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TECHNICAL MEMORANDUM

DATE: February 23, 2023 Project No.: 941-80-22-26 B.2

TO: Ground-Level Monitoring Committee

CC: Peter Kavounas, *General Manager of the Chino Basin Watermaster*

FROM: West Yost Associates, *Watermaster Engineer*

REVIEWED BY: Andy Malone, PG

SUBJECT: *Description of Subsidence Management Alternative #1 for 1D Model Simulation of Subsidence in Northwest MZ-1 (DRAFT)*

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BACKGROUND AND OBJECTIVES

The Chino Basin Watermaster's Subsidence Management Plan (SMP)[1] identified several "Areas of Subsidence Concern" across the western portion of Chino Basin where the future occurrence of land subsidence and ground fissuring is a concern. The SMP states that if data from existing monitoring efforts in the "Areas of Subsidence Concern" indicate the potential for adverse impacts due to subsidence, Watermaster will revise the SMP to avoid those adverse impacts.

Figure 1 is a map of the so-called Northwest MZ-1 Area of Subsidence Concern (Northwest MZ-1). Watermaster has monitored vertical ground motion in Northwest MZ-1 via InSAR[2] dating back to 1992. Land subsidence in Northwest MZ-1 was first identified as a concern in 2006 in the MZ-1 Summary Report[3] (WEI, 2006). Of particular concern is that the subsidence across the San Jose Fault in Northwest MZ-1 has occurred in a pattern of concentrated differential subsidence—the same pattern of differential subsidence that occurred in the Managed Area during the time of ground fissuring. Ground fissuring is the main subsidence-related threat to infrastructure.

The issue of differential subsidence and the potential for ground fissuring in Northwest MZ-1 has been discussed at prior meetings of the Ground Level Monitoring Committee (GLMC), and the subsidence has been documented and described as a concern in Watermaster's State of the Basin Reports, the annual reports of the GLMC, and in the Initial Hydrologic Conceptual Model for Northwest MZ-1.[4] Watermaster increased monitoring efforts in Northwest MZ-1 beginning in 2012 to include ground-elevation surveys and electronic distance measurements (EDM) to monitor ground motion and the potential for fissuring.

In 2015, the Watermaster's Engineer developed the *Work Plan to Develop a Subsidence Management Plan for the Northwest MZ-1 Area* (Work Plan).[5] The Work Plan is characterized as an ongoing Watermaster effort and includes a description of a multi-year scope of work, a cost estimate, and an implementation schedule. The Work Plan was included in the SMP as Appendix B. Implementation of the Work Plan began in July 2015. On an annual basis, the GLMC analyzes the data and information generated by the implementation of the Work Plan. The results and interpretations generated from the analysis are documented in the annual report of the GLMC and used to prepare recommendations for future activities.

[1] Wildermuth Environmental, Inc. 2015. Chino Basin Subsidence Management Plan. Prepared for the Chino Basin Watermaster. July 23, 2015.

[2] Interferometric Synthetic Aperture Radar (InSAR) is a remote sensing technique that is used to monitor vertical ground motion over time.

[3] Wildermuth Environmental, Inc. 2006. MZ-1 Summary Report. Prepared for the MZ-1 Technical Committee. February 2006.

[4] Wildermuth Environmental, Inc. 2017. Initial Hydrologic Conceptual Model and Monitoring and Testing Program for the Northwest MZ-1 Area. Prepared for the Chino Basin Watermaster. December 2017.

[5] Wildermuth Environmental, Inc. 2015. Work Plan to Develop a Subsidence-Management Plan for Northwest MZ-1. Prepared for the Chino Basin Watermaster. July 23, 2015.

The objective of the *Subsidence Management Plan for Northwest MZ-1* is to provide guidance for the Watermaster and the Parties for how to manage hydraulic heads in Northwest MZ-1 (potentially through the management of pumping, recharge, the use of managed storage, and/or the design and implementation of Storage and Recovery Programs) so that the future occurrence of subsidence is minimized or abated in this area. The development of the *Subsidence Management Plan for Northwest MZ-1* will also include the evaluation of the minimum recharge quantity of supplemental water in MZ-1 as called for in Section 8.4 of the Peace II Agreement.[6]

The Work Plan included tasks to construct, calibrate, and use one-dimensional aquifer-system compaction models in Northwest MZ-1 (1D Models) to:

- Assist in understanding the mechanisms behind the ongoing subsidence in Northwest MZ-1
- Assist in the development of the *Subsidence Management Plan for Northwest MZ-1*.

The Work Plan envisioned the use of the 1D Models to update the Watermaster's three-dimensional groundwater-flow model so it could simulate aquifer-system compaction and then be used to develop the Subsidence Management Plan for Northwest MZ-1. However, the GLMC has decided to use the 1D Models directly to develop the Subsidence Management Plan for Northwest MZ-1.

In 2021 and 2022, the Watermaster Engineer constructed and calibrated the 1D Models and published a technical memorandum to document the results.[7] The GLMC has advised the Watermaster that the 1D Models are sufficiently calibrated to be used to estimate the future occurrence of land subsidence in Northwest MZ-1, and therefore, can be used to help develop the *Subsidence Management Plan for Northwest MZ-1*.

The next step is to use the 1D Models to project the future magnitude of land subsidence in Northwest MZ-1 under various "Subsidence Management Alternatives." The first Subsidence Management Alternative (SMA-1) represents the recent plans of the Chino Basin Parties for groundwater management over a defined planning horizon (e.g., pumping, recharge, use of managed storage, etc.). The need to develop additional Subsidence Management Alternatives for 1D Model simulations will be based on the 1D Model results of prior alternatives. Each new Subsidence Management Alternative must be reviewed and approved by the GLMC before model simulations are conducted.

The objective of this memorandum is to describe the assumptions of SMA-1 for review and approval by the GLMC.

TECHNICAL APPROACH AND METHODS

This section describes the technical approach and methods that will be employed to achieve the objectives of this investigation.

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[6] See Section 8.4 of the *Final_Peace_II_Documents.pdf (cbwm.org)*

[7] West Yost Associates. 2022. *Construction and Calibration of One-Dimensional Compaction Models in the Northwest MZ-1 Area of the Chino Basin*. Prepared for the Chino Basin Watermaster. December 2022.

The primary question that needs to be answered to develop a *Subsidence Management Plan for Northwest MZ-1* is: What groundwater levels and groundwater management activities need to occur to minimize or abate the future occurrence of land subsidence in Northwest MZ-1 over the planning horizon? To help answer this question, the following steps are proposed:

1. **Develop SMA-1 with review and approval of the GLMC**. SMA-1 will represent the recent plans of the Chino Basin parties for pumping, recharge, and the use of managed storage over a defined planning horizon. SMA-1 must be approved by the GLMC before being used in this effort.
2. **Simulate the hydrologic response of the Chino Basin to SMA-1 by aquifer layer**. The existing numerical groundwater-flow model of the Chino Basin (referred to as the Chino Valley Model [CVM]) is used to simulate the hydrologic response of the Chino Basin to SMA-1. The CVM is a five-layer model, so it can predict the hydraulic heads in each model layer under the projected pumping and recharge stresses over the planning horizon.
3. **Simulate the land subsidence that is predicted to occur in Northwest MZ-1 under SMA-1**. The hydraulic heads of SMA-1, as simulated by the CVM in each model layer, are used as input data for the 1D Models. The output of the 1D Models represents the vertical aquifer-system compaction (and hence, the land subsidence) that is predicted to occur in Northwest MZ-1 under SMA-1. The output is described in terms of the rates, duration, and magnitude of vertical deformation of the aquifer sediments that is predicted to occur at the 1D Model locations over the planning horizon. Through analysis of the 1D Model output data, a determination must be made by the GLMC as to the "acceptableness" of the predicted land subsidence.
4. **Evaluate model results and develop recommendations**. The GLMC will evaluate the projected hydraulic heads versus the projected compaction as simulated by the 1D Models, and then make the following determinations and/or recommendations:
    a. Determine acceptable thresholds for projected land subsidence based on the simulation results.
    b. Recommend "subsidence management strategies" for Northwest MZ-1. These recommended strategies may come in the form of:
        i. Recommended operating ranges for hydraulic heads by aquifer layer.
        ii. Recommended groundwater management practices, such as pumping, recharge, the use of local storage, and/or the design of Storage and Recovery Programs.
    c. Recommend the minimum recharge quantity of supplemental water in MZ-1.
    d. Consider recommending additional work, such as developing additional SMAs, performing CVM and 1D Model simulations of the additional SMAs, and making revised determinations and/or recommendations based on the model results (*i.e.,* 4.a. through 4.c. above). Any additional SMAs must be approved by the GLMC before taking the next step to simulate the SMA with the CVM and the 1D Models.
5. **Repeat methods to develop the Subsidence Management Plan for Northwest MZ-1**. The methods above are repeated until GLMC is satisfied that enough information has been generated to develop the *Subsidence Management Plan for Northwest MZ-1*.

SUBSIDENCE MANAGEMENT ALTERNATIVE #1

SMA-1 is equivalent to the planning scenario that was simulated to support the 2020 Safe Yield Recalculation (2020 SYR)[8] using the 2020 CVM. The 2020 SYR was intended to represent and simulate the Parties' projected pumping, recharge, and use of storage through 2050. This scenario spanned from fiscal year (FY) 2018 through 2050 and included the cultural conditions (e.g., land use, water supply plans) that were assumed based on the best-available planning data at the time of the 2020 SYR.[9] An advantage of using 2020 SYR as the planning scenario for SMA-1 is that the CVM modeling is complete and the simulated hydraulic heads by model layer are readily available for use as input data for the 1D Models.

The remainder of this section describes the pumping and recharge assumptions of 2020 SYR (*i.e.,* SMA-1) and the CVM output, which is the simulated hydrologic response of the aquifer system to SMA-1.

Pumping Projections

The Parties' projected pumping and use of managed storage is based on planning data collected from the Parties. The Parties provided projections of monthly groundwater pumping and other water supplies, the use of current and projected wells including a prioritization of use, and the future use of their local storage accounts. These projections were used to develop monthly pumping projections by well in the Chino Basin for 2018-2050.

Table 1 shows the projected pumping by well for the three Appropriative Pool parties with wells near Northwest MZ-1 for 2018-2050: Monte Vista Water District (MVWD), City of Pomona (Pomona), and Golden State Water Company (GSWC). Projected pumping of the three parties reaches 18,650 afy in FY 2040 and stays constant through FY 2050.

Managed Recharge Projections

Recharge components in the Chino Basin primarily include (i) subsurface inflow from adjacent groundwater basins and bedrock, (ii) deep infiltration of precipitation and applied water, (iii) streambed infiltration, and (iv) managed aquifer recharge. Managed aquifer recharge includes the recharge of stormwater, recycled water, and imported water in the Chino Basin via spreading basins or Aquifer Storage and Recovery (ASR) wells.

Table 2 shows the projected managed aquifer recharge at the recharge basins located within or directly upgradient of Northwest MZ-1. Projected stormwater recharge was based on the CVM's surface-water model simulations, which included planned improvements developed during and after the 2013 Recharge Master Plan Update that were assumed to be operational in FY 2023. Projected recycled water recharge at spreading basins were estimates provided by the Inland Empire Utilities Agency (IEUA). Projected imported water recharge were estimates based on the requirement to satisfy a portion of the Parties' replenishment obligations when aggregate production exceeds aggregate production rights. Projected managed aquifer recharge in Northwest MZ-1 reaches about 7,000 afy in FY 2040 and stays constant through FY 2050.

[8] West Yost Associates. 2020. *2020 Safe Yield Recalculation*. Prepared for the Chino Basin Watermaster. May 2020.

[9] Refer to Section 7.3 of the 2020 SYR report for more detail on the pumping and recharge projections.

Hydrologic Response of the Aquifer System to SMA-1

SMA-1 was simulated for the 2020 SYR from FY 2018 through 2050. Figures 2, 3, and 4 are maps of the Chino Basin that illustrate the changes in hydraulic heads from FY 2018 to FY 2050 in CVM Layers 1, 3, and 5, respectively:

- Figure 2 shows that heads in Layer 1 are projected to decline by up to 25 feet across Northwest MZ-1. At the 1D Model locations, heads are projected to increase in Layer 1 by about 13 to 15 feet.
- Figure 3 shows that heads in Layer 3 are projected to increase by up to 40 feet in the western portion of Northwest MZ-1 and decrease by up to 30 feet in the eastern portion of Northwest MZ-1. At the 1D Model locations, heads are projected to increase by about 10 feet near PX and decrease by about 10 feet near MVWD 28.
- Figure 4 shows that heads in Layer 5 are projected to increase by up to 40 feet across most of Northwest MZ-1. At the 1D Model locations, heads are projected to increase by about 25 feet near PX and increase by about 40 feet near MVWD 28.

Figures 5 and 6 are time-series charts of hydraulic heads in CVM model layers 1, 3, and 5 at the PX and MVWD 28 locations, respectively. These charts indicate the following changes in hydraulic heads from 2018 to 2050:

- In Layers 1 and 3, heads at the PX and MVWD-28 locations are projected to decline at a gradual rate starting in 2019 with total declines of up to 17 ft by 2050. These declines in heads are generally due to a projected increase in pumping from 2018 through 2050 across the Chino Basin.
- In layer 5, heads at the PX and MVWD-28 locations increase immediately and significantly at the start of the projection. This immediate increase in heads is due to less projected pumping at several wells in Northwest MZ-1 that are screened across Layer 5. However, by 2030 heads begin to gradually decline through 2050, but remain above their initial 2019 heads.

Recommendations and Next Steps

The GLMC should review this memorandum and come prepared to discuss at the next GLMC meeting scheduled for March 2, 2023 at 9am at Watermaster offices. Written comments and suggested revisions to SMA-1 and this memorandum are due to Andy Malone (amalone@westyost.com), Edgar Tellez-Foster (etellezfoster@cbwm.org), and David Huynh (dhuynh@cbwm.org) by March 24, 2023.

Once the SMA-1 is approved by the GLMC, West Yost will perform the 1D Model simulation of SMA-1 and document the 1D Model results in a TM for GLMC review. In its review, the GLMC will evaluate the projected hydraulic heads versus the projected compaction as simulated by the 1D Models, and then make the following determinations and/or recommendations:

a. Determine acceptable thresholds for projected land subsidence based on the simulation results.

b. Recommend "subsidence management strategies" for Northwest MZ-1. These recommended strategies can be considered a preliminary or draft *Subsidence Management Plan for Northwest MZ-1*, and may come in the form of:

i. Recommended operating ranges for hydraulic heads by aquifer layer.

ii. Recommended groundwater management practices, such as pumping, recharge, the use of local storage, and/or the design of Storage and Recovery Programs.

c. Recommend the minimum recharge quantity of supplemental water in MZ-1.

d. Consider recommending additional work, such as developing additional SMAs, performing CVM and 1D Model simulations of the additional SMAs, and making revised determinations and/or recommendations based on the model results (*i.e.,* 4.a. through 4.c. above). Any additional SMAs must be approved by the GLMC before simulating the SMA with the CVM and the 1D Models.

Other Related Recommendations

1. **Construct and Calibrate Additional 1D Models Across Western Chino Basin**. Quantifying the risk of future land subsidence resulting from future pumping and recharge behavior is one of the criteria upon which the potential for Material Physical Injury (MPI) is evaluated in the Chino Basin. 1D Models of aquifer-system compaction are likely the most appropriate tools to evaluate for MPI due to land subsidence. Therefore, the GLMC should consider recommending to the Watermaster the use of 1D Models to evaluate subsidence-related MPI in future groundwater modeling studies, such as the forthcoming reevaluation of the Safe Yield of the Chino Basin (2025 SYR). Such a recommendation may include:

    - Verifying and/or recalibrating the 1D Model that was prepared by the GLMC in the Managed Area at the Ayala Park Extensometer.
    - Constructing and calibrating additional 1D Models in other Areas of Subsidence Concern, such as the Southeast Area around the Chino Desalter well fields and in the Northeast Area (City of Ontario).
    - Determining "subsidence thresholds" that, if exceeded, would represent MPI.

2. **Provide Advice in the Development of the 2025 SYR Scenarios**. The forthcoming 2025 SYR will involve the development of multiple projection scenarios of future hydrology, pumping, managed recharge, and use of managed storage in the Chino Basin. These projection scenarios will be simulated with an updated CVM. The CVM results will be evaluated for MPI and then used to evaluate the current Safe Yield of the Chino Basin. The GLMC should advise the development of the 2025 SYR scenarios, and then use 1D Models to simulate the land subsidence. These CVM and 1D Model results could be used by the GLMC and Watermaster to:

    a. Evaluate for the potential for subsidence-related MPI associated with the Safe Yield estimates.

    b. Evaluate for the minimum recharge quantity of supplemental water in MZ-1 as required by the Peace II Agreement.

    Providing GLMC advice on the projection scenarios should be conducted in conjunction with the 2025 SYR and can be discussed at regularly scheduled GLMC meetings. The evaluations for MPI

and for the minimum recharge quantity of supplemental water in MZ-1 would likely be conducted in FY 2024/25.

Table 1. Projected Pumping at Wells in Northwest MZ-1 for Subsidence Management Alternative #1

Well Name	Well Owner	Well Layers	Historical Pumping FY 2010-18 (afy)	Annual Projected Pumping by Fiscal Year[1] (af)																				
				2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
2	Pomona	1	1,362	0	1,190	1,190	1,190	1,200	1,200	1,200	1,200	1,200	1,210	1,210	1,210	1,210	1,220	1,210	1,220	1,220	1,220	1,220	1,220	1,220	1,220
5B	Pomona	1,3	725	500	850	850	850	850	850	850	850	850	860	860	860	860	860	860	860	860	870	860	860	860	870
6	Pomona	1,3	101	640	900	890	900	900	900	900	900	900	910	910	910	910	910	910	910	910	920	910	910	910	920
10	Pomona	1,3	1,258	1,130	1,000	990	1,000	1,000	1,000	1,000	1,000	1,000	1,010	1,010	1,010	1,010	1,010	1,010	1,010	1,020	1,020	1,020	1,020	1,020	1,020
15	Pomona	1	355	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Pomona	1	353	550	850	850	850	850	850	850	850	850	860	860	860	860	860	860	860	860	870	860	860	860	870
17	Pomona	1,3	235	420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Pomona	1	649	340	800	800	800	800	800	800	800	800	810	810	810	810	810	810	810	810	810	810	810	810	810
23	Pomona	1,3	864	410	900	890	900	900	900	900	900	900	910	910	910	910	910	910	910	910	920	910	910	910	920
25	Pomona	1,3	1,541	1,540	1,090	1,090	1,100	1,100	1,100	1,100	1,100	1,100	1,110	1,110	1,110	1,110	1,110	1,110	1,120	1,120	1,120	1,120	1,120	1,120	1,120
26	Pomona	1,3	569	270	500	500	500	500	500	500	500	500	500	500	500	500	510	510	510	510	510	510	510	510	510
27	Pomona	1,3	525	1,250	800	800	800	800	800	800	800	800	810	810	810	810	810	810	810	810	810	810	810	810	810
29	Pomona	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Pomona	1,3	1,296	1,490	1,190	1,190	1,190	1,200	1,200	1,200	1,200	1,200	1,210	1,210	1,210	1,210	1,220	1,210	1,220	1,220	1,220	1,220	1,220	1,220	1,220
35	Pomona	1,3	7	0	500	500	500	500	500	500	500	500	500	500	500	500	510	510	510	510	510	510	510	510	510
36	Pomona	1,3	1,007	730	800	800	800	800	800	800	800	800	800	810	810	810	810	810	810	810	810	810	810	810	810
Margarita #1	GSWC	1	447	530	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370	370
4	MVWD	1	247	290	190	190	180	180	180	180	180	180	180	180	180	190	190	190	190	190	190	190	190	190	190
5	MVWD	1,3	1,084	1,020	660	650	650	640	640	640	640	640	640	650	650	650	650	650	650	660	660	660	660	660	670
10	MVWD	1,3	165	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	MVWD	1,3,5	1,997	2,480	800	790	790	780	780	770	780	780	780	780	790	790	790	790	800	800	800	800	800	810	810
26	MVWD	1,3,5	1,789	1,330	890	880	880	870	870	860	870	870	870	880	880	880	890	890	890	890	900	900	900	900	910
27	MVWD	1,3,5	384	370	100	100	90	90	80	80	80	80	90	90	90	100	100	100	110	110	110	110	120	120	120
28	MVWD	1,3,5	2,129	1,540	870	860	860	850	850	840	840	850	850	850	860	860	860	860	870	870	870	870	880	880	880
30	MVWD	1,3,5	182	330	100	100	90	90	80	80	80	80	90	90	90	100	100	100	110	110	110	110	120	120	120
31	MVWD	1,3,5	967	370	940	930	920	920	920	910	910	920	920	920	920	930	930	930	940	940	940	940	950	950	950
32	MVWD	1,3,5	495	310	100	100	90	90	80	80	80	80	90	90	90	100	100	100	110	110	110	110	120	120	120
33	MVWD	1,3,5	659	0	940	930	920	920	920	910	910	920	920	920	920	930	930	930	940	940	940	940	950	950	950
34	MVWD	1,3,5	244	0	940	930	920	920	920	910	910	920	920	920	920	930	930	930	940	940	940	940	950	950	950
Subtotal from Layers 1 and 3			*12,790*	*11,110*	*12,590*	*12,550*	*12,580*	*12,590*	*12,590*	*12,590*	*12,590*	*12,590*	*12,700*	*12,710*	*12,710*	*12,720*	*12,760*	*12,740*	*12,770*	*12,790*	*12,830*	*12,790*	*12,790*	*12,790*	*12,840*
Subtotal from Layers 1, 3, and 5			*8,845*	*6,730*	*5,680*	*5,620*	*5,560*	*5,530*	*5,500*	*5,440*	*5,460*	*5,500*	*5,530*	*5,540*	*5,560*	*5,620*	*5,630*	*5,630*	*5,710*	*5,710*	*5,720*	*5,720*	*5,790*	*5,800*	*5,810*
Total			**21,635**	**17,840**	**18,270**	**18,170**	**18,140**	**18,120**	**18,090**	**18,030**	**18,050**	**18,090**	**18,230**	**18,250**	**18,270**	**18,340**	**18,390**	**18,370**	**18,480**	**18,500**	**18,550**	**18,510**	**18,580**	**18,590**	**18,650**

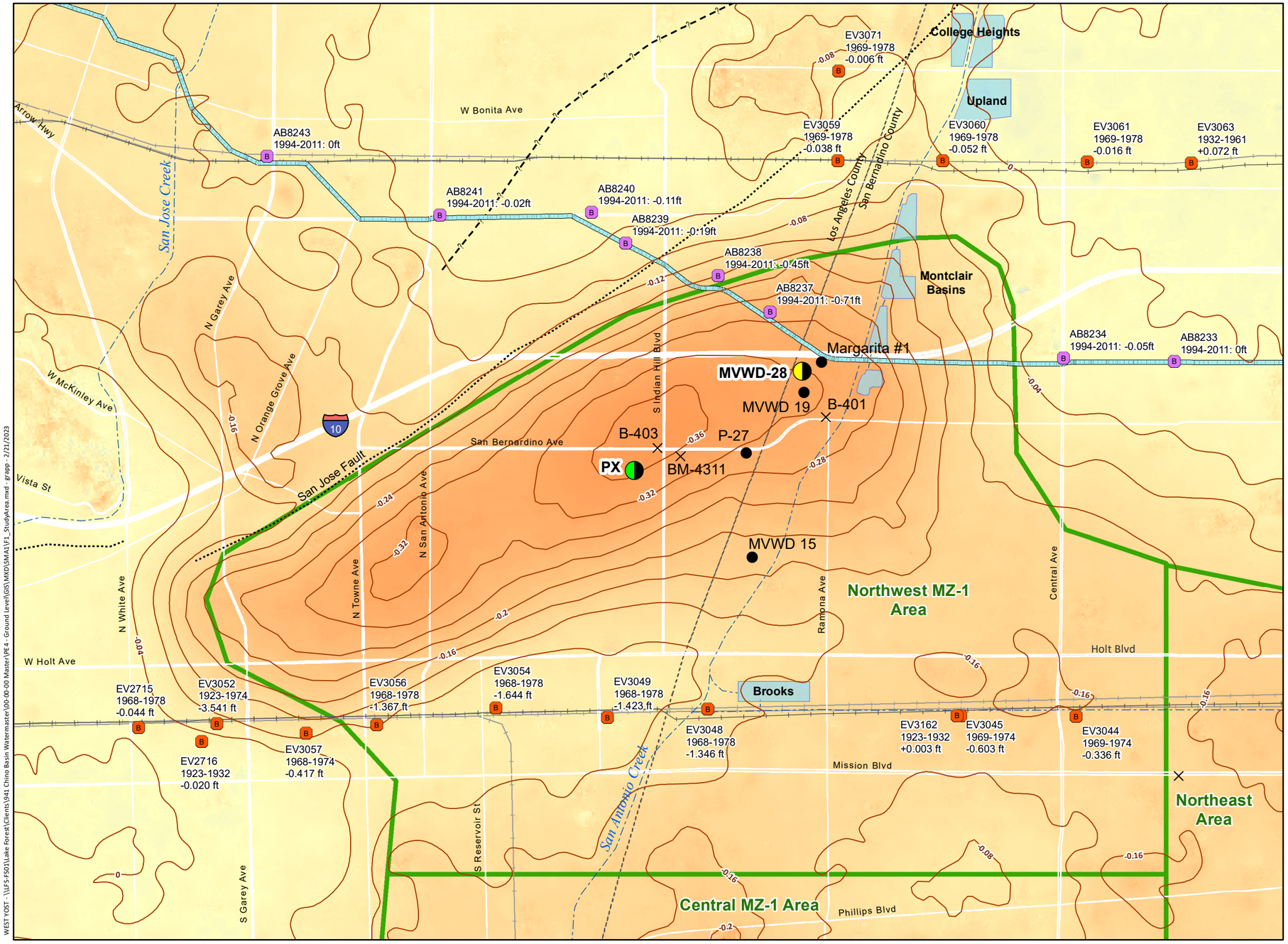
[1] Annual pumping is constant after FY 2040.

Table 2. Projected Managed Recharge Near Northwest MZ-1 for the Baseline Management Alternative

Managed Recharge Type	Historical Recharge FY 2010-18 (afy)	Annual Projected Recharge Volume Near Northwest MZ-1 by Fiscal Year[1,2] (af)																						
		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Stormwater	1,528	2,520	2,500	2,520	2,620	2,610	2,590	2,610	2,610	2,610	2,590	2,610	2,610	2,610	2,590	2,610	2,610	2,610	2,590	2,610	2,610	2,610	2,580	2,600
Recycled Water	1,177	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650	1,650
Imported Water	6,748	0	0	0	0	0	0	0	0	10	150	350	510	320	760	1,200	1,630	2,060	2,380	2,690	3,010	3,330	3,550	2,810
Total	**9,453**	**4,170**	**4,150**	**4,170**	**4,270**	**4,260**	**4,240**	**4,260**	**4,260**	**4,270**	**4,390**	**4,610**	**4,770**	**4,580**	**5,000**	**5,460**	**5,890**	**6,320**	**6,620**	**6,950**	**7,270**	**7,590**	**7,780**	**7,060**

[1] Tabulated recharge includes recharge in College Heights Basins, Upland Basin, Montclair Basins, Brooks Basin, and MVWD ASR wells. No imported water recharge is projected to occur via ASR wells.

[2] Annual managed recharge is constant from FY 2041 through FY 2050.



1D Model Locations

- MVWD-28
- PX

Land Subsidence Features

+0.55 ft
0 ft
-0.55 ft

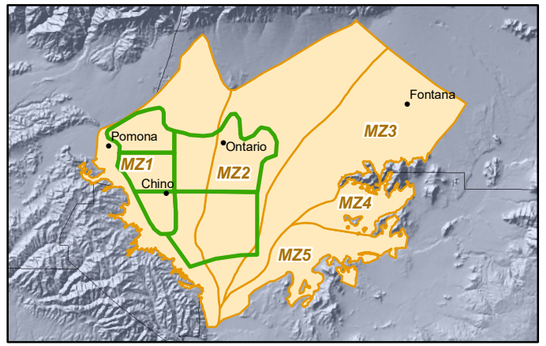
Relative Change in Land Surface Elevation as Estimated by InSAR *(March 2011 to March 2022)*

-1:0- Contours of Relative Change in Land Surface Elevation as Estimated by InSAR *(March 2011 to March 2022)*

- Benchmark used for 1D Model Calibration
- NGS Benchmarks
- MWD Benchmarks

Other Features

- Well with Historical Measured Heads
- Recharge Basin
- Areas of Subsidence Concern
- Fault (dotted where concealed; queried where uncertain)
- MWD Upper Feeder
- Railroads



Prepared by:

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Water. Engineered.

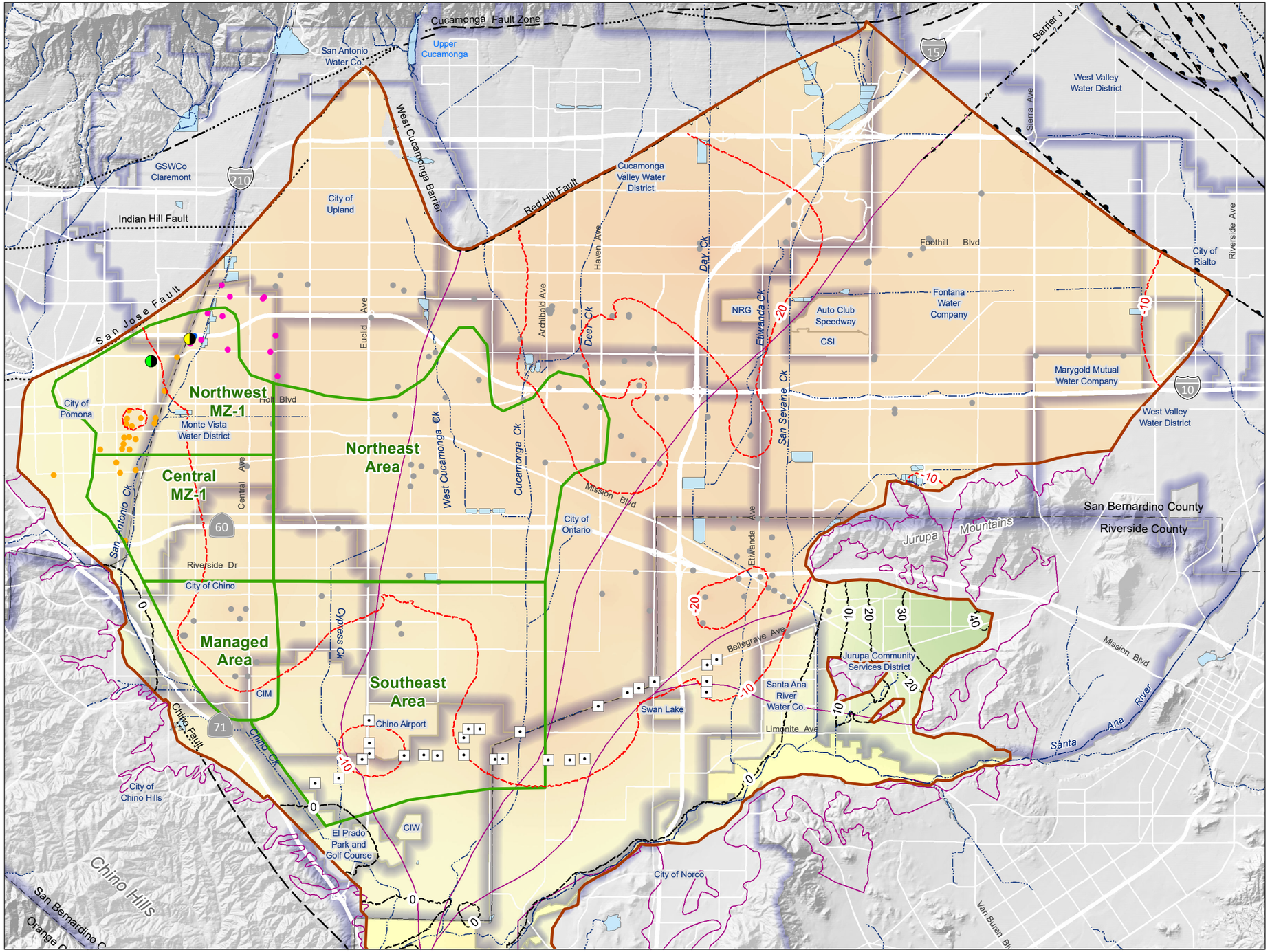
0 1 2 Miles
0 2 4 Km

Draft

Figure 1

Locations of PX and MVWD-28 1D Models and Historical Elevation Surveys at Benchmarks

Chino Basin Watermaster
Ground-Level Monitoring Committee
Subsidence Management Plan for Northwest MZ-1



Contour of Difference in Hydraulic Head (ft)
Positive Change *July 2018 through June 2050 - SMA-1*

Contour of Difference in Hydraulic Head (ft)
Negative Change *July 2018 through June 2050 - SMA-1*

Difference in Hydraulic Head (ft)
July 2018 through June 2050 - SMA-1

100 — *Increasing*
0
-100 — *Decreasing*

1D Model Locations

- MVWD-28
- PX

Wells

- Monte Vista Water District
- City of Pomona
- Golden State Water Co.
- Other Appropriative Pool
- Chino Desalter Wells

Other Features

- Streams & Flood Control Channels
- Flood Control & Conservation Basins
- Areas of Subsidence Concern
- Water Service Area
- Chino Basin Part of the Active CVM MODFLOW Domain
- OBMP Management Zones

Prepared by:

WEST YOST

Author: GR
Date: 2/21/2023
File: Figure 2 SYR_2050-2018_L1.mxd

0 1 2 3 4 5 Miles
0 2 4 6 8 Km

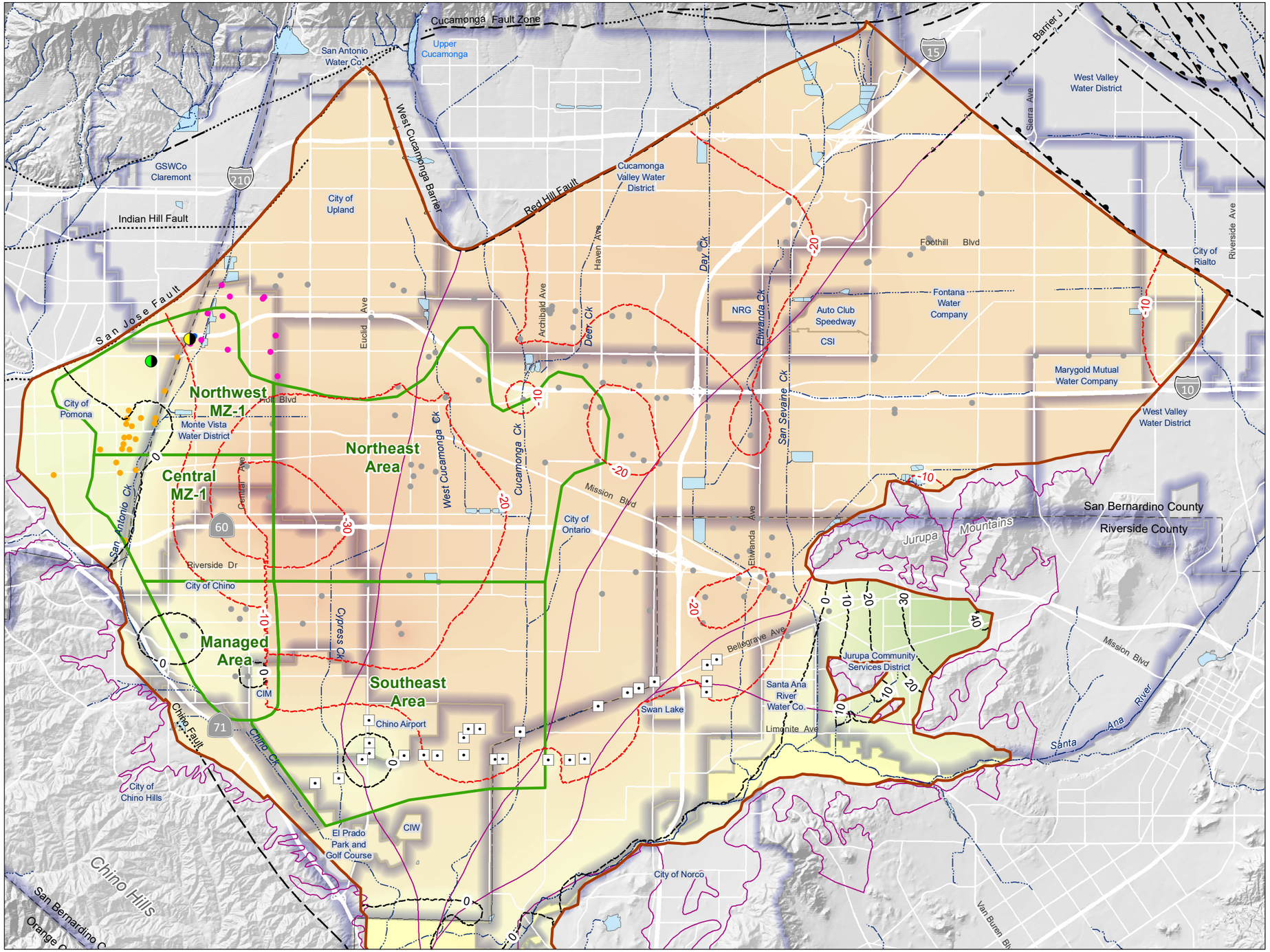
Prepared for:

Evaluation of Land Subsidence in Northwest MZ-1 under SMA-1

Projected Difference in Hydraulic Head for Layer 1
Subsidence Management Alternative #1
July 2018 through June 2050

Draft

Figure 2



Contour of Difference in Hydraulic Head (ft)
Positive Change *July 2018 through June 2050 - SMA-1*

Contour of Difference in Hydraulic Head (ft)
Negative Change *July 2018 through June 2050 - SMA-1*

Difference in Hydraulic Head (ft)
July 2018 through June 2050 - SMA-1

100 — *Increasing*
0
-100 — *Decreasing*

1D Model Locations

- MVWD-28
- PX

Wells

- Monte Vista Water District
- City of Pomona
- Golden State Water Co.
- Other Appropriative Pool
- Chino Desalter Wells

Other Features

- Streams & Flood Control Channels
- Flood Control & Conservation Basins
- Areas of Subsidence Concern
- Water Service Area
- Chino Basin Part of the Active CVM MODFLOW Domain
- OBMP Management Zones

Prepared by:

WEST YOST

Author: GR
Date: 2/21/2023
File: Figure 3 SYR_2050-2018_L3.mxd

0 1 2 3 4 5 Miles
0 2 4 6 8 Km

Prepared for:

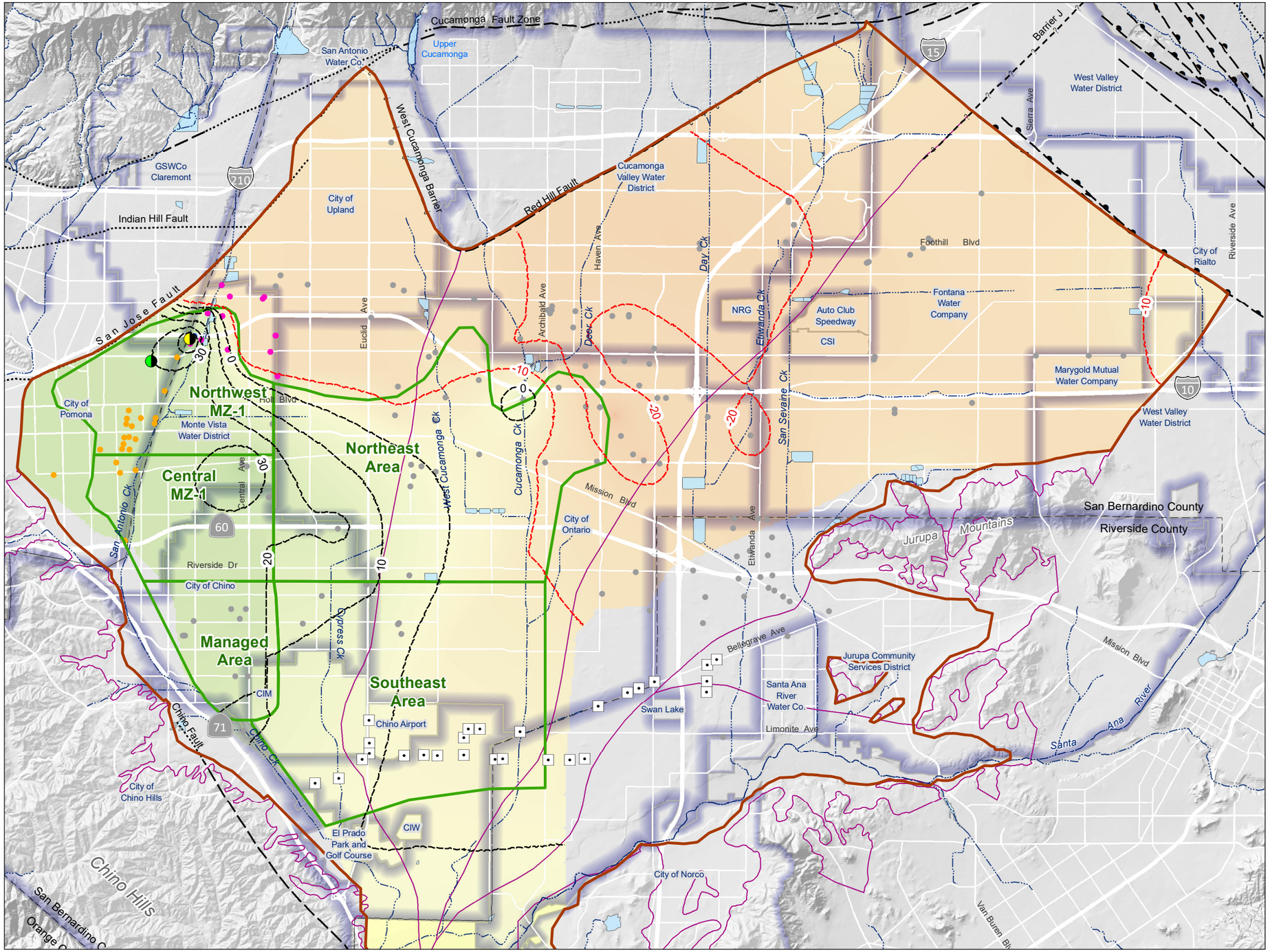
Evaluation of Land Subsidence in Northwest MZ-1 under the SMA-1

CHINO BASIN WATERMASTER — Partners in Basin Management

Projected Difference in Hydraulic Head for Layer 3
Subsidence Management Alternative #1
July 2018 through June 2050

Draft

Figure 3



Contour of Difference in Hydraulic Head (ft)
Positive Change *July 2018 through June 2050 - SMA-1*

Contour of Difference in Hydraulic Head (ft)
Negative Change *July 2018 through June 2050 - SMA-1*

Difference in Hydraulic Head (ft)
July 2018 through June 2050 - SMA-1

100 — *Increasing*
0
-100 — *Decreasing*

1D Model Locations

- MVWD-28
- PX

Wells

- Monte Vista Water District
- City of Pomona
- Golden State Water Co.
- Other Appropriative Pool
- Chino Desalter Wells

Other Features

- Streams & Flood Control Channels
- Flood Control & Conservation Basins
- Areas of Subsidence Concern
- Water Service Area
- Chino Basin Part of the Active CVM MODFLOW Domain
- OBMP Management Zones

Prepared by:

WEST YOST

Author: GR
Date: 2/21/2023
File: Figure 4 SYR_2050-2018_L5.mxd

0 1 2 3 4 5 Miles
0 2 4 6 8 Km

Prepared for:

Evaluation of Land Subsidence in Northwest MZ-1 under SMA-1

Projected Difference in Hydraulic Head for Layer 5
Subsidence Management Alternative #1
July 2018 through June 2050

Draft

Figure 4

Figure 5. Simulated Heads at the PX Site under SMA-1

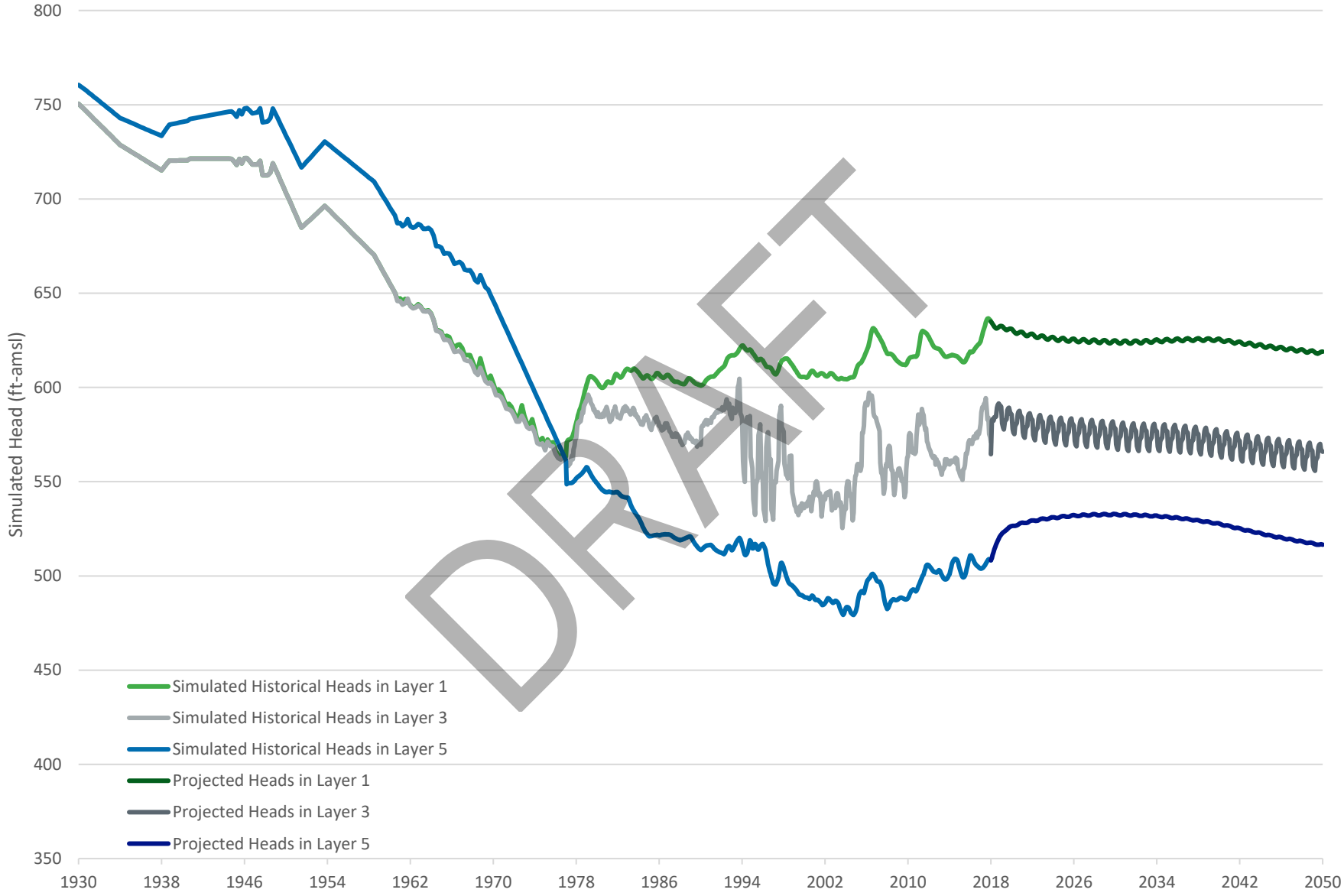


Figure 6. Simulated Heads at MVWD 28 under SMA-1