

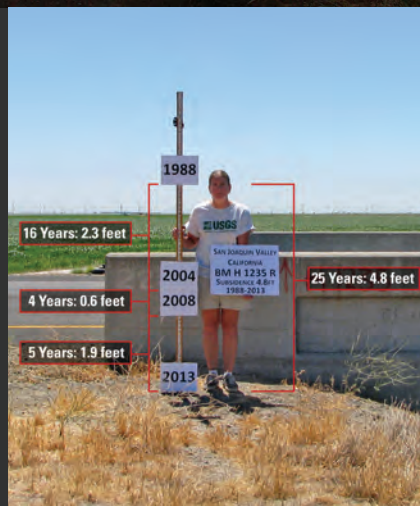


Merced Groundwater Subbasin

GROUNDWATER SUSTAINABILITY PLAN

Water Year 2022 Annual Report

Image courtesy: Veronica Adrover/UC Merced





**MERCED
GROUNDWATER
SUBBASIN
GROUNDWATER
SUSTAINABILITY
PLAN:**

**WATER YEAR
2022 ANNUAL
REPORT**

801 T Street
Sacramento, California 95811
916.999.8700

woodardcurran.com

March 2023

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ACRONYMS

Acronym	Definition
AFY	Acre-Feet per Year
AWMP	Agricultural Water Management Plan
BHMWC	Buchanan Hollow Mutual Water Company
CCR	California Code of Regulations
CDEC	California Data Exchange Center
CEQA	California Environmental Quality Act
CFS	cubic feet per second
CWC	California Water Code
CWD	Chowchilla Water District
DDW	Division of Drinking Water
DPR	Department of Pesticide Regulation
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
ESJWQC	East San Joaquin Water Quality Coalition
GAMA	Groundwater Ambient Monitoring and Assessment
GDE	groundwater dependent ecosystems
GICIMA	Groundwater Elevation Monitoring Groundwater Information Center Interactive Mapping Application
GPS	global positioning system
GQTMP	Groundwater Quality Trend Monitoring Program
GRAT	Groundwater Recharge Assessment Tool
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
ILRP	Irrigated Lands Regulatory Program
IQR	interquartile range
IRWM	Integrated Regional Water Management
IWFM	Integrated Water Flow Model
LGAWD	Le Grand Athlone Water District
LIDAR	Light Detection and Ranging
LPMWC	La Paloma Mutual Water Company
MAF	million acre-feet
MAR	managed aquifer recharge
MCL	Maximum Contaminant Level
MCWD	Merquin County Water District
MID	Merced Irrigation District
MIUGSA	Merced Irrigation-Urban Groundwater Sustainability
MSGSA	Merced Subbasin Groundwater Sustainability Agency
NASA	National Aeronautics and Space Administration
NRCS	National Agricultural Statistics Service
PRISM	Precipitation-Elevation Regressions on Independent Slopes Model
PVC	polyvinyl chloride
SAGBI	Soil Agricultural Groundwater Banking Index
SDAC	Severely Disadvantaged Community

SGC	Stakeholder Guidance Committee
SGM	Sustainable Groundwater Management
SGMA	Sustainable Groundwater Management Act
SMCL	secondary maximum contaminant level
SWD	Stevinson Water District
TAF	thousand acre-feet
TIWD	Turner Island Water District
TIWD GSA-1	Turner Island Water District Groundwater Sustainability Agency #1
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WY	water year

EXECUTIVE SUMMARY

The Merced Groundwater Subbasin (Subbasin) Groundwater Sustainability Plan (GSP) was adopted in late 2019 by the three Groundwater Sustainability Agencies (GSAs) that were formed in accordance with the Sustainable Groundwater Management Act (SGMA) to coordinate, develop, and implement a GSP for the Subbasin: Merced Irrigation-Urban Groundwater Sustainability Agency (MIUGSA), Merced Subbasin Groundwater Sustainability Agency (MSGSA), and Turner Island Water District Groundwater Sustainability Agency #1 (TIWD GSA-1) (MIUGSA, MSGSA, & TIWD GSA-1, 2019). The GSP was initially submitted to the California Department of Water Resources (DWR) in January 2020, ahead of the January 31, 2020 regulatory deadline for submission of GSPs for critically overdrafted subbasins.

On January 28, 2022, DWR completed its review and evaluation of the Merced Subbasin GSP and made a determination that it was “incomplete”. The three GSAs worked collaboratively to respond to DWR’s comments and engage stakeholders and members of the public to address three identified deficiencies from February through June 2022. A revised GSP was adopted and submitted to DWR in July 2022 with updates in key places to address DWR’s recommendations. This Annual Report compares recent observations against the new published sustainable management criteria from the 2022 revised GSP.

On March 2, 2023, DWR posted a letter to the SGMA Portal indicating that Department staff anticipate recommending approval of the revised GSP, with recommended corrective actions to further assist the GSA with implementation of the GSP and achieving Subbasin sustainability goals (DWR, 2023d). The final assessment with more detailed information is anticipated to be available by approximately March 30, 2023.







California Water Code (CWC) §356.2 requires the submission of an annual report to DWR by April 1 of each year following the adoption of the GSP. The following annual reports have been submitted to date:

- The first Annual Report was submitted on March 31, 2020 and provided an update on Subbasin conditions and plan implementation progress within the Merced Subbasin for water years 2016-2019 (October 1, 2015 – September 30, 2019)
- The Second Annual Report was submitted on March 31, 2021 and provided an update for water year (WY) 2020 (October 1, 2019 – September 30, 2020).
- The Third Annual Report was submitted on March 31, 2022 and provided an update for WY 2021 (October 1, 2020 – September 30, 2021).

CWC §356.2 requires annual reports to include information about groundwater elevations (contour maps and hydrographs), groundwater extraction, surface water supply, changes in groundwater storage, and a description of progress towards implementation of the GSP since the previous annual report. Table ES-1 provides a summary of the definition of undesirable results and summary of compliance with the sustainability management criteria.

For WY 2022, the San Joaquin Valley Water Year Type Index was 1.56, classified as a Critical year type. The value of 1.56 is 48% of average (DWR, 2023b). Given the drought conditions in WY 2022, the Subbasin experienced greater demand on the groundwater system.

Table ES-1-1: Summary of Sustainable Management Criteria

Sustainability Indicator	Minimum Threshold (MT)	Interim Milestone (IM)	Measurable Objective (MO)	Undesirable Result	WY 2022 Annual Report Status
 Groundwater Levels	Fall 2015 groundwater elevation	Based on range of projected values that account for hydrologic uncertainty	November or October 2011 groundwater elevation (measured, or estimation if historical record not available)	Greater than 25% of representative wells fall below MT in 2 consecutive years	16/20 wells (80%) fell below MT. 20 of 20 wells fell below MO. 19/20 are above 2025 IM. 1 well not measured.
 Groundwater Storage	Not applicable - not present and not likely to occur in the Subbasin due to the significant volumes of freshwater in storage				
 Seawater Intrusion	Not applicable - not present and not likely to occur due to the distance between the Subbasin and the Pacific Ocean (and Sacramento-San Joaquin Delta)				
 Degraded Water Quality	1,000 mg/L TDS	1,000 mg/L TDS	500 mg/L TDS	At least 25% representative wells exceed MT for 2 consecutive years	No wells exceeded MT. 3 wells exceeded MO.
 Land Subsidence	0 ft/year, subject to uncertainty of +/-0.16 ft/year	2025: -0.75 ft/year 2030: -0.5 ft/year 2035: -0.25 ft/year	0 ft/year	Exceedance of MT at 3 or more representative sites for 2 consecutive years	4/4 sites exceeded MT & MO but are within 2025 IM.
 Depletions of Interconnected Surface Waters	Groundwater levels used as a proxy for this sustainability indicator				

Groundwater Levels

Generally, groundwater level declines were observed in WY 2022. Based on data from 11 wells in the Above Corcoran Clay Principal Aquifer, average groundwater level change was -3.8 ft from fall 2021 to fall 2022. Based on data from 17 wells in the Below Corcoran Clay Principal Aquifer, average groundwater level change was -5.1 ft from fall 2021 to fall 2022. Based on data from 17 wells in the Outside Corcoran Clay Principal Aquifer, average groundwater level change was -7.0 ft from fall 2021 to fall 2022. Hydrographs and contour maps of groundwater elevation can be found in **Appendix A** and **Appendix B**, respectively.

WY 2022 is the first year in which the revised undesirable result threshold has been in place; the presence of undesirable results as a result of a second consecutive year of groundwater levels below MTs will be evaluated in the next WY 2023 annual report. Per DWR's draft Best Management Practice guidance

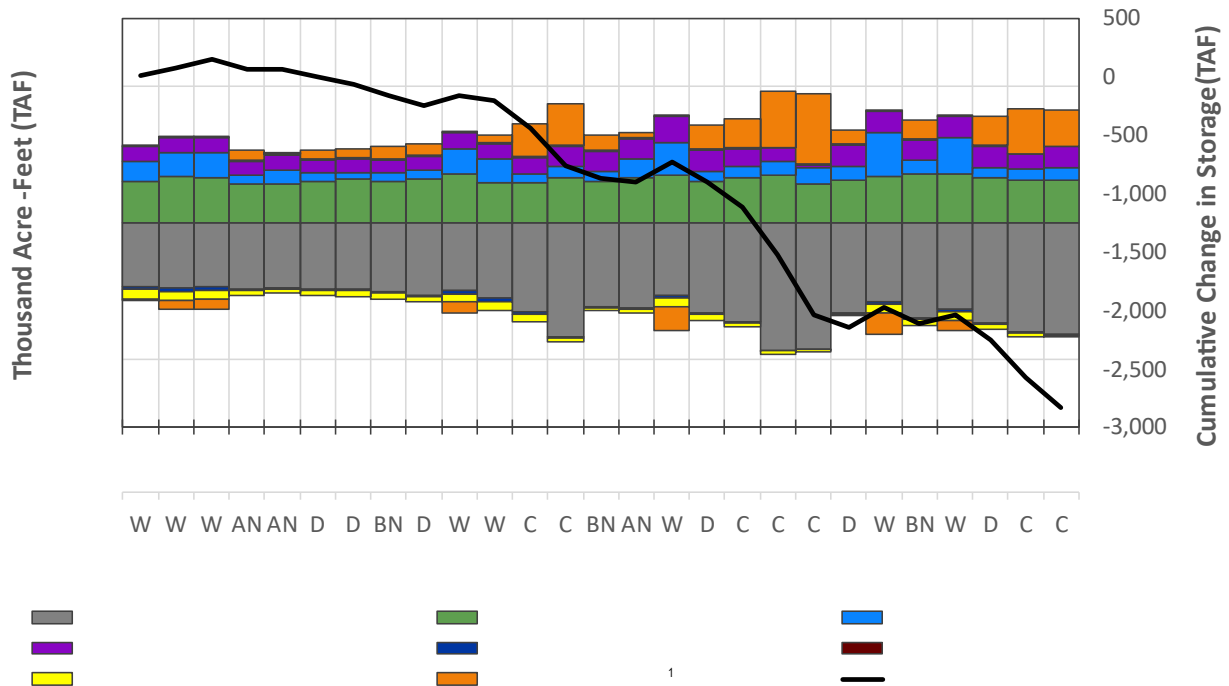
document for sustainability management criteria, "Avoidance of the defined undesirable results must be achieved within 20 years of GSP implementation...Some basins may experience undesirable results within the 20-year period, particularly if the basin has existing undesirable results as of January 1, 2015. The occurrence of one or more undesirable results within the initial 20-year period does not, by itself, necessarily indicate that a basin is not being managed sustainably, or that it will not achieve sustainability within the 20-year period" (DWR, 2017). Note that all measurements except for one are above the 2025 IM. IMs were established to facilitate the Subbasin reaching its measurable objectives for groundwater levels. The GSAs expect some level of continued groundwater level decline in much of the Subbasin (as was observed during critically dry conditions in WY 2022) while projects and management actions are developed and implemented, and due to hydrologic uncertainty. Many representative monitoring wells were below their MT when the sustainable management criteria were revised in July 2022. Thus, the IMs for groundwater levels allow for temporary further groundwater level decline below the MT.

Groundwater Storage

The Merced Water Resources Model (MercedWRM) was updated with recent hydrologic and Subbasin operation information from WY 2022 to estimate the historical change in storage in the Merced Subbasin. The cumulative change in storage during water years 2006-2022 was estimated as -2.68 million acre-feet (MAF), or an average reduction of 158 thousand acre-feet (TAF) per year. During WY 2022, the cumulative change in storage was estimated as -262 TAF. Note that the average annual reduction of 192 TAF per year established in the GSP using the hydrologically balanced period of WYs 2006-2015 remains the current estimate of long-term overdraft in the Subbasin.

Figure ES-1-1 shows the cumulative change in storage together with annual groundwater uses developed in the water budget and water year type. On the figure, cumulative change in storage (WYs 1996-2022) is shown as a black line with values indicated on the right vertical axis and the annual groundwater budget uses are shown as bar charts with values indicated on the left vertical axis.

Figure ES-1-1: Historical Annual Water Budget and Cumulative Change in Storage



Notes:

"Change in Storage" is placed on the chart to balance the water budget. For instance, if annual outflows (-) are greater than inflows (+), there is a decrease in storage, and this is shown on the positive side of the bar chart to balance out the increased outflows on the negative side of the bar chart.

Water year types based on San Joaquin Valley Water Year Index (DWR, 2023a).

Land Subsidence

Subsidence remains an ongoing concern in the Subbasin. Subsidence is measured at static GPS control points throughout the San Joaquin Valley monitored by the United States Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program. Measurements have been recorded semiannually in July and December of each year to monitor ongoing subsidence since 2011. Subsidence values in the last year (December 2021 to December 2022) exceed the minimum threshold and measurable objective (both are 0 ft/year) but are below the 2025 interim milestone (-0.75 ft/year).

Groundwater Quality

The GSAs established a minimum threshold of 1,000 milligrams per liter (mg/L) of Total Dissolved Solids (TDS) at representative monitoring sites for the degraded water quality sustainability indicator. The measurable objective and all interim milestones were set at 500 mg/L TDS. Beginning with this Annual Report, the GSAs are using Electrical Conductivity (EC) to estimate TDS in years where TDS is not sampled. Out of the seven TDS measurements (direct or estimated) in WY 2022, none exceeded the MT but three exceeded the MO.

In addition to monitoring for TDS, the GSAs are conducting water quality coordination activities for other water quality constituents. These activities include review of monitoring reports published by other

monitoring programs as well as compiling data submitted by Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), and Department of Toxic Substances Control (DTSC) to the Groundwater Ambient Monitoring and Assessment (GAMA) database. The purpose of these reviews is to monitor the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable maximum contaminant level (MCL) or secondary maximum contaminant levels (SMCL). The GSAs have collected information from GAMA and will use this information to document regional groundwater quality and to assess whether there is a need for changes to existing sustainable management criteria or developing additional sustainable management criteria for water quality as part of the GSP 5-year evaluation.

Plan Implementation Progress

The GSAs made meaningful progress in GSP implementation in 2022 despite critical dry year conditions.

Implementation of Projects

Beginning with this Annual Report, GSP projects are included in the Merced Integrated Regional Water Management (MercedIRWM) Opti project tracker, which, along with the GSP, is viewed by the Merced Subbasin GSAs as a “living” document. The GSAs have added numerous projects to the Opti project tracker in addition to the original 12 priority projects identified in the GSP. Updates to specific projects are described in Section 3.2 of this annual report. Future updates to the Opti project tracker will be incorporated into subsequent annual reports.

Implementation of Management Actions

The Merced Subbasin GSP includes four Management Actions. For the **water allocation framework**, an Ad Hoc Working Group was previously established with GSA staff and representatives to conduct discussions on an initial framework. Currently, the GSAs are working individually within their own jurisdictions to develop GSA-specific demand reduction and water allocation programs. A formal allocation agreement between the GSAs for the Subbasin as a whole has not been developed and is not scheduled for the upcoming water year.

The **MSGSA Demand Reduction Program** has begun implementation and continues to develop in recognition of the need to reduce groundwater pumping in the Subbasin. The MSGSA approved an objective that by WY 2025 the consumption of groundwater within the MSGSA will be reduced by a minimum of 15,000 AF annually, with this minimum to be increased annually thereafter. MSGSA has adopted a Two Phased GSP Implementation Approach, focusing on land repurposing as a near-term option to achieve the WY 2025 objective, combined with importing surface water in the GSA (flood waters or purchased water). In 2022, the MSGSA developed and implemented the first year of a locally funded Land Repurposing Program, as part of the Phase 1 GSP Implementation. The MSGSA signed Agreements with landowners to repurpose lands saving approximately 7,000 AF of groundwater consumption. Additionally, the MSGSA has been developing an Allocation Policy to be implemented in Phase 2, with an established Strategic Planning Ad Hoc Committee making step-wise policy recommendations to the MSGSA Board, starting in Fall 2022.

The Revised GSP includes a **Domestic Well Mitigation Plan** that involves the planned development of a domestic well mitigation program to respond to adverse impacts experienced by domestic well users where regional overdraft conditions occurring after 2015 are causing declining groundwater levels that interfere

with groundwater production or quality. In WY 2022, as part of its Proposition 218 compliant funding mechanism for Phase 1, the MSGSA established a Domestic Well Mitigation Program Fund from which to address qualified mitigation efforts from the to-be-developed program.

The Revised GSP also includes a management action for **Above Corcoran Sustainable Management Criteria Adjustment Consideration** which would consider an adjustment to the groundwater level sustainable management criteria for all or a portion of the Above Corcoran Clay Principal Aquifer. No action has been taken on this management action at this time.

Additional Implementation Support Activities

In addition to projects and management actions, the GSAs undertook a number of activities to support GSP implementation. This included updating the MercedWRM model with the most recent monitoring data, completing development of a Data Gaps Plan, and continuing development of a remote-sensing decision support tool. The GSAs also pivoted to hybrid Coordination Committee and Stakeholder Advisory Committee meetings which were held monthly to quarterly in 2022.

The MIUGSA Board adopted a three year groundwater allocation for the period of April 1, 2023-December 31, 2025 of 3.3 AF/AC over three years (1.1 AF/AC per year on average), and anticipates updating the allocation on a regular basis at the end of the current allocation period. The MIUGSA Board also adopted a well registration program for all production wells within its boundaries. Additionally, MIUGSA began working as a pilot partner with Environmental Defense Fund and Water Data Consortium on the Groundwater Accounting Platform as a key component of monitoring and enforcing the groundwater allocation within MIUGSA's boundaries. The Groundwater Accounting Platform is an open-source platform that can be scaled for use by GSAs throughout the state. MIUGSA is independently developing a well registration portal that can be considered for integration with the Groundwater Accounting Platform. In 2023, MIUGSA anticipates finalizing additional policies for measuring, monitoring, and enforcing the groundwater allocation, such as flow meter requirements, and penalties and fees.

Activities Anticipated for the Coming Year

The three Merced GSAs intend to continue activities necessary to implement the GSP and put the Subbasin on a path toward sustainable management. Activities anticipated for 2023 include initiation of numerous grant-funded projects, continued implementation of the Data Gaps Plan (e.g., incorporating additional wells into the monitoring network and pursuing funding for installation of new wells), completing development of the Remote-Sensing Decision Support Tool, and making progress on internal GSA-specific plans for pumping reductions and water allocation frameworks.

1. INTRODUCTION

The Merced Groundwater Subbasin (Subbasin) Groundwater Sustainability Plan (GSP) was initially adopted in late 2019 by the three Groundwater Sustainability Agencies (GSAs) that were formed in accordance with the Sustainable Groundwater Management Act (SGMA) to coordinate, develop, and implement the GSP: Merced Irrigation-Urban Groundwater Sustainability Agency (MIUGSA), Merced Subbasin Groundwater Sustainability Agency (MSGSA), and Turner Island Water District Groundwater Sustainability Agency #1 (TIWD GSA-1) (MIUGSA, MSGSA, & TIWD GSA-1, 2019). The GSP was initially submitted to the California Department of Water Resources (DWR) in January 2020, ahead of the January 31, 2020 regulatory deadline for submission of GSPs for critically overdrafted subbasins.

On January 28, 2022, DWR completed its review and evaluation of the Merced Subbasin GSP and made a determination that it was “incomplete”. The three GSAs worked collaboratively to respond to DWR’s comments and engage stakeholders and members of the public to address three identified deficiencies from February through June 2022. A revised GSP was adopted and submitted to DWR in July 2022 with updates in key places to address DWR’s recommendations. This Annual Report compares recent observations against the new published sustainable management criteria from the 2022 revised GSP.

On March 2, 2023, DWR posted a letter to the SGMA Portal indicating that Department staff anticipate recommending approval of the revised GSP, with recommended corrective actions to further assist the GSA with implementation of the GSP and achieving Subbasin sustainability goals (DWR, 2023d). The final assessment with more detailed information is anticipated to be available by approximately March 30, 2023.

California Water Code (CWC) §356.2 requires the submission of an annual report to DWR by April 1 of each year following the adoption of the GSP. The following annual reports have been submitted to date:

- The first Annual Report was submitted on March 31, 2020 and provided an update on Subbasin conditions and plan implementation progress within the Merced Subbasin for water years 2016-2019 (October 1, 2015 – September 30, 2019)
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- The Third Annual Report was submitted on March 31, 2022 and provided an update for water year 2021 (October 1, 2020 – September 30, 2021).

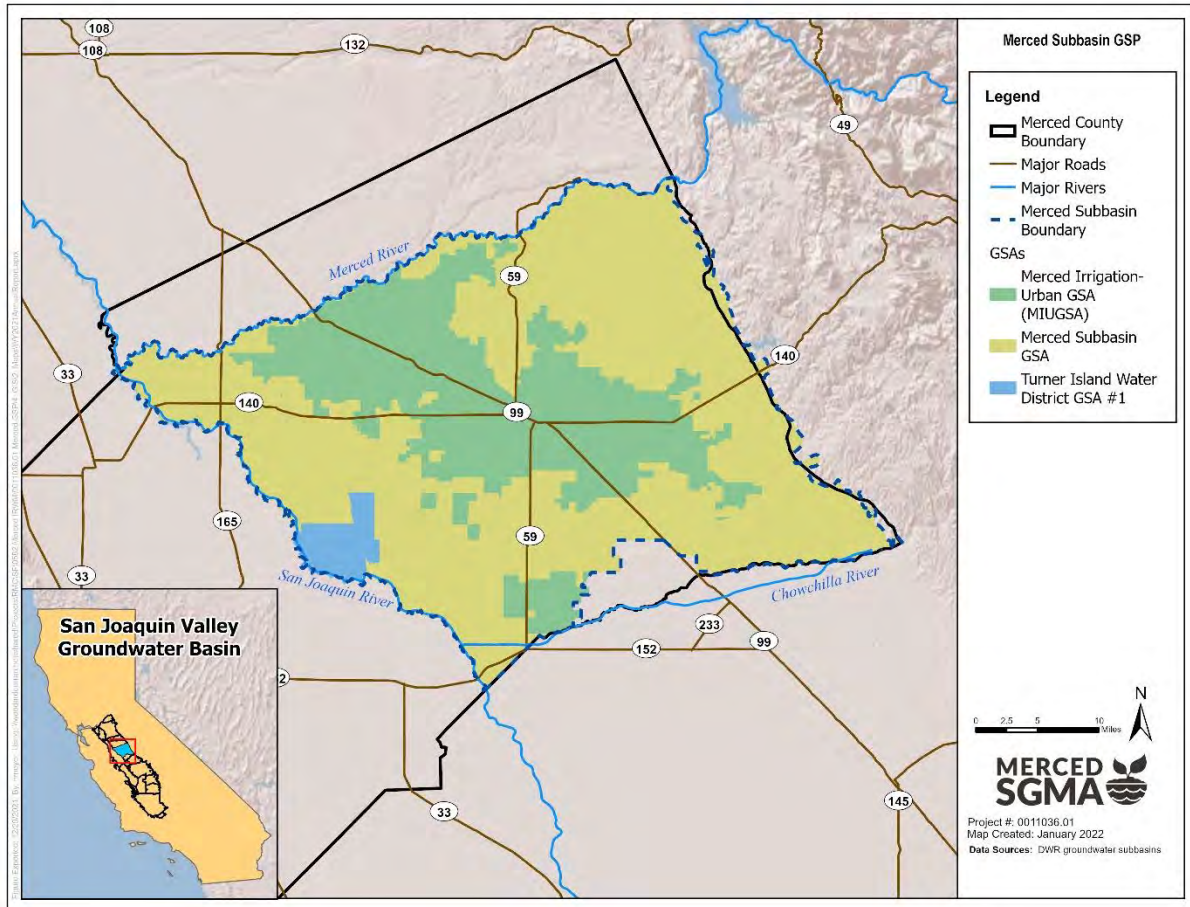
CWC §356.2 requires annual reports to include information about groundwater elevations (contour maps and hydrographs), groundwater extraction, surface water supply, changes in groundwater storage, and a description of progress towards implementation of the GSP since the previous annual report.

The annual report is organized into two sections: Basin Settings and Plan Implementation. The Basin Settings section provides updates to water budgets and other subbasinwide information for WY 2022. The Plan Implementation section discusses progress on implementation of the GSP since the third Annual Report was submitted with a focus on updates on the status of projects and management actions identified in the GSP and later added via the new living project list described further in Section 3.

Figure 1-1 shows a map of the Merced Subbasin and the extent of the three GSAs. An inset map shows the location of the Merced Subbasin within the larger San Joaquin Valley Groundwater Basin located in the

Central Valley of California. A more detailed description of the Merced Subbasin can be found in the GSP's Section 1.2 (Plan Area) and Section 2.1 (Hydrogeologic Conceptual Model).

Figure 1-1: Location Map



2. BASIN SETTING

2.1 Groundwater Elevations

According to DWR's San Joaquin Valley Water Year Index, the previous water year (2021) and WY 2022 are both classified as a critically dry years (DWR, 2023a). Generally, groundwater levels declined during WY 2022 for all three principal aquifers. Out of 21 representative monitoring wells, 16 had November 2022 elevations below the MT, 20 had November 2022 elevations below the MO, and 1 well was not measured. The revised 2022 GSP defines undesirable results as "during GSP implementation when November groundwater levels at greater than 25 percent of representative monitoring wells (at least 6 of 21) fall below their minimum thresholds for two consecutive years" (MIUGSA, MSGSA, & TIWD GSA-1, 2022). WY 2022 is the first year in which the revised undesirable result threshold has been in place; the presence of undesirable results as a result of a second consecutive year of groundwater levels below MTs will be evaluated in the next WY 2023 annual report.

Per DWR's draft Best Management Practice guidance document for sustainability management criteria, "Avoidance of the defined undesirable results must be achieved within 20 years of GSP implementation...Some basins may experience undesirable results within the 20-year period, particularly if the basin has existing undesirable results as of January 1, 2015. The occurrence of one or more undesirable results within the initial 20-year period does not, by itself, necessarily indicate that a basin is not being managed sustainably, or that it will not achieve sustainability within the 20-year period" (DWR, 2017). Note that all measurements except for one (Station ID 8604) are above the 2025 IM. IMs were established to facilitate the Subbasin reaching its measurable objectives for groundwater levels. The GSAs expect some level of continued groundwater level decline in much of the Subbasin (as was observed during critically dry conditions in WY 2022) while projects and management actions are developed and implemented, and due to hydrologic uncertainty. Many representative monitoring wells were below their MT when the sustainable management criteria were revised in July 2022. Thus, the IMs for groundwater levels allow for temporary further groundwater level decline below the MT.

Based on data from 11 wells in the Above Corcoran Clay Principal Aquifer, average groundwater level change was -3.8 ft from fall 2021 to fall 2022. Based on data from 17 wells in the Below Corcoran Clay Principal Aquifer, average groundwater level change was -5.1 ft from fall 2021 to fall 2022. Based on data from 17 wells in the Outside Corcoran Clay Principal Aquifer, average groundwater level change was -7.0 ft from fall 2021 to fall 2022. These values do not take into account that monitoring wells are not evenly distributed throughout the Subbasin, but the overall values still function to provide an overview of trends based on available data. Figure 2-1 shows the location of the wells in the Merced Subbasin GSP monitoring network for groundwater levels. Individual hydrographs for these wells can be found in **Appendix A**. All available data are shown, except for measurements flagged for quality control reasons. Hydrographs for representative monitoring wells also display the minimum threshold, measurable objective, and 2025 interim milestone, that were developed in Chapter 3 (Sustainability Indicators) of the GSP, last revised in the July 2022 GSP Update. The hydrographs also show a water year type indicator according to the San Joaquin Valley Water Year Hydrologic Classification Index. As previously stated, WY 2022 has been categorized as a Critical year, the driest category of the San Joaquin Valley Water Year Hydrologic Classification (DWR, 2023b). Monitoring network data have been uploaded to the Merced Opti data management system (<https://opti.woodardcurran.com/merced>) and SGMA Portal.

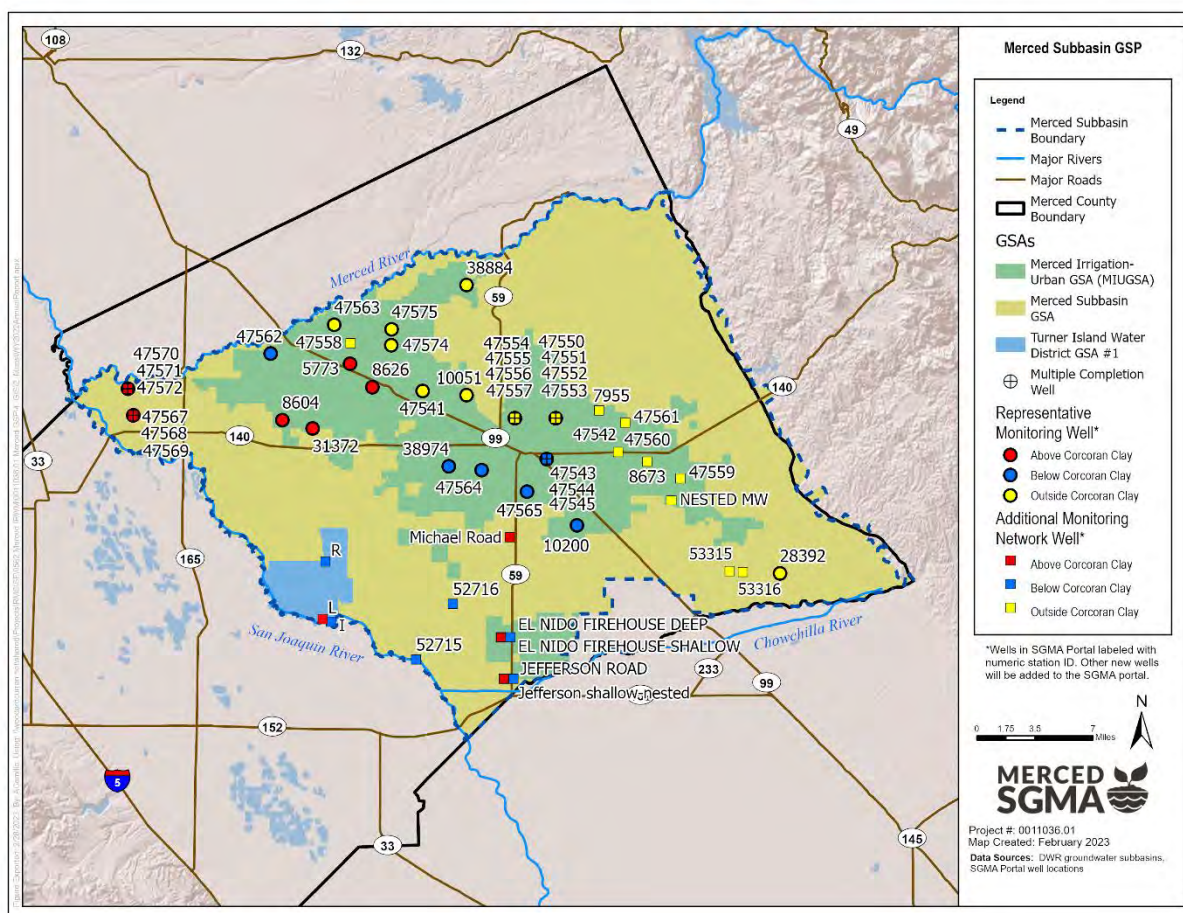
The following monitoring well was recently installed and is anticipated to be officially added to the monitoring network:

- Well "Michael Road", located near Highway 59, south of the City of Merced, and completed within the Above Corcoran Clay Principal Aquifer.

As of the prior WY 2021 report, the following wells located in TIWD GSA-1 were anticipated to be added to the groundwater level monitoring network, pending site visit reviews to confirm well accessibility for ongoing future monitoring. Their status remains the same while TIWD GSA-1 continues to evaluate these wells.

- Well "R", located in the northern portion of TIWD GSA-1 and completed within the Below Corcoran Clay Principal Aquifer.
- Well "I", located along the southern edge of TIWD GSA-1 and completed within the Below Corcoran Clay Principal Aquifer.
- Well "L", located along the southern edge of TIWD GSA-1 and completed within the Above Corcoran Clay Principal Aquifer.

Figure 2-1: Groundwater Level Monitoring Network



Appendix B shows contour maps of seasonal high (spring) and seasonal low (fall) groundwater elevations for each of the three principal aquifers for fall 2021, spring 2022, and fall 2022. Groundwater level data were obtained from the SGMA Data Viewer and the GSP monitoring network for groundwater levels¹. Groundwater levels reported by both monitoring network wells and other voluntary and representative wells in the Merced, Turlock, Delta-Mendota, Chowchilla, and Madera Subbasins were used to develop contours. Measurements from neighboring subbasins were included to provide spatial coverage for contoured groundwater levels along the edges of the Merced Subbasin. The contour maps for the Above Corcoran Clay and Outside Corcoran Clay Principal Aquifers show hatched areas labeled “Area of increased uncertainty due to data limitations” which indicate regions with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due to the data limitations. The GSP identifies this as a data gap and the GSAs are in the process of implementing recommendations from a recently completed Data Gaps Plan to address critical data gaps in the Subbasin.

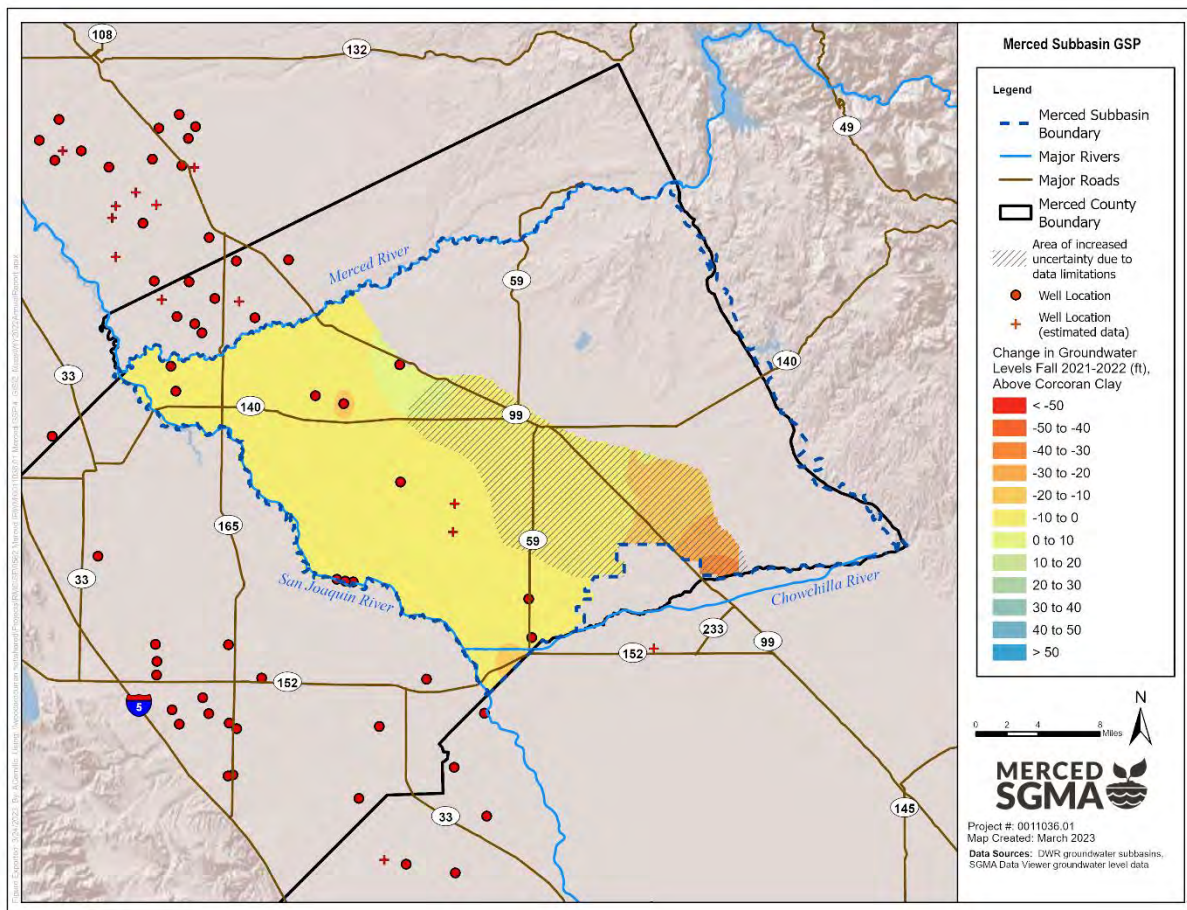
Groundwater level contours at 20-foot intervals were developed using an interpolation method of inverse distance weighting, with local averaging performed to generate smoother contour lines. Groundwater level measurements were classified as spring if they were recorded in the month of March (± 5 days) and classified as fall if they were recorded in the month of October (± 5 days). Contour maps for each season and principal aquifer can be found in **Appendix B**.

Many voluntary wells do not consistently report groundwater elevations each spring and fall. In some cases, measurements for monitoring network wells were discounted due to nearby pumping or another data quality flag. A multiple linear regression tool was applied to estimate the groundwater elevations for the missing seasons for wells with missing seasonal data located within the Merced Subbasin. The estimate is necessary to provide consistent results between time periods, despite variability in available data. The multiple linear regression was applied separately at each well for fall and spring measurements where there were several years of historical data for each respective season. The multiple linear regression methodology makes use of historical observed data at the well being analyzed, as well as other observations such as water storage changes from the NASA Gravity Recovery and Climate Experiment, soil moisture from the Global Land Data Assimilation System, or the Palmer Hydrologic Drought Index, based on the methodology developed by the BYU Hydroinformatics Laboratory (n.d.). Wells at which groundwater elevation was estimated for the purpose of developing contours are identified in the contour maps in **Appendix B**. All other data points use observed data.

Figure 2-2 through Figure 2-4 show the total change in groundwater levels between fall 2021 and fall 2022 for each principal aquifer, based on comparing the interpolated groundwater level surfaces. The Above Corcoran Clay Principal Aquifer generally shows a slight net decrease in groundwater levels throughout most of the aquifer. In the Below Corcoran Clay and Outside Corcoran Clay Principal Aquifers, groundwater levels were found to decrease across most of the aquifer, with pockets of no change or small increase.

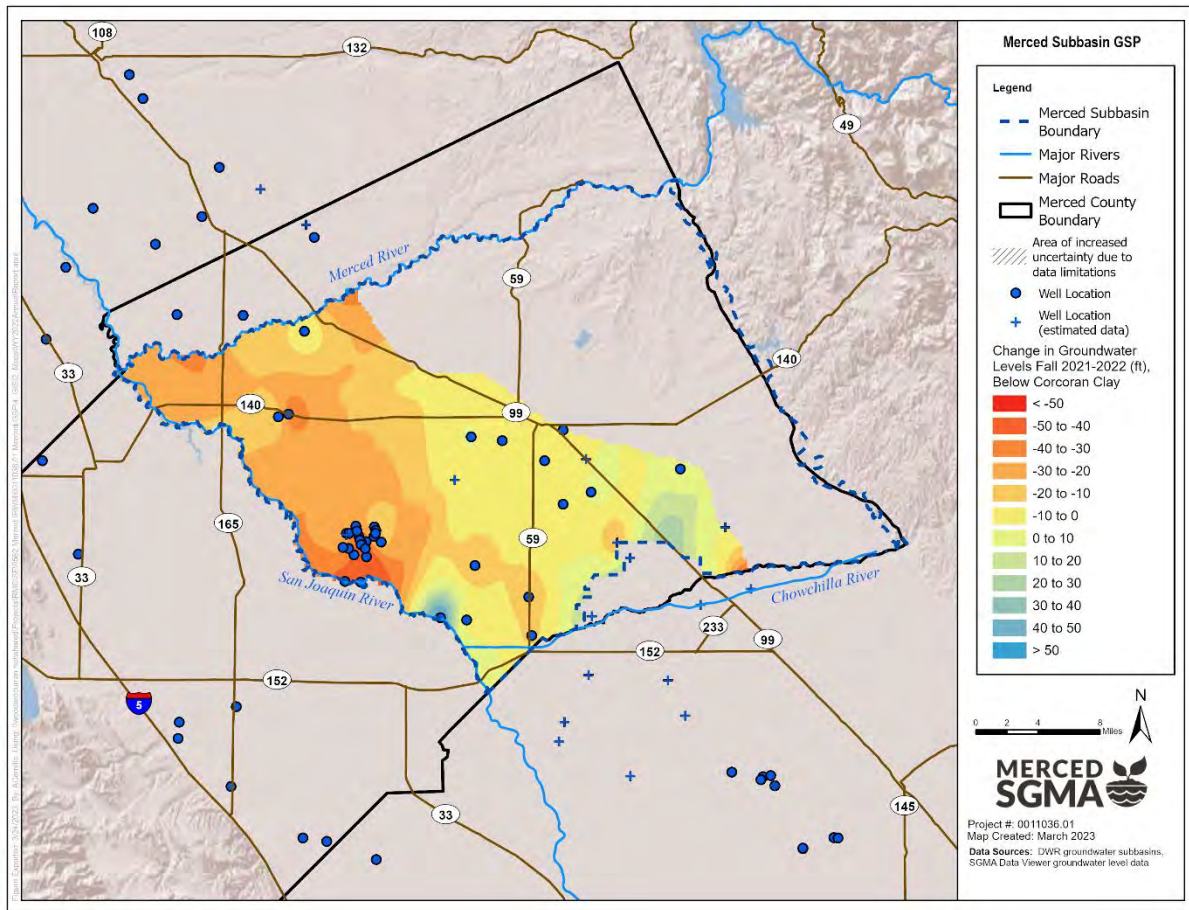
¹ TIWD GSA-1 also provided additional static water level measurements for wells within the GSA boundary that are not part of the SGMA Data Viewer system. Monitoring data from relatively new monitoring wells in the El Nido and Planada regions have not yet been uploaded to the SGMA Data Viewer but were used in the development of this Annual Report. MIUGSA plans to upload ongoing collected data from the El Nido and Planada sites to the SGMA Data Viewer starting in WY 2023.

Figure 2-2: Total Change in Groundwater Levels Fall 2021 to Fall 2022, Above Corcoran Clay



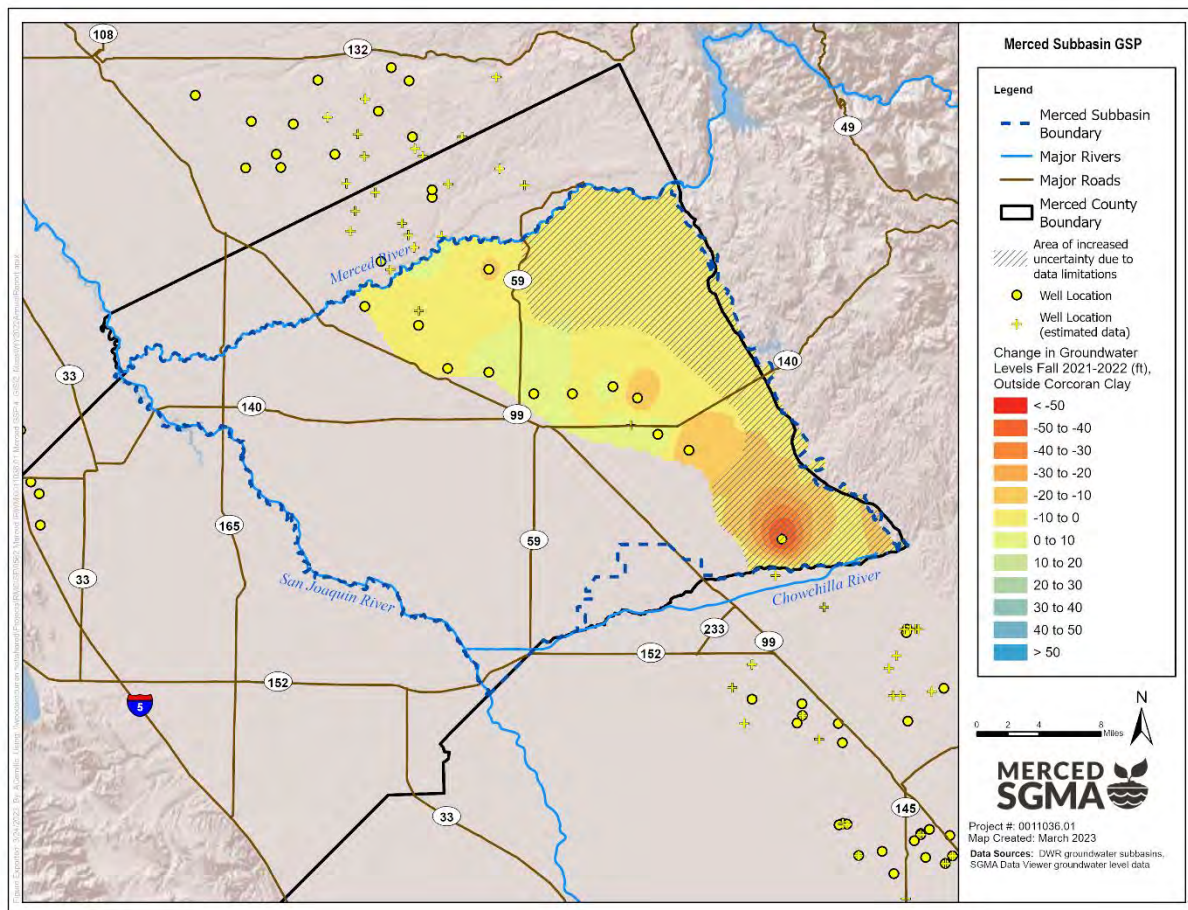
1. For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in **Appendix B**.
2. The hatched area labeled "Area of increased uncertainty due to data limitations" indicates a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due to the data limitations. The GSP identifies this as a data gap; the GSAs developed a Data Gaps Plan in 2021 and are in the process of implementing the plan.

Figure 2-3: Total Change in Groundwater Levels Fall 2021 to Fall 2022, Below Corcoran Clay



1. For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in **Appendix B**.

Figure 2-4: Total Change in Groundwater Levels Fall 2021 to Fall 2022, Outside Corcoran Clay



1. For additional details on change in groundwater levels in specific areas, please refer to contour maps for each season developed in **Appendix B**.
2. The hatched area labeled "Area of increased uncertainty due to data limitations" indicates a region with a relatively lower density of monitoring wells. Contours were developed based on available surrounding data, but the change in groundwater levels are considered to have a higher level of uncertainty in this area due the data limitations. The GSP identifies this as a data gap; the GSAs developed a Data Gaps Plan in 2021 and are in the process of implementing the plan.

Table 2-1 lists the representative monitoring wells for the sustainability indicator of chronic lowering of groundwater levels, with a comparison of fall 2022 groundwater elevations against minimum threshold, measurable objective, and interim milestone 2025 elevations. The sustainable management criteria are updated as of the July 2022 GSP.

Table 2-1: Groundwater Elevation at Representative Monitoring Wells

State Well ID	Site Code	Station ID	Principal Aquifer	Fall 2022 GW Elevation ¹	Minimum Threshold Elevation ¹	Measurable Objective Elevation ¹	Interim Milestone 2025 ¹
06S12E33D001M	373732N1206679W001	5773	Above	40.49	46.5	73.8	26.8
07S11E15H001M	373243N1207424W001	8604	Above	52.52	59.0	67.0	55.9
07S12E03F001M	373532N1206432W001	8626	Above	41.93	48.9	78.0	15.5
07S11E24A001M	373166N1207091W001	31372	Above	42.33	50.8	75.6	33.9
07S10E17D003M	373278N1209054W002	47569	Above	63.98	61.2	68.2	59.4
07S10E06K002M	373510N1209113W001	47571	Above	59.39	56.8	66.3	53.8
08S14E15R002M	372335N1204199W001	10200	Below	61.06 ²	67.2	145.2	11.5
07S13E32H001M	372838N1205602W001	38974	Below	76.60	73.9	104.4	61.8
07S14E35E001M	372904N1204207W001	47542	Below	59.44	73.7	112.6	38.3
06S11E27F001M	373821N1207551W001	47562	Below	62.82	58.8	75.3	48.8
07S13E34G001M	372806N1205241W001	47564	Below	53.80	70.2	108.7	53.5
08S14E06G001M	372617N1204747W001	47565	Below	48.66	55.9	100.9	28.5
07S13E09A001M	373457N1205429W001	10051	Outside	61.74 ²	73.7	92.6	48.1
08S16E34J001M	371902N1201985W001	28392	Outside	-99.90	-94.5	47.5	-169.7
06S13E04H001M	374421N1205407W001	38884	Outside	51.21	70.7	100.4	40.4
07S12E07C001M	373496N1205890W001	47541	Outside	40.12	56.1	66.4	29.9
07S14E16F004M	373260N1204432W004	47553	Outside	73.44	87.4	118.1	56.8
07S13E13H004M	373260N1204880W004	47557	Outside	59.77	62.4	102.1	37.4
06S12E17M001M	374074N1206859W001	47563	Outside	49.48 ²	50.5	81.0	33.1
06S12E23P001M	370000N1200000W001	47574	Outside	45.00 ²	56.0	80.0	40.0
06S12E23C001M	370000N1200000W002	47575	Outside	N/A ³	45.0	89.0	26.1

1. All elevations reported in feet above sea level, datum NAVD88.

2. Station IDs 10200, 10051, 47563, and 47574 were not measured in November 2022; the displayed measurement is from October 2022.

3. Station ID 47575 was not recorded in fall 2022 (last available measurement was June 2022).

4. In previous years, Station IDs 47562, 10051, and 47563 have had a QA flag of "Oil or foreign substance in casing". While they were not flagged for this issue this year, it is likely the issue persists. Oil layer depths were not measured and thus an adjusted water surface elevation cannot be estimated.

2.2 Groundwater Extractions

Table 2-2 summarizes monthly groundwater extractions for WY 2022 by water use sector and method of measurement. An annual comparison of groundwater pumping by sector for Water Years 2016-2022 (the period of time over which annual reports have been developed) is shown in Table 2-3. Groundwater extraction data were requested from groundwater agencies located in the Merced Subbasin, listed below:

- City of Atwater
- City of Livingston
- City of Merced
- Merced Irrigation District (MID)
- Turner Island Water District GSA #1
- Stevinson Water District
- Merquin County Water District
- Planada Community Services District
- Lone Tree Mutual Water Company
- American Water, Meadowbrook
- Winton Water and Sanitary District
- Le Grand Community Services District
- Merced National Wildlife Refuge

All reported values from agencies were directly measured. Data are a mixture of metered data and some data from pump tests using run time data. Quantitative estimates of accuracy of measurement (e.g., by percentage or +/- AF) were requested from each agency but not provided by all. Directly measured data are expected to have a qualitative high level of accuracy.

Groundwater extractions from private irrigators and domestic wells are estimated by the Merced Water Resources Model (MercedWRM) based on factors including land use, evapotranspiration, and population. Details about the MercedWRM can be found in the GSP, while recent updates to the model can be found in Section 3.4.1 of this annual report. A map illustrating the general location and volume of groundwater extractions as estimated by the MercedWRM for WY 2022 can be found in Figure 2-5. These estimated data are expected to have a qualitative medium level of accuracy.

Table 2-2: Monthly Groundwater Extractions (in AF), Water Year 2022

Month	Sector						Total
	Agriculture		Urban		Habitat ⁴		
	Agency Pumping ¹	Private Pumping ²	Agency Pumping ¹	Private Pumping ³	Direct ⁴	Estimated ⁴	
Oct-2021	3,323	45,861	3,235	4,616	1,789	125	58,949
Nov-2021	976	4,875	2,292	3,439	1,803	399	13,784
Dec-2021	126	1,891	2,043	2,853	1,572	412	8,896
Jan-2022	148	2,501	1,854	2,709	1,132	412	8,756
Feb-2022	3,637	1,398	2,107	2,640	642	200	10,625
Mar-2022	7,885	49,089	2,758	3,209	698	324	63,964
Apr-2022	12,766	79,221	2,906	4,247	63	240	99,444
May-2022	17,932	70,304	3,825	5,275	0	83	97,418
Jun-2022	16,090	116,295	4,328	5,555	0	83	142,352
Jul-2022	17,748	124,496	4,606	6,041	0	83	152,975
Aug-2022	16,919	132,219	4,476	5,832	0	83	159,529
Sep-2022	7,674	87,147	3,759	5,161	74	83	103,898
TOTAL	105,225	715,297	38,189	51,578	7,773	2,527	920,588

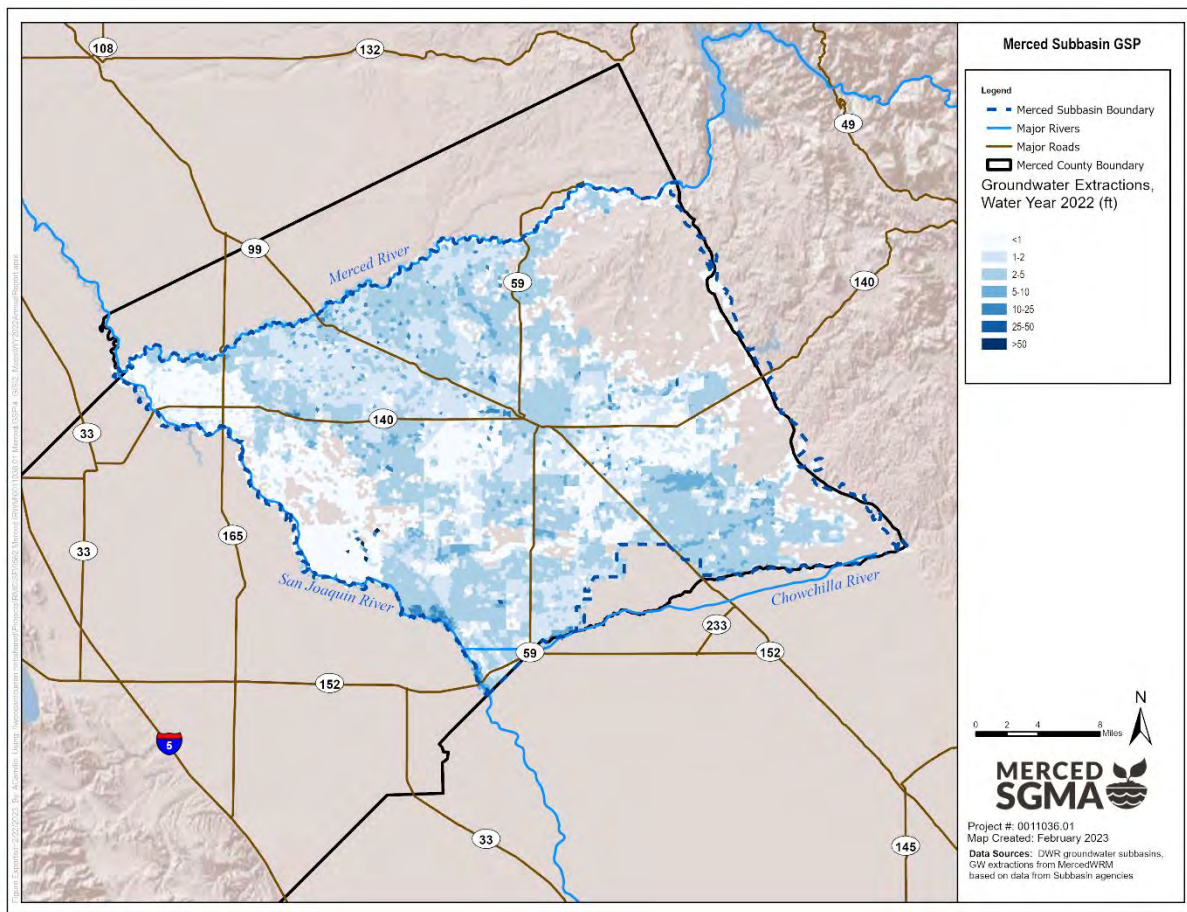
1. "Agency Pumping" indicates direct measurements of volumes of pumped groundwater reported by agricultural purveyors and urban water suppliers. Directly measured data are expected to have a qualitative high level of accuracy.
2. "Private Pumping" for the agricultural sector is estimated by the MercedWRM based on land use and evapotranspiration data. See Section 3.4.2 - MercedWRM Update (Water Year 2022). These estimated data are expected to have a qualitative medium level of accuracy.
3. "Private Pumping" for the urban sector (primarily from domestic wells in rural regions) is estimated by the MercedWRM based on census data for population multiplied by a volumetric water use factor averaged from the urban regions. See Section 3.4.2 - MercedWRM Update (Water Year 2022). These estimated data are expected to have a qualitative medium level of accuracy.
4. The "Habitat" sector includes directly measured volumes of groundwater extractions at Merced National Wildlife Refuge within the Merced Unit of the refuge. Directly measured data are expected to have a qualitative high level of accuracy. The Merced National Wildlife Refuge also provided some estimated groundwater extractions from the Arena Plains and Snobird Units of the refuge. These estimated data are expected to have a qualitative medium level of accuracy. Groundwater pumping for other wetland/habitat areas are included in the "Agriculture" sector due to a lack of information for demands from these wetlands/habitat areas. Demands were estimated based on DWR land use categorizations of native vegetation or agricultural land.

Table 2-3: Annual Groundwater Extractions (in AF), Water Years 2016-2022

Water Year	Sector						Total
	Agriculture		Urban		Habitat ⁴		
	Agency Pumping ₁	Private Pumping ₂	Agency Pumping ₁	Private Pumping ₃	Direct ⁴	Estimated ₄	
2016	23,310	580,083	33,364	10,661	9,060	0	656,477
2017	15,215	516,103	33,441	11,072	7,611	0	583,442
2018	25,994	611,986	33,528	15,057	12,065	0	698,630
2019	17,321	559,521	34,313	14,154	12,495	0	637,804
2020	59,505	575,499	41,074	10,422	14,891	0	701,391
2021	88,937	645,337	41,491	9,172	13,290	2,527	800,754
2022	105,225	715,297	38,189	51,578	7,773	2,527	920,588

1. "Agency Pumping" indicates direct measurements of volumes of pumped groundwater reported by agricultural purveyors and urban water suppliers. Directly measured data are expected to have a qualitative high level of accuracy.
2. "Private Pumping" for the agricultural sector is estimated by the MercedWRM based on land use and evapotranspiration data. These estimated data are expected to have a qualitative medium level of accuracy.
3. "Private Pumping" for the urban sector (primarily from domestic wells in rural regions) is estimated by the MercedWRM based on census data for population multiplied by a volumetric water use factor averaged from the urban regions. These estimated data are expected to have a qualitative medium level of accuracy.
4. The "Habitat" sector includes directly measured volumes of groundwater extractions at Merced National Wildlife Refuge within the Merced Unit of the refuge. Directly measured data are expected to have a qualitative high level of accuracy. The Merced National Wildlife Refuge also provides some estimated groundwater extractions which are expected to have a qualitative medium level of accuracy. Groundwater pumping for other wetland/habitat areas are included in the "Agriculture" sector due to a lack of information for demands from these wetlands/habitat areas. Demands were estimated based on DWR land use categorizations of native vegetation or agricultural land.

Figure 2-5: Map of Groundwater Extractions (Water Year 2022)



2.3 Surface Water Supply

SGMA requires that the GSP annual report tabulate *"Surface water supply used or available for use..."* (emphasis added, CCR §356.2 [b] [3]). Table 2-4 summarizes total monthly surface water available for use for WY 2022, broken down by method of measurement. These tables report total surface water diversions and not surface water used, which is difficult to parse out by sector. Direct measurements were provided by MID, Stevinson Water District, TIWD, and Lone Tree Mutual Water Company. Directly measured data are expected to have a qualitative high level of accuracy. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under both the agricultural and habitat sectors. Diversions made by Lone Tree Mutual Water Company are exclusively flood flow diversions.

Note also that there are several riparian diverters in the Subbasin whose diversions have not been captured for the purpose of the annual report because they divert a relatively small volume of surface water compared to the diversions made by agencies. It is anticipated that some of these data will be incorporated into future reports, as data will become available as a result of implementation of Senate Bill 88 (2015).

Table 2-4: Monthly Surface Water Available for Use (in AF), Water Year 2022

Month	Method of Measurement ¹	Total
	Direct	
Oct-2021	19,359	19,359
Nov-2021	2,738	2,738
Dec-2021	2,508	2,508
Jan-2022	1,886	1,886
Feb-2022	2,980	2,980
Mar-2022	19,481	19,481
Apr-2022	15,189	15,189
May-2022	41,591	41,591
Jun-2022	68,882	68,882
Jul-2022	76,249	76,249
Aug-2022	64,132	64,132
Sep-2022	35,685	35,685
TOTAL	350,680	350,680

1. *This table reports total surface water diversions and not surface water used due to data limitations. Both surface diversions and surface water used are difficult to parse out by sector as well. Note that MID diversions include surface water ultimately used by Stevinson Water District, Merquin County Water District, Merced National Wildlife Refuge, Le Grand-Athlone Water District, and Lone Tree Mutual Water Company, which fall under the agriculture and habitat sectors.*

2.4 Total Water Use

Per SGMA requirement, Table 2-5 summarizes monthly combined groundwater use (Table 2-2) and surface water available for use (Table 2-4) for WY 2022 by water use sector and method of measurement. The same qualifications for method of measurement and sector of use apply from Table 2-2 and Table 2-4.

Table 2-5: Monthly Total Water Use, Water Year 2022

Month	Sector						Total
	Agriculture		Urban		Habitat		
	Direct ¹	Estimate ²	Direct	Estimate ₂	Direct	Estimate	
Oct-2021	22,681	45,861	3,235	4,616	1,789	125	78,307
Nov-2021	3,714	4,875	2,292	3,439	1,803	399	16,522
Dec-2021	2,634	1,891	2,043	2,853	1,572	412	11,404
Jan-2022	2,034	2,501	1,854	2,709	1,132	412	10,642
Feb-2022	6,617	1,398	2,107	2,640	642	200	13,605
Mar-2022	27,366	49,089	2,758	3,209	698	324	83,444
Apr-2022	27,955	79,221	2,906	4,247	63	240	114,633
May-2022	59,523	70,304	3,825	5,275	0	83	139,009
Jun-2022	84,972	116,295	4,328	5,555	0	83	211,234
Jul-2022	93,997	124,496	4,606	6,041	0	83	229,224
Aug-2022	81,051	132,219	4,476	5,832	0	83	223,661
Sep-2022	43,360	87,147	3,759	5,161	74	83	139,583
TOTAL	455,905	715,297	38,189	51,578	7,773	2,527	1,271,268

1. Surface water diversions have been reported under the category of Agriculture, Direct. As described in Table 2-4, this includes total surface water diversions and not surface water used, and cannot be accurately measured between the agriculture and habitat sectors. Surface water diversions account for approximately 80% of this column.
2. See Table 2-2 for more detailed notes on groundwater pumping estimates.

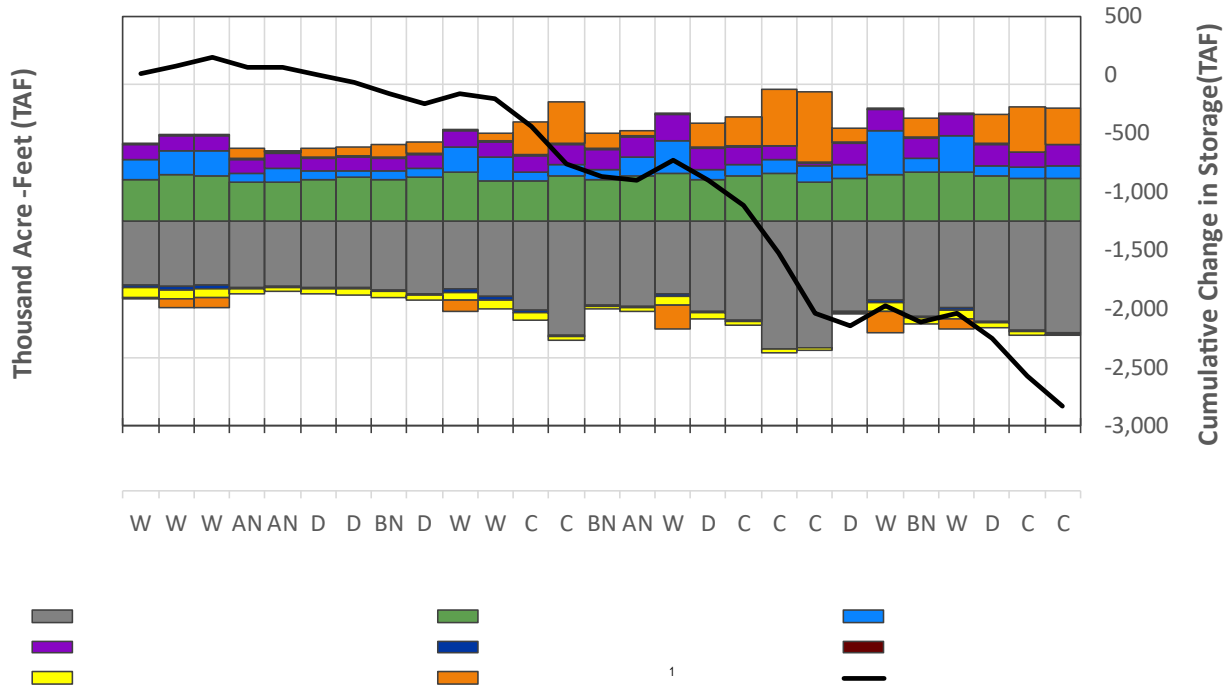
2.5 Change in Groundwater Storage

The Merced Water Resources Model (MercedWRM) was used to estimate historical change in groundwater storage in the Merced Subbasin from water years 1996-2021 for the Merced GSP and subsequent annual reports and then extended through WY 2022 to support quantification of storage change for this annual report. See Section 3.4.1 for more information about the recent model update for this annual report. Note that the time period of 2006-2015 was originally selected as the historical water budget time period reported in the Merced GSP as representative of average precipitation and capturing recent Subbasin operations.

After extending the historical water budget through WY 2022, the current (2022) total fresh groundwater storage was estimated as 45.1 MAF and the cumulative change in storage from WYs 2006-2022 was estimated as -2.68 MAF, or an average reduction of 158 TAF per year. During WY 2022, the change in storage was estimated as a reduction of 262 TAF, which exceeds the 2006-2022 average by approximately 104 TAF. Note that the average annual reduction of 192 TAF per year established in the GSP using the hydrologically balanced period of WYs 2006-2015 remains the current estimate of long-term overdraft in the Subbasin.

Figure 2-6 shows the cumulative change in storage for WYs 1996-2022 against groundwater uses developed in the water budget and water year type. Figure 2-7 shows the cumulative departure from 50-year (WYs 1969-2018) mean precipitation of 12.6 inches from WYs 1996-2022. The cumulative departure is 33.7 inches, indicating that the period of WYs 1996-2022 has been wetter as a whole than the 50-year average.

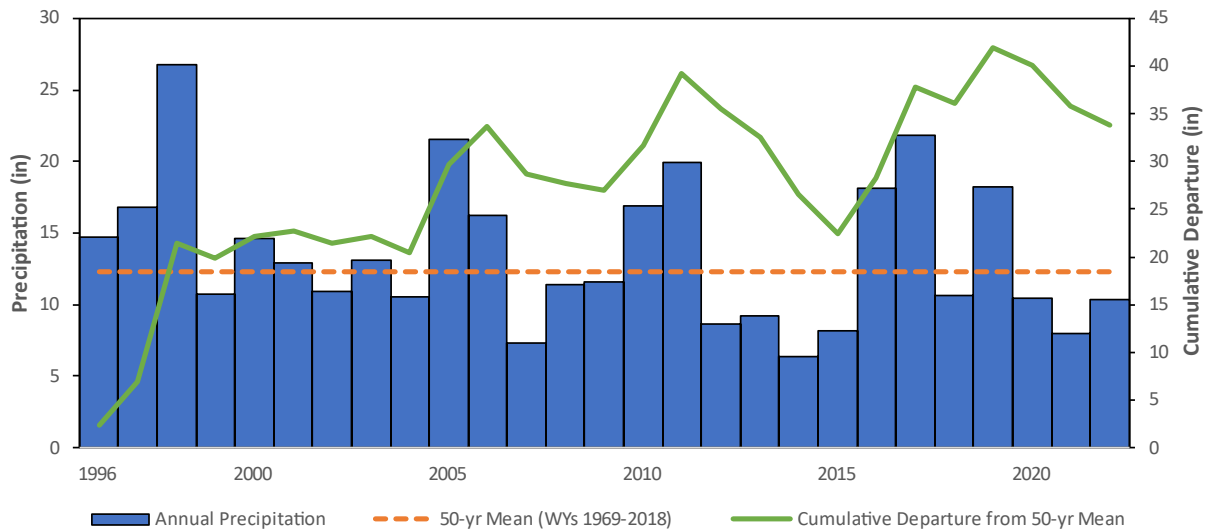
Figure 2-6: Historical Annual Water Budget – Groundwater System, Merced Subbasin



1. "Change in Storage" is placed on the chart to balance the water budget. For example, if annual outflows (-) are greater than inflows (+), there is a decrease in storage, and this is shown on the positive side of the bar chart to balance out the increased outflows on the negative side of the bar chart.

Source: Water year types based on San Joaquin Valley Water Year Index (DWR, 2023a).

Figure 2-7: Cumulative Departure from Mean Precipitation, Merced, California



Sustainable management criteria were not developed for this sustainability indicator because significant and unreasonable reduction of groundwater storage is not present and not likely to occur in the Subbasin. The 2006-2022 cumulative change in storage described above, which includes both representative dry and wet years, reflects a rate of overdraft of approximately 0.2 percent of total freshwater storage per year. It is not reasonable to expect that the available groundwater in storage would be exhausted, noting that issues related to accessibility of groundwater to beneficial users are addressed through the groundwater level and depletions sustainability indicators.

Figure 2-8 through Figure 2-10 show the total change in groundwater storage by principal aquifer for WY 2022 in a spatial format as estimated by outputs from the MercedWRM. The change in storage is shown in units of feet. The MercedWRM calculates a change in volume per area of each model element. Since the model elements vary in size, visually displaying a map of volume change per model element is not spatially intuitive, so the results have been normalized to show change in depth by dividing the volume by area per model element.

Change in groundwater storage is a function of changes in groundwater levels and physical properties of the aquifer. As such, it would be expected that areas with increases in groundwater storage would also have increases in groundwater levels in Figures 2-2 through 2-4 and that areas with decreases in groundwater storage would also have decreases in groundwater levels. While this is true in many cases, it is not true in all cases due to uncertainties in the underlying data. Uncertainties in the change in groundwater storage are associated with the MercedWRM, while uncertainties in the change in groundwater levels are associated with limited data points and individual data points that may be impacted by nearby pumping, screen depths, or otherwise provide non-representative values. It is useful to look at these figures together to better understand patterns of change in groundwater levels and storage.

Subbasin storage decreased during WY 2022 and the figures below primarily show corresponding areas of relative decrease in storage (associated with declining groundwater levels; shown in green shades). The Above Corcoran Clay shows several areas of moderate decrease in storage. The Below Corcoran Clay shows relatively small decrease in storage throughout, with higher magnitude of reduction along the eastern edge. Notable in the Below Corcoran Clay is a lack of substantial declines in storage in areas with increased declines in groundwater levels shown in Figure 2-9; this suggests a need for additional understanding of the monitored data, additional work characterizing the area within MercedWRM, or both. The Outside Corcoran Clay shows a relatively higher level of decrease in storage throughout its entire extent.

Figure 2-8: Change in Storage Water Year 2022 (AF), Above Corcoran Clay

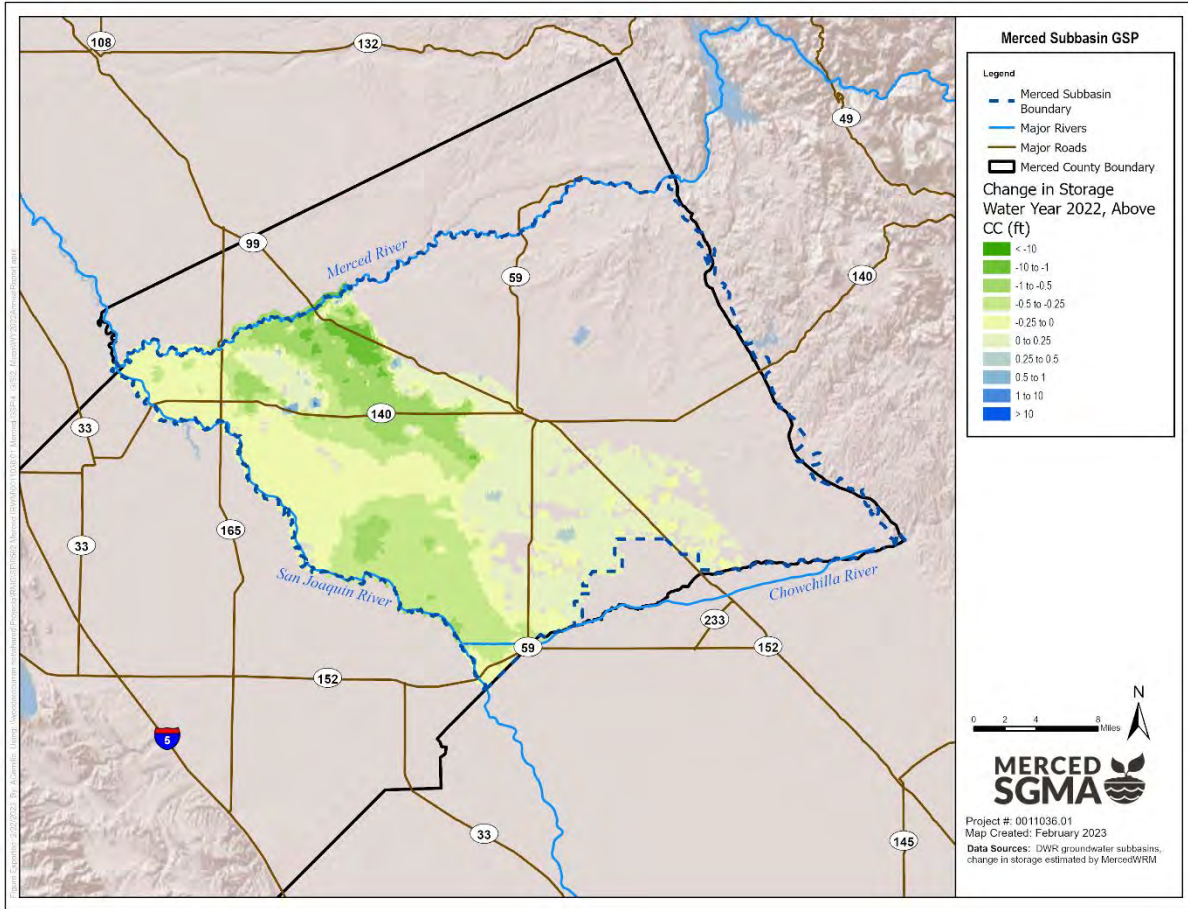


Figure 2-9: Change in Storage Water Year 2022 (AF), Below Corcoran Clay

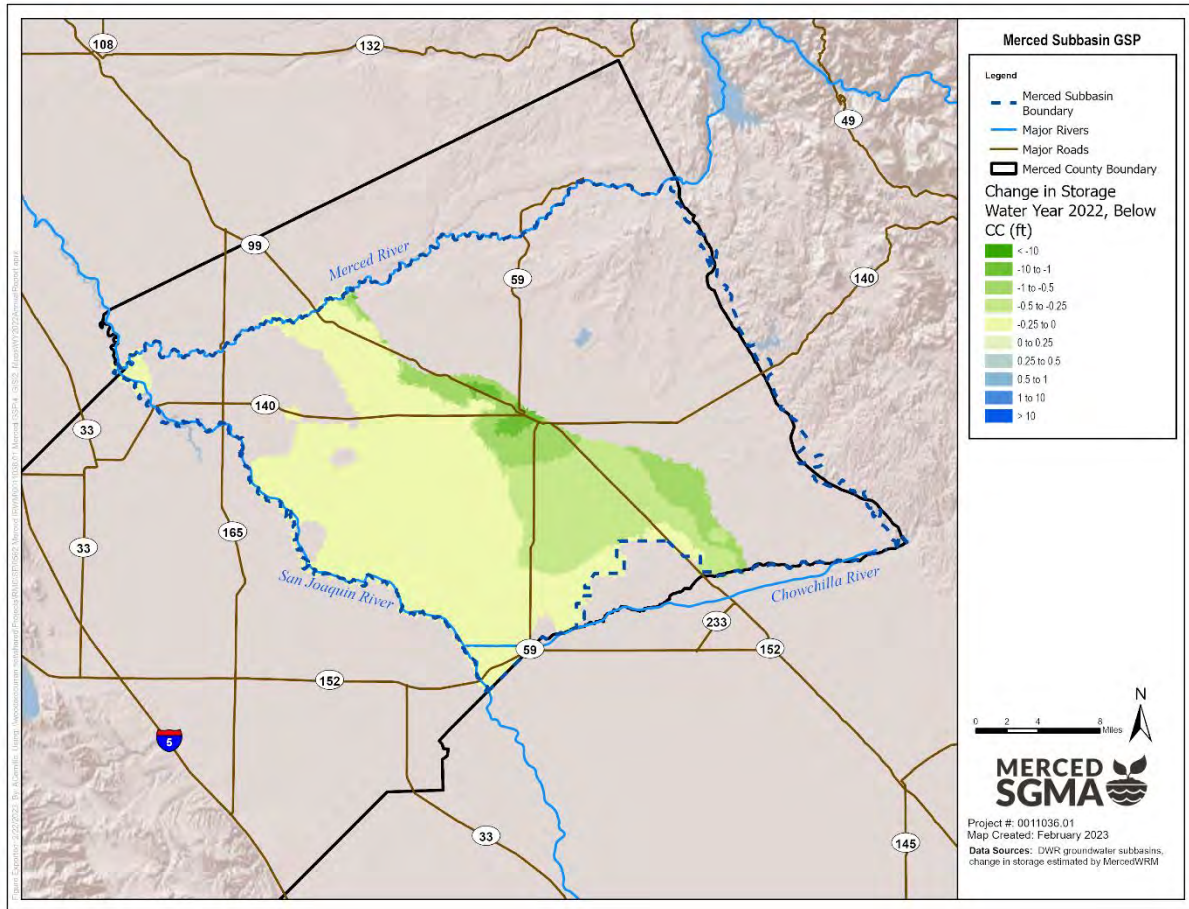
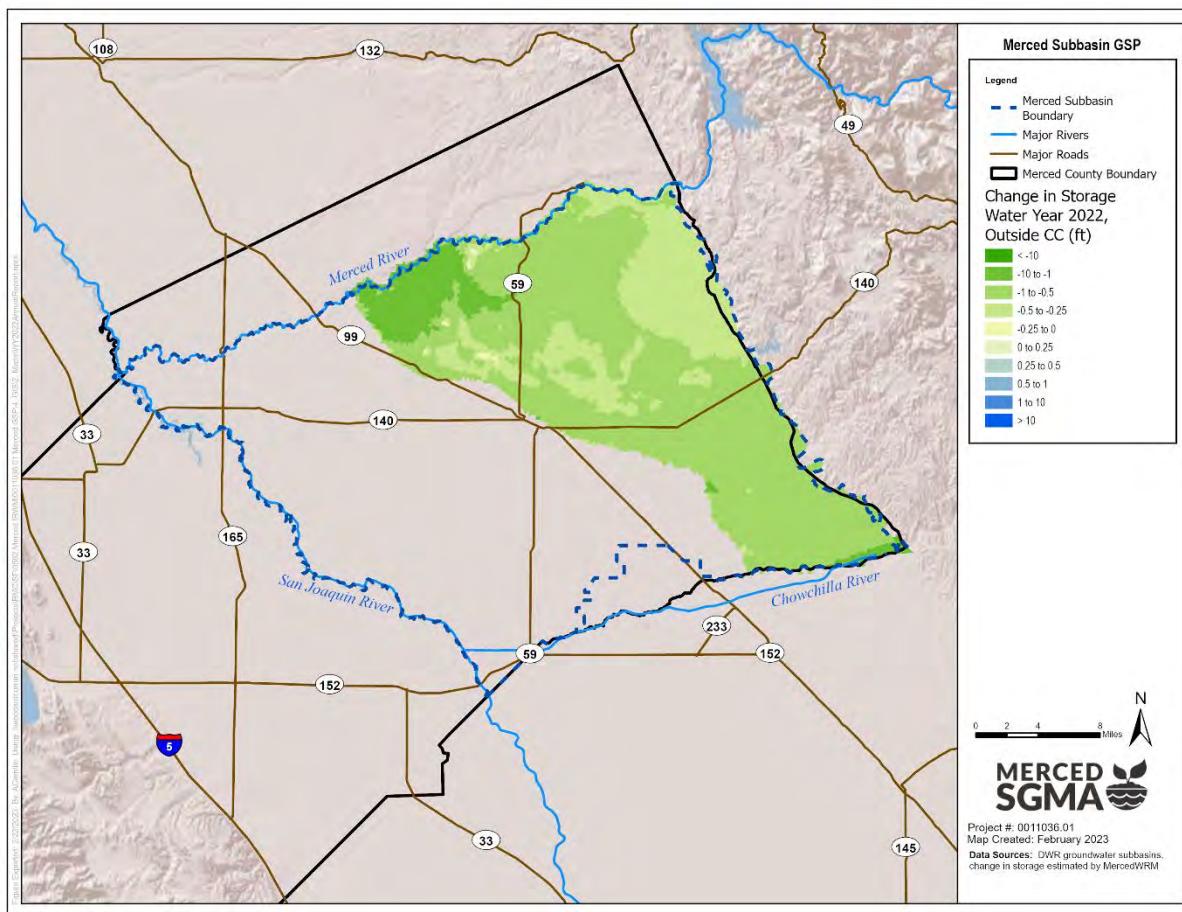


Figure 2-10: Change in Storage Water Year 2022 (AF), Outside Corcoran Clay



1. The eastern portion of the Outside Corcoran Clay Principal Aquifer is a region with a relatively lower density of monitoring wells and thus higher level of uncertainty due the data limitations. The GSP identifies this as a data gap; the GSAs developed a Data Gaps Plan in 2021 and are in the process of implementing the plan.

2.6 Land Subsidence

This section provides maps of the most recent subsidence measurements taken in and around the Subbasin and compares them to the GSP's sustainable management criteria. Subsidence is measured at static GPS control points throughout the San Joaquin Valley monitored by the US Bureau of Reclamation (USBR) as part of the San Joaquin River Restoration Program. Measurements have been recorded semiannually in July and December of each year to monitor ongoing subsidence since 2011. Figure 2-11 shows the total subsidence occurring from December 2021 to December 2022. Figure 2-12 shows the average subsidence occurring from December 2015 through December 2022.

Figure 2-11: Total Subsidence December 2021 to December 2022

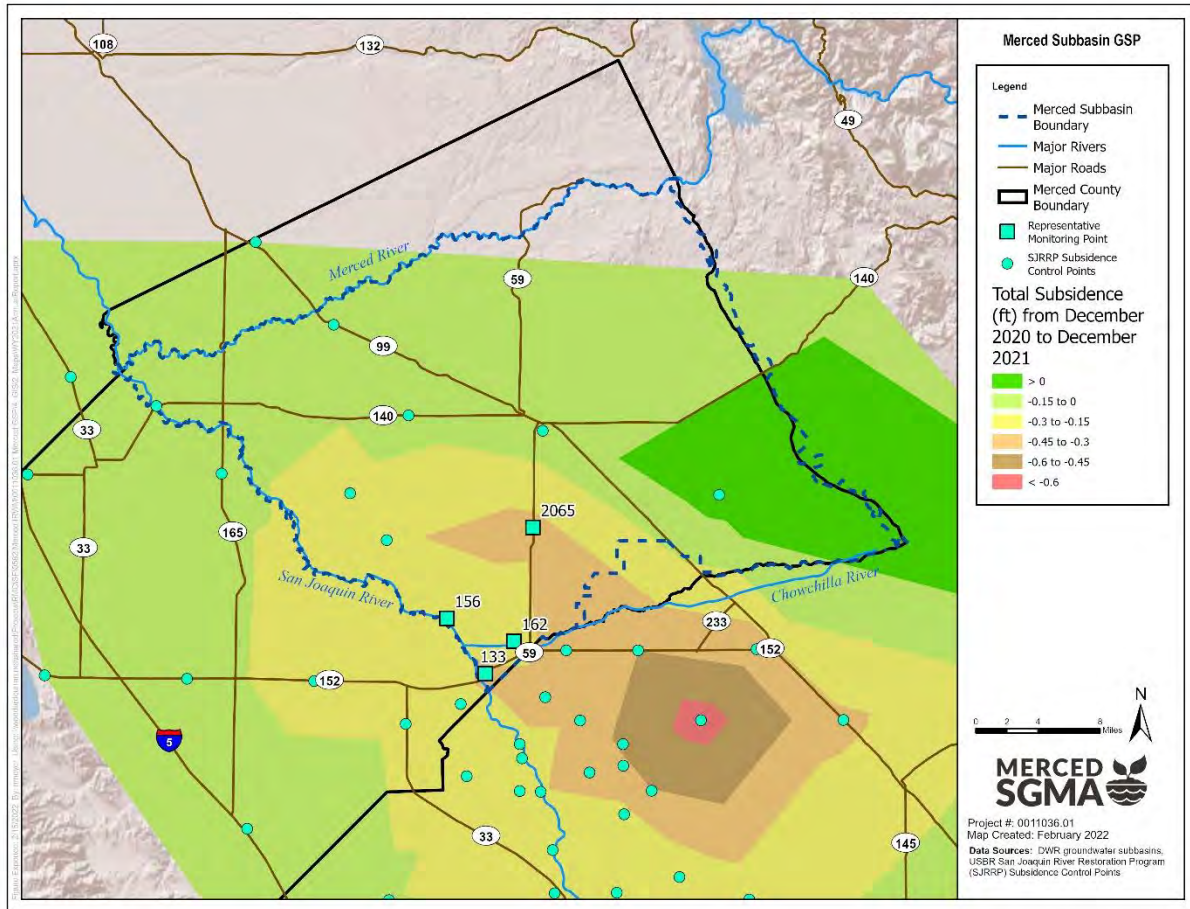
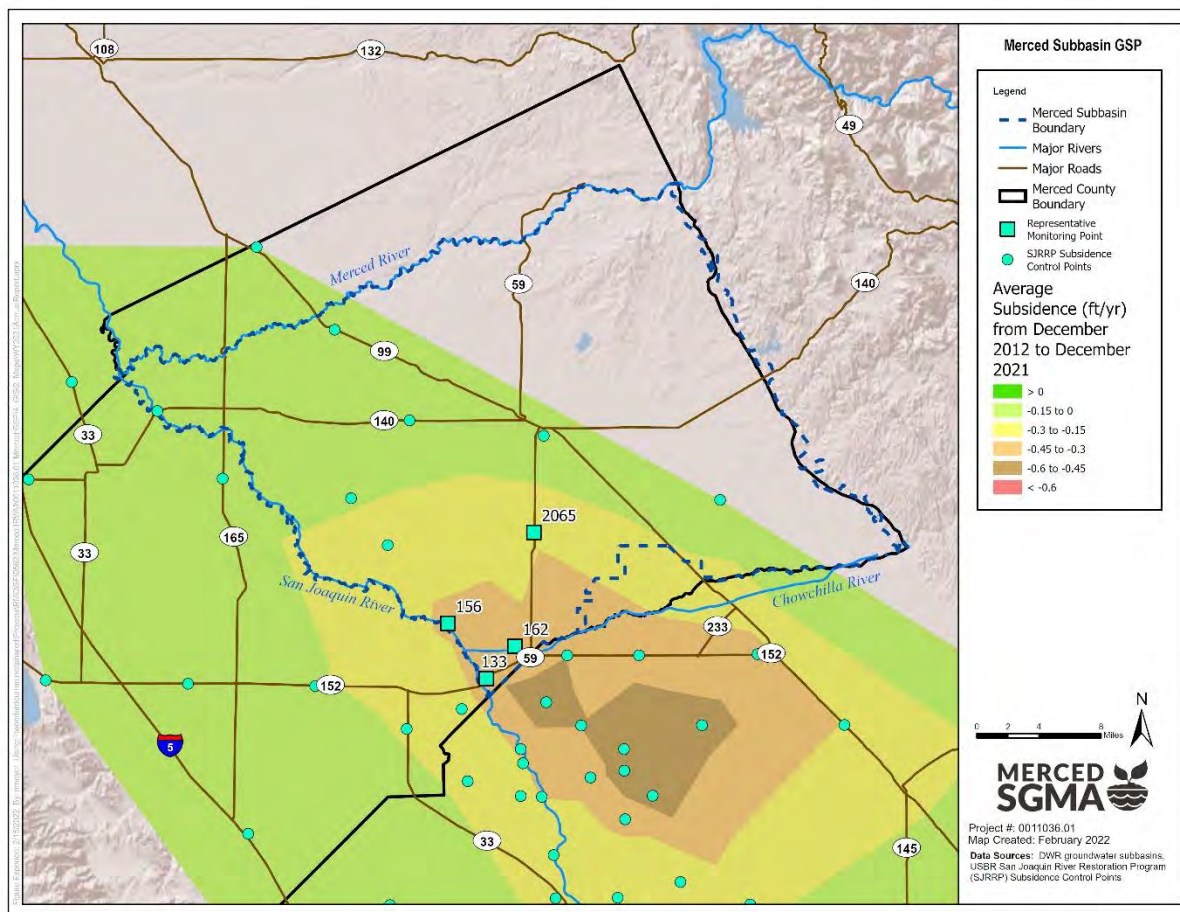


Figure 2-12: Average Subsidence Rate December 2015 to December 2022



In the 2022 revised GSP, the GSAs established a minimum threshold of 0 ft/year (subject to uncertainty of ± 0.16 ft/year) at four representative monitoring stations. The measurable objective is also 0 ft/year, with interim milestones of -0.75 ft/year (2025), -0.50 ft/year (2030), and -0.25 ft/year (2035) of subsidence. The GSP identifies undesirable results for subsidence as “exceedances of minimum threshold rates of land subsidence at three or more monitoring sites out of four for two consecutive years” (MIUGSA, MSGSA, & TIWD GSA-1, 2022).

As shown in Table 2-6, subsidence has consistently been observed (e.g. greater magnitude than the MT and MO of 0 ft/yr) at the representative monitoring sites from 2015 to 2022. However, the rate of subsidence has consistently been less than the 2025 IM of 0.75 ft/yr. Work is currently underway to better understand how to stabilize subsidence in the Subbasin. Subsidence is a gradual process that takes time to develop and time to halt. As a result, some level of future subsidence, likely at rates similar to those currently experienced, is likely to be underway already and will not be able to be prevented.

Table 2-6: Subsidence at Representative Monitoring Stations

	Point ID	133	162	2065	156
	Station Name	H 1235 RESET	RBF 1057	W 938 RESET	W 990 CADWR
Subsidence (ft)	Dec 2015-Dec 2016	-0.44	-0.25	-0.16	-0.29
	Dec 2016-Dec 2017	-0.18	-0.07	-0.16	0.01
	Dec 2017-Dec 2018	-0.30	-0.17	-0.17	-0.32
	Dec 2018-Dec 2019	-0.24	-0.10	-0.14	-0.07
	Dec 2019-Dec 2020	-0.39	-0.26	-0.30	-0.28
	Dec 2020-Dec 2021	-0.33	-0.19	-0.35	-0.23
	Dec 2021-Dec 2022	-0.46	-0.34	-0.52	-0.35
	Minimum Threshold (ft/yr)	0 ± 0.16	0 ± 0.16	0 ± 0.16	0 ± 0.16
	Measurable Objective (ft/yr)	0	0	0	0
	2025 Interim Milestone (ft/yr)	-0.75	-0.75	-0.75	-0.75

2.7 Groundwater Quality

In addition to comparing water quality monitoring to the GSP’s interim milestones and other sustainable management criteria, this section provides a summary of ongoing water quality coordination activities being conducted by the GSAs.

2.7.1 Representative Monitoring

In the GSP, the GSAs established a minimum threshold of 1,000 mg/L of Total Dissolved Solids (TDS) at representative monitoring sites for the degraded water quality sustainability indicator. The measurable objective and all interim milestones were set at 500 mg/L TDS. Undesirable results are defined in the GSP as “during GSP implementation when at least 25% of representative monitoring wells (6 of 22 sites) exceed the minimum threshold for degraded water quality for two consecutive years” (MIUGSA, MSGSA, & TIWD GSA-1, 2022).

Figure 2-13 through Figure 2-15 show the spatial distribution of TDS concentration measurements in the three principal aquifers based on TDS and electrical conductivity (EC) data reported in the Groundwater Ambient Monitoring & Assessment (GAMA) database within WY 2022 for wells in the Merced Subbasin monitoring network (including more than just representative wells).² EC measurements were converted to estimates of TDS only if TDS samples were not measured directly during WY 2022. Figure 2-16 shows

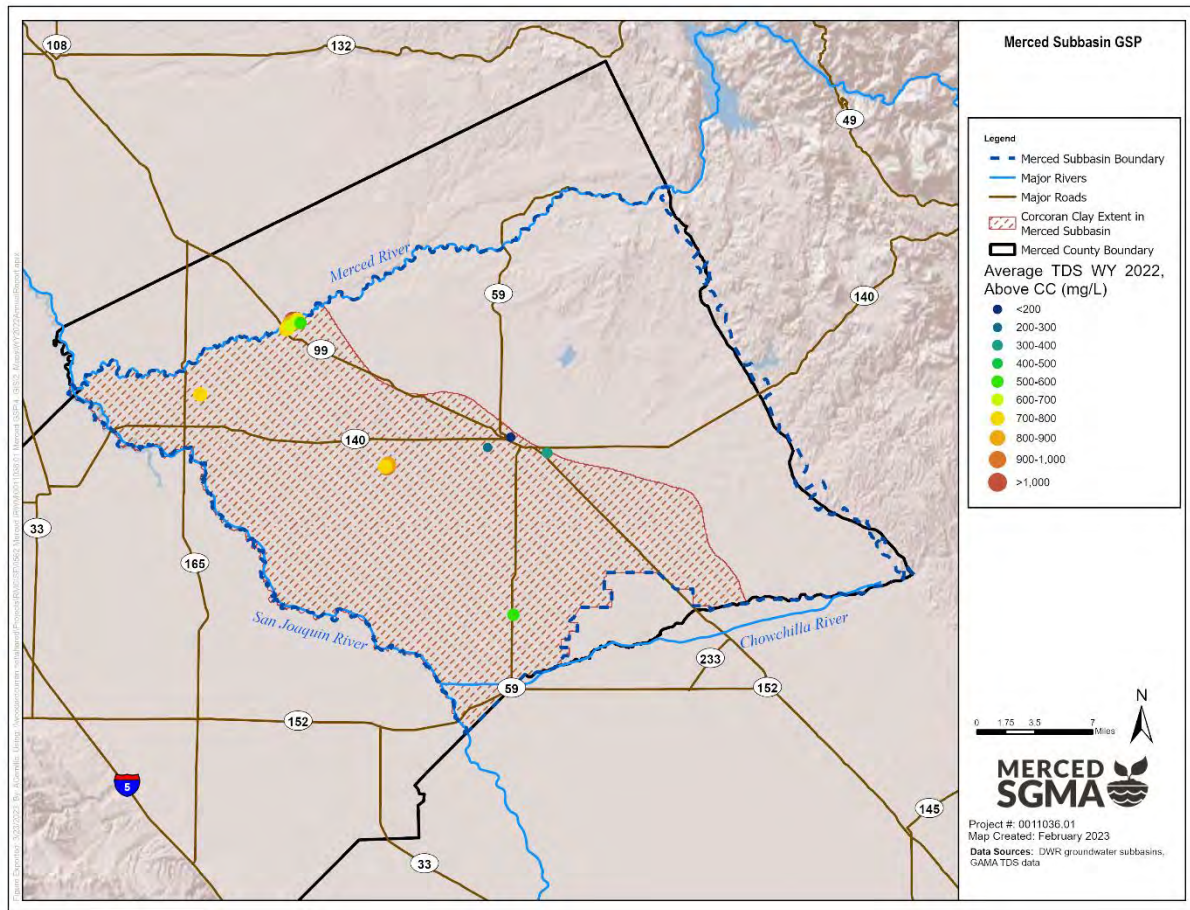
² TDS concentration was estimated using the estimation formula of TDS (mg/L) ≈ EC (µS/cm) * 0.640, described later in this section.

concentrations for which the principal aquifer is unknown due to a lack of well construction data (e.g., lacking total well depth or screened interval). The GSP monitoring network includes both designated representative wells as well as any public water supply wells that report data to the Division of Drinking Water (DDW).

While elevated TDS (actual and/or estimated from EC) concentrations (greater than 1,000 mg/L) were observed in monitoring data for WY 2022, they were confirmed to be at five locations where either samples were collected at environmental monitoring wells monitored by regulated facilities (3 sites) or a domestic well (1 site). The remaining 1 site is GAMA ID CA2400075_002_002 which correlates to one of two wells operated at the El Nido Elementary School as a municipal well which reports to DDW. This well has shown consistently high measurements, including 920 mg/L TDS sampled directly in 2014, and measurements ranging from 832 – 1,024 mg/L TDS as estimated from EC across 2014-2022.

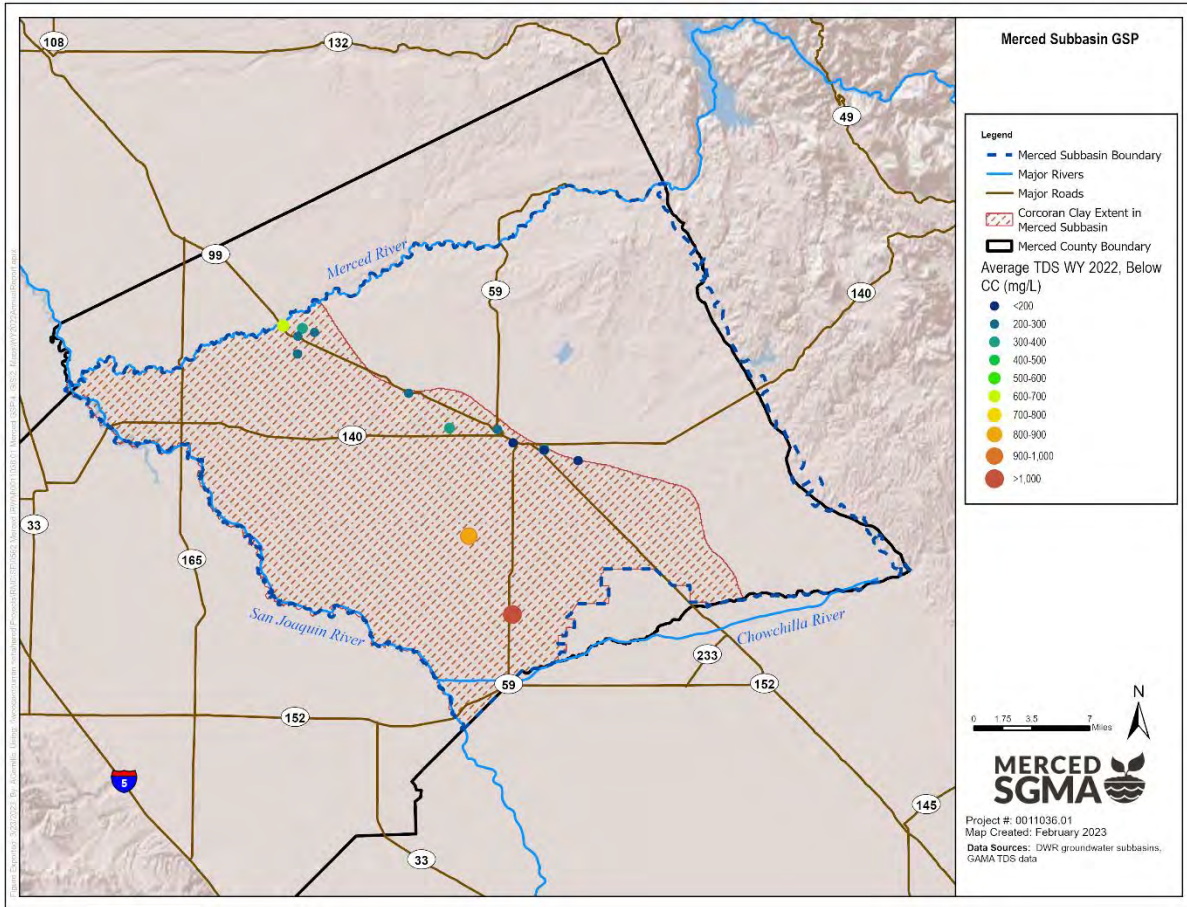
The Merced GSP describes that there are pockets of the Subbasin known to have such elevated concentrations and water use behaviors have already shifted to accommodate these concentrations. For example, agriculture has focused on more salt-tolerant crops, and more saline water supplies are blended with less saline water supplies. As a result, TDS concentrations in excess of 1,000 mg/L where currently experienced are not unexpected. There is, however, a desire on the part of Subbasin stakeholders to limit increases in salinity in parts of the Subbasin where TDS is below 1,000 mg/L to prevent undesirable results such as requirements to change cropping, blending supplies, etc.

Figure 2-13: Average TDS Concentration Water Year 2022, Above Corcoran Clay Principal Aquifer



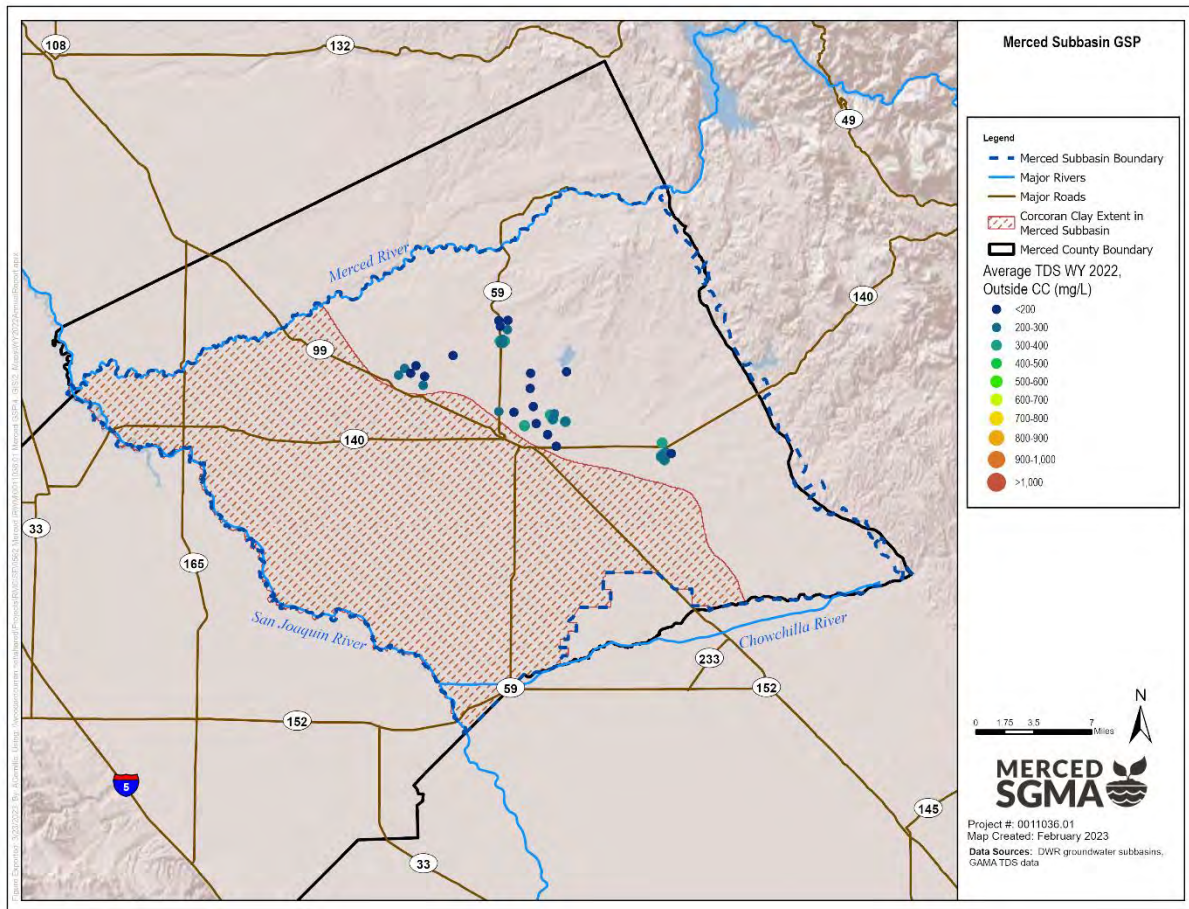
1. Some TDS values are estimated based on EC measurements.

Figure 2-14: Average TDS Concentration Water Year 2022, Below Corcoran Clay Principal Aquifer



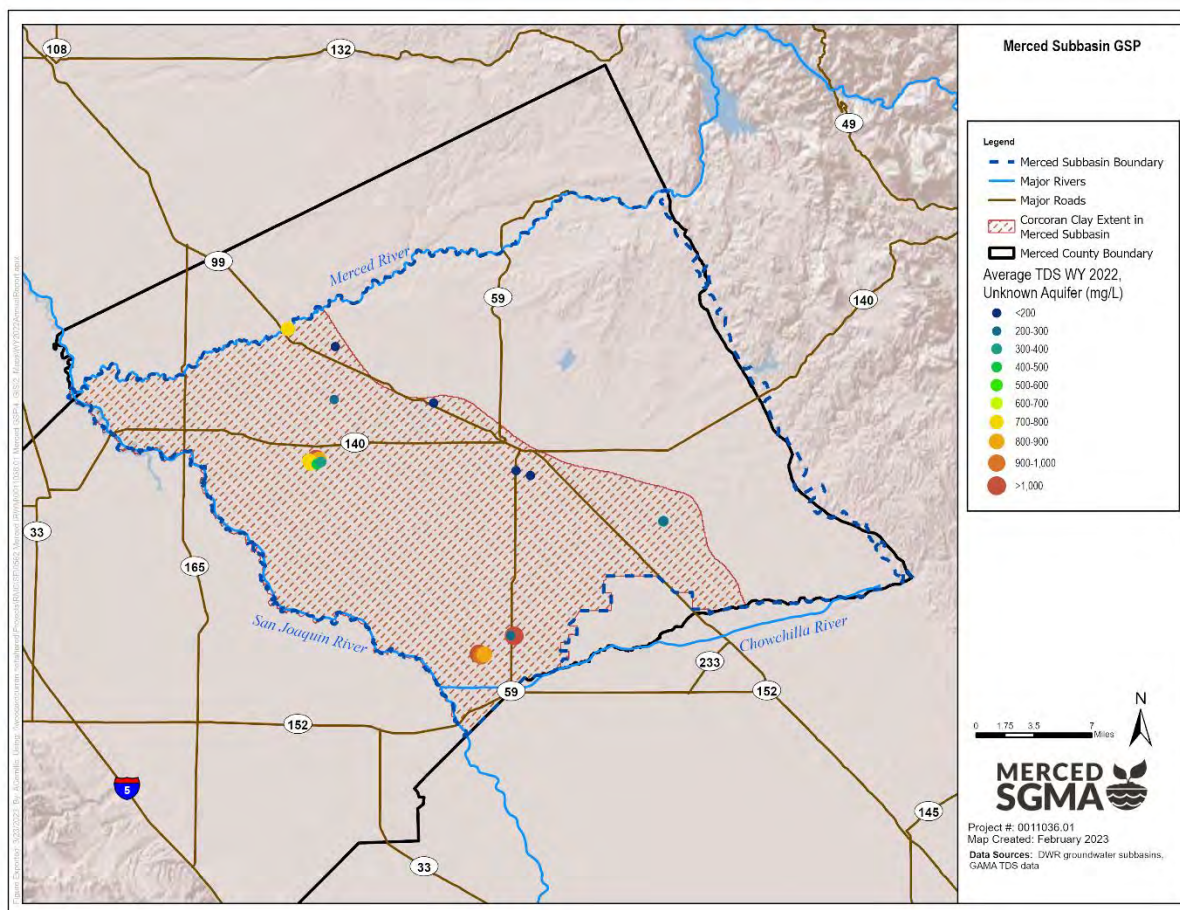
1. Some TDS values are estimated based on EC measurements.

Figure 2-15: Average TDS Concentration Water Year 2022, Outside Corcoran Clay Principal Aquifer



1. Some TDS values are estimated based on EC measurements.

Figure 2-16: Average TDS Concentration Water Year 2022, Unknown Principal Aquifer



1. Some TDS values are estimated based on EC measurements.

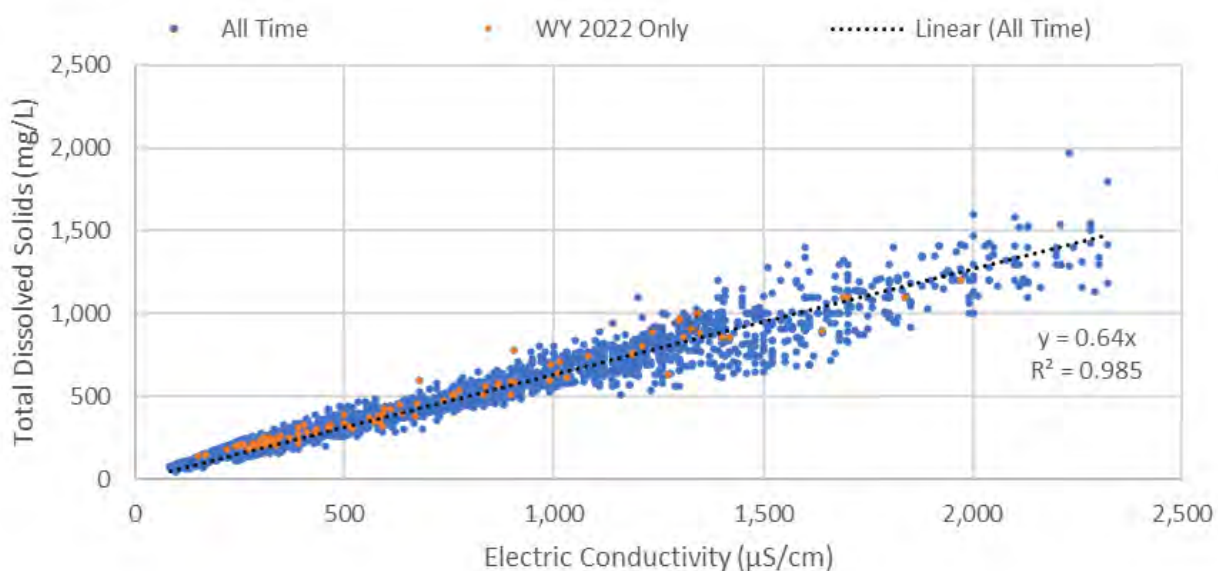
The East San Joaquin Water Quality Coalition (ESJWQC) is a group of agricultural interests and growers formed to represent dischargers who own or operate irrigated lands east of the San Joaquin River within Madera, Merced, Stanislaus, Tuolumne, and Mariposa Counties, as well as portions of Calaveras County. The ESJWQC has developed a Groundwater Quality Trend Monitoring Program (GQTMP) as part of the Irrigated Lands Regulatory Program (ILRP), which includes a targeted set of domestic wells (denoted as principal wells) supplemented by public water system wells (denoted as complementary wells) (ESJWQC, 2018). There are currently eight principal wells and 14 complementary wells in the Merced Subbasin that are designated as representative monitoring wells in the Merced GSP at which sustainable management criteria are established (shown in Table 2-7). Data collected by ESJWQC are submitted to GAMA annually.

ESJWQC monitors EC, pH, dissolved oxygen, temperature, and nitrate + nitrate as N annually. TDS and other constituents are monitored every five years. TDS was recorded in July 2022 for five of the eight principal monitoring wells in the GQTMP that are located in the Merced Subbasin. For the remaining three sites, the most recent EC field measurements collected by the ESJWQC were used to estimate TDS. The most recent TDS observations (whether direct or estimated) for Merced GSP representative wells are summarized in Table 2-7. None of the wells with reported data have measured or estimated TDS concentrations above the

MT. Three wells show a TDS concentration that is above the MO and IM. Note that for the 14 complementary wells (identified with GQTMP Well ID beginning with “C”), only two (C42 and C43) had TDS or EC data reported in GAMA for the reporting period.

There is a relationship between EC and TDS (SWRCB, 2004), with a typical acceptable ratio of TDS to EC ranging from 0.55 to 0.7 (American Public Health Association, American Water Works Association, and Water Environment Foundation, 1999). TDS is measured by ESJWQC every five years, though the definition of undesirable results in the Merced GSP is based on the assumption that measurements will be recorded annually. Because ESJWQC is already measuring EC annually, the GSAs will begin using EC measurements to estimate TDS in years where TDS was not sampled. The ratio used for conversion will be 0.64 (where $TDS [mg/L] \approx EC [\mu S/cm] * 0.64$). This is based on an analysis of paired EC and TDS measurements recorded in Merced County, as shown in Figure 2-17. Each paired EC/TDS measurement was recorded on the same day at the same site. The line of best fit has a slope of 0.64 (the ratio), with a strong level of correlation based on the coefficient of determination (R-squared or R^2) value of 0.985 out of 1.

Figure 2-17: Relationship Between Electrical Conductivity & Total Dissolved Solids



- This graph is based on 3,593 measurements of EC and TDS recorded on the same day at monitoring sites throughout Merced County from 1925-2022.
- Outliers were identified by calculating the interquartile (IQR) range of EC measurements (75th percentile value minus 25th percentile value). Measurement pairs (EC with TDS) were flagged as outliers and excluded from the analysis if they had an EC measurement that was higher than: (75th percentile EC value) + 1.5 * IQR, or 2,325 $\mu S/cm$. A second-step outlier analysis using the same methodology was performed on a small handful of remaining measurement pairs where the ratio between TDS and EC was outside of the range 0.43 – 0.94 ([25th percentile ratio – 1.5 IQR] to [75th percentile ratio + 1.5 IQR]). Overall, 350 outliers were excluded out of 3,943 measurement pairs.

Table 2-7: TDS Concentrations at Representative Monitoring Wells

GQTMP Well ID	GAMA Well ID	EC (μS/cm)	TDS (mg/L)	Date of Measurement ^b	Minimum Threshold (mg/L TDS)	Measurable Objective and Interim Milestones (mg/L TDS)	Principal Aquifer
P06	AGC10001233 1-ESJQC00006	307	196 ^a	8/5/2020	1,000	500	Outside Corcoran Clay
P07	AGC10001233 1-ESJQC00007	304	195 ^a	7/28/2021	1,000	500	Below Corcoran Clay
P08	AGC10001233 1-ESJQC00008		330	7/26/2022	1,000	500	Outside Corcoran Clay
P09	AGC10001233 1-ESJQC00009		420	7/27/2022	1,000	500	Below Corcoran Clay
P10	AGC10001233 1-ESJQC00010		970	7/25/2022	1,000	500	Below Corcoran Clay
ESJQC00019	AGC10001233 1-ESJQC00019		750	7/26/2022	1,000	500	Below Corcoran Clay
ESJQC00022	AGC10001233 1-ESJQC00022		560	7/25/2022	1,000	500	Above Corcoran Clay
ESJQC00030	AGC10001233 1-ESJQC00030	769	492 ^a	7/27/2021	1,000	500	Below Corcoran Clay
C35	CA2400172_0 01_001		362	1/22/2009	1,000	500	Above Corcoran Clay
C41	CA2400220_0 01_001			5/5/2016	1,000	500	Above Corcoran Clay
C45	CA2400089_0 01_001				1,000	500	Above Corcoran Clay
C38	CA2410004_0 11_011	420	269 ^a	6/22/2021	1,000	500	Below Corcoran Clay
C44	CA2400218_0 01_001	460	294 ^a	6/22/2021	1,000	500	Below Corcoran Clay
C40	CA2410001_0 06_006		290	3/16/2006	1,000	500	Outside Corcoran Clay
C42	CA2400046_0 02_002		320	8/11/2022	1,000	500	Outside Corcoran Clay
C43	CA2410007_0 05_005	410	262 ^a	4/5/2022	1,000	500	Outside Corcoran Clay
C46	CA2410007_0 02_002		209	1/31/1991	1,000	500	Outside Corcoran Clay
C47	CA2400194_0 01_001				1,000	500	Outside Corcoran Clay
C39	CA2400119_0 01_001				1,000	500	Outside Corcoran Clay

GQTMP Well ID	GAMA Well ID	EC (μS/cm)	TDS (mg/L)	Date of Measurement ^b	Minimum Threshold (mg/L TDS)	Measurable Objective and Interim Milestones (mg/L TDS)	Principal Aquifer
C48	CA2410011_0 05_005		220	10/18/2022	1,000	500	Outside Corcoran Clay
C49	CA2400172_0 12_012		300	12/16/2020	1,000	500	Unknown
C50	CA2400079_0 01_001	320	205 ^a	11/2/2020	1,000	500	Unknown

a. TDS concentration was estimated using the formula $TDS (mg/L) \approx EC (\mu S/cm) * 0.640$.

b. All WY 2022 data are shown. If no data for WY 2022 are available, the most recent measurement of TDS (or TDS estimated from EC) is shown.

2.7.2 Water Quality Coordination Activities

In addition to monitoring for TDS (see Section 2.7.1 - Representative Monitoring), the GSAs are conducting water quality coordination activities to address other water quality constituents. These activities include review of monitoring reports published by other monitoring programs as well as compiling data submitted by Department of Pesticide Regulation (DPR), Division of Drinking Water (DDW), and Department of Toxic Substances Control (DTSC) to the GAMA database. The purpose of these reviews is to evaluate the status of constituent concentrations throughout the Subbasin with respect to typical indicators such as applicable maximum contaminant level (MCL)³ or secondary maximum contaminant levels (SMCL)⁴.

Established in 2000, the GAMA Program monitors groundwater quality throughout California. GAMA is intended to create a comprehensive groundwater monitoring program throughout the state and increase public availability and access to groundwater quality and contamination information. Agencies submit data from monitoring wells for 244 constituents. GAMA data for the Merced Subbasin contains wells monitored or regulated by the DDW, DPR, DWR, USGS, and environmental monitoring wells monitored by regulated facilities. The GSAs have collected information from GAMA and will use this information to document regional groundwater quality and to assess whether there is a need for changes to existing sustainable management criteria or developing additional sustainable management criteria for water quality as part of the GSP 5-year update.

³ MCLs are drinking water standards that are adopted as regulations and describe the highest level of a contaminant allowed in drinking water, based on health risks and also detectability, treatability, as well as the costs of treatment.

⁴ Secondary MCLs are established by the USEPA and then adopted by the SWRCB. The secondary MCL is a Secondary Drinking Water Standard that is established for aesthetic reasons such as taste, odor, and color and is not based on public health concerns.

3. PLAN IMPLEMENTATION PROGRESS

This section of the Annual Report provides updates on Interim Milestones (Section 3.1), projects (Section 3.2), and management actions (Section 3.3), as well as other implementation support activities (Section 3.4) and anticipated upcoming activities (Section 3.5).

This Annual Report provides a snapshot of projects and management actions (PMAs) and their respective implementation status. Beginning with the publication of this Water Year 2022 Annual Report, the PMAs are also included in the Merced Integrated Regional Water Management (MercedIRWM) Opti project tracker (<https://opti.woodardcurran.com/irwm/merced/>), which, along with the GSP, is viewed by the Merced Subbasin GSAs as a “living” document. The list of PMAs maintained in the MercedIRWM Opti system will be revised periodically and reflects, at any time in the future, the list of PMAs associated with the GSP. When revised, the PMA list will be approved by the Merced Subbasin Coordination Committee or other body, as appropriate, following updating, and will be made available via the MercedIRWM Opti system. As such, the list of PMAs maintained in the MercedIRWM Opti system is considered to be the official Merced Subbasin GSP PMA list; no formal GSP adoption will be required for PMA list updating.

3.1 Interim Milestones

Interim Milestones were identified in Chapter 3 (Sustainable Management Criteria) of the GSP for all Sustainability Indicators and provided in tabular form for Groundwater Elevations and Groundwater Quality Sustainability Indicators (see Tables 3-1 and 3-2 in GSP). These Interim Milestones are anticipated to be achieved over the course of GSP implementation in increments of five years, pursuant to the CCR definition “Target values representing measurable groundwater conditions, in increments of five years, set by an Agency as part of a Plan” [CCR Title 23, Division 2, §351(q)]. Progress toward achieving Interim Milestones since submitting the original 2019 and revised 2022 GSP are provided in Sections 2.1 (Groundwater Elevations), 2.6 (Land Subsidence), and 2.7 (Groundwater Quality). Further updates are expected in the first Five Year Assessment for the Merced Subbasin GSP, with status checks provided in future annual reporting.

3.2 Implementation of Projects

Since the initial publishing of the GSP in 2020, various projects have been started, completed, and new projects have been added. The different sources of projects are described in the subsections below, after which Table 3-1 describes completed projects and Table 3-2 describes projects in progress.

Original GSP Projects

The GSP originally identified twelve priority projects. These original projects were selected for inclusion in the GSP based on their ability to address a list of priorities identified by the Stakeholder Advisory and Coordination Committee members and the public. Seven of the twelve priority projects are considered complete (see Table 3-1). Table 3-2 provides a summary of updated project information for the five ongoing priority projects since the previous annual report, as provided by project proponents.

Proposition 68 SGM Grant Program Planning Grant

The Merced Subbasin was awarded a Proposition 68 SGM Grant Program Planning Grant which was contracted with DWR in May 2020. The grant funded a GSP Development Project for Addressing Critical Data Gaps which consists of developing a Data Gaps Plan, upgrading & incorporating existing wells into

the monitoring network, installing new well(s) in critical locations, and stakeholder outreach. It also funded the development of a remote-sensing decision support tool. These projects are shown in Table 3-2 under Project Source "Proposition 68 SGM Grant Program Planning Grant".

Proposition 68 SGM Grant Program Implementation Grant

The Merced Subbasin received Proposition 68 SGM Grant Program Implementation Grant in 2021 for two projects described in Table 3-2 under Project Source "Proposition 68 SGM Grant Program Implementation Grant".

Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant

At the end of February 2022, the GSAs submitted an application and spending plan to DWR for a cumulative approximately \$13.7 million of grant funding for 18 projects and received \$7.6 million of funding for 15 of those projects. These projects are shown in Table 3-2 as Project Source "Projects Funded by the SGM Implementation Grant Round 1".

Round 2 Sustainable Groundwater Management Implementation Planning and Projects Grant

In December 2022, the GSAs submitted an application and spending plan to DWR for a cumulative approximately \$18.4 million of grant funding for 7 projects. DWR is currently in the process of reviewing and scoring applications. The grant solicitation was open to both high and medium priority groundwater basins, including critically overdrafted basins. DWR received 82 applications requesting over \$780 million in grant funds, with only \$200 million available, with the exact amount dependent upon legislative approval for the 2023/2024 State Budget Act (DWR, 2023c). The draft award list is anticipated to be released in spring 2023, with final awards made in summer 2023 and grant agreements executed in the following several months.

These projects are shown as Project Source "Projects Requesting Funding via the SGM Implementation Grant Round 2 Application" in Table 3-2.

Table 3-1: Completed Projects

Project Name	Project Update Description
Project 1: Planada Groundwater Recharge Basin Pilot Project	Cone Penetration Tests did not show favorable geologic conditions for a recharge basin; Pursuing alternative approaches to a traditional recharge basin, like installation of dry well(s). Proposed permanent monitoring well installed in September 2020. This well has been added to the Merced Subbasin's Monitoring Network.
Project 2: El Nido Groundwater Monitoring Wells	All planned well site installations have been completed. These wells have been added to the Merced Subbasin's Monitoring Network.
Project 3: Meadowbrook Water System Intertie Feasibility Study	Study completed in January 2021.
Project 5: Merced Irrigation District to Lone Tree Mutual Water Company Conveyance Canal	Completed fall 2022 and currently in operation.
Project 8: Merced Groundwater Subbasin LIDAR	Funding for this project was awarded under the Proposition 1 Round 1 IRWM Implementation Grant in 2020. LIDAR data was collected in December 2020 and will be used in conjunction with weather forecast data to predict local stormflows from rainfall events.
Project 9: Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD	The study has been completed. The GSAs received Proposition 68 Implementation Grant funding for the phase 1 portion of this work in 2021. An additional, separate phase 2 of work has been funded as part of the SGM Implementation Grant Round 1. Further, LGAWD has adopted an assessment with the intention of fully funding the remaining portion of the cost estimate, which is approximately \$25,000,000.
Project 11: Mini-Big Conveyance Project	Combined with Project 9 Study for Potential Water System Intertie Facilities from MID to LGAWD and CWD due to substantial overlap in scope.
Project 12: Streamlining Permitting for Replacing SubCorcoran Wells	The study has been completed and has been used by Merced County to support well permitting from below to above the Corcoran Clay in the Subsidence area.

Table 3-2: Description of Project Implementation Updates

Project Source	Project Name	Project Update Description
Original GSP Project	Project 4: Merquin County Water District Recharge Basin	Merquin County Water District is not currently pursuing this project.
	Project 6: Merced IRWM Region Climate Change Modeling	No update of information in 2022 revised GSP to report at this time.
	Project 7: Merced Region Water Use Efficiency Program	No update of information in 2022 revised GSP to report at this time.
	Project 10: Vander Woude Dairy Offstream Temporary Storage	This project was approved for funding in May 2022 as part of the Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant (“Vander Woude Storage Reservoir”) and reflects some minor modifications to what was initially proposed in the GSP. The project will build a 30-acre storage reservoir with a capacity of 250 AF. The project will divert flood water from Mariposa and Owens Creeks and store it for later use to meet crop demand. It’s estimated the reservoir would be filled 3 times per year for an estimated yield of 750 AFY. In addition, the project will permanently fallow 30-acres of productive farmland that has a crop demand of 150 AFY. The total project yield is 900 AFY. The Project is in the final stages of design with construction expected to begin in summer 2023.
Proposition 68 SGM Grant Program Planning Grant	Merced Subbasin GSP Development Project for Addressing Critical Data Gaps	<p>The “Addressing GSP Gaps” component has multiple sub-components:</p> <ul style="list-style-type: none"> • The Data Gaps Plan document was completed in July 2021 and provides tools to prioritize filling the data gaps and identifies implementation procedures necessary to fill such gaps. The Data Gaps Plan does not attempt to completely fill all identified gaps, but rather acts as a starting point and guidance framework for ongoing efforts to do so. • Upgrade and Incorporate Existing Wells into Monitoring Network – MIUGSA and MSGSA have identified existing candidate wells for potential incorporation into the monitoring network. The GSAs will continue to investigate, through video logs, site

Project Source	Project Name	Project Update Description
		<p>visits, and well completion reports, then instrument and incorporate the appropriate wells in the first half of 2023.</p> <ul style="list-style-type: none"> Install New Monitoring Well(s) in Critical Locations – new dual completion (2 casings) monitoring well scheduled for construction in March 2023 in southwest corner of the Subbasin. <hr/> <p>Develop Remote Sensing Decision Support Tool for Subbasin - can be used to support basin management by quantifying net groundwater use within the Merced Subbasin. Remote-sensing technology will be used to estimate monthly crop evapotranspiration (ETc) at the field scale and combined with data on surface water use to estimate groundwater use. The tool was delayed several times during WY 2022 to learn from experiences with remote sensing products from neighboring subbasins. The tool is scheduled for completion in spring 2023.</p>
Proposition 68 SGM Grant Program Implementation Grant	El Nido Conveyance System Improvements Project	Will provide conveyance improvements at four existing siphons/pipelines in MID’s El Nido Conveyance System to allow more surface water to be diverted from the Mariposa Creek to the El Nido area, an Underrepresented Community ¹ suffering from declining groundwater levels and subsidence. Survey and design work began in August 2021. Construction concluded in March 2022.
	LeGrand-Athlone Water District Intertie and Recharge Project (Phase 1)	Note that Phase 2 of the project is described in the row below. The project in its entirety will create a new surface water supply by capturing and storing floodwaters that would otherwise be lost by constructing an approximately 2-mile canal to connect MID’s Booster Lateral 3 to Dutchman Creek and construct a 10-acre groundwater recharge basin in Le Grand. Expected to begin construction in summer 2023.

¹ Underrepresented Communities are defined by the SGM Grant Program as a DAC, SDAC, or EDA; Tribal Lands/Tribes; California Communities Environmental Health Screening Tool Classified DACs (EnvDACs); and Fringe Communities.

Project Source	Project Name	Project Update Description
Projects Funded by the SGM Implementation Grant Round 1 ¹	LeGrand-Athlone Water District Intertie Canal (Phase 2)	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022. The Project is in the final stages of design and CEQA has been completed. Construction is expected to begin in spring 2024.
	Merced Subbasin Integrated Managed Aquifer Recharge Evaluation Tool (MercedMAR)	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	Vander Dussen Subsidence Priority Area Flood-MAR Project	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022. The Project is in the final stages of design with construction expected to begin in 2023.
	Vander Woude Storage Reservoir	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	Filling Data Gaps Identified in Data Gaps Plan	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	Amsterdam Water District Surface Water Conveyance and Recharge Project	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022. CEQA has been completed and the investigation is expected to be complete in 2023.
	GSP Project 31: Crocker Dam Modification	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	G Ranch Groundwater Recharge, Habitat Enhancement & Floodplain Expansion Project - Planning	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022. La Paloma Mutual Water Company has partnered with River Partners and Ducks Unlimited with initial planning activities scheduled to begin in spring 2023.
	Merquin County Water District (MCWD) Sustainable Yield Management Plan and Plan Implementation	Merquin County Water District has withdrawn this project from the grant agreement.
	Purdy Project (E. Purdy, W. Purdy, and Kevin Recharge Basins) (Project No. 38)	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.

Project Source	Project Name	Project Update Description
	Purdy Project (East Pike Recharge Basin) (Project No. 37)	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	Buchanan Hollow Mutual Water Company Floodwater Recharge Project	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022. CEQA has been completed and the investigation is expected to be complete in 2023.
	G Ranch Groundwater Recharge, Habitat Enhancement & Floodplain Expansion Project - Implementation	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	Turner Island Water District (TIWD) Water Conservation	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
	TIWD Shallow Well Drilling	Project is funded but pending initiation by project team; grant agreement executed recently in October 2022.
Projects Requesting Funding via the SGM Implementation Grant Round 2 Application	Merced Irrigation-Urban GSA Pilot, Small-Scale Recharge Projects	\$1,850,000 requested; involves investigating, designing, and implementing four types of small-scale recharge projects in collaboration with private landowners. The tasks involve environmental and permitting, siting and design, construction of pilot projects, developing a monitoring plan, and outreach and engagement.
	Lone Tree Mutual Water Company Storage and Recharge Reservoir	\$5,308,500 requested; will construct a regulating reservoir and recharge spreading ground. Tasks include environmental compliance, contract services, site preparation and construction of the reservoir and recharge grounds, monitoring, and public outreach.
	Merced Subbasin GSA Water Platform Development	\$340,000 requested; will consist of designing a platform and water accounting system including incorporating evapotranspiration data and creating a portal for landowner use. The platform will be enhanced based on user feedback.
	Merced Irrigation-Urban GSA Well Registration and Extraction Measurement Program	\$5,134,000 requested; will consist of environmental compliance and design, bidding, and construction of up to 400 flow meters and up to 400 telemetry units throughout MIUGSA. A Well Registration Portal will be developed. The Component also includes stakeholder outreach for landowners interested in installing flow meters and monitoring to identify areas of improvement.

Project Source	Project Name	Project Update Description
	La Paloma Mutual Water Company G Ranch Groundwater Recharge, Habitat Enhancement, and Floodplain Expansion – Phase II (Construction)	\$2,610,000 requested; involves constructing groundwater recharge ponds on the G Ranch property. Tasks involve contract services, construction administration, construction, monitoring, and outreach. Construction will be based on design and environmental compliance previously completed.
	La Paloma Mutual Water Company Bear Creek Ranch Groundwater Recharge, Habitat Enhancement, and Floodplain Expansion – Phase I (Planning)	\$750,000 requested; involves planning for the groundwater recharge ponds on Bear Creek Ranch. Tasks include obtaining long-term access agreements, preparing CEQA documentation, acquiring permits, preparing complete design and specifications, monitoring groundwater levels, and conducting public outreach meetings.
	Lone Tree Mutual Water Company and Sandy Mush Mutual Water Company Shallow Well Investigation and Construction in the Subsidence Area	\$2,195,000 requested; involves conducting a geotechnical investigation to determine the best locations to drill shallow monitoring and production wells, followed by obtaining access agreements and preparing environmental compliance and permitting documentation. Well drilling tasks include contract services, construction administration, and implementation. Component 8 also includes developing a monitoring plan and outreach.

Notes:

1. *Three projects from the SGM Implementation Grant Round 1 were not funded:*
 - a. *MIUGSA Groundwater Extraction Measurement Program*
 - b. *Deadman Creek Canal Off Stream Storage and Recharge*
 - c. *Tri City's Water Recharge/Underground Storage Feasibility*

3.3 Implementation of Management Actions

The July 2022 updated Merced Subbasin GSP four two Management Actions. This has not changed as of the current Annual Reporting period. The four Management Actions are:

- Management Action 1: Water Allocation Framework
- Management Action 2: MSGSA Demand Reduction Program
- Management Action 3: Domestic Well Mitigation Program
- Management Action 4: Above Corcoran Sustainable Management Criteria Adjustment Consideration

Water Allocation Framework: An Ad Hoc Coordination Committee Working Group, supported by GSA staff, was previously established to conduct discussions on an initial framework. Currently, the GSAs are working individually within their own jurisdictions to develop GSA-specific demand reduction and water allocation programs, described immediately below for MSGSA and in Section 3.4.1 for MIUGSA. A formal allocation agreement between the GSAs for the Subbasin as a whole has not been developed and is not scheduled for the upcoming water year.

MSGSA Demand Reduction Program: The MSGSA has initiated a demand reduction program in recognition of the need to reduce groundwater pumping in the subbasin. On July 8, 2021, the MSGSA Board approved Resolution 2021-01 which described an objective that by WY 2025 the consumptive use of groundwater within the MSGSA will be reduced by a minimum of 15,000 AF annually, with this minimum to be increased annually thereafter.

The MSGSA has adopted a Two Phased GSP Implementation Approach, with Phase 1 focusing on land repurposing as a near-term option to achieve the WY 2025 objective, combined with importing surface water in the GSA (flood waters or purchased water). Phase 2 will involve increasing to substantially greater reductions by 2040.

Phase 1's voluntary land repurposing program was designed and launched in WY 2022 to encourage landowner participation through the use of an incentive payment system driven by landowner applications. Multiple public presentations and outreach activities took place throughout WY 2022. Applications were accepted through November 2022 and the MSGSA approved 16 applications, totaling 2,944 acres, in December 2022, which will begin land repurposing in WY 2023. These efforts are anticipated to reduce consumptive use of groundwater by 7,263 AF.

Starting in 2026, MSGSA expects to implement an allocation approach in combination with the continued land repurposing/fallowing and imported surface water. Development and implementation of this program is still ongoing: the GSA will continue to conduct analyses, develop policies, adopt procedures, establish monitoring and reporting tools, and conduct outreach.

Domestic Well Mitigation Plan: The July 2022 Revised GSP includes this new management action that involves the planned development of a domestic well mitigation program to respond to adverse impacts experienced by domestic well users where regional overdraft conditions occurring after 2015 are causing declining groundwater levels that interfere with groundwater production or quality. In WY 2022, as part of

its Proposition 218 compliant funding mechanism for Phase 1, the MSGSA established a Domestic Well Mitigation Program Fund from which to address qualified mitigation efforts from the to-be-developed program.

Above Corcoran Sustainable Management Criteria Adjustment Consideration: The July 2022 Revised GSP includes this new management action which would consider an adjustment to the groundwater level sustainable management criteria for all or a portion of the Above Corcoran Clay Principal Aquifer. The Above Corcoran Clay Principal Aquifer has traditionally seen lower levels of use for water supply. As a result, minimum thresholds in this area are likely to be relatively high, as they are based on fall 2015 levels. A large component of the selection of fall 2015 as the minimum threshold was to limit impacts to domestic well users and to limit impacts of subsidence. Much of the Above Corcoran Clay Principal Aquifer has few domestic wells, and the Above Corcoran Clay Principal Aquifer is not thought to contribute to subsidence.

No action has been taken since July 2022 on this management action.

3.4 Additional Implementation Support Activities

Additional activities have taken place within or just after the Annual Reporting period that contribute to the overall GSP implementation progress. These are described below in Section 3.4.1, while Section 3.4.2 includes the MercedWRM update for WY 2022.

3.4.1 Other Implementation Activities

GSP Implementation Coordination: After pivoting to virtual Coordination Committee and Stakeholder Advisory Committee meetings in WY 2021, the GSAs began holding hybrid (in-person, with full virtual participation) meetings of both committees starting in March 2022. Meetings were held with an increased frequency (monthly or every other month) in the middle of WY 2022 in order to collect iterative feedback on the development of the revised GSP in response to DWR’s January 28, 2022 determination letter. Besides the primary topic of the revised GSP development, Stakeholder Advisory Committee presentation and discussion topics have also included status of projects (e.g., Data Gaps Plan), updates on the ongoing drought, and collection of feedback on grant application projects.

MIUGSA Development of Guidelines for GSP Implementation: In June 2021, MIUGSA published a Public Involvement Plan and formed a Stakeholder Guidance Committee (SGC) to “facilitate communication, provide for the dissemination of information and involvement” (MIUGSA, 2021) between the SGC and the MIUGSA Board during the implementation of the GSP. The SGC met 10/12/21, 3/9/22, and 5/4/22 in WY 2022 to provide input on draft water management actions, such as methods to monitor groundwater use, a water use accounting system for tracking water use and trading water, water allocation approaches and rules, and enforcement and penalties for overuse.

In May 2022, the MIUGSA Board adopted a groundwater allocation considered consistent with the GSP’s sustainable yield, in effect from April 2023 through December 2025, of 3.3 AF/acre over three years (1.1 AF/acre per year on average). On October 12, 2022 an agricultural well registration program was also adopted, with a goal of establishing an online platform and procedure to register all wells in the GSA prior to December 31, 2025.

MIUGSA is currently developing policies for measuring groundwater use and will be working with stakeholders to analyze and vet policies for the future use of flow meters. Policies will then be reviewed and adopted by the MIUGSA Board of Directors. Until then, initial groundwater use measurements will be made using remote sensing technology (satellite imagery). MIUGSA intends to make groundwater use measurements available to individual users within the GSA to better track and understand their water usage (MIUGSA, 2022).

3.4.2 MercedWRM Update (Water Year 2022)

The MercedWRM was originally developed and calibrated to model historical groundwater storage from water years (WY) 1996-2015, updated with WY 2015-2019 data in the 2020 annual report, and updated yearly for each following annual report. The model was updated for the current annual report to reflect more recent data. Data from WY 2022 were collected from the same public and private sources that had provided the historical data through WY 2020 used in the GSP and previous annual reports. The historical water budget was extended through WY 2022, including an updated estimate of the change in groundwater storage reflecting the latest data.

The WY 2022 continuation of the historical water budget is intended to further evaluate the aquifer system under a variety of hydrological and anthropogenic conditions. The full annual groundwater budget for WY 1996-2022 is shown earlier in Figure 2-6.

Data Sources

Data were requested and received from the following entities in the Subbasin to complete the MercedWRM update:

Agricultural and Environmental Water Purveyors

- Merced Irrigation District
- Stevinson Water District
- Merquin County Water District
- Turner Island Water District
- Lone Tree Mutual Water Company
- Merced National Wildlife Refuge

Municipal Water Purveyors

- City of Merced
- City of Atwater
- City of Livingston
- Le Grand Community Services District
- Planada Community Services District
- Winton Water and Sanitary District
- California American Water, Meadowbrook

Additional publicly available data were downloaded to complete the MercedWRM update:

State

- DWR SGMA Data Viewer
- DWR California Data Exchange Center (CDEC)

Federal

- United States Department of Agriculture, Natural Resources Conservation Service, National Agricultural Statistics Service (NRCS): CropScape
- United States Geological Survey (USGS) National Water Information System
- United States Census Bureau

Other

- Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) Climate Group, Oregon State University

Updated Components

The above data sources provided the necessary data to allow the historical model run to reflect the most recent conditions. The following components of the model were updated for the annual report.

Surface Water Diversions and Deliveries: Monthly surface water diversions and deliveries were provided for October 2021 through September 2022 by Merced Irrigation District, Turner Island Water District, Stevinson Water District, Merquin County Water District, and Lone Tree Mutual Water Company. MID

deliveries were aggregated at the subregional level for both in- and out-of-district sales, whereas the other water agencies were summarized within their boundaries.

Groundwater Pumping: Groundwater extractions from October 2021 to September 2022 were provided by all agricultural and municipal entities listed in Section 2.2. Agency pumping by MID and TIWD were simulated using measured data at each production well whereas other agencies have pumping aggregated evenly across their institutional boundaries based on aggregate reported data. Pumping estimates were made for private agriculture and domestic wells based on land use type and population.

Population: The City of Merced's population was pulled from a summary generated by the city based on California Department of Finance data. For the City of Atwater and the City of Livingston, populations were updated based on data publicly available from the US Census online database (2021 actual and 2022 estimate prepared by US Census Bureau). Rural population updates for previous model updates have typically been extracted from census block data. However, at the time of the model update these had not yet been updated based on the most recent 2020 census data, thus populations were projected based on historical trends.

Land Use: Each element within the MercedWRM is comprised of some fraction of 14 land uses, including 11 agricultural crop categories, native vegetation, riparian vegetation, and urban. For the 2022 update, the model utilizes annual data based on the NRCS CropScape program which provides data throughout the model domain on a gridded resolution of 30 meters.

Precipitation: Monthly precipitation into the Subbasin and its watersheds was derived on a four-kilometer grid using the Precipitation-Elevation Regressions on Independent Slopes Model (PRISM) dataset available online from Oregon State University through a partnership the NRCS National Water and Climate Center.

Streamflow: Monthly inflow to the Merced Subbasin was downloaded for the San Joaquin River from the USGS and from CDEC for Merced River, Bear Creek, Owens Creek, and Mariposa Creek. Chowchilla River flows were estimated based on similar months and water year types from historical USGS gauge data. Non-gauged tributaries into the Subbasin were estimated internally by the model using the Integrated Water Flow Model (IWFM) small-watershed package.

Boundary Conditions: Groundwater elevation contours were downloaded from DWR's SGMA Data Viewer for fall 2021 and spring 2022 and used to update the assumed groundwater elevation boundary conditions in the model. As groundwater level contours are only available in semiannual intervals, intermediary months were estimated through linear interpolation.

Canal Recharge: The MercedWRM estimates MID canal recharge based on historical monthly diversions and the water year index. An in-depth analysis of MID operational water budgets was developed as part of MID's 2020 Agricultural Water Management Plan (AWMP) (MID, 2021). As a result, the MercedWRM may be updated with further refined datasets in the future. SWD and TIWD have also estimated seepage from unlined canals due to their conveyance of developed supply as described in the GSP Section 6.2.

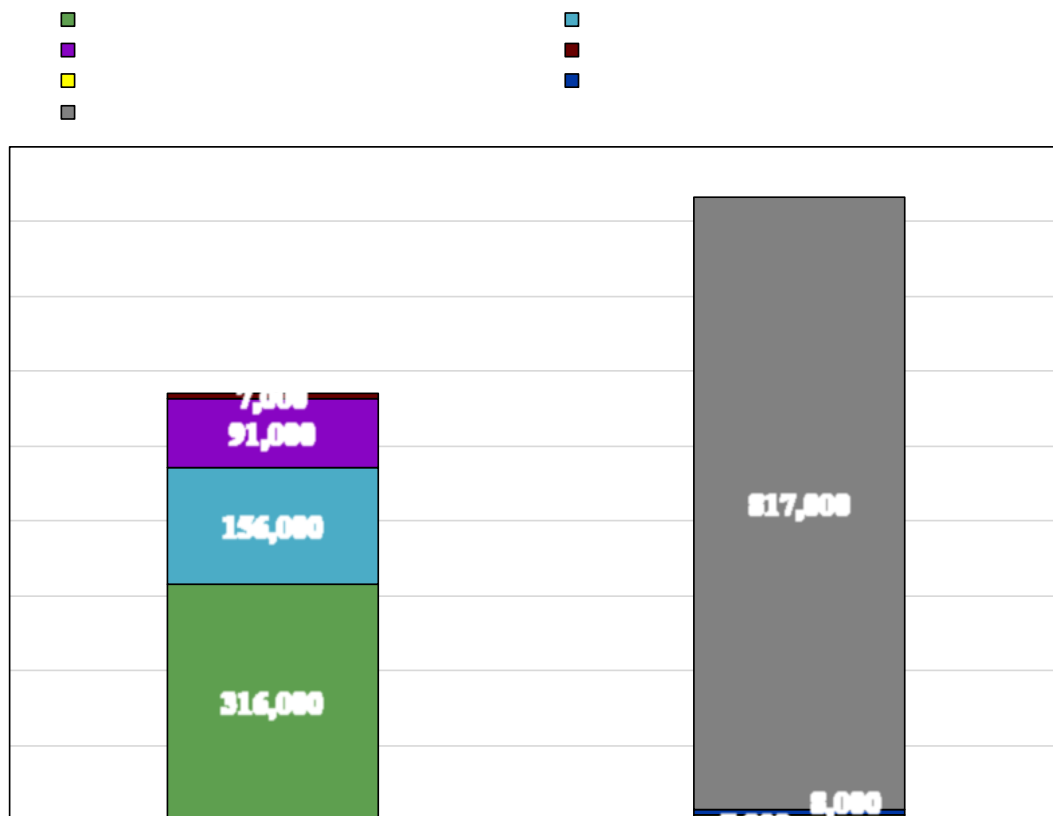
Interbasin Flows: The MercedWRM simulates groundwater flow between the Merced Subbasin and the neighboring subbasins to the north (Turlock), west (Delta-Mendota) and south (Chowchilla). The rate and direction of this interbasin subsurface flow depends on the groundwater operations and levels during the historical and projected periods on both sides of the boundary. The MercedWRM has been calibrated using limited available data for areas in the vicinity of the boundaries in neighboring subbasins. During the

development of the Merced Subbasin GSP, there was no information on the projected conditions from the neighboring subbasins. Modeling for the Merced GSP shows net flows from the Merced Subbasin to the Turlock Subbasin. All neighboring subbasins have now completed their GSP or have relatively recently completed their GSP; thus, it is expected that additional data and/or assumptions on the groundwater operations will be available from the neighboring subbasins for future updates of the model and assessments of the Merced Subbasin sustainability conditions. Interbasin coordination meetings have been held with all three surrounding subbasins, and coordination agreements have been put in place with the Turlock and Chowchilla Subbasins to facilitate such exchange of data and information. Additionally, the GSAs have received grant funding (from the Round 1 Sustainable Groundwater Management Implementation Planning and Projects Grant) for a Merced Subbasin Integrated Managed Aquifer Recharge (MAR) Evaluation Tool (“MercedMAR”) which will involve MercedWRM enhancements that update subsurface flows to/from Turlock, Delta Mendota, and Chowchilla subbasins. Work is anticipated to begin in 2023.

Results

Evaluation of WY 22 (Figure 3-1) shows that the Merced Subbasin experienced net 570,000 AF of inflows and 832,000 AF of outflow. Deep percolation from rainfall and irrigation applied water (316,000 AFY) is the largest contributor of groundwater inflow, followed by net-recharge from the stream and canal systems (247,000 AFY), and net-subsurface inflows from local subbasins and the Sierra Nevada foothills (7,000 AFY). Groundwater production (817,000 AFY) accounts for the greatest outflow from the Merced Subbasin, followed by outflow to adjacent areas (7,000 AFY) and outflow to root zone (8,000 AFY).

Figure 3-1: Annual Estimated Groundwater Budget 2022, Merced Subbasin



3.5 Activities Anticipated for the Coming Year

The Merced GSAs intend to continue activities necessary to implement the GSP and put the Subbasin on a path toward sustainable management through the activities described in the subsections below.

Project Implementation

Implementation continues for various grant-funded activities described in more detail in Section 3.2, including numerous projects to increase recharge and to improve the understanding of the groundwater system. The GSAs are currently wrapping up implementation of the portion of the Data Gaps Plan funded by the Proposition 68 SGM Grant Program Planning Grant, while ramping up new grant-funded monitoring well installation activities funded recently by the SGM Implementation Grant Round 1.

Once DWR determines which projects from the Round 2 Sustainable Groundwater Management Implementation Planning and Projects Grant will be funded (draft award expected spring 2023), the GSAs intend to coordinate with DWR to execute grant agreements and then begin associated activities as soon as grant agreements are in place.

Water Allocation & Demand Reduction

All three GSAs plan to continue making progress on internal GSA plans for pumping reductions and GSA-specific water allocation frameworks.

The MSGSA will continue developing the Demand Reduction Program, by conducting analyses, developing additional policies, adopting procedures, establishing monitoring and reporting tools, and conducting outreach. The MSGSA will focus on implementing the Two Phased GSP Implementation Approach which was adopted via resolution in November 2021. Phase 1 activities include the continued implementation of the Land Repurposing Program, making parcel based water budgets available to growers, and continued public engagement on an allocation policy to be implemented in Phase 2.

It is anticipated that MIUGSA will actively monitor and enforce the allocation and registration policies that were adopted in WY 2022, and will continue to develop and adopt additional Rules and Regulations, and various policies for implementation of the Merced GSP within MIUGSA's boundaries during WY 2023.

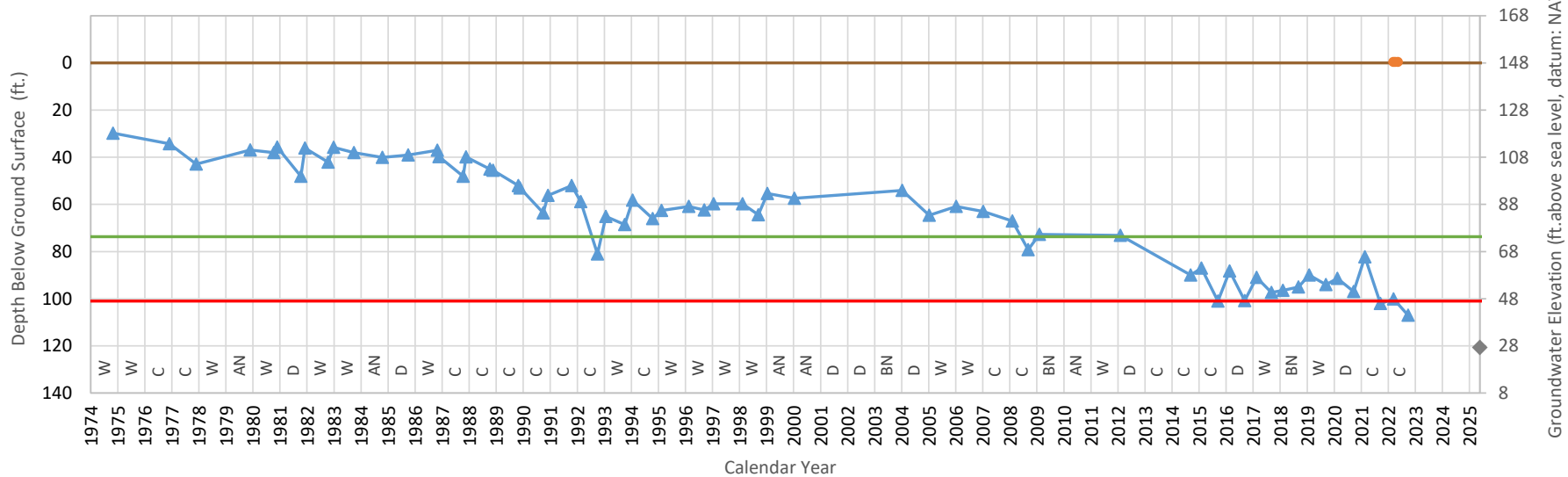
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APPENDIX A: HYDROGRAPHS

Ground Surface Elevation: 147.5 ft.
 Minimum Threshold Elevation: 46.5 ft.
 Measurable Objective Elevation: 73.8 ft.
 2025 Interim Milestone Elevation: 26.8 ft.

Hydrograph Station ID 5773 - Above CC

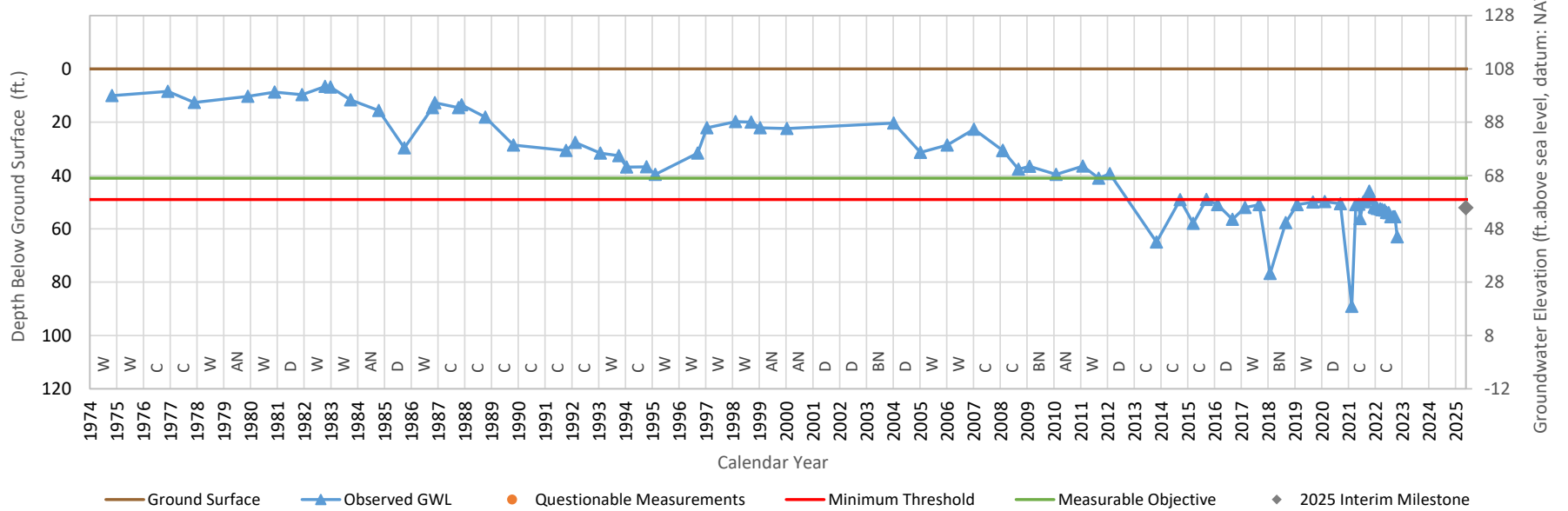


Ground Surface Observed GWL Questionable Measurements Minimum Threshold Measurable Objective 2025 Interim Milestone

Measurements with QA flags have been screened out

Ground Surface Elevation: 108.0 ft.
 Minimum Threshold Elevation: 59.0 ft.
 Measurable Objective Elevation: 67.0 ft.
 2025 Interim Milestone Elevation: 55.9 ft.

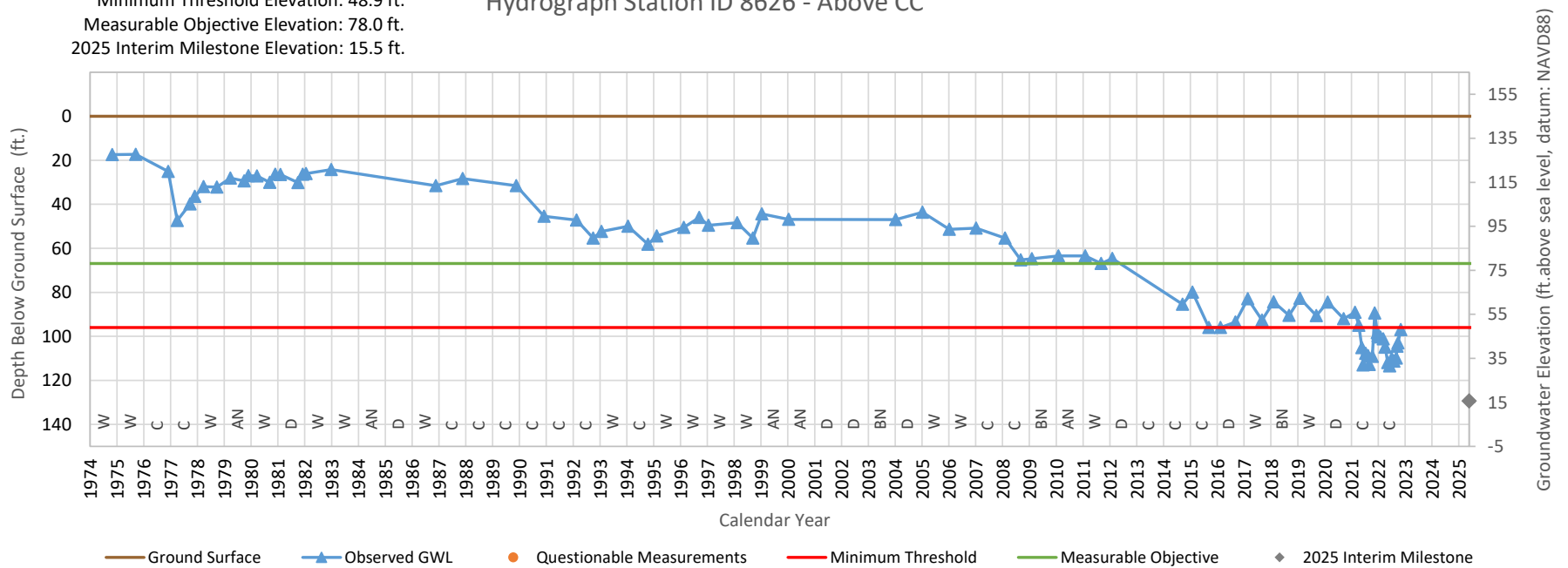
Hydrograph Station ID 8604 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 144.9 ft.
 Minimum Threshold Elevation: 48.9 ft.
 Measurable Objective Elevation: 78.0 ft.
 2025 Interim Milestone Elevation: 15.5 ft.

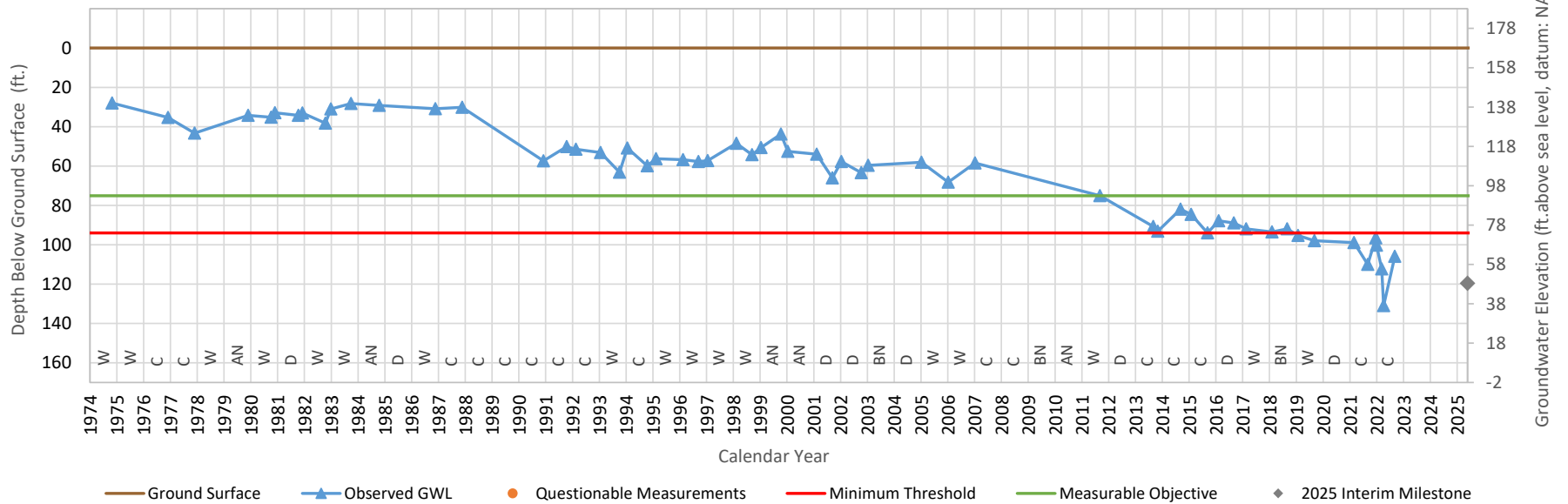
Hydrograph Station ID 8626 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 167.7 ft.
 Minimum Threshold Elevation: 73.7 ft.
 Measurable Objective Elevation: 92.6 ft.
 2025 Interim Milestone Elevation: 48.1 ft.

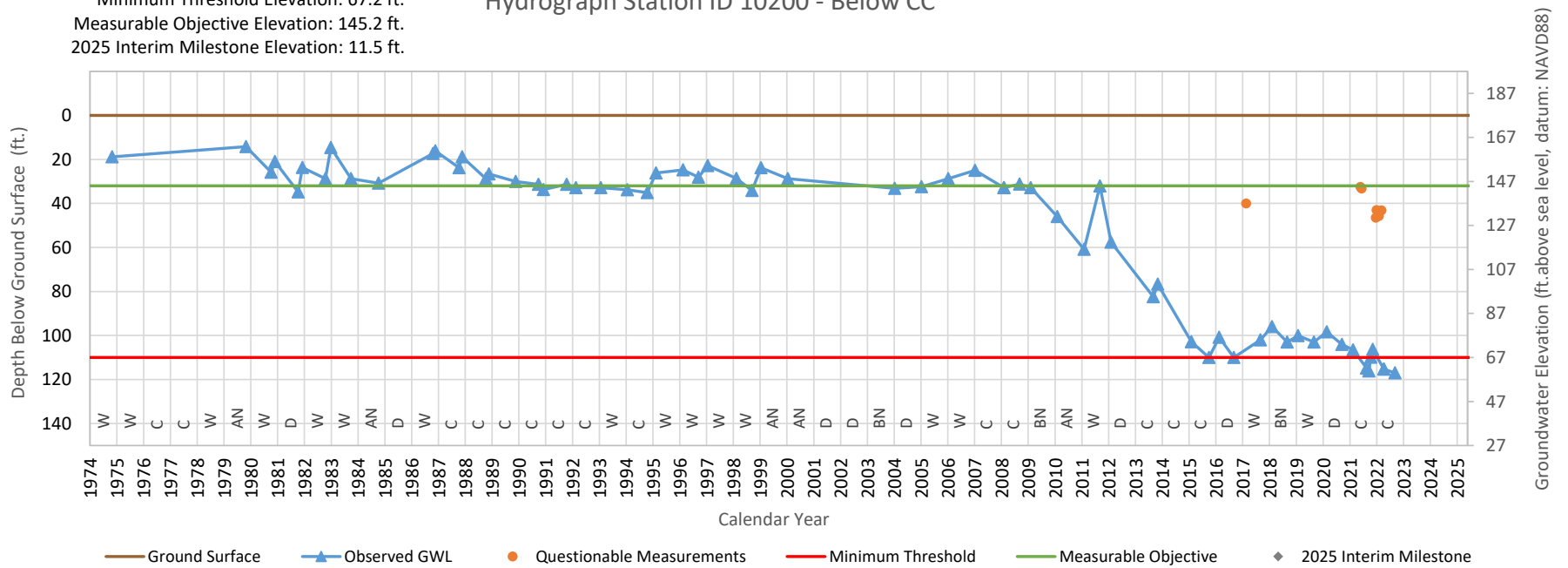
Hydrograph Station ID 10051 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 177.2 ft.
 Minimum Threshold Elevation: 67.2 ft.
 Measurable Objective Elevation: 145.2 ft.
 2025 Interim Milestone Elevation: 11.5 ft.

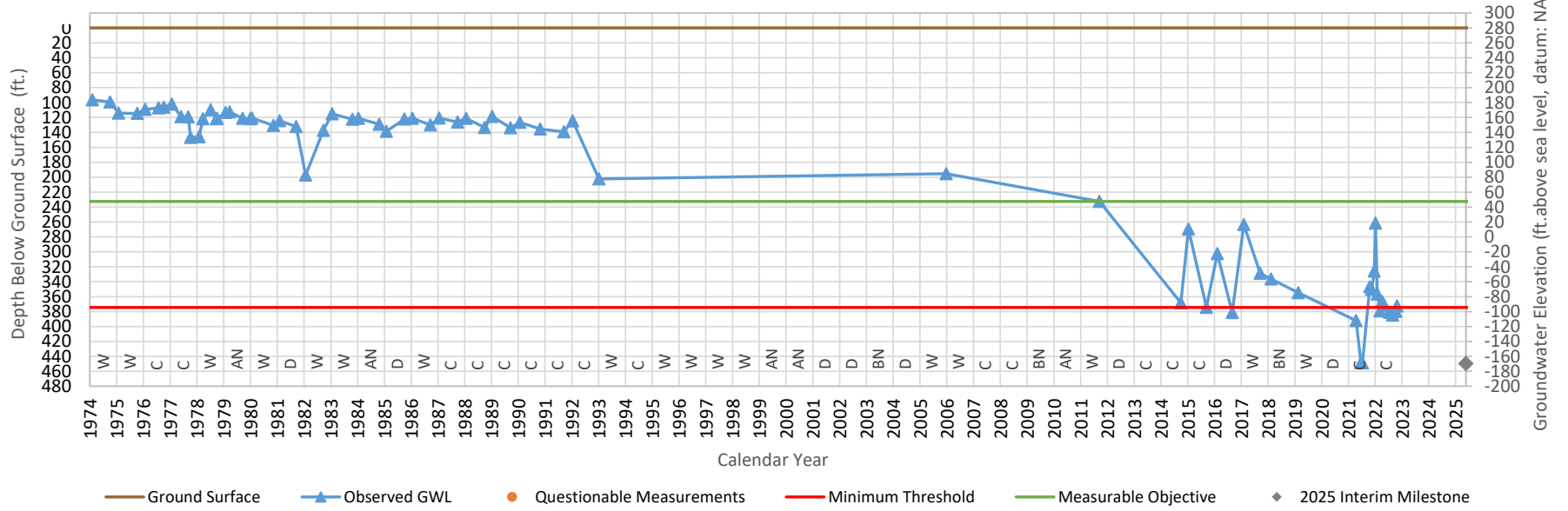
Hydrograph Station ID 10200 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 280.0 ft.
 Minimum Threshold Elevation: -94.5 ft.
 Measurable Objective Elevation: 47.5 ft.
 2025 Interim Milestone Elevation: -169.7 ft.

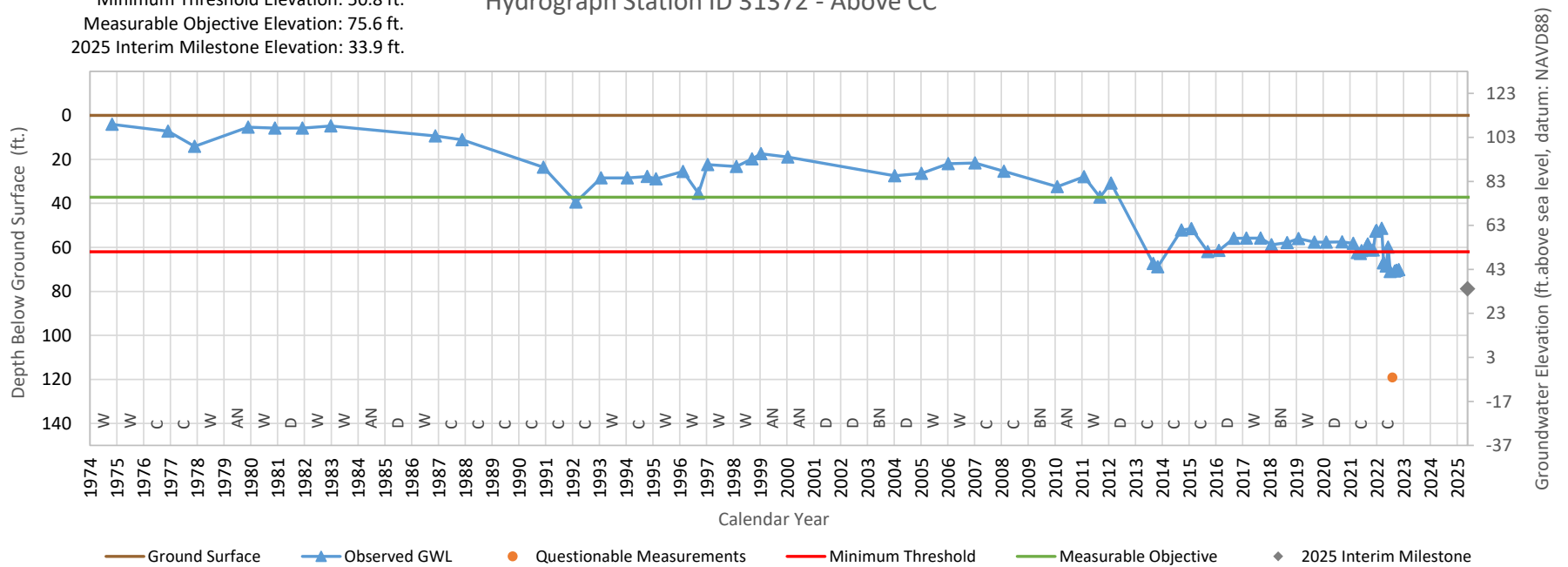
Hydrograph Station ID 28392 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 112.8 ft.
 Minimum Threshold Elevation: 50.8 ft.
 Measurable Objective Elevation: 75.6 ft.
 2025 Interim Milestone Elevation: 33.9 ft.

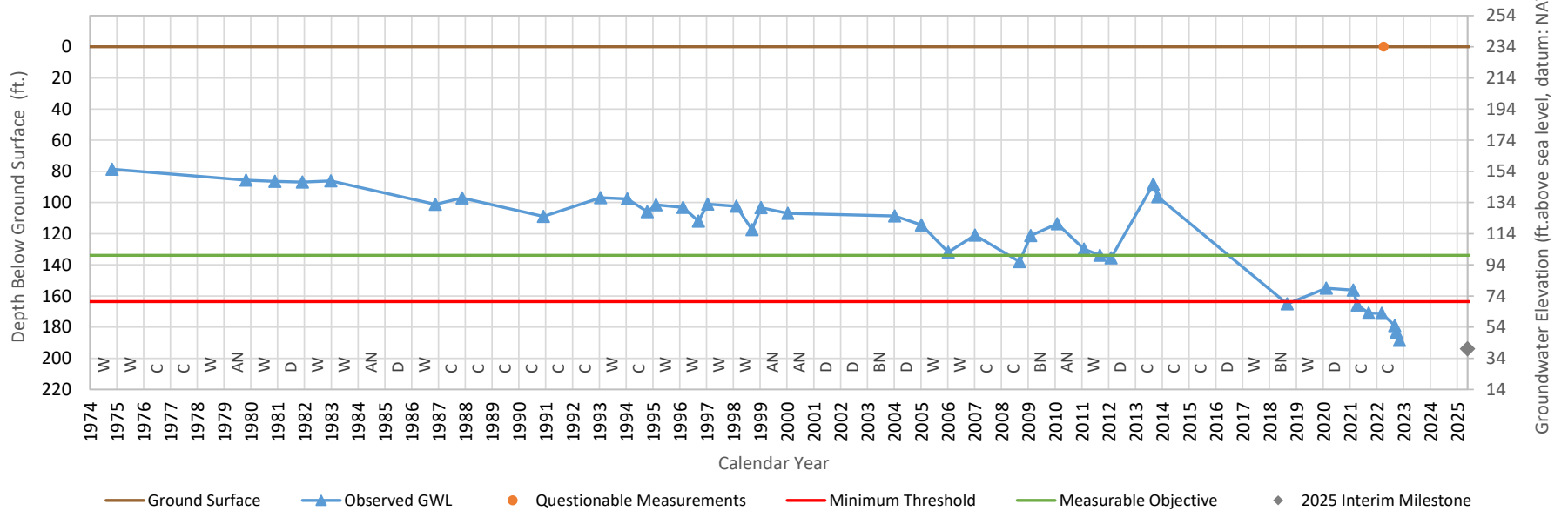
Hydrograph Station ID 31372 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 234.3 ft.
 Minimum Threshold Elevation: 70.7 ft.
 Measurable Objective Elevation: 100.4 ft.
 2025 Interim Milestone Elevation: 40.4 ft.

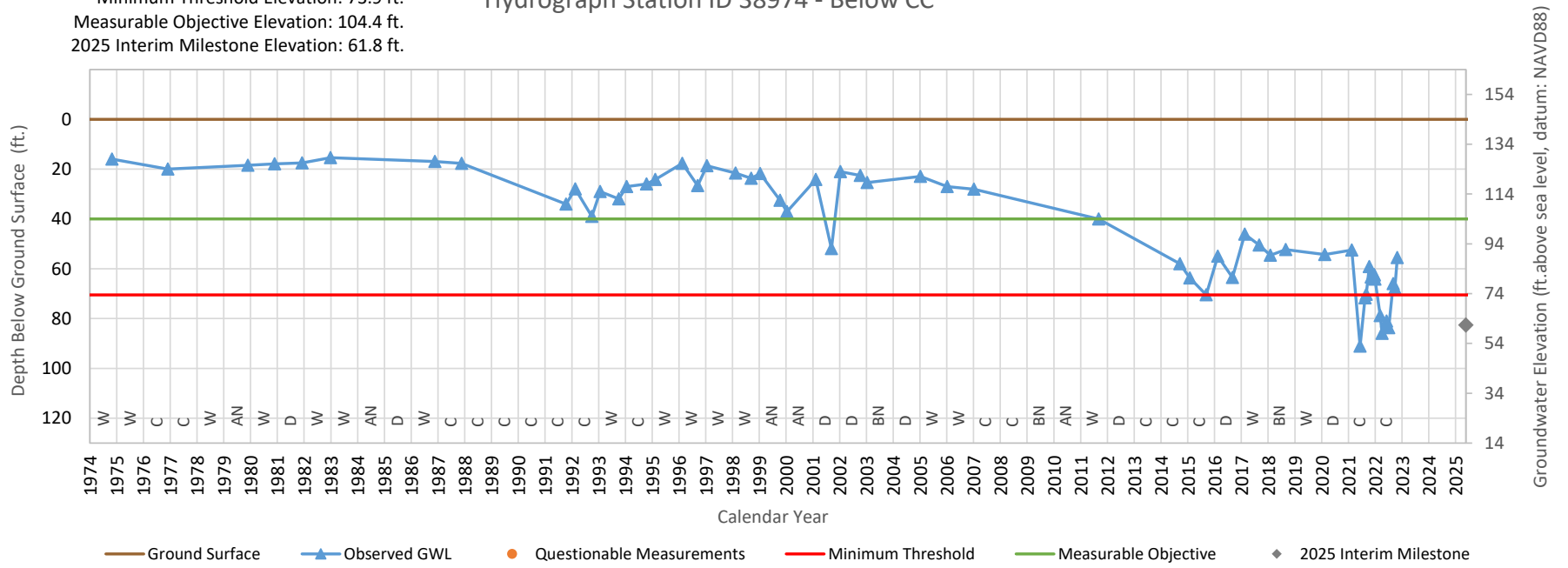
Hydrograph Station ID 38884 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 144.4 ft.
 Minimum Threshold Elevation: 73.9 ft.
 Measurable Objective Elevation: 104.4 ft.
 2025 Interim Milestone Elevation: 61.8 ft.

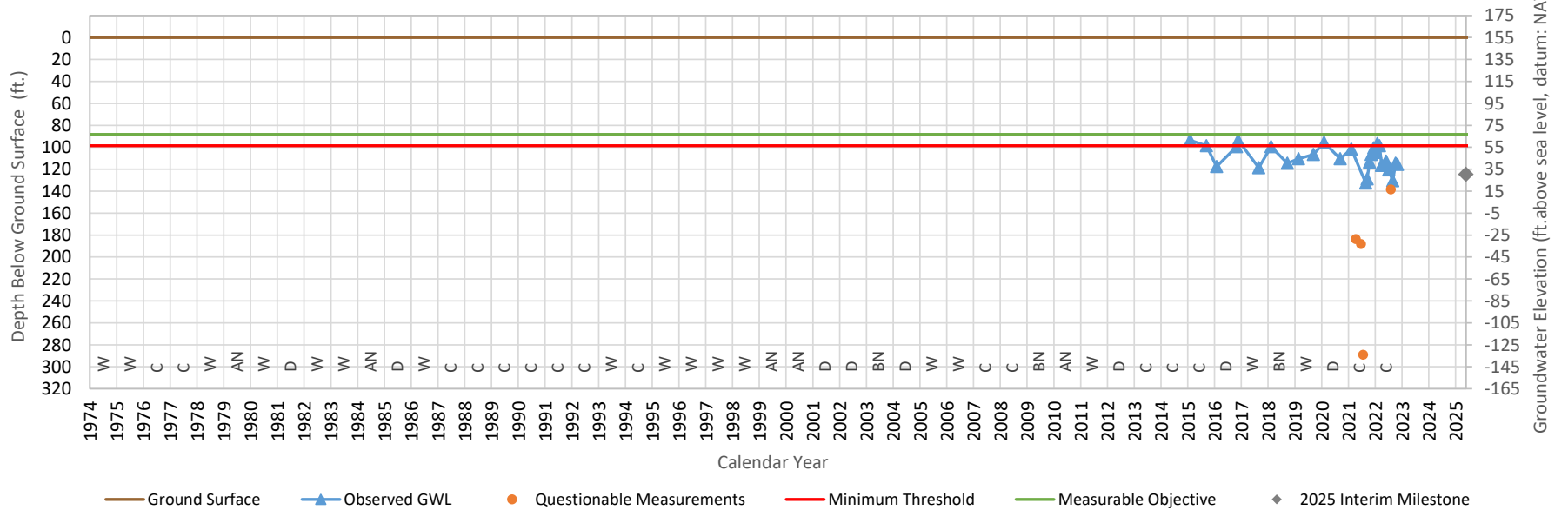
Hydrograph Station ID 38974 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 154.7 ft.
 Minimum Threshold Elevation: 56.1 ft.
 Measurable Objective Elevation: 66.4 ft.
 2025 Interim Milestone Elevation: 29.9 ft.

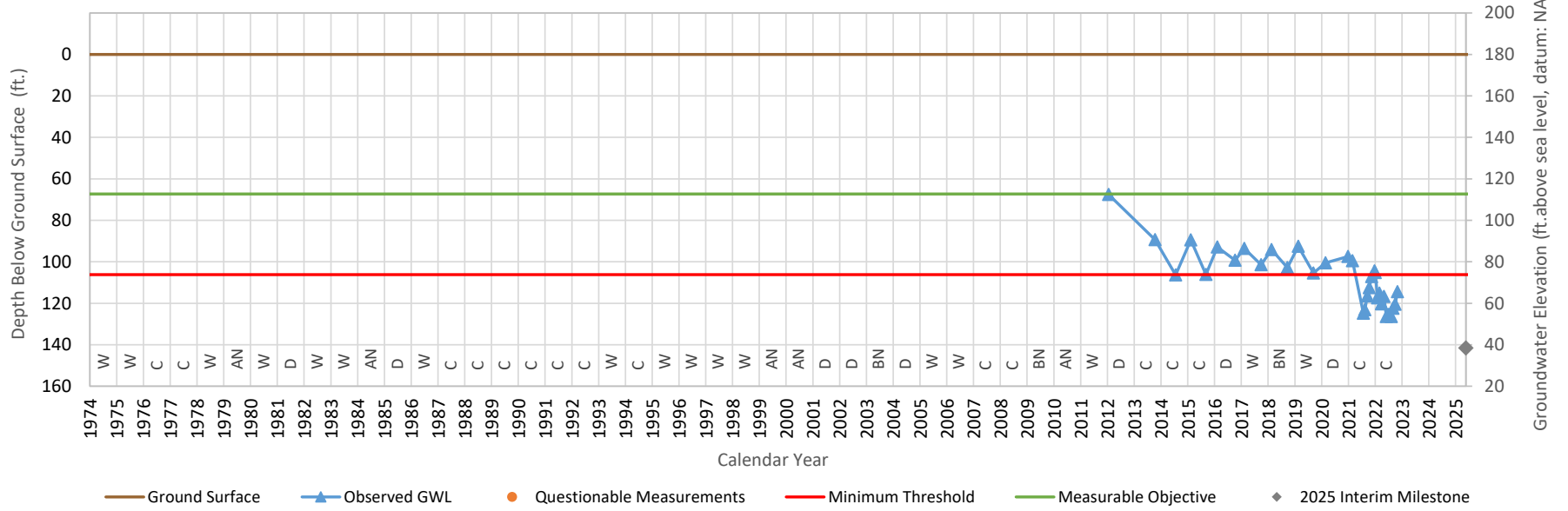
Hydrograph Station ID 47541 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 179.9 ft.
 Minimum Threshold Elevation: 73.7 ft.
 Measurable Objective Elevation: 112.6 ft.
 2025 Interim Milestone Elevation: 38.3 ft.

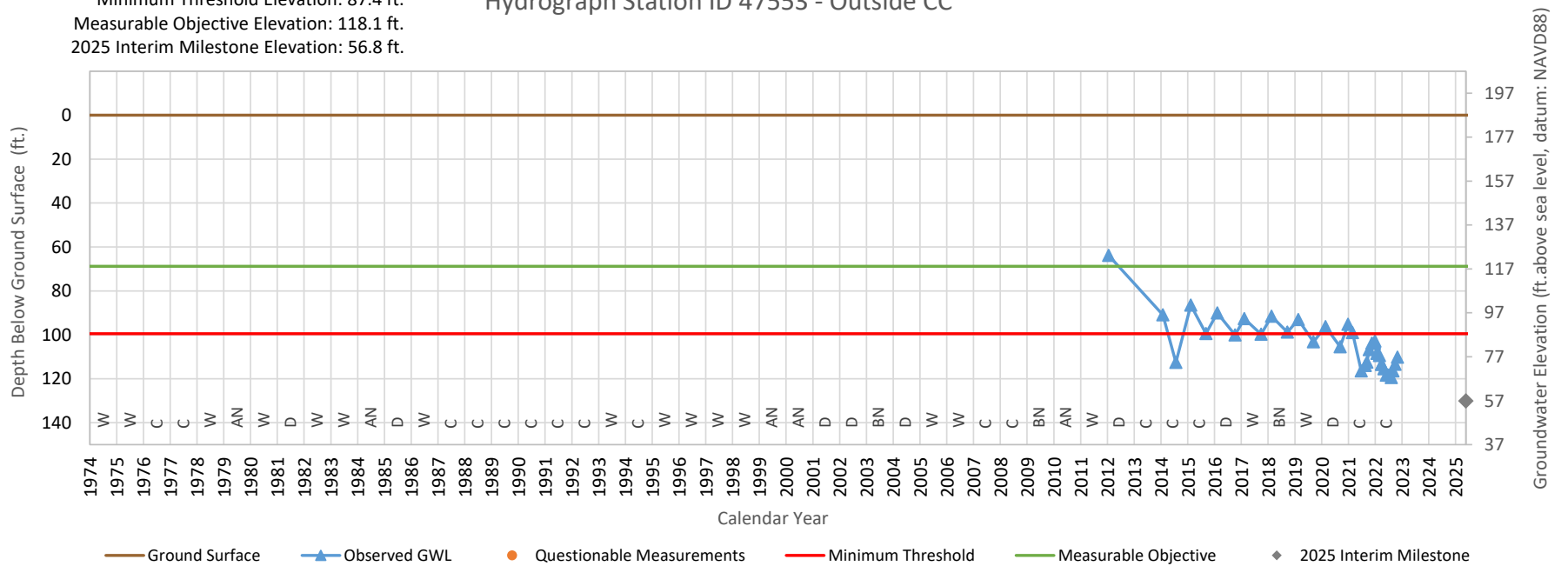
Hydrograph Station ID 47542 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 186.9 ft.
 Minimum Threshold Elevation: 87.4 ft.
 Measurable Objective Elevation: 118.1 ft.
 2025 Interim Milestone Elevation: 56.8 ft.

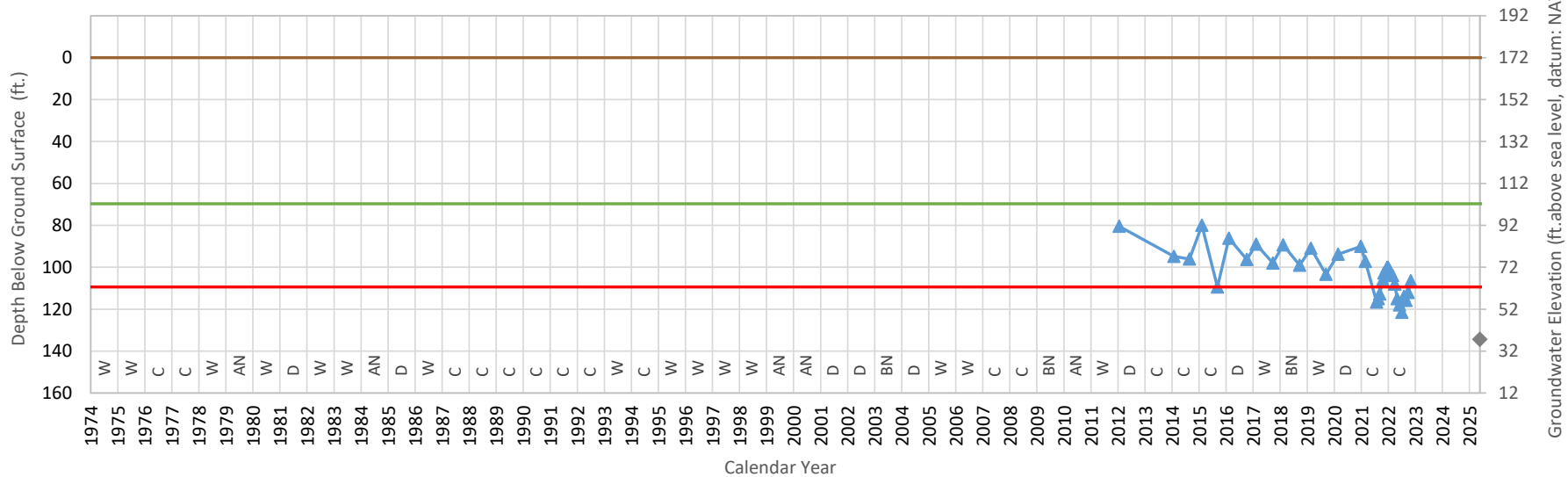
Hydrograph Station ID 47553 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 171.8 ft.
 Minimum Threshold Elevation: 62.4 ft.
 Measurable Objective Elevation: 102.1 ft.
 2025 Interim Milestone Elevation: 37.4 ft.

Hydrograph Station ID 47557 - Outside CC

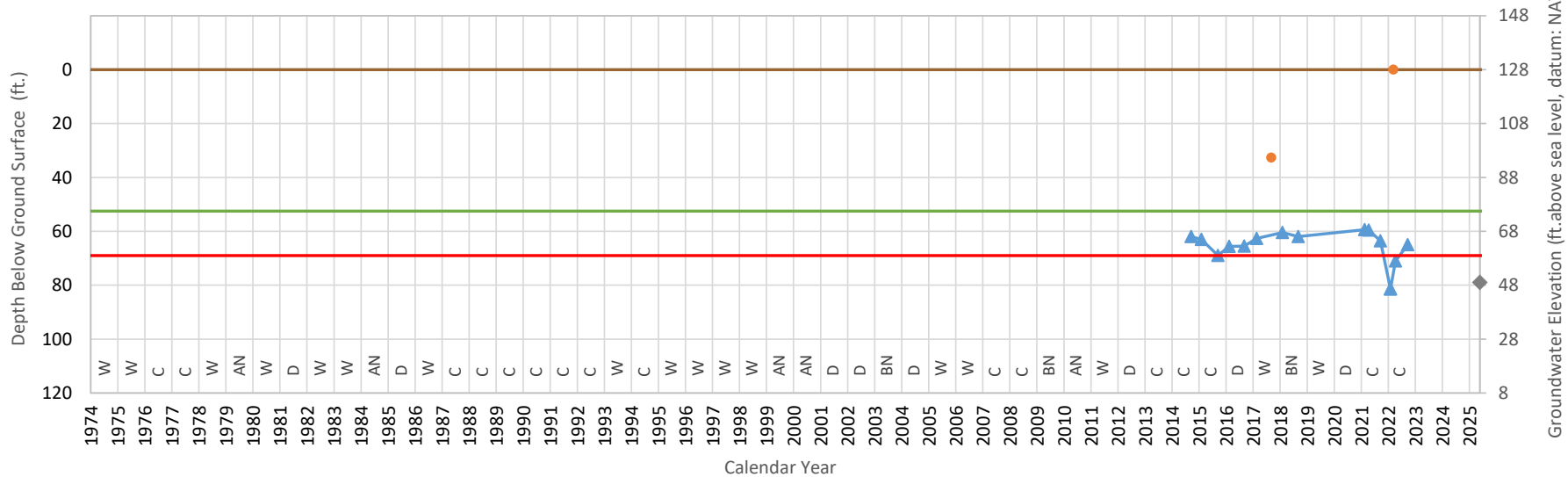


— Ground Surface
 ▲ Observed GWL
 ● Questionable Measurements
 — Minimum Threshold
 — Measurable Objective
 ◆ 2025 Interim Milestone

Measurements with QA flags have been screened out

Ground Surface Elevation: 127.8 ft.
 Minimum Threshold Elevation: 58.8 ft.
 Measurable Objective Elevation: 75.3 ft.
 2025 Interim Milestone Elevation: 48.8 ft.

Hydrograph Station ID 47562 - Below CC

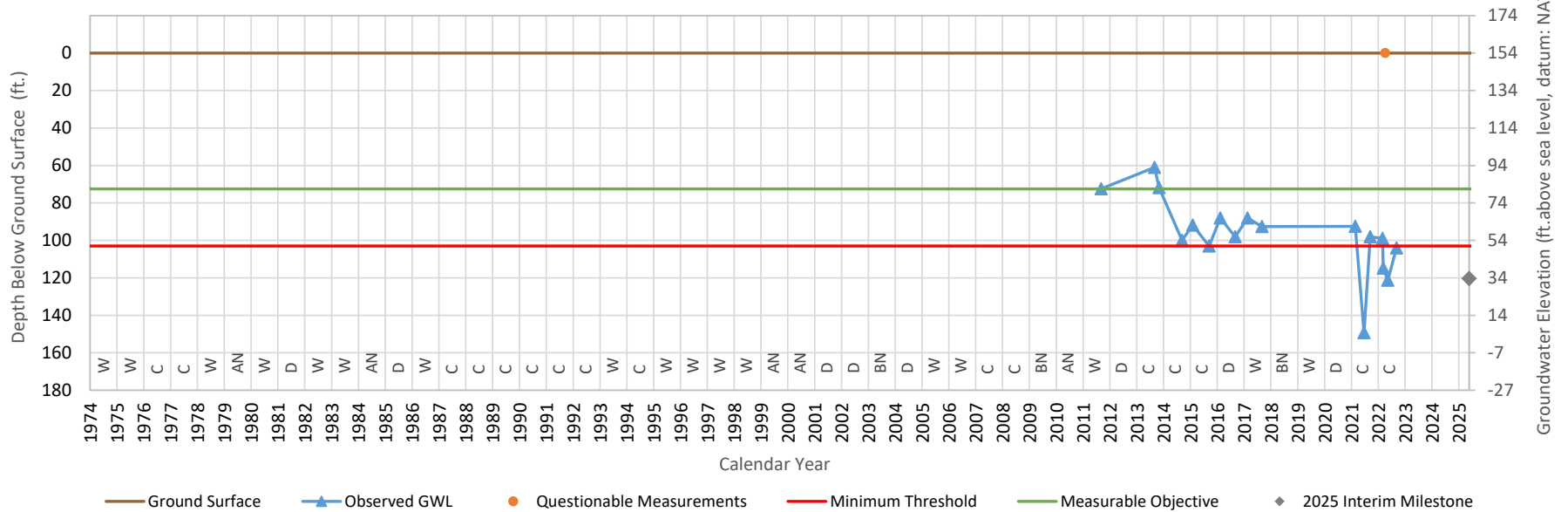


— Ground Surface
 ▲ Observed GWL
 ● Questionable Measurements
 — Minimum Threshold
 — Measurable Objective
 ◆ 2025 Interim Milestone

Measurements with QA flags have been screened out

Ground Surface Elevation: 153.5 ft.
 Minimum Threshold Elevation: 50.5 ft.
 Measurable Objective Elevation: 81.0 ft.
 2025 Interim Milestone Elevation: 33.1 ft.

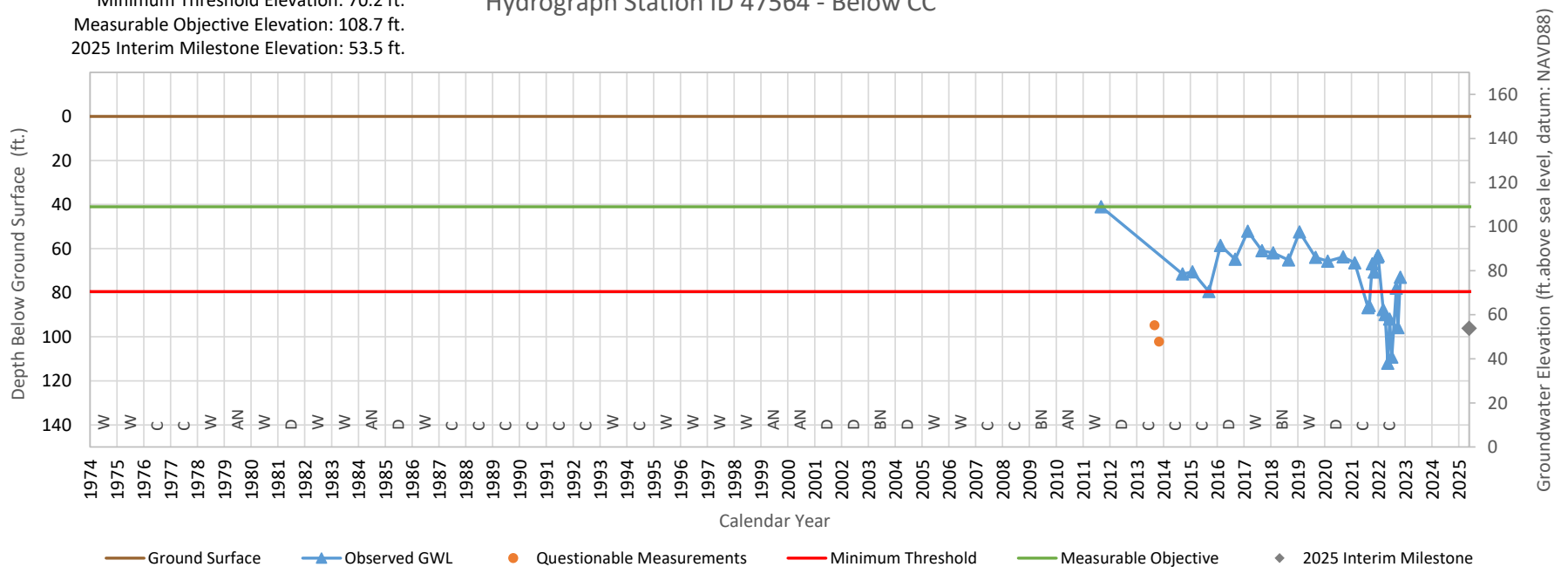
Hydrograph Station ID 47563 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 149.7 ft.
 Minimum Threshold Elevation: 70.2 ft.
 Measurable Objective Elevation: 108.7 ft.
 2025 Interim Milestone Elevation: 53.5 ft.

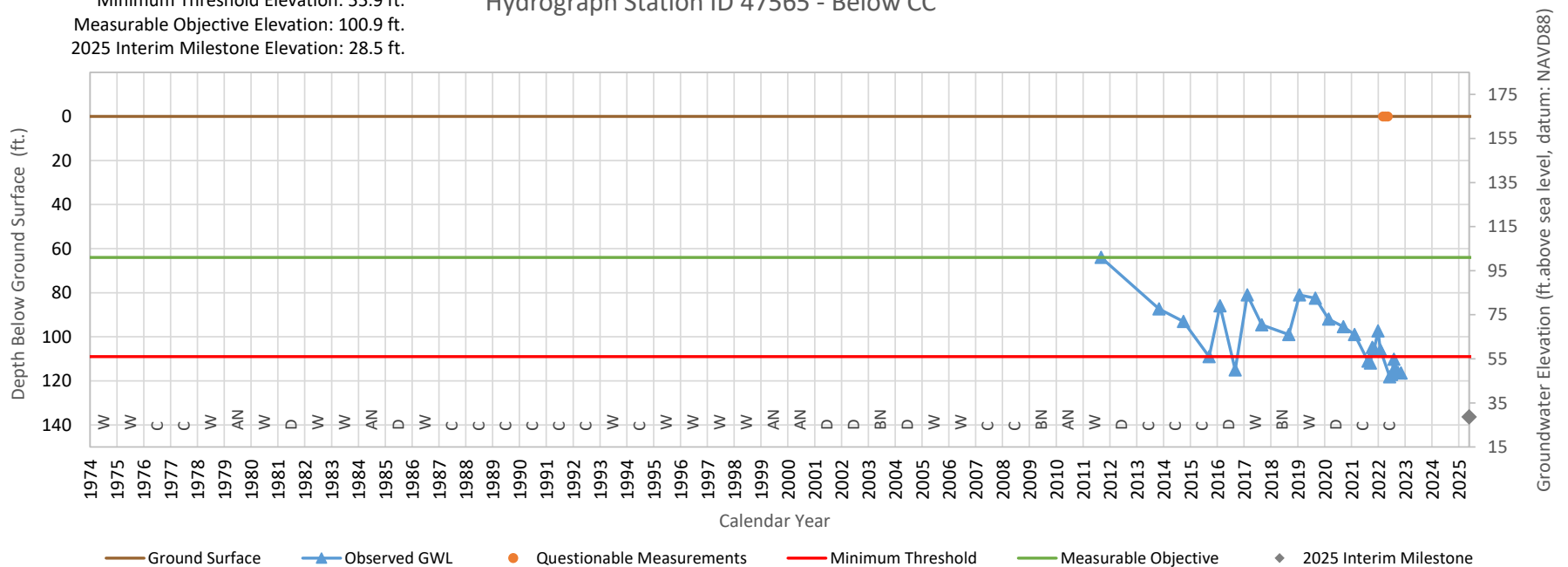
Hydrograph Station ID 47564 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 164.9 ft.
 Minimum Threshold Elevation: 55.9 ft.
 Measurable Objective Elevation: 100.9 ft.
 2025 Interim Milestone Elevation: 28.5 ft.

Hydrograph Station ID 47565 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 77.0 ft.
 Minimum Threshold Elevation: 61.2 ft.
 Measurable Objective Elevation: 68.2 ft.
 2025 Interim Milestone Elevation: 59.4 ft.

Hydrograph Station ID 47569 - Above CC

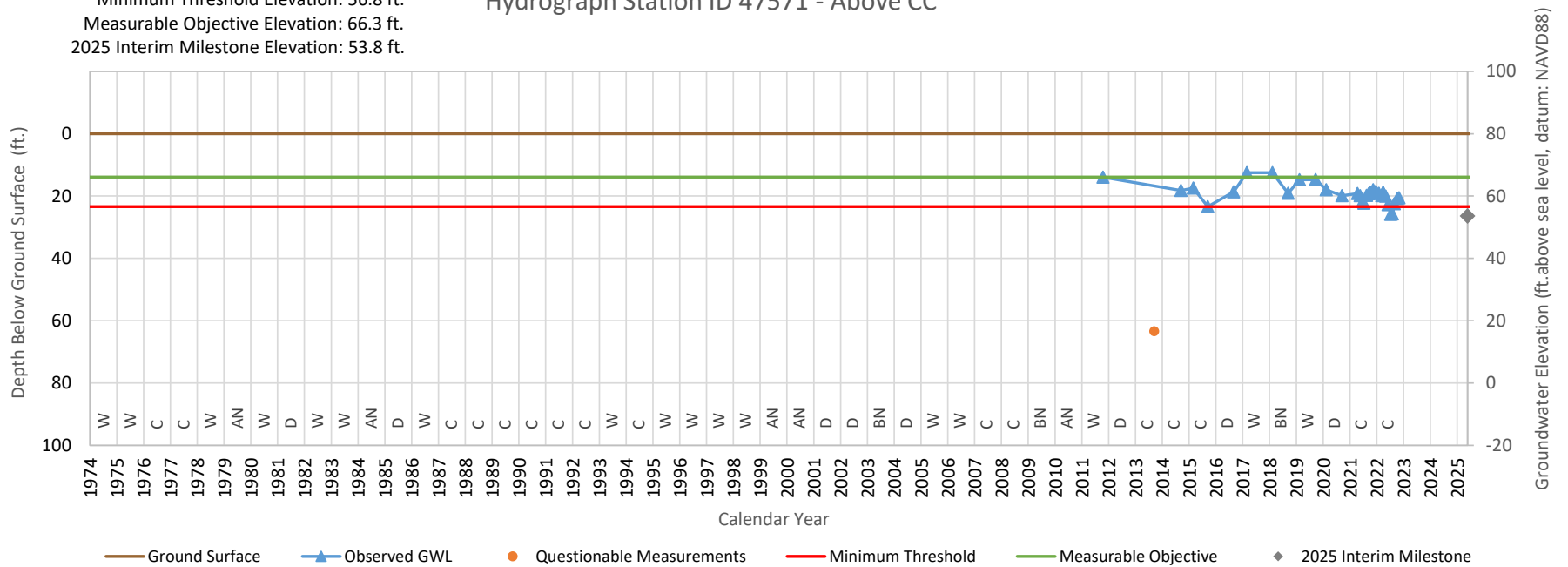


— Ground Surface
 ▲ Observed GWL
 ● Questionable Measurements
 — Minimum Threshold
 — Measurable Objective
 ◆ 2025 Interim Milestone

Measurements with QA flags have been screened out

Ground Surface Elevation: 80.2 ft.
 Minimum Threshold Elevation: 56.8 ft.
 Measurable Objective Elevation: 66.3 ft.
 2025 Interim Milestone Elevation: 53.8 ft.

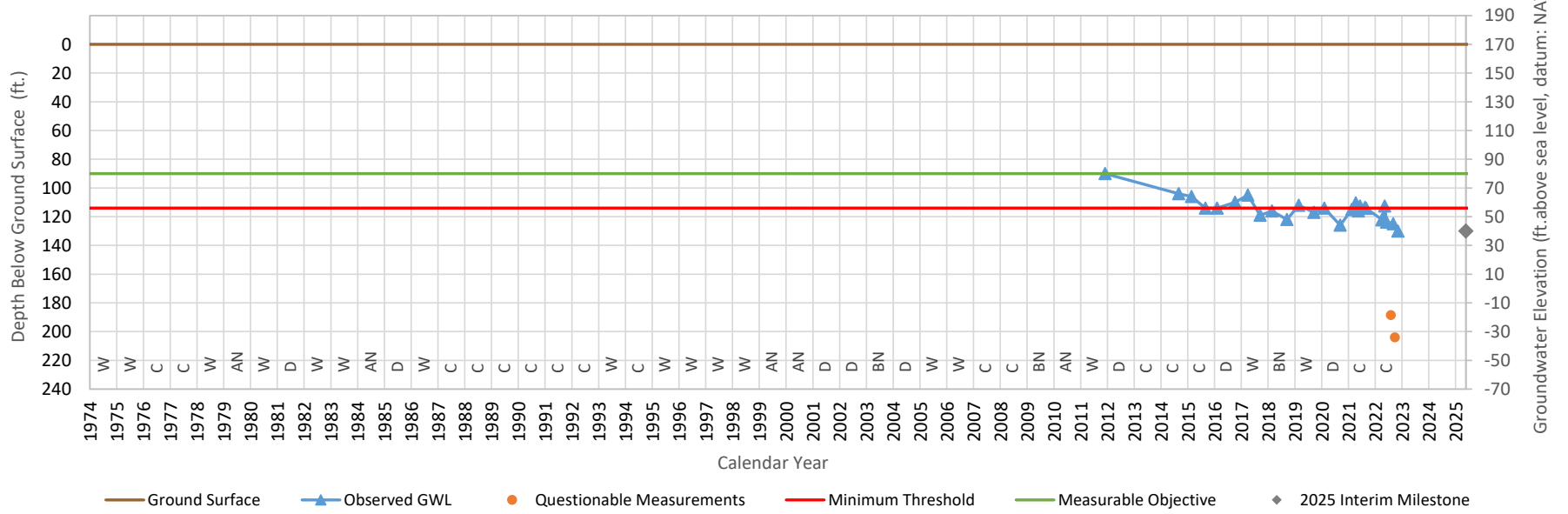
Hydrograph Station ID 47571 - Above CC



Measurements with QA flags have been screened out

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 Minimum Threshold Elevation: 56.0 ft.
 Measurable Objective Elevation: 80.0 ft.
 2025 Interim Milestone Elevation: 40.0 ft.

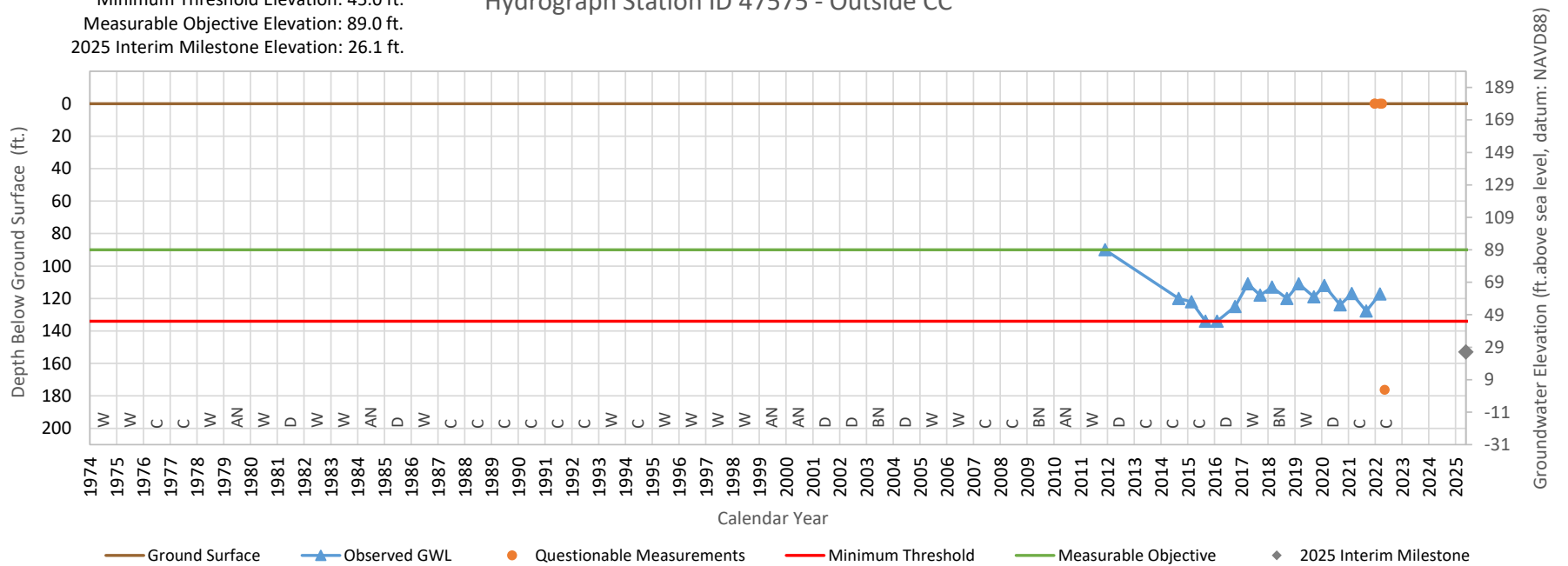
Hydrograph Station ID 47574 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 179.0 ft.
 Minimum Threshold Elevation: 45.0 ft.
 Measurable Objective Elevation: 89.0 ft.
 2025 Interim Milestone Elevation: 26.1 ft.

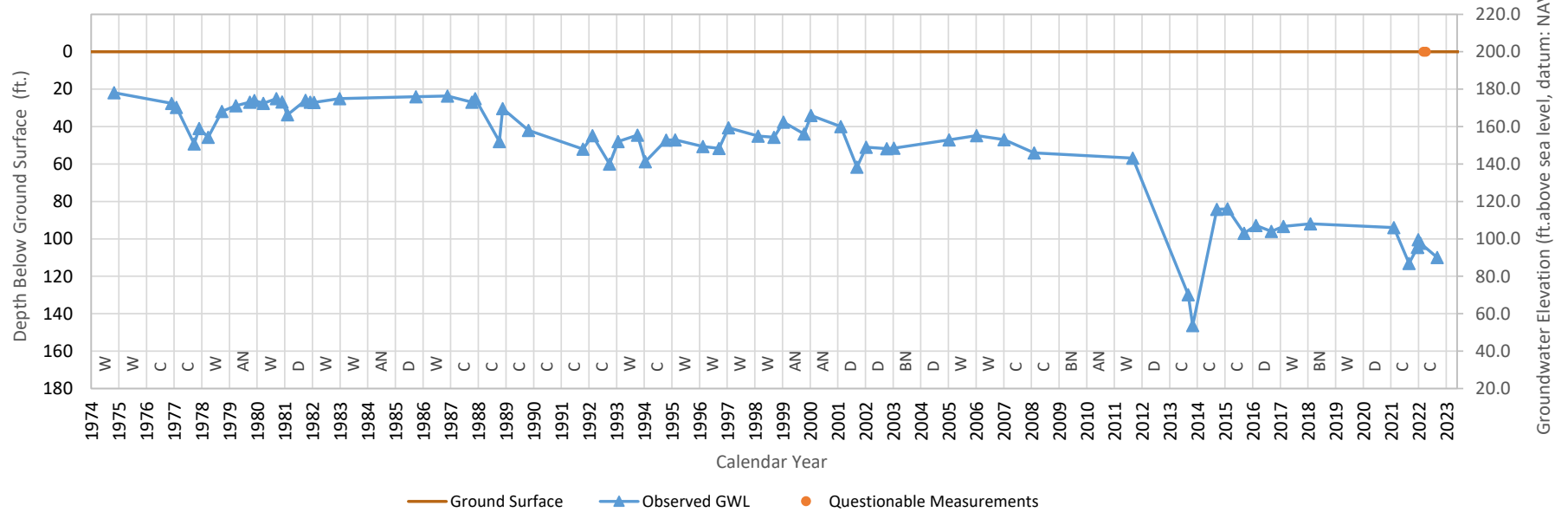
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Measurements with QA flags have been screened out

Ground Surface Elevation: 202.3 ft.

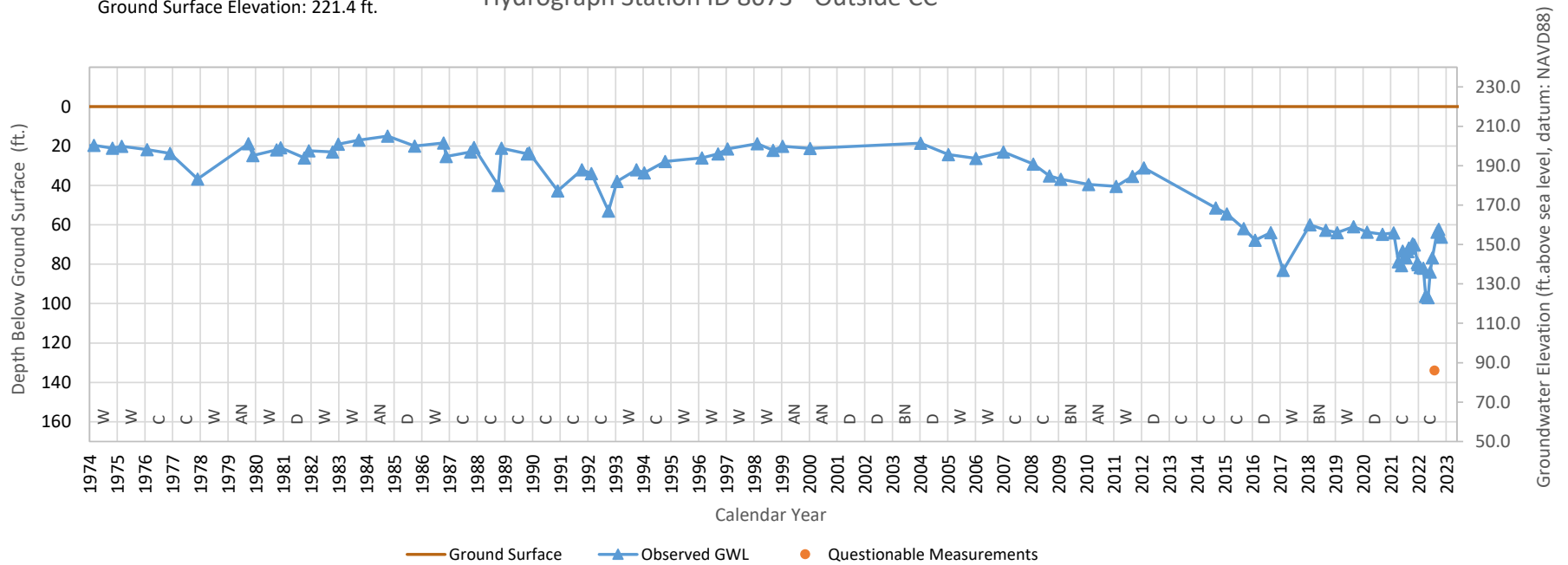
Hydrograph Station ID 7955 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 221.4 ft.

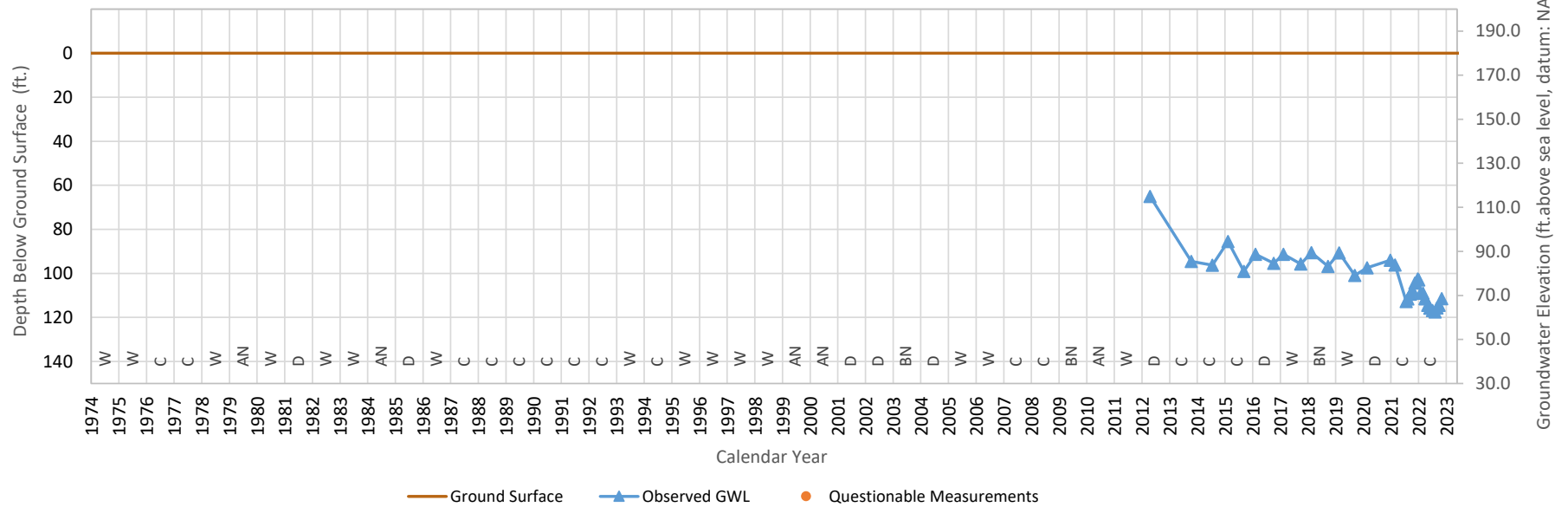
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Measurements with QA flags have been screened out

Ground Surface Elevation: 179.9 ft.

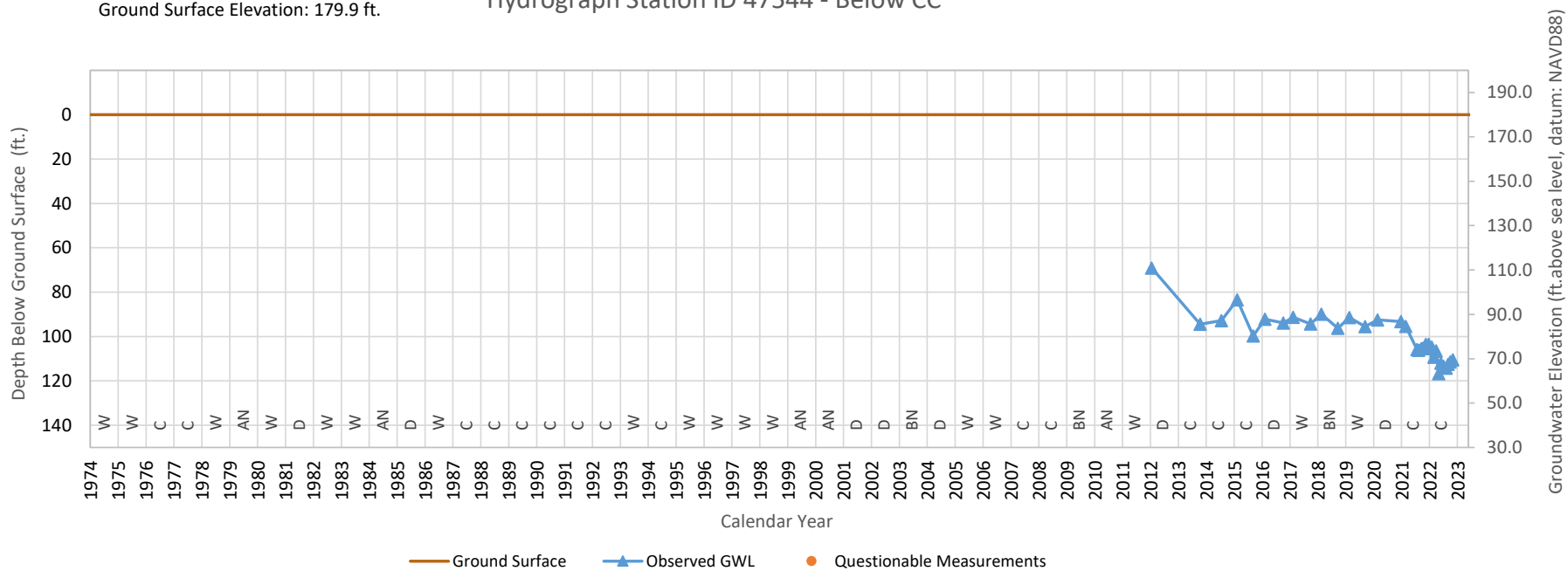
Hydrograph Station ID 47543 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 179.9 ft.

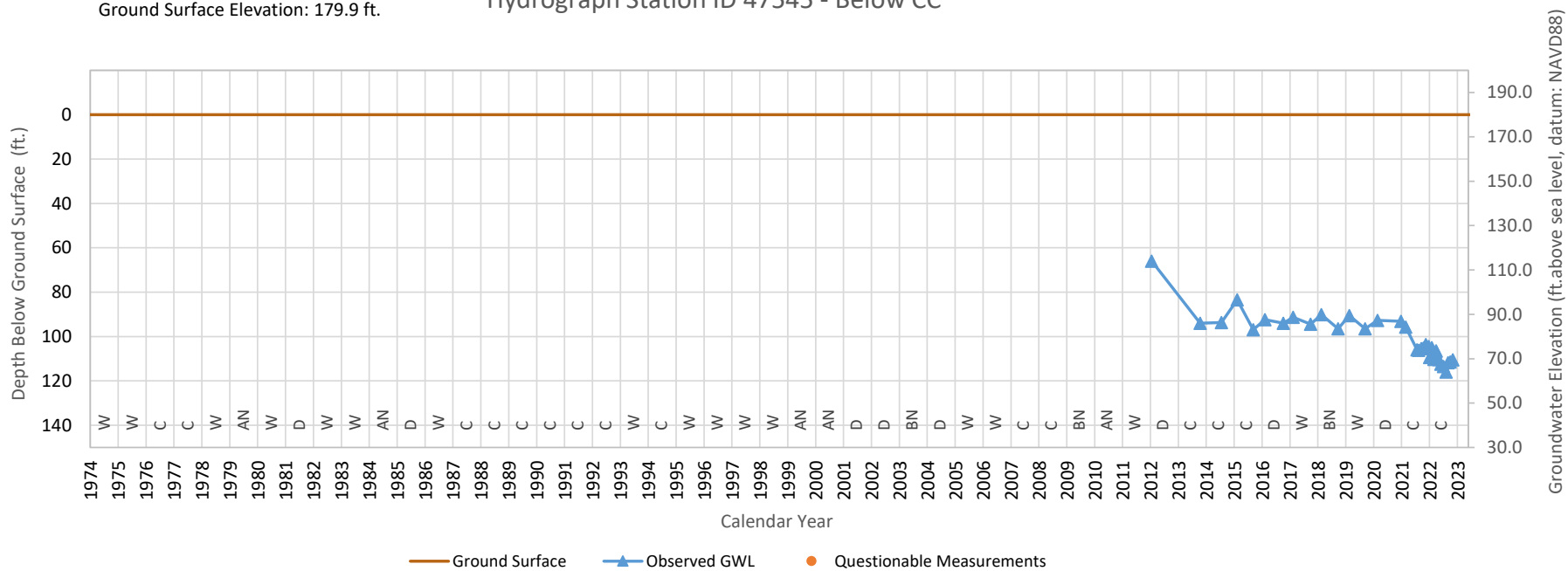
Hydrograph Station ID 47544 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 179.9 ft.

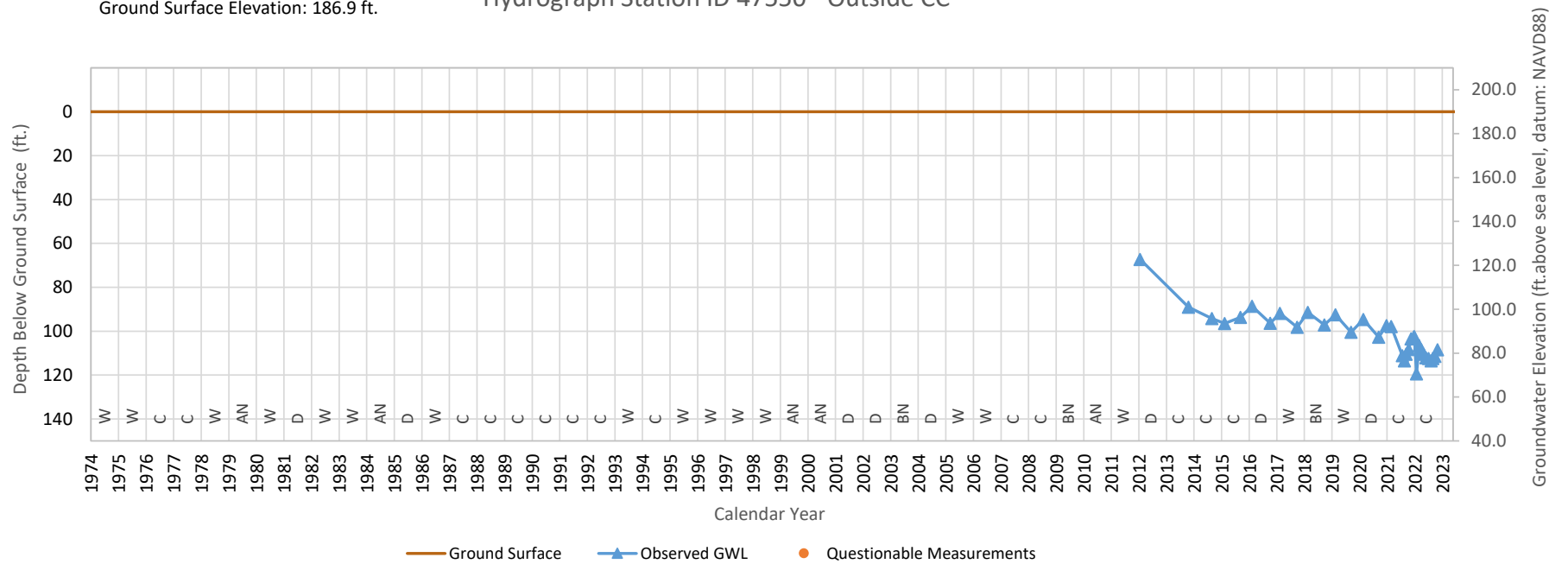
Hydrograph Station ID 47545 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 186.9 ft.

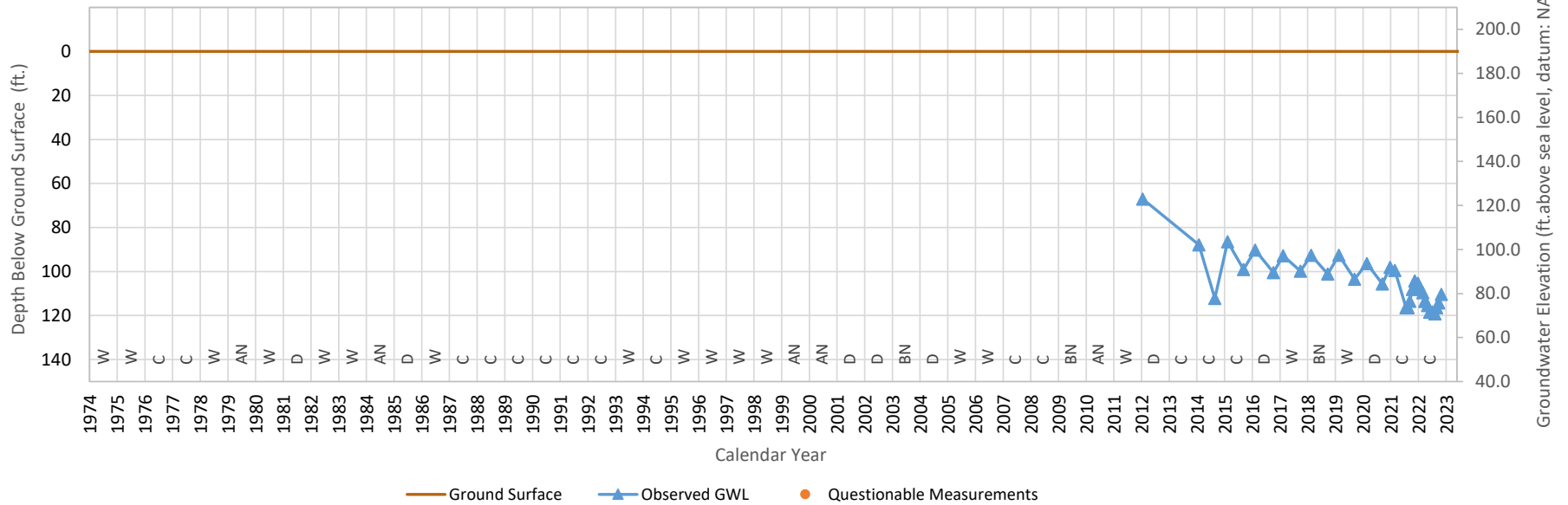
Hydrograph Station ID 47550 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 186.9 ft.

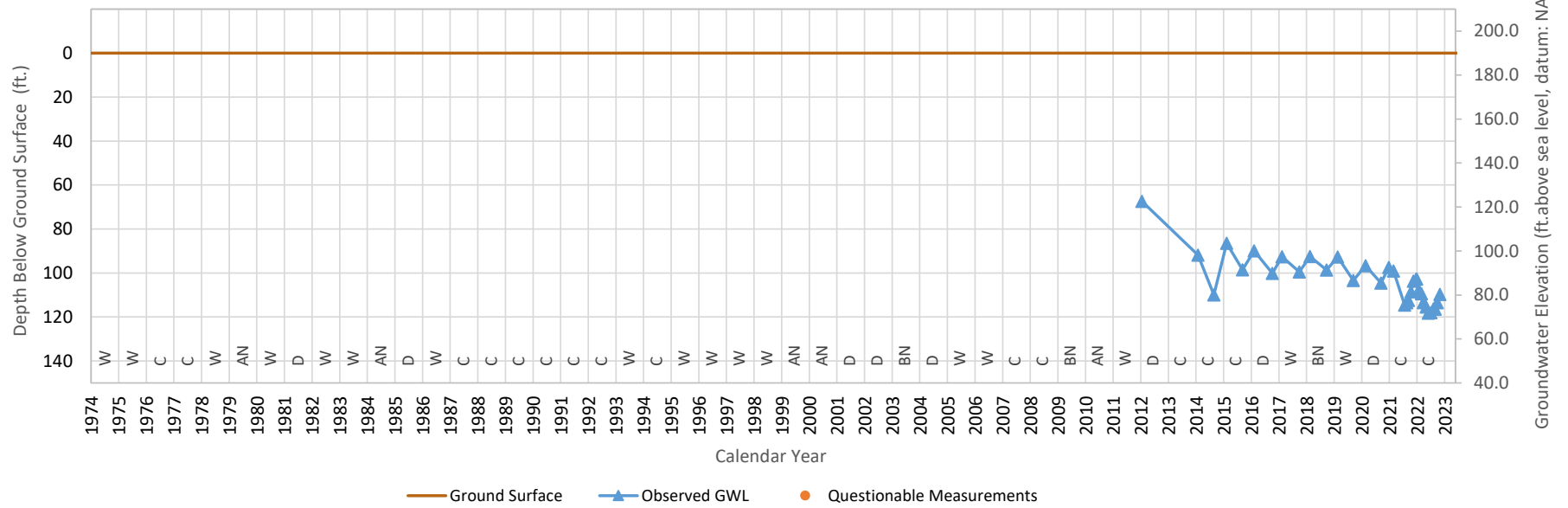
Hydrograph Station ID 47551 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 186.9 ft.

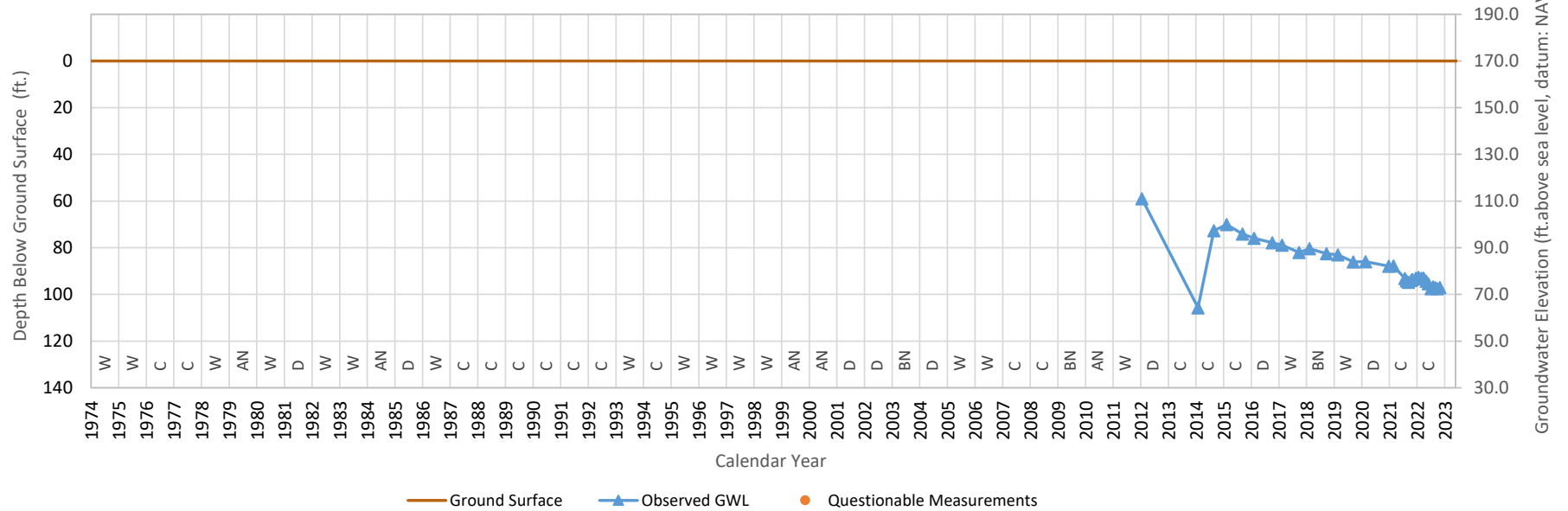
Hydrograph Station ID 47552 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 171.8 ft.

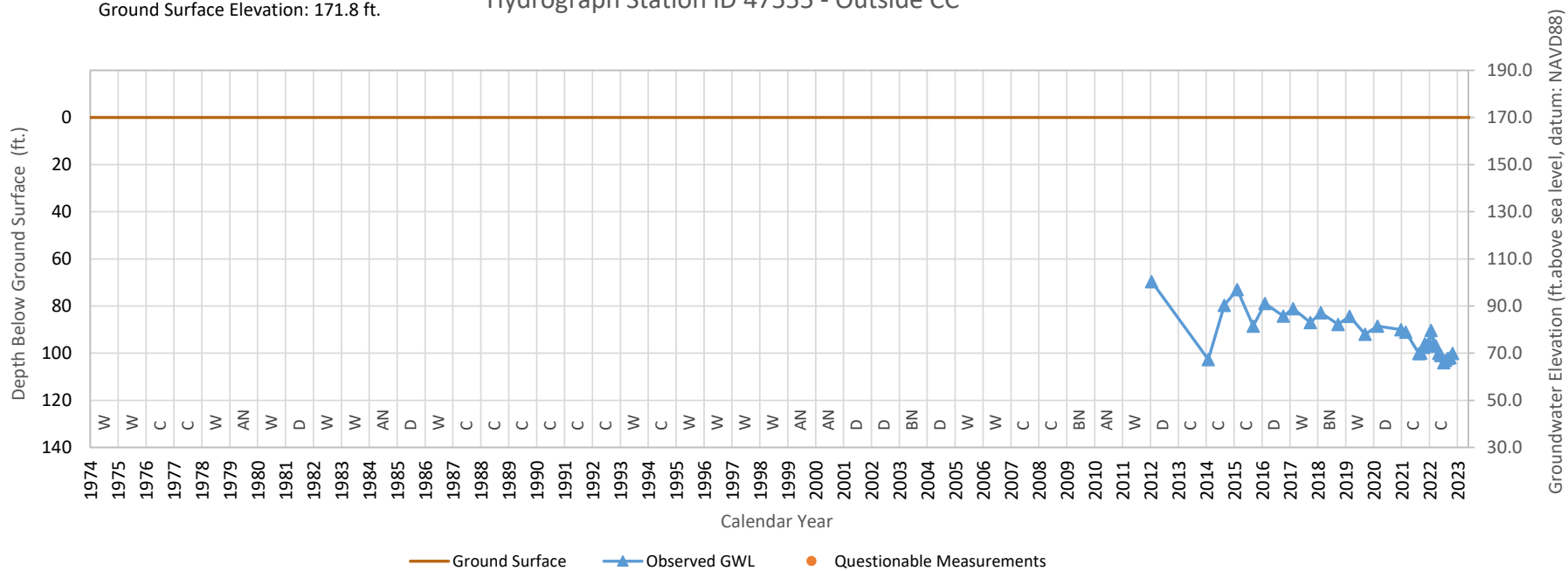
Hydrograph Station ID 47554 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 171.8 ft.

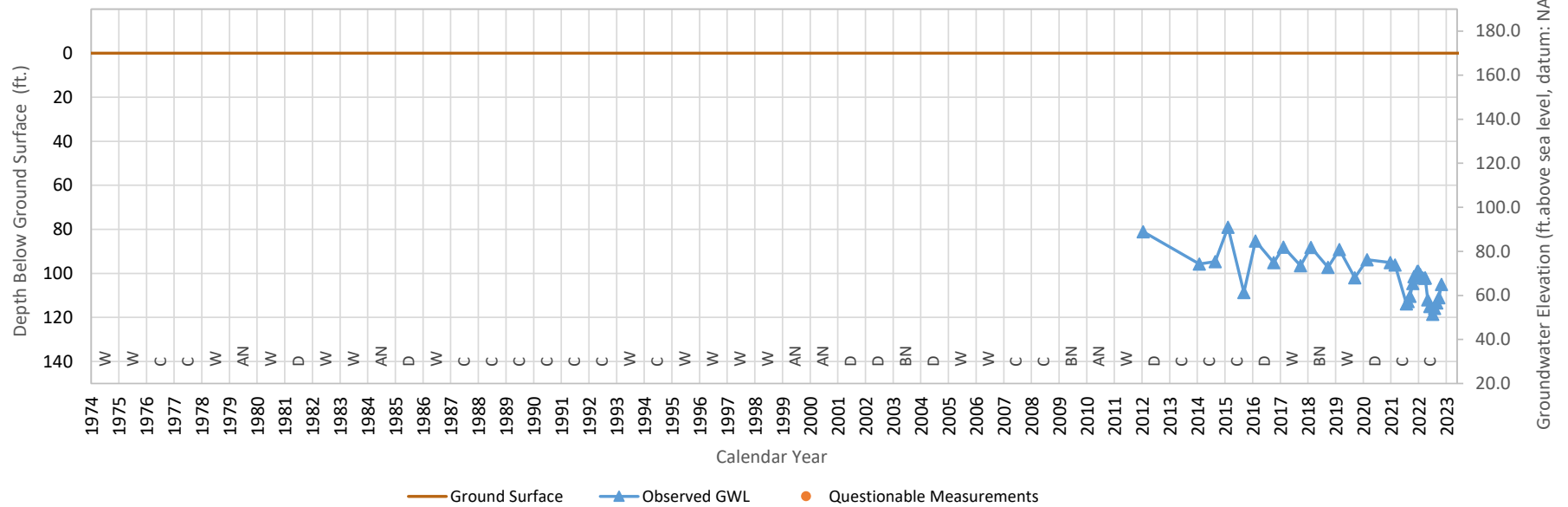
Hydrograph Station ID 47555 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 171.8 ft.

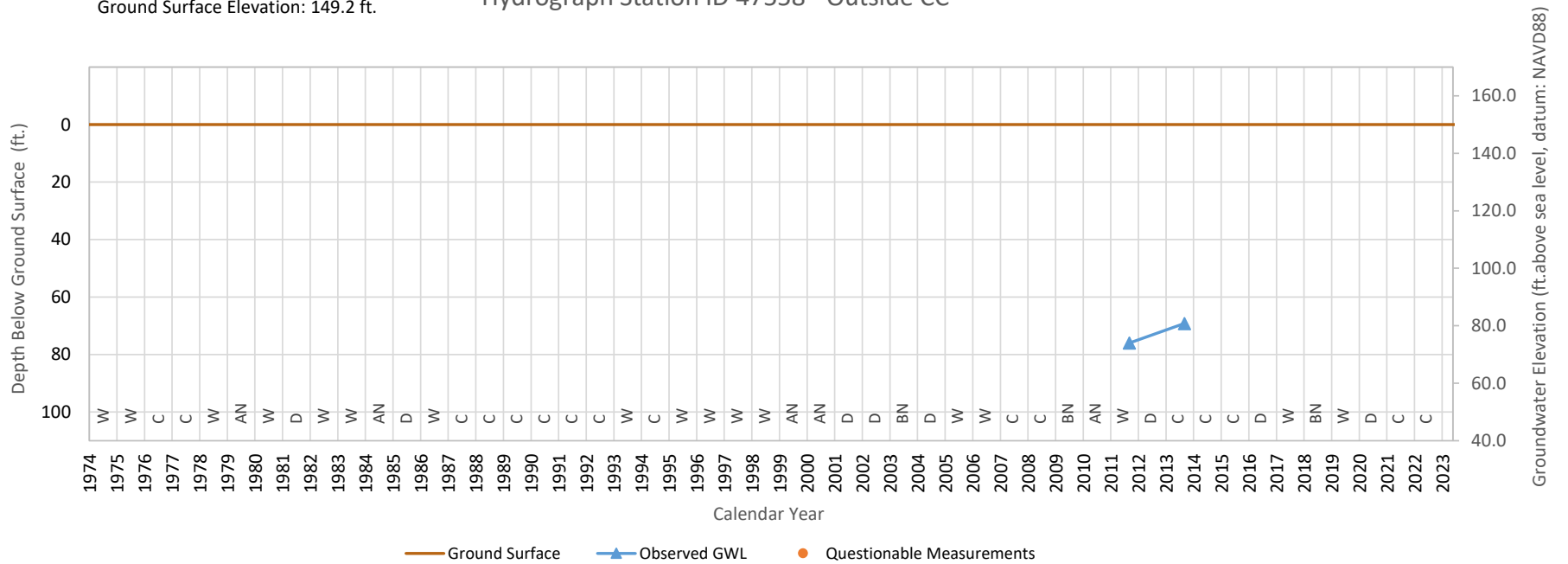
Hydrograph Station ID 47556 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 149.2 ft.

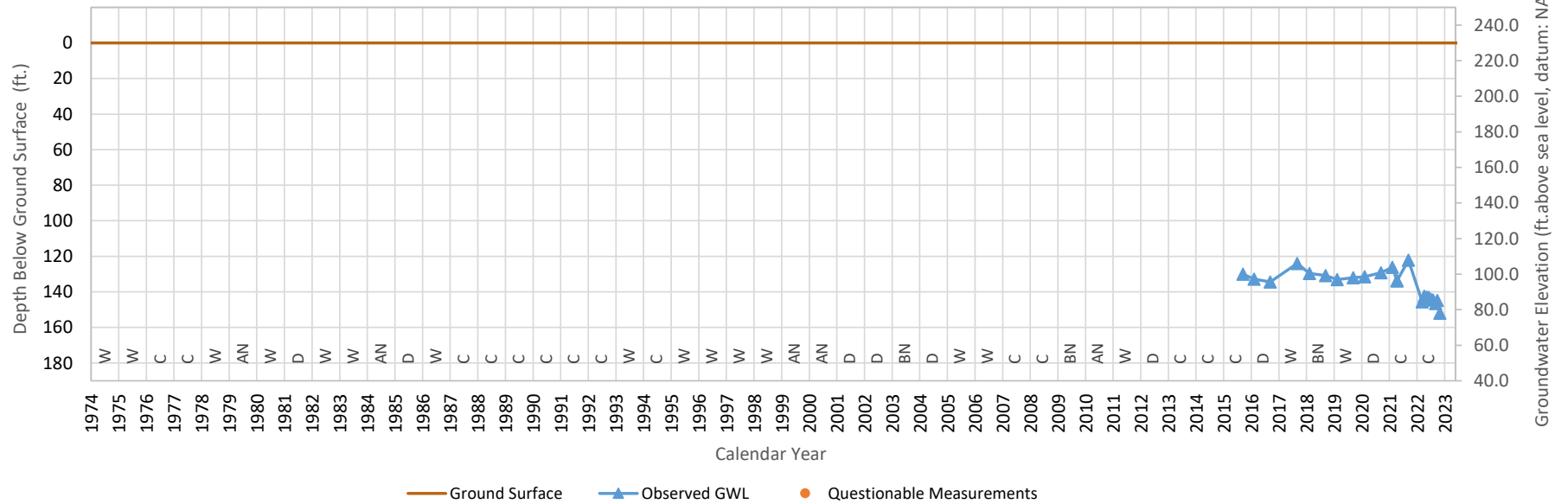
Hydrograph Station ID 47558 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 233.3 ft.

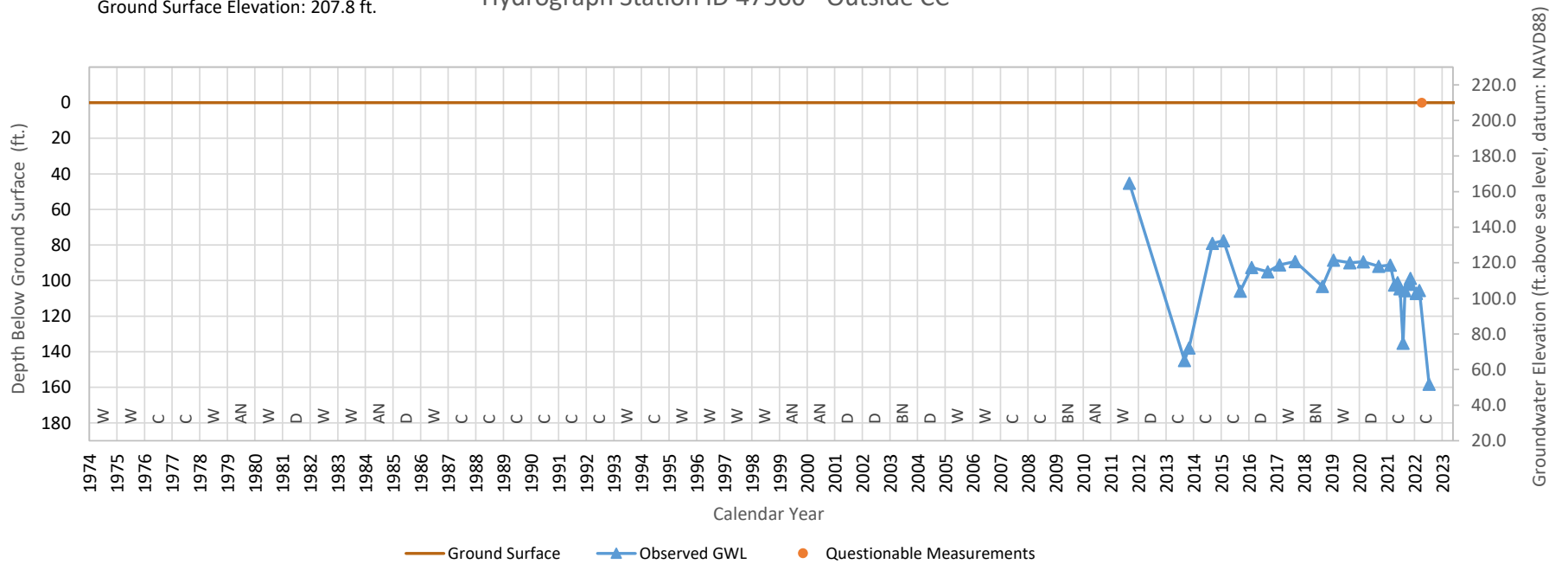
Hydrograph Station ID 47559 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 207.8 ft.

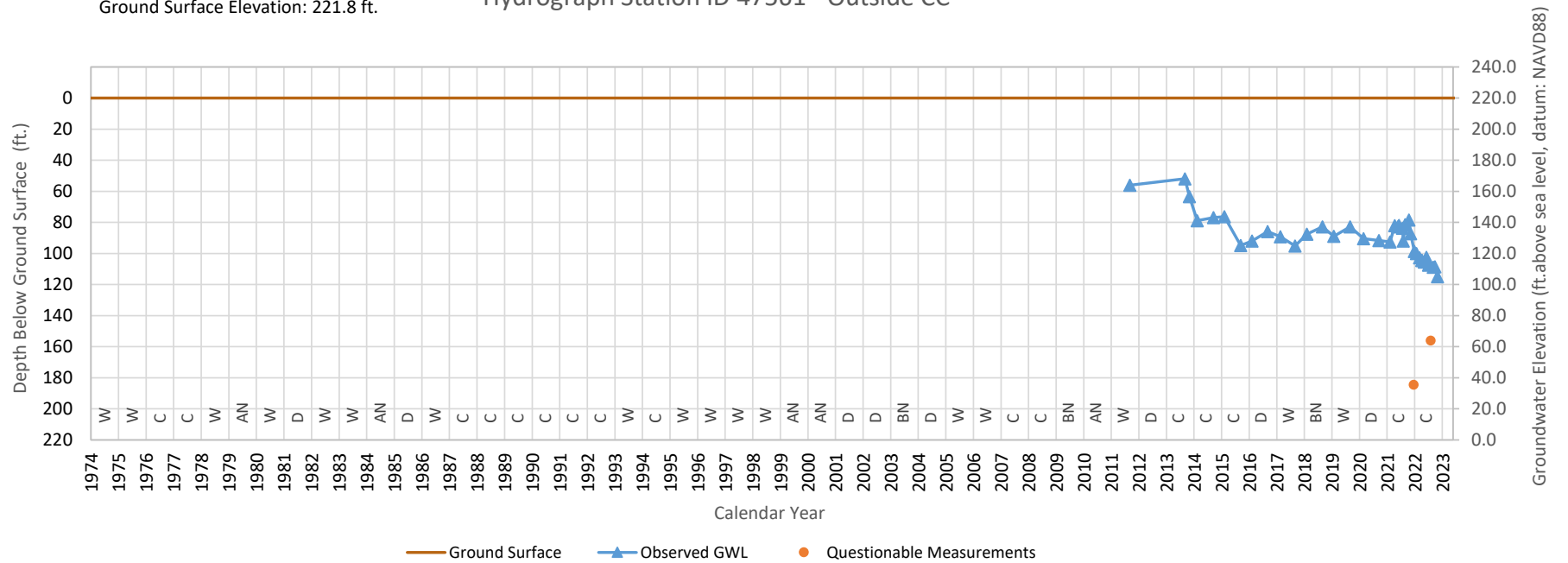
Hydrograph Station ID 47560 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 221.8 ft.

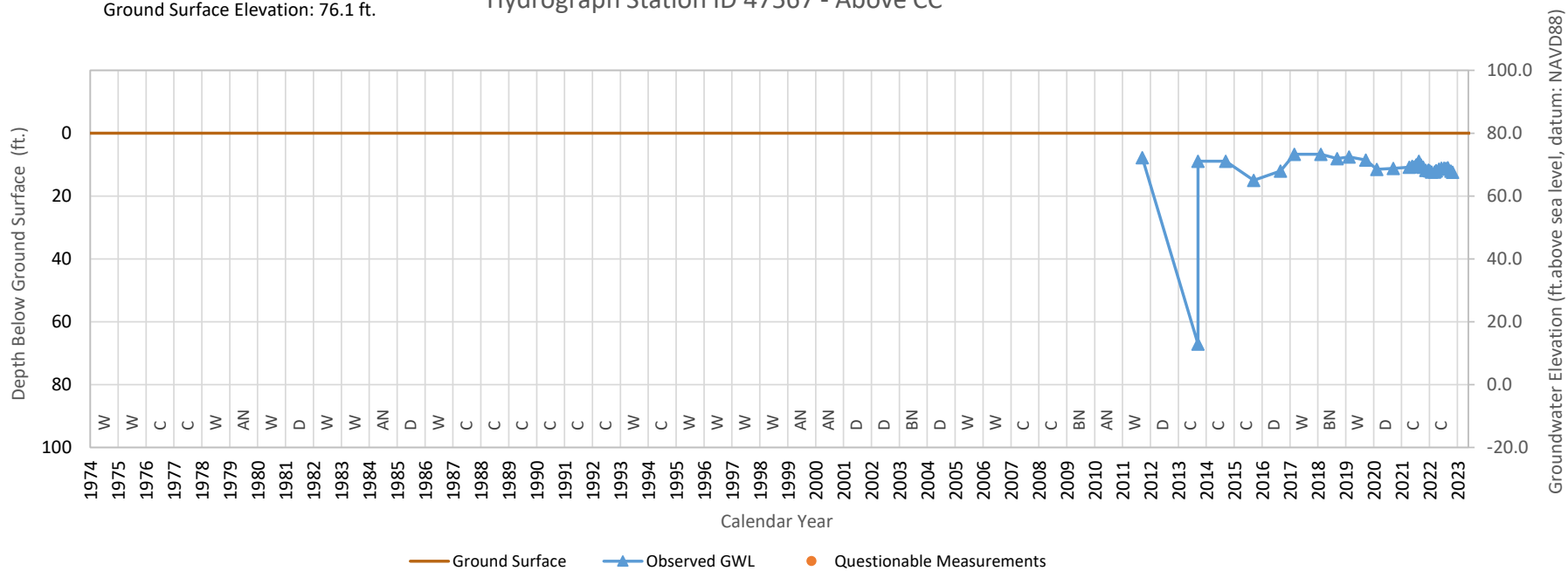
Hydrograph Station ID 47561 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 76.1 ft.

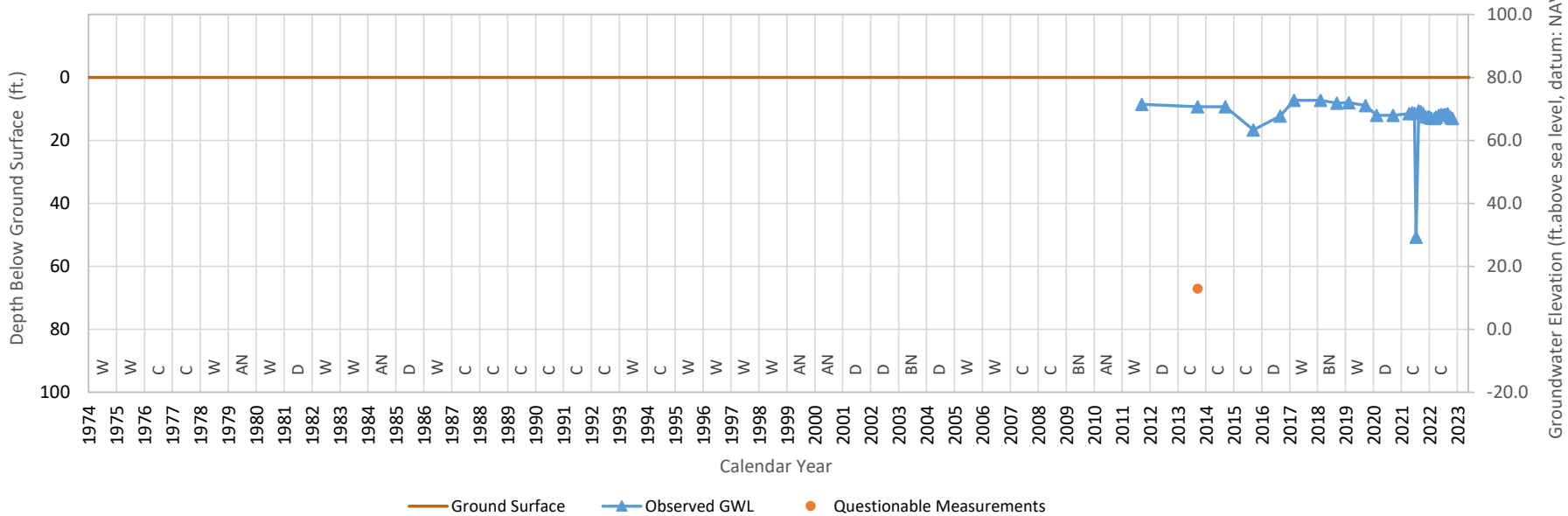
Hydrograph Station ID 47567 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 76.7 ft.

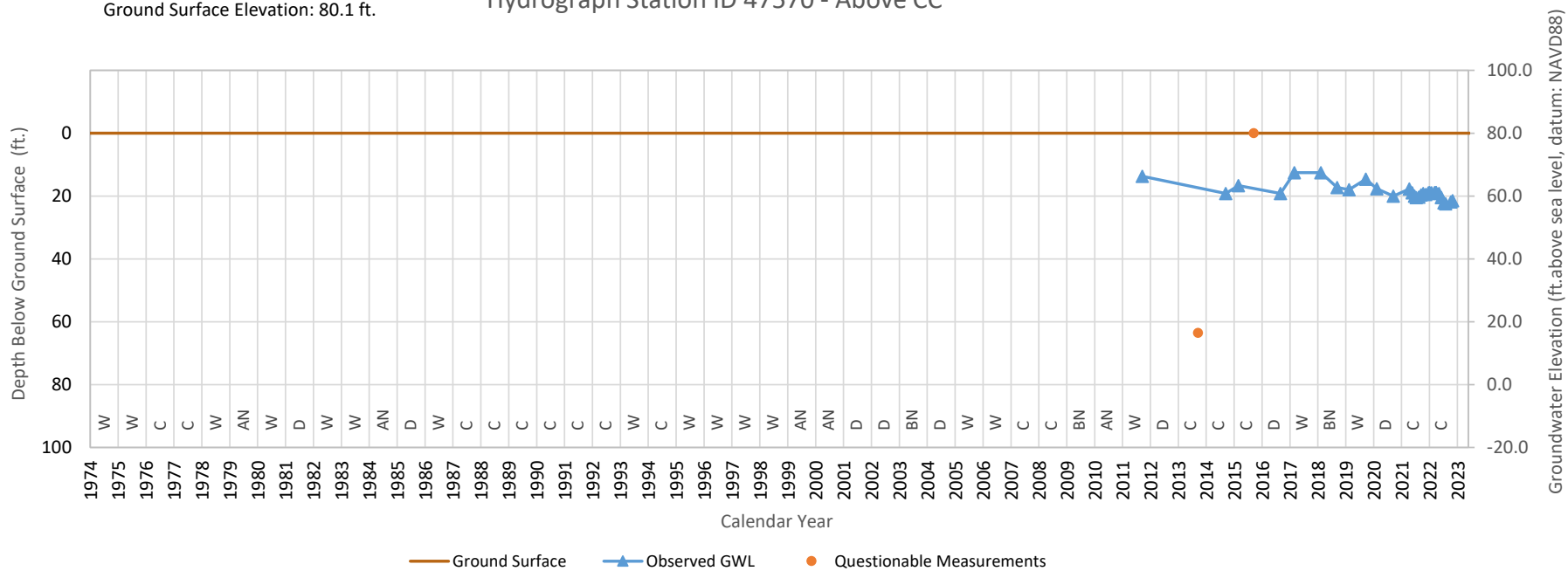
Hydrograph Station ID 47568 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 80.1 ft.

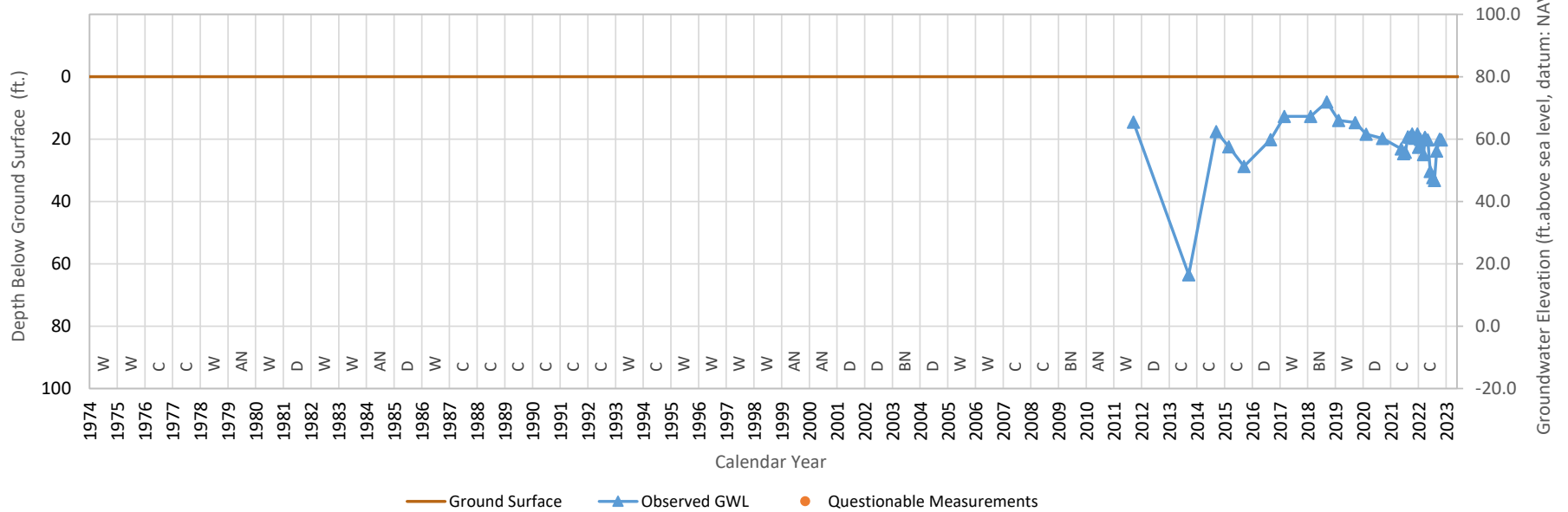
Hydrograph Station ID 47570 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 80.2 ft.

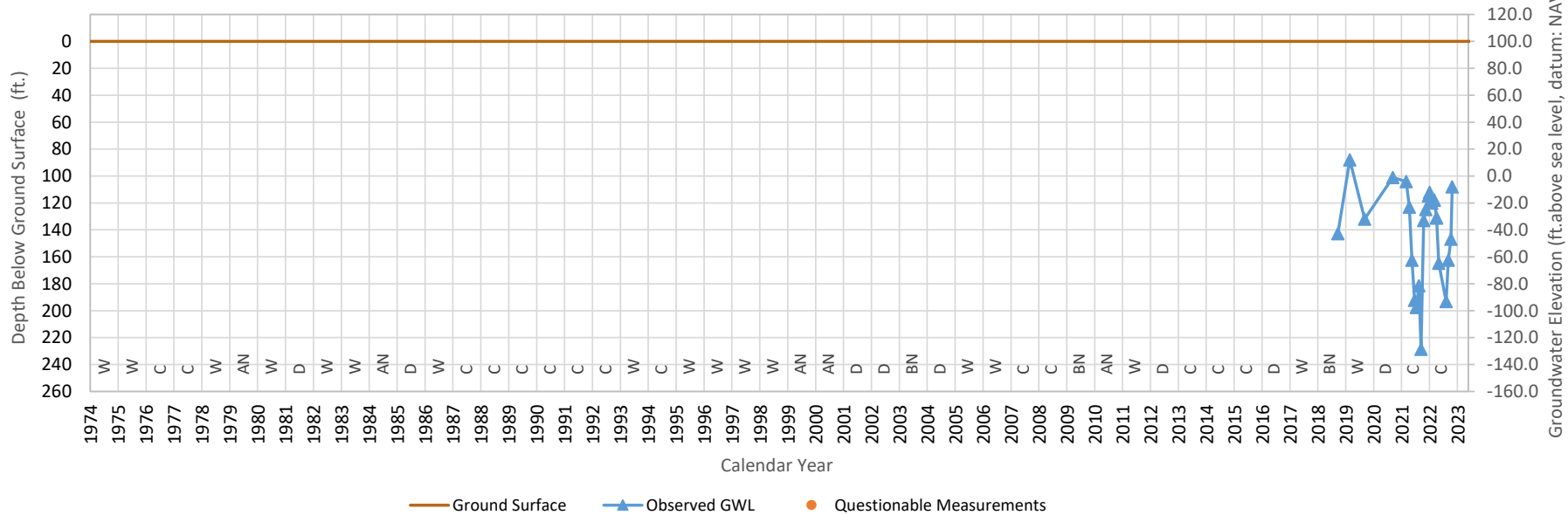
Hydrograph Station ID 47572 - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 100 ft.

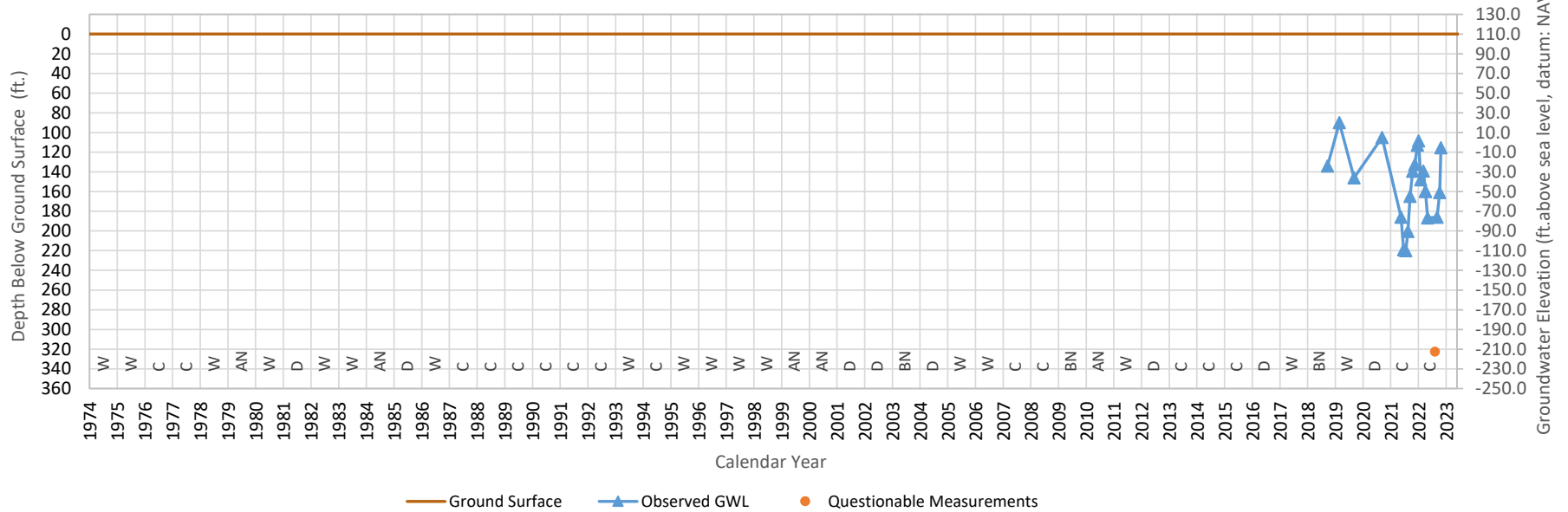
Hydrograph Station ID 52715 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 105 ft.

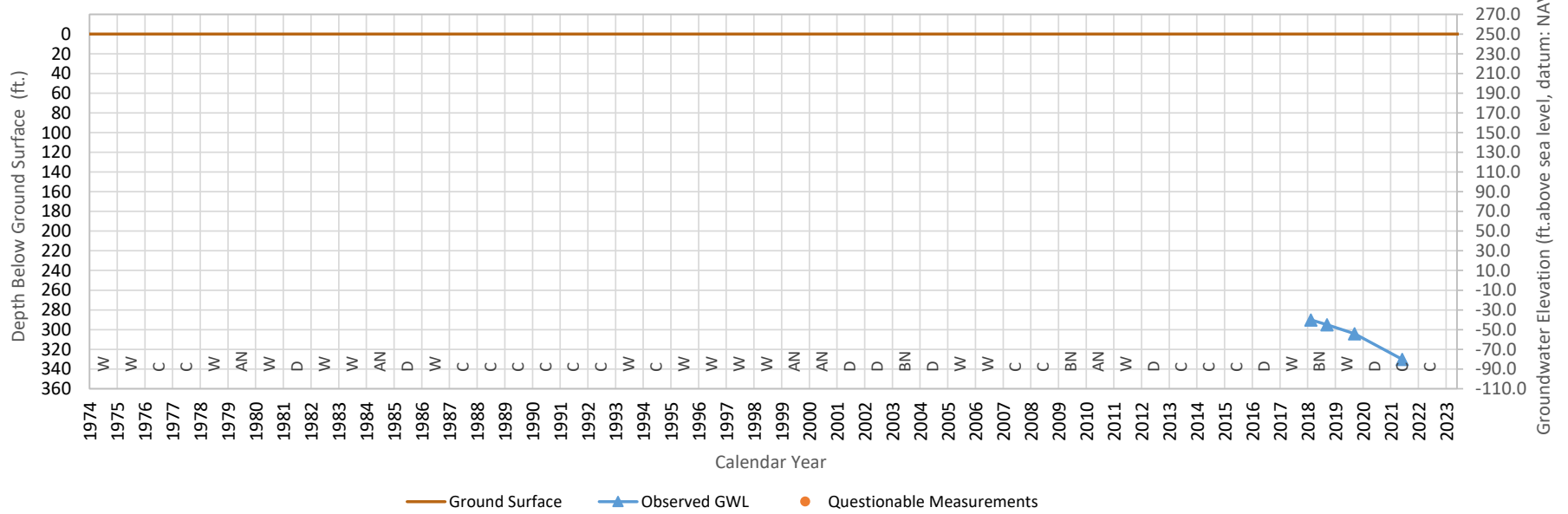
Hydrograph Station ID 52716 - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 248.8 ft.

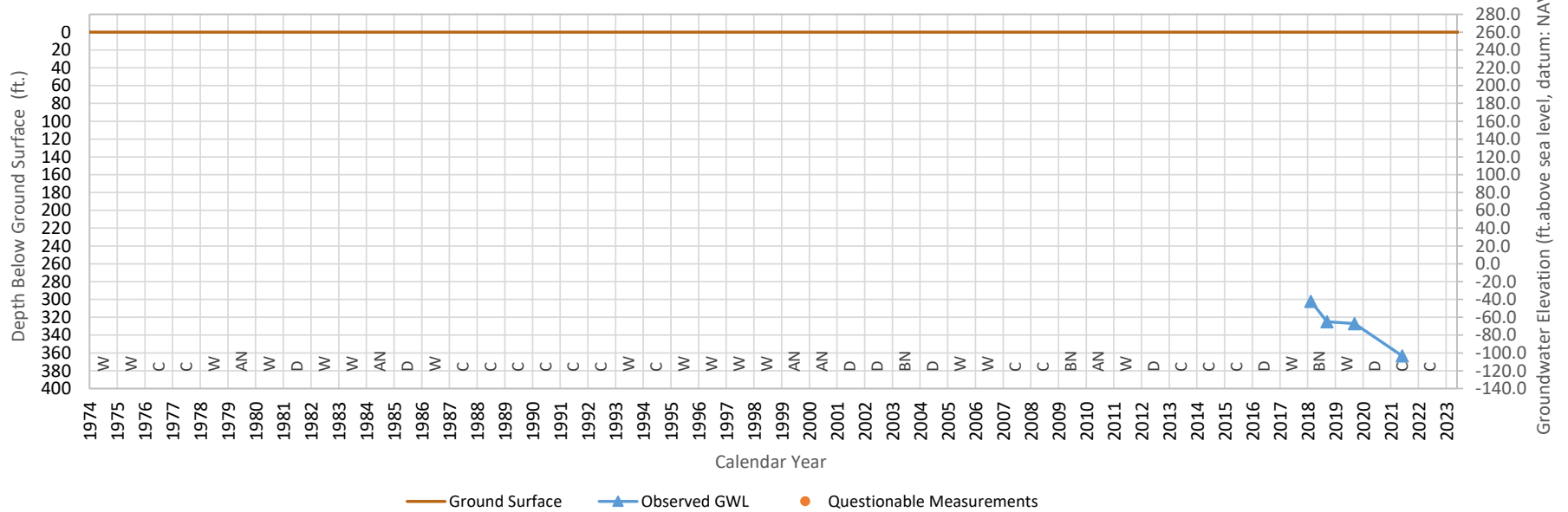
Hydrograph Station ID 53315 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 258.3 ft.

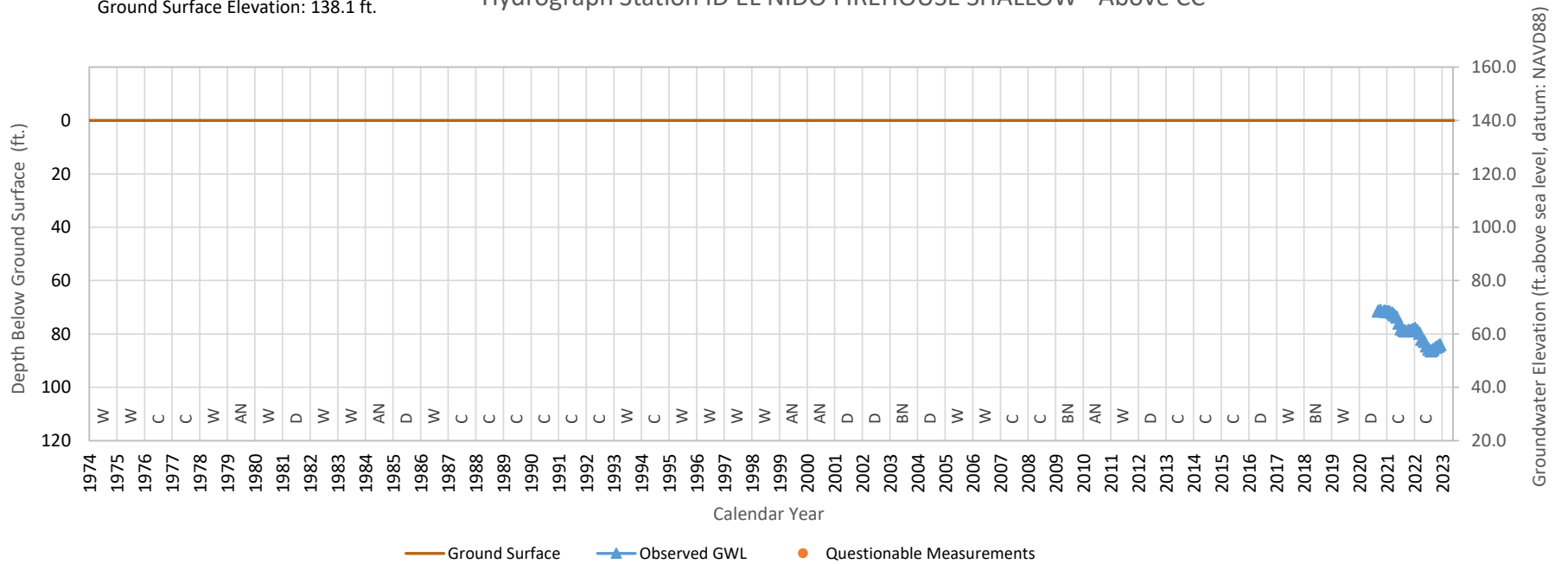
Hydrograph Station ID 53316 - Outside CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 138.1 ft.

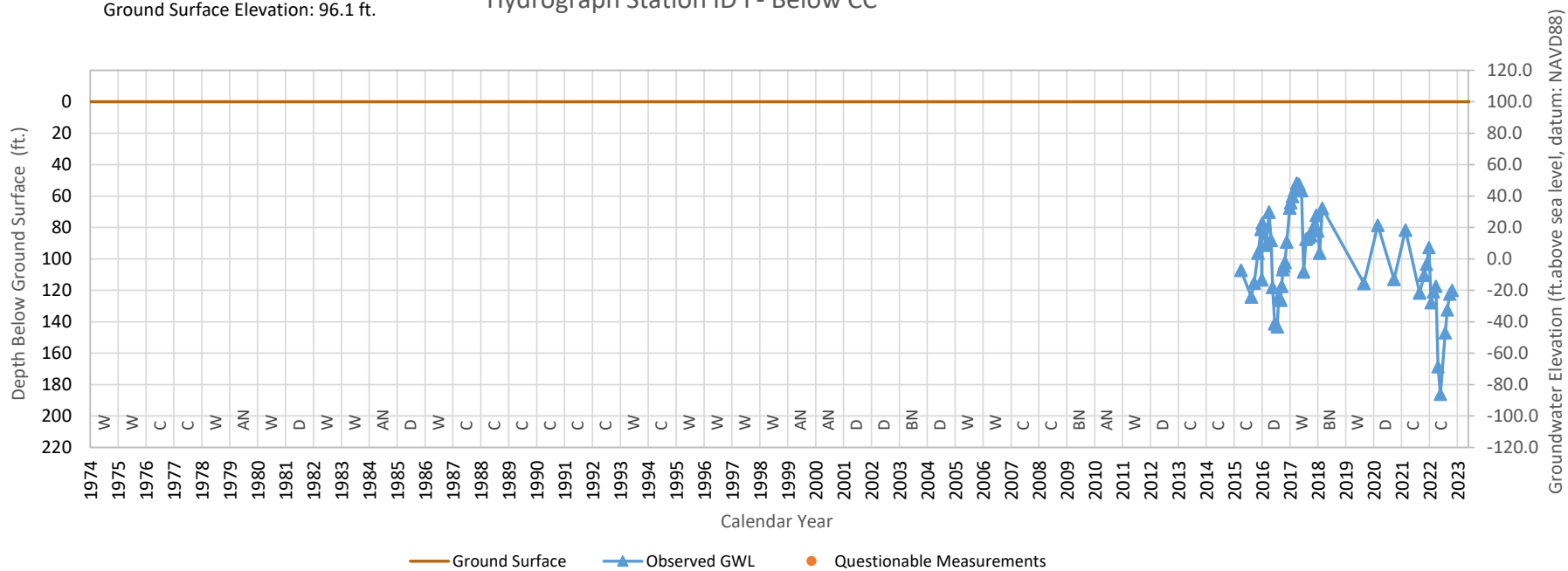
Hydrograph Station ID EL NIDO FIREHOUSE SHALLOW - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 96.1 ft.

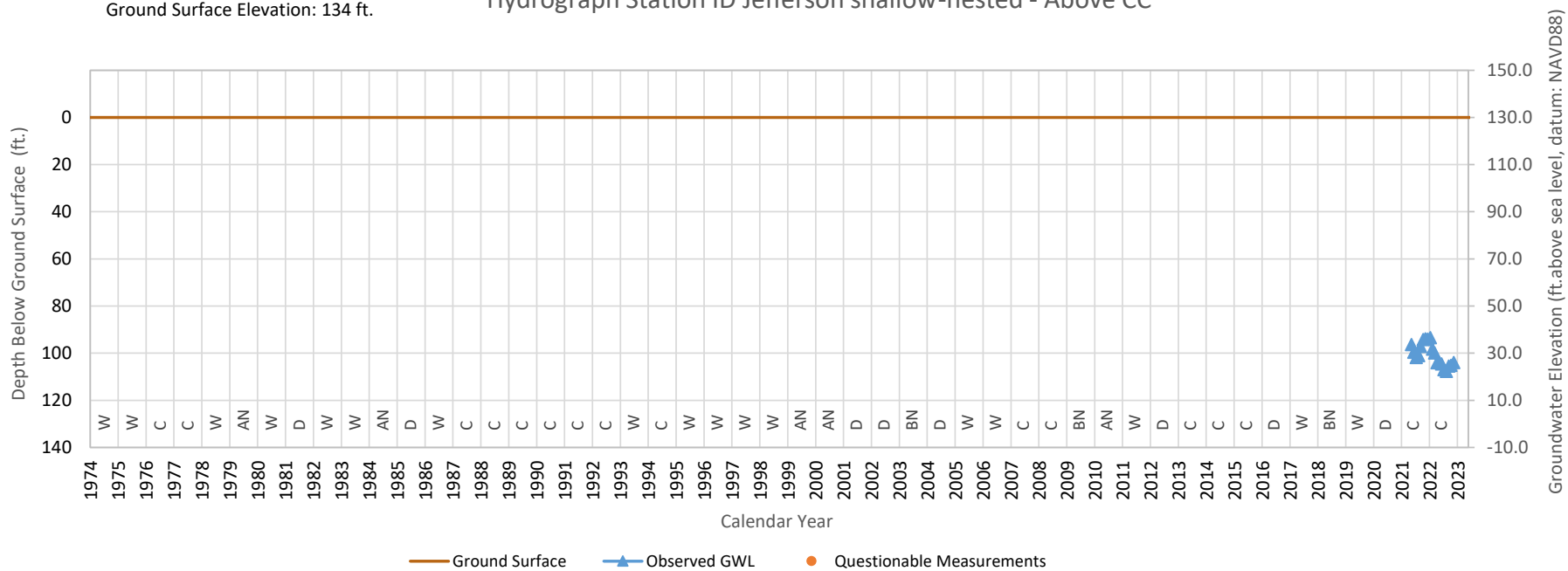
Hydrograph Station ID I - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 134 ft.

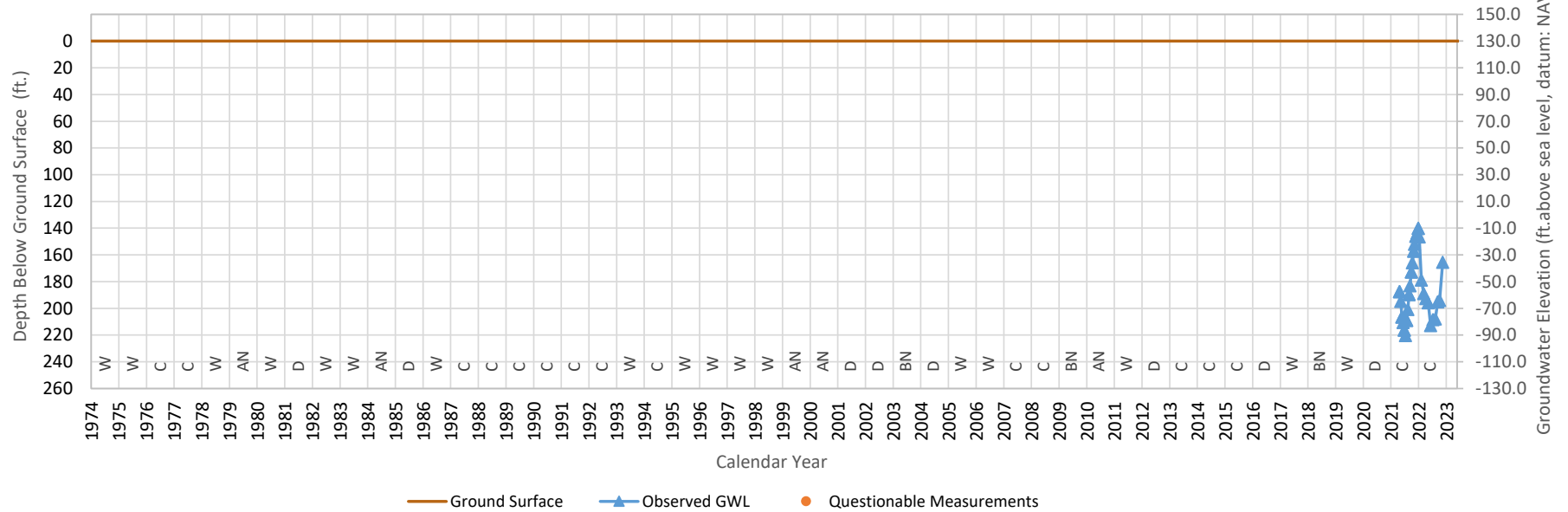
Hydrograph Station ID Jefferson shallow-nested - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 133.7 ft.

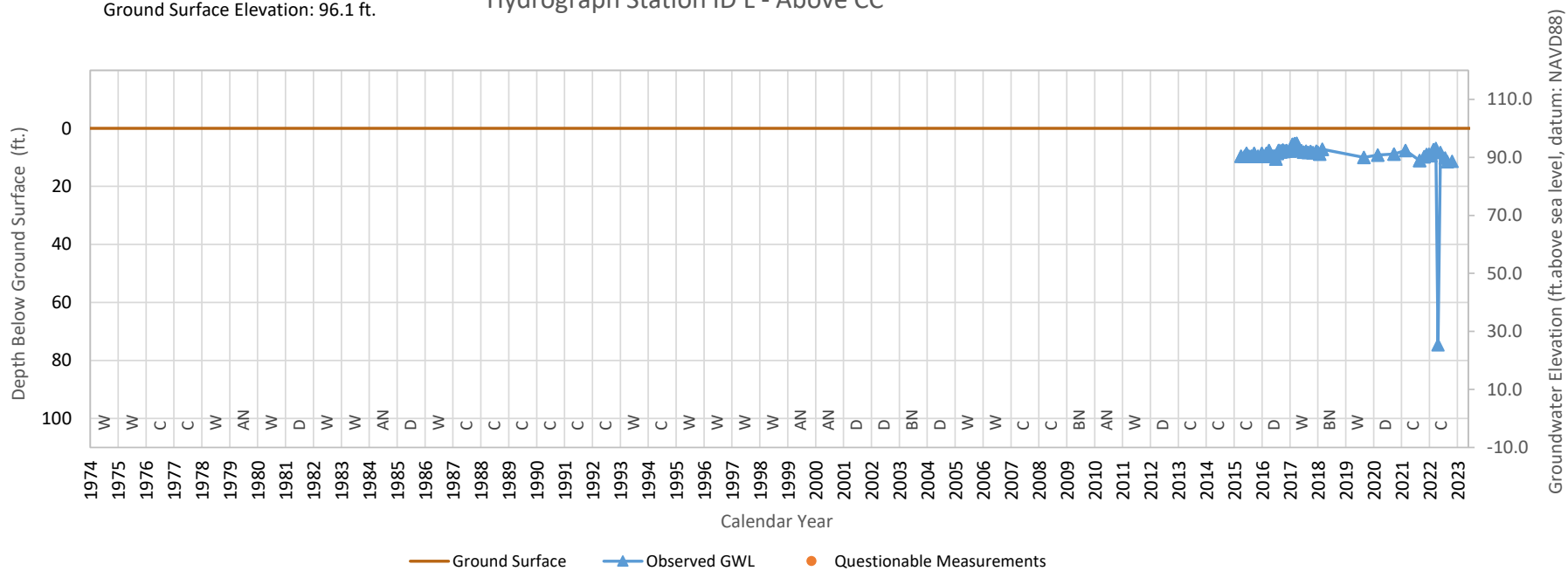
Hydrograph Station ID JEFFERSON - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 96.1 ft.

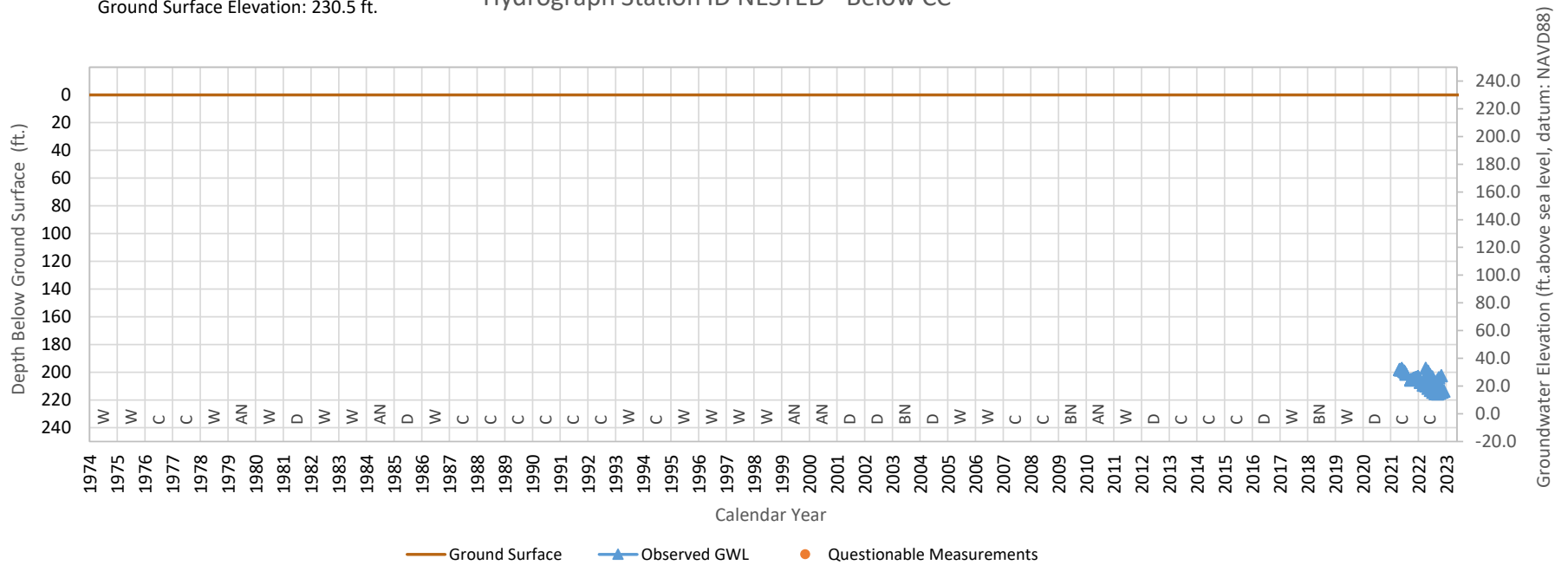
Hydrograph Station ID L - Above CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 230.5 ft.

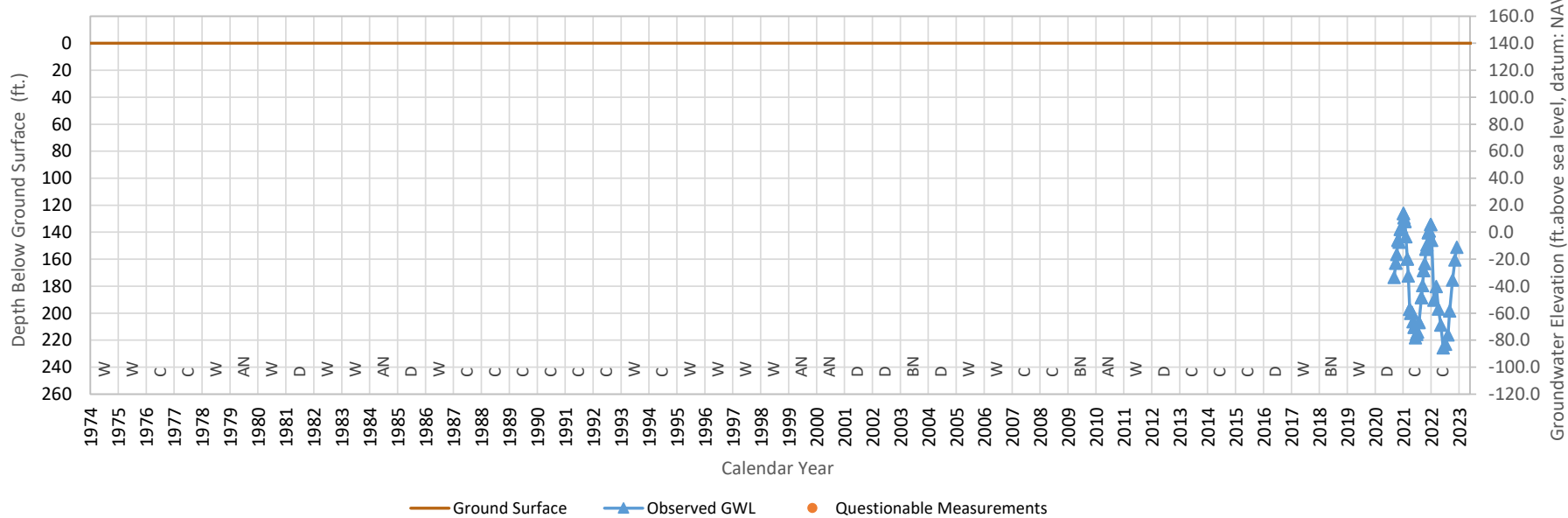
Hydrograph Station ID NESTED - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 138.2 ft.

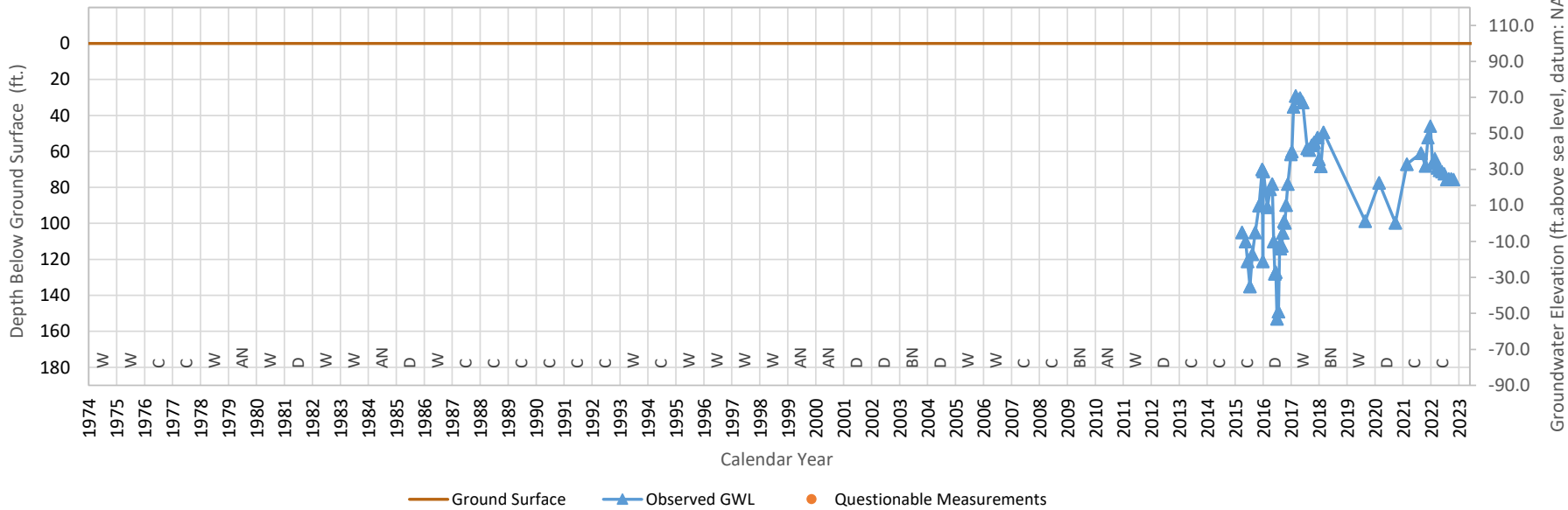
Hydrograph Station ID NIDO - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 95.6 ft.

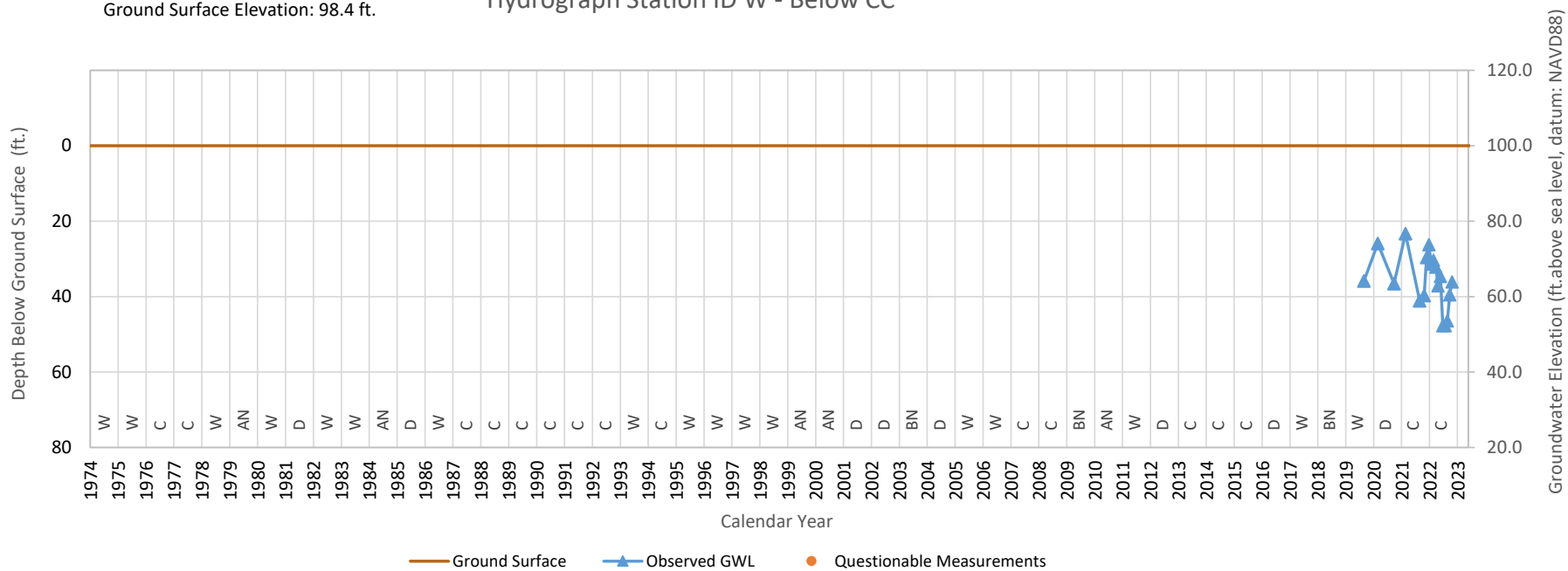
Hydrograph Station ID R - Below CC



Measurements with QA flags have been screened out

Ground Surface Elevation: 98.4 ft.

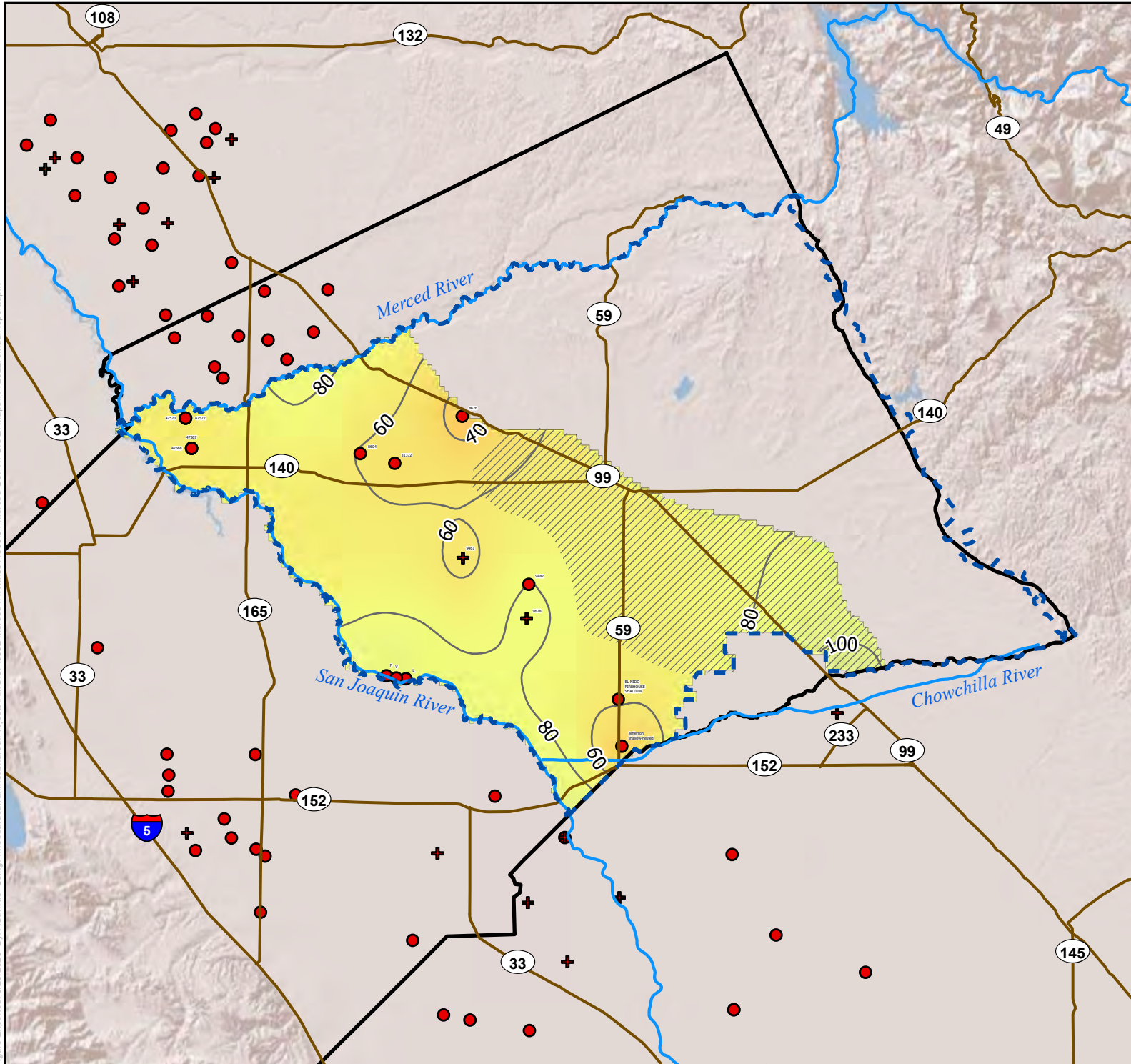
Hydrograph Station ID W - Below CC



Measurements with QA flags have been screened out

APPENDIX B: GROUNDWATER LEVEL CONTOUR MAPS

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodandcurran\neel\share\Projects\RM\GIS\SF\0592\Merced\IR\WM\0011036_01\Merced_GSP\4_GIS\2_Maps\WY2022\AnnualReport.aprx

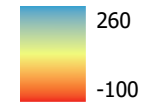


Merced Subbasin GSP Fall 2021

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary
- Well Locations by Principal Aquifer**
- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)

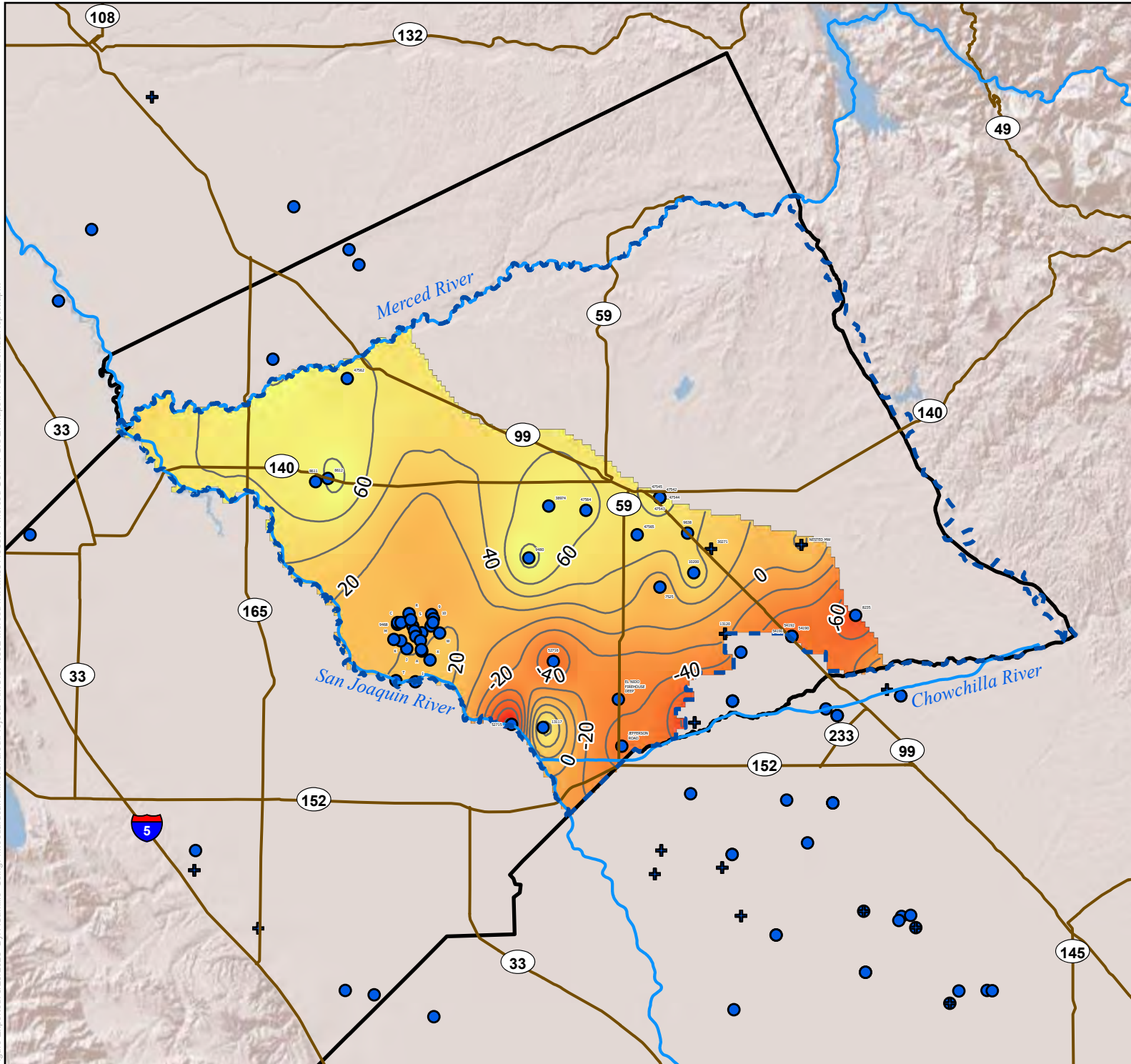


*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodandcurran\neel\share\Projects\RM\GIS\SF\0592\Merced\GSP\4_GIS2_Maps\WY2022\AnnualReport.aprx



Merced Subbasin GSP Fall 2021

Legend

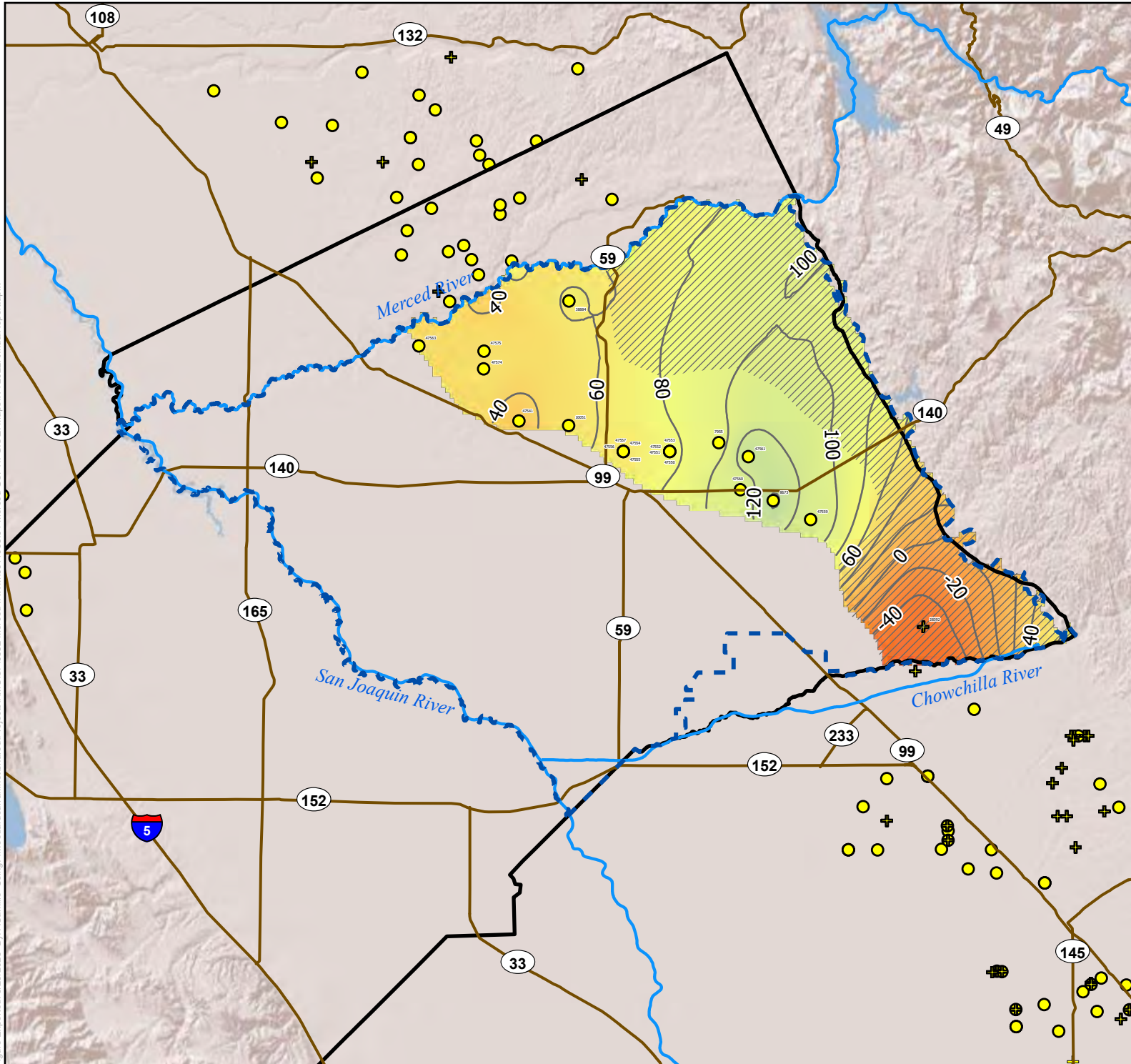
- Merced Subbasin Boundary
- Major Rivers
- ▭ Merced County Boundary
- Well Locations by Principal Aquifer**
- Above CC
- + Above CC (estimated data)
- Below CC
- + Below CC (estimated data)
- Outside CC
- + Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- ▨ Area of increased uncertainty due to data limitations
- Groundwater Elevation (ft*)**
- 260
- 100

*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodlandcurran\ne\share\Projects\RM\CS\SF\0592\Merced\IR\W\0011036.01\Merced_GSP\4_GIS2_Maps\WY2022\AnnualReport.aprx

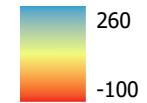


Merced Subbasin GSP Fall 2021

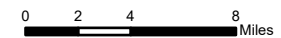
Legend

- Merced Subbasin Boundary
- Major Rivers
- ▭ Merced County Boundary
- Well Locations by Principal Aquifer**
 - Above CC
 - ⊕ Above CC (estimated data)
 - Below CC
 - ⊕ Below CC (estimated data)
 - Outside CC
 - ⊕ Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- ▨ Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)



*Feet above sea level
Datum: NAVD88

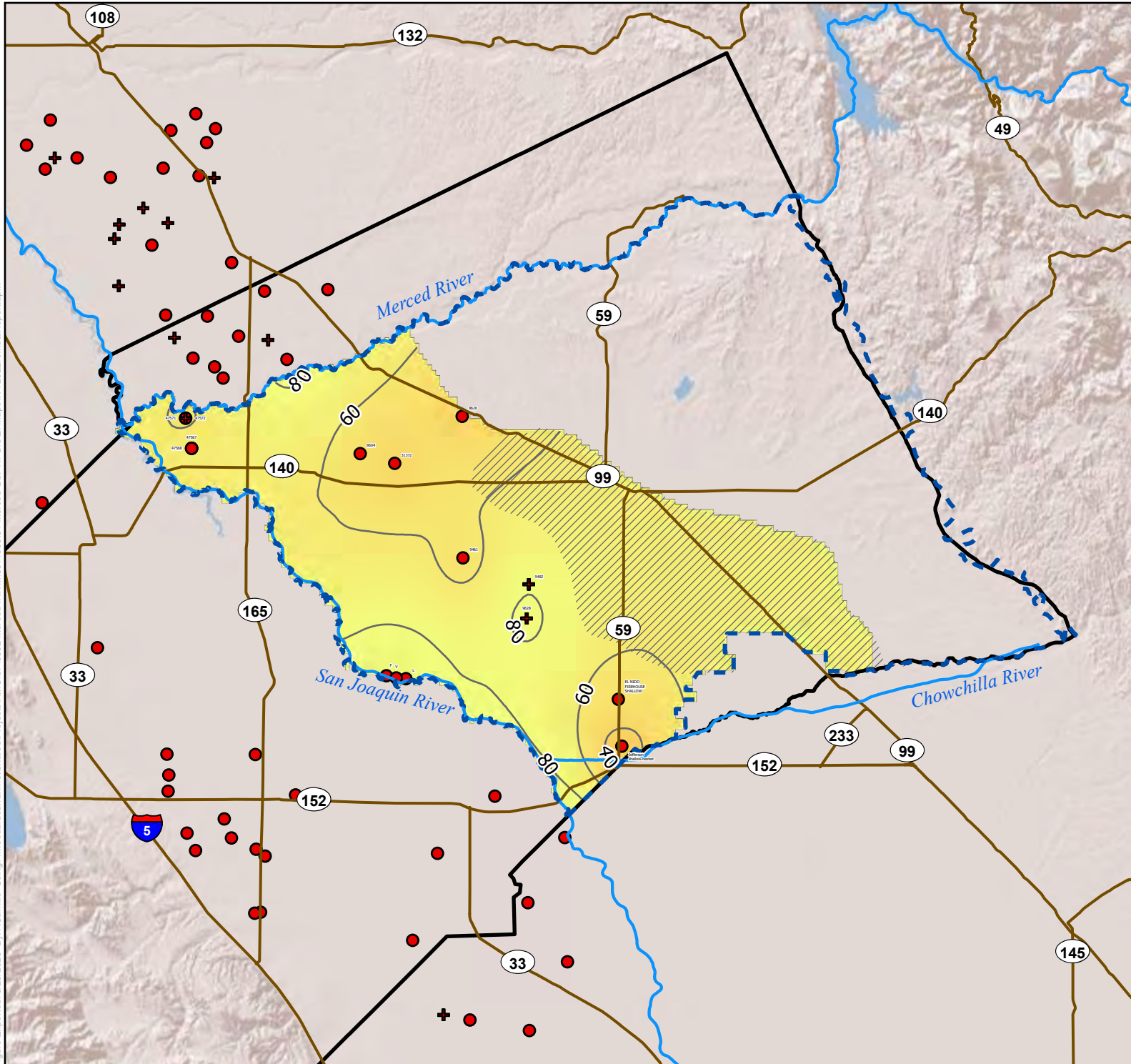


Project #: 0011036.01

Map Created: March 2023

Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodandcurran.net\share\Projects\RM\CS\SF\0592\Merced\IR\WM\0011036.01\Merced_GSP\4_GIS\2_Maps\WY2022\AnnualReport.aprx

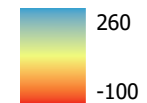


Merced Subbasin GSP Fall 2022

Legend

- Merced Subbasin Boundary
- Major Rivers
- ▭ Merced County Boundary
- Well Locations by Principal Aquifer**
- Above CC
- + Above CC (estimated data)
- Below CC
- + Below CC (estimated data)
- Outside CC
- + Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- ▨ Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)

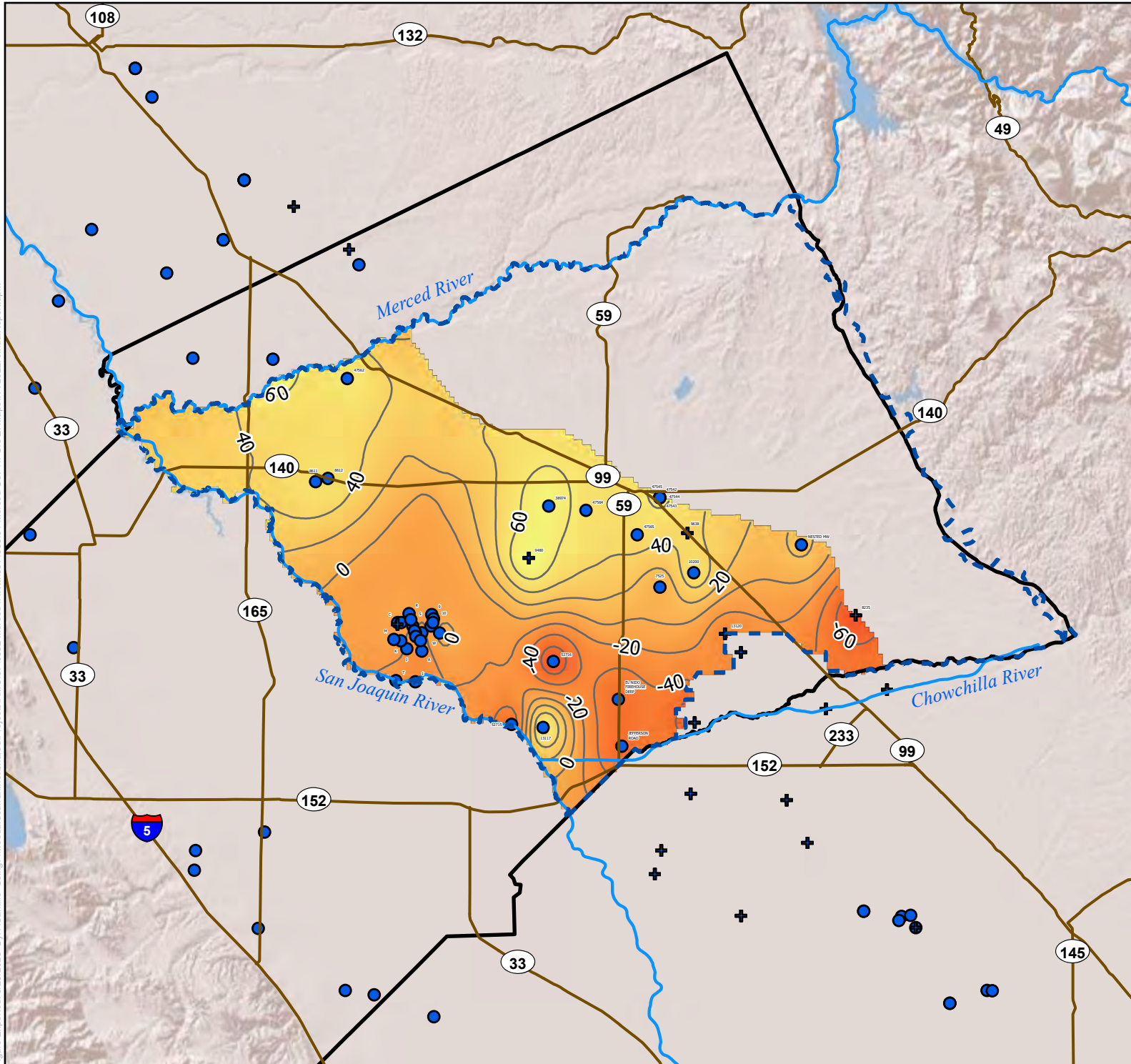


*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodandcurran\neel\share\Projects\RM\CS\SF\0592\Merced\GSP\4_GIS2_Maps\WY2022\AnnualReport.aprx

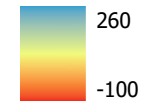


Merced Subbasin GSP Fall 2022

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary
- Well Locations by Principal Aquifer**
- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)

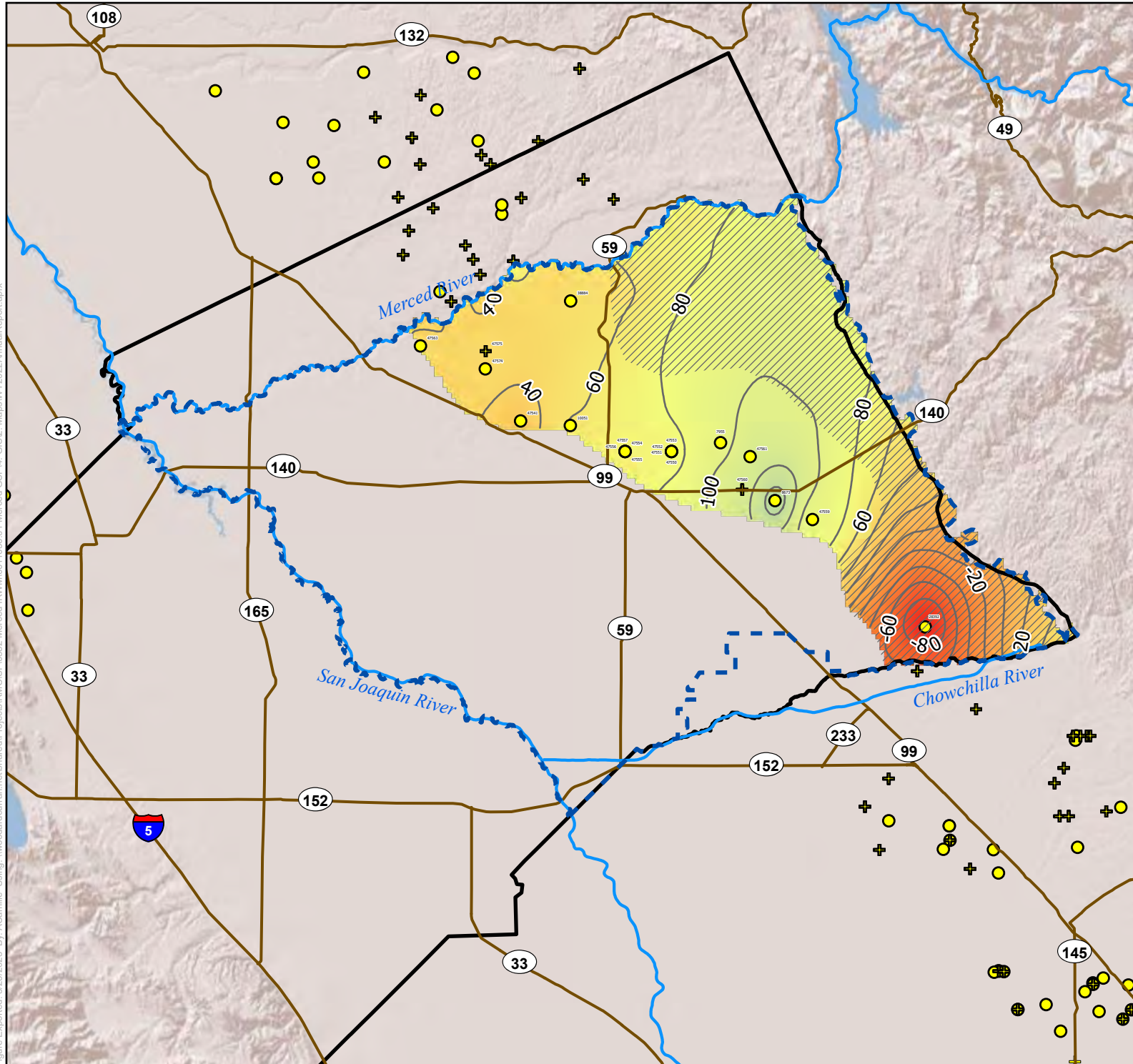


*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodlandcurran\ne\share\Projects\RM\CS\SF\0592\Merced\IR\W\0011036.01\Merced_GSP\4_GIS2_Maps\WY2022\AnnualReport.aprx



Merced Subbasin GSP Fall 2022

Legend

- Merced Subbasin Boundary
- Major Rivers
- ▭ Merced County Boundary
- Well Locations by Principal Aquifer**
 - Above CC
 - + Above CC (estimated data)
 - Below CC
 - + Below CC (estimated data)
 - Outside CC
 - + Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- ▨ Area of increased uncertainty due to data limitations
- Groundwater Elevation (ft*)**
 - 260
 - 100

*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023

Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

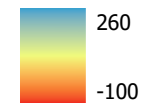
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Merced Subbasin GSP Spring 2022

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary
- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)



*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
 Map Created: March 2023
 Data Sources: DWR groundwater subbasins,
 wells from SGMA Data Viewer & monitoring
 network

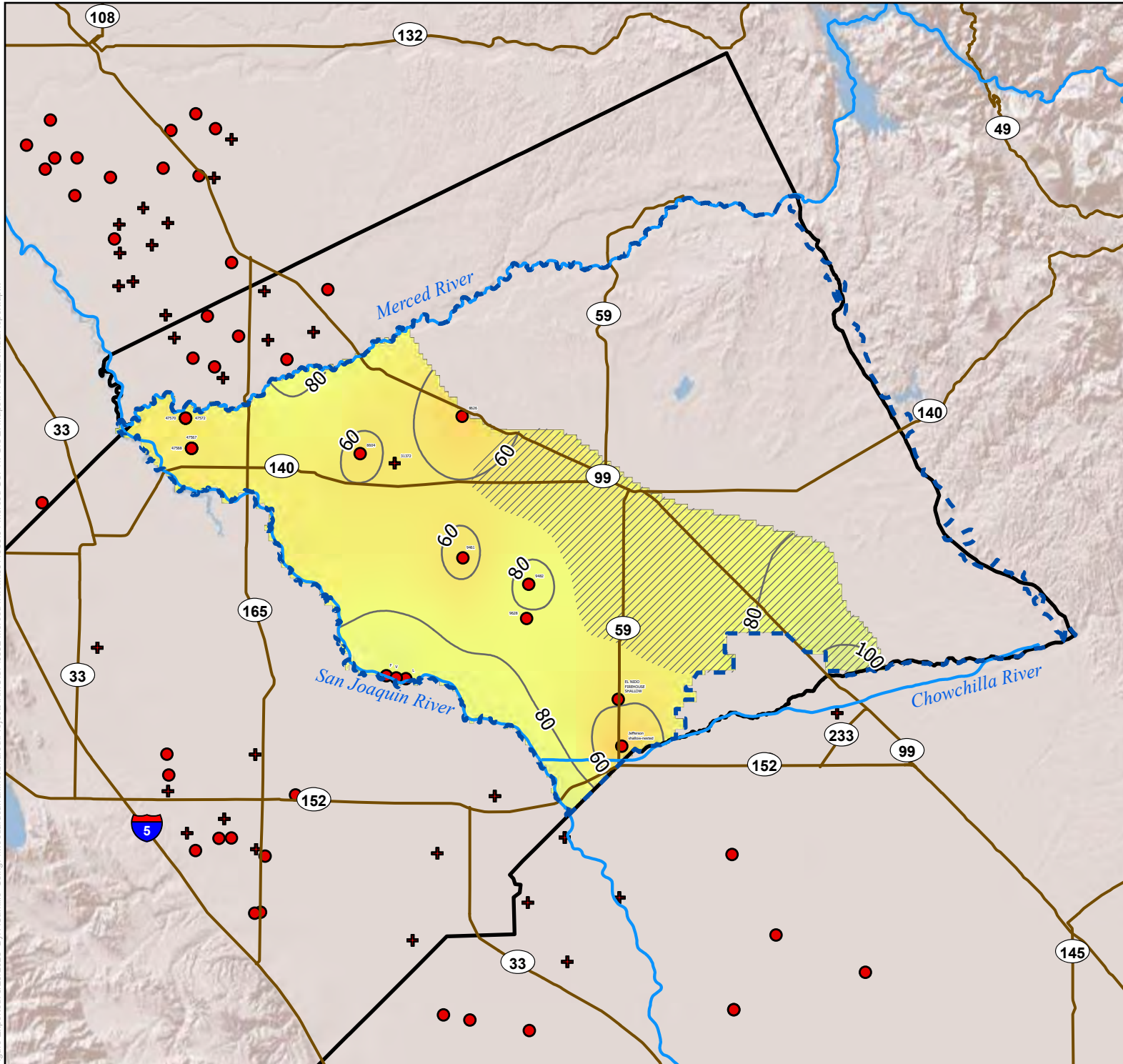
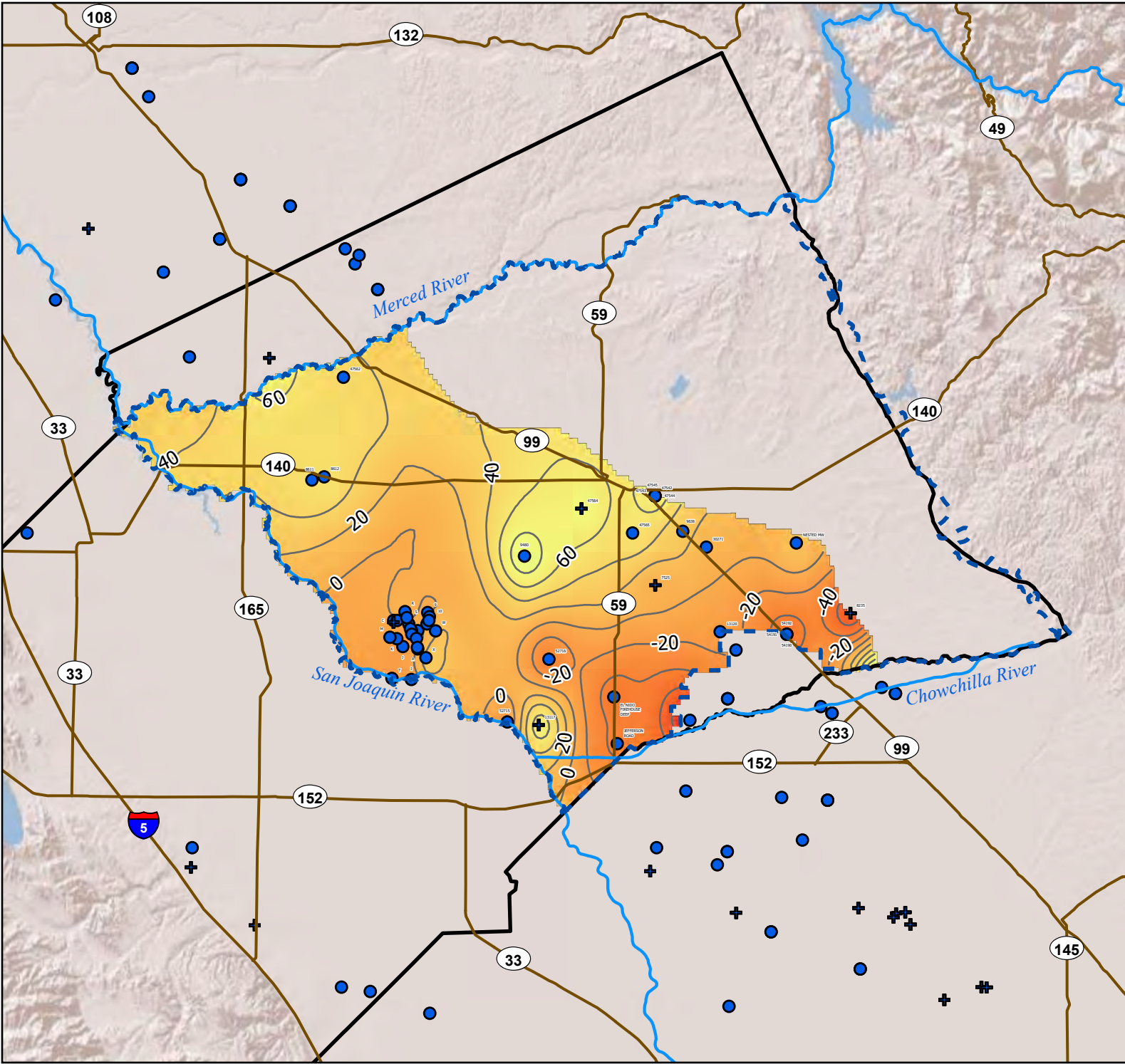


Figure Exported: 3/23/2023, By: ACamille, Using: \\woodandcurran\neel\share\Projects\RM\CS\SF\0592\Merced\GSP\4_GIS\2_Maps\WY2022\AnnualReport.aprx

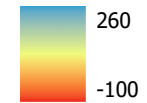


Merced Subbasin GSP Spring 2022

Legend

- Merced Subbasin Boundary
- Major Rivers
- Merced County Boundary
- Well Locations by Principal Aquifer**
- Above CC
- Above CC (estimated data)
- Below CC
- Below CC (estimated data)
- Outside CC
- Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- Area of increased uncertainty due to data limitations

Groundwater Elevation (ft*)



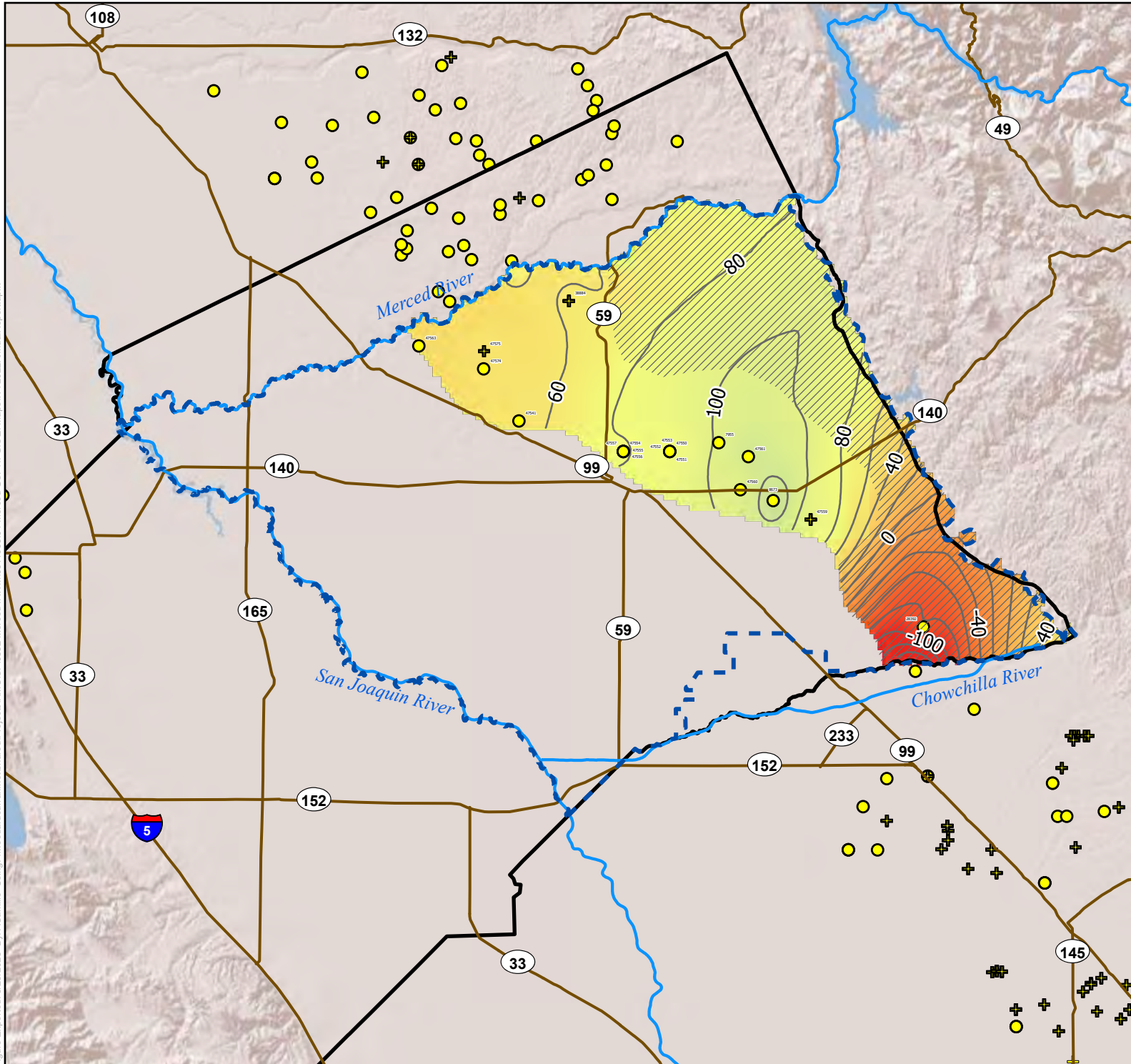
*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023

Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network

Figure Exported: 3/23/2023, By: ACamille, Using: \\woodlandcurran\ne\share\Projects\RM\CS\SF\0592\Merced\IR\W\0011036.01\Merced_GSP\4_GIS2_Maps\WY2022\AnnualReport.aprx



Merced Subbasin GSP Spring 2022

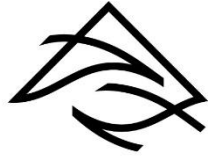
Legend

- Merced Subbasin Boundary
- Major Rivers
- ▭ Merced County Boundary
- Well Locations by Principal Aquifer**
- Above CC
- + Above CC (estimated data)
- Below CC
- + Below CC (estimated data)
- Outside CC
- + Outside CC (estimated data)
- Groundwater Elevation Contour Lines (20 ft* interval)
- ▨ Area of increased uncertainty due to data limitations
- Groundwater Elevation (ft*)**
- 260
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*Feet above sea level
Datum: NAVD88



Project #: 0011036.01
Map Created: March 2023
Data Sources: DWR groundwater subbasins, wells from SGMA Data Viewer & monitoring network



**Woodard
& Curran**

woodardcurran.com



Prepared by:
Woodard & Curran
801 T Street
Sacramento, CA 95811
916.999.8700



Image courtesy: Veronica Adrover/UC Merced

