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SUPERIOR COURT OF THE STATE OF CALIFORNIA

FOR THE COUNTY OF ORANGE, CIVIL COMPLEX CENTER

MOJAVE PISTACHIOS, LLC; et al., Plaintiffs,

v.

INDIAN WELLS VALLEY WATER DISTRICT; et al., Defendants.

INDIAN WELLS VALLEY WATER DISTRICT, Cross-Complainant,

v.

ALL PERSONS WHO CLAIM A RIGHT TO EXTRACT GROUNDWATER, et al., Cross-Defendants.

SEARLES VALLEY MINERALS INC., Cross-Complainant,

v.

ALL PERSONS WHO CLAIM A RIGHT TO EXTRACT GROUNDWATER, et al., Cross-Defendants.

Case No. 30-2021-01187275-CU-OR-CJC
Related to: 30-2021-01187589-CU-WM-CXC; 30-2021-01188089-CU-WM-CXC

Assigned For All Purposes To:
The Hon. William D. Claster, Dept. CX101

UNITED STATES' PHASE 2 POST-TRIAL BRIEF ON SAFE YIELD

Action Filed: November 19, 2019
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INTRODUCTION

The Indian Wells Valley Groundwater Basin ("Basin" or "IWV Basin") is a critically overdrafted groundwater basin that has been designated a "high priority" for sustainable management by the California Department of Water Resources ("DWR"). *See generally* Groundwater Sustainability Plan for the Indian Wells Valley Groundwater Basin, EX 108.[1] Sustainable management of the Basin's groundwater has long been a priority for the United States because of the national defense assets located there. Naval Air Weapons Station China Lake ("NAWS China Lake"), the Navy's principal facility for air weapons research, development, and testing, overlies about 40% of the Basin's surface area, employs and supports thousands of civilian and military personnel, and depends upon groundwater as its sole source of water supply. NAWS China Lake also requires a stable Basin aquifer that supports the surface conditions necessary for the Navy's sensitive weapons research and testing operations. Thus, there is a strong national public interest in curtailing the overdraft that threatens the base.

In this case, the public interest in halting overdraft is best served by (1) defining the Basin's safe yield based on long-term average recharge, as the law requires, and (2) employing conservative, evidence-backed estimates to calculate that amount. The trial record demonstrates that a safe yield of 7,650 acre-feet-per year ("AFY"), equal to the DWR-approved "sustainable yield" for the Basin, satisfies both criteria. The trial record also demonstrates that the estimates of safe yield advocated by the Basin's major groundwater extractors (other than the Navy), do not satisfy those criteria. None of those estimates is based on a credible reconstruction of the Basin's water balance. Pumping at the rate those parties propose would not be "safe" at all: it would only prolong and aggravate critical overdraft conditions and the associated risks to the United States' national defense assets at NAWS China Lake. As discussed below, the evidence demonstrates that the maximum safe yield of the IWV Basin should be established as 7,650 AFY, the long-term average of the natural recharge to the Basin.

[1] "EX" refers to exhibits admitted during the Phase 2 trial. Some exhibits were admitted for demonstrative purposes only or subject to other limitations as noted on the parties' Joint Exhibit List and as identified herein. Citations are to the "pdf" page rather than the internal page number.

SUMMARY OF ARGUMENT

The record for the Phase 2 trial contains testimony from ten expert witnesses over ten days of trial, and hundreds of exhibits totaling thousands of pages. The United States has attempted to organize and synthesize this information in the manner that facilitates review by the Special Master, the Court, and the public. A summary is presented here for convenience.

This Brief begins with the IWV Basin Setting and Physical Characteristics, primarily as set forth in the Technical Report prepared by the Indian Wells Valley Groundwater Authority ("Groundwater Authority") pursuant to California Code of Civil Procedure Section 845. The Brief then provides a Statement of the Case with procedural background and an overview of the numerical groundwater models discussed at trial. After that, the Brief discusses the legal definition of safe yield and summarizes the safe yield estimates presented through expert testimony.

The Brief then presents the following Argument:

I. The most reasonable and best-supported estimate of the Basin's safe yield is 7,650 AFY. *See* p. 20, *infra.* A. Under *San Fernando* and *Santa Maria*, safe yield cannot exceed the long-term average recharge to the Basin. The expert testimony and the best available science, modeling, and evidence confirm that 7,650 AFY is a reasonable estimate of long-term average natural recharge to the Basin. The United States' expert witness, Dr. Sean McKenna, showed that recharge of 7,650 AFY is within a reasonable range of estimates calculated by methods developed for arid basins, and that it is consistent with recharge ratios in the adjacent Owens Valley. He also showed that the 2025 Desert Research Institute ("DRI") numerical model comprehensively represents the Basin's hydrogeology and accurately simulates water levels from 1921 to 2023 with variable natural recharge averaging 7,650 AFY. The alternative estimate of natural recharge offered by Dr. Matthew Tonkin, the expert retained by the Indian Wells Valley Water District ("Water District"), is based on a statewide model—the Basin Characterization Model, version 8 ("Statewide BCM")—that is not calibrated for the IWV Basin, includes components of recharge that are not available in the IWV Basin, and was evaluated over a base period that includes two abnormally "wet" periods. A change of storage analysis shows that when an appropriate base period is used the Statewide BCM outputs support a safe yield less than 7,650 AFY.

B. The TWG's objections to DRI's use of 7,650 AFY as the average recharge in its model are irrelevant and unsupported. *See* p. 34, *infra*. The calibration methods used for the older DRI model and the representation of storage in the current model have no bearing on Dr. McKenna's testimony, and the objections relating to those issues are contradicted by the record in any event.

C. Anthropogenic recharge is not contributing to the Basin's current water balance. *See* p. 44, *infra*. Dr. Tonkin vouched for a water budget that includes 2,500 AFY of recharge from irrigation returns, Los Angeles Aqueduct leakage and emergency releases, leakage from the Water District's distribution system, or percolation from the ponds at the City of Ridgecrest's Wastewater Treatment Plant ("WWTP"). There is no evidence demonstrating that water from these sources has reached the water table. No party disputed that there is a "lag" before the water recharges the groundwater supply, and no party presented evidence refuting Dr. McKenna's calculation of the length of that lag. Dr. McKenna and the Groundwater Authority's expert, Dr. Todd Kincaid, also testified that there is insufficient evidence verifying the quantities and timing of the releases from these sources to justify their inclusion.

D. Establishing 7,650 AFY as the maximum safe yield of the Basin is a reasonable and conservative approach necessary to protect national defense assets and operations at NAWS China Lake. *See* p. 51, *infra.* Critical overdraft conditions in the Basin have caused and are continuing to cause subsidence under NAWS China Lake and may contribute to dust that impedes visibility at the airfield. Defining 7,650 AFY as the maximum safe yield appropriately reflects uncertainty about natural discharge to evapotranspiration and outflows to Salt Wells Valley, which have not been expressly deducted.

The following table shows how, with the use of an appropriate base period and the exclusion of anthropogenic recharge, the long-term average natural recharge estimated by Dr. McKenna, Dr. Tonkin, the Statewide BCM, and a "local" version of it for the IWV Basin, all converge at or around 7,650 AFY:

CONVERGENCE ON A RANGE AROUND 7,650 AFY

	McKENNA	LOCAL BCM (USGS 2026)	TONKIN Statewide BCM (Expert Report)	TONKIN Statewide BCM (Alternative) [d]
Base Period	1981-2010	1981-2010	1980-2023	1990-2015
Mountain-Front	7,462 – 8,475	8,680	9,200	Variable
Rose Valley	(1,919) [a]	0	2,600 [b]	Variable
Subtotal Natural Recharge	7,462-8,475	8,680	11,800	Variable
Irrig. Returns	0	n/a	2,400 [c]	1,600-2,100 [e]
Other Sources (Aqueduct, Water System, Ponds)	0	n/a	200	Variable
TOTAL RECHARGE	**7,462-8,475**	**8,680**	**14,400**	**9,890**
(Less Irrig. Returns)	7,462-8,475	8,680	12,000	7,790-8,290
(Less Other Incidental)	**7,462 - 8,475**	**8,680**	11,800	**6,470 – 6,970**

Notes

[a] Included within mountain-front recharge calculations.

[b] Taken from Ramboll Model Report, EX 97, pdf 94, t. 6-6.

[c] Based on Ramboll return flow estimates for 1980-2023.

[d] Hypothetical from cross-examination, includes deduction for evapotranspiration. *See* 6/16/26 Tr. 1078-1081.

[e] *See* Ramboll Model Report, EX 97, pdf 45, t. 4-3; 6/16/26 Tr. 1071:17-22.

SUMMARY OF ARGUMENT (continued)

II. The safe yield estimates offered by the "Technical Working Group" ("TWG") witnesses[2] are not credible. *See* p. 53, *infra*. A. The irrational aquifer parameters in the Ramboll numerical model ("Ramboll Model") underlie, and disqualify, each of the safe yield estimates offered by witnesses for the TWG parties. The TWG change-in-storage estimates (of 15,400 AFY or greater) all directly result from the Ramboll Model's calibrated specific yield values, which are implausibly low, effectively representing the Basin's top layer as silt. Dr. Tonkin's recharge-based estimate of 14,400 AFY is premised on Ramboll's simulated water budget, which is also dependent upon Ramboll's calibration using improper aquifer parameters.

B. Even when its aquifer parameters are assumed to be reasonable, the Ramboll Model demonstrates that the TWG's safe yield estimates are too high. *See* p. 61, *infra*. A no-pumping modeling scenario using the Ramboll Model and 10,740 AFY of recharge created a lake with a surface area of 2.5 square miles and a depth of 2 feet on the China Lake playa, where there has been no lake in the past 1,000 years. This absurd result shows that the 11,800 AFY of natural recharge in the Ramboll Model, and assumed by Dr. Tonkin, is too high, or must be subject to significant discounting for evapotranspiration.

C. Dr. Tonkin's safe yield estimate of 14,400 AFY has no independent evidentiary support. *See* p. 62, *infra*. Because he was tied to the Ramboll Model's water budget, Dr. Tonkin included components of recharge that do not exist, accepted a calibrated value for Rose Valley subflow, and added anthropogenic recharge that was unsupported and was not discounted for lag time. Dr. Tonkin's alternative method of discounting for evapotranspiration lacks a sound evidentiary basis. Dr. Tonkin's estimate of safe yield should be rejected.

D. The TWG's polygon-method estimates are not consistent with the legal definition for safe yield, depend on an improper base period, and rely upon arbitrary assumptions that are not

[2] Only for the sake of convenience, the United States refers to the other major groundwater extractors as "the TWG." This moniker, short for "Technical Working Group," was adopted by the Water District, Meadowbrook Dairy Real Estate ("Meadowbrook"), Searles Valley Minerals, Inc. ("Searles"), and Mojave Pistachios, LLC, to describe their collective effort to develop estimates of safe yield higher than the GSP's sustainable yield of 7,650 AFY.

linked to any scientific method. *See* p. 63, *infra*. The estimate of 15,400 AFY offered by Meadowbrook's expert Eddy Teasdale, and endorsed by Searles' expert Lauren Wicks, based on the change in storage over the years 2014 to 2023, which includes two abnormal outlier years for precipitation and was rejected by Dr. Tonkin because it was too wet. Further, safe yield estimates based on the polygon method, and Teasdale's application of that method in particular, are not scientifically rigorous or credible. They are subject to error, as illustrated by Teasdale's misreading of his own hydrographs. And while Teasdale and Wicks claimed that the change of storage method avoids uncertainty, Teasdale relied upon arbitrary and unsupported assumptions in his calculations because of missing data and uncertainty.

III. The amount of groundwater in storage is irrelevant to safe yield. *See* p. 71, *infra*. Testimony about the amount of water in storage should be disregarded because storage is not a factor included in the legal definition of safe yield. The TWG has presented its storage estimate only to lay foundation for proposing a physical solution that would allow them to continue to mine the Basin for years to come. This is not an appropriate or lawful consideration in determining safe yield and should be disregarded.

IV. Setting a maximum safe yield of 7,650 AFY promotes efficiency and finality because it aligns the judgment with the approved Groundwater Sustainability Plan ("GSP") for the Basin. *See* p. 72, *infra*. The recent court of appeals decision *AquAlliance v. Vina Groundwater Sustainability Agency*, 122 Cal. App. 5th 118, 347 Cal. Rptr. 3d 1 (2026), *reh'g denied* (Aug. 19, 2026), indicates that a court should give special consideration to DWR's approval of the sustainable yield in a GSP. In this case, the evidence overwhelmingly supports a maximum safe yield of 7,650 AFY, with or without the GSP. However, if the Special Master or the Court find that the question is a close one, circumstances that tip the balance in favor of 7,650 AFY include the approval of the GSP by DWR, the practical benefits of aligning the judgment with the GSP, and the potential harm to national defense assets and operations at NAWS China Lake that could result from overestimating safe yield instead of defining it conservatively.

IWV BASIN SETTING AND PHYSICAL CHARACTERISTICS

The IWV Basin is located in the northwestern Mojave Desert and is bounded by the Sierra Nevada, Coso, Argus, and El Paso mountain ranges. *See* Indian Wells Valley Groundwater Basin Technical Report May 2026 ("Technical Report" or "Tech. Rep.");[3] *see* EX 60, pdf 15, fig. 3. The Basin has an arid, high-desert climate, characterized by hot summers, cold winters, and sparse and irregular precipitation. Tech. Rep. at 14. The federal government owns roughly 80% of the land overlying the Basin. *Id.* at 3. About half of the federal land falls within the military reservation for NAWS China Lake. *See id.*; *see also* EX 110, pdf 5 fig. 2-3; EX 929, pdf 189 fig. 2-3.

The IWV Basin is one of the few areas in California located in the Basin and Range Physiographic Province, the desert that encompasses the State of Nevada and parts of other western states. *See* Tech. Rep. at 8; EX 64, pdf 12 (depicting boundary). The Basin and Range province is defined by isolated mountain ranges and desert basins. *See* Tech. Rep. at 8. Typical of the Basin and Range, the IWV Basin consists of thick sedimentary deposits surrounded by mountains. *Id.* at 9-10; EX 24, pdf 70 fig. 5-5; *see also* 6/24/26 Tr. 1964; EX 24, pdf 23 fig. 2-7; EX 67, pdf 11. Over millions of years, the layers of sediments have been fractured, uplifted, or down-dropped by seismic activity along the Basin's numerous faults. *See* Tech. Rep. at 9, 11; EX 24, pdf 42 fig. 3-11, EX 80, pdf 15 fig. 3.

The primary inflow to the Basin's groundwater system is mountain-front recharge. Tech. Rep. at 15. Infiltration of rain and runoff on the valley floor itself is very limited due to high rates of evapotranspiration and the low-permeability, clay-like material present in shallower layers of the aquifer. *See id.* at 7; *see also id.* at 10; EX 24, pdf 36 fig. 3-7 (map depicting lateral extent of "clay" unit). Subsurface flows from Rose Valley that enter the Basin from the northwest supply an additional source of recharge, though the mechanism and magnitude of this flow are not well understood. *See id.* at 13.

[3] The Technical Report was submitted by the Groundwater Authority pursuant to section 845(d) of the Code of Civil Procedure and is "prima facie evidence of the physical facts found [therein]," subject to the presentation of rebuttal evidence. *See* Code Civ. Proc. § 845(d)(4). The Technical Report was marked as Exhibit 955 but is cited herein as the Technical Report to aid in the identification of facts that should be treated as prima facie evidence.

The IWV Basin is a closed or terminal basin. *Id.* at 2. Water is only discharged from the Basin by pumping, evapotranspiration, and minor subsurface flow to the Salt Wells Valley basin. *Id.* at 7, 13, 19-22. The streams and surface waters in the Basin are ephemeral due to low average precipitation and mountain-front recharge. *Id.* at 7. Any stormwater runoff drains to the China Lake "playa" area, where it evaporates or is consumed by vegetation. *Id.* at 20; *see also* EX 929, pdf 236 fig. 5-12.

Groundwater pumping in the Basin has created a state of long-term overdraft. *See id.* at 1. Pumping began in the early 20th century, *id.* at 28, peaked at about 29,000 AFY in the 1980s, *id.* at 45, and currently averages around 20,000 AFY, *id.* at 31, t.14. Pumping has caused water levels to decline, leading to the formation and expansion of drawdown "cones" under the City of Ridgecrest and on the western edge of NAWS China Lake. *Id.* at 33*;* EX 24, pdf 96 fig. 6-2. Groundwater pumping has also contributed to subsidence in the southern part of the Indian Wells Valley, where the Navy's Supersonic Naval Ordnance Research Track ("SNORT") is located. *Id.* at 36-37. Between 1992 and 2010, subsidence in this area was estimated to be 2.2 millimeters (0.09 inches) per year. *Id.* Subsidence under NAWS China Lake continues to occur. EX 929, pdf 214 fig. 2-28.

DWR has designated the Basin as critically overdrafted and a high priority for management under the Sustainable Groundwater Management Act ("SGMA"). In 2020, Groundwater Authority published a Groundwater Sustainability Plan ("GSP") for the Basin, EX 108, which DWR approved in 2022. *See* EX 359. The GSP identifies the sustainable yield of the Basin as 7,650 AFY, equal to estimated long-term average recharge. *See* EX 108, pdf 39-40.

Since the adoption of the GSP, the Basin is estimated to have lost over 85,000 AFY of groundwater from storage due to continuing overdraft. Tech. Rep. 42, t.18.

STATEMENT OF THE CASE

This litigation originated as an action by Mojave Pistachios, LLC, against the Water District, Searles, and Meadowbrook, to determine their respective rights to IWV Basin groundwater. In 2021, the District filed a cross-complaint seeking a comprehensive adjudication of all water rights in the Basin pursuant to Code of Civil Procedure section 830. Separately, Mojave Pistachios and Searles each filed suit against the Groundwater Authority to challenge the GSP.

In 2024, the Court set two phases of trial in the adjudication action. The Phase 1 trial, to determine the federal reserved water right for NAWS China Lake, took place in May 2025. The Court issued a final Statement of Decision on September 15, 2025, establishing the Navy's water right as 2,008 AFY. The Phase 2 trial, to determine the Basin's safe yield, commenced on June 8, 2026, and took place over ten court days, concluding June 29, 2026. On October 30, 2026, the Court appointed Bryan Bondy as Special Master to make a recommendation to the Court on issues relating to safe yield.

Prior to the Phase 2 trial, Mojave Pistachios and Searles voluntarily dismissed their respective lawsuits challenging the GSP. The Court also denied the Water District's request to prosecute Searles' lawsuit in its place. At this time, there is no pending action to challenge the GSP, and the time to bring a reverse validation action has passed. *See* Code Civ. Proc. §§ 860, 863.

IWV BASIN GROUNDWATER MODELS

Two numerical models of IWV Basin groundwater flow were produced by the parties during discovery to support their competing estimates of safe yield. Near the close of discovery, the United States Geological Survey ("USGS") published a third numerical model of the IWV Basin hydrologic budget that was also the subject of testimony. The trial record includes the model documentation for these models but not the code.

A. The 2025 DRI Model

The Groundwater Authority produced the model developed by the Desert Research Institute ("DRI"), as updated in 2025. *See* EX 24 (model report). DRI originally developed the model for the Navy in 2016, as a tool for evaluating the risk of future water level declines and subsidence on NAWS China Lake. *See* EX 21 (2016 "McGraw" model report). The model was created because the existing numerical model for the Basin, developed by Brown and Caldwell in 2009, was not able to simulate measured water levels with an assumed recharge of 8,822 AFY. *See id.*, pdf 18 ("The major limitation of the Brown and Caldwell (2009) model is that it cannot accurately reproduce drawdown rates, which is a requirement for the model to be used to support water-resource decision making."); *id.*, pdf 22 (noting that Brown & Caldwell reduced the recharge to

8,900 AFY from an initial estimate of 11,000 AFY during model calibration); EX 67, pdf 34 (showing final recharge estimate of 8,822 AFY).

For its 2016 model, DRI updated the Brown & Caldwell recharge calculation using precipitation data from 1981 to 2010, then scaling the results to match predevelopment (1920-21) water level contours reported by Brown & Caldwell. *See generally* EX 21, pdf 21, 26. This process resulted in total calculated recharge of 7,650 AFY, distributed across the areas of mountain-front recharge, including the Rose Valley basin to the north. *Id.*, pdf 35. DRI's 2016 model assigned 7,650 AFY of recharge every year based on these calculations. *See* EX 24, pdf 66. DRI updated the model in 2017, to include additional faults. *See* EX 22, pdf 2.

In 2018, the Navy transferred management of the DRI model to the Groundwater Authority as an in-kind contribution to the GSP development process. *See* Tech. Rep. 37 n.18. Following a peer review process, and coordination with the Groundwater Authority's Technical Advisory Committee, DRI updated the model and fully recalibrated it for use in the GSP. *See* EX 108, pdf 172-173. In its memo approving the 2020 GSP, DWR found that the plan used the "best available science and information," EX 359, pdf 7, including DRI's modeling work. *See, e.g.*, *id.*, pdf 11 (finding that the GSP "utilizes the best available science and information to analyze and describe the physical characteristics of the surface water and groundwater systems in the hydrogeologic conceptual model, groundwater conditions, and water budgets"); *id.*, pdf 28 ("The water budgets and Numerical Model used in the development of the Plan rely on a variety of reports and studies conducted by various groups over a number of years, that the Department regards to be consistent with the best available information and science.")

In 2025, DRI completed another significant update to the model using data developed after the GSP. *See generally* EX 24. Among other changes, DRI adjusted the model domain, better defined the depth to bedrock, represented newly identified faults, refined the representation of other faults and the subsurface clay unit, overhauled the distribution and range of aquifer parameters, and incorporated water level measurements from an additional 139 observation wells. *See generally* EX 24. Like the earlier version of the model, the 2025 DRI Model represents steady-state (baseline) conditions based on conditions prior to 1921, before significant development of groundwater

pumping. *See id.* 24, pdf 65, 77. For the 2025 update, DRI constructed a transient-historical simulation that replicates conditions in the Basin from 1921 to 2023 (Water Year 2022). *See id.*, pdf 65. For the transient-historical simulation, DRI assigned recharge that varies on a monthly and annual basis, based on observed precipitation data. *See id.*, pdf 66. The model distributes the recharge in a way that achieves an average of 7,650 AFY over the 102-year simulation period. *See id.* at 66-67 & fig. 5-1, pdf 87, fig. 5-18 (simulated flow budget). Using this long-term average of 7,650 AFY, DRI was able to calibrate the model to observed water-level measurements with all measures of relative error below 3%, a significant improvement from the previous version of the model. *See* EX 60, pdf 35.

The DRI Model was not created for use in this litigation. The United States' retained testifying expert, Dr. Sean McKenna, was an executive director at DRI during the 2025 model update but had no direct involvement in its creation. The Groundwater Authority's non-retained expert, Jean Moran, advised DRI on the updates but did not engage in model design. The Groundwater Authority's retained expert, Dr. Todd Kincaid, had no involvement in the development of the model.

B. The Ramboll Model

To support the TWG's safe yield estimates, the Water District produced a model developed by Ramboll, a Danish engineering firm. *See* EX 97 (model report). Ramboll first published a conceptual framework for a model in 2019, *see* EX 364, and it completed a numerical model in 2025 for use in the Phase 2 trial. In 2024, the TWG used Ramboll's conceptual framework and information from a preliminary version of the model to produce a position paper on safe yield. *See* EX 3; 6/22/26 Tr. 1414-1416. The "preliminary" version of the model used by the TWG at the end of 2024 was not calibrated, 6/10/26 Tr. 560:18-23, and was never produced in discovery.

Ramboll's transient simulation covers the years 1986 to 2023. *See* EX 97, pdf 39. Ramboll also simulated the six years prior to the transient period (1980 to 1985) as an initial, "quasi-steady-state" baseline condition. *Id.* The period 1980 to 1985 is not a predevelopment condition or a period of average precipitation and climatic conditions; it appears that Ramboll used this period for its baseline simply because it preceded the transient simulation. *See id.*, pdf 39 (acknowledging

higher-than-average precipitation at China Lake gauging station); *id.*, pdf 50, fig. 4-5 (showing pumping between 25,000 and 31,000 AFY for years 1980-1985); *see also* EX 48, pdf 32, fig. 6-3 (hydrographs for China Lake and for Northern Sierra precipitation and snowpack); Tech. Rep. 28 (estimating pumping at "historical peak" of 29,000 AFY in the early 1980s).

The average recharge in Ramboll's transient simulation is 13,300 AFY. *See id.*, pdf 94, t. 6-6. This average includes: 8,200 AFY of mountain-front recharge and recharge from surface runoff; 2,600 AFY of recharge from Rose Valley subflow; and additional 2,500 AFY of incidental (anthropogenic) recharge. *See id.*; *see generally id.,* pdf 41-48. If the steady state simulation is included, the average recharge increases to about 14,400 AFY. *See* EX 123, pdf 67, t.4-2.

None of the TWG experts cited the Ramboll Model simulations to support their estimates. It is undisputed that the Ramboll Model has "flooded cells" representing water levels above land surface in the dry China Lake playa, which is not credible. *See* EX 61, pdf 31-32, fig. 9; *but see* Tech. Rep. 8 (China Lake "is usually a dry playa, except following significant rainfall.").

C. USGS "Local" BCM

The USGS's Basin Characterization Model, version 8 ("BCM") is a statewide model that uses precipitation data, climatic data, and land-surface modeling to simulate surface hydrology and recharge to groundwater systems in California. *See* EX 242 (model report). Ramboll used the BCM to supply or inform the recharge inputs for mountain-front recharge and recharge from runoff. EX 97, pdf 41. However, the BCM is calibrated at a regional level, and is expressly designed to allow for further "local" calibration using site-specific data. *See* EX 242, pdf 16-17; *id.* 93-98. The model documentation notes that, due to "regional calibration and associated errors, subregional applications of BCMv8 could benefit from additional local calibration to obtain more accurate estimates for calculating the water balance in a given watershed." *Id.*, pdf 17.

The USGS began developing a locally calibrated version of the BCM for the IWV Basin in or around 2015. *See* 6/9/26 Tr. 462:17-26; 464:11-22. The model was completed in March 2026, at the end of discovery for the Phase 2 Trial. *See* EX 363 ("Local BCM"). The Local BCM simulates an average 8,680 AFY of mountain-front recharge for the period 1981 to 2010. *Id.*, pdf 23. According to Dr. Tonkin, the results from the Statewide BCM, over the same 1981 to 2010

period, are similar, within 2 to 3% (+/- 260 AFY). *See* 6/16/26 978: 3-7. The Local BCM does not simulate subflow from Rose Valley, and it does not incorporate anthropogenic recharge to the Basin because the BCM is not designed to do so.

Because it was published at the end of discovery, the parties' experts offered only some preliminary impressions of the Local BCM at trial. For example, both Dr. Tonkin, for the Water District, and the Groundwater Authority's non-retained expert, Jean Moran, testified that the recharge attributed to the "Volcanics" area on the north end of the Basin appeared to be excessive. *See* 6/9/26 Tr. 398:24-399:2; 6/16/26 Tr. 978-79. Dr. Tonkin testified that the Local BCM's exclusion of Rose Valley subflow was not supported. *See* 6/16/26 Tr. 979-80. Neither he nor any of the other experts advocated for the Local BCM to be used to set the safe yield of the IWV Basin.

LEGAL DEFINITION OF SAFE YIELD

The Court has endorsed the following definition of safe yield for use in the Phase 2 trial: "The safe yield is the maximum amount of water that [can] be extracted annually, year after year, without eventually depleting the underground basin. [citation omitted] Safe yield is generally calculated as the net of inflows less subsurface and surface outflows." *City of Santa Maria v. Adam* (2012) 211 Cal. App. 4th 266, 279. *See* [Proposed] Order Appointing Special Master Re Phase 2 Trial (Ex. 2 to Notice of Ruling from Oct. 30, 2026 Status Conference, Instruction No. 13) (filed Nov. 3, 2026).[4]

The *Santa Maria* standard, and Instruction No. 13 quoted above, must be applied in a manner consistent with the definition of safe yield in *City of San Fernando v. City of Los Angeles*, 14 Cal. 3d 199, 537 P.2d 1250 (1975), which is controlling state supreme court precedent. The first sentence in the *Santa Maria* definition is almost entirely a direct quotation from *San Fernando* (*id.* at 214), and the second sentence in the definition is followed by a citation to the water balance accounting in *San Fernando* (*id.*at 278-279). *Santa Maria*, and Instruction No.13, thus incorporate the *San Fernando* definition of safe yield, and *San Fernando*'s definition is controlling in the event of a conflict.

[4] At the time of filing, the Proposed Order appointing the Special Master had not been finalized or signed because the parties were working to address certain administrative provisions.

San Fernando defines safe yield as "'the maximum quantity of water which can be withdrawn annually from a ground water supply under a given set of conditions without causing an undesirable result,'" where "[t]he phrase 'undesirable result' is understood to refer to a gradual lowering of the ground water levels resulting eventually in depletion of the supply." *Id.*, 14 Cal. 3d at 278-79 (quoting *City of Pasadena v. City of Alhambra*, 33 Cal. 2d 908, 929, 207 P.2d 17 (1949)). Undesirable results may also include secondary effects of the loss of groundwater storage. As Searles explained, in its brief supporting the setting of a Phase 2 trial on safe yield, "[a]n 'undesirable result' is customarily equated with the unregulated lowering of the groundwater table and physical impacts such as land subsidence, water quality degradation, and salt water intrusion." Searles' Notice of Mot. & Mot. to Set a Phase 2 Trial on Safe Yield & Phase 3 Trial to Adjudicate Groundwater Rights & Physical Solution 6 (filed May 22, 2024) (citing *San Fernando*, 14 Cal. 3d at 278; *Antelope Valley Groundwater Cases*, 59 Cal.App.5th 241, 252 (2020); and Cal. Water Code, § 10721, subds. (x)(1)-(6)).

In *San Fernando*, safe yield was deemed equivalent to "net groundwater recharge." 14 Cal. 3d at 278. The court defined net groundwater recharge as (1) recharge from natural sources (native precipitation and runoff) plus return flows from application of groundwater and imported water, *less* (2) losses from natural groundwater depletions, including subsurface and surface outflows, groundwater infiltration into sewers, and "excessive evaporative losses in high ground water areas and through vegetation along streams." *Id.* at 278-79. This definition is cited in *Santa Maria* as authority for defining the safe yield as the "net of inflows less subsurface and surface outflows." *Santa Maria*, 211 Cal. App. 4th at 279. Thus, the itemized accounting of inflows and outflows in *San Fernando*, including "excessive evaporative losses" and losses "through vegetation," should inform how the *Santa Maria* definition is applied under the Court's Instruction. *See also, e.g. Antelope Valley Groundwater Cases*, 63 Cal. App. 5th 17, 26 n.1 (2021) ("In essence, safe yield examines the available groundwater recharge from replenishing sources," "less losses incurred through natural groundwater depletions such as subsurface outflow or evaporative losses.").

THE PARTIES' SAFE YIELD ESTIMATES

The parties have offered testimony and evidence to support the following safe yield estimates, arranged from lowest to highest:

Dr. Todd Kincaid, a retained expert for the Groundwater Authority, testified in support of safe yield between **6,100 AFY and 8,400 AFY**, representing total recharge discounted by 15% to account for evapotranspiration and climate change. *See* EX 80 (report); EX 84 (response report); EX 1205 (CV).

Dr. Sean McKenna, a retained expert for the United States, testified in support of a maximum safe yield at or around **7,650 AFY,** which represents long-term average recharge from 1921 to 2023 without a quantified discount for evapotranspiration. *See* EX 60 (report); EX 61 (rebuttal report); EX 71 (CV).

Dr. Matthew Tonkin, a retained expert for the Water District, advocated for a safe yield of **14,400 AFY**, which represents average recharge over the period 1980-2023, without deducting for evapotranspiration. *See* EX 123 (report, including CV); EX 125 (rebuttal report).

Eddy Teasdale, a retained expert for Meadowbrook Dairy, testified in support of a safe yield of **15,400 AFY**, based on estimated change in storage in the basin from 2014 to 2023. EX 85 (report); EX 91 (response report); EX 500 (CV). Lauren Wicks, an expert retained by Searles, testified in support of Teasdale's estimate and the methodology and base period underlying it. EX 6 (report, with J. Yeh); EX 51 (CV).[5]

Other estimates of safe yield were discussed at trial, including those in the TWG's 2024 Safe Yield Paper, and others discussed by the Water District's consultant Timothy Parker, of Ramboll. These estimates were not offered as the expert opinion of any witness.[6]

[5] Searles agreed not to present witnesses in the Phase 2 trial, but Wicks was examined by Meadowbrook and planned to bill Searles for her time testifying. *See* 6/15/26 Tr. 740:14-22. Wicks's work with the TWG was largely in a capacity as a "project manager," which included managing drafts, reviewing others' work product, and streamlining communications. 6/10/26 Tr. 634: 1-10, 635:2-11; 6/15/26:11-15.

[6] Parker produced a report with a safe yield estimate, but he did not testify in support of that estimate at trial, and his report was neither introduced nor admitted into evidence. Parker provided only "high-level" testimony on various aspects of TWG's work. *See* 6/10/26 Tr. 522: 23-24.

ARGUMENT

I. THE MOST REASONABLE AND BEST SUPPORTED ESTIMATE OF THE IWV BASIN'S SAFE YIELD IS 7,650 AFY.

Safe yield is defined as s a water budget: the net of inflows, less subsurface and subsurface losses, or "net groundwater recharge," *San Fernando*, 14 Cal. 3d at 278-279. *See also Santa Maria*, 211 Cal. App. 4th at 279; Instruction No. 13. Therefore, the safe yield of the IWV Basin cannot exceed the average annual recharge. Dr. McKenna, the expert witness called by the United States, showed, through multiple lines of reasoning and evidence, that 7,650 AFY is a reasonable and reliable estimate of long-term average recharge to the Basin, consisting solely of natural recharge.[7] Dr. McKenna demonstrated that anthropogenic recharge cannot reasonably be included in the Basin's safe yield because of the "lag" before the water recharges the groundwater system, and because of the absence of evidence demonstrating exactly how, where, when, and if that recharge occurs. Dr. Kincaid supported these opinions, and both he and Dr. McKenna and Dr. Kincaid agreed that natural recharge (of 7,650 AFY or any other number) must be treated, conservatively, as a maximum because it does not account for evapotranspiration or the potential for undesirable results like subsidence. *See San Fernando*, 14 Cal. 3d at 279 (subtracting outflows to "excessive evaporation" and vegetation losses).

A. THE EXPERT TESTIMONY AND BEST AVAILABLE SCIENCE AND MODELING SUPPORT A LONG-TERM AVERAGE NATURAL RECHARGE OF APPROXIMATELY 7,650 AFY.

Mountain-front recharge on the western slope of the Sierra Nevada is the predominant source of recharge to the Basin, with some additional mountain-front recharge occurring in the Coso Range to the north, Argus Range to the east, and El Paso Mountains to the south. *See* EX 21, pdf 27, t.4 (summary of prior mountain-front recharge estimates by zone); EX 24, pdf 66 (DRI

[7] Dr. McKenna is a professional hydrogeologist at the Desert Research Institute ("DRI"), a nonprofit research institution within the Nevada system of higher education. 6/24/26 Tr. 1942. From 2020 to early 2026, Dr. McKenna was the Executive Director of DRI's Division of Hydrological Sciences, which has a "particular focus" on groundwater systems in arid regions. *Id.* Across a 35-year career, Dr. McKenna has published around 100 peer-reviewed articles, approximately 40 of which concern groundwater modeling. *See generally* EX 71 (CV); 6/24/26 Tr. 1942-1945. Dr. McKenna played only a supervisory role with respect to the 2025 DRI Model and was not involved in any prior version of the model. *See id.* at 1945: 19-26.

distribution of mountain-front recharge); EX 97, pdf 40 (Ramboll distribution of mountain-front recharge). In addition to mountain-front recharge, natural recharge that occurs in the adjacent Rose Valley Basin also reaches the IWV Basin as subsurface flow. *See* Tech. Rep. 13; EX 97, pdf 43. There are no surface water sources contributing to natural recharge in the Basin. *See* Tech. Rep. 7.

Dr. McKenna testified that 7,650 AFY is "within the range of reasonable estimates" of long-term average natural recharge to the Basin. 6/24/26 Tr. 1988:7-9. Dr. McKenna's opinion is based on (1) regression calculations developed for arid basins, (2) a comparison with recharge rates in the Owens Valley, and (3) the fact that the DRI Model simulates expected water levels using a long-term average recharge rate of 7,650 AFY and aquifer parameters and boundary conditions that make sense for the Basin. These methods covered numerous possible base periods and converged on a range around 7,650 AFY. The only TWG expert who disputed Dr. McKenna's opinion on natural recharge was Dr. Tonkin, and for the most part he agreed with Dr. McKenna's methods and calculations.

1. Dr. McKenna Demonstrated that 7,650 AFY is a Reasonable Estimate of Long-Term Average Natural Recharge.

Dr. McKenna presented multiple lines of evidence to support his opinion that 7,650 AFY is a reasonable estimate of natural recharge in the Basin.

a. Regression Calculations

Dr. McKenna made initial calculations of long-term average recharge using regression methods developed for arid basins. Regression is a mathematical technique to derive a relationship between two sets of observed data (precipitation and recharge, for example). The result of a regression is an equation that can be used to solve for one variable when only the other variable is known. In this case, Dr. McKenna used regression methods and precipitation data from 1981 to 2010 to calculate the average annual recharge to the Basin during that 30-year period. Regression methods are widely accepted. The Water District's expert, Dr. Tonkin, testified that he uses them "all the time" to make initial calculations. 6/16/26 Tr. 853.

The regression methods Dr. McKenna employed were also employed in DRI's report for the 2016 version of model, known as the "McGraw" report. EX 21. The McGraw report was a

logical place for Dr. McKenna to start because it is based on earlier work by DRI and the District's former modelers at Brown & Caldwell. Dr. McKenna used the same 1981-2010 precipitation data as McGraw and the same two regression methods to make his own calculations. For convenience, these methods will be called the "Anderson" and "Epstein/BBRM" methods. *See* EX 64 (Anderson, 1992); EX 65 (Epstein, 2010).

(i) Anderson Method

Dr. McKenna calculated recharge of 7,462 AFY using the Anderson method. *See* 6/24 Tr. 1960-1963; EX 60, pdf 22-23. The Anderson method was developed by the USGS and uses recharge rates derived from observations in 72 basins across Arizona, California, Nevada, and New Mexico. *See* EX 64. Like the IWV Basin, these basins are arid, surrounded by mountains, characterized by deep sedimentary layers and faults, and recharge and discharge significantly less than the basin's total storage capacity. 6/24/26 Tr. 1960:17-21; *see also* EX 64, pdf 25-31.

The Anderson method derives mountain-front recharge rates using a regression model with total precipitation in areas receiving more than 8 inches of precipitation per year. *See* EX 64, pdf 43. Anderson's calculations correlated better with other recharge estimates when areas receiving 8 inches of precipitation or less were excluded. *Id.* Anderson notes that using 8 inches as a threshold effectively excludes the precipitation that would be lost to evapotranspiration, *id.*, Dr. McKenna testified that it is "general practice" to exclude such areas in arid basins because small amounts of precipitation are presumed to evaporate or to be consumed by desert vegetation. 6/24/26 Tr. 1961; *id.* at 1962-63.

Using the Anderson method, Dr. McKenna calculated average recharge of 7,462 AFY for the period 1981-2010, as shown in Table 1 of his expert report. EX 60, pdf 23. His calculation includes mountain-front recharge into Rose Valley and, further, assumes that 100% of the recharge from Rose Valley reaches the Basin, even though the actual percentage that moves through subsurface flow is "highly uncertain." Tech. Rep. 13.

(ii) Epstein/BBRM Method

Dr. McKenna next employed the Epstein/BBRM method and calculated average recharge of 8,745 AFY for the period 1981-2010. *See* 6/24/26 Tr. 1963-66; EX 60, pdf 24; EX 65. The

Epstein/BBRM recharge rates were derived from observations in 90 Nevada groundwater basins, including several along the California border. *See* EX 65, pdf 10; *id.*, pdf 23, fig. 4. Like the IWV Basin, these basins are in the Basin and Range province, and they are arid, have thick sediments, are surrounded by mountains, and have low recharge and discharge relative to storage. 6/16/26 Tr. 1964 (comparing them to Anderson basins).

Under the Epstein/BBRM method, recharge rates are based on precipitation contours such that the surface area of a basin is apportioned according to the amount of annual precipitation in receives (8-10 inches, 10-12 inches, and so on); each portion of the surface area is then multiplied by an assigned recharge coefficient. *See* EX 65, pdf 25. "BBRM" stands for "Bootstrap Brute Force Recharge Model." The terms "Bootstrap" and "Brute-Force" are shorthand for the methods used to account for statistical uncertainty in the data. *See id.*, pdf 10, 24.

Dr. McKenna calculated 8,745 AFY average recharge to the Basin for the years 1981-2010 using these recharge rates. EX 60, pdf 24. Dr. McKenna used the surface area apportionment made by McGraw, such that recharge into Rose Valley is included in the calculation. *See id.* And, as he did with the Anderson calculation, Dr. McKenna excluded recharge from areas receiving less than 8 inches of precipitation. *See id.*

(iii) Dr. Tonkin's Critiques

Dr. Tonkin was the only TWG expert to testify about Dr. McKenna's regression calculations. He found no mathematical errors in Dr. McKenna's work. Both Dr. McKenna and Dr. Tonkin had identified mistakes in the calculations reported by McGraw, and Dr. Tonkin agreed that Dr. McKenna had corrected those mistakes. 6/16/26 Tr. 858:20-21.

Dr. Tonkin's only methodological criticism related to Dr. McKenna's exclusion of areas with 8 inches of precipitation or less (for convenience, "low-precipitation areas") from the Epstein/BBRM method. As noted above, Dr. McKenna testified that it is general practice to exclude low-precipitation areas from recharge calculations for arid basins because the water is presumed to be lost to evapotranspiration. 6/24/26 Tr. 1962-63; *see also id.* at 1966:10-15. With respect to the Epstein/BBRM method, Dr. McKenna performed a statistical analysis and confirmed that the

recharge rate associated with these low-precipitation areas was "not significantly different from zero." *Id.* at 1966:16-22.

Dr. Tonkin did not dispute Dr. McKenna's statements about the general practice in the industry or Dr. McKenna's statistical significance analysis. Dr. Tonkin testified only that the Epstein/BBRM recharge rates are so interrelated the low-precipitation areas cannot be excluded from the analysis. 6/15/26 Tr. 865-67; 6/16/26 Tr. 1000-1001. When Dr. Tonkin performed an Epstein/BBRM calculation, and accounted for uncertainty, he found that low-precipitation areas could generate anywhere from 0 to 14,070 AFY of recharge. *See* 6/16/26 Tr. 1004; EX 436 (demonstrative).

Dr. Tonkin's alternative Epstein/BBRM calculation provides support for Dr. McKenna's decision to exclude low-precipitation areas. Dr. McKenna testified that including low-precipitation areas in regression calculations adds "too much recharge" to the total and "degrades the fit" between the regression and the observed data. 6/24/26 Tr. 1963: 1-7. Dr. Tonkin's calculations bear that out. Dr. Tonkin's range of 0 to 14,070 AFY indicates that the precipitation occurring in low-precipitation areas either can have no effect on total recharge or that it can effectively double it. Even using the *mean* recharge value for the low-precipitation areas (6,520 AFY), the total recharge he calculates under the Epstein/BBRM method is 15,200 AFY, which is 3,400 AFY higher than the 11,800 AFY of natural recharge that Dr. Tonkin used in his own water budget. *See* 6/15/26 Tr. 869; EX 437 (demonstrative). Dr. Tonkin's calculations thus illustrate Dr. McKenna's point that including low-precipitation areas in the recharge calculation for an arid basin adds too much recharge and degrades the predictive value of the regression method.

Dr. Tonkin's only other critique of Dr. McKenna's use of the Anderson and Epstein/BBRM methods was that they are subject to large bands of uncertainty, and that Dr. Tonkin's own estimate of 9,200 AFY of mountain-front recharge fell within those bands. 6/15/26 Tr. 861-62; *id.* at 873-74; EX 439 (demonstrative). However, Dr. Tonkin testified that he uses regression methods "all the time" in his work, that they can be used to generate a "good first estimate," 6/16/26 Tr. 855:2-3, and that he is not "anti" empirical regression analysis. *Id.* at 853:20-21. Although Dr. Tonkin suggested that "physically based" or "site-specific" models may do more to explain the processes

that lead to recharge, 6/16/26 Tr. 817:5-10, Dr. McKenna's regression methods were derived from dozens of basins with similar aridity, topography, and hydrogeology to the IWV Basin.

Dr. Tonkin did not testify that Dr. McKenna's estimates from these regression methods were inaccurate or unreliable. And, tellingly, Dr. Tonkin did not testify that the estimates he derived from the Statewide BCM were more accurate and reliable than Dr. McKenna's.

b. Owens Valley Recharge Ratio

As an additional "check" on his work, Dr. McKenna compared the precipitation-to-recharge ratios in his Anderson and Epstein/BBRM calculations to the ratios in the Owens Valley. *See* 6/24 Tr. 1967-1985; EX 62; EX 1283; EX 1289. Dr. McKenna testified that the Owens Valley provides a useful comparison for the IWV Basin because the Owens Valley is the basin directly to the north along the Sierra Nevada and has been the subject of "considerable study" by the USGS and the Los Angeles Department of Water and Power ("LADWP"). 6/24/26 Tr. 1967:25-1968:3. Dr. McKenna noted that although the basins are similar, the hydrology of the Owens Valley differs from the IWV Basin in that it is cooler, receives more precipitation, and the precipitation is sufficient to support perennial streams. *Id.* at 1968: 9-20. He accounted for these differences in his analysis.

Dr. McKenna derived recharge ratios for the Owens Valley from a 1998 report, known as the Danskin report, prepared by the USGS and LADWP. *See* EX 1211 (Danskin, 1998). The Danskin report quantified precipitation and recharge volumes in the Owens Valley for the years 1970 to 1984. Dr. McKenna compared these reported volumes for areas that did not have perennial streams on the western (Sierra Nevada) side of the Owens Valley.[8] Dr. McKenna calculated a recharge ratio of 3.7% for these areas. 6/24/26 Tr. 1973-1974; EX 1289. Dr. McKenna obtained similar recharge ratios in his regression calculations for the period 1981 to 2010. *See* EX 1289. Under the Anderson method, Dr. McKenna's estimate of 7,462 AFY was 3.19% of the total

[8] Wicks questioned Dr. McKenna's decision to limit his comparison to certain areas. *See* 6/10/26 Tr. 692-699. Dr. McKenna more than sufficiently answered her questions: He explained that he excluded areas with precipitation sufficient to support perennial streams because the IWV Basin does not have perennial streams. *See* 6/24/26 Tr. 1969:13-1970:7. Dr. McKenna also explained that he limited his analysis to the recharge areas on the west side of the Owens Valley (along the Sierra Nevada) because he was comparing recharge values on the west side of the IWV Basin, and because the east side of the Owens Valley is in the "rain shadow" of the Sierra Nevada and receives considerably less precipitation. *Id.* at 1972

precipitation in that period; under the Epstein/BBRM method, Dr. McKenna's estimate of 8,745 AFY was approximately 3.74%. *Id.*

Dr. McKenna also showed that the 3.7% recharge ratio for the Sierra mountain front is consistent with the DRI Model's distribution of recharge. Dr. McKenna applied a 3.7 % recharge ratio in the Northern and Southern Sierra recharge areas of the IWV Basin for the years 1970 to 1984 and calculated 3,394 AFY of average annual recharge. 6/24/26 Tr. 1974:2-19. The DRI Model—which is calibrated to a long-term average of 7,650 AFY—assigns an average annual recharge of 3,370 AFY to the Northern/Southern Sierras, essentially the same as what would results from using the 3.7% ratio. 6/24/26 Tr. 1980: 22-25; EX 24, at 66. Thus, the 3.7 % recharge ratio appeared to be consistent across (1) the 1970 to 1984 period Danskin used for the Owens Valley, (2) the 1981 to 2010 period Dr. McKenna used in the Anderson and Epstein/BBRM calculations, and (3) the 1921-2023 period DRI used for its transient simulation.[9] Dr. McKenna testified that the consistency of the recharge estimates across different time periods "speaks to the consistency across the[] different techniques" he used to estimate recharge and strengthened his conclusion that 7,650 AFY is a reasonable estimate of long-term average recharge. 6/24/26 Tr. 1981: 11-15.

c. DRI Model Validation

Dr. McKenna also testified that the DRI Model's accuracy in simulating observed water using long-term average recharge of 7,650 AFY provides additional validation for his recharge calculations because the model represents the Basin's hydrogeology in detail, incorporating numerous data sources. *See* 6/24/26 Tr. 1988-1994; *see also* EX 60, pdf 32-36.

Dr. McKenna recognized that 7,650 AFY is a calibrated recharge value that does not, on its own, prove that average recharge to the Basin is 7,650 AFY. Dr. McKenna explained that groundwater models that employ very different assumptions about recharge can simulate the same water levels with similar accuracy. *See* 6/24/26 Tr. 1949-1952 (discussing non-uniqueness). Through the calibration process, a modeler can make adjustments to the aquifer parameters (such

[9] At trial, counsel mistakenly characterized the DRI Model base period as 2010-2023. 6/24/26 Tr. 1979. The DRI transient-historical simulation covers Water Year 1921 through Water Year 2022, which is equivalent to October 1, 1921 to September 30, 2023. EX 24, at 64.

as specific yield and hydraulic conductivity) and the boundary conditions (such as recharge and evapotranspiration), and combine them in different ways, to simulate the same set of water levels. *See* EX 1241, pdf 9 (USGS guidelines for groundwater models). For example, a model with high recharge and high hydraulic conductivity could achieve the same water levels as a model with low recharge and low hydraulic conductivity. *See* EX 61, pdf 19, fig. 5 (examples A and D); EX 218 (demonstrative); 6/24/26 Tr. 1949-52. Recharge from a calibrated model is preassigned by the modeler, and the model is calibrated to support the modeler's choice.

For purposes of his opinions, however, Dr. McKenna found it reasonable to consider the "high quality fit" that the 2025 DRI Model achieves with observed water levels because the model incorporates a large amount of data to represent the complex hydrogeology of the Basin. Dr. McKenna testified that the 2025 DRI Model is "a very good integration" of all the available data, that it "shows consistency" across all of model components, and that fits together all of the "pieces of the puzzle." 6/24/26 Tr. 1988: 7-1989:2. Those pieces include the hydrogeological conceptual framework, the representation of faults, aquifer property values, groundwater levels, and model calibration. 6/24/26 Tr. 1988:17-23. *See generally* EX 60, pdf 32-36. Dr. McKenna highlighted in particular DRI's use of aerial electromagnetic survey data and seismic studies to add significant detail to the representation of the Basin's fault system and clay unit. DRI used this data to represent how the fractured layers of the Basin aquifer are up-lifted and down-dropped against each other, and how those offsets influence the movement of water. *See* 6/24/26 Tr. 1990-93, 2030-31; 6/29/26 Tr. 2077-78; *see also* EX 24, pdf 25-31 (modeling of clay unit).

With this detailed representation of the Basin, and a variable recharge averaging to 7,650 AFY over 102 years, the DRI Model simulates observed water levels in the Basin with a high degree of accuracy. Dr. McKenna testified that the 2025 DRI Model "calibrates very, very well," and in particular, the calibration statistics for the transient model (for the years 1921 to 2023) are "twice as good" as the those for the previous version of the model. 6/24/26 Tr. 1990: 11-21; *see* EX 60, pdf 35 (comparing 2020 and 2025 model calibration statistics). Dr. McKenna found it notable that DRI achieved that level of calibration using "three times the number of water level observations"

than were used in the earlier model. *Id.* *See* EX 24, pdf 79 (noting that 2025 model uses measurements from 189 wells compared to the 50 used in the 2020 model).

Dr. McKenna explained that the fit achieved by the DRI Model supports his opinion that the recharge rate of 7,650 AFY used in the model is "very reasonable, given all the of the data in the context of the Indian Wells Valley." 6/24/26 Tr. 1989: 4-8. *See also* EX 60, pdf 36.

d. Consistency with Prior Studies

The Groundwater Authority's expert, Dr. Kincaid, testified to an opinion that total recharge to the Basin is between 6,100 AFY and 8,400 AFY, which is consistent with Dr. McKenna's estimates. *See* EX 80, pdf 3; 6/22/26 Tr. 1588: 10-14. Dr. Kincaid derived this range by examining previous studies and estimates in the literature, while excluding outliers. *Id*. at 1597-1599.

2. Dr. Tonkin's Estimate of 11,800 AFY of Natural Recharge Depends on Unsupported Assumptions and an Improper Base Period.

Dr. Tonkin's safe yield estimate includes 9,200 AFY of mountain-front recharge and surface-runoff recharge, as well as 2,600 AFY of interbasin flow from Rose Valley. Neither amount is credible.

a. Mountain-Front Recharge and Surface-Runoff Recharge

Dr. Tonkin's estimates of mountain-front recharge and surface-runoff recharge are based on the inputs to the Ramboll Model in the years 1980 to 2023, which are derived from the Statewide BCM. *See* EX 123, pdf 38; EX 97, pdf 41-42; *id.*, pdf 69. Dr. Tonkin admitted that he had not made calculations using the Statewide BCM prior to this litigation, and that the only calculations he performed with the Statewide BCM for purposes of his testimony were for "QA" (quality assurance) on the Ramboll Model. 6/16/26 Tr. 939.

Dr. Tonkin presented no justification for using the Statewide BCM to estimate recharge in the IWV Basin other than the fact that Ramboll had already decided to use the Statewide BCM in its model. *See id.* at 949 (admitting the idea to use the BCM came from Ramboll).[10] In an attempt to distinguish the Statewide BCM from the regression methods used by Dr. McKenna, Dr. Tonkin

[10] The Water District retained Dr. Tonkin at the end of February 2025, after the Water District's senior modeler at Ramboll resigned.

characterized the Statewide BCM as a "physically based" model that provides "more site-specific estimates" because it uses "site-specific values and parameters." 6/15/26 Tr. 817:8-9. But the Statewide BCM was not calibrated to site-specific values and parameters in the IWV Basin, hence the need for a separate Local BCM, *see* EX 363.

In fact, Dr. Tonkin failed to show that the Statewide BCM was calibrated to conditions in any basin with the aridity, topography, and lithology of the IWV Basin. Dr. Tonkin could not say whether the Statewide BCM is calibrated to any basin in the Basin and Range province, 6/15/26 Tr. 939, and there is no evidence showing that it was.[11] Other evidence in the record also suggests that the Statewide BCM tends to overestimate available water in arid basins. Jean Moran, a non-retained expert for the Groundwater Authority, testified that an earlier version of the Statewide BCM "produced too much water" to be used for modeling in the arid Anza-Terwilliger Basin. 6/8/26 Tr. 170: 13-19; *see also* 6/9/26 Tr. 399. And Dr. McKenna showed that in 2017, the Statewide BCM overestimated stream-gaged runoff in the IWV Basin by more than 300%. EX 61, pdf 25; *id.*, pdf 27 fig.7.

Here, despite his emphasis on "site specific" and "physically based" calculations, 6/15/26 Tr. 817:6, Dr. Tonkin's reliance on the Statewide BCM caused him to misrepresent an important site specific, physically based aspect of the Basin's hydrology: **The Coso Range and part of the Argus Range drain into Airport Lake, not the IWV Basin**. *See* 6/29/26 Tr. 2074 (McKenna); *see also* EX 61, pdf 22-23, fig. 6. Airport Lake is a dry playa that has no outlet. *See id.* Dr. McKenna testified that mountain-front recharge in the Coso and Argus Ranges cannot be counted as direct recharge to the IWV Basin but must instead be treated as subsurface flow, akin to the subflow from Rose Valley. *See id.;* 6/24/26 Tr. 2062-2063. Dr. McKenna showed that correcting this error in the Ramboll Model's water budget for the years 1986 to 2023 reduced mountain-front recharge by about 700 AFY. *See* 6/29/26 Tr. 2075; EX 61, pdf 24, t.4. Dr. Tonkin's extended 1980

[11] Dr. Tonkin testified that the Statewide BCM model report includes a list of the basins used to calibrate it, and he could not recall whether any were in the Basin and Range. 6/15/26 Tr. 939. The report, EX 242, does not include a list of the basins used in calibration.

to 2023 period, which has higher average recharge, likely would require a deduction larger than 700 AFY.

Dr. Tonkin's inclusion of recharge from surface runoff was also shown to be unsupported. This recharge component also came from Ramboll's water budget, where Ramboll assumed that 15% of surface runoff in the Basin becomes recharge to the groundwater system. *See* 6/16/26 Tr. 956; EX 97, pdf 74. The Ramboll water budget has an average 500 AFY of surface-runoff recharge in the transient simulation, EX 97, pdf 94, t. 6-6, and an average 886 AFY in the steady-simulation that was added into Dr. Tonkin's safe yield estimate, *see id.*, pdf 76 t. 5-7. When Dr. Tonkin asked Ramboll to supply the basis for the 15% figure, Ramboll provided Dr. Tonkin with an excerpt from a 2007 USGS report relating to an earlier version of the BCM. *See* 6/16/26 Tr. 962-964. However, as Dr. McKenna pointed out, the current version of the Statewide BCM—the one used by Ramboll—includes recharge from surface runoff in its water-balance accounting, making it unnecessary to add *more* recharge from surface runoff unless there is data to support doing so. *See* 6/29/26 Tr. 2075-76; EX 61, pdf 24. Dr. Tonkin, who simply adopted Ramboll's model inputs, did not testify to any data supporting the inclusion of surface-runoff recharge in the IWV Basin using the current Statewide BCM. Removing surface-runoff recharge of more than 500 AFY and Airport Lake recharge of 700 AFY would reduce Dr. Tonkin's estimate of direct natural recharge from 9,200 AFY to less than 8,000 AFY.

Other than using the Statewide BCM to "QA" Ramboll's calculations, Dr. Tonkin provided no independent analysis or modeling to support his estimate of 9,200 AFY for mountain-front and surface-runoff recharge. Dr. Tonkin attempted to use the Anderson and Epstein/BBRM methods to support his estimates, but the most he could show was that his estimate of 9,200 AFY fell within the bands of uncertainty for those methods. *See* pp. 24-25, *supra*. Dr. Tonkin's modeler, Dr. Bedekar, attempted to demonstrate that the inflows in the Ramboll Model correspond well with observed precipitation, but to support that testimony he presented graphs showing only that the BCM-modeled recharge aligns with BCM-modeled precipitation and snowpack in the Northern Sierra zone, which is hardly surprising. *See* 6/16/26 Tr. 1132-34; EX 244 (demonstrative based on

EX 48, pdf 32, fig. 6-3). The only other source Dr. Bedekar cited was the precipitation record at the China Lake gaging station on the playa, where no recharge occurs. *See id.*

In sum, Dr. Tonkin's estimate of 9,200 AFY of mountain-front and surface-runoff recharge is based solely on the preselected inputs to the Ramboll Model from the Statewide BCM, and those inputs are not supported.

b. Rose Valley

Dr. Tonkin would also include 2,600 AFY of recharge from Rose Valley subflow in his estimate of natural recharge to the Basin, because that is the value that Ramboll used in its water budget. The 2,600 AFY estimate is a calibrated model value without evidentiary support. According to the model report, Ramboll initially included 2,100 AFY of Rose Valley subflow in the deeper layers of the model, but later added 466 AFY to the shallow layers "to provide[] better calibration." *See* EX 97, pdf 69. The report supplies no empirical basis for the 466 AFY addition. The report speculates only that surface water runoff "could" account for the additional water at this location, *id.*, and the only citation offered to support this speculation is a link to the Statewide BCM, *id.* n.23. As noted above, the Statewide BCM is not calibrated to the IWV Basin and does not support the addition of recharge from runoff without an evidentiary basis.

Dr. Tonkin offered no independent support for Ramboll's 2,600 AFY value for Rose Valley subflow. Dr. Tonkin acknowledged that 2,600 AFY is a calibrated value, 6/15/26 Tr. 983, and that it is higher than all previous estimates of Rose Valley subflow in the past century, including the TWG's estimate of 2,200 AFY based on a literature review. 6/16/26 Tr. 986-987; *see* EX 4, pdf 9, 17. Dr. Tonkin also acknowledged that the amount of Rose Valley subflow is subject to ongoing study and is "highly uncertain." 6/16/26 Tr. 987- 988; *see also* Tech. Rep. 13. And Dr. Tonkin admitted that, if he had used the Epstein/BBRM method to support his estimate of mountain-front recharge of 9,200 AFY, that estimate would have already incorporated recharge from Rose Valley, such that including an *additional* 2,600 AFY to represent it the water budget would be double-counting. 6/16/26 Tr. 1012.

Dr. Tonkin's inclusion of 2,600 AFY of Rose Valley subflow in his estimate of natural recharge is based on Ramboll's modeling, not his own expertise, and has no evidentiary support. \

c. 1980-2023 Base Period

Dr. Tonkin's estimate of natural recharge is also significantly influenced by his selection of a 1980 to 2023 base period, which is bookended by periods of above-average precipitation. *See* EX 123, pdf 55, fig. 3-6; *id.*, pdf 64, fig. 4-7. It is well established that estimates of inflows must be based on a representative base period. In *San Fernando*, for example, the sources of recharge and discharge were evaluated over a 29-year base period "for which (1) adequate hydrological data was available and (2) precipitation figures were representative, in both average level and fluctuations, of the 85 years for which weather records were relatively complete." 14 Cal. 3d at 279. *See also* Cal. Water Code § 10721 (w) (requiring sustainable yield to be "calculated over a base period representative of long-term conditions in the basin").

Dr. Tonkin provided no justification for selecting a base period of 1980 to 2023. No other expert or source has used a base period of 1980 to 2023 to estimate recharge in the IWV Basin. The period 2014-2023 includes several of the highest-precipitation years on record, including a tropical storm that appears to be without precedent. See EX 123, pdf 55, fig. 3-6, EX 48, pdf 45; *see also* 6/22/26 Tr. 1573:24-1574:6. Dr. Tonkin agreed that the years 2014 to 2023 were "wetter" years, *see, e.g.*, 6/16/26 Tr. 1058:7-14, so wet, in fact, that he did not believe 2014 to 2023 was an appropriate base period. *See* EX 123, pdf 38.[12] The Ramboll Model's transient simulation uses the period 1986 to 2023, and includes that wet period as well as drier conditions before it. Dr. Tonkin nevertheless added recharge from the Ramboll steady state period of 1980 to 1985, which is the second wettest period (after 2014-2023) in the 120-year period of record, 60% wetter than the long-term average. *See* 6/24/26 Tr. (McKenna) 2055:10-12; EX 61, pdf 32, fig. 8. The average mountain-front-recharge in the Statewide BCM for 1980-1985 is 14,255 AFY, compared to 7,700 AFY in the 1986-2023 period. *See* EX 97, pdf 67, t.5-4, 97, t.6-6. Given that the 2014-23 wet period is included in the Ramboll 1986-2023 transient simulation, there was no reason for Dr. Tonkin to use these *additional* high-recharge years in 1980 to 1985 in the base period, except to inflate the average recharge that would result.

[12] Dr. Tonkin's decision to retain 2023 in the base period is also unsupported, as he admitted that Ramboll did not have complete data for that year. 6/16/26 Tr. 1058. 13-17.

Dr. Tonkin acknowledged that his use of a 1980 to 2023 base period inflated his estimate of recharge from the Statewide BCM relative to the base periods. Dr. Tonkin admitted that adding the period 1980-1985 to his base period resulted in higher average natural recharge than he would have calculated using the Ramboll transient period of 1986 to 2023. *See* 6/16/26 Tr. 961. Dr. Tonkin also calculated that, with a 1981 to 2010 base period, the Statewide BCM would simulate average natural recharge "within 2 or 3 percent" of 8,680 AFY (around 8,420 – 8,940 AFY). *See* 6/16/26 Tr. 978 (comparing Statewide BCM to Local BCM recharge). Dr. Tonkin also could have used the Statewide BCM to calculate natural recharge using a much longer base period (such as the 1921 to 2023 period of DRI's transient simulation) because it models recharge back to 1896. EX 242, pdf 17. Dr. Tonkin did not do so, however, because his estimate was dependent upon what was available to him in the Ramboll Model.

In sum, Dr. Tonkin's use of a 1980-2023 base period appears to have been selected to generate the highest possible estimate of natural recharge. Dr. McKenna's estimates cover a range of base periods, including the 1981 to 2010 period used by McGraw, the Statewide BCM, and the Local BCM, and have additional validation in the 2025 DRI Model, which uses the period 1921-2023. Dr. McKenna's estimates are more representative and, therefore, more reasonable.

3. Dr. Tonkin's Calculations Support 7,650 AFY of Natural Recharge.

A change in storage analysis using Dr. Tonkin's calculations shows that, when an appropriate base period is used, 7,650 AFY is a reasonable estimate of natural recharge in the IWV Basin. Although a change in storage analysis does not provide an accounting of inflows and outflows, as the definition of safe yield requires, it provides additional support for the conclusion that 7,650 AFY is an appropriate estimate of long-term average natural recharge and maximum safe yield.

A change in storage analysis is can be used to estimate safe yield with the following equation: **Safe Yield = Change in Storage + Pumping + Evapotranspiration**. Table 4-1 of Dr. Tonkin's Report shows the change in storage, pumping, and evapotranspiration generated by running the Ramboll Model. EX 123, pdf 66. On cross-examination, Dr. Tonkin was asked to use the information in Table 4-1 to conduct a change in storage analysis over the period of 1990-2015.

See 6/16/26 Tr. 1078-1082. This period excludes the wet years in 1980 to 1985, 2017, and 2023; it is the period used as the balanced hydrologic period in the GSP, EX 108, pdf 177; and it is similar to the 1991-2014 period the TWG originally considered for its Safe Yield paper. *See* EX 92. Dr. Tonkin agreed that with the 1990-2015 base period, a change of storage analysis results in a safe yield of 9,890 AFY, accounting for evapotranspiration. 6/16/26 Tr. 1079.

The 9,890 AFY figure, however, includes all of the sources of recharge assumed in the Ramboll Model, including anthropogenic recharge To isolate natural recharge, Dr. Tonkin was asked to assume that irrigation returns had not yet reached the water table in 1990 to 2015. 6/16/26 Tr. 1080; *see also id.* at 1071-72 (discussing lag time). Dr. Tonkin was also asked to assume that these returns ranged from 1,600 AFY on the low end, to 2,100 AFY on the high end, as estimated by Ramboll. *See id.* at 1081; EX 97, pdf 45. Dr. Tonkin agreed that subtracting the irrigation returns resulted in a safe yield range of 7,790 AFY and 8,290 AFY. 6/16/26 Tr. 1081.

As discussed in more detail below, the principle of lag time supports the deduction of all of the sources of anthropogenic recharge in Dr. Tonkin's water budget, not only irrigation returns. For example, the Ramboll Model (and, thus, Dr. Tonkin) assume 1,320 AFY of recharge from water system leakage, Los Angeles Aqueduct leakage, and percolation from the wastewater treatment ponds. *See* EX 97, pdf 45. If this other recharge is subtracted from Dr. Tonkin's calculations, the safe yield range becomes 6,470 AFY to 6,970 AFY. This range is consistent Dr. Kincaid's estimated safe yield range, and with Dr. McKenna's opinion that safe yield would need to be less than total recharge of 7,650 AFY to account for evapotranspiration. *See* Summary Table at p. 8, *supra*.

B. THE TWG's OBJECTIONS TO THE USE OF 7,650 AFY IN THE DRI MODEL ARE IRRELEVANT AND UNSUPPORTED.

The TWG spilled considerable ink and consumed much time at trial criticizing DRI's calibration of its model to an average recharge of 7,650 AFY. *See, e.g.*, TWG Joint Pretrial Br., Argument I. These critiques are irrelevant to Dr. McKenna's opinions because Dr. McKenna made independent calculations to support his recharge estimates, did not calibrate those estimates in any way, and cited the 2025 DRI Model only as a source of validation for those calculations. The TWG's criticisms are contradicted by the record in any event.

1. The TWG's Objections to McGraw's Calibration to 1920 Conditions Are Irrelevant and Unsupported.

The TWG contends that the 7,650 AFY recharge estimate in the DRI Model should be rejected because it results from the use of a two-dimensional model ("the 2-D Model") to calibrate recharge to historical conditions that were drier than average and not representative of a predevelopment condition. These contentions have no bearing on Dr. McKenna's opinions because he did not use the 2-D Model or the outputs of the 2-D Model in his analysis, and he did not calibrate his recharge calculations to historical conditions.

The 2-D Model was a tool used by McGraw and his DRI co-authors (for convenience, "McGraw") to develop an updated recharge estimate for the Basin. *See* EX 21, pdf 26. McGraw used the Epstein/BBRM method to calculate recharge using precipitation data from 1981 to 2010, then used the 2-D Model to "adjust the magnitude and spatial distribution of recharge until there was a general agreement between the simulated and measured predevelopment (1920 to 1921) water levels." *Id.* Application of the 2-D Model reduced the estimated recharge from 9,265 AFY under the Epstein/BBRM method to 7,650 AFY. *See id.*, pdf 27-28 (rounding to 7,700 AFY). DRI used 7,650 AFY as the recharge for every year in its three-dimensional model in 2016. In its 2025 model, DRI varied the recharge in its 2025 model based on precipitation data and scaled it to 7,650 AFY over a century-long transient simulation. *See* EX 24, pdf 66-67.

None of the TWG's objections to McGraw's calibration apply to Dr. McKenna's testimony or to the 2025 DRI Model.

Unavailability of the 2-D Model. The unavailability of the 2-D Model is not relevant because Dr. McKenna did not use McGraw's 2-D Model or rely upon the determinations McGraw made when by applying the 2-D Model. *See* 6/29/26 Tr. 2159: 13-14; *see also* 6/16/26 Tr. 997-98 (Dr. Tonkin, agreeing that Dr. McKenna had not used the 2-D Model).[13] Dr. McKenna used precipitation data from 1981 to 2010 and calculated recharge of 7,462 AFY and 8,745 AFY using

[13] The Water District requested production of the 2-D Model files on September 22, 2025. The United States' responses, served November 22, 2025, stated that the United States did not have files responsive to the request. No party served additional discovery requests or subpoenas to obtain the model files or requested to meet and confer with the United States about the discovery response.

the Anderson and Epstein/BBRM methods, respectively. He then compared the recharge ratios associated with those calculations to the ratios calculated for the Owens Valley over a 1970 to 1984 period. None of these calculations used or depended upon outputs from McGraw's 2-D Model.

Calibration to 1920-1926 Dry Period. The TWG's allegation that McGraw calibrated recharge to dry conditions in the years 1920 to 1926 is irrelevant and unsupported. It is irrelevant because Dr. McKenna did not use McGraw's results and did not calibrate his calculations to historical conditions; it is unsupported because the TWG did not show that McGraw used water levels from a seven-year dry period. McGraw used the 2-D Model to achieve a "general agreement between simulated and measured predevelopment (1920 to 1921) water levels." EX 21, pdf 26. McGraw's report refers to data from 259 well locations for the year 1920, and to "interpolated values generated by Brown and Caldwell." *Id.* The report clarifies that Brown & Caldwell's measurements were originally published as Plate 2 in a 1973 USGS study (Dutcher & Moyle). There are no references in Brown & Caldwell (EX 67) or Dutcher & Moyle (EX 1012) to water level measurements from years after 1921.[14]

The distinction between the 1920-1926 "dry period" asserted by the TWG and the 1920-21 period that McGraw actually used is significant. Dr. Tonkin agreed that there would be a "lag" before the water levels in the aquifer showed the influence of a 1920 to 1926 dry period. *See* 6/16/26 Tr. 1012-13. By the same logic, the influence of dry conditions in 1920 and 1921 would not be reflected in the same-year water level measurements used for McGraw's calibration. Instead, the 1920-1921 water levels used by McGraw would have reflected, if anything, the precipitation that occurred before then, in years that Dr. Tonkin agreed were "wetter," 6/16/26 Tr. 1013:8-12.

[14] Dr. Tonkin testified only to an "understanding" that McGraw used water levels from 1920 to 1926 to calibrate the Epstein/BBRM recharge estimate. *See, e.g.*, 6/16/26 Tr. 995; *see also, e.g.*, 6/15/26 Tr. 847, 849, 864. His understanding was based on stray references in the McGraw report to "observed water levels prior to 1926." *See, e.g.*, EX 21, pdf 19. Nothing in the McGraw report explains "prior to 1926" or indicates that water levels from 1922 to 1926 were used, or even available. Dr. Tonkin did not review the Brown & Caldwell model to confirm his "understanding," *see* 6/16/26 Tr. 1011, nor, apparently, did he consult Plate 2 in Dutcher & Moyle, which McGraw cites as the source of the measurements. *See* EX 21, pdf. 16. Plate 2 shows water levels for 1920-21. *See* EX 1012, pdf 4 (table of contents). Plate 2 is not in the exhibit copy but is available at https://pubs.usgs.gov/wsp/2007/plate-2.pdf.

Pumping vs. Predevelopment Conditions in 1920. McGraw's use of 1920 as a "predevelopment" condition despite the occurrence of some pumping has no relevance to Dr. McKenna's opinions or to McGraw's calculations. As noted, Dr. McKenna did not rely upon McGraw's calibration to 1920 conditions or make any independent attempt to calibrate his recharge estimates to a "predevelopment" baseline. The McGraw report indicates that pumping in 1920 was less than 1,000 AFY or less, *see* EX 21, pdf 28, but McGraw did not include pumping in his recharge calculations because the methods he used were based strictly on precipitation and recharge ratios. *See generally id.* at 22-27. Dr. Tonkin did not quantify the amount of pumping occurring in 1920 or suggest that accounting for it would have changed McGraw's calculations in any material way.

The 1929 Thompson report, which Dr. Tonkin cites, is also unavailing for the TWG. The report is based on a survey of the Basin in 1919. *See* EX 487, pdf 187-189. The report describes the number of wells and pumping plants, the types of crops being grown, the estimated irrigation demand, and some anecdotal evidence about crop production. *See id.* The Thompson report does not quantify pumping in the Basin as of 1920. The map of the Basin in the report, although it shows many wells, depicts the wells where it was "probable" that water could be obtained year-round. *See id.*, pdf 158. The reports notes that some of the wells have no pumping equipment or were only pumped for limited periods. *See id.* The map is not intended to represent active wells or total groundwater extraction in 1920.

DRI's Use of 7,650 AFY in Subsequent Model Updates. The TWG's real aim in challenging McGraw's calibration is to undermine the 7,650 AFY recharge estimate in the 2020 version of the DRI Model used for the GSP. *See, e.g.*, 6/9/26 Tr. 346:5-26 (cross-examination of Moran as to whether the 2016 model calibration was "carried forward" into the 2020 GSP modeling). The validity of the GSP and the modeling to support it are not before the Court, and the TWG's objections to the use of a "1920-1926" calibration period are inapplicable to the 2025 DRI Model. The steady state simulation in the 2025 DRI Model is based on conditions prior to and including 1920. *See* EX 24, pdf 65; 6/29/26 Tr. 2082. The transient simulation covers 1921 to 2023, with monthly and annual variations in recharge that achieve an average 7,650 AFY over that 102-year period. EX 24, pdf 66-67. The methods DRI used to improve the representation of

mountain-front recharge in the model are described in the model report and an accompanying Technical Memorandum that were not referenced by the TWG experts. *See id.*, pdf 134. [15]

2. Dr. Bedekar's Criticisms of the DRI Model are Not Credible.

The only witness who offered criticism of the 2025 DRI Model was Dr. Vivek Bedekar, who is employed by the same firm as Dr. Tonkin, and was retained by the Water District. Dr. Bedekar testified that the 2025 DRI Model does not show a sufficient response to high-inflow events and has improper storage parameters. *See generally* 6/16/26 Tr. 1132-1163; 6/17/26 Tr. 1174-1196; EX 50. Dr. Bedekar's opinions are largely irrelevant because Dr. McKenna did not use the 2025 DRI Model to calculate safe yield. Dr. Bedekar's opinions also lack credibility because they are based on incomplete calculations or asymmetrical comparisons, and he ignored problems in the Ramboll Model of a far more significant magnitude.

a. Response to High Inflows

Dr. Bedekar testified that the 2025 DRI Model cannot be used to estimate inflows because it does not "reproduce some of the observed groundwater responses" to inflow events. *See* 6/16/26 Tr. 1126:10-12. This criticism turned out to be limited to the model's simulation of recharge after the 2017 outlier year. Dr. Bedekar testified that the DRI Model generally captured the observed hydrologic data "quite well." *See id.* at 1139:10-13. Although he suggested that average recharge of 7,650 AFY was problematic in light of McGraw's calibration, *see id.* at 1138:16-25, Dr. Bedekar did not allege or show a mismatch between the variable recharge in the 2025 DRI Model and observed precipitation.[16]

Dr. Bedekar next compared how the Ramboll Model and DRI Model simulated water levels after 2017, when there was abnormally high precipitation and an intentional release of water from

[15] When the Navy transferred management of the DRI Model to the Groundwater Authority, the Groundwater Authority agreed to implement measures to protect the integrity of the model through a Configuration Management Plan. *See* 6/8/26 Tr. 167; *id.* at 190; *see also* Tech. Rep. 37 n.18. The Configuration Management Plan requires any changes to the model to be fully documented and peer-reviewed. *See* EX 929, pdf 1501-11 (plan); *see, e.g.*, EX 24, pdf 126.

[16] Dr. Bedekar inaccurately stated that the inflows in the 2025 DRI Model are taken from the inflows in the 2016 McGraw report. 6/16/26 Tr. 1129:21-22; *but see* EX 24, pdf 66; *id.*, pdf 87, fig. 5-18; *id.*, pdf 134.

the Los Angeles Aqueduct. *See generally* 6/16/26 Tr. 1141-1143; EX 249 (demonstrative based on EX 50, pdf 20, fig. 2-4). The graphs compare the model-simulated water levels to the observed water levels at a single well location on the west side of the Basin. *See* 6/17/26 Tr. 1257:9-11. Based on the graphs, Dr. Bedekar testified that "the wet year inflow is missing" in the DRI Model simulation. 6/16/26 Tr. 1143:7-8. On cross-examination, however, Dr. Bedekar admitted that he used a different vertical axis for the DRI Model hydrograph, and that doing so had the effect of exaggerating the difference between the observed and simulated water levels. *See* EX 249; 6/17/26 Tr. 1255:22-1256:9. And, later, Dr. Bedekar testified that there are only "sparse" water level measurements on the western side of the Basin, and that this "data limitation" makes it difficult to simulate the inflows occurring in that area. *See* 6/17/26 Tr. 1211:20-1212:1; 1253:1-7. In light of these concessions, Dr. Bedekar had no basis to suggest that the water levels at his selected well location are representative of water levels in the western part of the Basin, or that they supply a sound basis for evaluating how numerical models simulate inflows.

Dr. Bedekar's graphs show, if anything, that the DRI Model is the better tool for representing safe yield. As Dr. McKenna pointed out, Dr. Bedekar's graphs show that the DRI Model simulated water levels in Layer 2 that closely track the observed water levels over a 30-year period and reflected a rise in the water level a year or so after 2017, consistent with observed water levels. *See* 6/24/26 Tr. 2006-2008 (discussing EX 249/EX 50, pdf 20).

The same cannot be said of the Ramboll Model. On Dr. Bedekar's hydrographs, the slope of the simulated water levels in the Ramboll Model does not match the slope of the observed water levels. *See* EX 50, pdf 20. Further, the Ramboll Model simulates the high inflows from 2017 event recharging the deeper layers of the aquifer instantly, whereas the measured water levels show a delayed response. 6/24/26 Tr. 2007 . Dr. Bedekar made this same observation, and testified that he thinks Ramboll should *add* this "lag" to its model, which does not currently represent it. 6/16/26 Tr. 1209: 6-10. The simulated water levels in Layer 2 of the Ramboll Model are also higher than the observed measurements in every year of the 30-year period on the graph. *See* EX 50, pdf 20. Dr. Bedekar's graphs demonstrate that the DRI Model is more capable of simulating observed water

levels than the Ramboll Model, and that his testimony comparing the responsiveness of the models is off the mark.

b. Storage Parameters

Dr. Bedekar's rebuttal testimony focused primarily on the storage properties in the 2025 DRI Model. In his report, Dr. Bedekar opined that the DRI Model simulates a high degree of "storativity" in the Basin in order to accommodate inflows that, in his view, are too low. See EX 50, pdf 11-13. Storativity is a measure of how much water can be stored in and released from an aquifer. 6/24/26 Tr. 2009 (McKenna). In a confined aquifer, storativity is a function of specific storage, while in an unconfined aquifer, it is overwhelmingly a function of specific yield. *See* 6/24/26 Tr. 2009-2010; *see also* EX 1241, pdf 17 (USGS guidelines). Dr. Bedekar repeatedly blurred these distinctions in his opinions and testimony.

Storativity and Specific Yield In Layer 1. Dr. Bedekar offered no testimony or evidence showing that the DRI Model incorrectly represents storativity in Layer 1 of the model, which is the unconfined part of the aquifer where most pumping occurs. *See* 6/17/26 Tr. 1243:21-22.[17] Storativity in Layer 1 is governed by specific yield. *Id.* Dr. Bedekar did not criticize the specific yield values in the 2025 DRI Model. At trial, Dr. Bedekar clarified that his opinion was limited to how the DRI Model represents the compressed (confined) aquifer where storativity is governed by specific storage. *See* 6/17/26 Tr. 1175:11-1176:4.

Specific Storage Values. Dr. Bedekar's criticism of the specific storage values in the DRI Model is unsupported and, even if it were supported, would apply with greater force to the Ramboll Model, which Dr. Bedekar endorses. At trial, Dr. Bedekar opined that the specific storage (hereafter, "Ss") values in the DRI Model are too high and appear to have been "inflated" to compensate for lower recharge. *See* 6/17/26 Tr. 1176:25-1177:5; *see also* EX 50, pdf 13. To support this opinion, Dr. Bedekar noted that 40% of the cells in the DRI Model have an Ss greater than

[17] In his report, Dr. Bedekar refers to a finding that the majority (50-60%) of water released from storage in the DRI Model comes from confined units, not from the unconfined units. *See* EX 50, pdf 12. Dr. Bedekar does not cite the source of this finding or provide supporting calculations for it, and he did not testify to this finding at trial.

0.0004, which he characterized as "hitting the limits" for the materials in the aquifer. *See* 6/17/26 Tr. 1178:25-1179:2; EX 255 (demonstrative). But the table of Ss values that Dr. Bedekar used to form this opinion shows Ss values above 0.0004 for clay and for sand and gravel, *see id.*, which are the primary components of the Basin fill. *See* Tech. Rep. 18. And Dr. Bedekar's finding that 40% (less than half) of the cells in the model have values at the higher end of the range does not demonstrate a lack of correspondence between the model and the subsurface materials in any given area of the aquifer. Dr. McKenna showed that the Ramboll Model—which Dr. Bedekar endorses—uses a similar range for Ss. *See* EX 63, pdf 8 (purple lines); 6/24/26 Tr. 2017:9-22.

Dr. Bedekar came up short in his efforts to identify any actual mismatch between the DRI Model's Ss values and known aquifer characteristics. At trial, Dr. Bedekar presented figures purportedly showing that the DRI Model has high Ss values in areas with coarse materials, when high Ss is typically associated with finer-grained materials. *See* EX 257 (demonstrative from EX 50, pdf 22). These figures are misleading, in several respects. First, Dr. Bedekar claims to identify a mismatch for Ss in Layer 1, which is an unconfined unit where specific yield (not Ss) is the relevant storage parameter. For Layer 2, Dr. Bedekar did not identify any mismatch. And, although Dr. Bedekar illustrates a mismatch for the Ss in the deeper layers, Dr. McKenna showed that the Ramboll Model has higher Ss values at depth than the DRI Model. *See* EX 63, pdf 8 (purple lines); 6/24/26 Tr. 2017:9-22. In fact, Dr. McKenna was "very surprised" by just how high the values in the Ramboll Model were. *Id.* at 2019:11. He noted that Ramboll's values are higher than what would be predicted using a model created from a global dataset. *See id.* at 2020-2021. Dr. Bedekar's opinion that the Ss values in the DRI Model are too high cannot be credited when the Ramboll Model has values that are the same or higher. Further, Dr. McKenna testified that the storativity values based on Ss in Layer 2 and the lower, fully confined layers of the DRI Model are reasonable. *See* 6/24/26 Tr. 2010:13-17.

Dr. Bedekar also presented figures purportedly showing that the 2025 DRI Model has higher Ss values for coarse materials than those in the earlier version of the model used for the 2020 GSP. These figures do not support Dr. Bedekar's point because they do not identify which layers and materials they represent. The figures depicting Ss in the 2025 DRI Model appear to represent

Layers 3 through 6, which represent the deeper, confined areas of the aquifer. *Compare* EX 258 (demonstrative) *with* EX 50, pdf 31, fig. 2-9. What the figures do show is that the Ss values in the 2025 model are more varied in distribution in these layers than they were in the earlier model. Dr. McKenna's figures, which provide greater resolution than Dr. Bedekar's, show that the distribution of Ss is more nuanced in the DRI Model than what Dr. Bedekar represented, and far more nuanced and varied than the distribution in the Ramboll Model. *See* 6/24/26 Tr. 2018-2021; EX 63, pdf 7.

Storativity Comparisons. Dr. Bedekar's other opinions about storativity were based on misleading comparisons and should be disregarded. For example, Dr. Bedekar presented a map of storativity in the Basin to suggest there are mismatches between the DRI Model and the aquifer materials in particular areas. *See* EX 50, pdf 28, fig. 2-12; EX 259 (demonstrative); *see, e.g.* 6/17/26 Tr. 1185:12-1186 (opining that the DRI Model's high storativity values for the coarse materials in in the western part of the Basin are a "red flag"). But Dr. Bedekar calculated storativity using Ss, which is not appropriate for the unconfined aquifer represented by Layer 1, *and* his map combines the storativity values for all layers of the DRI Model together, so that those incorrect values cannot be extracted. *See* EX 50, pdf 11; 6/17/26 Tr. 1185:12-21; 1250:22-1251:3; 1317:14-1318:4. Similarly, in his rebuttal report, Dr. Bedekar graphed the specific storage values for all model layers together, including Layer 1 where specific storage is not the relevant parameter. *See* EX 50, pdf 22, fig. 2-6 (a). He also graphed storativity values from all layers of the DRI Model together in a comparison to the hydraulic conductivity and specific yield values, respectively, from all layers together. *See id.*, pdf 24, fig. 2-7. The graphs thus include—but do not identify—the irrelevant values for Layer 1, and they do not demonstrate a mismatch in any particular area of the model. Dr. Bedekar's graphs, like his map, cannot be used to draw any valid conclusion about the DRI Model.

Dr. Bedekar's testimony comparing storativity in the DRI Model to "site-specific" aquifer test results was also improper. *See* 6/17/26 Tr. 1182-1183. At trial, Dr. Bedekar showed field measurements from aquifer tests at the Water District's Well 10 and at the Quist Ranch well. *See* EX 257 (demonstrative based on EX 50, pdf 24, fig. 2-8). Dr. Bedekar testified that "the values used by the [DRI] Model are one to two orders of magnitude greater than [those] analyzed" at the

two well locations. *See* 6/17/26 Tr. 1182:25-1183:1. But Dr. Bedekar did not identify the storativity values in the areas of the DRI Model domain that correspond to the well locations. He thus lacks any basis for his opinion that the DRI Model's storativity is inconsistent with the measured values. In his rebuttal report, Dr. Bedekar stated that the "majority" of the values in the DRI Model—not *all* of the values, or the site-specific values—are greater than the measured values at the two well locations. EX 50, pdf 11. This clarification is significant. Observing that the "majority" of the storativity values in the entire DRI Model domain are greater than the test measurements does not demonstrate that the DRI Model misrepresents the values at these locations, or at any other specific location in the Basin. A true apples-to-apples comparison would compare the "site-specific" storativity measurements at the wells to the "site-specific" storativity values in the corresponding parts of the DRI Model domain. Dr. Bedekar did not conduct that analysis.

Endorsement of Ramboll Model. Dr. Bedekar's testimony that the DRI Model cannot be used to assess safe yield because of the improper storage parameters is not credible because he has admitted that the Ramboll Model has improper storage parameters but continues to endorse it. Dr. McKenna showed that the Ramboll Model assigns high Ss values to the Rose Valley and El Paso areas that are many times greater than the surrounding areas and inconsistent with the subsurface materials found there. *See* EX 63, pdf 6; 6/25/26 Tr. 2016:15-26. Dr. Bedekar acknowledged these problems in his testimony: He admitted that the storativity value for Rose Valley was too high, *see* 6/16/26 Tr. 1318: 5-12, and that the storage parameters for the El Paso area were "weakly" calibrated and needed to be revised. *See id.* at 1250:4-15.[18] Despite these admissions, Dr. Bedekar testified that the "main conclusions" he drew from the Ramboll Model are "still valid." *Id.* at 1250:14-15. Dr. Bedekar's willingness to accept the storage parameters in the Ramboll Model for

[18] Dr. Bedekar suggested that poor calibration in the El Paso area had no significance because there is little pumping that occurs there, and the rate of inflows was more important. *See* 6/17/26 Tr. 1247:21-1250:13. But, as Dr. McKenna showed, the Ramboll Model uses unrealistic conductivity values that create a virtual "dam" at the mouth of the El Paso area, and unrealistic storativity values that store excessive water behind it, such that it functions as a reservoir providing additional recharge to the rest of the Basin when Ramboll's high rates of inflows are used. *See* 6/24/26 Tr. 2031:15-2034:5; *id.* at 2057:15-23; EX 61, pdf 41.

purposes of validating his own opinions undermines the credibility of his testimony that the storage parameters in the DRI Model are disqualifying.

Dr. Bedekar's opinions about the storage parameters in the DRI Model are based on misleading and incomplete data and do nothing to refute Dr. McKenna's conclusions about the DRI Model, recharge, or safe yield. Dr. McKenna's opinion that 7,650 AFY is a reasonable estimate of the long-term average natural recharge to the Basin is the opinion based on independent calculations and is credible for the IWV Basin.

C. ANTHROPOGENIC RECHARGE DOES NOT CONTRIBUTE TO THE BASIN'S CURRENT WATER BUDGET.

The record does not support the inclusion of incidental or anthropogenic recharge in the Basin's safe yield. Anthropogenic recharge originates from infrastructure and human activity on or near the surface. Dr. McKenna testified that there is a "lag" before the discharges at the surface reach the underground water table as recharge, and this lag would be 122 years at a minimum for sources like irrigation returns. Because irrigation returns and the other sources of anthropogenic recharge began less than 122 years ago, there is no basis for including anthropogenic recharge in the Basin's safe yield today. Further, Dr. McKenna and Dr. Kincaid both testified that there is insufficient evidence verifying the existence and extent of this recharge. Dr. McKenna testified that he would not include anthropogenic recharge in an estimate of safe yield unless there was "clear evidence of the locations, the magnitudes, [and] the timing" of the recharge. 6/24/26 Tr. 1954:9-11; *see also* 6/23/2026 Tr. 1789 (Kincaid). And, because safe yield must be based on representative conditions, Dr. McKenna "would be reluctant" to include anthropogenic recharge without considering whether the source will be "long-lived" and "constant." *Id.* at 5-6. As shown below, the record at trial contained no evidence, much clear evidence, to support the inclusion of anthropogenic recharge in the Basin's safe yield.

1. Lag Time

Dr. McKenna demonstrated that there is no basis for including anthropogenic recharge in the Basin's safe yield. A USGS report, cited by Dr. McKenna as well as the TWG experts, estimates the "travel time" for percolating water in a Mojave Desert basin to be about 1.6 feet per day. *See*

EX 60, pdf 31 (citing Izbicki, 2000 (EX 1230)); *see also* EX 4, pdf 15 (TWG Safe Yield Paper, Appendix A, citing Izbicki, 2000). Due to travel time, and the depth to water in the Basin, there is a significant "lag" before water percolating at or near the surface reaches the water table as recharge. *See* EX 60, pdf 31. For example, using the rate of 1.6 feet/day—and assuming no caliche or clay deposits in the aquifer—Dr. McKenna calculated that it would take a minimum of 122 years for irrigation returns in the agricultural area of the Basin to reach the water table 200 feet below it. *See* 6/24/26 Tr. 1955; EX 60, pdf 31. Irrigated agriculture in the Basin began less than 122 years ago, in 1910. *See* EX 581, pdf 338. Therefore, irrigation returns have yet to reach the water table as of 2026. Other potential sources of anthropogenic recharge, such as leakage from water distribution systems, began much later in the 20th century, and would be subject to a "lag" starting from those later years. EX 60, pdf 31.

None of the TWG experts disputed that anthropogenic recharge is subject to a lag, and none of them presented a competing estimate of travel time. The Water District's expert, Dr. Tonkin, agreed that there is a lag for anthropogenic recharge and that the rate calculated by Dr. McKenna was "fine." 6/16/26 Tr. 1020-21. *See also id.* at 1071-72; 6/15/26 Tr. 805. Searles' expert, Wicks, agreed that irrigation returns "would likely take many decades to reach the groundwater surface," based on the same rate of travel time that Dr. McKenna used. *See* 6/15/26 Tr. 739 (agreeing with discussion in TWG Safe Yield Appendix, EX 4, pdf 15). Dr. Bedekar, the District's modeling expert, testified that he would have included a lag in the Ramboll Model for the intentional releases of large amounts of water from the Los Angeles aqueduct. *See* 6/16/26 Tr. 1209: 6-10. Further, as discussed in more detail below, Dr. McKenna showed that there is insufficient evidence about the magnitude, timing, and location of anthropogenic recharge to support its inclusion even if some reasonable lag were incorporated.

Dr. McKenna's undisputed testimony about lag time demonstrates that the safe yield of the IWV Basin does not include anthropogenic recharge. The safe yield of the Basin cannot exceed long-term average natural recharge.

2. Irrigation Returns

When irrigation water is applied to crops, the water that is not taken up by the roots of the plants either evaporates or "returns" to the ground, where it becomes a potential source of recharge to the groundwater supply. Dr. McKenna did not include recharge from irrigation returns in his safe yield estimate because there is no evidence that water originating from irrigation has reached the Basin's groundwater supply. 6/24/26 Tr. 1954-55. The water table sits approximately 200 feet below the land surface in the western area of the Basin, where the irrigated farms are located. *See* EX 4, pdf 15. Thus, applying a travel-time rate of 1.6 feet per day, Dr. McKenna estimated it would take at least 122 years for irrigation returns to reach the water table. 6/24/26 Tr. 1955. The 1912 Lee Report suggests that irrigated agriculture was initiated by settlers who made land entries in 1910. *See* EX 581, pdf 338. Using Dr. McKenna's estimate, the recharge from the first irrigation in the Basin would not occur until 2032, at the earliest. Dr. McKenna also noted that his estimate did not account for caliche (or "hardpan"), which forms under irrigated areas in the desert. 6/24/26 Tr. 1955. Accounting for caliche or less permeable material in the aquifer would result in longer travel time than Dr. McKenna calculated. *Id. See also* 6/10/26 Tr. 573:3-16, 606: 1-3 (Parker, agreeing there is caliche in the Basin); EX 487, pdf 166 (finding caliche in 1919).

As explained above, the TWG offered no evidence to refute Dr. McKenna's calculation that it would take at least 122 years for irrigation returns to reach the water table. Parker, of Ramboll, testified that he did not conduct any independent analysis to determine whether irrigation return flows actually make their way to the water table, or the time it would take for them to reach the table. 6/10/26 Tr. 604: 10-26, 605: 1-8. The TWG's 2024 Safe Yield Paper, in an appendix, cites the same travel time figure from Izbicki and reaches a similar conclusion to Dr. McKenna: "Given the depth to groundwater beneath agricultural areas (i.e., greater than 200 feet (ft) below ground surface [bgs]), [irrigation] return flows would likely take many decades to reach the groundwater surface" and "the recharge benefit from agricultural pumping in the past few decades ha[s] yet to be realized." EX 4, pdf 15.

The TWG presented no evidence showing that historical irrigation began before 1910 (as reported by Lee), such that return flows from irrigation could be included in a current-year water

budget or estimate of safe yield. Dr. Tonkin's testimony was limited to recognizing there was "some pumping occurring in the Indian Wells Valley in 1920." 6/15/26 Tr. 895:17-19. And the report that Dr. Tonkin intended to offer additional opinions about (Thompson, 1929) only characterizes the irrigation occurring between 1919 and 1921. *See* EX 487, pdf 187-88. That report does not quantify irrigation returns, and it does nothing to undermine Dr. McKenna's opinion about lag time.

The problem with the Dr. Tonkin's inclusion of irrigation returns as recharge can be illustrated with the following example: If 1,000 AFY was being pumped for agriculture in 1920, and the crops consumed 50% of the applied water, the potential recharge to the Basin associated with that pumping is at most 500 AFY, and it would not reach the water table until 2042 at the earliest. Moreover, even if the lag were shorter, say 70 years, the returns from irrigation in 1920 in this example would be no more than 500 AFY occurring in 1990. The minimum return flow value in the Ramboll Model, and considered in Dr. Tonkin's water budget, is 1,600 AFY. But, more importantly, there is no evidence to support the assumptions underlying the 500 AFY estimate in this example: There is no evidence in the record that 1,000 AFY of pumping was occurring for irrigation use in 1920 (some may have been for domestic use, for example); there is no evidence in the record concerning irrigation efficiency in 1920, and there is no evidence that all of the water that initially percolates into the soil reaches the water table. Even if this evidence did exist, and was in the record, however, the hypothetical in the illustration shows that irrigation returns cannot reasonably included as a source of recharge in a current-year water budget to establish the Basin's safe yield.[19]

Dr. Kincaid agreed that irrigation returns should not be included in the Basin's water budget. Dr. Kincaid questioned whether these returns exist, and in what magnitude. *See* EX 80, pdf 13, 27 ("agricultural return flows are, by their nature speculative" and "agricultural irrigation…is not metered and must be estimated."). He explained that in areas where there are known to be return

[19] It may be appropriate to consider recharge from irrigation returns in a future reevaluation of the Basin's safe yield **if** there is evidence sufficient to quantify that recharge and assign it to particular water years in a scientifically valid manner that takes into account significant improvements in irrigation efficiency that reduce return flows. *See* 6/16/26 Tr. 1025-26 (Tonkin, agreeing that irrigation efficiency has improved); EX 97, pdf 46-47 (citing Meadowbrook return flows of 5% for pistachios and 11% for alfalfa).

flows, such as agricultural returns, there is normally evidence of those return flows. 6/23/2026 Tr. 1755-1756. He testified that the "most direct evidence" would be a response in groundwater elevations, which would be evident seasonally, so there would be evidence of the "return flow both in the form of the groundwater elevation itself and the periodicity of that response." 6/23/2026 Tr. 1756:6-7. In addition, Dr. Kincaid would expect to see a "chemical indication of the return flow," and in particular in the IWVGN, there would be an expectation of an "increase in salinity." *Id.* at 20. Dr. Kincaid testified that he had "not seen any data to suggest, on either of those, that they exist." 6/23/2026 Tr. 1756:23-24.

3. Los Angeles Aqueduct Releases

After irrigation returns, the largest source of anthropogenic recharge suggested by the TWG is the intentional release of water from the Los Angeles Aqueduct. Dr. McKenna found no evidence to support the inclusion of recharge from these releases in his estimate of safe yield. 6/24/26 Tr. 1957; *see also* EX 61, pdf 28. The record contains evidence of only two intentional discharges of water from the Los Angeles Aqueduct since it was completed in 1913. One discharge occurred in 2017, and another in 2023. *See* EX 97, pdf 79. The TWG parties did not present evidence or testimony demonstrating that these releases would happen in the future, in what amounts, where, or at what frequency. And none of the TWG experts supplied evidence documenting the volume of recharge to the Basin groundwater associated with these releases. Ramboll had simply assumed that 15% of the volume on the surface became recharge. 6/16/26 Tr. 1031. Dr. McKenna found no evidence that these releases had reached the water table. *See* 6/24/26 Tr. 1957; EX 61, pdf 28.

The TWG presented no testimony from the City of Los Angeles or its agencies to demonstrate that the Aqueduct releases are a reliable and credible source of recharge to the IWV Basin. In the absence of testimony establishing that the City will continue to make releases from the Los Angeles Aqueduct at particular times and places, with particular volumes and flow rates, there is no basis to include aqueduct releases in a water budget, now or in the future. Dr. McKenna was correct to dismiss these releases from his analysis.

4. Los Angeles Aqueduct Leakage

Dr. McKenna also concluded that leakage from the Aqueduct was not source of recharge that should be considered in safe yield. *See* 6/24/26 Tr. 1956. The TWG contends that the Aqueduct is leaking, and that the volume of the leakage can be quantified by apportioning the total measured loss from the Aqueduct among the different reaches of the pipes. See 6/8/26 Tr. 53-54 (Brown). But, as Dr. McKenna explained, including a source as recharge requires "clear evidence of the locations, the magnitude, [and] the timing" of the recharge. *See* 6/24/26 Tr. 1954:9-11. Dr. McKenna found no study quantifying the leakage or confirming it reaches the water table. 6/24/26 Tr. 1956. *See also* EX 60, pdf 31 ("There is no compelling evidence of water leakage of a volume that would create significant recharge to the groundwater system."). Dr. Kincaid similarly observed that the magnitude and spatial distribution of leakage from the Aqueduct is unknown, and the proportion of leakage that would result in recharge, if any, is also unknown. EX 80, pdf 25-26.

None of the TWG witnesses provided empirical observations or measurements to show if or where leakage was occurring, when, or how much. Dr. Tonkin testified that he relied on the number given to him by Ramboll without reading its source material. 6/16/26 Tr. 1030. Parker, of Ramboll, admitted that he did not do any independent study to determine whether there is leakage from the Aqueduct that is making it to the water table. 6/10/26 Tr. 603:19-23.

5. Leakage from Water Distribution Systems

Ramboll, and thus Dr. Tonkin, assume that leakage from the Water District's distribution system contributes 220 AFY of recharge to the Basin. *See* EX 97, pdf 45. Although Dr. McKenna did not dispute the possibility of system leakage, he opined that leakage from the system would be subject to the same lag as irrigation returns and recharge would not occur for at 120 years. 6/24/26 Tr. 1955-56. Because the Water District's distribution system was built in or around the 1950s, there is no basis for including leakage from that system in a current-day estimate of recharge and safe yield. *Id.* at 1956.

No concrete evidence to document the amount of leakage and associated recharge was presented. Further, Ramboll's estimate of recharge is simply a percentage of the Water District's supply in 2021-2022, based on the current extent of its service area. EX 97, pdf 45. Ramboll's 220

AFY value does not account for growth in the system over time. Dr. Tonkin, acknowledged that the amount of leakage could vary with the number of people served, but his analysis did not consider when the system had been built or whether it had expanded over time, such that the volumes conveyed (and leaked) today would not be representative of prior decades. 6/16/26 Tr. 1034-35.

Setting aside the question of lag, the Groundwater Authority's Technical Report also concludes that incidental recharge occurring in the City of Ridgecrest and on the valley floor (where the Water District's distribution system is located) does not contribute to the groundwater supply because of high rates of evapotranspiration and the presence of the clay unit. *See* Tech. Rep. 7. This fact is entitled to prima facie weight, and the TWG provided no evidence to refute it.

6. Percolation from WWTP Ponds

Dr. McKenna and Dr. Kincaid also dismissed percolation from the City's Wastewater Treatment Plant ("WWTP") settling ponds as a valid component of safe yield. EX 61, pdf 28; EX 80, pdf 25-26. The Ramboll water budget assumes 100 AFY of recharge from the ponds, EX 97, pdf 45; *id.*, pdf 48. But the WWTP ponds are lined with clay, limiting leakage and percolation. *See* EX 108, pdf 118. Further, the subsurface, fine-grained clay unit of the aquifer is also present beneath the WWTP ponds. *See* EX 60, pdf 17 fig. 5.

Dr. McKenna concluded that the clay unit would impede the downward movement of any percolation from the ponds to the water table. *See* 6/24/26 Tr. 1957:16-24; *see also* EX 61, pdf 28. The TWG presented no evidence to refute that conclusion. In fact, Dr. Tonkin's suggestion that the hydraulic gradients on the China Lake playa (near the WWTP ponds) would support *upward* movement of water toward the surface would weigh against the inclusion of any recharge associated with the ponds. *See* 6/16/26 Tr. 1086. Thus there is no evidentiary basis for including percolation from the WWTP ponds or any other anthropogenic recharge in the safe yield of the Basin.

D. ESTABLISHING 7,650 AFY AS THE MAXIMUM SAFE YIELD OF THE BASIN IS A REASONABLE AND CONSERVATIVE APPROACH NECESSARY TO ENSURE THE PROTECTION OF THE NATIONAL DEFENSE ASSETS AT NAWS CHINA LAKE.

Safe yield is defined in terms of net recharge: recharge minus natural discharge. *See San Fernando*, 14 Cal. 3d 199; *Santa Maria*, 211 Cal. App. 4th at 266; Cal. Water Code. § 10721(w) (sustainable yield). There is significant uncertainty about the volume of natural discharge, and thus net recharge, in the Basin. In light of that uncertainty, and the potential consequences of setting safe yield too high (in particular for the Navy), safe yield should be estimated conservatively.

No one disputes that plants in the Basin discharge a large volume of water through evapotranspiration, or that the amount of this discharge is uncertain. Dr. McKenna testified that estimates of evapotranspiration using remote-sensing satellite data have averaged around 4,000 AFY, but he also noted that evapotranspiration has decreased over time. 6/24/26 Tr. 2048-49. In his report, Dr. McKenna explained that, under predevelopment conditions, evapotranspiration would have been equivalent to natural recharge (and thus higher than 4,000 AFY). *See* EX 60, pdf 29-30. Dr. Kincaid reduced his estimated range of recharge, based on studies that may have accounted for evapotranspiration to begin with, by an additional 15% to account for both evapotranspiration and potential climate change trends. *See* 6/23/26 Tr. 1796; EX 80, pdf 12. The TWG erred in the other direction: the Ramboll Model has a maximum evapotranspiration rate of about 3,000 AFY, *see* EX 61, pdf. 29-30, and Dr. Tonkin testified that the average between 1980 and 2023 was about 2,100 AFY. 6/15/26 Tr. 810:9-15.

Outflows to Salt Wells Valley are also uncertain. DRI has estimated those outflows to be 50 AFY, Tech. Rep. 13, but previous estimates range from 0 to 200 AFY. *See* EX 60, pdf 29. These outflows are included in the DRI Model, EX 24, pdf 68, but not in the Ramboll Model. *See* EX 94, pdf 56. Because the magnitude of this discharge is relatively small, in comparison to pumping and evapotranspiration, no expert separately accounted for it.

The uncertainty about the volume of outflow requires a conservative estimate of safe yield. In addition to the harms that declining water levels cause for all water users in the Basin, setting safe yield too high would perpetuate ongoing impairment of federal interests in the Basin at NAWS China Lake. Groundwater extraction has been associated with subsidence in the southern area of

the Indian Wells Valley, under the SNORT Track. *See* Tech. Rep. 36; EX 108, pdf 166-68; EX 929, pdf 56-57; 6/24/26 Tr. 1946-47. The SNORT Track is sled used to test rockets and air weaponry at supersonic and hypersonic speeds, and it must be "perfectly level." 6/24/26 Tr. 1947. It is a unique and irreplaceable national asset that plays a critical role in the Navy's ability to fulfill the weapons development and testing mission at NAWS China Lake. Subsidence was estimated to be occurring in the area of the SNORT Track at a rate of 2mm per year, prior to 2010, which is equivalent to 0.09 inches. Tech. Rep. 36. A report prepared for the Navy in 2015 finds that the rates may be around 3mm per year. *See* EX 21, pdf 221. The Navy is continuing to study and monitor subsidence at NAWS China Lake and at the SNORT Track in particular. 6/24/26 Tr. 1946. Meanwhile, subsidence under NAWS China Lake is continuing to occur. Tech. Rep. 36-37; EX 929, pdf 214 fig. 2-28.

In addition to subsidence, irreversible vegetation loss caused by declining groundwater levels also threatens Navy interests. Dr. McKenna testified that vegetation loss creates a risk of destabilizing sand dunes, leading to dust formation that could affect visibility at the China Lake Air Range. 6/24/26 Tr. 1947; 2049; EX 60, pdf 28. In Dr. Tonkin's view, evapotranspiration and vegetation loss should be treated as a "management issue" rather than factor into safe yield. 6/16/26 Tr. 970-973. But by "management issue," Dr. Tonkin meant that pumping could be allowed to an extent that would capture water that would otherwise go to the plants. *See id*. Such a proposal would not be consistent with *San Fernando*'s water accounting, which deducted "losses to vegetation" to calculate "net groundwater recharge," 14 Cal. 3d at 278-79. If losses to vegetation are not expressly subtracted from safe yield, as they were in *San Fernando*, a safe yield determination should nevertheless account for the uncertainty about natural discharge to avoid the risk of overdraft.

Safe yield should be set conservatively, to prevent irreversible damage to important national defense assets and operations at NAWS China Lake. Dr. McKenna's opinion that the safe yield cannot be higher than recharge, and would need to be lower to account for evapotranspiration, is a reasonable starting place and not disputed as a general principle. The best way to apply that principle is to establish 7,650 AFY as the maximum safe yield for the IWAV Basin.

II. THE TWG'S ESTIMATES OF SAFE YIELD ARE NOT CREDIBLE.

The TWG experts proposed safe yields ranging from 14.400 AFY (Tonkin) to 15,400 AFY (Teasdale and Wicks) to 18,000 AFY (Parker), with several others in between. None of these estimates was supported by reliable evidence. Each estimate relies directly or indirectly upon the aquifer parameters employed in the Ramboll Model, which are not credible. And there are numerous other, independently sufficient bases for rejecting these estimates. Tonkin's estimate, based on Ramboll's water budget, includes so much unsupported recharge that it creates a lake in the China Lake playa where none has existed for thousands of years. Parker's estimated safe yield range of 14,300 AFY to 18,000 AFY can be dismissed out of hand because it is based on an even more fantastical interpretation of the Ramboll water budget. The estimates by Wicks and Teasdale, based on the Thiessen Polygon Method, are also higher than Dr. Tonkin's already-too-high estimate and are not supported by any plausible account of the Basin's water balance. Wicks and Teasdale acknowledged significant data gaps in the record they used to support these estimates, and that base period was pegged to the highest recharge years in the Basin in recent history. Each of these estimates should be rejected.

A. RAMBOLL'S UNSUPPORTED AQUIFER PARAMETERS DISQUALIFY ALL OF THE TWG SAFE YIELD ESTIMATES.

The TWG estimates of safe yield all depend, directly or indirectly, upon the aquifer parameters employed in Ramboll's numerical model. The polygon-based estimates advocated by Teasdale and Wicks used the specific yield values from the Ramboll model to calculate the safe yield based on a change in storage analysis. Tonkin used the Ramboll water budget to define his safe yield estimate, and Ramboll was only able to calibrate its model to match that water budget by distorting specific yield and hydraulic conductivity. In a complicated, technical case, the implausibility of Ramboll's specific yield values supplies a bright-line basis for disqualifying the safe yield estimates offered by the TWG.

1. The Effect of Low Specific Yield on Safe Yield Estimates

Specific yield is a physical attribute of the subsurface materials in an aquifer. "Specific yield is defined as the ratio of (1) the volume of water that a saturated rock or soil will yield by

gravity to (2) the total volume of the rock or soil." EX 12, pdf 7; EX 61, pdf 8. In an unconfined aquifer, where the water level is influenced by gravity, specific yield is the attribute that governs the release of water from storage. 6/24/26 Tr. 2002 (McKenna). Because the water table in the IWV Basin fluctuates within the shallow, unconfined layers of the aquifer, Dr. McKenna characterized specific yield as "the most important aquifer parameter for purposes of estimating safe yield." *Id.* at 2035.

Specific yield is inversely correlated with safe yield. Higher specific yield is associated with a lower safe yield, and a lower specific yield is associated with a higher safe yield. *See* 6/8/26 Tr. 26-27 (Brown);[20] EX 61, pdf 8-9 (McKenna). For example, in change in storage analysis, safe yield can be calculated as the amount of pumping plus (or minus) the change in storage. The change in storage is equal to the change in water levels multiplied by area and specific yield. EX 61, pdf 9. Reducing the specific yield multiplier makes the resulting change in storage smaller, which in turn brings the Basin's safe yield up, toward the amount of pumping.

The relationship between specific yield and safe yield can also be illustrated in a numerical groundwater model. Specific yield is an aquifer parameter that is assigned by the modeler to each of the cells in the model grid. The values for specific yield can be adjusted during calibration to generate a fit between a predetermined amount of recharge and the water levels the modeler wants to target. Lowering the specific yield in a model allows a modeler to represent outflows from a model as coming from recharge rather than storage. As Dr. McKenna explained, where specific yield values are lower than the hydrogeology indicates they should be, "less water comes out of storage, [and] more water will have to come from recharge. So lower [specific yield values]. . . support a higher recharge." 6/24/26 Tr. 2042. A lower specific yield thus facilitates higher inflows to the model and, therefore, higher safe yield.

The evidence demonstrates that the specific yield values employed in the Ramboll Model, are too low to be credible for the IWV Basin's unconfined aquifer.

[20] Anthony Brown was originally retained by Mojave Pistachios, which did not participate in the Phase 2 trial. The Water District called Brown as a non-retained expert to testify about general groundwater concepts and the TWG's Storage Paper.

2. The Ramboll Model Uses Specific Yield Values That are Too Low

Aquifer properties for every cell in a model cannot always be backed by hard evidence. In constructing a numerical model, a modeler must often interpolate the aquifer properties for a cell, or a set of cells from known values. *See generally* EX 1241 (USGS guidelines). Although there are many ways a modeler can interpolate values, the "general guideline" in the field is "that it is best to use the simplest interpolation method that is consistent with the known data." *Id.*, pdf 18. The record demonstrates that Ramboll ignored the "known data" about specific yield in the Basin, and that its resulting specific values are not consistent with it.

The specific yield ranges in a 1967 USGS report by A.I. Johnson (EX 12) are considered to be authoritative and representative of the specific yield for the materials in the Basin aquifer. The Johnson paper compiles field measurements of specific yield from throughout California over a 70-year period. Dr. McKenna testified that the paper is a "seminal work" that has been cited over 750 times and is cited in textbooks, 6/24/26 Tr. 2040, and the TWG used Johnson's specific yield ranges in its 2024 Storage Paper. *See* EX 5, pdf 29. Johnson summarized the specific yield ranges in this table:

Specific yields, in percent, of various materials

[Rounded to nearest whole percent]

Material	Number of determinations	Specific yield		
		Maximum	Minimum	Average
Clay	15	5	0	2
Silt	16	19	3	8
Sandy clay	12	12	3	7
Fine sand	17	28	10	21
Medium sand	17	32	15	26
Coarse sand	17	35	20	27
Gravelly sand	15	35	20	25
Fine gravel	17	35	21	25
Medium gravel	14	26	13	23
Coarse gravel	14	26	12	22

EX 12, pdf 7. The TWG paper notes that Johnson's ranges "correspond with the values from the Basin," *id.*, and at trial, expert Anthony Brown testified that the TWG was able to use Johnson's ranges to define specific yield values "representative of the materials in the aquifer." 6/8/26 Tr. 93-94. The specific yield values in the shallow aquifer zone of the DRI Model, which range from

0.5% to more than 20%, are also consistent with Johnson's ranges. *See* EX 24, pdf 76, fig. 5-9. None of the TWG experts criticized the specific yield values in the DRI Model.

The Ramboll Model, on the other hand, uses specific yield values that are far lower—in fact, less than half—the values indicated by the Johnson paper for the materials in the shallow aquifer. Dr. Bedekar's mapping shows most of the shallow aquifer zone as composed of material that is 91% to 100% coarse grained (referred to as "the coarse fraction"). *See* EX 48, pdf 29, fig 5-2. Johnson's study indicates that different types of coarse-grained materials have a specific yield ranging from 21% to 27%. *See* EX 12, pdf 7; EX 61, pdf 14 & t.2 (summary table). In the Ramboll Model, **the maximum specific yield value in the shallow aquifer is 11%.** EX 61, pdf 13. In fact, every cell in every layer of the Ramboll Model is assigned a specific yield value of either 8%, 9% or 11%. *See* 6/17/26 Tr. 1234; EX 48, pdf 41, fig. 7-9. These values are consistent with fine-grained silts and clays, not alluvial deposits of sand and gravel. *See* EX 12, pdf 7; EX 5, pdf 29. The specific yield values in the Ramboll Model thus portray the entire Basin as a dense unit of water-retaining clay and silt, contradicting the undisputed facts about the Basin's composition.

Even if the Johnson paper is set to the side (and no party has suggested it should be), the Ramboll Model's specific yield values are also far below the site-specific estimates and measurements that are available. Dr. McKenna's report explains that the values in the Ramboll Model are far lower than those reported for the IWV Basin in Dutcher & Moyle, and for the Owens Valley in a 1991 paper. *See* EX 61, pdf 14. The values in Ramboll's numerical model are also significantly lower than what would be suggested by Ramboll's storage analysis, which includes specific yield values ranging from 12% to 17%. *See* EX 97, pdf 34, t.3-1. Even that range appears to be too low, however. Measurements based on a pump test on Meadowbrook's land suggested specific yield in that area was on the order of 20%. *See* EX 85, pdf 40-41. There is no value even close to 20% in the Ramboll Model.

The TWG experts offered no coherent defense of Ramboll's low specific yield values at trial. The most Dr. Bedekar offered was an opinion, "off the cuff," that an appropriate range of values for the Basin would be 5-15%, 6/17/26 Tr. 1235, and that Ramboll's values (8%, 9%, and 11%) were at the average because they are "all about 10%." *See* 6/17/26 Tr. 1234-37. Dr. Bedekar,

who is a modeler, not a hydrogeologist, admitted that the Ramboll values were not based on a site-specific analysis, *id.* at 1236, and he was not aware of the field measurements made by Meadowbrook that supported specific yield values of 20%, *id.* at 1237. He also agreed that his mapping of the Basin showed that the materials in the top layer of the aquifer are about 90% coarse-grained in most places, and he agreed that those materials have a higher specific yield—not the average. *See id.* at 1236.

Parker, of Ramboll, suggested only that specific yield is a "challenge" to estimate, 6/10/26 Tr. 544:25-545:6, but Ramboll chose not to use the range of estimates available from its conceptual framework, the 2024 Storage Paper, and Meadowbrook's field measurements. Parker did not explain why Ramboll chose to employ patently implausibly specific yield rather than simply reduce the recharge that the model was showing to be excessive.

The low specific yield values in the Ramboll Model, which represent the entire Basin as silt and clay, are not credible and are the result of model calibration to accommodate higher recharge than is realistic.

3. <u>The Ramboll Model Uses Hydraulic Conductivity Values that are Too High in Some Areas, and Too Low in Others.</u>

The values for hydraulic conductivity in the Ramboll Model are also implausible and unsupported, and reflect calibration to accommodate higher inflows. Hydraulic conductivity is a measure of how easily water can flow through an aquifer, either vertically or horizontally. *See* 6/24/26 Tr. 2043:2-8. An aquifer with higher "horizontal" hydraulic conductivity will be able to move more recharge to points of discharge than an aquifer with a lower hydraulic conductivity. *Id.* at 2043:20-24. Like specific yield, hydraulic conductivity is an aquifer parameter that can be adjusted in a numerical model to calibrate the model to achieve targeted water levels using an assumed level of recharge. *See* EX 61, pdf 19, fig.5.

The Ramboll Model has been calibrated with hydraulic conductivity values that bear no rational relationship to the Basin but do appear to be related to the higher recharge that the Ramboll Model uses. Dr. McKenna identified several irregularities, two of which are particularly significant:

First, Dr. McKenna showed that the Ramboll Model uses excessively high hydraulic conductivity values in the lower layers of the aquifer, which enables the model to simulate those layers as transmitting additional recharge. *See* 6/24/26 Tr. 2044:7-2045:1; *see* EX 61, pdf 16-20. For example, in Layers 3 and 4 of the Ramboll Model, which represent clay, the horizontal hydraulic conductivity values are at least 100 times greater than the textbook values. 6/24/26 Tr. 2045:4-13. The horizontal hydraulic conductivity values in Layers 5 and 6, which are consolidated rock, should be lower than the values for the unconsolidated materials in Layers 1 and 2, but are essentially the same. *Id.* 2045:25-2046:5. As a consequence, the Ramboll Model can simulate pumping as taking the additional recharge transmitted by these lower layers instead of causing a loss of storage.

Dr. McKenna also showed that the Ramboll Model assigns excessively *low* horizontal hydraulic conductivity values to a fault at the mouth of the El Paso area. The values Ramboll used for the fault represent it as having hydraulic conductivity *one million times lower* than that of a granite countertop, and *three billion times lower* than the conductivity Ramboll assigned to the Little Lake Fault in the northern part of the Basin. 6/24/26 Tr. 2031:14-2032:3; *see also* EX 61, pdf 20. The El Paso fault zone is thus represented as a hard-rock dam that turns the El Paso subarea into a storage reservoir for the recharge that accumulates there. However, the fault is also disconnected in places. As a consequence, the dam not only stores large amounts of water, but then leaks it out to provide additional recharge to the main part of the Basin. *See* 6/24/26 Tr. 2032:4-15; EX 61, pdf 43. This is inconsistent with what is known about the fault zone. *See* EX 24, pdf 30.

The unrealistic horizontal hydraulic conductivity values in the Ramboll Model, like the unrealistic specific yield values, have the effect of muting the loss of storage associated with a given level of pumping that would be represented if appropriate values were used. And these are only two of the many questionable applications of hydraulic conductivity that Dr. McKenna identified. *See also* EX 61, pdf 10 (describing lack of heterogeneity in conductivity values relative to conceptual framework); *id.*, pdf 10-11 (unexplained omission of the boundaries around the deltaic deposit represented in the conceptual framework).

Together, the unrealistic specific yield and unrealistic horizontal hydraulic conductivity values in the Ramboll Model allow the model to calibrate to measured water levels using high recharge, high pumping, supporting an unrealistically high safe yield.

4. All of the TWG Estimates of Safe Yield are Influenced by Ramboll's Unsupported Aquifer Properties and Should Be Rejected.

The TWG safe yield estimates should be rejected because they each depend upon the calibrated aquifer properties in the Ramboll Model, which are not credible.

The 15,400 AFY safe yield estimate presented by Teasdale, on behalf of Meadowbrook, is linked directly to Ramboll's implausible specific yield values. *See* EX 85, pdf 55. Teasdale used a change-in-storage analysis to estimate safe yield (Safe Yield = Change in Storage + Pumping). Teasdale divided the Basin into polygons and then calculated the change in storage within each polygon for the years 2014-2023, using the equation **Change in Storage** = **Change in Water Level x Polygon Area x Specific Yield**. *See* EX 85, pdf 20.

For all but four of the polygons, Teasdale used a specific yield value of 8% to 11%, based on the Ramboll Model's specific yield values; for the other four polygons, Teasdale used a Meadowbrook field-measured value of 20%. *See* 6/22/26 Tr. 1415-1418; 6/22/26 Tr. 1487:4-12; EX 85, pdf 62 t.A-2. While Teasdale did find a loss of storage over the 2014-2023 period, his use of the Ramboll specific yield values resulted in a much smaller loss of storage—and a higher safe yield—than would have resulted from the use of reasonable specific yield values.[21] Teasdale's methodology and estimates are also flawed in numerous other respects, discussed below, but it is not necessary to address those flaws because the improper specific yield is fatal to his analysis.

The other TWG safe yield estimates based on change of storage are also dependent on the Ramboll Model's aquifer parameters and should be rejected on that basis. Wicks merely endorsed Teasdale's estimate of 15,400 AFY as "reasonable" based on a review of his report. *See* 6/10/26

[21] Teasdale also estimated a safe yield of 14,600 AFY using the specific yield values from the Brown & Caldwell model, *see* EX 85, pdf 54, but this estimate far exceeds the 8,822 AFY recharge in the model, *see* EX 67, pdf 34, and Teasdale's opinion was that the higher safe yield of 15,400 AFY based on Ramboll's specific yield should be used.

Tr. 701-702. Parker discussed hypothetical change-in-storage estimates of safe yield based on a demonstrative that was not admitted into evidence, without testifying to the calculations that supported those estimates or offering an opinion of his own. *See* 6/10/26 Tr. 558-560 (discussing demonstrative EX 375).[22] Parker is not an expert in modeling. 6/9/26 Tr. 446: 14-16; 6/10/26 Tr. 487:14-16, 583: 11-13. With the limited foundation he offered, Parker's testimony is credible only for the purpose of showing that Ramboll (his employer) calculated a change-in-storage safe yield of 18,000 AFY using the specific yield values in its model. That estimate, to the extent it is offered as expert opinion in this case, should be rejected because the Ramboll model's values are not credible.

Tonkin's safe yield estimate of 14,400 AFY, even though it purports to be based strictly on recharge, is also dependent upon Ramboll's calibrated aquifer parameters, if indirectly. For example, Tonkin used 2,600 AFY of recharge from Rose Valley because 2,566 AFY is the value that Ramboll arrived at through model calibration. EX 97, pdf 69. Tonkin also simply adopted each of Ramboll's water budget components, each of which involved discretionary choices by Ramboll that Ramboll could only accommodate by calibrating specific yield and hydraulic conductivity in irrational ways.

The implausible aquifer properties in the Ramboll Model are at the foundation of every TWG expert's opinion of safe yield and disqualify each of them from serious consideration in evaluating the safe yield of the IWV Basin.

[22] Parker's demonstrative slide—a bar chart purportedly representing a range of safe yield estimates from 13,000 AFY to 18,000 AFY—was not admitted into evidence, and Parker only testified about what it showed at a general level, without explaining the calculations. *See* 6/10/26 Tr. 558-561. The slide is also misleading and unreliable in several respects. For example, the slide indicates that the Brown & Caldwell specific yield values result in a safe yield of around 18,000 AFY, which is significantly higher than Teasdale's 14,600 AFY estimate. The slide also represents that the 2025 DRI Model as having an average specific yield of 7% indicative of a safe yield of 18,000 AFY. The average recharge in the DRI Model (as the TWG has emphasized) is 7,650 AFY. The actual specific yield values in Layer 1 of the DRI Model, which is the focus of the change-in-storage analysis are depicted on Figure 5-9 of the model report. *See* EX 24, pdf 76, fig. 5-9.

B. THE RAMBOLL MODEL DEMONSTRATES THAT THE TWG SAFE YIELD ESTIMATES ARE FAR TOO HIGH.

It is undisputed that the Ramboll Model simulates a lake in the China Lake playa when pumping is removed from the model. This outcome demonstrates that the recharge in the model is too high, or that the evapotranspiration in the model is too low, or both.

In his expert report, Dr. McKenna presented a modeling scenario where the Ramboll Model was run without pumping, and a recharge rate of 10,740 AFY,[23] but all other steady state conditions were maintained, including the rate of evapotranspiration. *See generally* EX 61, pdf 35-39. This simulation resulted in water levels above land surface, so "drains" were simulated to show where the water went. The simulation resulted in 9,100 AFY of surface discharge from the drains. Combined with additional surface runoff into the playa, this discharge formed a perennial lake on the China Playa with an area of 2.5 square miles over a depth of 1 to 2 feet. *See* EX 61, pdf 39. This is an absurd result because there has been no perennial lake on the China Lake playa in the past 1,000 years. *Id*.

Dr. McKenna's modeling scenario shows that 10,740 AFY is too high an estimate of recharge, even in the Ramboll Model. Dr. McKenna testified that the simulation of a lake on the China Lake play shows "there's either much too much recharge coming into the model or not nearly enough discharge leaving the model or some combination of both of those." 6/24/26 Tr. 2052:1-7. *See also id.* at 2052: 10-13 ("[It] certainly looks like that recharge is too high."). None of the TWG experts found fault with Dr. McKenna's modeling scenario, or the conclusions he drew from it. And none of the TWG experts testified that the evapotranspiration rate in the Ramboll Model is too low. Therefore, the TWG has no basis to dispute that 10,740 AFY of recharge is too high, and that safe yield cannot be greater than that amount.

Dr. Bedekar, the District's modeling expert, obtained similar results in his "no pumping" scenario. *See* EX 48, pdf 17. When he turned pumping "off" in the model, and applied drains, the Ramboll Model simulated surface discharge and pooling over the China Lake playa area. *See id.*, pdf 42, fig.7-10. Dr. Bedekar was unable to reconcile this result with real-world conditions, despite

[23] This recharge figure was based on Ramboll's conceptual water balance for the years 1986 to 2023. *See* EX 97, pdf 40, t. 4-1.

making several attempts. In his expert reports, Dr. Bedekar concluded that the lake generated in a "no pumping" scenario was consistent with "historical pooling" in predevelopment conditions. *See id.*, pdf 17. This conclusion was based on a plate in the Ramboll Model report (from Rosenthal, 2017) that represented the surface water system in the Basin during the Pleistocene era. *See* EX 97, pdf 22-24. At trial Dr. Bedekar acknowledged that his "historical pooling" explanation was mistaken. 6/17/26 Tr. 1241:8-24. Dr. Bedekar then offered an alternative theory that the flooding represented water being discharged to evapotranspiration. *See id.* But this theory is also unavailing because the Ramboll Model already simulates evapotranspiration. Dr. Bedekar thus failed to refute that his no-pumping scenario shows that the recharge in the Ramboll Model is too high.

Dr. Tonkin's safe yield estimate of 14,400 AFY is based on the Ramboll Model water budget, including 11,800 AFY of natural recharge that supposedly would still occur under predevelopment conditions. The modeling scenarios performed by Dr. McKenna and Dr. Bedekar show that these estimates and the higher ones offered by the other TWG experts are far too high.

C. DR. TONKIN'S ESTIMATE BASED ON THE RAMBOLL WATER BUDGET HAS NO INDEPENDENT SUPPORT OR JUSTIFICATION.

Dr. Tonkin offered a safe yield estimate of 14,400 AFY based on the Ramboll Model recharge inputs for 1980 to 2023. This estimate has no evidentiary support. As discussed above:

- Dr. Tonkin's estimate of mountain-front recharge is based on the Statewide BCM, which is not calibrated to the IWV Basin, and it includes at least 700 AFY of unsupported recharge from the Coso and Argus Ranges that drain into Airport Lake;
- Dr. Tonkin includes at least 500 AFY of recharge from surface-runoff, but the Statewide BCM includes runoff in its water balance, and no data was supplied to justify adding more;
- Dr. Tonkin includes 2,600 AFY of subflow from Rose Valley, which is a value Ramboll arrived at through model calibration;
- Dr. Tonkin includes 2,500 AFY of anthropogenic recharge for which there is no evidentiary support, and without accounting for lag time.

Dr. Tonkin's opinion was that safe yield should be established as 14,400 AFY, without a deduction for evapotranspiration. 6/16/26 Tr. 970:9-15 That opinion is not credible or supported. Neither is Dr. Tonkin's alternative estimate of 12,300 AFY if necessary to reflect evapotranspiration. The value he subtracted for evapotranspiration—2,100 AFY--also lacked an

evidentiary basis. This value was based upon the average evapotranspiration simulated for his base period in the Ramboll Model. *See* 6/15/26 Tr. 810:9-15. In his rebuttal report, Dr. McKenna showed that Ramboll's evapotranspiration rates were based on rates calculated at a single location, by a program intended for cropland, and that Ramboll had misinterpreted them to be higher than what that model would calculate. *See* EX 61, pdf 29. Dr. McKenna testified that remote-sensing satellite data has estimated evapotranspiration to be about 4,000 AFY. *See* 6/24/26 Tr. 2048.

Dr. Tonkin's safe yield estimate cannot be accepted because every component is either unsupported, unrealistic, or erroneous.

D. THE TEASDALE AND WICKS POLYGON METHOD IS NOT CONSISTENT WITH THE LEGAL STANDARD FOR SAFE YIELD, RELIES UPON AN IMPROPER BASE PERIOD, AND EMPLOYS ARBITRARY ASSUMPTIONS TO MAKE UP FOR A LACK OF DATA.

Teasdale offered a safe yield estimate of 15,400 AFY, which Wicks endorsed as "reasonable." 6/15/26 Tr. 758:24-759:11. This estimate is based on application of "Thiessen polygons" and a change in storage analysis for the years 2014-2023. As discussed above, Teasdale's estimate of 15,400 AFY is not credible because it is premised on Ramboll's specific yield values, which are implausibly low. *See* p. 59, *supra*. Teasdale's estimate and those in the TWG Safe Yield paper should also be disqualified because they use a short, unrepresentative base period (2014-2023) characterized by the highest recharge conditions in the Basin's history. Further, the calculations made by Teasdale and the TWG demonstrate that the polygon method is not a rigorous or reliable scientific method for estimating safe yield, at least as they have applied it. Teasdale's application of the polygon method is characterized by data limitations, arbitrary assumptions, and error. His estimate of 15,400 AFY, and any other the TWG might advocate based on the polygon method, should be rejected.

1. Polygon Estimates Do Not Satisfy the Legal Definition of Safe Yield.

The legal standard for safe yield requires an analysis of "net groundwater recharge." *San Fernando*, 14 Cal. 3d at 278-79. This standard requires an analysis of inflows and outflows. *See id.*; *see also Santa Maria*, 211 Cal. App. 4th at 279 (net of groundwater inflows less subsurface and surface losses). *See generally* Legal Standard for Safe Yield at p. 17, *supra*.

The polygon method used by Teasdale and Wicks does not involve calculating recharge. In fact, Wicks endorsed the polygon method *because* it does not involve calculating recharge. *See* 6/10/26 Tr. 651:23-652:8 (stating that a recharge-based method for calculating safe yield has "challenges" because it requires "the proper identification of all of [the] inflows and outflows, and you also have to quantify them"); 6/10/26 Tr. 701:10-17 (summarizing her opinions and stating that "the change in storage approach offers a superior method for determining safe yield"). The polygon method is a rough change-of-storage analysis. There was no testimony showing it had ever been used before in a groundwater adjudication.

The polygon method is not consistent with the recharge-based definition of safe yield under state law, or under the Court's Instruction to the Special Master. For this reason alone, the Teasdale and Wicks safe yield estimates, and any other estimate the TWG may present based on a polygon change of storage analysis, should be rejected.

2. <u>The 2014-2023 Base Period is Not Representative of the Basin.</u>

Even if the polygon method were consistent with the safe yield definition (and it is not), and even if it could be applied in a scientifically rigorous manner (and, as shown below, it cannot and was not), Teasdale's polygon estimate is based on change in storage over the period 2014 to 2023, a period that is both too short and too wet to be representative of the Basin. In fact, the Water District's expert, Dr. Tonkin, concluded that the period was too wet to be used in his recharge-based estimate. *See* EX 123, pdf 38; 6/15/26 Tr. 936:23-937:2, 9-24. The improper 2014-2023 base period supplies another basis for dismissing out of hand the polygon-method estimates offered by Teasdale and other TWG experts.

The 2014 to 2023 period is not representative of recharge conditions in the Basin because it includes high levels of precipitation, including two outlier years in 2017 and 2023. Dr. Tonkin calculated that this period is 8% to 9% wetter than the average from 1980 to 2023 that he used. 6/16/26 Tr. 937:9-24. The years 2017 and 2023 include the two of the highest recharge events that have occurred since 1980. First, 2017 was an unusually wet year, with precipitation "substantially higher" than other years. 6/22/26 Tr. 1575:1-7 (Teasdale); EX 48, pdf 45 (Bedekar). Similarly, in 2023, the Basin received extremely high levels of precipitation from Tropical Storm Hillary.

6/22/26 Tr. 1573:24-1574:3. The TWG presented no evidence showing that tropical storms are recurring features and thus representative of long-term conditions in the Basin. *See, e.g.*, 6/22/26 Tr. 1574:4-6 (Teasdale) (unaware of any prior tropical storm in the Basin). In addition, there were two intentional emergency flood flow releases from the Los Angeles Aqueduct in these years, that were also without precedent. *See*; EX 97, pdf 47; 6/22/26 Tr. 1572:20-24 (Teasdale).

The 2014-2023 base period is far too short to compensate for the effects of these outlier years. Although a 10-year base period may be adequate in some circumstances, the anomalous wet conditions in 2017 and 2023 warranted the use of a base period significantly longer than 10 years, or excluding those years entirely. Those two years account for 64% of the recharge in the 10-year period, according to Dr. Tonkin's Table 4-1. *See* EX 123, pdf 66. Further, and of particular relevance to the polygon analysis, there were two major earthquakes in the Basin in 2019 that distorted water levels for a period of time. Tech. Rep. 43; 6/9/26 Tr. 329: 2-3. Although Parker characterized the earthquakes as a "minor disruption" that "gets averaged out" as the Basin equilibrates, 6/10/26 Tr. 556-57, Parker did not show that the base period of 2014-2023 was long enough to average out the earthquake conditions.

None of the TWG witnesses provided a scientifically based explanation for selecting the 2014-2023 period over other options. The record showed that the TWG initially considered using a 33-year base period of 1991 to 2014. *See* EX 92. In 2022, Wicks wrote in an e-mail that this period "look[ed] promising" because "it starts at the end of a dry cycle . . . and ends with a dry period, the average precipitation is similar to the long-term average, and it includes wet and dry conditions." *Id.* The same e-mail shows that Teasdale wanted to compare the "safe yield value" from that base period to the one that would result from using 2016 to 2021. *See id.* The TWG ultimately selected a base period of 2014-2023, in order to have the minimum length base period required by certain SGMA regulations. *See* 6/10/26 Tr. 606:14-26. Teasdale failed to articulate a rationale for rejecting the 1991-2014 period that was originally proposed, except that 2014-2023 was more recent. 6/22/26 Tr. 1578:26-1579:18.

At trial, Wicks attempted to justify the 2014-2023 base period on the ground that it represented a period of average precipitation at the gauging station at China Lake, on the valley

floor. 6/10/26 Tr. 661-663. But the primary source of recharge to the Basin is mountain-front recharge that originates as precipitation in the Sierra Nevada, which is substantially higher than the precipitation on the China Lake Playa. *See* Tech. Rep. 14. While the 2014-2023 period may have representative precipitation at this one station, the record shows that precipitation in the Sierra Nevada during this period was abnormally high. In fact, Dr. Bedekar testified that precipitation at the China Lake gage does *not* correlate with the mountain-front recharge that occurred during 2017. 6/16/26 Tr. 1324:18-1325:4.

The selection of the 2014-2023 base period undermines the credibility of the testimony of the witnesses who relied upon it. Teasdale, for example, testified that 2014-2023 is a "balanced hydrologic period," 6/22/26 Tr. 1581:17-1582:6, despite the undisputed evidence that it is not. The willingness of Teasdale and other witnesses to endorse the use of this base period calls into question the reliability of the other opinions they expressed at trial. As shown below, those opinions are not reliable for numerous other reasons, as well.

3. The TWG's Polygon Safe Yield Estimates are Not Based on Rigorous or Reliable Scientific Methods and Assumptions.

The calculations made by Teasdale and the TWG using the polygon method show that it is not a scientifically rigorous or reliable method for estimating safe yield. Groundwater Authority expert Moran, who developed the polygon method for use in the groundwater context,[24] testified that it is only a "back-of-the-envelope calculation" for the loss of storage, based on limited data. 6/9/26 Tr. 325:4-5 (Moran). Dr. McKenna, who has taught Thiessen polygons to graduate students, noted that the method dates to a time before computers existed. *See* 6/29/26 Tr. 2083:13-16. He agreed with Moran's "back of the envelope" characterization. *Id.* at 2083: 17-18.

Contrary to the views of the TWG experts, the polygon method is not only subject to uncertainty, but subject to greater uncertainty and greater risk of error than the recharge-based

[24] Thiessen polygons are a tool originally developed for estimating precipitation between measurement stations. *See* 6/9/26 Tr. 323:6-8. Prior to her work in the IWV Basin, Moran had developed a method for using Thiessen polygons to estimate the change in storage in a different California groundwater basin. *Id.* at 323:13-23. The Groundwater Authority has since used the polygon method to estimate the annual loss of storage in the IWV Basin. *See, e.g.*, EX 85.

methods for estimating safe yield presented at trial. For example, Parker vouched for the polygon method because it relies upon "hard data" and "simple math," 6/10/26 Tr. 554-55, and Wicks seemed to fault recharge-based methods because they require "estimates, which have a considerable amount of uncertainty associated with them," *id.* at 652. The equation at the core of the polygon method depends on specific yield, a value that must be estimated because it cannot be directly measured at every location. Parker even characterized the estimation of specific yield as "challenging" because there was *no* hard data for it. 6/10/26 Tr. 546. As Dr. McKenna explained, the polygon method is more susceptible to *error* because specific yield value is the only aquifer parameter that is taken into account. *See* 6/29/26 Tr. 2087:25-2089:20; *id.* at 2145:17-22; EX 61, pdf 47.

In fact, Teasdale's calculations demonstrate the susceptibility of the method to error. As Dr. McKenna explained, Teasdale appears to have misinterpreted the depth-to-groundwater measurements in his Figure 2-6, EX 85, pdf 33, as groundwater elevations, such that he characterizes water level declines as water level *gains*. *See* EX 61, pdf 48. This mistake would make his estimate of safe yield too high, even if all the other deficiencies in the polygon method are ignored. *See id.* Teasdale admitted this mistake at trial. *See* 6/22/26 Tr. 1517-1525. Because there are no cross-checks on the simplistic math in the polygon method, or comparisons with other components of the conceptual framework, this error was not identified prior to the production of his expert report.

The fact that the polygon method has only a few variables shows only that it is convenient; not that it is a credible, rigorous, or reliable method for evaluating safe yield. The way the polygon method was implemented by Teasdale to generate implausibly high safe yield estimates is a case in point, as further demonstrated below.

a. The specific yield values in Teasdale's analysis are arbitrary.

Teasdale used a mix-and-match approach to specific yield that combined calibrated values with empirically based values without a clear methodology or scientific basis. As noted above, Teasdale used the calibrated specific yield values from the Ramboll Model (between 8% and 11%) for all but four of the polygons, and for those polygons, which include Meadowbrook land, Teasdale

used a value of 20%, based on his interpretation of soil lithology and pump test results. *See* 6/22/26 Tr. 1487:4-12; EX 85, pdf 62, t.A-2; *id.*, pdf 68, t.A-4. Teasdale defended his ad hoc use of empirical values for Meadowbrook on the basis that it resulted in a "conservative" (lower) safe yield estimate than would result from using Ramboll's values in those polygons. 6/22/26 Tr. 1417:21-1418:25. But Teasdale's testimony only confirmed that his distribution of specific yield values was entirely arbitrary.

To begin, Teasdale's calculation of the specific yield at the Meadowbrook wells was informal and not systematic. Teasdale calculated a specific yield range of 15% to 20% based on a pump test at a single well on Meadowbrook's land. *See* 6/22/26 Tr. 1416:8-23. A Meadowbrook employee (not Teasdale) conducted the pump test and collected the data. 6/22/26 Tr. 1479:20-1480:1; 1481: 9-23; 1487: 9-22; 1488: 9-25. Teasdale calculated the specific yield from that data. *Id.* at 1487:9-22. But Teasdale agreed that a standard industry pump test requires accounting for the influence of other wells in the surrounding area at the time the test is being conducted. *See id.* at 1488:9-12. Teasdale admitted that, at the time of the test, there were at least five other active wells in the Meadowbrook area, and that the influence of these wells was not considered in his calculation of specific yield. *Id.* at 1487:23-1488:15. *See also* EX 513 (showing seven Meadowbrook production wells). Teasdale did not conduct pump tests at any other Meadowbrook well or at any other well owned by the TWG parties, even though the Water District has at least one well where a pump test was used to make field measurements of aquifer values. *See* EX 50, pdf 24, fig. 2-8.

In addition to relying on a single pump test, Teasdale failed to explain why he did not assign values of 15-20% to polygons near the Meadowbrook land, when doing so would have resulted in any even more conservative estimate. Teasdale said a specific yield range of 15-20% would be expected for the Meadowbrook area because it is one of the most "prolific" areas of the aquifer. 6/22/26 Tr. 1416:18-1417:20. Yet, Teasdale did not assign a specific yield of 15-20% to any other polygon in that area. For example, polygons 52, 54, and 55 are just south of Meadowbrook polygon 59 and are assigned a specific yield of just 8% (the lowest value in the Ramboll model), *see* EX 85, pdf 62-64, t.A-2, even though the Brown & Caldwell specific yields considered by Teasdale show

those polygons as having *higher* specific yield than polygon 59. *See id.*, pdf 37. A specific yield of 8% is more consistent with fine sand or sandy clay, not the alluvium in this area. *See* EX 12, pdf 7 (Johnson).

Teasdale also appears to have made judgment calls about how to apply the Ramboll Model's specific yield values. There are only three specific yield values in the Ramboll Model: 8%, 9%, and 11%. *See* 6/17/26 Tr. 1234; EX 48, pdf 41, fig. 7-9. Teasdale's tables show that he used a specific yield value of 10% for several polygons under both approaches. *See, e.g.*, EX 85, pdf 62-64, t.A-2 (polygons 47, 63, 68, 76, 80, and 81 in Approach #1); *id.*, pdf 69-70, t.A-4 (polygons 47, 68, and 81 in Approach #2). It is unclear how the 10% figures were derived. Parker testified that when the Ramboll model identified multiple specific yield values for areas within a single polygon, the TWG made "judgment" calls to select which specific yield to use. 6/10/26 Tr. 588:24-589:1; *id.* at 592:24-594:1. If Teasdale relied upon the TWG determinations, then his exercise of judgment was just as arbitrary.

Teasdale's ad hoc application of specific yield values, to polygons in the same area of the Basin show that his calculations are not scientifically rigorous or reliable.

b. Teasdale used "judgment" and assumptions to fill data gaps.

Teasdale also admitted that the TWG's application of the polygon method involved judgment calls and assumptions to compensate for incomplete or inconsistent data.

First, the polygon method is premised an assumption that the Basin can be divided in a rational way so that each polygon is centered on a representative well, but this assumption proved challenging to implement. Teasdale explained that in his Approach #1, using 85 polygons, there were approximately 150 wells with water-level data, meaning that some polygons contained more than one well. 6/22/26 Tr. 1485:22-1486:3. In these instances, Mr. Teasdale made a "judgment call" to select a representative well for the polygon. *Id.* at 1486:10-24.

Teasdale also acknowledged there were "big gaps" in the water level data he used to calculate the change in storage. *Id.* at 1492:1-22. Teasdale admitted that in his 85-polygon analysis there were polygons, particularly near "the edge of the Basin that had no water level data" because there were no wells in the polygons. *Id.* at 1486:6-9. And even in his 81-polygon analysis, there

were still some polygons that did not have representative wells and, therefore, did not have water level data. *Id.* at 1483:13-15; *id.* at 1485:6-14.

For both of these scenarios—multiple wells in one polygon or no well in a polygon—Mr. Teasdale's reports are devoid of any analysis that sets forth his decisionmaking process for selecting a representative well. *Id.* at 1486:25-1487:3; *id.* at 1500:5-1501:7.

c. Teasdale's polygons are inconsistent and do not represent faults.

In his testimony, McKenna identified numerous other problems with using polygons, rather than a three-dimensional model, to represent the Basin. He explained that polygons are not well-suited for the study of groundwater because they do not take into account all of the Basin's properties and thus do not capture the physics of groundwater movement. 6/29/26 Tr. 2083:8-2084:24.

The polygon method employed by the TWG and Teasdale suffers from this problem For example, the Basin is characterized by numerous faults, with two significant faults—the Little Lake Fault and the fault at the mouth of the El Paso area—effectively dividing the Basin into three distinct areas, each with distinct water flow patterns. *See* Tech. Rep. 9; 6/24/26 Tr. 1992-93; 6/29/26 Tr. 2078:3-23. Parker also agreed that the faults are important for understanding groundwater flow within the Basin. 6/10/26 Tr. 573:19-22. At trial, Teasdale disclosed that the "polygon generator" used to draw polygons did not take into account the faults in the Basin. 6/22/26 Tr. 1483:13-21. And Parker also admitted that Ramboll "didn't include faults in the polygons" that it used. 6/10/26 Tr. 582: 14-24. The polygons used by Teasdale and the TWG thus do not account for significant differences in the water flow patterns within the Basin. 6/29/26 Tr. 2084:14-2085:18.

Dr. McKenna also noted that the polygon method's reliance on representative well measurements leads to problems in the way that water level changes are weighted across the Basin. Because each polygon is theoretically centered on a well, areas with fewer wells will be split into fewer, and larger, polygons. *See* 6/9/26 Tr. 324-25 (Moran). The water level change in a large polygons will be less certain than that in a smaller polygon, because there is only one well to choose from; consequently, the areas of the Basin that have the least data will receive the heaviest weight in calculating change in storage. *See* 6/29/26 Tr. 2085:23-2086:16; EX 61, pdf 48.

The TWG safe yield estimates based on the polygon method, as well as Dr. Tonkin's estimate based on recharge, are unsupported and implausible. All depend upon the specific yield values from the Ramboll Model, which cannot be credited, and none of them has independent support in the evidence or a reliable scientific methodology. The record demonstrates that 7,650 AFY is the most reasonable estimate and is backed by the best available science and evidence.

III. THE AMOUNT OF WATER IN STORAGE IS IRRELEVANT TO SAFE YIELD.

Testimony from the TWG witnesses regarding the amount of groundwater in storage should be disregarded because it is irrelevant to the Court's determination of safe yield. Safe yield does not legally, or scientifically, include consideration of the total amount of water in storage. *See Santa Maria*, 211 Cal. App. 4th at 279 (defining safe yield as the "net of inflows less subsurface and surface outflows"). As Dr. McKenna explained in his rebuttal report: "When considering the question of Safe Yield, the total volume of groundwater held in storage is irrelevant. If water is removed at a faster rate than it is replenished, water levels will decline regardless of the quantity of water in storage." EX 61, pdf 49.

The TWG presented testimony about storage because they would like to obtain a judgment that authorizes them to continue to mine the Basin, as long as the depletions of storage are "insignificant" and "reasonable." *See* 6/8/26 Tr. 27-28; *id.* at 71:10-16 (Brown). The Court correctly recognized that such a proposal has nothing to do with safe yield. *See id.* at 86: 15-21 (The Court: "On page 278 and 279, [*San Fernando*] defines what a safe yield is. And the fact that [counsel] and Mr. Brown keep referring to insignificant and reasonable depletions of storage, I can't find that there."); *see also* 6/10/26 Tr. 536:7-13 (The Court: "Mr. Brown . . . basically opined that taking a small amount of groundwater out of storage, like 5,000 acre-feet-per-year, is minimal and won't have an undesirable effect. Okay. That's his view. I'm not sure I agree with him on the law.").

The Court's resistance to Brown's proposal was well-founded. Allowing pumping in excess of "net groundwater recharge," *San Fernando*, 14 Cal. 3d at 278, *i.e.*, the "net of inflows less subsurface and surface outflows," *Santa Maria*, 211 Cal. App. 4th at 279, is, by definition pumping in excess of safe yield. And, while the TWG may seek to argue for some ability to mine the Basin

as part of a physical solution remedy, any proposal relating to a physical solution is not before the Court in the Phase 2 trial on safe yield.

IV. A SAFE YIELD OF 7,650 AFY PROMOTES EFFICIENCY AND FINALITY BECAUSE IT ALIGNS THE JUDGMENT WITH THE DWR-APPROVED GSP.

The trial record overwhelmingly supports a determination that the maximum safe yield of the Basin is 7,650 AFY. That estimate is supported by regression calculations, by recharge ratios, by a high-quality groundwater model, and even by a change-in-storage analysis using the Statewide BCM and a reasonable base period. The question whether the safe yield should be 7,650 AFY or twice that amount is not a close one. If, however, the Court or the Special Master determines otherwise, the interests in efficiency and finality should tip the balance in favor of 7,650 AFY because it is the sustainable yield identified in the DWR-approved GSP for the Basin.

The recent court of appeals decision *AquAlliance v. Vina Groundwater Sustainability Agency*, 122 Cal. App. 5th 118 (2026), *reh'g denied* (Aug. 19, 2026), strongly suggests that DWR's approval of a GSP warrants special consideration by a court adjudicating groundwater-management issues after SGMA. In that case, the plaintiff challenged the sustainable yield determination in a GSP that DWR had not yet approved. DWR approved the GSP while the case was pending, and the trial court dismissed the suit. The court of appeals affirmed the dismissal based on the doctrine of primary jurisdiction, in light of DWR's approval of the GSP. *See id.* at 149-50.[25] The court held that dismissing the challenge to the GSP's sustainable yield would serve the goals of efficiency and uniformity because, "had the trial court conducted its own sustainability evaluation . . . and disagreed with the [DWR's] evaluation, there would have been an intra-basin inconsistency . . . on whether the plan satisfied [SGMA] and how [the groundwater agency] should move forward in managing the basin." *Id.* at 147. The court also predicted that "[t]his problem would burgeon if

[25] The doctrine of primary jurisdiction applies where deciding a claim "requires the resolution of issues which, under a regulatory scheme, have been placed within the special competence of an administrative body; in such a case the judicial process is suspended pending referral of such issues to the administrative body for its views.' *AquAlliance*, 122 Cal. App. 5th at 140 (citation omitted). The primary jurisdiction doctrine promotes efficiency "by allowing courts to take advantage of administrative expertise," and it "helps assure uniform application of regulatory laws." *Id.* (citation omitted).

permitted across the state, potentially creating a multitude of intra- and inter-basin inconsistencies." *Id.*

AquAlliance did not involve a groundwater adjudication or a determination of safe yield, and it does not compel the Court to adopt a safe yield of 7,650 AFY solely because the GSP identifies 7,650 AFY as the Basin's sustainable yield. But the decision does suggest that a court owes special consideration to DWR's approval of the GSP in this case, whether as an exercise of deference or to prevent the "problem" of "intra- and inter-basin inconsistencies" in groundwater management, *Id.* Any legal distinction that may exist between the concepts of "safe yield" and "sustainable yield" does not affect this analysis. The GSP, which identified 7,650 AFY as the average recharge to the Basin, and DWR concluded that the GSP was based on the best available science, specifically citing the water budgets as an example. *See* EX 359, pdf 7; *id.*, pdf 11. Therefore, a factual finding that average recharge to the Basin is greater than 7,650 AFY would represent "disagree[ment] with [DWR's] evaluation" of the GSP, and would create "intra-basin inconsistency" as to how the Groundwater Authority "should move forward in managing the Basin," *AquAlliance*, 122 Cal. App. 5th at 147. The policies that underlie the primary jurisdiction doctrine, if not directly applicable here, would nevertheless weigh against such a result in this case.

The sound management of groundwater resources in the IWV Basin is of critical importance to the United States Navy and national defense. A judgment that is inconsistent with the GSP creates uncertainty and adds costs that will delay the implementation of measures to bring the Basin into equilibrium, prevent the ongoing depletion of groundwater, and curb subsidence that impacts NAWS China Lake. The risk of delay is not speculative. For example, if the Court were to adopt a safe yield of 14,400 AFY, as Dr. Tonkin proposes, a groundwater model would need to be developed to simulate potential management scenarios around that amount of recharge. There is no reason to think that DRI would be able to credibly recalibrate the DRI Model to recharge significantly greater than 7,650 AFY, or that it would be willing and funded sufficiently to do so. And it has been established that the Ramboll Model is no substitute. *See generally* EX 61. Modifying or creating a model to represent a safe yield nearly twice what is currently modeled and approved by DWR would cause delay and increase costs for all water users.

CONCLUSION

The IWV Basin has been mined for groundwater for decades, to the detriment of the United States and other water users. The Basin will continued to be mined for decades, until pumping is limited to a safe and sustainable yield. The testimony and evidence at trial overwhelmingly demonstrate that the maximum safe yield of the IWV Basin is 7,650 AFY.

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PROOF OF SERVICE

I, Symone Hetzel, declare I am over the age of eighteen years and not a party to the within action. I am a resident of or employed in the county where the service described below occurred. My business address is 999 18th St., North Terrace, Ste. 600, Denver, Colorado 80202.

On November 11, 2026, I served the below listed document: UNITED STATES' PHASE 2 POST-TRIAL BRIEF ON SAFE YIELD on all interested parties in this action by uploading to the Case Anywhere website pursuant to the Court Order Authorizing Electronic Service, dated December 2, 2022.

SEE ATTACHED CASE ANYWHERE SERVICE LIST

I declare under penalty of perjury under the laws of the State of California that the above is true and correct. Executed on November 11, 2026, at Denver, CO.

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