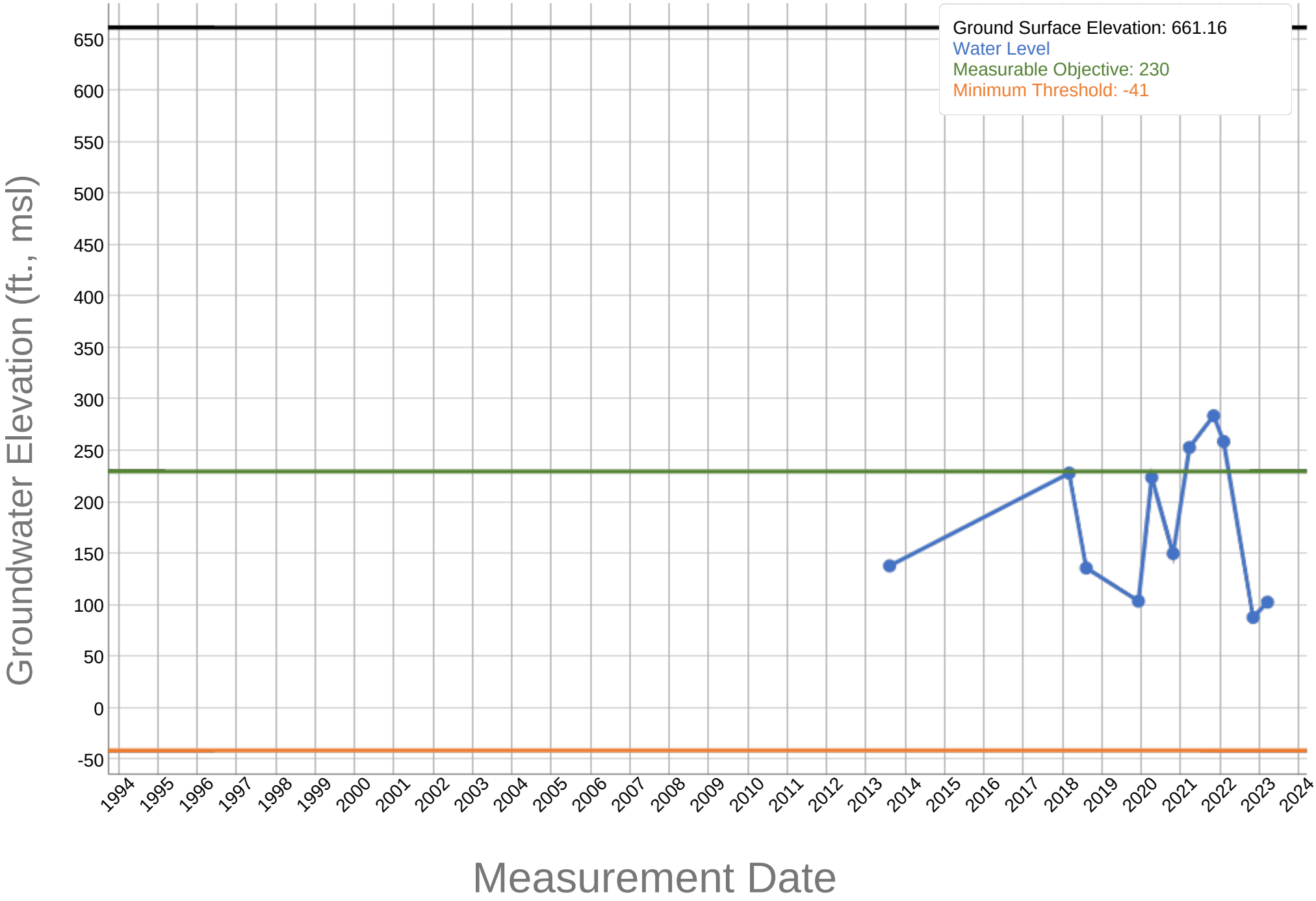
A3-12

Eastside Water Management Area - EWMA #30 - 356421N1190690W001



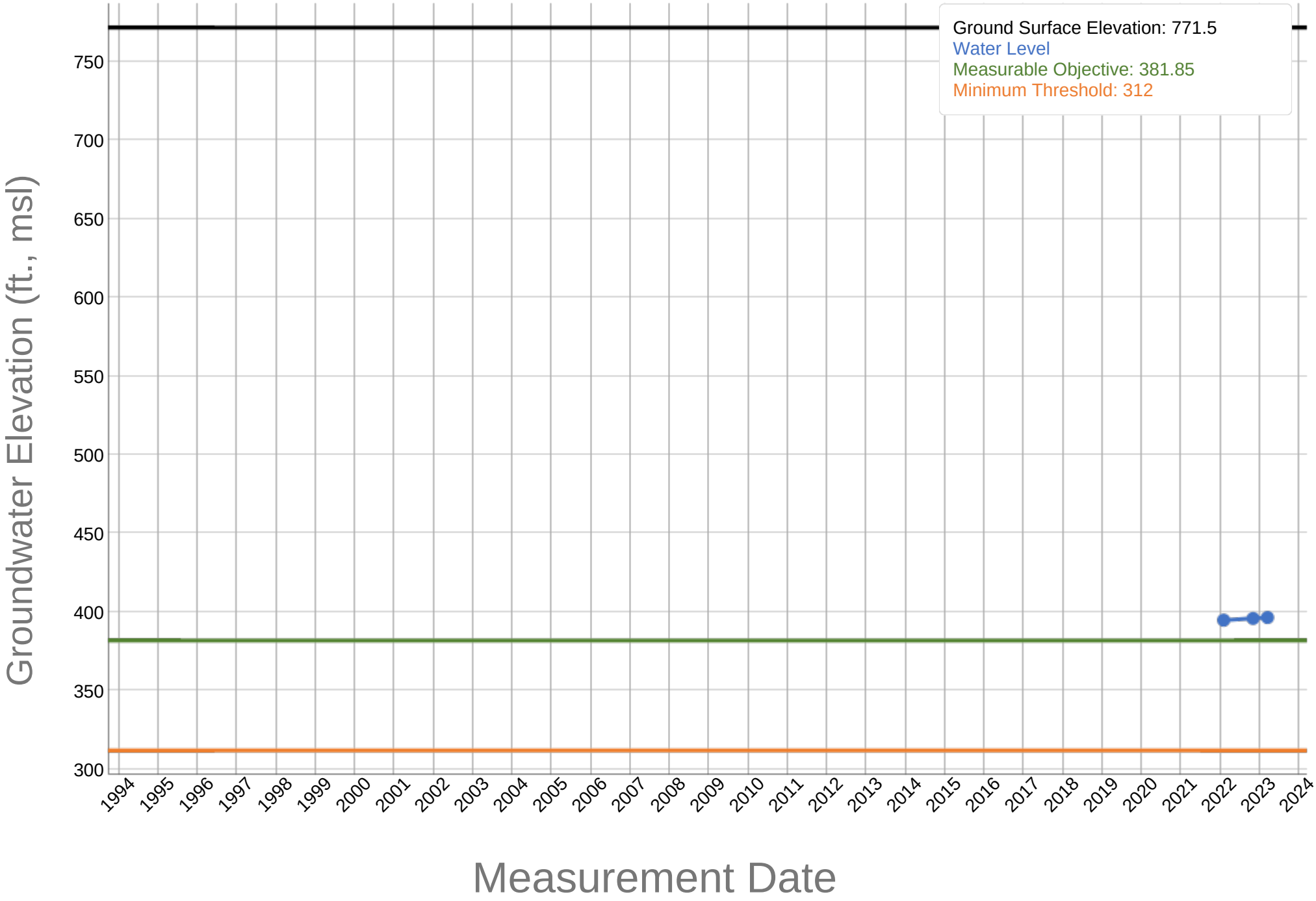
A3-13

Eastside Water Management Area - EWMA #41 - 355706N1190911W001



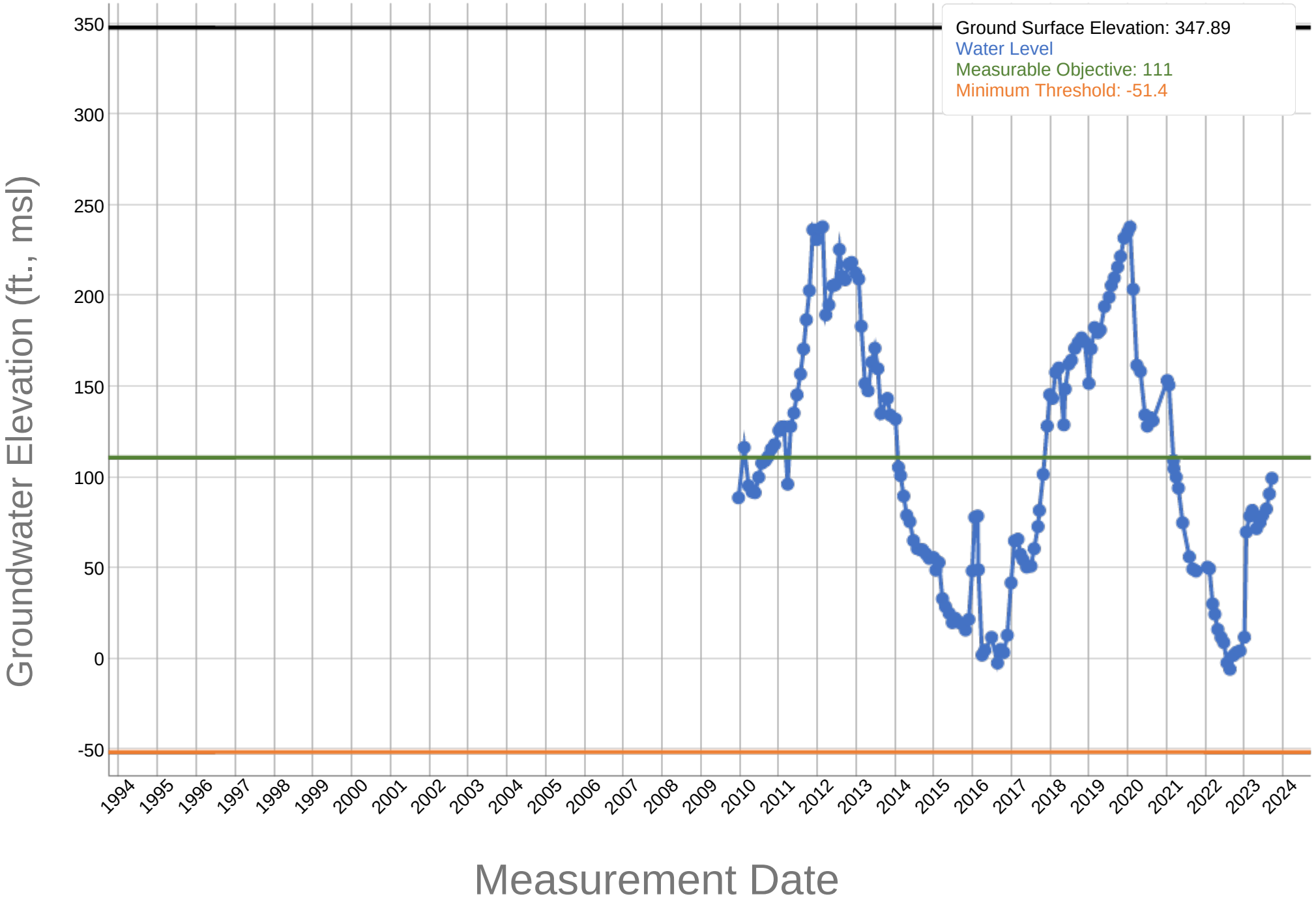
A3-14

Eastside Water Management Area - EWMA #49 - 357364N1189549W001



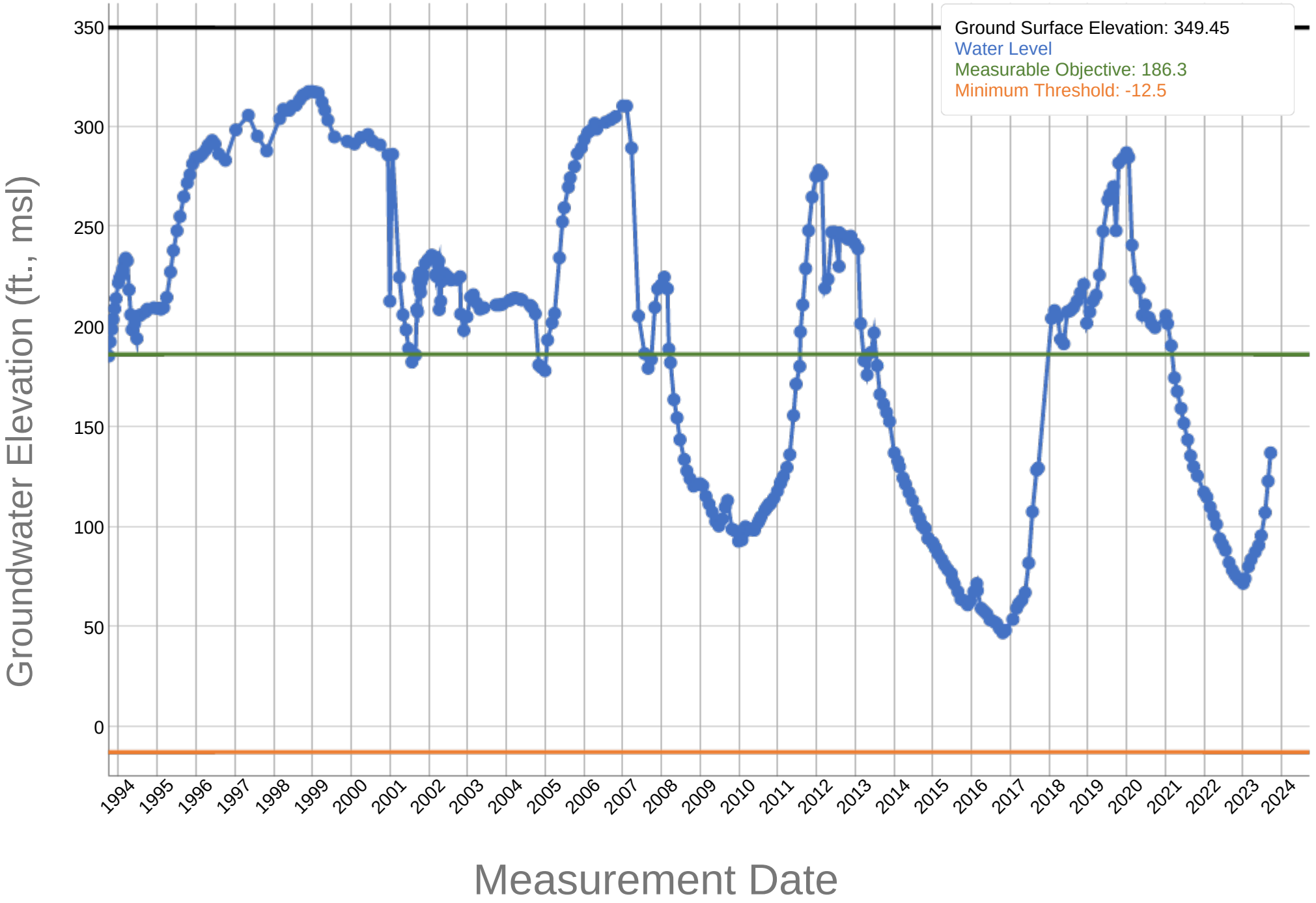
A3-15

Kern County Water Agency - Pioneer GSA - 30S/26E-04D003M - 353543N1191966W001



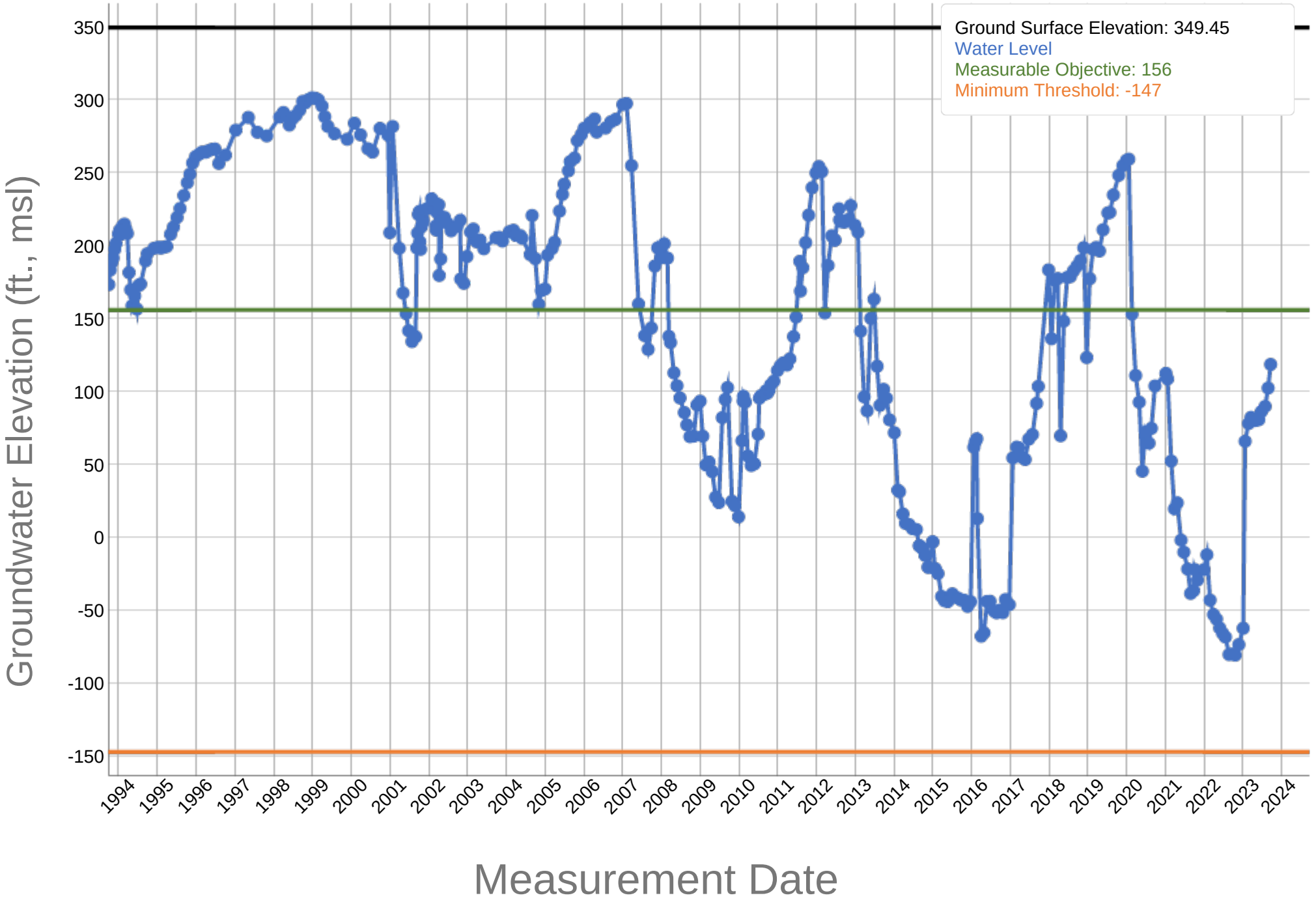
A3-16

Kern County Water Agency - Pioneer GSA - 30S/26E-04J002M - 353434N1191816W001



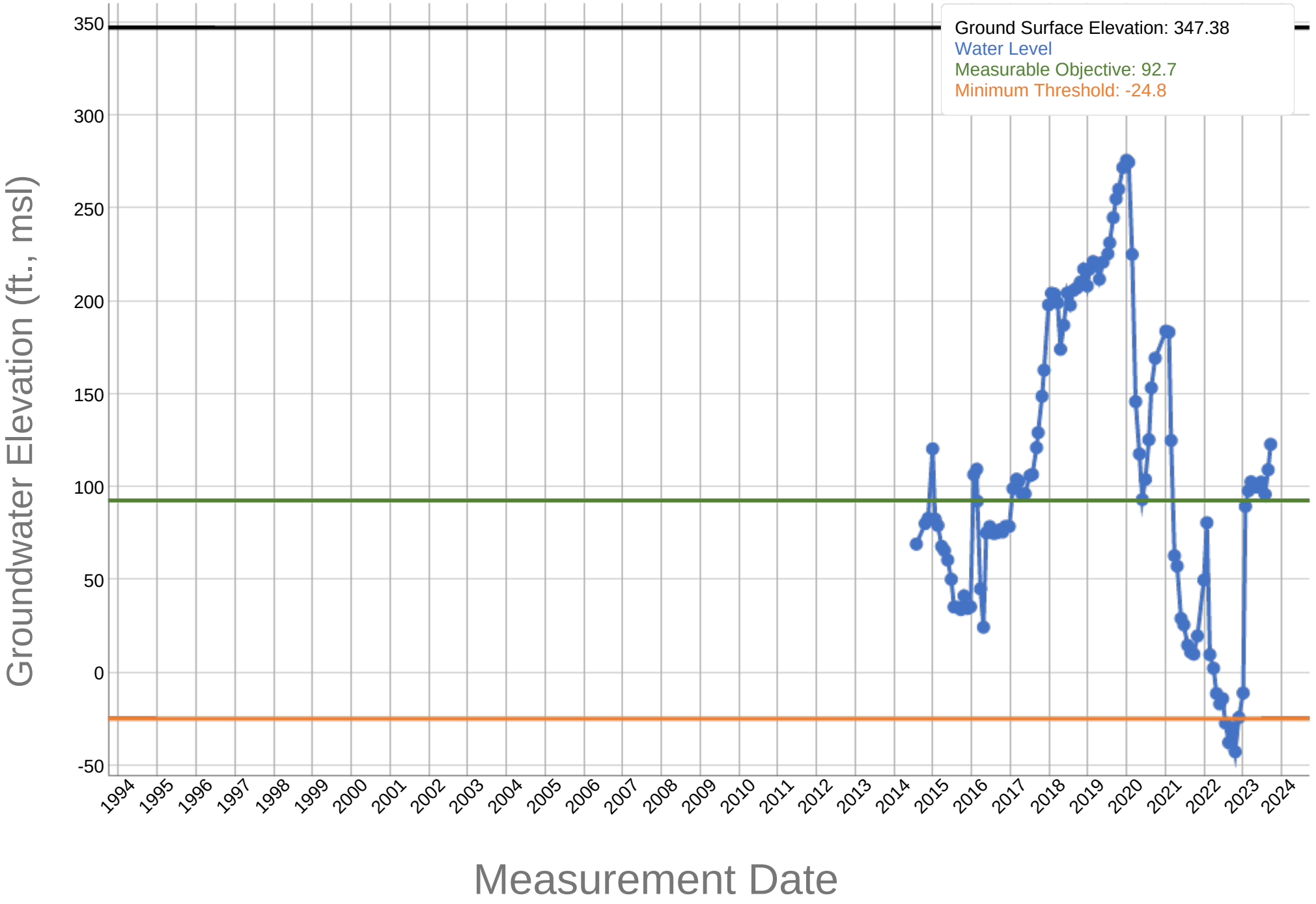
A3-17

Kern County Water Agency - Pioneer GSA - 30S/26E-04J003M - 353434N1191816W002



A3-18

Kern County Water Agency - Pioneer GSA - 30S/26E-10P004M - 353250N1191739W001



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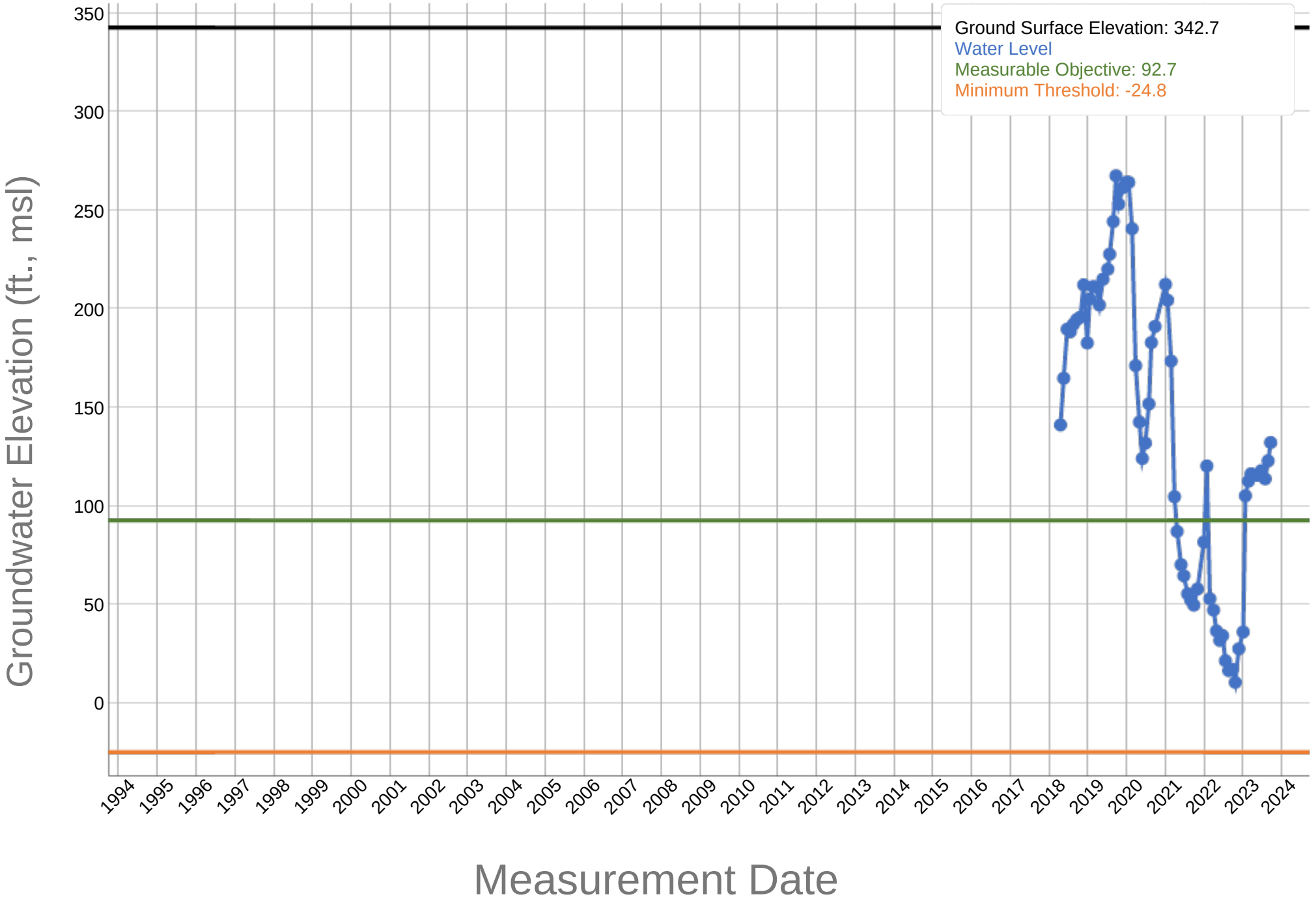
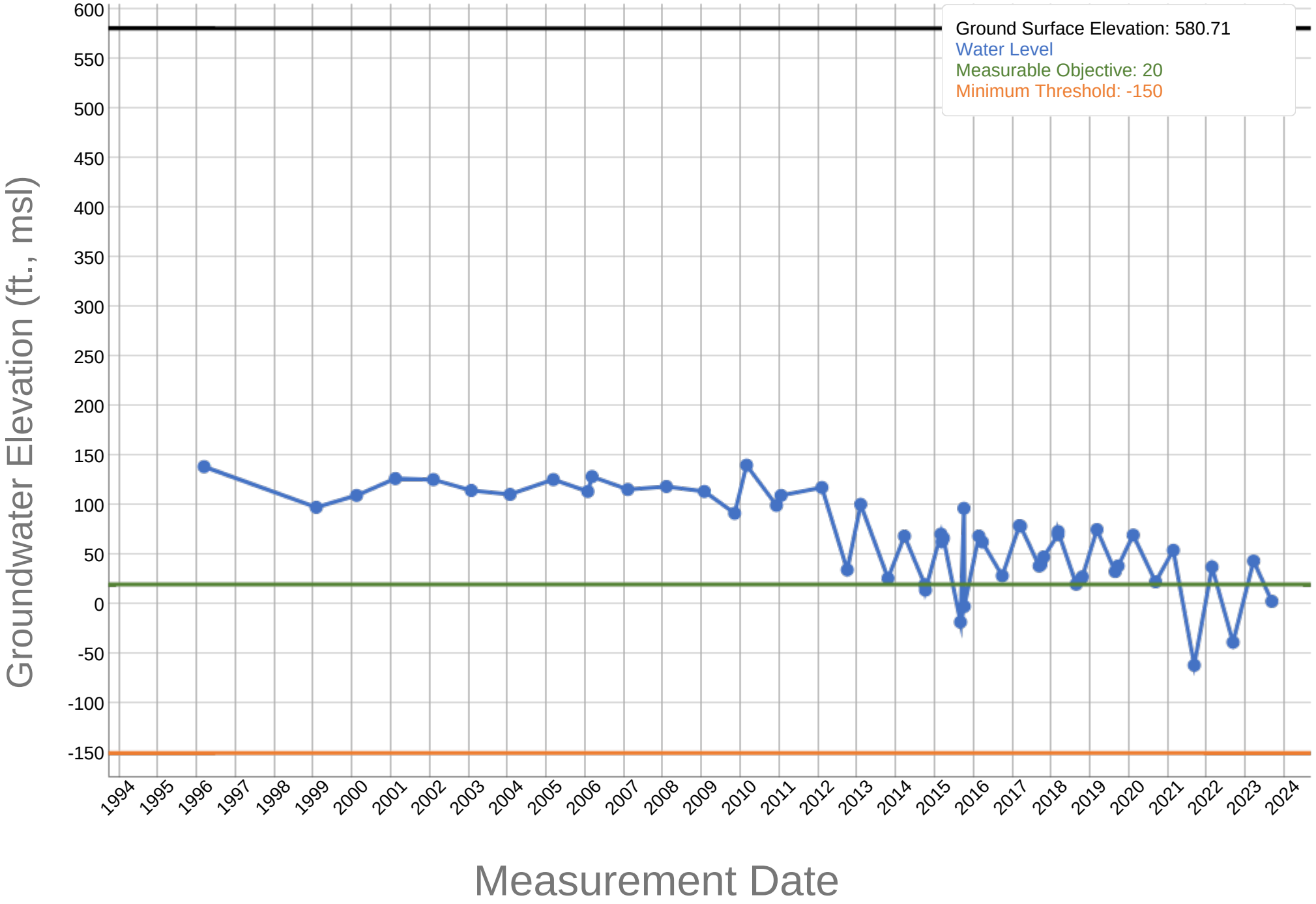


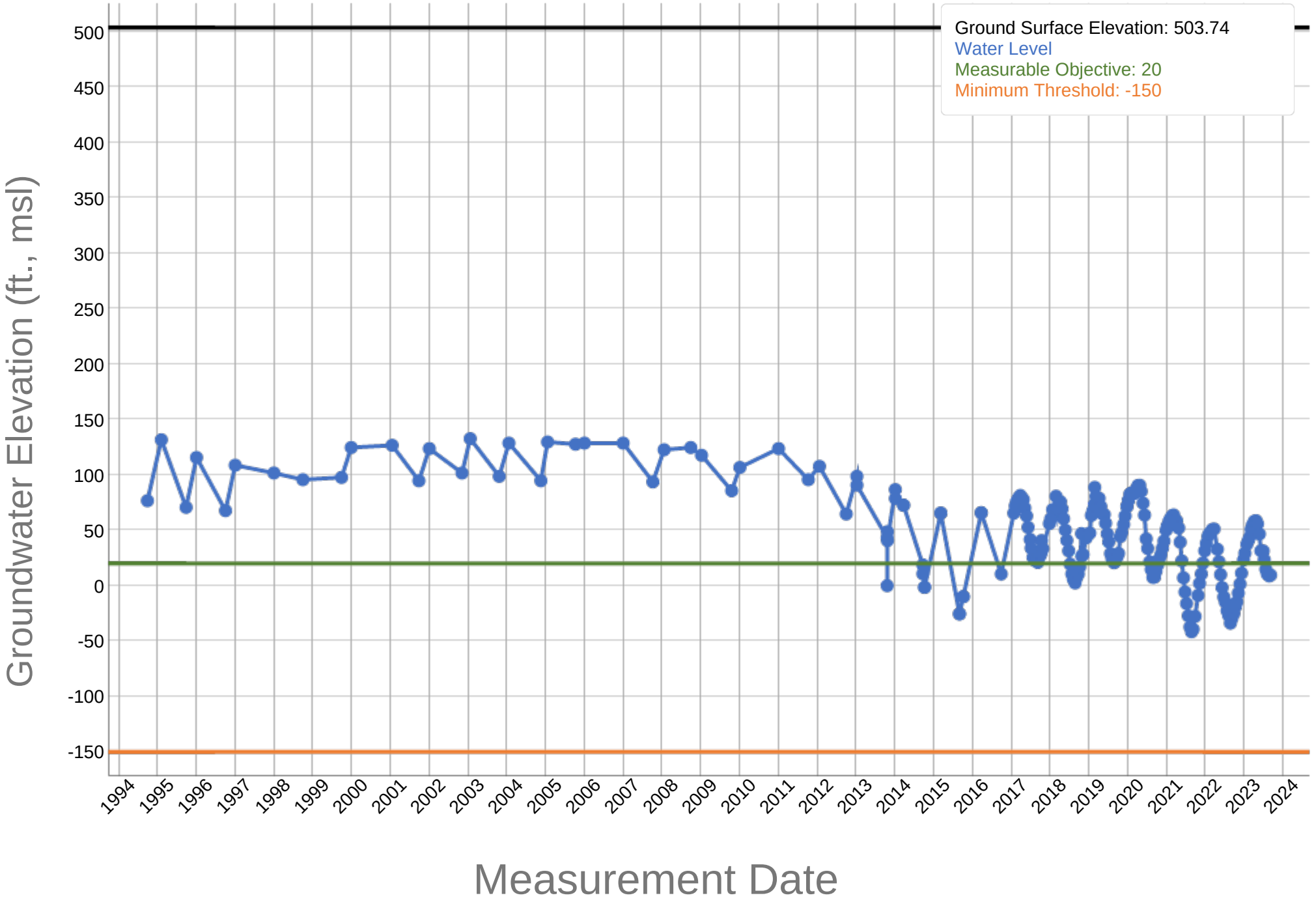
A3-20

Kern-Tulare Water District - Well 4P1 - 357781N1190720W001



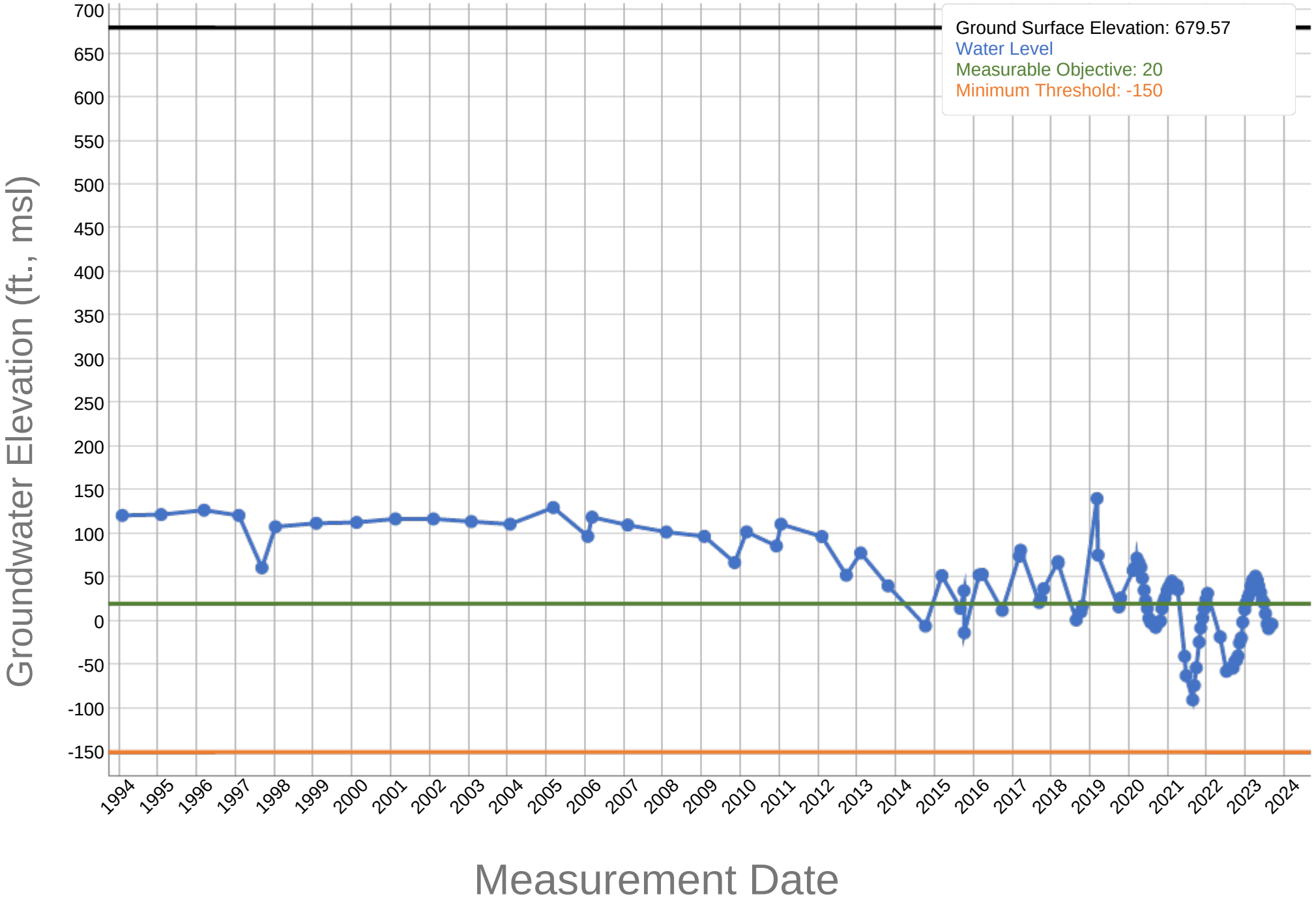
A3-21

Kern-Tulare Water District - Well 8L1 - 358561N1190806W001



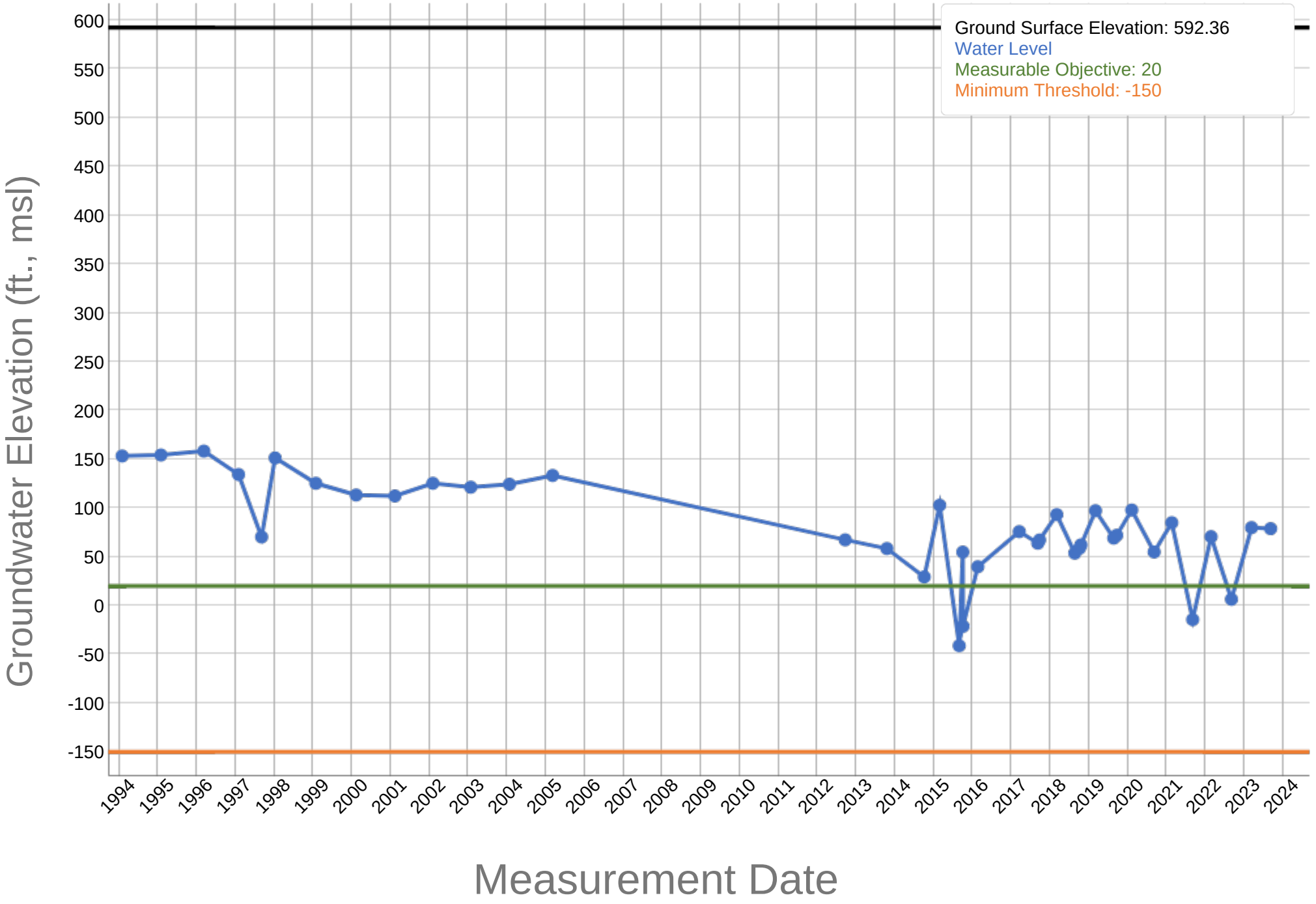
A3-22

Kern-Tulare Water District - Well 15P1 - 357503N1190578W001



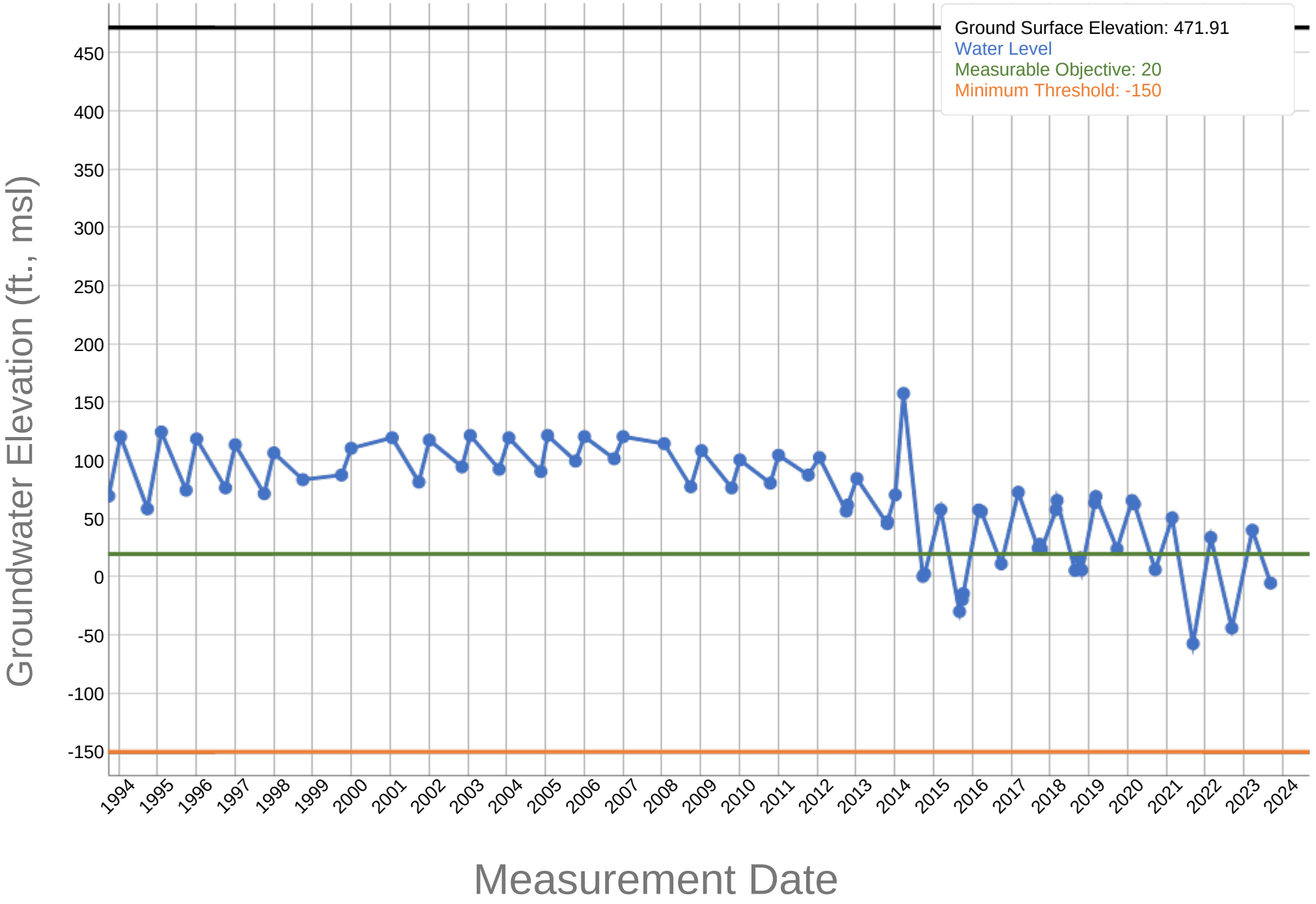
A3-23

Kern-Tulare Water District - Well 20C1 - 357464N1190898W001



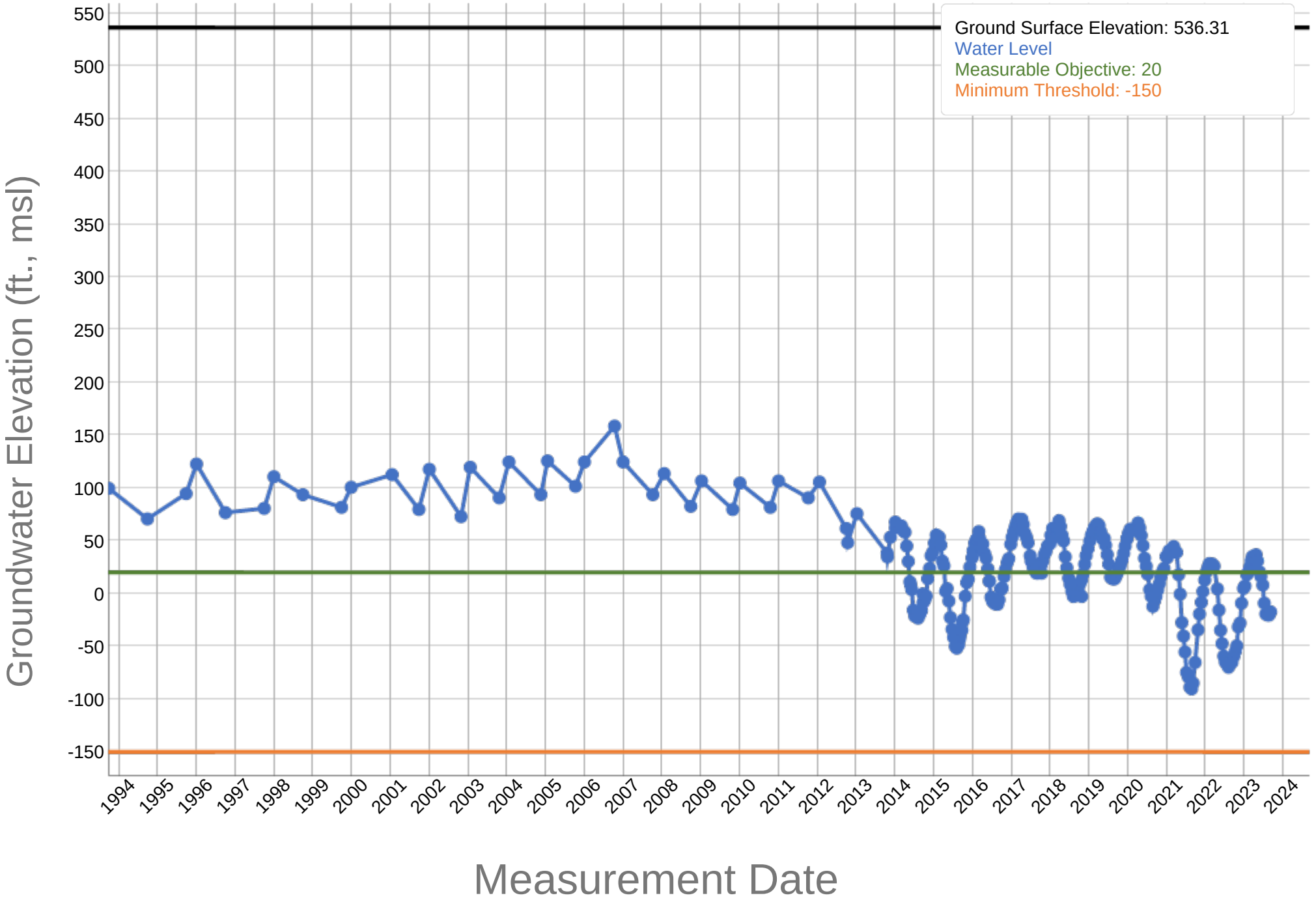
A3-24

Kern-Tulare Water District - Well 24Q1 - 358231N1191126W001



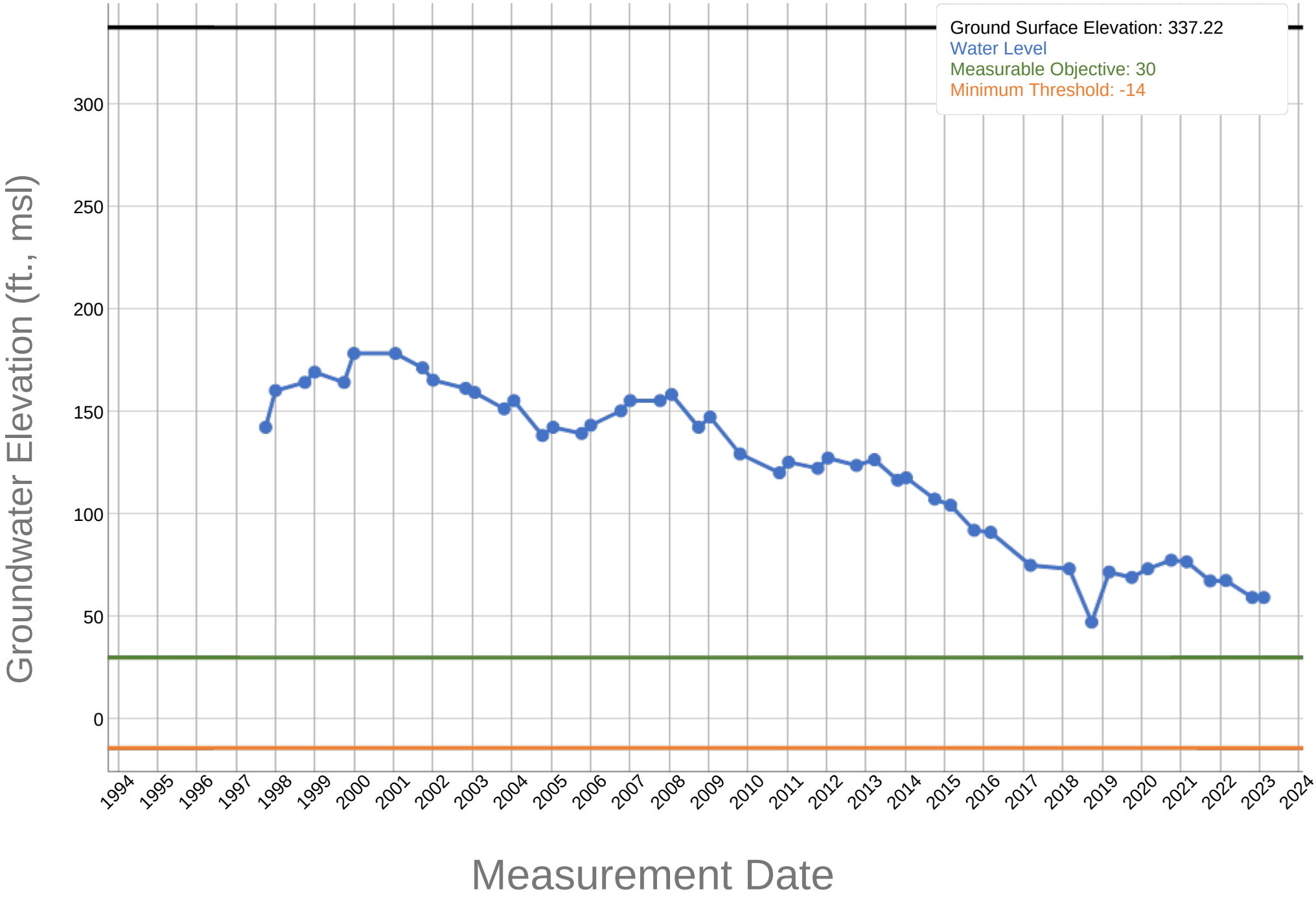
A3-25

Kern-Tulare Water District - Well 32M1 - 357944N1190845W001



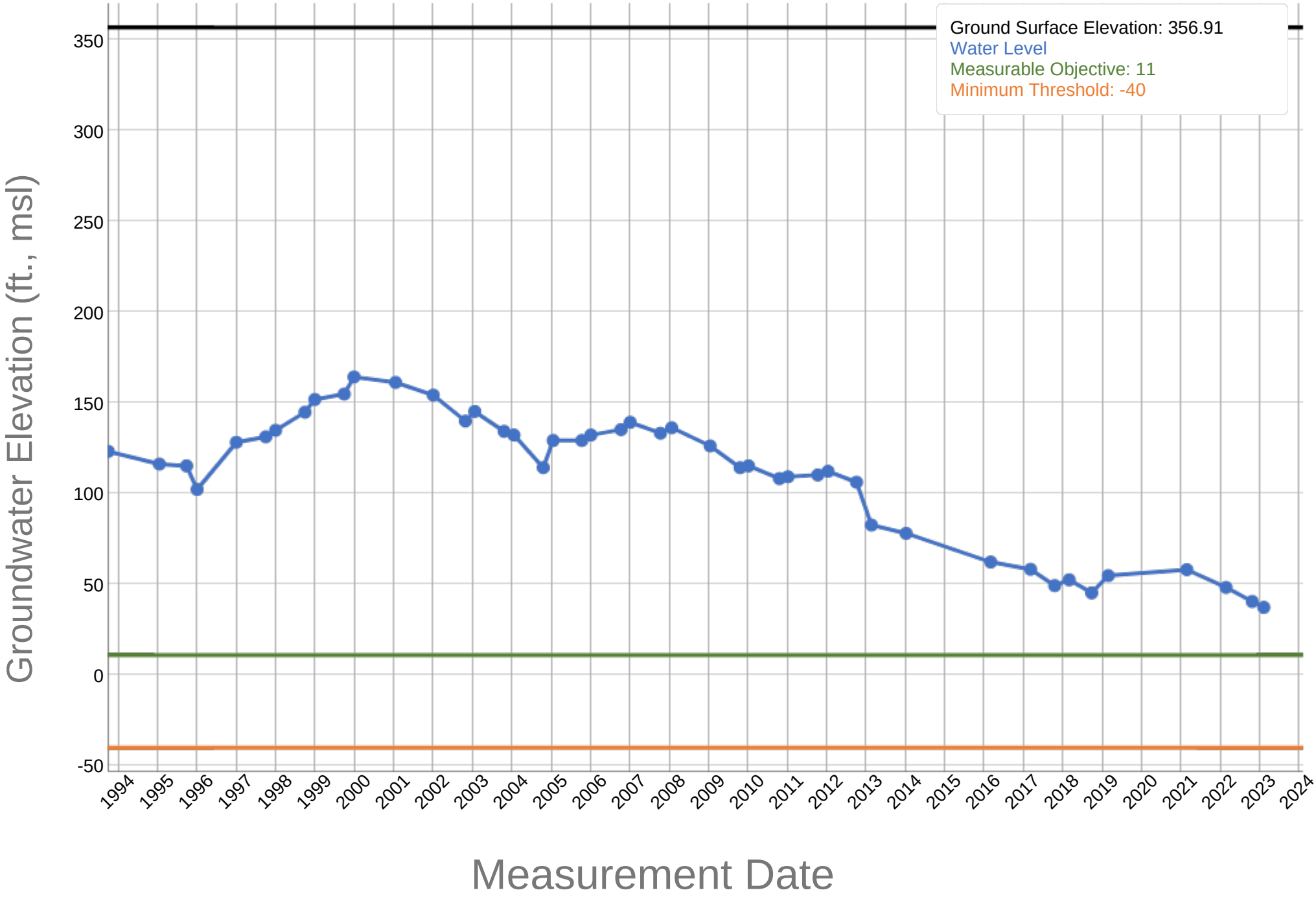
A3-26

North Kern Water Storage District GSA - DW097 - 354172N1192190W001



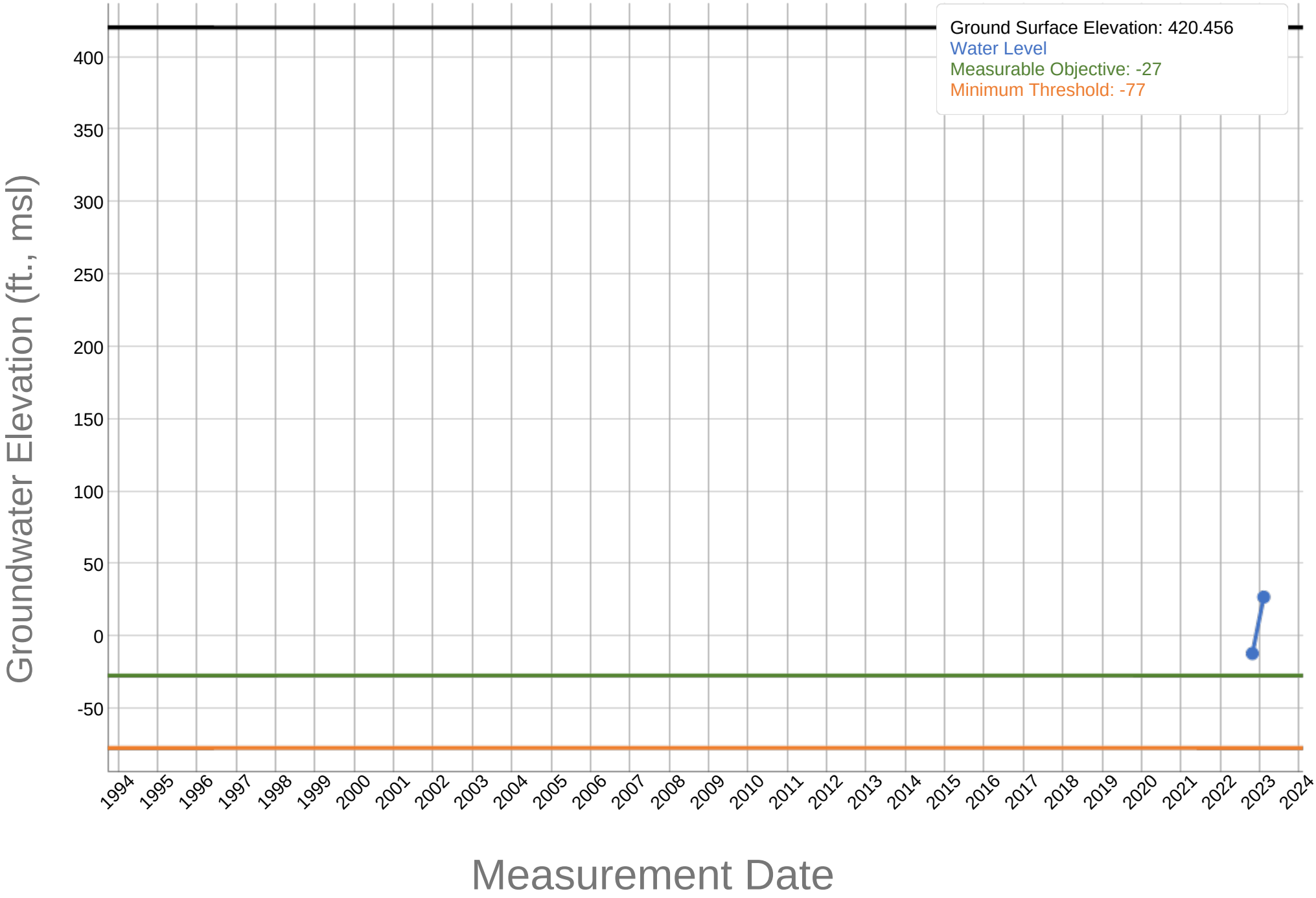
A3-27

North Kern Water Storage District GSA - 3361-62 - 354714N1192174W001



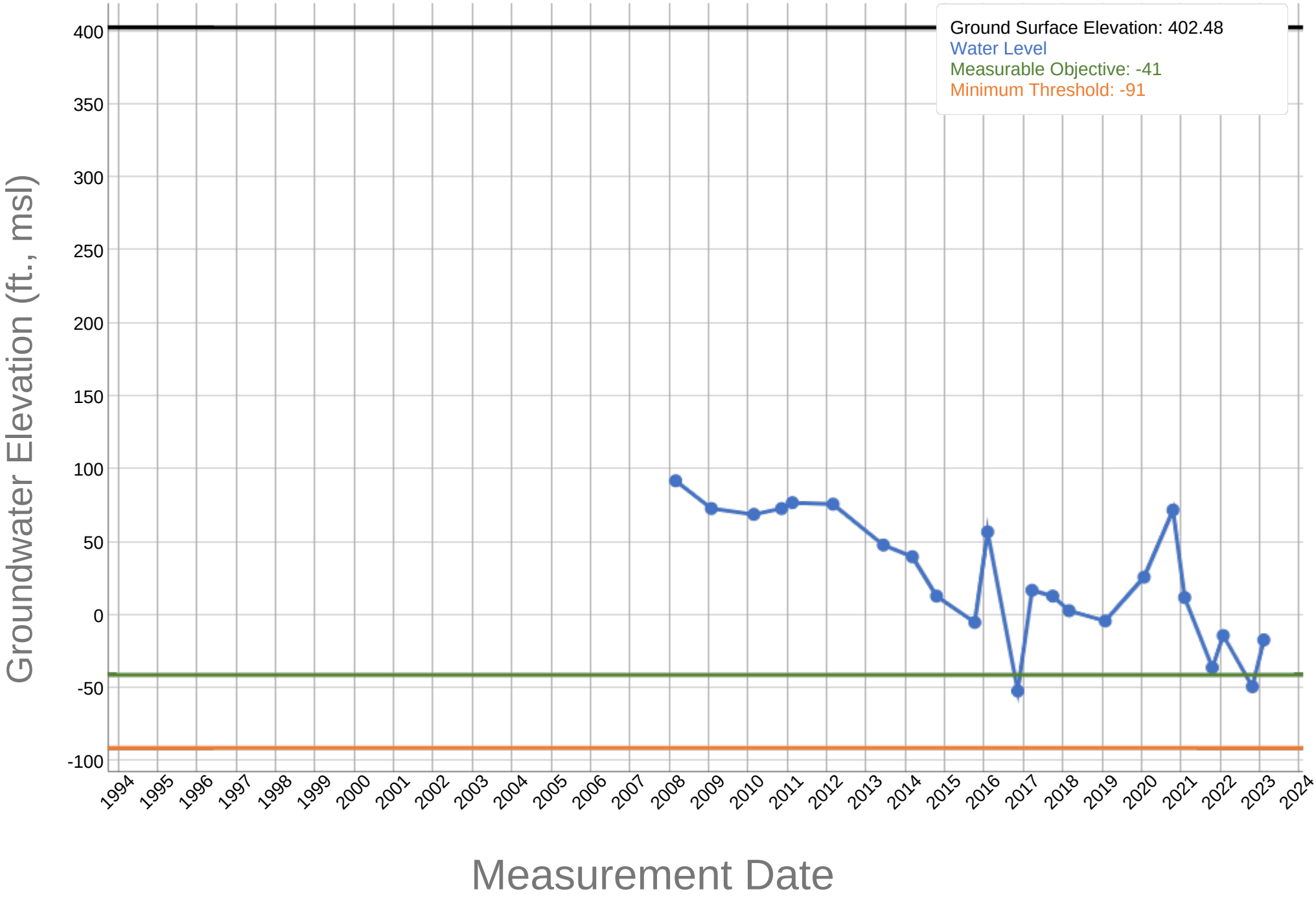
A3-28

North Kern Water Storage District GSA - 88-03-009R - 354970N1191706W001



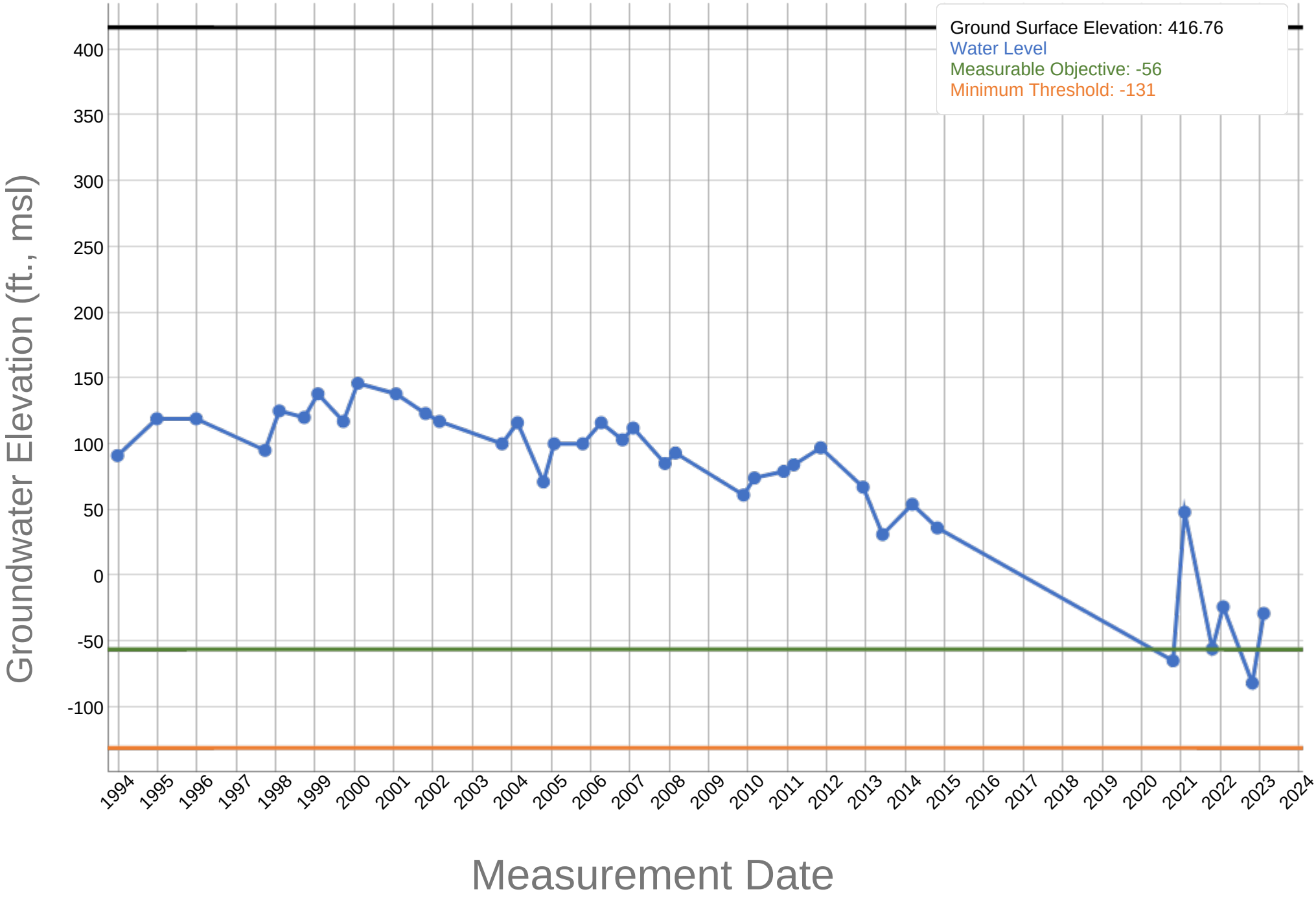
A3-29

North Kern Water Storage District GSA - 88-09-009 - 355364N1192330W001



A3-30

North Kern Water Storage District GSA - 88-21-005 - 355878N1192269W001



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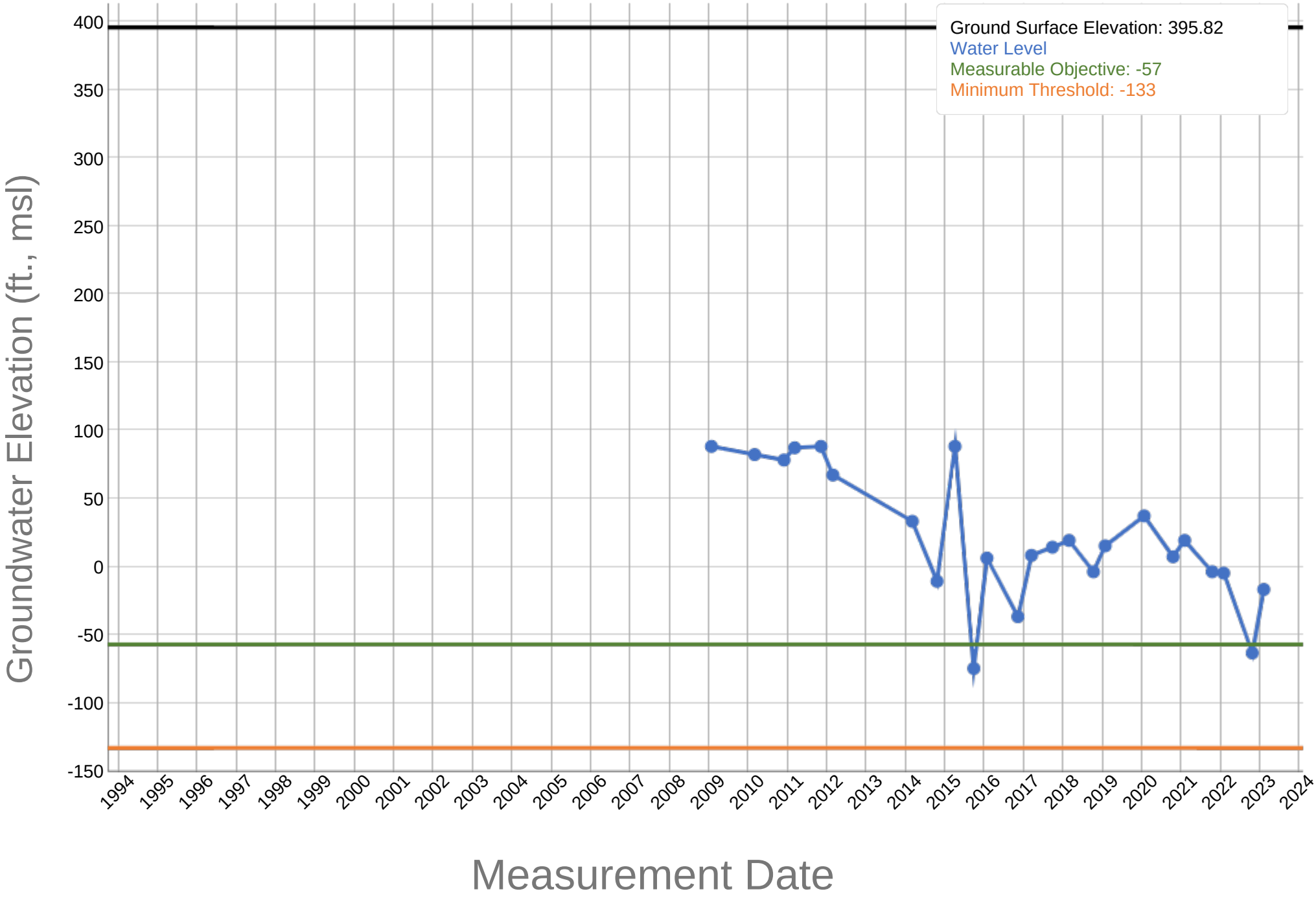
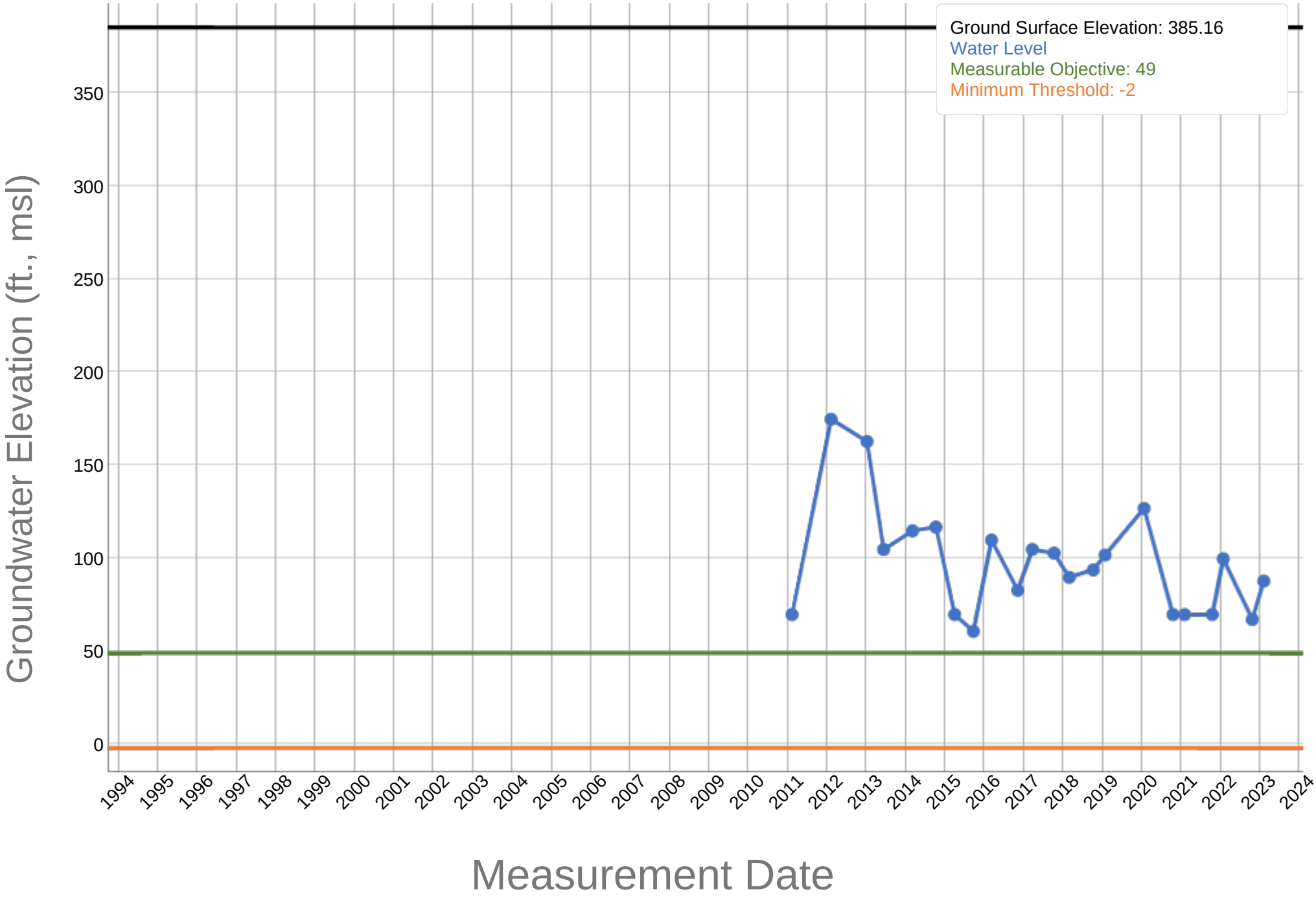
North Kern Water Storage District GSA - 88-29-014 - 356232N1192245W001



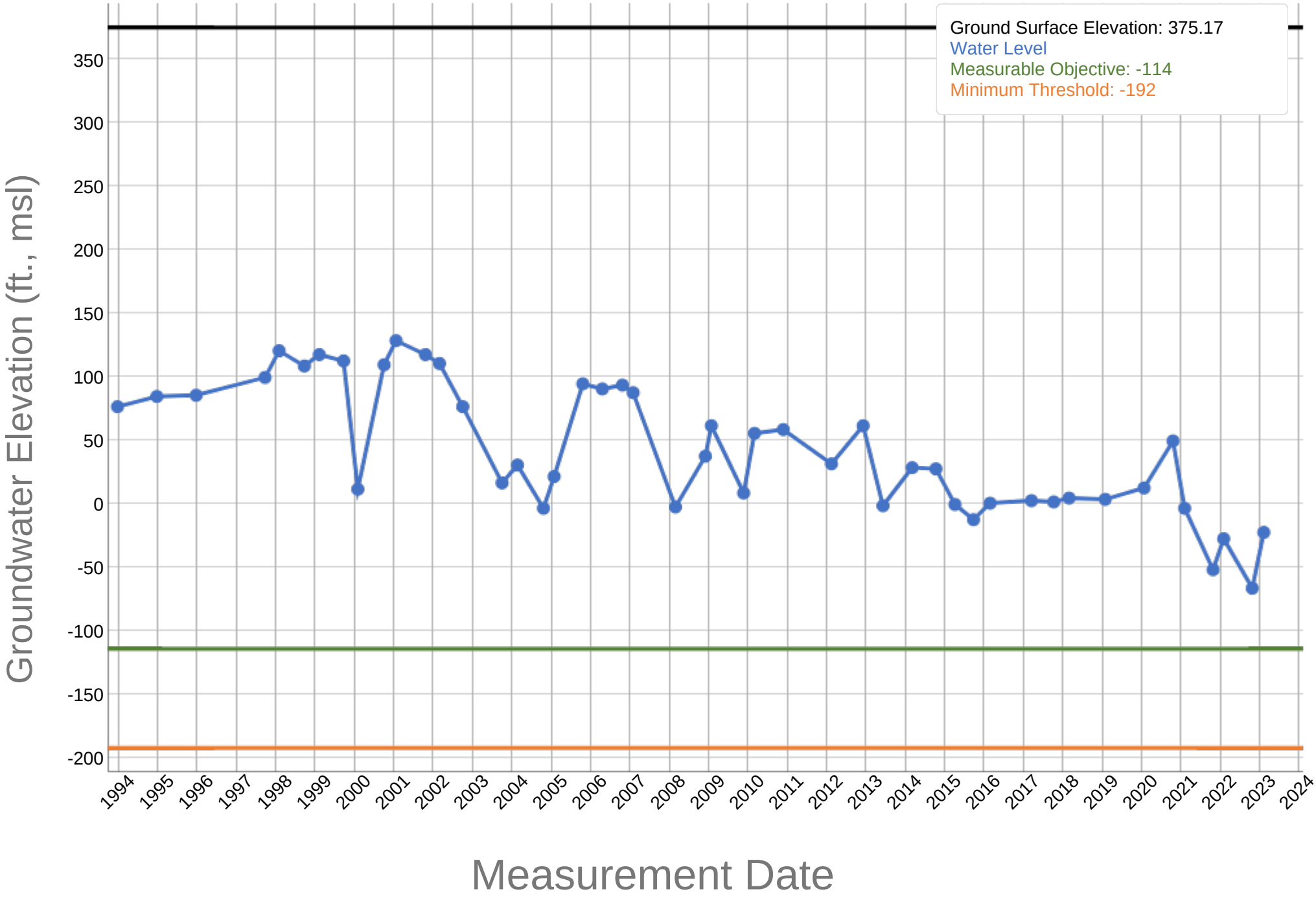
A3-32

North Kern Water Storage District GSA - 99-00-003 - 354424N1191332W001



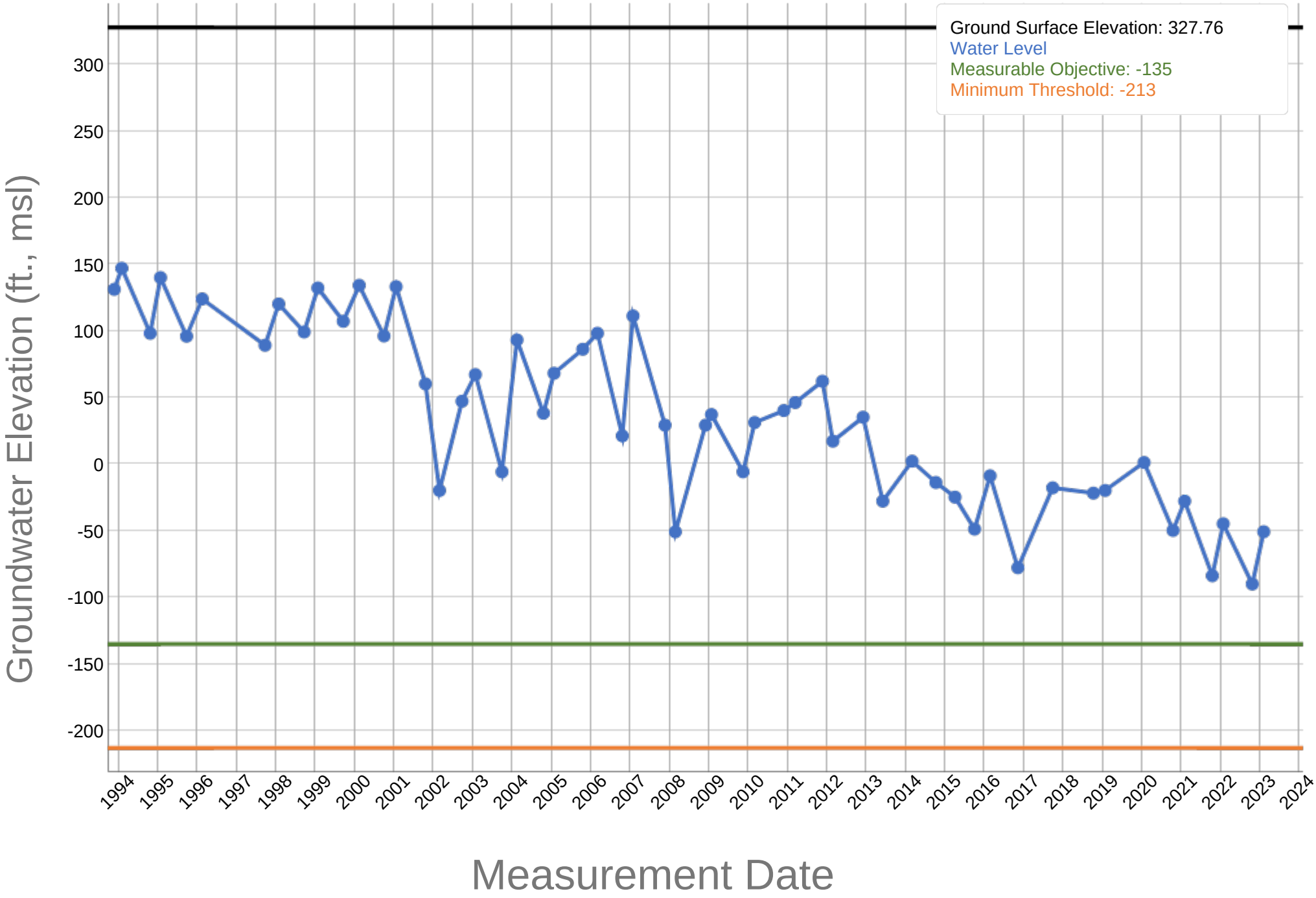
A3-33

North Kern Water Storage District GSA - 99-00-081 - 355764N1192818W001



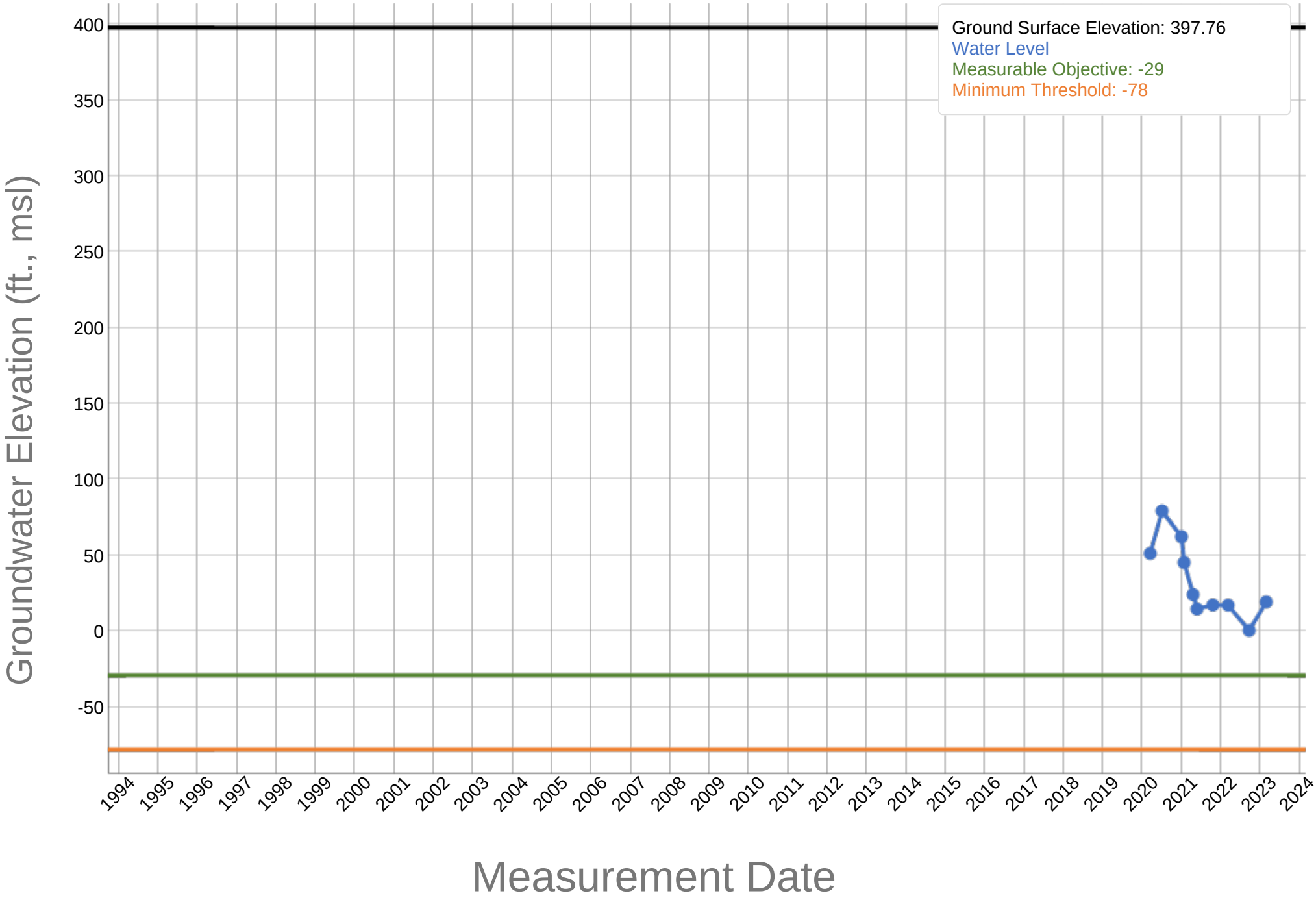
A3-34

North Kern Water Storage District GSA - 99-22-084 - 356380N1193124W001



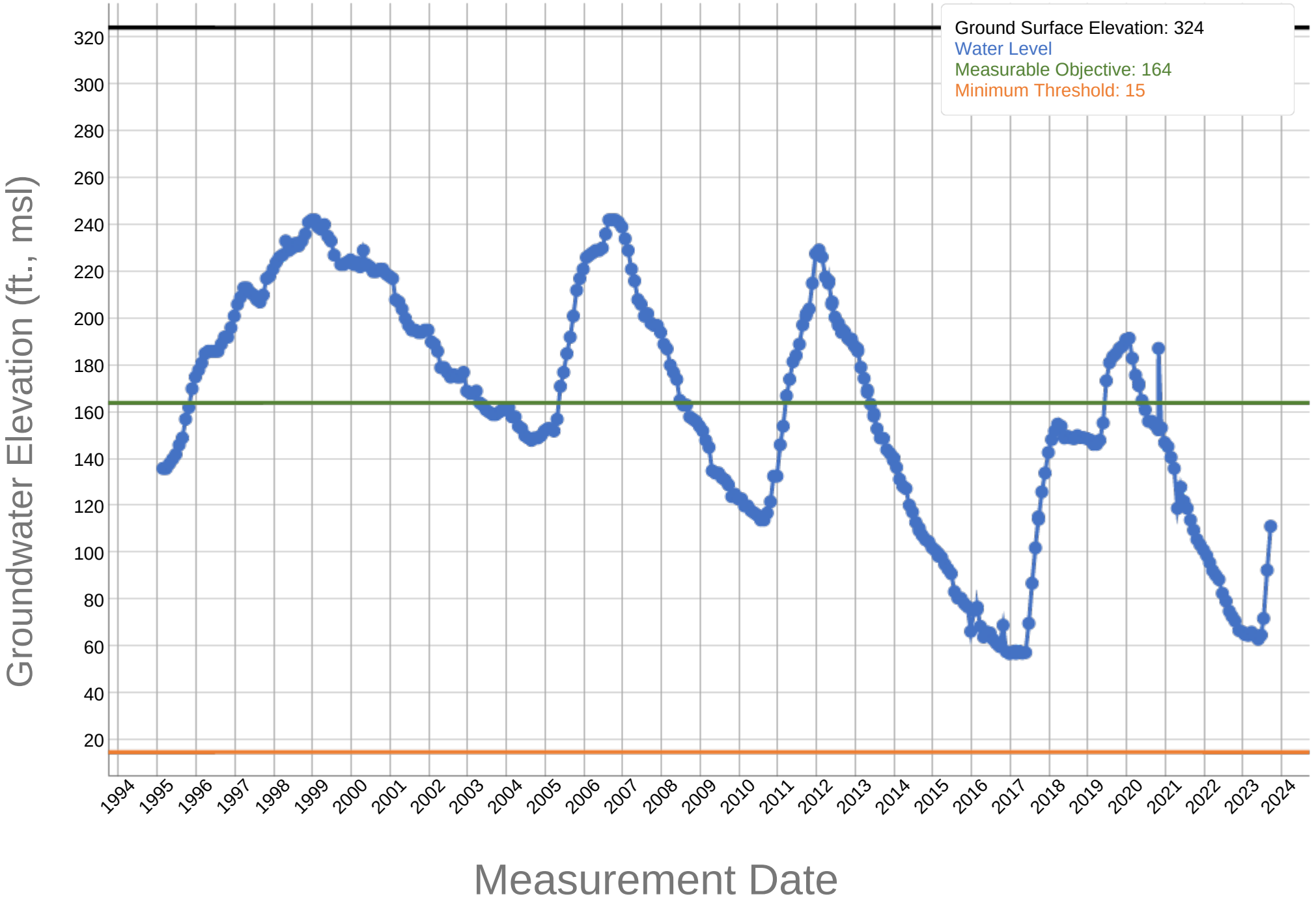
A3-35

North Kern Water Storage District GSA - Shafter Well 18 - 355010N1192067W001



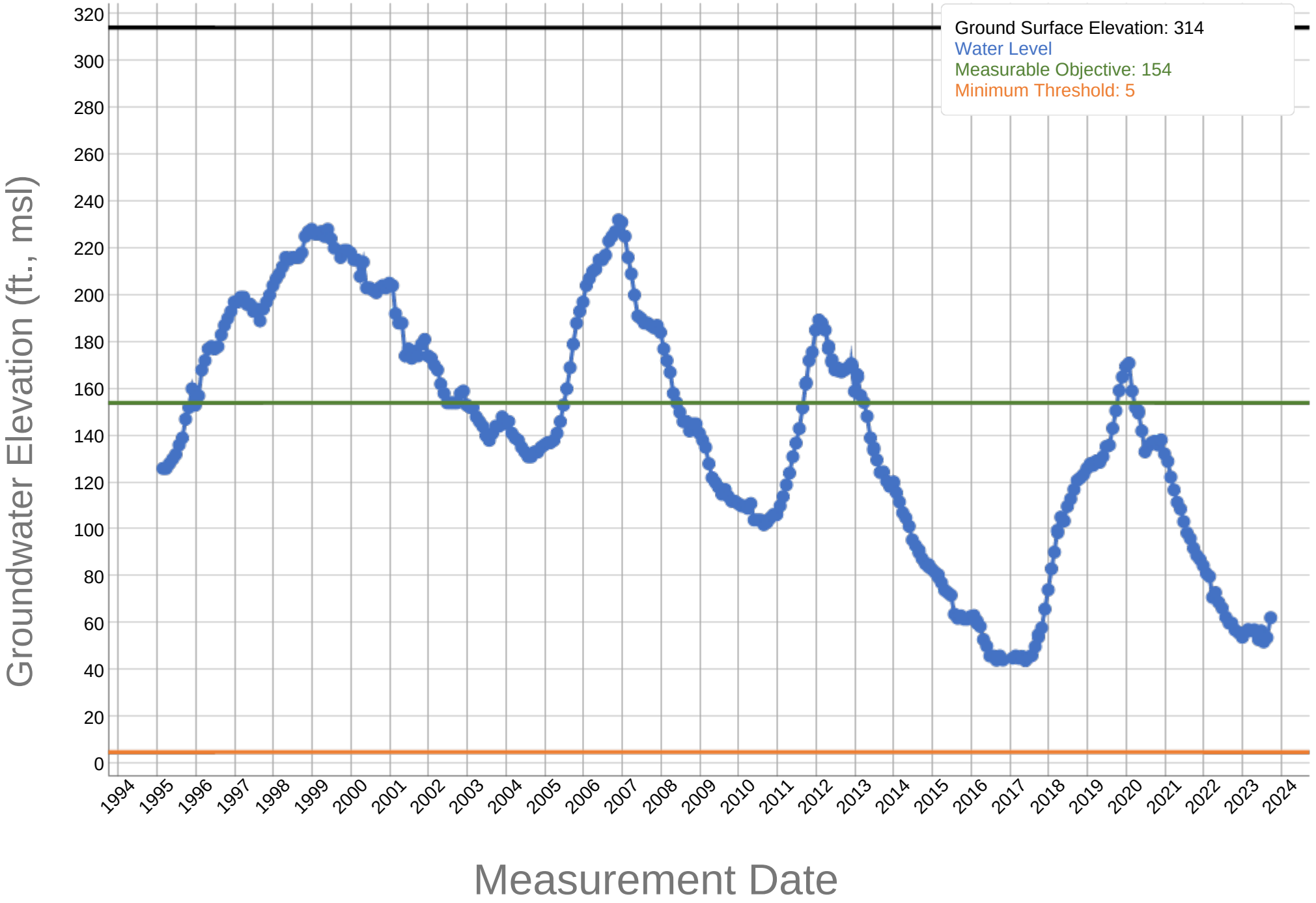
A3-36

Rosedale-Rio Bravo Water Storage District - 25M Enos - 353760N1192498W002



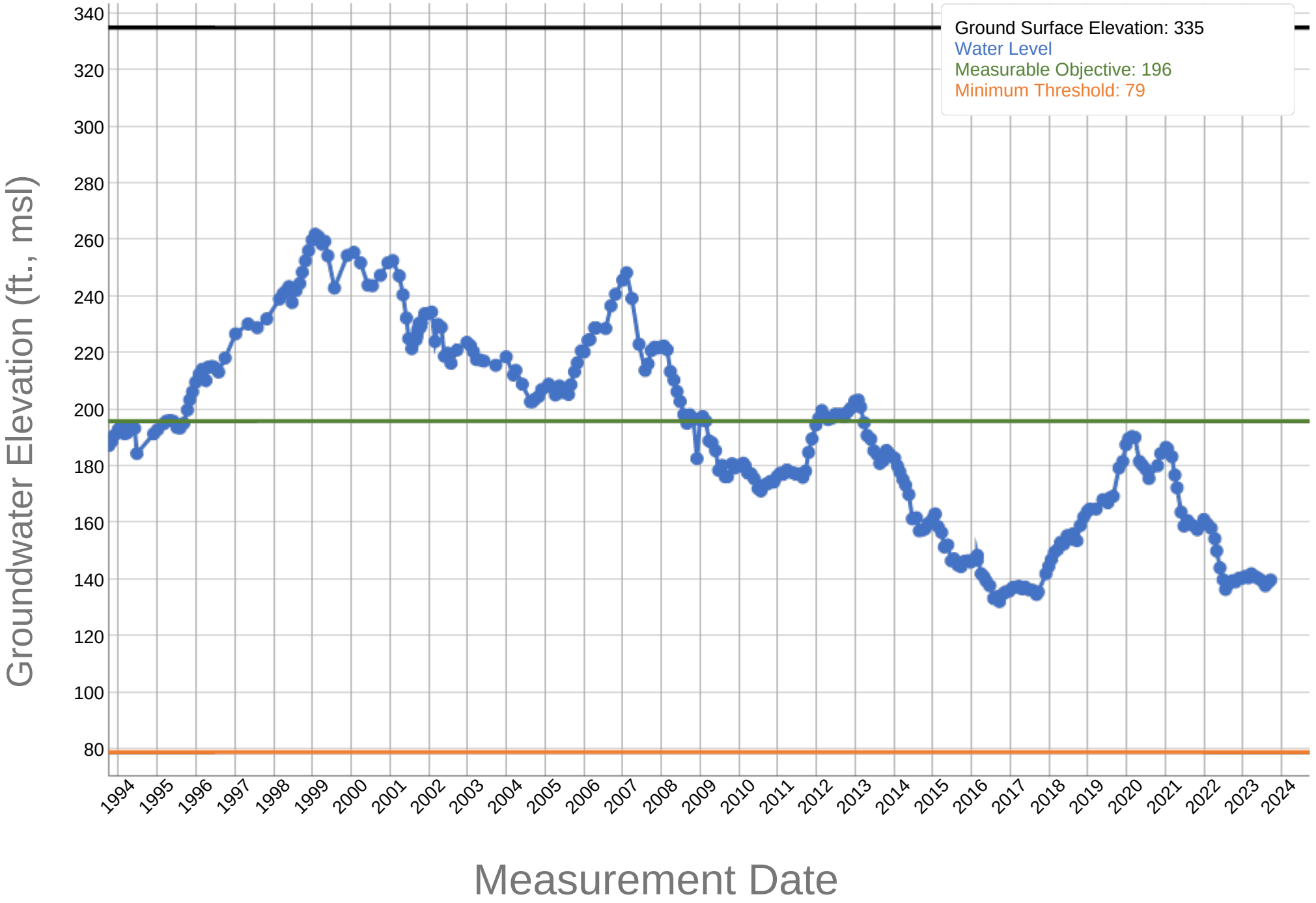
A3-37

Rosedale-Rio Bravo Water Storage District - 27N Mayer - 353699N1192856W002



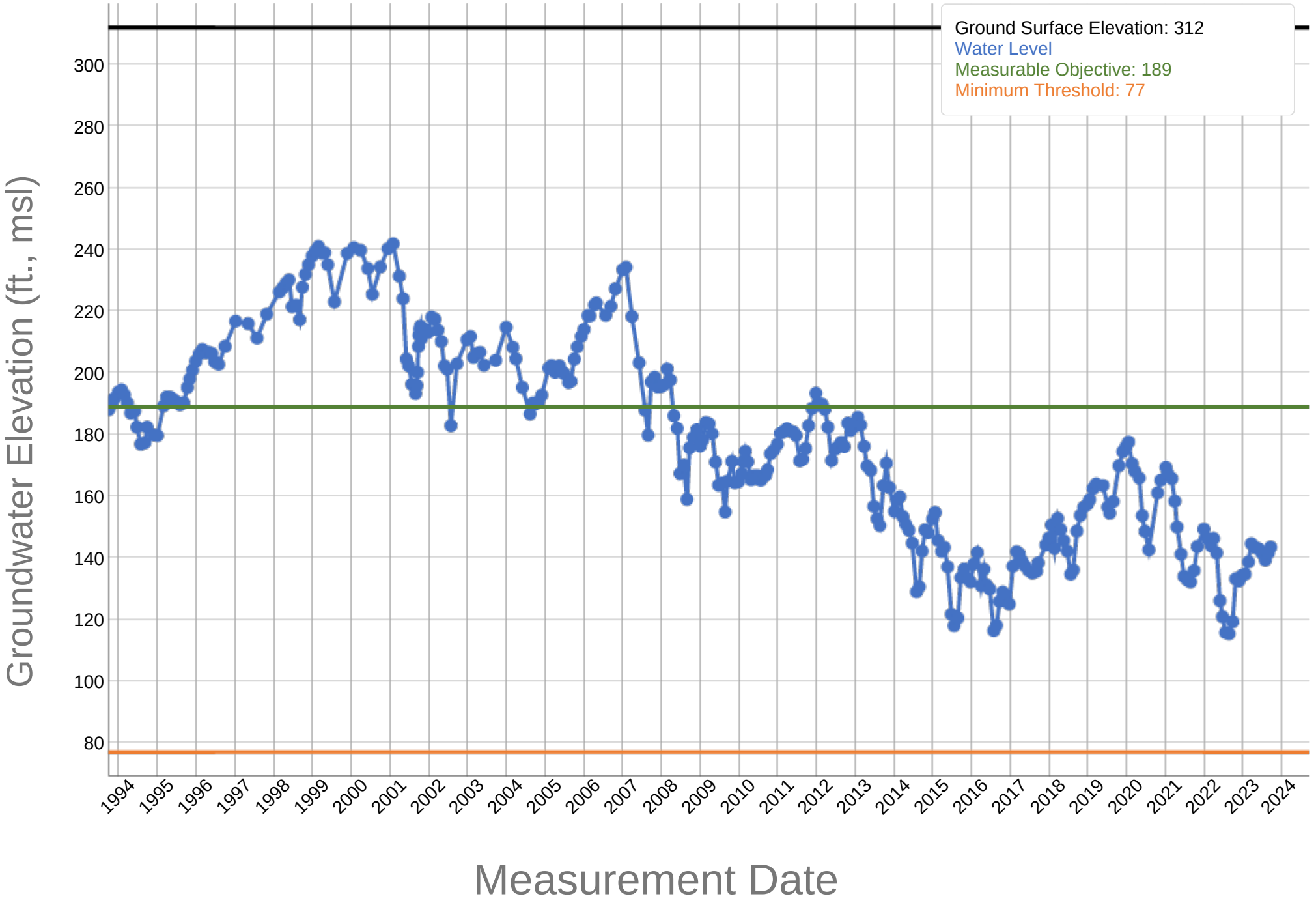
A3-38

Rosedale-Rio Bravo Water Storage District - 28J Triple - 352889N1191814W001



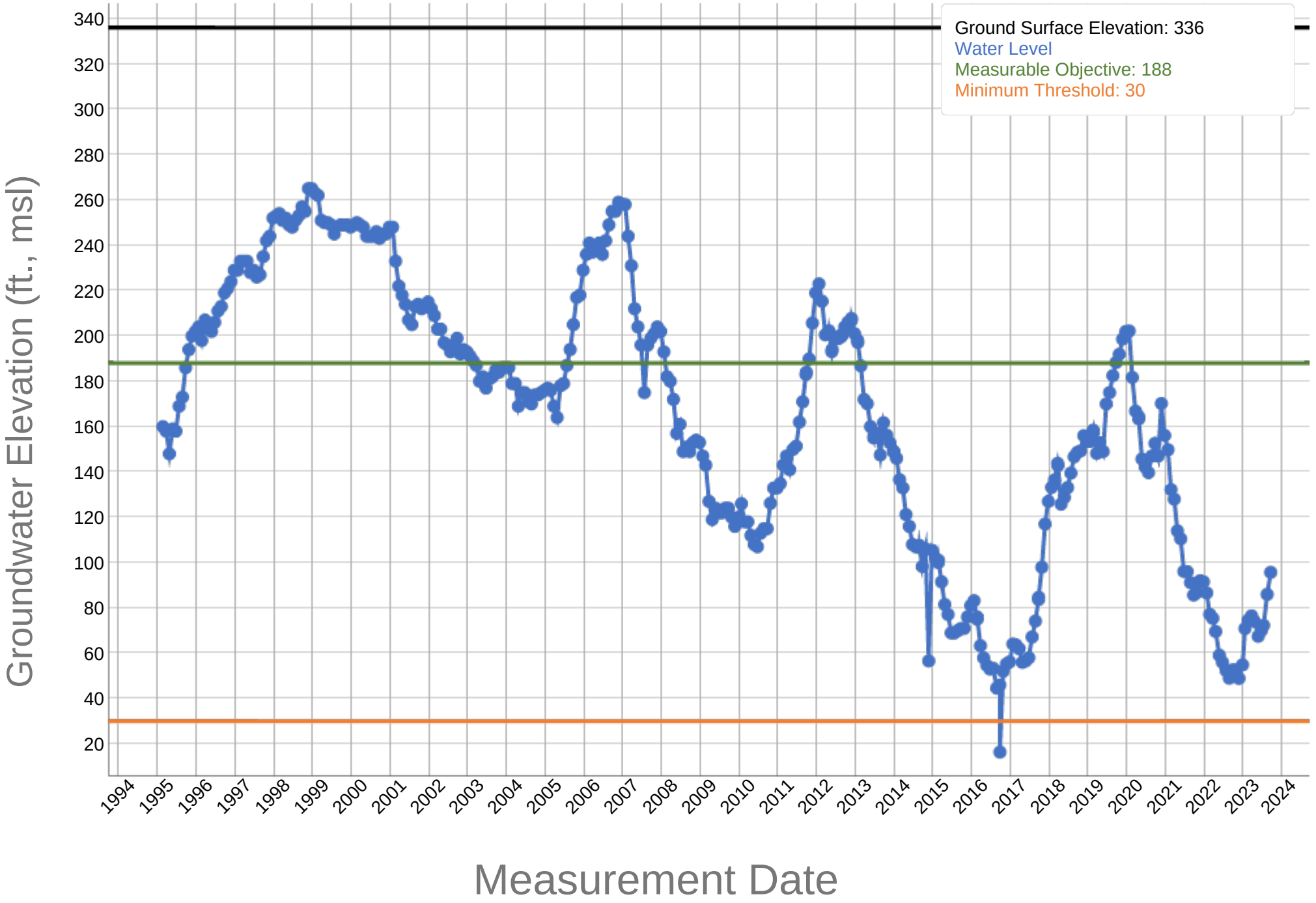
A3-39

Rosedale-Rio Bravo Water Storage District - 32N Triple - 352673N1192138W002



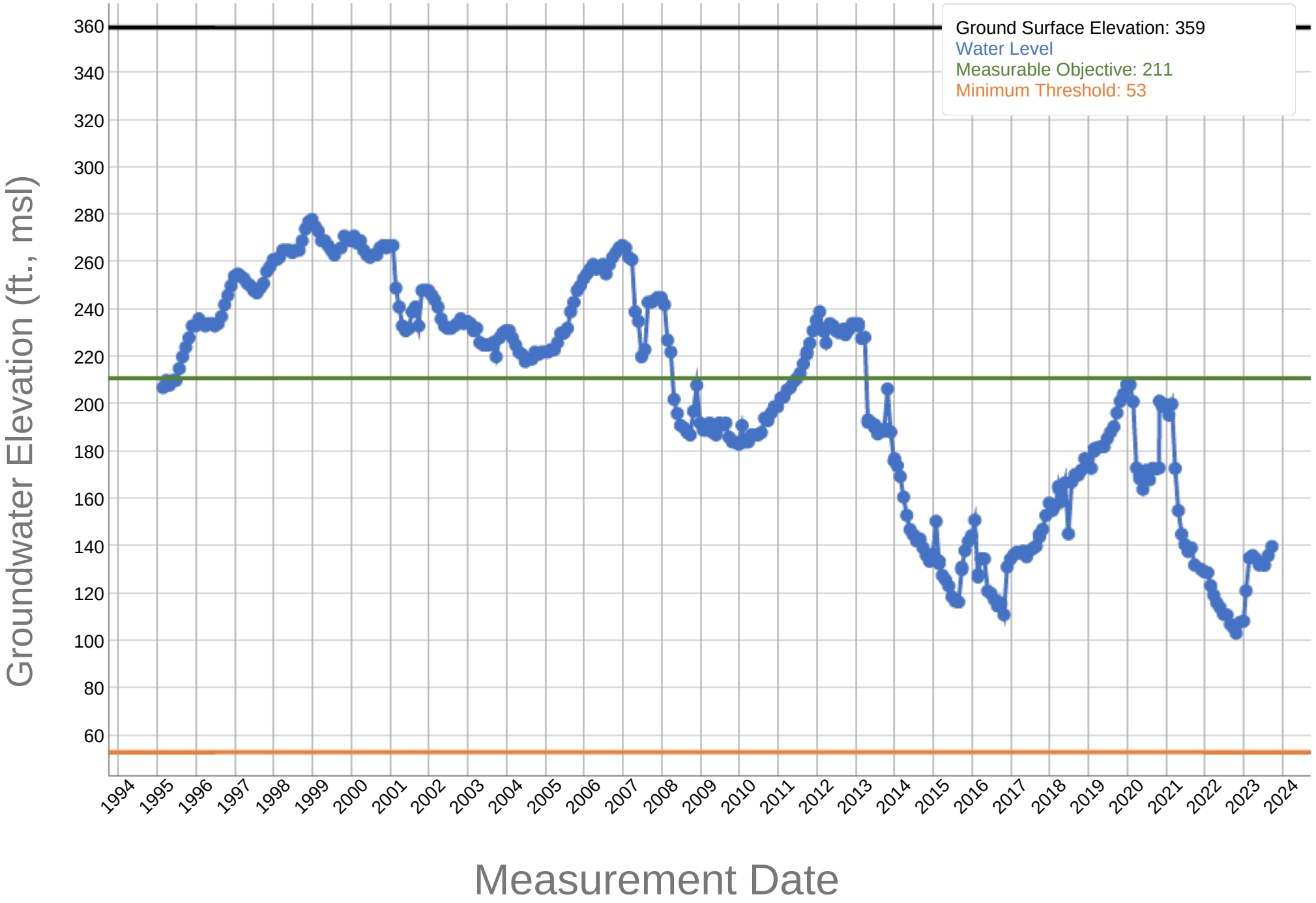
A3-40

Rosedale-Rio Bravo Water Storage District - 31H Greeley - 353618N1192169W001



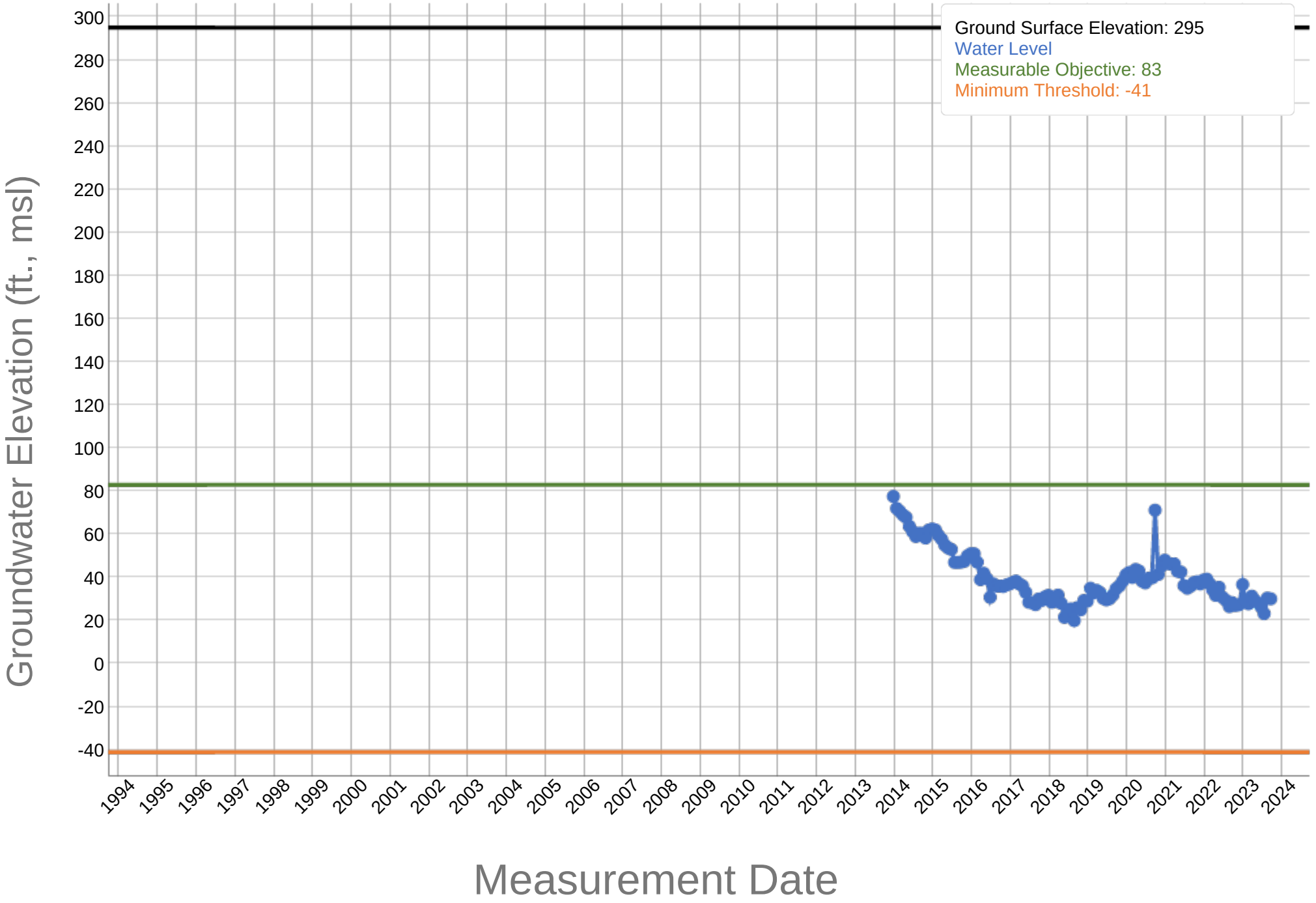
A3-41

Rosedale-Rio Bravo Water Storage District - 35H RRBWSD Shop - 353620N1191457W002



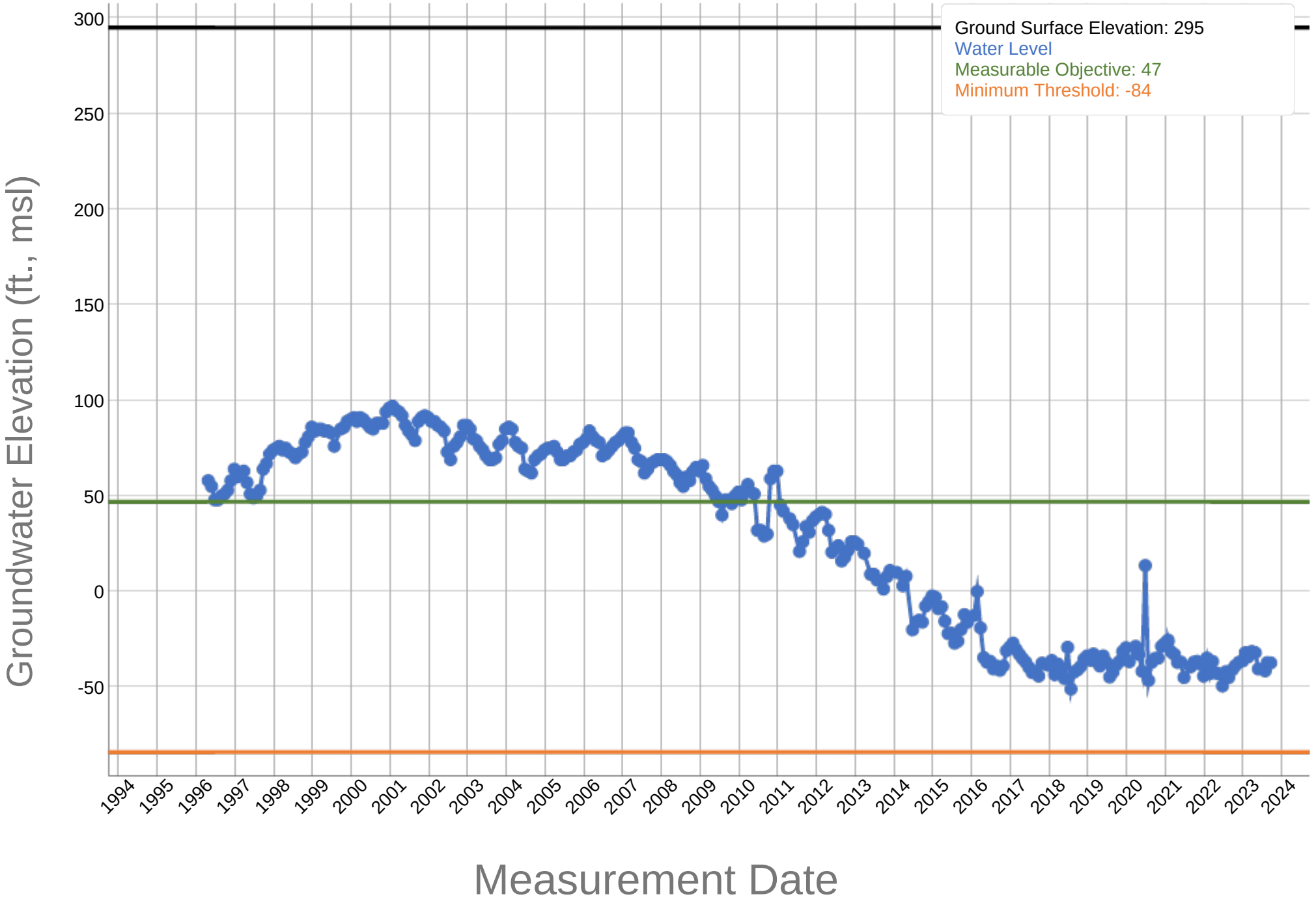
A3-42

Rosedale-Rio Bravo Water Storage District - Blacco HQ - 353915N1193454W001



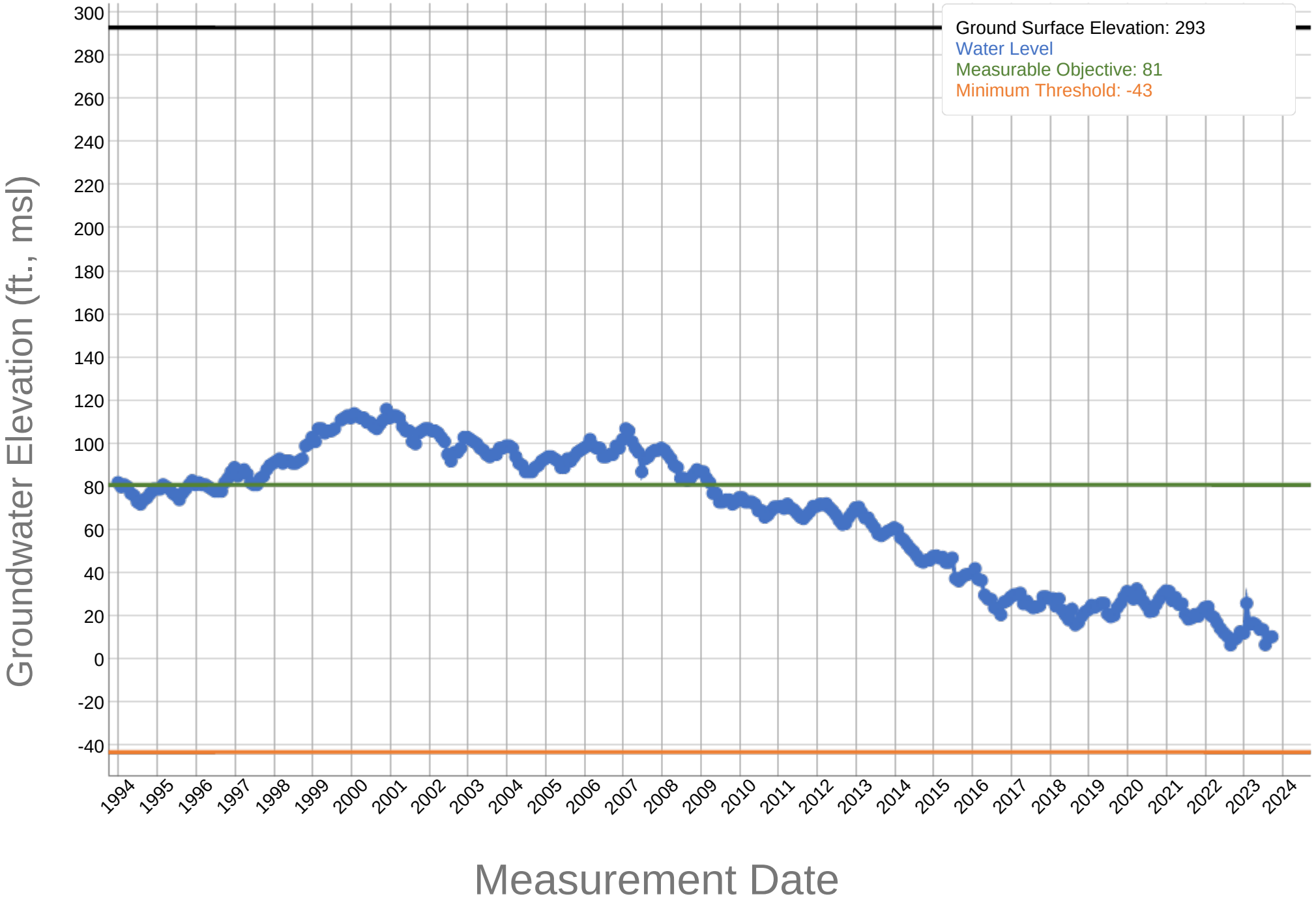
A3-43

Rosedale-Rio Bravo Water Storage District - Bushnell - 354350N1193586W001



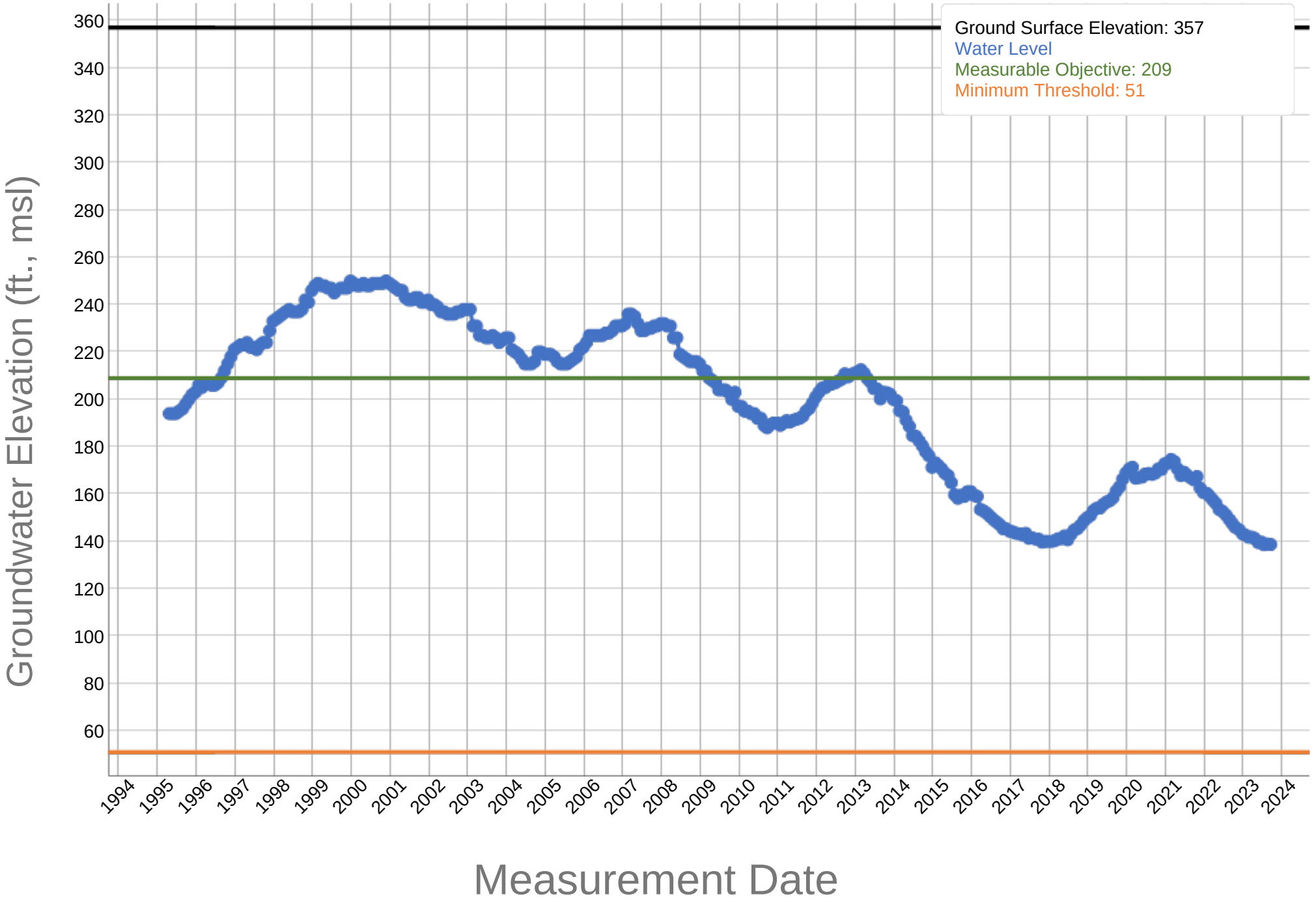
A3-44

Rosedale-Rio Bravo Water Storage District - Cauzza - 353986N1193948W001



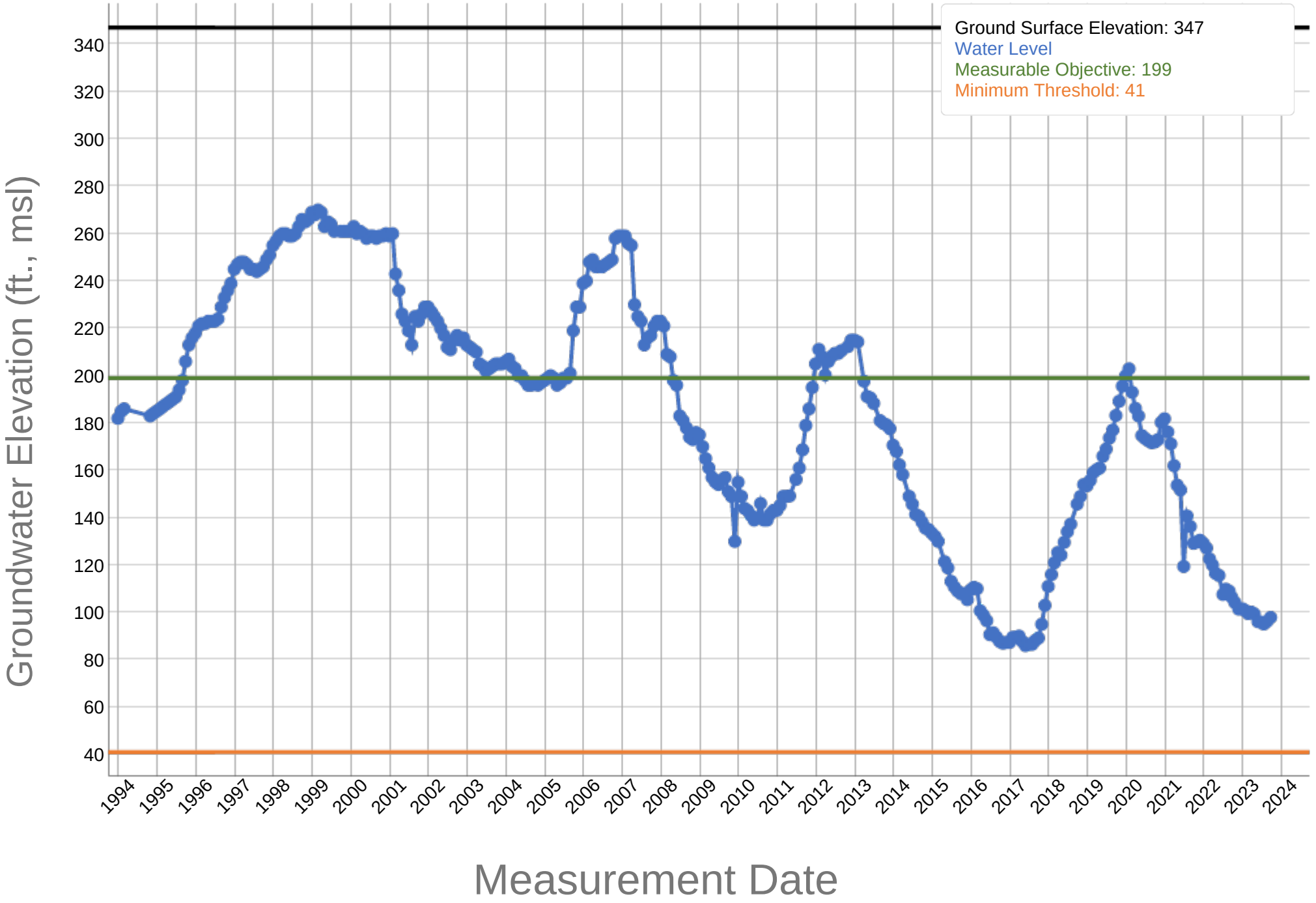
A3-45

Rosedale-Rio Bravo Water Storage District - Chet Reed - 353890N1191471W001



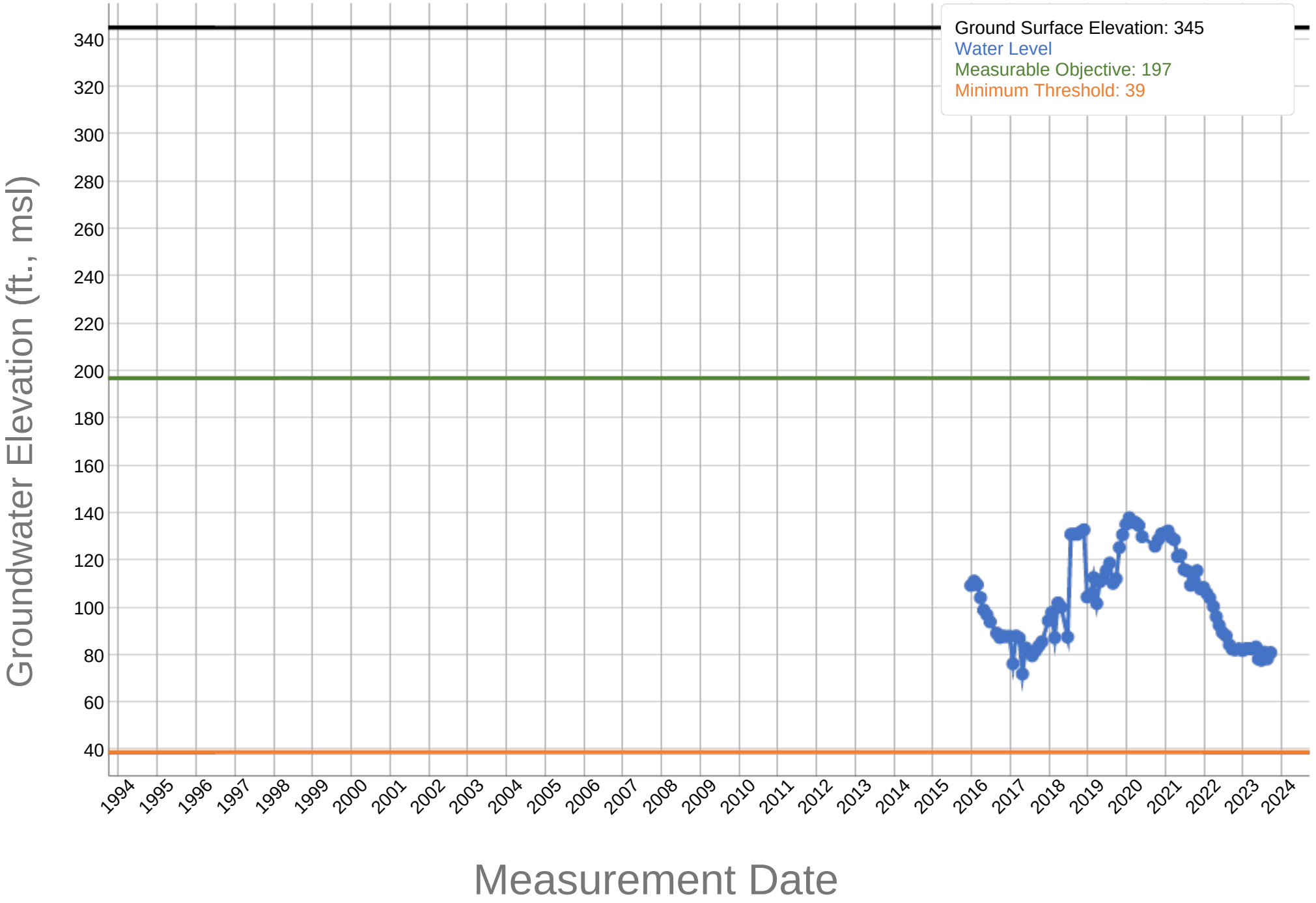
A3-46

Rosedale-Rio Bravo Water Storage District - Harvest Ranch - 353634N1191766W001



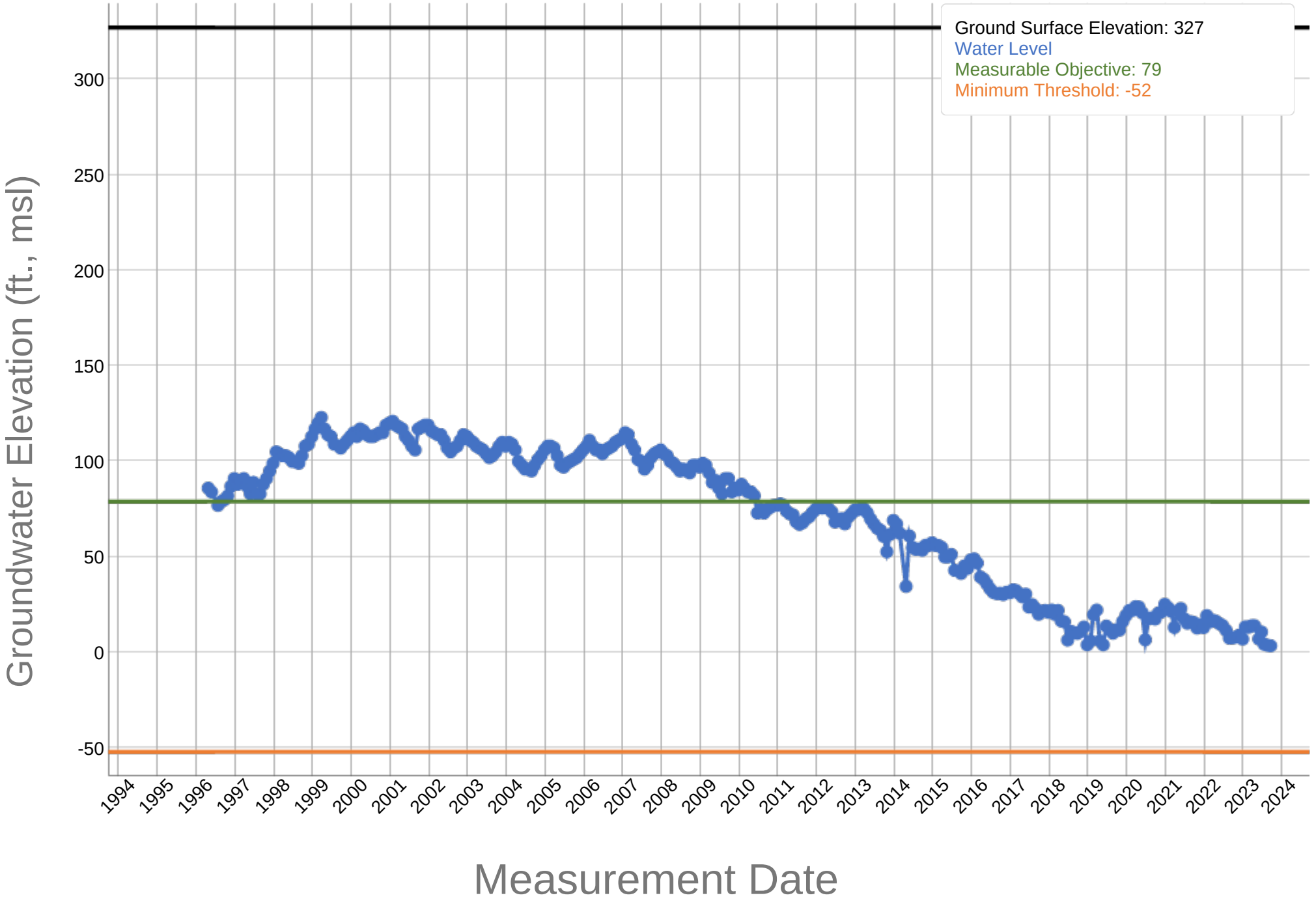
A3-47

Rosedale-Rio Bravo Water Storage District - Home Place - 353824N1192035W001



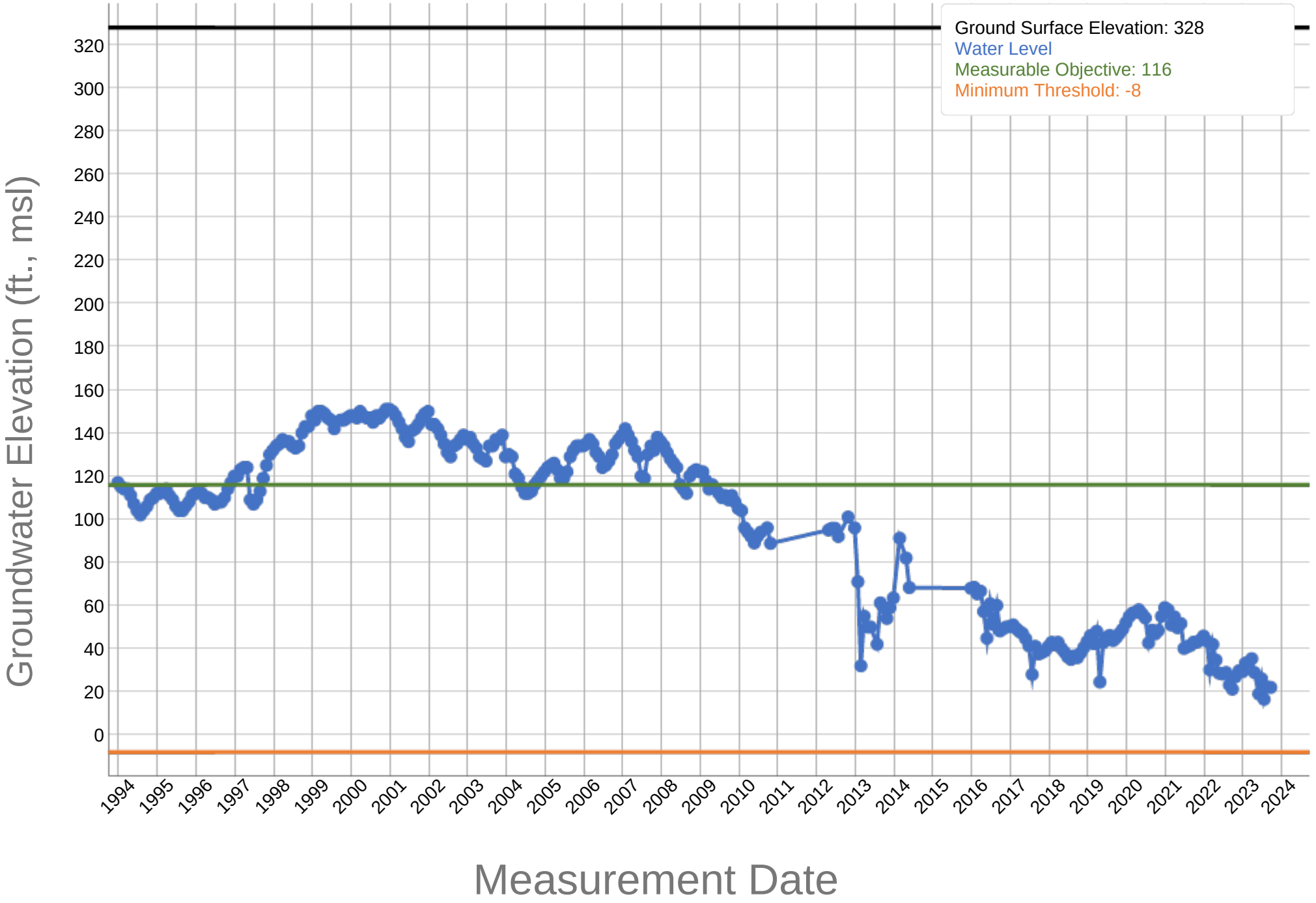
A3-48

Rosedale-Rio Bravo Water Storage District - L.R. Stout - 354309N1192859W001



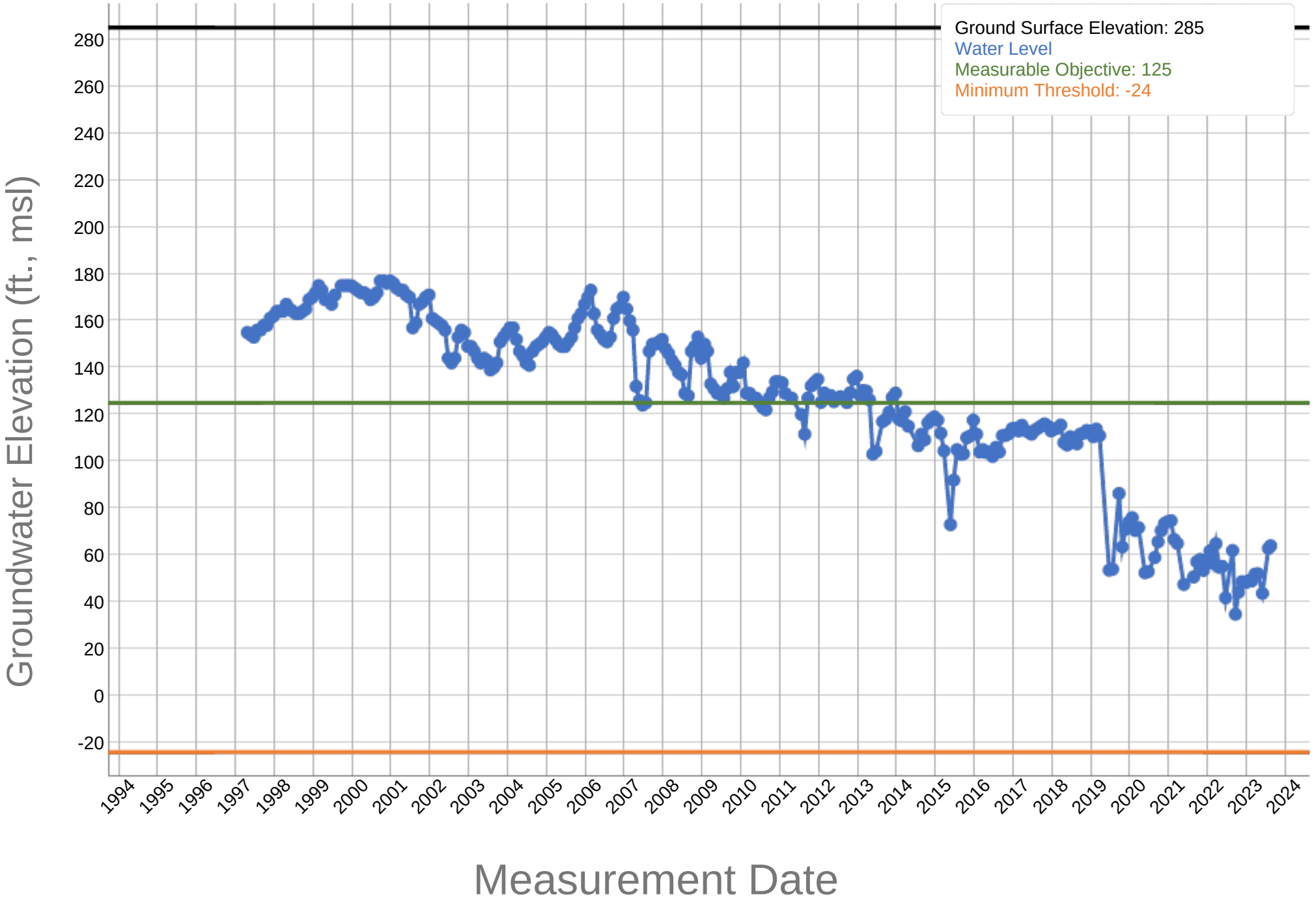
A3-49

Rosedale-Rio Bravo Water Storage District - P. Enns Domestic - 354121N1192623W001



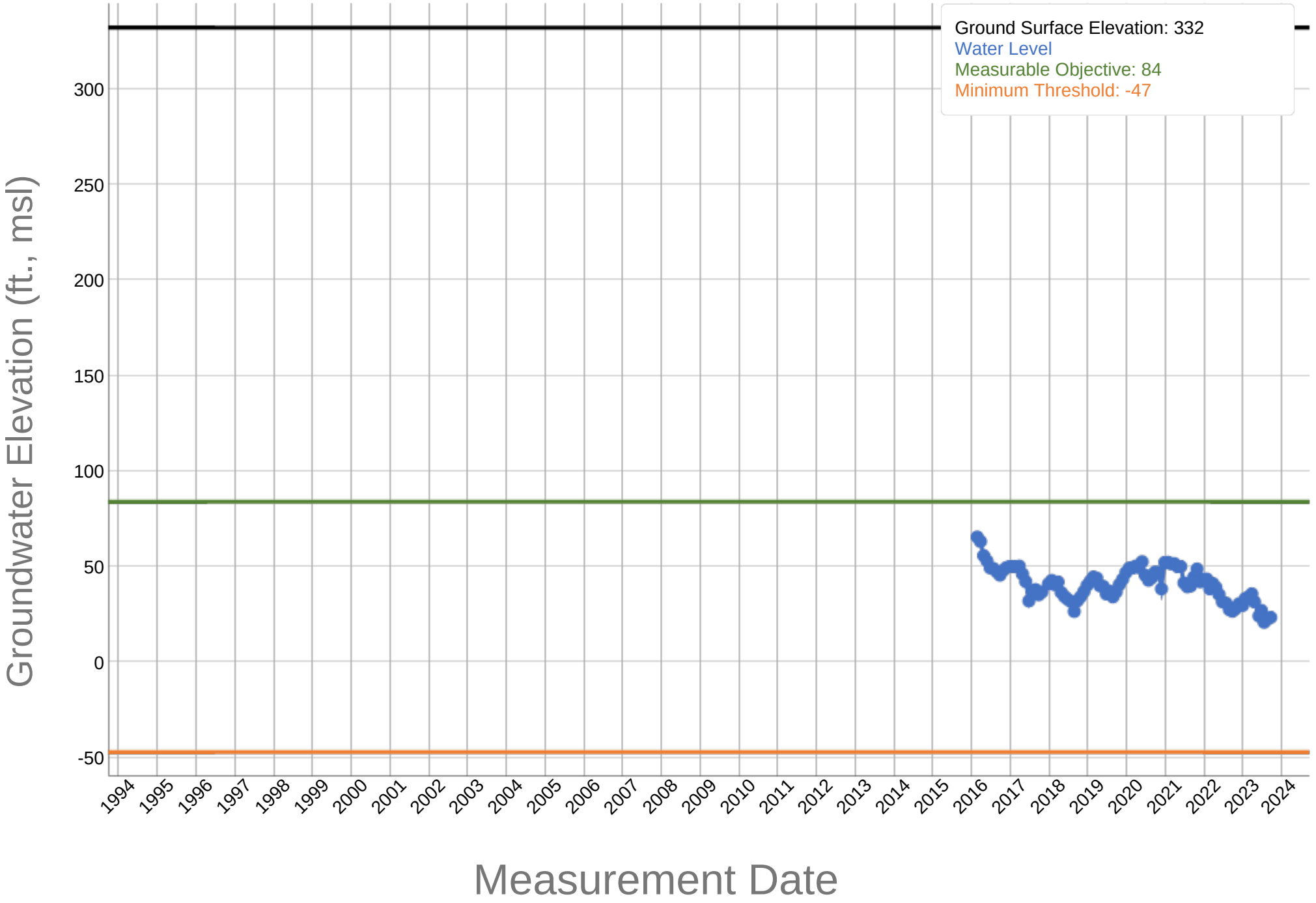
A3-50

Rosedale-Rio Bravo Water Storage District - Parsons - 353663N1193859W001



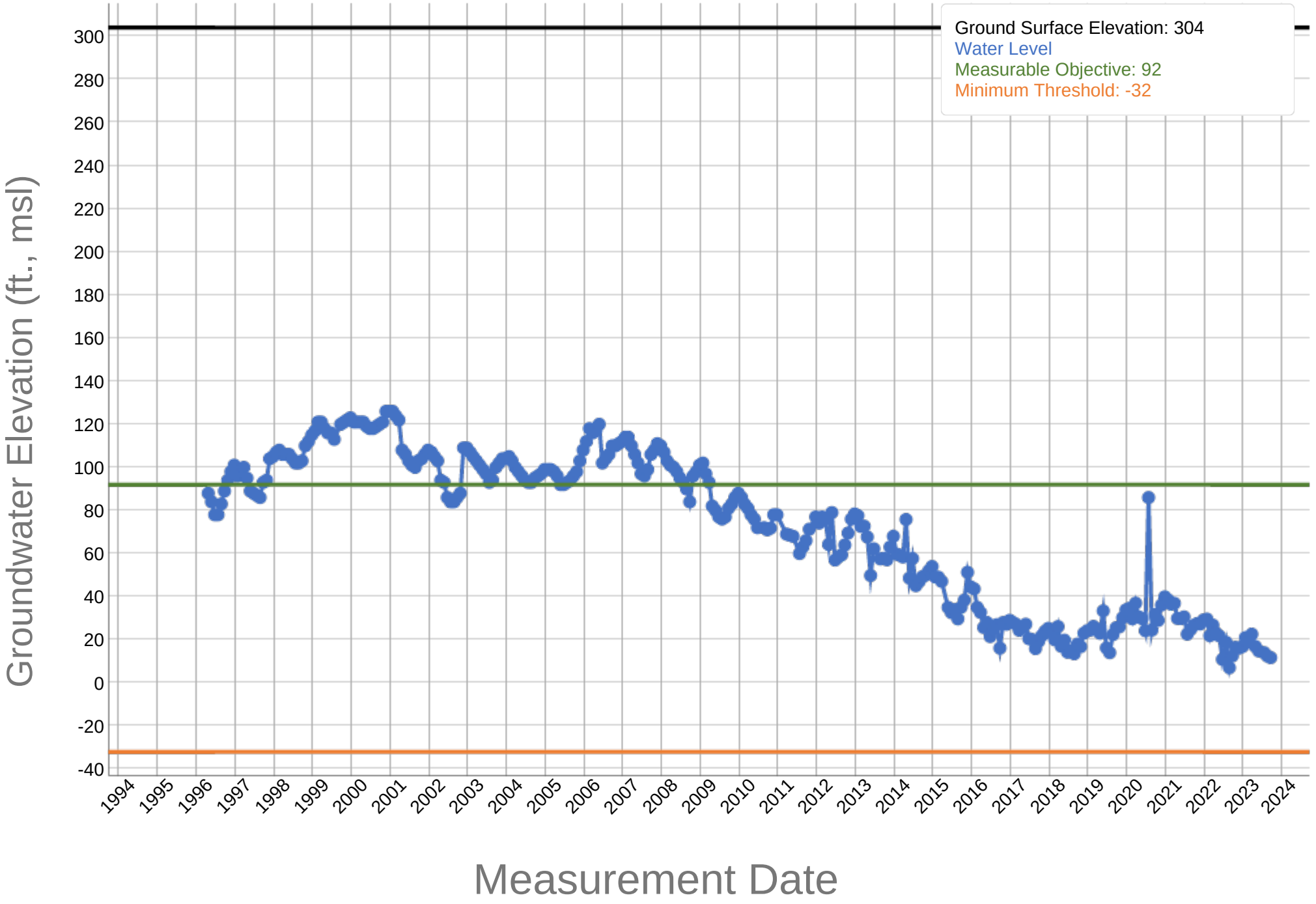
A3-51

Rosedale-Rio Bravo GSA - RBG School - 354197N1192544W001



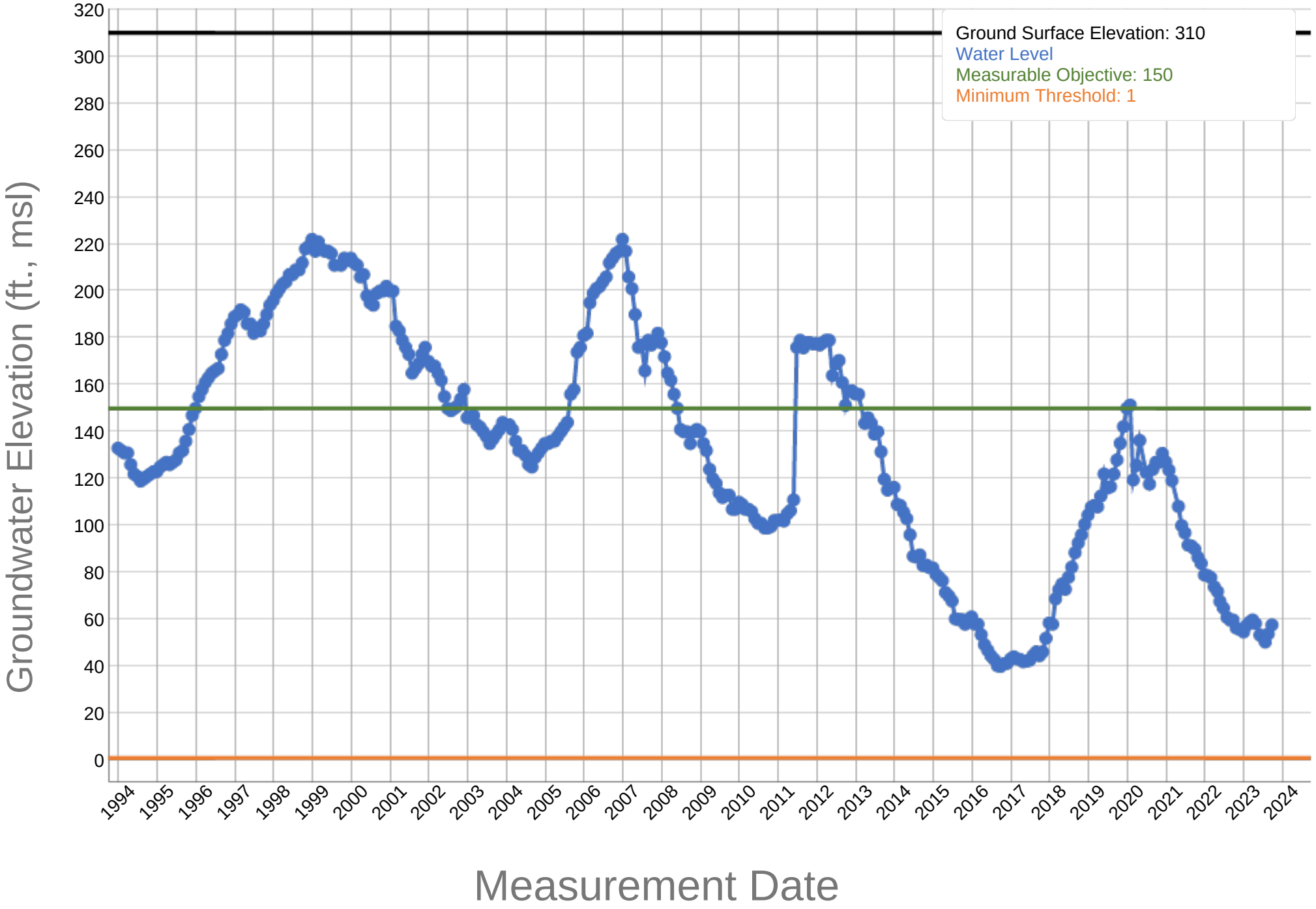
A3-52

Rosedale-Rio Bravo Water Storage District - Section 18 - 354090N1193318W001



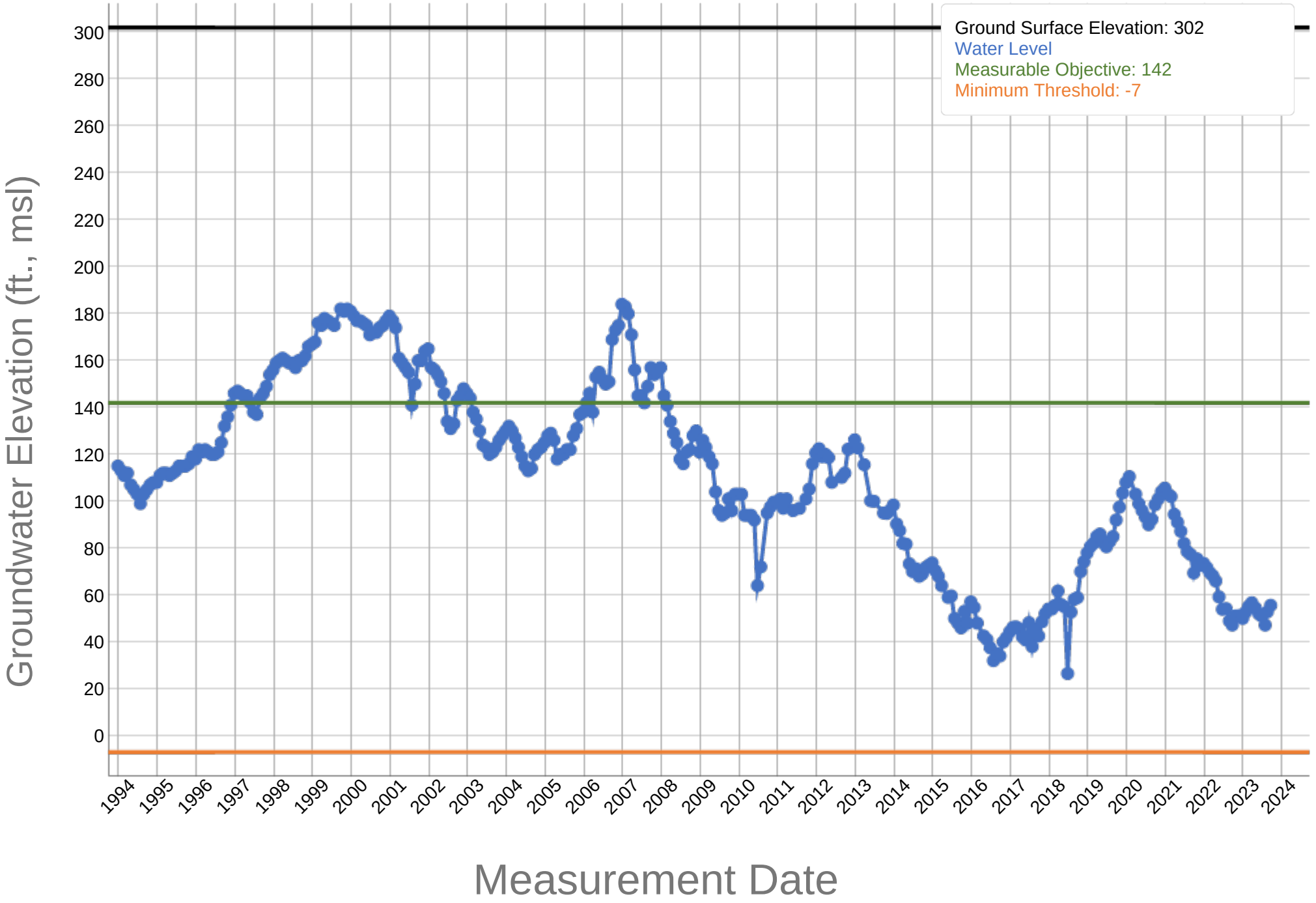
A3-53

Rosedale-Rio Bravo Water Storage District - Virgil Bussell - 353619N1193099W001



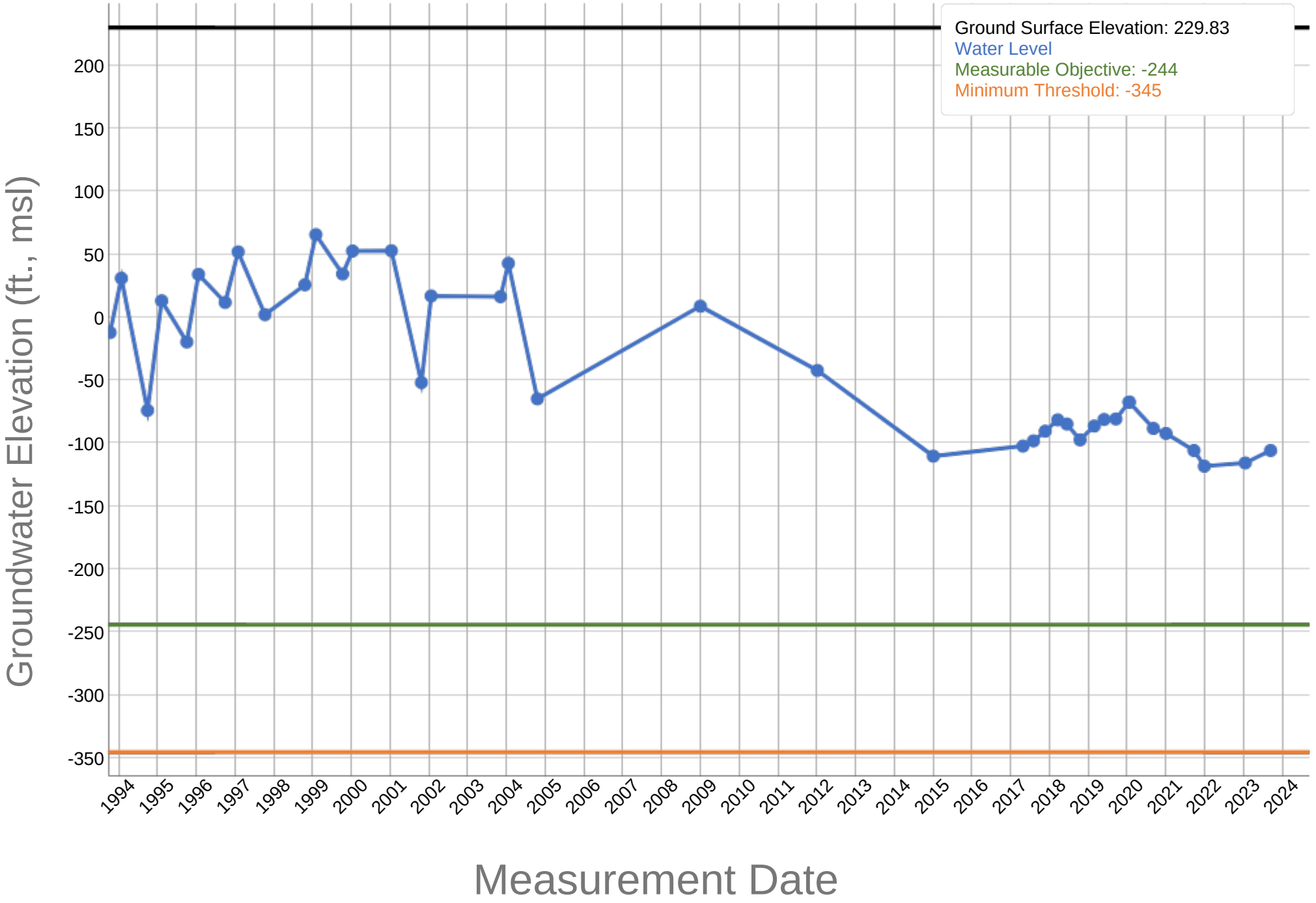
A3-54

Rosedale-Rio Bravo Water Storage District - West I-5 - 353564N1193412W001



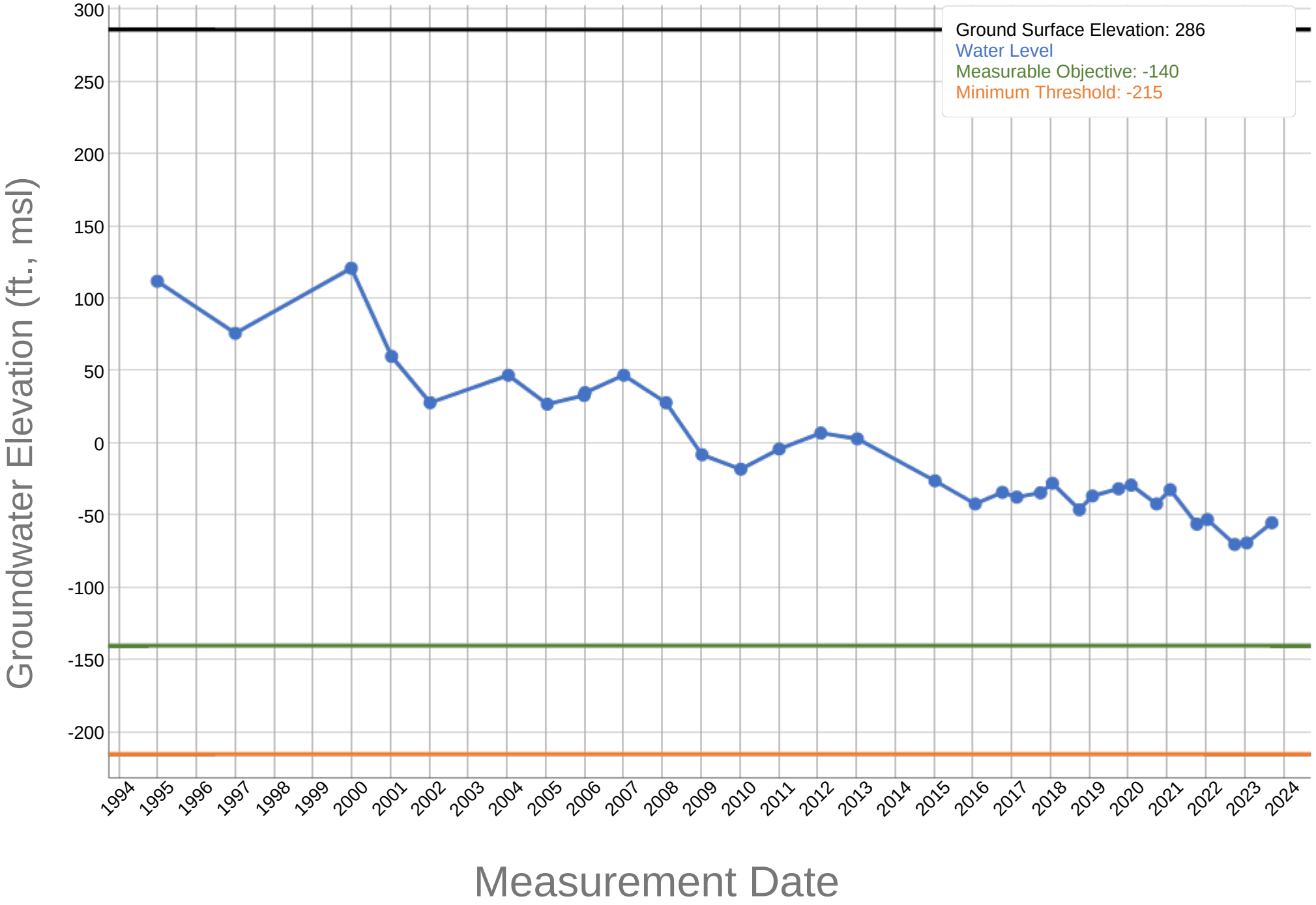
A3-55

Semitropic Water Storage District GSA - 26S-23E-15A1 - 356736N1194735W001



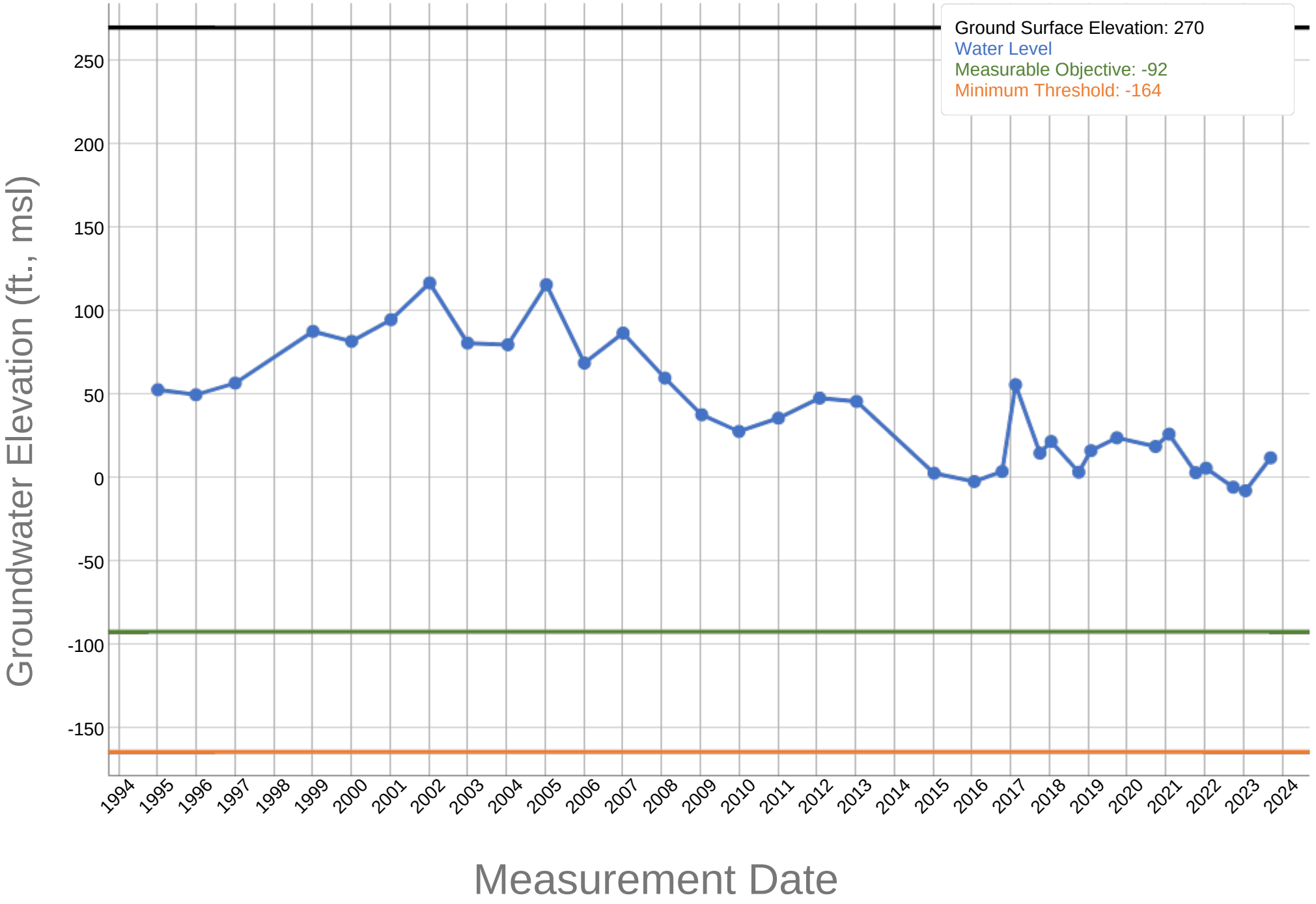
A3-56

Semitropic Water Storage District GSA - 28/23/16/G - 354950N1195013W001



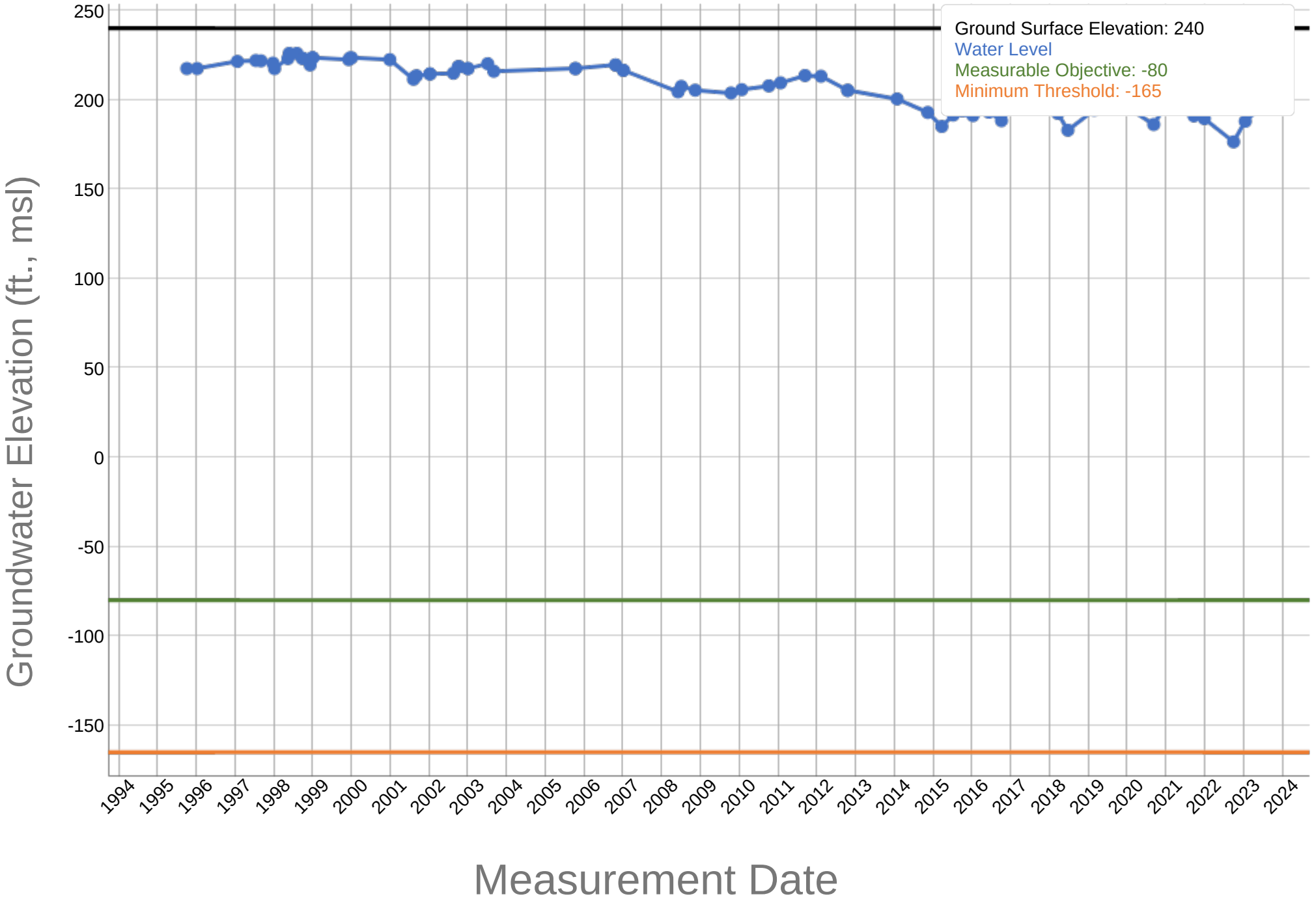
A3-57

Semitropic Water Storage District GSA - 28/23/36/R - 354426N1194398W001



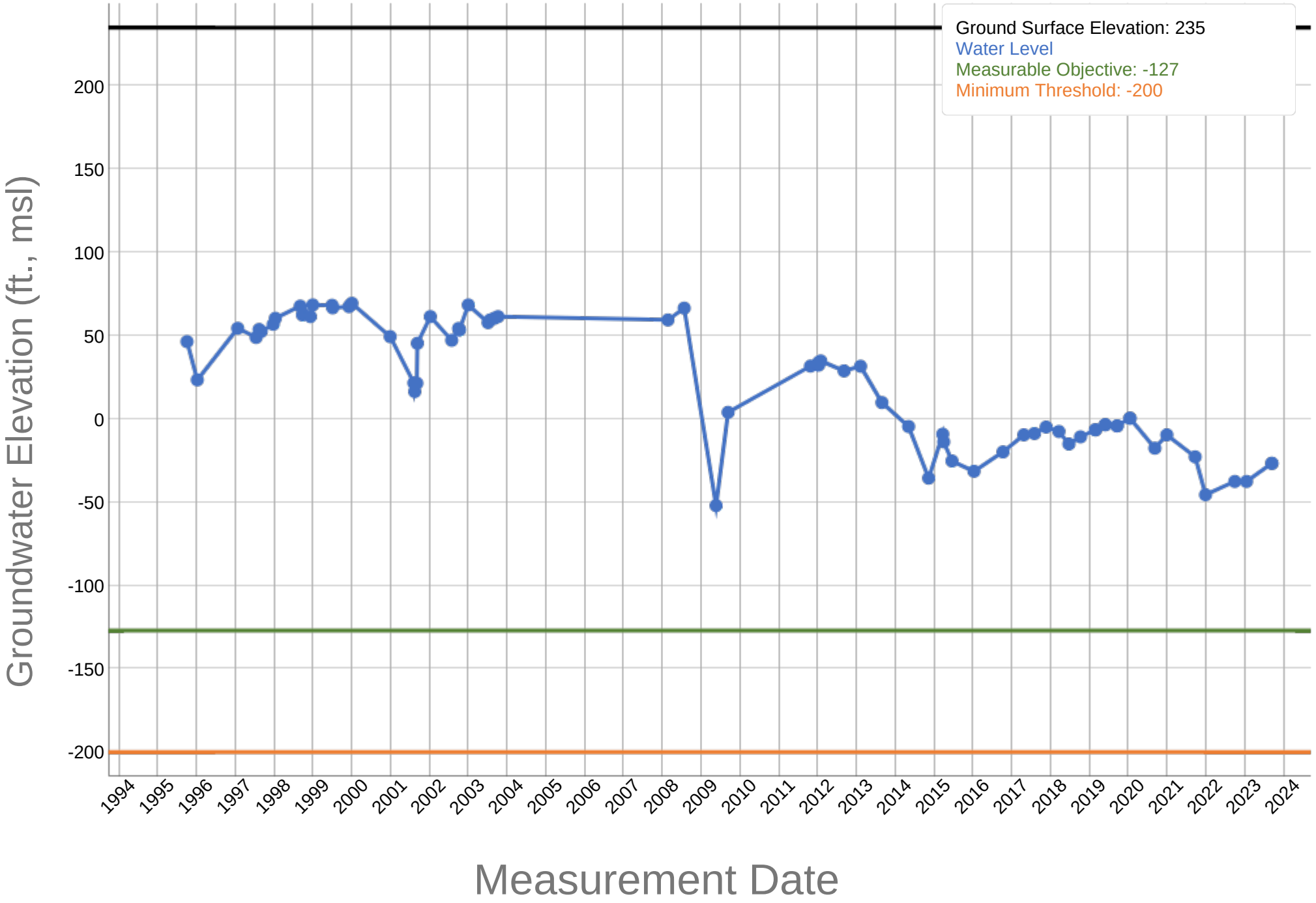
A3-58

Semitropic Water Storage District GSA - S-1 - 355944N1195814W001



A3-59

Semitropic Water Storage District GSA - S-2 - 355687N1195623W001



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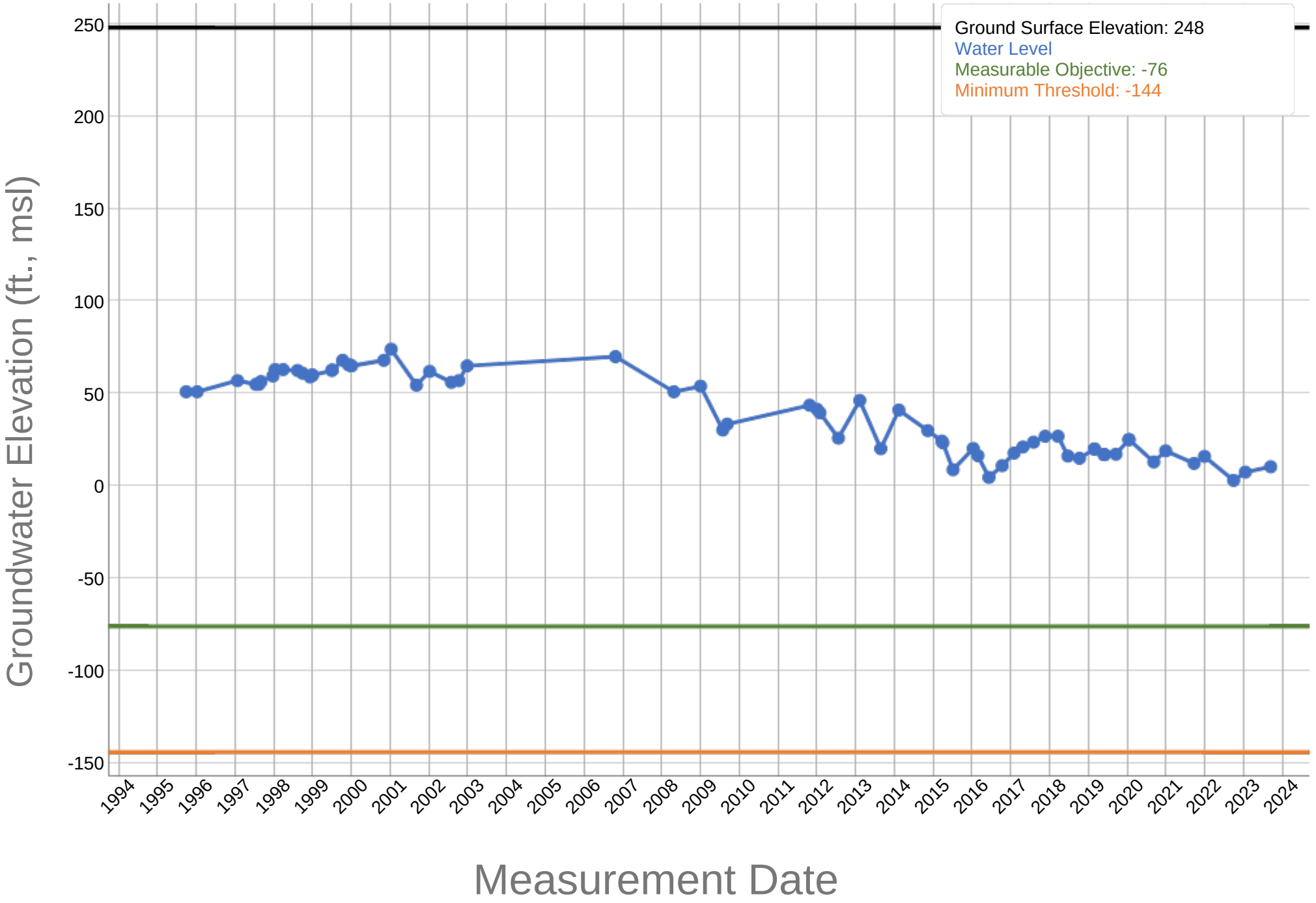
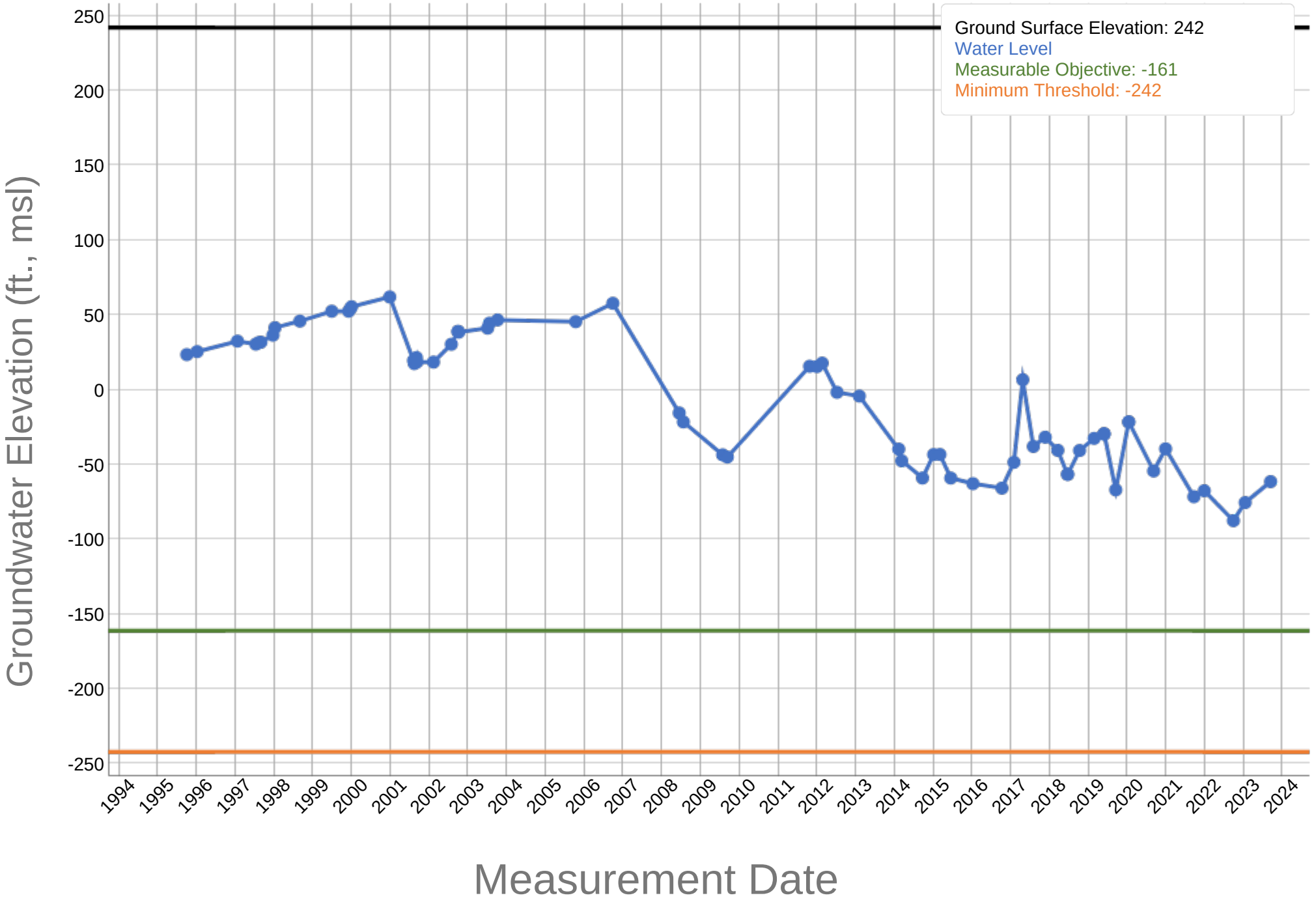
Semitropic Water Storage District GSA - S-4 - 355205N1195821W001



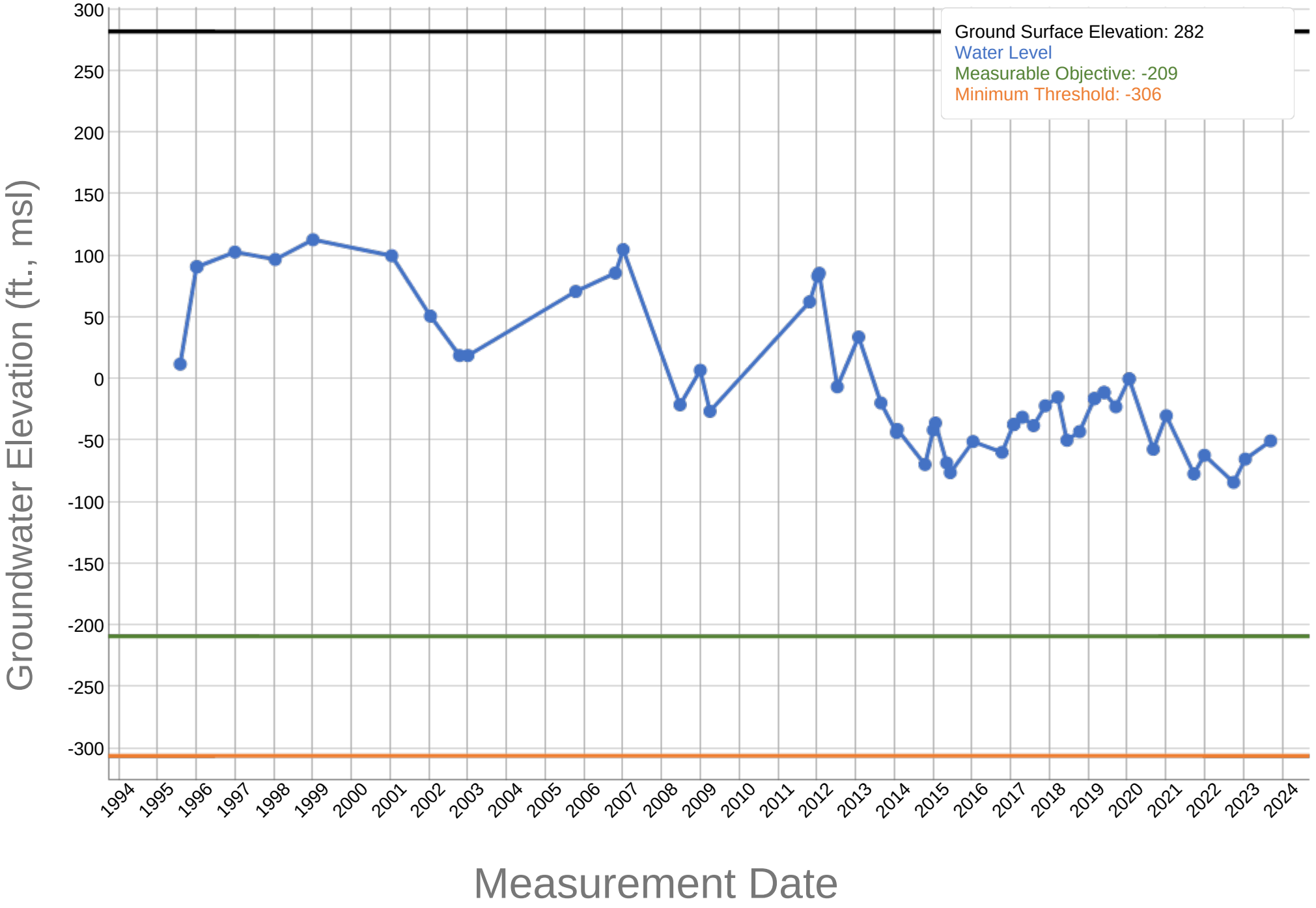
A3-61

Semitropic Water Storage District GSA - S-5 - 355506N1195271W001



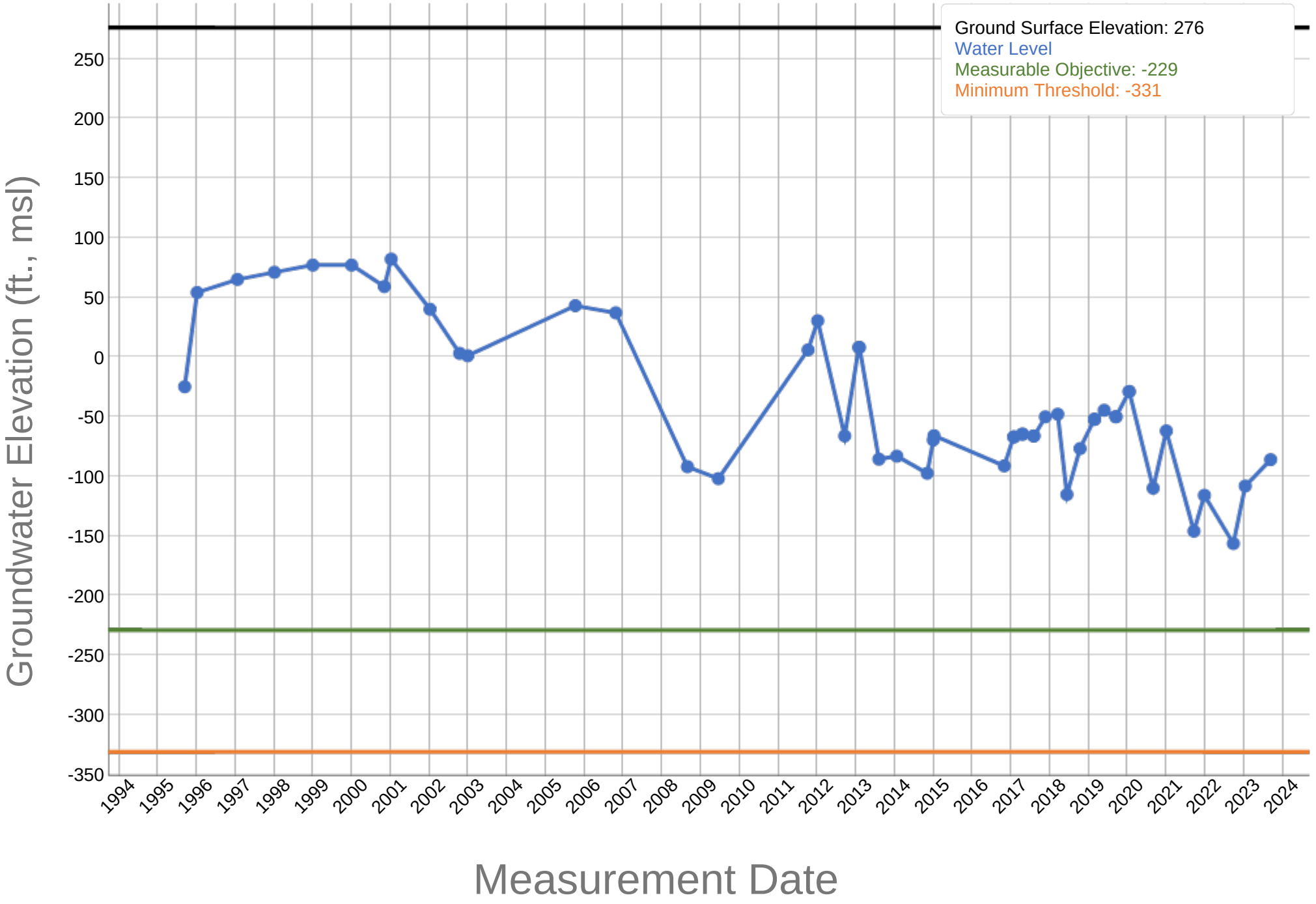
A3-62

Semitropic Water Storage District GSA - S-6 - 357036N1193392W001



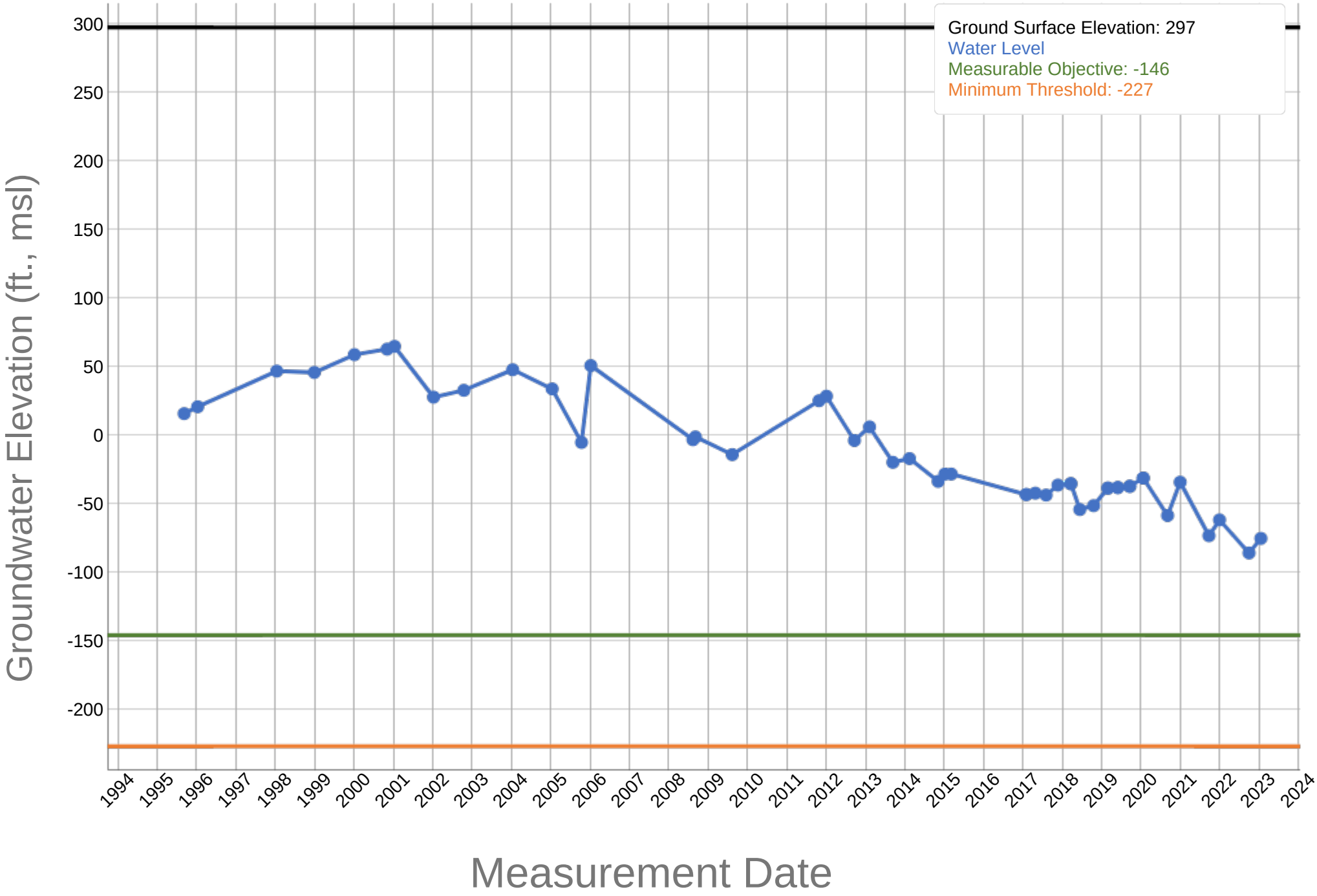
A3-63

Semitropic Water Storage District GSA - S-8A Cluster 1 of 2 - 356305N1194021W001



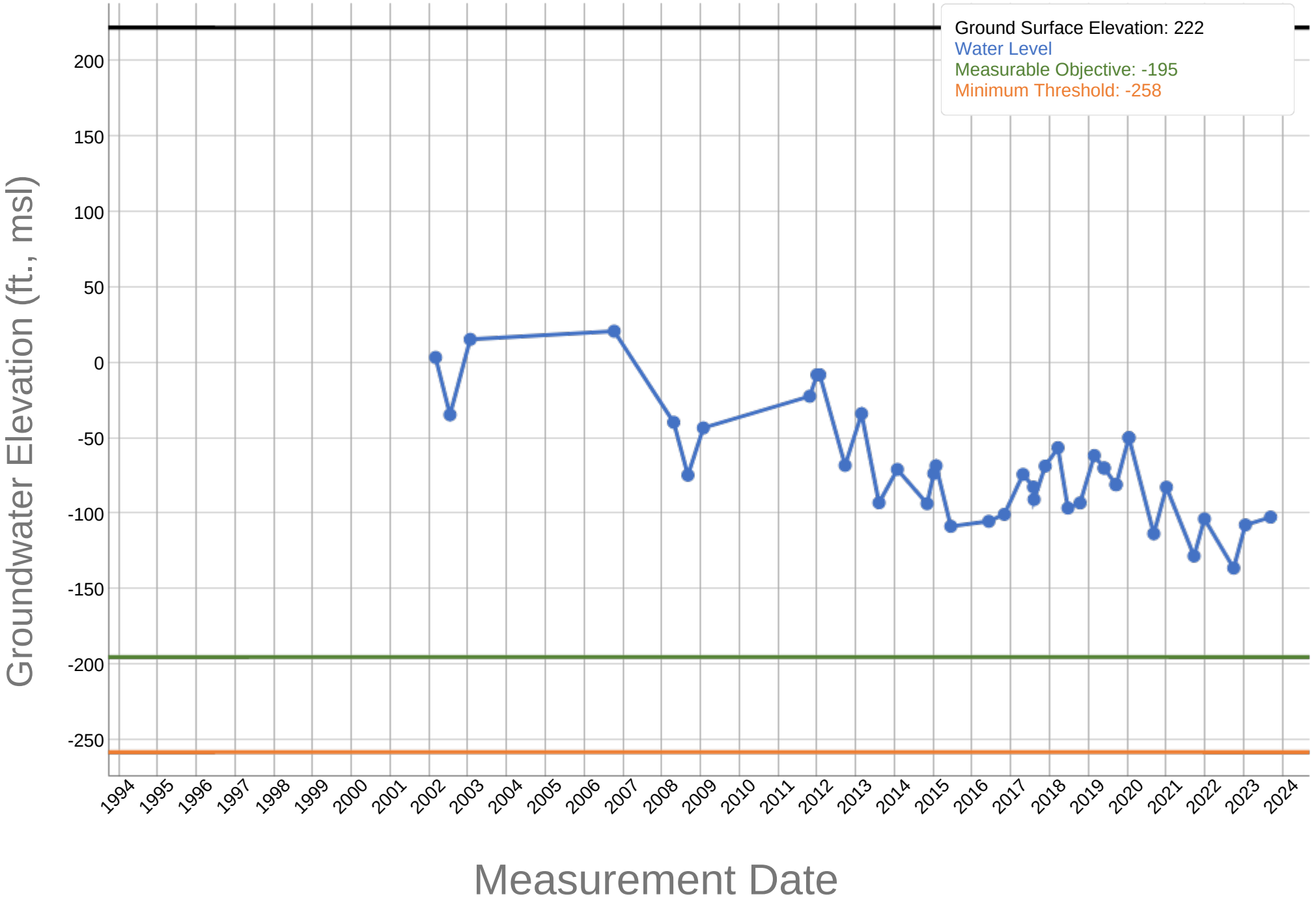
A3-64

Semitropic Water Storage District GSA - S-9A Cluster 1 of 2 - 355219N1193943W001



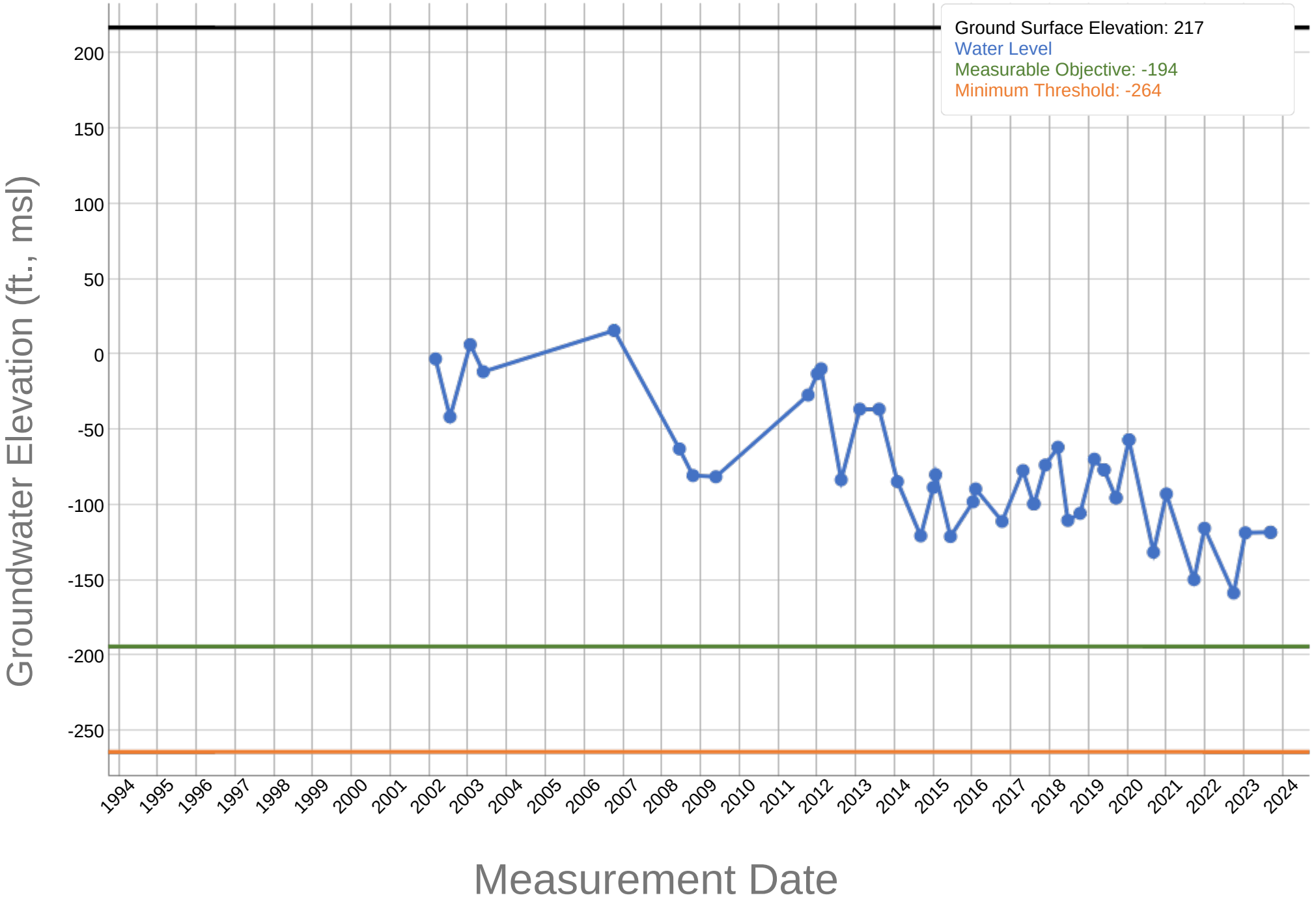
A3-65

Semitropic Water Storage District GSA - S-11 - 356956N1195623W001



A3-66

Semitropic Water Storage District GSA - S-12 - 357228N1195538W001



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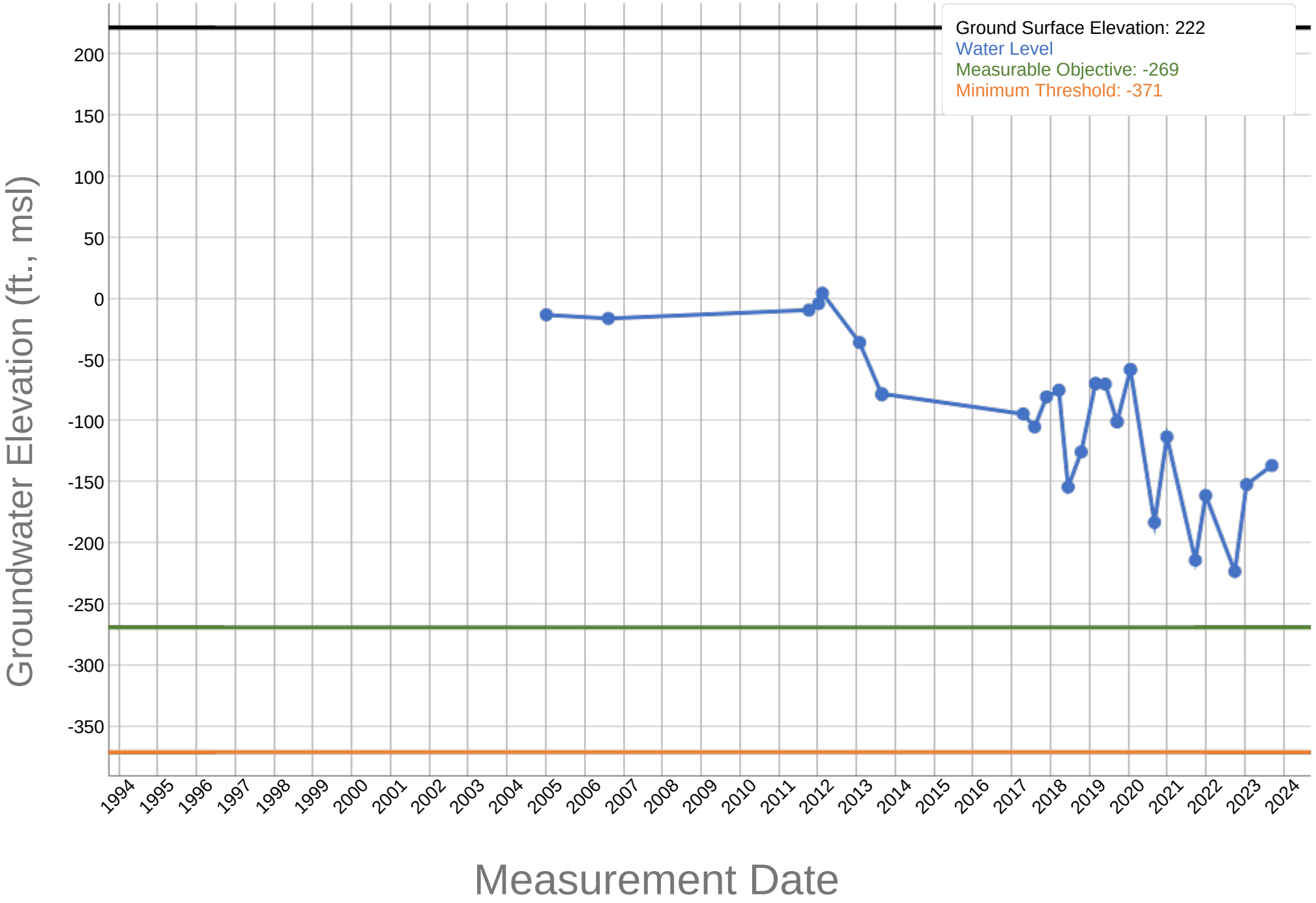
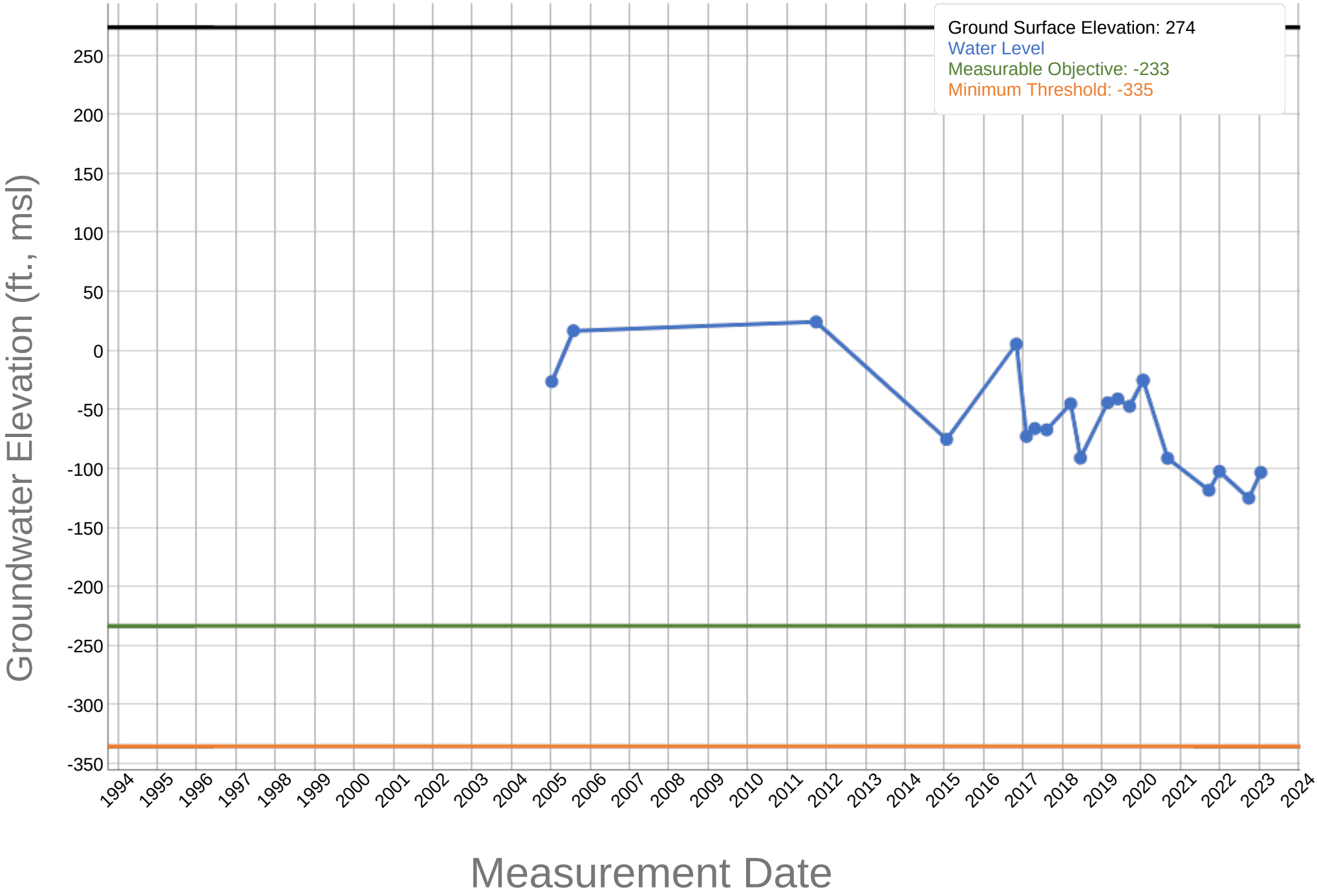
Semitropic Water Storage District GSA - S-13A Cluster 1 of 2 - 357609N1194366W001



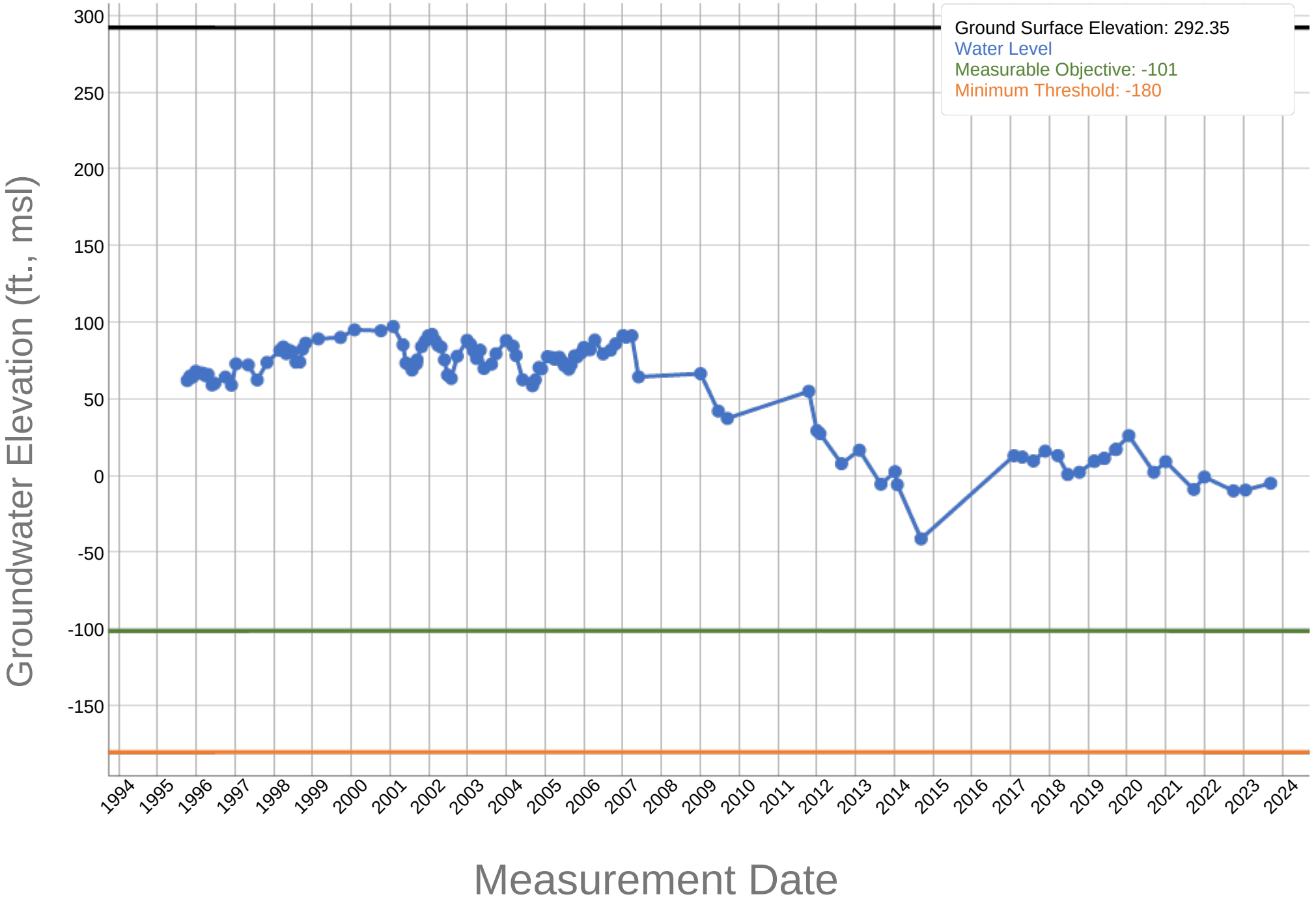
A3-68

Semitropic Water Storage District GSA - S-14B Cluster 2 of 2 - 356668N1193841W002



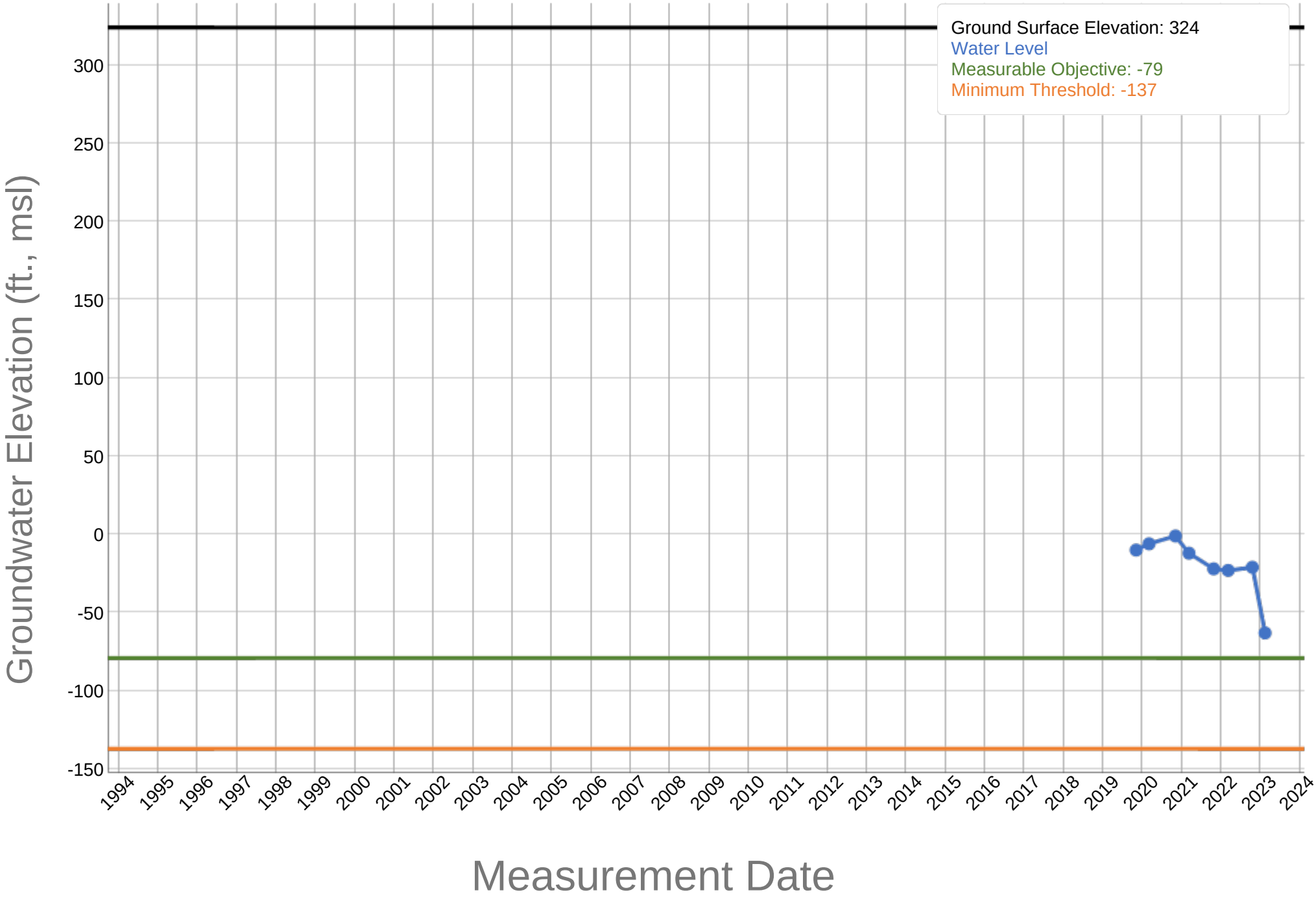
A3-69

Semitropic Water Storage District GSA - 948L02 Cluster1 of 2 - 354189N1194216W001



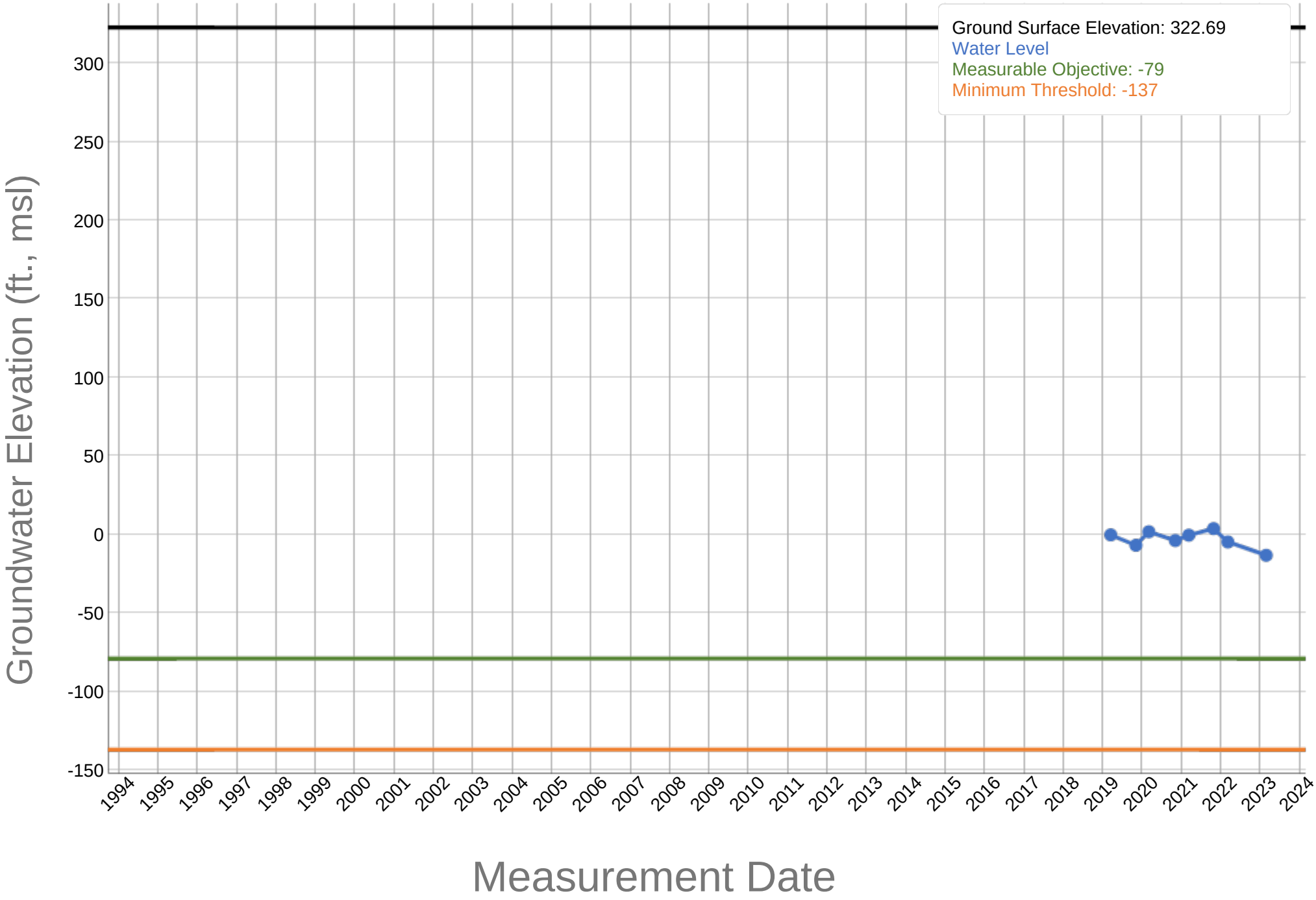
A3-70

Shafter-Wasco Irrigation District GSA - 7th Standard 19G - 354779N1193145W001



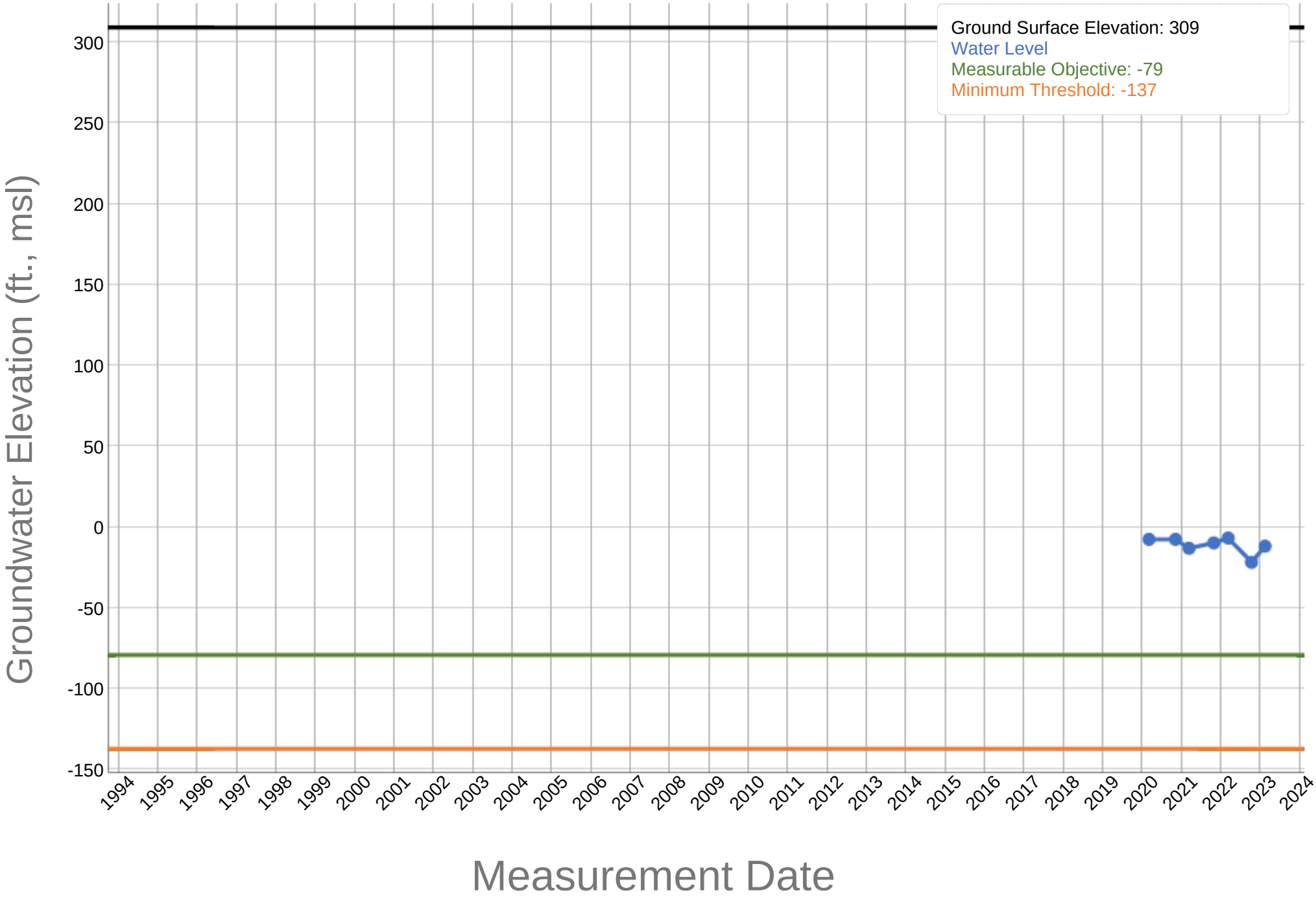
A3-71

Shafter-Wasco Irrigation District GSA - 7th Standard 31J - 354494N1193182W001



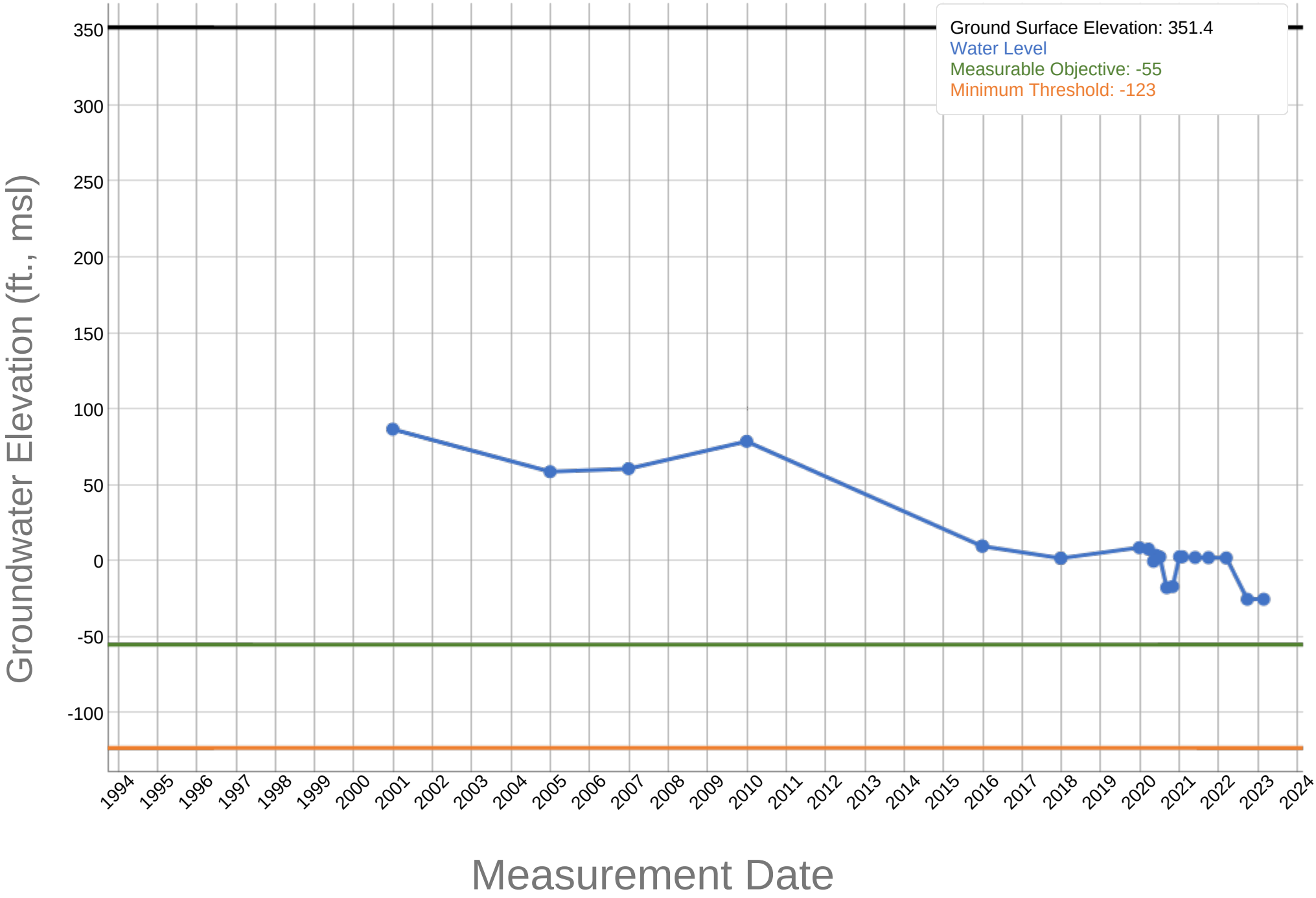
A3-72

Shafter-Wasco Irrigation District GSA - 7th Standard 35C - 354561N1193595W001



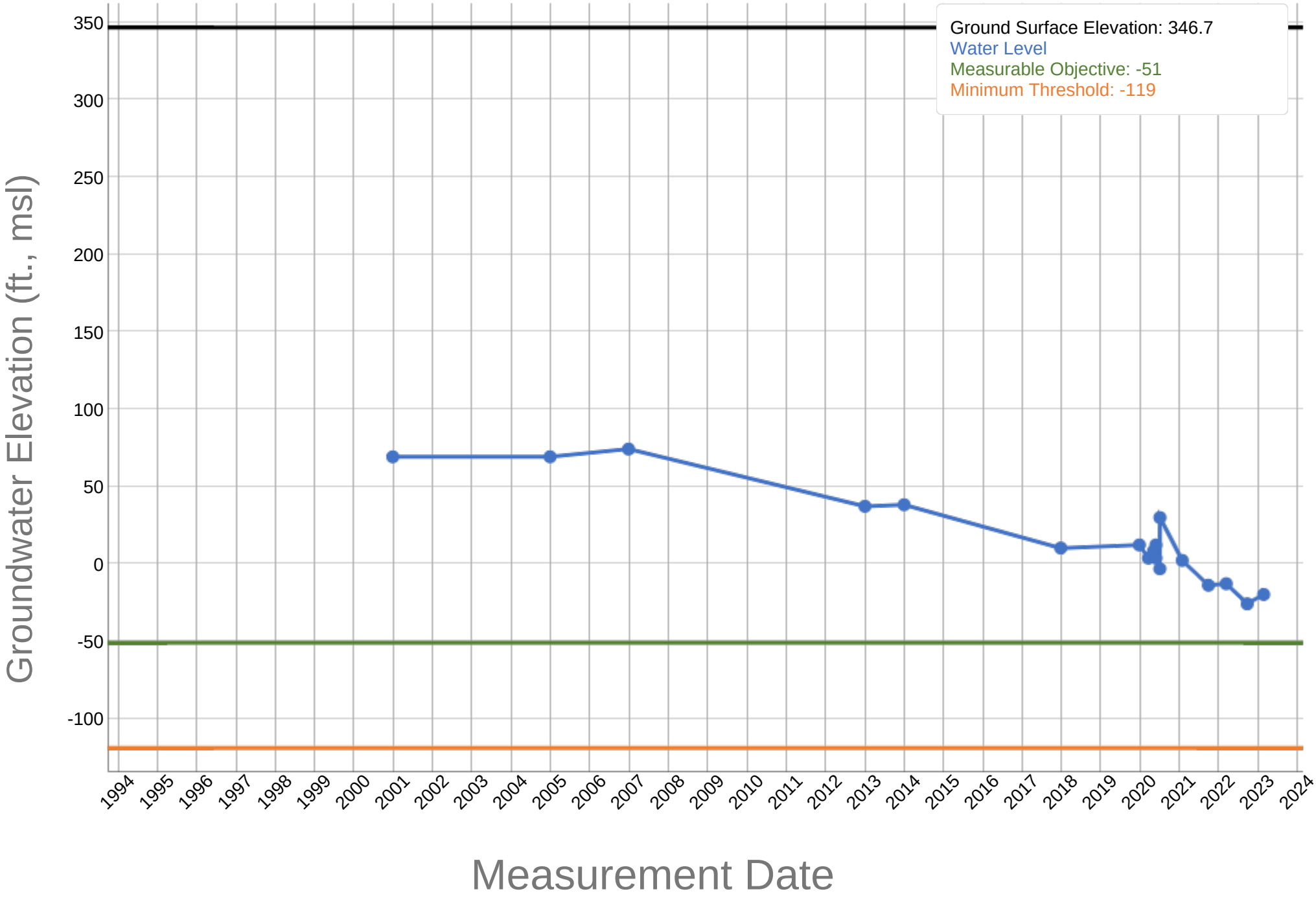
A3-73

Shafter-Wasco Irrigation District GSA - Shafter Well 7 - 355080N1192777W001



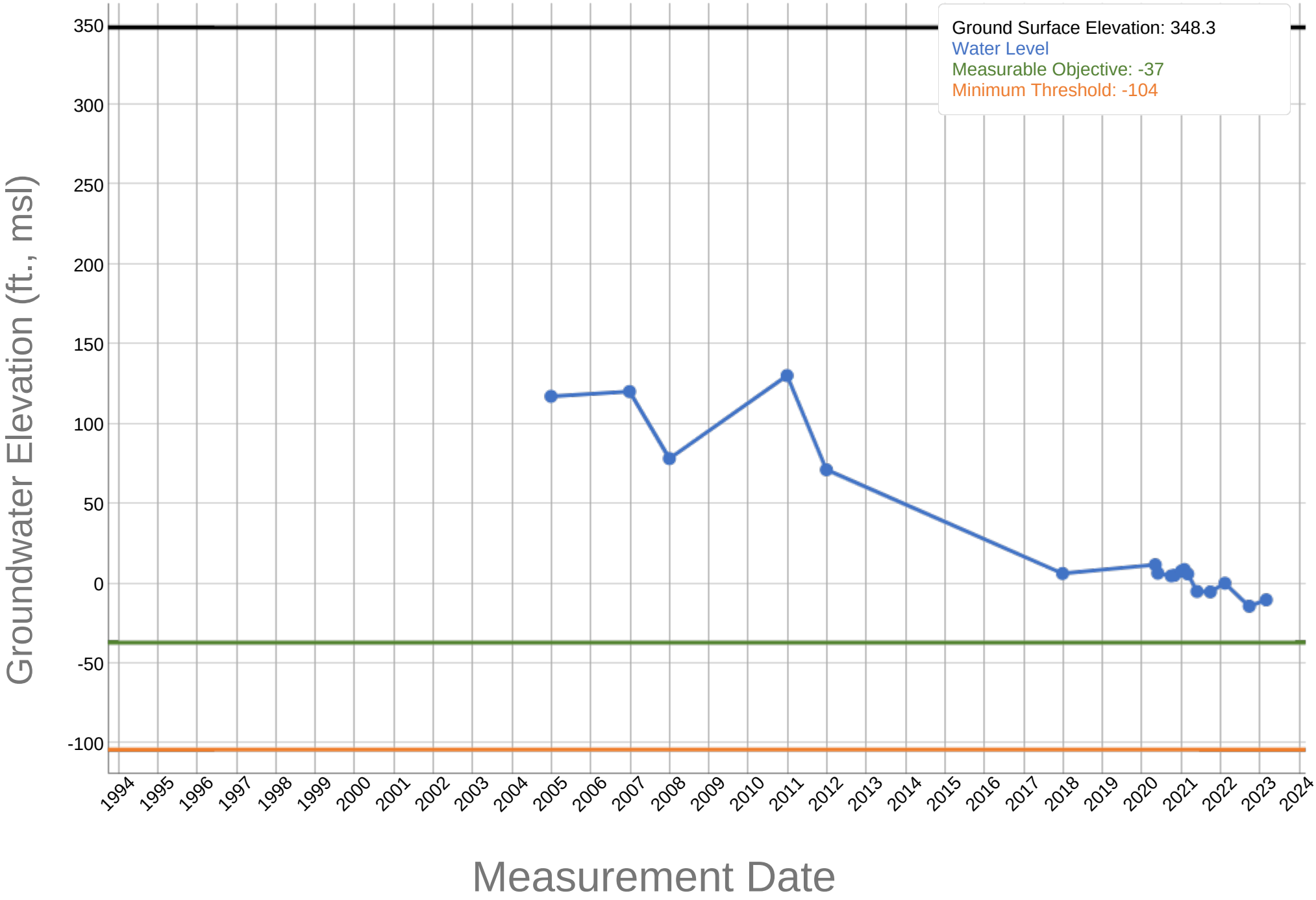
A3-74

Shafter-Wasco Irrigation District GSA - Shafter Well 12 - 355020N1192748W001



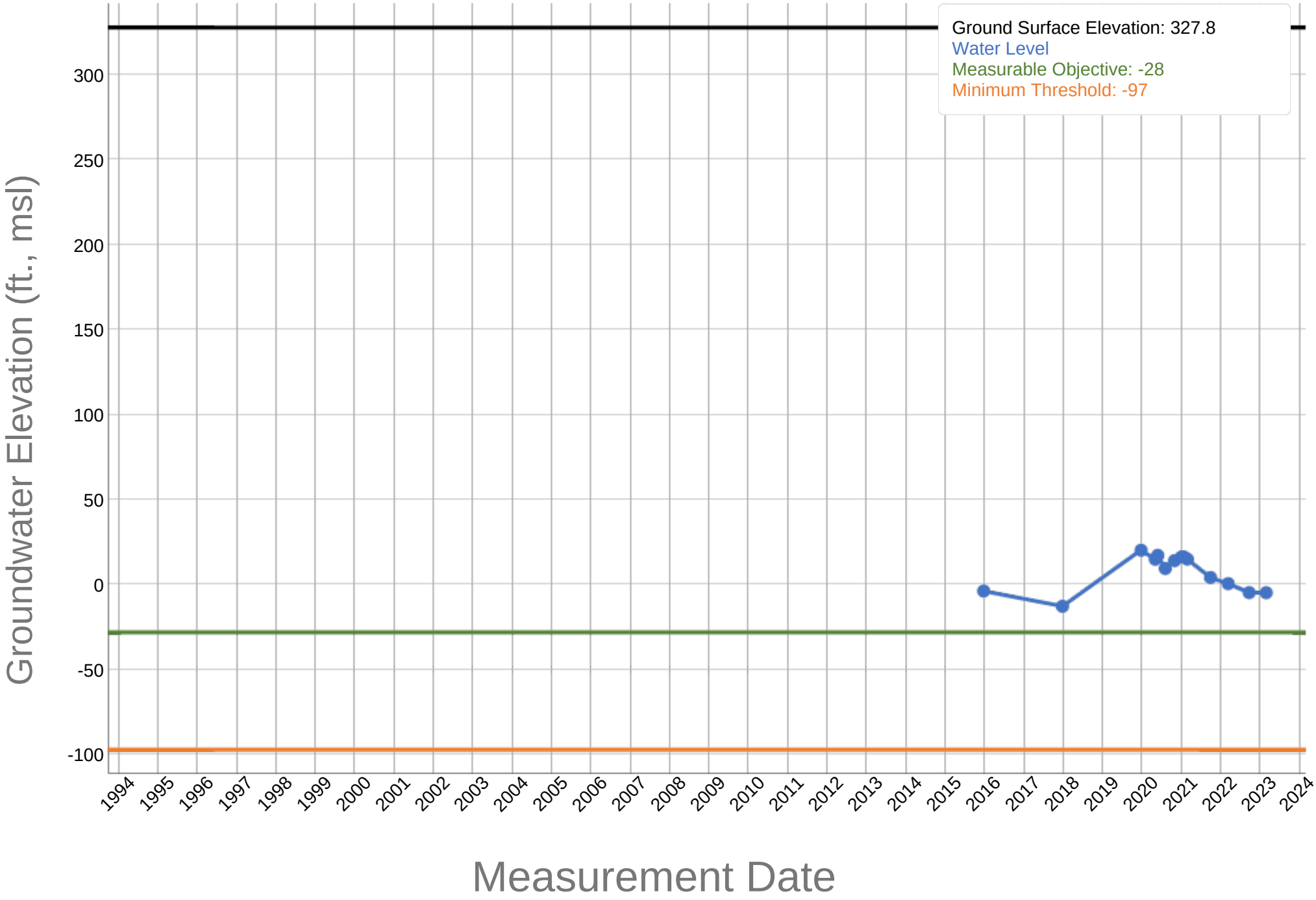
A3-75

Shafter-Wasco Irrigation District GSA - Shafter Well 14 - 354943N1192593W001



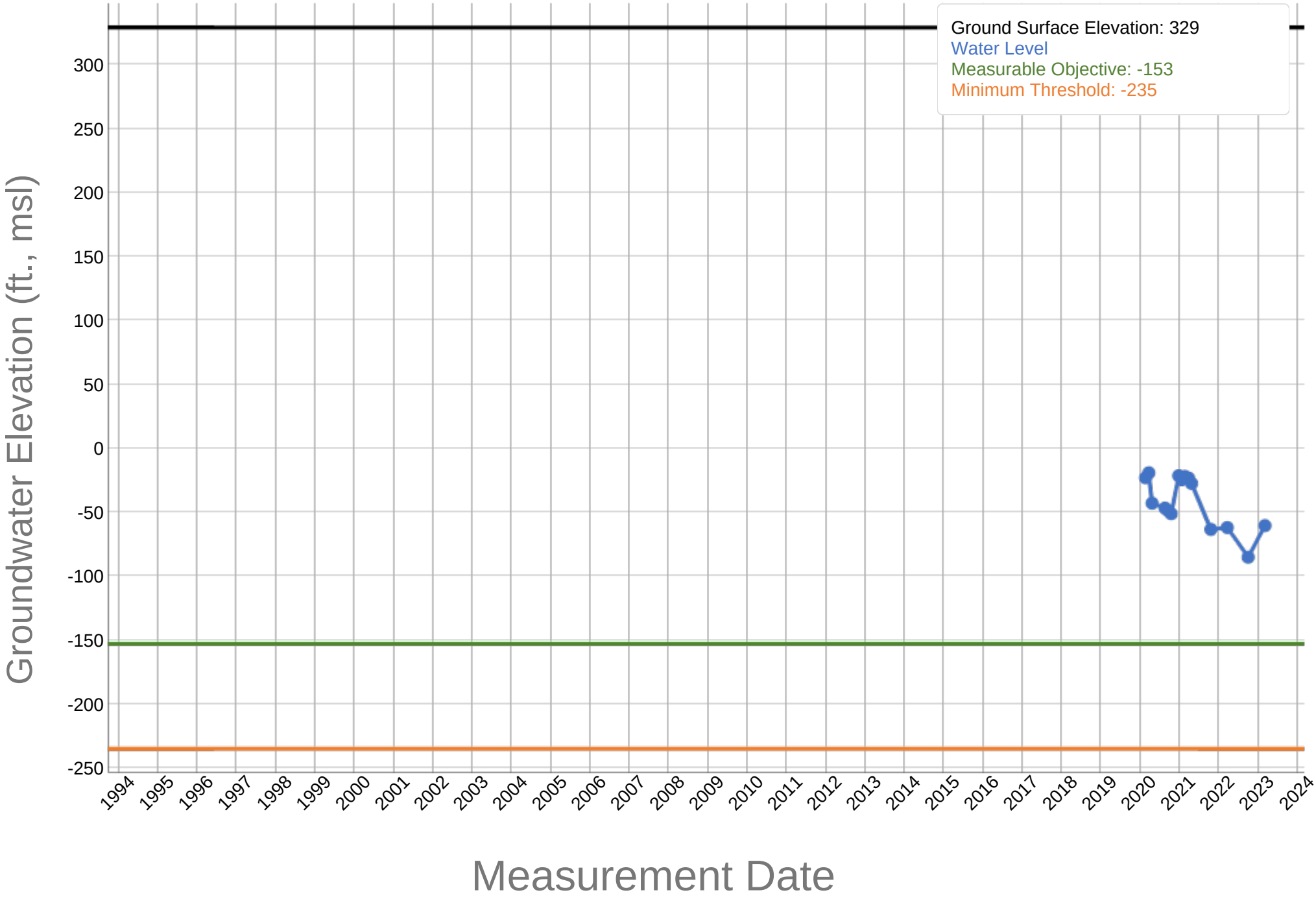
A3-76

Shafter-Wasco Irrigation District - Shafter Well 15 - 354705N1192792W001



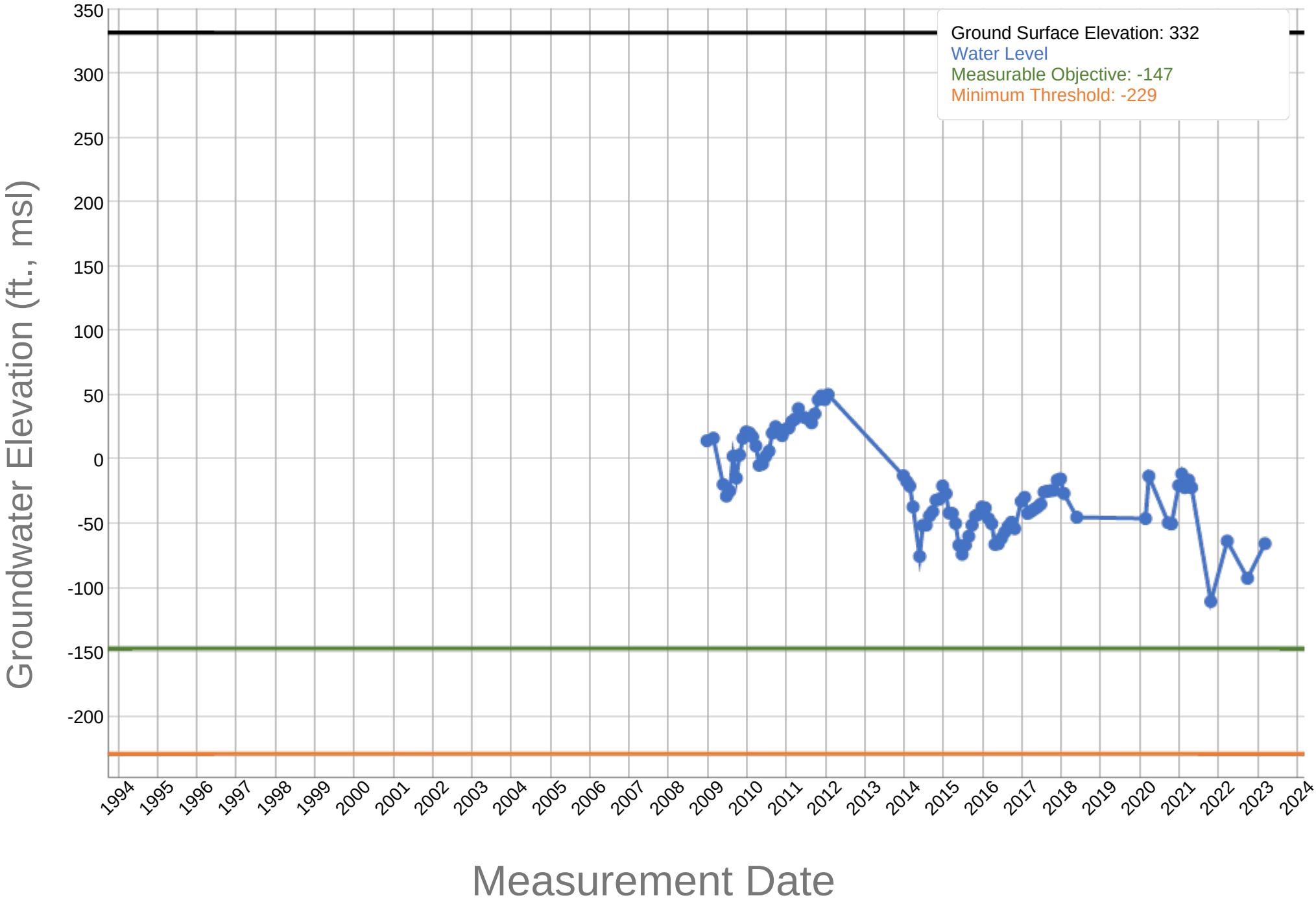
A3-77

Shafter-Wasco Irrigation District GSA - Wasco 8A - 355874N1193523W001



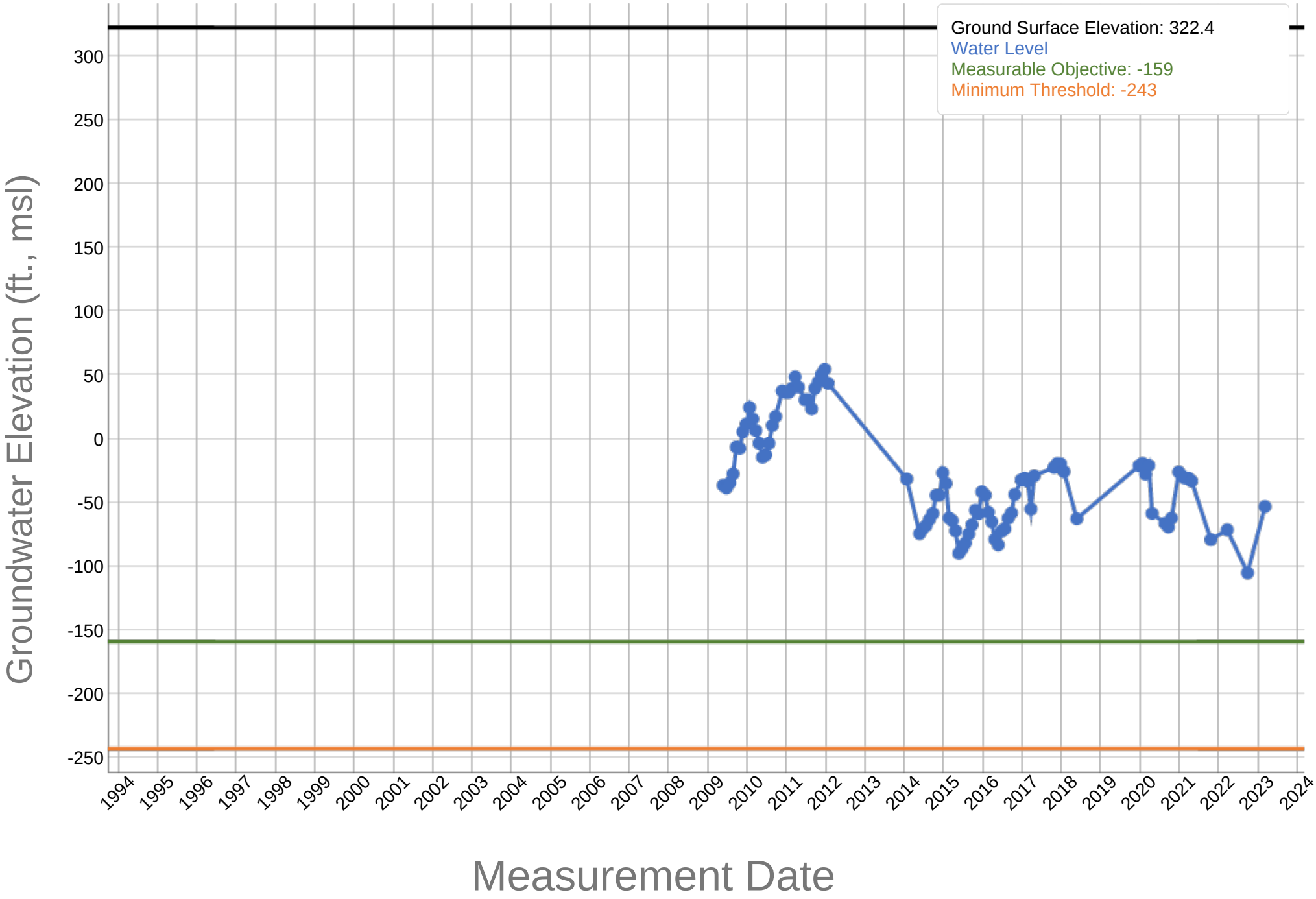
A3-78

Shafter-Wasco Irrigation District GSA - Wasco 11 - 355891N1193417W001



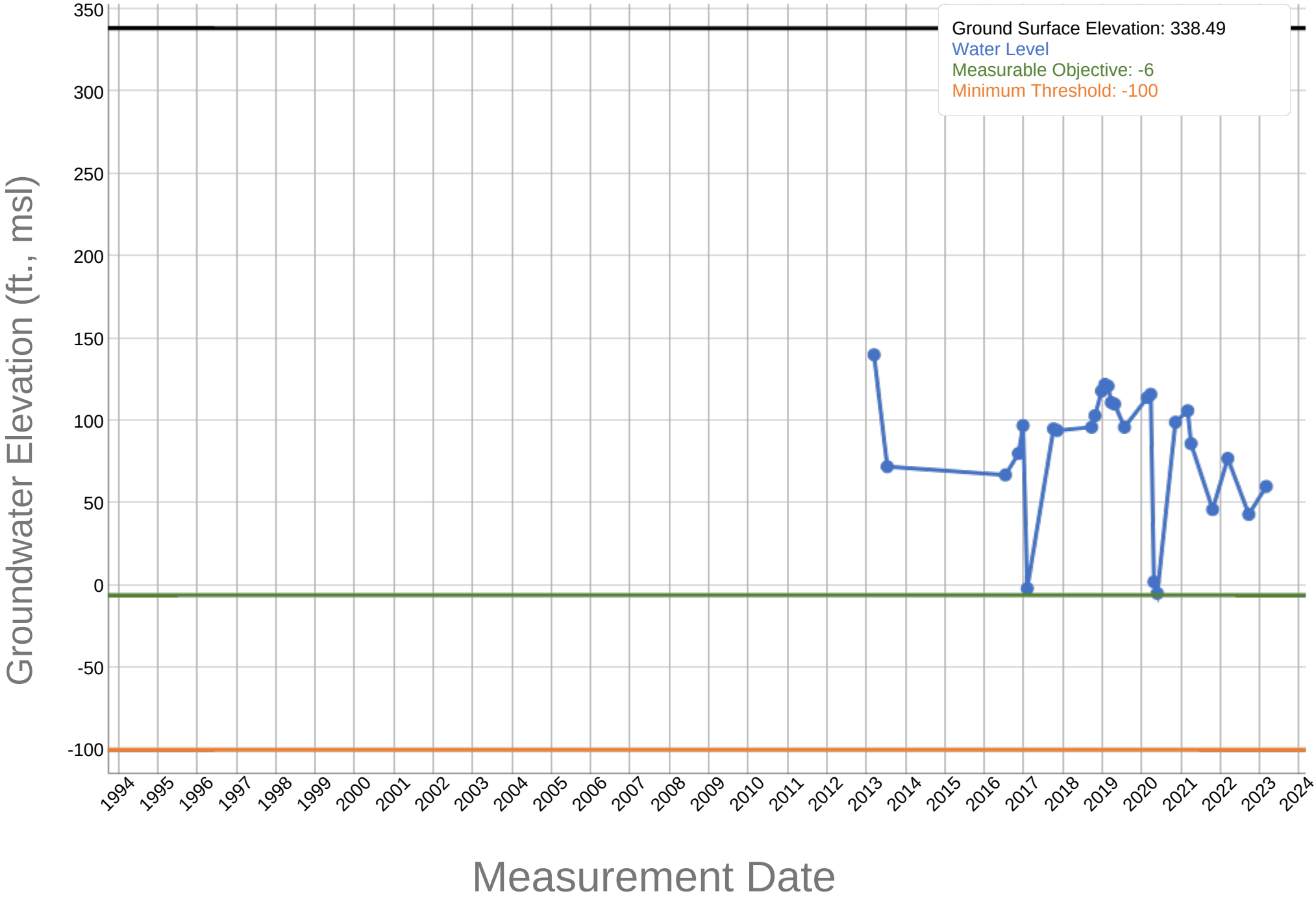
A3-79

Shafter-Wasco Irrigation District GSA - Wasco 12 - 356157N1193397W001



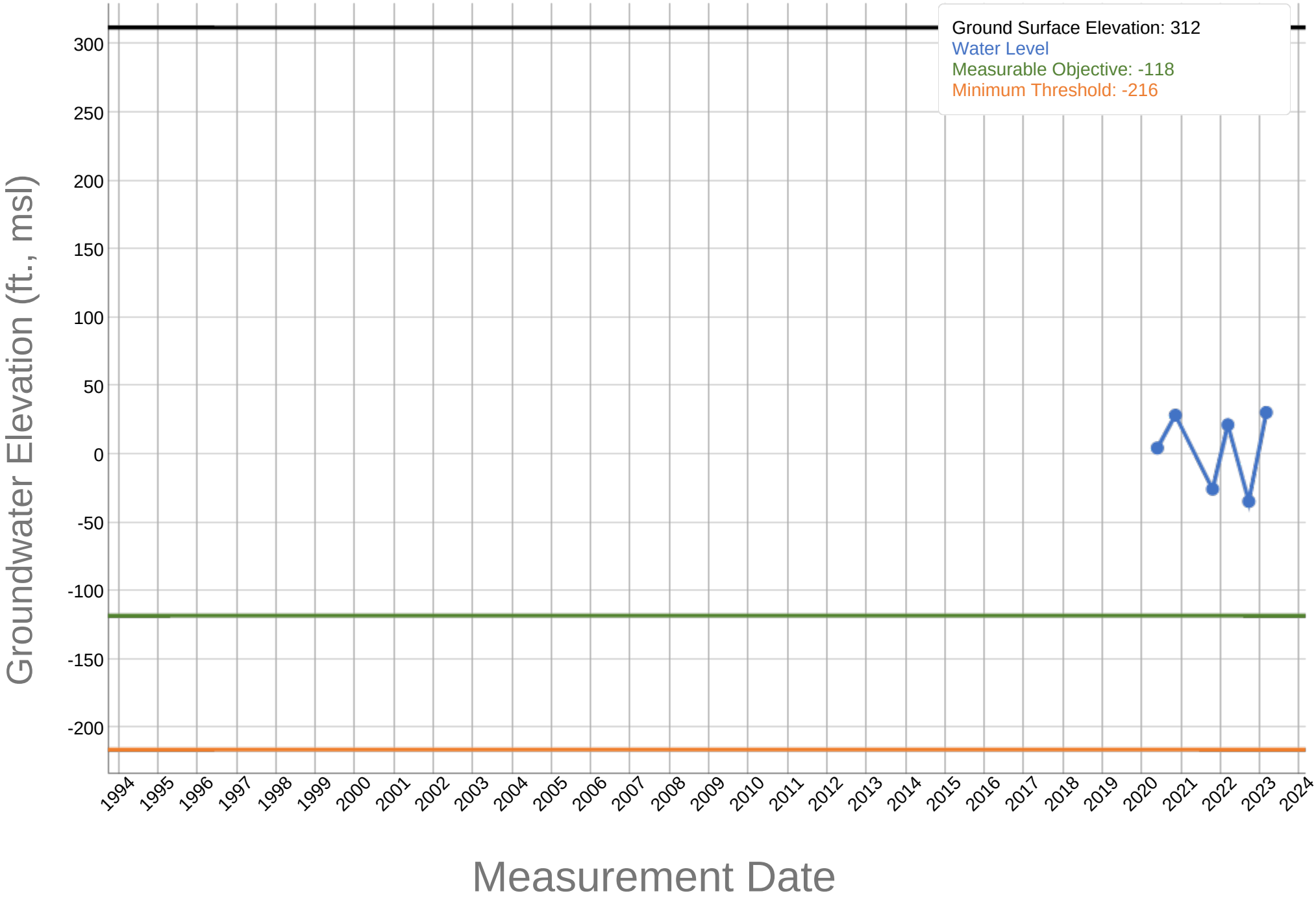
A3-80

Southern San Joaquin Municipal Utility District GSA - Delano 30 - 357898N1192302W001



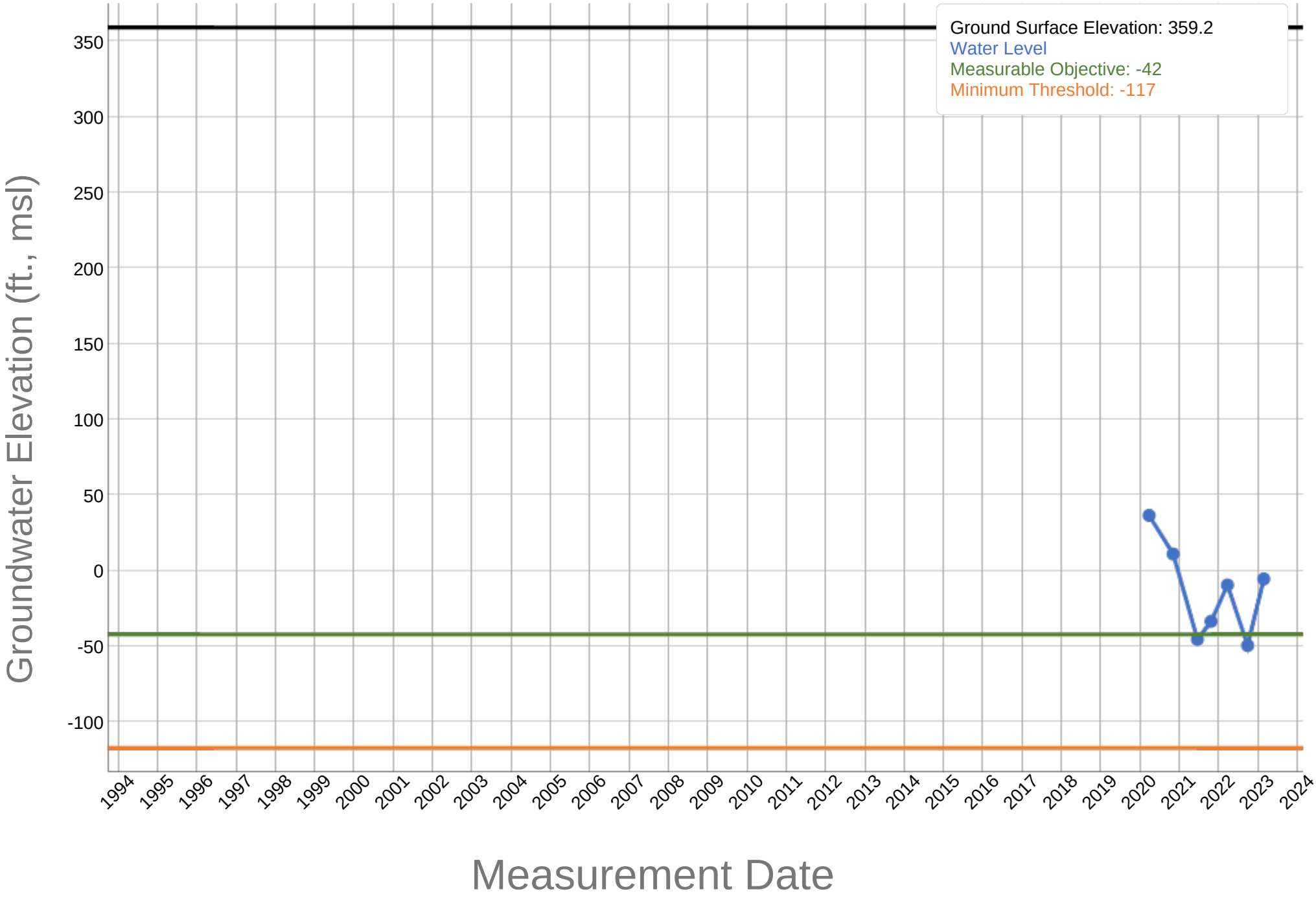
A3-81

Southern San Joaquin Municipal Utility District - Delano 34 - 357436N1192587W001



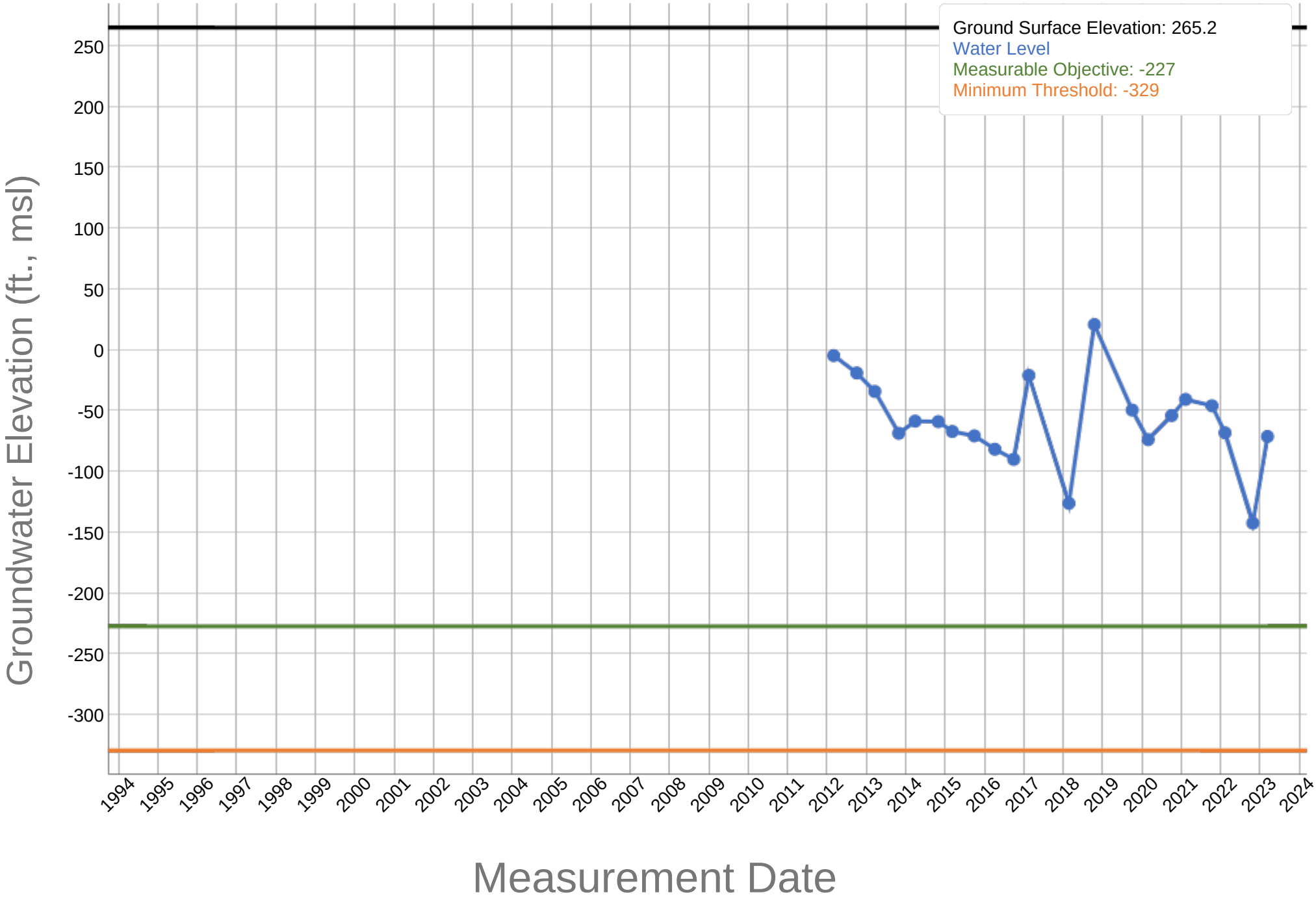
A3-82

Southern San Joaquin Municipal Utility District - McFarland Taylor Ave Well - 356675N1192402W001



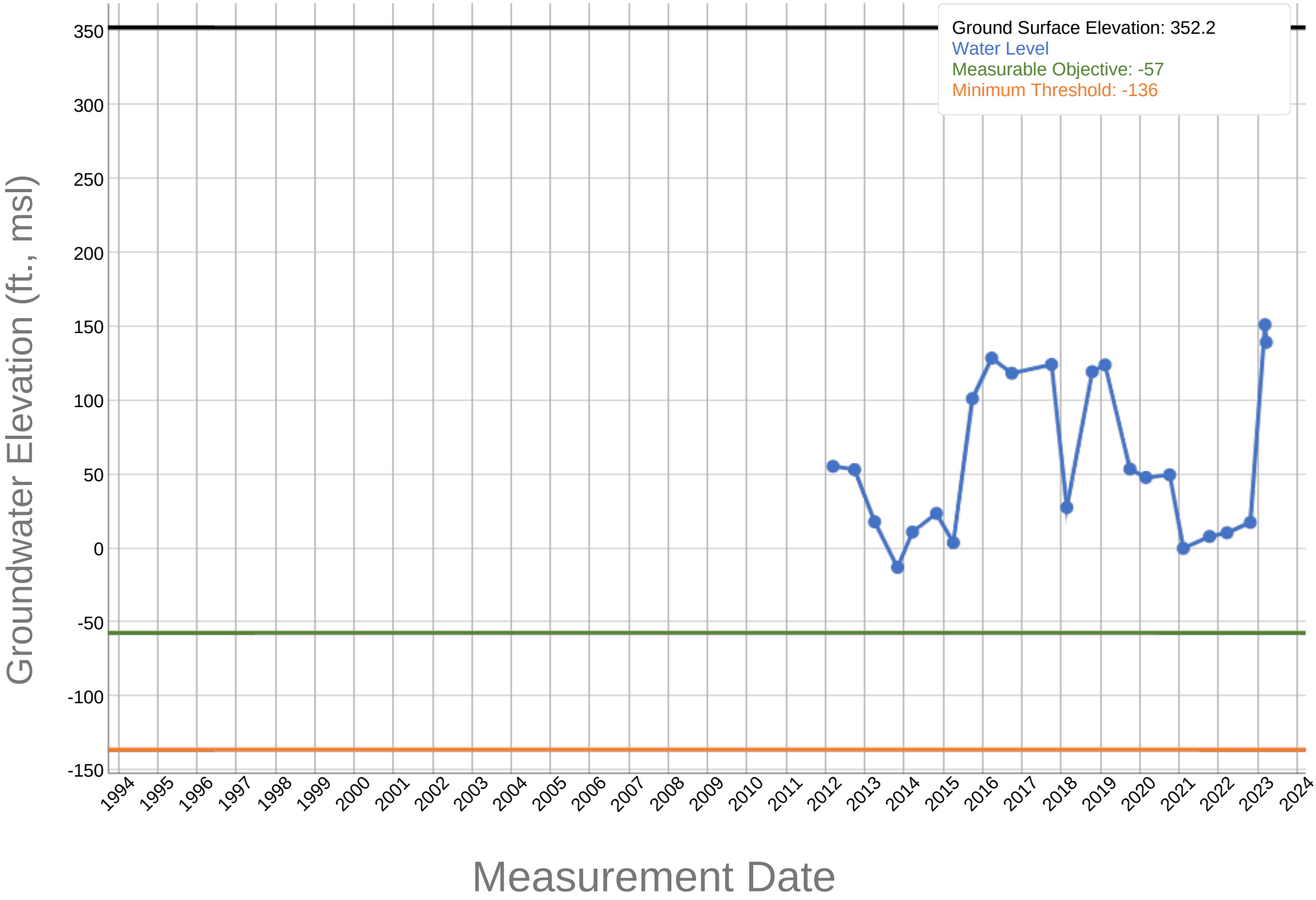
A3-83

Southern San Joaquin Municipal Utility District GSA - SSJMUD 8 - 357470N1193360W001



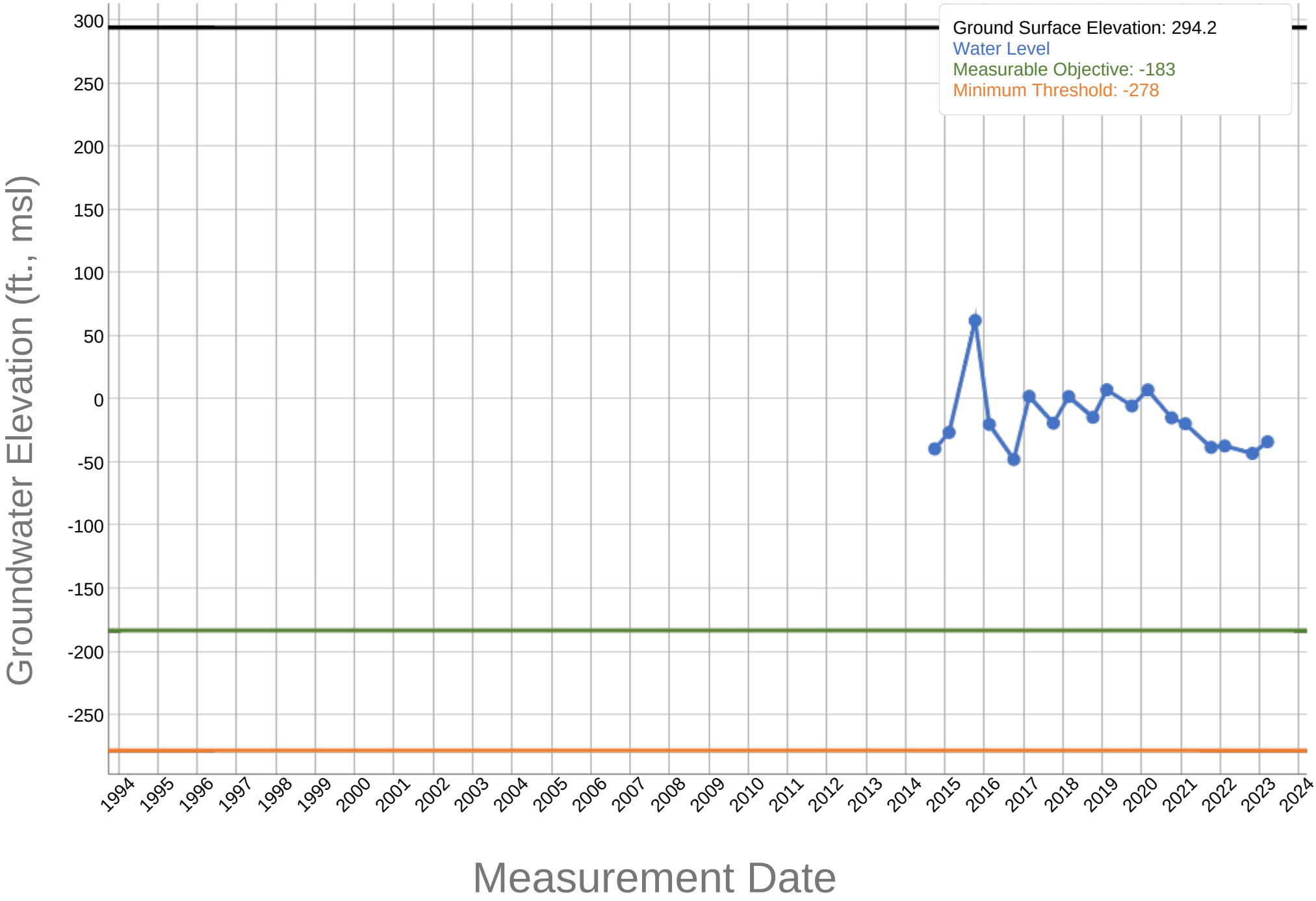
A3-84

Southern San Joaquin Municipal Utility District GSA - SSJMUD 14 - 357395N1192052W001



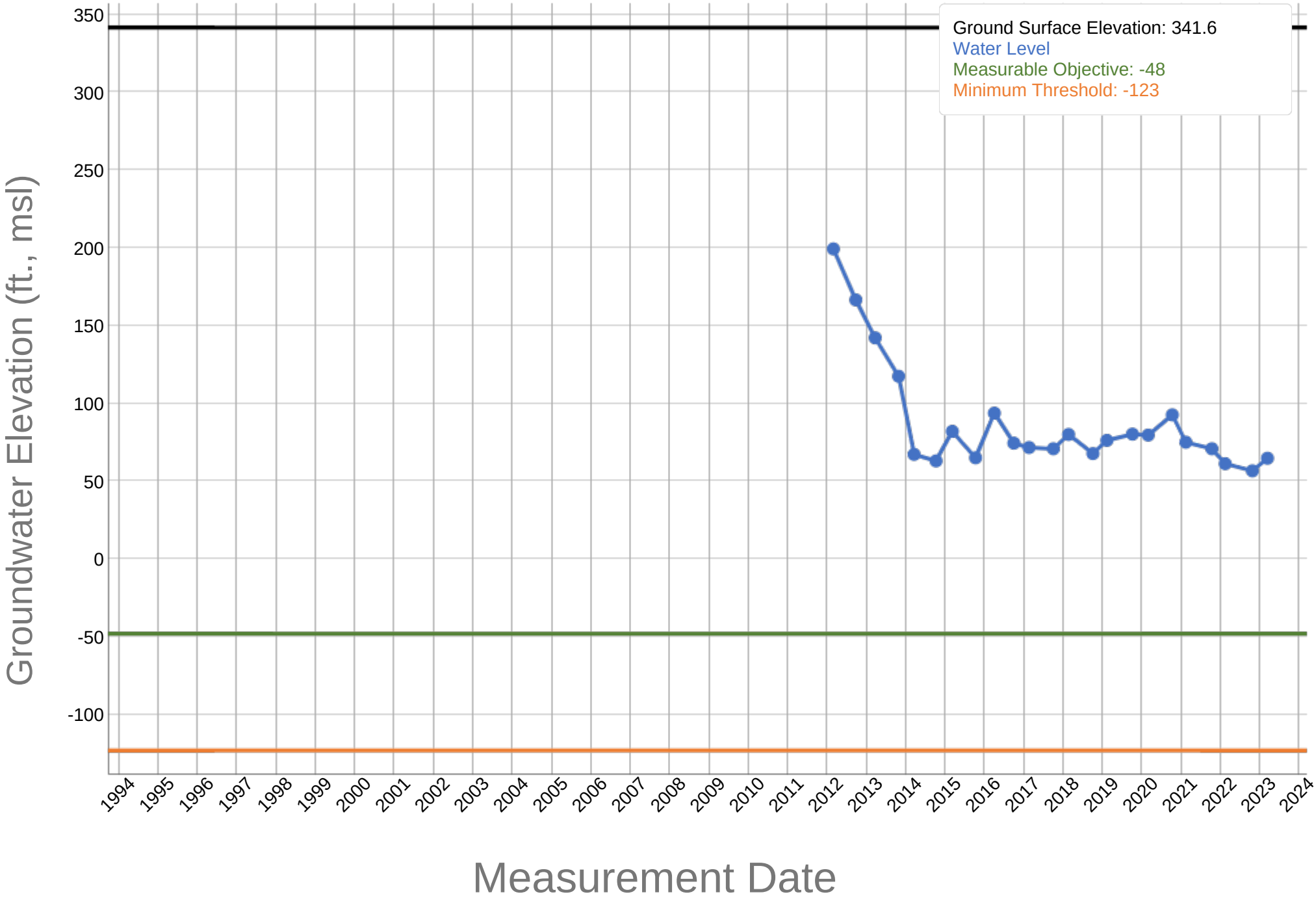
A3-85

Southern San Joaquin Municipal Utility District GSA - SSJMUD 23 - 357185N1193042W001



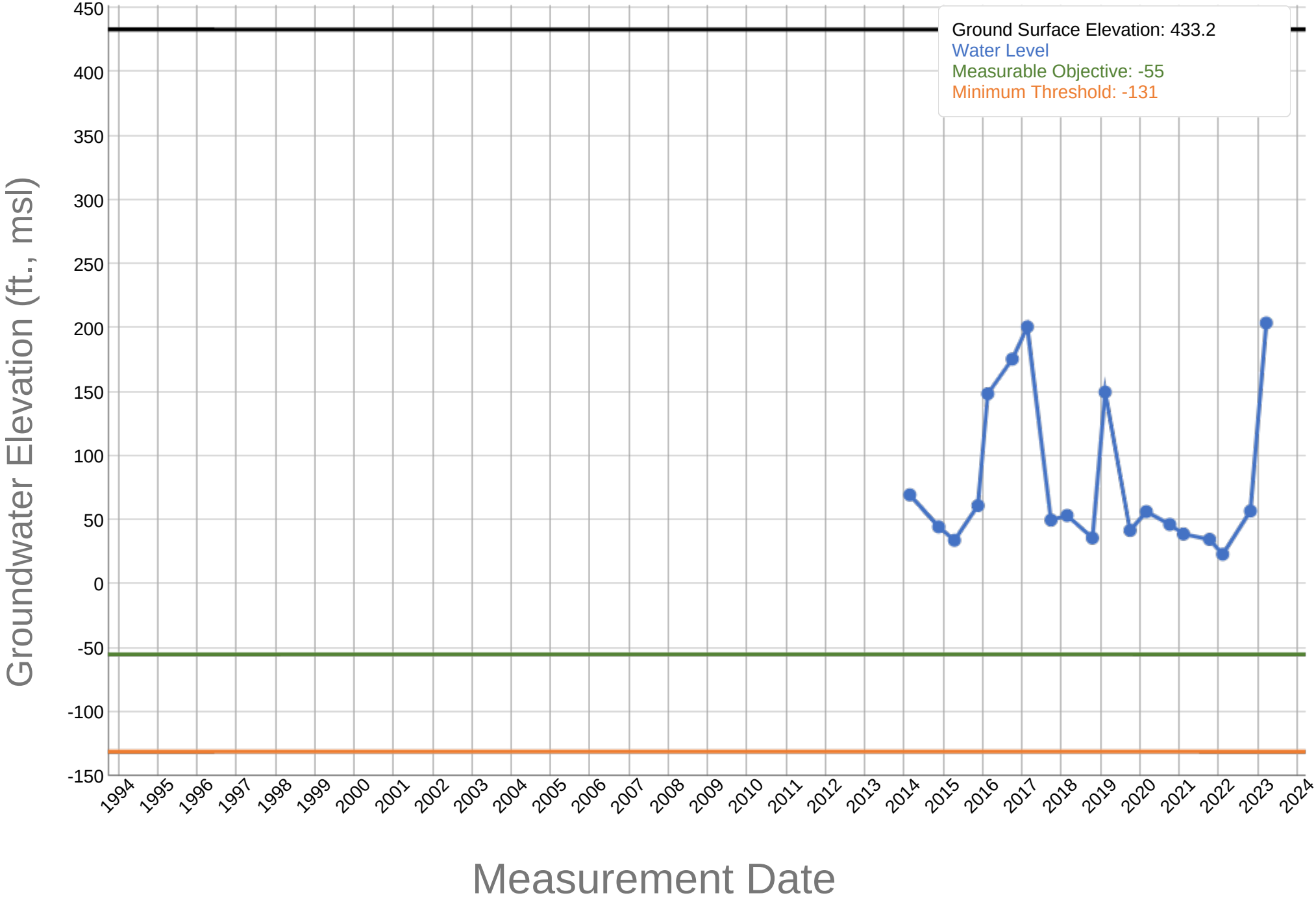
A3-86

Southern San Joaquin Municipal Utility District GSA - SSJMUD 42 - 356930N1192320W001



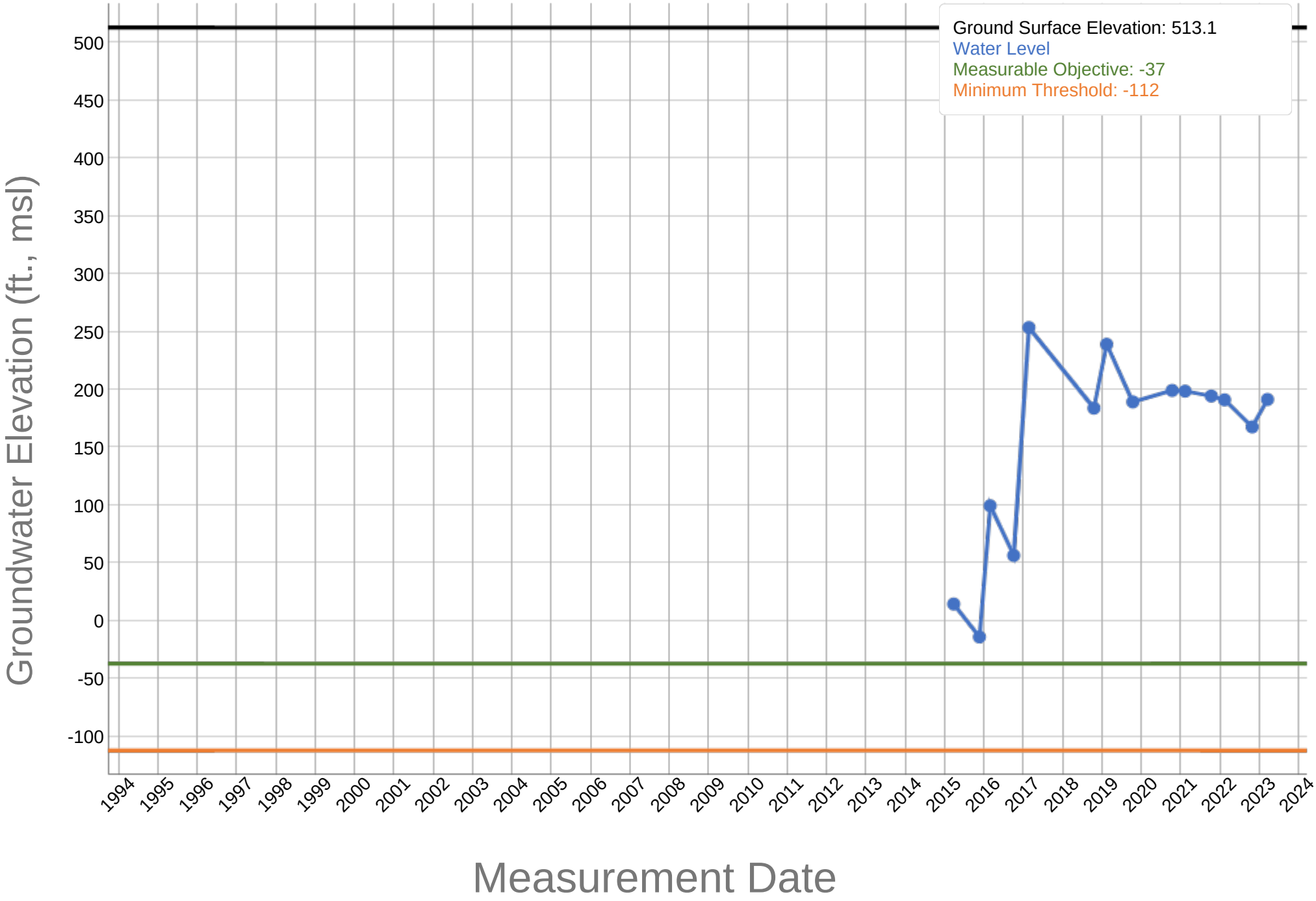
A3-87

Southern San Joaquin Municipal Utility District GSA - SSJMUD 53 - 356307N1191912W001



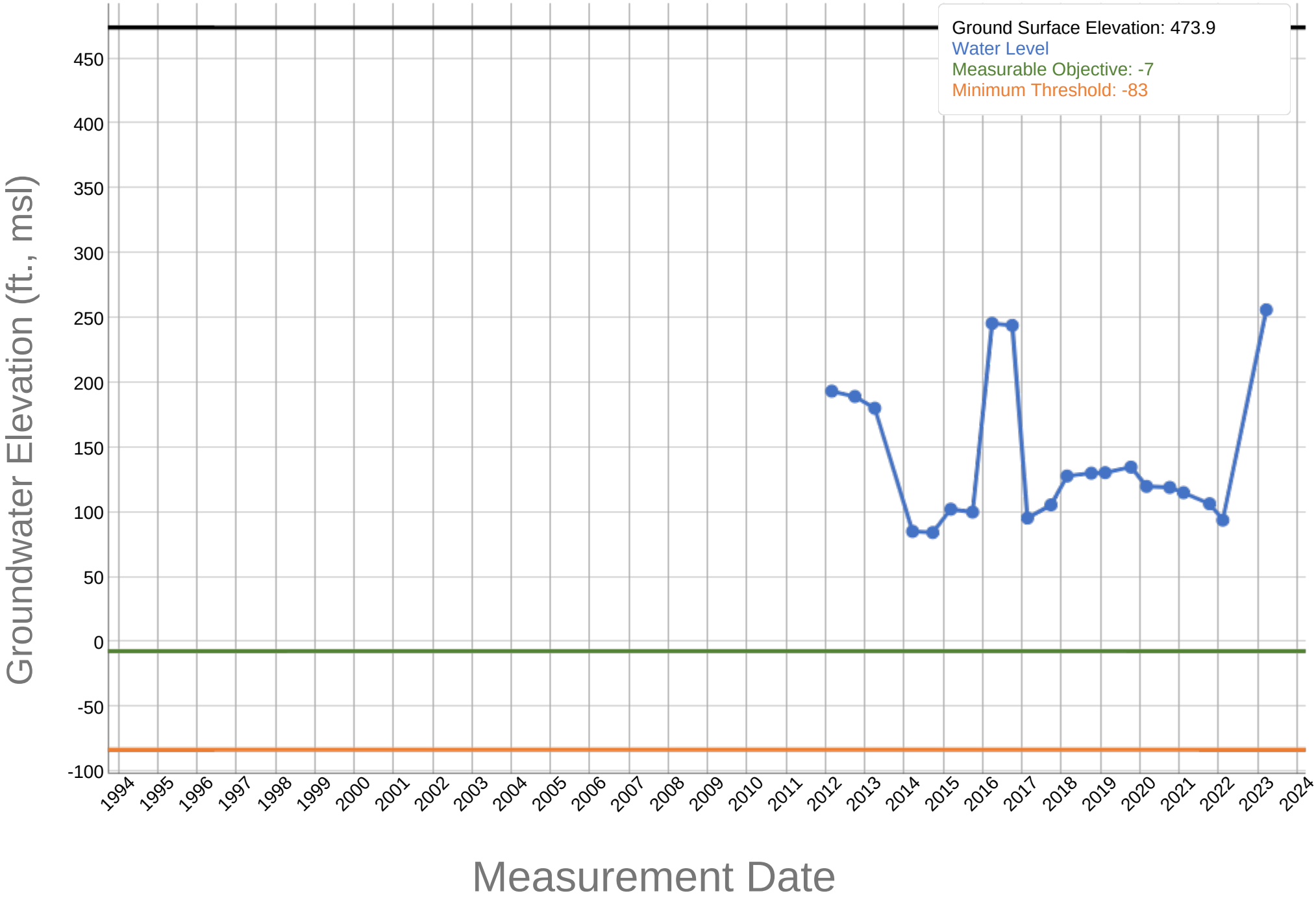
A3-88

Southern San Joaquin Municipal Utility District GSA - SSJMUD 59 - 356820N1191517W001



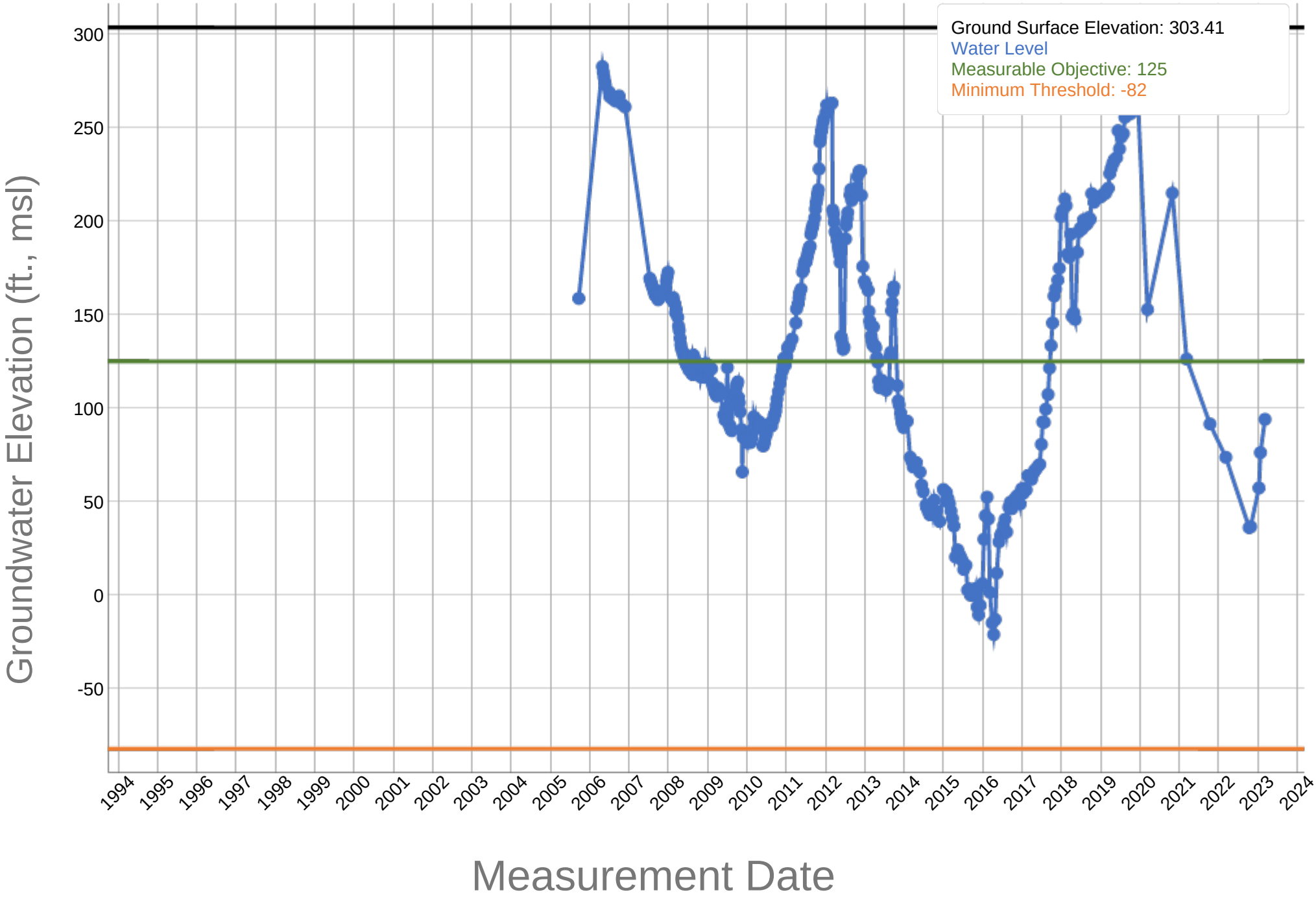
A3-89

Southern San Joaquin Municipal Utility District GSA - SSJMUD 62 - 357184N1191449W001



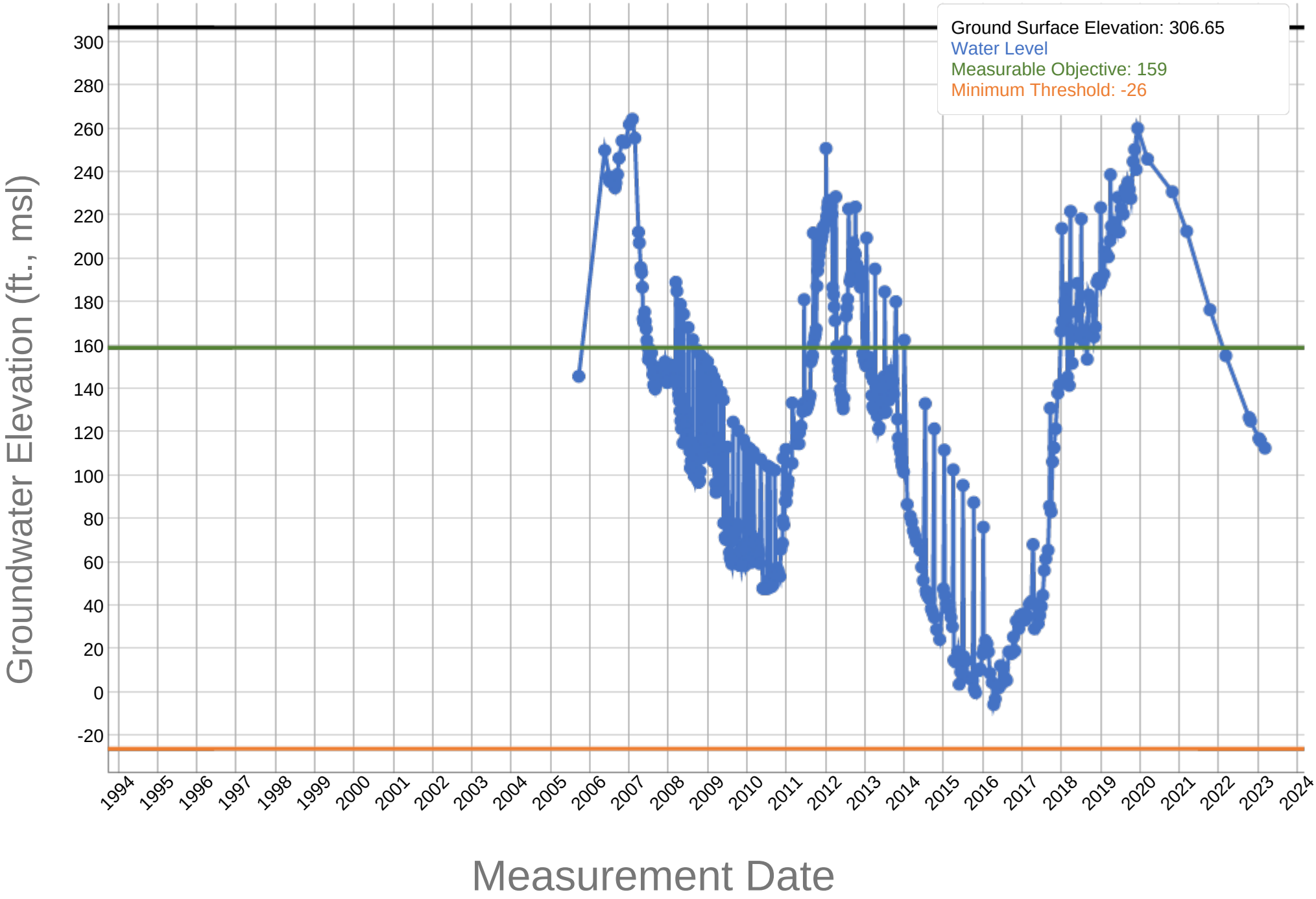
A3-90

West Kern Water District GSA - Well 6-04 - 353028N1192780W001



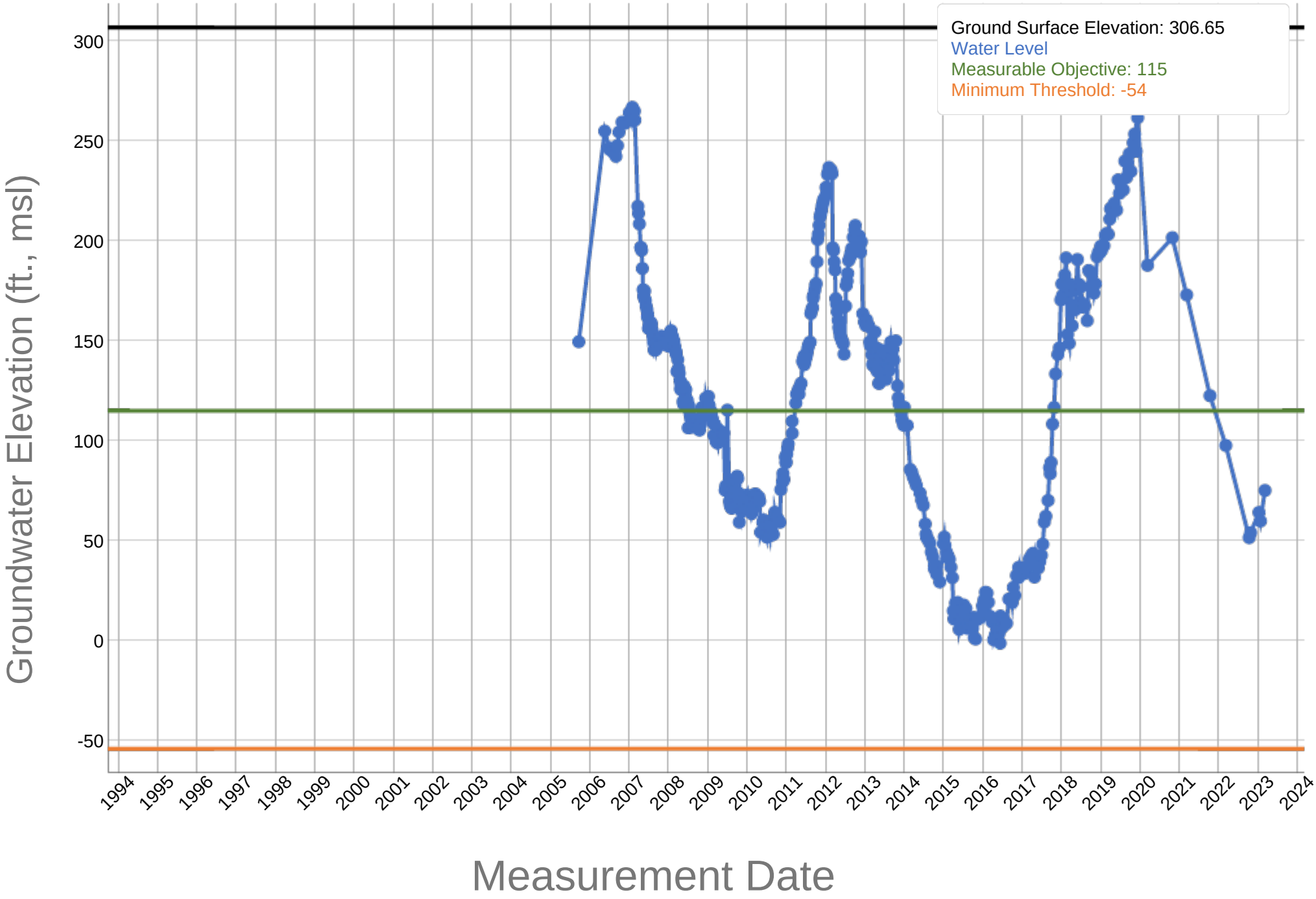
A3-91

West Kern Water District GSA - 21L-S - 353020N1193011W001



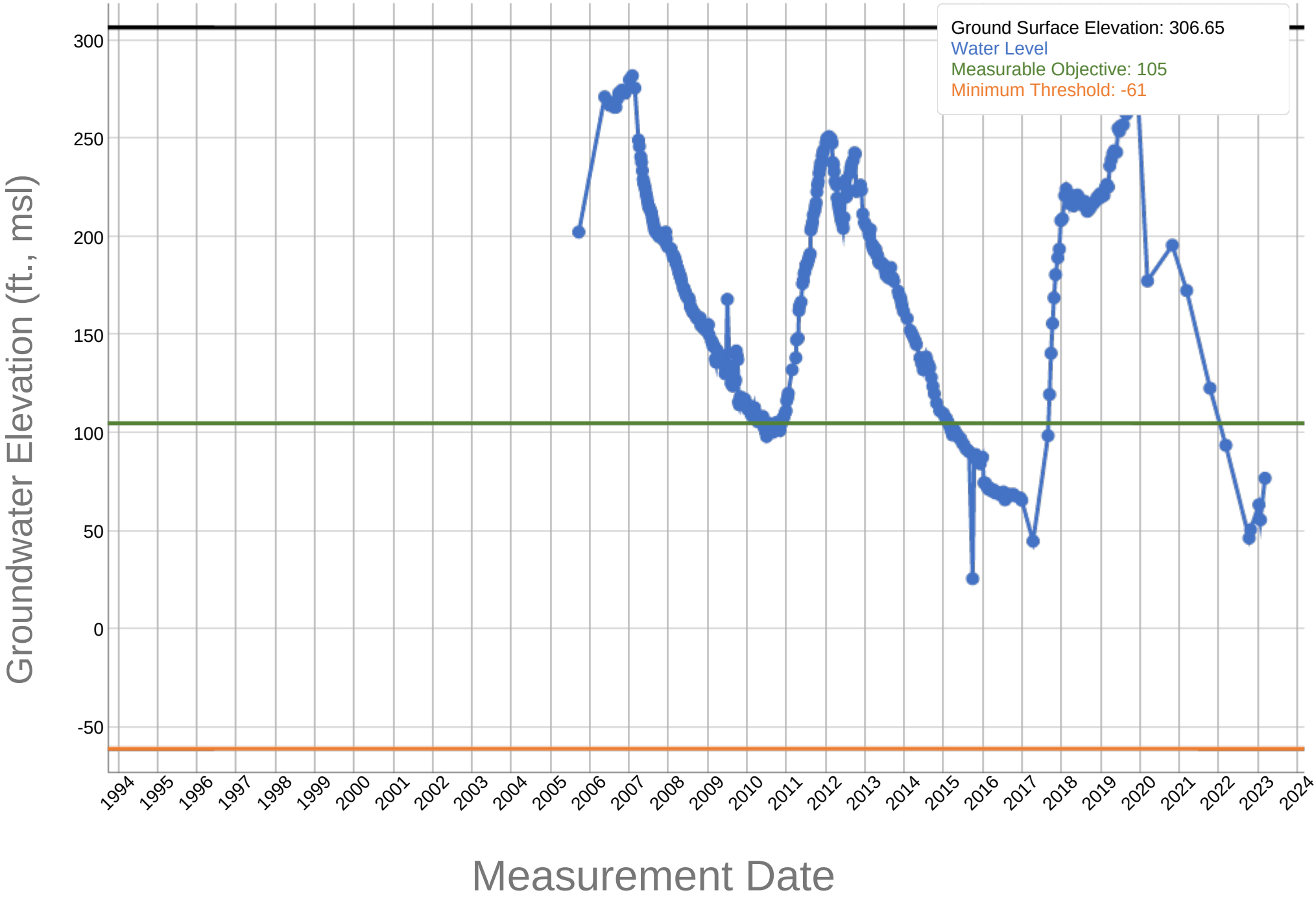
A3-92

West Kern Water District GSA - 21L-M - 353020N1193011W002



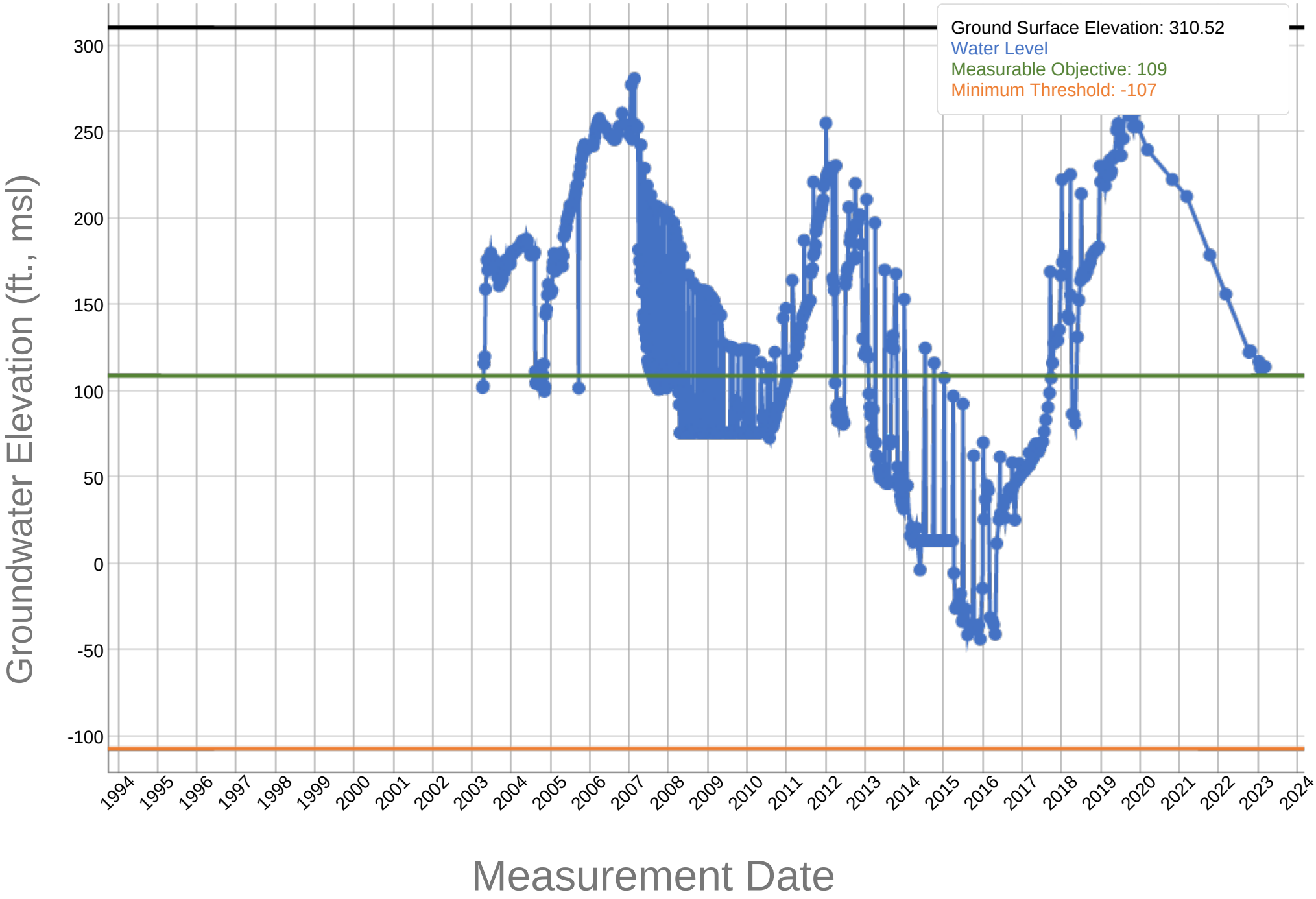
A3-93

West Kern Water District GSA - 21L-D - 353020N1193011W003



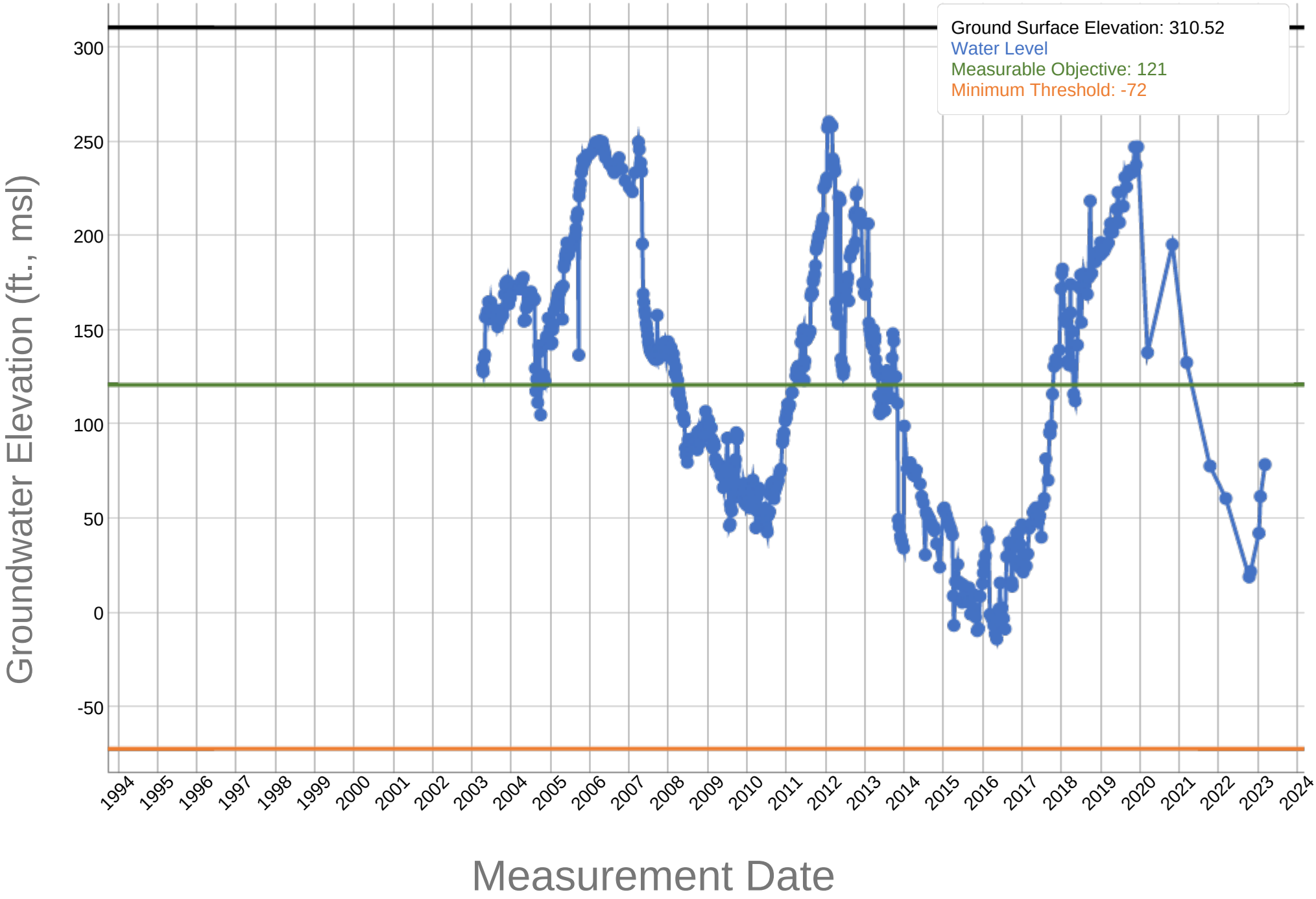
A3-94

West Kern Water District GSA - 21R-S - 352967N1192895W001



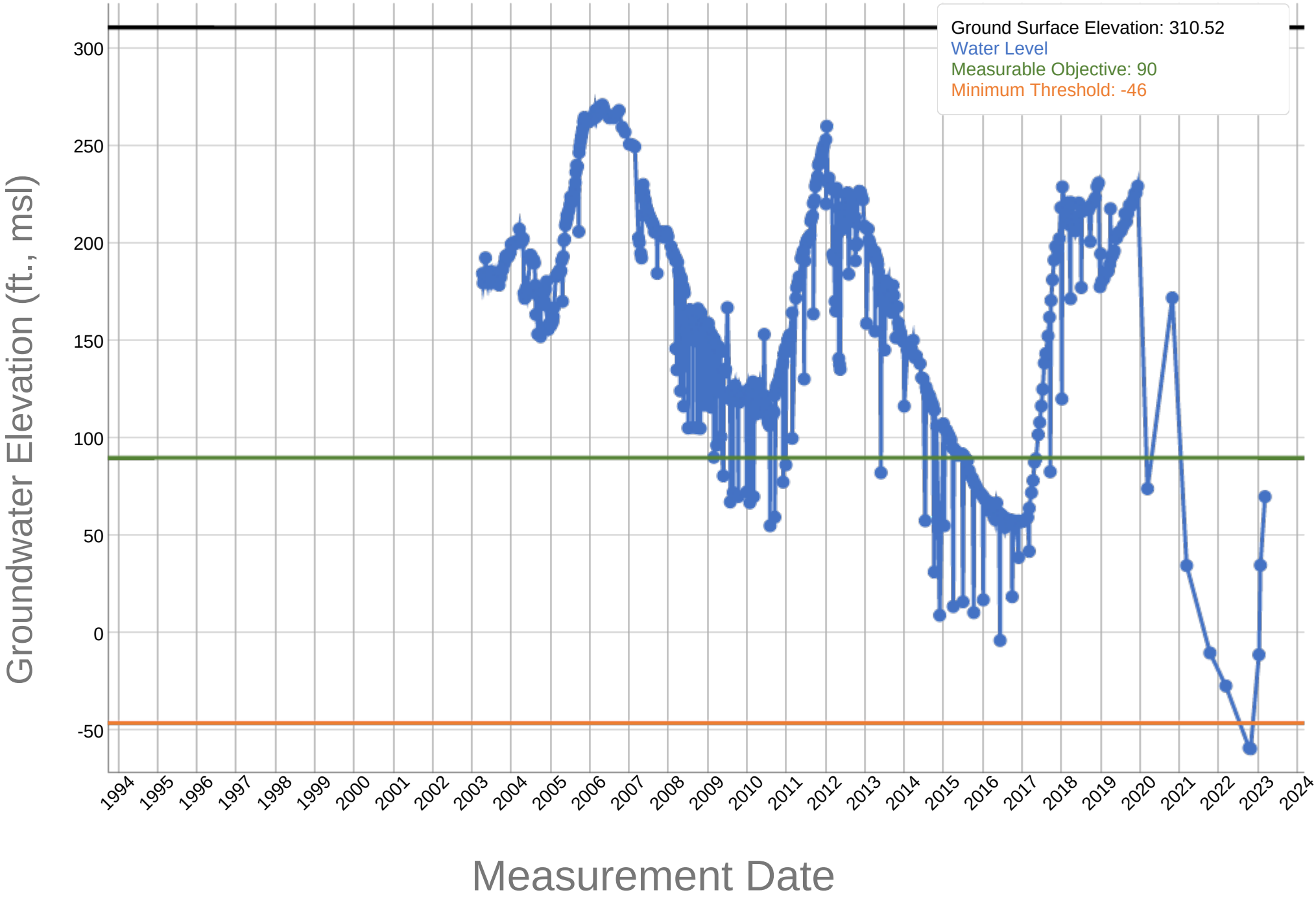
A3-95

West Kern Water District GSA - 21R-M - 352967N1192895W002



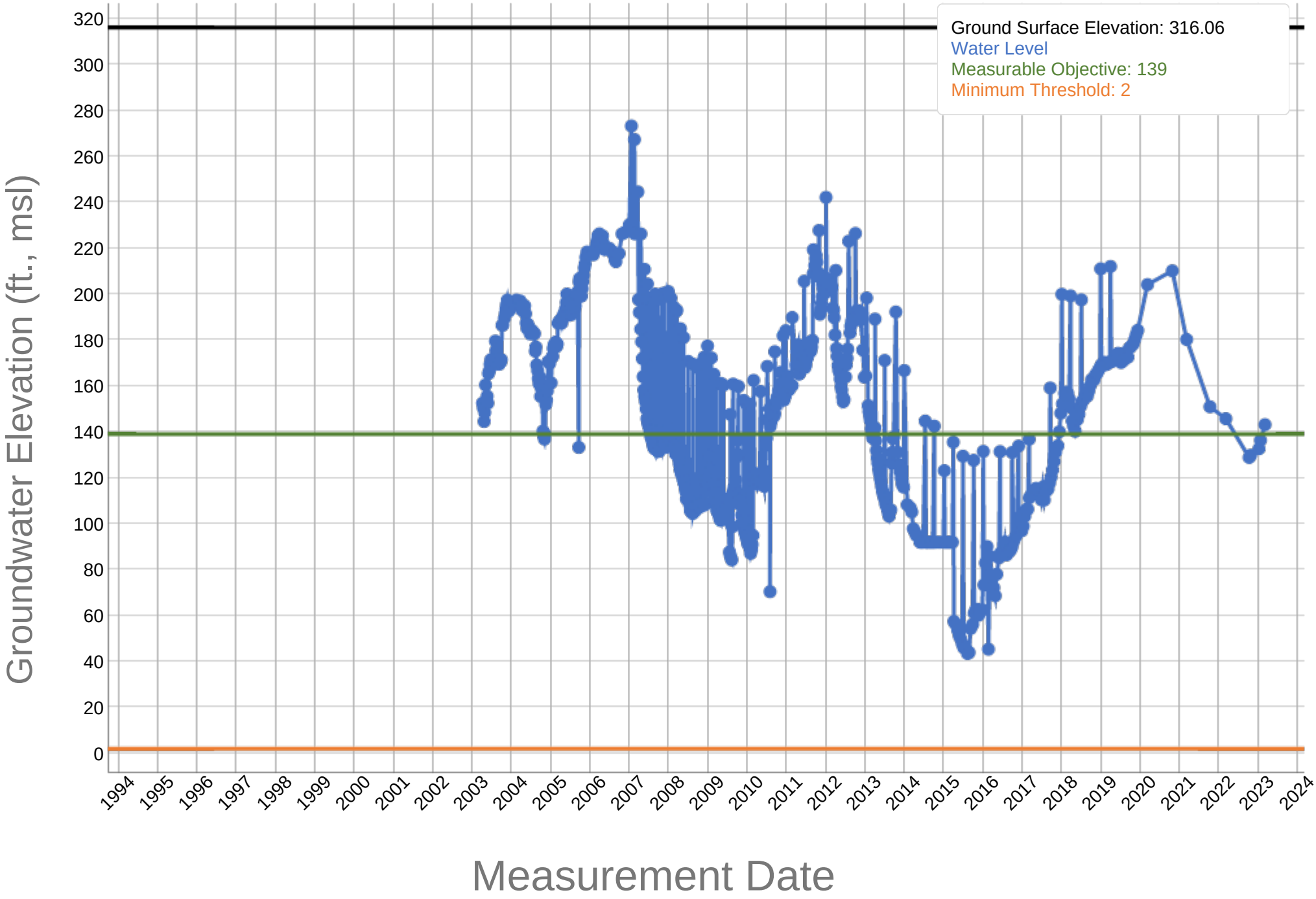
A3-96

West Kern Water District GSA - 21R-D - 352967N1192895W003



A3-97

West Kern Water District GSA - 22K-S - 353005N1192761W001



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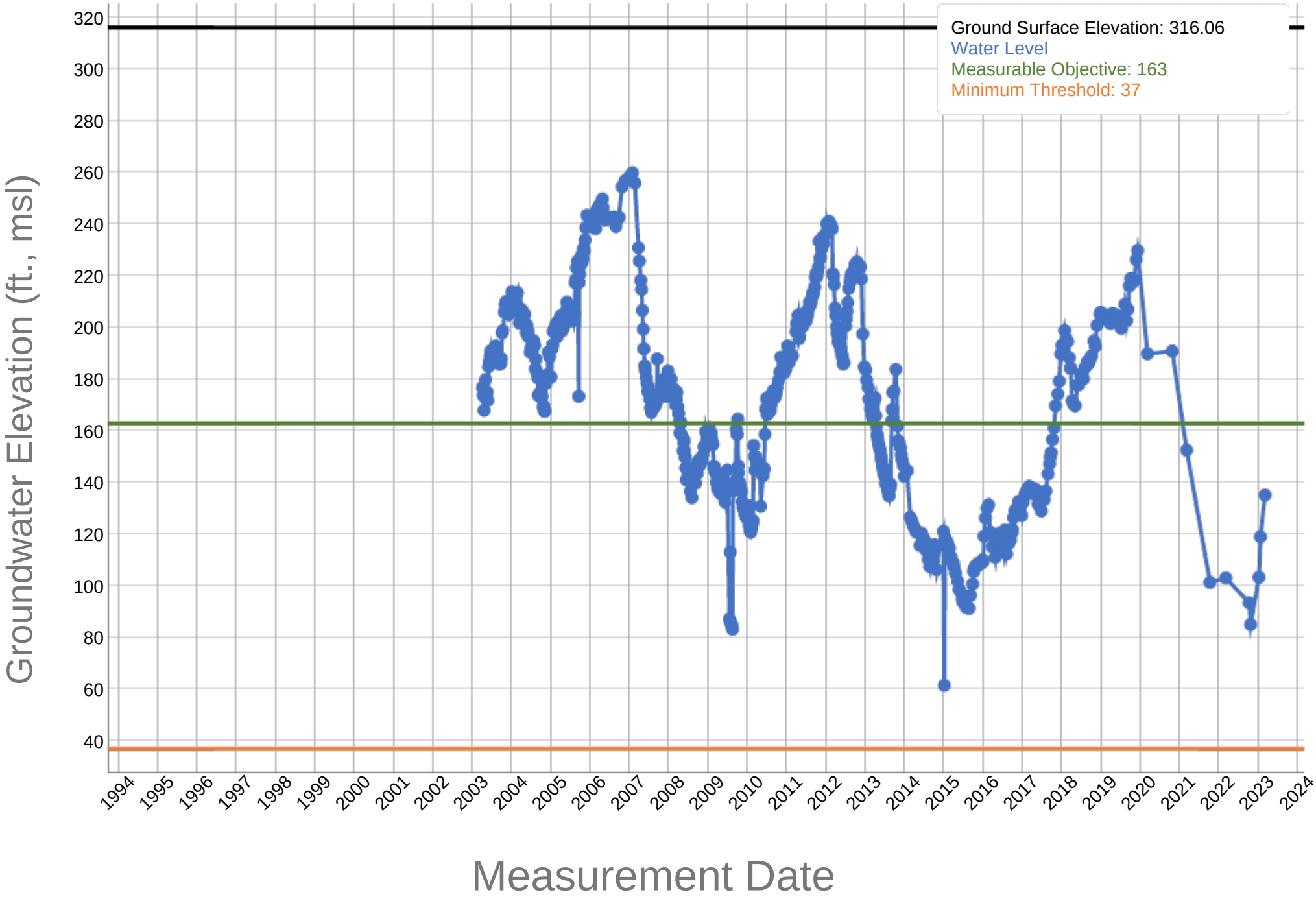
West Kern Water District GSA - 22K-M - 353005N1192761W002



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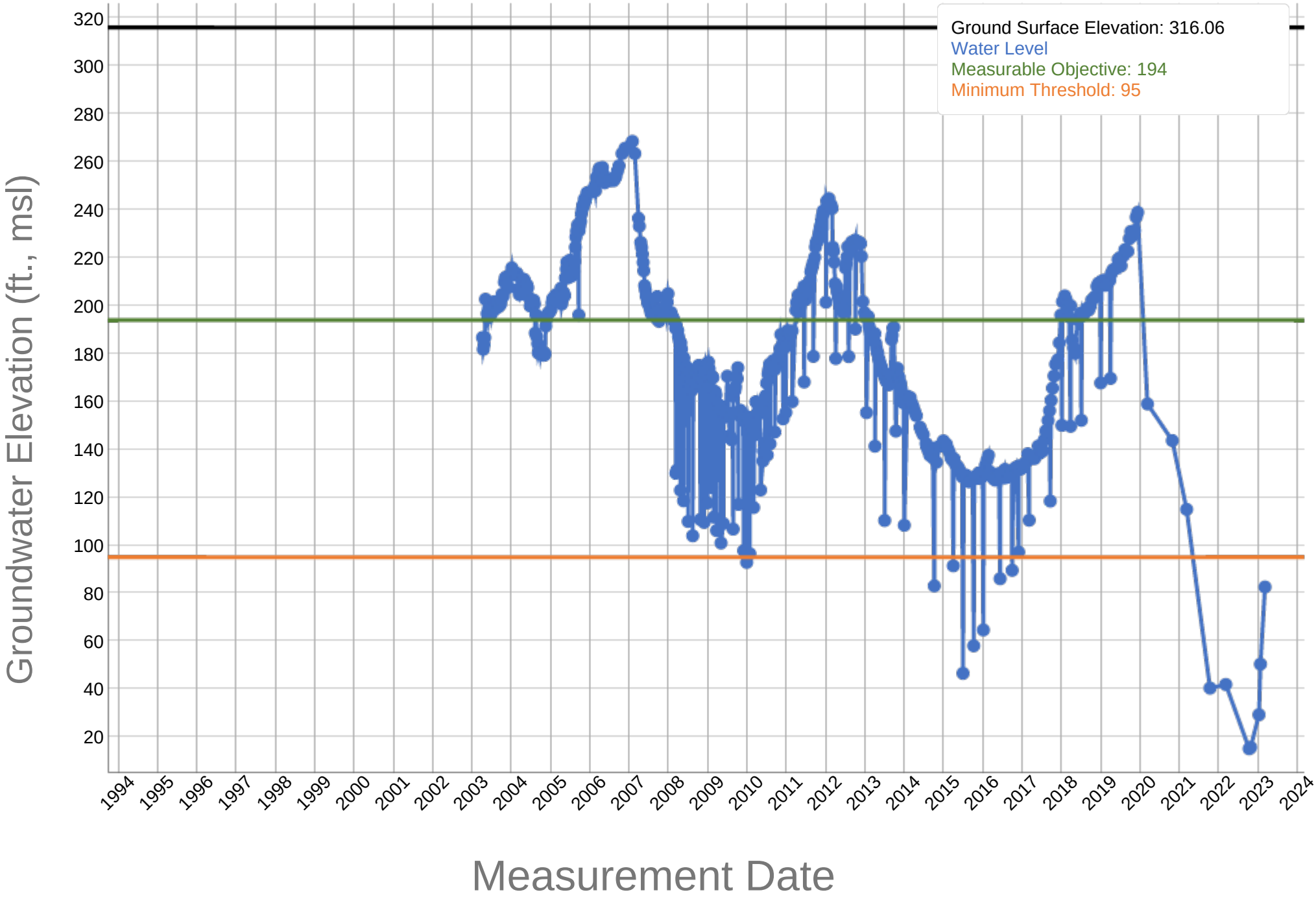

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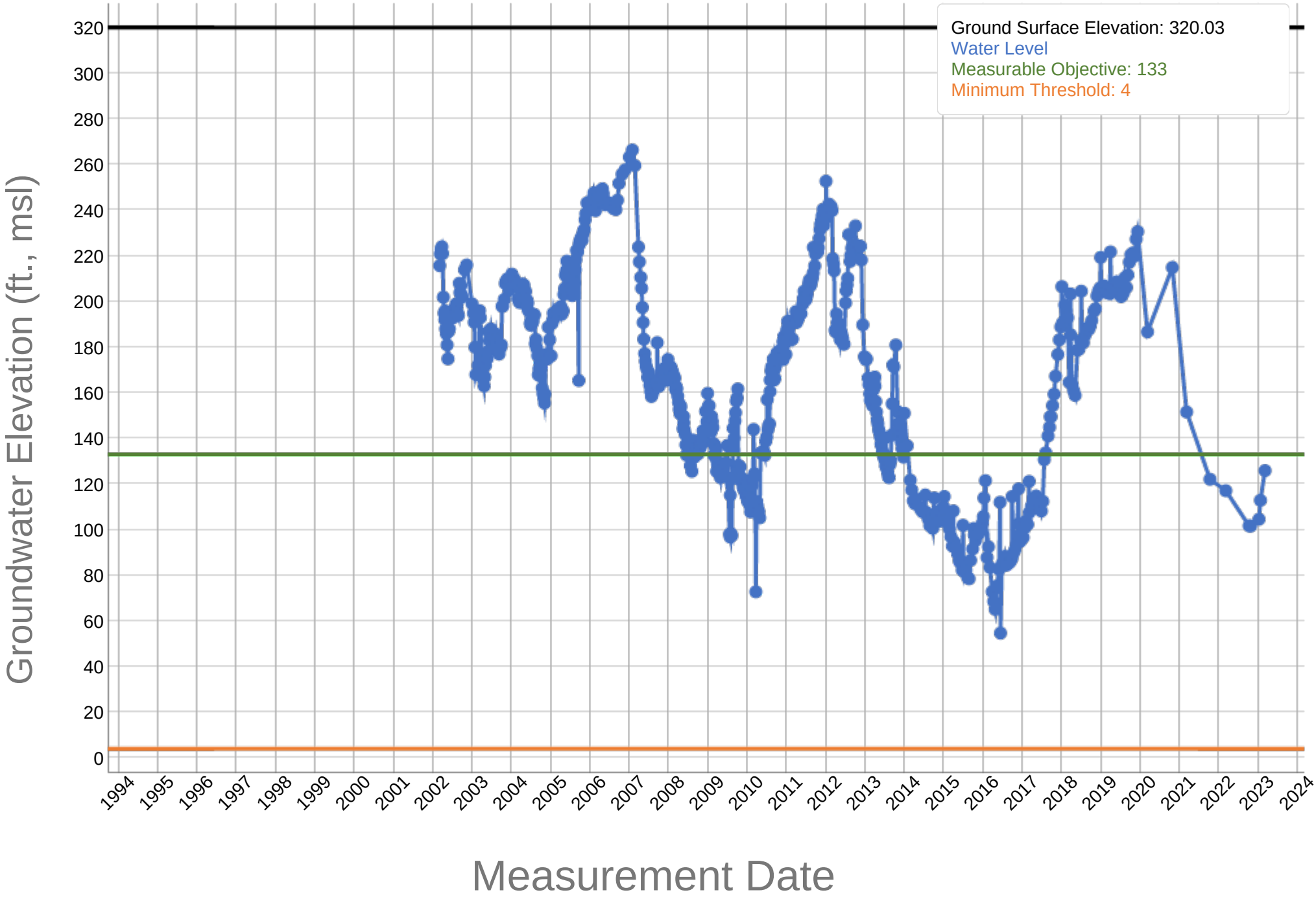

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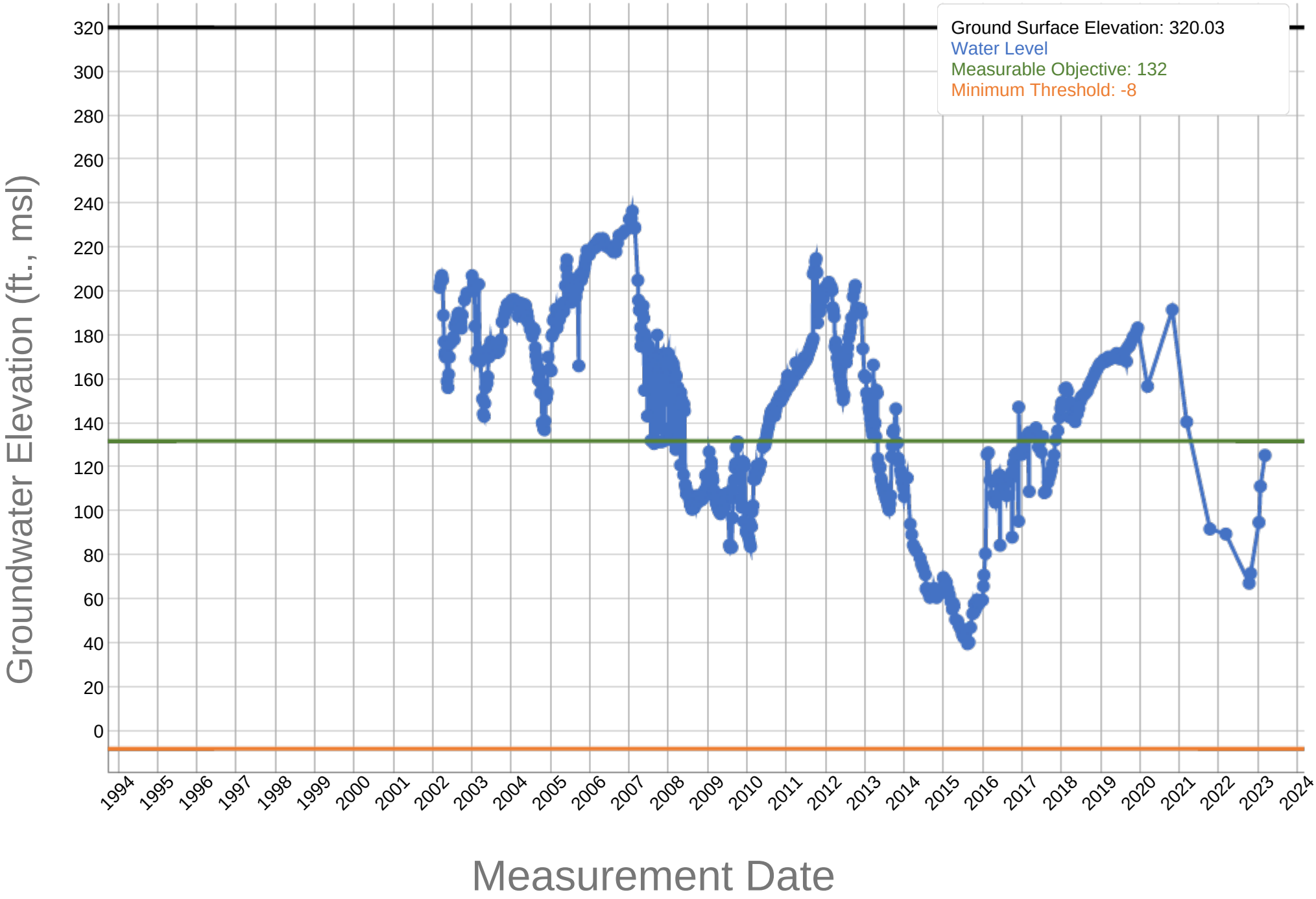
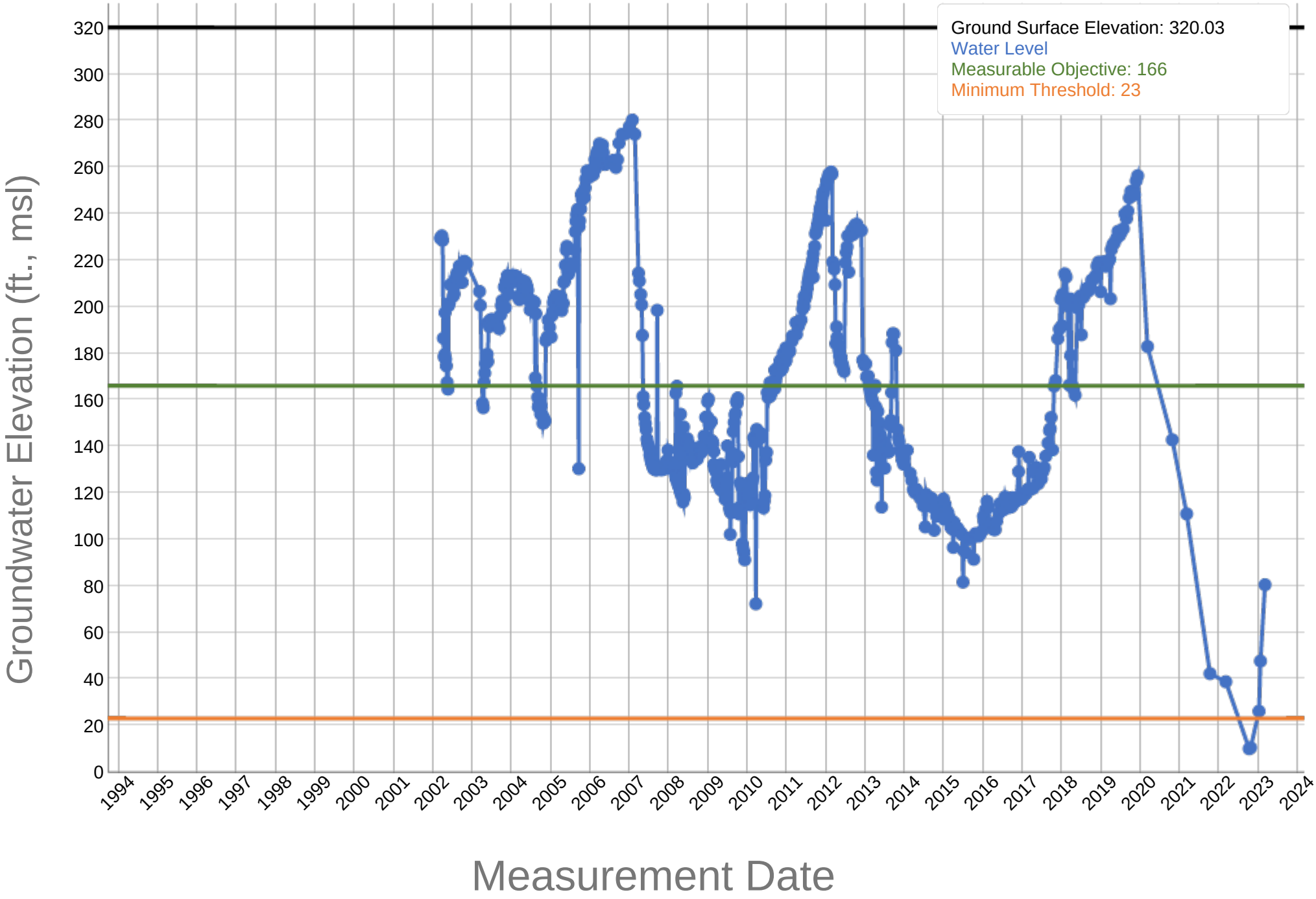


A3-102

West Kern Water District GSA - 23M-D - 353037N1192699W003



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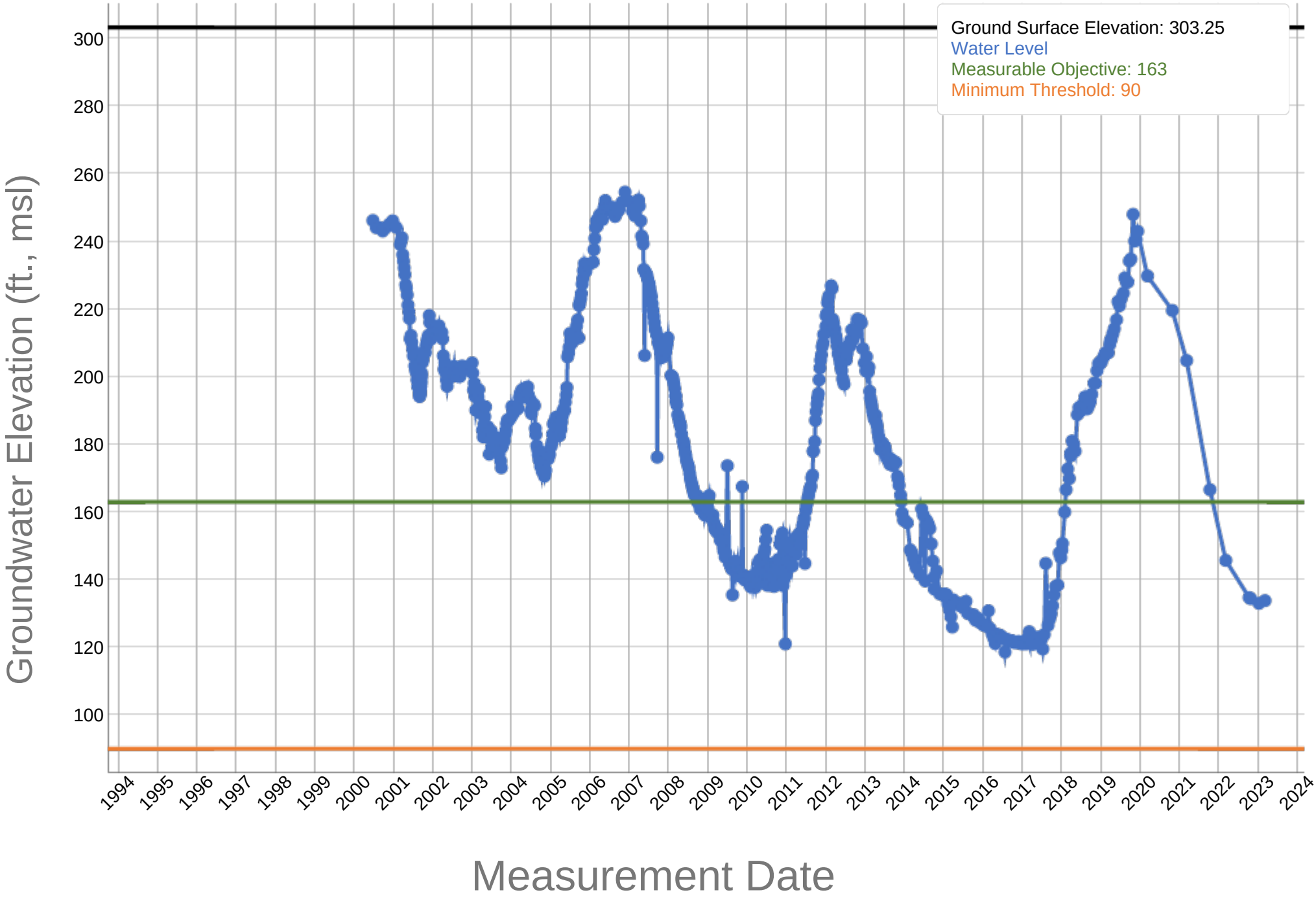
West Kern Water District GSA - 28E-S - 352895N1193032W001



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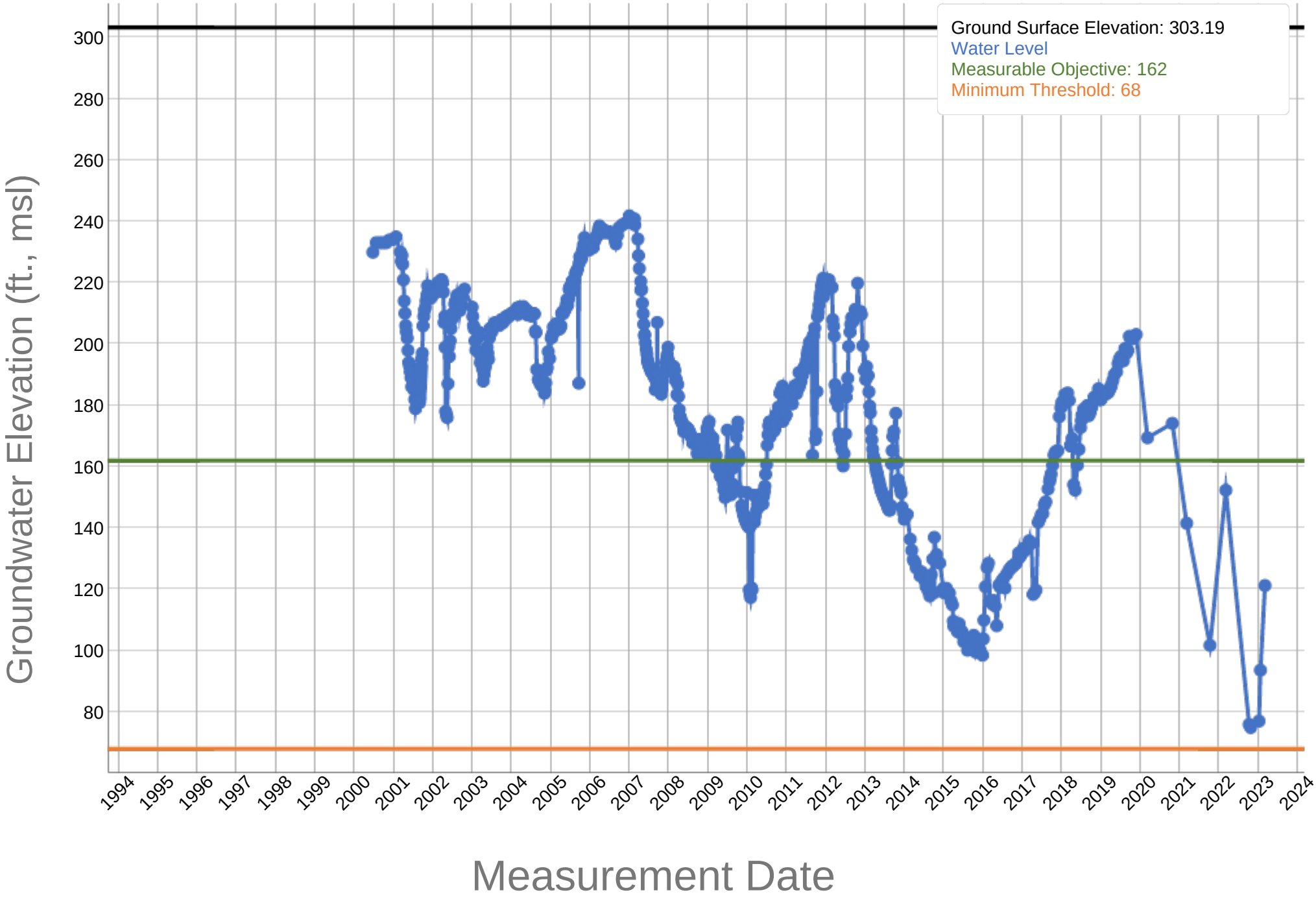

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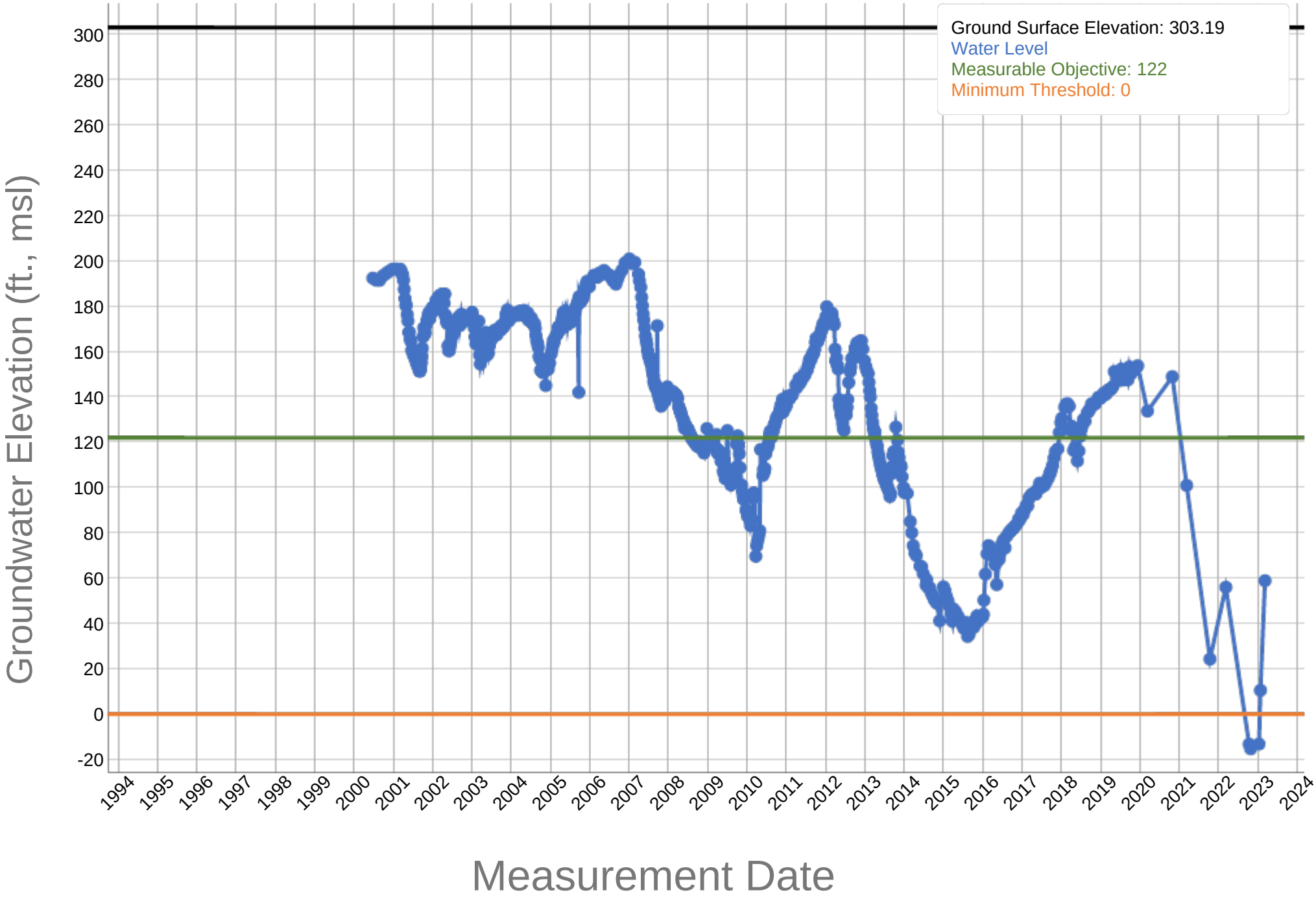

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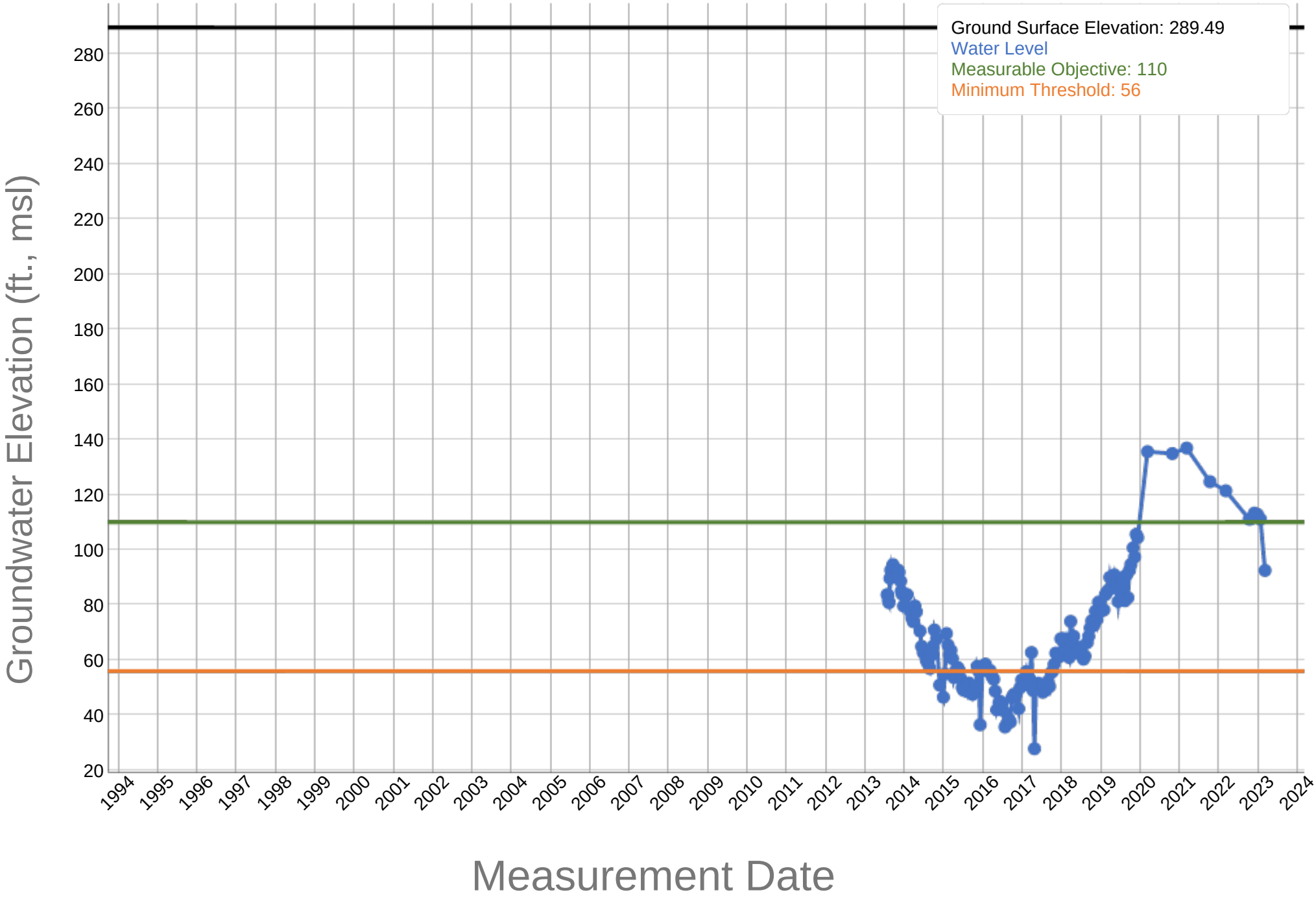
West Kern Water District GSA - NWM1-S - 353464N1193684W004



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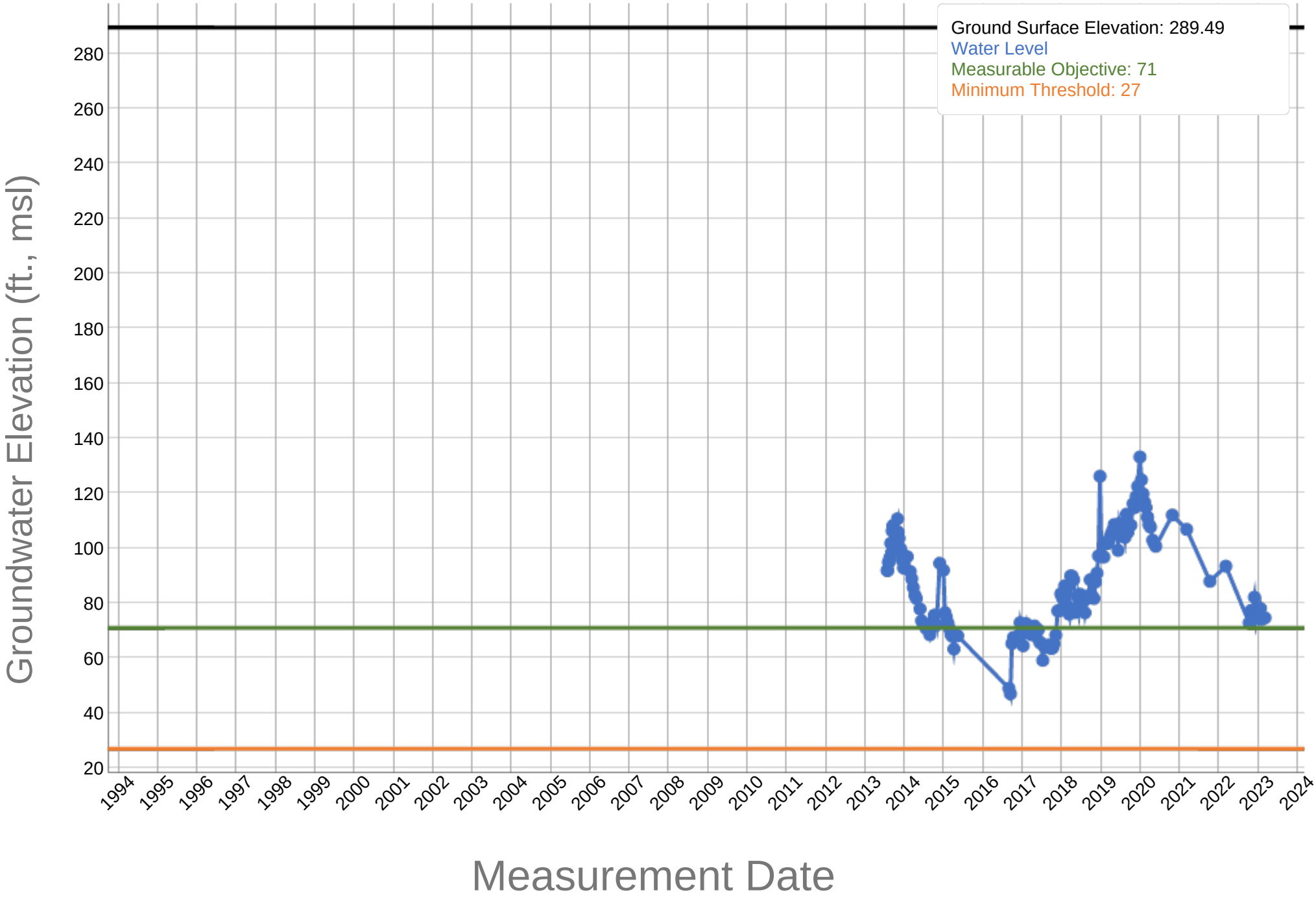

A3-108

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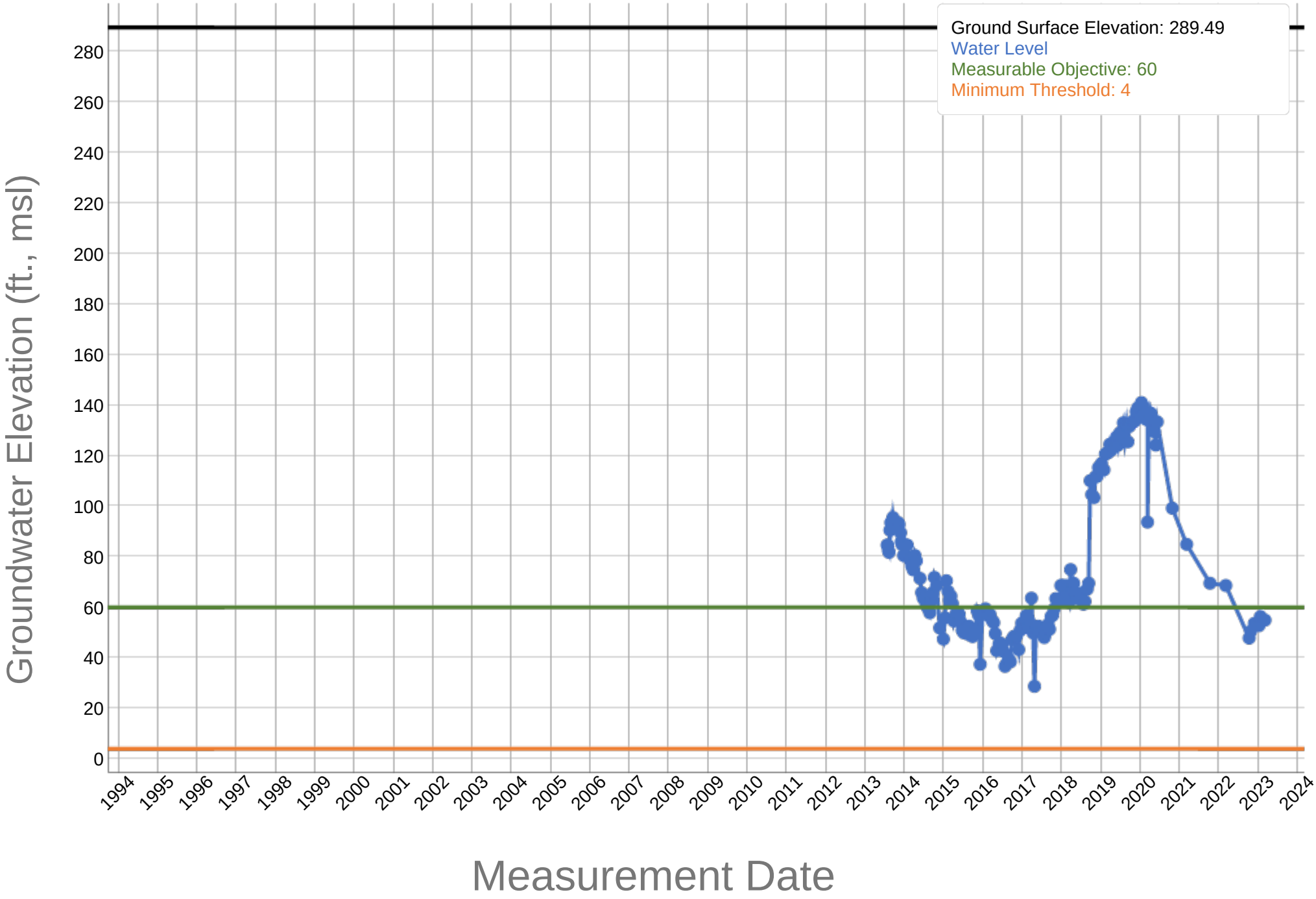
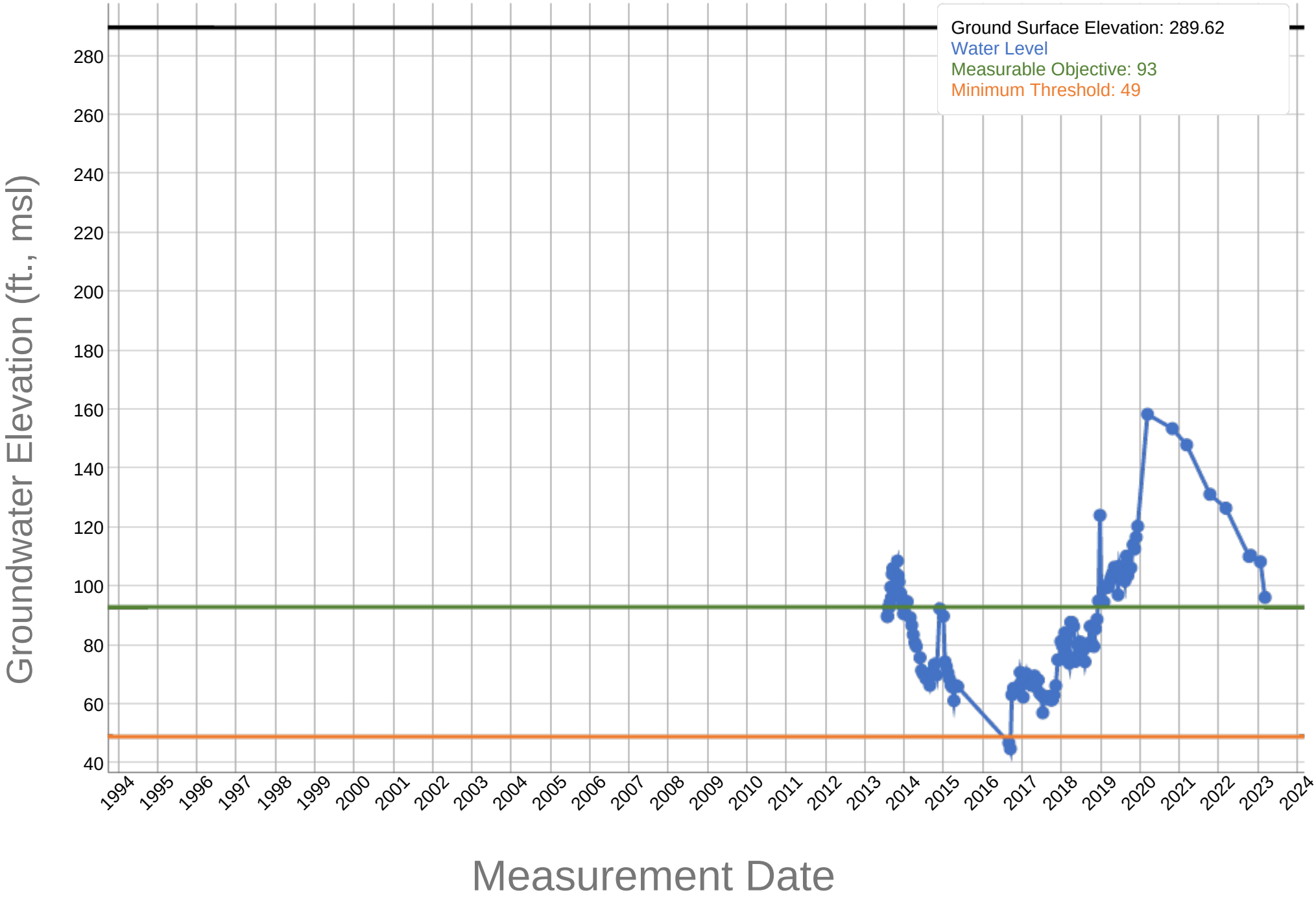


A3-109

West Kern Water District GSA - NWM2-S - 353342N1193700W004



A3-110

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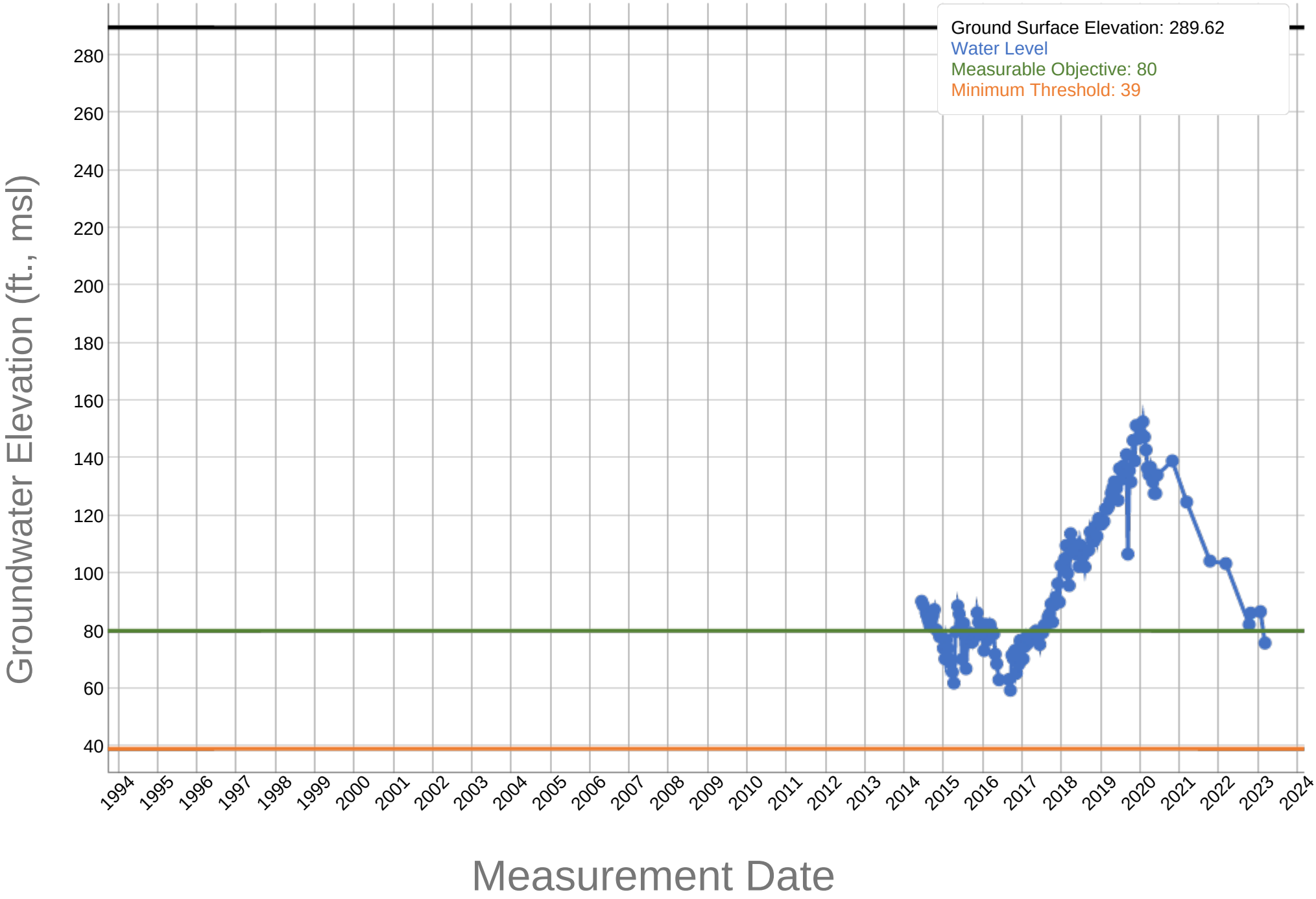
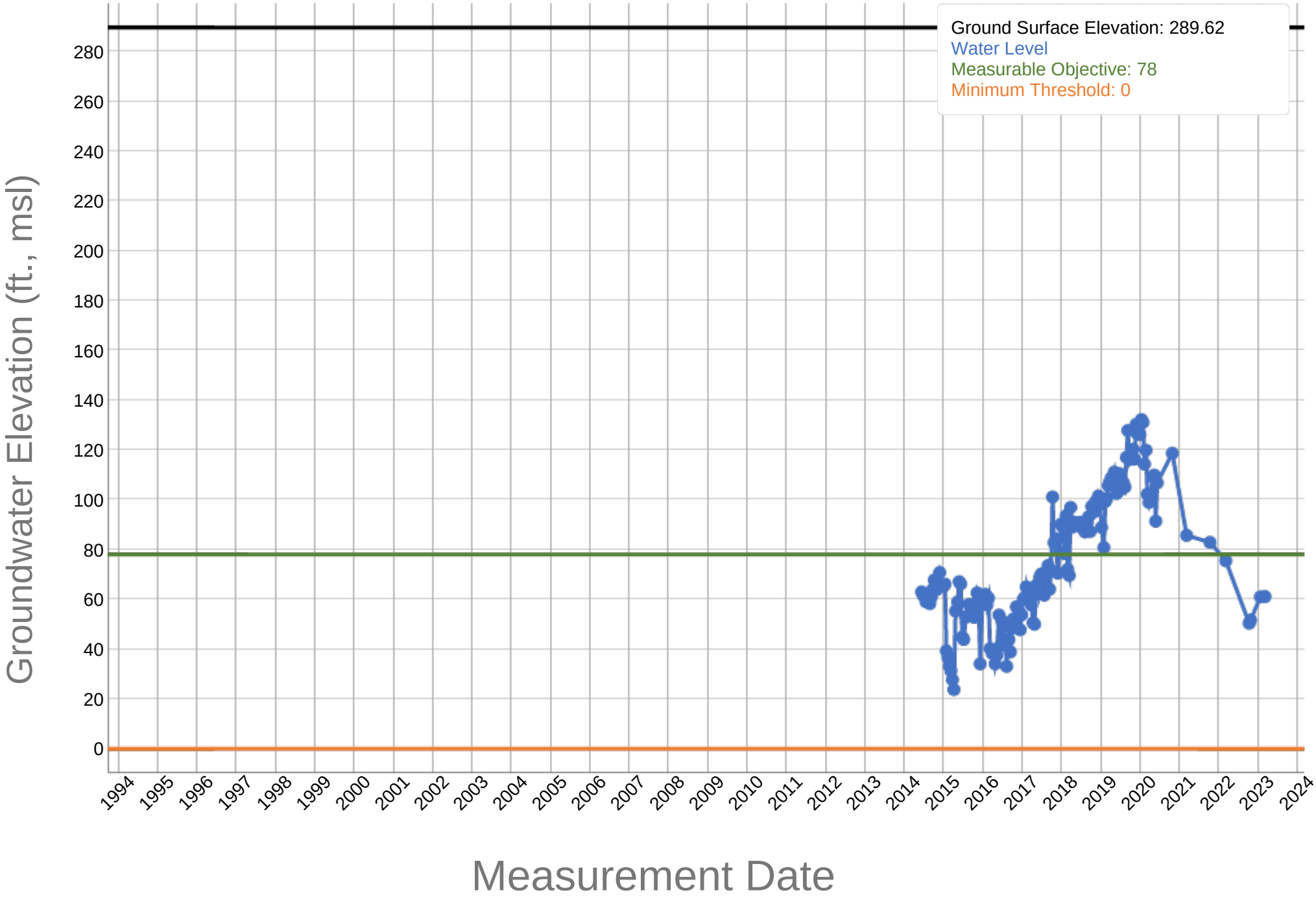


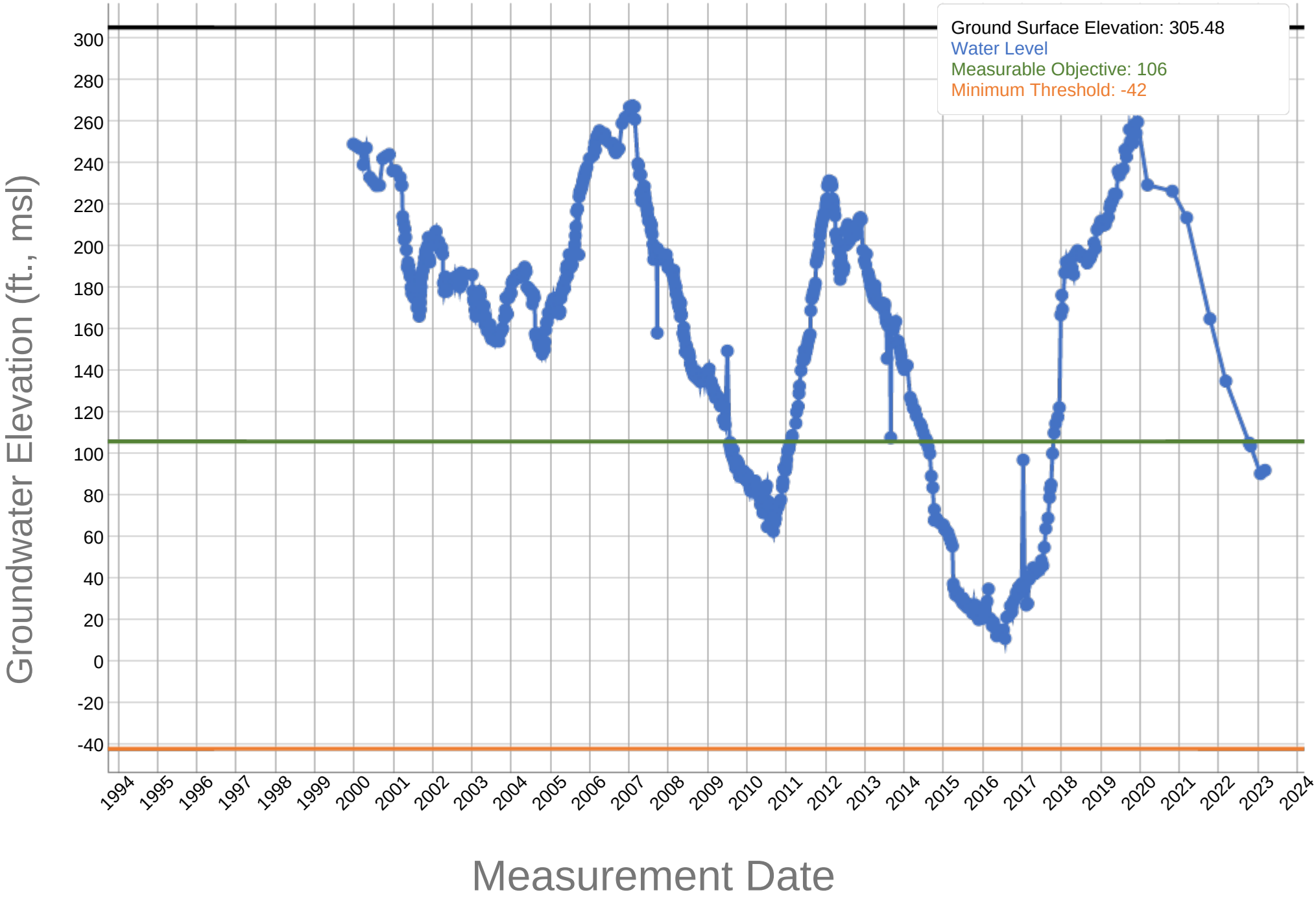
A3-111

West Kern Water District GSA - NWM2-D - 353342N1193700W007



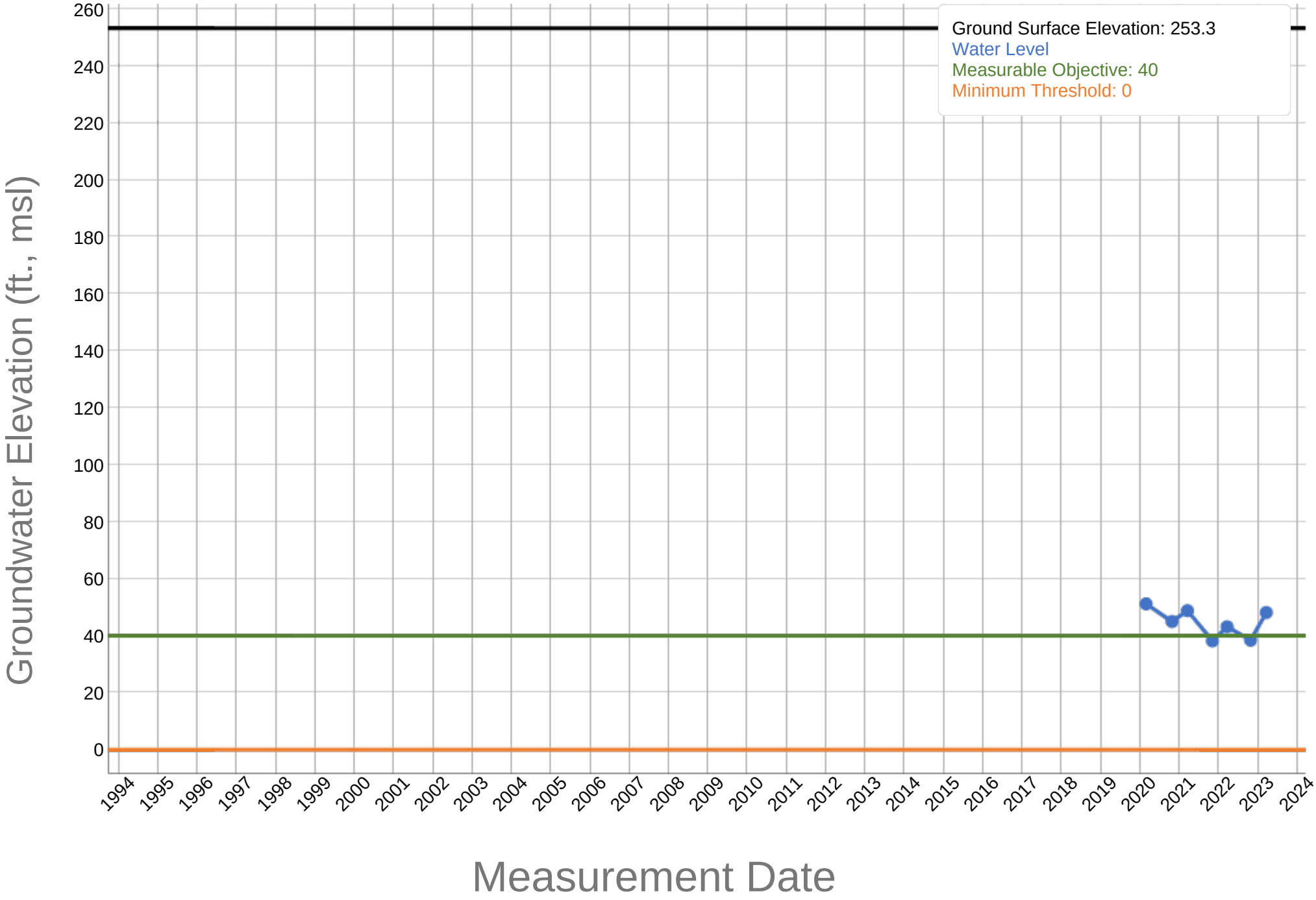
A3-112

West Kern Water District GSA - Well 7 - 352958N1193011W001



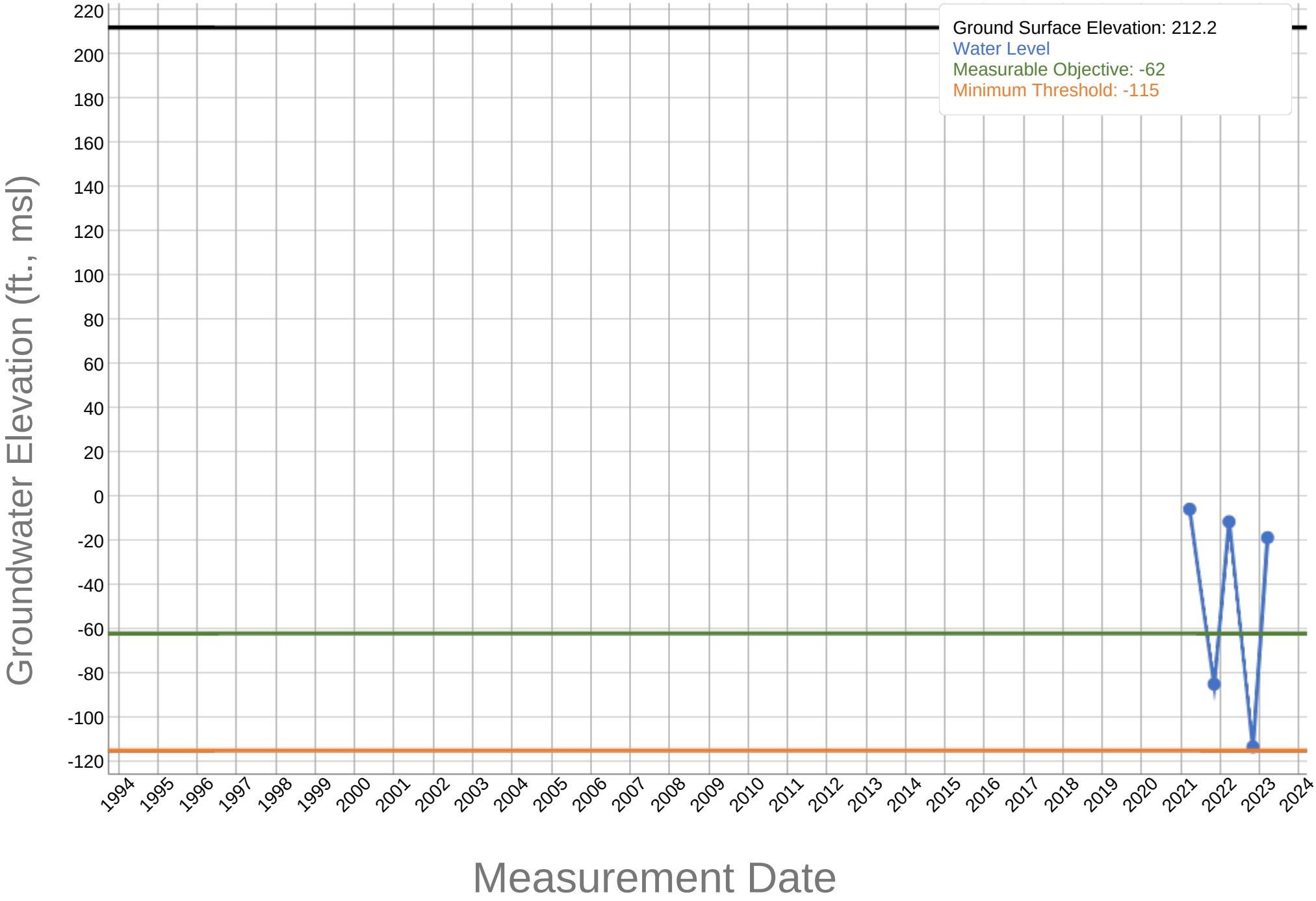
A3-113

Westside District Water Authority - 7106-63 - 355505N1196368W001



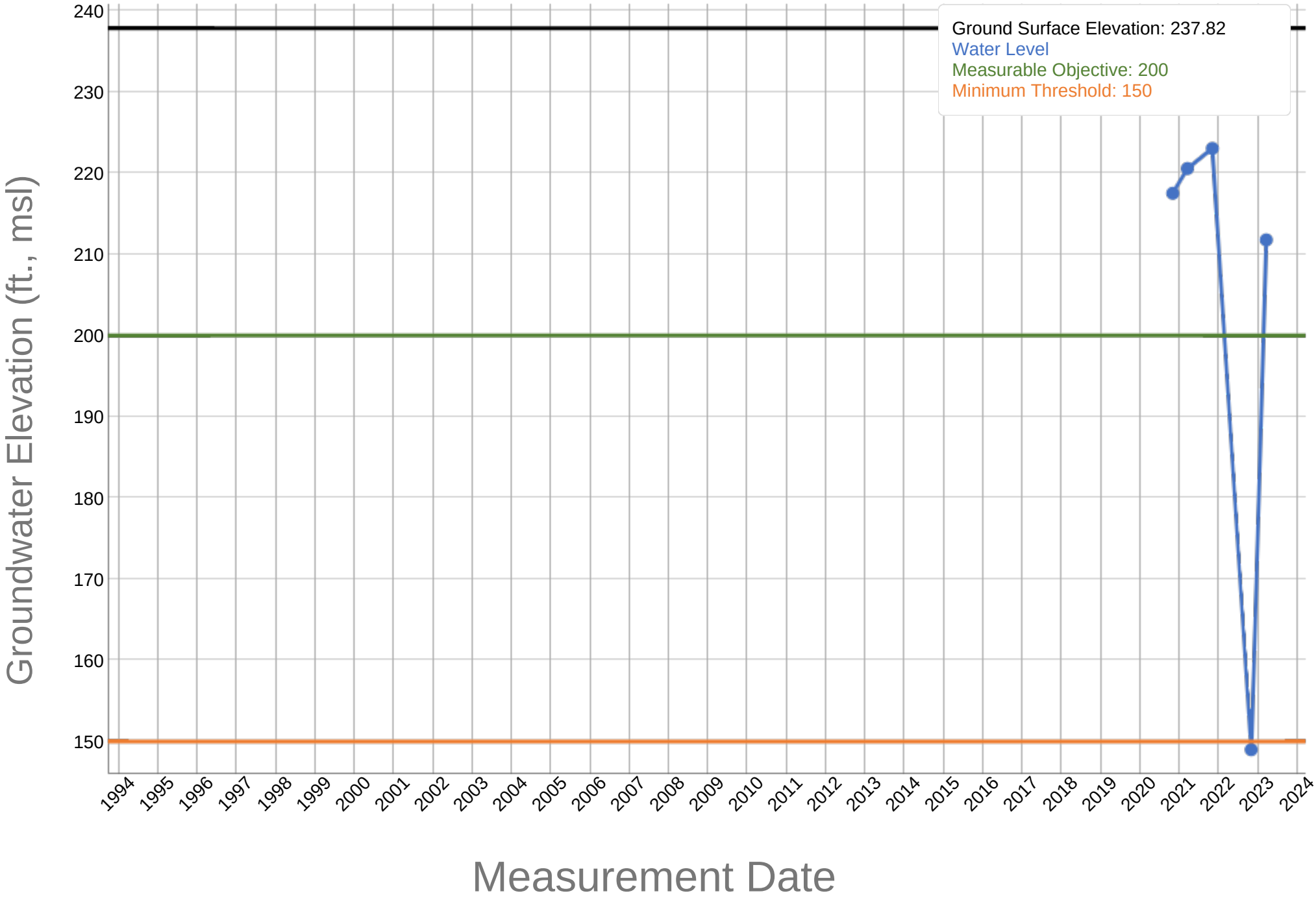
A3-114

Westside District Water Authority - 7108-66 - 357762N1196902W001



A3-115

Westside District Water Authority - S#14 - 356675N1196724W001



APPENDIX A4

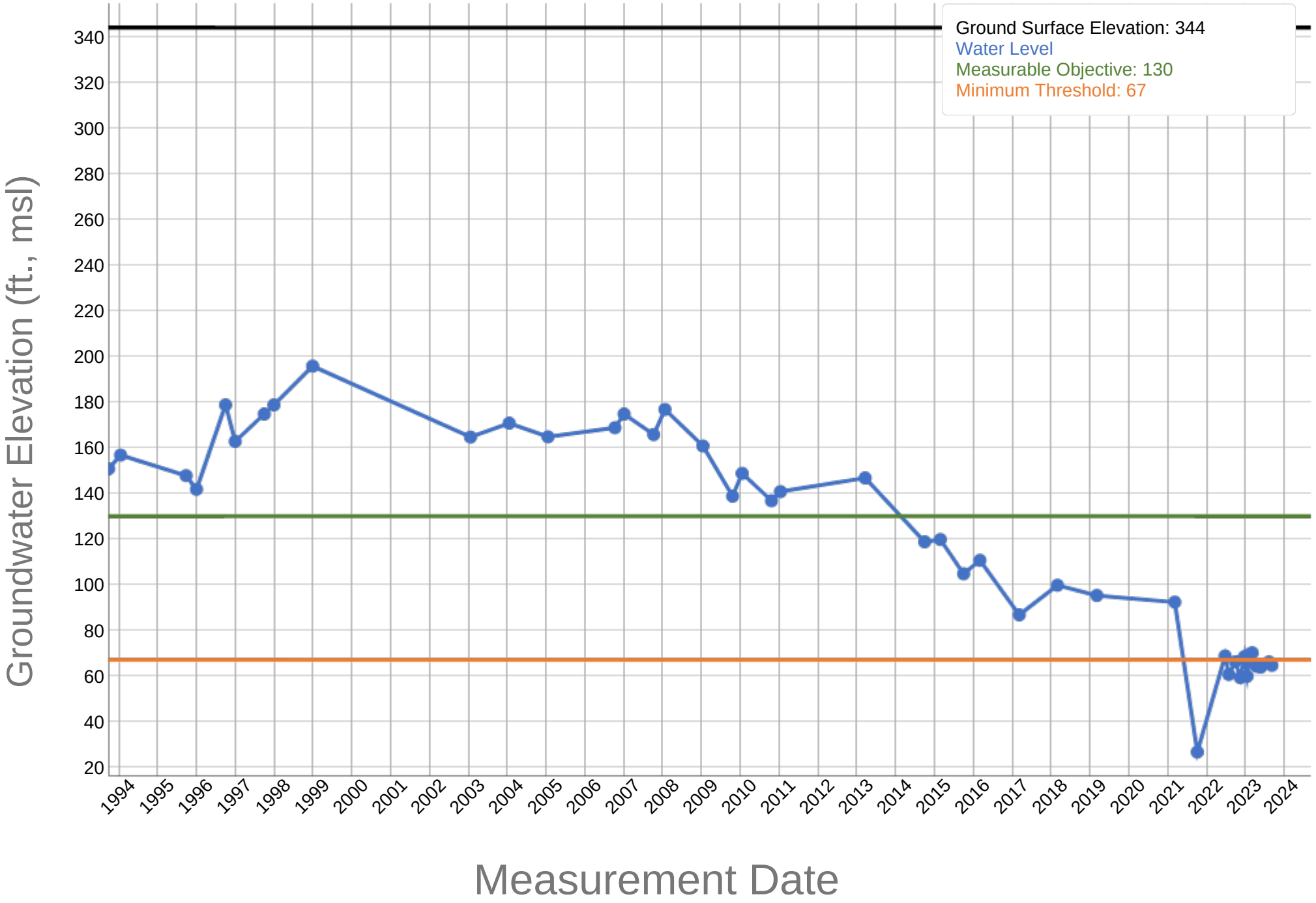
Hydrographs of Groundwater Elevations

GSP Monitoring Network Wells

Kern River GSA

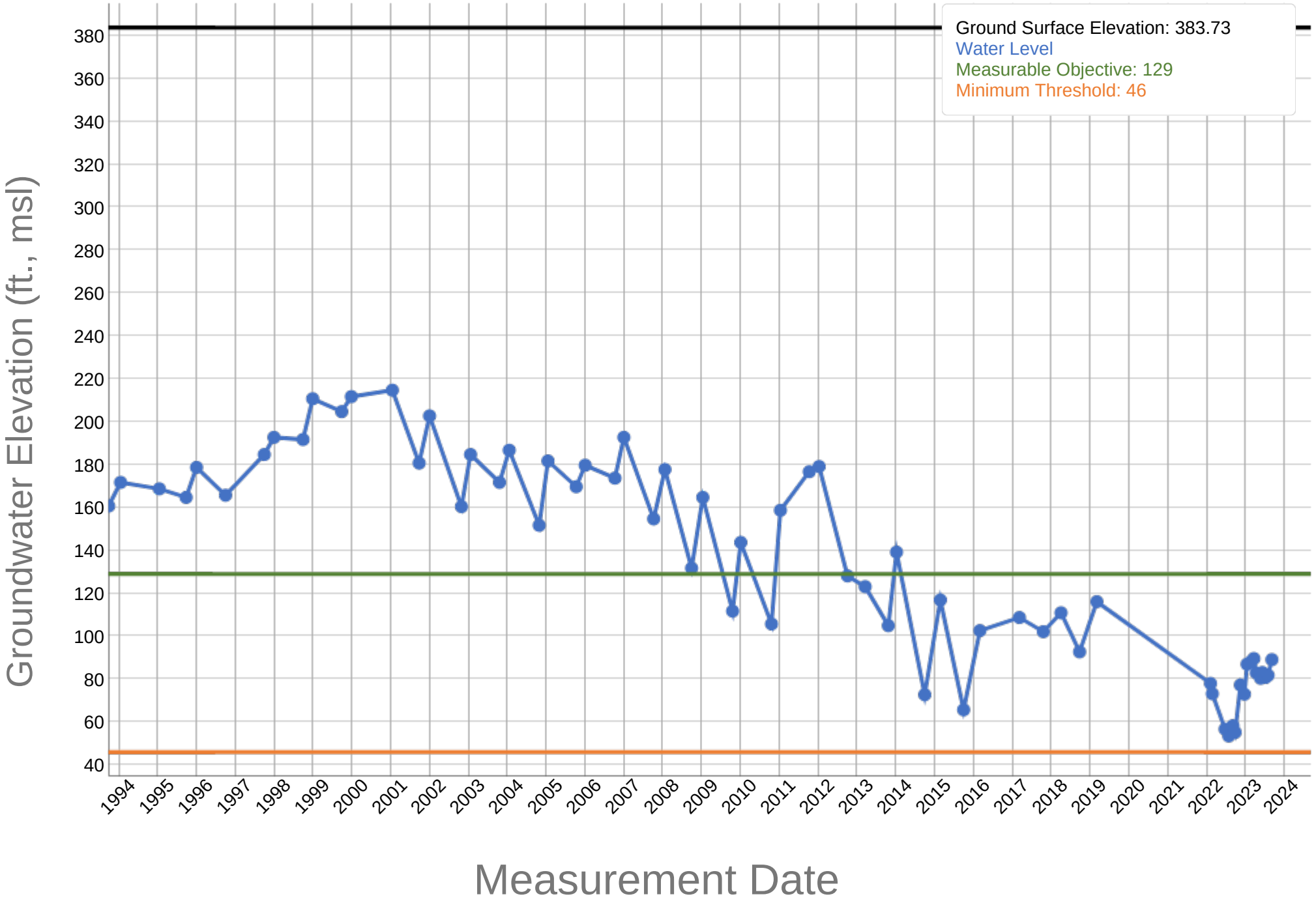
A4-1

Kern County Water Agency - RMW-017 - 354206N1191817W001



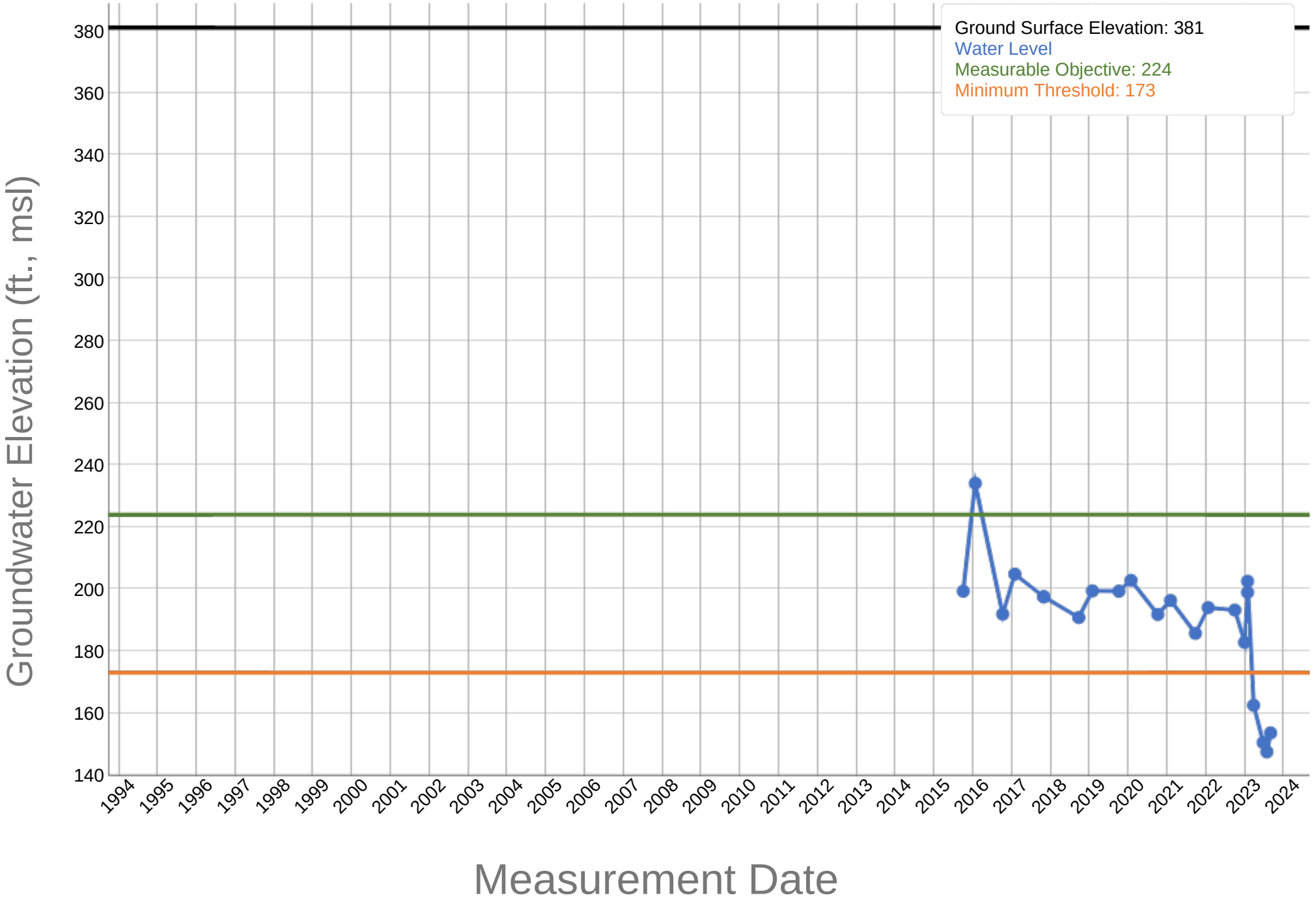
A4-2

Kern County Water Agency - RMW-018 - 354344N1191337W001



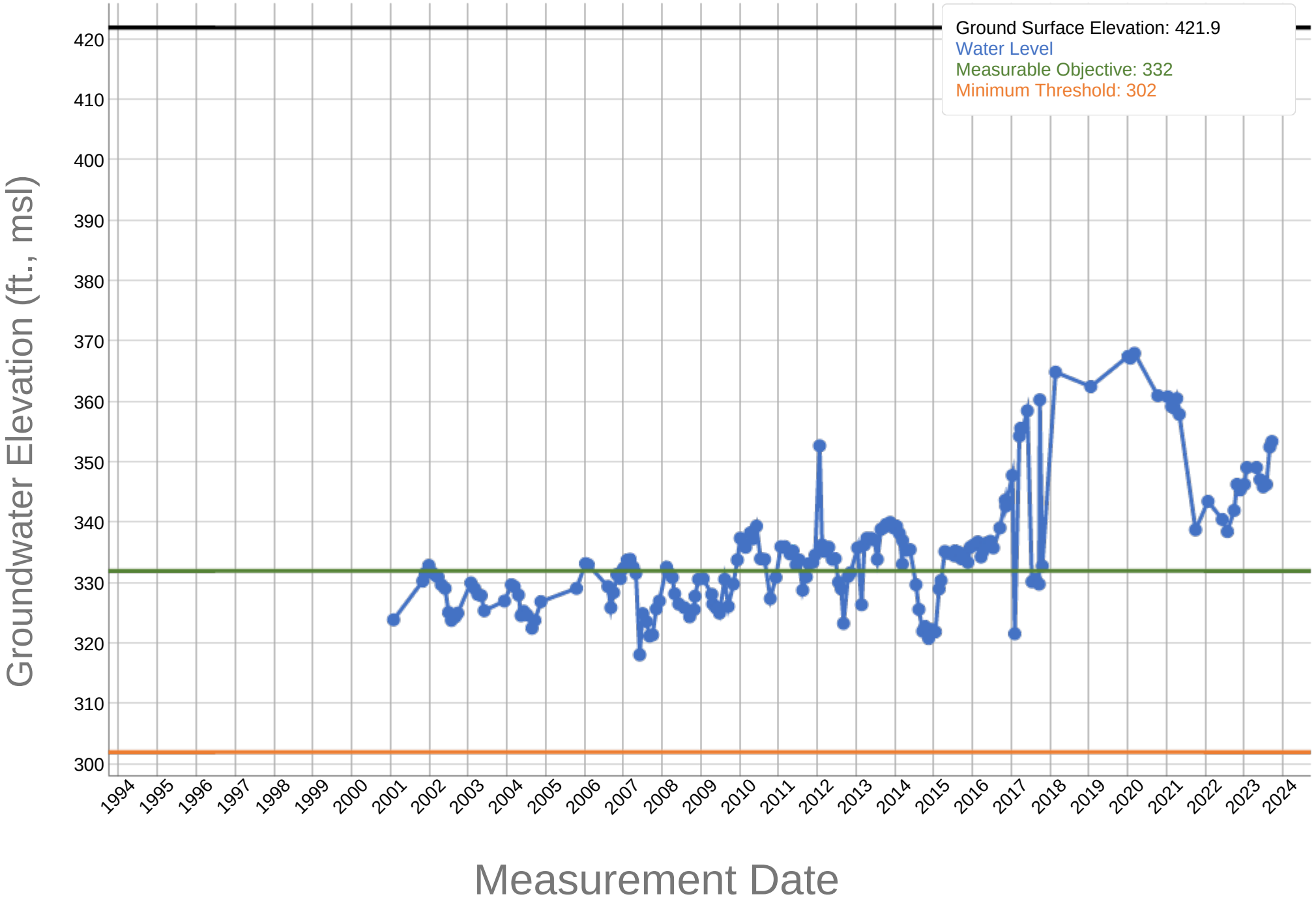
A4-3

Kern River GSA - RMW-019R - 354199N1190930W001



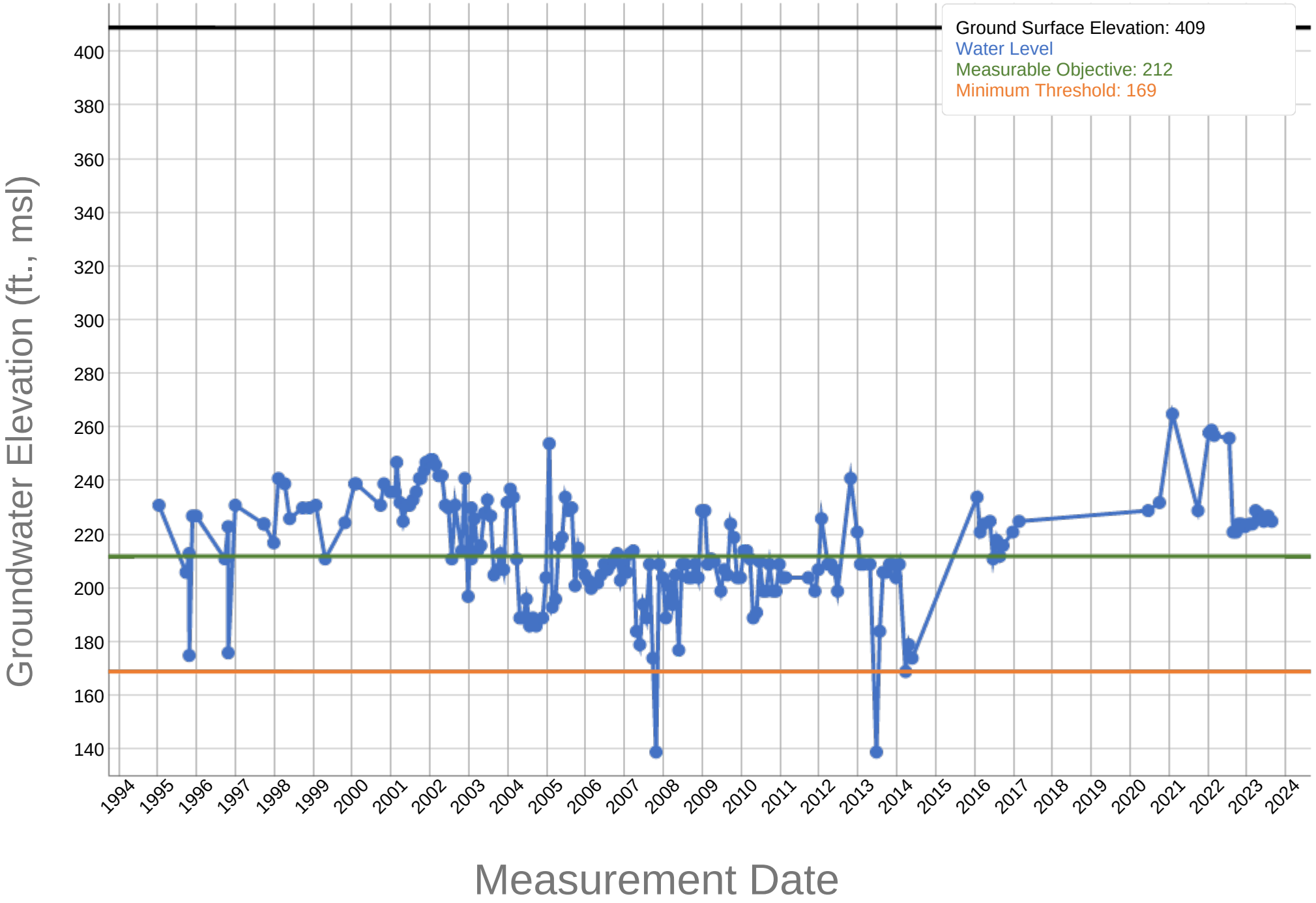
A4-4

Kern County Water Agency - RMW-020 - 354048N1190102W001



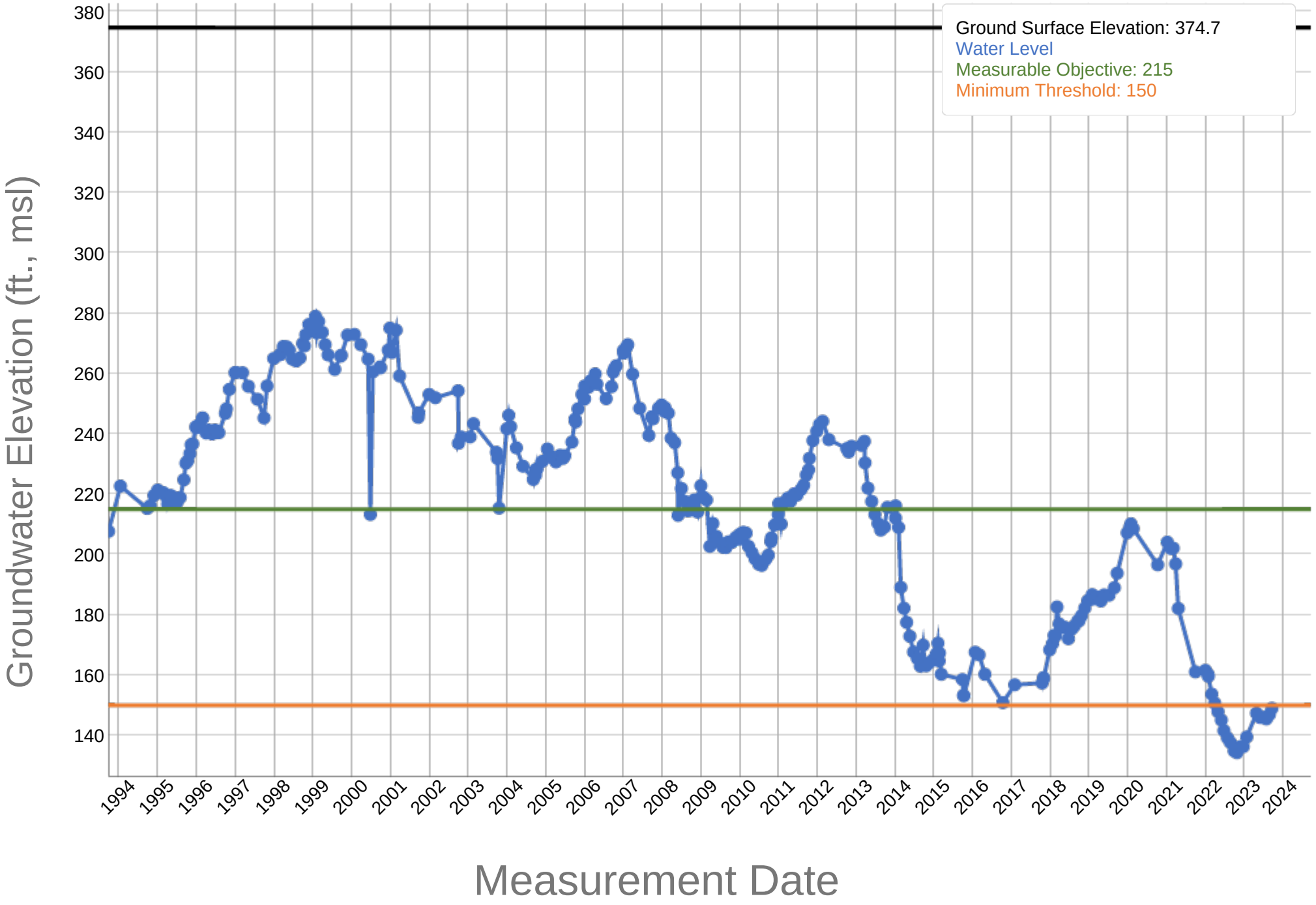
A4-5

Kern River GSA - RMW-021 - 353898N1190087W001



A4-6

Kern County Water Agency - RMW-025 - 353539N1191118W001



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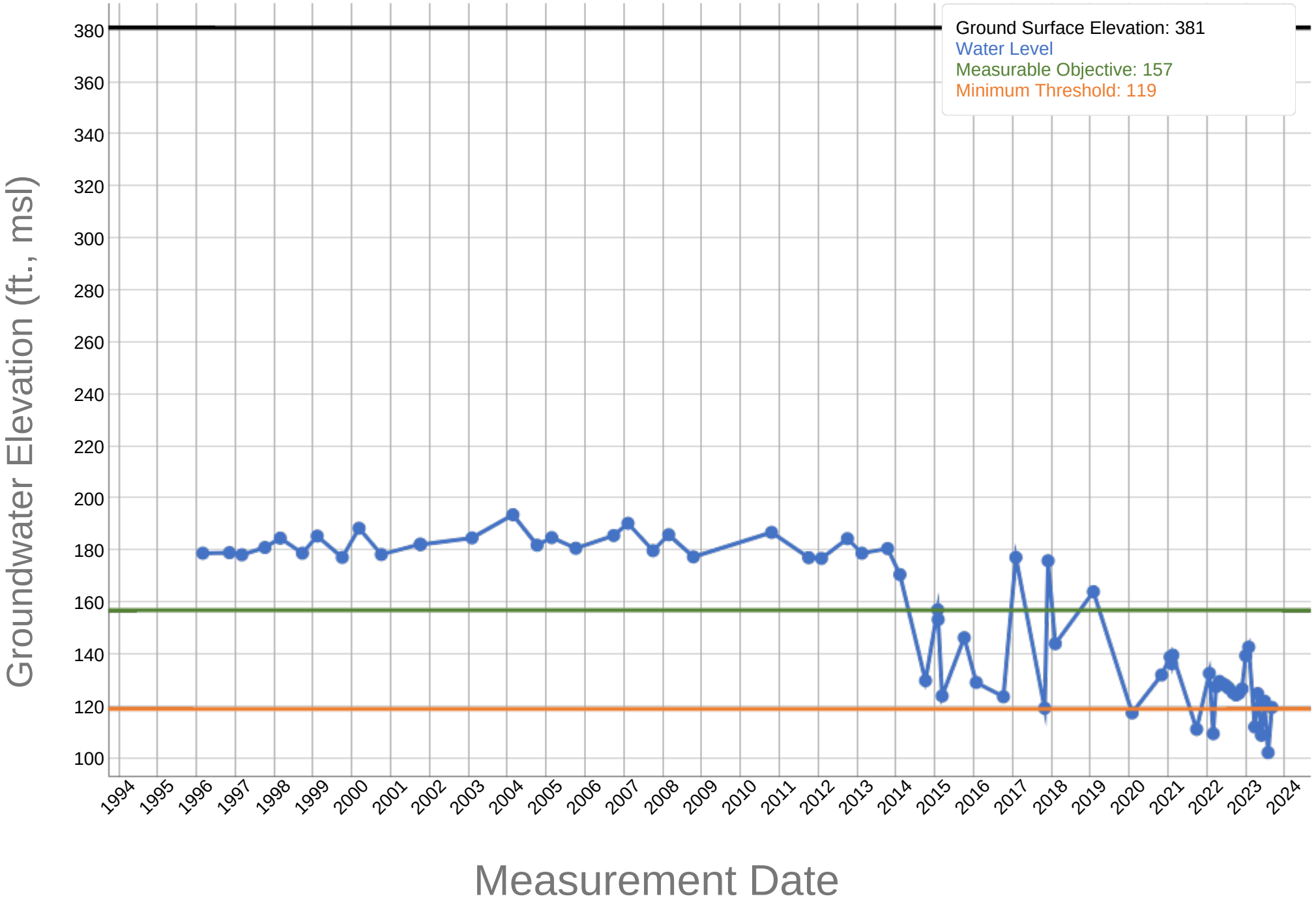
Kern County Water Agency - RMW-026 - 353512N1189673W001



A4-8

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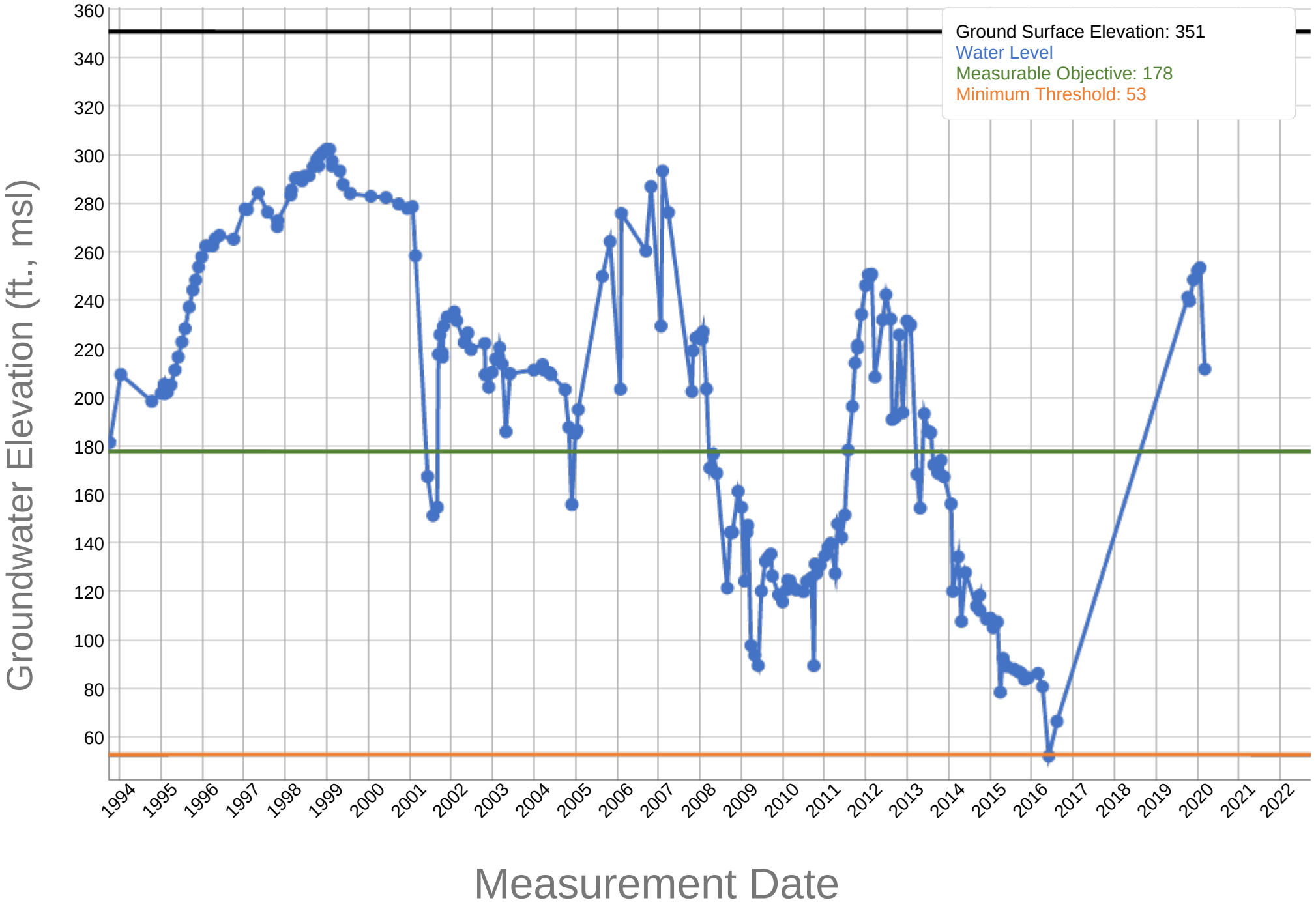

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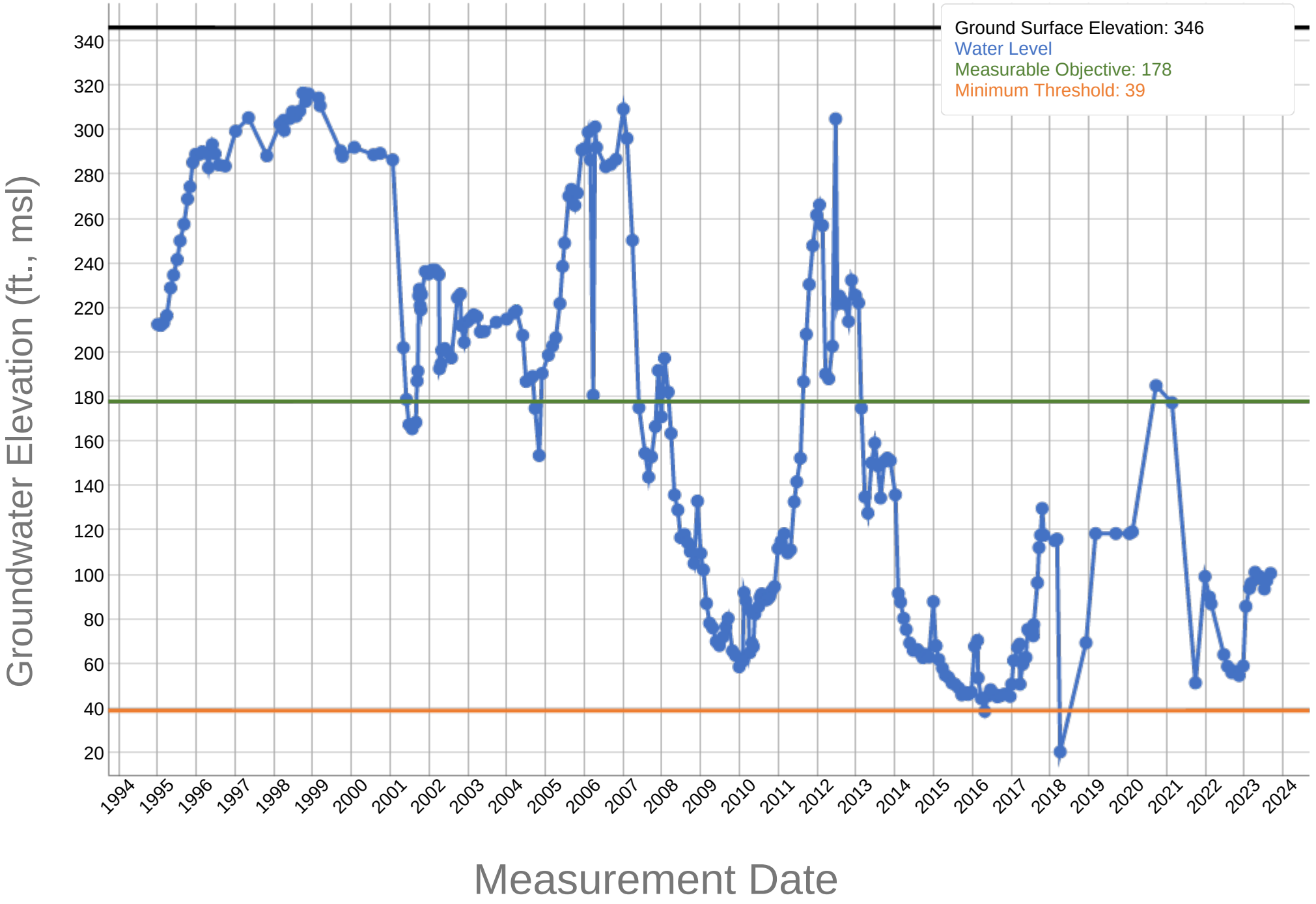
Kern River GSA - RMW-029 - 353247N1191870W001



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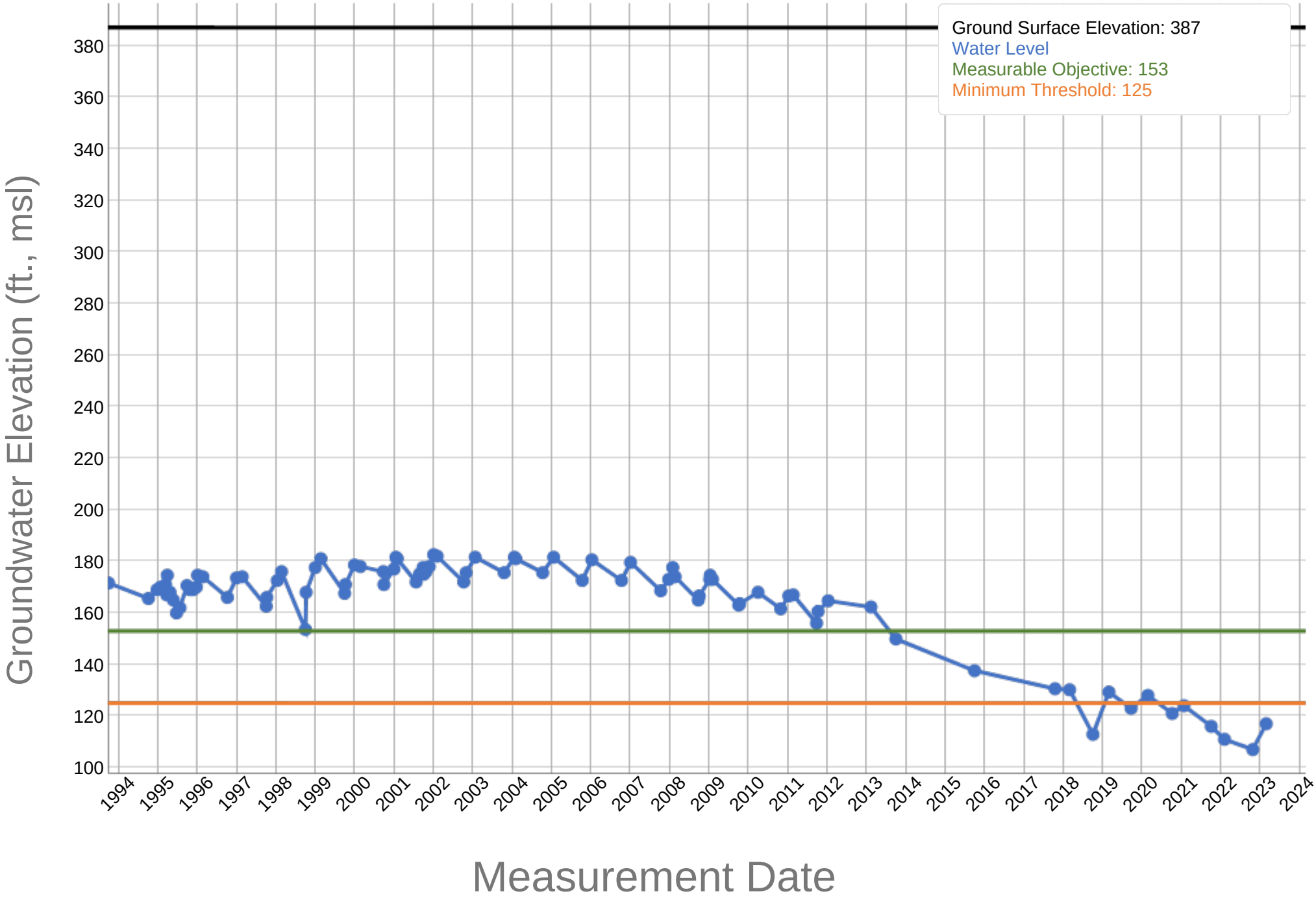

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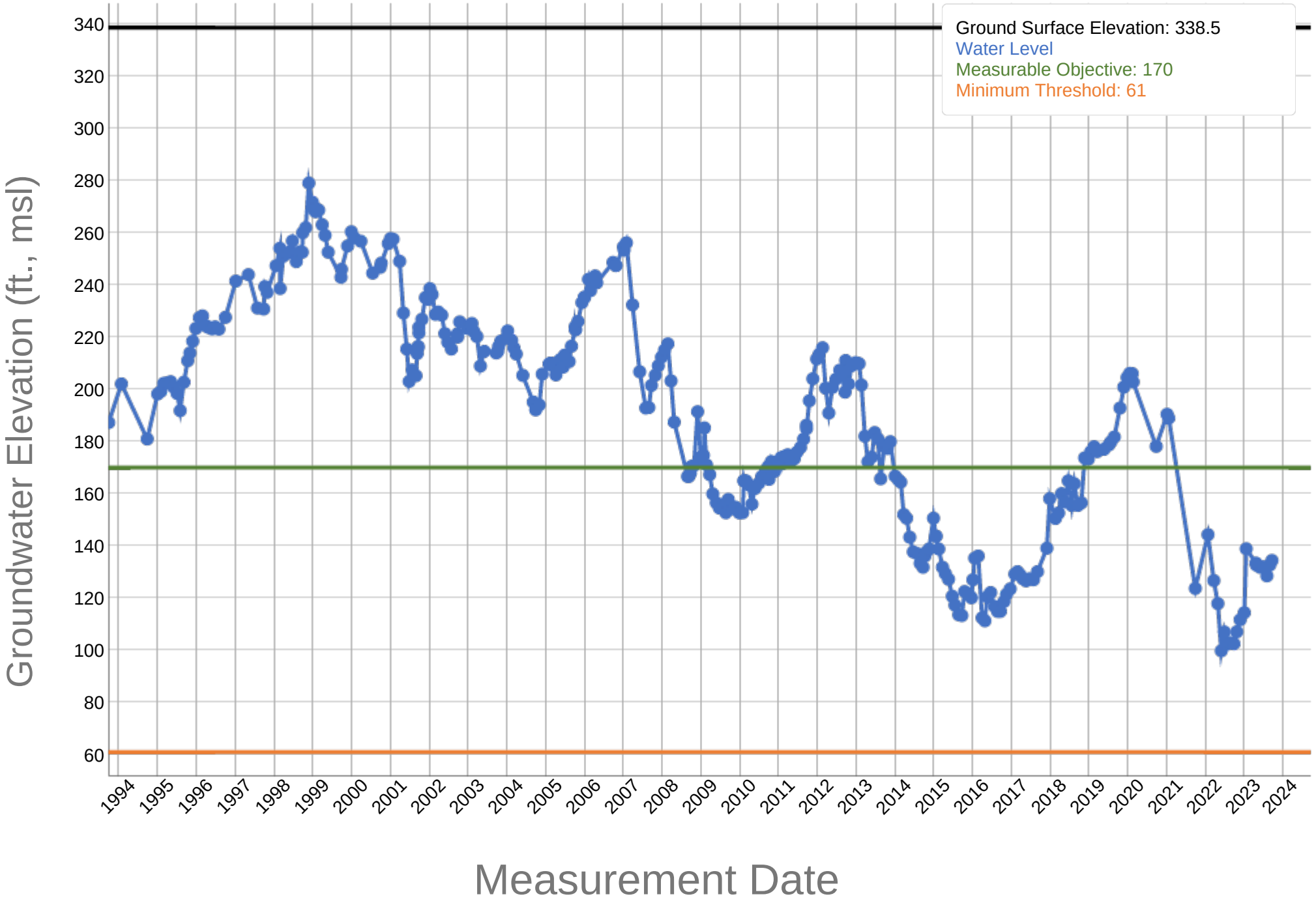
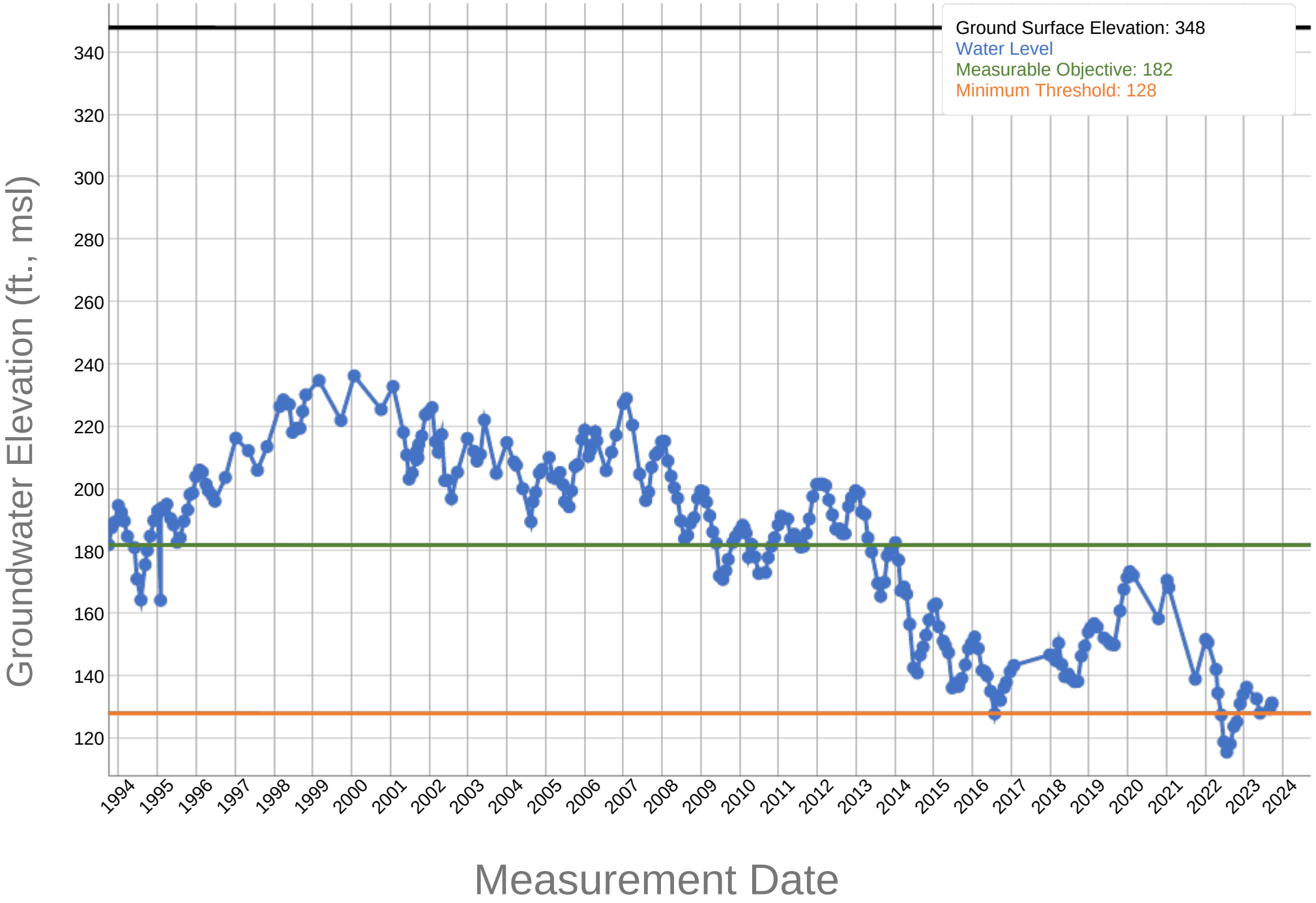
Kern County Water Agency - RMW-031 - 352964N1191741W003



A4-12

Kern County Water Agency - RMW-032 - 352953N1191285W001



A4-13

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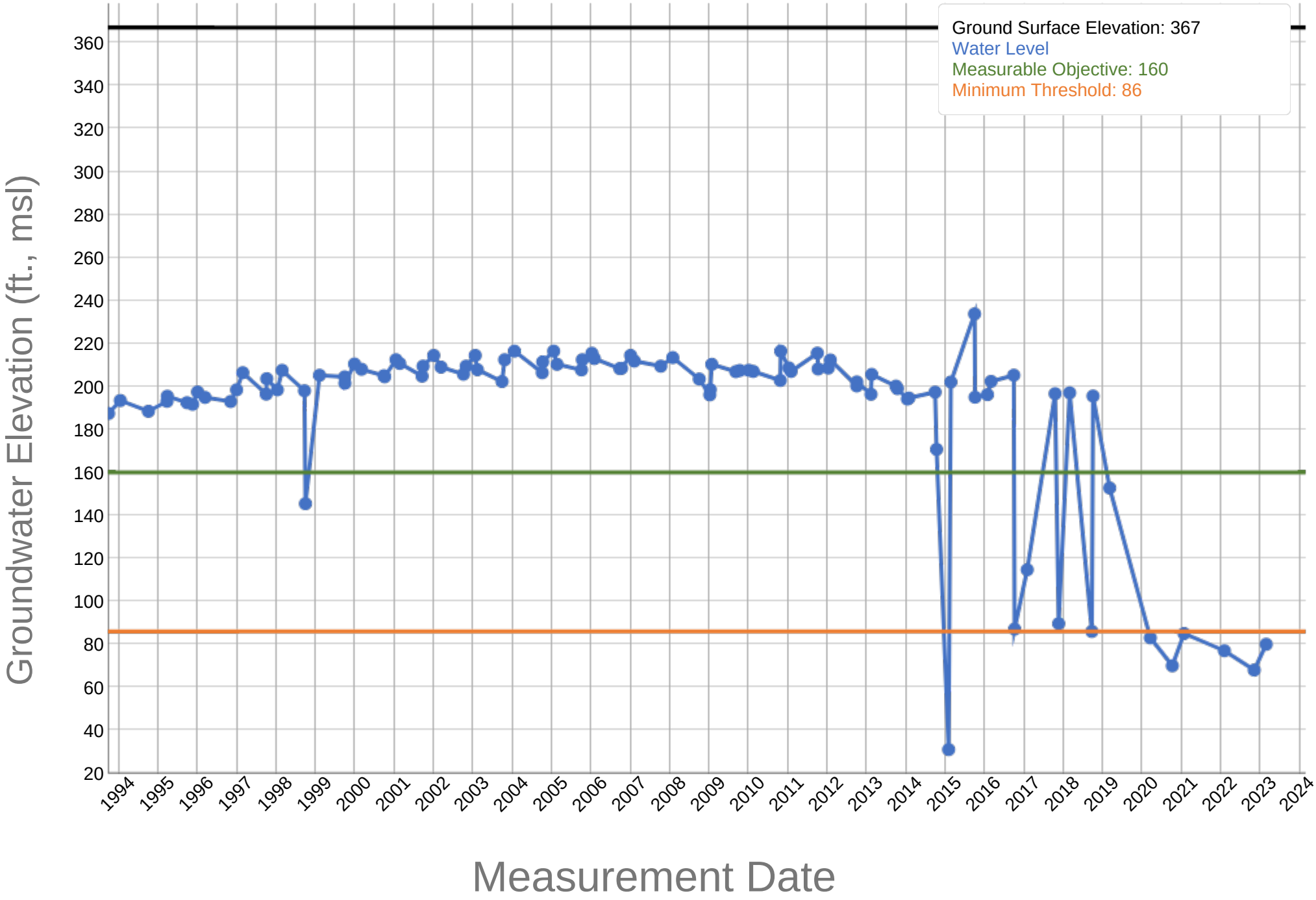

A4-14

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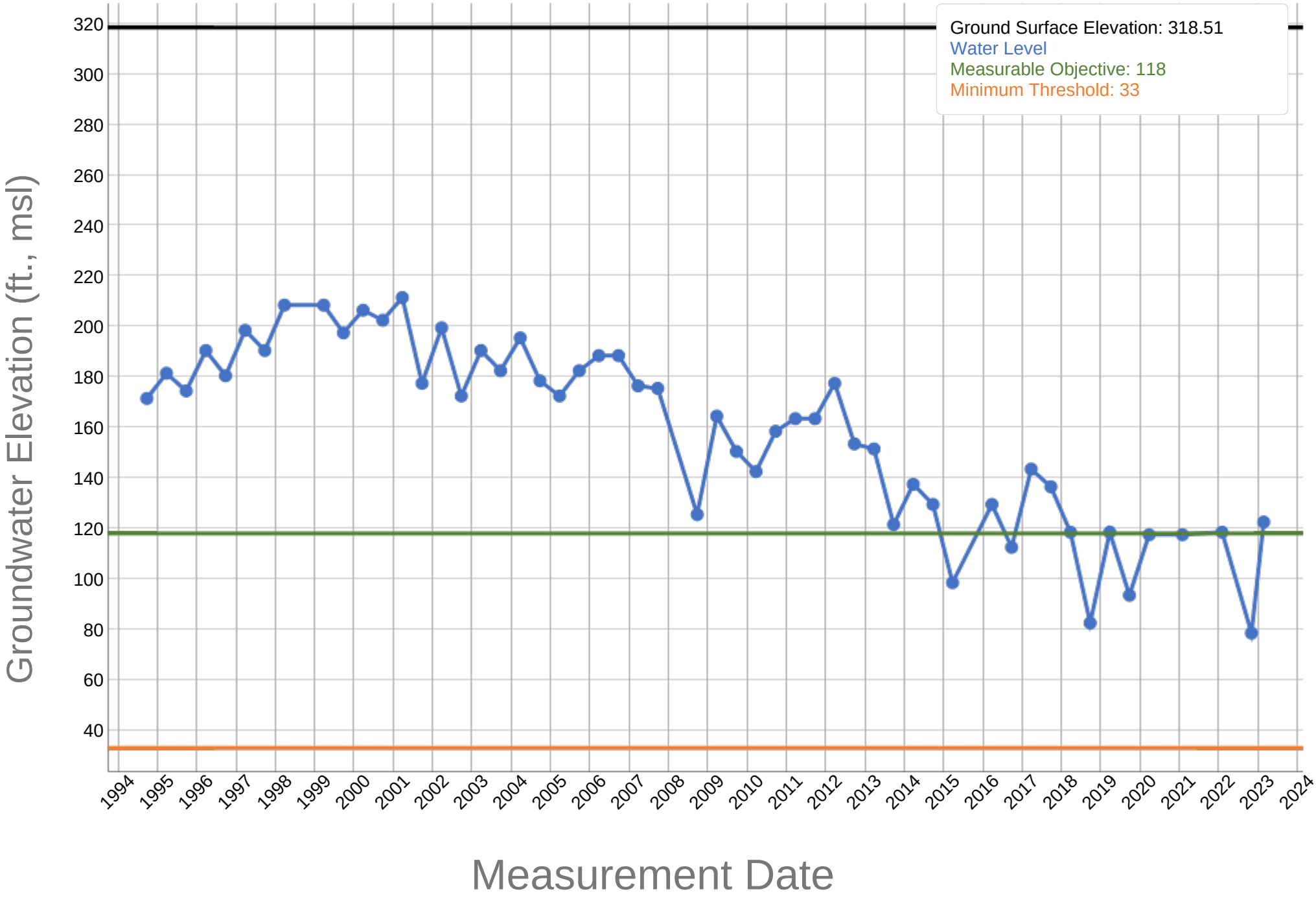

A4-15

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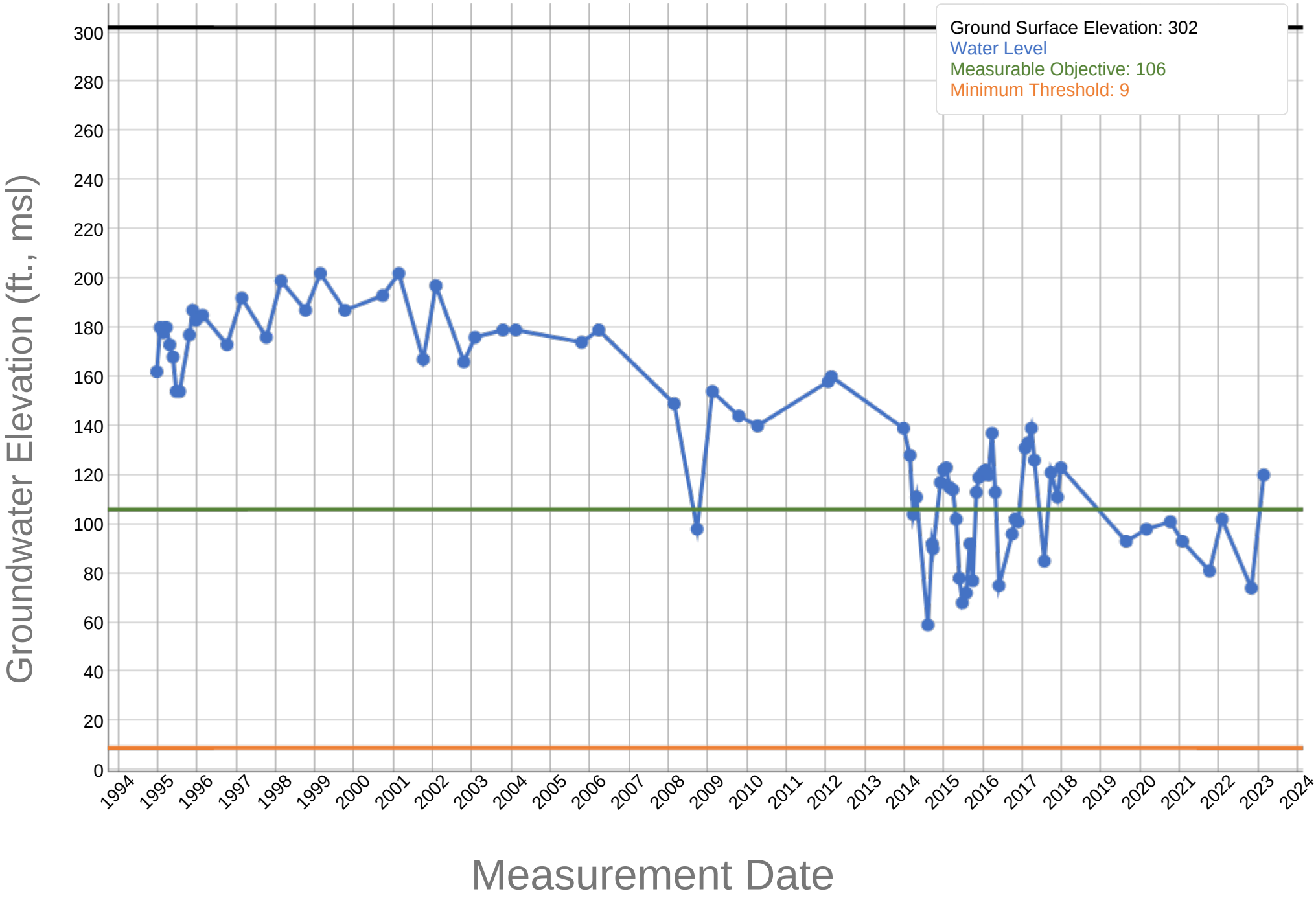

A4-16

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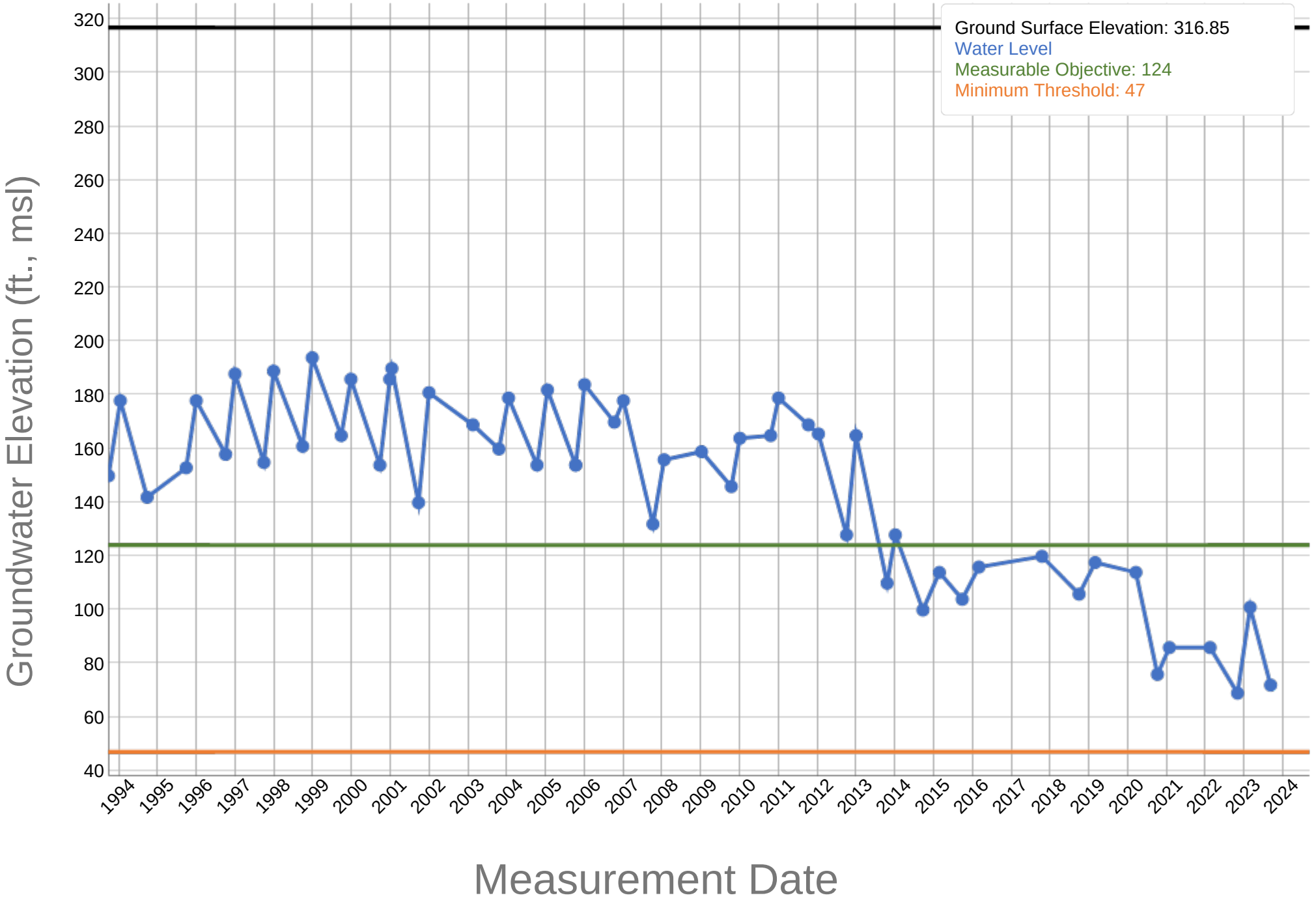
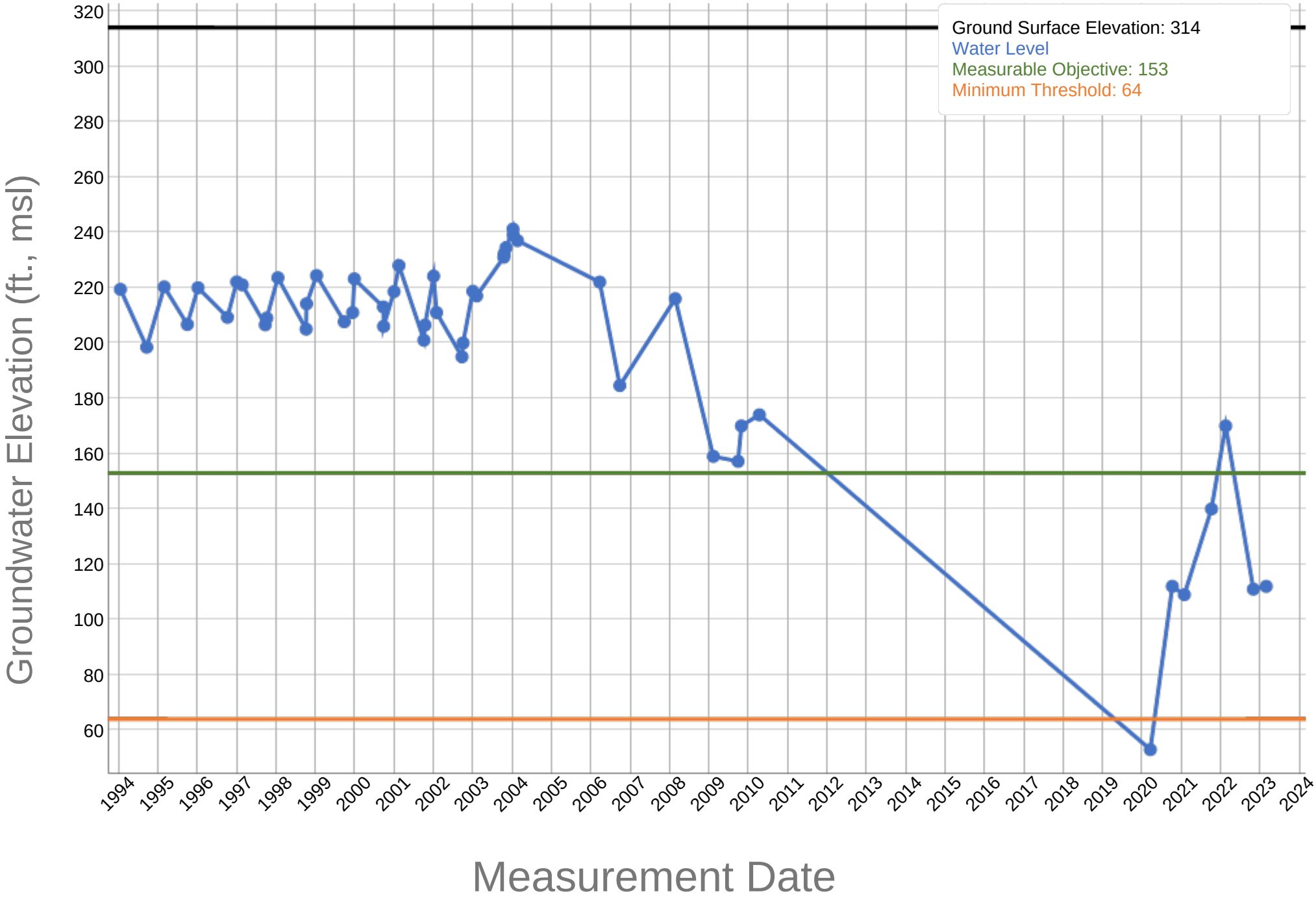


A4-17

Kern River GSA - RMW-040 - 352083N1190362W001



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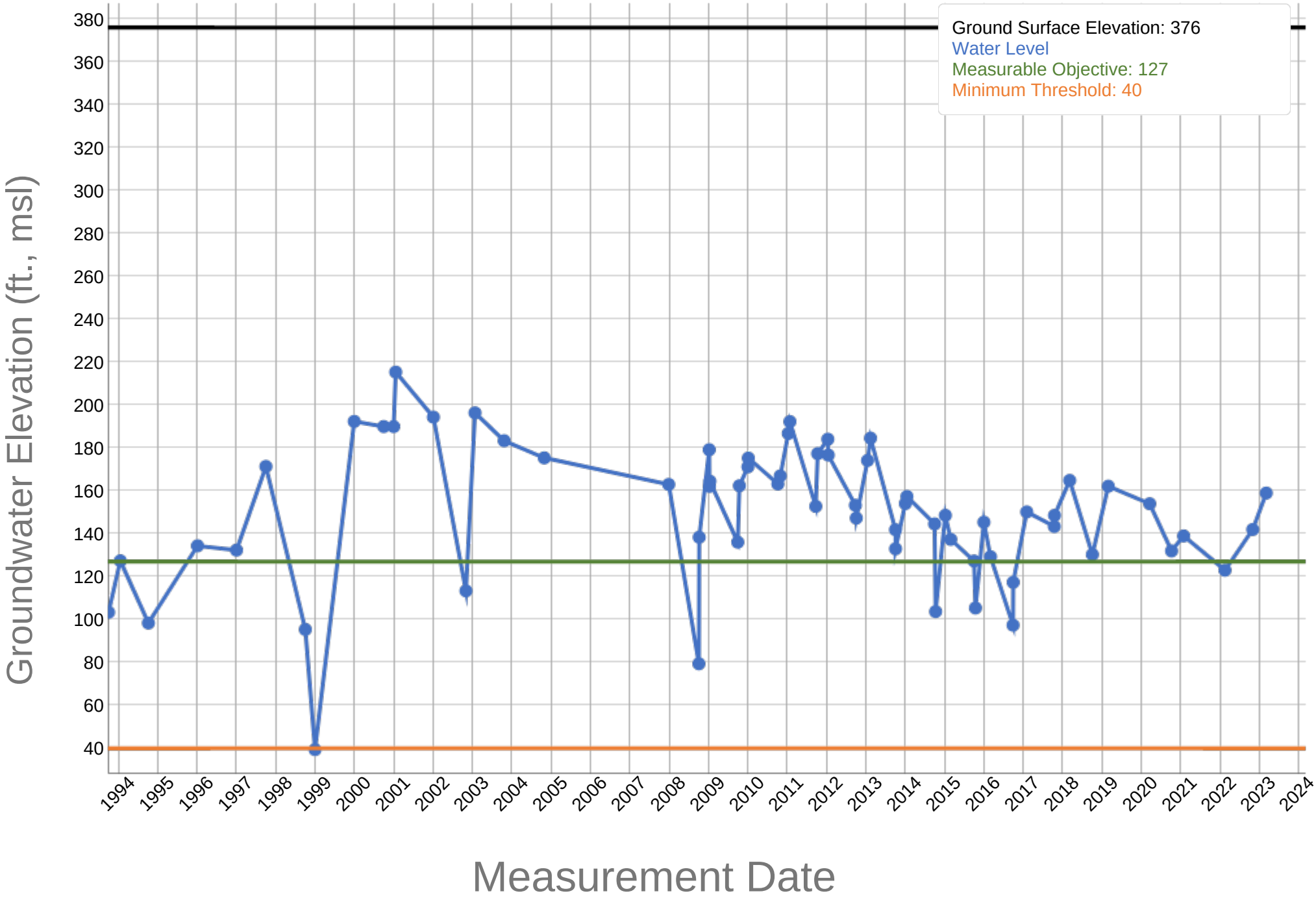
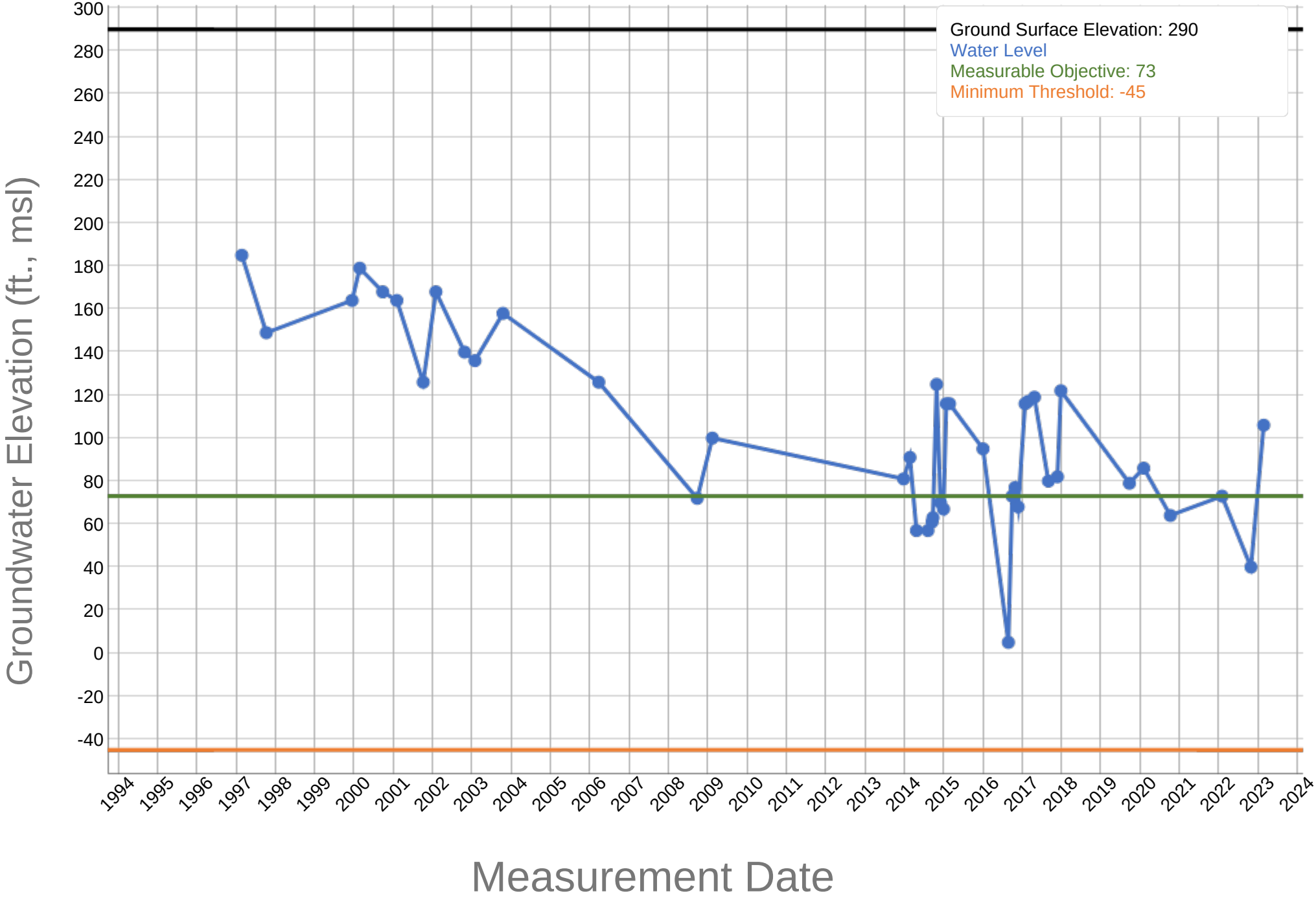
Kern River GSA - RMW-041 - 352027N1188996W001



A4-19

Kern Delta Water District - RMW-042 - 351922N1192052W001



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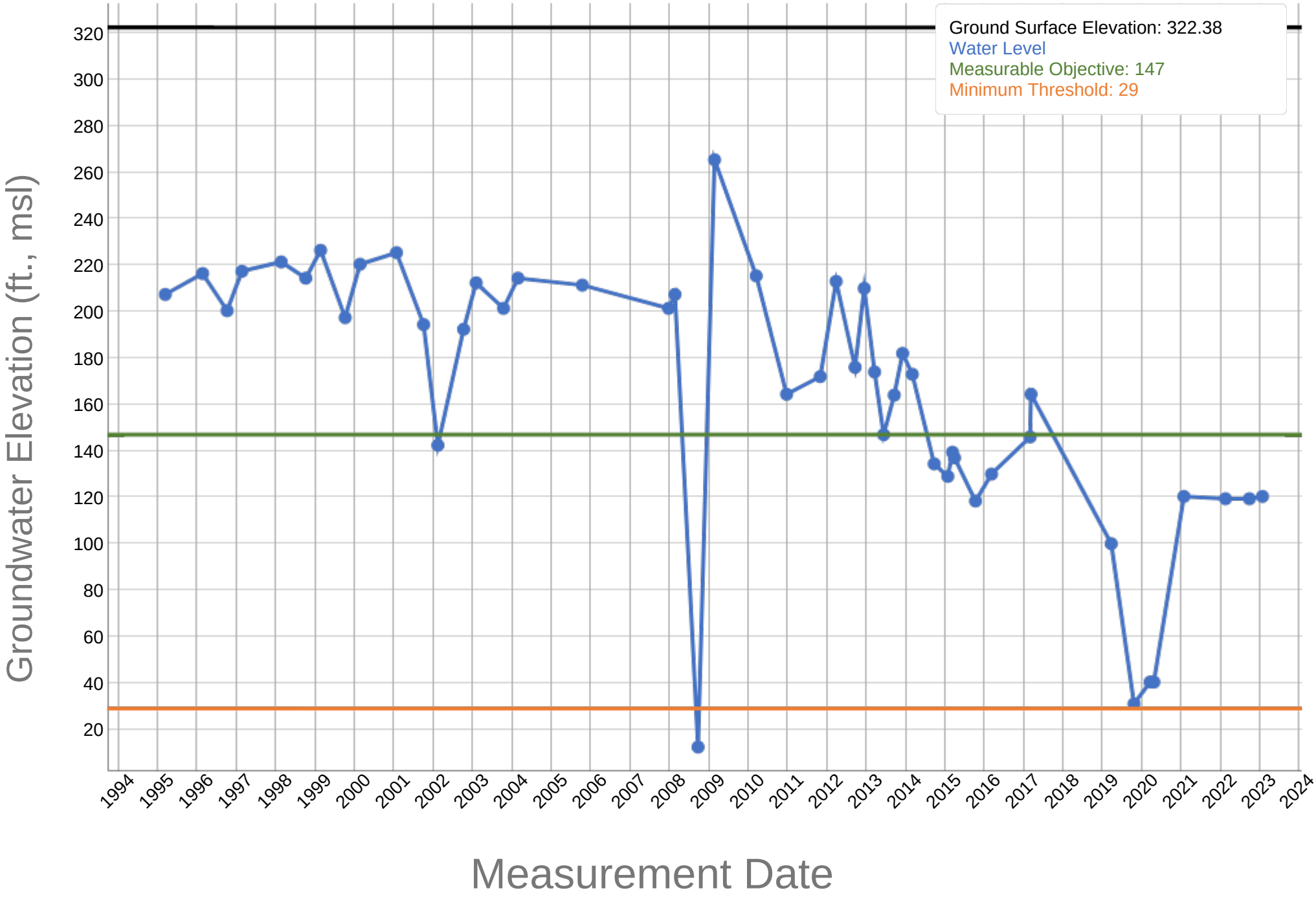

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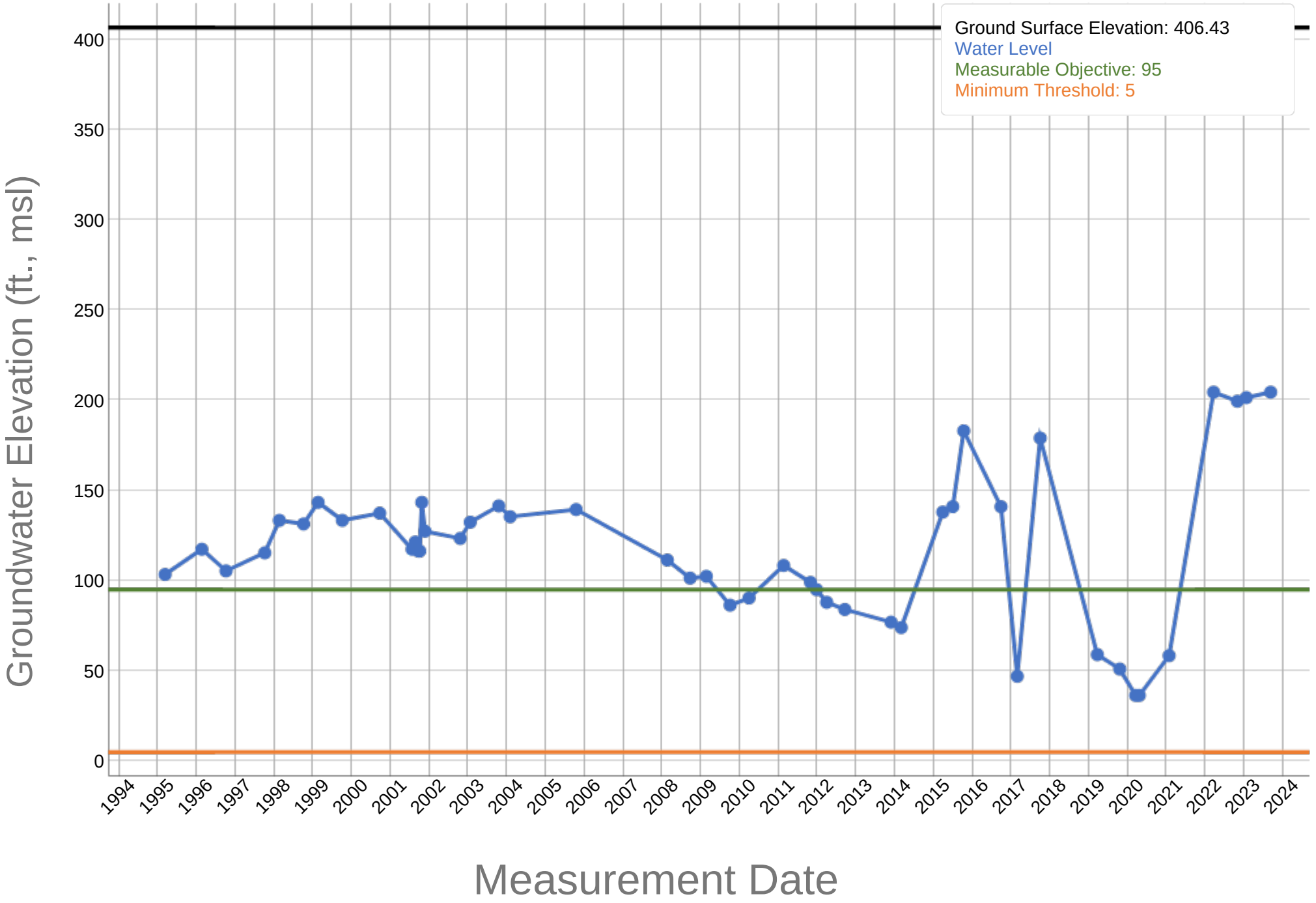

A4-22

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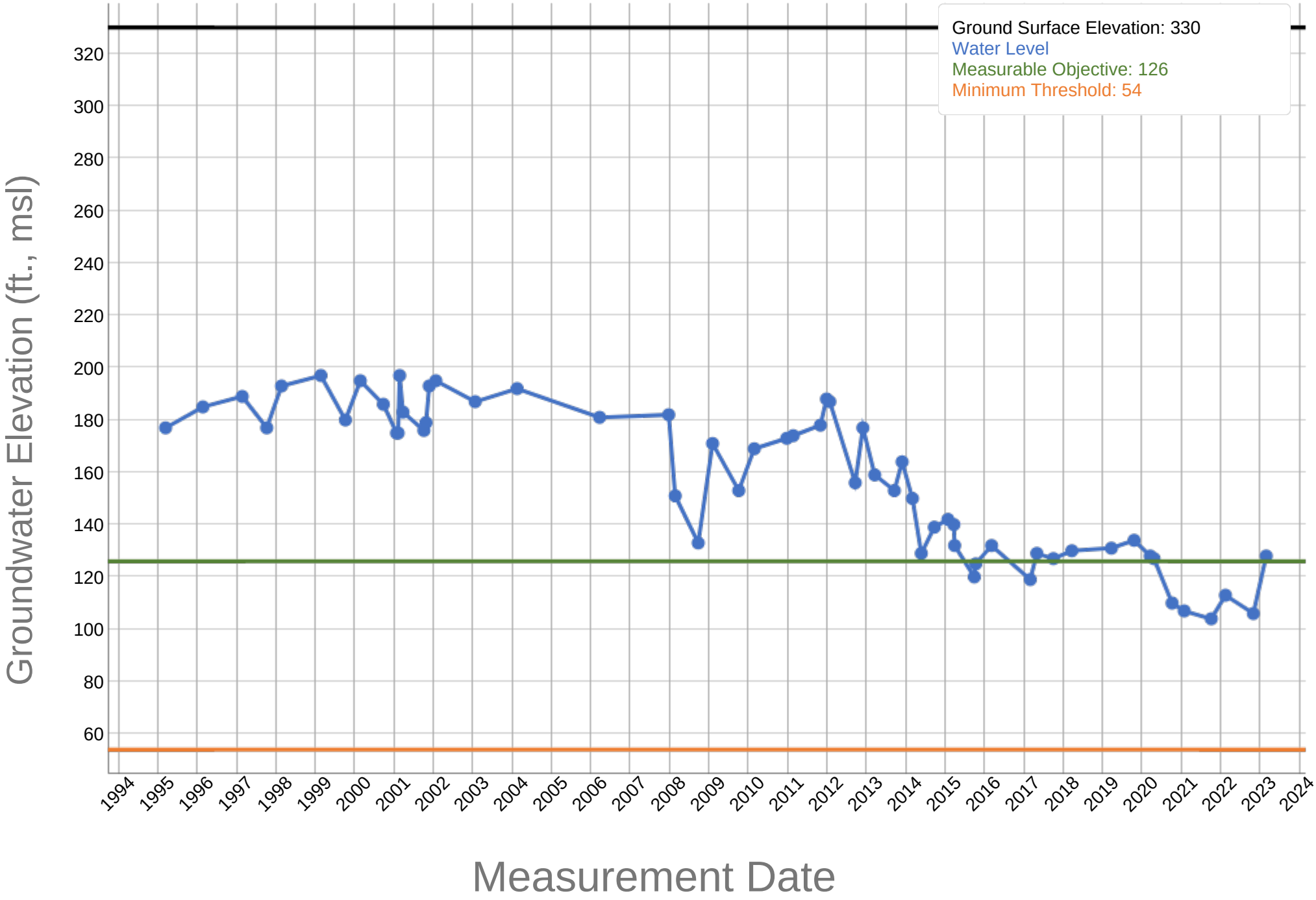

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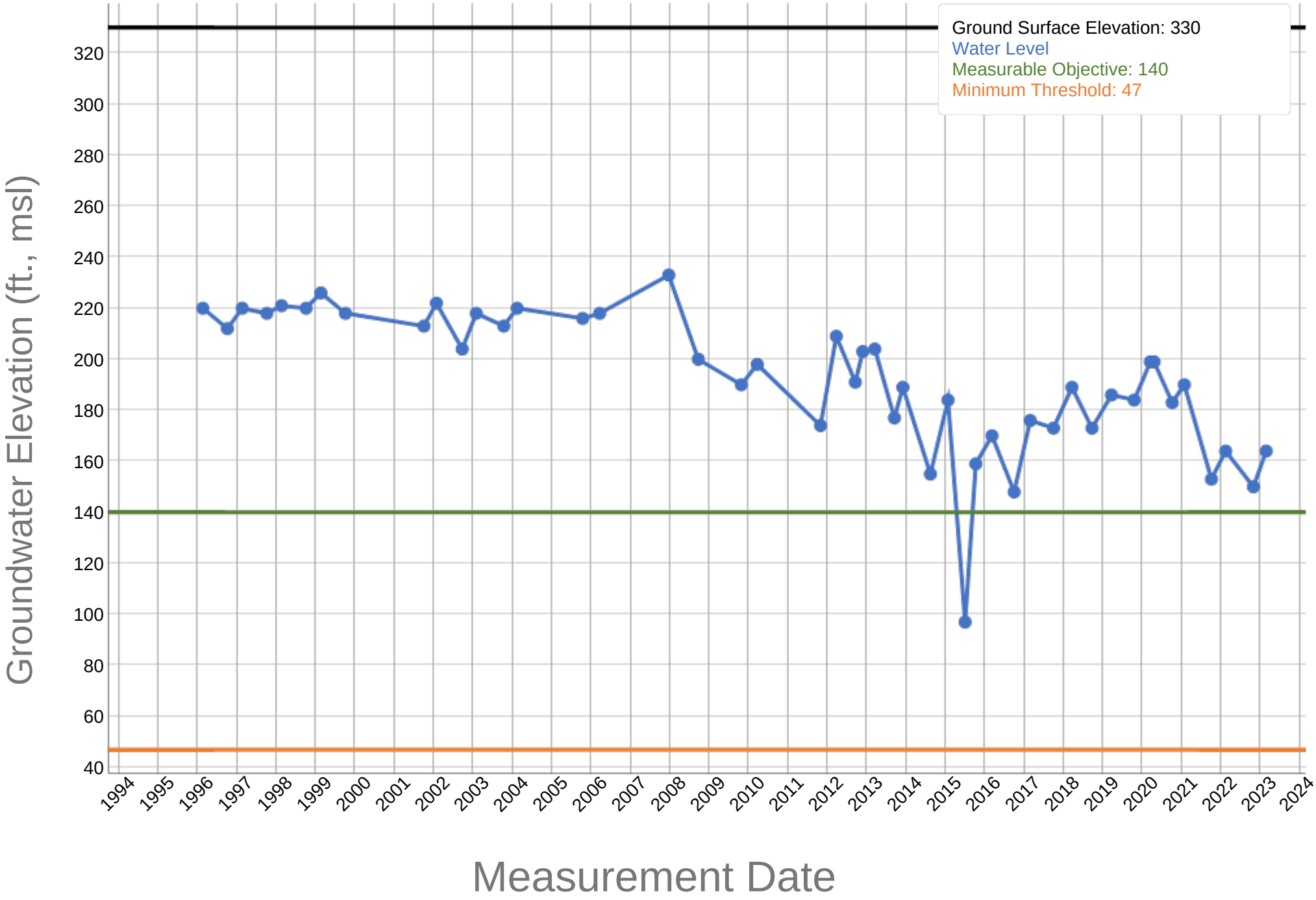

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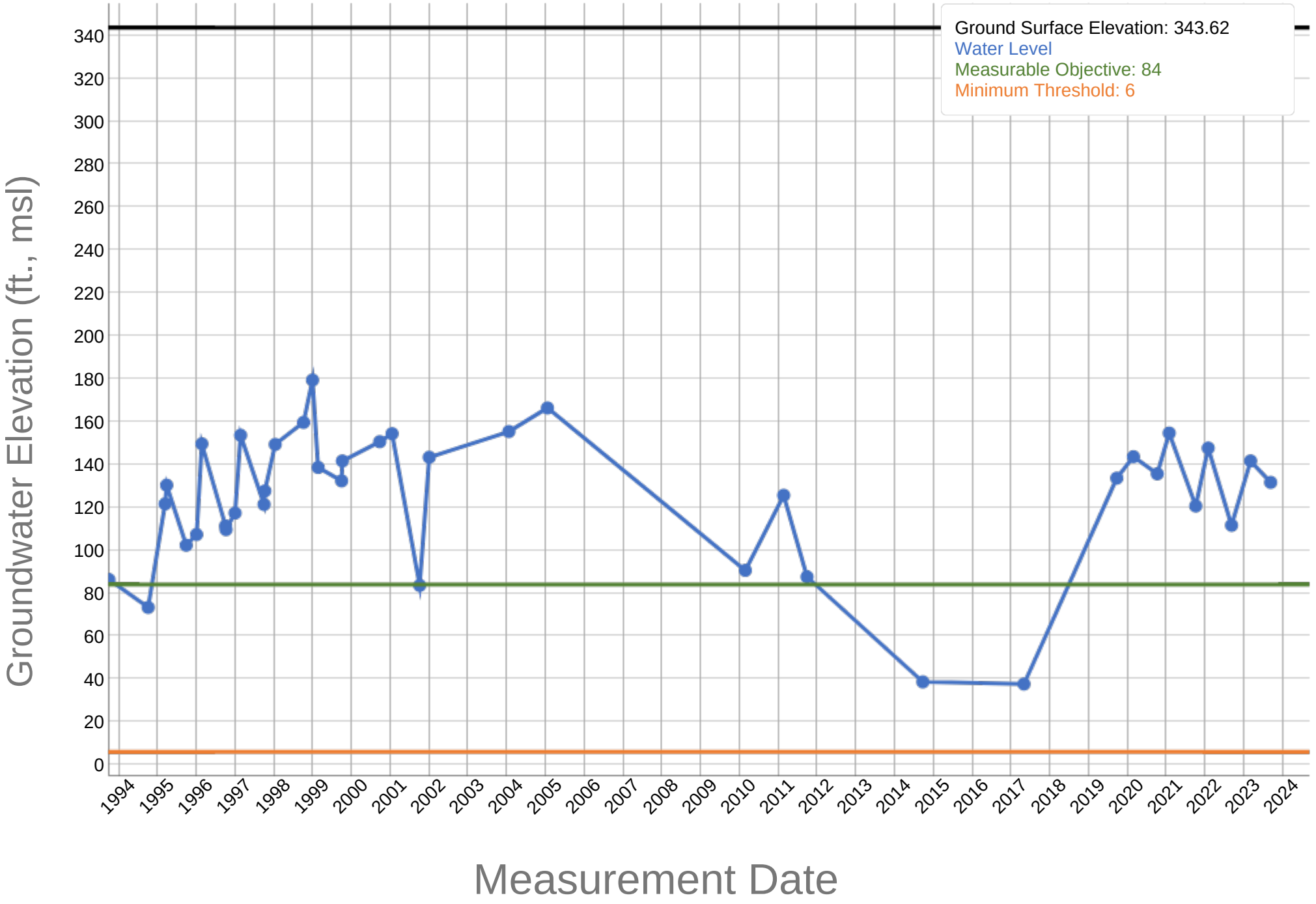

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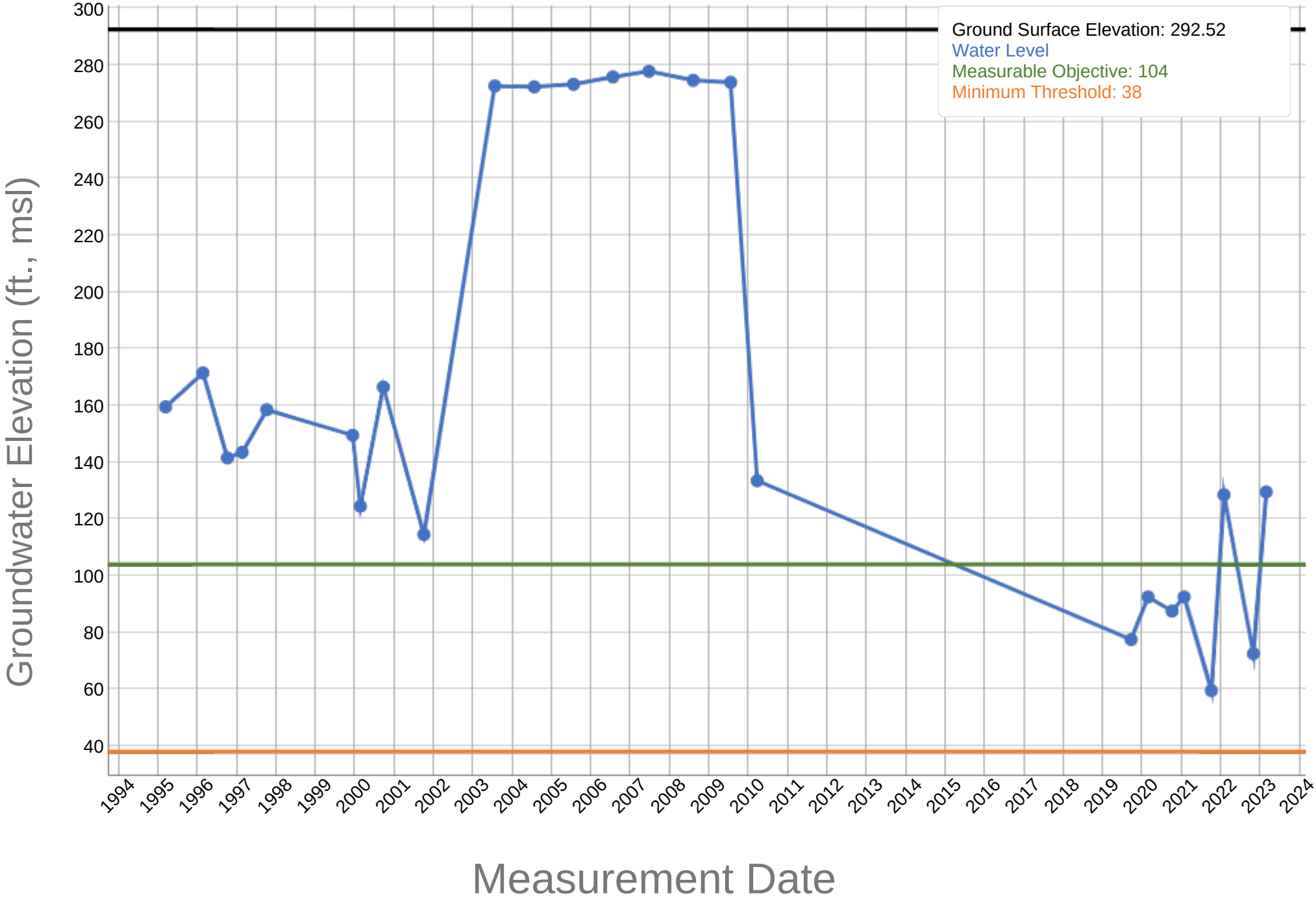

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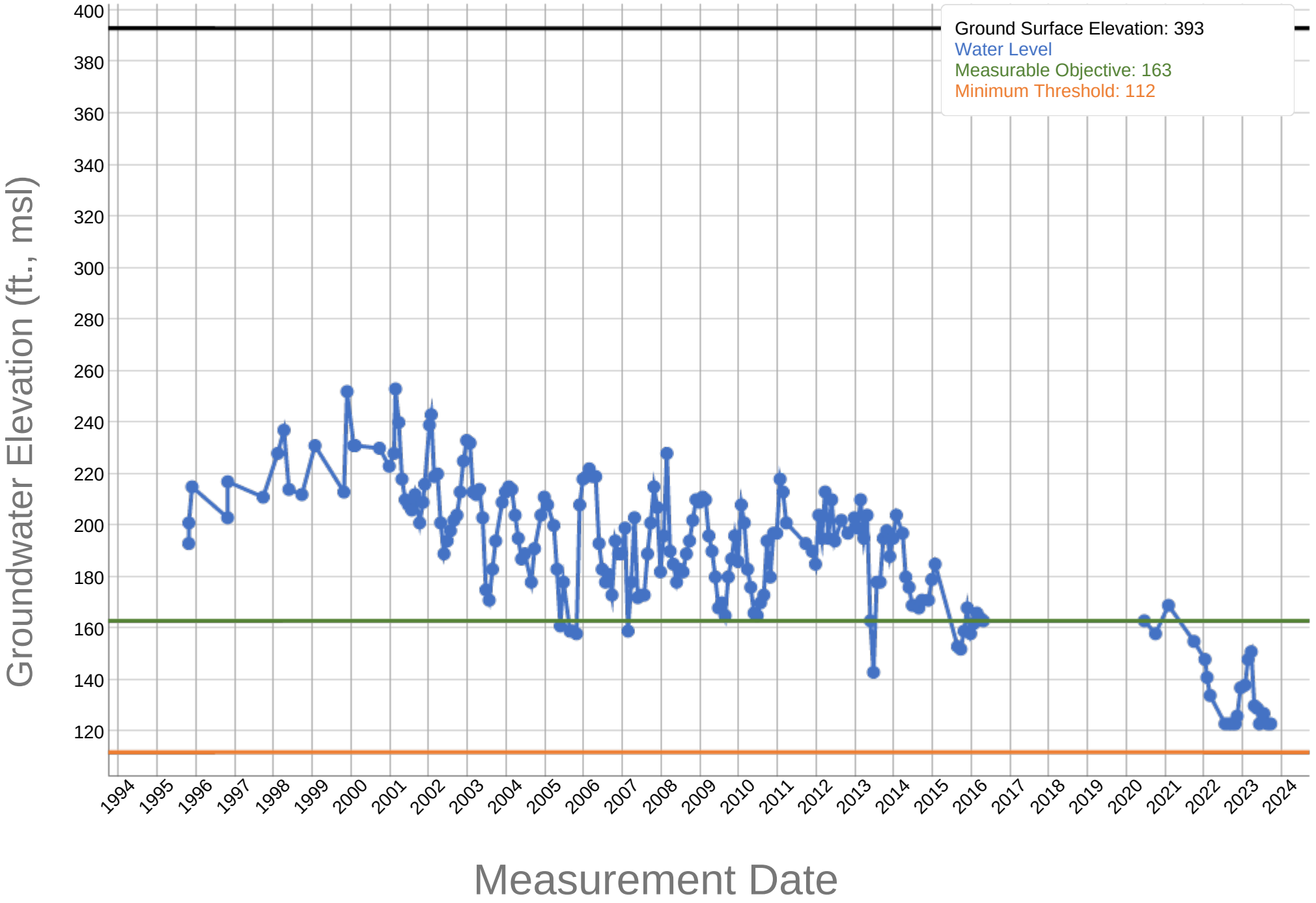

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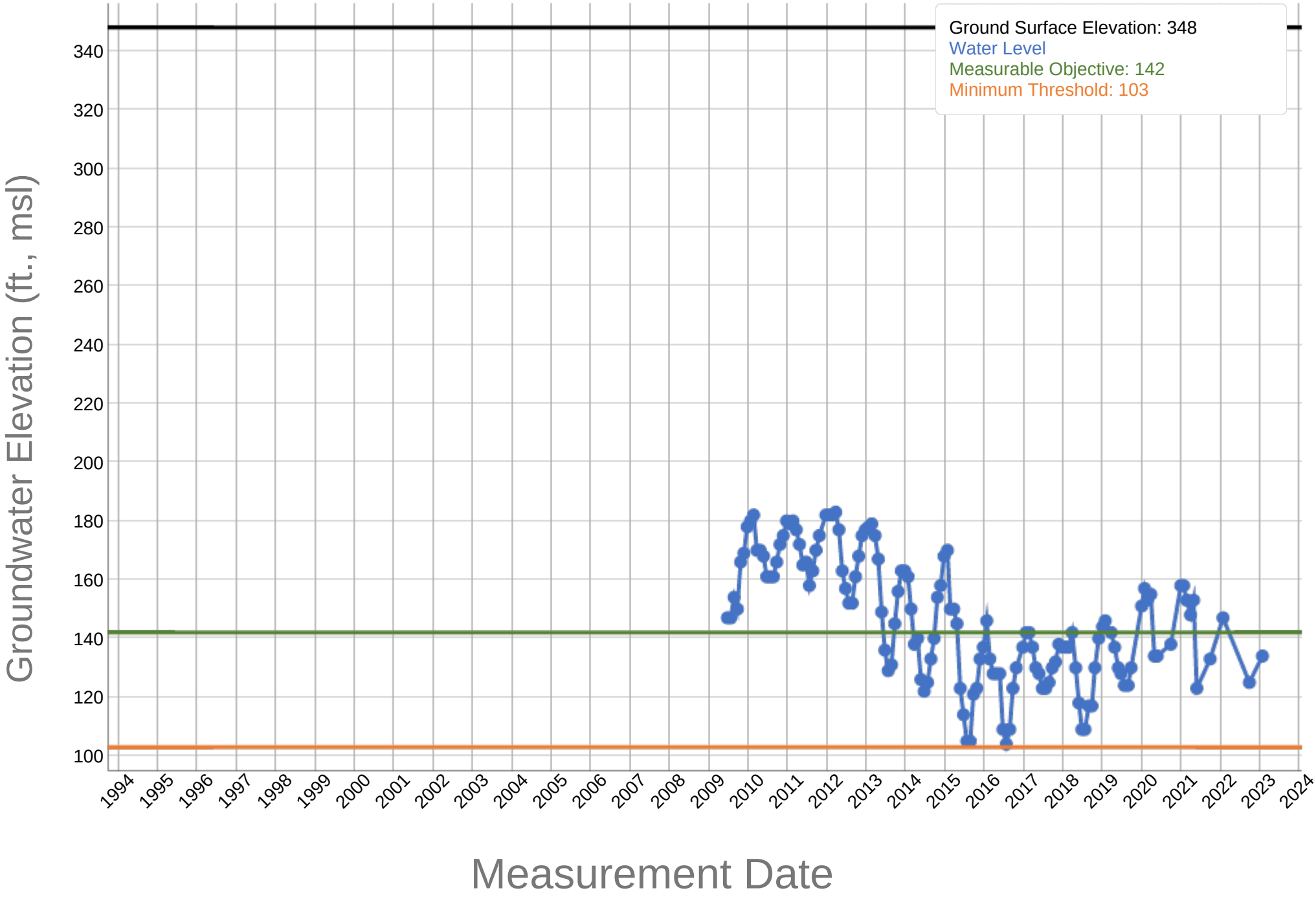

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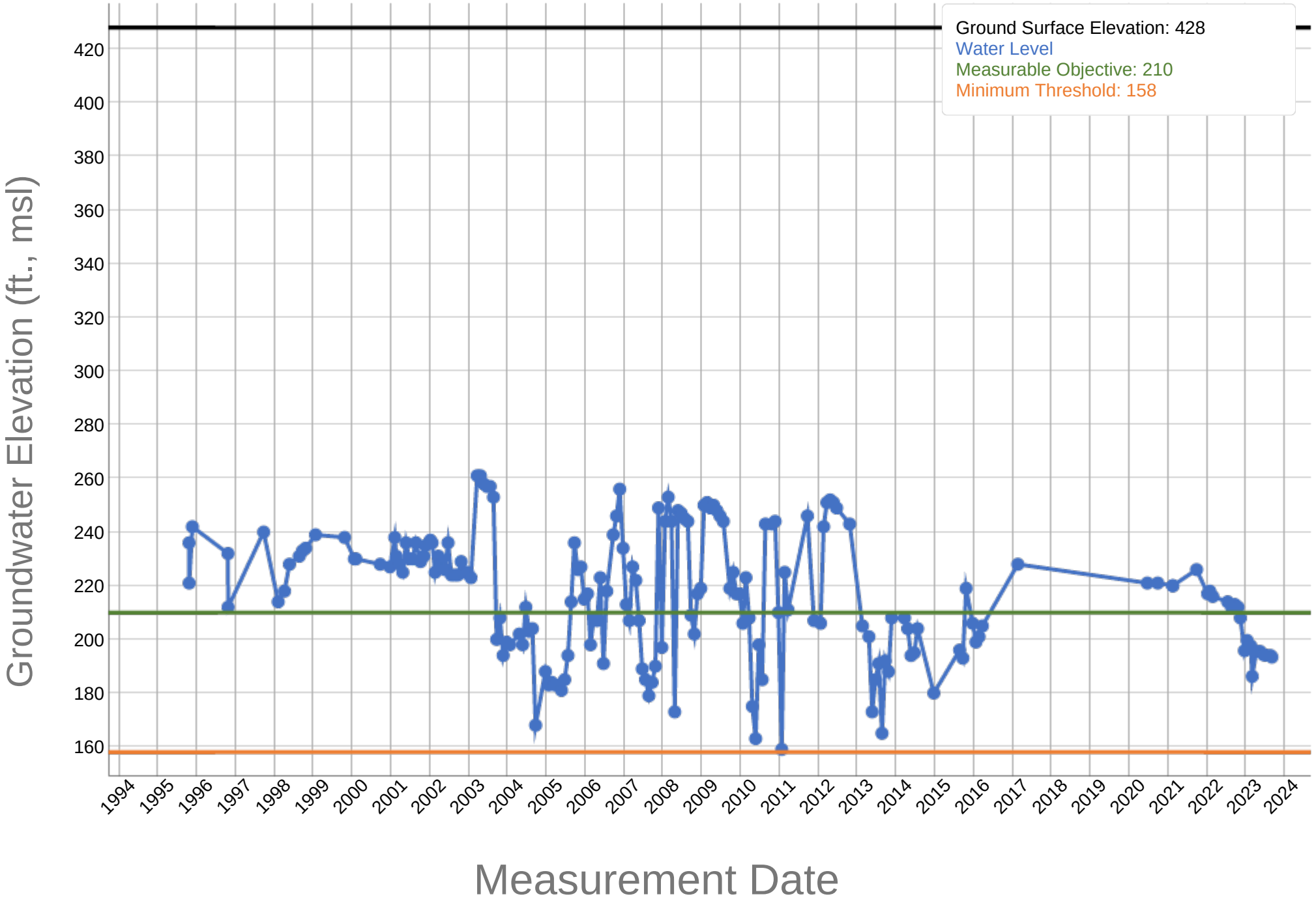
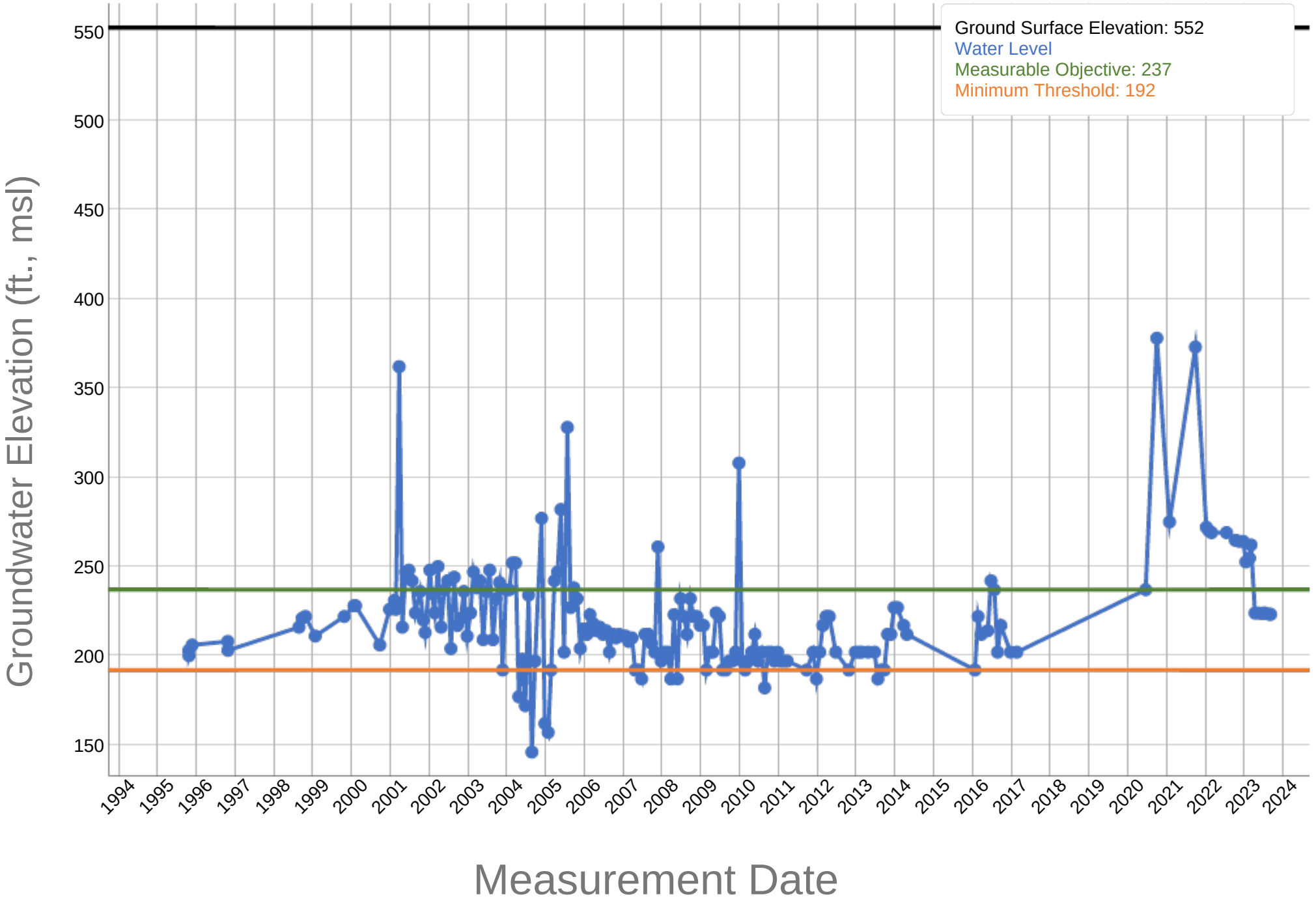
Kern River GSA - RMW-209 - 354226N1190748W001



A4-29

California Water Service - RMW-210 - 353907N1189752W001



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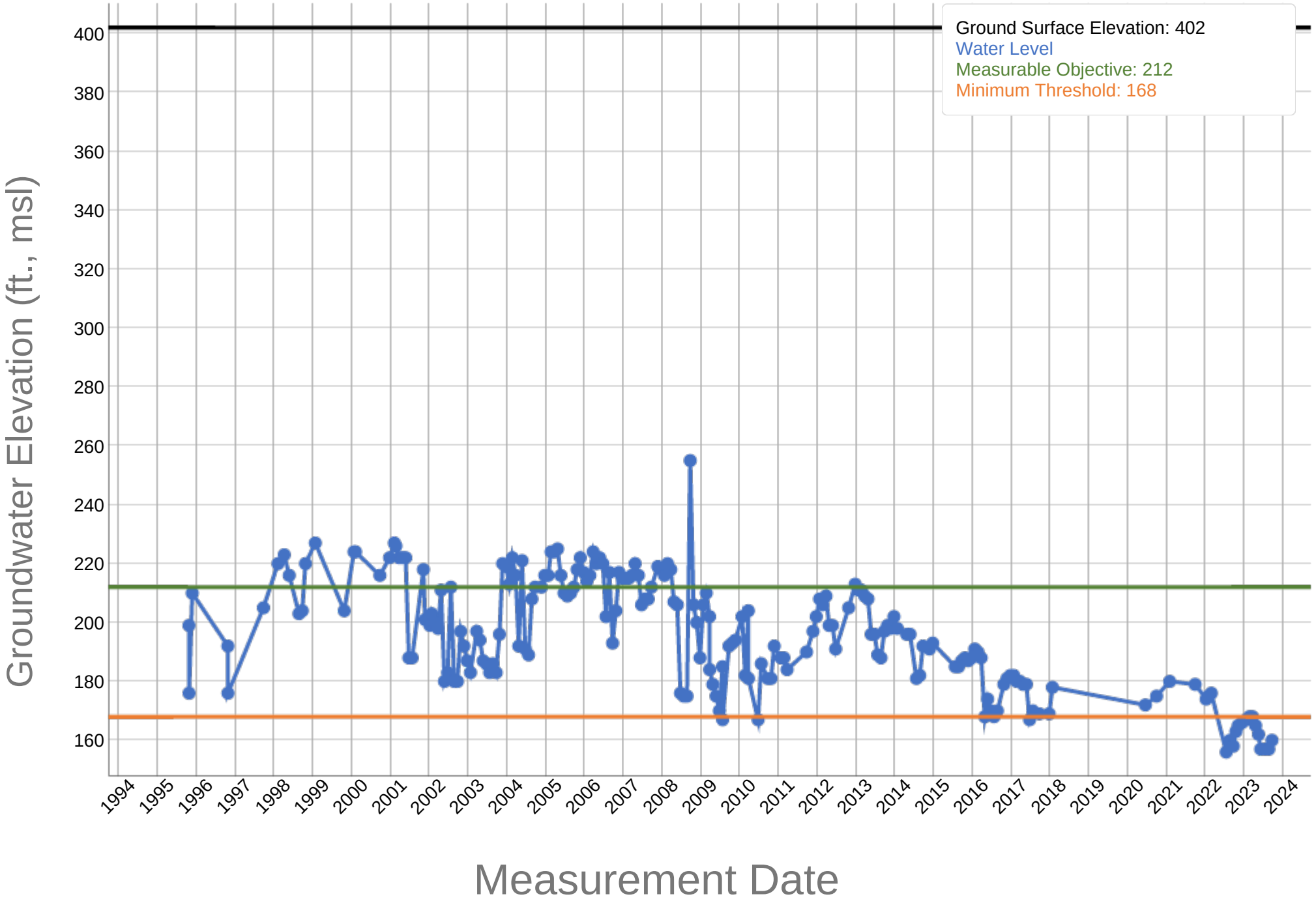
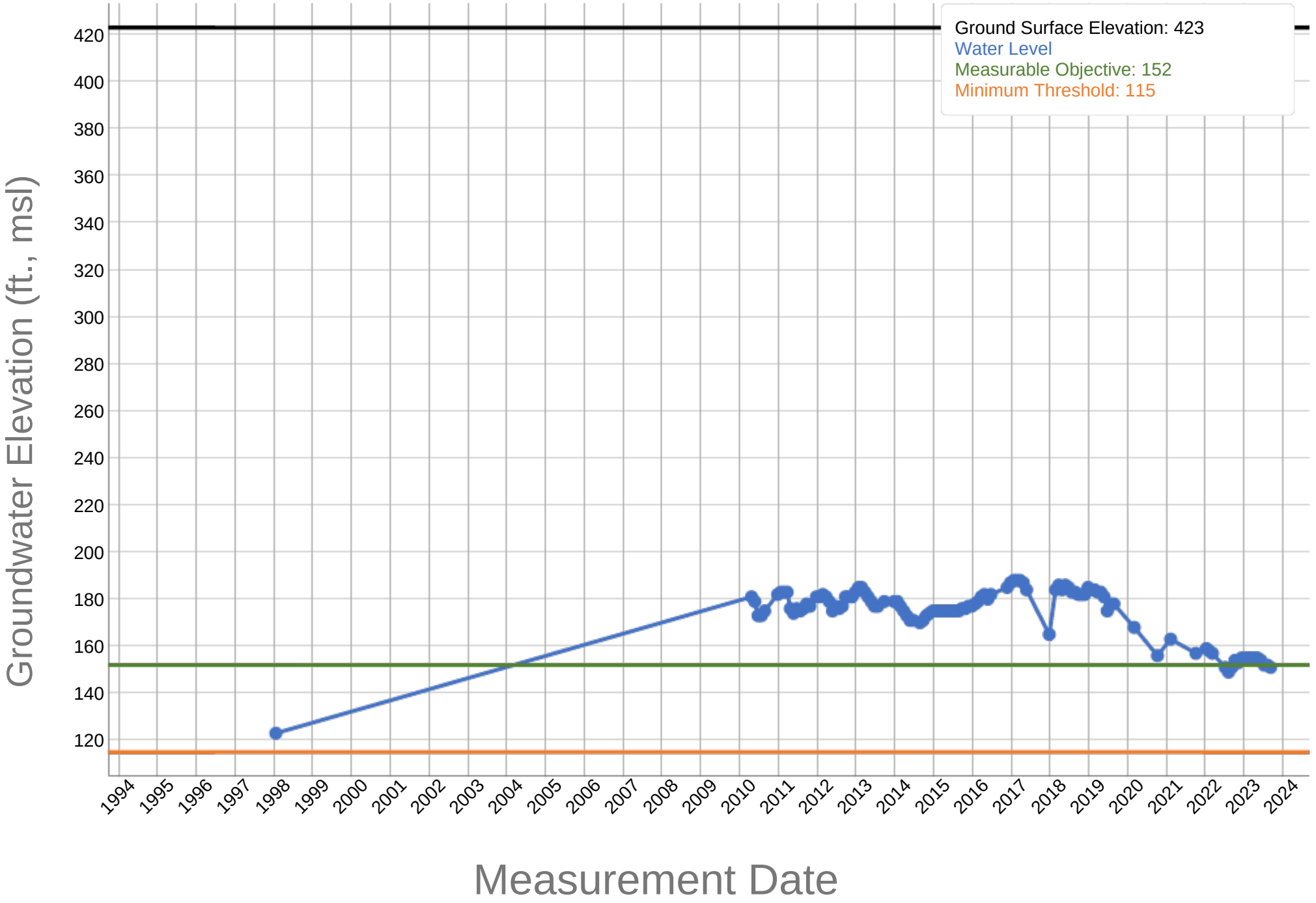
Kern River GSA - RMW-211 - 353681N1190101W001



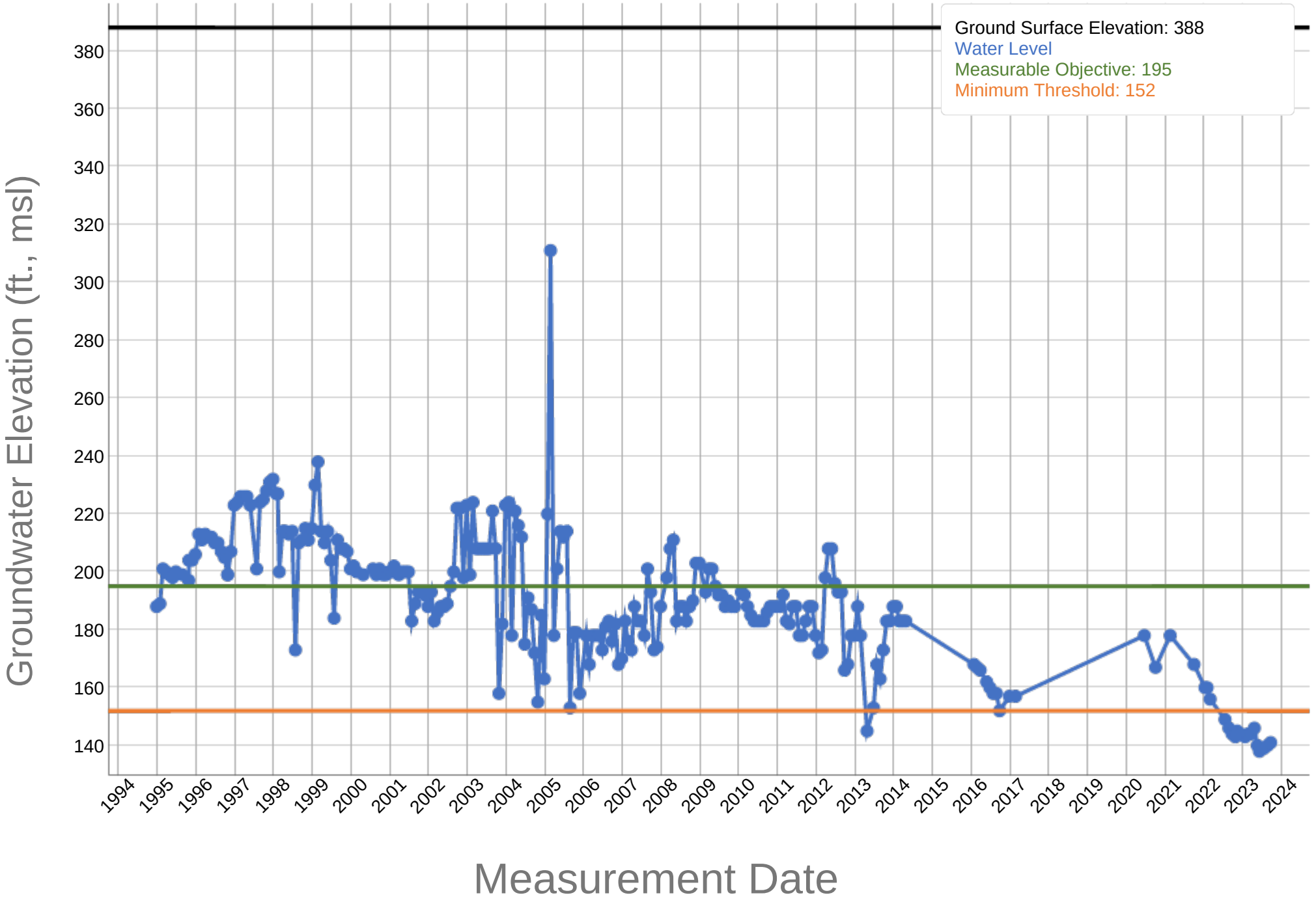
A4-31

Kern River GSA - RMW-212 - 353618N1189334W001



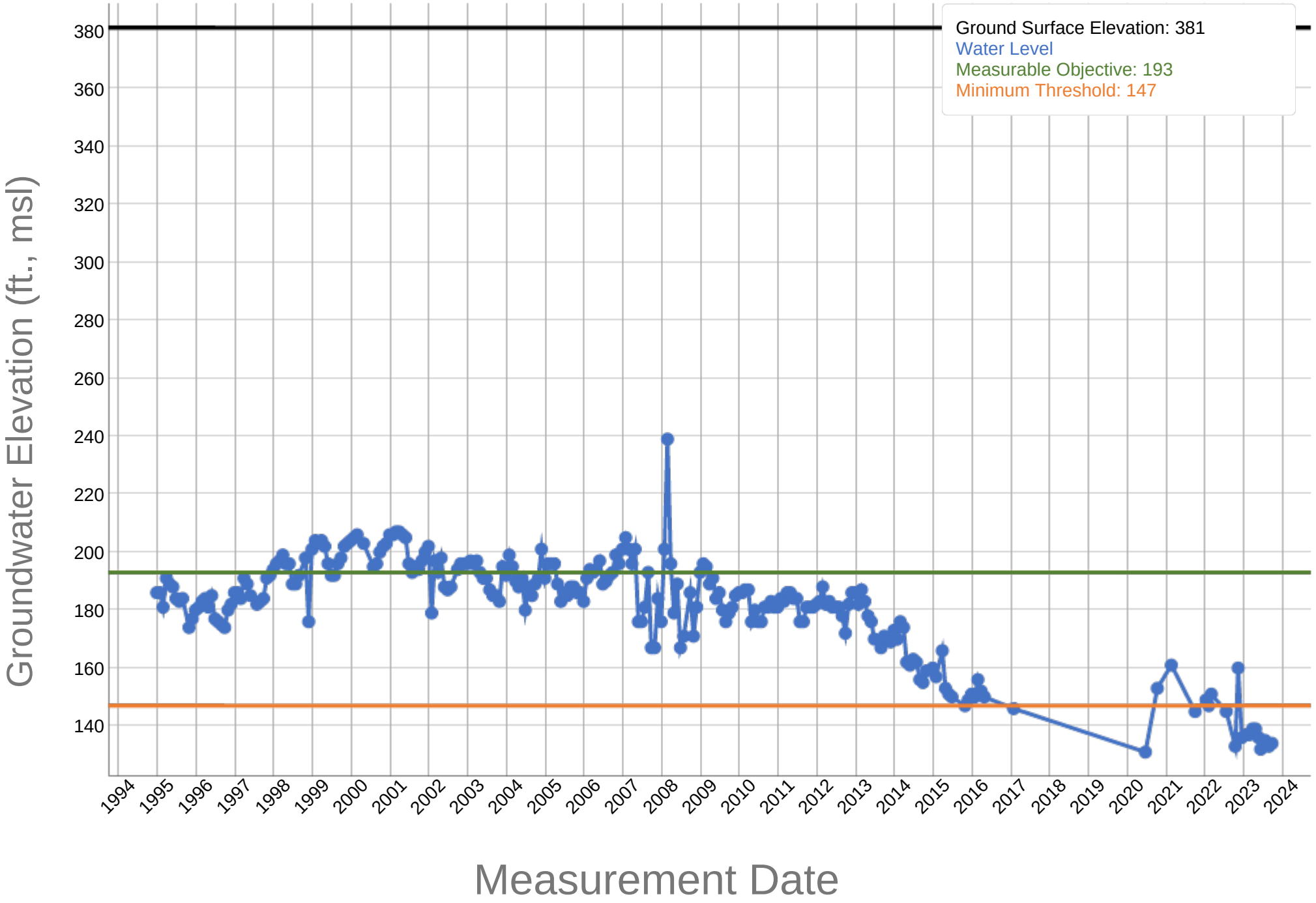
A4-32

California Water Service - RMW-213 - 353536N1190539W001



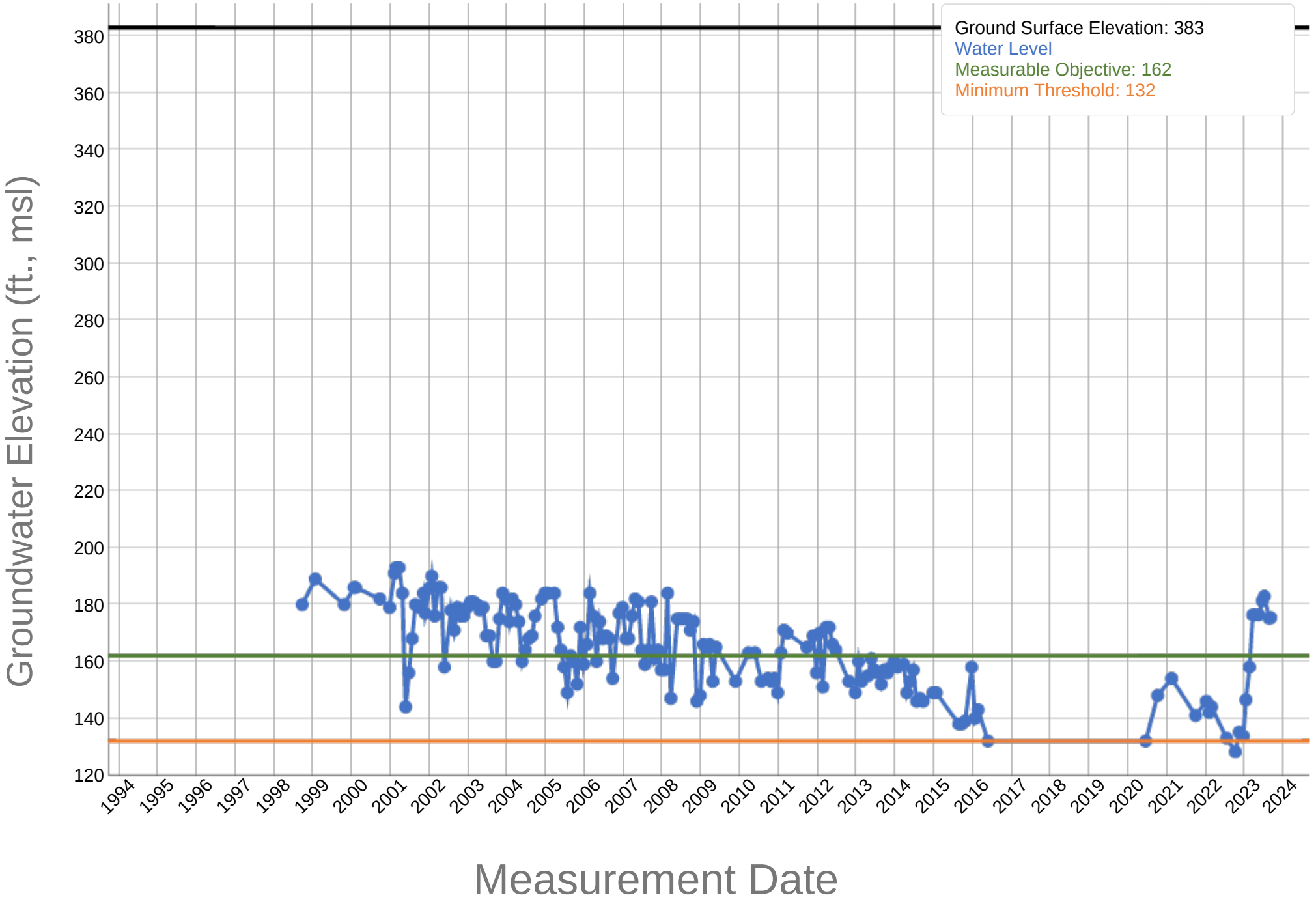
A4-33

Kern River GSA - RMW-214 - 353286N1190221W001



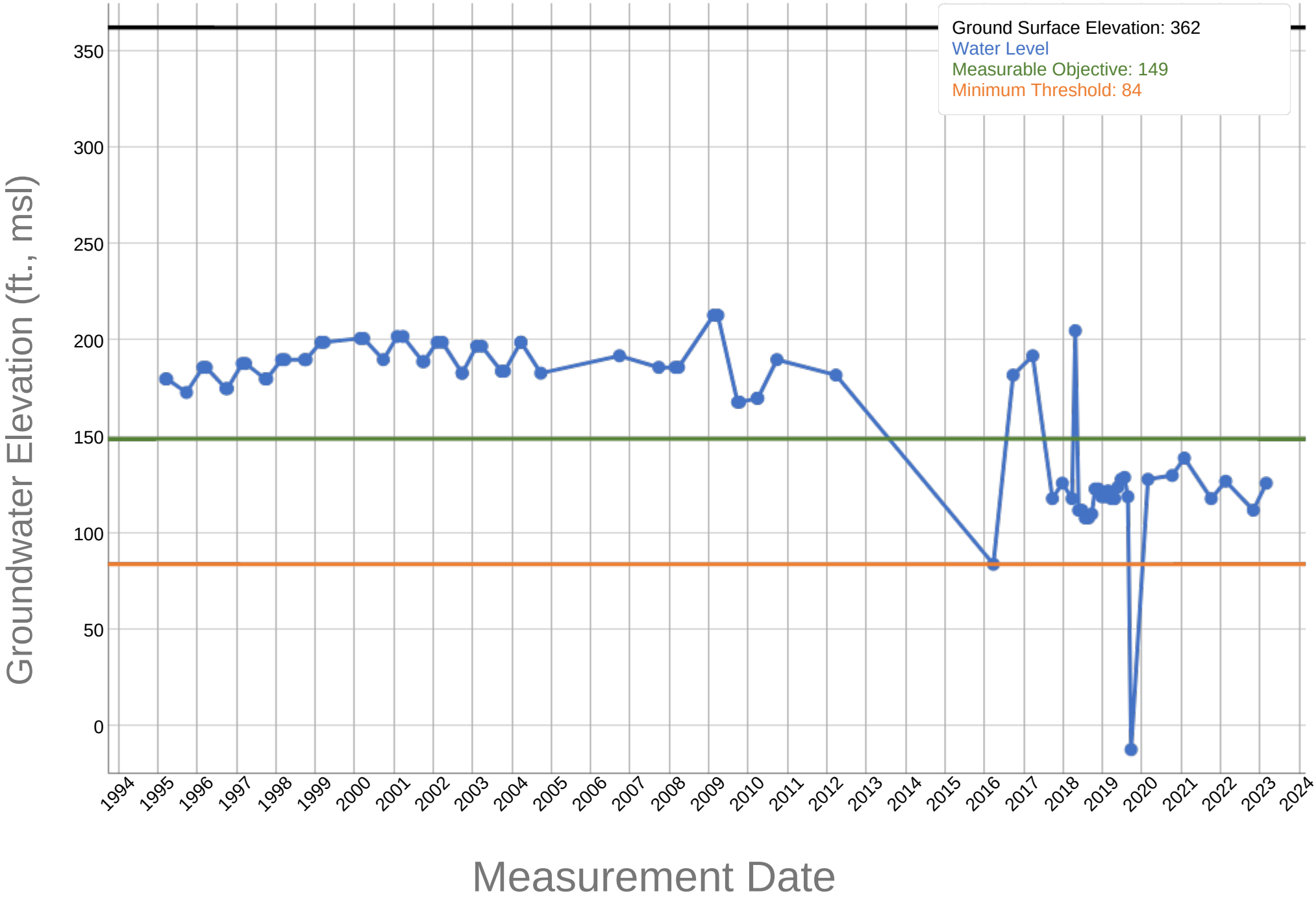
A4-34

Kern River GSA - RMW-215 - 353325N1190016W001



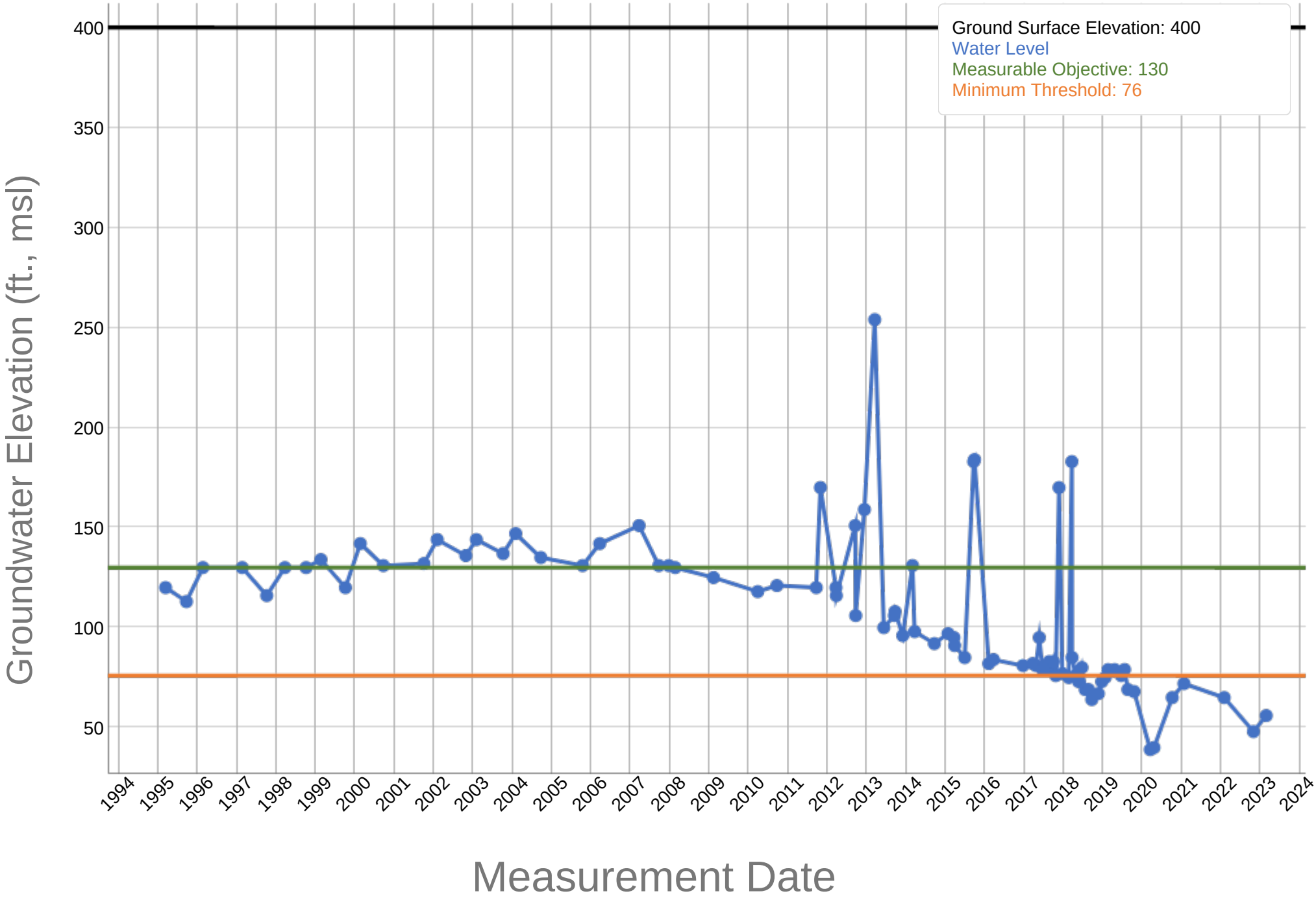
A4-35

Kern River GSA - RMW-216 - 352924N1189911W001



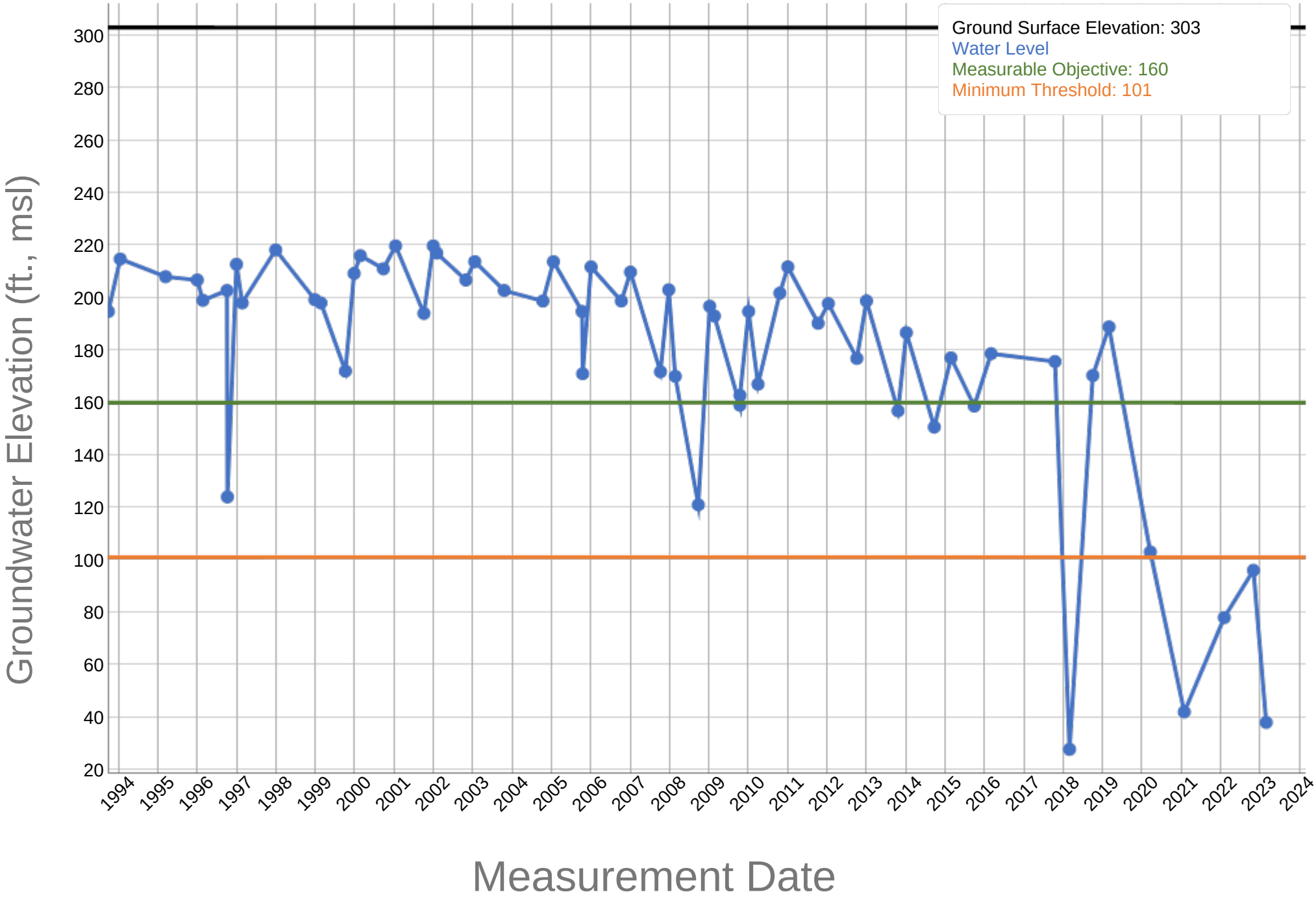
A4-36

Kern River GSA - RMW-217 - 352800N1189080W001



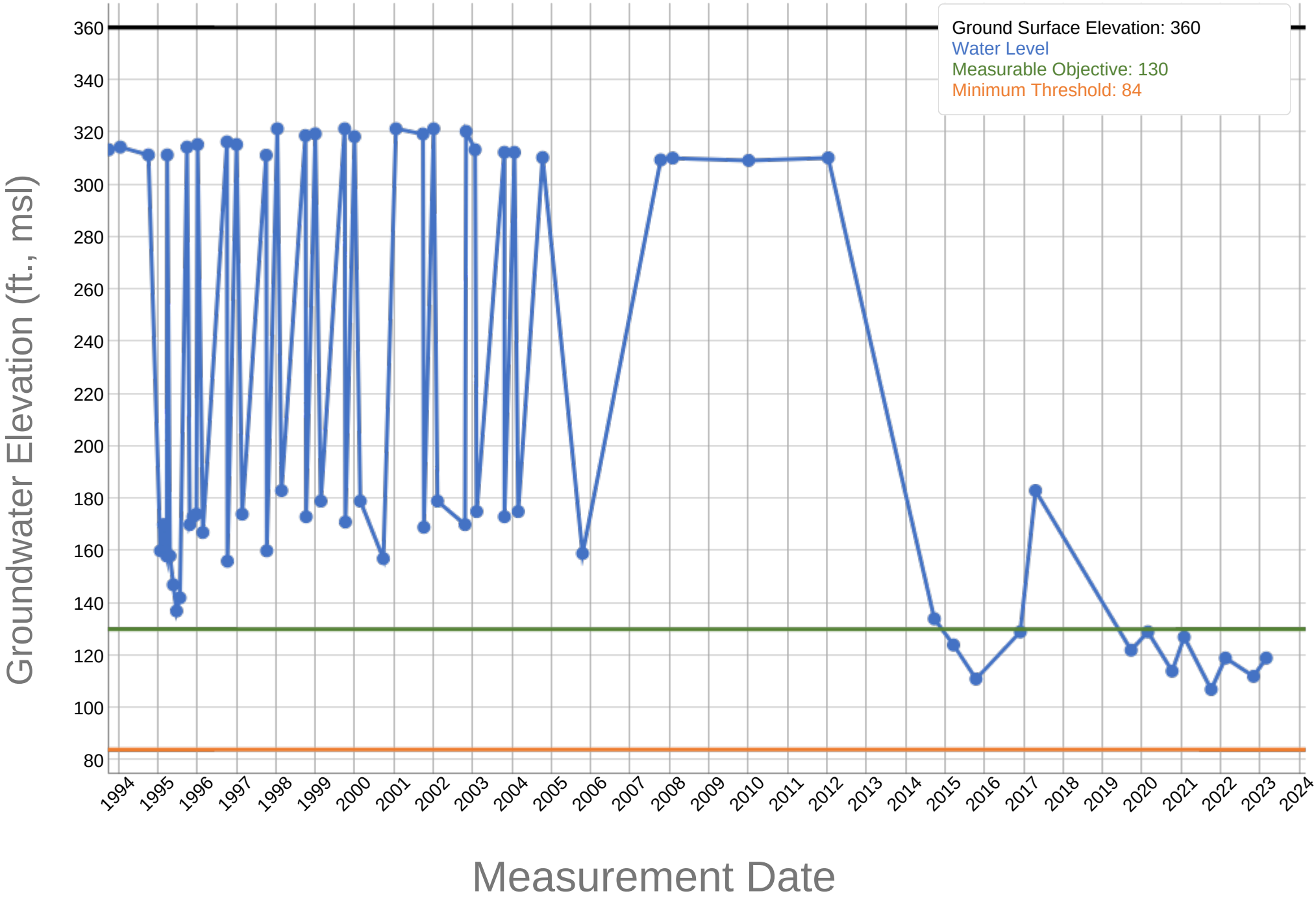
A4-37

Kern River GSA - RMW-218 - 351867N1190820W001



A4-38

Kern River GSA - RMW-219 - 352389N1189485W001



APPENDIX A5

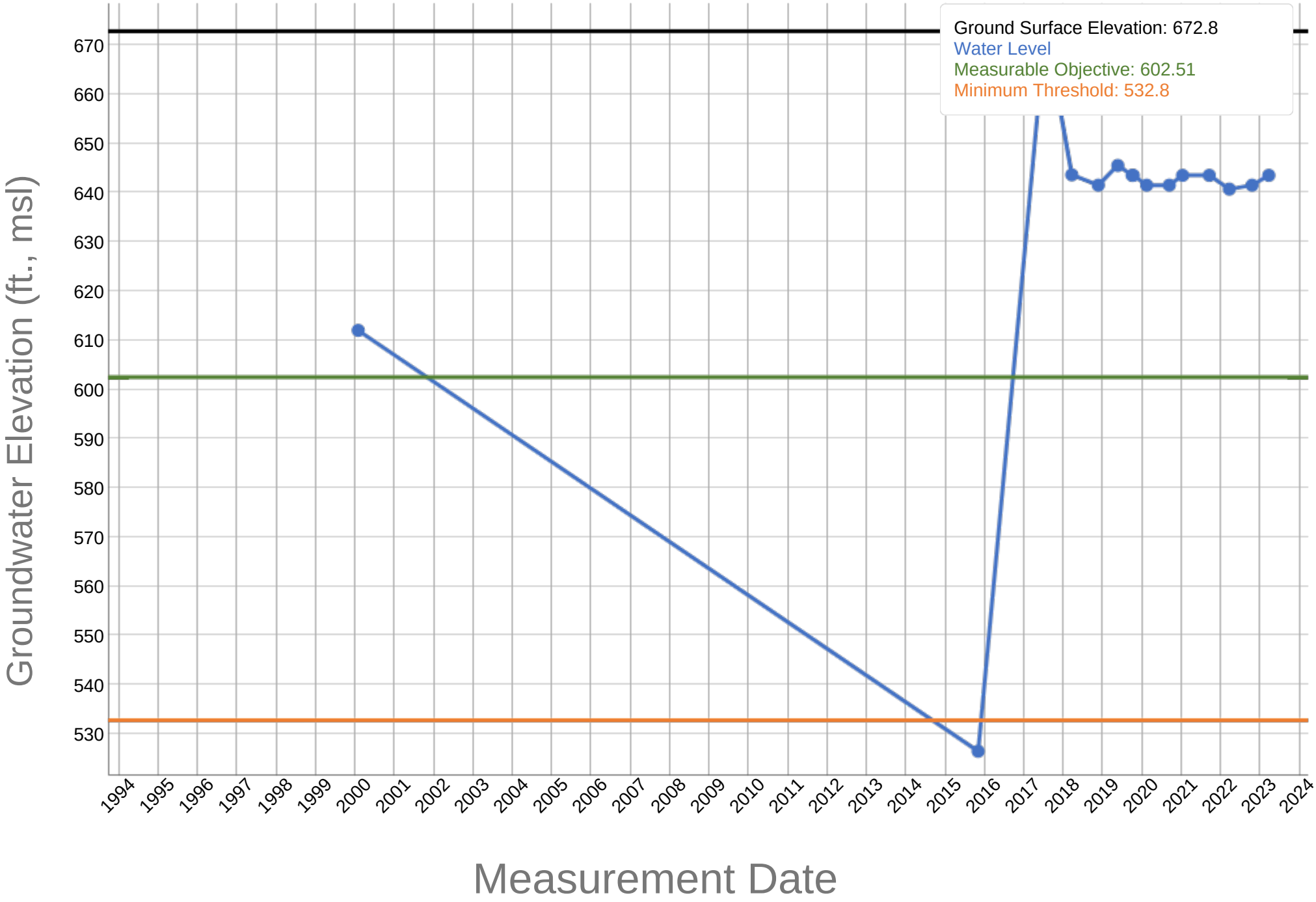
Hydrographs of Groundwater Elevations

GSP Monitoring Network Wells

Olcese Water District GSA

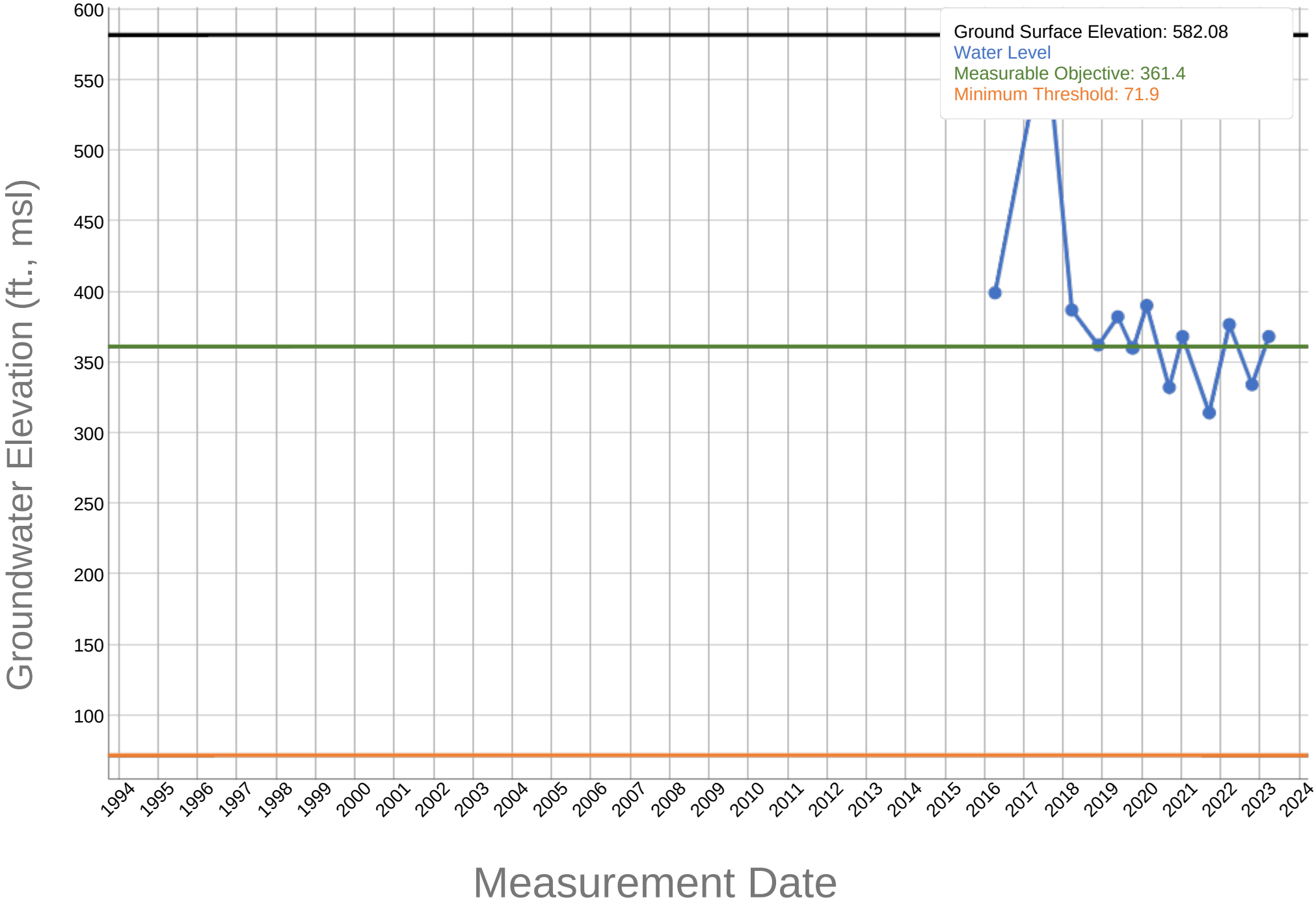
A5-1

Olcese Water District GSA - Canyon View Ranch - 354386N1188035W002



A5-2

Olcese Water District GSA - Well #4 - 354310N1188411W002



APPENDIX A6

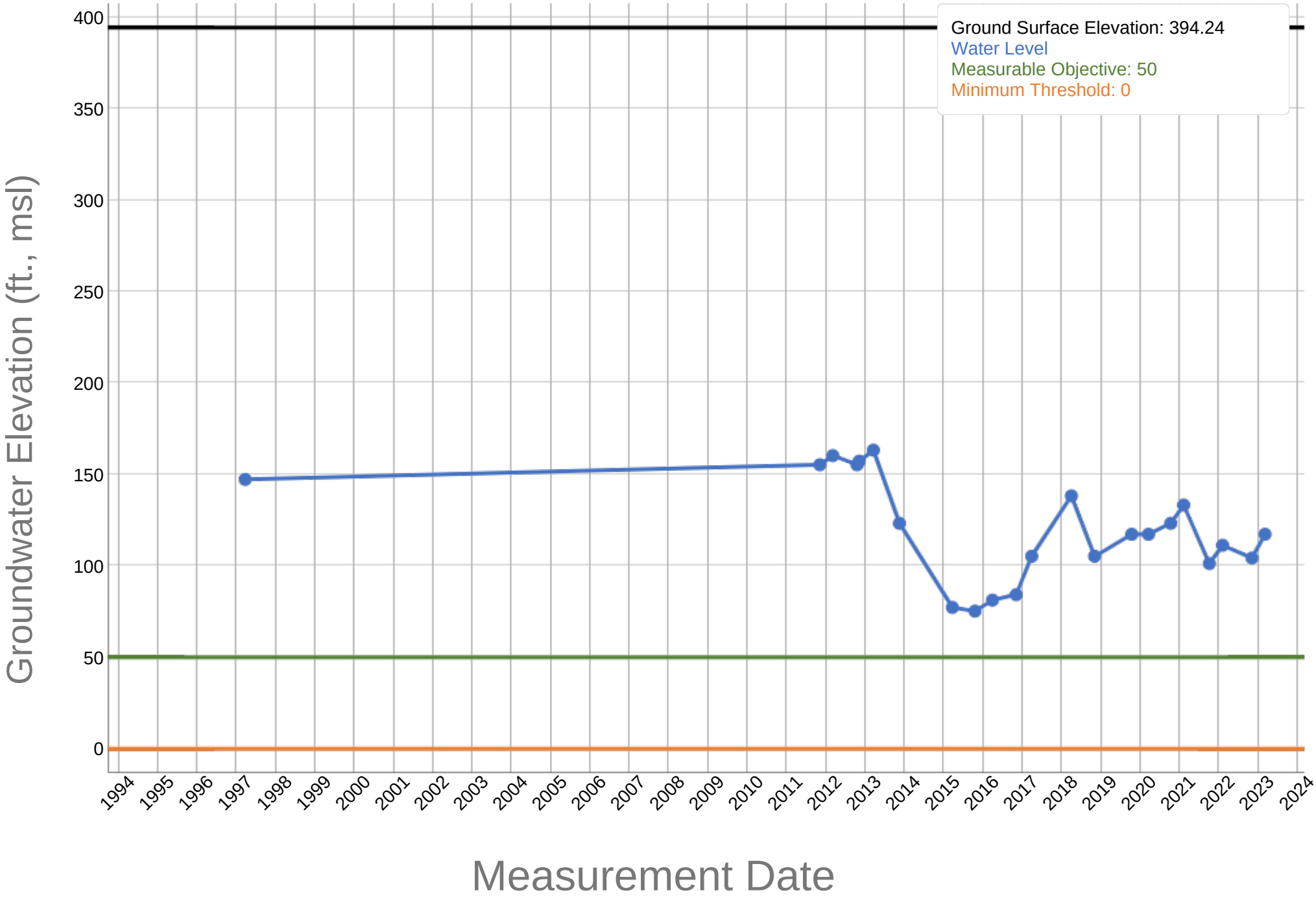
Hydrographs of Groundwater Elevations

GSP Monitoring Network Wells

South of Kern River GSAs

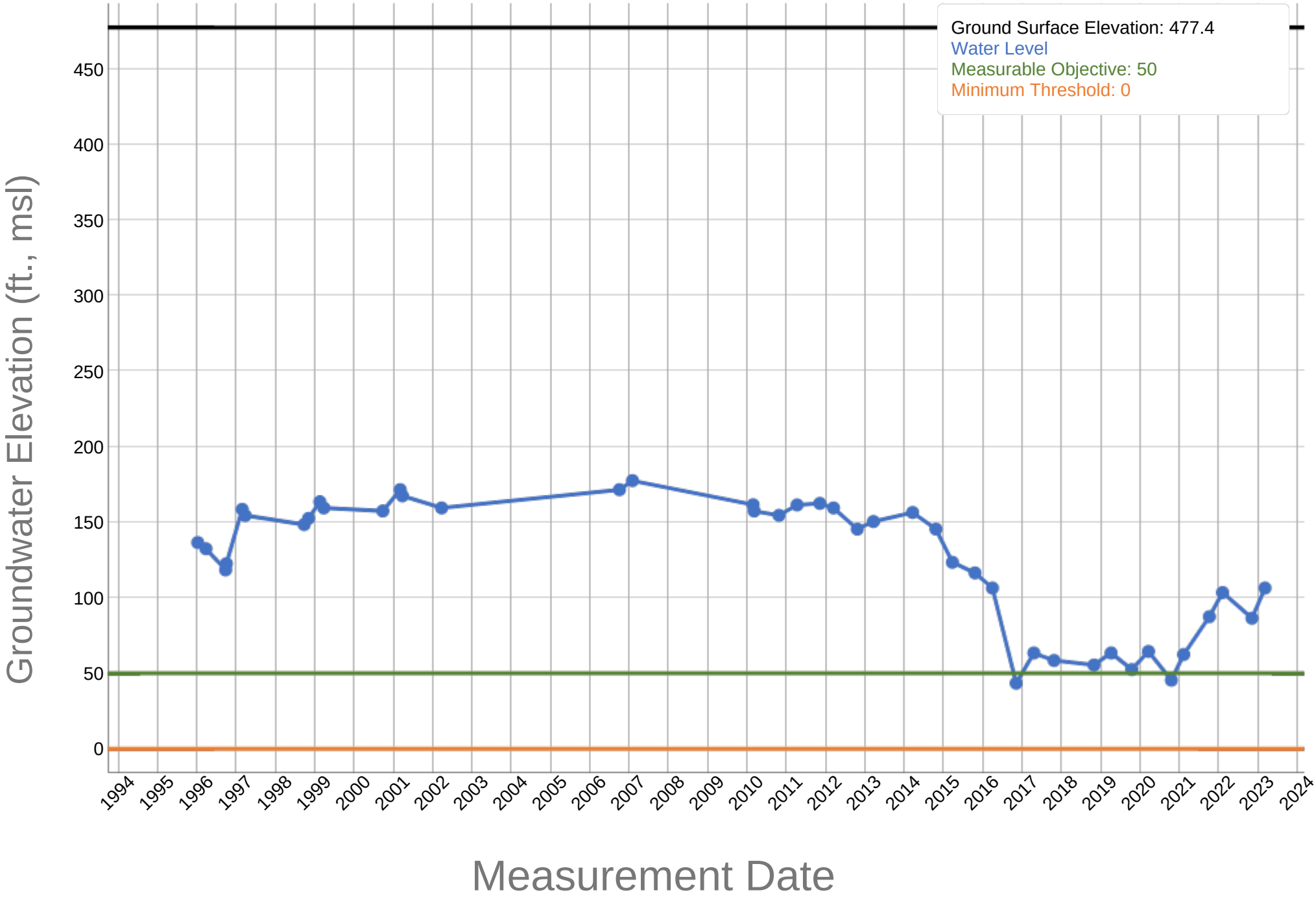
A6-1

Arvin GSA - 11N20W05J001S - 350669N1190295W001



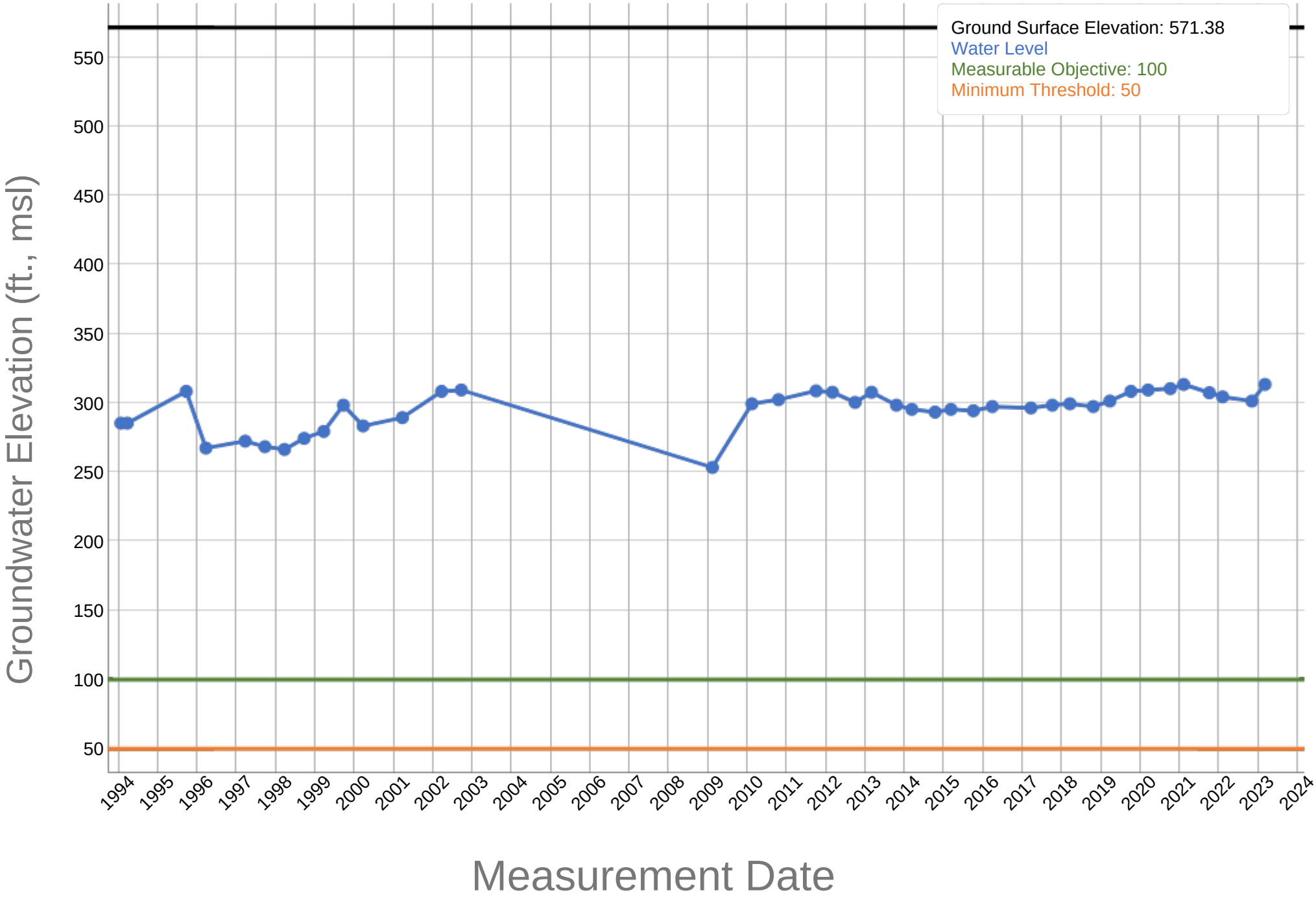
A6-2

Arvin GSA - 12N20W36G001S - 350833N1189632W001



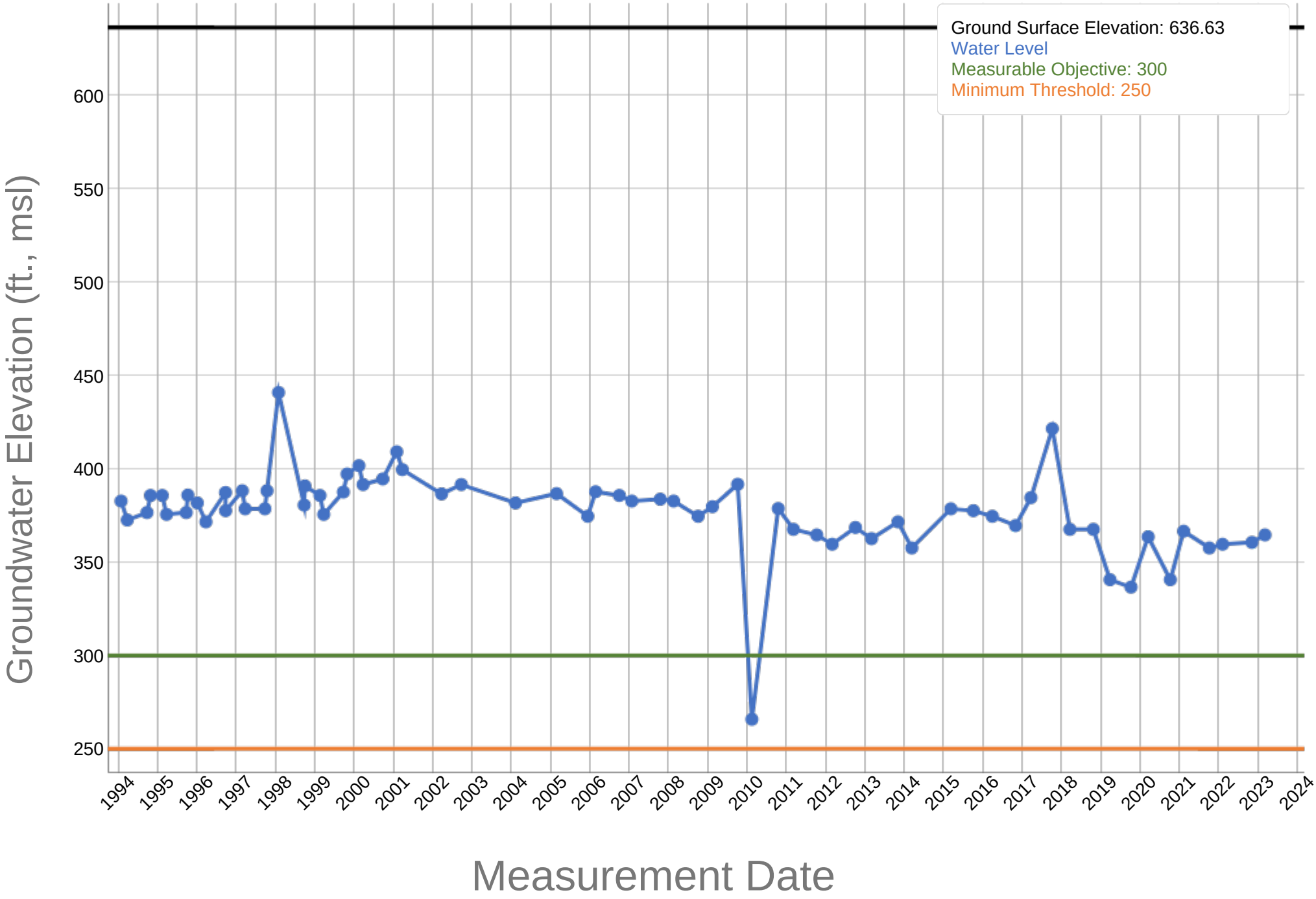
A6-3

Arvin GSA - 29S29E33N001M - 353577N1188771W001



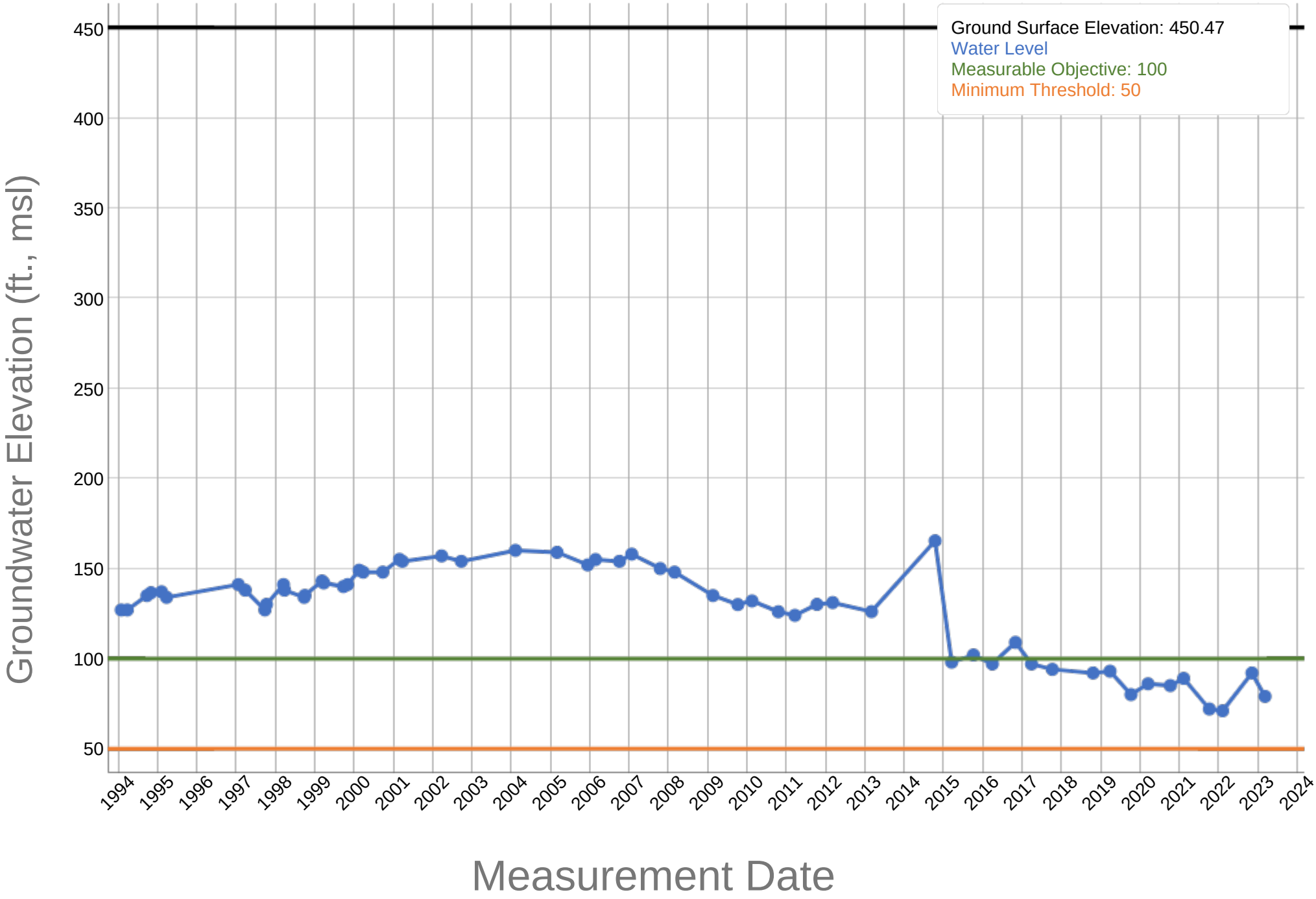
A6-4

Arvin GSA - 30S29E11N001M - 353269N1188418W001



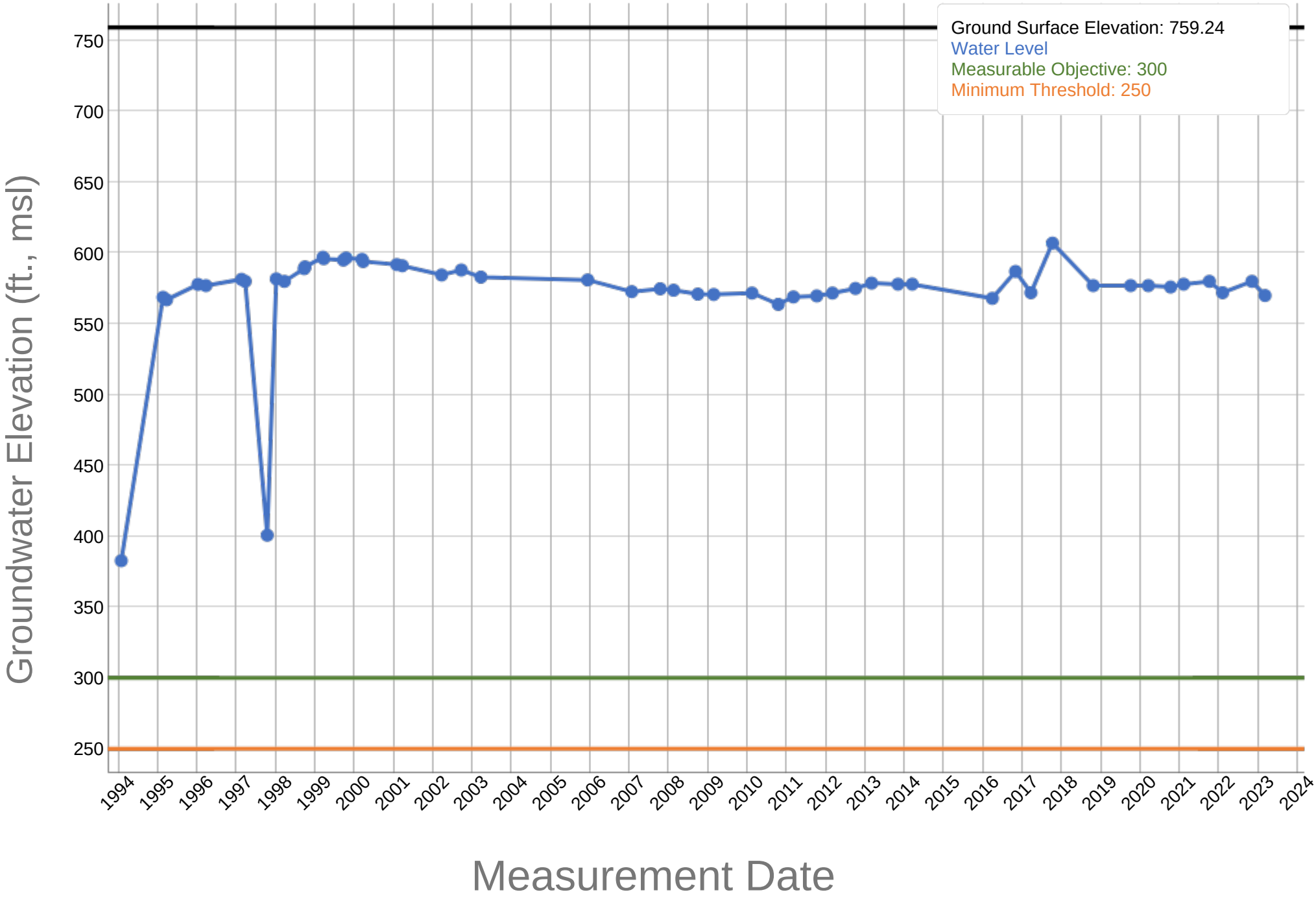
A6-5

Arvin GSA - 30S29E29A001M - 352958N1188807W001



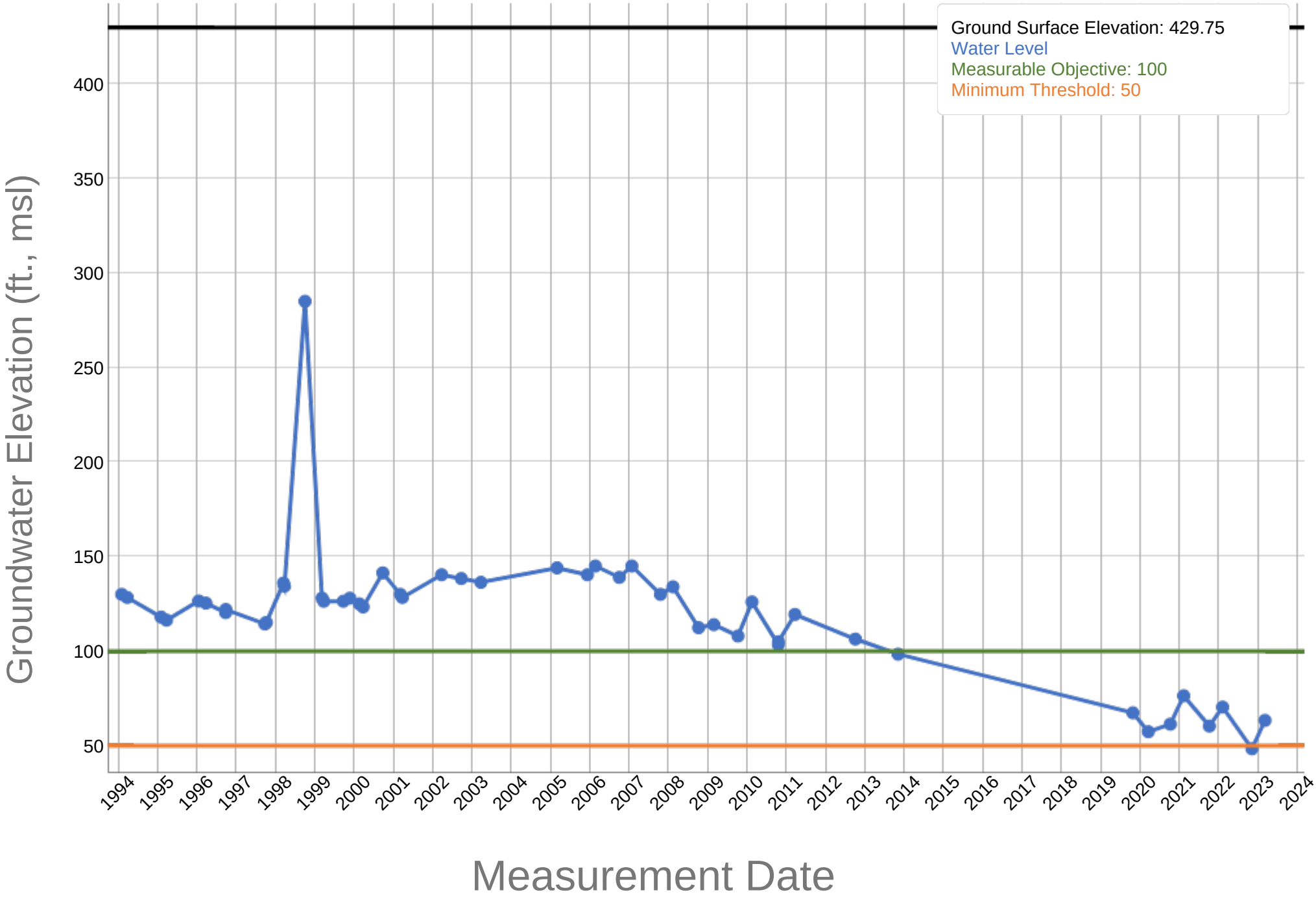
A6-6

Arvin GSA - 30S30E19E001M - 353072N1188037W001



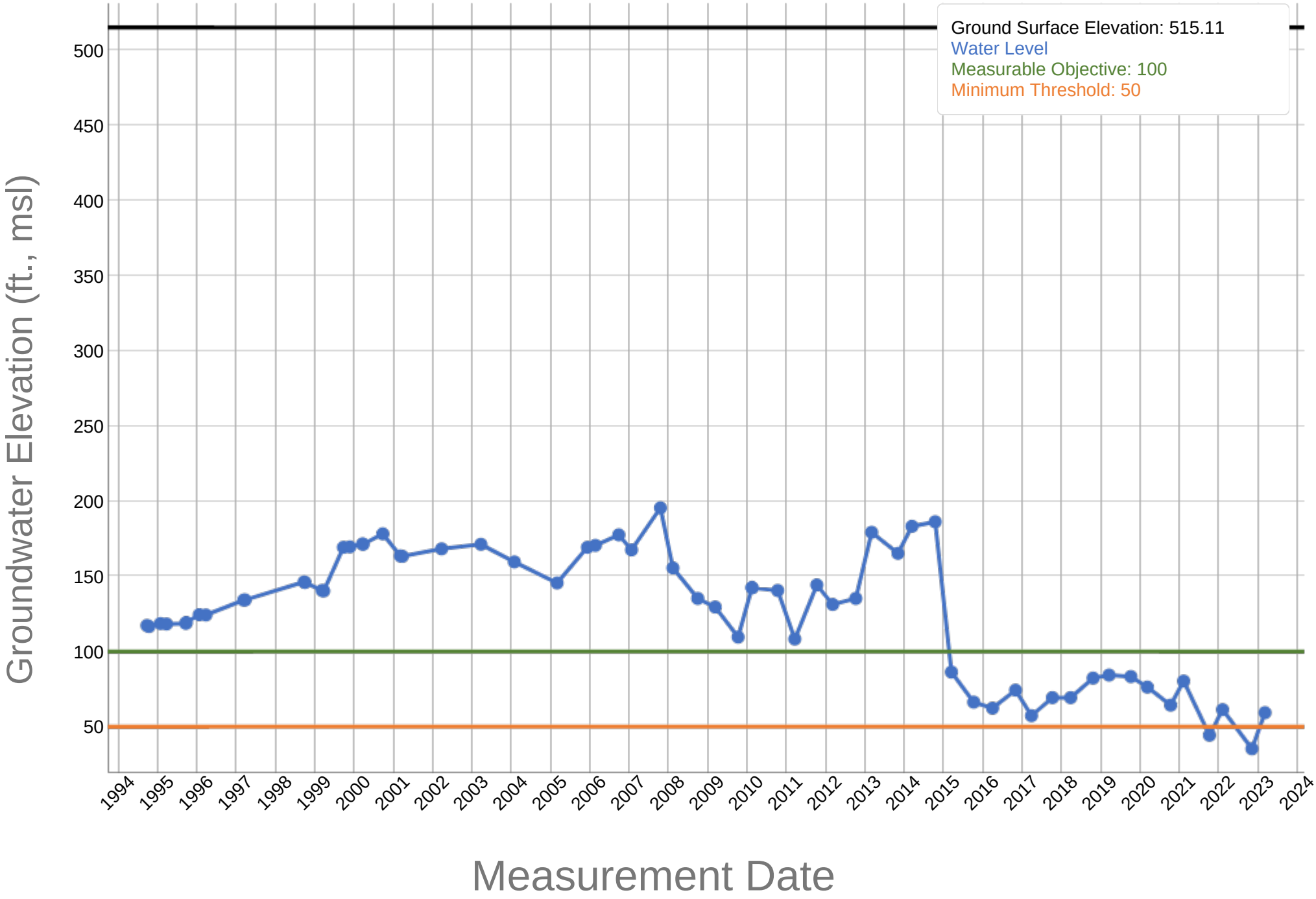
A6-7

Arvin GSA - 31S29E05E001M - 352605N1188932W001



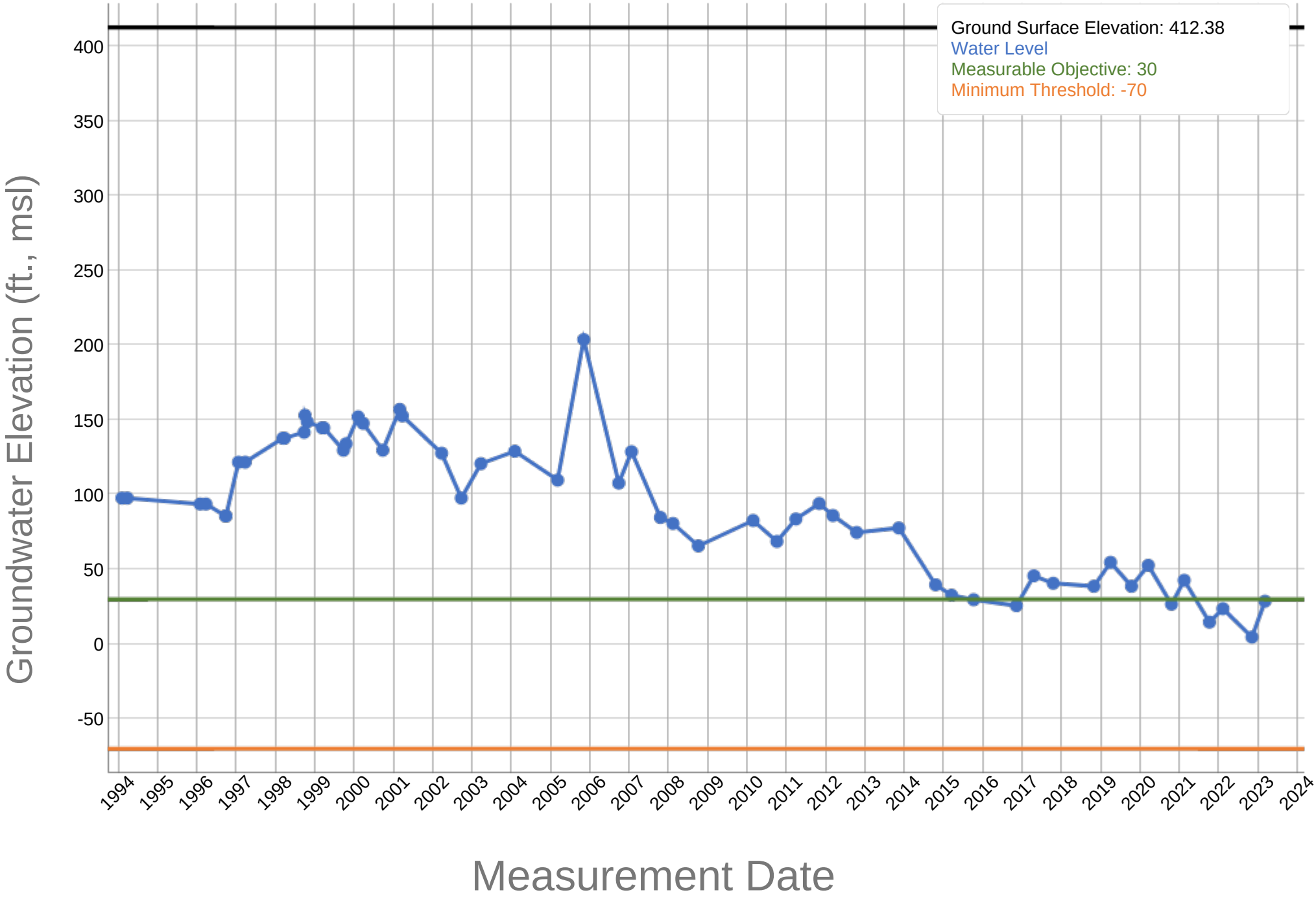
A6-8

Arvin GSA - 31S29E12M001M - 352452N1188243W001



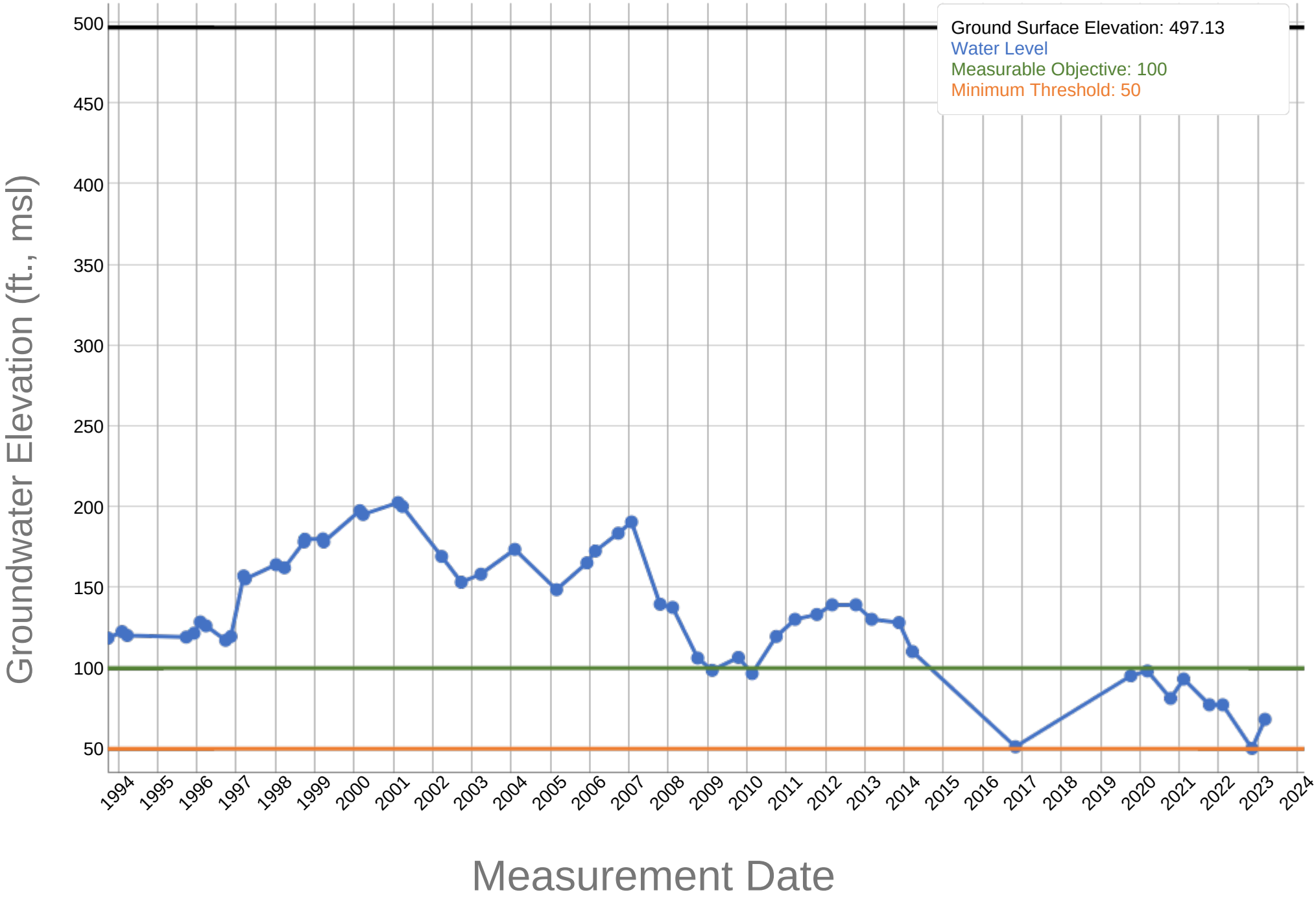
A6-9

Arvin GSA - 31S29E34A001M - 351944N1188423W001



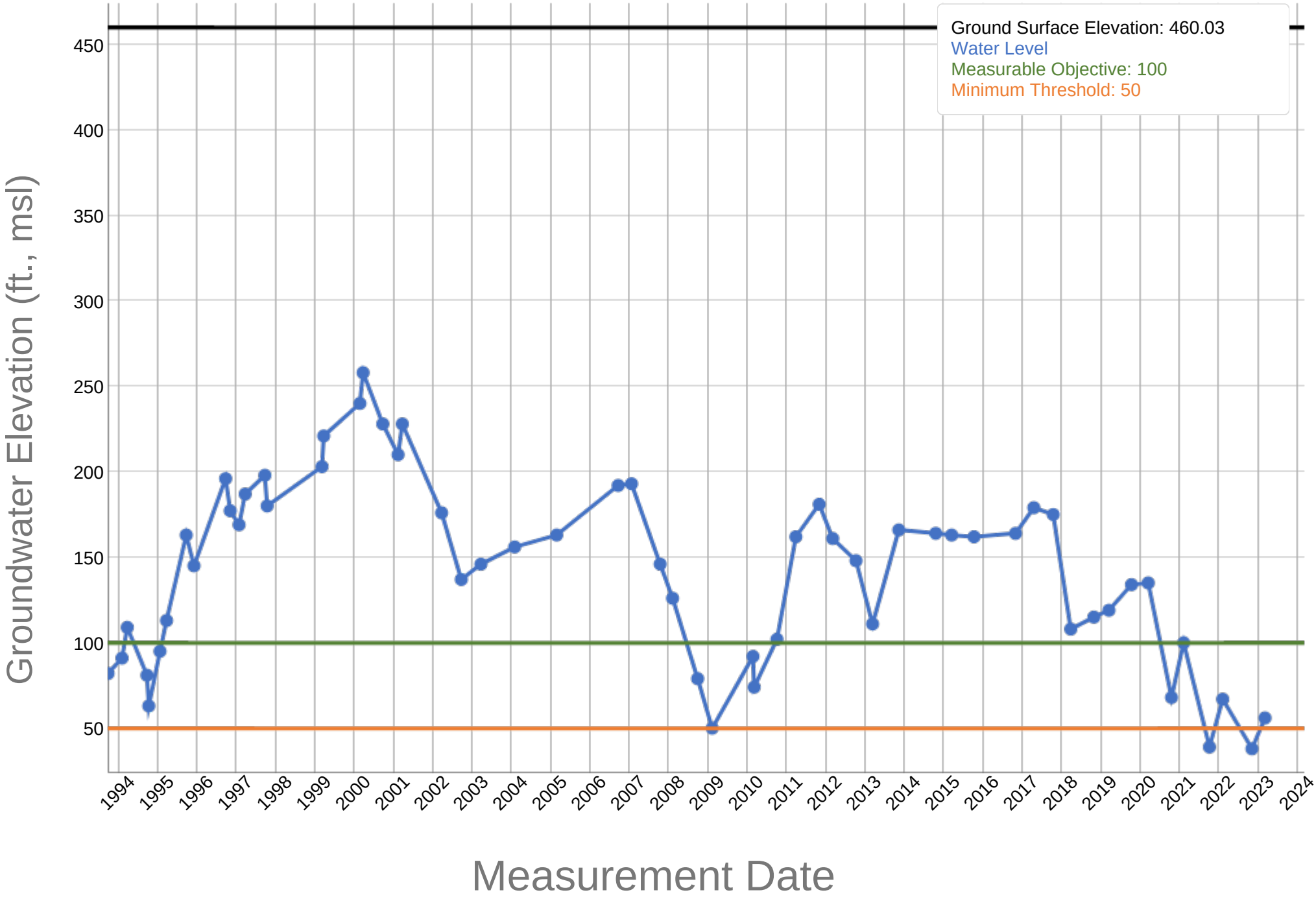
A6-10

Arvin GSA - 31S30E17K001M - 352311N1187790W001



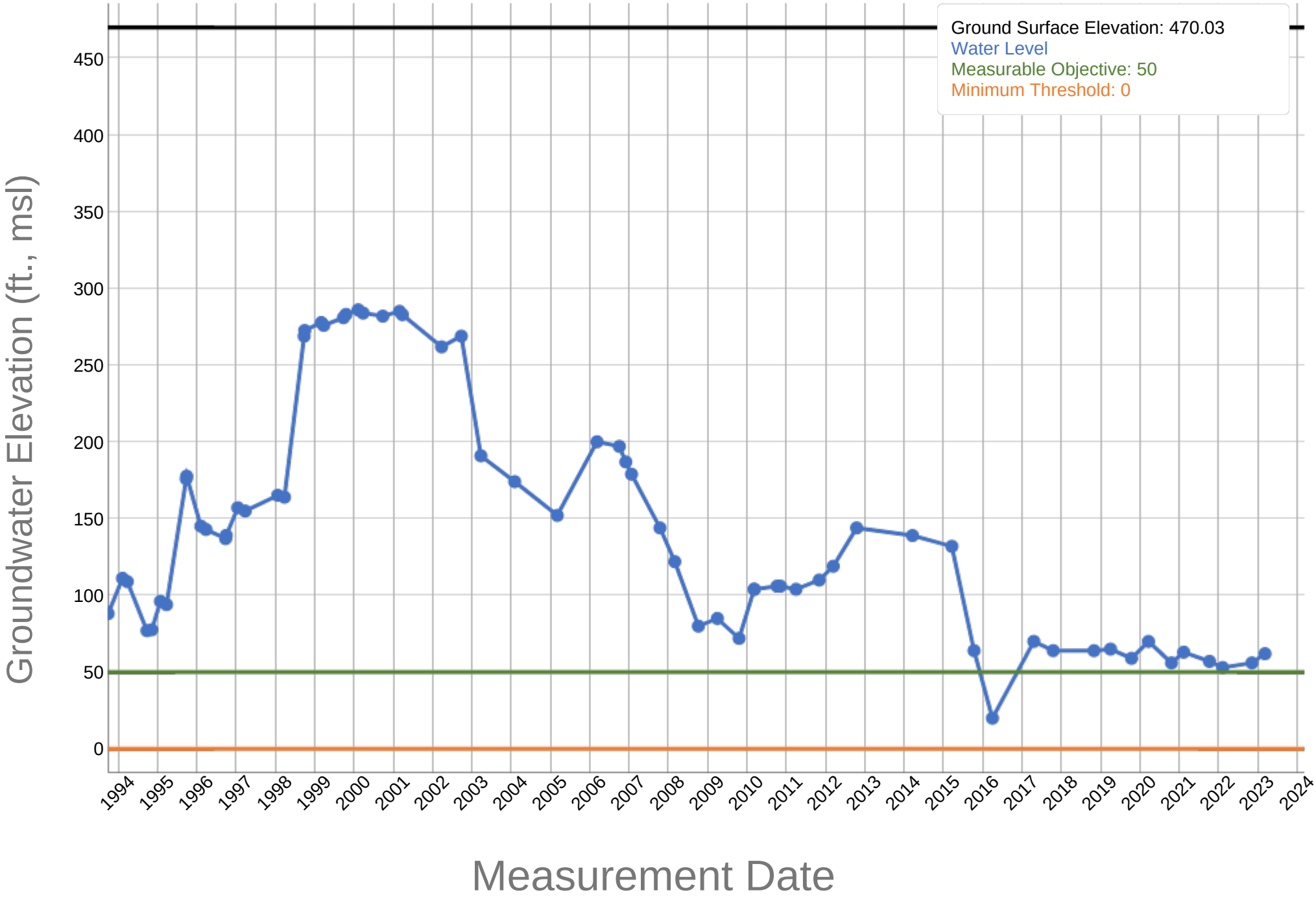
A6-11

Arvin GSA - 31S30E30J001M - 352017N1187987W001



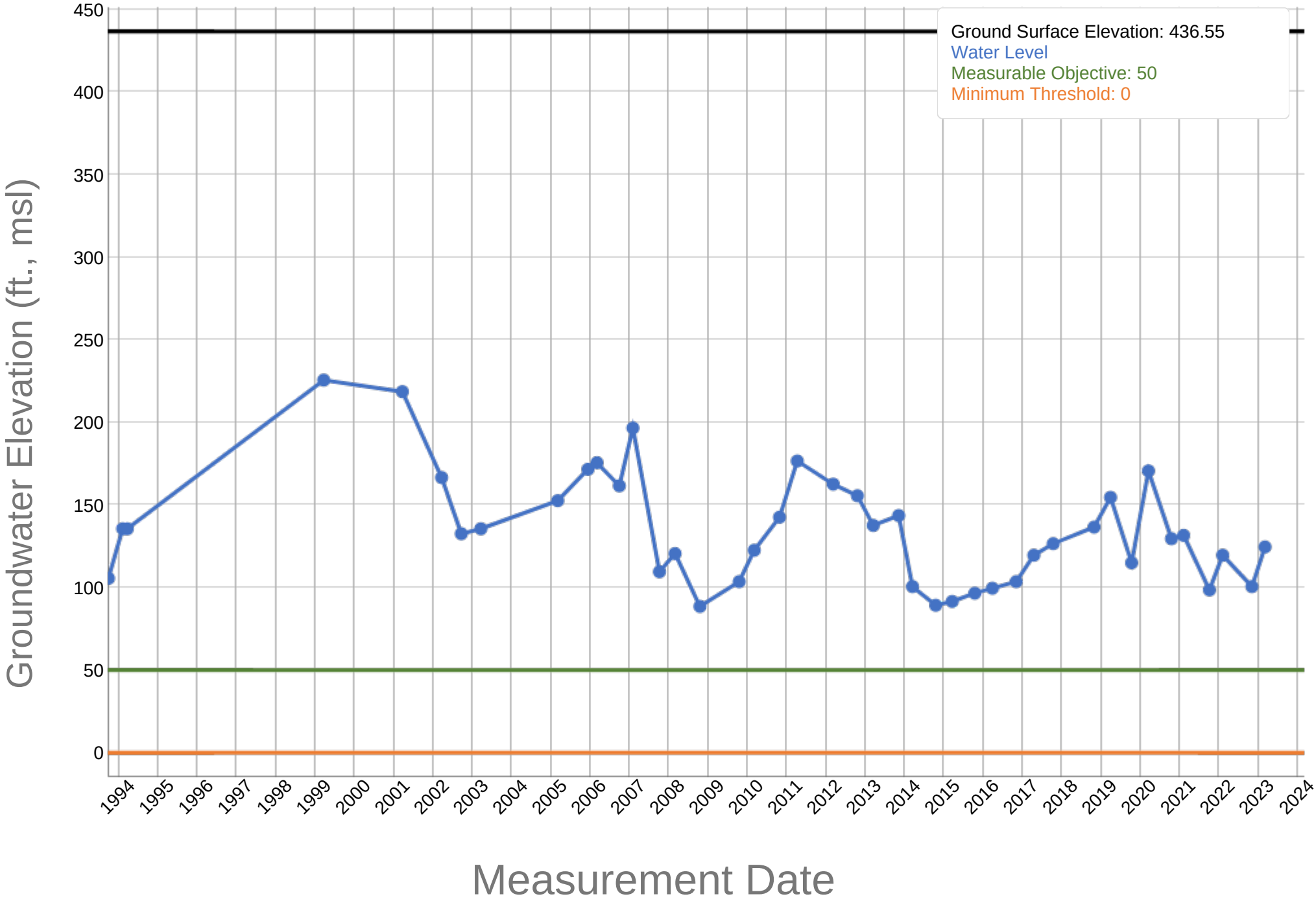
A6-12

Arvin GSA - 32S29E12P001M - 351522N1188199W001



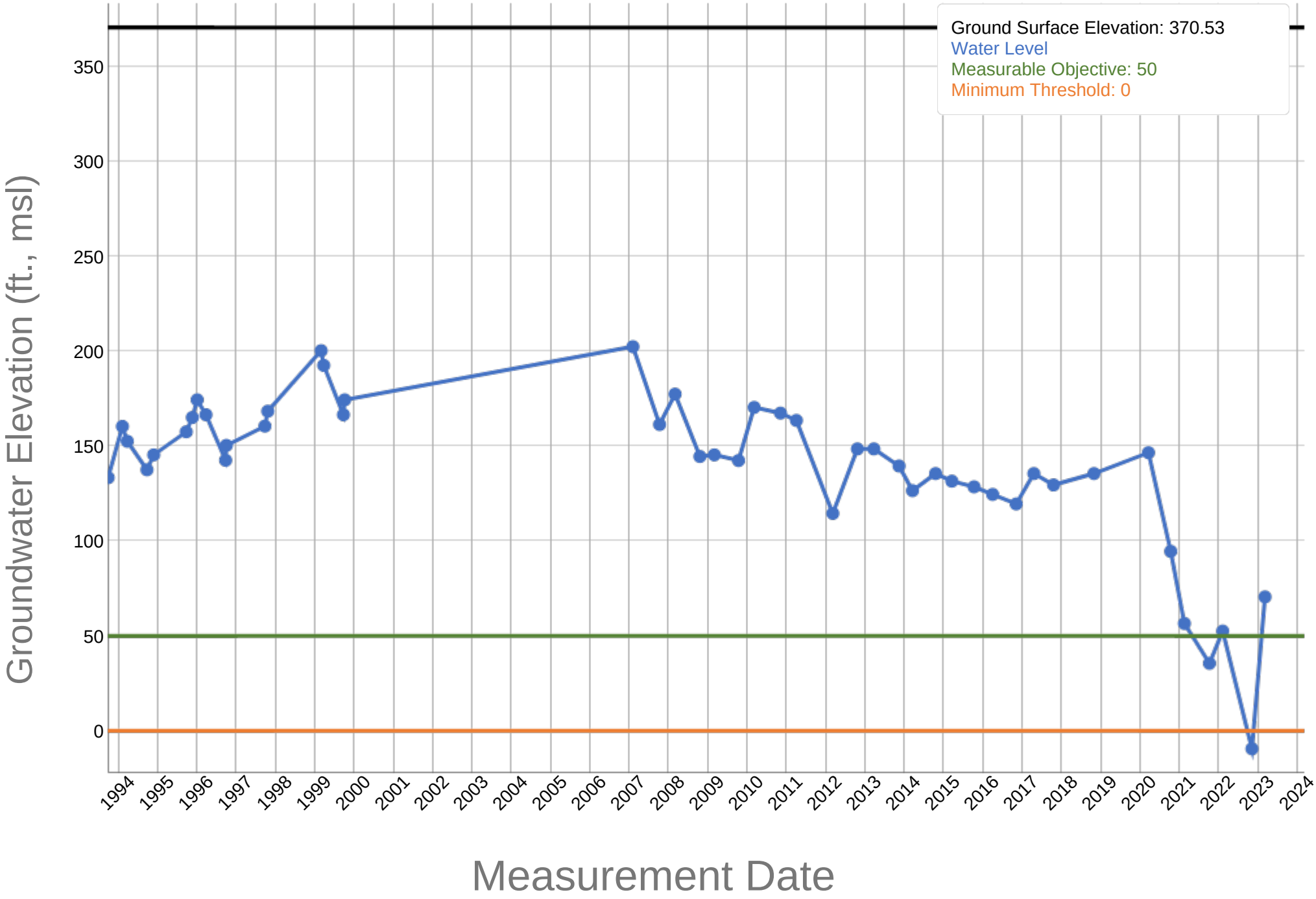
A6-13

Arvin GSA - 32S29E20H001M - 351300N1188781W001



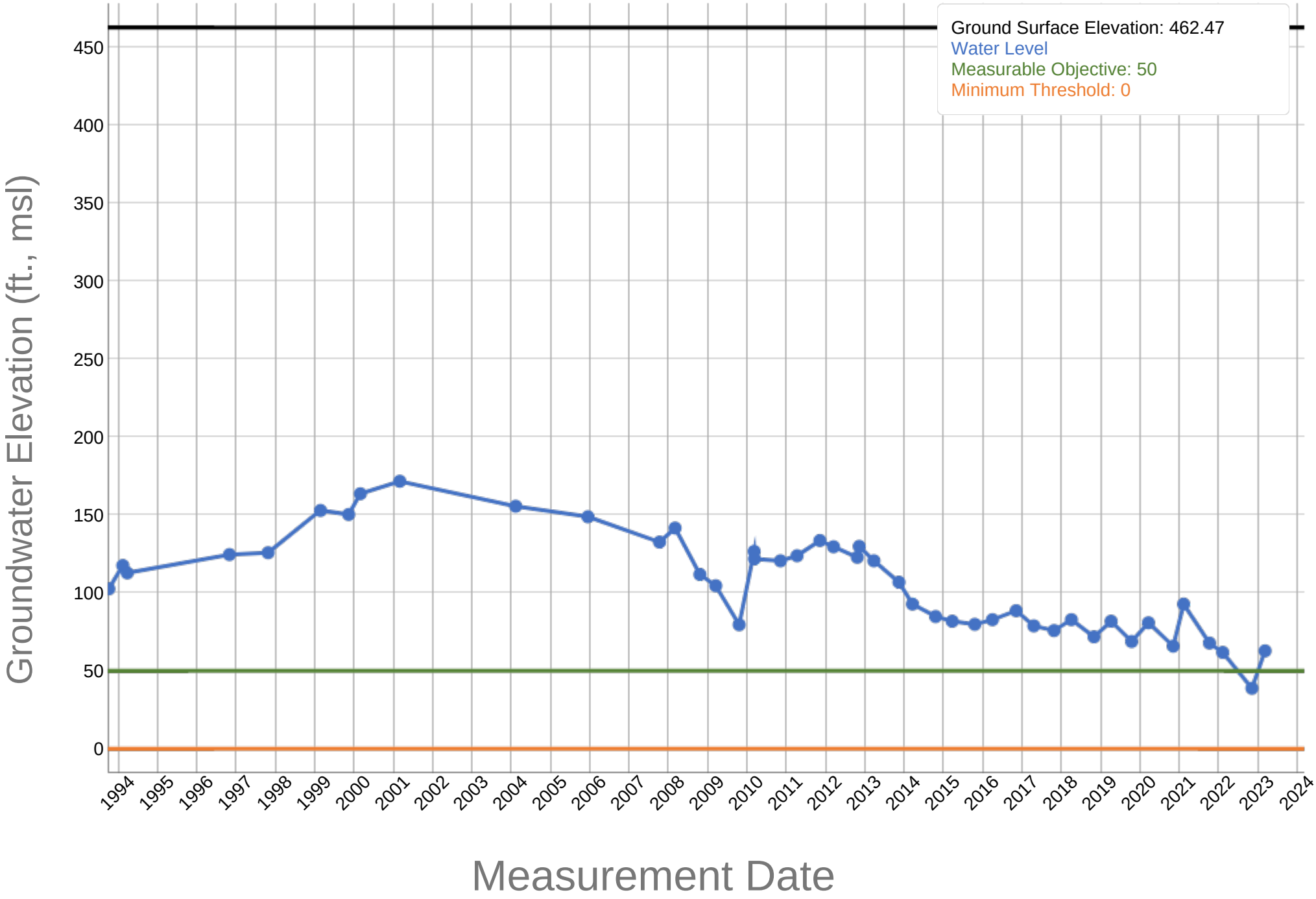
A6-14

Arvin GSA - 32S28E23H001M - 351300N1189357W001



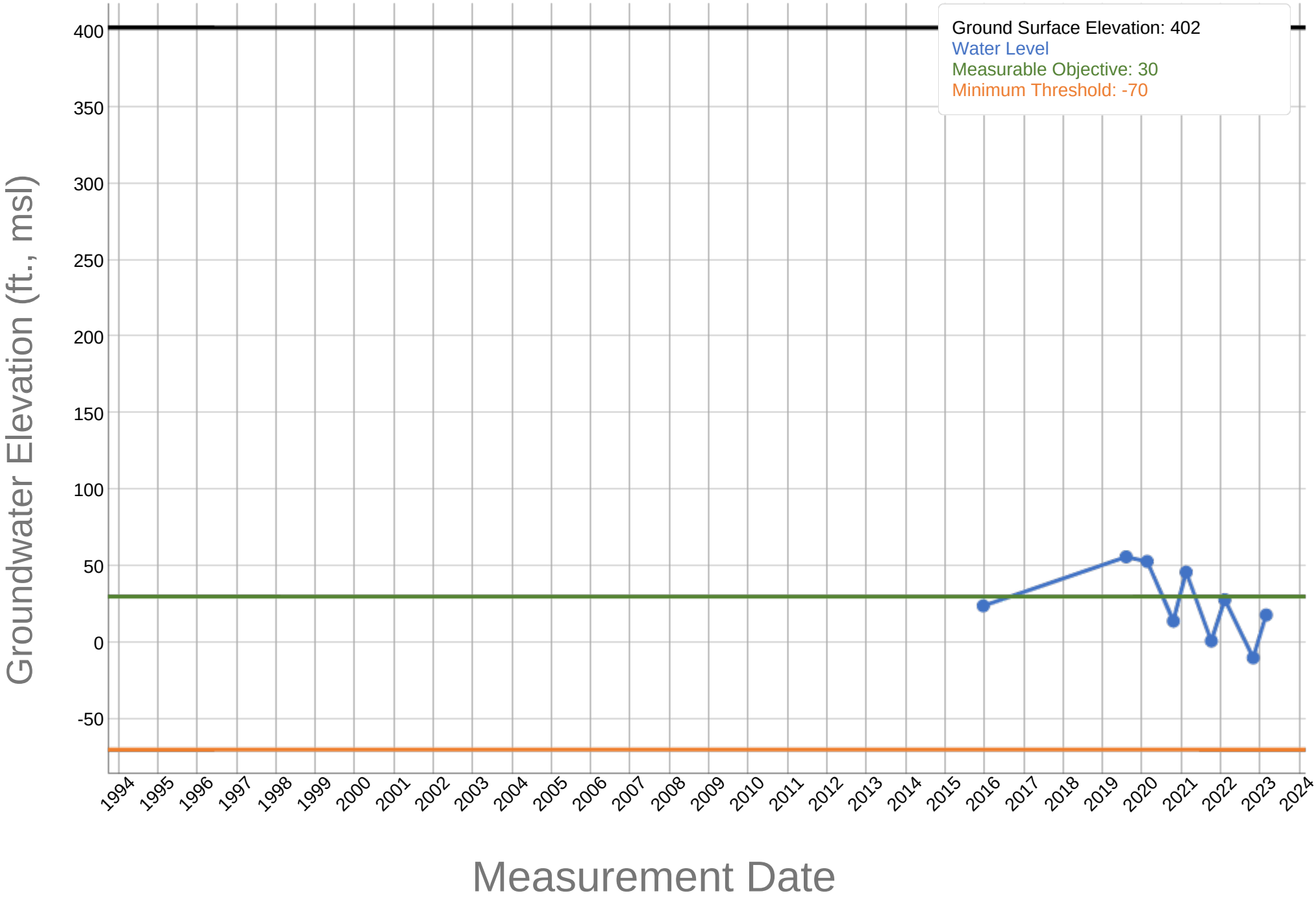
A6-15

Arvin GSA - 32S29E31N001M - 350931N1189123W001



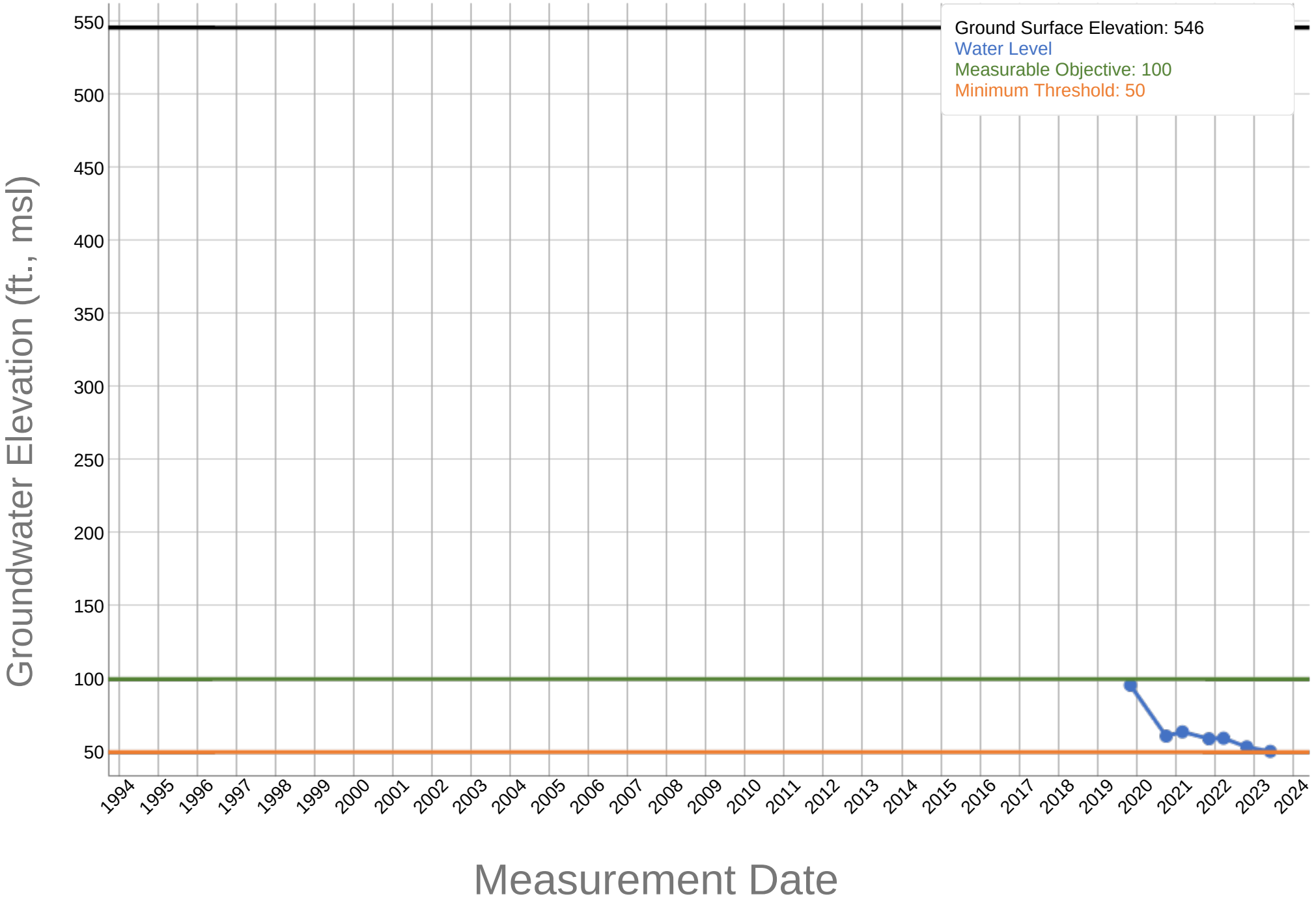
A6-16

Arvin GSA - ACSD Well #14 - 351942N1188484W001



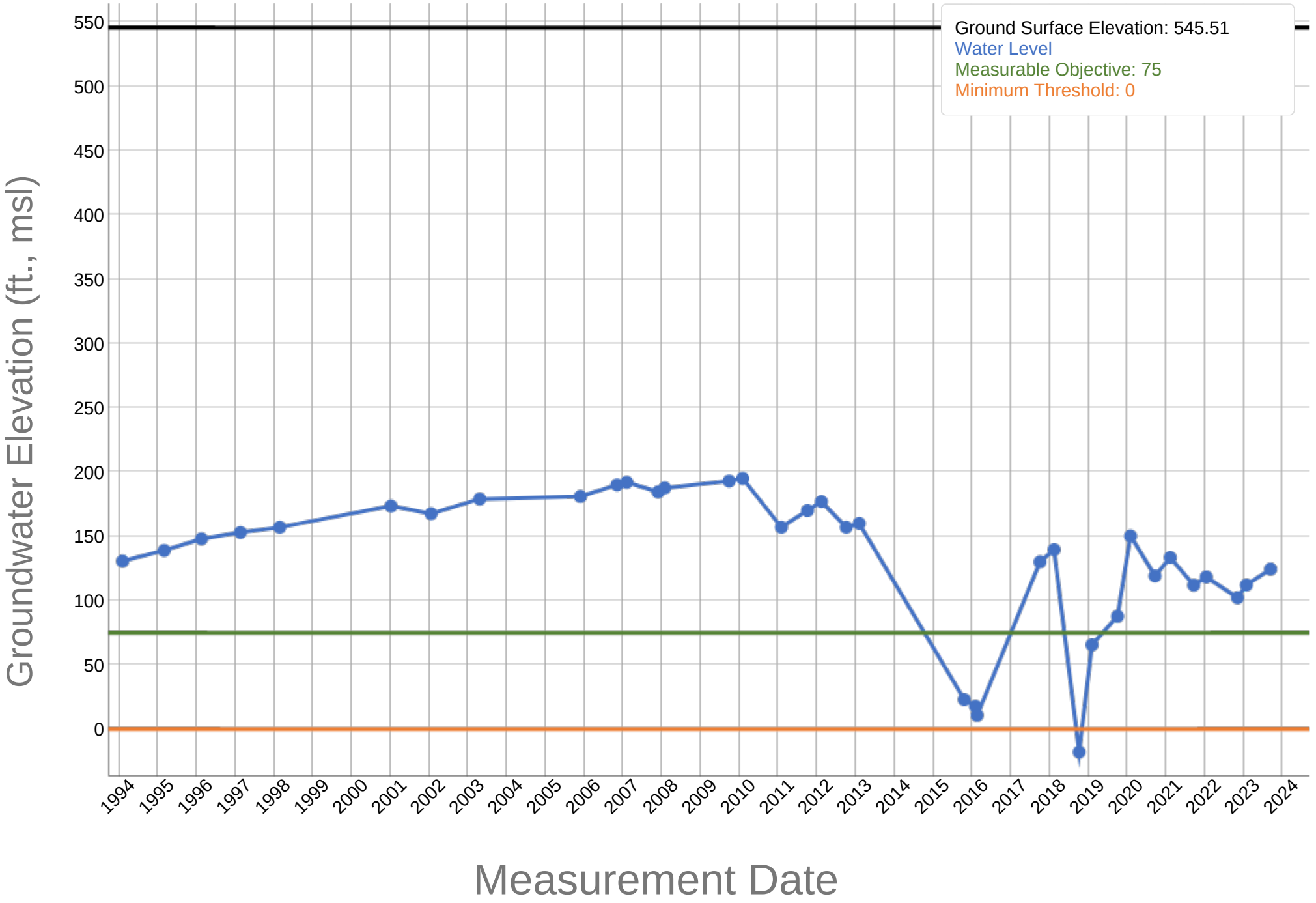
A6-17

Tejon-Castac Water District GSA - Caratan Well (RMS-1) - 352002N1187698W001



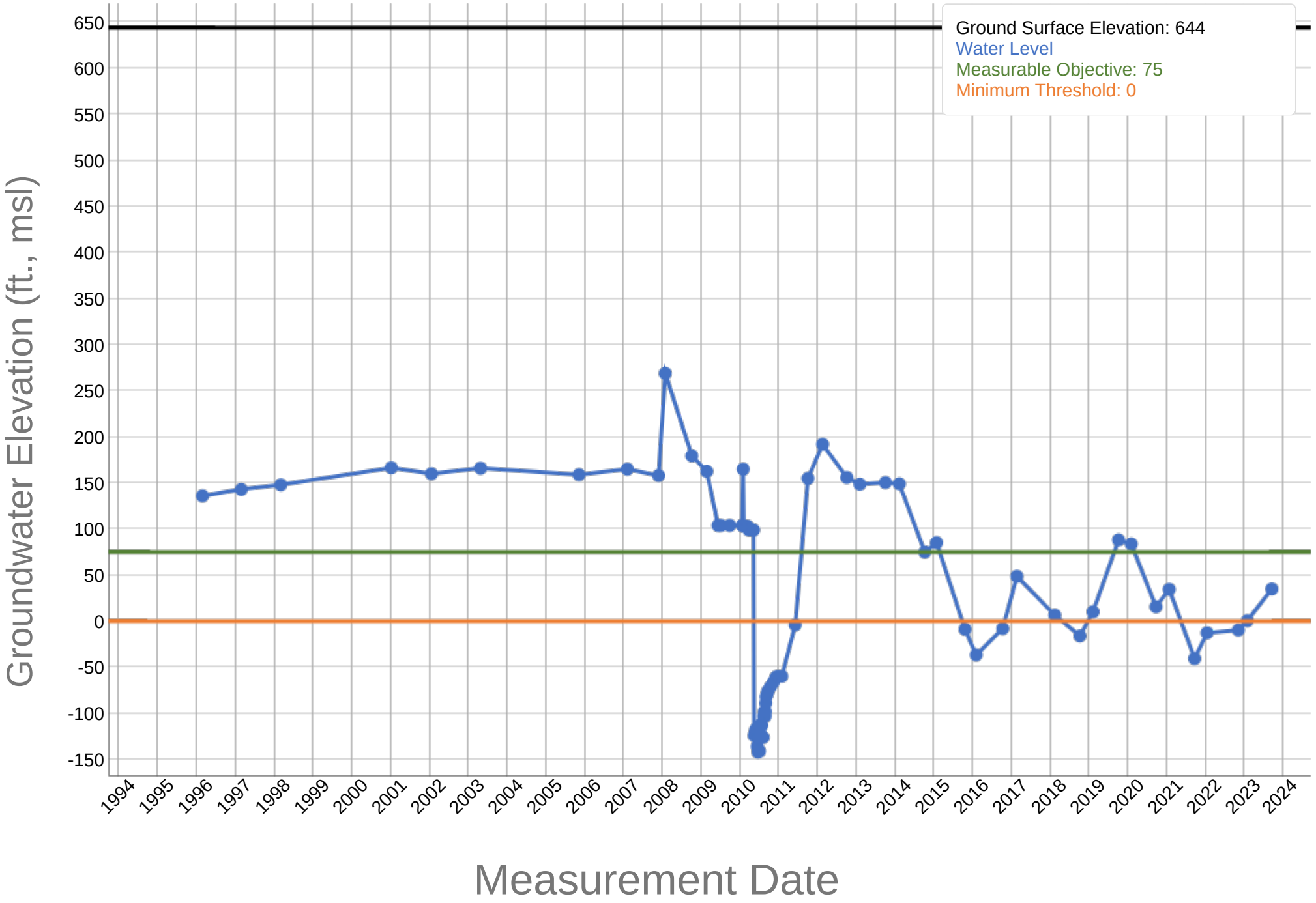
A6-18

Wheeler Ridge-Maricopa GSA - 11N21W09C001S - 350592N1191328W001



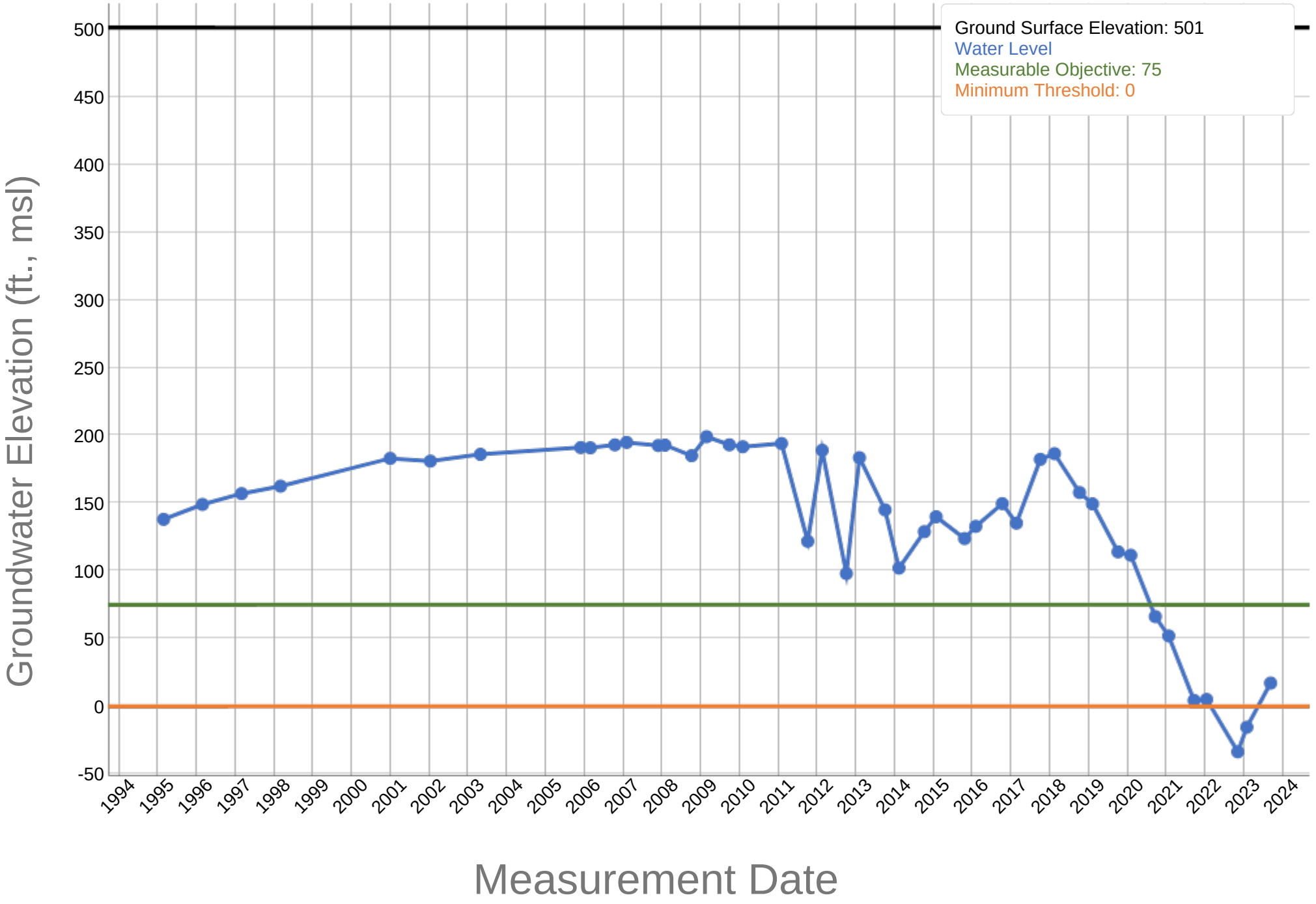
A6-19

Wheeler Ridge-Maricopa GSA - 11N21W16E001S - 350428N1191355W001



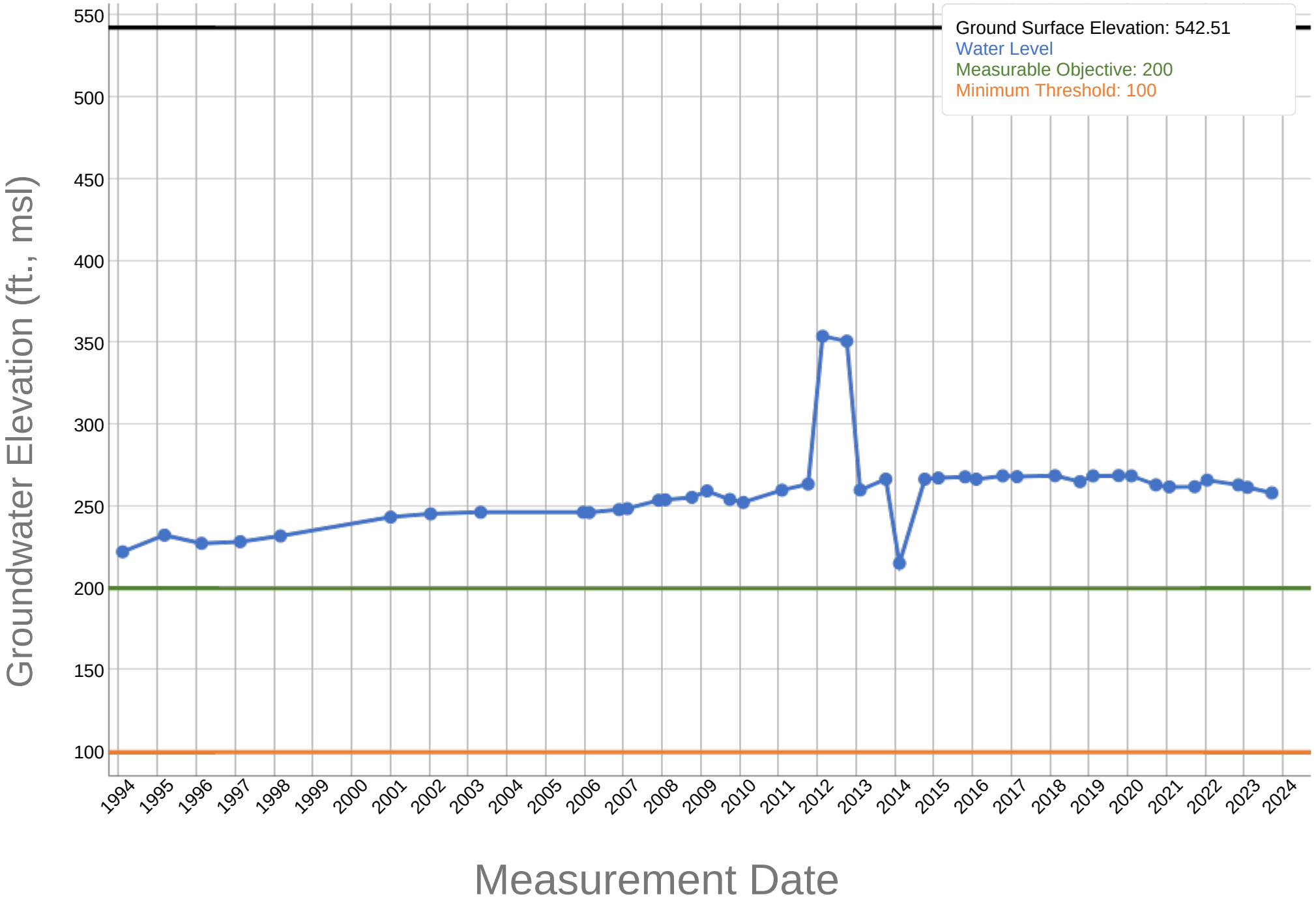
A6-20

Wheeler Ridge-Maricopa GSA - 11N22W01D001S - 350750N1191892W001



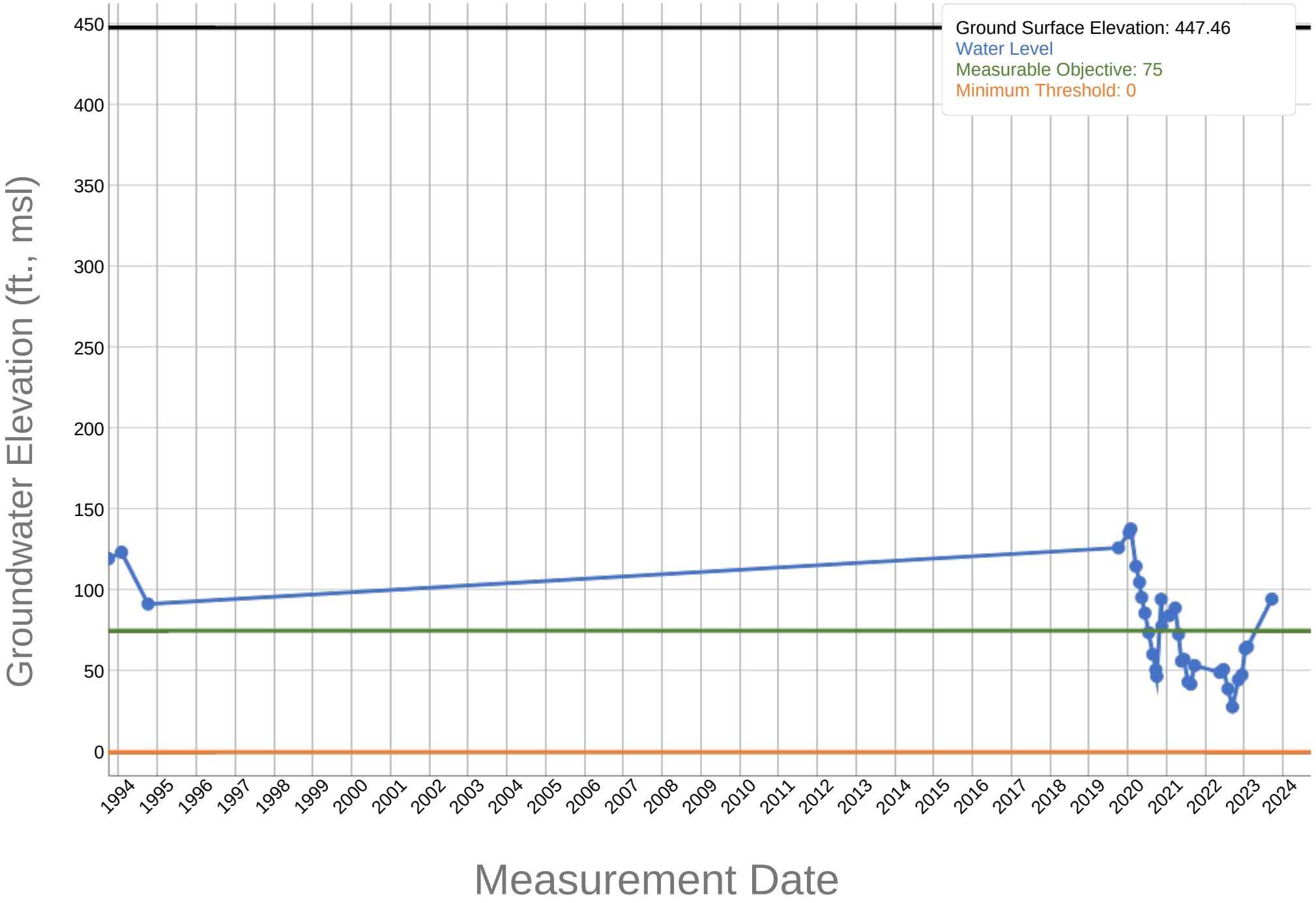
A6-21

Wheeler Ridge-Maricopa GSA - 11N22W06H001S - 350686N1192609W001



A6-22

Wheeler Ridge-Maricopa GSA - 12N21W34N001S - 350772N1191178W001



A6-23

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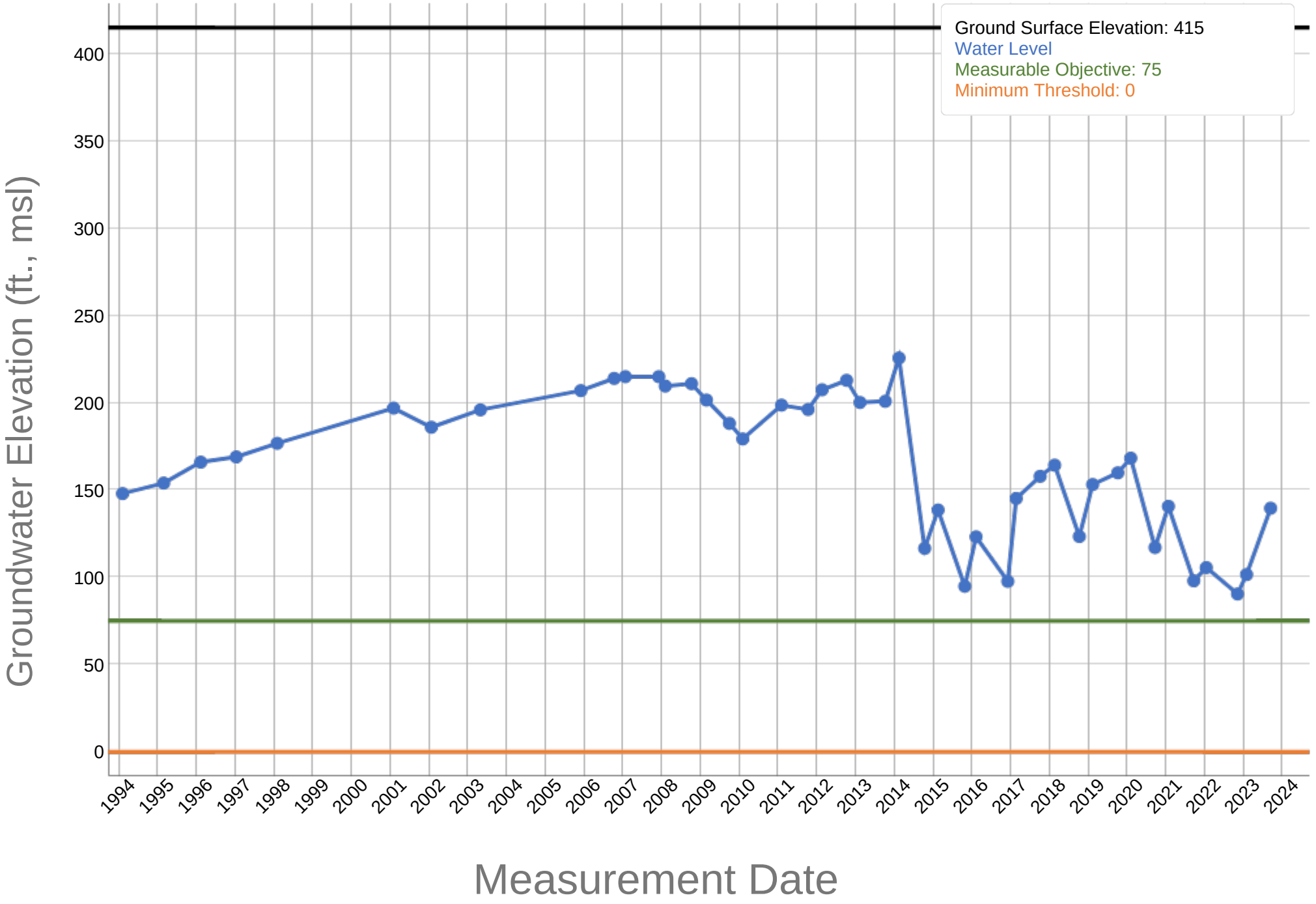
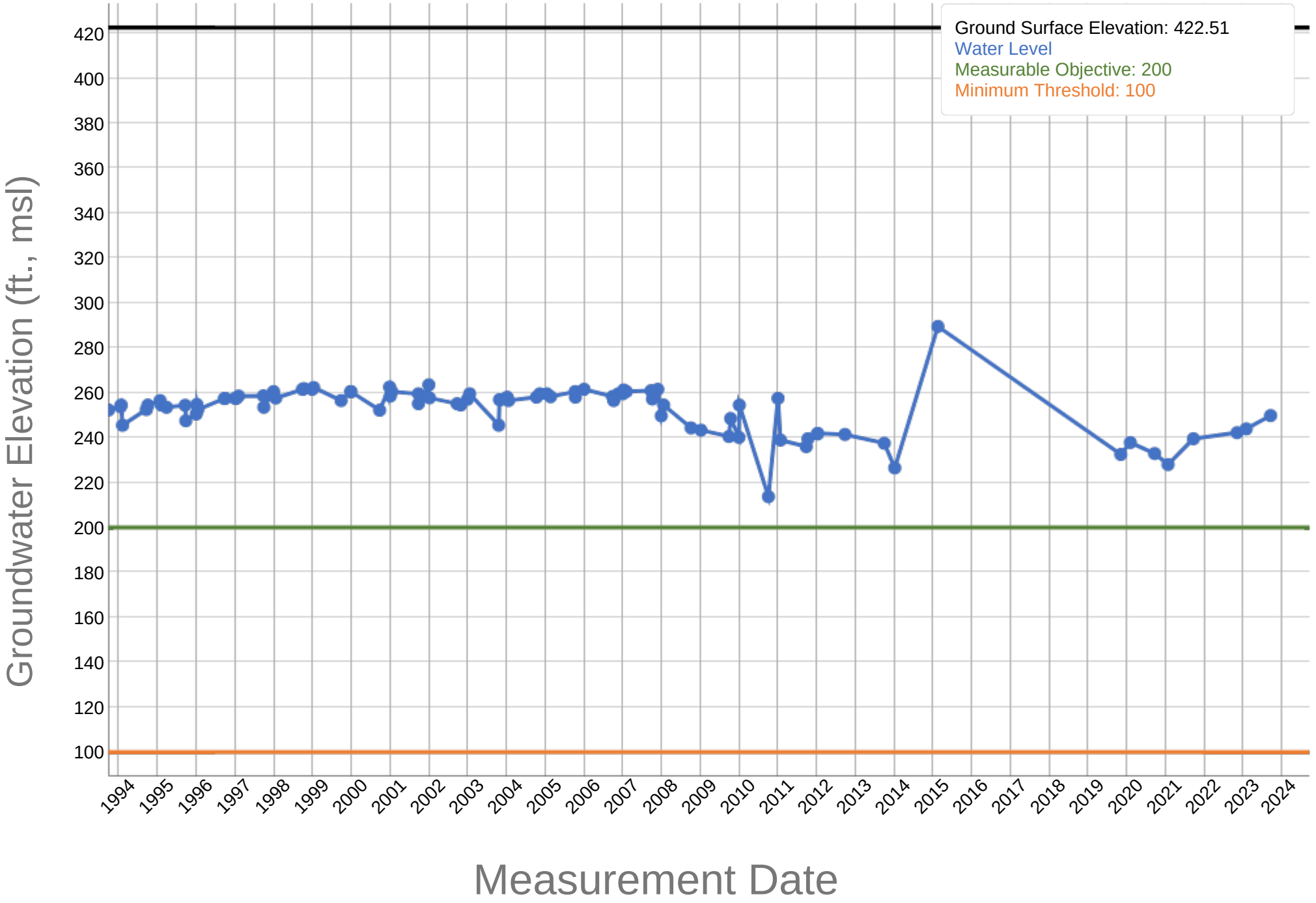


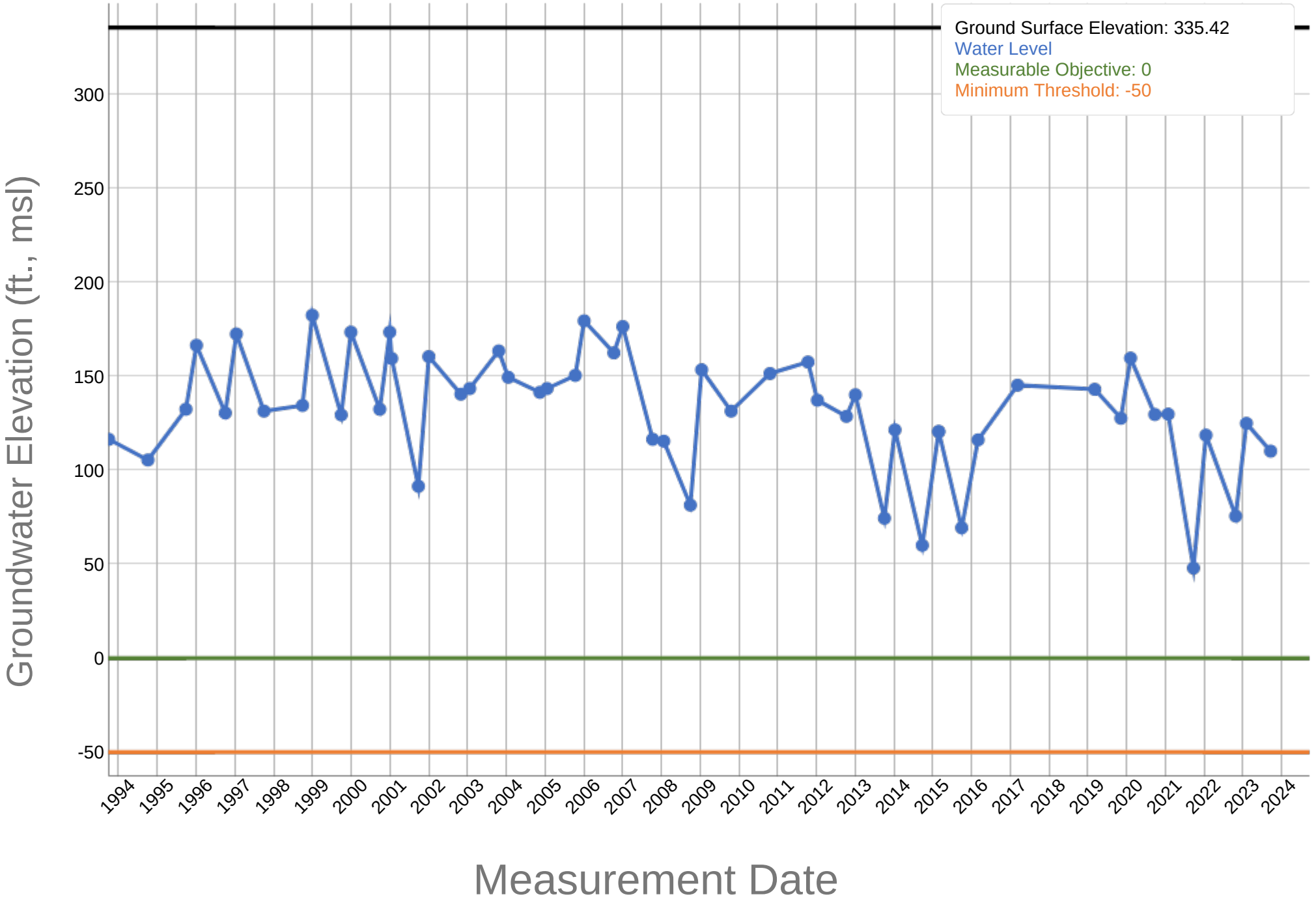
A6-24

Wheeler Ridge-Maricopa GSA - 32S25E29Q001M - 351083N1193140W001



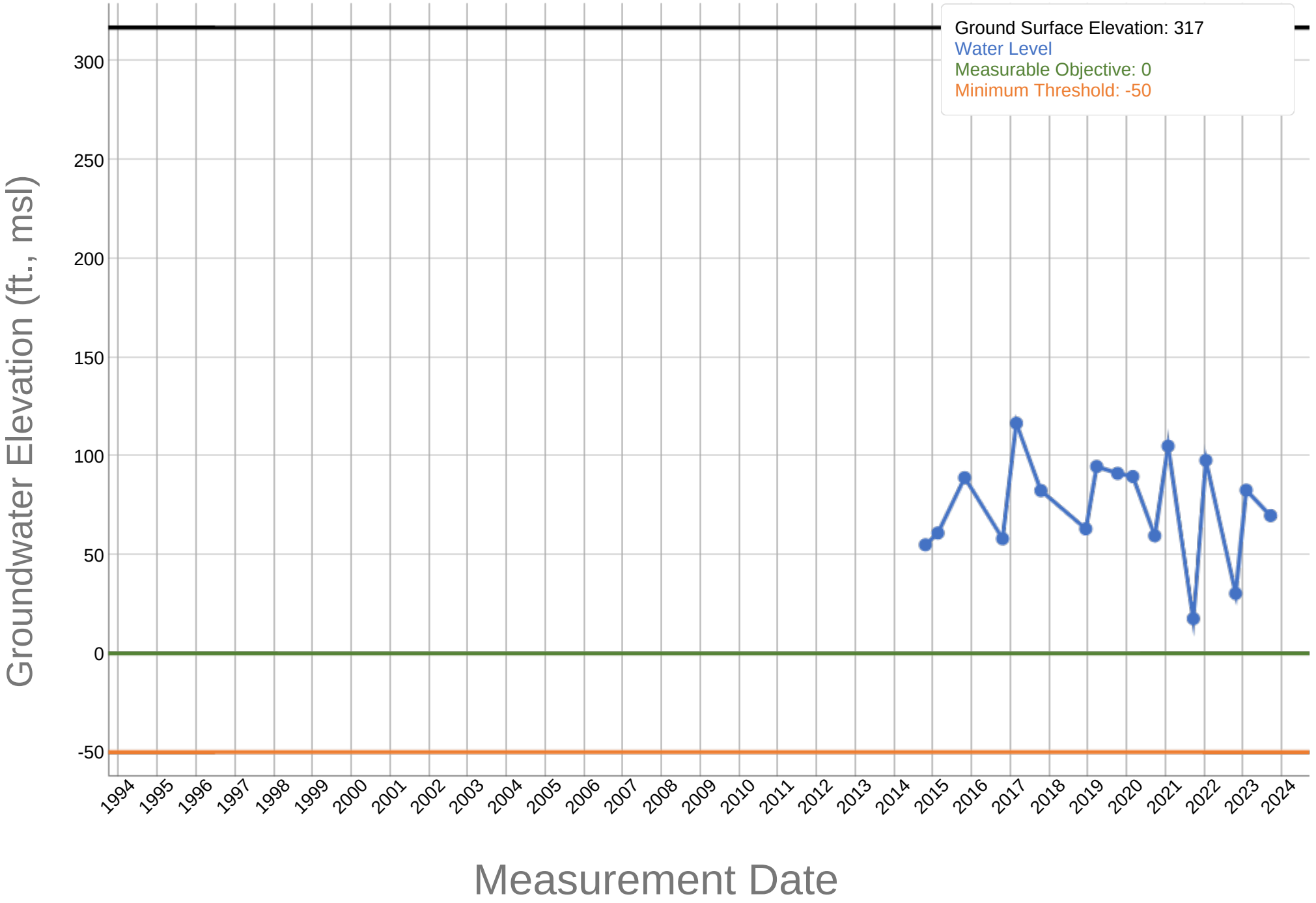
A6-25

Wheeler Ridge-Maricopa GSA - 32S26E20G001M - 351303N1192078W001



A6-26

Wheeler Ridge-Maricopa GSA - 32S26E24K001M - 351304N1191366W001



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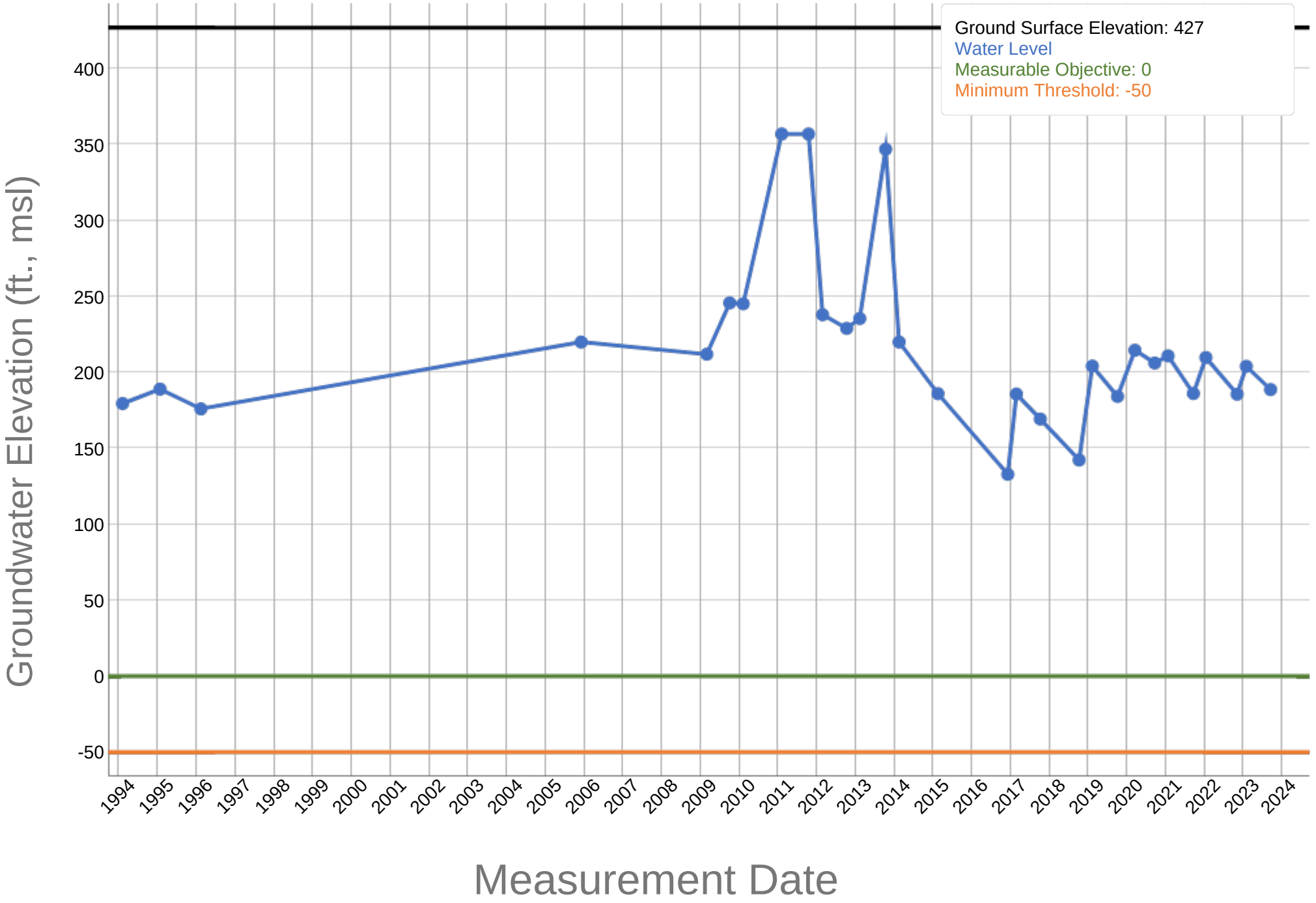
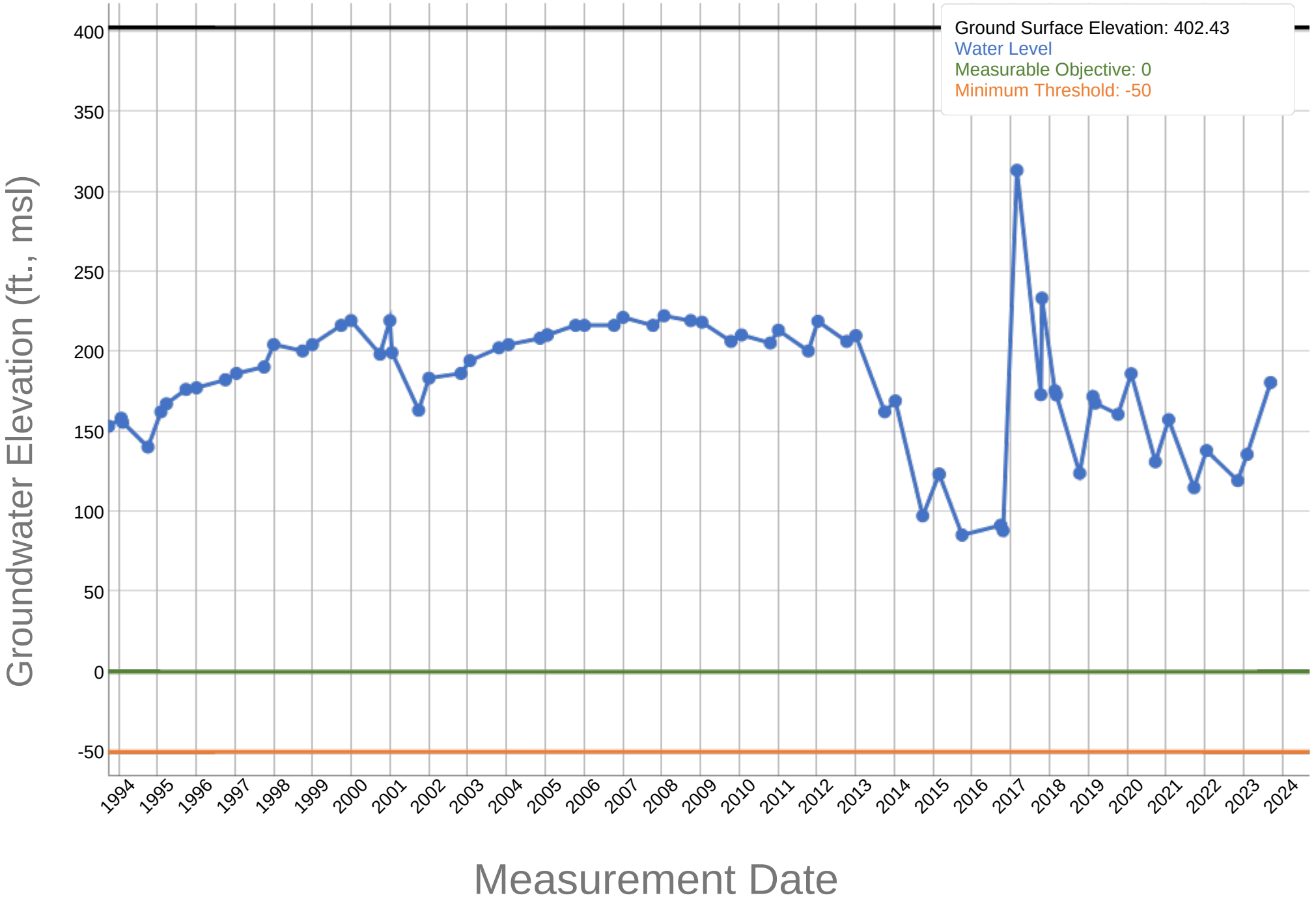
Wheeler Ridge-Maricopa GSA - 32S26E34P001M - 350943N1191736W001



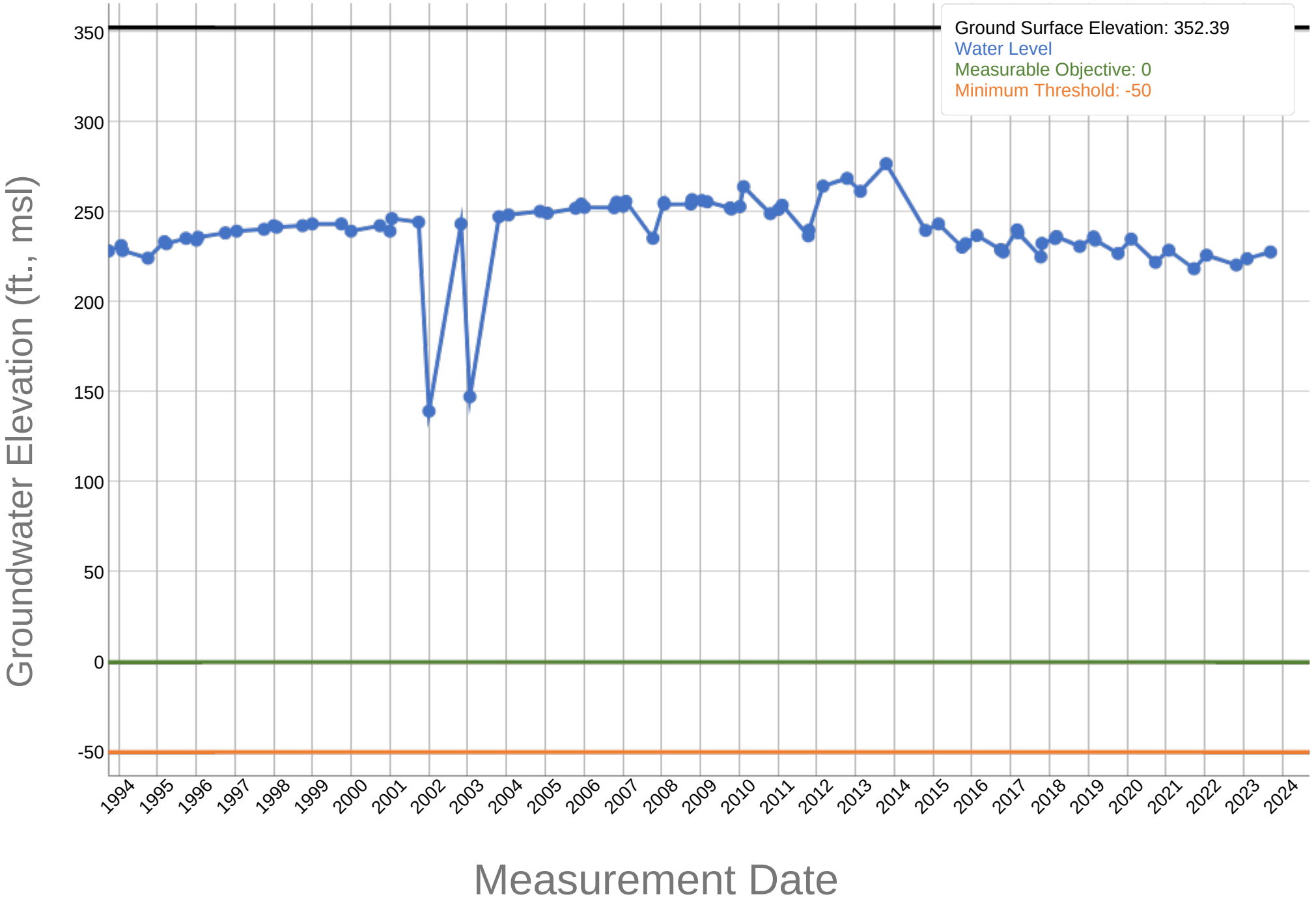
A6-28

Wheeler Ridge-Maricopa GSA - 32S26E36P002M - 350947N1191370W001



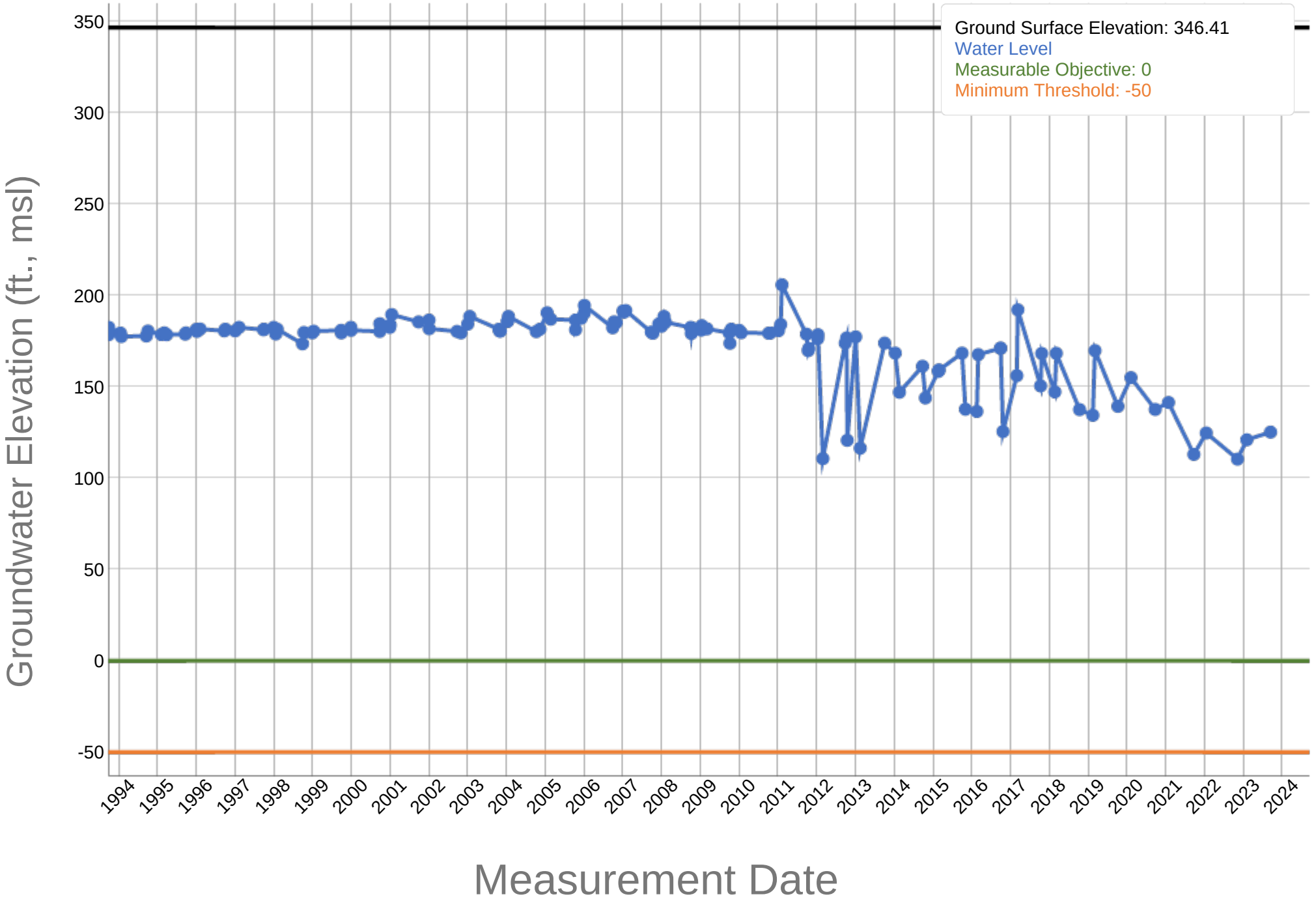
A6-29

Wheeler Ridge-Maricopa GSA - 32S27E30N001M - 351092N1191270W001



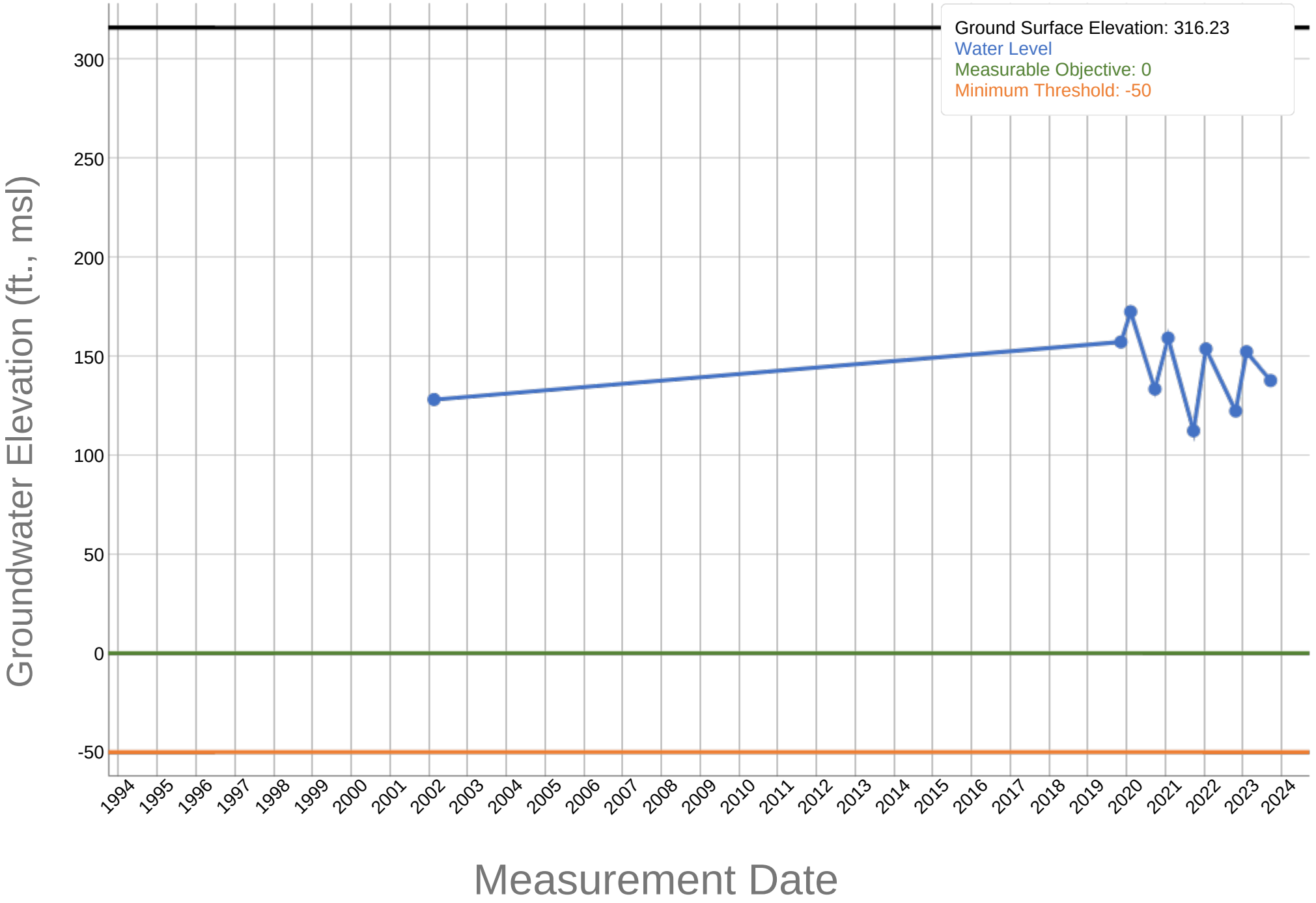
A6-30

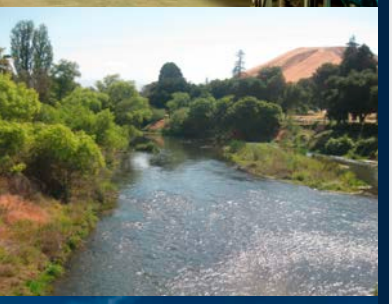
Wheeler Ridge-Maricopa GSA - 32S27E35R001M - 350961N1190435W001



A6-31

Wheeler Ridge-Maricopa GSA - 32S28E16P001M - 351397N1189767W001





TODD GROUNDWATER