

## TECHNICAL MEMORANDUM

DATE: February 24, 2022 Project No.: 941-80-20-22  
SENT VIA: EMAIL

TO: Ground-Level Monitoring Committee

FROM: Andy Malone and Austin Poncelet

REVIEWED BY: Andy Malone

SUBJECT: Recommended Scope of Work and Budget of the Ground-Level Monitoring Committee for Fiscal Year 2022/23 (Draft)

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### BACKGROUND AND PURPOSE

Pursuant to the Optimum Basin Management Program Implementation Plan and the Peace Agreement, the Chino Basin Watermaster (Watermaster) implements a Subsidence Management Plan (SMP) for the Chino Basin to minimize or stop the occurrence of land subsidence and ground fissuring. The Court approved the SMP and ordered its implementation in November 2007 (2007 SMP). The 2007 SMP was updated in 2015 (2015 SMP) and can be downloaded from the Watermaster [website](#). The SMP outlines a program of monitoring, data analysis, and annual reporting. A key element of the SMP is its adaptive nature—Watermaster can adjust the SMP as warranted by the data.

The Watermaster Engineer, with the guidance of the Ground-Level Monitoring Committee (GLMC), prepares annual reports which include the results of the monitoring program, interpretations of the data, recommendations for the Ground-Level Monitoring Program (GLMP) for the following fiscal year (FY), and recommendations for adjustments to the SMP, if any.

This Technical Memorandum (TM) describes the Watermaster Engineer's recommended activities for the GLMP for FY 2022/23 in the form of a proposed scope of services and budget.

Members of the GLMC are asked to:

- Review this TM prior to March 3, 2022.
- Attend a meeting of the GLMC at 9:00 am on March 3, 2022 to discuss the proposed scope of services and budget for FY 2022/23.
- Submit comments and suggested revisions on the proposed scope of services and budget for FY 2022/23 to the Watermaster by March 25, 2022.
- Attend a meeting of the GLMC at 9:00 am on March 31, 2022 to discuss comments and revisions to the proposed scope of services and budget for FY 2022/23 (if necessary).

- Submit additional comments and suggested revisions on the proposed scope of services and budget for FY 2022/23 to the Watermaster by April 8, 2022.

The final scope of services and budget that is recommended by the GLMC will be included in the Watermaster's FY 2022/23 budget. The final scope of services, budget, and schedule for FY 2022/23 will be included in Section 4 of the *2021/22 Annual Report of the GLMC*.

## **RECOMMENDED SCOPE OF SERVICES AND BUDGET – FY 2022/23**

A proposed scope of services for the GLMP for FY 2022/23 is shown in Table 1 as a line-item cost estimate. The proposed scope of services is summarized below.

### **Task 1. Setup and Maintenance of the Monitoring Network**

The Chino Basin extensometer facilities are key monitoring facilities for the GLMP. They require regular and as-needed maintenance and calibration to remain in good working order and to ensure the recording of accurate measurements.

#### ***Task 1.1. Maintain Extensometer Facilities***

This subtask includes performing monthly visits to the Ayala Park, Chino Creek, and Pomona extensometer facilities to ensure functionality and calibration of the monitoring equipment and data loggers.

#### ***Task 1.2. Annual Lease Fees for the Chino Creek Extensometer Site***

The County of San Bernardino (County) owns the land the Chino Creek extensometer facility is located on. As such, the Watermaster entered into a lease agreement with the County in 2012 and pays the County an annual rental payment of \$1,596.

### **Task 2. Aquifer-System Monitoring and Testing**

This task involves the collection and compilation of hydraulic head and aquifer-system deformation data from the Ayala Park, Chino Creek, and Pomona extensometer facilities.

#### ***Task 2.1. Conduct Quarterly Data Collection from Extensometers; Data Checking and Management***

This subtask involves the routine quarterly collection and checking of data from the extensometer facilities. Quarterly data collection is necessary to ensure that the monitoring equipment is in good working order and to minimize the risk of losing data because of equipment malfunction. For this subtask, the complete extensometer records from the Ayala Park, Chino Creek, and Pomona extensometer facilities will be loaded to HydroDaVE<sup>SM</sup> (Hydrologic Database and Visual Explanations) and checked. Both hydraulic head and aquifer-system data from the extensometer facilities will be loaded and checked to HydroDaVE on a quarterly basis.

Table 1. Work Breakdown Structure and Cost Estimates for the Ground-Level Monitoring Program: FY 2022/23

Task Description	Labor (days)		Other Direct Costs						Totals					
	Person Days	Total	Travel	New Equip.	Equip. Rental	Outside Pro	Misc.	Total	Totals by Task	Recommended Budget 2022/23	Approved Budget 2021/22	Net Change from 2021/22	Potential Carry-Over 2022/23	Budget with Carry-Over 2022/23
										a	b	a - b	c	a - c
<b>Task 1. Setup and Maintenance of the Monitoring Network</b>		<b>\$28,082</b>						<b>\$7,388</b>	<b>\$35,470</b>	<b>\$35,470</b>	<b>\$33,596</b>	<b>\$1,874</b>	<b>\$0</b>	<b>\$35,470</b>
1.1 Maintain Extensometer Facilities														
1.1.1 Routine maintenance of Ayala Park, Chino Creek, and Pomona extensometer facilities	14	\$20,922	\$1,056	\$250	\$152			\$1,458	\$22,380	\$22,380	\$21,282	\$1,098	\$0	\$22,380
1.1.2 Replacement/repair of equipment at extensometer facilities	4	\$7,160	\$264	\$2,000	\$70	\$2,000		\$4,334	\$11,494	\$11,494	\$10,718	\$776	\$0	\$11,494
1.2 Annual Lease Fees for the Chino Creek extensometer facility	0	\$0						\$1,596	\$1,596	\$1,596	\$1,596	\$0	\$0	\$1,596
<b>Task 2. MZ-1: Aquifer-System Monitoring and Testing</b>		<b>\$30,007</b>						<b>\$680</b>	<b>\$30,687</b>	<b>\$30,687</b>	<b>\$31,416</b>	<b>-\$729</b>	<b>\$0</b>	<b>\$30,687</b>
2.1 Conduct Quarterly Data Collection from Extensometers; Data Checking and Management														
2.1.1 Download data from the Ayala Park Extensometer facility	2	\$2,753	\$230		\$76			\$306	\$3,059	\$3,059	\$2,993	\$66	\$0	\$3,059
2.1.2 Download data from the Chino Creek Extensometer facility	2	\$2,753	\$26					\$26	\$2,778	\$2,778	\$2,713	\$66	\$0	\$2,778
2.1.3 Download data from Pomona Extensometer facility	4	\$5,505	\$272		\$76			\$348	\$5,853	\$5,853	\$5,722	\$131	\$0	\$5,853
2.1.4 Process, check, and upload data to database	12	\$18,997						\$0	\$18,997	\$18,997	\$19,988	-\$991	\$0	\$18,997
<b>Task 3. Basin Wide Ground-Level Monitoring Program (InSAR)</b>		<b>\$5,472</b>						<b>\$85,000</b>	<b>\$90,472</b>	<b>\$90,472</b>	<b>\$90,116</b>	<b>\$356</b>	<b>\$0</b>	<b>\$90,472</b>
3.1 Acquire TerraSAR-X data and prepare interferograms for 2022/23	1	\$1,892				\$85,000		\$85,000	\$86,892	\$86,892	\$86,845	\$47	\$0	\$86,892
3.2 Check and review InSAR results	2	\$3,580						\$0	\$3,580	\$3,580	\$3,271	\$309	\$0	\$3,580
<b>Task 4. Perform Ground-Level Surveys</b>		<b>\$7,434</b>						<b>\$30,807</b>	<b>\$38,241</b>	<b>\$38,241</b>	<b>\$93,982</b>	<b>-\$55,741</b>	<b>\$0</b>	<b>\$38,241</b>
4.1 Conduct Spring-2023 Elevation surveys in Northwest MZ-1	0.5	\$1,102				\$25,157		\$25,157	\$26,259	\$26,259	\$26,083	\$176	\$0	\$26,259
4.2 Conduct Spring-2023 Elevation Survey in the Northeast Area	0	\$0				\$47,069		\$0	\$0	\$0	\$0	\$0	\$0	\$0
4.3 Conduct Spring-2023 Elevation Survey in the Southeast Area	0	\$0				\$49,797		\$0	\$0	\$0	\$50,723	-\$50,723	\$0	\$0
4.4 Conduct Spring-2023 Elevation and EDM Surveys in the Managed Area/Fissure Zone	0	\$0				\$54,410		\$0	\$0	\$0	\$0	\$0	\$0	\$0
4.5 Replace Destroyed Benchmarks (if needed)	0	\$0				\$5,650		\$5,650	\$5,650	\$5,650	\$11,300	-\$5,650	\$0	\$5,650
4.6 Process, Check, and Update Database	4	\$6,332						\$0	\$6,332	\$6,332	\$5,877	\$456	\$0	\$6,332
<b>Task 5. Data Analysis and Reporting</b>		<b>\$85,760</b>						<b>\$2,129</b>	<b>\$87,888</b>	<b>\$87,888</b>	<b>\$85,586</b>	<b>\$2,303</b>	<b>\$0</b>	<b>\$87,888</b>
5.1 Prepare Draft 2021/22 Annual Report of the Ground-Level Monitoring Committee	20.5	\$34,124						\$0	\$34,124	\$34,124	\$33,286	\$838	\$0	\$34,124
5.2 Prepare Final 2021/22 Annual Report of the Ground-Level Monitoring Committee	10.5	\$19,993						\$0	\$19,993	\$19,993	\$19,546	\$446	\$0	\$19,993
5.3 Compile and Analyze Data from the 2022/23 Ground-Level Monitoring Program	14	\$21,643						\$0	\$21,643	\$21,643	\$21,144	\$500	\$0	\$21,643
5.4 Conduct Reconnaissance-Level Subsidence Investigation of the Northeast Area (southeast part)	0	\$10,000	\$129	\$2,000				\$2,129	\$12,129	\$12,129	\$11,610	\$519	\$0	\$12,129
<b>Task 6. Develop a Subsidence-Management Plan for Northwest MZ-1</b>		<b>\$165,404</b>						<b>\$138</b>	<b>\$165,541</b>	<b>\$165,541</b>	<b>\$238,644</b>	<b>-\$73,102</b>	<b>\$97,267</b>	<b>\$68,275</b>
6.1 Aquifer-System Monitoring														
6.1.1 Collect pumping and piezometric level data from agencies every two months; check and upload data to HDX	9.75	\$12,995						\$0	\$12,995	\$12,995	\$12,669	\$326	\$0	\$12,995
6.1.2 Prepare and analyze charts and data graphics of pumping and recharge (Northwest MZ-1), piezometric levels, and aquifer-system deformation from PX	8.25	\$12,208						\$0	\$12,208	\$12,208	\$11,913	\$295	\$0	\$12,208
6.3 Document the One-Dimensional (1D) Compaction Models at the MVWD-28 and PX Locations														
6.3.1 Prepare for and conduct a meeting to review the results of the 1D compaction models	0	\$0						\$0	\$0	\$0	\$8,842	-\$8,842	\$0	\$0
6.3.2 Review and respond to the GLMC comments on the 1D compaction models	0	\$0						\$0	\$0	\$0	\$6,140	-\$6,140	\$0	\$0
6.3.3 Prepare a draft TM summarizing the construction and calibration of the PX 1D compaction model and updates to the MVWD-28 1D compaction model and distribute to the GLMC	0	\$0						\$0	\$0	\$0	\$61,813	-\$61,813	\$0	\$0
6.3.4 Prepare for and conduct a GLMC meeting to receive feedback and comments on the draft TM	0	\$0						\$0	\$0	\$0				
6.3.5 Incorporate the GLMC comments and prepare a final technical memorandum	0.0	\$0						\$0	\$0	\$0				
6.4 Refine and Evaluate Subsidence-Management Alternatives														
6.4.1 Run the Baseline Management Alternative (BMA)	19	\$33,946						\$0	\$33,946	\$33,946				
6.4.2 Prepare a TM that summarizes the evaluation of the BMA and a recommended ISMA	10.75	\$19,871						\$0	\$19,871	\$19,871				
6.4.4 Meet with the GLMC to receive feedback on the TM	4.5	\$8,962	\$69					\$69	\$9,031	\$9,031				
6.4.5 Run the Initial Subsidence Management Alternative (ISMA)	25.75	\$48,047						\$0	\$48,047	\$48,047	\$137,267	\$3,072	\$97,267	\$43,072
6.4.6 Prepare a technical memorandum that summarizes the evaluation of the ISMA and a recommended Subsidence Management Alternative (SMA-2)	10.75	\$19,871						\$0	\$19,871	\$19,871				
6.4.7 Prepare for and conduct a meeting to receive feedback and comments on the draft technical memorandum	4.75	\$9,504	\$69					\$69	\$9,573	\$9,573				
<b>Task 7. Meetings and Administration</b>		<b>\$54,241</b>						<b>\$318</b>	<b>\$54,559</b>	<b>\$54,559</b>	<b>\$54,220</b>	<b>\$339</b>	<b>\$0</b>	<b>\$54,559</b>
7.1 Prepare for and Conduct Four Meetings of the Ground-Level Monitoring Committee	18	\$29,737	\$249					\$249	\$29,986	\$29,986	\$28,117	\$1,869	\$0	\$29,986
7.2 Prepare for and Conduct One As-Requested Ad-Hoc Meeting	3	\$4,956	\$69					\$69	\$5,025	\$5,025	\$6,024	-\$999	\$0	\$5,025
7.3 Perform Monthly Project Management	6	\$10,740						\$0	\$10,740	\$10,740	\$11,108	-\$369	\$0	\$10,740
7.4 Prepare a Recommended Scope and Budget for the GLMC for FY 2023/24	5.25	\$8,808						\$0	\$8,808	\$8,808	\$8,970	-\$162	\$0	\$8,808
<b>Totals</b>		<b>\$376,401</b>						<b>\$126,459</b>		<b>\$502,860</b>	<b>\$627,560</b>	<b>-\$124,700</b>	<b>\$97,267</b>	<b>\$405,593</b>

### Task 3. Basin-Wide Ground-Level Monitoring Program (InSAR)

This task involves the annual collection and analysis of Synthetic Aperture Radar (SAR) scenes to estimate the vertical ground motion across the western portion of Chino Basin from March 2022 to March 2023.

#### Task 3.1. Acquire TerraSAR-X SAR Data and Prepare Interferograms for 2021/22

In this subtask, five SAR scenes that will be acquired by the TerraSAR-X satellite from March 2022 to March 2023 are purchased from the German Aerospace Center. General Atomics (formerly Neva Ridge Technologies) will use the SAR scenes to prepare 12 interferograms that describe the incremental and cumulative vertical ground motion that occurred from March 2022 to March 2023 and since 2011. The associated costs for General Atomics to task, acquire, purchase, and process the InSAR data is as follows:

- Task TerraSAR-X for five acquisitions for the western Chino Basin (\$12,000)
- Purchase all TerraSAR-X data (\$17,000)
- Process the purchased TerraSAR-X data (\$56,000)

#### Task 3.2. Check and Review InSAR Results

In this subtask, the Watermaster Engineer reviews the InSAR results with General Atomics and performs checks for reasonableness and accuracy of the InSAR estimates of vertical ground motion across the western Chino Basin.

### Task 4. Perform Ground-Level Surveys

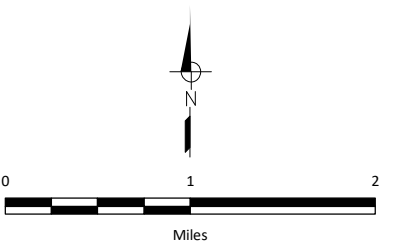
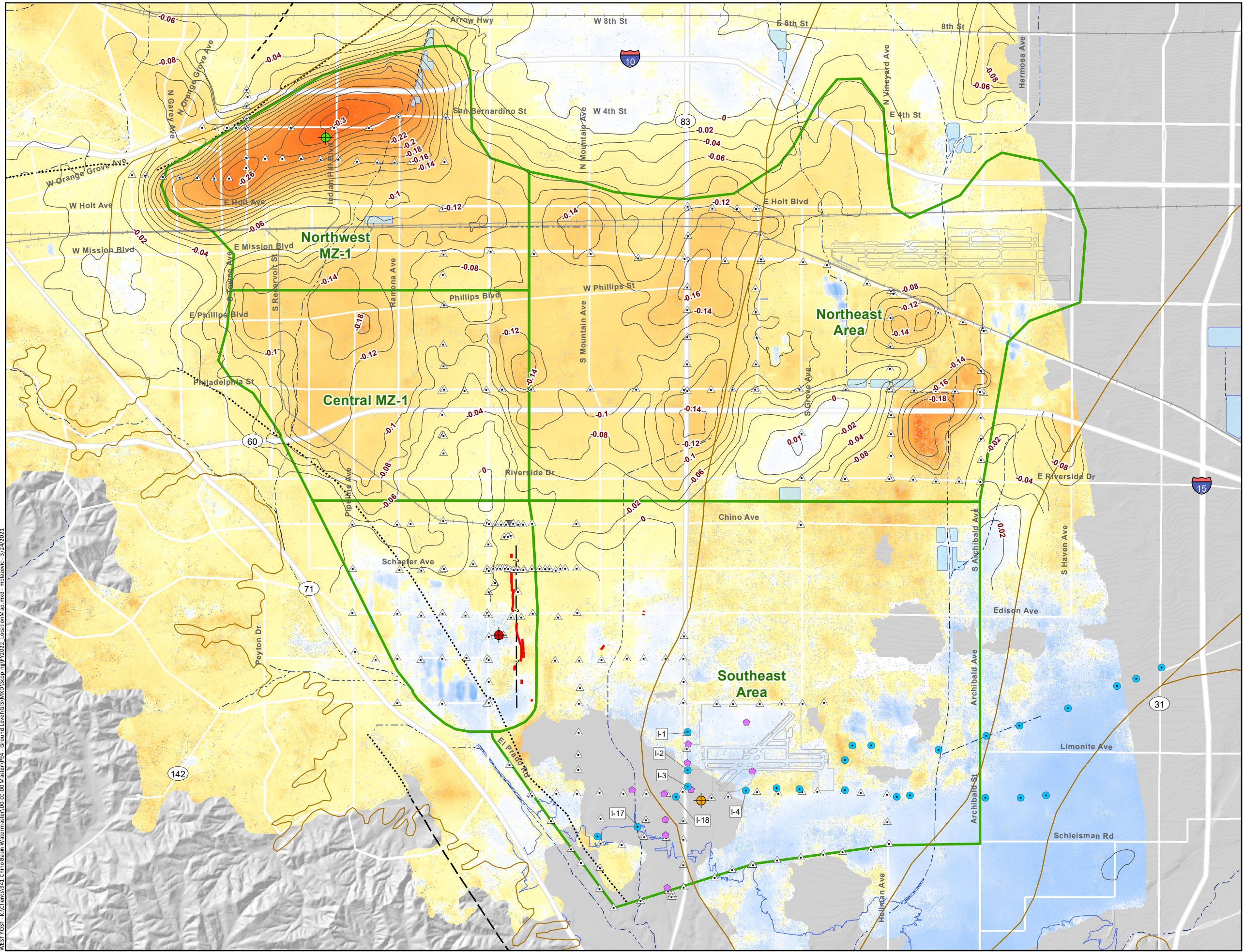
This task involves conducting elevation surveys at benchmark monuments across defined areas of western Chino Basin to estimate the vertical ground motion that occurred since the prior survey. Figure 1 shows the location of the benchmark monuments surveyed across the western Chino Basin. Electronic distance measurements (EDM surveys) are also performed periodically between monuments to estimate horizontal ground motion in areas where ground fissuring due to differential land subsidence is a concern.

Table 2 documents the areas surveyed over the last six years as part of the GLMP.

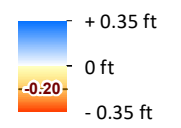
Ground-Level Survey Area	Ground-Level Survey Completed (Y/N)?					
	2017	2018	2019	2020	2021	2022 <sup>(b)</sup>
Managed Area	N	Y	N	N	N	N
Fissure Zone Area <sup>(a)</sup>	N	Y	N	N	N	N
Central Area	N	N	N	N	N	N
Northwest Area	Y	Y	Y	Y	Y	Y
San Jose Fault Zone Area <sup>(a)</sup>	Y	Y	Y	Y	Y	N
Southeast Area	Y	Y	N	N	N	Y
Northeast Area	N	Y	Y	Y	N	N

(a) Denotes EDM survey area (measurements of horizontal strain).  
 (b) The 2022 ground-level surveys are scheduled to begin in early March 2022.





Relative Change in Land Surface Altitude as Estimated by InSAR (March 2011 to March 2020)



- InSAR absent or incoherent
- Areas of Subsidence Concern
- Pomona Extensometer Facility
- Ayala Park Extensometer Facility
- Chino Creek Extensometer Facility
- Chino Desalter Authority Well
- SB County Proposed Extraction Well
- Ground-Level Survey Benchmark
- Ground Fissures
- Approximate Location of the Riley Barrier



**Figure 1**  
**Ground-Level Monitoring Program**  
**Fiscal Year 2021/22**  
 Chino Basin Watermaster  
 Ground-Level Monitoring Committee

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The ground-level surveys recommended for FY 2022/23 include the following Tasks:

#### ***Task 4.1. Conduct Spring-2023 Elevation surveys in Northwest MZ-1***

In this subtask, the surveyor conducts elevation and EDM surveys at the established benchmarks in Northwest MZ-1 in Spring 2022. The elevation survey will begin at the Pomona Extensometer Facility and includes benchmarks across Northwest MZ-1. The elevation survey will be referenced to a newly established elevation datum at the Pomona Extensometer.

*The vertical elevation survey is recommended in FY 2022/23 because of the recent subsidence that has occurred in Northwest MZ-1 and because the survey will support the development of a subsidence management plan in Northwest MZ-1. The EDM survey is **not** recommended to be performed across the San Jose fault zone because past surveys (2013-2021) have demonstrated that the horizontal strain measured between benchmark pairs appears to behave elastically. The EDM surveys should be conducted less frequently than annual (e.g., once every five years).*

#### ***Ground-Level Surveys Not Recommended for FY 2022/23***

Ground-level surveys are **not** recommended for FY 2022/23 include all other Areas of Subsidence Concern. This recommendation is justified because:

- InSAR is proving to be an accurate, more efficient, higher-resolution method to monitor vertical ground motion across the western Chino Basin.
- Hydraulic heads and vertical ground motion in some of these areas are stable or increasing.

Ground-level surveys should be conducted in these areas less frequently than annual (e.g., once every five years).

#### ***Task 4.5. Replace Destroyed Benchmarks (if needed)***

In this subtask, the surveyor replaces benchmark monuments that have been destroyed since the last survey, if any.

#### ***Task 4.6. Process, Check, and Update Database***

In this subtask, the Watermaster Engineer receives and catalogs the survey results provided by the surveyor, prepares the data for display as a GIS layer, and performs checks against InSAR and extensometer data for reasonableness and accuracy.

## **Task 5. Data Analysis and Reporting**

#### ***Task 5.1. Prepare Draft 2021/22 Annual Report of the Ground-Level Monitoring Committee***

Prepare the text, tables, and figures for a draft *2021/22 Annual Report of the GLMC* and submit the report to the GLMC by September 23, 2022 for review and comment.

#### ***Task 5.2. Prepare Final 2021/22 Annual Report of the Ground-Level Monitoring Committee***

Update the text, tables, and figures based on the comments received from the GLMC and prepare a final *2021/22 Annual Report of the GLMC* by November 4, 2022. Responses to comments will be included as an appendix to the final report. The report will be included in the agenda packet for the November 2022 Watermaster meetings for approval.

### ***Task 5.3. Compile and Analyze Data from the 2022/23 Ground-Level Monitoring Program***

In this subtask, monitoring data generated from the GLMP during 2022/23 is checked, mapped, charted, and analyzed as the first step in the preparation of the subsequent annual report. Some of the maps, charts, and tables are shared with the GLMC at its meetings in early 2023 during the development of a recommended scope of services and budget for FY 2023/24.

### ***Task 5.4. Conduct Reconnaissance-Level Subsidence Investigation of the Northeast Area***

In the Northeast Area, the long-term and short-term InSAR estimates indicate that persistent downward ground motion has occurred in a concentrated area south of the Ontario International Airport between Vineyard Avenue and Archibald Avenue. The western edge of this subsiding area exhibits a steep subsidence gradient or “differential subsidence.” Subsidence may have occurred in this area due to aquifer-system compaction, but there is not enough historical data in this area to confirm this relationship. In FY 2021/22, the Watermaster Engineer is conducting a *Reconnaissance-Level Subsidence Investigation of the Northeast Area* that includes the review and analysis of readily-available borehole and lithologic data, historical air photos, pumping and recharge data, hydraulic head data, and InSAR estimates of vertical ground motion at up to four locations in this area of concern. Figures and charts are being prepared and analyzed to derive interpretations and recommendations for future investigations and monitoring, if appropriate. This investigation is not yet complete. The GLMC should consider dedicating contingency budget for FY 2022/23 to implement the recommendations derived the investigation (\$10,000).

## **Task 6. Develop a Subsidence-Management Plan for Northwest MZ-1**

The 2007 SMP called for ongoing monitoring and data analysis of the Managed Area; including annual reporting and adjustments to the SMP, as warranted by the data. The 2007 SMP also called for expanded monitoring of the aquifer-system and land subsidence in other areas of subsidence and ground fissuring concern. Figure 1 shows the location of these so-called Areas of Subsidence Concern: Central MZ-1, Northwest MZ-1, Northeast Area, and Southeast Area. The expanded monitoring efforts outside of the Managed Area are consistent with the requirements of OBMP Program Element 1 and its implementation plan contained in the Peace Agreement.<sup>1</sup>

The 2007 SMP stated that if data from existing monitoring efforts in the Areas of Subsidence Concern indicate the potential for adverse impacts due to subsidence, the Watermaster would revise the SMP to avoid those adverse impacts. The 2014 Annual Report of the GLMC recommended that the 2007 SMP be updated to better describe the Watermaster’s land subsidence efforts and obligations, including areas outside of MZ-1. As such, the update included a name change to the 2015 Chino Basin Subsidence Management Plan (2015 SMP) and a recommendation to develop a subsidence management plan for Northwest MZ 1.

The Watermaster had been monitoring vertical ground motion in Northwest MZ-1 via InSAR during the development of the 2007 SMP. Land subsidence in Northwest MZ-1 was first identified as a concern in 2006 in the MZ-1 Summary Report and again in 2007 in the 2007 SMP. Of particular concern was the occurrence of concentrated differential subsidence across the San Jose Fault in Northwest MZ-1—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

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<sup>1</sup> [http://www.cbwm.org/rep\\_legal.htm](http://www.cbwm.org/rep_legal.htm).

subsidence, and the potential for ground fissuring in Northwest MZ-1, has been discussed at prior GLMC meetings, and the subsidence has been documented and described as a concern in the Watermaster’s State of the Basin Reports, the annual reports of the GLMC, and in the *Initial Hydrologic Conceptual Model and Monitoring and Testing Program for the Northwest MZ-1 Area* (WEI, 2017). The Watermaster increased monitoring efforts in Northwest MZ-1 beginning in FY 2012/13 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; WEI 2015b).<sup>2</sup> 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 2015 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.

### ***Progress to Implement Work Plan thru FY 2021/22***

The progress that has been made to implement the Work Plan (through FY 2021/22) includes the following:

- An initial hydrogeologic conceptual model of the Northwest MZ-1 Area was developed, and a report was published in 2017.<sup>3</sup> This report described the hydrogeology of the area, speculated on the causes of the observed land subsidence, and included a recommended monitoring program.
- A preliminary one-dimensional (1D) compaction model, based on hydrogeologic information from the MVWD-28 well site, was constructed, calibrated, and used to explore the future occurrence of subsidence in Northwest MZ-1 under various basin-operation scenarios of groundwater production and artificial recharge and to identify potential subsidence mitigation strategies. A report<sup>4</sup> was published to document the results of the modeling and included a recommendation to construct the Pomona Extensometer.
- The initial monitoring program was implemented to closely track groundwater-levels, groundwater production, recharge, and ground motion across Northwest MZ-1. This monitoring program included the construction of the Pomona Extensometer to measure and record depth-specific heads and aquifer-system deformation. Implementation of the monitoring program is ongoing.
- A new 1D model was constructed and calibrated using the hydrogeologic information collected at the Pomona Extensometer. The 1D model at MVWD-28 was also updated and recalibrated using current information. The objectives of this exercise were to: (i) describe the subsidence mechanisms and the pre-consolidation head by aquifer-system layer in Northwest MZ-1 and (ii) develop modeling tools that will be used to explore the future occurrence of subsidence in Northwest MZ-1 under various basin-operation scenarios of groundwater production and artificial recharge and to identify potential subsidence mitigation strategies. This work has been reviewed by the GLMC. The GLMC has recommended additional model calibration refinements and

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<sup>2</sup> [Work Plan to Develop a Subsidence-Management Plan for Northwest MZ-1](#)

<sup>3</sup> [https://cbwm.syncedtool.com/shares/folder/PaauzoQapiZ/?folder\\_id=5150940](https://cbwm.syncedtool.com/shares/folder/PaauzoQapiZ/?folder_id=5150940)

<sup>4</sup> [https://cbwm.syncedtool.com/shares/folder/PaauzoQapiZ/?folder\\_id=5150942v](https://cbwm.syncedtool.com/shares/folder/PaauzoQapiZ/?folder_id=5150942v)



sensitivity analyses. This additional work is currently being performed and should be completed by the beginning of FY 2022/23.

Based on the expected progress through FY 2021/22, the following work is recommended for FY 2022/23 to develop the Subsidence Management Plan for Northwest MZ-1:

### ***Task 6.1. Aquifer-System Monitoring***

The established monitoring program of piezometric levels and pumping at wells in Northwest MZ-1 will continue through various techniques, including: (i) SCADA-based monitoring by the Monte Vista Water District; (ii) monitoring of piezometric levels via sonar<sup>5</sup>; (iii) monitoring of piezometric levels via pressure transducers at City of Pomona production wells; and (iv) manual measurements of piezometric levels. These data, along with data collected from the PX in Task 2.1, will improve the understanding of the hydrogeology in Northwest MZ-1, will be used to develop the Subsidence Management Plan for Northwest MZ-1, and in the future, will be used to adapt the Subsidence Management Plan, as appropriate.

In this subtask, all data is collected, compiled, checked, and analyzed every three months. Charts and data graphics of pumping, piezometric levels, and aquifer-system deformation will be updated to support the data collection and analysis.

### ***Task 6.4. Refine and Evaluate the Subsidence-Management Alternatives***

This task will help answer the question: What are potential methods to manage the land subsidence in Northwest MZ-1 over the planning horizon?

The 1D compaction models at MVWD-28 and PX will be used to characterize the mechanical response of the aquifer-system to a Baseline Management Alternative (BMA). A draft TM will be prepared that summarizes the evaluation of the BMA, particularly, the ability of the BMA to raise and hold piezometric levels above the estimated pre-consolidation stresses. The draft TM may also include a recommendation for the Initial Subsidence Management Alternative (ISMA) if the BMA is not successful at minimizing or abating land subsidence over the planning horizon. The assumptions of the ISMA, including the groundwater production and replenishment plans of the Chino Basin parties, will be described and must be agreed upon by the GLMC. A GLMC meeting will be held to review the model results and evaluation of the BMA, review the recommended ISMA, and to receive feedback on the draft TM.

After the recommended ISMA is agreed upon by the GLMC, the Watermaster's MODFLOW model will be updated to run the ISMA and will be used to estimate the hydraulic head response to the ISMA at the MVWD-28 and PX locations. The projected hydraulic heads generated from the MODFLOW model using the ISMA will be extracted from the MODFLOW model results at the MVWD-28 and PX locations and will be used as input files for both 1D compaction models. The 1D compaction models will then be run to characterize the mechanical response of the aquifer-system to the ISMA at both the MVWD-28 and PX locations.

A draft TM will be prepared that summarizes the evaluation of the ISMA, particularly, the ability of the ISMA to raise and hold piezometric levels above the estimated pre-consolidation stresses. The draft TM may also include a recommendation for a second Subsidence-Management Alternative (SMA-2), if the ISMA is not successful at raising and holding hydraulic heads above the estimated pre-consolidation

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<sup>5</sup> The use of sonar technology to measure piezometric levels in wells is currently being used in Monte Vista Water District wells 28 and 31.

stresses. The assumptions of the SMA-2, including the groundwater production and replenishment plans of the Chino Basin parties, will be described, and must be agreed upon by the GLMC. A GLMC meeting will be held to review the model results and evaluation of the ISMA, review the recommended SMA-2, and to receive feedback on the TM.

If necessary and recommended by the GLMC, additional subsidence management alternative scenarios may be run in FY 2023/24. It is currently envisioned by the GLMC that, based on the results of the 1D compaction model results, the GLMC may recommend an update to the Watermaster’s Subsidence Management Plan in FY 2023/24 to minimize or abate the future occurrence of land subsidence in Northwest MZ-1.

## **Task 7. Meetings and Administration**

### ***Task 7.1. Prepare for and Conduct Four Meetings of the Ground-Level Monitoring Committee***

This subtask includes preparing for and conducting four meetings of the GLMC:

- July 2022 – Implementation of the GLMP for FY 2022/23
- September 2022 – Review the draft 2021/22 Annual Report of the Ground-Level Monitoring Committee
- February 2023 – Review the draft recommended scope and budget for FY 2023/24
- March 2023 – Review the final recommended scope and budget for FY 2023/24 (if needed)

### ***Task 7.2. Prepare for and Conduct One As-Requested Ad-Hoc Meeting***

This subtask includes preparing for and conducting one ad-hoc meeting of the GLMC, as requested by the GLMC or Watermaster staff.

### ***Task 7.3. Perform Monthly Project Management***

This subtask includes monthly project administration and management, including staffing, financial and schedule reporting to Watermaster and subcontractor coordination.

### ***Task 7.4. Prepare a Recommended Scope and Budget for the GLMC for FY 2023/24***

This subtask includes preparing a draft and final recommended scope of services and budget for FY 2023/24 for the GLMC to support the Watermaster’s budgeting process.