Notice and Agenda
Regular Meeting of the Beaumont Basin Watermaster

Wednesday, October 2, 2024 at 11:00 a.m.

Meeting Location:
Beaumont-Cherry Valley Water District
560 Magnolia Avenue • Beaumont, California 92223

This meeting is hereby noticed pursuant to California Government Code Section 54950 et. seq.

Members of the Watermaster Committee:

City of Banning
Beaumont-Cherry Valley Water District
City of Beaumont
South Mesa Water Company
Yucaipa Valley Water District

Remote attendance options are provided primarily as a matter of convenience to the public. Unless a Watermaster Committee member is attending remotely pursuant to provisions of GC 54953 et. seq., the public, in-person meeting will not stop or be otherwise suspended should a technological interruption occur with respect to the Zoom teleconference or call-in line listed on the agenda. Members of the public are encouraged to attend BBWM meetings in person at the above address, or remotely using the options listed.

Online Meeting Participation Link:
https://us02web.zoom.us/j/81638720446?pwd=UnNZcC9TbGZzTGFuMHdhVkRMblczQT09

Telephone: (669) 900-9128 / Meeting ID: 816-3872-0446 / Passcode: 636756
One-Tap Mobile: +16699009128,,81638720446#,,,,*636756#

*For Public Comment, use the **"Raise Hand"** feature if on the video call when prompted, if dialing in, please **dial *9 to "Raise Hand"** when prompted*

Meeting materials are available on the Watermaster website:
https://beaumontbasinwatermaster.org/

I. Call to Order

II. Roll Call

Committee Member Agency	Primary Representative		Alternate	
City of Banning	Arturo Vela, Chair		Nathan Smith	
City of Beaumont	Robert Vestal		Dustin Christensen	
Beaumont-Cherry Valley Water District	Daniel Jaggers		Mark Swanson	
South Mesa Water Company	Dave Armstrong		Brittany Lim	
Yucaipa Valley Water District	Joseph Zoba		Jennifer Ares	

III. Pledge of Allegiance

IV. Public Comments

Public Comments At this time, members of the public may address the Beaumont Basin Watermaster on matters within its jurisdiction; however, no action or discussion may take place on any item not on the agenda. To provide comments on specific agenda items, please complete a Request to Speak form and provide that form to the Secretary prior to the commencement of the meeting, or, RAISE HAND electronically or Press *9 when prompted for public comment.

ACTION ITEMS

Action may be taken on any item on the agenda.

V. Consent Calendar

A. Meeting Minutes

   i. August 7, 2024 Regular Meeting [Page 6]

B. Status Report on Water Level Monitoring throughout the V-B and Beaumont Basin through September 16, 2024 [Page 15]

C. Comparison of Production Rights versus Production through August 2024 [Page 26]

VI. Reports

A. Report from Engineering Consultant - Hannibal Blandon, ALDA Engineering

B. Report from Hydrogeological Consultant - Thomas Harder, Thomas Harder & Co.

C. Report from Administrative Consultant – Steve Stuart, Dudek

D. Report from Legal Counsel - Thierry Montoya/Keith McCullough, Frost, Brown, Todd

VII. Discussion Items

A. Update on the Redetermination of the Safe Yield in the Beaumont Basin [Memorandum No. 24-32, Page 28]
   Recommendation: For information and discussion

B. Analysis of Beaumont Basin Storage Losses using the Model [Memorandum No. 24-33, Page 145]
   Recommendation: For information and discussion

C. Approval of costs and work of Thomas Harder & Co for preparation of data in response to California Public Records Act Request [Memorandum No. 24-34, Page 153]
   Recommendation: Approve the proposal from Thomas Harder & Co for preparation of data in response to California Public Records Act Request

D. Discussion on Proposed Revisions to Rules & Regulations [Memorandum No. 24-35, Page 158]
   Recommendation: No recommendation

VIII. Topics for Future Meetings

	Item	Date Listed
A	Development of a Recycled Water Policy	3/27/2019
B	Development of a return flow accounting policy	3/27/2019
C	Development of a methodology and policy to account for groundwater storage losses in the basin / groundwater management	3/27/2019
D	Procurement Policy including thresholds for RFP process	8/17/2021
E	Incidental discharge	10/6/2021
F	Monitoring of future west side well sites and methodologies, and potential collaboration with USGS	10/5/2022
G	Discussion on what to do when an Appropriator goes negative	10/4/2023 and 11/1/2023
H	Discussion on Policy to Document and Account for Emergency Potable Water Transfers from Appropriator to Overlying Party (Tabled from 4/17/24 meeting)	4/17/2024

IX. Comments from the Watermaster Committee Members

X. Announcements

2024 / 2025 Meeting Dates:

2024

Wednesday, December 4 at 11 a.m.	Regular Meeting

2025

Wednesday, January 15 at 11 a.m.	Special Meeting
Wednesday, February 5 at 11 a.m.	Regular Meeting
Wednesday, March 5 at 11 a.m.	Special Meeting

XI. Adjournment

NOTICES

AVAILABILITY OF AGENDA MATERIALS - Agenda exhibits and other writings that are disclosable public records distributed to all or a majority of the members of the Beaumont Basin Watermaster Committee in connection with a matter subject to discussion or consideration at an open meeting of the Committee are available for public inspection in the Office of the Watermaster Secretary, at 560 Magnolia Avenue, Beaumont, California ("Office") during business hours, Monday through Thursday from 7:30 a.m. to 5 p.m. If such writings are distributed to members of the Committee less than 72 hours prior to the meeting, they will be available from the Office at the same time or within 24 hours' time as they are distributed to Board Members, except that if such writings are distributed one hour prior to, or during the meeting, they can be made available in the Board Room at the District Office. Materials may also be available on the Watermaster website: https://beaumontbasinwatermaster.org/.

REVISIONS TO THE AGENDA - In accordance with §54954.2(a) of the Government Code (Brown Act), revisions to this Agenda may be made up to 72 hours before the Board Meeting, if necessary, after mailings are completed. Interested persons wishing to receive a copy of the set Agenda may pick one up at the Office, located at 560 Magnolia Avenue, Beaumont, California, or download from the website up to 72 hours prior to the Meeting.

REQUIREMENTS RE: DISABLED ACCESS - In accordance with §54954.2(a), requests for a disability related modification or accommodation, including auxiliary aids or services, in order to attend or participate in a meeting, should be made to the Office, at least 48 hours in advance of the meeting to ensure availability of the requested service or accommodation. The Office may be contacted by telephone at (951) 845-9581, email at info@bcvwd.gov or in writing to the Beaumont Basin Watermaster Committee, c/o Beaumont-Cherry Valley Water District, 560 Magnolia Avenue, Beaumont, California 92223.

CERTIFICATION OF POSTING: A copy of the foregoing notice was posted near the regular meeting place of the Beaumont Basin Watermaster Committee and to its website at least 72 hours in advance of the meeting (Government Code §54954.2(a)).

Consent Calendar

Record of the Minutes of the Beaumont Basin Committee Meeting of the Beaumont Basin Watermaster Regular Meeting Wednesday, August 7, 2024

Meeting Location:

Beaumont-Cherry Valley Water District
560 Magnolia Ave., Beaumont, CA 92223

I. Call to Order

Chair Art Vela called the meeting to order at 11:00 a.m.

II. Roll Call

City of Banning	*Art Vela*	*Present*
City of Beaumont	*Dustin Christensen*	*Present*
Beaumont-Cherry Valley Water District	*Dan Jaggers*	*Present*
South Mesa Water Company	*David Armstrong*	*Present*
Yucaipa Valley Water District	*Joseph Zoba*	*Present*

Hanibal Blandon was present as engineer for the Beaumont Basin Watermaster (BBWM).
Thomas Harder was present as hydrogeologist for BBWM.
Thierry Montoya was present as BBWM legal counsel.
Steve Stuart of Dudek was present as BBWM administrator.

Members of the public who registered and / or attended:
Brittany Lim, South Mesa Water Company
Joyce McIntire, Yucaipa Valley Water District
Brett Granlund, Yucaipa Valley Water District
Lance Eckhart, San Gorgonio Pass Water Agency
Kevin Walton, San Gorgonio Pass Water Agency
Mark Swanson, Beaumont-Cherry Valley Water District
Robert Rasha, Beaumont-Cherry Valley Water District

III. Pledge of Allegiance

IV. Public Comments: None.

V. Consent Calendar

A. Meeting Minutes
   a. June 5, 2024 Regular Meeting
   b. July 10, 2024 Special Meeting

B. Status Report on Water Level Monitoring throughout the Beaumont Basin through July 23, 2024

C. A Comparison of Production Rights versus Production through June 2024

It was moved by Member Zoba and seconded by Member Jaggers to approve Consent Calendar items A, B and C.

AYES:	Armstrong, Christiansen, Jaggers, Vela, Zoba
NOES:	None
ABSTAIN:	None
ABSENT:	None
STATUS:	Motion Approved

VI. Reports

A. Report from Engineering Consultant – Hannibal Blandon, ALDA Engineering
No report.

B. Report from Hydrogeological Consultant – Thomas Harder
No report.

C. Report from Administrative Consultant – Steve Stuart, Dudek – *Mr. Stuart advised that feedback is being sought from Committee members on use of the Beaumont Basin Data Management System (DMS). Matt Palavido has provided instructions on uploading data to the system.*

D. Report from Legal Counsel – Thierry Montoya – Frost, Brown, Todd
No report.

VII. Discussion Items

A. Update on Safe Yield Redetermination Technical Report (tabled from 7/10/2024 meeting)

Recommendation: For information and discussion.

Tom Harder of Thomas Harder & Co. reminded that a draft Technical Memorandum / report was submitted for review last May summarizing the updated safe yield. Forty-one comments were received from Dudek and all were addressed, most have been incorporated into the draft final report in the agenda packet. Those not addressed are noted in the comment letter, and supporting information was provided. He said his understanding was that the draft final report would also be submitted to the overliers for review.

Mr. Harder reminded the Committee of the request to look at how the new safe yield of 7,100 acre-feet per year for the next 10-year period would be proportioned in terms of allocation, and presented a table showing Overlying Parties Production Rights.

There is a question about the applicable Safe Yield calculation time periods applicable, Harder noted, and asked about submittal of the draft report to the overliers. Mr. Jaggers said he would work to get a package together to go out Monday, August 12.

B. Update on Revising the BBWM Rules and Regulations

Recommendation: For discussion purposes only

- *Section 2.13 Interveners*

Steve Stuart reminded the Committee about discussion at the June 5 meeting and the recommendation to strike Section 2.13 Interventions and to examine the last sentence. Member Zoba noted that interveners are covered in the Judgment and would be addressed by a legal document filed with the Court, not with the Watermaster. Following recommendation from Legal Counsel Montoya of not having procedures relative to interveners, as the Watermaster cannot legally dictate that process, it was decided to strike Section 2.13.

- *Section 4.3 Losses or Spills from the Basin*

Mr. Stuart pointed to the last sentence and asked about loss of supplemental recharge water loss prior to loss of native groundwater. He reminded that it was agreed that Basin losses and flow needed to be better understood. He noted the last sentence will remain.

Mr. Jaggers added that the original overlier allocation considered an opportunity without replenishment for the first 10 years to pump a hole in the Basin and crate an opportunity for storage. He noted that BCVWD has been balancing through conjunctive use, but which water was pumped first could become muddied by the nuances of extraction vs. replenishment. He suggested finding a solution that would balance the health of the Basin with replenishment and assuring water for the future. He discussed water flow and suggested further discussion on Basin losses.

Chair Vela wondered why the designation of which water was lost first was important, and if it impacted the Safe Yield calculation. Mr. Stuart said it did not; the question is about the physical movement of water through the Basin and the effects when working through a policy on accounting for Basin losses. Mr. Jaggers added that there was thought about storage in the Basin and which entity might lose water first, making sure that the players of Basin are not adversely affected.

- *Definition of "stored water*

Mr. Stuart reminded about the suggestion to include new yield water in the definition and said it will be revised accordingly.

- *Revision of Watermaster forms*

Mr. Stuart indicated he sent out recommended revisions and requested feedback.

- *Timeline*

Mr. Stuart indicated that the goal was to have a revised document for review and approval by the end of the year. This is a document that will be constantly reviewed and revised, but this is the first deep dive that has been taken in a number of years, he noted. He requested feedback.

In response to Chair Vela regarding Section 6.4.2, Mr. Stuart explained it is not creating a new process, it is a revision of a form related to an application for extraction for the purpose of clarity.

San Gorgonio Pass Water Agency General Manager Lance Eckhart commented on carefully working through the basin losses item, pointing to the pumping of supplemental water, previous years' unused operating safe yield, and temporary surplus water. He cautioned about economically disincentivizing from importing water and retaining a few years' supply that can be referenced in Urban Water Management Plans and keeps the Basin overall healthy.

Eckhart discussed Basin optimization, noting that stable water levels are being seen and those indicate the water is hanging around. He recommended performing an analysis of how long water remains in the Basin, similar to what has been done for a neighboring basin.

Member Jaggers added that Basin optimization incudes not only conjunctive use but mechanical activities such as moving wells and siting recharge facilities in other areas. He noted proximity of BCVWD facilities that could provide water without pumping to YVWD.

C. Revisions to the **2013** Annual Report and Revisions to the **2023** Consolidated Annual Report and Engineering Report

Recommendation: Approve the Revisions to the Final 2023 Consolidated Annual and Engineering Report or Delay Finalizing the Report until the Beaumont Basin Safe Yield for the 2023-32 Period is Approved and a Corresponding Resolution is Adopted

Hannibal Blandon pointed out that the 10-year periods of the Safe Yield redetermination are inconsistent with the annual reports since 2013. Based on Section VI, Article 5Y of the Judgment, the Safe Yield shall be redetermined at least every 10 years beginning 10 years after the date of entry of the judgment (February 2004). He explained that the first redetermination should have been applicable in 2014, but was adopted with Resolution 2015-05 for the period 2013 to 2022, which does not match the calculations in the annual report and resulted in a discrepancy of 1,950 acre-feet. He recommended revisions to the 2023 annual report adopted in June 2024 to be consistent with the Safe Yield analysis conducted in 2013, or delay finalizing the report until the 2023-2032 Safe Yield is adopted. He also recommended amendment of Resolution 2015-05 to render the previous annual reports correct regarding unused overlying water.

Mr. Blandon responded to questions from Member Zoba, noting that the 2023 annual report could be corrected in the 2024 report to reflect the Safe Yield of 7,100 af. Zoba posited that it may not be possible to be retroactive, as what is contained in an annual report occurs in that year. He suggested there is compliance with the judgment which says Safe Yield redetermination at least every 10 years but is silent about the application of the redetermined Safe Yield. He recommended stating in the next resolution the effective date of the new Safe Yield.

Mr. Blandon responded to questions from Member Jaggers, who concurred with some statements from Member Zoba. Legal Counsel Montoya stated the Watermaster has been acting consistent with its obligations under the judgment and within its discretion. Going back in time can be done, but there has been reasonable reliance on the information, he said. It can be corrected going forward, which is within the tenor, spirit, and restrictors of the judgment, and is consistent with the Watermaster's discretion, he advised.

Chair Vela emphasized consistency with the judgment and said he would rather correct in the upcoming year rather than muddy the record. He agreed with the identification of an implementation period in the resolution adopting the new safe yield.

Mr. Blandon concurred that the judgment is silent on applicability. He concluded, and Mr. Montoya stated, that the 2023 Annual Report will stand as approved.

D. Discussion on Basin Losses (tabled from 7/10/2024 meeting)
Recommendation: for information and discussion

Mr. Harder referred to earlier discussion at this meeting and at the June meeting and reminded that Basin losses have been evaluated in the past, *and establishing a policy to address those losses had been considered. It has been recommended that those losses be accounted for, as it is a part of the water balance.*

He reminded about the different hydrogeologic conditions on the east side and west side of the Basin and differences in change in storage and other aspects. He recommended retaining the information as a reference and later considering a formal management area.

Natural Basin losses are accounted for in the Safe Yield estimates but imported (owned) water stored in the Basin is not, Harder continued. He reviewed the model information and discussed scenarios. He recommended the technical team revisit the 2018 information and see how it dovetails with the model analysis stress test and revise the scope of work to include a loss analysis policy for consideration and make recommendations.

Member Zoba supported the suggestion but added that he was uncertain that the temporary surplus existed for SMWC and YVWD in the westerly portion of the Basin. How would this have been done right from the start, and how does it move forward, he asked.

Member Jaggers acknowledged the imbalance in Basin storage, and advocated a consistent approach to management with all opportunities on the table and across boundaries. The health of the basin is the most important thing, and agencies must work together more and more as water supply is subject to whiplash hydrology, he stated.

Member Armstrong emphasized it is an adjudicated Basin with storage accounts, and advised caution amid talk of Sustainable Groundwater Management Act types of activities.

Chair Vela acknowledged this is a complicated analysis and there are solutions. He pointed to variables and differences in agencies' production activities. It is the right thing to do to develop the loss policy, he stated.

In response to a question from Jaggers, Harder indicated there are currently no undesirable results in the Basin and the groundwater levels are relatively stable in most areas. The model is a planning tool for information and asking "what if," he noted.

Jaggers emphasized reasonable balance in the Basin, and understanding where weaknesses are in order for the producers and overliers to be able to support them. He offered examples of management. Harder concurred and emphasized reasonable, plausible, and not unrealistic.

Mr. Eckhart pointed out the model will become more sophisticated with time. He advised caution in making decisions with some of these tools. He *noted in another area that focus was placed on groundwater monitoring, and advised that the body of knowledge can change over time.*

Eckhart pointed out that many overliers are on the west side of the Basin, and unused production is pumped on the west and east. There is potential to balance the basin by doing just a few things such as looking at the overliers pumping, or moving water from the mound area by partnering with corresponding agencies. He suggested doing things that encourage bringing water in on a consistent basis to get through drought periods and examining whether recharge water is needed if the model shows it is getting squeezed out. He suggested that SGPWA would like to participate in some of the BBWM workshops to help carefully and thoughtfully work through some of the technical issues.

Mr. Rose offered public comment. He cautioned about use of modeling to establish policy and suggested assuring that no policy would be implemented until the community verifies the information and all the questions of all participants are answered. He encouraged accountability for losses and over purchasing / over expenditures, and said fiduciary penalties should never occur to those who would be picking up the slack for the inefficiencies of a governing body. He commented on overpaying for technology with no real outcome.

E. Discussion on Evaluating Future Hydrogeologic Scenarios Using the Model (tabled from 7/10/2024 meeting)

Recommendation: None.

Mr. Harder discussed management of the basin to avoid undesirable outcomes and reminded about the scope and cost to provide straw man scenarios that stress test the Basin. The purpose would be to use the groundwater flow model to develop a plausible range of hydrogeological conditions to stress the Basin and determine environmental results. The goal would be to establish a basis for identifying significant and unreasonable conditions that would be considered undesirable results. This would be a planning tool for future projects and management actions such as those suggested by Mr. Eckhart.

Mr. Harder described the proposed scope of work with recommended incorporation of the loss analysis.

Member Zoba clarified the scope of work, and Member Jaggers discussed scenarios and management actions for consideration. Chair Vela pointed to recycled water production and potential for supplemental extraction. Mr. Harder noted these are ways to optimize the basin, and the consultants had not envisioned inclusion, but later evaluating varying ways of managing.

He noted this work can be included if desired; Jaggers spoke in favor of including some elementary concepts.

Chair Vela commented on regional management strategy and agencies working together as key. He suggested creating different scenarios later as policy decisions change based on the regional approach. Mr. Eckhart recommended fine tuning the monitoring program and data wrap up before doing any modeling runs.

Eckhart suggested consideration of period of drought and local hydrology in addition to imported water delivery capability. He encouraged the current management actions and noted those along with a good monitoring program is where the Watermaster needs to be. He offered assistance and data from the SGPWA.

Director Kevin Walton of the SGPWA expressed concern that this meeting appears to show the consultants are the "tail wagging the dog." He said he hoped the Committee is looking at it from the perspective of the public who is paying for this work, and suggested spending money wisely.

Member Zoba assured that the Committee is frugal and cost effective. It is easy to do only the reports required by the judgment, but the Committee is turning the corner by looking at managing future water supply and the Basin. The Committee looks at the consultant work and makes sure that value is obtained. With the State Water Project reliability at 44 percent, there are other places to look where money is being spent on the SWP with no return to this area.

Member Armstrong concurred, noting there is a lot of information already, and his goal is to assure SMWC funds are being spent wisely. Although he sometimes feels the action is not going in the right direction, the BBWM is doing the right thing and collaboration is important.

Jaggers reminded that the members had been siloed, but things are getting better. He said he was encouraged by the outlooks and action, and does not feel it is high cost. At the end of the day, all want the community to have an assured water supply over time and it is important to memorialize the Committee's discussions and actions to assure the next members have a roadmap.

Chair Vela agreed it is important to parcel out the things that the BBWM is required to do (annual report) and those that the Committee is electing to do (modeling and analysis) in order to have the right information to make data-driven decisions. The costs are split among the members, he added.

VIII. Topics for Future Meetings

	Item	Date Listed
A	Development of a Recycled Water Policy	3/27/2019
B	Development of a return flow accounting policy	3/27/2019
C	Development of a methodology and policy to account for groundwater storage losses in the basin / groundwater management	3/27/2019
D	Procurement Policy including thresholds for RFP process	8/17/2021
E	Incidental discharge	10/6/2021
F	Monitoring of future west side well sites and methodologies, and potential collaboration with USGS	10/5/2022
G	Discussion on what to do when an Appropriator goes negative	10/4/2023 and 11/1/2023
H	Discussion on Policy to Document and Account for Emergency Potable Water Transfers from Appropriator to Overlying Party (Tabled from 4/17/24 meeting)	4/17/2024

IX. Comments from the Watermaster Committee Members: None.

X. Announcements

2024 Meeting Dates:

Wednesday, September 4 at 11 a.m. Special Meeting
Wednesday, October 2 at 11 a.m. Regular Meeting
Wednesday, December 4 at 11 a.m. Regular Meeting

XI. Adjournment

Chair Vela adjourned the meeting at 1:05 p.m.

Attest:

DRAFT UNTIL APPROVED

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Daniel Jaggers, Secretary
Beaumont Basin Watermaster

Item V-B

BEAUMONT BASIN WATERMASTER

Date:	October 2nd, 2024
From:	Hannibal Blandon, ALDA Inc.
Subject:	Status Report on Water Level Monitoring throughout the Beaumont Basin through Sep 16, 2024
Recommendation:	Presentation - No recommendation.

At the present time, there are 15 monitoring wells equipped with pressure transducers collecting water level information on an hourly basis at various locations throughout the basin. In addition, two of these monitoring wells are equipped with additional probes to collect barometric pressures at opposite ends of the Beaumont Basin. The location of active monitoring wells is depicted in the attached Figure No. 1. The location of three potential monitoring wells currently being considered are identified in red in this figure. Ground elevations at all sites were obtained from Google Earth, which has varied over time at selected sites and could continue to vary in the future. The Watermaster Committee is in the process of surveying all production and monitoring wells using a common datum.

Water levels at selected locations are depicted in Figures 2 through 7 and are described as follows:

- ✓ Figure No. 2 – Water levels at YVWD Well No. 34 and Oak Valley Well No. 5 are considered representative of basin conditions in the Northwest portion of the basin. From the summer of 2015 through the spring of 2019, water levels at these two wells were fairly steady; however, over the last five years a significant decline has been observed. A 20-foot decline has been recorded at YVWD 34 over this period to its current elevation of 2,122 ft. The decline at Oak Valley 5 has been steeper with a drop 24 feet in the first half of 2020 despite the fact that this well was pumped last in the fall of 2019. Oak Valley 5 is no longer being monitored, as of the Summer of 2020, as it has been destroyed. It is being included here for reference purposes at this time since there is no other well in the immediate area that could be used to monitor levels in the area.

- ✓ Figure No. 3 – Two of the Noble Creek observation wells are presented in this figure representing the shallow and deep aquifers. From the summer of 2016 through the spring of 2018, the water level in the shallow aquifer monitoring well increased over 80 feet to an elevation of 2,422 ft. Water level continued to increase, although at a lower rate, over the ensuing 18 months reaching a peak elevation of 2,431 ft in the fall of 2019. Since, it declined 100 feet to 2,331 ft. in the spring of 2023, a significant recovery of 91 ft has been recorded over the last year to its current elevation of 2,422 ft. In the deeper aquifer, the increase in water level was steady from the summer of 2016 through the spring of 2020 reaching a peak elevation of 2,302 ft.; a decline of 57 feet has been recorded since to a low elevation of 2,245 ft, recorded on August 15, 2023. On that date, this well was vandalized resulting in the disruption of the communications cable and the temporary collection of accurate water level information. With the November visit, the data was cleaned and it is now included in the figure. A new communications cable was installed on December 6th 2023. Since August 2023, water level at this well has increased by 32 ft. to elevation 2,277 ft.

- ✓ Figure No. 4 – Southern Portion of the Basin. The water level at the Summit Cemetery well is highly influenced by a nearby pumping well that is used to irrigate the cemetery grounds. Since monitoring began, the water level has fluctuated over a 20-foot range. Water level information between January and October 2022 was not collected due to equipment malfunction and vandalism. New water level monitoring equipment was installed at the beginning of October 2022 and the site has been secured to minimize future vandalism. The newly installed optical communications cable worked for a few months, but failed to transmit and was replaced on January 10, 2024. Since the beginning of the spring, water level at this well has declined 20 ft to a 2,499 ft elevation near the bottom of its operating range.

- ✓ Also depicted in Figure No. 4 is the water level at the Sun Lakes well site. It has fluctuated minimally between 2015 and the end of 2021, when it began to decline. Between November 2021 and May 2022, the water level dropped by eight feet to 2,405 ft. However, it has recovered to 2,417 ft in the last two years. Water level information could not be collected between May and early October 2022 due to equipment malfunction. Several optical communication cables have been replaced in the last two years due to manufacturer's defect. The latest cable was installed in January 2024 and has been working properly since.

- ✓ Figure No. 5 illustrates water levels at three wells owned by the City of Banning in the Southeast portion of the basin. While water level at the Old Well No. 15 (Chevron Well) has been fairly flat over the last six years at an elevation of 2,197 ft.: a somewhat significant and steady decline, close to 40 feet, has been recorded at Banning M-8 between the summer of 2015 and the present to its current elevation of 2,039 ft. Water level at Banning M-9 has fluctuated in a 19-foot range, between 2,128 ft and 2,147 ft. Current water level elevation is at 2,139 ft. While the water level probe has been collecting data hourly at this well, over the last two years, three communications cables have been replaced due to the failure of the water seal at the bottom of the cable. The latest replacement cable was installed during our January visit and continued to work through our September visit, a good sign.

- ✓ Figure No. 6 illustrates recorded water level at BCVWD No. 2 and BCVWD No. 25. Water level at these two wells follow the same seasonal pattern rising in the fall through the spring months and falling during the summer as production increases. The water level at BCVWD No. 25 has been fluctuating over a 25 ft range between 2,191 ft and 2,215 ft in elevation; however, this past summer (2023) it declined more than normal to a low elevation of 2,192 ft; since, water level is recovering to the March 2024 elevation of 2,203 ft. Over the last three years, summer lows have been lower each year, 2,199 ft in the summer of 2021, 2,194 ft in 2022, and 2,193 in 2023. In the Summer of 2024, water level elevation at this well was recorded at 2,196ft. Data for the last two months could not be retrieved from the probe, which will be changed at the November visit. At BCVWD No. 2, water levels since 2017 have ranged between 2,188 ft and 2,216 ft with a current elevation of 2,199 ft. in the middle portion of its operating range. Similar to BCVWD No. 25, lower summer lows have been recorded in recent years. A new communications cable was installed at this well on December 6, 2023; however, no data was recorded through March 2024 due to malfunctioning of the recording probe. A different probe was installed at that time and has been working fine since. Current water elevation at BCVWD No. 2 is 2,197 ft.

- ✓ Figure No. 7 depicts the recorded water level at the two newest observation wells, BCVWD No. 29 and Tukwet Canyon Well "B". BCVWD No. 29 is a pumping well on the western portion of the basin. This well was extensively used prior to 2022; however, minimum pumping has been recorded since the winter of 2021. A decline in water level of nine feet has been recorded between the spring of 2019 and the spring of 2021. During the May 2021 visit, the communications cable could not be pulled and information from the water level probe could not be downloaded. During our January 2022 visit, the water level meter got lodged between the pump column and the well casing and could not be removed; it has been there since. There is a chance that the water level meter probe may not be recovered until the column is pulled from the well and the equipment recovered.

- ✓ Tukwet B is a dedicated monitoring well in the southern portion of the basin with minimal fluctuations in elevation since the probe was installed in the spring of 2019. The March 2024 water level was recorded at 2,218 ft representing the highest recorded level since monitoring began. No water level information was available between March and May 2024 due to malfunctioning of the recording probe. Water level between May and July could not be collected due to miscommunications with operations staff. Water level information could not be retrieved from the probe at this site.

Monitoring Wells Additions

None during this period

Equipment Installation and Replacement

Water level probes were replaced at the following wells:

- ✓ There are four water level probes being refurbished and calibrated at Solinst; we are waiting for these probes to arrive to be installed.

Troubleshooting Issues

Water level information was manually retrieved at the following wells due to malfunctioning of the communication cables:

- ✓ BCVWD No. 25
- ✓ Mountain View
- ✓ Noble Creek Spreading Grounds – Shallow aquifer well

Potential Monitoring Sites

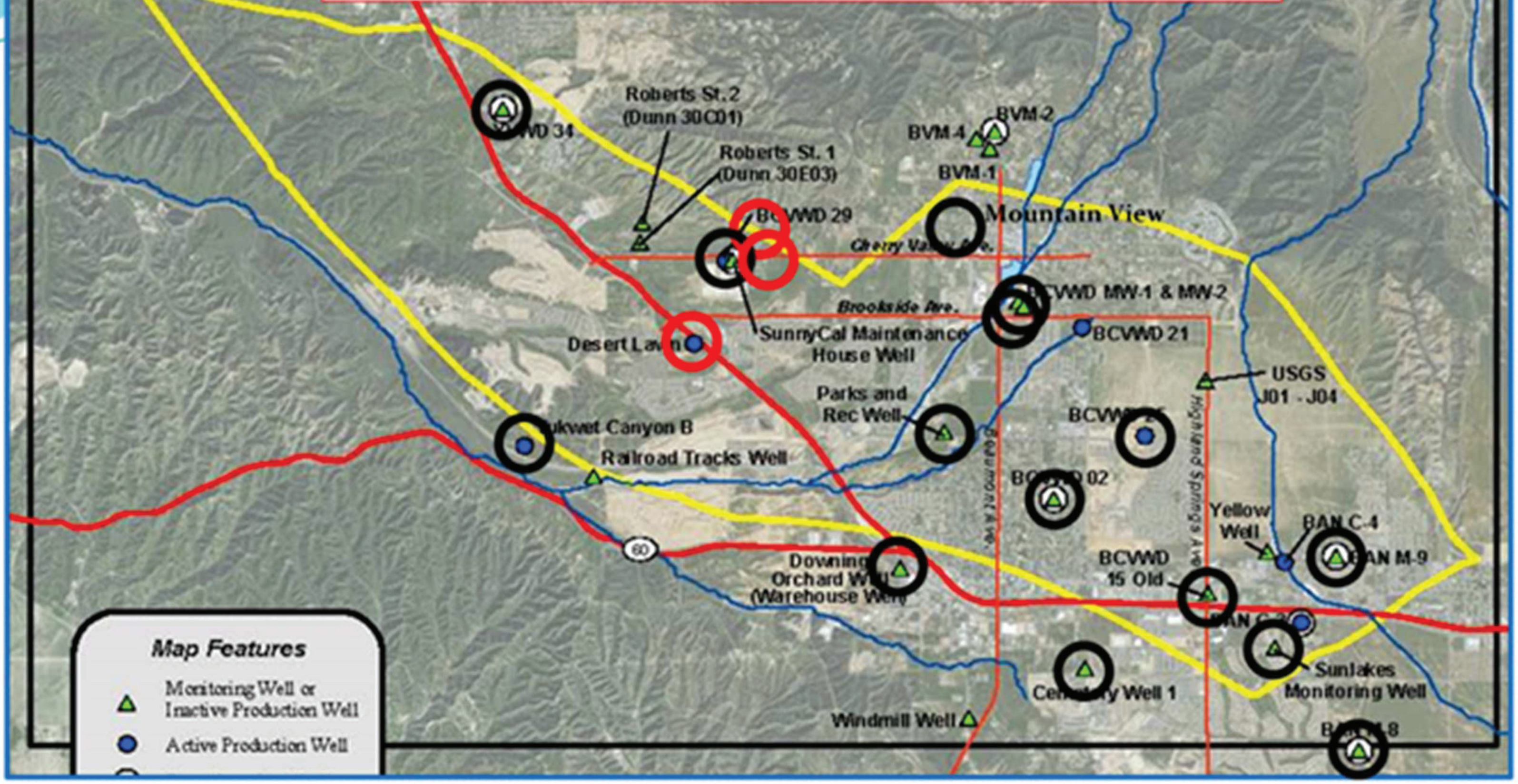
Two production wells have been identified as potential monitoring wells recently. The owners have been contacted and the sites visited. The first well is owned by the Beaumont-Cherry Valley Recreation and Park District. The well is located on the north side of Cherry Valley Blvd and has been recently used to supply water during grading for construction of two warehouses nearby.

Upon construction of these facilities, this well will be available to irrigate nearby lands; a monitoring probe could be installed with minor modifications at the well head.

The second well is owned by Plantation on the Lake. The site has been visited and owner is considering drilling a hole on the well head to accommodate the monitoring probe. No progress has been made by owner.

In addition to the two production wells, a new monitoring groundwater well, located approximately 400 ft east of BCVWD No. 29 is currently being considered. Water level at this well is 400 ft below surface and the well has a measured depth of 465 ft.

Beaumont Basin Watermaster – Monitoring Wells



Wells with Working Monitoring Probes		
Mountain View	Tukwet Well B	BCVWD No. 2
Noble Creek Ponds 4 Deep	Summit Cemetery No. 1	BCVWD No. 25
Noble Creek Ponds 4 Shallow	Sun Lakes Golf Course	BCVWD No. 29
Noble Creek Park	Banning M-8	YVWD No. 34
BCVWD Old 15 (Banning)	Banning M-9	Icon Warehouse

Potential Monitoring Wells
Beaumont Parks and Rec.
Plantation on the Lake
Sunny Cal Well – East of BCVWD No. 29

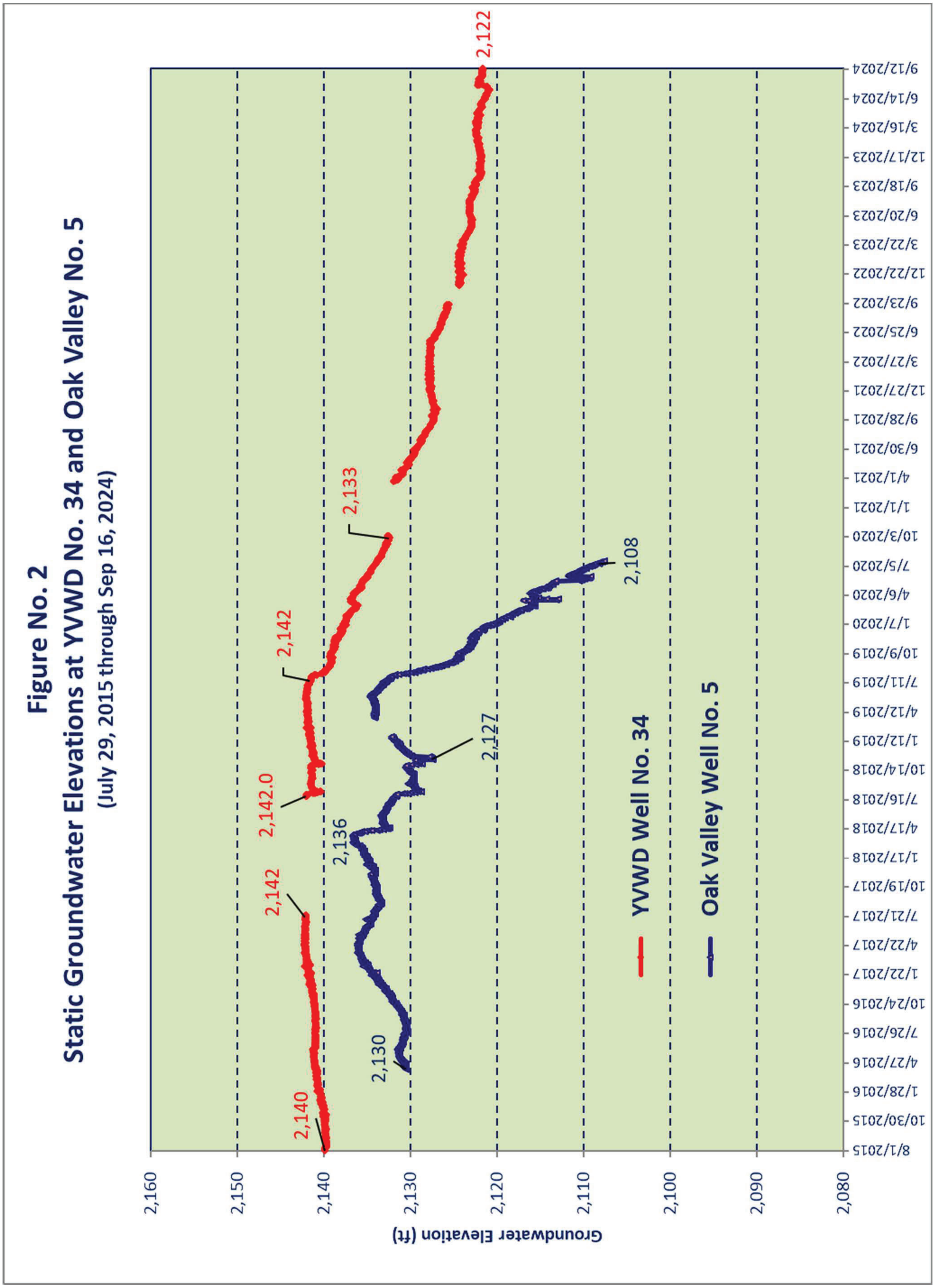


Figure No. 2
Static Groundwater Elevations at YVWD No. 34 and Oak Valley No. 5
(July 29, 2015 through Sep 16, 2024)
Groundwater Elevation (ft)
2,160
2,150
2,140
2,130
2,120
2,110
2,100
2,090
2,080
8/1/2015
10/30/2015
1/28/2016
4/27/2016
7/26/2016
10/24/2016
1/22/2017
4/22/2017
7/21/2017
10/19/2017
1/17/2018
4/17/2018
7/16/2018
10/14/2018
1/12/2019
4/12/2019
7/11/2019
10/9/2019
1/7/2020
4/6/2020
7/5/2020
10/3/2020
1/1/2021
4/1/2021
6/30/2021
9/28/2021
12/27/2021
3/27/2022
6/25/2022
9/23/2022
12/22/2022
3/22/2023
6/20/2023
9/18/2023
12/17/2023
3/16/2024
6/14/2024
9/12/2024
2,140
2,142
2,142.0
2,142
2,133
2,122
2,130
2,136
2,127
2,108
YVWD Well No. 34
Oak Valley Well No. 5

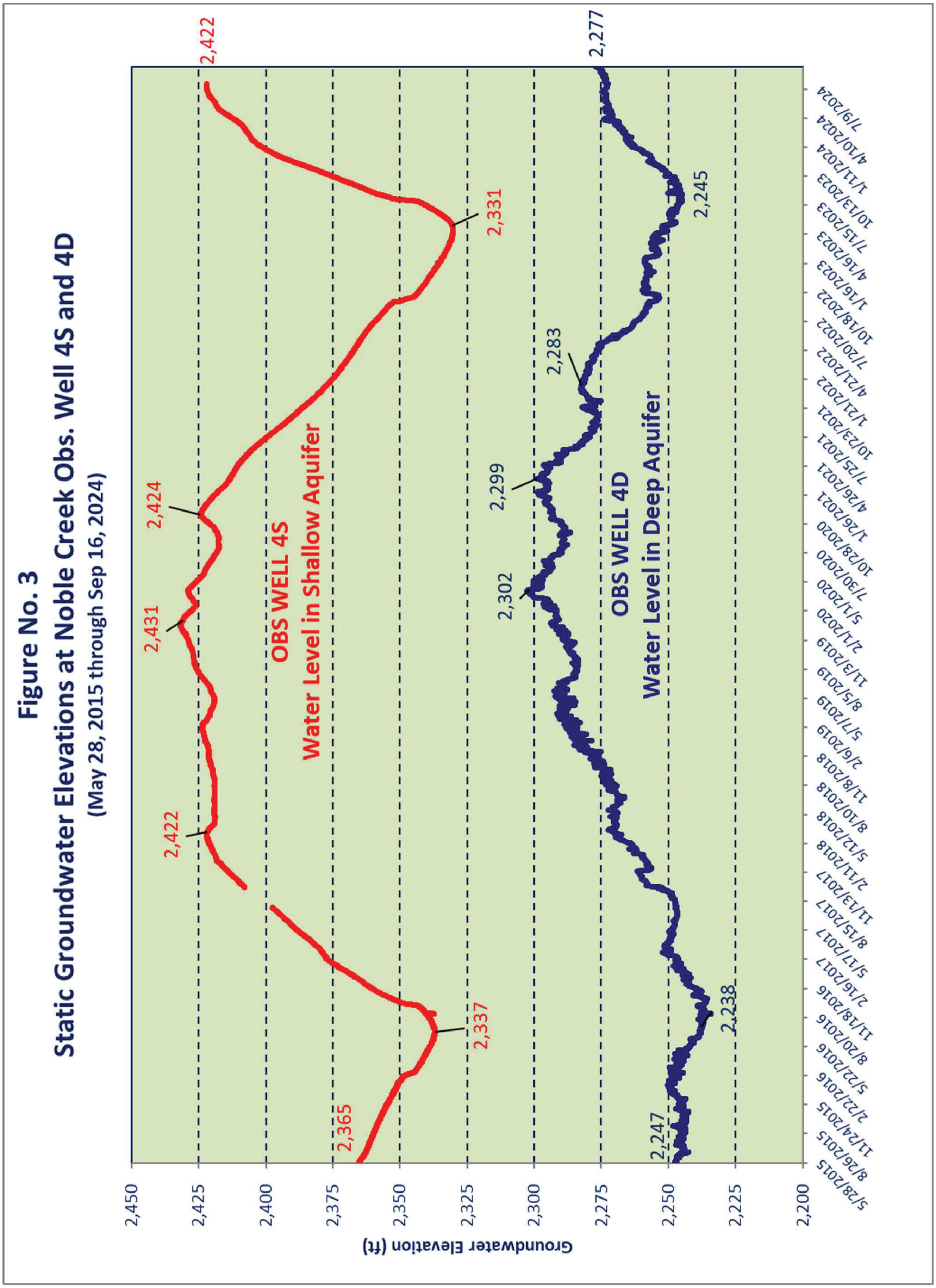


Figure No. 3
Static Groundwater Elevations at Noble Creek Obs. Well 4S and 4D
(May 28, 2015 through Sep 16, 2024)
Groundwater Elevation (ft)
2,450
2,425
2,400
2,375
2,350
2,325
2,300
2,275
2,250
2,225
2,200
OBS WELL 4S
Water Level in Shallow Aquifer
OBS WELL 4D
Water Level in Deep Aquifer
2,365
2,337
2,422
2,431
2,424
2,331
2,422
2,247
2,238
2,302
2,299
2,283
2,245
2,277
5/28/2015
8/26/2015
11/24/2015
2/22/2016
5/22/2016
8/20/2016
11/18/2016
2/16/2017
5/17/2017
8/15/2017
11/13/2017
2/11/2018
5/12/2018
8/10/2018
11/8/2018
2/6/2019
5/7/2019
8/5/2019
11/3/2019
2/1/2020
5/1/2020
7/30/2020
10/28/2020
1/26/2021
4/26/2021
7/25/2021
10/23/2021
1/21/2022
4/21/2022
7/20/2022
10/18/2022
1/16/2023
4/16/2023
7/15/2023
10/13/2023
1/11/2024
4/10/2024
7/9/2024

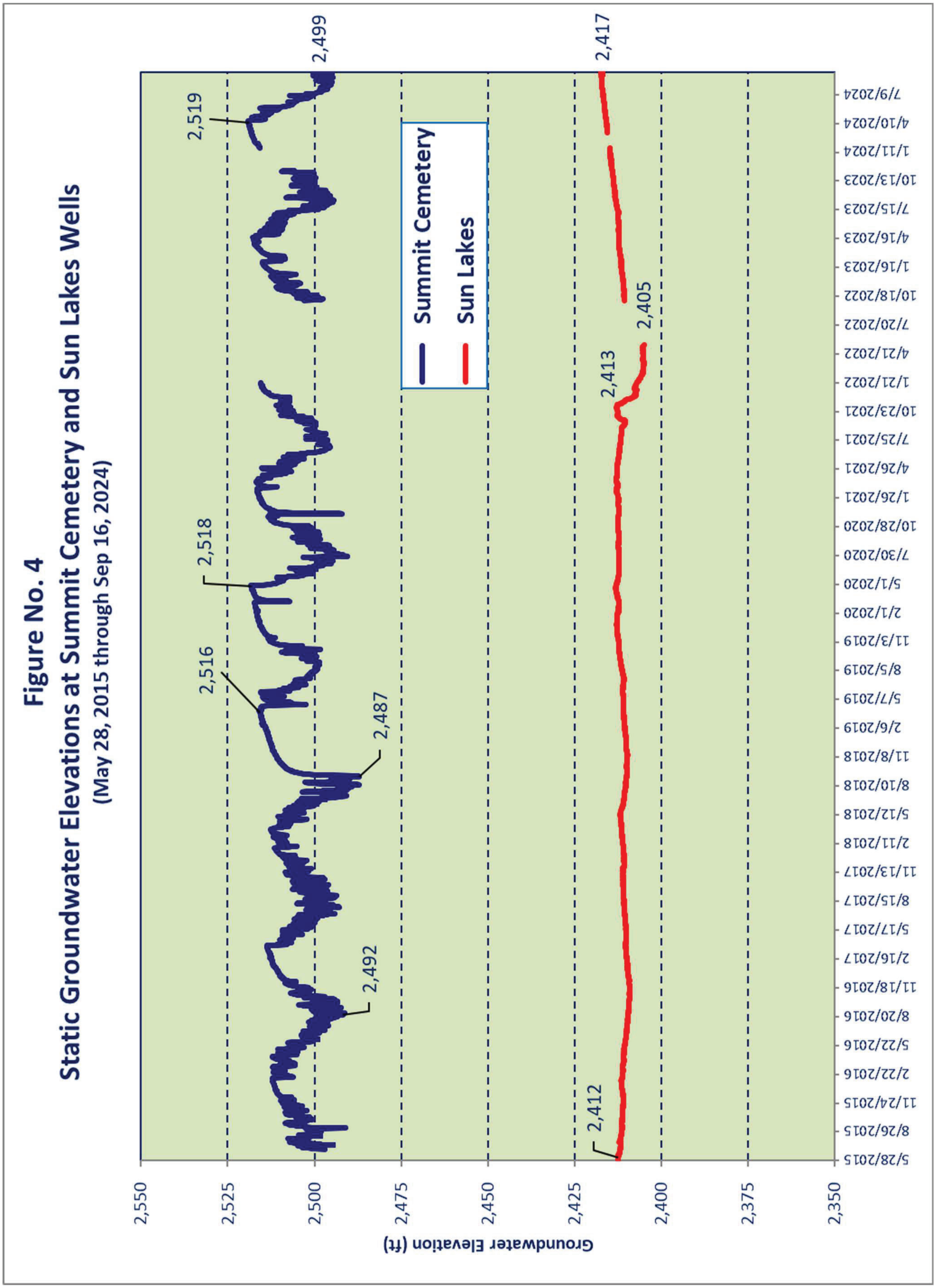


Figure No. 4
Static Groundwater Elevations at Summit Cemetery and Sun Lakes Wells
(May 28, 2015 through Sep 16, 2024)
Summit Cemetery
Sun Lakes
Groundwater Elevation (ft)
2,550
2,525
2,500
2,475
2,450
2,425
2,400
2,375
2,350
5/28/2015
8/26/2015
11/24/2015
2/22/2016
5/22/2016
8/20/2016
11/18/2016
2/16/2017
5/17/2017
8/15/2017
11/13/2017
2/11/2018
5/12/2018
8/10/2018
11/8/2018
2/6/2019
5/7/2019
8/5/2019
11/3/2019
2/1/2020
5/1/2020
7/30/2020
10/28/2020
1/26/2021
4/26/2021
7/25/2021
10/23/2021
1/21/2022
4/21/2022
7/20/2022
10/18/2022
1/16/2023
4/16/2023
7/15/2023
10/13/2023
1/11/2024
4/10/2024
7/9/2024
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2,516
2,518
2,519
2,499
2,412
2,413
2,405
2,417

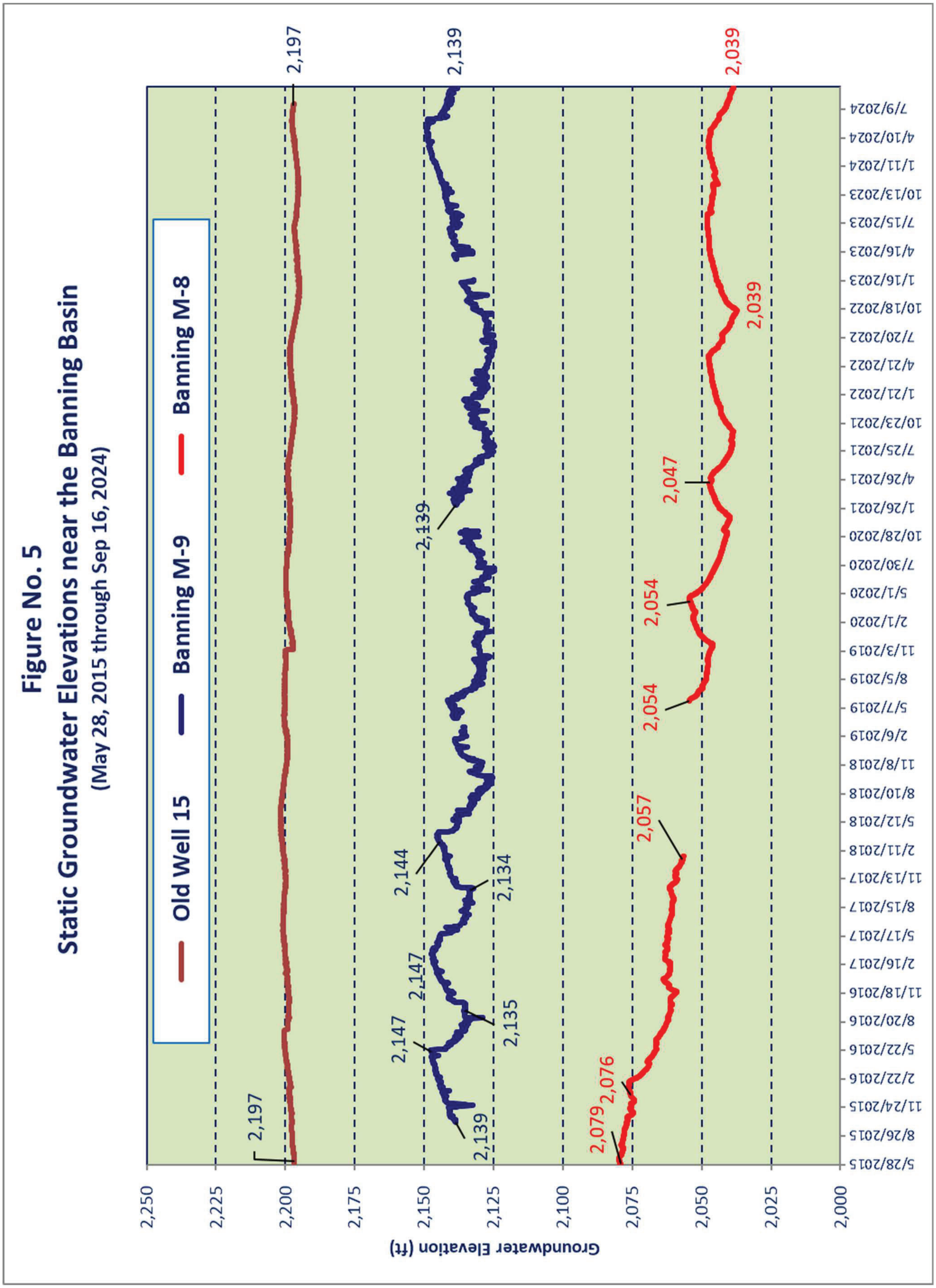
Figure No. 5
Static Groundwater Elevations near the Banning Basin
(May 28, 2015 through Sep 16, 2024)
Old Well 15
Banning M-9
Banning M-8
Groundwater Elevation (ft)
2,250
2,225
2,200
2,175
2,150
2,125
2,100
2,075
2,050
2,025
2,000
5/28/2015
8/26/2015
11/24/2015
2/22/2016
5/22/2016
8/20/2016
11/18/2016
2/16/2017
5/17/2017
8/15/2017
11/13/2017
2/11/2018
5/12/2018
8/10/2018
11/8/2018
2/6/2019
5/7/2019
8/5/2019
11/3/2019
2/1/2020
5/1/2020
7/30/2020
10/28/2020
1/26/2021
4/26/2021
7/25/2021
10/23/2021
1/21/2022
4/21/2022
7/20/2022
10/18/2022
1/16/2023
4/16/2023
7/15/2023
10/13/2023
1/11/2024
4/10/2024
7/9/2024
2,197
2,197
2,139
2,147
2,135
2,147
2,134
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2,139
2,139
2,079
2,076
2,057
2,054
2,054
2,047
2,039
2,039

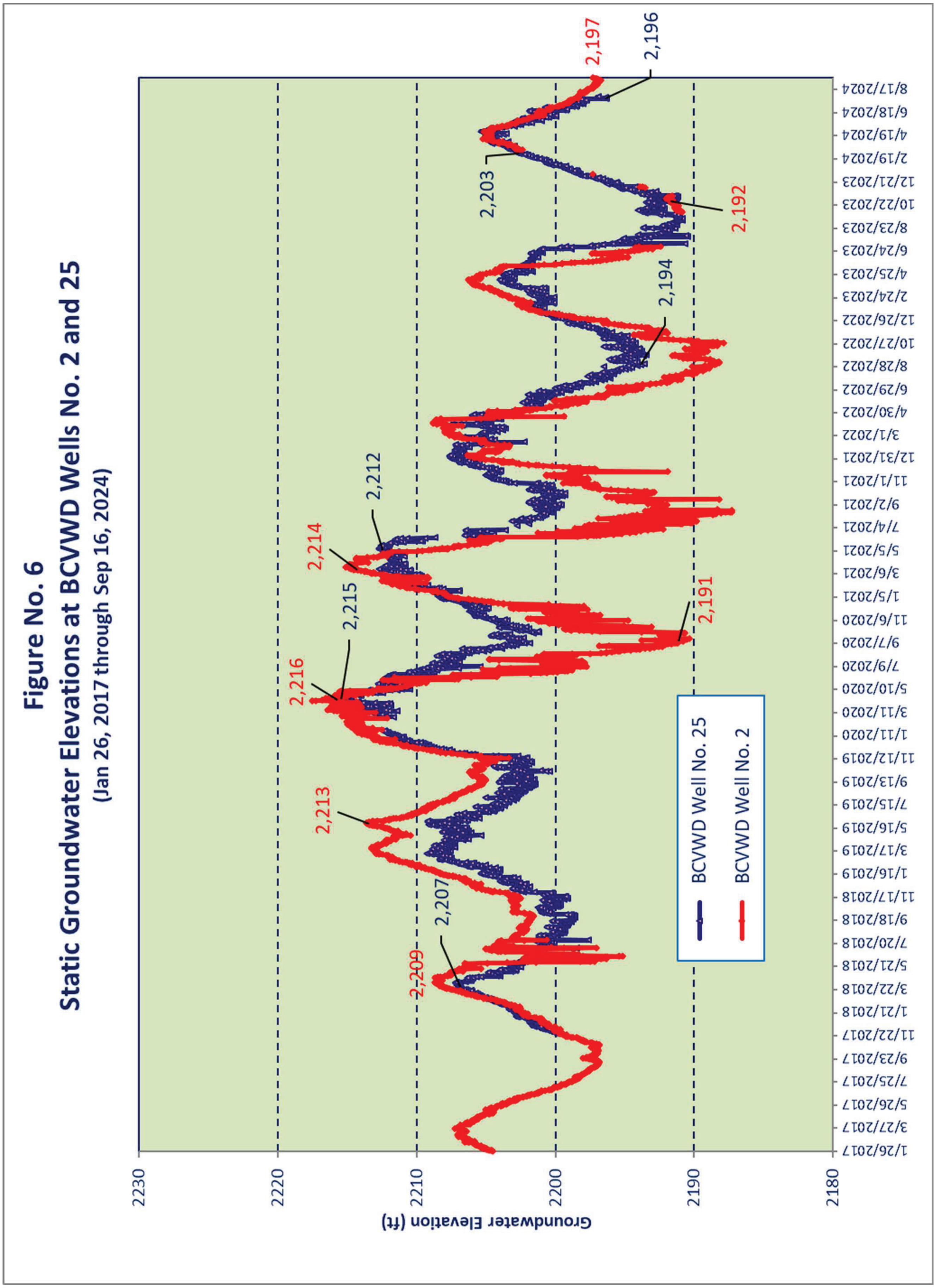
Figure No. 6
Static Groundwater Elevations at BCVWD Wells No. 2 and 25
(Jan 26, 2017 through Sep 16, 2024)
BCVWD Well No. 25
BCVWD Well No. 2
Groundwater Elevation (ft)
2230
2220
2210
2200
2190
2180
1/26/2017
3/27/2017
5/26/2017
7/25/2017
9/23/2017
11/22/2017
1/21/2018
3/22/2018
5/21/2018
7/20/2018
9/18/2018
11/17/2018
1/16/2019
3/17/2019
5/16/2019
7/15/2019
9/13/2019
11/12/2019
1/11/2020
3/11/2020
5/10/2020
7/9/2020
9/7/2020
11/6/2020
1/5/2021
3/6/2021
5/5/2021
7/4/2021
9/2/2021
11/1/2021
12/31/2021
3/1/2022
4/30/2022
6/29/2022
8/28/2022
10/27/2022
12/26/2022
2/24/2023
4/25/2023
6/24/2023
8/23/2023
10/22/2023
12/21/2023
2/19/2024
4/19/2024
6/18/2024
8/17/2024
2,209
2,207
2,213
2,216
2,215
2,191
2,214
2,212
2,194
2,192
2,203
2,197
2,196

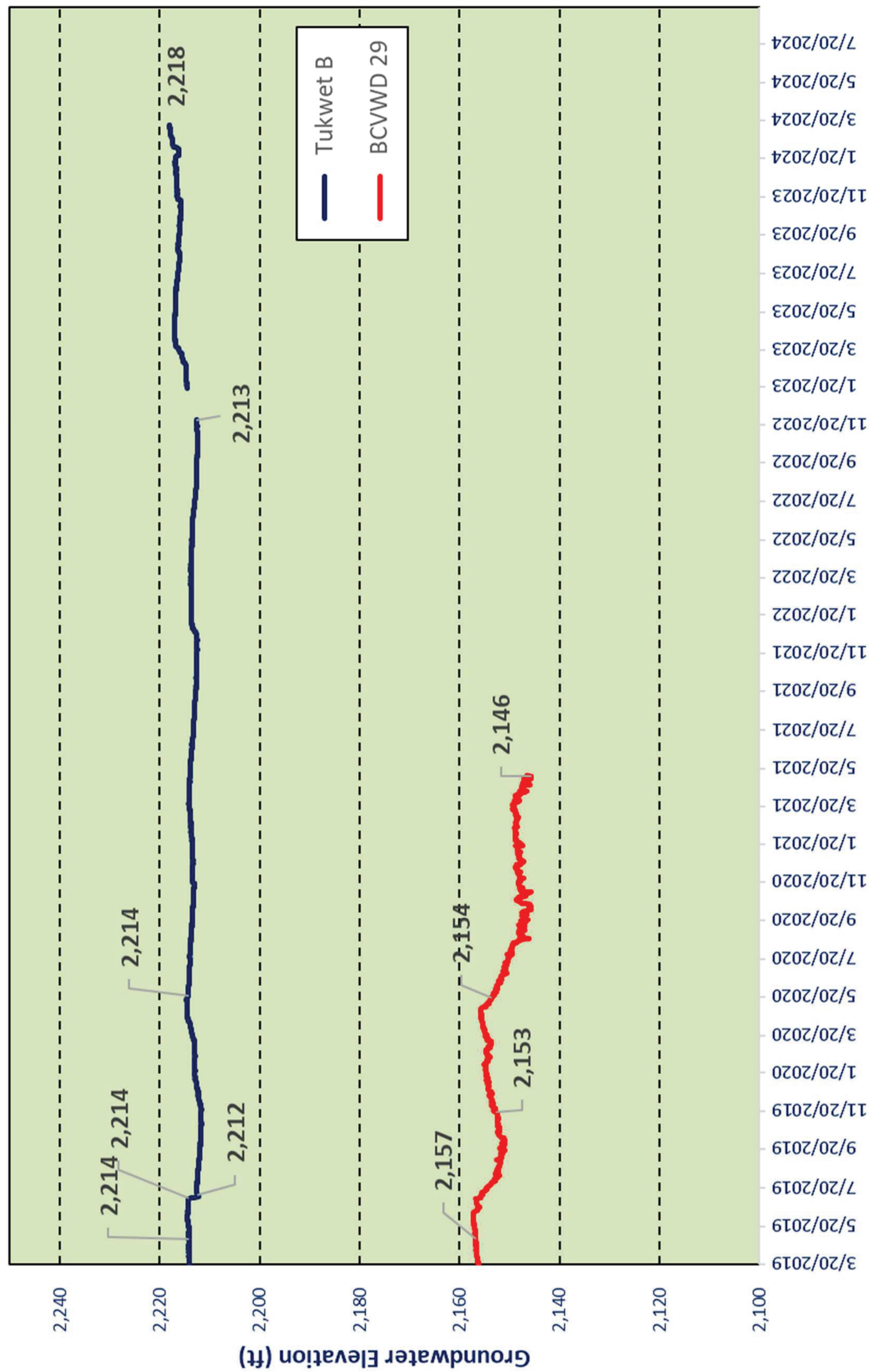

Figure No. 7
Static Water Level at BCVWD No. 29 and Tukwet Cyn Well B
(Mar 20, 2019 through Sep 16, 2024)

BEAUMONT BASIN WATERMASTER

Date: October 2nd, 2024

From: Hannibal Blandon, ALDA Inc.

Subject: A Comparison of Production Rights vs. Production through August 2024

Recommendation: No recommendation - For informational purposes only

This Technical Memorandum presents a comparison of Appropriator's Production Rights from the Beaumont Basin against actual production. At the beginning of each year, Appropriators have certain Production Rights resulting from: a) unused production by overlying users from 2019 and/or b) permanent transfers of overlying water rights. Production Rights for individual Appropriators can be increased through the course of the year by spreading imported (supplemental) water.

Total production by Appropriators through August 2024 was 8,324 ac-ft while Appropriator's Production Rights for the same period were 13,939 ac-ft resulting in a positive storage balance of 5,615 ac-ft, as presented in the table below. Spreading of supplemental water in the first eight months of the year was 8,599 ac-ft between BCVWD, the city of Banning, and YVWD. The Production Rights for all Appropriators was higher than their respective production amounts resulting in a net temporary addition to their individual storage accounts. Change in storage accounts will be adjusted throughout the calendar year.

	City of Banning	Beaumont Cherry Valley W. D.	South Mesa Mutual W. C.	Yucaipa Valley W. D. (1)	Total
Appropriative Water Rights	1,528	2,067	607	660	4,862
Transfer of Overlying Water Right to Appropriator	0	0	0	478	478
Supplemental Water	1,000	6,599	0	1,000	8,599
Appropriator's Production Rights	2,528	8,666	607	2,138	13,939
Production (2)	790	6,809	117	608	8,324
Change in Storage Account	1,738	1,857	490	1,530	5,615
Storage Account Balance as of December 2023	47,651	32,884	10,506	16,855	107,896

1.- YVWD was credited at the beginning of the year with 478.30 ac-ft of Overlying transfers from OVP. Actual credit may be different at the end of the year.
2.- Production by the City of Banning includes 17 ac-ft of groundwater produced by BCVWD and delivered to the city at their two connection points.

Discussion Items

ITEM VII-A

BEAUMONT BASIN WATERMASTER
MEMORANDUM NO. 24-32

Date:	October 2, 2024
From:	Thomas Harder, Thomas Harder & Co.
Subject:	Update on the Redetermination of the Safe Yield of the Beaumont Basin
Recommendation:	For Information and Discussion

As per the 2003 Beaumont Basin Judgment, "The Safe Yield of the Beaumont Basin shall be redetermined at least every 10 years beginning 10 years after the date of entry of this Judgment."[1] The first redetermination of the Beaumont Basin Safe Yield was conducted in 2013[2] and revised the Safe Yield to be 6,700 acre-ft per year. The proposed revised Safe Yield for the next 10-year period from 2023 to 2032 is 7,100 acre-ft per year.

The draft report documenting the Reevaluation of the Beaumont Basin Safe Yield was submitted in May 2024. Based on comments received, TH&Co revised the report and submitted a Draft-Final version in July 2024. The Draft-Final version of the report was submitted to the Overlying Parties to the Judgment in August of 2024.

TH&Co is soliciting direction from the Committee to finalize the report.

Attachment: Draft Final 2023 Reevaluation of the Beaumont Basin Safe Yield (116 pages)

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[1] Beaumont Basin Judgment. Section VI Administration, 5 (Y).
[2] Thomas Harder & Co., 2015. 2013 Reevaluation of the Beaumont Basin Safe Yield. Dated April 3, 2015.

DRAFT-FINAL 2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024

Prepared for

Beaumont Basin Watermaster

Prepared by

Thomas Harder, PG, CHG
Principal Hydrogeologist

Matthew Ford
Staff Hydrogeologist

Jim Van de Water, PG, CHG
Principal Hydrogeologist

Thomas Harder & Co.
Groundwater Consulting

Table of Contents

Tables

Figures

Appendices

Acronyms

ASR – Aquifer Storage & Recovery

BCF – Block-Centered Flow Package

BCVWD - Beaumont-Cherry Valley Water District

CGS – California Geological Survey

CHD - Constant Head Boundary

CIMIS – California Irrigation Management Information System

DEM – Digital Elevation Model

DRT – Drain Return Package

DWR – Department of Water Resources (California)

ESRI – Environmental Systems Research Institute

ET- Evapotranspiration

ET_o – Reference evapotranspiration

GHB – General Head Boundary

LSGCRF – Little San Gorgonio Creek Recharge Facility

MBR – Mountain Block Recharge

MODFLOW – Modular Finite-Difference Flow Model

NRMSE – Normalized Root Mean Square Error

PEST – Parameter Extinction Software Test

RIC – Responsive Interventions for Change

SFR – Streamflow-Routing Package

SGPWA - San Gorgonio Pass Water Agency

SMWC - South Mesa Water Company

STF – San Timoteo Formation

STR – Stream Package

SWP – State Water Project (California)

TH&Co - Thomas Harder & Company

UPW – Upstream Weighting Package

USGS – United States Geological Survey

VIC – Variable Infiltration Capacity

WEL – Well Package

WWTP – Wastewater Treatment Plant

YVWD - Yucaipa Valley Water District

1.0 Introduction

1.1 Background

The Beaumont Basin is located in the San Gorgonio Pass, a low-relief highland located between the San Bernardino Mountains and the San Timoteo Hills in Riverside County, California (Figure 1). The boundaries of the Beaumont Basin (also referred to as the Beaumont Storage Unit) were originally defined by Bloyd (1971) and adopted by the Superior Court of the State of California (the Court), when the basin was adjudicated per Riverside County case number RIC 389197, *San Timoteo Watershed Management Authority vs. City of Banning, et al*. (the Judgment) (Figure 2). It is noted that subsequent studies of the Beaumont Basin area have redefined the hydrogeologic boundaries of the groundwater basin (Rewis et al., 2006). However, for purposes of this report, the Beaumont Basin refers to the adjudicated basin area as defined in the Judgment.

The Safe Yield of the Beaumont Basin is defined by the Judgment as "The maximum quantity of water which can be produced annually from a groundwater basin under a given set of conditions without causing a gradual lowering of the groundwater level leading eventually to depletion of the supply in storage." The Safe Yield in the original Judgment was 8,650 acre-ft/yr. As per the Judgment, the Safe Yield is to be reevaluated every 10 years. In 2013, the Safe Yield was reset at 6,700 acre-ft/year. This report presents the 10-yr reevaluation of the Safe Yield of the Beaumont Basin for 2023.

1.2 Purpose and Scope

The purpose of this analysis was to reevaluate the Safe Yield of the Beaumont Basin in keeping with the requirements of the Judgment. The evaluation was conducted by developing a detailed water balance of the basin and vicinity with the aid of a calibrated numerical groundwater flow model.

The groundwater flow model used for the analysis was originally based on a model previously developed by the United States Geological Survey (USGS) for the Beaumont area (Rewis et al., 2006). The model had been updated and refined for the 2013 Safe Yield reset. For the 2023 Safe Yield reset, the groundwater model was further updated and refined to reflect new data collected over the previous 10 years.

The scope of the evaluation consisted of:

1. Obtaining and compiling data.
2. Updating and refining the existing groundwater flow model.

3. Calibrating the groundwater flow model through December 2022.
4. Create a 50-year future model projection.
5. Reevaluating the safe yield of the Beaumont Basin Adjudicated Area using the calibrated groundwater flow model.
6. Preparing this report summarizing the findings.

1.3 Safe Yield Reevaluation Approach

The Safe Yield of the Beaumont Basin is a function of the overall water balance of the area. Changes in water/groundwater inflow to the basin and water/groundwater outflow from the basin impact the Safe Yield. As groundwater management and land use changes impact the water balance, they also impact the Safe Yield. A generalized expression of the water balance is as follows:

$$\text{Inflow} - \text{Outflow} = +/- \text{ Change in Storage} \qquad (1)$$

The water balance equation for pre-developed conditions (prior to human occupation) can be further expressed as:

$$(I_{ss} + I_{mfr} + I_{pr} + I_{str}) - (O_{ss} + O_{et} + O_{st}) = \Delta S \qquad (2)$$

Where:

I_{ss} = Inflow from Subsurface Underflow

I_{mfr} = Inflow from Mountain Front Recharge

I_{pr} = Inflow from Areal Recharge from Precipitation

I_{str} = Inflow from Infiltration from Runoff in Stream Beds

O_{ss} = Subsurface Outflow

O_{et} = Evapotranspiration

O_{st} = Groundwater Discharge to Streams

ΔS = Change in Groundwater Storage

Under pre-developed conditions, the groundwater basin would be in a state of equilibrium such that the inflow and outflow would balance and there would be no significant long-term change in storage. Under this condition, groundwater levels would be relatively stable (Figure 3).

Under developed land use conditions, the water balance changes as groundwater is pumped from the basin for irrigation and municipal supply (Figure 4). Lowering of the groundwater table resulting from pumping reduces the amount of groundwater that would otherwise leave the basin and reduces evapotranspiration losses in areas of shallow groundwater (e.g. San Timoteo Creek). Some of the pumped groundwater used for irrigation infiltrates past the roots of the plants and returns to the groundwater as return flow. Groundwater return flow also occurs as a result of discharges from individual septic systems. Other sources of recharge to the groundwater under developed land use include wastewater treatment plant discharges and artificial recharge in spreading basins. Finally, the balance of precipitation infiltration and runoff changes in areas of buildings and roads that were previously native soil and vegetation.

The water balance equation for developed land use conditions is as follows:

$$(I_{ss} + I_{mfr} + I_{pr} + I_{str} + I_{rf} + I_{ar}) - (O_{ss} + O_{et} + O_{st} + O_p) = \Delta S \qquad (3)$$

Where:

I_{rf} = Inflow from Return Flow

I_{ar} = Inflow from Artificial Recharge

O_p = Outflow from Groundwater Pumping

Under developed basin conditions, if the inflow terms exceed the outflow terms, then the groundwater in storage increases (become positive) and groundwater levels rise. If the outflow terms exceed the inflow, then the groundwater in storage decreases (become negative) and groundwater levels drop.

The Safe Yield of a developed groundwater basin is the combination of pumping and recharge under a given land use condition that results in no long-term change in groundwater storage in the basin. The water balance equation can be rearranged and simplified to estimate Safe Yield:

$$\text{Safe Yield} = \Delta S + O_p - I_{ar} \qquad (4)$$

This relationship is valid if the following conditions are met:

1. The Safe Yield incorporates a hydrology that is representative of a relatively long period of record that includes multiple wet and dry hydrologic cycles.
2. The land use conditions are representative of the time period.
3. Pumping and recharge within the basin does not result in adverse impacts.

The approach used to reevaluate the Safe Yield of the Beaumont Basin was to use the calibrated numerical groundwater flow model to simulate future projections of groundwater pumping and artificial recharge in the context of a long-term average hydrology and return flow based on projected land use conditions. The Safe Yield for 2023 to 2032 is based on Equation 4 above and is the arithmetic average of 55 annual safe yield values spanning the calendar years 1978 through 2032.[1]

1.4 Types and Sources of Data

Compilation, review and analysis of multiple types of data were necessary to refine the groundwater flow model. The various types of data are summarized in Figure 5 and include geology, soils/lithology, hydrogeology, surface water hydrology, climate, land use, topography, groundwater recharge and recovery, and climate change data. Groundwater levels, precipitation, imported water, well construction information, groundwater quality, and pumping test data were stored in a relational database expanded from database files provided by the USGS, San Gorgonio Pass Water Agency (SGPWA), Beaumont Cherry Valley Water District (BCVWD), South Mesa Water Company (SMWC), City of Banning, Yucaipa Valley Water District (YVWD), Riverside County Flood Control and Water Conservation District, and Beaumont Basin Watermaster. Other types of data necessary for analysis were compiled into spreadsheets. Historical groundwater quality data was collected and can be incorporated into future model analyses if a water quality transport component is added to the existing groundwater flow model.

Data for updating and refining the groundwater flow model were obtained from multiple sources:

Geological Data including geologic maps and cross sections were obtained from the USGS and the California Geological Survey (CGS).

Soils/Lithological Data including detailed lithologic logs from wells and test boreholes, geophysical logs, and drillers' logs from wells and test boreholes were obtained from the California Department of Water Resources (DWR), City of Banning, Yucaipa Valley Water District (YVWD), South Mesa Water Company (SMWC), and Beaumont-Cherry Valley Water District (BCVWD).

[1] Each of the 55 annual safe yield values is based on 12 monthly safe yield values. For example, the annual safe yield for calendar year 2020 is the sum of the safe yield values for January through December 2020.

Hydrogeological Data including groundwater levels, pumping test data, and groundwater chemistry were obtained from the San Gorgonio Pass Water Agency (SGPWA), BCVWD, SMWC, YVWD, and City of Banning.

Groundwater Recharge and Recovery Data including spreading basin locations and dimensions, artificial recharge, water well construction, well locations, groundwater production, and information for septic return flow estimates were obtained from SGPWA, BCVWD, SMWC, YVWD, and City of Banning.

Hydrological (i.e. Surface Water) Data consisted of stream gage data along Little San Gorgonio Creek and San Timoteo Creek and was obtained from BCVWD and USGS. Wastewater treatment plant discharge data was obtained from the City of Beaumont.

Climate Data was acquired from the Riverside County Flood Control and Water Conservation District for the Beaumont weather station and DWR's California Irrigation Management Information System (CIMIS) at the University of California, Riverside station. Future climatology, hydrology, and streamflow was obtained from DWR.

Land Use Data was obtained from the DWR. Aerial photographs of land use conditions were obtained from the USGS, the United States Department of Agriculture Firescope, and ESRI Imagery Basemaps. Zoning maps from General Plans were obtained from the City of Beaumont, the City of Banning, the City of Calimesa, and Riverside County.

Topographical Data including Digital Elevation Models (DEMs) and topographical maps were acquired from the USGS.

In addition to the various types of data, numerous historical reports on the geology, hydrogeology and groundwater management of the Study Area were reviewed. These reports included USGS publications, DWR reports and bulletins, and agency reports. Publications relied on for the generation of this report are listed in the References (Section 7).

2.0 Updates to the Groundwater Flow Model

The groundwater flow model used for the analysis was originally based on a model previously developed by the United States Geological Survey (USGS) for the Beaumont area (Rewis et al., 2006). For the 2013 Reevaluation of the Beaumont Basin Safe Yield, Thomas Harder & Co. (TH&Co) refined and updated the USGS model for use in the Safe Yield estimate. Full documentation of the model used in the 2013 Safe Yield redetermination (i.e., "the previous model") is provided in TH&Co (2015).

For the 2023 Reevaluation of the Beaumont Basin Safe Yield, certain aspects of the 2013 model (i.e. "the previous model") remain unchanged. The area of the model remains approximately 6.5 miles in the north-south direction and 12.2 miles in the east-west direction (approximately 79 square miles). Discretization of the model is also unchanged, with 164 ft by 164 ft cells in 393 columns and 210 rows. The model coordinate system remains State Plane Zone 6.

Several updates and modifications were applied to the previous model thereby resulting in the "updated model" used for the analysis presented herein. These updates were made: 1) to incorporate data collected since the previous update, 2) to make use of more recent groundwater flow modeling software, and 3) to make use of the most recent advances in model calibration and uncertainty analysis software. These updates and modifications are summarized in the list below and detailed in the subsections that follow as necessary.

1. The previous model was converted from an outdated single-precision version of MODFLOW-2005 to the most recent[2] double-precision version of MODFLOW-NWT (Niswonger and Panday, 2011). This conversion necessitated replacing the block-centered flow (BCF) package with the upstream weighting (UPW) package and the preconditioned conjugate-gradient (PCG) package with the Newton solver (NWT) package.
2. A low permeability layer was inserted within Layer 1 of the previous model thereby increasing the number of model layers from two to four. That is, Layer 1 of the previous model now consists of three layers in the updated model used for this analysis and Layer 2 of the previous model is now Layer 4 in the updated model. This necessitated modification of several packages, notably, the horizontal flow barrier (HFB) and general head boundary (GHB) packages.
3. The stream (STR) package was replaced with the streamflow routing (SFR) package.
4. The well (WEL) package was replaced with the multinode well (MNW2) package.
5. The time-variant specified head (CHD) package was integrated within the revised general head boundary (GHB) package and is therefore not used in the updated model. The GHB package was expanded along the perimeter of the active model area using 16 segments of varying lengths in those areas believed to contribute or remove groundwater. Wells used

[2] Version 1.3.0, July 1, 2022 as posted on USGS website.

as influx boundaries along the perimeter of the active model area in the previous model were integrated into the revised GHB package. Therefore, there no longer any influx boundaries simulated using wells in the updated model. The new GHB segments extend through all four of the new layers comprising the updated model.

6. Additional months of measured data (e.g., pumping, imported water, wastewater discharges, and groundwater elevations) were appended to model stress packages (e.g., well [MNW2], recharge [RCH], streamflow routing [SFR], and general head boundary [GHB] packages) through December 2022.
7. The RCH package was modified to include additional managed recharge facilities (i.e., Noble Creek Southeast, Brookside West, and Brookside East).
8. The drain return flow (DRT) package was introduced to simulate groundwater outflow through alluvial channels in the northwestern area of the Beaumont Basin. It was later found that the original USGS model incorporated the drain (DRN) package for the same reason. As such, the approach taken in the updated model is conceptually consistent with the original USGS model.
9. Model stress periods, which were variable in length in the previous model, were modified such that all model stress periods are 1 month in duration (i.e., 28 or 29 days for February, 30 days for April, June, September, and November, and 31 days for January, March, May, July, August, October, and December). These changes necessitated changes to the stress packages (i.e., the evapotranspiration [EVT], GHB, RCH, SFR, MNW2 packages).
10. The updated model was configured within a PEST++-IES framework as discussed in Section 4.

Given these modifications, the updated model:

- Consists of four layers, each of which contains 210 rows by 393 columns;
- Consists entirely of uniformly-sized square model grid cells that are 164 feet on each side (these dimensions are retained from the original USGS model, which used units of meters and square cells 50 meters on each side);
- The active area of Layers 1 and 2 are identical whereas those of Layers 3 and 4 are smaller);[3]
- Layers 1 and 2 each contain 37,503 active cells whereas Layers 3 and 4 contain 37,282 and 29,067 active cells, respectively (i.e,, the updated model contains a total of 141,355 active cells);
- Simulates the time period of January 1, 1978 through December 31, 2032;
- Contains 660 monthly stress periods; and

[3] The "active area" consists of those model cells in which the equations associated with the various input packages (e.g., UPW, SFR, GHB, etc.) are solved by MODFLOW-NWT.

- As each stress period consists of a single timestep, the time step multiplier was set to 1.0 for all stress periods.

2.1 Updated Model Calibration Period

The previous model had been updated each year since 2013 with groundwater pumping, recharge, and imported water data through December 2021. For the update described herein, data for the calendar year 2022 were appended to these input files to extend the model calibration period from January 2022 through December 2022. The updated 2023 model uses monthly stress periods; therefore, twelve stress periods were appended to the model to extend the calibration through December 2022.

The previous historical period of the model was January 1927 through December 2021. TH&Co shortened the historical calibration period by removing January 1927 through December 1977 from the model. This modification was made to reduce model runtimes. Therefore, the model calibration period for the updated model is January 1978 through December 2022.

2.2 Created Uniform Model Stress Periods

Model stress periods are discrete time intervals over which groundwater flow and associated boundary conditions are simulated in a groundwater flow model. These stress periods divide the simulation period into manageable segments, allowing for the representation of temporal variations in boundary conditions, such as recharge rates, pumping rates, and hydraulic head values. Each stress period typically represents a fixed duration, such as a month, a season, or a year, depending on the temporal resolution required for the model simulation period.

In the previous version of the model, each stress period did not represent a uniform period. There were stress periods which represented multiple years and stress periods which represented only a few days. Having uniform stress periods helps maintain numerical stability during the simulation by preventing abrupt changes in boundary conditions between time steps. This reduces the likelihood of convergence issues, and numerical instabilities that may arise when the model encounters discontinuities in boundary conditions. Consistent stress periods make model updates easier as it becomes unnecessary to convert model input data received from the stakeholders into various time units of years, months, and days. Lastly, uniform stress periods increase the compatibility of post-processing the results of the groundwater flow model; making temporal conversions redundant.

2.3 Changed Model Layering

The previous version of the Beaumont Basin groundwater model consistently underestimated shallow groundwater levels at the Noble Creek recharge basins, relative to measured groundwater level data. The discrepancy between simulated and measured groundwater levels at Noble Creek Shallow monitoring well NC-4S was greatest during times when large volumes were being recharged into the Noble Creek recharge basins. Further analysis of cross sections of the area suggested that the model was not representing the interbedded fine-grained layers (silt and/or clay) in the upper approximately 400 feet of subsurface sediments that were, in reality, impeding the recharge rates and resulting in a higher recharge mound.

To address the model calibration issues in the Noble Creek recharge basin area and better represent the interbedded nature of the sediments above the regional aquifer system, TH&Co added a low permeability 50-foot-thick confining unit uniformly across the entire model domain (Figures 6 through 8). This confining unit was added based upon silt/clay lenses observed in lithologic logs for wells SMWC 04, YVWD 34 and 48, BCVWD 24 through 26, BCVWD 29, BCVWD MW-1, 2S/1W-35J01, Banning C-2A, Banning C-3, and Banning M9. The addition of the new low permeability unit resulted in splitting the previous model Layer 1 into three layers (Layers 1 through 3; Figures 7 and 8). The previous model Layer 2 became model Layer 4 and has not changed in terms of thickness or depth relative to the previous version of the model. The thickness of each of the four new model layers is shown on Figure 9a through 9d.

Overall, adding the low permeability layer significantly improved model calibration at well NC-4S (see Section 4). The model calibration at well NC-4D was largely unchanged and is acceptable, especially from 2019 onward (see Appendix C, page 23 of 87).

2.4 Updated The Model Solver

As discussed in the introduction to this section, the model was converted from a single-precision version MODFLOW 2005 to the most recent double-precision version of MODFLOW-NWT. This conversion required the use of the NWT solver and UPW package. This conversion was made to improve accuracy of groundwater flow calculations, convergence, and stability.

2.5 Updated the Stream Simulation Package in the Model

To better represent flow in San Timoteo Creek in the southern part of the model domain, TH&Co updated the Beaumont Basin groundwater flow model with an updated version of the MODFLOW stream package. The stream package was updated from the STR package (Prudic, 1989) to the Streamflow Routing package (SFR) (Niswonger et al., 2006). The SFR package allows for dynamic simulation of streamflow routing and more accurate simulation of surface water-groundwater interactions, such as gaining and losing streams, infiltration, and seepage, which are critical for representing groundwater-surface water interactions, such as occur along the San Timoteo Creek drainage.

Streamflow in San Timoteo Creek is generated by a combination of discharges of treated wastewater from the City of Beaumont wastewater treatment plant, rising groundwater, and periodic stormflow runoff from Marshall Creek, Noble Creek, and Little San Gorgonio Creek

(Figure 10). Stream flow data used for this study were obtained from a USGS stream gage on Little San Gorgonio Creek and manual gaging of San Timoteo Creek (Figure 10). Little San Gorgonio Creek surface water flows were measured by the USGS from 1948 to 1985. Surface water flow within San Timoteo Creek was measured by YVWD on a weekly basis from 2002 to 2012.

Baseflow in San Timoteo Creek is sustained from treated wastewater discharges to Cooper's Creek by the City of Beaumont and groundwater discharge to the creek channel. The primary wastewater discharge point is in Cooper's Creek adjacent to the wastewater treatment plant (WWTP) (Figure 10). The second discharge point is in a small drainage north of the WWTP. Monthly wastewater discharge data were available from the City of Beaumont for the model update period through 2022 and historical discharges formed the basis for San Timoteo Creek flow in Segment 1 of the SFR (Figure 11). Flow in Segment 2 of the SFR was based on YVWD manual measurements (Figure 12) taken at the downstream location shown on Figure 10.

2.6 Modified Simulation Method for Groundwater Flow Between No Flow Zones in the Western Model Domain

The MODFLOW DRT (Drain Return) (Prudic, 1989) package was incorporated into the Beaumont Basin model in parts of the western Beaumont Basin to better simulate groundwater flow between isolated no flow zones (Figure 13). The isolated no flow zones are conceptualized to represent outcrops of low permeability San Timoteo Formation separated by more permeable shallow alluvial channels that direct groundwater from the Singleton Hills area to San Timoteo Creek.

2.7 Updates to Model Package Controlling Cell-by-Cell Flow

Use of the MODFLOW Newton solver allowed TH&Co to incorporate a more robust package to simulate the flow between model cells. Accordingly, TH&Co replaced the Block-Centered Flow (BCF) package (McDonald & Harbaugh, 1988) in the previous model with the Upstream Weighting (UPW) (Niswonger & Panday, 2011) package, which is designed to improve the representation of hydraulic conductivity and anisotropy within the model domain. The transition to the UPW package enhances the model's capability to represent spatial variability in hydrogeological properties, improve simulation accuracy, and better capture flow dynamics in heterogeneous groundwater systems.

2.8 Updated Model Calibration Targets

In addition to appending the previous model calibration target wells with updated data, TH&Co revised the calibration targets in the updated model. Three calibration targets were removed: Powers (2S/1W-32G01), Phillips (3S/1W-12D01), and Wilkins (2S/1W-34M01). These wells were removed since data for the updated calibration period was unavailable. TH&Co added ten new groundwater level calibration target wells: Noble Creek Park, Noble Creek 4, BCVWD 25, Tukwet B, Tukwet C, Tukwet D, YVWD 34, BCVWD 29, Delph, and Hewitt (Figure 14). New calibration targets were primarily wells identified as locations in the model which had good quality groundwater level data and were generally further from other calibration targets.

2.9 Updated Model Boundary Conditions

In addition to updating model input files, TH&Co updated the hydrographs used for boundary conditions with groundwater level data measured through December 2022 (Appendix A). Figure 13 shows the updated 2023 model boundary conditions which includes no flow cells, General Head Boundary (GHB) (McDonald & Harbaugh, 1988) cells, and Boundary Recharge cells. A comparison of previous model boundary conditions with the current updated model is shown on Figure 15.

2.9.1 Conversion of Constant Head Boundary Cells to General Head Boundary Cells

For some boundary conditions, TH&Co converted the Constant Head (CHD) (Harbaugh et al., 2000) package boundary condition cells to the General Head Boundary (GHB) package (Figure 13). MODFLOW GHB boundary cells are more flexible and versatile than CHD boundaries. While CHD boundaries maintain a constant head value throughout the simulation, GHB boundaries allow for spatially varying head values, which can better represent natural conditions such as local gradients or hydraulic head variations along a boundary. GHB boundaries can simulate various boundary conditions, including specified head, specified flow, or a combination of both. This flexibility allows for the simulation of more complex hydrogeological scenarios.

2.9.2 Conversion of General Head Boundary Cells to Mountain Block Recharge Cells

TH&Co converted all of the cells along the northern model boundary from GHB cells to mountain block recharge cells. Recharge in these cells is simulated using injection wells in the MODFLOW WEL (Well) (Harbaugh et al., 2020) package (Figure 13). Mountain block recharge cells are used to represent the infiltration of precipitation or snowmelt into the groundwater system, capturing the spatial variability of recharge rates along the boundary. This allowed for more flexibility in adjusting recharge across the boundary during calibration.

2.10 Updates to Groundwater Pumping

Groundwater pumping for municipal supply was updated in the 2023 model based on data provided by BCVWD, SMWC, YVWD, and City of Banning. All municipal groundwater pumping was updated through December of 2022. Figure 16 shows the location of all the production wells inside the model. Total groundwater pumping in the Beaumont Basin has increased from just over 5,000 acre-ft/yr in 1978 to just under 19,000 acre-ft/yr in 2022 (Figure 17).

2.11 Incorporated Additional Recharge Basins

Additional recharge basins were constructed and put into operation within the Beaumont Basin Adjudicated area since the last Safe Yield reset in 2013 (Figure 16). In the previous model only San Gorgonio Pass Water Agency's (SGPWA's) Little San Gorgonio Creek Recharge Facility (LSGCRF) (located outside the adjudicated boundary) and BCVWD's Noble Creek northwest recharge facility existed. In the 2023 model update, TH&Co incorporated Noble Creek southeast and Brookside East and West were added to the model. Imported water deliveries to LSGCRF were discontinued in 2020 and no deliveries to these basins were included in the 10-year forecast period. BCVWD started delivering imported water to Noble Creek 1 & 2 starting in 2006 and continued to recharge water through 2022 and into the forecast (Table 1). SGPWA delivered water to Brookside East from 2019 to 2022. Brookside West was added to the model but in this model update does not receive water in the calibration or forecast period. SGPWA along with other stakeholders do plan on using this basin for imported water recharge in the future.

2.12 Updated Recharge From Precipitation

The climate of the Study Area has been characterized as transitional, with marine coastal influences to the west and arid Mojave Desert influences to the east (Rewis et al., 2006). The area has hot summers and cool winters. Historical annual precipitation at the Beaumont precipitation station, operated by the Riverside County Flood Control District, has ranged from 6.4 inches in 1999 to 35.0 inches in 1978 with an annual average of 17.2 inches (Figure 18). Analysis of the cumulative departure from mean precipitation at this station indicates the following trends:

- The period from approximately 1885 through 1903 was relatively dry.
- The period from 1904 through 1946 was relatively wet.
- The period from 1947 through 1977 was relatively dry.
- The period from 1978 through 1983 was relatively wet.
- The period from 1984 through 1990 was relatively dry.
- The period from 1991 through 1998 was relatively wet.
- The period from 1999 through 2023 was relatively dry.

Average annual reference evapotranspiration (ET_o) in the Study Area is relatively high. Average annual ET_o at the University of California, Riverside CIMIS station, located approximately 12 miles west of the Study Area, is 56.37 inches. Due to the relatively deep groundwater table throughout most of the Study Area, only groundwater in the riparian area along San Timoteo Creek is subject to ET (Figure 10).

Groundwater recharge from artificial recharge basins, return flow associated with the various land use conditions, and infiltration in Noble Creek and Marshall Creek were addressed in the model using the recharge package. Recharge was applied to the uppermost active model layer within 34 individual recharge zones (Figure 19). The relatively large number of recharge zones was necessary to enable the simulation of changes in return flow and streambed infiltration over time.

2.13 Changes in Aquifer Parameters from Recalibration of the Updated Model

Given the changes in model layering and other boundary conditions in the updated 2023 model relative to the previous version, it was necessary to recalibrate the model to provide an optimum match of measured and model-generated groundwater levels (see Section 4 herein). As aquifer parameters were adjusted during this process, the recalibration effort resulted in changes to parameter value arrays in the model, including horizontal hydraulic conductivity, vertical hydraulic conductivity, specific yield, and specific storage (see Appendix B).

3.0 Future Projections

As the reevaluation of the Safe Yield of the Beaumont Basin applies to the future period from 2023 through 2033, TH&Co included a 10-year projection of basin recharge and pumping in the water budget period used to estimate the Safe Yield. The forecast is based on assumptions for hydrology, groundwater pumping demand, imported water recharge, and anticipated projects to recharge/pump groundwater for a 50-year projection, as described herein. However, only the forecasted period from 2023 through 2033 was quantified in the analysis of Safe Yield.

3.1 Climate and Precipitation Projection

The climate and precipitation forecast for the 50-year projection period was completed using the 2070 climate change factors from the DWR climate change model (DWR, 2018). DWR's climate change model outputs a precipitation factor across a 6 km by 6 km grid matrix covering California. The precipitation factor is applied to the historical precipitation record at each grid cell to estimate how much a historical year's rainfall will be affected by climate change by 2070 (Figure 20). To account for future precipitation in the Beaumont model forecast, TH&Co conducted a statistical analysis on the historical precipitation record at the Beaumont Precipitation Station (see section 2.12), classifying historical years into the following precipitation categories: very wet, wet, average, dry, and very dry. A proxy precipitation year was then picked for each one of the categories and the DWR 2070 climate change factor was then applied (Table 2). TH&Co applied a random 50-year pattern of the five precipitation categories described above across the 50-year model projection (2023-2071).

3.2 Groundwater Pumping Forecast

Projected groundwater pumping in the model forecast period 2023-2072 was based on pumping projections provided by BCVWD, SMWC, YVWD, and City of Banning. Forecast period total groundwater pumping for the entire Study Area for 2023-2032 is shown in (Figure 17). Groundwater pumping is forecast to increase from just over 20,000 acre-ft/yr in 2023 to over 25,000 acre-ft/yr in 2032. Overlyer pumping for the 50-yr projection simulation was based on the 5-year historical average monthly pumping from 2018-2022.

3.3 Imported Water Forecast

Projections of artificial recharge in the model forecast period were estimated based on SGPWA's Table A imported water allocation and DWR projections of imported water availability in the future. SGPWA's Table A allocation is 17,300 acre-ft/yr. DWR's Final State Water Project Delivery Capability Report (DWR, 2020) describes the percentage of Table A water State Water Project contractors can expect in the future and the number of years they can expect it. TH&Co assigned imported water deliveries in any given year in accordance with the climate categories described in Section 3.1 (Table 3). Very wet years hydrologically were assigned a high percentage of imported water delivery (97 percent). In contrast, very dry years hydrologically were assigned a low percentage of imported water delivery (7 percent).

Imported water was assigned to individual recharge facilities in the Beaumont Basin on a priority basis. Water was first assigned to the Noble Creek Recharge facility. If the recharge capacity of those basins were maximized, recharge was then assigned to Brookside East. The recharge capacity at each facility was based upon the area of each basin and a historical maximum infiltration rate.

3.4 Natural Recharge Water Forecast

Precipitation recharge for the model forecast period was assigned to the MODFLOW recharge package based on the proxy year precipitation projections shown in Table 2. The recharge value for each recharge package zone (Figure 19) for the historical proxy year was applied to the forecast period in accordance with its precipitation category (very wet, wet, average, dry, and very dry (see Section 3.1 and Table 2 for more information).

3.5 YVWD ASR Project

The YVWD is planning to implement a groundwater recharge and recovery project which would become operational in 2026. This project includes four injection wells and three extraction wells, as shown on Figure 21. The project would recharge and/or recover up to 2,000 acre-ft/yr of imported water. These injection and extraction wells were added into the 2023 updated model based on planned locations provided to TH&Co by YVWD (Figure 21). The ASR project involves purchasing imported water during wet periods when excess water is available and injecting it into the local aquifer for storage. During times of high demand or drought, the stored water can be withdrawn from the aquifer and treated for distribution to meet the needs of YVWD's customers.

4.0 Model Calibration

The revisions to the model changed the pumping and recharge stresses that affect model calibration, so the model was recalibrated to reflect the new data. This involved a two-step process:

1. Manually modifying aquifer property values to optimize the fit between measured groundwater levels and modeled groundwater levels, and
2. Conducting an automated parameter estimation process (PEST++-IES, White et al, 2020) to further refine the calibration.

PEST++" refers to a suite of software programs that are the most recent update of "PEST" whereas IES (iterative ensemble smoother) is one of several variants of PEST++. IES was used as it allows for calibration of many thousands of parameters without incurring the computational burden of doing so as is the case with other PEST variants.[4] IES also simplifies uncertainty analysis in that it generates a user-specified number of realizations.

With respect to the second step noted above, PEST varied the following parameters (137,379 total) to calibrate the model:

- BAS package: layer-specific array multiplier for starting heads (initial conditions) arrays (4 parameters);
- WEL package: layer- and stress period-specific injection rates for mountain block recharge (15,120 parameters);
- EVT package: stress period-specific array multipliers for evapotranspiration surface and evaporation rate, and constant extinction depth (1,620 parameters);
- GHB package: layer-specific conductances and layer- and stress period-specific heads (5,099 parameters);
- SFR package: segment- and reach-specific streambed thicknesses and conductances and segment- and stress period-specific roughness coefficients, upstream widths, and downstream widths (3,920 parameters);
- HFB package: layer- and cell-specific fault conductivities (13,236 parameters);
- DRT package: drain conductances (479 parameters);
- UPW package: layer-specific hydraulic conductivities, storage coefficients, and anisotropy ratios (78,725 parameters); and
- RCH package: stress period and zone-specific recharge rates (19,176 parameters).

Except for aquifer parameters (i.e., parameters associated with hydraulic conductivities and storage coefficients), all parameters that were varied by PEST were characterized by their

[4] Note that PEST stands for "Parameter ESTimation" and, in the text follows, the terms "PEST", "PEST++", and IES are used interchangeably.

"priors" (a.k.a., 'mean values', 'preferred values', or simply 'initial pre-calibration estimates') and standard deviations based on their ranges (assumed lower and upper bounds), with the assumption that all are lognormally distributed. Aquifer parameters were also assumed to be lognormally distributed but were characterized by their priors and covariance matrices. The covariance matrix approach is commonly used for aquifer parameters because it is generally accepted that the latter are spatially correlated. For example, the hydraulic conductivity in a specific model cell is expected to be similar to the hydraulic conductivity in nearby model cells with this expectation decreasing for more distant model cells. Given the spatial configuration of the aquifer parameters, pilot points (Doherty et al., 2003) along with the PEST spatial interpolation utility program PLPROC (Doherty, 2020), was used to assign the cell-specific values to the aquifer parameters varied by PEST.

IES generates an initial "ensemble", which is group of models. The initial ensemble consisted of 100 realizations; however, the final ensemble consisted of 79 calibrated models (a.k.a., "realizations"). The 21 realizations that are not part of the final ensemble were likely removed by IES due to 'timed-out' runs. Timed-out runs occur when the runtime for a realization being conducted by a particular agent exceeds twice the average runtime of all previously completed runs conducted during the PEST iteration up to that point. The long runtime for a timed-out run is usually due to a difficult parameter field, an overworked operating system, or both.

Regardless of the reason, the calibration can only be assessed for the 79 surviving realizations. The calibration is assessed in two ways: 1) visual inspection of calibration hydrographs and 2) consideration of calibration statistics, with the first way being self-explanatory, qualitative, and generally subjective. With respect to the second way, the calibration statistics used for this analysis include the correlation coefficient, normalized root mean square error (NRMSE), and the coefficient of variation of objective functions for all realizations in the final ensemble.

Calibration hydrographs showing both measured and model-generated groundwater elevations are provided in Appendix C. These hydrographs are for one of the realizations in the final ensemble. The simulated groundwater elevations reasonably match the measured elevations at most of the target wells in the model. A scatter plot for this same realization of simulated versus measured groundwater elevations for the 2,689 groundwater level observations in the calibration is displayed model wide in (Figure 22). The correlation coefficient between the simulated and measured values is 0.93, which meets the benchmark minimum value of 0.90 noted in DWR (2016) and Hill and Tiedemann (2007). Values of 0.90 and above indicate a strong positive correlation between the measured and model-generated groundwater levels (i.e., as one value increases, so does the other and vice versa).

The NRMSE is expressed in units of percent, where the error is the difference between the measured and model-generated groundwater level. NRMSE values less than 10 percent are generally considered to be acceptable. The NRMSE for the 2023 model with respect to groundwater elevations is 5.4 percent (Figure 22).

For uncertainty analysis, which relies on all realizations in the final ensemble, the coefficient of variation, which is the standard deviation of the objective function (which is the sum of squared errors) divided by its mean value. The coefficient of variation is 2%, which means the fits for all 79 realizations in the final ensemble are very similar. The NRMSE of the "best fit" realization (the one with the lowest objective function) and that of the "worst fit" realization (the one with highest objective function) were 5.3% and 5.6%, respectively. These acceptably low summary statistics support the inclusion of all 79 realizations in the uncertainty analysis.

5.0 Analysis of Safe Yield

The Safe Yield of the Beaumont Basin is a function of the overall water balance of the adjudicated area. As described in Section 1.3, the Safe Yield can be expressed using the following equation:

$$\text{Safe Yield} = \Delta S + O_p - I_{ar} \qquad (4)$$

where:

ΔS = Change in Groundwater Storage

O_p= Outflow from Groundwater Pumping

I_{ar} = Inflow from Artificial Recharge of Supplemental Water

This relationship is valid if the following conditions are met:

1. The Safe Yield incorporates a hydrology that is representative of a relatively long period of record that includes multiple wet and dry hydrologic cycles.
2. The land use conditions are representative of the time period.
3. Pumping and recharge within the basin does not result in adverse impacts.

The updated Safe Yield estimate for the Beaumont Basin was based on a water budget developed using the updated and recalibrated groundwater flow model of the basin (see Table 4). The water budget includes both the historical period from 1978 through 2022 and the forecast period from 2023 through 2032. The Safe Yield is based on Equation 4 and is the arithmetic average of 55 annual safe yield values spanning the calendar years 1978 through 2032.[5]

Multiple realizations of the Beaumont Basin model, as discussed in Section 4, were evaluated before selecting the water budget shown on Table 4, which was used to estimate Safe Yield. The purpose of analyzing multiple model realizations is to account for uncertainty in the model input parameters, many of which are estimated. A model realization is an acceptably-calibrated model with the same area and layering but different parameter distributions. For the analysis of Safe Yield, the 79 realizations discussed in Section 4, each with different aquifer parameters, hydrology, and mountain front recharge varied within reasonable ranges.

[5] Each of the 55 annual safe yield values is based on 12 monthly safe yield values. For example, the annual safe yield for calendar year 2020 is the sum of the safe yield values for January through December 2020.

The Safe Yield estimates from each of the 79 acceptable realizations are plotted on Figure 23. The Safe Yield estimates ranged from approximately 6,800 acre-ft/yr to 7,300 acre-ft/yr and do not include artificial recharge as shown in Equation 4 above. The Safe Yield recommended herein (7,100 acre-ft/yr) represents the 50th percentile of the Safe Yield values derived using the 79 realizations (i.e., the curve shown on Figure 23 is a smoothed line through 79 data points). This 50th percentile value means that half of the realizations gave a Safe Yield less than 7,100 acre-ft/yr and half gave a Safe Yield greater than 7,100 acre-ft/yr. That is, there is a 50 percent chance that the actual Safe Yield is between 6,800 and 7,100 acre-ft/yr and a 50 percent change that the actual Safe Yield is between 7,100 and 7,300 acre-ft/yr. Along those same lines, there is no chance the Safe Yield is less than 6,800 acre-ft/yr or greater than 7,300 acre-ft/yr.

6.0 Findings and Recommendations

A calibrated numerical groundwater flow model of the Beaumont Basin has been updated and refined based data collected since the earlier version of the model was developed. The updated and refined model is calibrated to industry standards and is a valuable tool for evaluating both the historical water balance of the Beaumont Basin and future water balance based on projections of groundwater production and artificial recharge. Analysis of the Beaumont Basin historical water budget from the groundwater flow model has resulted in the following findings:

- The water balance resulting from the analysis of future groundwater production and artificial recharge shows that change in groundwater storage during the 50-yr historical and forecast period from 1978 to 2032 ranges from 10,370 acre-ft/yr to -13,995 acre-ft/yr with an average of -1,634 acre-ft/yr. Average storage change over the 10-yr period (2013-2022) was -3,258 acre-ft/yr.
- Changes in groundwater storage over the 50-year period (1978-2032) are variable and are highly dependent on groundwater pumping, recharge from precipitation, and imported water for recharge. As noted in TH&Co (2018), imported water recharge that is not captured downgradient will likely result in higher losses.
- The Safe Yield based on an uncertainty analysis of the model-generated water budgets from 79 different realizations of the updated Beaumont Basin model is approximately 7,100 acre-ft/yr. This value represents the 50th percentile of the normalized distribution of safe yield estimates from the 79 different realizations.

Based on the analysis presented herein, including an analysis of model uncertainty, the recommended Safe Yield of the Beaumont Basin for the next 10 years (2023 through 2032) is 7,100 acre-ft/yr.

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Tables

Beaumont Basin Annual Imported Water Deliveries

Calendar Year	Little San Gorgonio Creek Recharge Facility (acre-ft)	Noble Creek Recharge Facility (1 & 2) (acre-ft)	Brookside East Recharge Facility (acre-ft)	Brookside West Recharge Facility (acre-ft)	Annual Total (acre-ft)
2003	77	0	0	0	77
2004	814	0	0	0	814
2005	687	0	0	0	687
2006	778	3,501	0	0	4,279
2007	541	4,501	0	0	5,042
2008	758	3,933	0	0	4,691
2009	852	5,482	0	0	6,335
2010	1,215	7,065	0	0	8,280
2011	1,842	8,779	0	0	10,621
2012	1,827	8,983	0	0	10,810
2013	881	8,634	0	0	9,515
2014	17	5,013	0	0	5,030
2015	9	3,467	0	0	3,476
2016	18	10,796	0	0	10,814
2017	6	14,940	0	0	14,946
2018	0	12,621	0	0	12,621
2019	0	13,770	383	0	14,153
2020	1	11,005	464	0	11,470
2021	0	2,387	117	0	2,504
2022	0	1,311	500	0	1,811
2023	0	16,781	0	0	16,781
2024	0	13,496	0	0	13,496
2025	0	6,921	0	0	6,921
2026	0	10,034	0	0	10,034
2027	0	7,437	0	0	7,437
2028	0	4,801	0	0	4,801
2029	0	12,414	0	0	12,414
2030	0	12,020	0	0	12,020
2031	0	14,795	0	0	14,795
2032	0	7,437	0	0	7,437
Average (2003-2032)	344	7,744	49	0	8,137
Total (2003-2032)	10,323	232,324	1,464	0	244,112

Notes: Historical & forecast period imported water data was received from SMWC, YVWD, BCVWD, SGPWA, and The City of Banning.

Beaumont Model Forecast Period Proxy Year Selection

Model Forecast Year	Proxy Year	Proxy Year Precipitation (in.)	Category
2023	2005	26.9	Very Wet
2024	2005	26.9	Very Wet
2025	2018	6.6	Dry
2026	2015	10.1	Average
2027	2015	9.6	Average
2028	2007	4.4	Very Dry
2029	2019	19.8	Wet
2030	2015	10.7	Average
2031	2005	30.0	Very Wet
2032	2015	12.1	Average

Notes: Proxy year precipitation was determined from data at Beaumont Precipitation Station #13.
Categories were determined by statistically classifying the historical precipitation data.

Model Forecast Period SWP[2] Imported Water Proxies

Category[1]	Proxy Year	SWP Allocation (%)	Annual Allocation Volume[3] (acre-ft)	Logic
Very Wet	2005	97%	16,781	Single Wet Year allocation From DWR[4] SWP 2019 Delivery Capability Report
Wet	2019	78%	13,494	Average Between Average and Very Wet Year
Average	2015	58%	10,034	Long Term Average allocation From DWR SWP 2019 Delivery Capability Report
Dry	2018	33%	5,709	Average Between Average and Very Dry Year
Very Dry	2007	7%	1,211	Single Dry Year allocation From DWR SWP 2019 Delivery Capability Report

Notes:

[1] Categories were determined by statistically classifying the historical precipitation data. See Table 2 For More Information.

[2] SWP = State Water Project

[3] Based on San Gorgonio Pass Water Agencies maximum SWP Table A allocation which equals 17,300 acre-ft/yr.

[4] DWR = California Department of Water Resources

Groundwater Budget for the Beaumont Basin Adjudicated Area (January 1978 - December 2032)

	Groundwater Inflows (acre-ft)								Groundwater Outflows (acre-ft)						
									Total Subsurface Outflow[f]						
Year	Subsurface Inflow into the Adjudicated Area	"Channels" Inflow into the Adjudicated Area (DRT)	Imported Water for Recharge[a]	Imported Water for Injection[b]	Deep Infiltration of Precipitation and Runoff in Stream[c]	Recharge from the Mountain Block	Wellbore Flow[d]	Total Inflow[e]	Non-Channel Subsurface Outflow	Channel Subsurface Outflow	Evapotran-spritation (ET)	Groundwater Pumping	Total Outflow[g]	Change in Storage[h]	Annualized Safe Yield[i]
1978	11,318	0	0	0	3,279	46	1,178	15,820	(7,169)	(4,750)	0	(6,752)	(18,671)	(2,851)	2,724
1979	12,640	0	0	0	3,507	31	937	17,115	(8,170)	(2,483)	0	(6,738)	(17,391)	(276)	5,524
1980	15,055	0	0	0	3,419	47	719	19,240	(7,089)	(2,401)	0	(5,736)	(15,226)	4,014	9,031
1981	11,970	0	0	0	3,616	13	719	16,318	(6,637)	(2,327)	0	(6,341)	(15,305)	1,013	6,635
1982	14,024	0	0	0	3,600	29	707	18,360	(7,295)	(2,343)	0	(5,172)	(14,810)	3,551	8,016
1983	16,928	0	0	0	3,516	38	760	21,242	(8,057)	(2,337)	0	(4,479)	(14,873)	6,369	10,088
1984	12,514	0	0	0	3,700	10	724	16,949	(8,449)	(2,333)	0	(5,229)	(16,011)	938	5,443
1985	11,101	0	0	0	3,572	9	632	15,314	(7,214)	(2,306)	0	(6,464)	(15,984)	(670)	5,162
1986	11,173	0	0	0	3,692	10	598	15,474	(6,011)	(2,298)	0	(6,471)	(14,781)	693	6,566
1987	11,002	0	0	0	3,544	11	601	15,158	(7,221)	(2,287)	0	(7,240)	(16,748)	(1,590)	5,049
1988	10,528	0	0	0	3,738	10	576	14,852	(6,058)	(2,338)	0	(7,843)	(16,239)	(1,387)	5,881
1989	10,806	0	0	0	3,787	10	733	15,336	(6,066)	(2,316)	0	(10,924)	(19,305)	(3,969)	6,221
1990	10,796	0	0	0	3,795	8	729	15,330	(6,207)	(2,266)	0	(12,329)	(20,801)	(5,472)	6,128
1991	10,763	0	0	0	3,810	9	738	15,320	(6,783)	(2,300)	0	(10,497)	(19,580)	(4,260)	5,499
1992	12,031	0	0	0	3,778	24	701	16,534	(6,441)	(2,334)	0	(9,511)	(18,285)	(1,751)	7,059
1993	16,674	0	0	0	3,762	31	617	21,084	(7,370)	(2,368)	0	(7,157)	(16,895)	4,188	10,728
1994	14,501	0	0	0	3,769	30	614	18,914	(7,904)	(2,370)	0	(7,908)	(18,182)	732	8,026
1995	17,348	0	0	0	3,914	38	722	22,022	(8,187)	(2,403)	0	(5,859)	(16,448)	5,574	10,711
1996	12,728	0	0	0	3,802	9	715	17,254	(7,848)	(2,456)	0	(6,601)	(16,905)	349	6,234
1997	13,516	0	0	0	3,860	25	777	18,178	(8,056)	(2,476)	0	(7,887)	(18,419)	(241)	6,869
1998	17,156	0	0	0	4,016	35	884	22,090	(8,994)	(2,501)	0	(7,527)	(19,023)	3,068	9,711
1999	12,646	0	0	0	3,680	7	869	17,202	(7,889)	(2,489)	0	(9,820)	(20,198)	(2,996)	5,954
2000	11,648	0	0	0	3,916	8	849	16,422	(7,200)	(2,468)	0	(14,049)	(23,717)	(7,295)	5,905
2001	11,603	0	0	0	3,957	8	904	16,471	(7,407)	(2,367)	0	(14,538)	(24,313)	(7,842)	5,793
2002	11,278	0	0	0	3,870	9	829	15,987	(5,579)	(2,277)	0	(18,380)	(26,237)	(10,250)	7,301
2003	13,181	0	0	0	3,933	18	957	18,089	(5,686)	(2,301)	0	(12,107)	(20,094)	(2,005)	9,145
2004	14,892	0	0	0	4,033	22	805	19,752	(6,553)	(2,241)	0	(16,585)	(25,379)	(5,627)	10,153
2005	18,994	0	0	0	3,920	32	785	23,731	(7,106)	(2,229)	0	(14,497)	(23,832)	(101)	13,611
2006	14,645	0	3,501	0	4,242	5	826	23,220	(7,235)	(2,171)	0	(17,639)	(27,045)	(3,825)	9,486
2007	12,101	0	4,501	0	4,170	4	825	21,601	(7,740)	(2,115)	0	(20,329)	(30,184)	(8,583)	6,419
2008	12,520	0	3,933	0	4,764	12	736	21,964	(7,895)	(2,178)	0	(18,064)	(28,137)	(6,173)	7,222
2009	12,884	0	5,482	0	4,788	10	766	23,930	(8,128)	(2,217)	0	(16,410)	(26,755)	(2,825)	7,337
2010	14,003	0	7,065	0	5,270	15	754	27,106	(8,903)	(2,217)	0	(14,365)	(25,485)	1,620	8,167
2011	15,546	0	8,779	0	5,001	20	792	30,138	(10,499)	(2,209)	0	(14,471)	(27,179)	2,959	7,859
2012	14,738	0	8,983	0	5,198	8	738	29,665	(10,208)	(2,175)	0	(15,149)	(27,532)	2,133	7,561
2013	13,750	0	8,634	0	4,447	5	834	27,669	(11,260)	(2,089)	0	(17,613)	(30,962)	(3,293)	4,852
2014	13,750	0	5,013	0	3,365	7	760	22,895	(10,423)	(1,997)	0	(17,717)	(30,138)	(7,243)	4,701
2015	13,806	0	3,467	0	2,767	8	636	20,684	(9,943)	(1,982)	0	(13,421)	(25,346)	(4,662)	4,656
2016	13,860	0	10,796	0	4,624	11	690	29,981	(10,199)	(2,003)	0	(16,525)	(28,727)	1,254	6,293
2017	13,116	0	14,940	0	6,294	10	751	35,111	(12,461)	(1,979)	0	(16,618)	(31,058)	4,053	4,980
2018	14,450	0	12,621	0	4,367	12	736	32,187	(12,327)	(1,939)	0	(17,985)	(32,251)	(64)	4,564
2019	16,732	0	14,153	0	6,512	19	828	38,245	(14,103)	(1,900)	0	(16,961)	(32,965)	5,280	7,261
2020	15,652	0	11,469	0	5,908	9	812	33,849	(13,582)	(1,812)	0	(19,452)	(34,847)	(997)	6,174
2021	15,027	0	2,504	0	1,750	4	700	19,985	(11,017)	(1,924)	0	(21,039)	(33,980)	(13,995)	3,840
2022	15,166	0	1,811	0	2,321	5	762	20,065	(11,477)	(1,738)	0	(19,763)	(32,979)	(12,914)	4,276
2023	20,176	0	16,781	0	4,753	41	581	42,332	(9,068)	(1,756)	0	(21,138)	(31,962)	10,370	14,146

Table 4

Groundwater Budget for the Beaumont Basin Adjudicated Area (January 1978 - December 2032)

Year	Groundwater Inflows (acre-ft)								Groundwater Outflows (acre-ft)						
									Total Subsurface Outflow[f]						
	Subsurface Inflow into the Adjudicated Area	"Channels" Inflow into the Adjudicated Area (DRT)	Imported Water for Recharge[a]	Imported Water for Injection[b]	Deep Infiltration of Precipitation and Runoff in Stream[c]	Recharge from the Mountain Block	Wellbore Flow[d]	Total Inflow[e]	Non-Channel Subsurface Outflow	Channel Subsurface Outflow	Evapotran-spritation (ET)	Groundwater Pumping	Total Outflow[g]	Change in Storage[h]	Annualized Safe Yield[i]
2024	20,765	0	13,496	0	4,098	32	578	38,969	(9,361)	(1,766)	0	(21,388)	(32,516)	6,453	13,767
2025	16,249	0	6,921	0	2,439	8	591	26,208	(9,812)	(1,951)	0	(21,822)	(33,584)	(7,376)	6,934
2026	15,404	0	10,034	2,000	1,303	9	2,753	31,503	(10,011)	(1,625)	0	(23,732)	(35,367)	(3,864)	5,080
2027	14,835	0	7,437	2,000	1,416	6	2,740	28,434	(10,103)	(1,599)	0	(23,973)	(35,676)	(7,242)	4,555
2028	14,181	0	4,801	2,000	1,708	9	2,750	25,448	(8,642)	(1,827)	0	(24,226)	(34,695)	(9,247)	5,428
2029	16,746	0	12,414	2,000	783	20	2,775	34,738	(11,330)	(1,753)	0	(24,497)	(37,580)	(2,842)	4,465
2030	16,562	0	12,020	2,000	1,555	17	2,735	34,889	(10,053)	(1,533)	0	(24,711)	(36,297)	(1,408)	6,548
2031	20,821	0	14,795	2,000	2,501	33	2,689	42,839	(8,793)	(1,725)	0	(24,888)	(35,406)	7,433	12,837
2032	16,336	0	7,437	2,000	1,423	6	2,710	29,912	(10,068)	(1,501)	0	(25,147)	(36,716)	(6,804)	6,197
Average (1978 - 2022)	13,568	0	2,837	0	4,013	17	763	21,197	(8,401)	(2,289)	0	(12,181)	(22,872)	(1,675)	6,907
Average (1978 - 2032)	14,230	0	4,251	255	3,683	17	1,004	23,439	(8,642)	(2,183)	0	(14,249)	(25,073)	(1,634)	7,105

Notes:

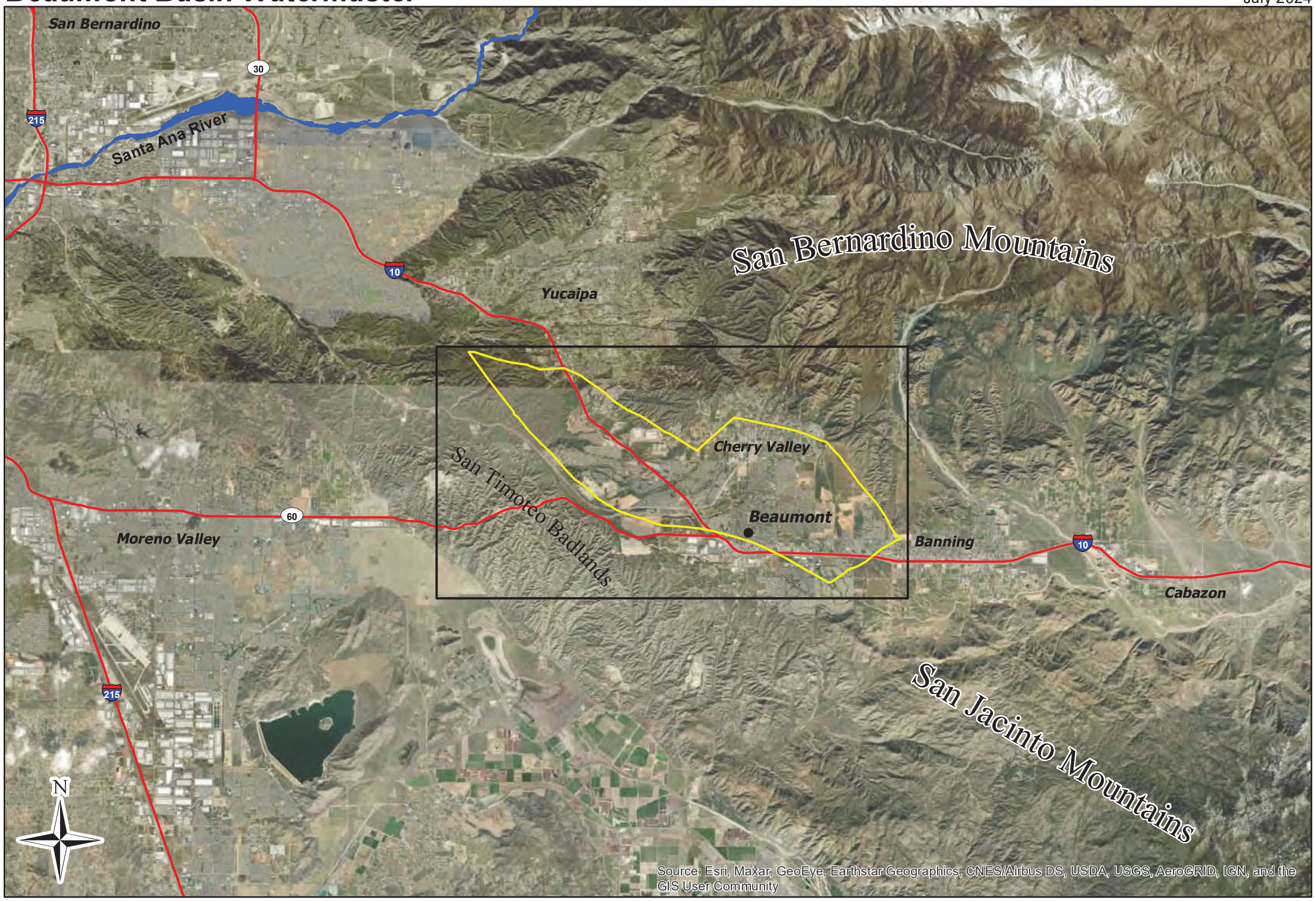
[a] Values prior to 2023 are reported values provided by the stakeholders. Values from 2023 onward are based on anticipated deliveries off the State Water Project associated with forecasted precipitation.
[b] Values reported by YVWD.
[c] Includes deep percolation of precipitation and runoff in stream, channels (stream channels include Noble Creek and Marshall Creek), and return flows (e.g., landscaping, parks, golf courses, transmission losses, septic systems, etc.).
[d] Wellbore flow refers to the movement of water through the annular space between the well casing and the surrounding formation in a groundwater well.
[e] "Total Inflow" is the sum of all the groundwater inflows.
[f] Total Subsurface Outflow is the sum of "Non-Channel Subsurface Outflow" and "Channel Subsurface Outflow".
[g] "Total Outflow" is the sum of "Total Subsurface Outflow", "Evapotranspiration", and "Groundwater Pumping".
[h] As all "Total Outflow" values are presented as negative (parenthesized) values, the "Change in Storage" is calculated as "Total Inflow plus Total Outflow".
[i] Annualized Safe Yield is based on net groundwater pumping, change in storage, and imported water for recharge and injection. Net groundwater pumping is the difference between “Groundwater Pumping” and “Wellbore Flow”. (See Equation 4 in Section 1.3)

Figures

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



0 1 2 4 Miles

NAD 83 State Plane Zone 6

Map Features

- Study Area
- Beaumont Basin Adjudicated Area
- Santa Ana River
- Freeway/Highway

Regional Setting

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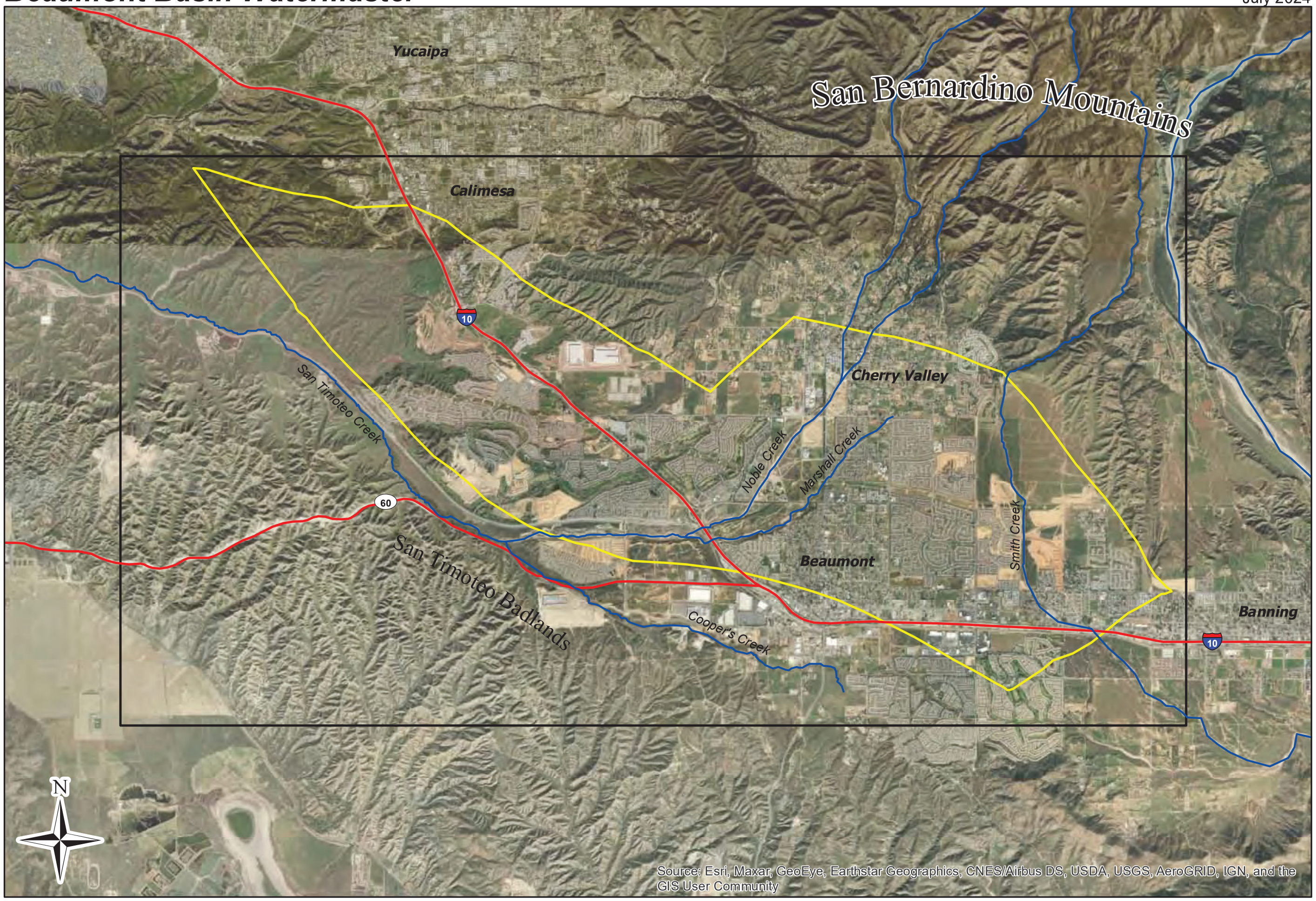
Regional Map

Figure 1

Beaumont Basin Watermaster

July 2024



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2023 Reevaluation of the Beaumont Basin Safe Yield

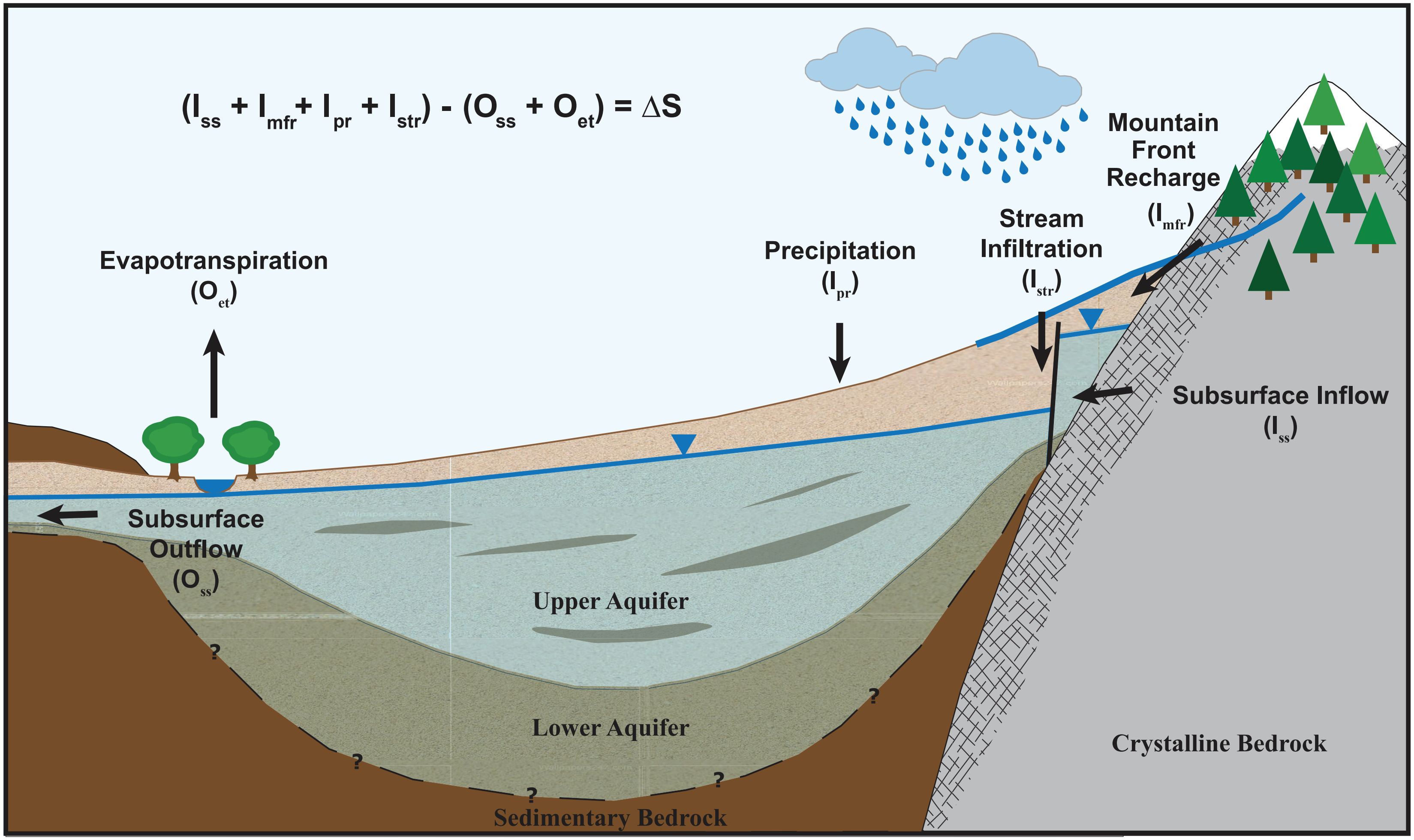
Map Features

- Study Area
- Beaumont Basin Adjudicated Area
- Creek
- Freeway/Highway

Beaumont Basin Study Area

Figure 2

Conceptual Water Balance - Pre-developed Conditions



Note:
*Not to scale.

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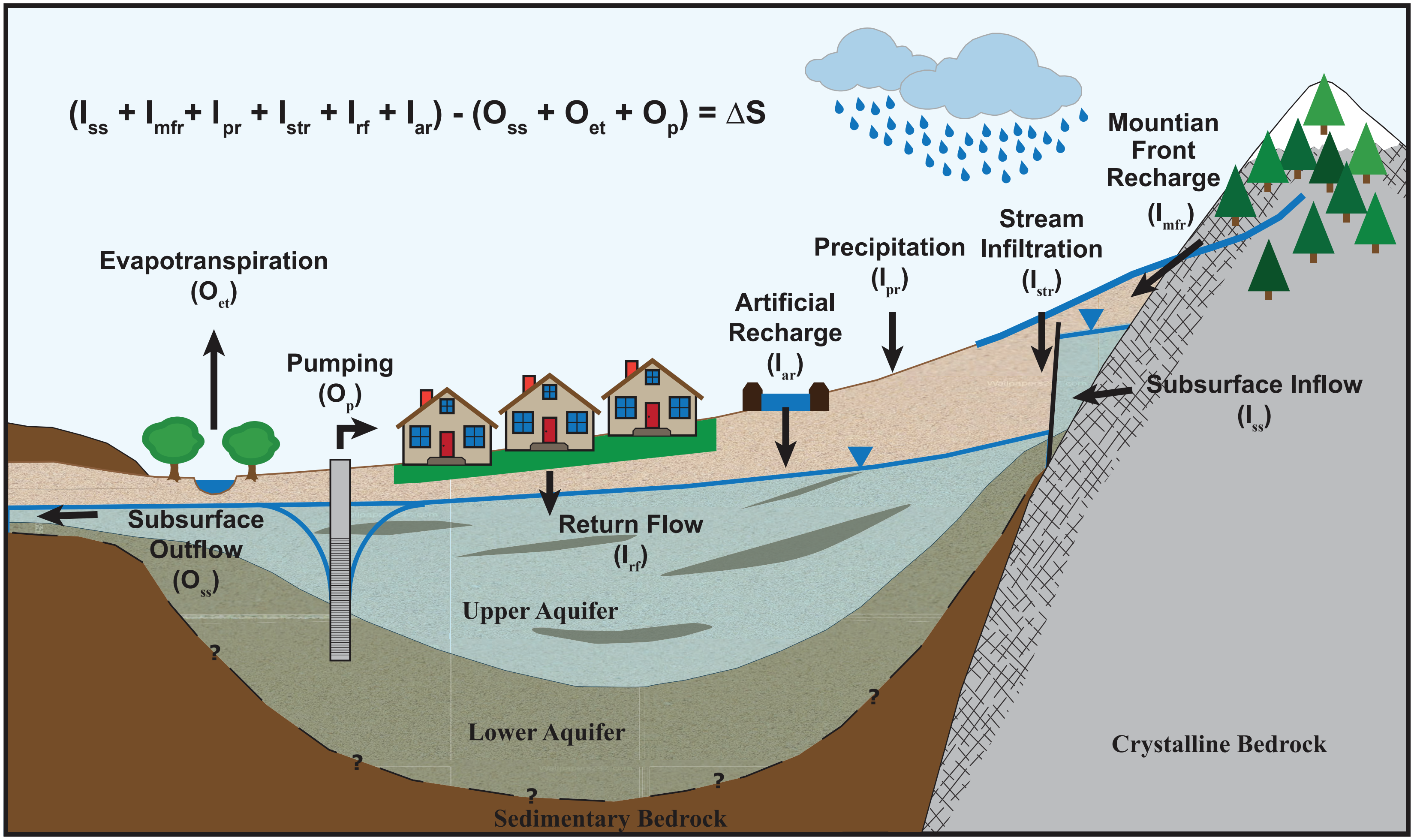
July 2024

Conceptual Water Balance - Developed Conditions



Note:
*Not to scale.

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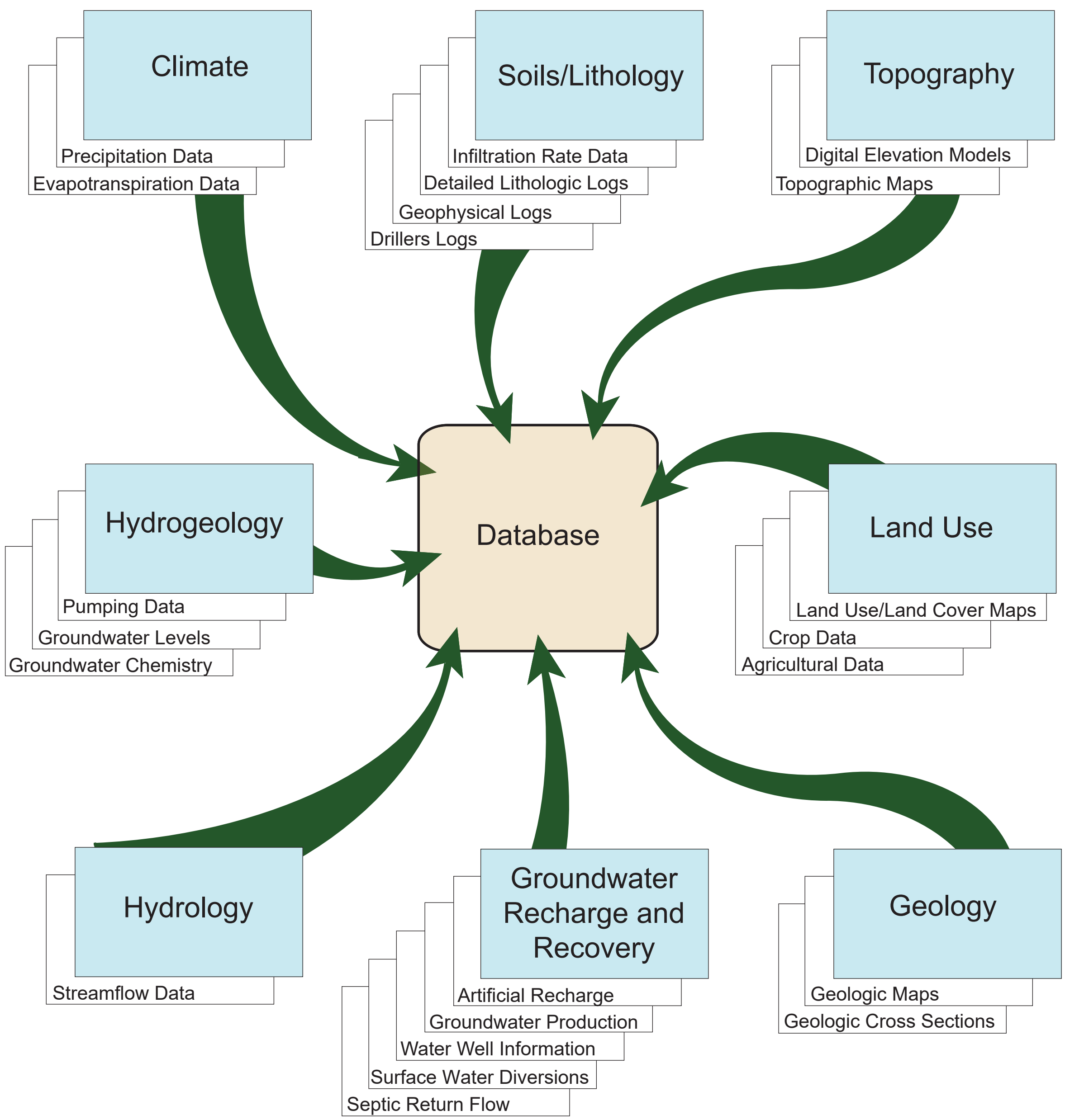
July 2024



Adapted from Faunt et al., 2009

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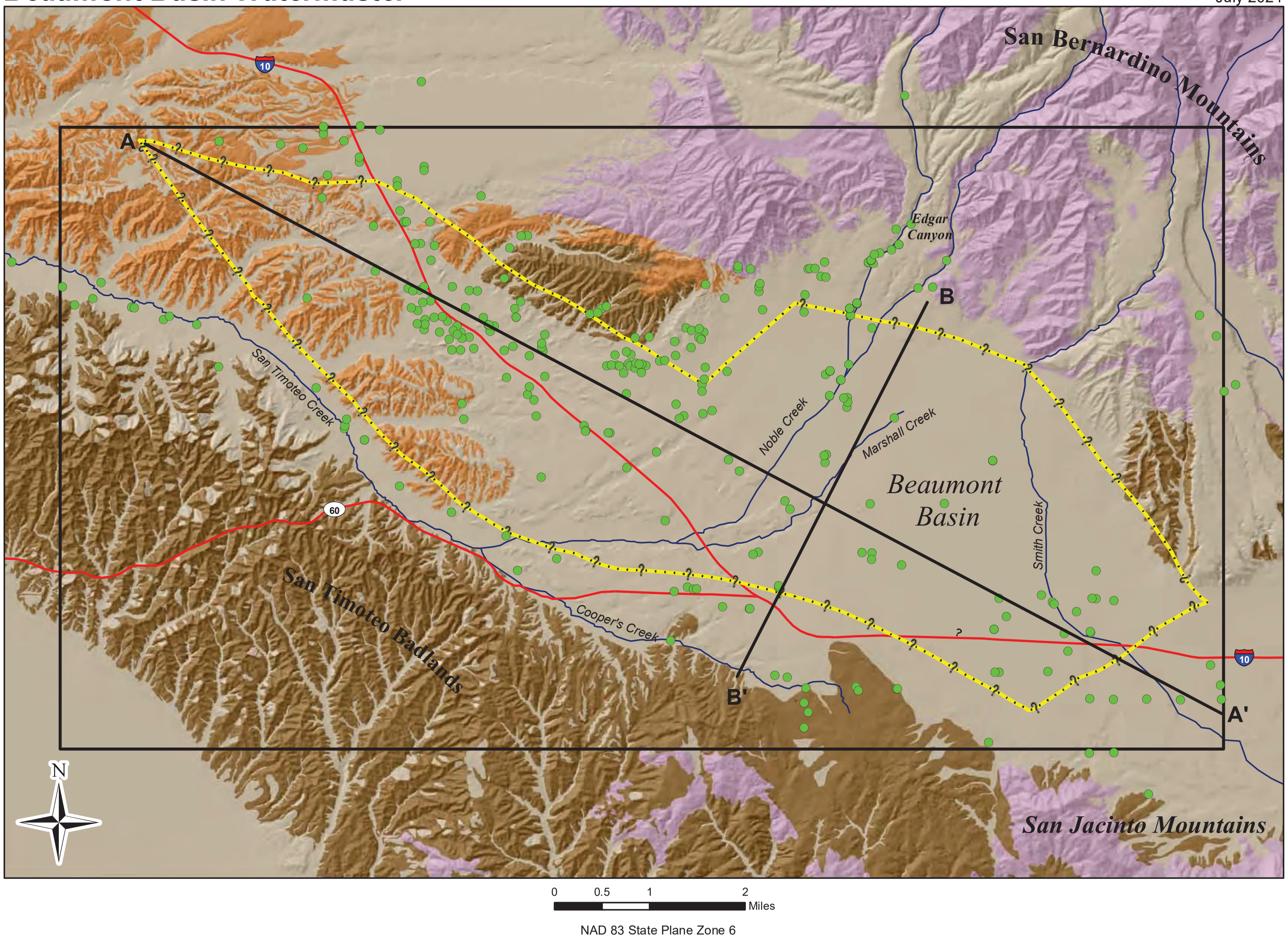
Data Type Diversity Flow Chart
Figure 5

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



Note: Geology modified from California Geological Survey, Special Report 217 (Revised, 2012); USGS Open-File Report 2005-1305; and USGS Scientific Investigations Report 2006-5026 (Rewis et al., 2006).

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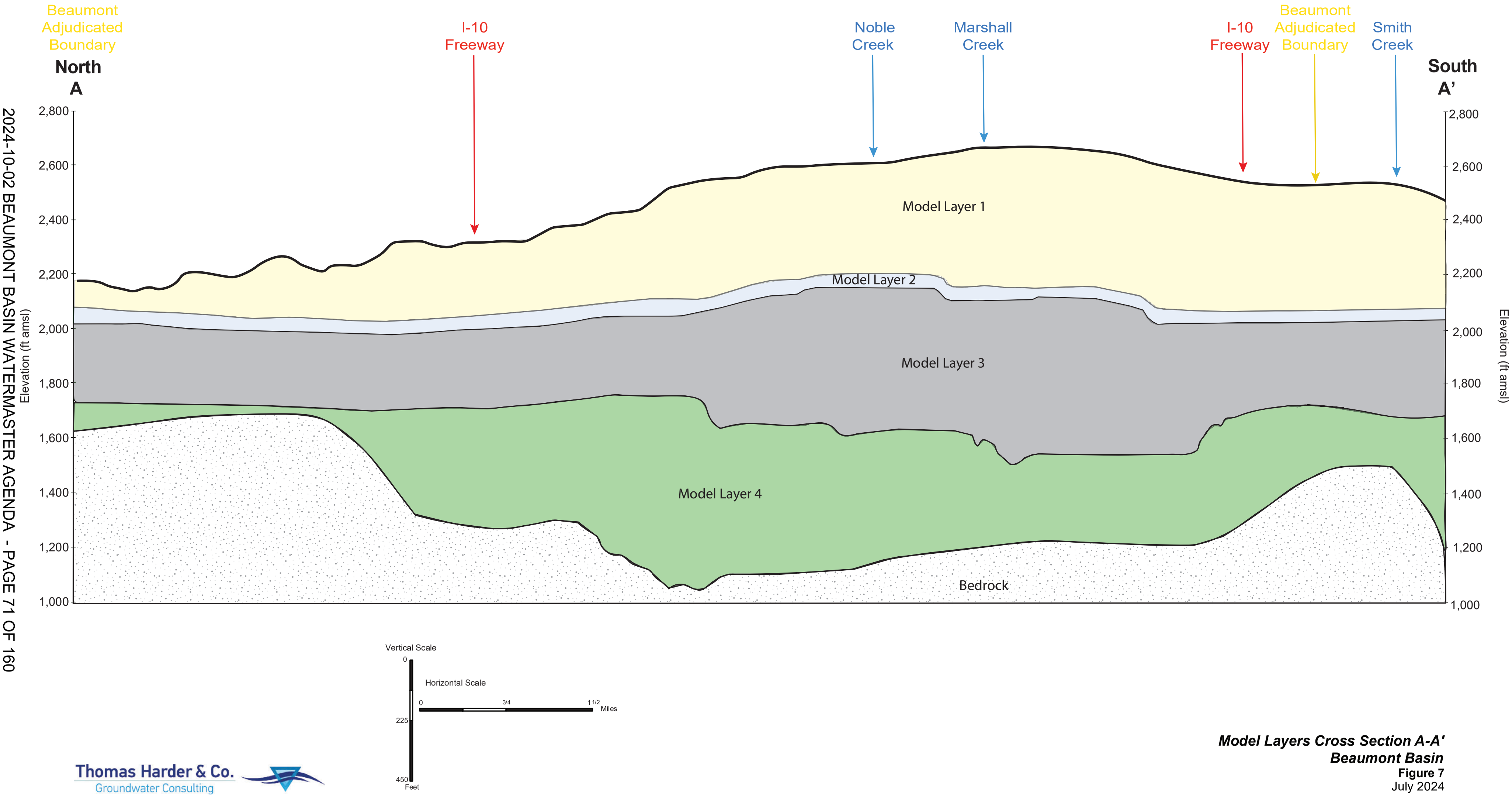
Geology of Beaumont Basin

Figure 6

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield



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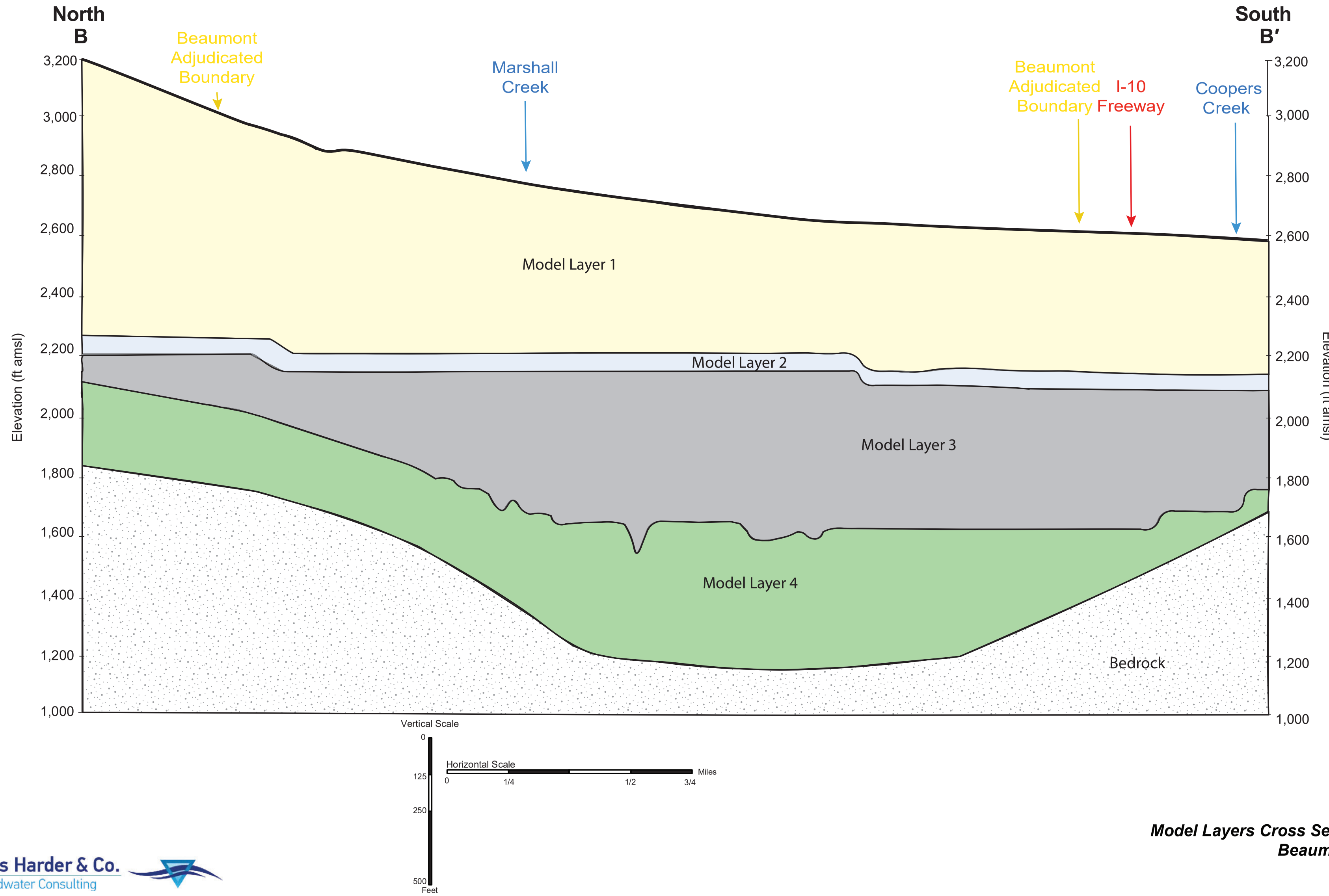
Model Layers Cross Section A-A'
Beaumont Basin
Figure 7
July 2024

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield



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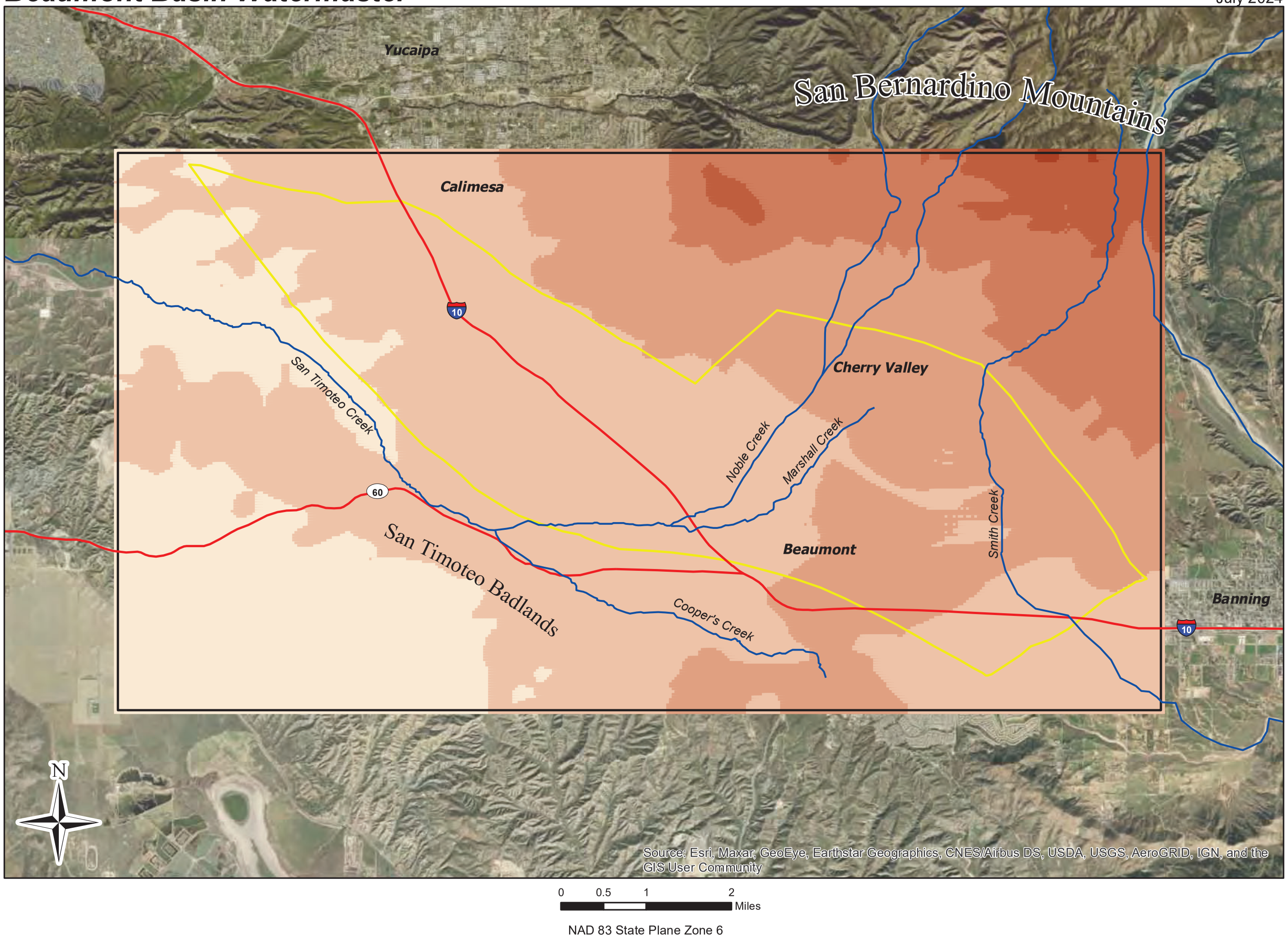
Model Layers Cross Section B-B'
Beaumont Basin
Figure 8
July 2024

Beaumont Basin Watermaster

July 2024



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2023 Reevaluation of the Beaumont Basin Safe Yield

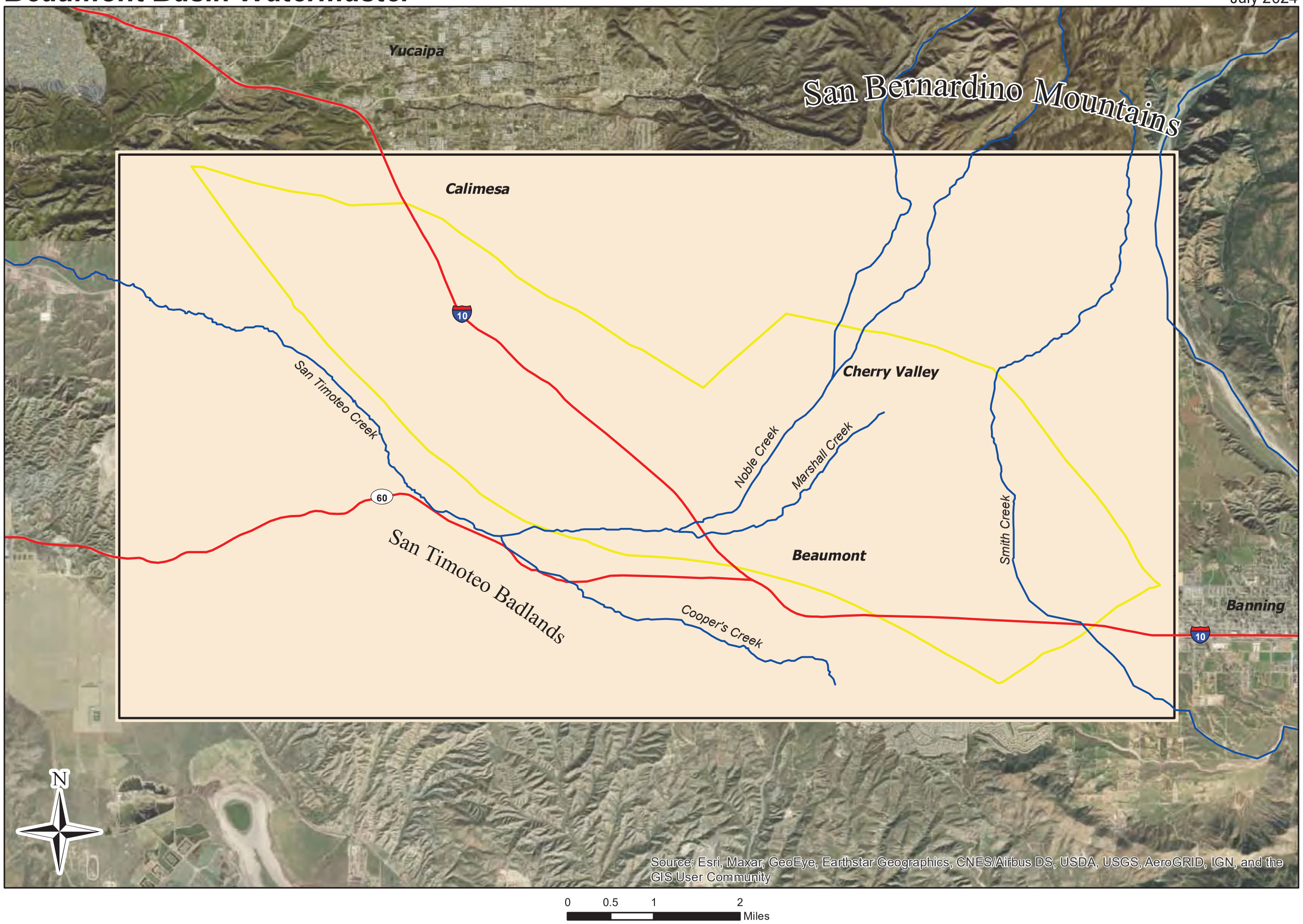
Layer 1 Thickness

Figure 9a

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



NAD 83 State Plane Zone 6

Map Features

Layer Thickness (ft)

- 50
- Study Area
- Beaumont Basin Adjudicated Area
- Creek
- Freeway/Highway

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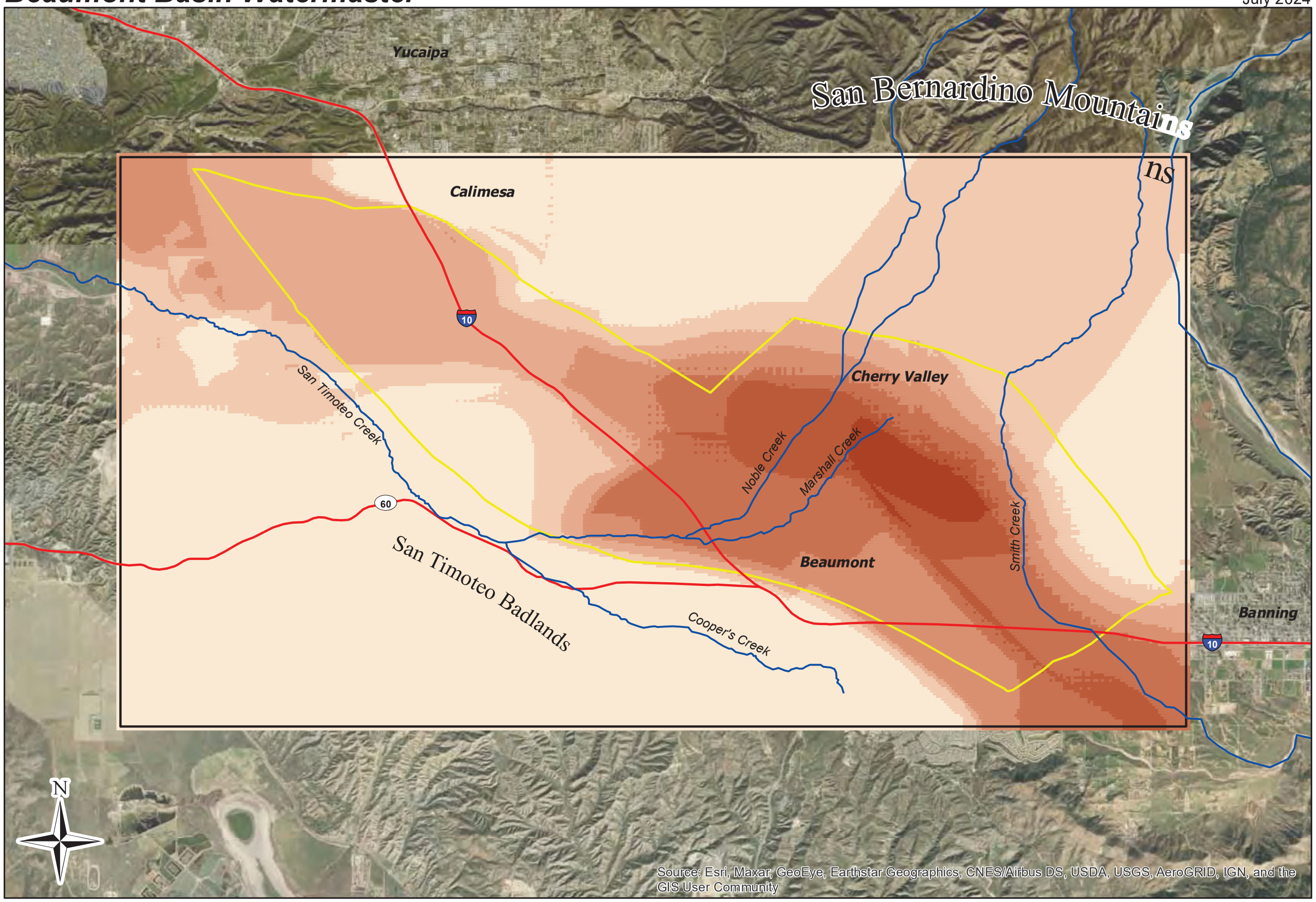
Layer 2 Thickness

Figure 9b

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



0 0.5 1 2 Miles

NAD 83 State Plane Zone 6

Map Features

Layer Thickness (ft)
- 0 to 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
- 600 to 700

- Study Area
- Beaumont Basin Adjudicated Area
- Creek
- Freeway/Highway

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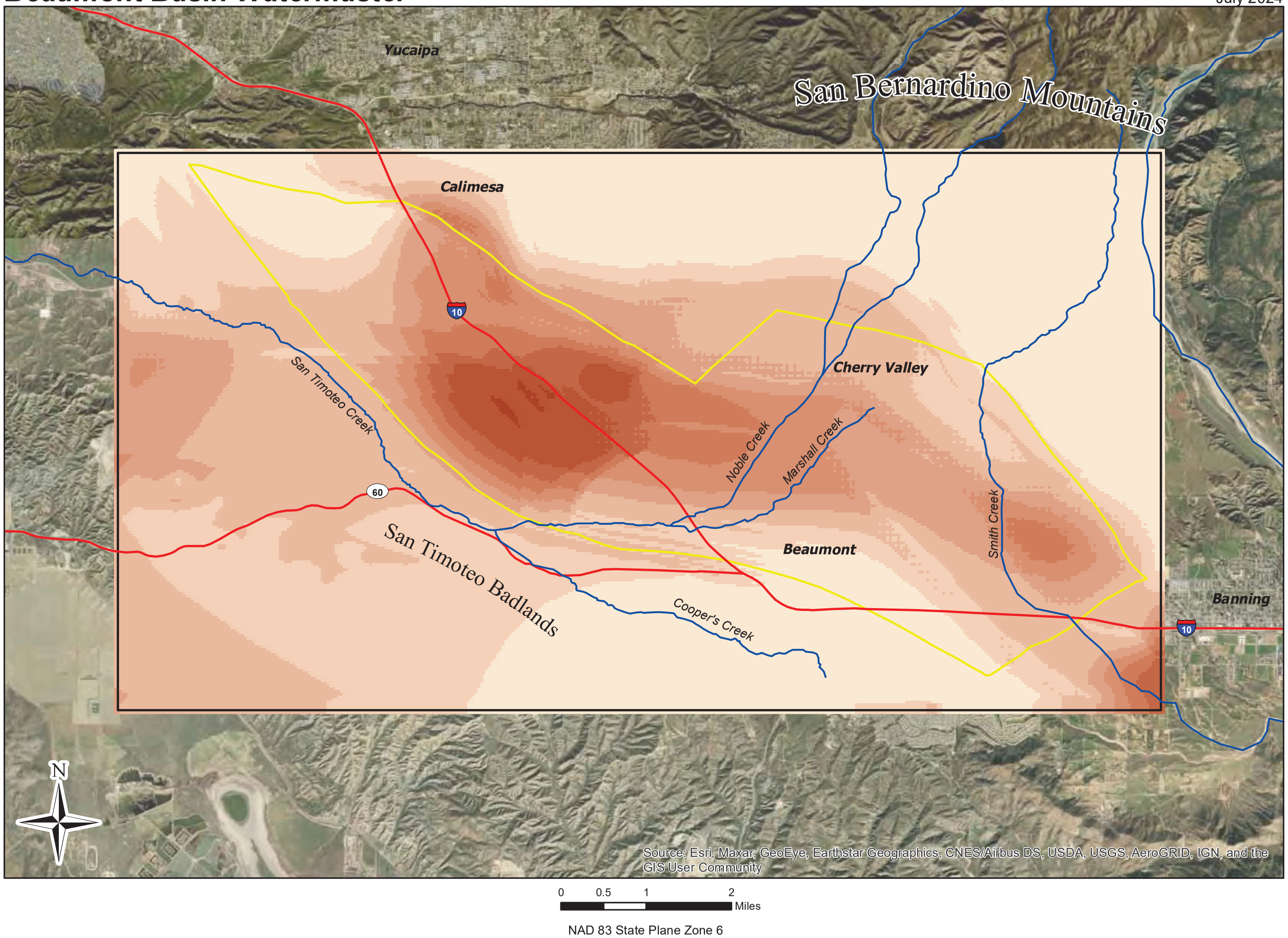
Layer 3 Thickness

Figure 9c

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



Map Features

Layer Thickness (ft)

- 0 to 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
- 600 to 700
- 700 to 800
- 800 to 900
- Study Area
- Beaumont Basin Adjudicated Area
- Creek
- Freeway/Highway

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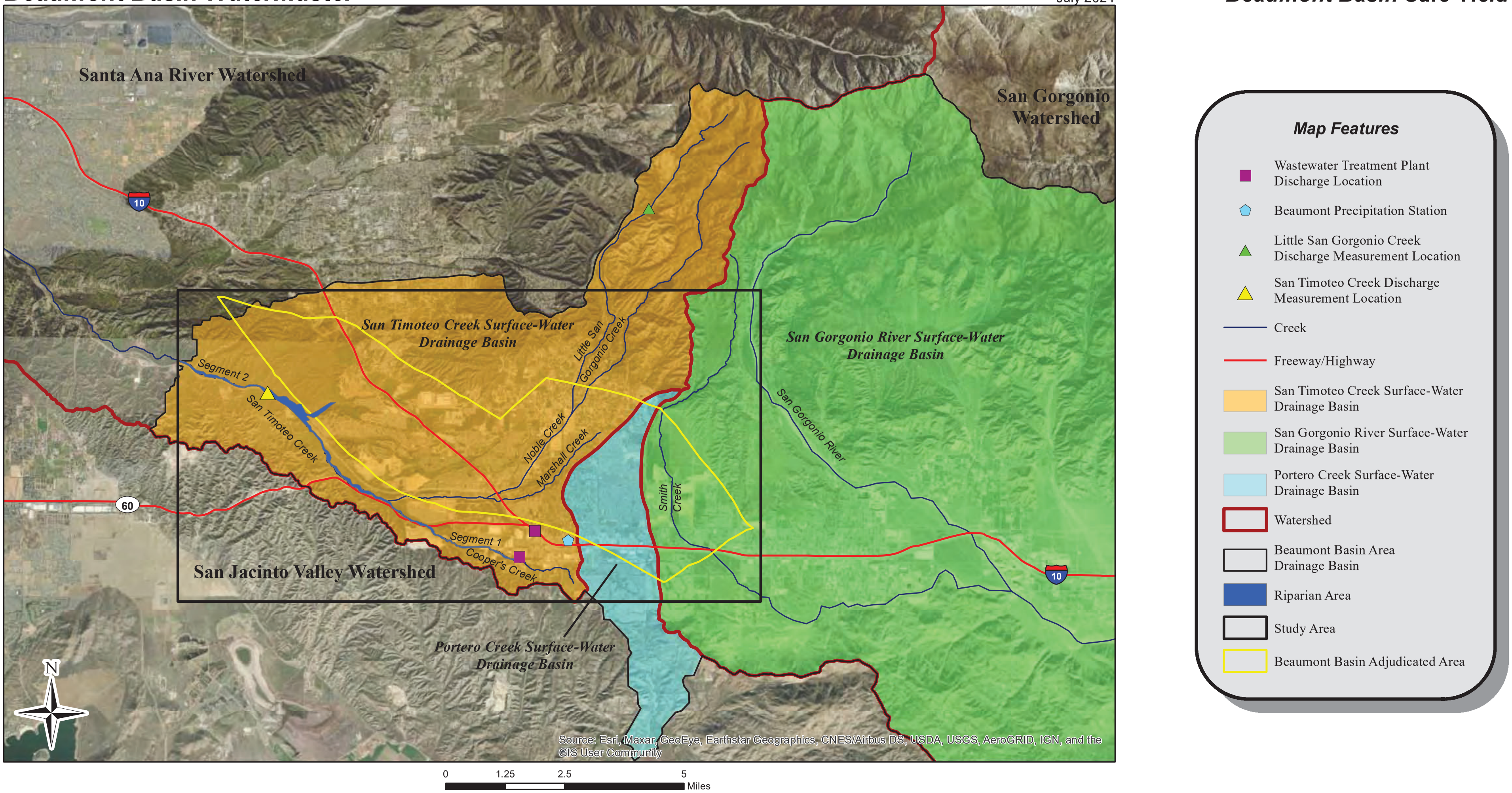
Layer 4 Thickness

Figure 9d

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



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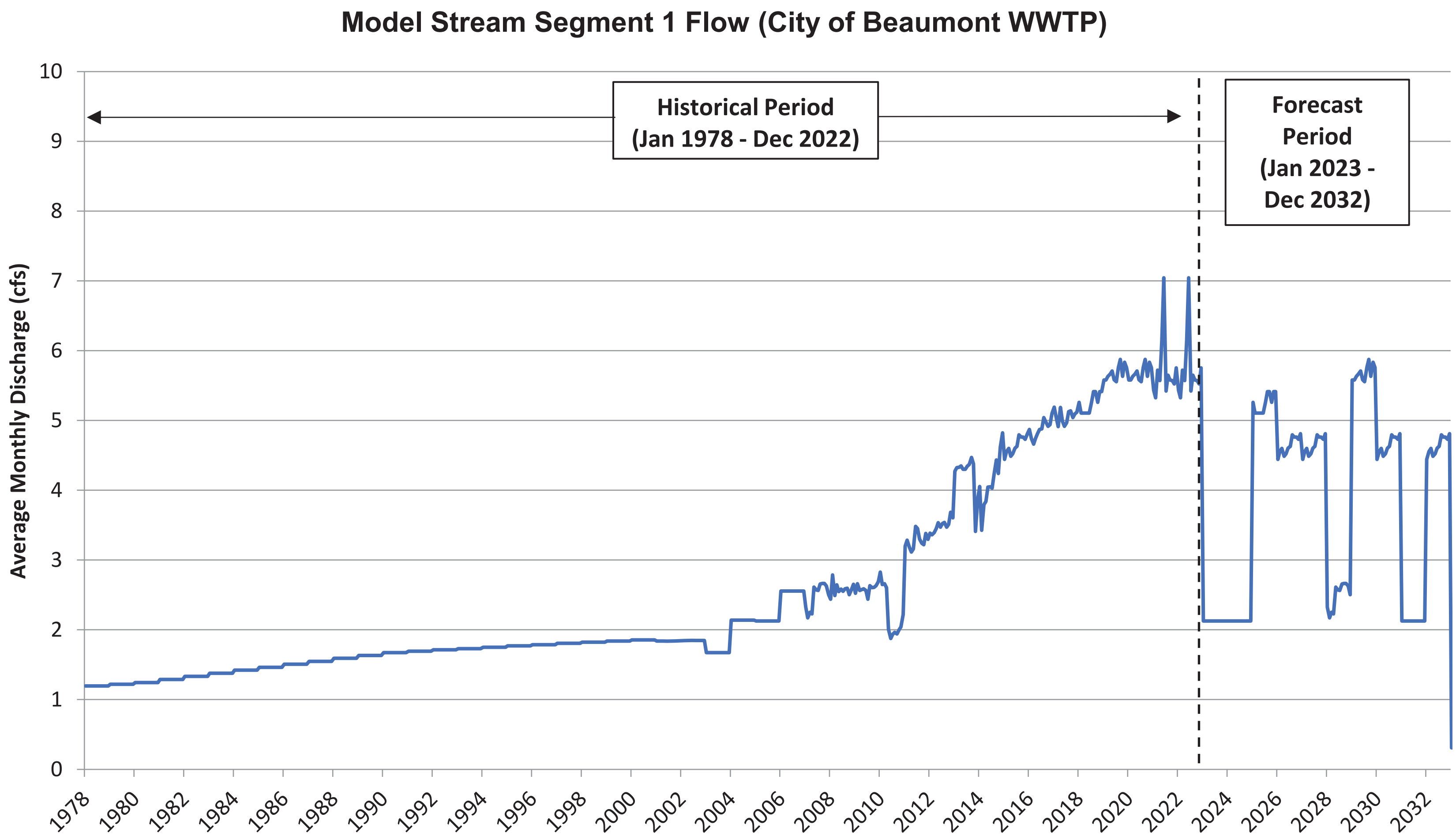
Surface Water Features in the Beaumont Basin Area

Figure 10

Figure 11



Notes: Historical period data comes from treated wastewater discharges to Coopers Creek by the City of Beaumont.
Forecast period wastewater recharge was determined using proxy years from the historical period (See Section 2.13).

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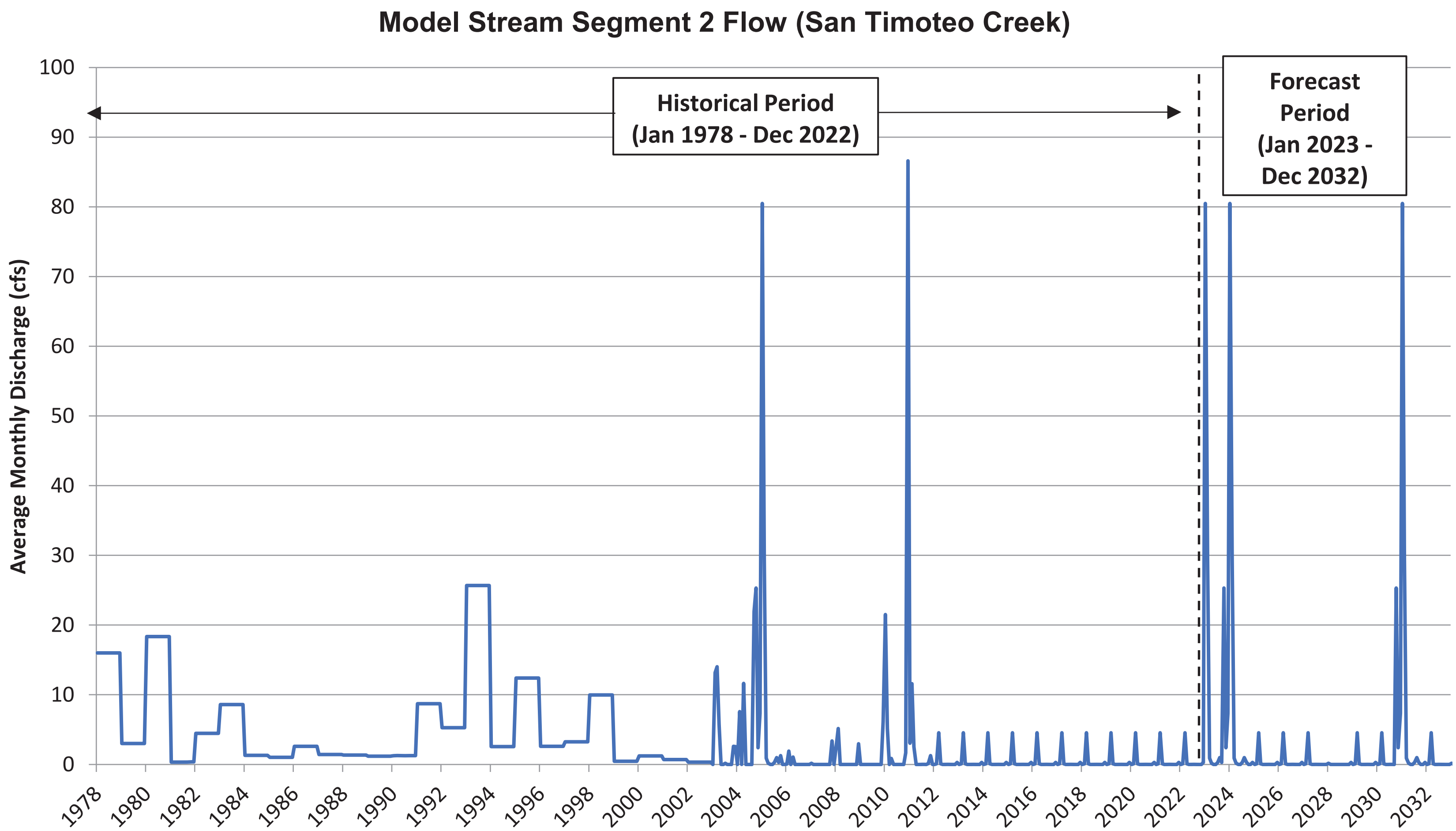
July 2024

Figure 12



Notes: Historical period data for 1978-1985 was interpolated from the USGS Little San Gorgonio Creek gage.
Historical period data for 2002-2012 was measued by YVWD on San Timoteo Creek.
Forecast period wastewater recharge was determined using proxy years from the historical period (See Section 2.13).

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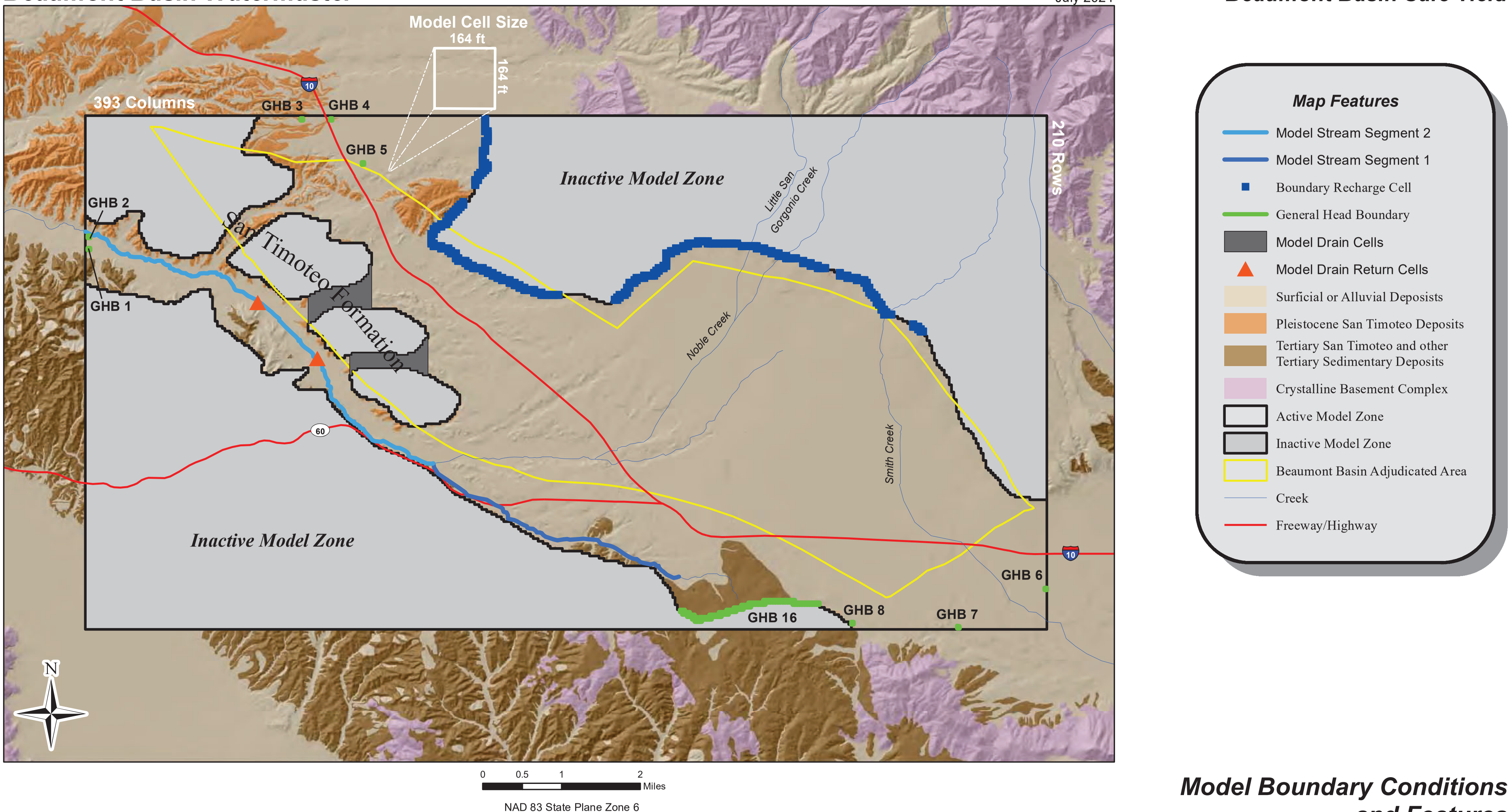

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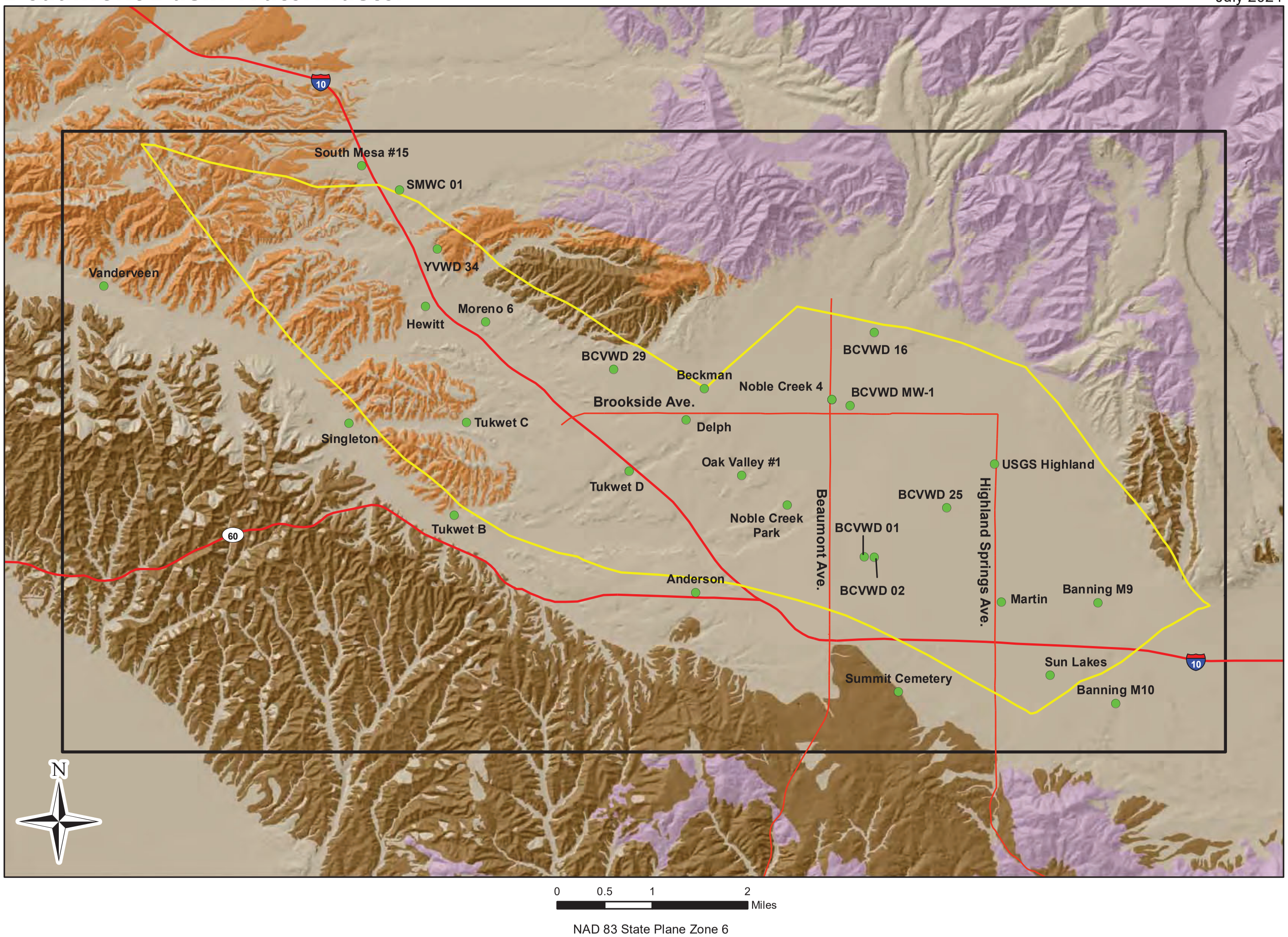
Model Boundary Conditions and Features

Figure 13

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



Map Features

- Calibration Well
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Study Area
- Beaumont Basin Adjudicated Area
- Major Street
- Freeway/Highway

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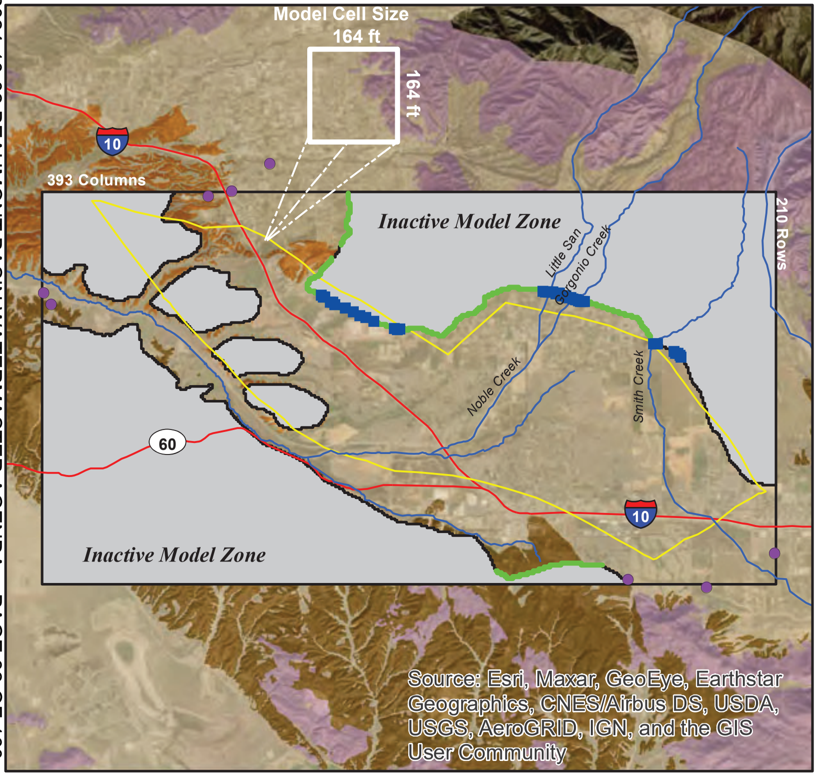
Monitoring Wells Used for Model Calibration

Figure 14

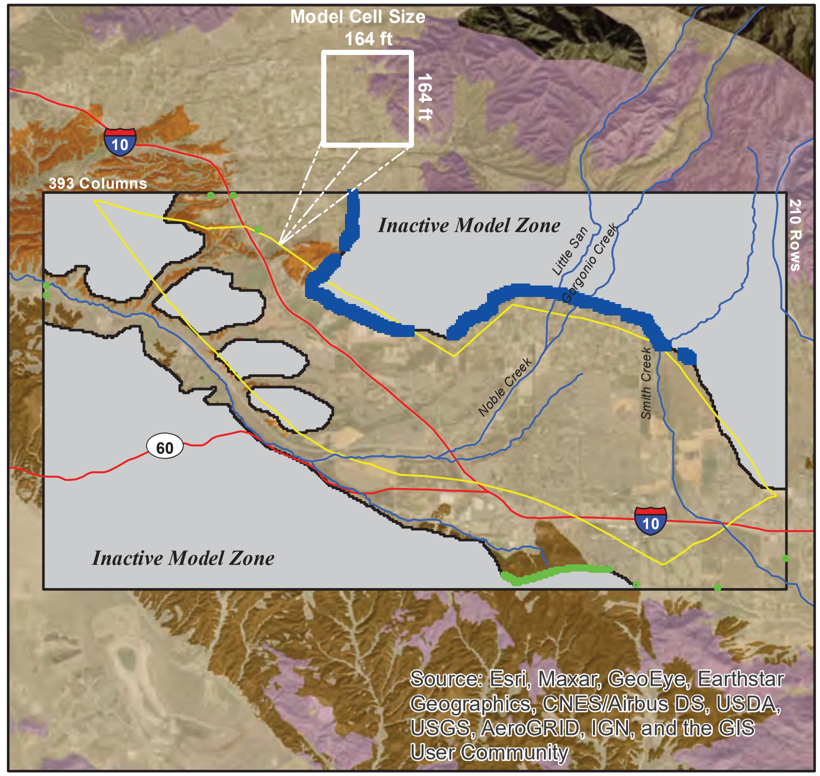
Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield
July 2024

2013 Model Update



2023 Model Update



Map Features

- Constant Head Cell
- Boundary Recharge Cell
- General Head Boundary
- Creek
- Freeway/Highway
- Active Model Zone
- Inactive Model Zone
- Beaumont Basin Adjudicated Area
- Surficial or Alluvial Deposits
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex

N

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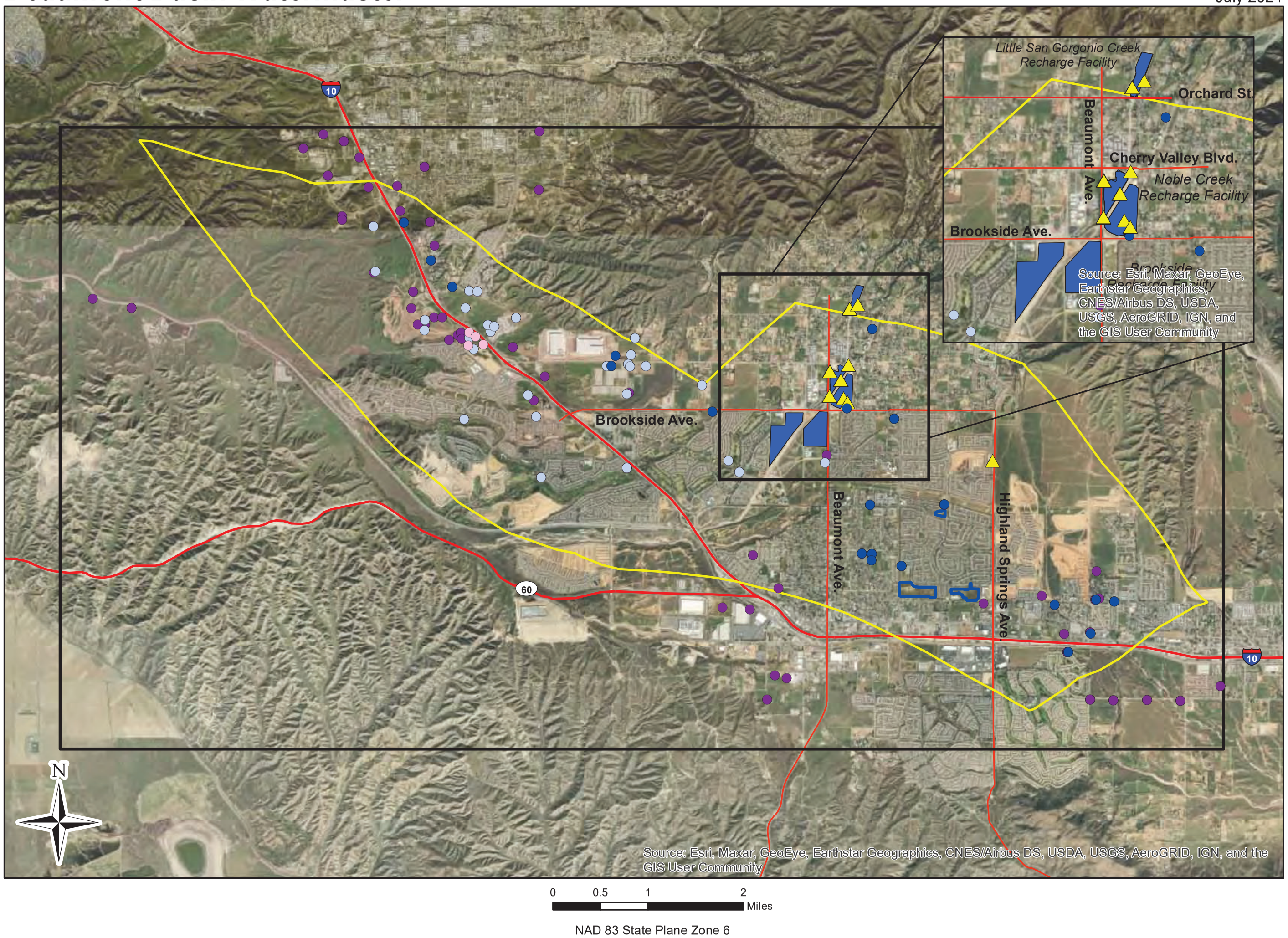
0 1.25 2.5 5 Miles
NAD 83 State Plane Zone 6

2023 Updates to Model Boundary Conditions
Figure 15

Beaumont Basin Watermaster

July 2024



Map Features

- Appropriator Production Well
- Overlayer Production Well
- Other Production Well
- Injection Well
- Monitoring Well
- Study Area
- Recharge Facility
- Beaumont Basin Adjudicated Area
- City of Beaumont Stormwater Capture Basin
- Major Street
- Freeway/Highway

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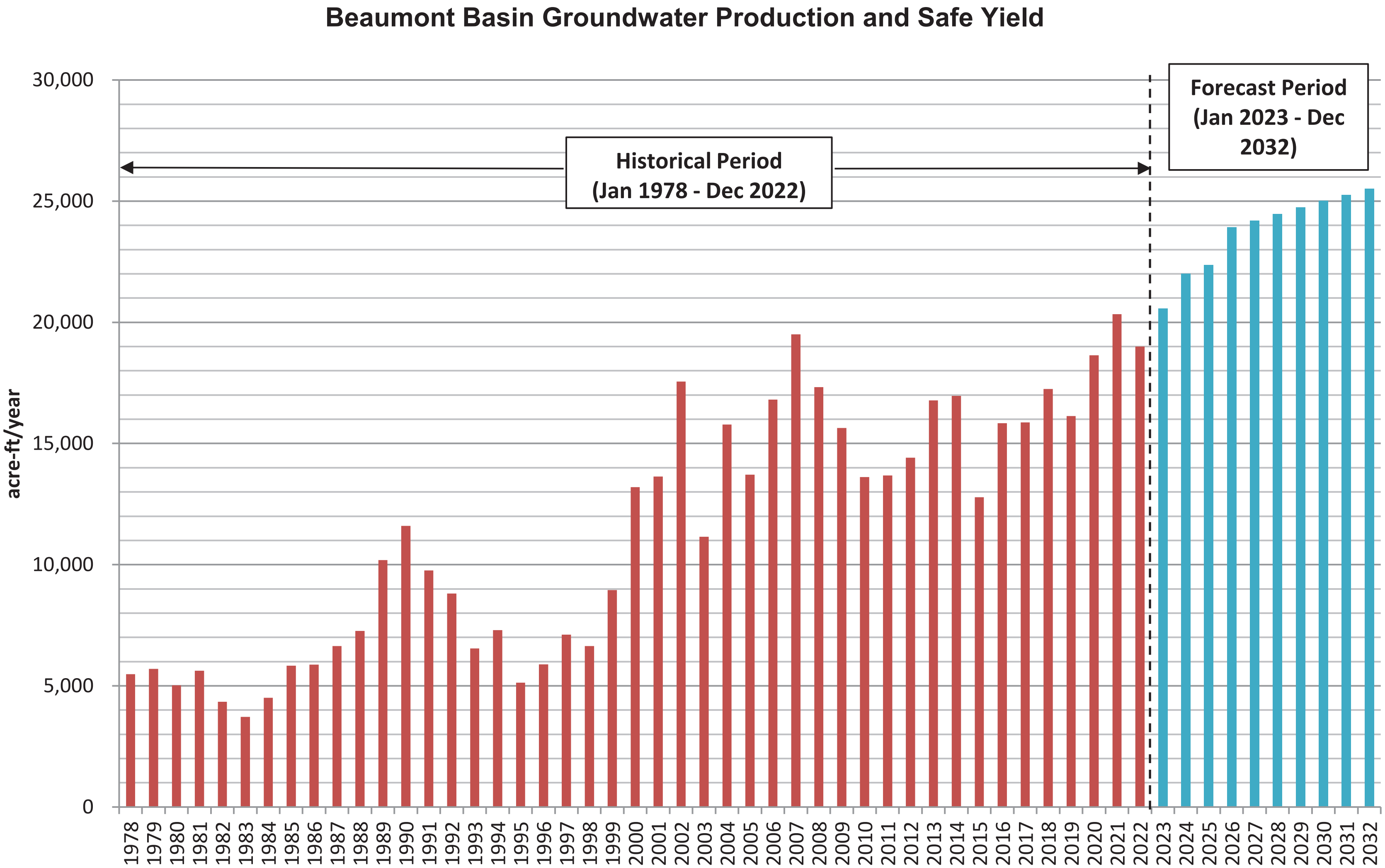
Groundwater Wells and Recharge Facilities

Figure 16

Beaumont Basin Watermaster
2023 Reevaluation of the Beaumont Basin
Safe Yield

Figure 17



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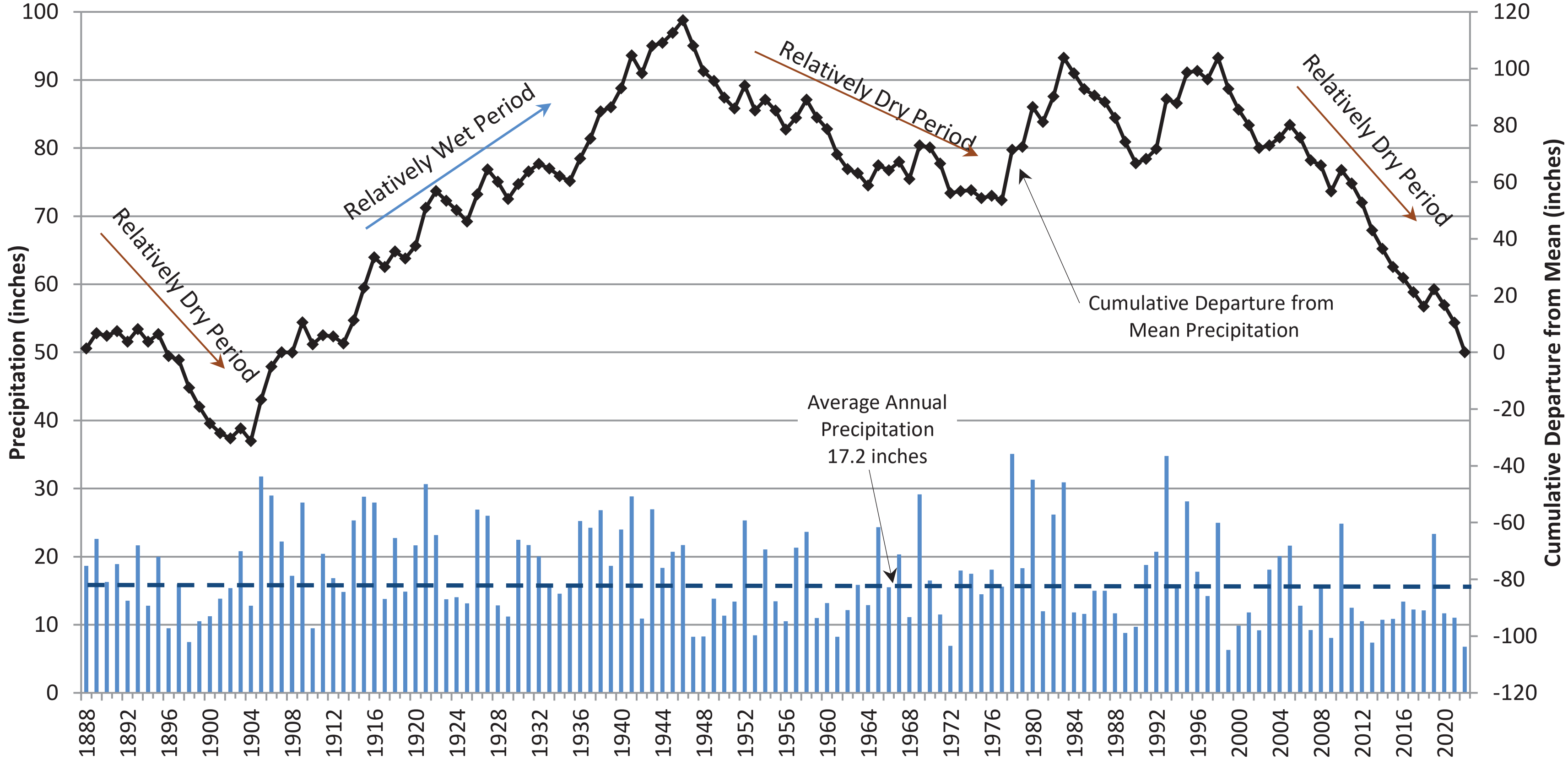
Beaumont Annual Precipitation
1888 - 2022



Source: Riverside County Flood Control Water Conservation District, Station Number 13 (2023)

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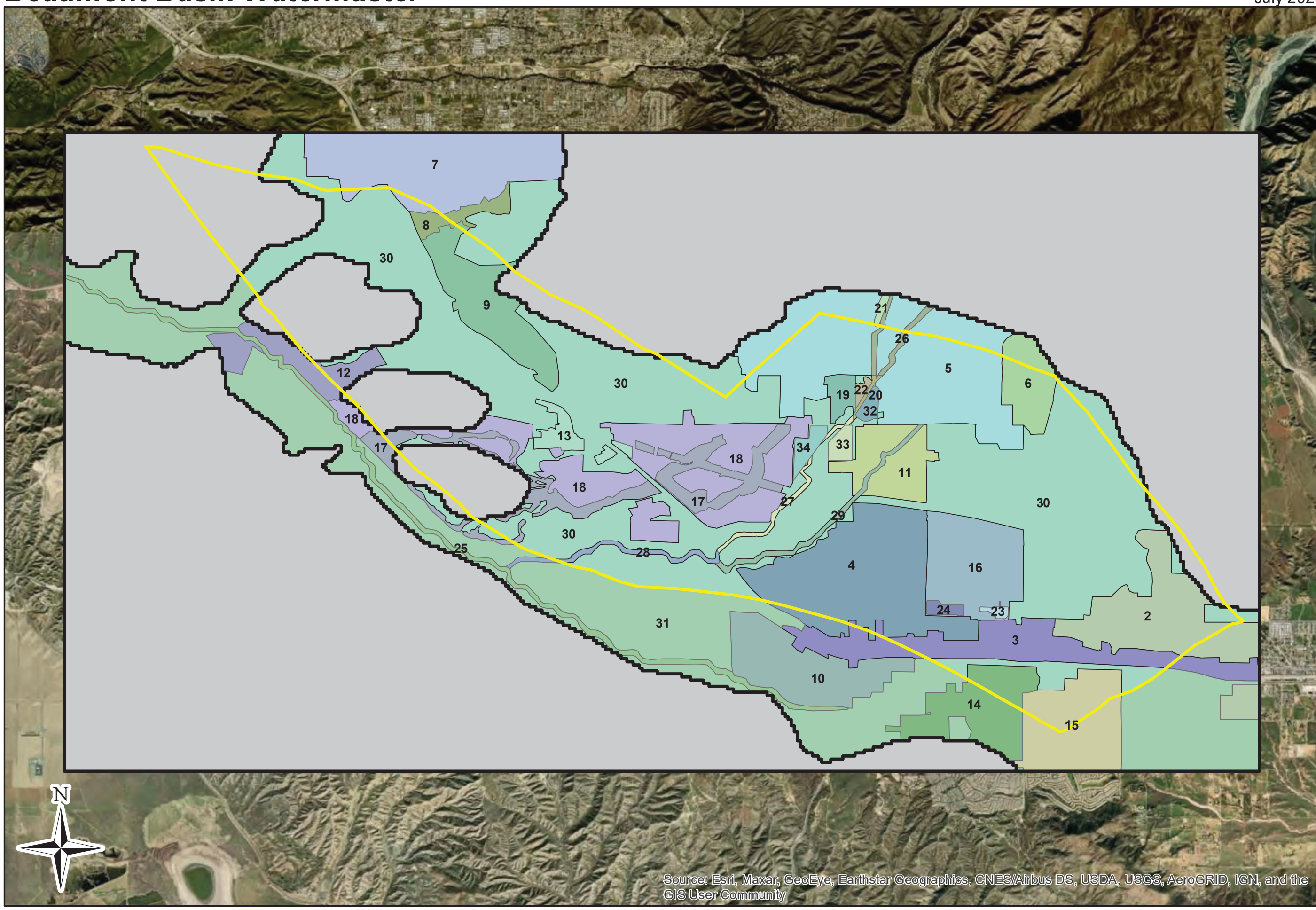
Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

RCH Zone #: Min: Max
- 2: 0.00005: 0.00008
- 3: 0.00004: 0.00005
- 4: 0.00021: 0.00031
- 5: 0.00031: 0.00047
- 6: 0.00021: 0.00031
- 7: 0.00016: 0.00025
- 8: 0.00059: 0.00089
- 9: 0.00015: 0.00023
- 10: 0.00005: 0.00008
- 11: 0.00008: 0.00012
- 12: 0.00006: 0.0001
- 13: 0.00005: 0.00008
- 14: 0.00016: 0.00024
- 15: 0.00007: 0.00011
- 16: 0.00003: 0.00004
- 17: 0.00008: 0.00012
- 18: 0.00002: 0.00003
- 19: 0.00027: 0.0004
- 20: 0: 0.00001
- 21: 0: 0.56362
- 22: 0: 4.21
- 23: 0.00008: 0.00012
- 24: 0.00001: 0.00001
- 25: 0.00001: 0.00001
- 26: 0.00124: 0.00187
- 27: 0.00072: 0.00108
- 28: 0.00001: 0.00002
- 29: 0.00398: 0.00596
- 30: 0.00027: 0.00041
- 31: 0.00027: 0.00041
- 32: 0: 1.03
- 33: 0: 0.313
- 34: 0: 0

Active Model Zone

Inactive Model Zone

Beaumont Basin Adjudicated Area

Note: Units for the minimum and maximum recharge rates are in feet/day.

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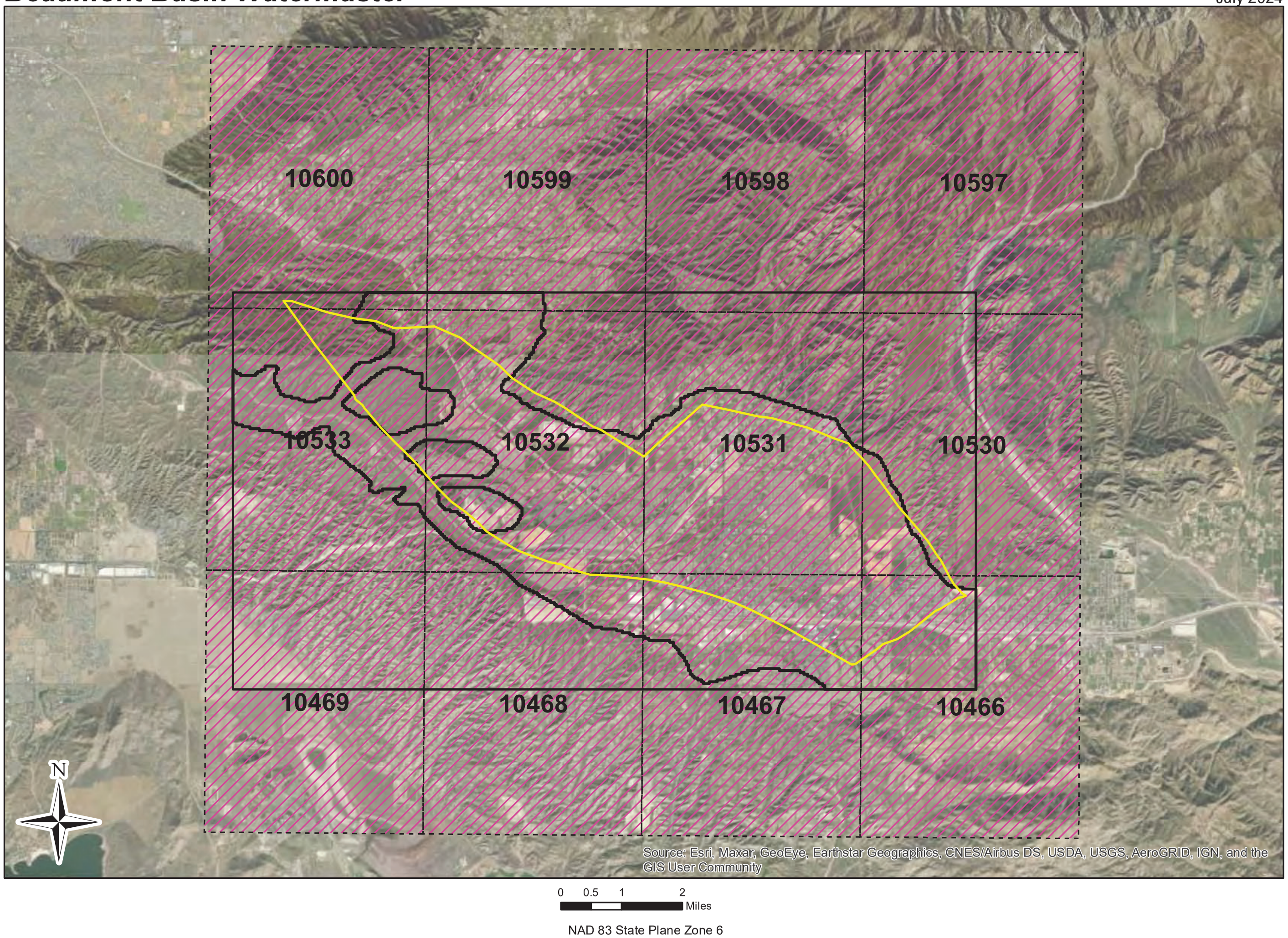
Recharge Zones Used in the Groundwater Flow Model

Figure 19

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

- DWR Climate Change Model Polygon
- Active Model Domain
- Beaumont Basin Adjudicated Area
- Study Area

Note: The number inside each DWR Climate Change Model Polygon denotes the Cell Identification Number of the California Department of Water Resources Variable Infiltration Capacity (VIC) model cell. DWR Climate Change Model Polygon from California Department of Water Resources. (n.d.). SGMA Data Viewer.

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Climate Change Model Areas

Figure 20

Beaumont Basin Watermaster

July 2024

0 0.05 0.1 0.2 Miles

NAD 83 State Plane Zone 6

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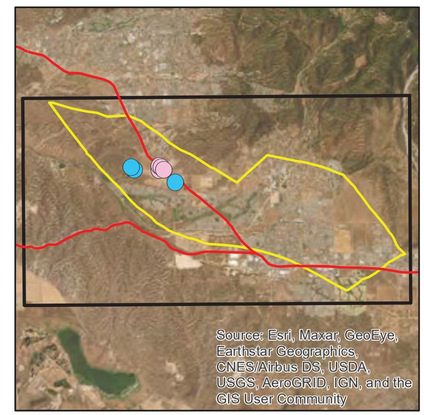
2023 Reevaluation of the Beaumont Basin Safe Yield

Map Features

- Injection Well
- Extraction Well
- Study Area
- Beaumont Basin Adjudicated Area
- Freeway/Highway

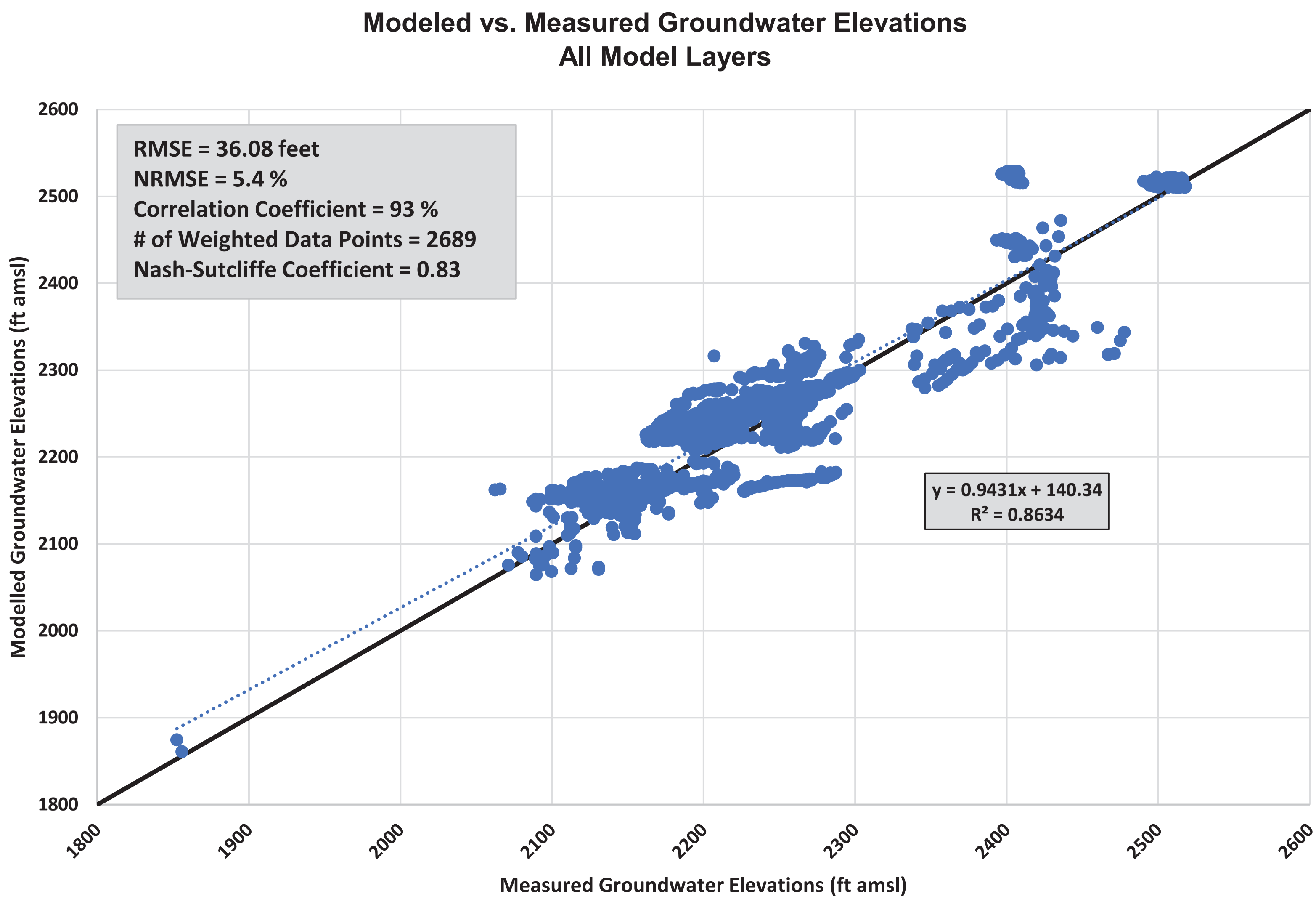


Yucaipa Valley Water District Proposed Aquifer Storage & Recovery Project Wells

Figure 21

Beaumont Basin Watermaster
2023 Reevaluation of the Beaumont Basin
Safe Yield

Figure 22



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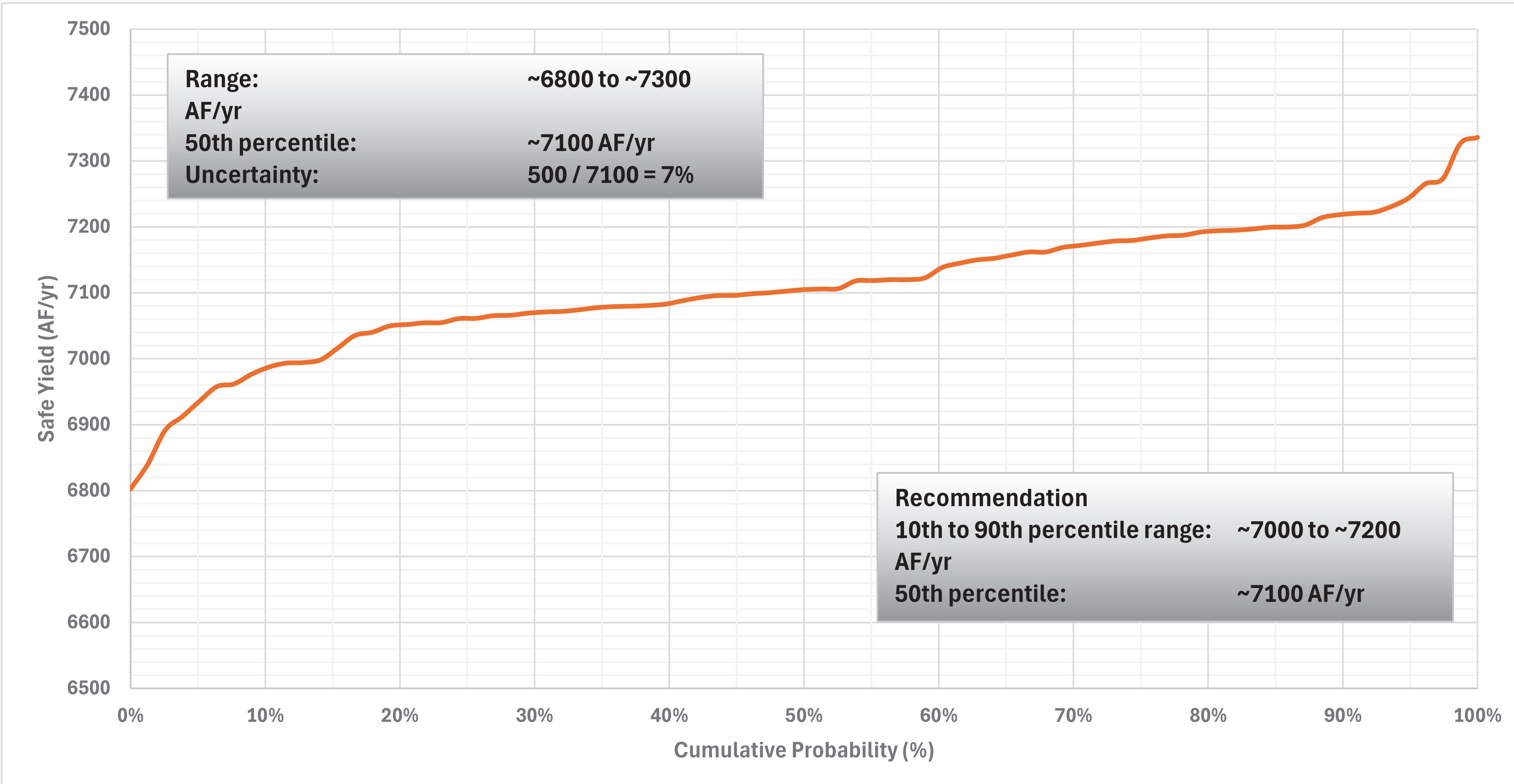
Beaumont Basin Watermaster
2023 Reevaluation of the
Beaumont Basin Safe Yield

Figure 23

Safe Yield vs. Cumulative Probability
1978 - 2032



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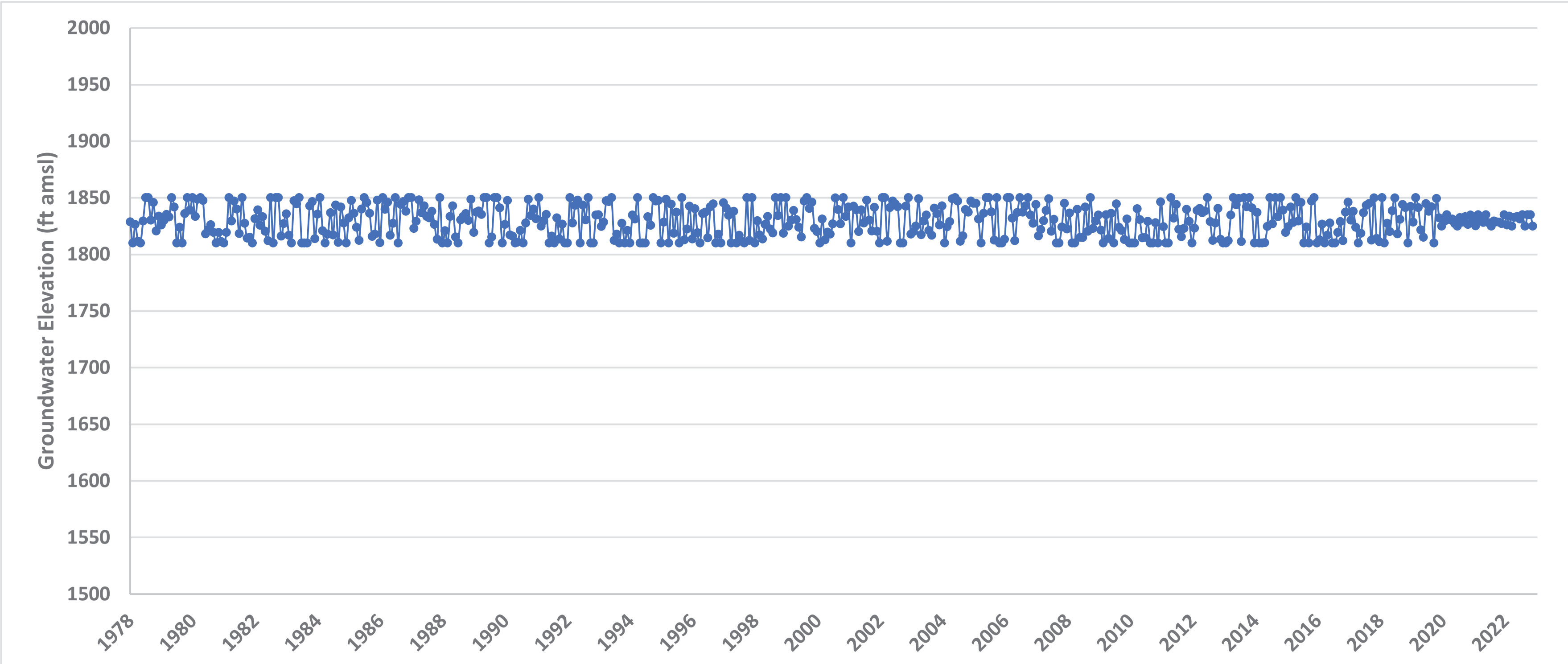
Appendices

Appendix A

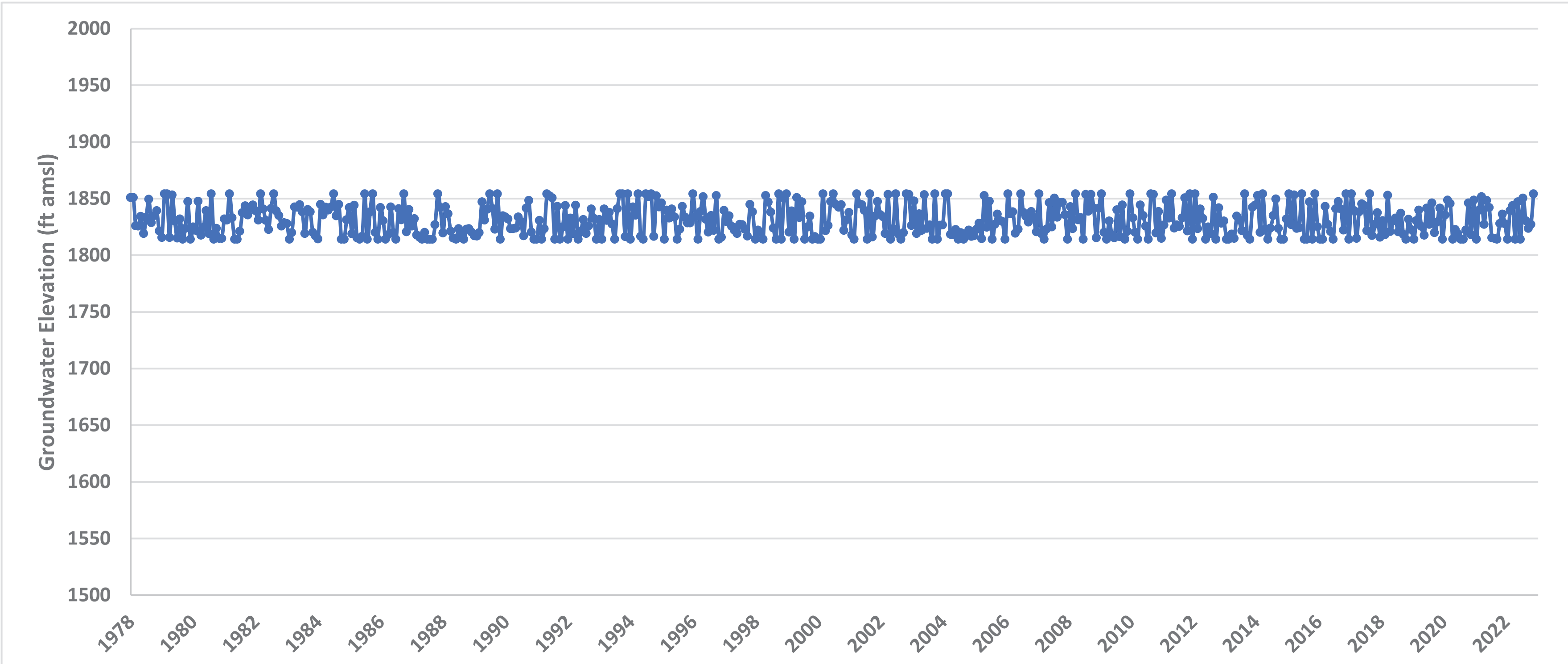
Model Boundary Condition Hydrographs

Boundary Condition Well Hydrograph
GHB 1 (Chester Well)



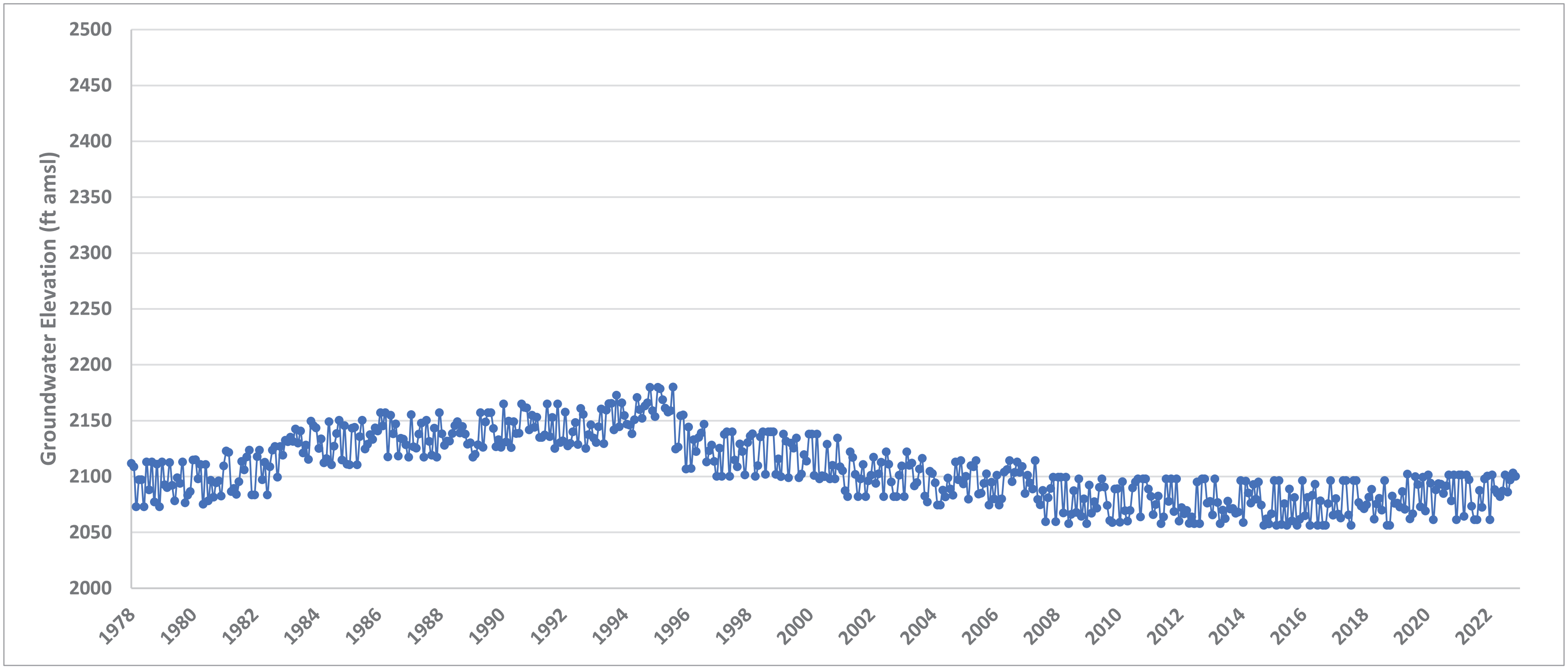
Notes: Groundwater elevations at this boundary well were selected based on observed data from Chester well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 2 (El Casco Schoolhouse Well)



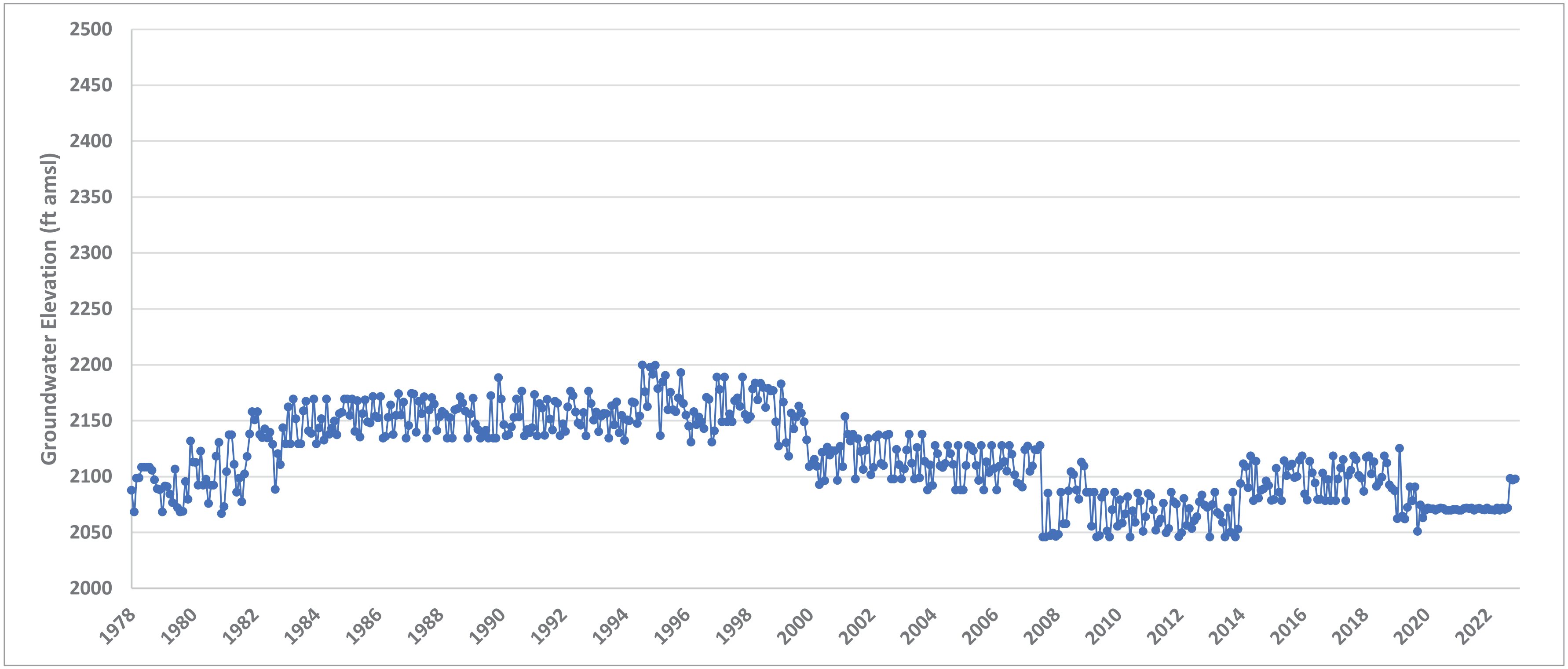
Notes: Groundwater elevations at this boundary well were selected based on observed data from El Casco Schoolhouse well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 3 (SMWC 07 Well)



Notes: Groundwater elevations at this boundary well were selected based on observed data from SMWC 07 well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

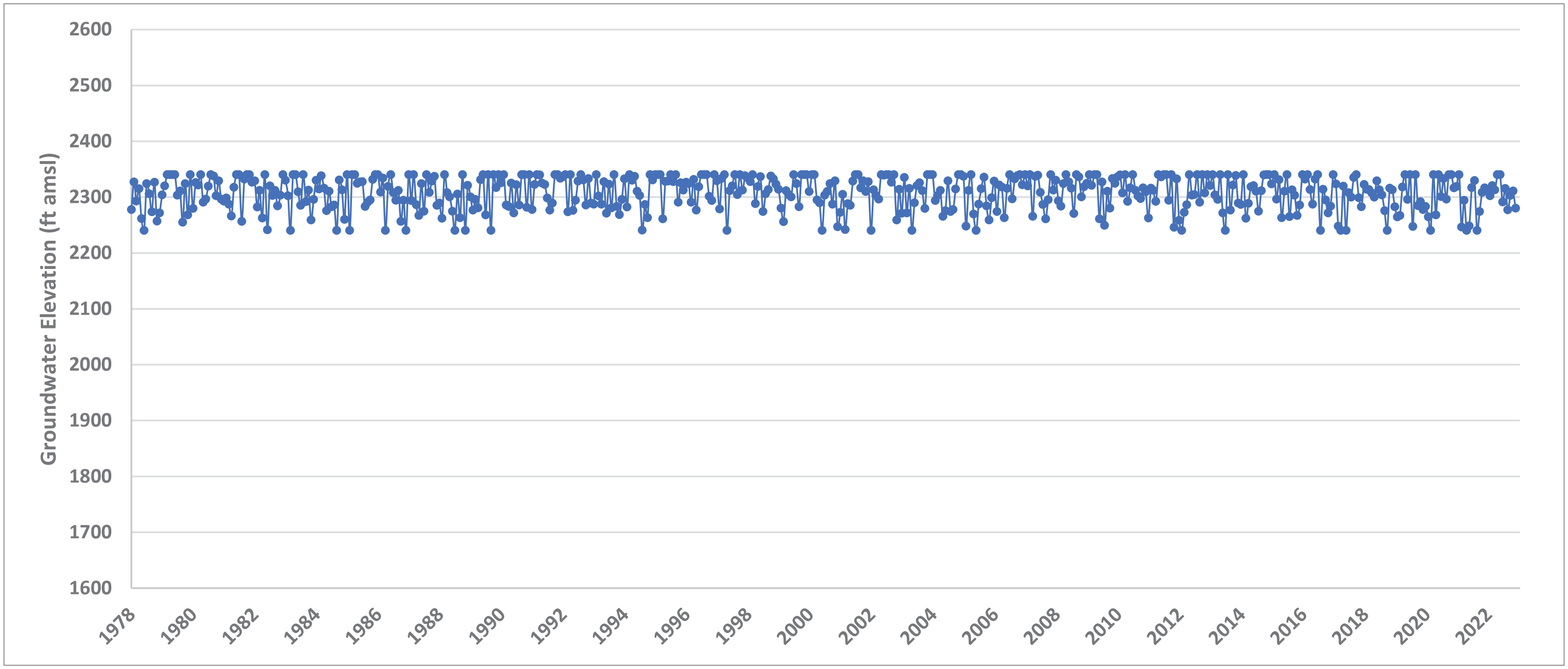
Boundary Condition Well Hydrograph
GHB 4 (SMWC 11 Well)



Notes: Groundwater elevations at this boundary well were selected based on observed data from SMWC 11 well.

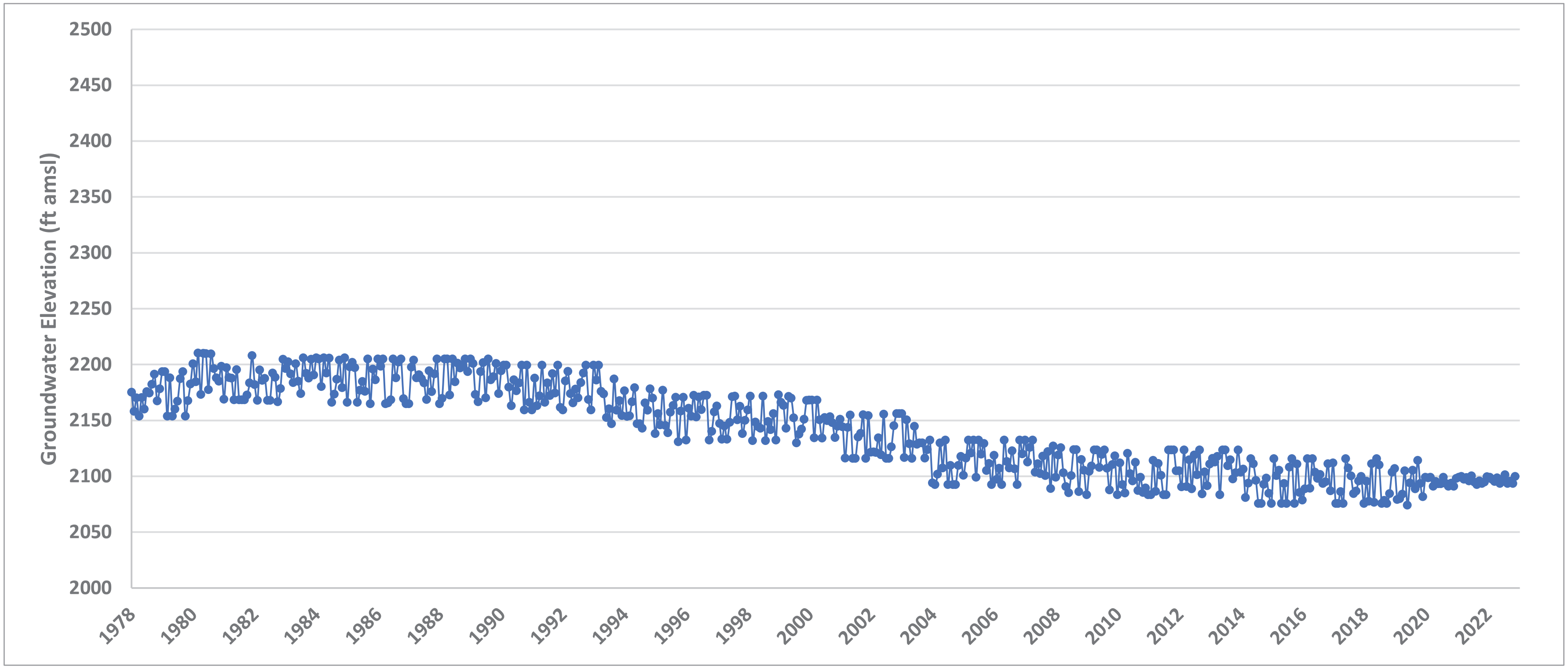
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 5 (SMWC 01 Well)



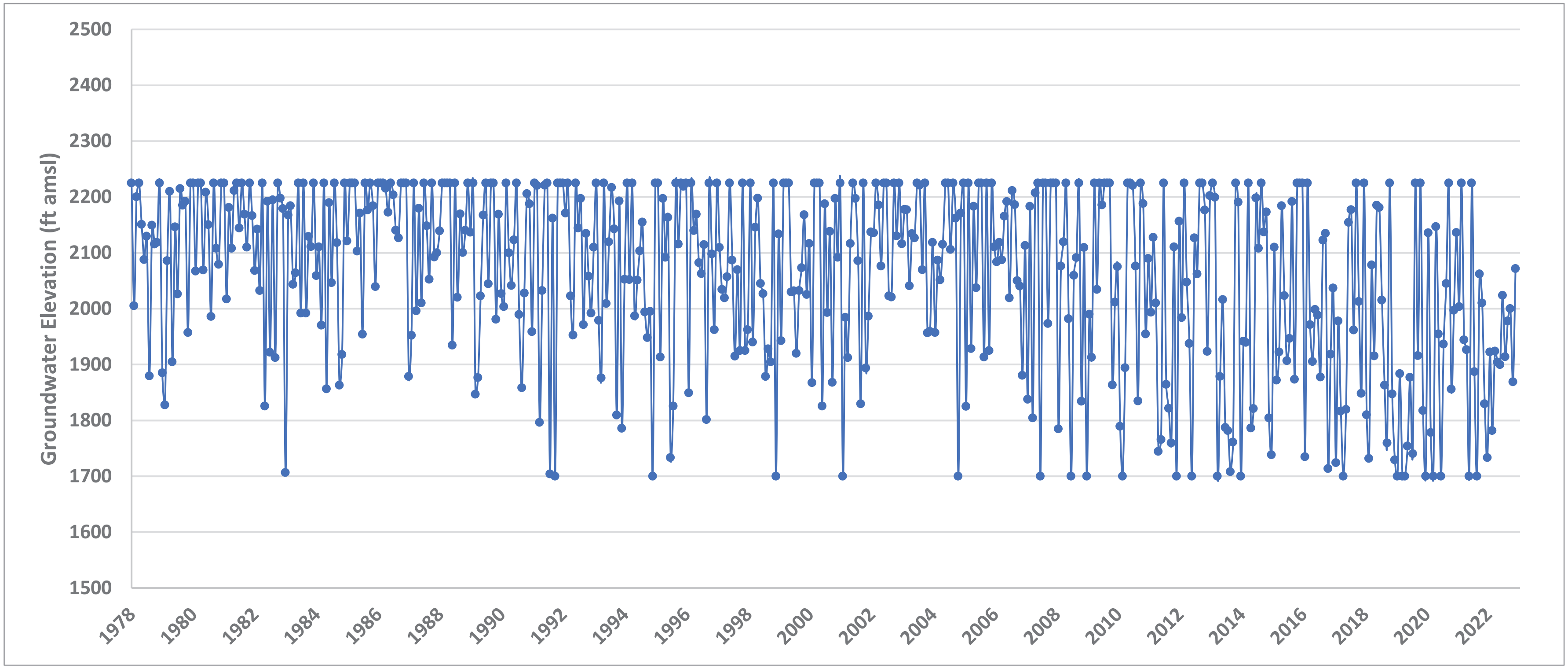
Notes: Groundwater elevations at this boundary well were selected based on observed data from SMWC 01 well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 6 (Banning CW #C5 Well)



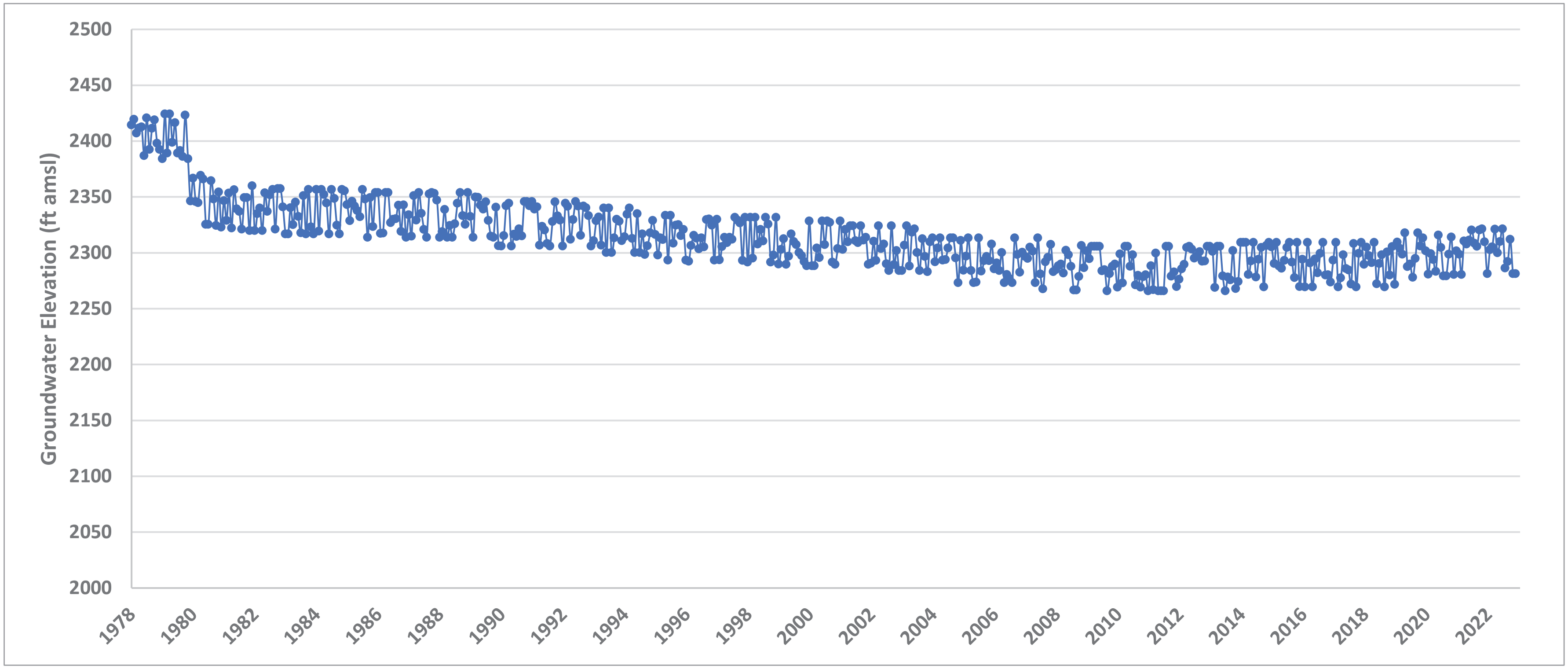
Notes: Groundwater elevations at this boundary well were selected based on observed data from Banning CW #C5 well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 7 (Banning M8 Well)



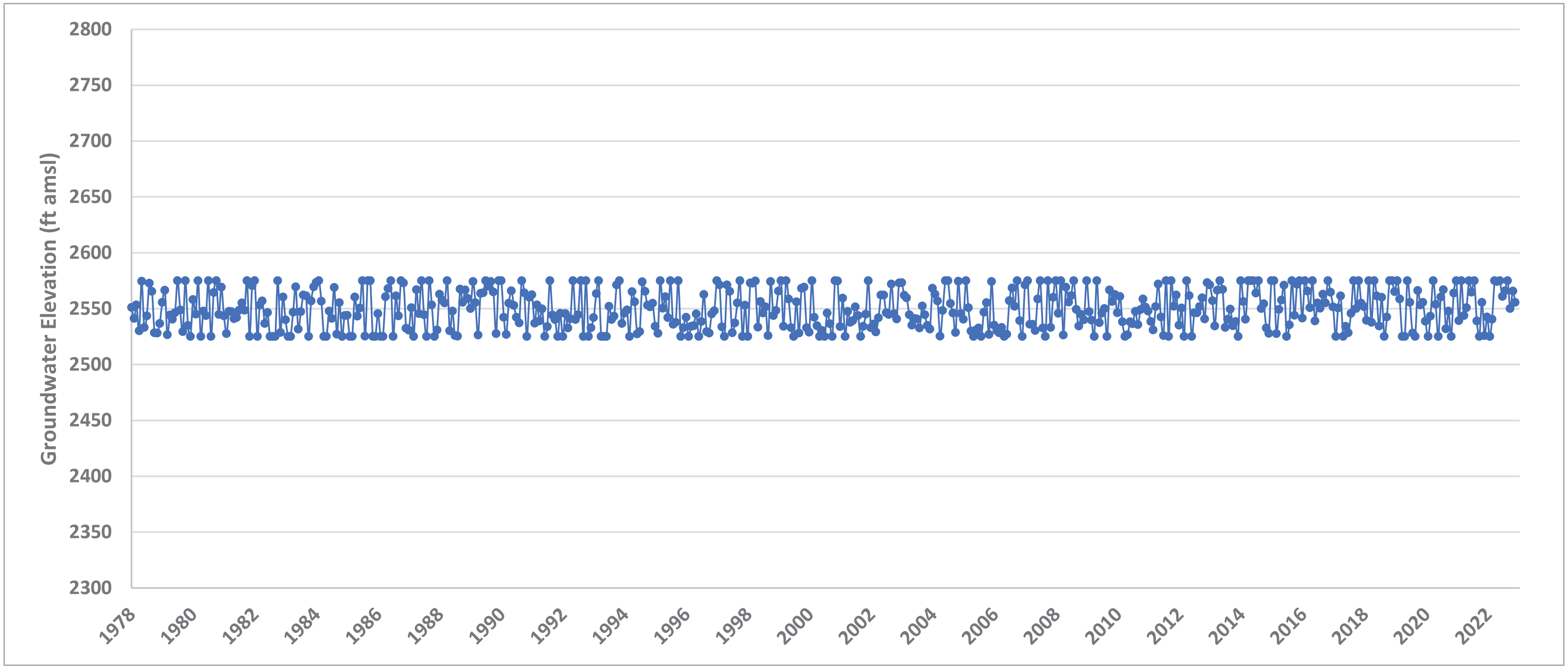
Notes: Groundwater elevations at this boundary well were selected based on observed data from Banning M8 well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 8 (3S/1W-14J02 Well)



Notes: Groundwater elevations at this boundary well were selected based on observed data from 3S/1W-14J02 well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

Boundary Condition Well Hydrograph
GHB 16 (Cemetery Well)



Notes: Groundwater elevations at this boundary well were selected based on observed data from Cemetery well.
The groundwater elevations bounds were allowed to vary based on model layering and reasonable expectations to get a decent calibration fit.

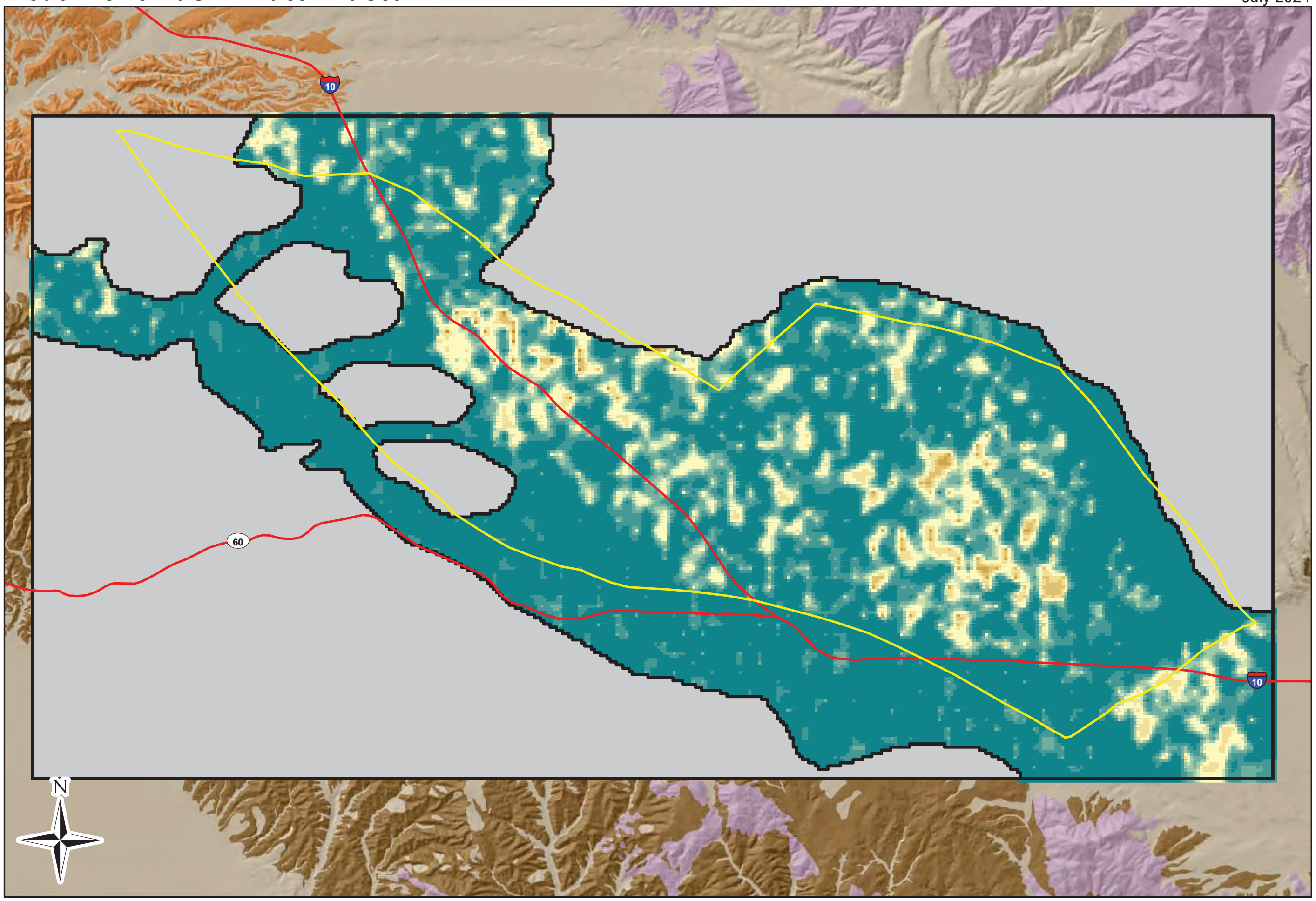
Appendix B

Model Parameters

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



0 0.5 1 2 Miles

NAD 83 State Plane Zone 6

Map Features

Horizontal Hydraulic Conductivity (ft/day)

- 0 to 20
- 20 to 40
- 40 to 60
- 60 to 80
- 80 to 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposits
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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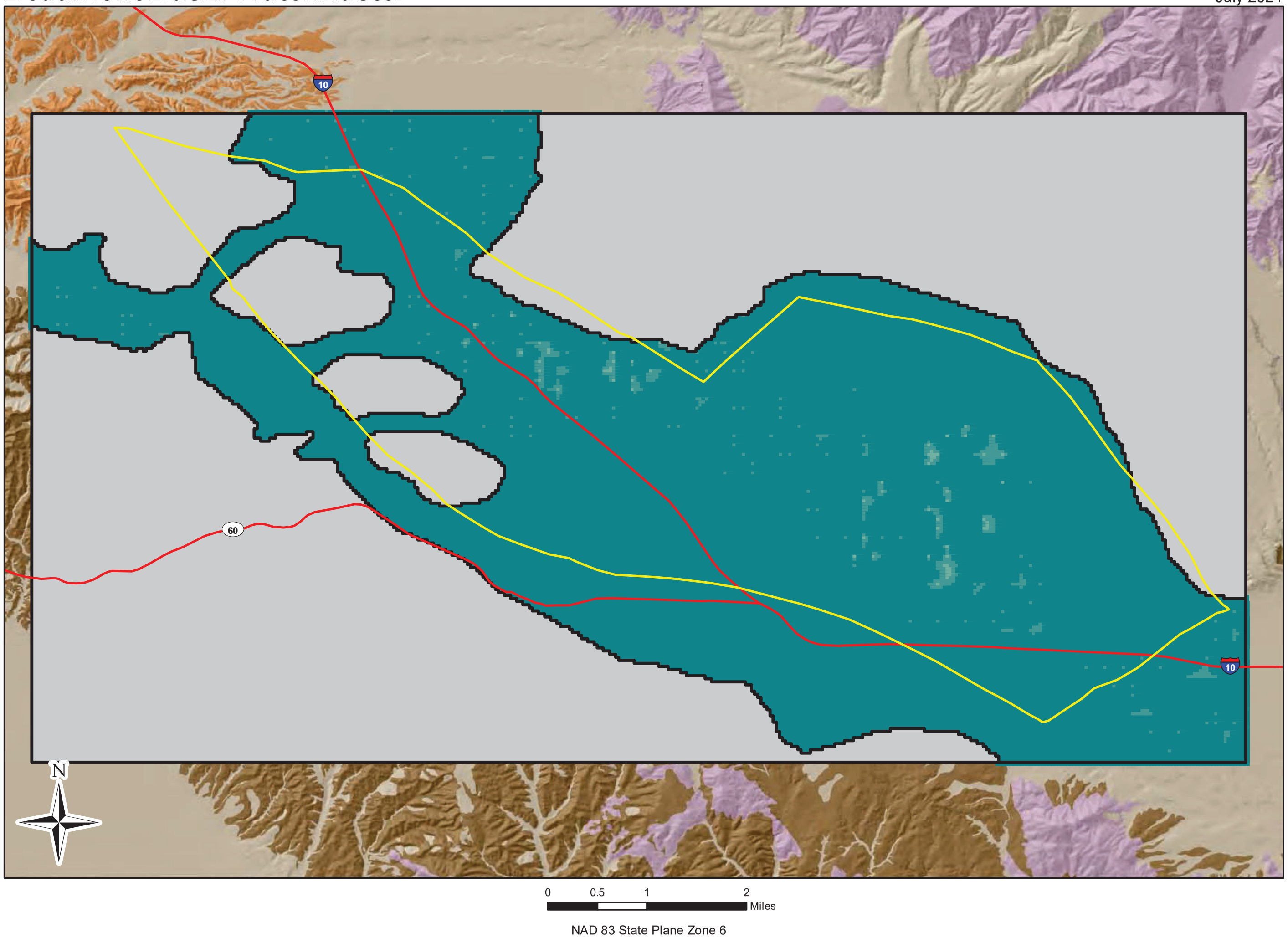
Horizontal Hydraulic Conductivity - Layer 1

Appendix B-1

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

Horizontal Hydaulic Conducticity (ft/day)
- 0 to 20
- 20 to 40
- 40 to 60
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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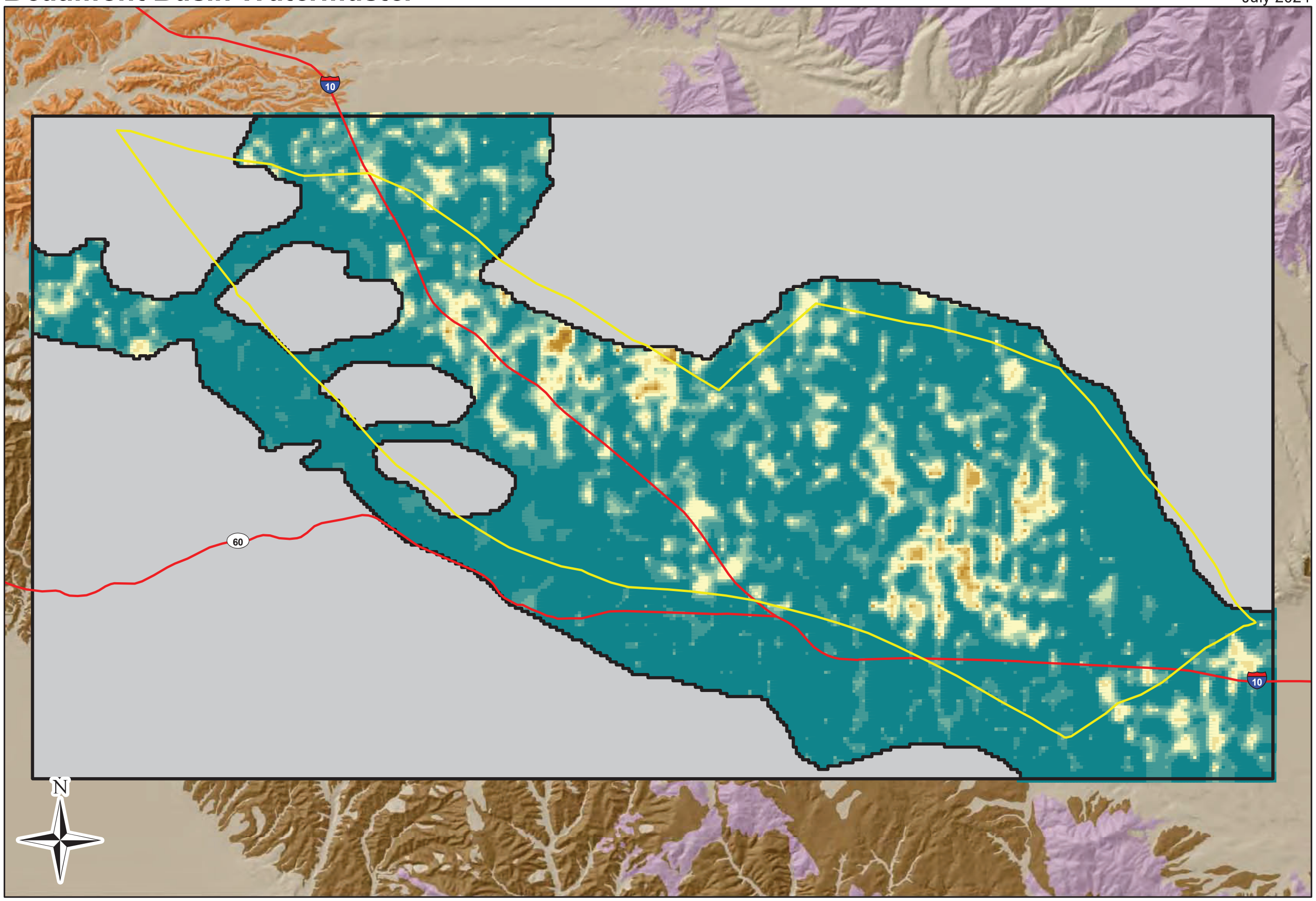
Horizontal Hydraulic Conductivity - Layer 2

Appendix B-2

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



0 0.5 1 2 Miles

NAD 83 State Plane Zone 6

Map Features

Horizontal Hydraulic Conductivity (ft/day)

- 0 to 20
- 20 to 40
- 40 to 60
- 60 to 80
- 80 to 100
- 100 to 200
- 200 to 300
- 300 to 400
- 400 to 500
- 500 to 600
- 600 +

- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposits
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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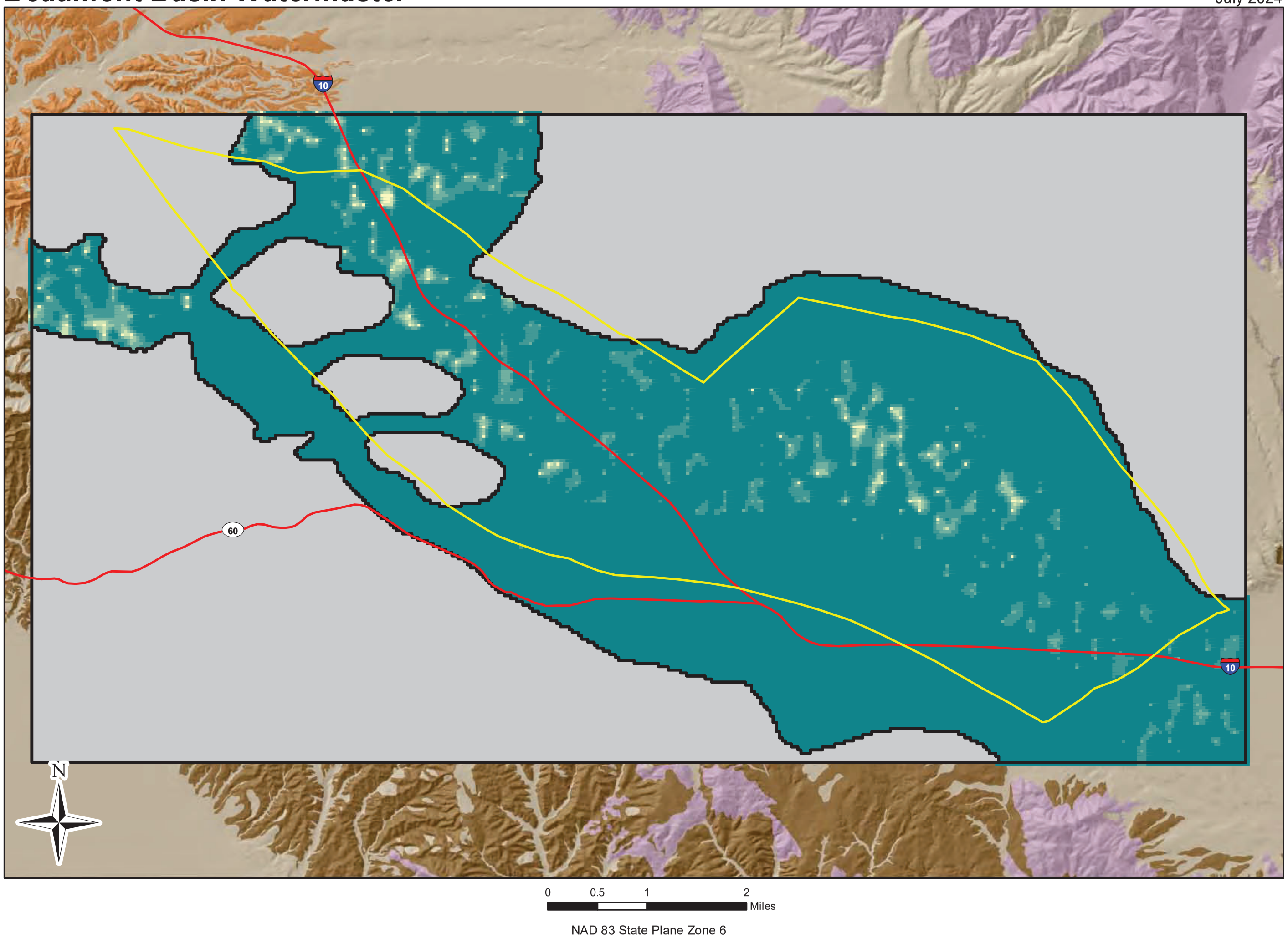
Horizontal Hydraulic Conductivity - Layer 3

Appendix B-3

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

Horizontal Hydraulic Conductivity (ft/day)

- 0 to 20
- 20 to 40
- 40 to 60
- 60 to 80
- 80 to 100
- 100 to 200
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposits
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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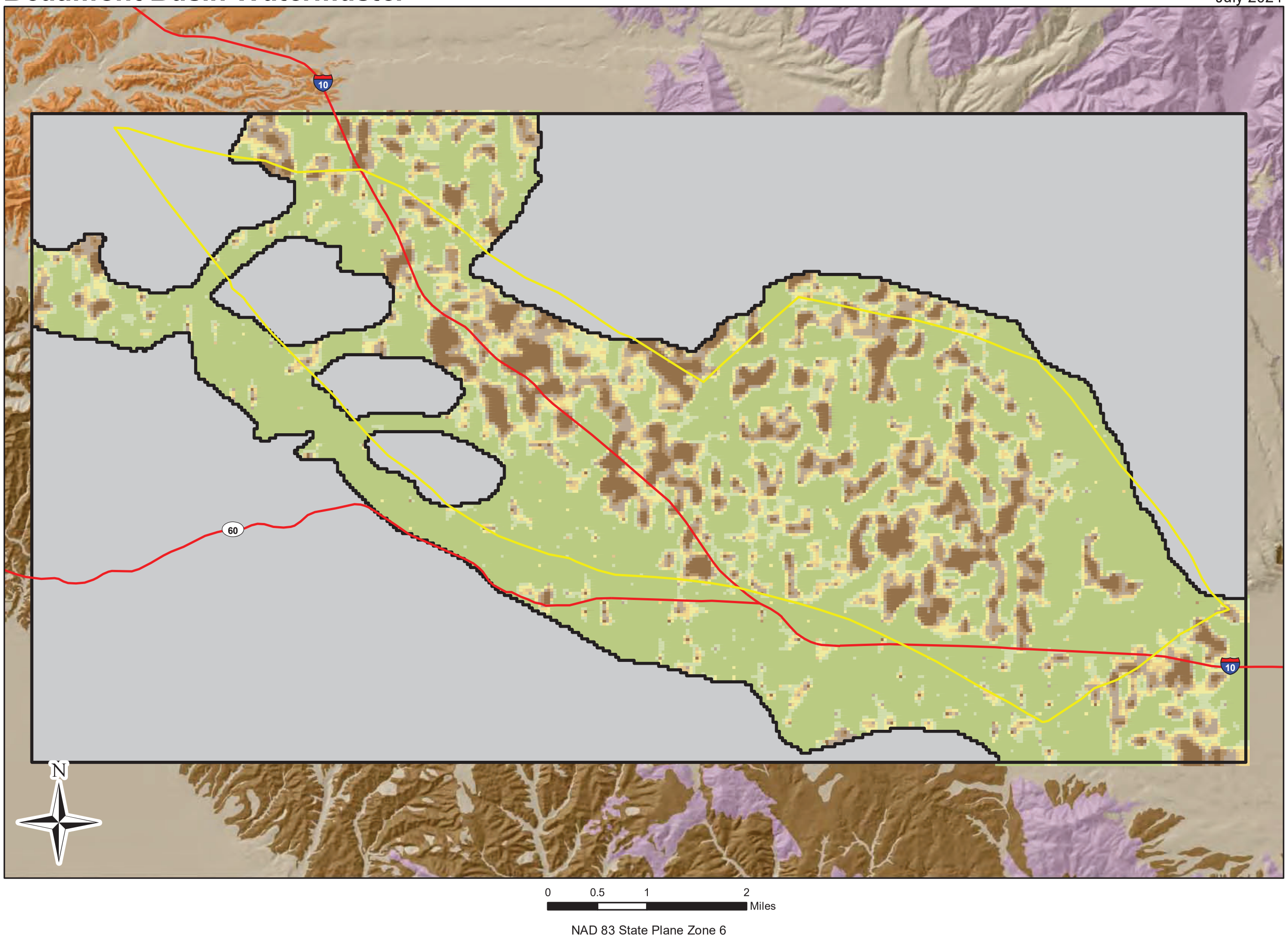
Horizontal Hydraulic Conductivity - Layer 4

Appendix B-4

July 2024



Map Features

Vertical Hydraulic Conductivity (ft/day)

- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 10
- 10 to 15
- 15 to 20
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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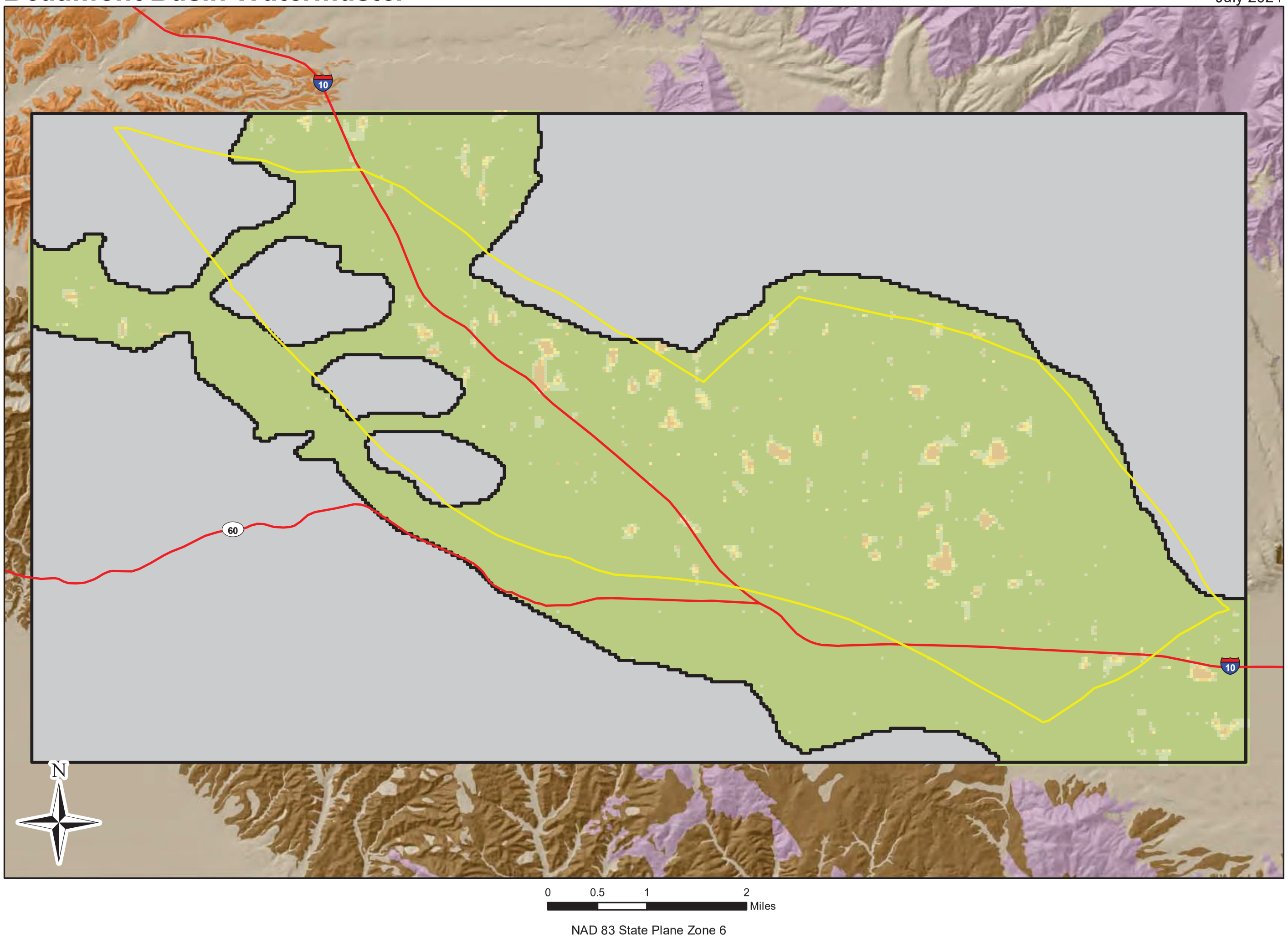
Vertical Hydraulic Conductivity - Layer 1

Appendix B-5

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

Vertical Hydraulic Conductivity (ft/day)
- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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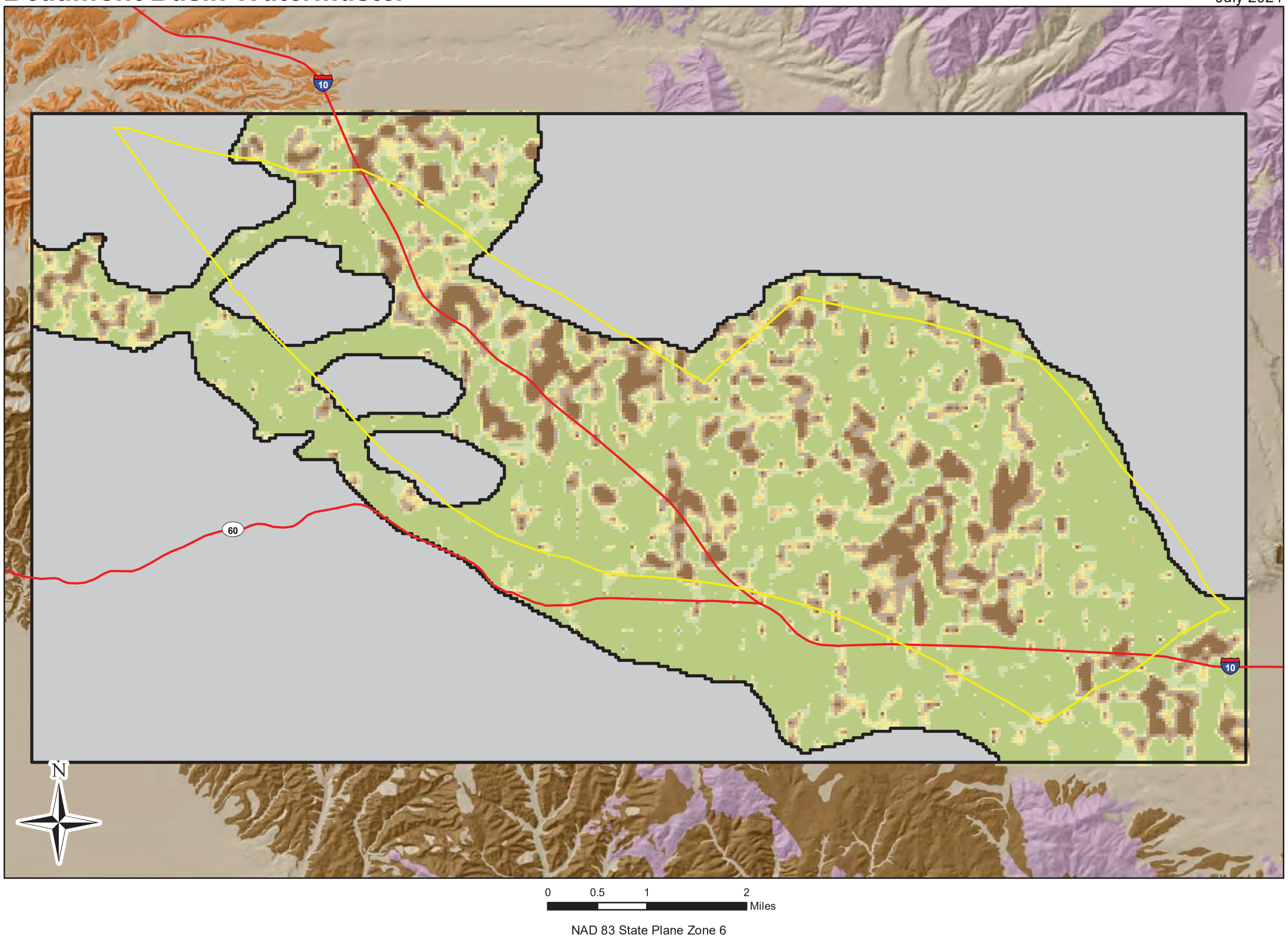
Vertical Hydraulic Conductivity - Layer 2

Appendix B-6

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

Vertical Hydraulic Conductivity (ft/day)

- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 10
- 10 to 15
- 15 to 20

- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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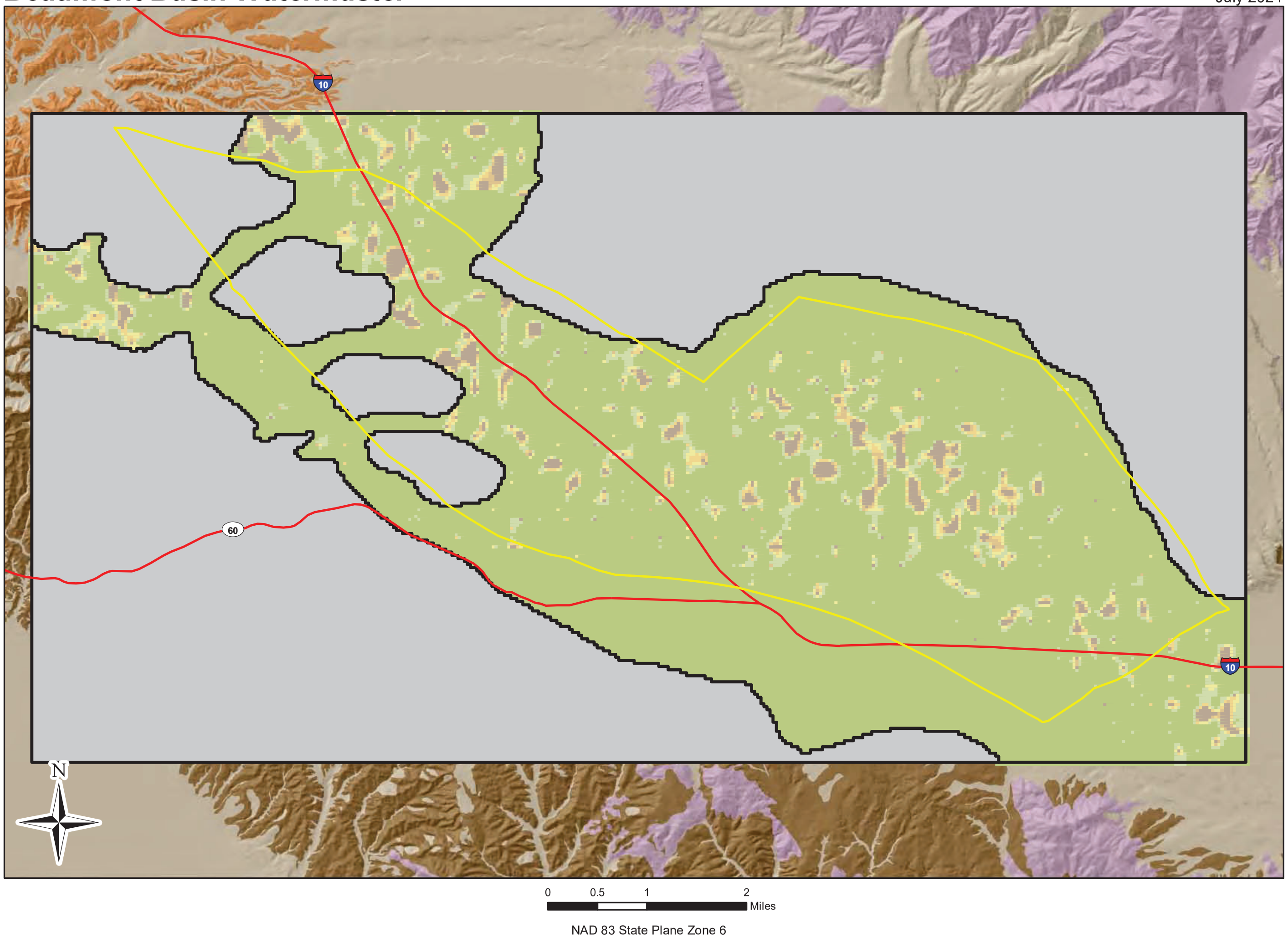
Vertical Hydraulic Conductivitiy - Layer 3

Appendix B-7

2023 Reevaluation of the Beaumont Basin Safe Yield

Beaumont Basin Watermaster

July 2024



Map Features

Vertical Hydraulic Conductivity (ft/day)

- 0 to 1
- 1 to 2
- 2 to 3
- 3 to 4
- 4 to 5
- 5 to 10
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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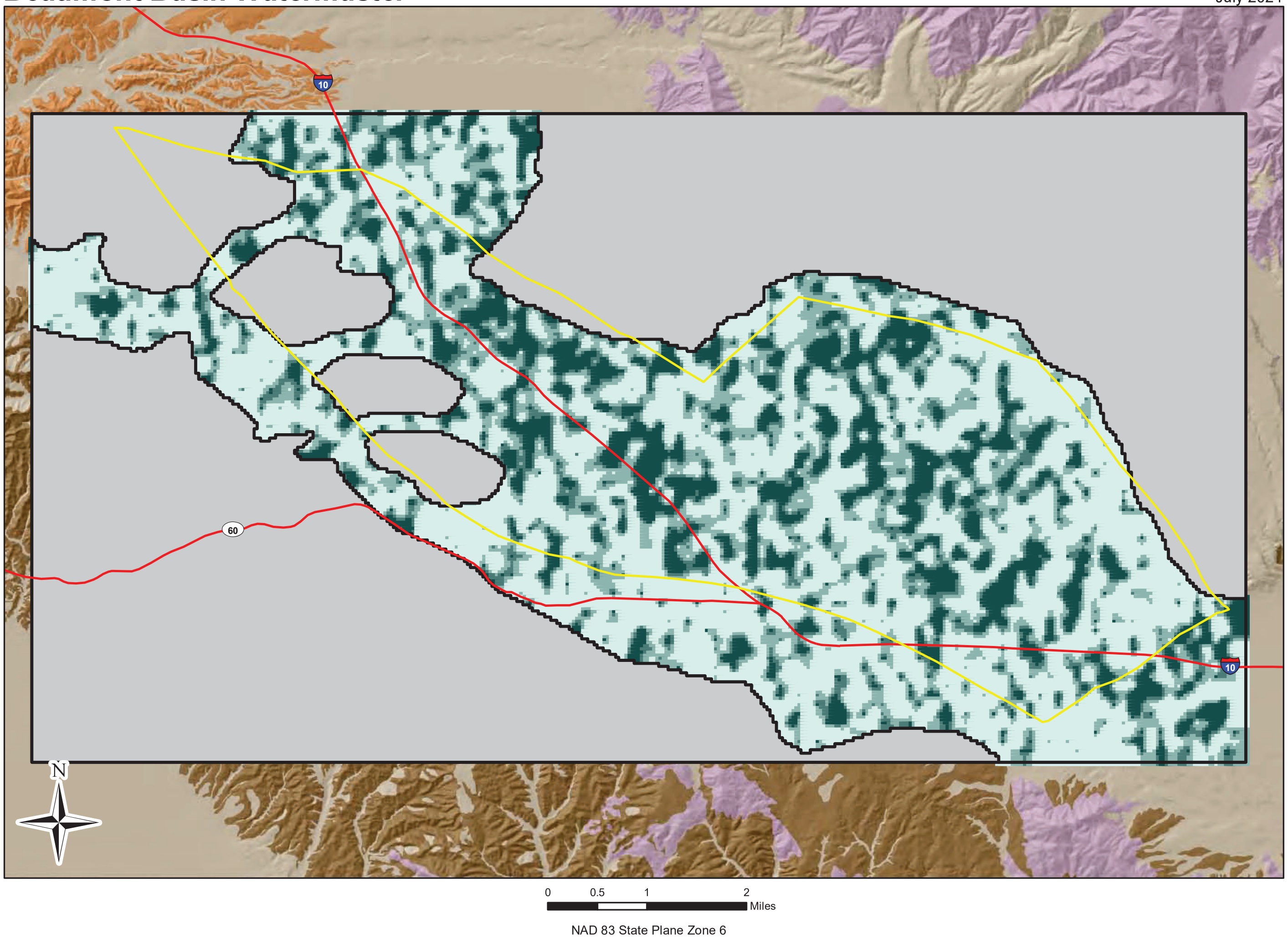
Vertical Hydraulic Conductivity - Layer 4

Appendix B-8

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

Specific Yield
- 0.00 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- 0.30 to 0.40

- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposits
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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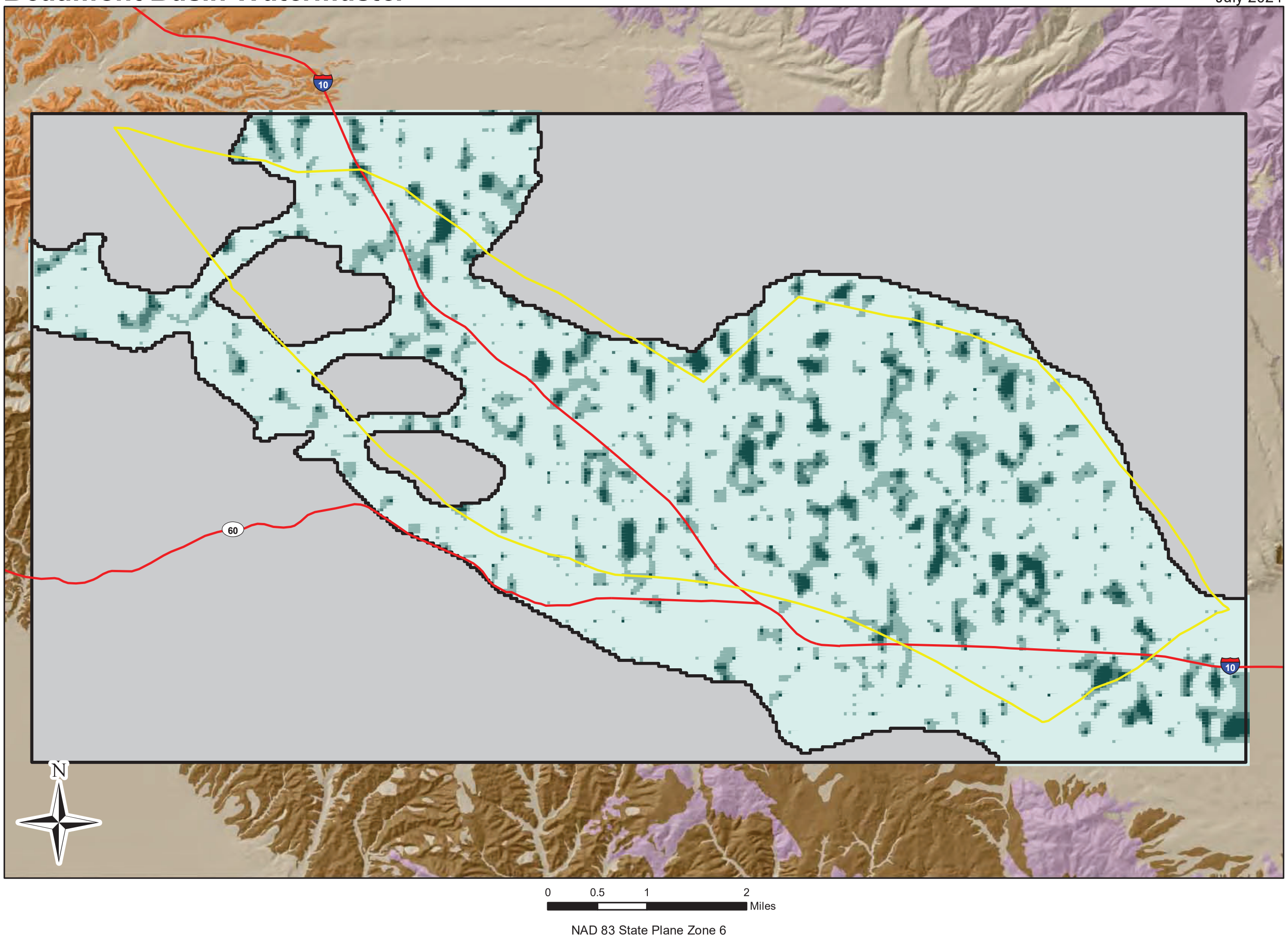
Specific Yield - Layer 1

Appendix B-9

July 2024



Map Features

Specific Yield

- 0.00 to 0.10
- 0.10 to 0.20
- 0.20 to 0.30
- 0.30 to 0.40
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposits
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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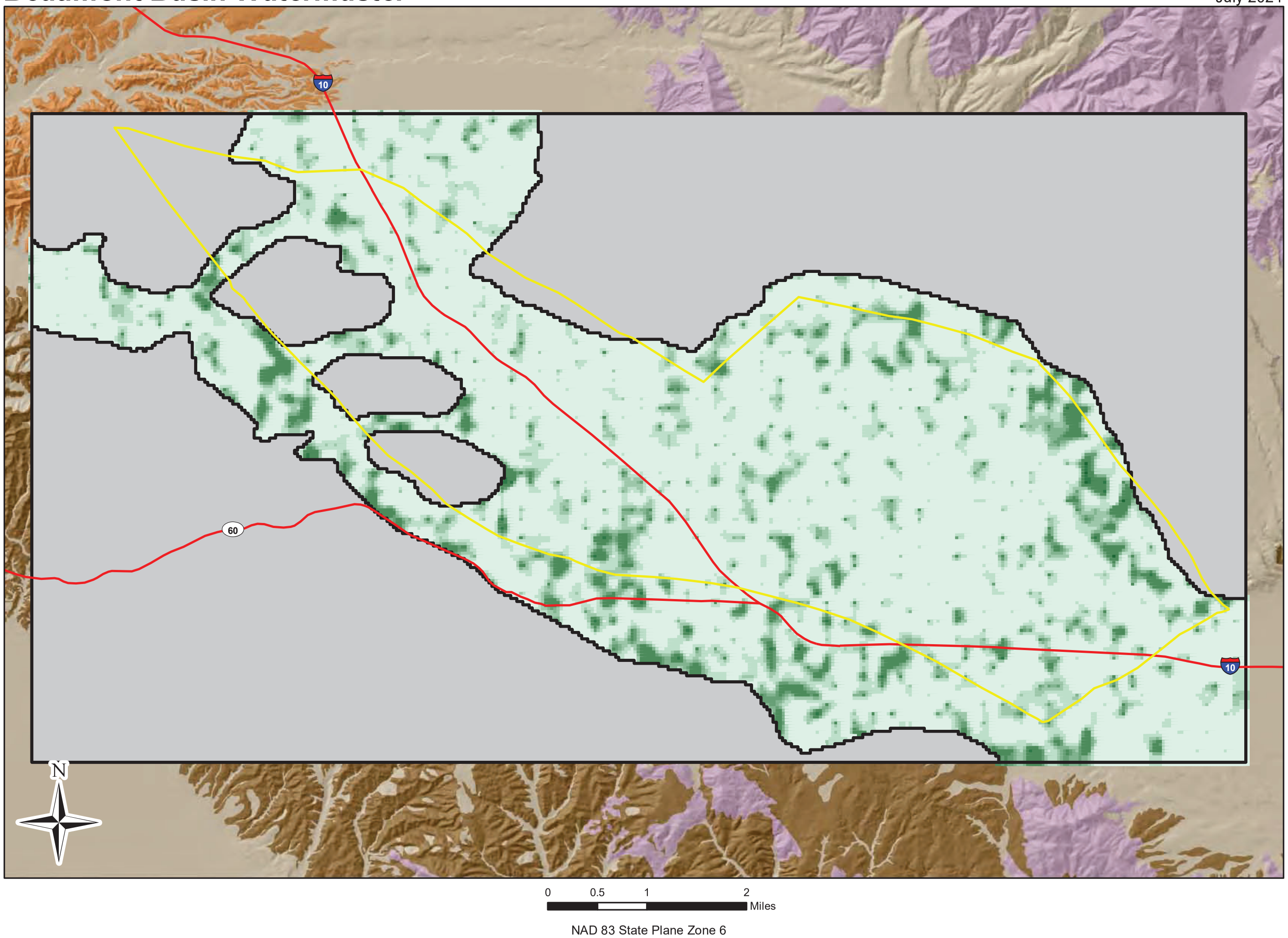
Specific Yield - Layer 2

Appendix B-10

Beaumont Basin Watermaster

July 2024

2023 Reevaluation of the Beaumont Basin Safe Yield



Map Features

Specific Storage
- 0.00000 to 0.00002
- 0.00002 to 0.00004
- 0.00004 to 0.00006
- 0.00006 to 0.00008
- 0.00008 to 0.0001
- 0.0001 to 0.0005
- 0.0005 to 0.001
- 0.001 +
- Active Model Zone
- Inactive Model Zone
- Surficial or Alluvial Deposists
- Pleistocene San Timoteo Deposits
- Tertiary San Timoteo and other Tertiary Sedimentary Deposits
- Crystalline Basement Complex
- Beaumont Basin Adjudicated Area
- Freeway/Highway

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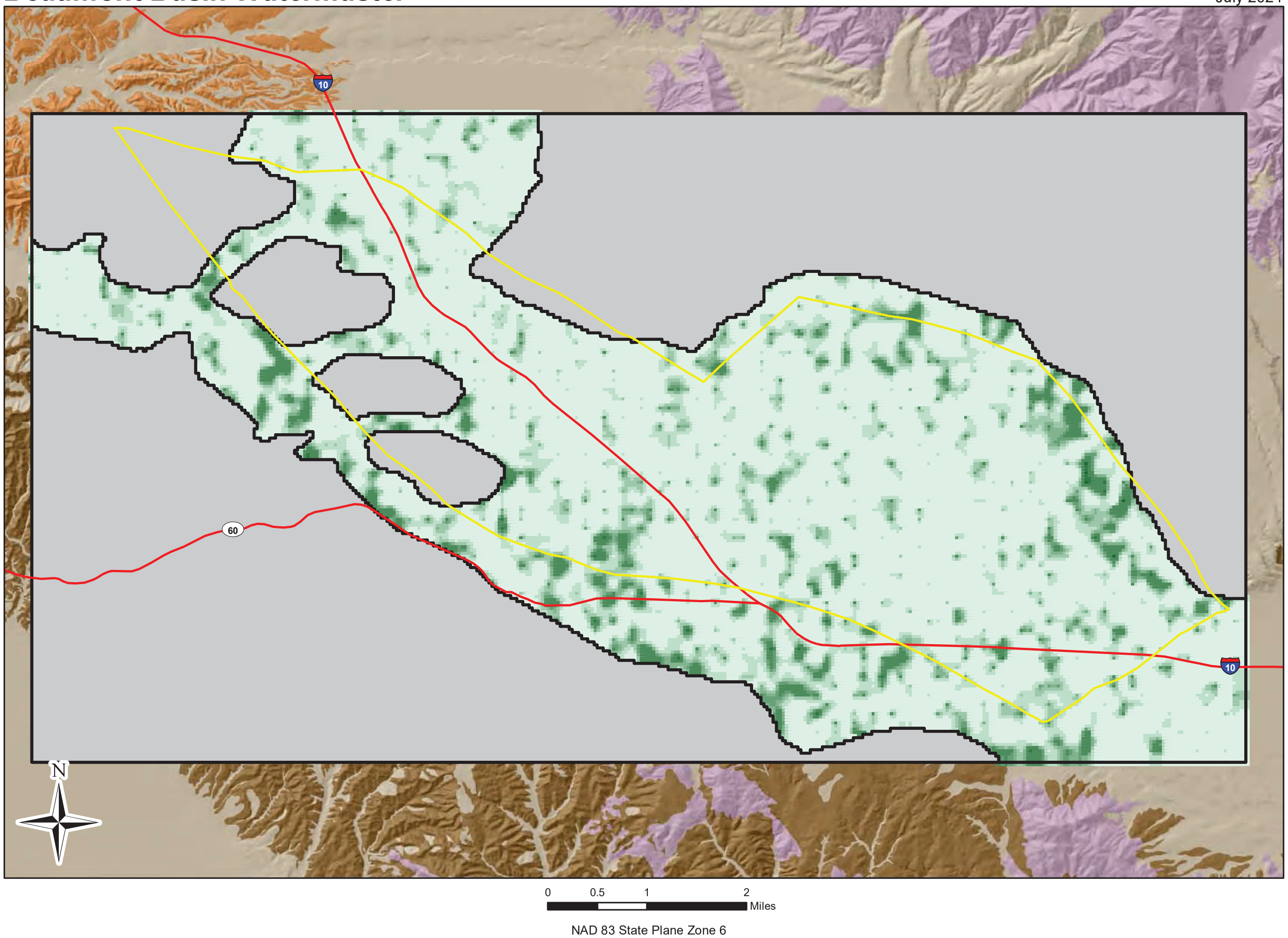
Specific Storage - Layer 3

Appendix B-11

Beaumont Basin Watermaster

2023 Reevaluation of the Beaumont Basin Safe Yield

July 2024



Thomas Harder & Co.
Groundwater Consulting

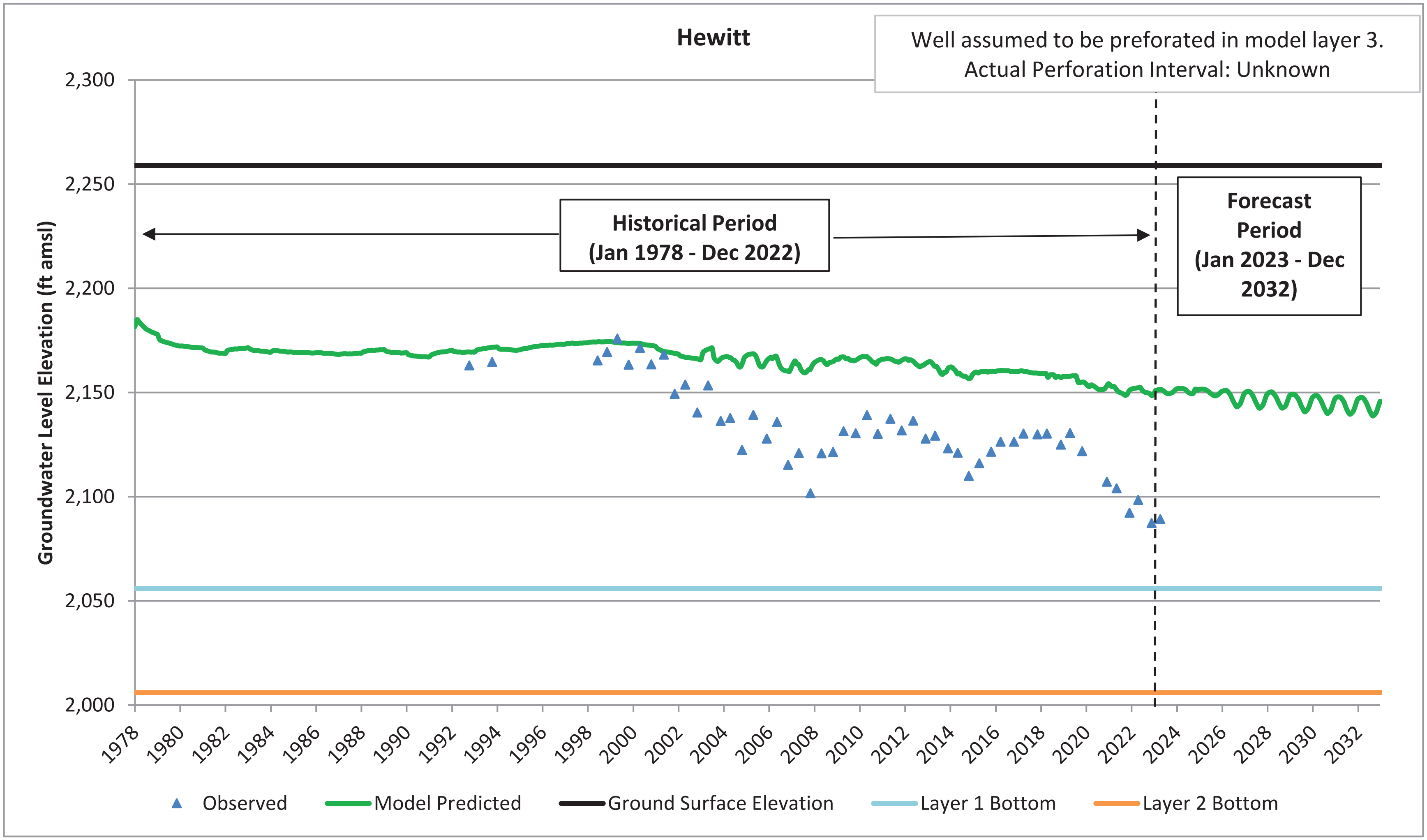
Specific Storage - Layer 4

Appendix B-12

Appendix C

Model Calibration & Forecast Period Hydrographs at Calibration Targets

Model Calibration Hydrographs



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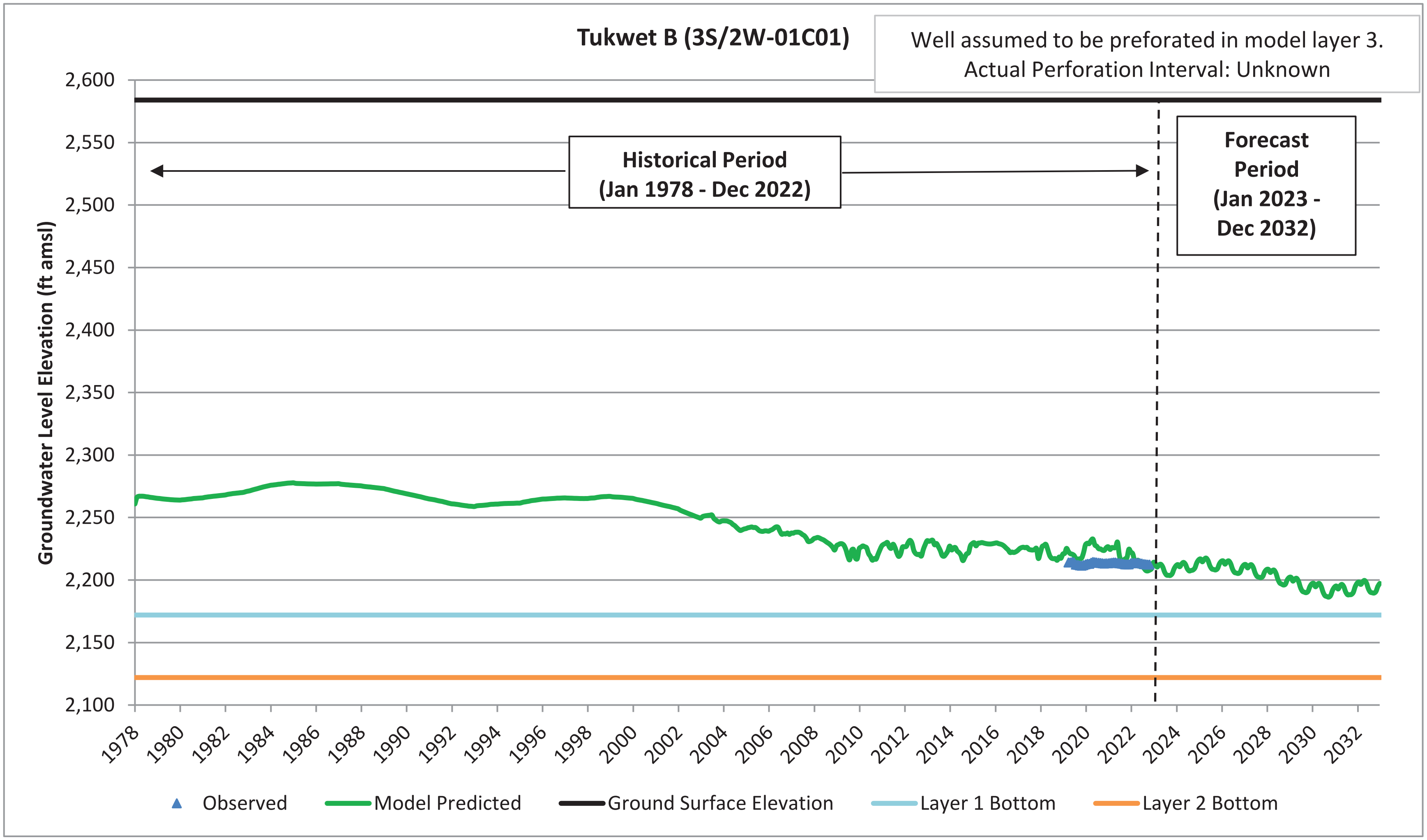

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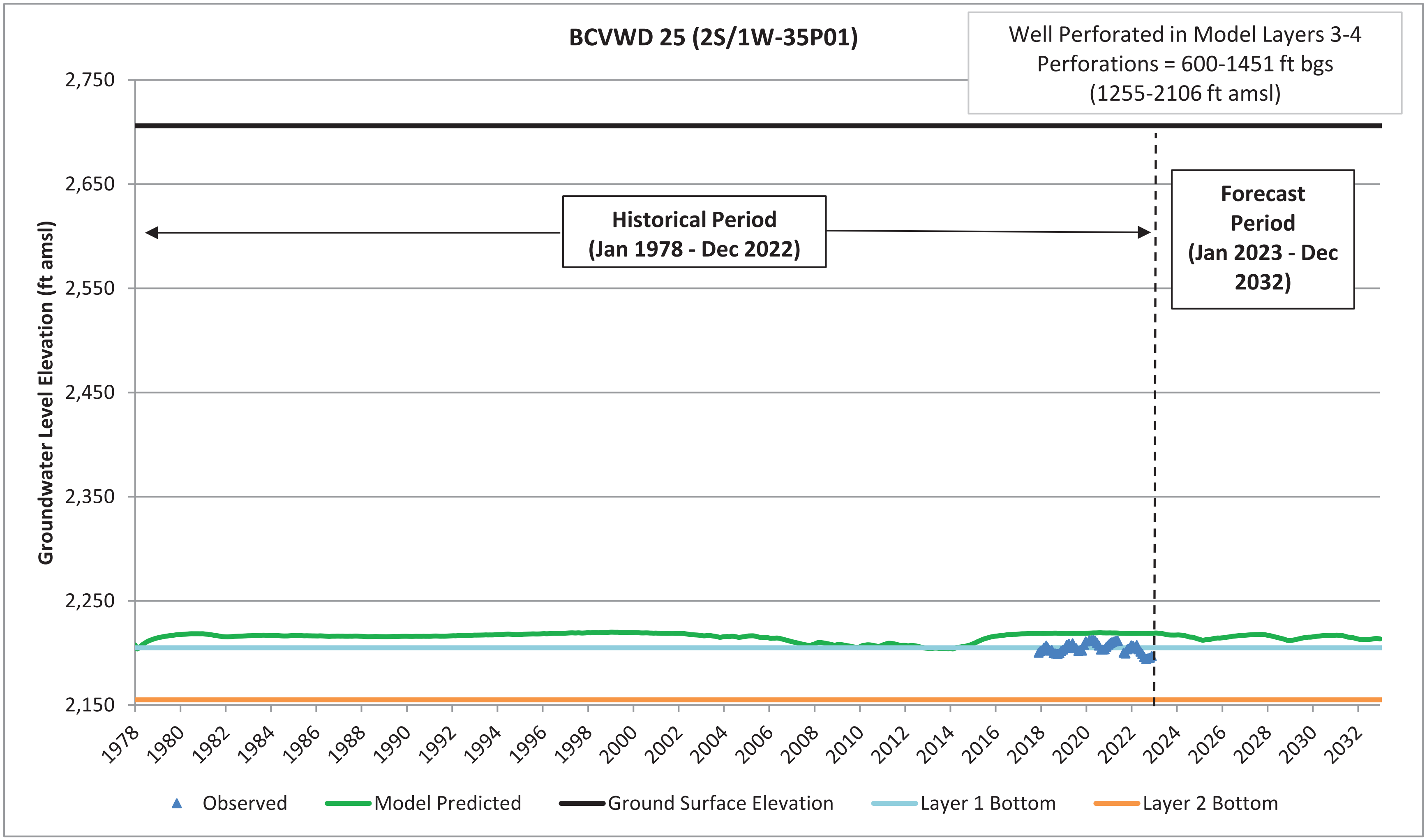

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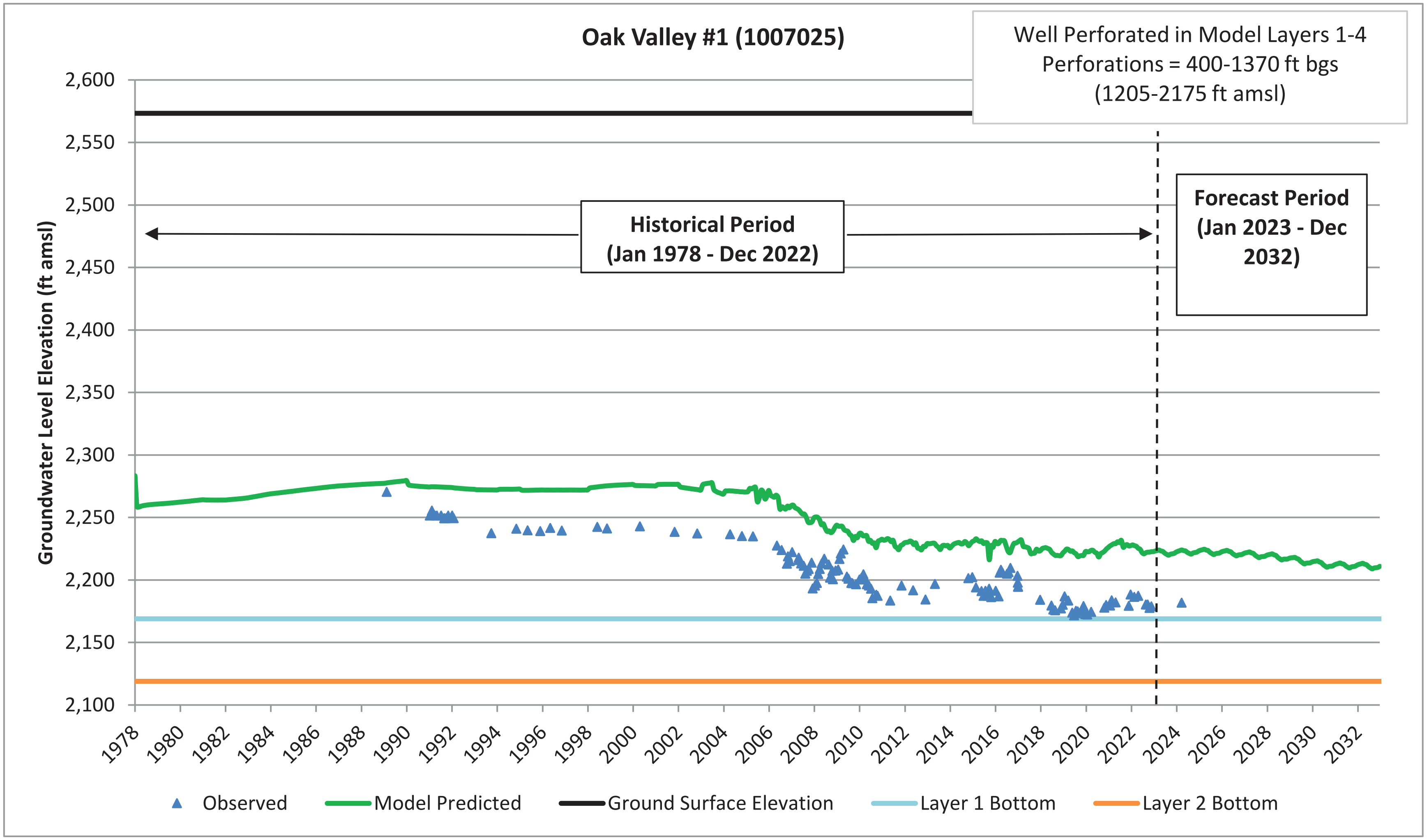

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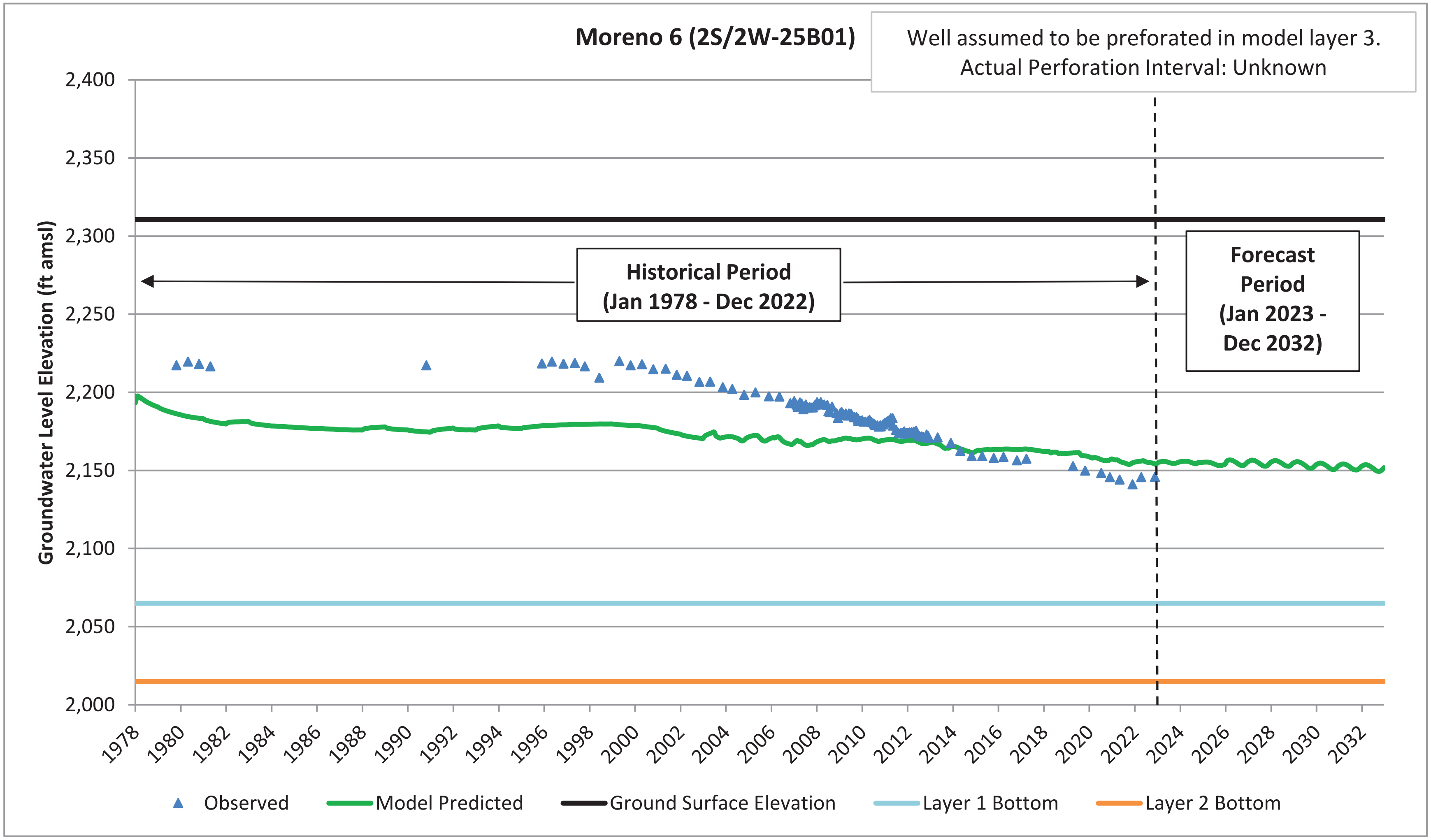

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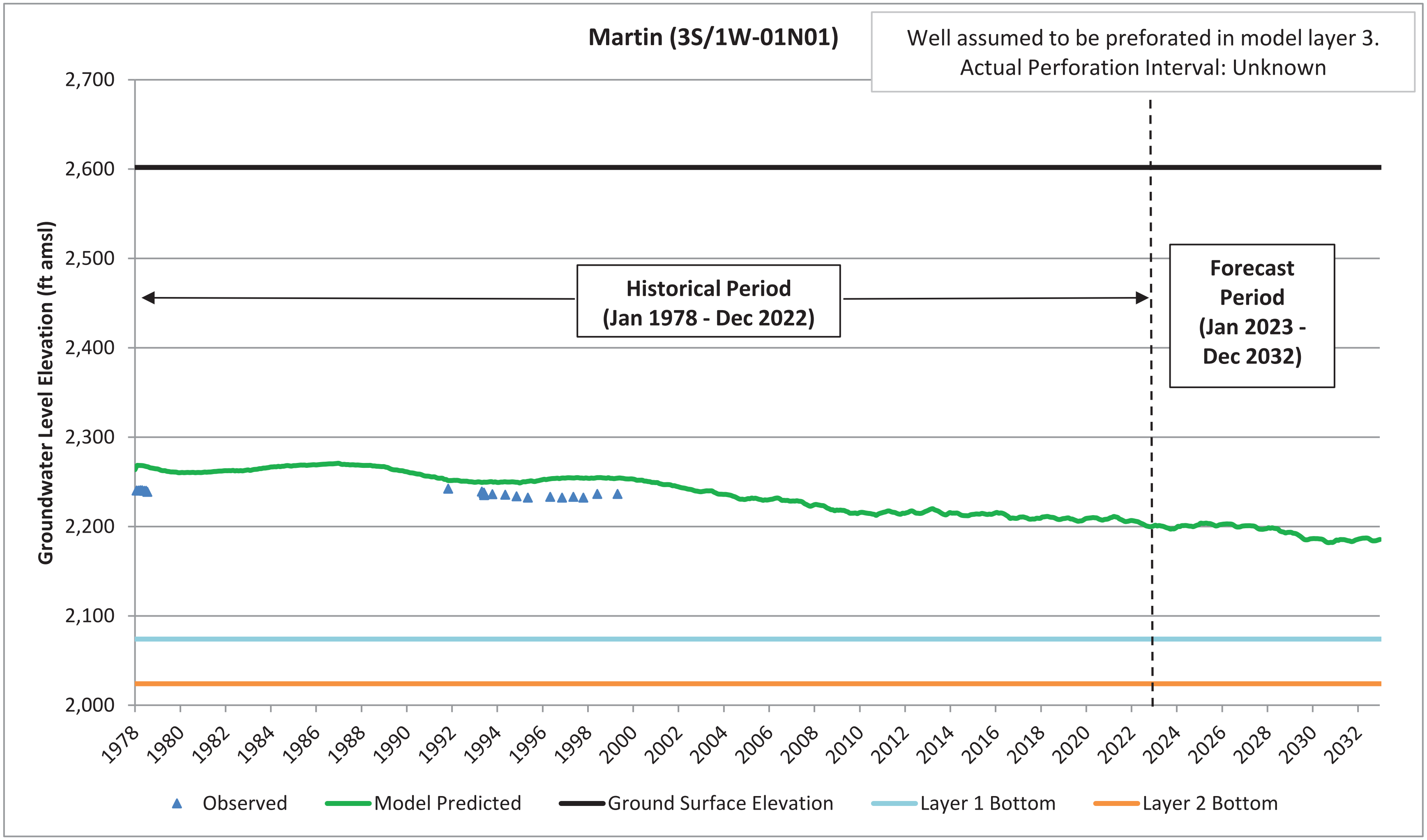

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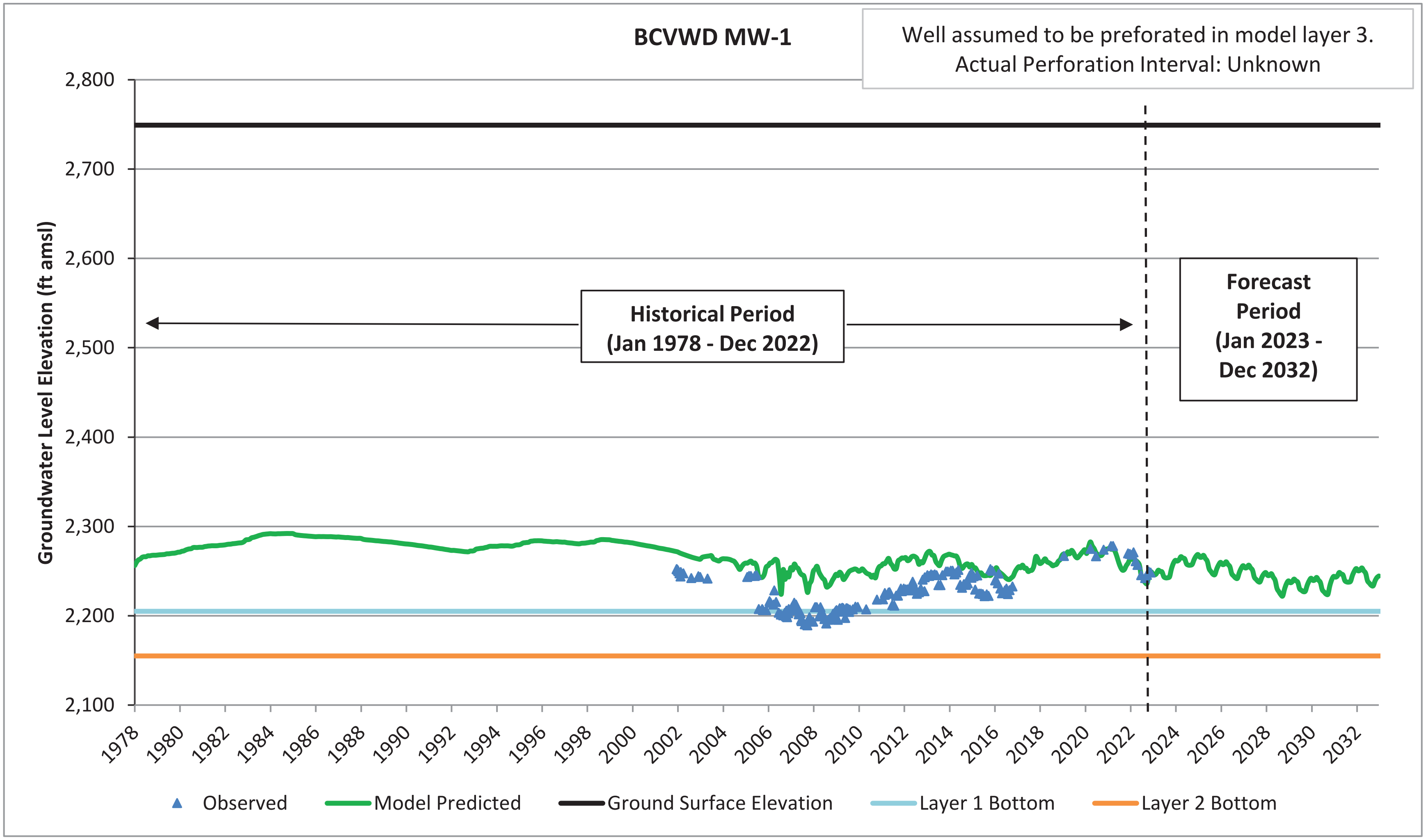

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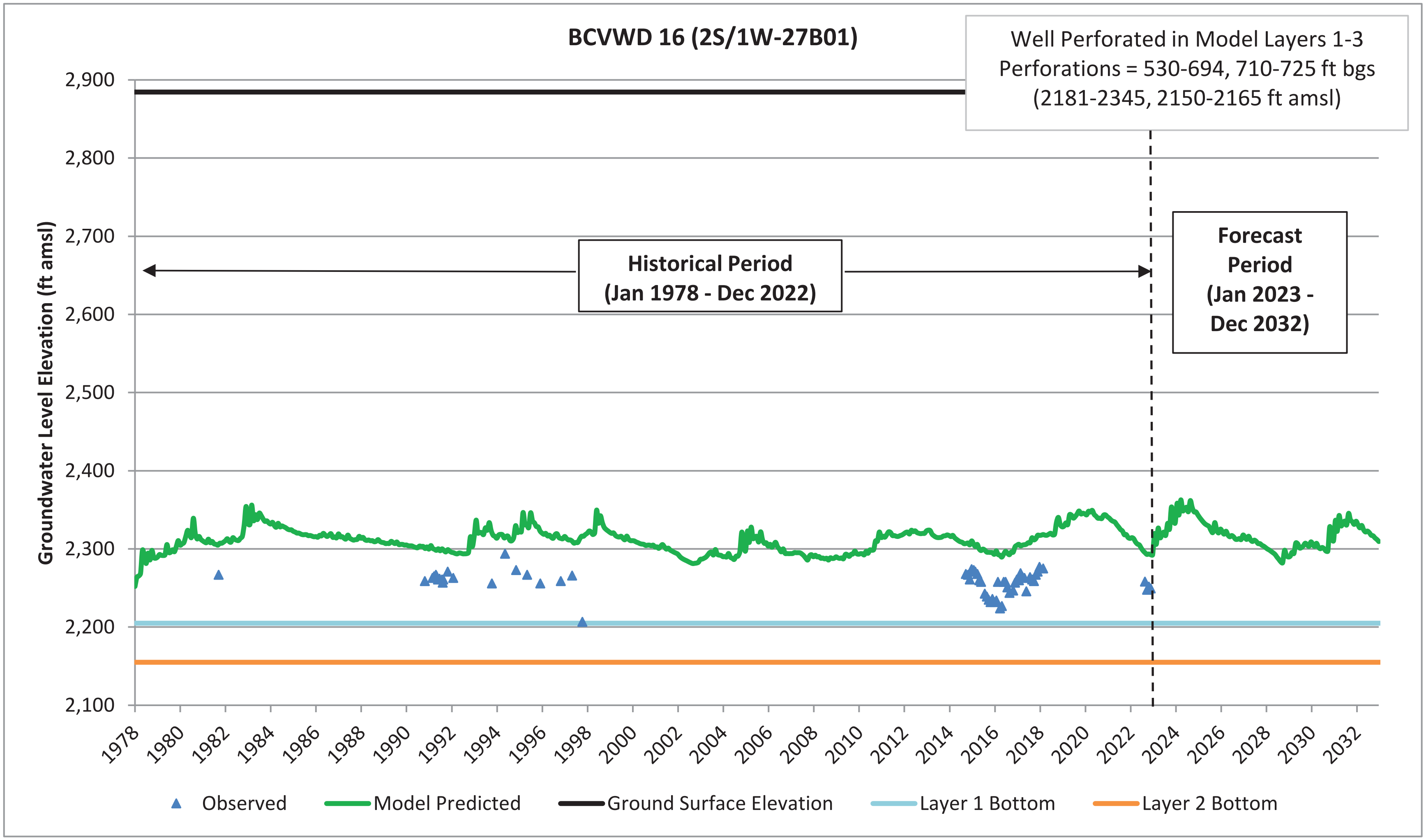

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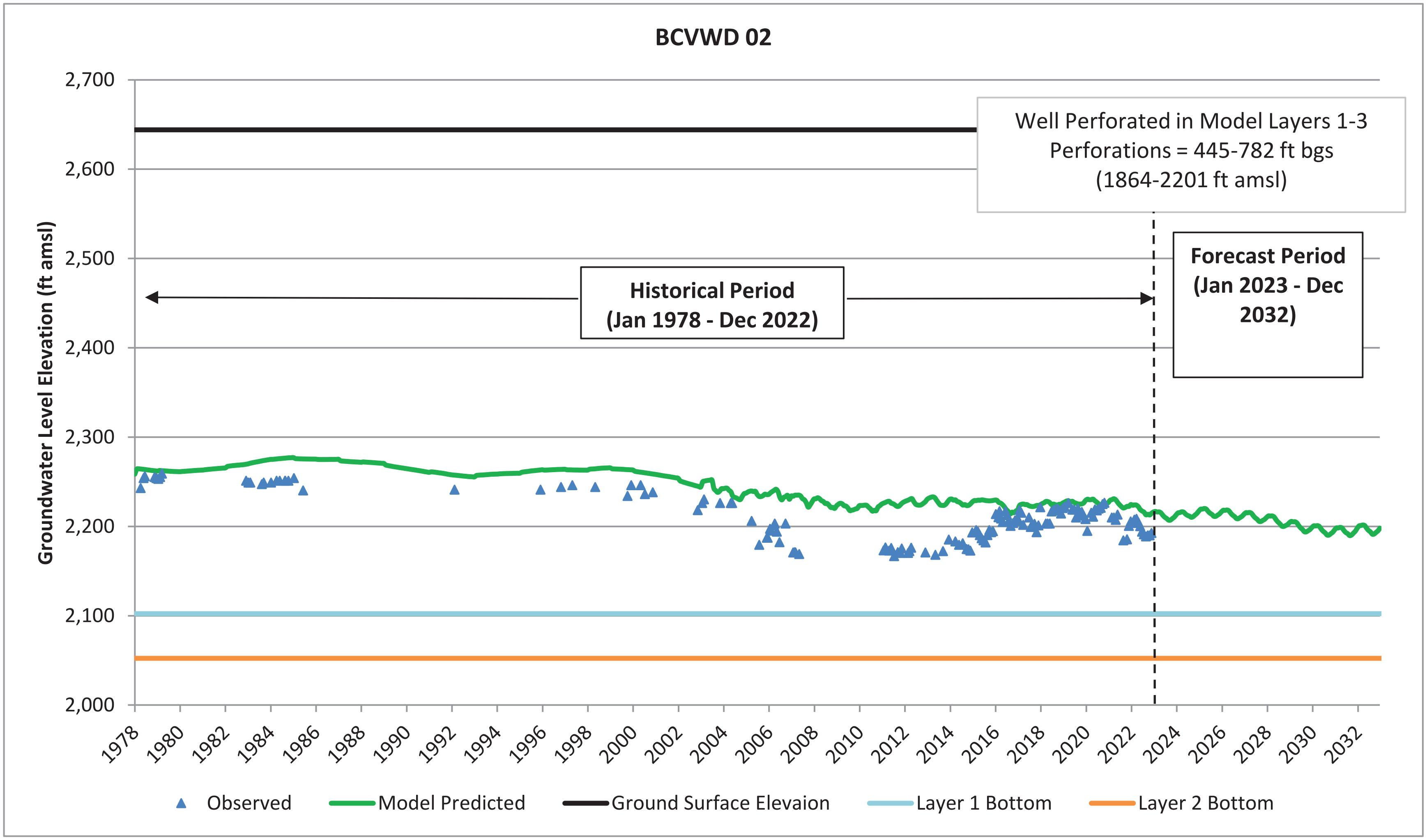

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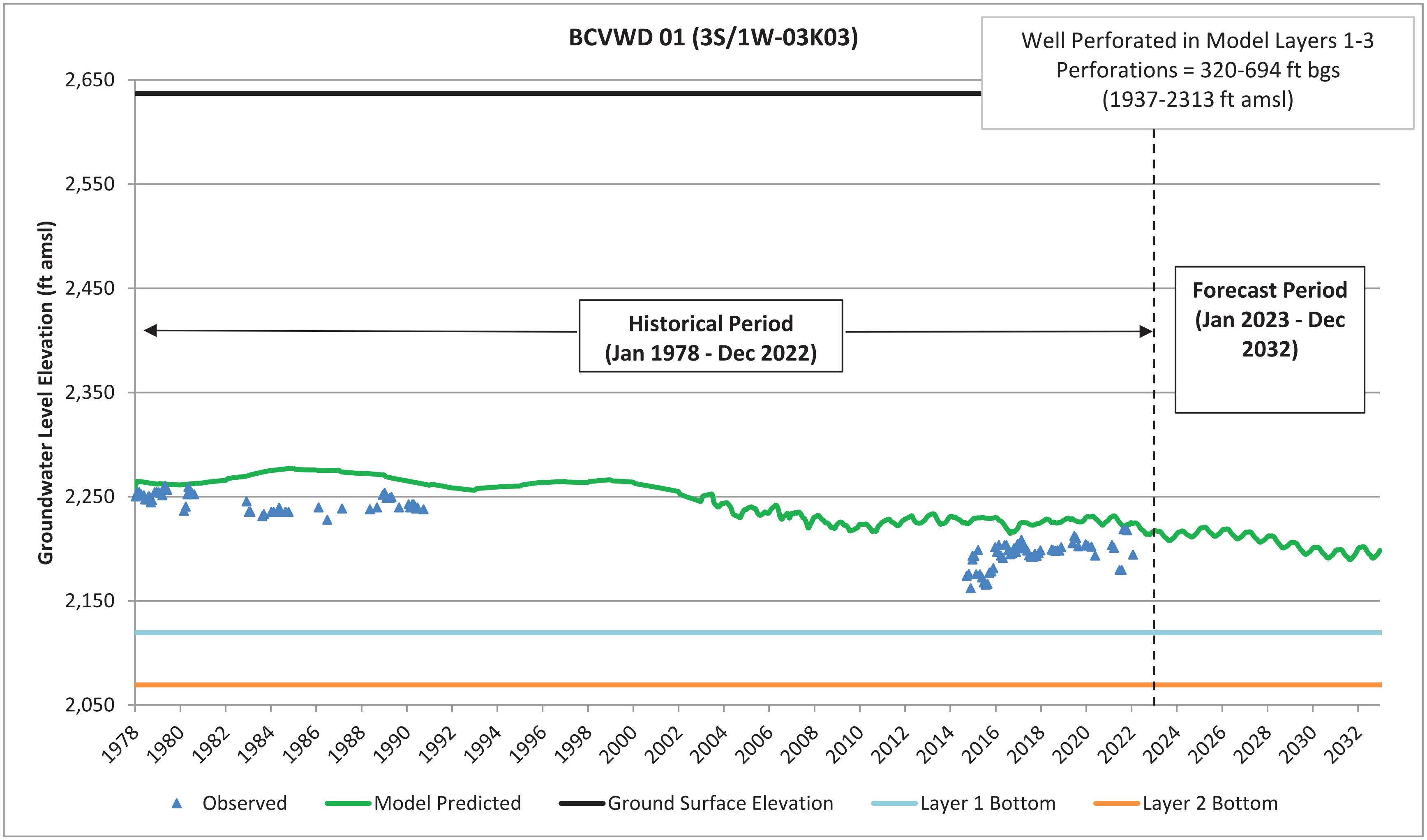

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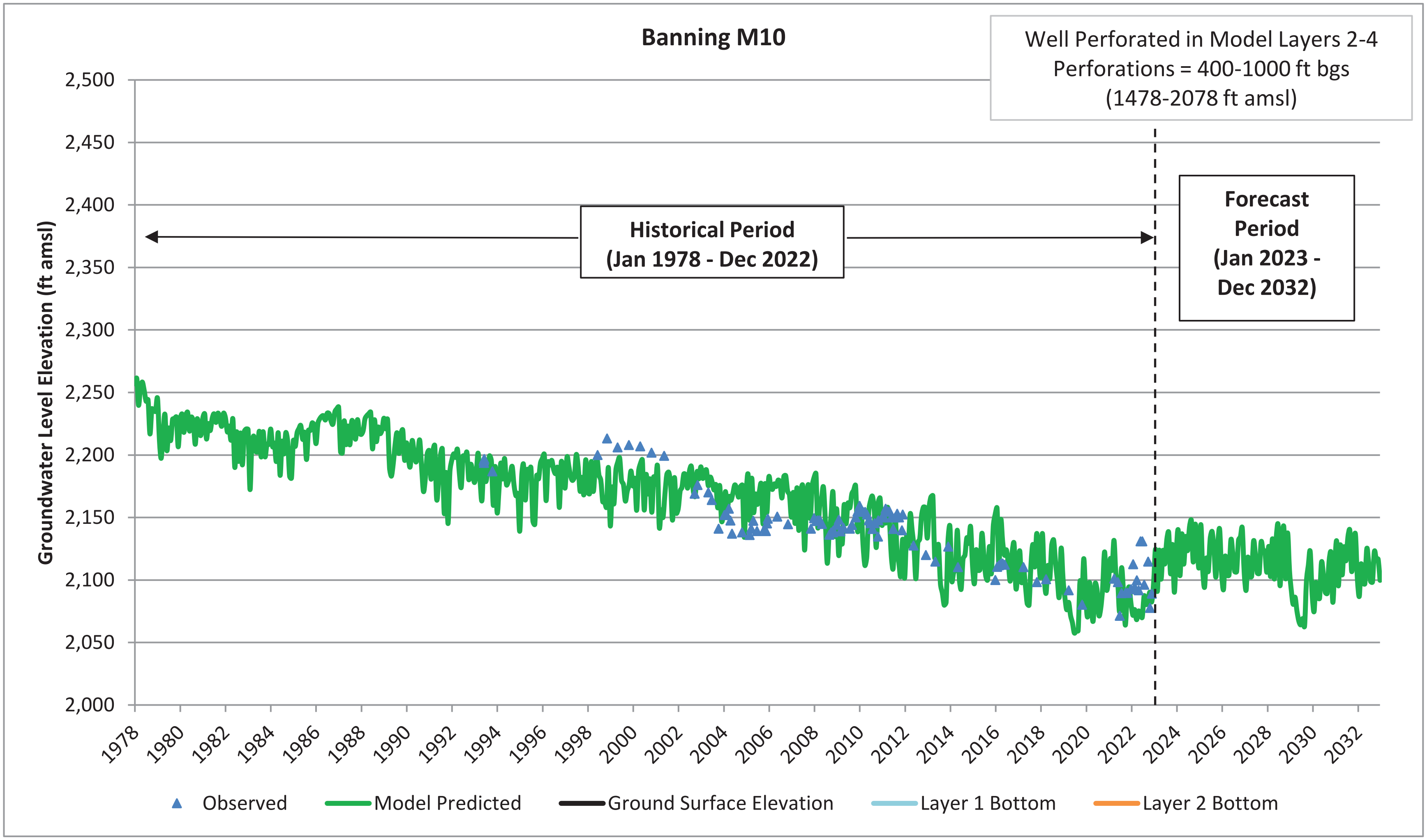

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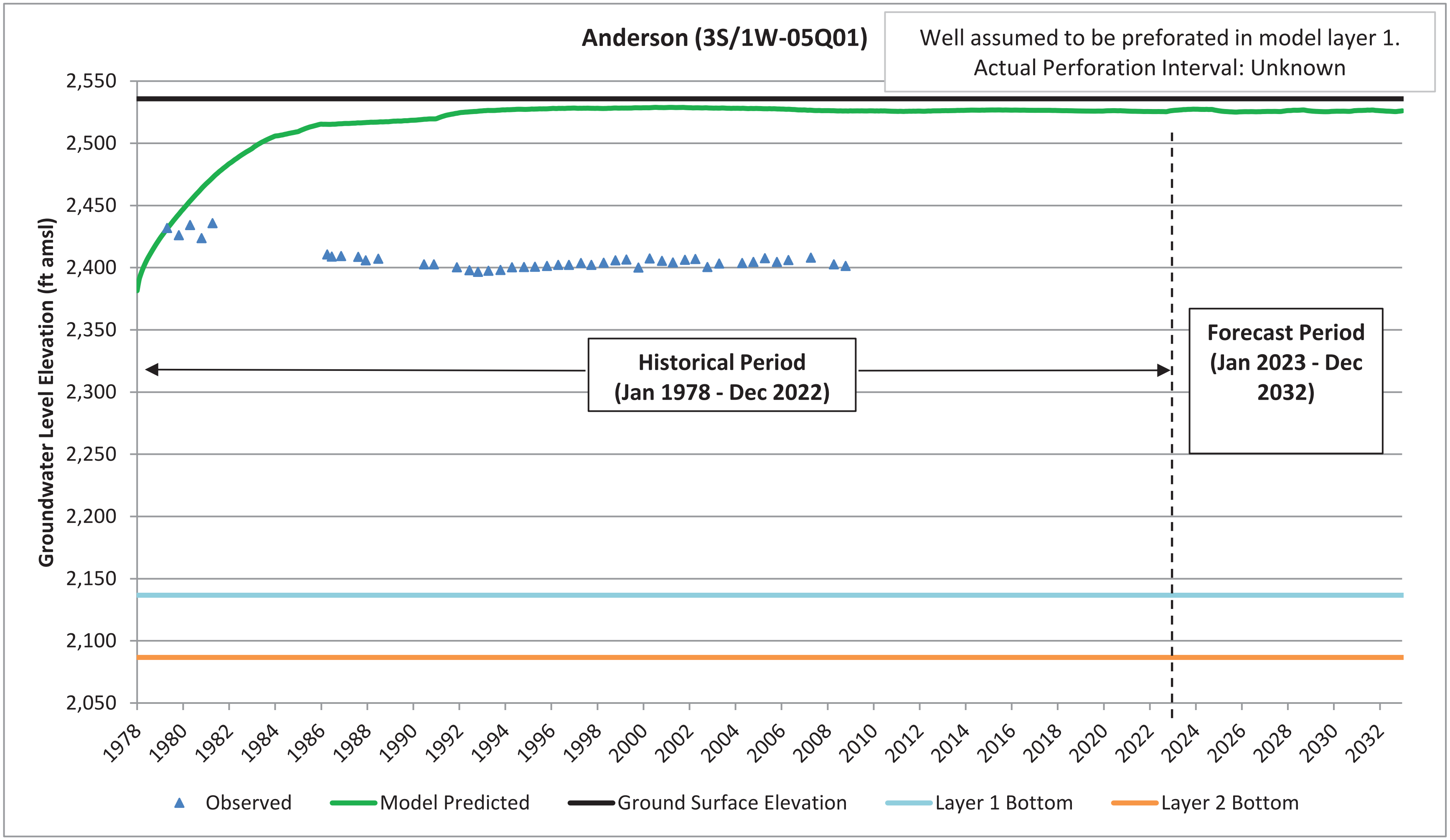

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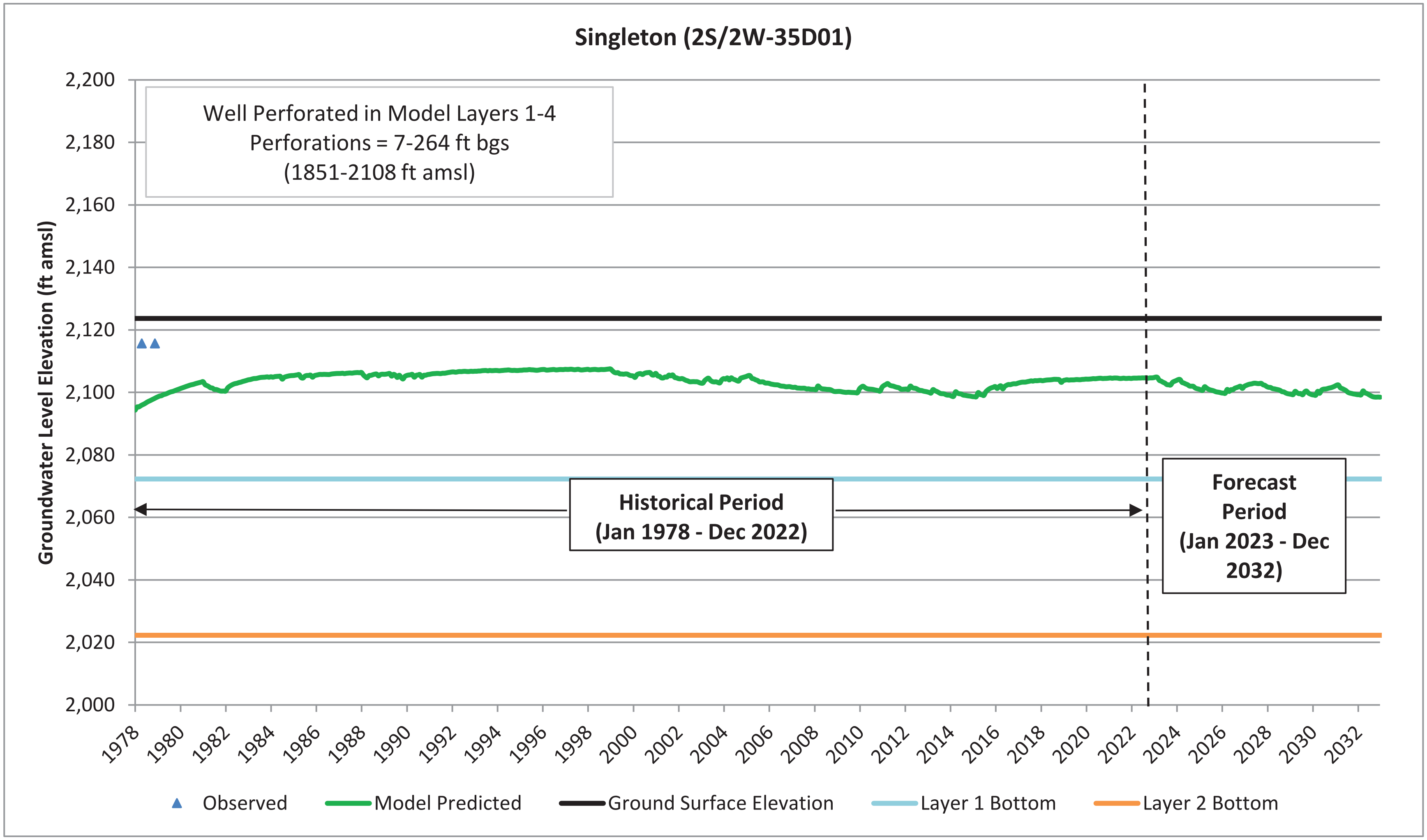

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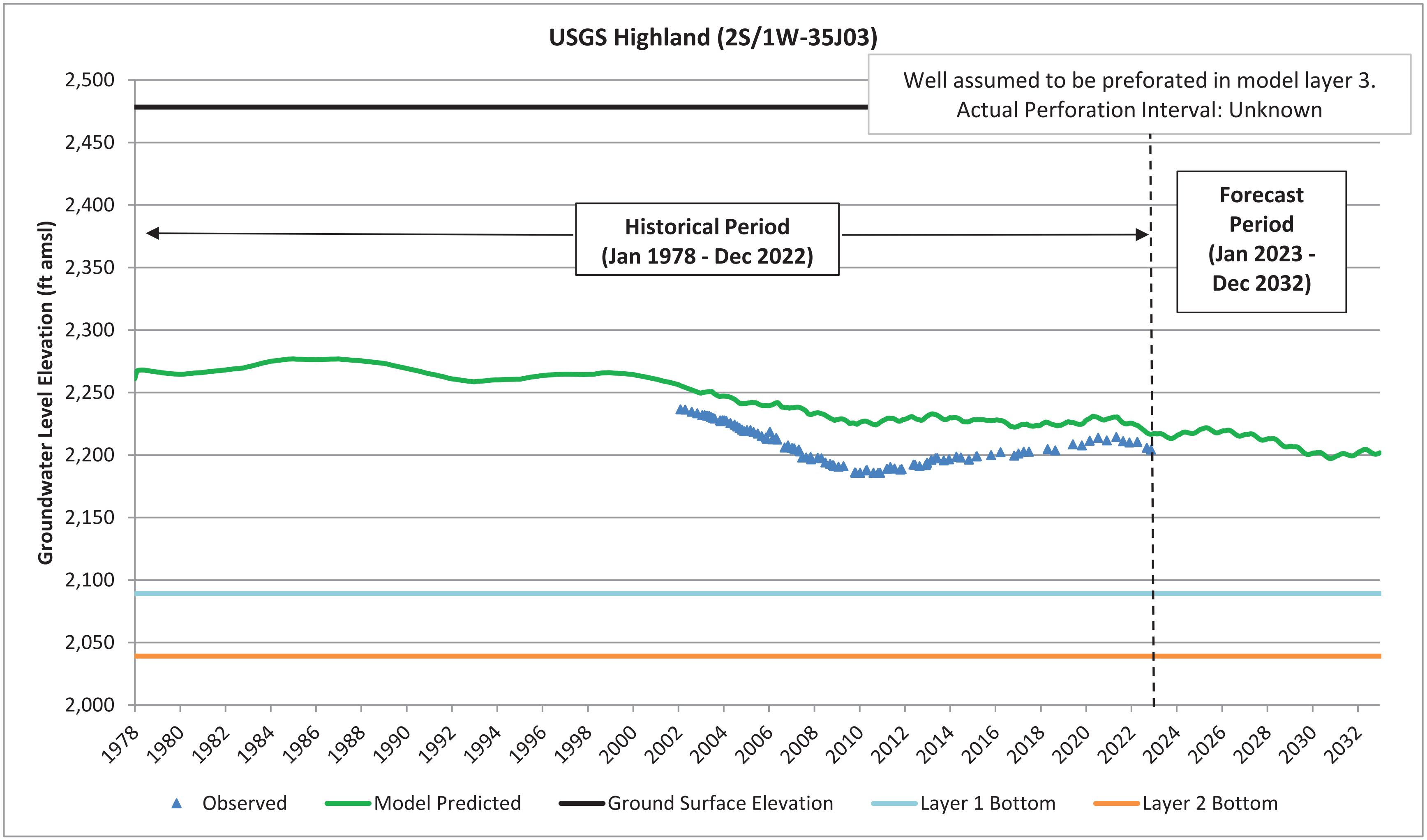

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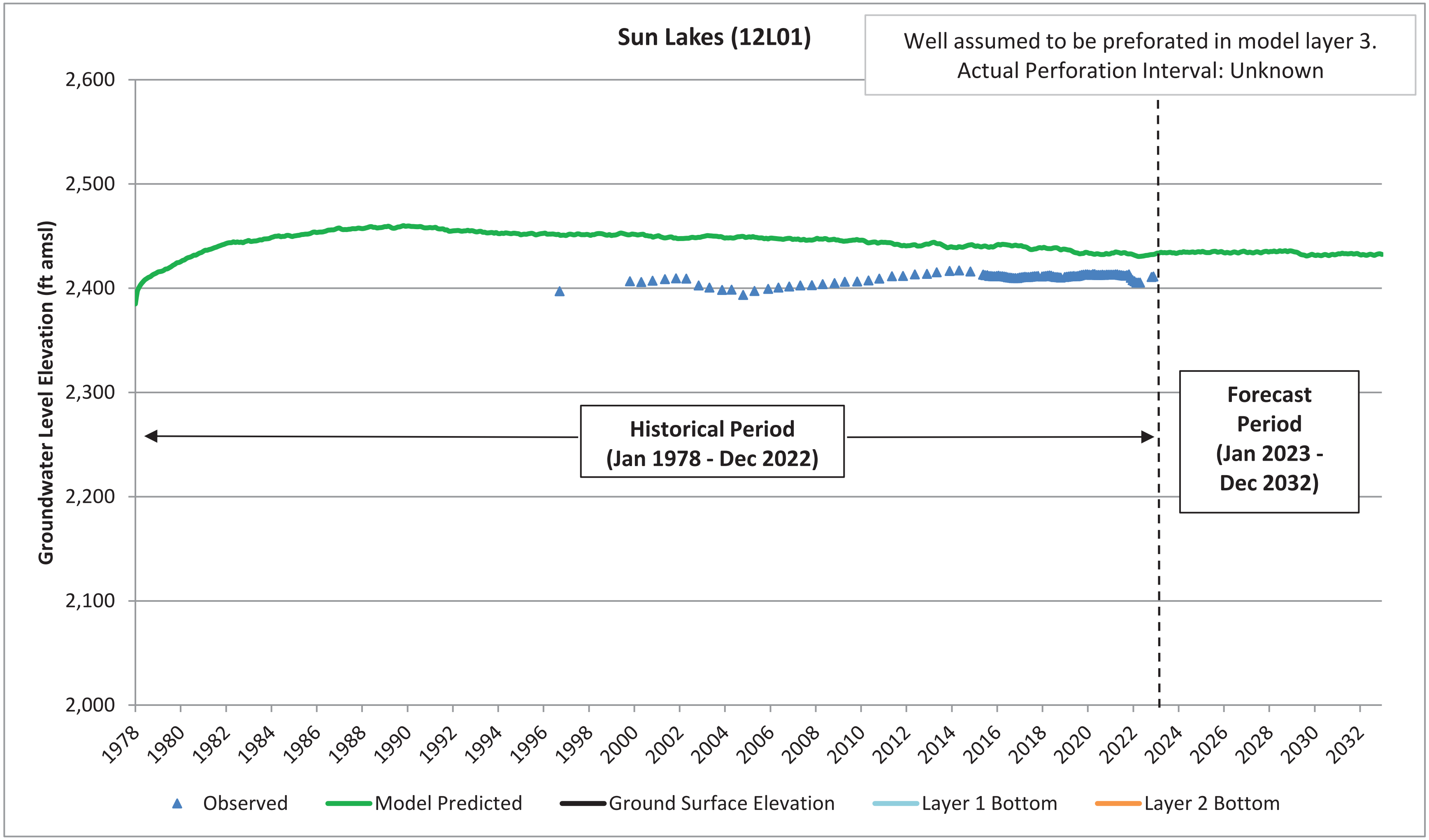

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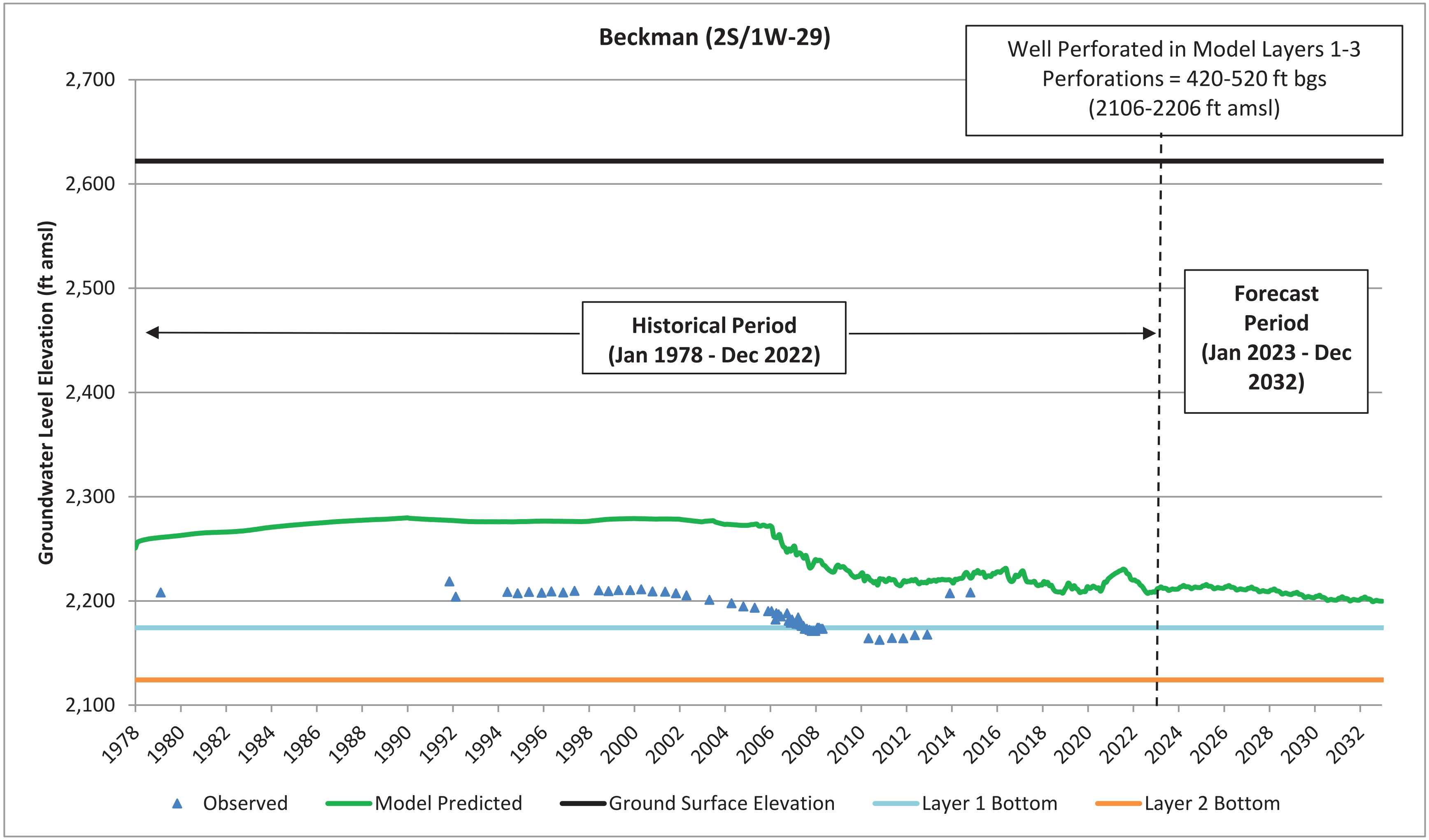

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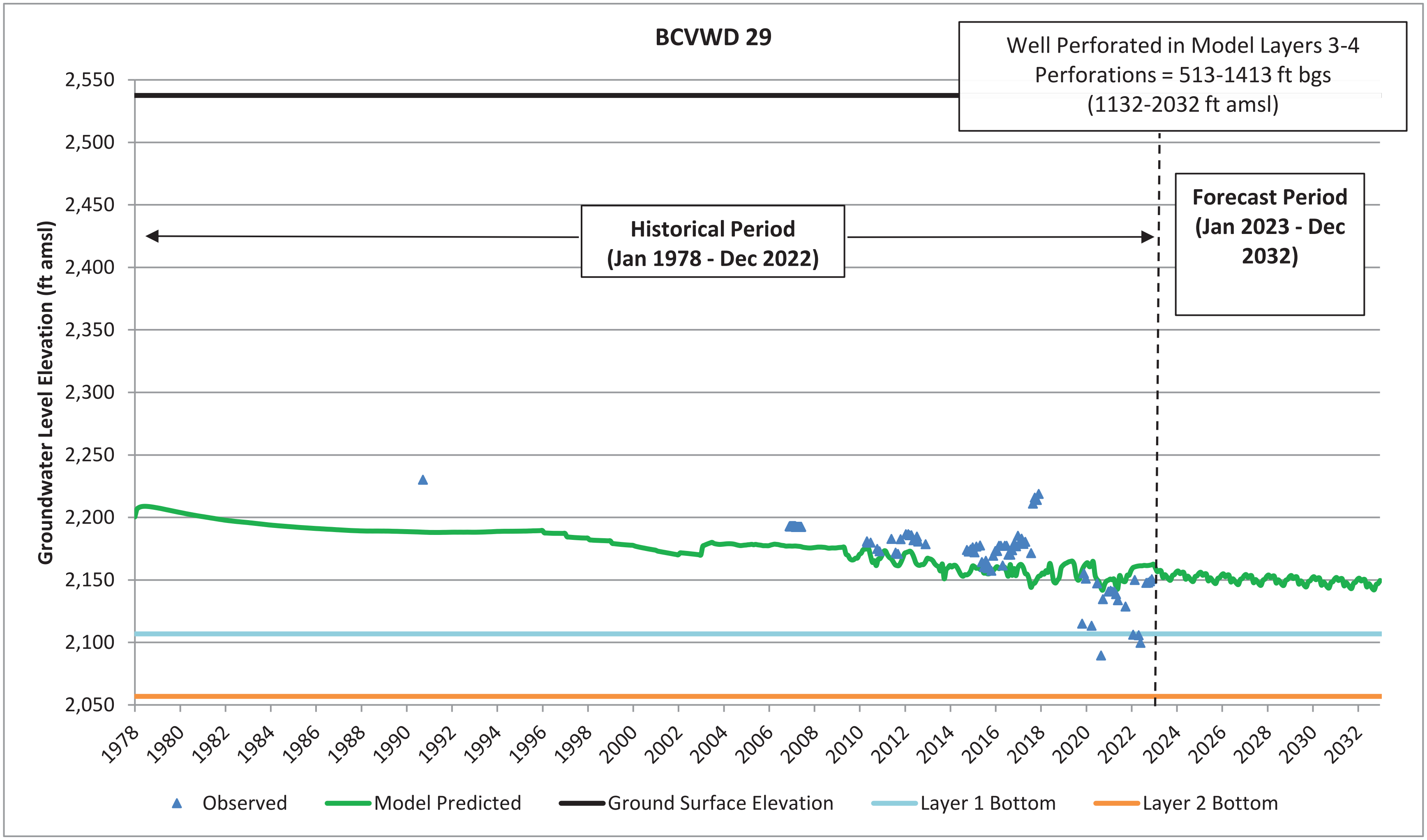

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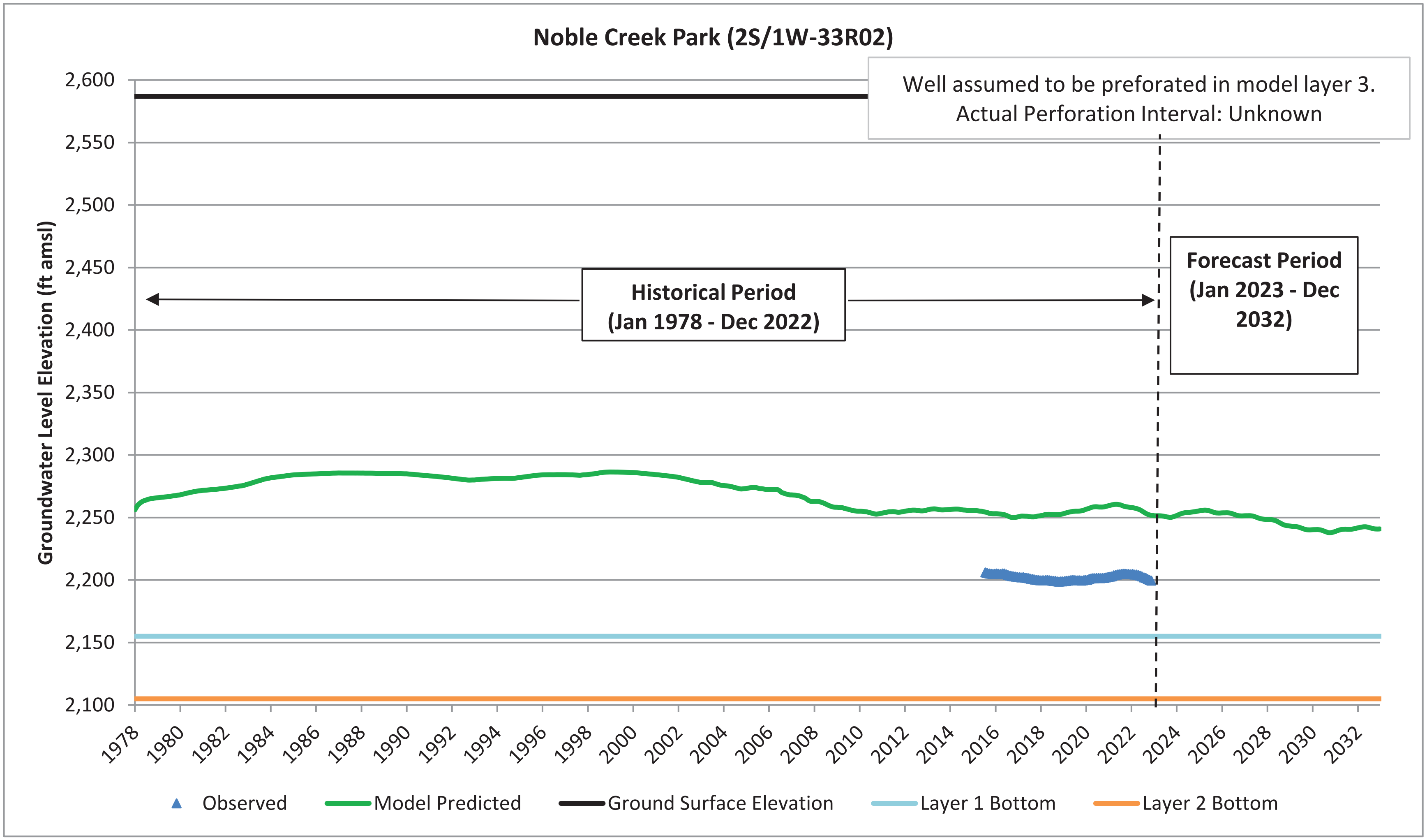

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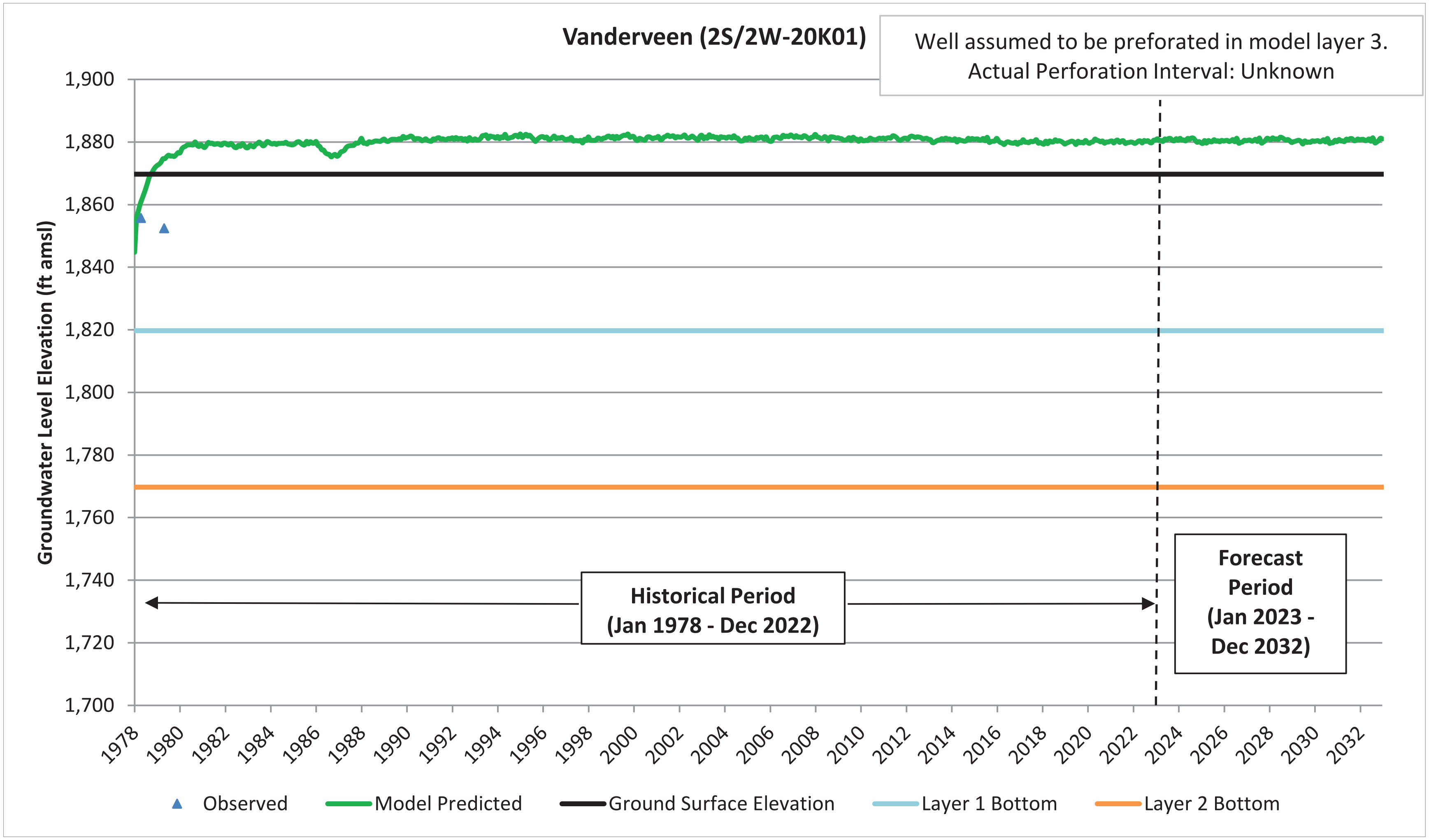

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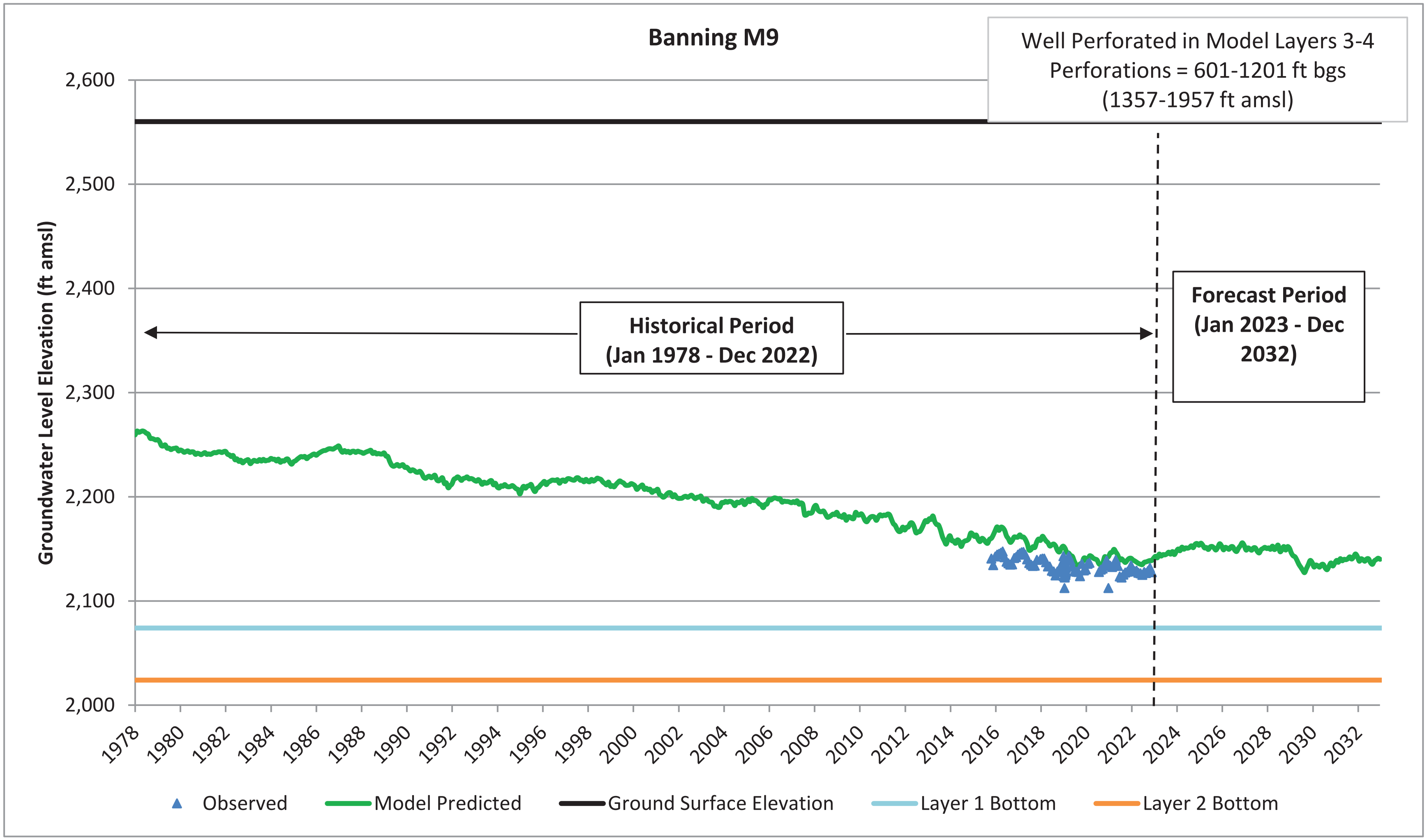

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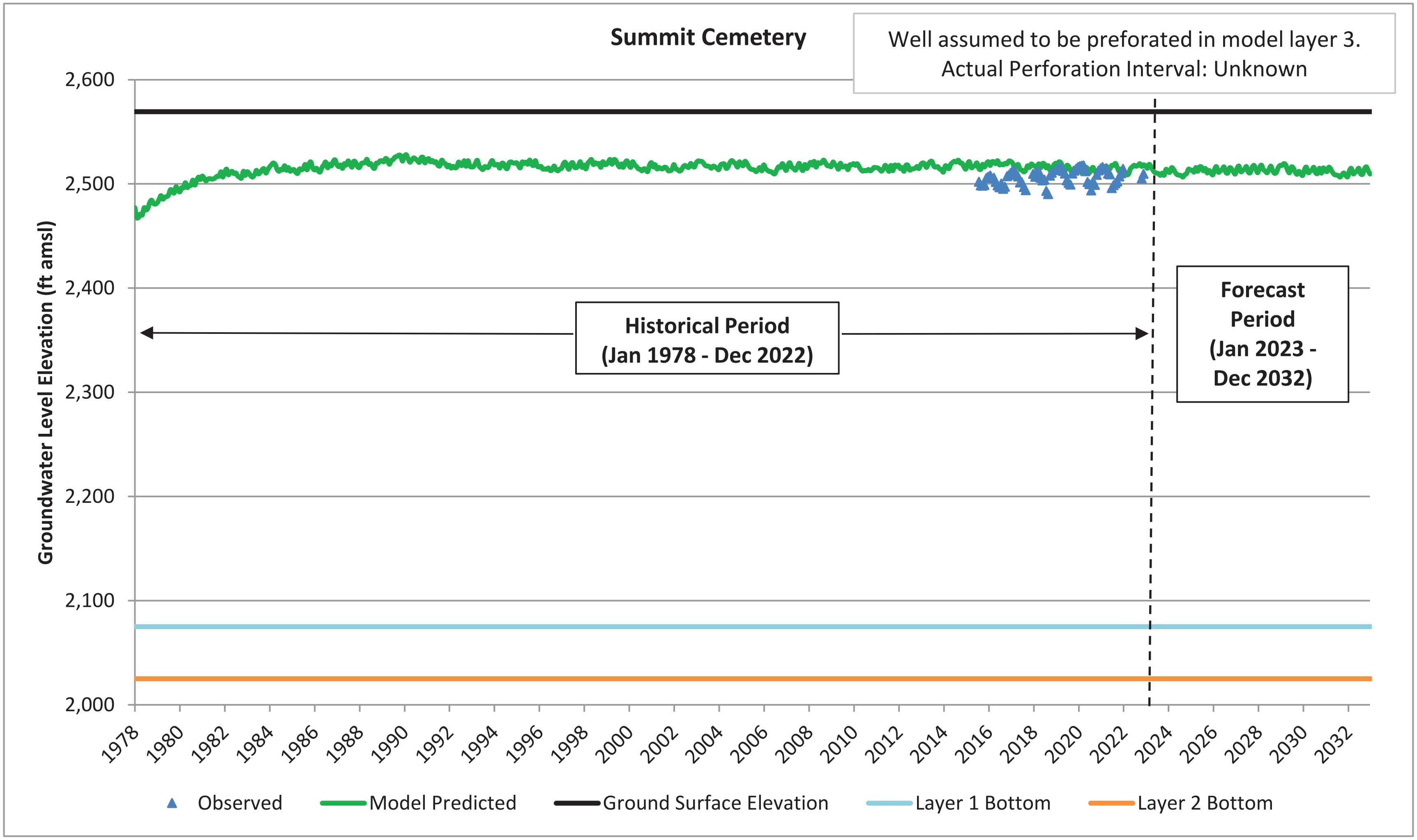

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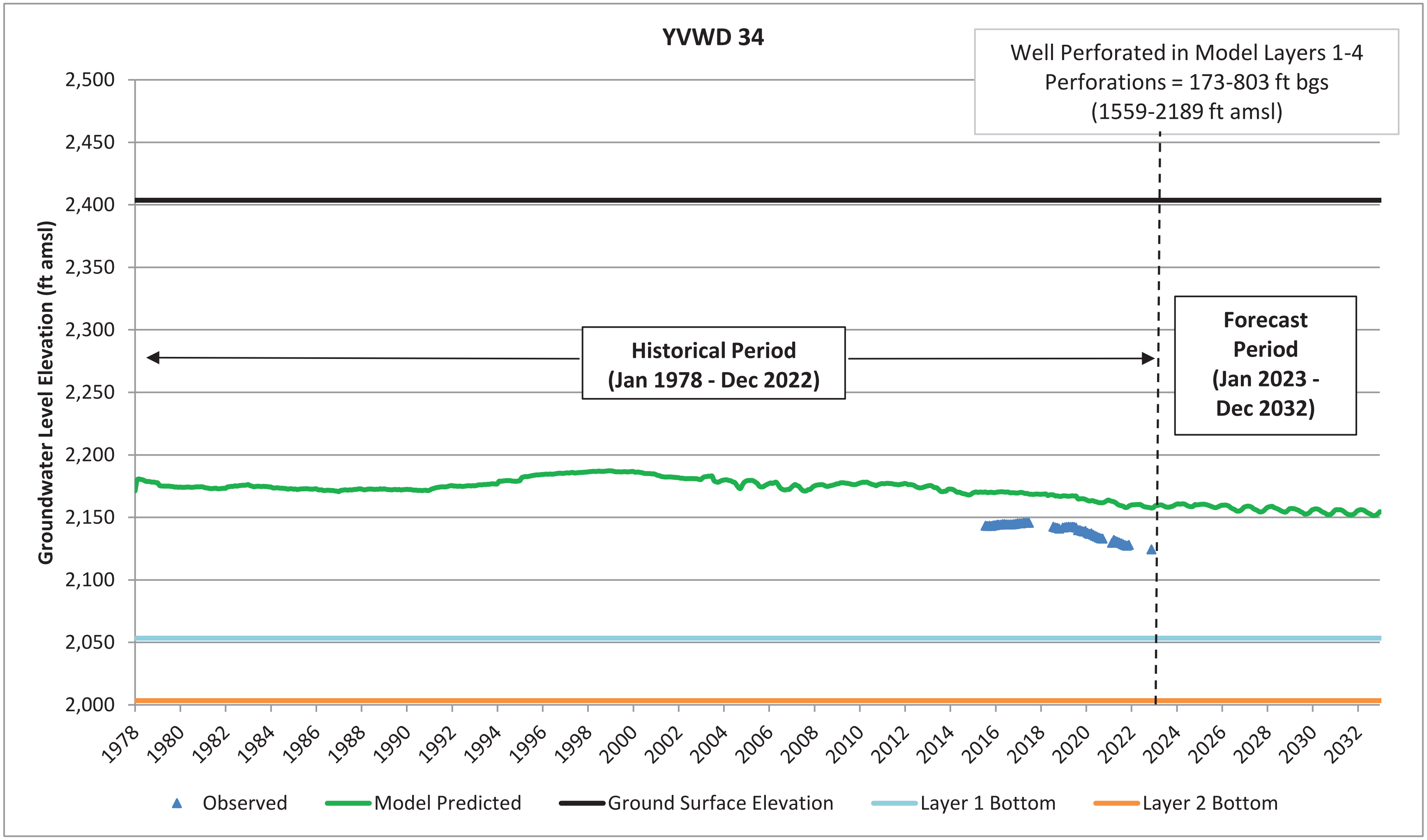

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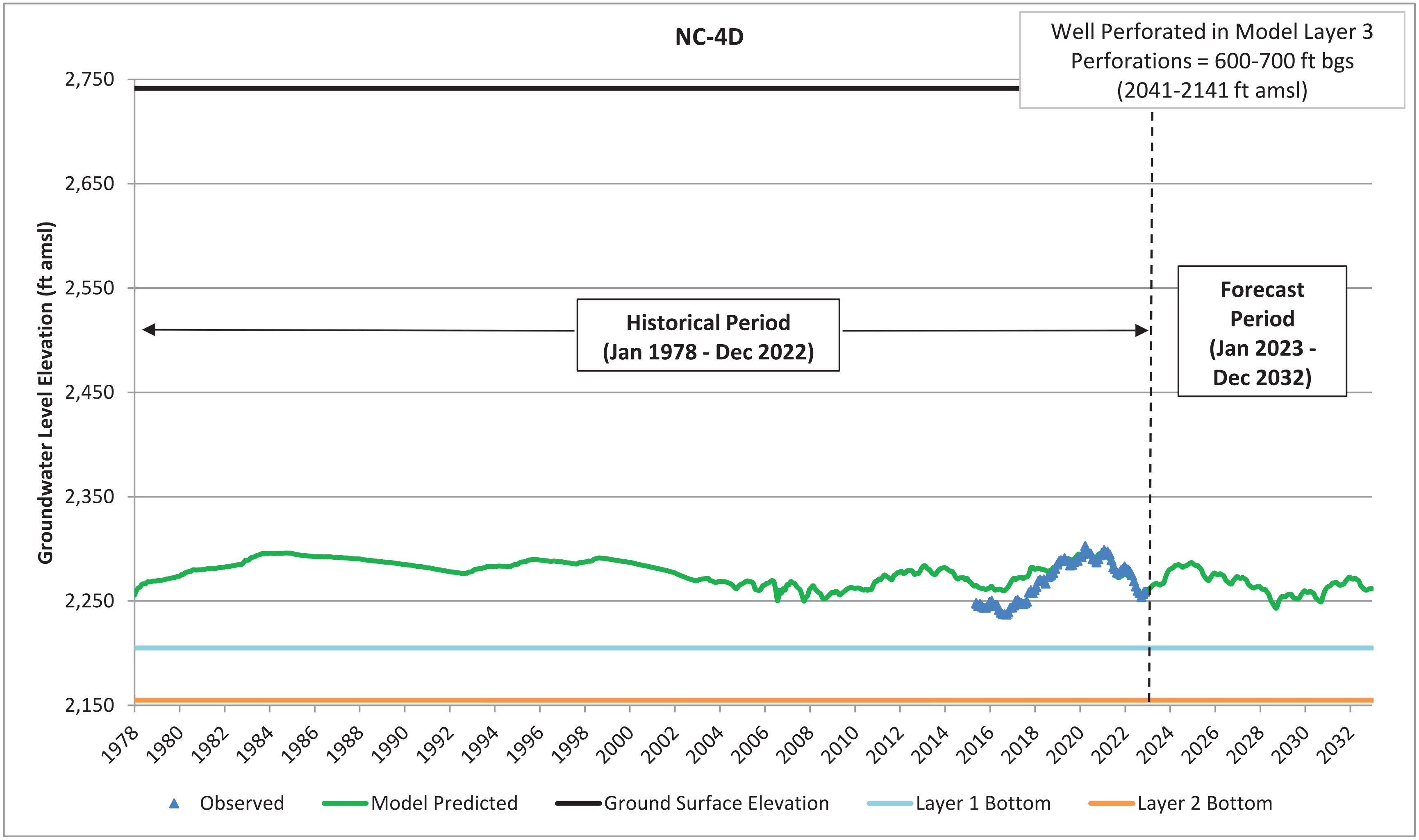

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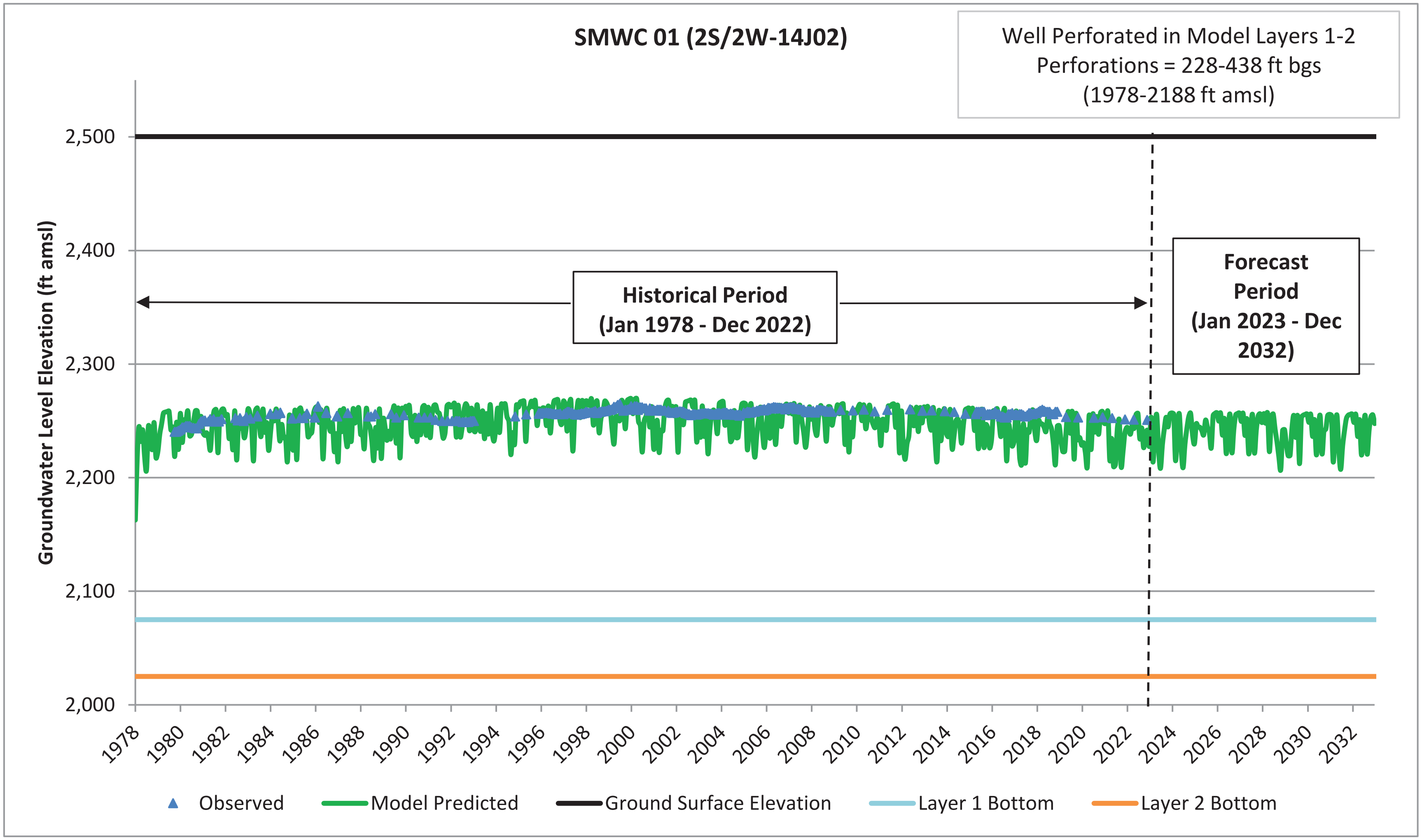

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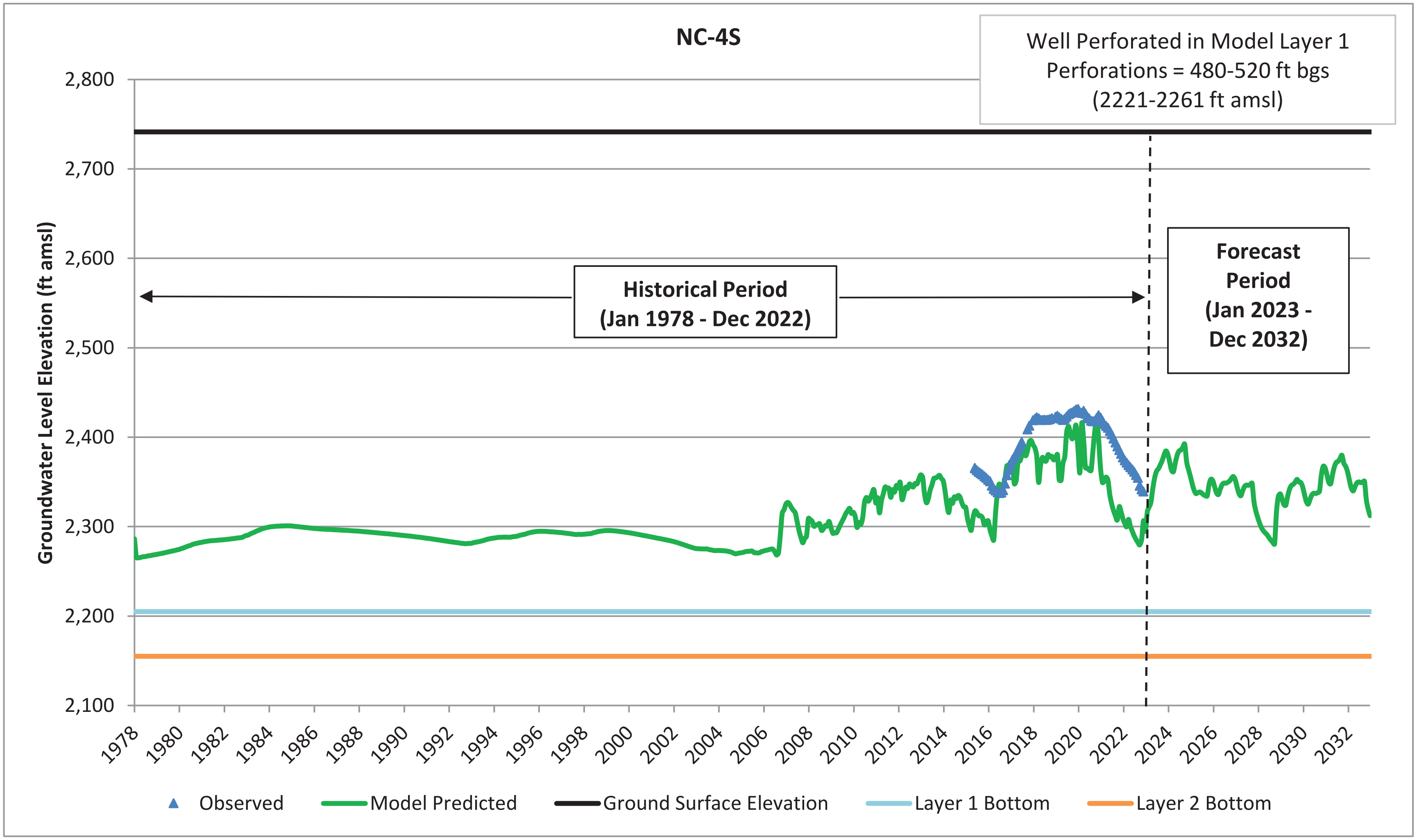

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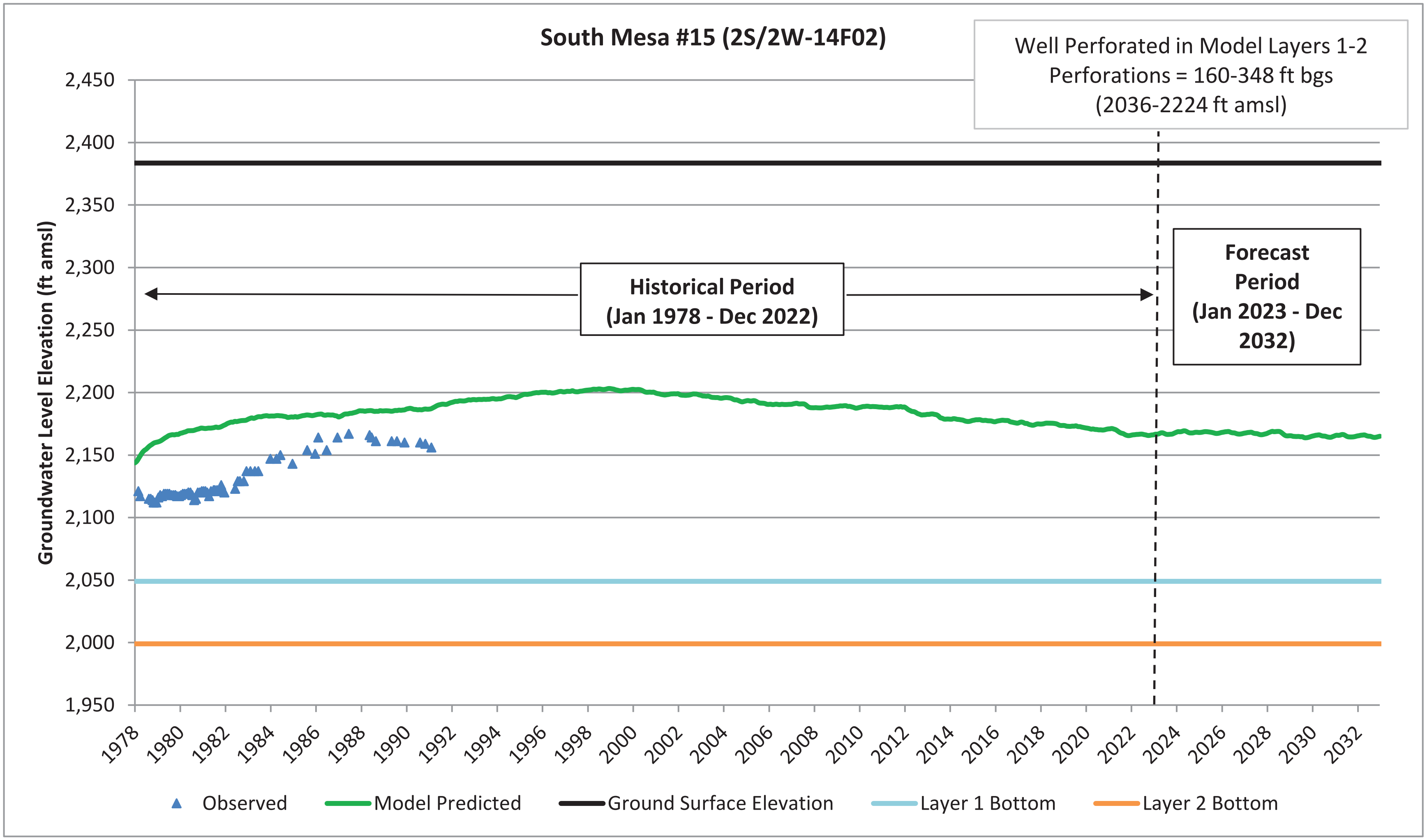

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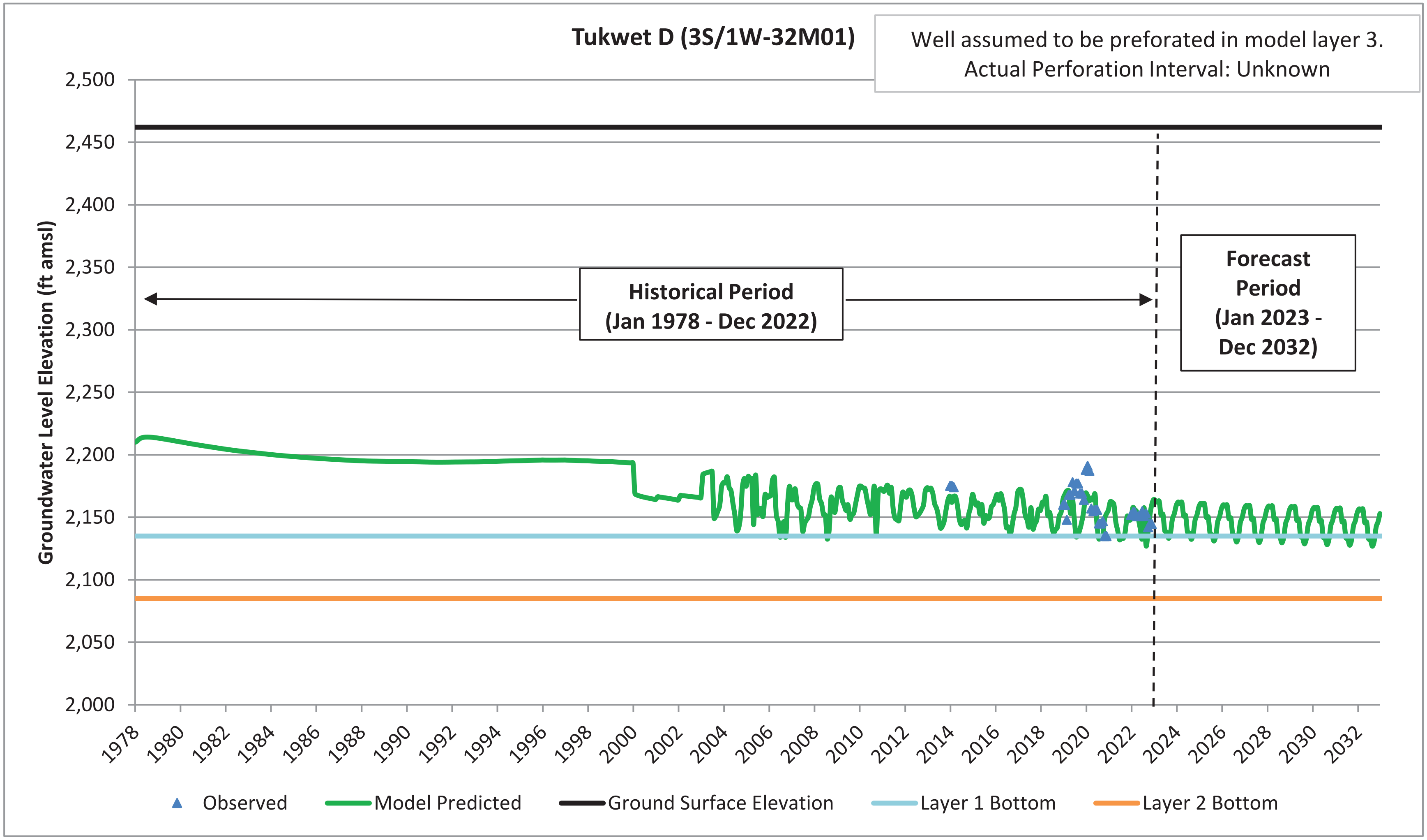

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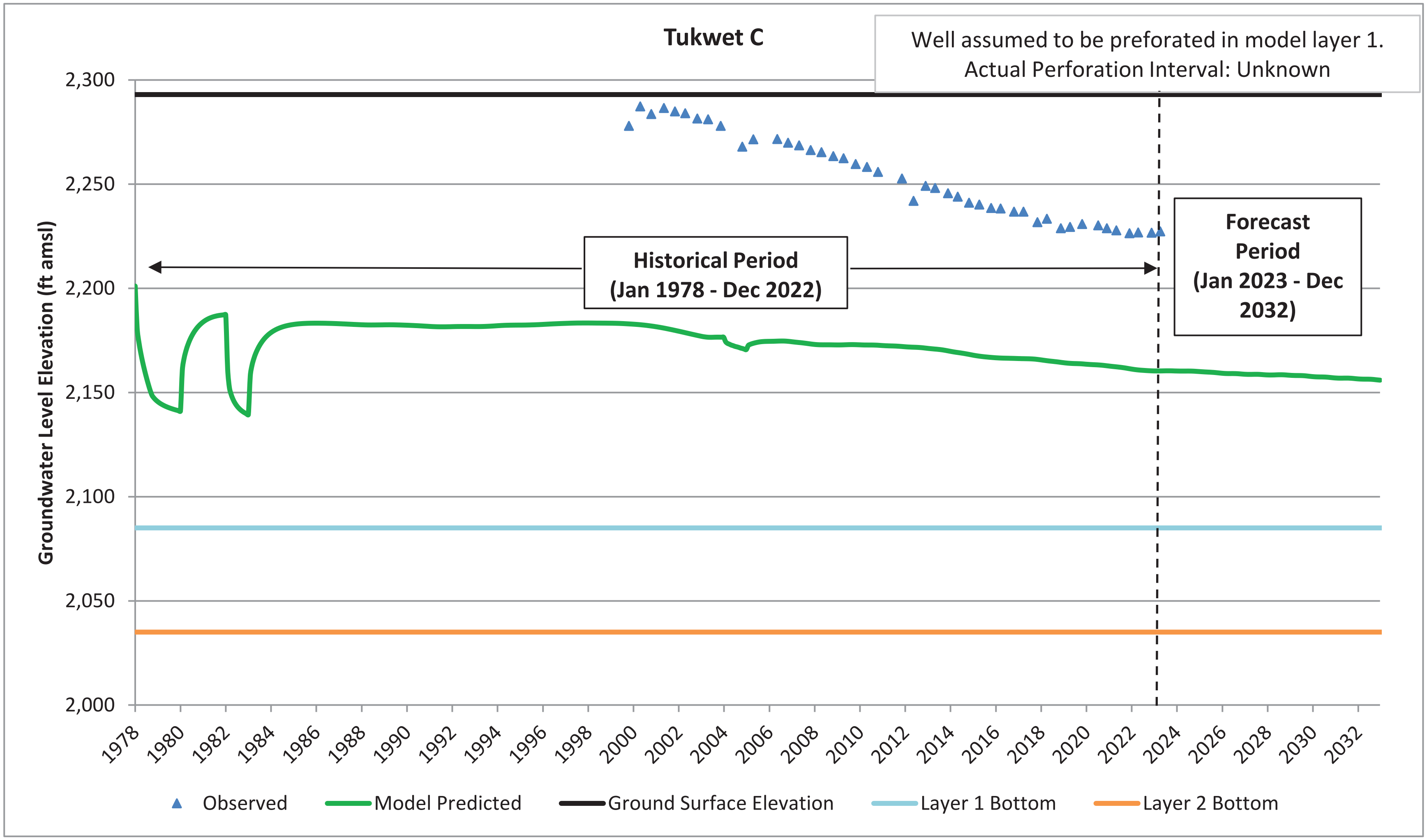

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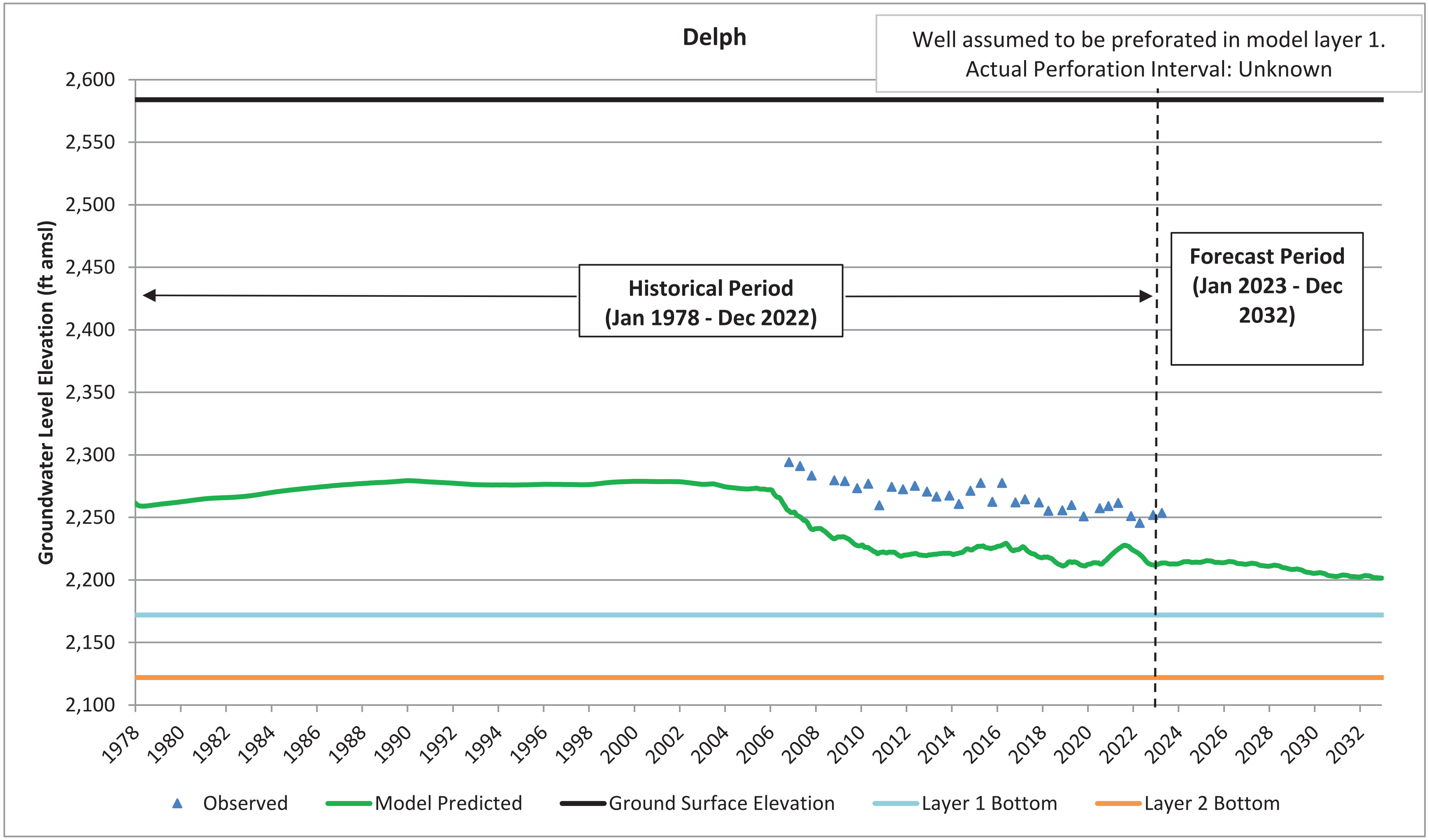


ITEM VII-B

BEAUMONT BASIN WATERMASTER

MEMORANDUM NO. 24-33

Date:	October 2, 2024
From:	Thomas Harder, Thomas Harder & Co
Subject:	Analysis of Basin Storage Losses Using the Model
Recommendation:	For Information and Discussion

At the September 4, 2024 Beaumont Basin Watermaster Special Committee meeting, TH&Co presented a scope of work and cost estimate to analyze potential undesirable results in the Beaumont Basin by virtue of a “stress test” using the groundwater flow model. Although the scope of work included analysis of basin storage losses, the Beaumont Basin Watermaster committee directed TH&Co to narrow the scope of work to focus on analysis of basin losses only.

TH&Co has prepared a scope of work and cost estimate (attached) to evaluate storage losses in the adjudicated area of the Beaumont Basin using the updated calibrated groundwater flow model of the Beaumont Basin. The proposed analysis is meant to expand on the previous loss analysis work conducted in 2018 to help answer the following questions:

1. What was the baseline subsurface outflow from the Beaumont Basin prior to supplemental managed recharge?
2. How has subsurface outflow in the Beaumont Basin changed since managed recharge started in 2006?
3. How might subsurface outflow change in the future with San Gorgonio Pass Water Agency planned imported supplies?
4. What are the implications of the estimated changes in subsurface outflow for developing an accounting policy for losses in the Basin?

The scope of work includes:

- Quantifying subsurface outflow in the basin for various historical periods, including periods with and without managed imported water recharge,
- Coordinating with San Gorgonio Pass Water Agency to identify a range of potential imported water forecasts for analysis of storage losses,
- Preparing model input files to analyze the scenarios,
- Analysis of the model output, and
- Reporting.

The report would include a preliminary draft basin loss policy for further discussion by the Committee. The cost estimate to conduct the scope of work is $57,140. The scope of work can be completed within six months of authorization to proceed.

Attachment: Proposal

September 24, 2024

Mr. Art Vela, P.E.
Beaumont Basin Watermaster
99 E. Ramsey St.
Banning, California 92220

Re: Revised Proposed Scope of Work for Analysis of Potential Basin Losses

Dear Mr. Vela:

At the request of the Beaumont Basin Watermaster (BBWM), Thomas Harder & Company (TH&Co) has prepared this proposed scope of work (SOW) to evaluate storage losses in the adjudicated area of the Beaumont Basin (the Basin) using a calibrated groundwater flow model (GFM). The proposed SOW has been developed based on input from BBWM Committee members at the September 4, 2024 workshop. The ultimate goal in estimating losses is to make sure the Beaumont Basin Watermaster's accounting of stored supplemental water is representative.

TH&Co previously conducted an analysis of storage losses for the BBWM in 2018.[1] The results of the previous analysis showed that losses associated with managed supplemental water recharge are highly sensitive to the volume of recharge and the location and pumping capacity of downgradient production wells to capture the water.

1 OBJECTIVES

The proposed analysis is meant to expand on the previous loss analysis work conducted in 2018 to help answer the following questions:

1. What was the baseline subsurface outflow from the Beaumont Basin prior to supplemental managed recharge?

[1] TH&Co, 2018. Beaumont Basin Storage Loss Analysis. Prepared for the Beaumont Basin Watermaster. Dated September 6, 2018.

2. How has subsurface outflow in the Beaumont Basin changed since managed recharge started in 2006?
3. How might subsurface outflow change in the future with San Gorgonio Pass Water Agency planned imported supplies?
4. What are the implications of the estimated changes in subsurface outflow for developing an accounting policy for losses in the Basin?

Implications of the loss analysis will be captured in a preliminary draft policy to account for groundwater storage losses in the Basin in the future. The preliminary draft policy will provide the basis for Committee review and discussion to form a final loss policy for the Basin.

2 Scope of Work

To meet the objectives and answer the questions, the scope of work consists of the following tasks:

1. Quantify subsurface outflow from the Basin under two historical time periods using the groundwater flow model;
2. Coordinate with SGPWA to develop a range of imported water forecasts with which to assess potential changes in subsurface losses in the future;
3. Develop GFM input files to simulate the forecast scenarios ("pre-processing");
4. Conduct the model simulations;
5. Conduct particle tracking analysis of managed recharge water for each model simulation;
6. Analyze, illustrate, and tabulate the model results ("analysis"); and
7. Prepare and submit draft technical memorandum of the results ("reporting") with the preliminary draft loss policy.

The analysis will utilize the updated GFM used to redetermine the safe yield of the Basin. The GFM is based on the United States Geological Survey's MODFLOW-NWT[2] computer code and post-processing utility code ZONEBUDGET[3]. The GFM is comprised of a historical ("calibration") period spanning January 1978 through December 2022 and a 10-year forecast period spanning January 2023 through December 2032. To meet the objectives stated above, this SOW will rely on the GFM using the same historical and forecast periods but with different

[2] Niswonger, R.G., Panday, S., and Ibaraki, M., 2011. MODFLOW-NWT, A Newton Formulation for MODFLOW-2005: U.S. Geological Survey Techniques and Methods 6-A37, 44 p.

[3] Harbaugh, A., 1990. A computer program for calculating subregional water budgets using results from the U.S. Geological Survey Modular Three-Dimensional Finite- Difference Ground-Water Flow Model, Open-File Report 90-392, 49 p.

alternative future imported water recharge scenarios ("forecast scenarios"). For each scenario, TH&Co will also run MODPATH[4] to estimate recharge water travel time and flow directions.

As the basin is bifurcated into two separate and distinct hydrologic areas, results of the analysis will be reported relative to a Western Study Area and an Eastern Study Area (**Figure 1**). The study areas are separated by the westernmost Beaumont Plains Fault.

2.1 Task 1: Quantify Subsurface Outflow Under Various Historical Periods

TH&Co will quantify subsurface outflow from the Basin during two different historical periods:

1. The period from 1978 through 2005 (pre-managed recharge in the Basin)
2. The period from 2006 through 2022 (with managed recharge in the Basin)

Annual and long-term average outflow for each period will be reported for both the Eastern Study Area and the Western Study Area. TH&Co will also conduct particle tracking for each period to assess travel time and flow directions of supplemental recharge.

2.2 Task 2: Coordinate with SGPWA to Develop Imported Water Forecasts for Analysis of Potential Storage Losses

TH&Co will coordinate with SGPWA to develop a range of potential imported water forecasts for analysis of storage losses using the GFM. Future groundwater pumping, hydrology, and recharge not associated with imported water will be the same as that assumed in the forecast used for the Safe Yield Redetermination.[5] In coordination with SGPWA, up to three future imported water scenarios will be developed for analysis using the GFM.

2.3 Task 3: Pre-Processing

TH&Co will create model input files to analyze each of the three imported water forecast scenarios. As the only variable in the model forecast will be imported water recharge, this will involve changes to the MODFLOW recharge package.

2.4 Task 4: Analysis

TH&Co will analyze the model output from each of the imported water recharge forecast scenarios to assess potential changes in subsurface outflow associated with changes in imported water recharge volumes. Basin outflow from each scenario will be analyzed and compared to basin

[4] Pollock, D.W., 2012. User Guide for MODPATH Version 6—A Particle-Tracking Model for MODFLOW: U.S. Geological Survey. Techniques and Methods 6–A41, 58 p. (Version 6.0.01, August 24, 2012).

[5] TH&Co, 2024. Draft-Final 2023 Reevaluation of the Beaumont Basin Safe Yield. Dated July 2024.

outflow from the baseline scenario used to redetermine the Safe Yield of the Basin. The differences in outflow between scenarios and as compared to the baseline will provide an indication of the losses attributed to changes in imported water recharge. Spatial and temporal changes in basin outflow for each scenario will be reported for both the Eastern Study Area and the Western Study Area.

To supplement the subsurface loss analysis, TH&Co will also perform particle tracking analysis, using the MODPATH utility of MODFLOW, to trace the paths imported recharge water takes upon reaching the water table over time.[6] The particles, which will serve as surrogates for recharge water, will be uniformly spaced throughout the areal extent of the Noble Creek recharge facility and, as necessary in the future depending on forecast imported water deliveries, the Brookside recharge facility.

The subsurface outflow analyses will be summarized in a table of inflow and outflow volumes (in units of acre-feet) for each Study Area over time. TH&Co will also generate one or more figures showing groundwater flow path lines in 2-dimensional plan view for one or more selected times. In those cases where imported water exits the Basin (i.e., is not captured by wells within the Basin), the number of particles exiting the Basin will be quantified and reported.

3 TASK 5: REPORTING

The findings of the analysis will be presented in a technical memorandum (TM). Information from the safe yield redetermination report prepared by TH&Co may be briefly summarized in the TM where relevant; however, the TM will focus on the loss analyses.

The TM will include as an attachment a preliminary draft basin loss policy. The policy will be informed by the loss analyses proposed herein. It is emphasized that this preliminary draft policy is for review by the BBWM Committee and is only meant to stimulate discussion on what a final policy will look like given the conditions in the Basin. Any final basin loss policy will be determined by the Committee.

The cost estimate for this task assumes preparation of one draft version of the report and one final version.

[6] Calibrated specific yield values will be used as effective porosity for the MODPATH particle tracking simulations for the uppermost (and unconfined) model layer (i.e., Layer 1). The effective porosity of Layers 2, 3, and 4 will be an assumed value of 0.20. Sensitivity simulations will also be conducted assuming effective porosity values for these three deeper layers of 0.10 and 0.30.

4 Cost and Schedule

The cost for the proposed scope of work is $57,140 (see **Attachment 1**). It is anticipated that the work can be completed within 6 months of receiving approval to proceed.

As always, we appreciate the opportunity to provide our services to the BBWM. If you have any questions, please contact us.

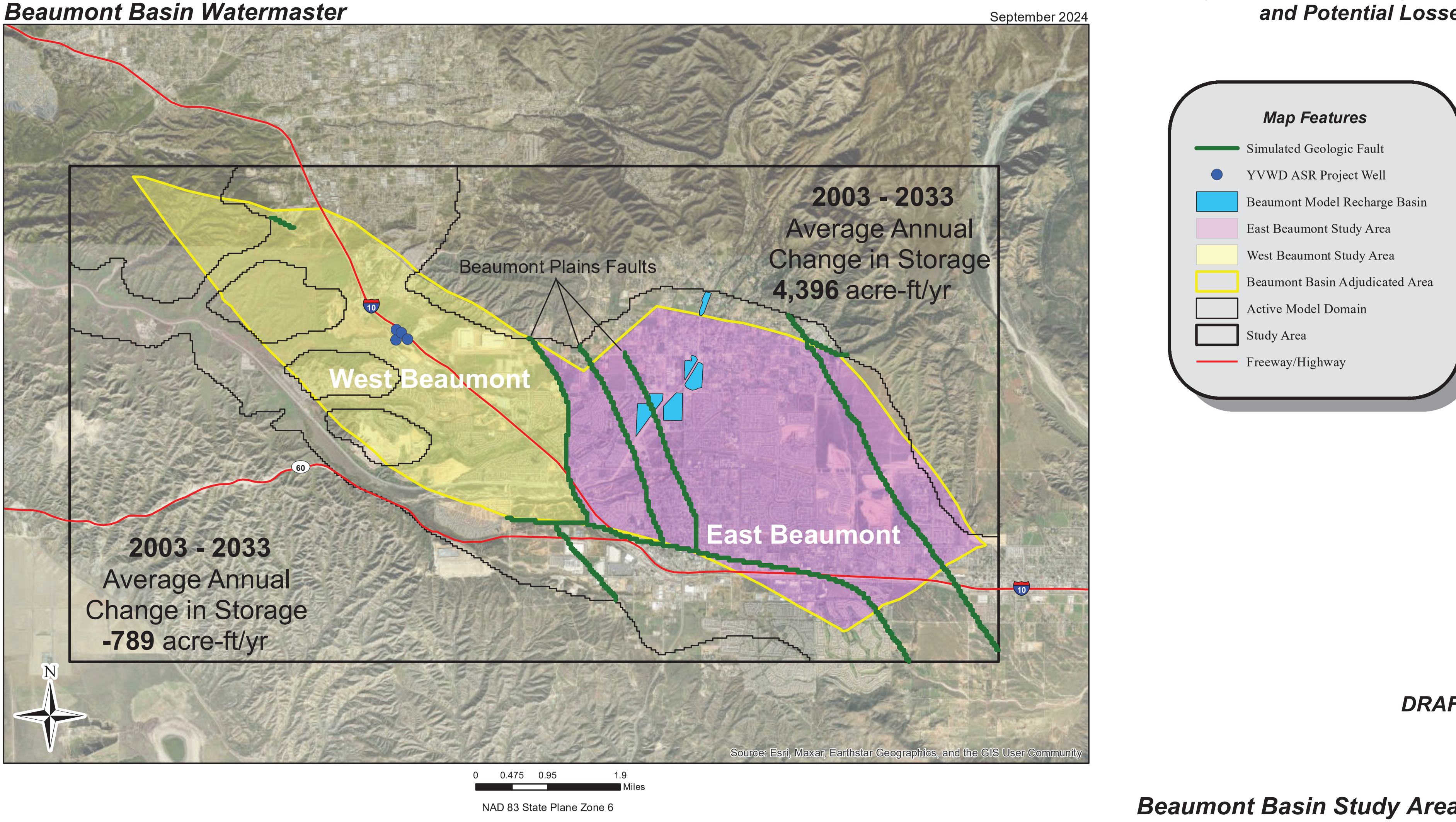
Sincerely,

Thomas Harder, P.G., C.HG.
Principal Hydrogeologist

Jim Van de Water, P.G., C.HG.
Principal Hydrogeologist

Revised Proposed SOW for Analysis of Basin Management and Potential Losses

Beaumont Basin Watermaster



Thomas Harder & Co.
Groundwater Consulting

DRAFT

Beaumont Basin Study Areas

Figure 1

Attachment 1

Cost Estimate

Beaumont Basin Watermaster - Analysis of Potential Basin Losses

Task	Description	Principal Hydrogeologist $220/hr	Associate Hydrogeologist $190/hr	Senior Geologist $160/hr	Project Geoscientist $135/hr	Staff Geoscientist $115/hr	Graphics $100/hr	Clerical $80/hr	Total Labor	Reimbursable Expenses	Total Cost
1	Quantify Subsurface Outflow Under Two Historical Time Periods (One Pre-Imported Water Recharge; One Post-Imported Water Recharge)	12	0	0	0	40	0	0	$7,240	$0	$7,240
2	Coordinate with SGPWA to Develop Up to Three Imported Water Recharge Forecasts for Analysis with the Model	12	0	0	12	12	0	0	$5,640	$0	$5,640
3	Pre-Processing; Preparation of Input Files	8	0	0	16	40	0	0	$8,520	$0	$8,520
4	Analysis of Model Simulations; includes Zonebudget and Particle Tracking Analyses	24	0	0	24	100	8	0	$20,820	$0	$20,820
5	Reporting (Includes Conceptual Basin Loss Policy)	60	0	0	24	40	8	4	$22,160	$0	$22,160
	Totals =>	**104**	**0**	**0**	**76**	**192**	**16**	**4**	**$57,140**	**$0**	**$57,140**

ITEM VII-C

BEAUMONT BASIN WATERMASTER

MEMORANDUM NO. 24-34

Date:	October 2, 2024
From:	Thomas Harder, Thomas Harder & Co
Subject:	City of Beaumont Data Request
Recommendation:	Approve costs and work of Thomas Harder & Co for preparation of data in response to California Public Records Act Request

The City of Beaumont has requested disclosable public records as indicated on the attached letter: modeling files pertaining to the Beaumont Basin Groundwater Flow Model (Model) (attached). Records responsive to the request are maintained by BBWM consultant Thomas Harder & Co. The records are maintained electronically and can be provided as requested. However, preparation of the files will require staff time on the part of the consultant.

The specific files requested include:

- Model grid shapefile.
- Model output files.
- Spreadsheet (or equivalent) of calibration analysis, broken down by well.
- MODFLOW Version used to run the Model.

This data request only pertains to files for the calibrated historical model, not any future planning or management scenarios.

Thomas Harder & Co. suggests that the requested model files be evaluated to better understand the Model's potential use in assessing changes in hydrology within Cooper's and San Timoteo Creeks. The evaluation would assess how appropriate the Model is for predicting changes in the surface water and groundwater hydrology downgradient of the WWTP in response to discharge reductions to Cooper's Creek.

It is noted that while Cooper's Creek and San Timoteo Creek are inside the active model domain of the model, they are outside the Beaumont Basin Adjudication area and were, therefore, not a focus of prior model analyses. In addition, the model was not developed to assess streamflow/groundwater interactions in the areas of these two creeks. As such, modification of the model will likely be necessary to adequately address the City's objective.

In general, costs to prepare electronic public records are not chargeable to the requestor. The cost to compile and submit the model files is $1,300. Staff recommends approval of the expenditure with cost share to be split equally between the five member agencies bearing the full cost of the action at no cost to the requestor.

Attachments:

1. PRA Request from the City of Beaumont
2. Data request from West Yost

CITY OF BEAUMONT
550 E. 6th Street, Beaumont, CA 92223
Phone (951) 769-8520 Fax (951) 769-8526
BeaumontCa.gov

September 10th, 2024

Beaumont Basin Watermaster
c/o Beaumont-Cherry Valley Water District
ATTN: William Clayton
560 Magnolia Avenue
Beaumont, CA 92223

Dear Beaumont Basin Watermaster,

Subject: Request for Modeling Files Pertaining to the Beaumont Basin Groundwater Flow Model

As part of the City of Beaumont's (City) ongoing research and analysis to support recycled water delivery to the area, the City has contracted with a team of consultants to develop an Adaptive Management and Mitigation Program (AMMP). In support of the AMMP, The City is writing to formally request the Beaumont Basin Watermaster modeling files associated with the Beaumont Basin Groundwater Flow Model.

Please find the enclosed letter detailing the consultant team's request.

If there are any conditions or procedures required to obtain these files, please let me know. Additionally, if there are any associated costs for processing this request, I would appreciate it if you could provide an estimate.

Thank you very much for your attention to this matter. I look forward to your response.

Sincerely,

Thaxton Van Belle
Director of Water Reclamation
City of Beaumont

With email to: Arturo Vela, Robert Vestal, Daniel Jaggers, Dave Armstrong, Joseph Zoba.

DATA REQUEST

DATE: September 10, 2024 Project No.: 1113-80-23-01

TO: Thaxton VanBelle (City of Beaumont)
Robert Vestal (City of Beaumont)

CC: Kaitlyn Dodson-Hamilton (Tom Dodson & Associates)
Lisa Patterson (HDR)
Matt Baillie (West Yost)
Lauren Sather (West Yost)

FROM: Clay Sorensen, West Yost

SUBJECT: Request for Modeling Files of the Beaumont Basin Groundwater Flow Model in Support of the City of Beaumont's Adaptive Management and Mitigation Program (AMMP)

PURPOSE

The purpose of this document is to formally request the Beaumont Basin Watermaster's modeling files pertaining to the Beaumont Basin Groundwater Flow Model (Model). Types of the specific files we are requesting are listed below and are further clarified in Table 1:

- All model input files in native MODFLOW format.
- Model grid shapefile.
- Model output files.
- Spreadsheet (or equivalent) of calibration analysis, broken down by well.
- MODFLOW Version used to run the Model.

This data request only pertains to files for the calibrated historical model, not any future planning or management scenarios.

BACKGROUND

The City of Beaumont (City or Beaumont) plans to reduce the discharge of treated wastewater from the Beaumont Wastewater Treatment Plant (WWTP) to Cooper's Creek. To reduce the volume of discharge, the City must file a Wastewater Change Petition (Change Petition) with the State Water Resources Control Board (SWRCB), Division of Water Rights. When the City first discussed the plan to apply for a change petition with the SWRCB, the Division of Water Rights staff advised that the City develop an AMMP to aid in the process of approving the reduced discharge. The purpose of the AMMP is to ensure there is a plan and program in place to assess and mitigate, if necessary, any impacts that result from reducing the WWTP discharge to Cooper's Creek. The City contracted with Tom Dodson & Associates (TDA), West Yost, and Lisa Patterson of HDR (collectively referred to as the Consultant Team) to develop the AMMP and support the change petition process.

As part of the scope of work, West Yost is reviewing available groundwater and surface water models for the region to evaluate if any can be utilized to predict changes in the surface water and groundwater hydrology downgradient of the WWTP in response to reductions in discharges to Cooper's Creek.

INTENDED USE OF THE MODEL FILES

Requested model files will be evaluated to better understand the Model's potential use in assessing changes in hydrology within Cooper's and San Timoteo Creeks. The evaluation will assess how appropriate the Model is for predicting changes in the surface water and groundwater hydrology downgradient of the WWTP in response to discharge reductions to Cooper's Creek. The Model will be test run to determine that it functions properly and that all input files are present. Model output files will be used solely to ensure that the delivered Model has run properly. The Model will not be modified in any way from what is delivered without written permission from the Model owner(s). Any such request for modification would occur in the next phase of work.

DATA REQUEST

Data request items are listed in Table 1. If it is helpful, we are happy to set up a meeting to discuss the goals and objectives of the AMMP and how the requested modeling files fit within its scope.

Thank you for your time and consideration. Please direct questions to Clay Sorensen at csorensen@westyost.com.

Table 1. Data Request for Beaumont Basin Watermaster

	Item	Requested Return Date	Comments
Beaumont Basin Groundwater Flow Model Information			
1	All model input files in native MODFLOW format	7/29/2024	Please provide all native MODFLOW input files (i.e., GUI-independent) needed to run the model.
2	Model grid shapefile	7/29/2024	
3	Model output files	7/29/2024	Please provide all native MODFLOW output files (i.e., GUI-independent) produced when the model is run using your desired output settings.
4	Spreadsheet (or equivalent) of calibration analysis, broken down by well	7/29/2024	Please provide an excel file (or equivalent file in native format) with calibration analysis broken down by well.
5	MODFLOW Version used to run the model	7/29/2024	

Version 1 (2024-07-16)

BEAUMONT BASIN WATERMASTER
MEMORANDUM NO. 24-35

Date:	October 2, 2024
From:	Steven Stuart, Dudek
Subject:	Discussion on Proposed Revisions to Rules & Regulations
Recommendation:	No recommendation

The Beaumont Basin Watermaster (Watermaster) authorized Dudek to review the Watermaster Rules and Regulations (last amended in December 2022) and propose modifications to either update existing sections and/or introduce new rules based on management strategies and policies recently considered by the Watermaster.

At this meeting, Dudek will present a proposed modification to section 7.0, *Adjustments of Rights*, that addresses the adjustment to Overlying Water Rights following a 10-year redetermination of the Beaumont Basin Safe Yield. Dudek will also present potential modifications to the Rules and Regulations following further studies on Basin Losses and Negative Storage Accounts and subsequent review and discussion with the Watermaster Committee at public meetings.

No other proposed modifications to the Rules and Regulations require further study and evaluation.

Proposed modifications to section 7.0 Adjustments of Rights

The following text is proposed for inclusion in Section 7 of the Rules and Regulations:

7.0 In General

In General, Overlying Parties shall have the right to exercise their respective Overlying Water Rights as decreed in Column 4 of Exhibit B to the Judgement, except to the extent provided in Section III, Paragraph 3, entitled Adjustment of Rights, of the Judgment. (Judgment, p. 6, lines 17-19). The allocation of Overlying Water Rights to each Overlying Party per Exhibit B to the Judgement was based on their individual historical usage from 1997 to 2001 and the projected maximum production for each Overlying Party, which together equaled the Beaumont Basin Safe Yield of 8,650 acre-feet per year defined at the time of the Judgement.

Subsequent 10-year redeterminations of the Safe Yield, as required per section VI.5.Y of the Judgement, will require modifications to each Overlying Water Right proportionate to Exhibit B to the Judgement. The summation of all modified Overlying Water Rights shall be equivalent to the redetermined Safe Yield. The modified

Overlying Water Rights shall remain in effect until the next 10-year redetermination of the Safe Yield and the approval and adoption of the redetermined Safe Yield by the Watermaster.

7.1 Overlying Water Rights and Redetermination of the Safe Yield

At the conclusion of a 10-year redetermination of the Safe Yield of the Beaumont Basin, the Watermaster shall prepare a draft technical report detailing the procedures and methodologies used to redetermine the Safe Yield. The report shall include a table documenting the initial Overlying Water Rights and subsequent modifications to those Overlying Water Rights for each redetermination of the Safe Yield.

If an Overlying Party has previously transferred a portion of or all of its Overlying Water Right to an Appropriator, then the Overlying Water Right will be adjusted accordingly by subtracting the transferred amount from the modified Overlying Water Right. If the modified Overlying Water Right is less than the amount previously transferred to an Appropriator, then the amount of the Overlying Water Right transferred to the Appropriator shall be reduced accordingly.

A draft of the technical report shall be presented to the Overlying Parties to review and provide comments. The Watermaster shall provide a 45-day review period for the Overlying Parties. The Overlying Parties shall provide, in writing, any comments to the Watermaster by the conclusion of the 45-day review period. The Watermaster shall respond, in writing, to the comments by the Overlying Parties within 30 days of the conclusion of the 45-day review period. The Watermaster may also consider, in their discretion, to hold a special meeting to address any technical and/or procedural questions by the Overlying Parties on the 10-year redetermination of the Safe Yield.

After the Overlying Parties comments are addressed and incorporated into the 10-year Redetermination of the Safe Yield technical report, the Watermaster shall consider approving the redetermined Safe Yield at a Watermaster Regular Meeting. The Watermaster shall document the approval of the redetermined Safe Yield in a resolution adopted by the Watermaster at a regular meeting.

The following items, Basin Losses and Negative Storage Accounts, have been identified as topics for future meetings. The Watermaster consultants are developing plans to study these two items and how they will affect Basin conditions and management strategies. The findings from these studies will be reviewed and discussed with the Watermaster Committee at subsequent public meetings. The recommendation is to eventually include language in the Rules and Regulations to address how these two items will be accounted for and managed by the Watermaster.

Potential Modifications to Section 4.0, Safe Yield and Storage Accounts

1) Negative Storage Account. In Section 4.2.3, *Storage Account Calculations*, the Watermaster may consider adding language addressing the consequences and potential responses for when a Storage Account of an Appropriator or Storage Party becomes negative. Any proposed language to the Rules and Regulations will follow studies conducted by the Watermaster consultants and subsequent review and public discussions with the Watermaster Committee.

2) Accounting for Basin Losses. In Section 4.3, *Losses or Spills from the Basin*, the Watermaster may consider adding language to the Rules and Regulations addressing Basin losses from other than pumping following studies conducted by the Watermaster's consultants and subsequent review and public discussions with the Watermaster Committee.